

Easergy MiCOM P433

Distance Protection and Control Unit

P433/EN M/R-g8-B

Version P433 -317 -430/431/432/433/434 -671

Technical Manual

Volume 1 of 2

General Note on the PDF Version of this Technical Manual

All entries in the Table of Contents and all cross-references to other sections, figures etc. in green letters are hyperlinks, i.e. by a single mouse click on the reference one can navigate directly to the referenced part of the manual.

In the Adobe Reader (or the Acrobat Pro), one can return back to the previous view by using the menu point *View / Page Navigation / Previous View* (keyboard shortcut: ALT + Left cursor key). (It might be necessary to do this several times, if the view at the target location has also been changed (e.g. by scrolling or changing the zoom setting)).

IMPORTANT INFORMATION

NOTICE:

Read these instructions carefully, and look at the equipment to become familiar with the device before trying to install, operate, or maintain it. The following special messages may appear throughout this documentation or on the equipment to warn of potential hazards or to call attention to information that clarifies or simplifies a procedure.



The addition of this symbol to a Danger or Warning safety label indicates that an electrical hazard exists, which will result in death or serious injury if the instructions are not followed.



This is the safety alert symbol. It is used to alert you to a potential personal injury hazard. Obey all safety messages that follow this symbol to avoid possible injury or death.

DANGER

DANGER indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.

WARNING

WARNING indicates a potentially hazardous situation which, if not avoided, can result in death or serious injury.

CAUTION

CAUTION indicates a potentially hazardous situation which, if not avoided, can result in minor or moderate injury with or without equipment damage.

NOTICE

NOTICE, used without safety alert symbol, indicates a potentially hazardous situation which, if not avoided, can result in equipment damage.

When electrical equipment is in operation, dangerous voltage will be present in certain parts of the equipment.

 DANGER

HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH

- Only qualified personnel, trained, authorized and familiar with the device and all the safety instructions in the general Safety Guide (SFTY/5LM/L11 or later version) and appropriate Chapter 5, Chapter 10, Chapter 11, Chapter 12 and Chapter 13 of this manual, shall work on installation, connection, commissioning, maintenance or servicing of this device.

Failure to follow these instructions will result in death or serious injury.

 DANGER

HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH

- Switch off the auxiliary power supply before any work in the terminal strip area.
- Switch off all the power supplies in connection to the equipment before any work in the terminal strip area to isolate the device.
- Do not touch the terminal strip area when equipment is in operation.
- Do not remove or add wires in the terminal strip area when equipment is in operation.
- Short-circuit the system current transformers before disconnecting wires to the transformer board (valid only for pin terminals, not required for ring terminals which have a shortening block).
- A protective conductor (ground/earth) of at least 1.5 mm² must be connected to the protective conductor terminal on the power supply board and on the main relay case.
- Do never remove the protective conductor connection to the device casing as long as other wires are connected to it.
- Where stranded conductors are used, insulated crimped wire end ferrules must be employed.

Failure to follow these instructions will result in death or serious injury.

Note: Regarding the appropriate wiring connections of the equipment refer to the document Px3x_Grounding_Application_Guide_EN_h.pdf.

The signals MAIN: Blocked/faulty and SFMON: Warning (LED) are permanently assigned to the LEDs labeled OUT OF SERVICE and ALARM and can be assigned to output relays to indicate the health of the device.

It is recommended that the signals MAIN: Blocked/faulty and SFMON: Warning (LED) are communicated to the substation automation system for alarm purposes, using hardwiring via output relays or the communication interface.

WARNING

HAZARD OF UNSAFE OPERATION

- Only qualified personnel, trained, authorized and familiar with the device and all the safety instructions in the general Safety Guide (SFTY/5LM/L11 or later version) and appropriate Chapter 5, Chapter 10, Chapter 11, Chapter 12 and Chapter 13 of this manual, shall work on installation, connection, commissioning, maintenance or servicing of this device.
- Proper and safe operation of this device depends on appropriate shipping and handling, proper storage, installation and commissioning, and on careful operation, maintenance and servicing. For this reason only qualified personnel shall work on or operate this device.
- Any modifications to this device must be in accordance with the manual. If any other modification is made without the express permission of Schneider Electric, it will invalidate the warranty, and may render the product unsafe.

Failure to follow these instructions can result in unintended equipment operation.

DANGER

HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH

In case of usage of the equipment with DHMI*:

- A protective conductor (ground/earth) of at least 1.5 mm² (US: AWG14 or thicker) must be connected to the DHMI protective conductor terminal to link the DHMI and the main relay case; these must be located within the same substation.
- The DHMI communication cable must not be in contact with hazardous live parts.
- The DHMI communication cable must not be routed or placed alongside high-voltage cables or connections. Currents can be induced in the cable which may result in electromagnetic interference.
- We recommend to use only cables of category CAT6 (or better), which has been tested up to a length of 10 m.

Failure to follow these instructions will result in death or serious injury.

* DHMI = Detachable Human Machine Interface

Changes after going to press

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1 Application and Scope

1.1 Overview

The P433 distance protection device has been designed for selective short-circuit protection, ground fault protection, and overload protection in medium- and high-voltage systems. Because of the specific functions provided by the devices the following preferred areas of application have evolved:

- Medium- and high-voltage systems with 3-pole high-speed reclosure (HSR)



Fig. 1-1: P433 in a 84 TE sized case.



Fig. 1-2: P433 in a 40 TE sized case.



Fig. 1-3: P433 in a 24 TE sized case.

From the software version -671, only 24 TE sized case uses the previous local control panel. 40 TE and 84 TE cases equip with the enhanced local control panel. Please refer to the Cortec for more information [Chapter 15, \(p. 15-1\)](#).

The systems can be solidly-grounded, resistance grounded, Petersen coil or insulated neutral type. The multitude of protection functions incorporated into the P433 enable the user to cover a wide range of applications in the protection of cable and line sections. The relevant protection parameters can be stored in four independent parameter subsets in order to adapt the protection device to different operating and power system management conditions.

The control functions are designed for the control of up to three electrically operated switchgear units equipped with plant status signaling and located in the bay of a medium-voltage substation (or a high-voltage station with basic topology). The P433 has almost 80 predefined Bay Types stored for selection.

The number of external auxiliary devices required is largely minimized by the integration of binary signal inputs operating from any auxiliary voltage, and versatile relay output contacts, by the direct connection option for current and voltage transformers, and by the comprehensive interlocking capabilities. This simplifies the handling of switch bay protection and control technology from planning to commission.

During operation, the user-friendly interface makes it easy to set the device parameters and allows safe operation of the substation by preventing non-permissible switching operations.

The P433 is equipped with a large number of protection and control functions. These can be individually configured and cancelled.

These features give the user the means to adapt the P433 to the protection and control capacity required in a specific application.

The powerful programmable logic provided by the protection device also makes it possible to accommodate special applications.

Protection functions				P433
ANSI	IEC 61850	Function group	Function	
21	DisPDISn	DIST	Distance protection ● Overcurrent and undervoltage starting ● Underimpedance starting with adjustable load blinding ● Polygonal (quadrilateral) or circular tripping characteristics ● Eight distance stages, including one that can be used as a special stage ● Ten timer stages, including two that function as backup timer stages ● Directional voltage memory	✓
68	RPSB1	PSB	Power swing blocking and out-of-step tripping	✓
30/ 74	AlmGGIO1	MCMON	Measuring-circuit monitoring	✓
50TD P/ N	DtpPhs- / DtpEftPTOCx	BUOC	Backup overcurrent protection	✓
50/ 27	SofPhs- / SofEftPSOF1	SOTF	Switch on to fault protection	✓
85 - 21	PsgPhsPSCH1	PSIG	Protective signaling	✓
79	RREC1	ARC	Auto-reclosing control (3-pole)	✓
25	RSYN1	ASC	Automatic synchronism check	(✓)
67 N	GfsResPTOC1 / -PTOV1 / -RDIR1	GFSC	Ground fault short circuit protection	✓
85 - 67N	PsgGfsPSCH1	GFCSG	Ground fault short circuit protection signaling	✓
67W/ YN	PSDE1	GFDSS	Ground fault direction determination (wattmetric)	✓
		GFTRP	Ground fault tripping	✓
85 - 67W	PsgGfdPSCH1	GFSIG	Ground fault protection signaling	✓
	PTEF1	TGFD	Transient ground fault direction determination	☑
50TD P/ Q/ N	DtpPhs- / DtpEft- / DtpNgsPTCOx	DTOC	Definite-time overcurrent protection, four stages, max. phase / negative-sequence / neutral or residual OC elements, directional neutral OC	✓

Protection functions				P433
ANSI	IEC 61850	Function group	Function	
51 P / Q / N	ItpPhs- / ItpEft- / ItpNGsPTOCx	IDMT	Inverse-time overcurrent protection, single-stage, directional max. phase / negative-sequence / neutral or residual OC elements	✓
67	DtpPhs- / DtpResRDIRx	SCDD	Short-circuit direction determination	✓
49	ThmPTTR1	THERM	Thermal overload protection	✓
27 / 59 / 47 P / Q / N	VtpPhs- / VtpNGs- / VtpPss- / VtpRefPTyVx	V<>	Over- /Undervoltage Protection	✓
81	FrqPTyFx	f<>	Over- /Underfrequency protection	✓
81P	PfPTUF1 / PfPDOP1 / PfPTOV1	Pf<	Active power controlled underfrequency load shedding protection	✓
32	PdpAct- / PdpRealPDyPx	P<>	Directional power protection	✓
32V	QvPDOP1 / QvPIOC1 / QvPTUV1 / QvPTRC1 / QvPTRC2	QV	Voltage controlled directional reactive power protection	✓
		DELTA	Delta-I protection	✓
50 / 62 BF	RBRFx	CBF	Circuit breaker failure protection	✓
	XCBR1	CBM	Circuit breaker supervision	✓
		TRMON	Transformer monitoring	✓
		LIMIT	Limit value monitoring	✓
LGC	PlGGIOx (Ed. 1) / PlGAPCx (Ed. 2)	LOGIC / LOG_2	Programmable logic	✓
	PHAR1	MAIN	Inrush stabilization	✓

Communication functions				P433
ANSI	IEC 61850	Function group	Function	
16S		COMM1, COMM2	2 communication interfaces serial, RS 422 / 485 or fiber optic	(✓)
CLK		IRIGB	Time synchronization IRIG-B	(✓)
		COMM3	Protection communication interface InterMiCOM, serial, RS 422/485, RS 232 or FO	☒
16E		IEC	Communication interface Ethernet	(✓)
16E	GosGGIO1	GOOSE	IEC 61850	(✓)
		VINP	Virtual Inputs	(✓)

Measuring inputs				P433
ANSI	IEC 61850	Function group	Function	
			Phase currents	3
			Residual current	1
			Voltages	4 ... 5

Binary inputs and outputs				P433	
ANSI	IEC 61850	Function group	Function	24 TE	40 TE and 84 TE
		INP	Optical coupler inputs	4 ... 10	4 ... 70
		OUTP	Output relays	8 ... 14	8 ... 38

Measured value functions, analog inputs and outputs				P433
ANSI	IEC 61850	Function group	Function	
26	RtdGGIO1 IdcGGIO1	MEASI	RTD input	☒
			1 × Measuring data input 20 mA, one settable input value	☒
		MEASO	2 × Measuring data output 20 mA, two settable output values	☒

Control functions				P433
ANSI	IEC 61850	Function group	Function	
52	XCBRx / XSWIx / CSWIX	DEV01 to DEV03	Control and monitoring of three switchgear units	☑
	CtIGGIO2 (Ed. 1) CtIGAPC2 (Ed. 2)	CMD_1	12 Single-pole commands	(✓)
	CtIGGIO2 (Ed. 1) CtIGAPC2 (Ed. 2)	SIG_1	12 Single-pole signals	(✓)
LGC		ILOCK	Interlocking logic	(✓)
		COUNT	Binary counters	4
		TIMER	Timer	4
		PULSE	Pulse detection	✓

Miscellaneous functions				P433
ANSI	IEC 61850	Function group	Function	
		CS	Cyber Security	(✓)
	LLN0.SGCB LLN0.CurSG	PSS	Parameter subset selection	✓
	PTRCx / RDRE1	FT_RC	Fault recording	✓
16S			6 configurable function keys	☑

✓ = Standard; (✓) = Ordering option; ☑ = Not for P433 in 24 TE case.
 "IEC 61850" = IEC 61850 Edition 1 and Edition 2.

For a list of all available function groups see the Appendix.

Function diagram for P433 in case 40 TE or 84 TE. (See function overview table for P433 variants in 24 TE case.)

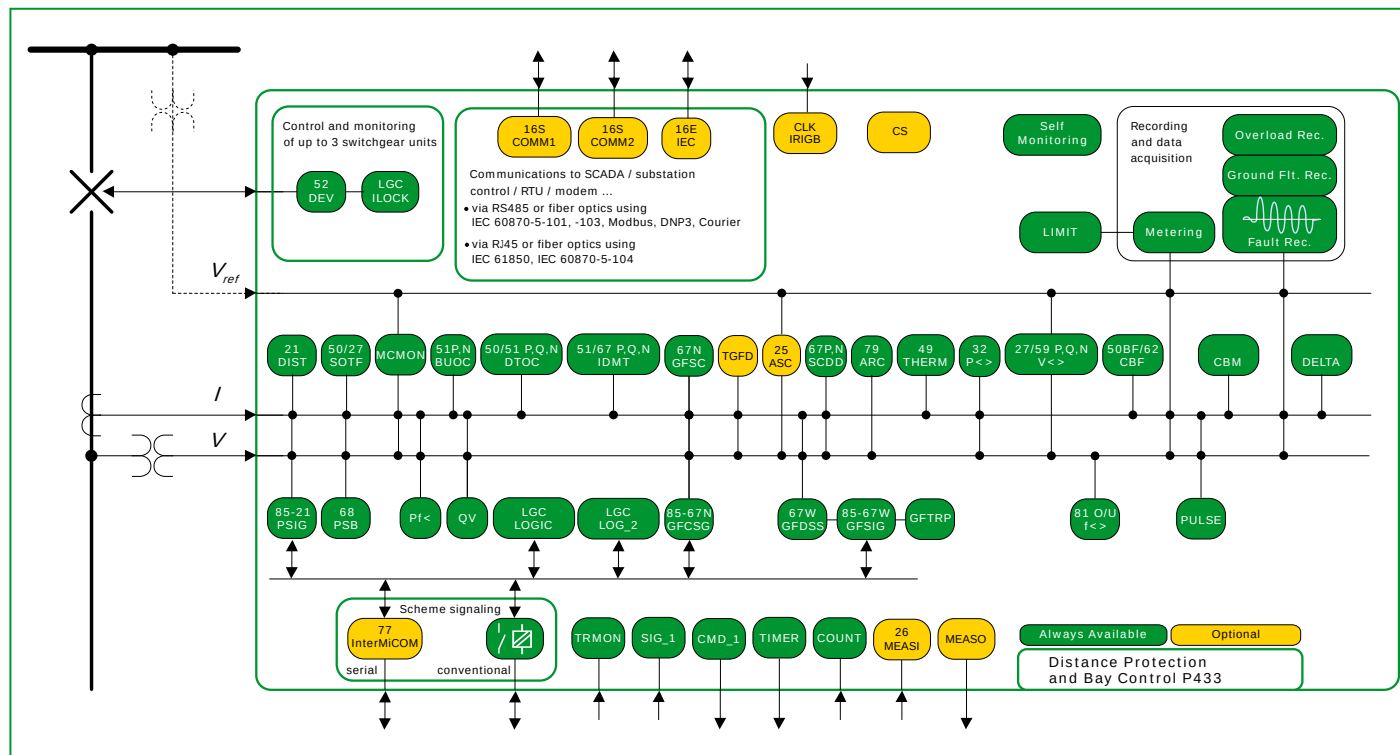


Fig. 1-4: Functional diagram.

1.2 General Functions

Functions listed in the tables above are self-contained function groups (except for ILOCK) and can be individually configured or de-configured according to the specific application requirements. Unused or cancelled function groups are hidden to the user, thus simplifying the menu.

This concept provides a large choice of functions and makes wide-ranging application of the protection device possible, with just one model version. On the other hand simple and clear parameter settings can be made.

In this way the protection and control functions (except for ILOCK) can be included in or excluded from the configuration; they are arranged on the branch "General Functions" of the menu tree.

1.3 Control Functions

Control functions are designed for the control of up to 3 electrically operated switchgear units equipped with electrical check-back signaling.

For the control of switchgear units either the binary inputs or the optional communication interface or the function keys of the local control panel can be used.

Up to 12 operation signals can be acquired through binary signal inputs and they are processed according to their primary significance (e.g. CB readiness). Each binary signal input for signals from switchgear and single-pole operations can have the debouncing and chatter suppression from three groups assigned, for which the debouncing and chatter time can be individually set.

For the acquisition of binary counters, up to four binary inputs may be configured. The contents of these counters are transmitted cyclically via the serial link. The counter values are stored so that they are not lost if the supply voltage should fail. Counting continues from the stored value as the initial value when the P433 restarts.

The P433 sends control signals only after it has checked the readiness and validity to carry out such commands, and it then monitors the operating time of the switchgear units. If the protection device detects that a switchgear unit has failed, it will signal this information (e.g. by configuration to a LED indicator).

Before a switching command is issued the interlocking logic on the P433 checks if this new switchgear status corresponds with the bay and station topology. The interlocking logic is stored in form of bay interlocking, with and without station interlocking, for each Bay Panel in the default setting. The interlocking conditions can be adapted to the actual bay and station topology. Interlocking display and operation correspond to the programmable logic.

When the P433 is included in a station control system the local interlocking can easily be integrated with the overall system interlocking.

When the P433 is not included in a station control system then bay interlocking is applied without station interlocking.

If the bay and station topology are found to be valid the switching command is issued. If a non-permissible status would result from the switching action then the issuing of such a switching command is refused and an alarm is issued.

If not all binary outputs are required by the bay type then these vacant binary outputs can be freely utilized for other purposes.

Besides issuing switching commands binary outputs may also be triggered by persistent commands.

1.4 Global Functions

In addition to the listed features, and extensive self-monitoring, the P433 is equipped with the following global functions:

- Parameter subset selection
- System measurements to support the user during commissioning, testing and operation
- Operating data recording
(time-tagged event logging)
- Overload data acquisition
- Overload recording
(time-tagged event logging)
- Ground fault data acquisition
- Ground fault recording
(time-tagged event logging)
- Fault recording
(time-tagged event logging together with fault value recording of the three phase currents, the residual current as well as the three phase-to-ground voltages and the neutral-point displacement voltage).

1.5

Design

The P433 is modular in design. The plug-in modules are housed in a robust aluminum case and electrically interconnected via one analog p/c board and one digital p/c board.

1.6 Inputs and Outputs

The following inputs and outputs are available with the basic device:

- 4 current measuring inputs
- 4 voltage measuring inputs
- 8 output relays, freely-configurable
- 4 binary signal inputs (opto-coupler)

Optionally available are:

- One or two binary modules X(6I 6O), to monitor and control 3 switchgear units. (Not available for 24 TE device.)
- Alternatively, one binary module X(6I 6O) plus optionally one binary module X(6I 8O), to monitor and control 3 switchgear units. (Not available for 24 TE device.)
- One binary module X(6O) (i.e. 6 output relays), or X(6I 3O) (i.e. 6 binary inputs and 3 output relays), or X(4H) (i.e. 4 high break contacts).
- One or two binary modules X(24I) with additional binary signal inputs with user-configurable function assignment. (Not available for 24 TE device.)
- One analogue board with 4x binary inputs, 2x binary outputs, 1x mA input, 2x mA outputs and 1x PT100 input. (Not available for 24 TE device.)

Depending on the order options ([Chapter 15, \(p. 15-1\)](#)) there are several more modules available. The location diagrams ([Section 5.7, \(p. 5-32\)](#)) give an overview of the combinations of modules that are technically possible. The module list ([Section 4.3, \(p. 4-11\)](#)) details the designations that appear in the location diagrams.

If at least one binary module X(6I 6O) is fitted, 3 switchgear units can be controlled by using pre-defined standard bay-types.

The nominal currents and nominal voltages of the standard measuring inputs can be set.

The nominal voltage range of the binary signal inputs (opto-coupler) is 24 to 250 V DC. As an option binary signal input modules with a higher operate threshold are available.

The auxiliary voltage input for the power supply is also designed for an extended range. The nominal voltage ranges are 60 to 250 V DC and 100 to 230 V AC. As an option there is a variant available for the lower nominal voltage range 24 V to 60 V DC.

All output relays can be utilized for signaling and command purposes.

The optional PT 100 input (on the analog module Y(4I)) is lead-compensated and balanced and linearized for PT 100 resistance thermometers as per IEC 751.

The optional 0 to 20 mA input provides open-circuit and overload monitoring, zero suppression defined by a setting, plus the option of linearizing the input variable via 20 adjustable interpolation points.

Two selectable measured variables (cyclically updated measured operating data and stored measured fault data) can be output as a burden-independent direct current via the two optional 0 to 20 mA outputs. The characteristics are defined by 3 adjustable interpolation points allowing a minimum output current (4 mA, for example) for slave-side open-circuit monitoring, knee-point definition for fine scaling, and a limitation to lower nominal currents (10 mA, for example). Where sufficient output relays are available, a selectable measured variable can be output in BCD-coded form by contacts.

The analog modules (i.e. the inputs for resistance thermometers and 0 to 20 mA inputs/outputs) are not available for 24 TE devices.

1.7 Control and Display

Enhanced local control panel

- Local control panel with monochrome text LC-display containing 12 × 32 alphanumeric characters
Portrait orientation QVGA (192 × 96 pixels) with 3.5 Inches dimension
- 25 LED indicators
5 fixed system LEDs
2 amber LED indicators for 'Local', 'Remote' and 'Local and Remote' states
12 multi-color LEDs with user-definable functional assignment
6 multi-color LEDs with user-definable functional assignment for function keys
- 6 configurable function keys
Customizable labels can be edited and inserted into the recessed pocket under the external membrane of the front panel
- PC interface (USB Type B)
- Communication interfaces (optional)

Local control panel (24 TE only)

- Local control panel with LC-display (4 × 20 alphanumeric characters)
- LED indicators: 10 LED indicators, 5 with user-definable functional assignment
- PC interface (RS232 9-pin D-Sub connector)
- Communication interfaces (optional)

1.8 Information Interfaces

Information exchange is done via the local control panel, the PC interface and optional Communication modules for serial and Ethernet based communication.

The serial communication module offers settable protocols conforming to IEC 60870-5-103, IEC 60870-5-101, DNP 3.0, Modbus and Courier. The second communication interface (COMM2) conforms to IEC 60870-5-103 and is intended for remote setting access only.

The 4 available Ethernet module variants provide IEC 61850 communication and offer optional Ethernet communication protocol conforming to IEC 60870-5-104 with single Ethernet or alternatively redundancy PRP, HSR or RSTP protocols with RJ45 wire or LC fiber optic connectors and RJ45 service interface.

External time synchronization can be done using a configured binary input, using one of the communication protocols or by using the optional IRIG-B signal input.

A direct link to another protection device (out of the platform Easergy MiCOM 30) can be set up by applying the optional InterMiCOM interface (COMM3).

2 Technical Data

2.1 Conformity

Notice

Applicable to P433, version -317 -430/431/432/433/434 -671.

Declaration of Conformity

The product designated "P433 Distance Protection and Control Unit" has been designed and manufactured in conformance with the EMC and safety standards IEC 60255-26 and IEC 60255-27 and with the "EMC Directive" and the "Low Voltage Directive" issued by the Council of the European Community.

2.2 General Data

2.2.1 General Device Data

Design

- Surface-mounted case suitable for wall installation, or
- Flush-mounted case for 19" cabinets and for control panels.

Installation Position

- Vertical $\pm 30^\circ$.

Degree of Protection

Per DIN VDE 0470 and IEC 60529.

- IP 52 for the front panel.
- Flush-mounted case:
 - IP 50 for the case (excluding the rear connection area)
 - IP 20 for the rear connection area, pin-terminal connection
 - IP 10 for the rear connection area, ring-terminal connection
- Surface-mounted case:
 - IP 50 for the case
 - IP 50 for the fully enclosed connection area with the supplied rubber grommets fitted

Weight

- 24 TE case: Max. 5 kg
- 40 TE case: Approx. 7 kg
- 84 TE case: Approx. 11 kg

Dimensions and Connections

See dimensional drawings ([Section 4.2, \(p. 4-5\)](#)), and the location and terminal connection diagrams ([Section 5.7, \(p. 5-32\)](#)).

Terminals

PC interface (X6)

- USB B connector (Enhanced local control panel)
- EIA RS232 (DIN 41652) connector, type D-Sub, 9-pin (24 TE only)

Communication interfaces COMM1 to COMM3

- Fiber (X7, X8 and X31, X32)
 - F-SMA optical fiber connection per IEC 60874-2 (for plastic fibers), or
 - optical fiber connection BFOC-ST[®] connector 2.5 per IEC 60874-10-1 (for glass fibers).

(ST[®] is a registered trademark of AT&T Lightguide Cable Connectors.)
- Wire leads (X9, X10 and X33)
 - M2 threaded terminal ends for wire cross-sections up to 1.5 mm².
- RS232 (X34) (for COMM3 / InterMiCOM only)
 - EIA RS232 (DIN 41652) connector, type D-Sub, 9-pin.

Communication interface IEC 61850

- Fiber (X13, X14)
 - Industry Standard Small Form Pluggable (SFP) package, LC duplex connector optical interface.
- Wire leads (X15)
 - RJ45 connector.
- IRIG-B Interface (X11)
 - 3 pin terminal block.

Current measuring inputs (conventional inputs)

- Threaded terminal ends, pin-type cable lugs: M5, self-centering with cage clamp to protect conductor cross-sections $\leq 4 \text{ mm}^2$, or:
- Threaded terminal, ring-terminal connection: M4.

Other inputs and outputs

- Threaded terminal ends, pin-type cable lugs: M3, self-centering with cage clamp to protect conductor cross-sections 0.2 to 2.5 mm², or:
- Threaded terminal ends, ring-type cable lugs: M4.

Creepage Distances and Clearances

- Per IEC 60255-27.
- Pollution degree 3, working voltage 250 V,
- overvoltage category III, impulse test voltage 5 kV.

2.3 Tests

2.3.1 Type Tests

2.3.1.1 Electromagnetic Compatibility (EMC)

All tests performed according IEC 60255-26 with typical setting parameter configurations. The following configuration shall be used to pass all tests without exceptions: /Parameters/Config. parameters/INP:

- (010 220) INP: Filter set to "6" (Default value).
- All binary inputs shall be set to filtered operating mode, i.e. "Active "high" filt." or "Active "low" filt.".
- All binary inputs assigned to switching devices DEV shall be subject to signal debouncing for "20 ms" (Default value), e.g. (221 200) MAIN: Debounce time gr. 1 with "0.02 s".

EMC tests on Ethernet are performed with cable of 8 meters (category 5E).

Conducted Emission

Per IEC 60255-26 and CISPR 22 Class A.

- 0.15 - 0.5 MHz, 79 dB μ V (quasi peak) 66 dB μ V (average).
- 0.5 - 30 MHz, 73 dB μ V (quasi peak) 60 dB μ V (average).

Radiated Emission

Per IEC 60255-26 and CISPR 11 Class A.

- 30 - 230 MHz, 40 dB μ V / m at 10 m measurement distance.
- 230 - 1 GHz, 47 dB μ V / m at 10 m measurement distance.

100 kHz and 1 MHz Damped Oscillatory Test

Per IEC 60255-26 and IEC 61000-4-18. level 3.

- Frequency: 100 kHz and 1 MHz.
- Common mode test level: ± 2.5 kV.
- Differential mode test level : ± 1 kV.

Immunity to Electrostatic Discharge

Per IEC 60255-26 and IEC 61000-4-2, severity level 4.

- 15 kV discharge in air to user interface, display, to all communication ports (outer earthed shell).
- 8 kV contact discharge to any metal part of the front of the product.

Immunity to Radiated Electromagnetic Field

Per IEC 60255-26 and IEC 61000-4-3, severity level 3.

- 10 V / m, 80 MHz to 1 GHz and 1.4 GHz to 2.7 GHz with 1 kHz 80 % AM.
- Spot tests at 80 MHz, 160 MHz, 380 MHz, 450 MHz, 900 MHz, 1850 MHz, and 2150 MHz.

Electrical Fast Transient or Burst Test

Per IEC 60255-26, Zone A.

- ± 4 kV, 5 kHz applied directly to auxiliary supply, CTs, VTs, opto inputs, output relays.
- ± 2 kV, 5 kHz applied to communication ports.

Per IEC 61000-4-4, Severity level 4.

- ± 4.0 kV, 5 kHz applied to all power supply and earth port.
- ± 2.0 kV, 5 kHz applied to all other ports.

EFT/Burst waveform parameter.

- Rise time of one pulse: 5 ns.
- Impulse duration (50 % value): 50 ns.
- Burst duration: 15 ms.
- Burst cycle: 300 ms.
- Source impedance: 50 Ω .

Power Frequency Immunity

Per IEC 60255-26, severity Zone A.

Phase-to-phase

- RMS value 150 V.
- Coupling resistance 100 Ω .
- Coupling capacitor 0.1 μF , for 10 s.

Phase-to-ground

- RMS value 300 V.
- Coupling resistance 220 Ω .
- Coupling capacitor 0.47 μF , for 10 s.

Surge Immunity Test

Per IEC 60255-26 and IEC 61000-4-5, severity Zone A or level 4.

- ± 4 kV line to earth and ± 2 kV line to line for power supply, CTs, VTs, opto inputs and output contacts.
- ± 4 kV cable shielded layer to ground for communication ports.

Surge waveform parameter.

- Open-circuit voltage front time / time to half-value: 1.2 / 50 μs .
- Short-circuit current front time / time to half-value: 8 / 20 μs .

CDN parameter.

- 12 Ω / 9 μF (line to earth) and 2 Ω / 18 μF (line to line) for power supply port.
- 42 Ω / 0.5 μF (line to earth) and 42 Ω / 0.5 μF (line to line) for IO ports.
- 2 Ω cable shielding layer to ground for shielding communication ports.

Conducted Immunity Test

Per IEC 60255-26 and IEC 61000-4-6, severity level 3.

- Test level: 10 V.
- Test frequency range: 150 kHz - 80 MHz.
- Modulation: 1 kHz sine wave, 80 % AM modulated.
- Spot test frequency: 27 MHz, 68 MHz.

Power Frequency Magnetic Field Immunity

Per IEC 61000-4-8, severity level 4.

- Test frequency: 50 Hz
- Test level: 30 A / m applied continuously, 300 A / m applied for 3 s.

Alternating Component (Ripple) in DC Auxiliary Energizing Quantity

Per IEC 60255-26 and IEC 61000-4-17.

- Test level: 15 % of rated DC value.

2.3.1.2 Insulation

Insulation Resistance

Per IEC 60255-27.

Insulation resistance > 100 MΩ at 500 Vdc.

Creepage Distances and Clearances

Per IEC 60255-27.

Pollution degree 3, Overvoltage category III.

High Voltage Withstand (Dielectric) Test

Per IEC 60255-27.

- 1 kV rms AC for 1 minute between RJ45 ports and the case earth (ground).
- 2 kV rms AC for 1 minute between all other terminals connected together and the case earth. Between all terminals of independent circuits.
- 1 kV rms AC for 1 minute, across open watchdog contacts.
- 1 kV rms AC for 1 minute, across open contacts of output relays.

Impulse Voltage Withstand Test

Per IEC 60255-27.

- Front time: 1.2 μs, Time to half-value: 50 μs.
Peak value: 1.5 kV, 0.5 J.
Between RJ45 ports and the case earth (ground).
- Front time: 1.2 μs, Time to half-value: 50 μs,
Peak value: 5 kV, 0.5 J.
Between all other independent circuits and the case earth, also between all terminals of independent circuits.

2.3.1.3 Environmental test

Ambient Temperature Range Test

Per IEC 60068-2-1 & IEC 60068-2-2.

- Operating temperature range: -25°C to +55°C (or -13°F to +131°F).
- Storage and transit:
 - 40°C to +70°C (or -40°F to +158°F) (Enhanced local control panel)
 - 25°C to +70°C (or -13°F to +158°F) (24 TE only)

Ambient Humidity Range Test

Per IEC 60068-2-78.

- 21 days at 93 % relative humidity and +40°C.

Per IEC 60068-2-14.

- 5 cycles, -25°C to +55 °C, 1°C / min rate of change.

Per IEC 60068-2-30.

- Damp heat cyclic, six cycles(12 hours + 12 hours), 93 % RH, +25°C to +55°C.

Corrosive Environment Test

Per IEC 60068-2-60: 1995, Part 2, Test Ke, Method (class) 3

Industrial corrosive environment/ poor environmental control, mixed gas flow test.

- 21 days at 75 % relative humidity and 30°C (86°F) with exposure to elevated concentrations of H₂S, NO₂, Cl₂ and SO₂.

2.3.1.4

Mechanical Test

Applicable to the following case variants:

- Surface-mounted 24 TE, 40 TE or 84 TE case
- Flush-mounted 24 TE, 40 TE or 84 TE case

Vibration Test

Per IEC 60255-21-1, test severity class 1.

Frequency range in operation

- 10 to 60 Hz, 0.035 mm, and
- 60 to 150 Hz, 0.5 g

Frequency range during transport

- 10 to 150 Hz, 1 g

Shock Response and Withstand Test, Bump Test

Per IEC 60255-21-2.

Acceleration and pulse duration:

- Shock Response tests are carried out to verify full operability (during operation), test severity class 1:
5 g for 11 ms.
- Shock Withstand tests are carried out to verify the endurance (during transport), test severity class 1:
15 g for 11 ms.
- Shock bump tests are carried out to verify permanent shock (during transport), test severity class 1:
10 g for 16 ms.

Seismic Test

Per IEC 60255-21-3, test procedure A, class 1.

Frequency range

- Horizontal axes of vibration: 1 Hz to 8 Hz with 3.5 mm peak displacement, 8 to 35 Hz with 10 m / s² peak acceleration. 2 x 1 cycle.
- Vertical axis of vibration: 1 Hz to 8 Hz with 1.5 mm peak displacement, 8 to 35 Hz with 5 m / s² peak acceleration. 1 x 1 cycle.

2.4 Environmental Conditions

Temperatures

Per IEC 60255-1 & IEC 60068-2-1

Recommended temperature range

- -5°C to +55°C [+23°F to +131°F].

Limit temperature range

- Operation: -25°C to +55°C [-13°F to +131°F].
- Storage and transport:
 - 40°C to +70°C [-40°F to +158°F] (Enhanced local control panel)
 - 25°C to +70°C [-13°F to +158°F] (24 TE only)

Ambient Humidity Range

- ≤ 75 % relative humidity (annual mean).
- 21 days at ≤ 95 % relative humidity and 40°C [104°F].
- Condensation not permitted.

Solar Radiation

Direct solar radiation on the front of the device must be avoided.

2.5 Inputs and Outputs

2.5.1 Measuring Inputs

Current Measuring Inputs

- Nominal current I_{nom} : 1 and 5 A AC (adjustable).
- Nominal consumption per phase:
 - 1 A CT burden: < 0.1 VA
 - 5 A CT burden: < 0.3 VA
- Load rating:
 - continuous: $4 \cdot I_{nom}$,
 - for 10 s: $30 \cdot I_{nom}$,
 - for 1 s: $100 \cdot I_{nom}$.
- Nominal surge current: $250 \cdot I_{nom}$.

Voltage Measuring Inputs

- Nominal voltage V_{nom} : 50 to 130 V AC (adjustable).
- Nominal consumption per phase: < 0.3 VA at $V_{nom} = 130$ V AC.
- Load rating:
 - continuous: 150 V AC
 - for 10 s: 300 V AC

Frequency

- Nominal frequency f_{nom} : 50 Hz and 60 Hz (adjustable).
- Operating range: 0.95 to 1.05 f_{nom} .
- Frequency protection: 40 to 70 Hz.

2.5.2

Binary Signal Inputs

Threshold pickup and drop-off points as per ordering option

- Standard variant with switching threshold at 65% of 24 V DC ($V_{A,min}$)

Special variants with switching thresholds from 58% to 72% of the nominal input voltage (i.e. definitively “low” for $V_A < 58\%$ of the nominal supply voltage, definitively “high” for $V_A > 72\%$ of the nominal supply voltage).

- Special variant with switching threshold at 65% of 110 V DC ($V_{A,nom}$).
- Special variant with switching threshold at 65% of 127 V DC ($V_{A,nom}$).
- Special variant with switching threshold at 65% of 220 V DC ($V_{A,nom}$).
- Special variant with switching threshold at 65% of 250 V DC ($V_{A,nom}$).

Power consumption per input

- 18 V standard variant:
 $V_A = 19 \text{ to } 110 \text{ V DC} : 0.5 \text{ W} \pm 30\%$,
 $V_A > 110 \text{ V DC} : V_A \cdot 5 \text{ mA} \pm 30\%$.
- Special variants:
 $V_A > \text{switching threshold} : V_A \cdot 5 \text{ mA} \pm 30\%$.

The standard variant of binary signal inputs (opto couplers) is recommended in most applications, as these inputs operate with any voltage from 19 V. Special versions with higher pick-up/drop-off thresholds are provided for applications where a higher switching threshold is expressly required.

The maximum voltage permitted for all binary signal inputs is 300 V DC.

2.5.3 IRIG-B Interface

- Minimum / maximum input voltage level
Demodulated: 2 Vpp / 6 Vpp (peak-peak)
Modulated: a few hundred mVpp / 10 Vpp
- Electrical isolation: 2 kVrms

2.5.4 Direct Current Input

- Input current: 0 to 26 mA
- Value range: 0.00 to 1.20 $I_{DC,nom}$ ($I_{DC,nom} = 20$ mA)
- Maximum continuous input current permitted: 50 mA
- Maximum input voltage permitted: 17 V DC
- Input load: 100 Ω
- Open-circuit monitoring: 0 to 10 mA (adjustable)
- Overload monitoring: > 24.8 mA
- Zero suppression: 0.000 to 0.200 $I_{DC,nom}$ (adjustable).

2.5.5 Resistance Thermometer

Only PT 100 permitted for analog (I/O) module, mapping curve per IEC 75.1.

- Value range: -40.0°C to +215.0°C (-40°F to +419°F).
- 3-wire configuration: max. 20 Ω per conductor.
- Open and short-circuited input permitted.
- Open-circuit monitoring: $\Theta > +215^{\circ}\text{C}$ and $\Theta < -40^{\circ}\text{C}$ ($\Theta > +419^{\circ}\text{F}$ and $\Theta < -40^{\circ}\text{F}$).

2.5.6 Direct Current Output

- Output current: 0 to 20 mA
- Maximum permissible load: 500 Ω
- Maximum output voltage: 15 V

2.5.7 Output Relays

	Binary I/O Module X(6I 6O) for switchgear control.	Binary I/O Module X(4H) with high-break contacts, applicable to DC circuits only.	All other modules
Rated voltage:	250 V DC 250 V AC	250 V DC	250 V DC, 250 V AC.
Continuous current:	8 A	10 A	5 A
Short-duration current:	● 30 A for 0.5 s	● 250 A for 0.03 s, ● 30 A for 3 s	30 A for 0.5 s.
Making capacity:	1000 W (VA) at L/R = 40 ms.	30 A	1000 W (VA) at L/R = 40 ms.
Breaking capacity:	● 0.2 A at 220 V DC and L/R = 40 ms, ● 4 A at 230 V AC and $\cos \varphi = 0.4$.	● 7500 W resistive or 30 A at 250 V DC, Maximum values: 30 A and 300 V DC. ● 2500 W inductive (L/R = 40 ms) or 10 A at 250 V DC, Maximum values: 10 A and 300 V DC.	● 0.2 A at 220 V DC and L/R = 40 ms, ● 4 A at 230 V AC and $\cos \varphi = 0.4$.
Operating time:	less than 5 ms	less than 0.2 ms	less than 5 ms
Reset time:	less than 5 ms	less than 8 ms	less than 5 ms

2.5.8 BCD Measured Data Output

Maximum numerical value that can be displayed: 399

2.6 Interfaces

2.6.1 Local Control Panel

Enhanced local control panel

Input or output

- 12 navigation/control keys, 4 context sensitive hotkeys and 6 user configurable function keys
- Portrait orientation QVGA (192 × 96 pixels) with 3.5 Inches dimension, LCDisplay containing 12 × 32 alphanumeric characters

State and fault signals

- 5 fixed system LEDs (Healthy, Alarm, Trip, Out of Service, Edit Mode)
- 2 LED indicators for 'Local', 'Remote' and 'Local and Remote' states
- 12 multi-color LED indicators with user configurable functional assignment
- 6 multi-color LED indicators with user configurable functional assignment for function keys

24 TE case

Input or output

- 7 keys and a 4 × 20 character liquid crystal display (LCD)

State and fault signals

- 10 LED indicators:
 - 5 fixed system LEDs (Healthy, Alarm, Trip, Out of Service, Edit Mode)
 - 5 multi-color LED indicators with user configurable functional assignment

2.6.2 PC Interface

- Transmission rate: 300 to 115,200 baud (adjustable)

2.6.3 Serial Communication Interface

The communication modules can be provided with up to three communication channels, depending on the module variant. Channel 1 and 3 may either be equipped to connect wire leads or optical fibers and channel 2 is only available to connect wire leads.

For communication interface 1, communication protocols based on IEC 870-5-103, IEC 60870-5-101, MODBUS, DNP 3.0, or Courier can be set.

- Transmission rate: 300 to 64000 baud (adjustable).

Communication interface 2 can only be operated with the interface protocol based on IEC 60870-5-103.

- Transmission rate: 300 or 57600 baud (adjustable).

Communication interface 3 permits end-end channel-aided digital communication schemes to be configured for real time protective signaling between two protection devices (InterMiCOM protective interface).

- Transmission rate: 600 or 19200 baud (adjustable).

Wire Leads

- Per RS 485 or RS 422, 2 kV isolation
- Distance to be bridged
 - Point-to-point connection: max. 1200 m
 - Multipoint connection: max. 100 m

Plastic Fiber Connection

- Optical wavelength: typically 660 nm
- Optical output: min. -7.5 dBm
- Optical sensitivity: min. -20 dBm
- Optical input: max. -5 dBm
- Distance to be bridged: max. 45 m
(Distance to be bridged given for identical optical outputs and inputs at both ends, a system reserve of 3 dB, and typical fiber attenuation)

Glass Fiber Connection G 50/125

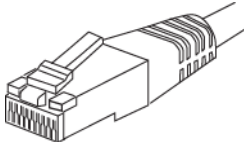
- Optical wavelength: typically 820 nm
- Optical output: min. -19.8 dBm
- Optical sensitivity: min. -24 dBm
- Optical input: max. -10 dBm
- Distance to be bridged: max. 400 m
(Distance to be bridged given for identical optical outputs and inputs at both ends, a system reserve of 3 dB, and typical fiber attenuation)

Glass Fiber Connection G 62.5/125

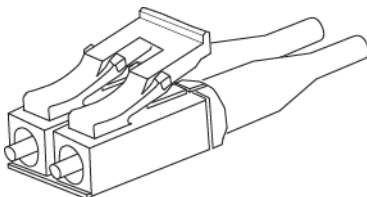
- Optical wavelength: typically 820 nm
- Optical output: min. -16 dBm
- Optical sensitivity: min. -24 dBm
- Optical input: max. -10 dBm
- Distance to be bridged: max. 1,400 m
(Distance to be bridged given for identical optical outputs and inputs at both ends, a system reserve of 3 dB, and typical fiber attenuation)

2.6.4 Ethernet Communication Interface

100BaseTx Port

Connector	Characteristics
Type	Shielded RJ45 jack 
Manufacturer / Reference	
Twisted pair cable	Cat 5
Max. cable length with Cat 5	100 m

100BaseFx Multi-Mode Port

Connector	Characteristics	
Fiber port type	LC duplex connector optical Interface 	
Manufacturer / Reference	AVAGO HFBR-57E5APZ	
Center wavelength	1308 nm (Typ.)	
Optimal fiber cable	62.5/125 µm	50/125 µm
Output Optical Power (TX)	- 20.0 (Min.) - 17.0 dBm (Typ.)	- 23.5 (Min.) - 20.0 dBm (Typ.)
Receiver Sensitivity (RX)	- 31.0 (Min.) dBm	- 31.0 (Min.) dBm
Max. Fiber distance	See Fiber optical budget calculation Section 2.6.5, (p. 2-16)	

2.6.5 Fiber Optic budget calculations

Optical power is expressed in Watts. However, the common unit of power measurement is the dBm, defined by the following equation: $\text{Power (dBm)} = 10 \log \text{Power (mW)} / 1 \text{ mW}$.

The fiber optic budget is the difference between the power emitted into the fiber and the sensitivity (minimum amount of power required) of the receiver connected through the fiber optic cable.

Link Power Budget = Transmitter Power (dBm) - Receiver Sensitivity (dBm)

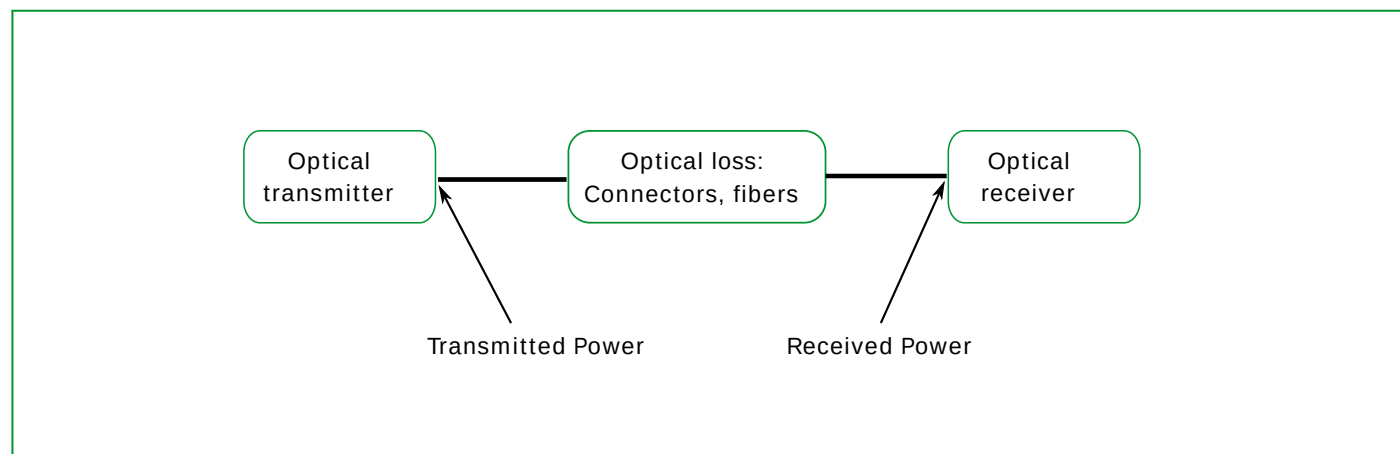


Fig. 2-1: Fiber budget.

Fiber type	Multi-Mode
Technology	62.5/125 micron
Power coupled into fiber	- 20 dBm (Min.)
Receiver Sensitivity	- 31 dBm (Min.)
Link Power Budget	11 dB

Example 1: between devices

Topic	Multi-Mode
Link Power budget	11 dB
Connector loss	1.6 dB
Protective Margin	4 dB
Allowed link attenuation	5.4 dB
Typical cable attenuation	1 dB/km
Maximum range	5.4 km

Example 2: between devices with patch panel

Topic	Multi-Mode
Link Power budget	11 dB
Connector loss	1.6 dB
Patch loss	2 dB
Protective Margin	4 dB
Allowed link attenuation	3.4 dB
Typical cable attenuation	1 dB/km
Maximum range	3.4 km

2.6.6

IRIG-B Interface

- Modulated signal (B122 format)
- Demodulated signal (B000 format)
- Carrier frequency: 1 kHz
- BCD- coded variable data (daily)
- 2kVrms Dielectric withstand

2.7 Information Output

Counters, measured data, and indications: see chapter “Information and Control Functions”.

2.8 Settings – Typical Characteristic Data

2.8.1 Main Function

- Minimum output pulse for trip command: 0.1 to 10 s (adjustable)
- Minimum output pulse for close command: 0.1 to 10 s (adjustable)

2.8.2 Distance Protection

- Minimum fault detection time: 12 ms
- Fault detector reset time $30 \text{ ms} \pm 10 \text{ ms}$
- Directional sensitivity up to 2 s after fault detection: ∞
- Directional sensitivity after 2 s after fault detection and for switching on to fault: $200 \text{ mV} \pm 10\%$
- Shortest tripping time: approx. 19 ms
- Fault detection and measurement resetting ratio: 0.95

2.8.3 Definite-Time and Inverse-Time Overcurrent Protection

- Operate time including output relay (measured variable from 0 to 2-fold operate value): $\leq 40 \text{ ms}$, approx. 30 ms
- Reset time (measured variable from 2-fold operate value to 0): $\leq 40 \text{ ms}$, approx. 30 ms
- Starting resetting ratio: approx. 0.95

2.8.4 Time-Voltage Protection

- Operate time including output relay (measured variable from nominal value to 1.2-fold operate value or measured variable from nominal value to 0.8-fold operate value):
 - $\leq 40 \text{ ms}$, approx. 30 ms
- Reset time (measured variable from 1.2-fold operate value to nominal value or measured variable from 0.8-fold operate value to nominal value):
 - $\leq 45 \text{ ms}$, approx. 30 ms
- Resetting ratio for $V<>$:
 - 1% to 10% (adjustable)

2.8.5 Power Directional Protection

- Operate time including output relay (measured variable from nominal value to 1.2-fold operate value or measured variable from nominal value to 0.8-fold operate value): $\leq 60 \text{ ms}$, approx. 50 ms
- Reset time (measured variable from 1.2-fold operate value to nominal value or measured variable from 0.8-fold operate value to nominal value): $\leq 40 \text{ ms}$, approx. 30 ms
- Resetting ratio for $P_>$, $Q_>$: 0.05 to 0.95 (adjustable)
- Resetting ratio for $P_<$, $Q_<$: 1.05 to 20 (adjustable)

2.9 Deviations

2.9.1 Deviations of the Operate Values

2.9.1.1 Definitions

Reference Conditions

- Quasi-stationary sinusoidal signals at nominal frequency f_{nom} (frequency protection excepted), total harmonic distortion $\leq 2\%$, ambient temperature 20°C (68°F), and nominal auxiliary voltage $V_{A,nom}$.

Deviation

- Deviation relative to the setting under reference conditions.

2.9.1.2 Distance Protection

- Starting $V_{<}$, $V_{NG>}$, $V_{NG>>}$:
 $\pm 3\%$ of the setting or $\pm 0.5\%$ of the nominal value
- Starting $I_{>}$, $I_{>>}$, $I_{N>}$:
 $\pm 3\%$ of the setting or $\pm 1\%$ of the nominal value
- Impedance measurement starting $Z_{<}$:
 $\pm 10\%$ of the setting or $\pm 20\text{ m}\Omega$ (secondary side)
- Impedance measurement tripping zones:
 $\pm 5\%$ of the setting or $\pm 10\text{ m}\Omega$ (secondary side)
- Directional Determination: $\pm 3^{\circ}$

2.9.1.3 Measuring-Circuit Monitoring

Operate values I_{neg} , V_{neg}

- Deviation: $\pm 3\%$ of the setting or $\pm 0.5\%$ of the nominal value

2.9.1.4 Overcurrent-Time Protection

Operate values $I_{>}$, $I_{N>}$

- Deviation: $\pm 5\%$ of the setting or $\pm 1\%$ of the nominal value

2.9.1.5 Thermal Overload Protection

Operate value Θ

- Deviation: $\pm 5\%$ of the setting or $\pm 1\%$ of the nominal value

2.9.1.6 Time-Voltage Protection

Operate values

- $V_{<>}$, $V_{pos<>}$: $\pm 1\%$ (in the range 0.6 to 1.4 V_{nom})
- $V_{NG>}$, $V_{neg>}$: $\pm 1\%$ (in the range $> 0.3 V_{nom}$)

- 2.9.1.7 Frequency Protection
- Operate values $f < >$
- $\pm 5 \text{ mHz}$
- Operate values df/dt
- $\pm 100 \text{ mHz/s}$
- 2.9.1.8 Underfrequency Load Shedding Protection (Function Group Pf<)
- Operate values
- $f <: \pm 5 \text{ mHz}$
 - $P_{\min}: \pm 20\%$ of the setting or $\pm 2\%$ of the nominal value
 - $I_{\min}: \pm 5\%$ of the setting or $\pm 1\%$ of the nominal value
 - Angle: $\pm 1^\circ$
- 2.9.1.9 Power Directional Protection
- Operate values $P < >, Q < >$
- Deviation: $\pm 5\%$ of the setting or $\pm 2\%$ of the nominal value
- 2.9.1.10 Voltage Controlled Directional Reactive Power Protection (QV)
- Operate values
- $V <: \pm 1\%$ (in the range 0.6 to 1.4 V_{nom})
 - $Q_{\min}: \pm 20\%$ of the setting or $\pm 2\%$ of the nominal value
 - $I_{\min}: \pm 5\%$ of the setting or $\pm 1\%$ of the nominal value
 - Angle: $\pm 1^\circ$
- 2.9.1.11 Circuit Breaker Failure Protection
- Operate value $I <$
- Hysteresis: 6.25% of the setting plus 4.8% of the nominal value
 - Deviation: $\pm 5\%$ of the setting or $\pm 2\%$ of the nominal value

- 2.9.1.12 Ground Fault Direction Determination Using Steady-State Values (GFDSS)
- Operate values $V_{NG>}$, $I_{N,act>}$, $I_{N,react>}$, $I_{N>}$
- Deviation: $\pm 3\%$ of the setting or $\pm 0.5\%$ of the nominal value
- Sector angle
- Deviation: $\pm 0.5^\circ$
- 2.9.1.13 Pulse Detection (PULSE)
- Operate values $V_{NG>}$, $I_{N>}$
- Deviation: $\pm 3\%$ of the setting or $\pm 0.5\%$ of the nominal value
- 2.9.1.14 Direct Current Input
- Deviation: $\pm 1\%$
- 2.9.1.15 Resistance Thermometer
- Deviation: $\pm 2^\circ\text{C}$ (in the range $-40^\circ\text{C} \dots 120^\circ\text{C}$)
- 2.9.1.16 Analog Measured Data Output
- Deviation: $\pm 1\%$
 - Output residual ripple with max. load: $\pm 1\%$
- 2.9.2 Deviations of the Timer Stages
- 2.9.2.1 Definitions
- Reference conditions
- Sinusoidal signals at nominal frequency f_{nom} , total harmonic distortion $\leq 2\%$, ambient temperature 20°C (68°F), and nominal auxiliary voltage $V_{A,nom}$.
- Deviation
- Deviation relative to the setting under reference conditions.
- 2.9.2.2 Definite-time stages
- Deviation: $\pm 1\% + 20\text{ ms to }40\text{ ms}$
- 2.9.2.3 Inverse-time stages
- Deviation when $I \geq 2 I_{ref}$: $\pm 5\% + 10\text{ to }25\text{ ms}$
 - For “extremely inverse” IEC characteristics and for thermal overload characteristics: $\pm 7.5\% + 10\text{ to }20\text{ ms}$

2.9.3 Deviations of Measured Data Acquisition

2.9.3.1 Definitions

Reference conditions

- Sinusoidal signals at nominal frequency f_{nom} , total harmonic distortion $\leq 2\%$, ambient temperature 20°C (68°F), and nominal auxiliary voltage $V_{A,nom}$.

Deviation

- Deviation relative to the nominal values under reference conditions.

2.9.3.2 Operating Data Measurement

Measuring input currents

- Deviation: $\pm 1\%$

Measuring input voltages

- Deviation: $\pm 0.5\%$

Internally formed resultant current and negative-sequence system current

- Deviation: $\pm 2\%$

Internally formed neutral-point displacement voltage and voltages of positive- and negative-sequence systems

- Deviation: $\pm 2\%$

Active power / active energy

- Deviation: $\pm 2\%$ when $\cos \varphi = \pm 0.7$
- Deviation: $\pm 5\%$ when $\cos \varphi = \pm 0.3$

Reactive power / reactive energy

- Deviation: $\pm 5\%$ when $\cos \varphi = \pm 0.7$
- Deviation: $\pm 2\%$ when $\cos \varphi = \pm 0.3$

Phase-to-phase impedances

- Magnitude deviation: $\pm 2\%$
- Angle deviation: $\pm 1^{\circ}$ (both for $V > 0.8 V_{nom}$, $I > 0.5 I_{nom}$)

Load angle

- Deviation: $\pm 1^\circ$

Frequency

- Deviation: ± 10 mHz

2.9.3.3

Fault Data

Short-circuit current and voltage

- Deviation: $\pm 3\%$

Short-circuit impedance, reactance, and fault location

- Deviation: $\pm 5\%$

2.9.3.4

Internal Clock

With free running internal clock

- Deviation: < 1 min/month

With external synchronization (with a synchronization interval ≤ 1 min)

- Deviation: < 10 ms

With synchronization via IRIG-B interface

- ± 1 ms

2.10 Resolution of the Fault Data Acquisition

2.10.1 Time Resolution

- 20 sampled values per period

2.10.2 Phase Currents System

Dynamic range

- $100 I_{nom}$

Amplitude resolution

- at $I_{nom} = 1 \text{ A}$: 6.1 mA_{rms}
- at $I_{nom} = 5 \text{ A}$: 30.5 mA_{rms}

2.10.3 Residual Current

Dynamic range

- $16 I_{nom}$

Amplitude resolution

- at $I_{nom} = 1 \text{ A}$: 1.0 mA_{rms}
- at $I_{nom} = 5 \text{ A}$: 4.9 mA_{rms}

2.10.4 Phase-to-Ground Voltages and Neutral-Point Displacement Voltage

Dynamic range

- 150 V

Amplitude resolution

- 9.2 mV_{rms}

2.11 Recording Functions

2.11.1 Organization of the Recording Memories

Operating Data Memory

Scope for signals

- All signals relating to normal operation; from a total of up to 2048 different logic state signals.

Depth for signals

- The 3000 most recent signals.

Monitoring Signal Memory

Scope for signals

- All self-monitoring logic state signals.

Depth for signals

- Up to 30 signals.

Overload Memory

Number

- The 8 most recent overload events.

Scope for signals

- All signals relevant for an overload event from a total of up to 2048 different logic state signals.

Depth for signals

- 200 entries per overload event.

Ground Fault Memory

Number

- The 8 most recent ground fault events.

Scope for signals

- All signals relevant for a ground fault event from a total of up to 2048 different logic state signals.

Depth for signals

- 200 entries per ground fault event.

Fault Memory

Number

- The 8 most recent faults.

Scope for signals and fault values

- All fault-relevant signals from a total of up to 2048 different logic state signals.
- Sampled values for all measured currents and voltages.

Depth for signals and fault values

- 200 entries per fault event.
- Recording duration per fault event is limited to 1 minute.
- Max. number of cycles per fault can be set by user;
1638 periods in total for all faults (incl. pre-fault time for next recording),
that is 32.76 s (for $f_{nom} = 50$ Hz) or 27.3 s (for $f_{nom} = 60$ Hz).

Resolution of the recorded data

- As per [Section 2.10, \(p. 2-26\)](#).

2.12 Power Supply

Nominal auxiliary voltage $V_{A,nom}$ (ordering option)

- 24 to 60 V DC (lower range supply)
- 60 to 250 V DC or 100 to 230 V AC (upper range supply)

Operating range for direct voltage

- 0.8 to 1.1 $V_{A,nom}$ with a residual ripple of up to 15% $V_{A,nom}$.

Operating range for alternating voltage

- 0.9 to 1.1 $V_{A,nom}$.

Nominal burden

- where $V_A = 220$ V DC and with maximum module configuration
 - 24 TE case, relays de-energized/energized: approx. 11 W / 20 W
 - 40 TE case, relays de-energized/energized: approx. 12.6 W / 34.1 W
 - 84 TE case, relays de-energized/energized): approx. 14.5 W / 42.3 W

Start-up peak current

- < 3 A for duration of 0.25 ms

Stored energy time

- ≥ 20 ms for interruption of $V_A \geq 24$ V DC (lower and upper range supply)
- ≥ 50 ms for interruption of $V_A \geq 36$ V DC (lower range supply)
- ≥ 50 ms for interruption of $V_A \geq 90$ V DC (upper range supply)

2.13 Current Transformer Specifications

2.13.1 Symbols

The following symbols are used in accordance with IEC 61869 standards:

I_{pn} Rated primary current (nominal primary current) of the CT

I_{sn} Rated secondary current (nominal secondary current) of the CT

I_{psc} Rated primary (symmetrical) short-circuit current

K_{ssc} Rated symmetrical short-circuit current factor:

$$K_{ssc} = \frac{I_{psc}}{I_{pn}}$$

I_{ref} Reference current of IDMT protection element

R_{bn} Rated resistive burden (secondary connected) of the CT

P_{bn} Equivalent power over the rated resistive burden of the CT for rated secondary current:

$$P_{bn} = R_{bn} \cdot I_{sn}^2$$

R_b Actual resistive burden (secondary connected) of the CT

P_b Equivalent power over the actual resistive burden of the CT for rated secondary current:

$$P_b = R_b \cdot I_{sn}^2$$

R_{ct} Secondary winding resistance of the CT

P_{ct} Equivalent power over the secondary winding resistance of the CT for secondary rated current:

$$P_{ct} = R_{ct} \cdot I_{sn}^2$$

V_{sal} Secondary accuracy limiting voltage (e.m.f.) of the CT

V_k Rated knee point voltage (e.m.f.) of the CT

n_n Rated accuracy limit factor of the CT

n_b Actual accuracy limit factor of the CT:

$$n_b = n_n \cdot \frac{R_{ct} + R_{bn}}{R_{ct} + R_b} = n_n \cdot \frac{P_{ct} + P_{bn}}{P_{ct} + P_b}$$

R_l One-way lead resistance from CT to relay

R_{rel} Resistive burden of relay's CT input

T_p Primary time constant (primary system time constant)

ω (System) angular frequency

X_p/R_p Primary impedance ratio (system impedance ratio):

$$\frac{X_p}{R_p} = \omega \cdot T_p$$

K_d Dimensioning factor for the CT

K_{emp} Relay specific, empirically determined dimensioning factor for the CT

2.13.2

General Equations

The current transformer can be dimensioned

- either for the minimum required secondary accuracy limiting voltage acc. to IEC 61869, 3.4.209:

$$V_{sal} \geq K_d \cdot K_{ssc} \cdot I_{sn} \cdot (R_{ct} + R_b)$$

- or for the minimum required rated accuracy limit factor acc. to IEC 61869, 3.4.208, as follows:

$$n_n \geq K_d \cdot K_{ssc} \cdot \frac{R_{ct} + R_b}{R_{ct} + R_{bn}} = K_d \cdot K_{ssc} \cdot \frac{P_{ct} + P_b}{P_{ct} + P_{bn}}$$

The relation between both methods is given as follows:

$$V_{sal} = n_n \cdot \left(\frac{P_{bn}}{I_{sn}} + I_{sn} \cdot R_{ct} \right)$$

The actual secondary connected burden R_b is given as follows:

- For phase-to-ground faults: $R_b = 2 \cdot R_l + R_{rel}$
- For phase-to-phase faults: $R_b = R_l + R_{rel}$

The wire lead burden is calculated as:

$$R_l = \rho \cdot \frac{l}{A}$$

- ρ = specific conductor resistance
(e.g. for copper $0.021 \Omega \text{ mm}^2/\text{m} = 2.1 \cdot 10^{-8} \Omega \text{ m}$, at 75°C)
- l = wire length
- A = wire cross section

For devices out of the platform Easergy MiCOM 30, the input CT burden R_{rel} is less than $20 \text{ m}\Omega$, independent of the set nominal current (1 A or 5 A). Usually this relay burden can be neglected.

The rated knee point voltage V_k according to IEC 61869, 3.4.217 is lower than the secondary accuracy limiting voltage V_{sal} according to IEC 61869, 3.4.209. It is not possible to give a general relation between V_k and V_{sal} , but for standard core material the following relations applies:

- $V_k \approx 0.85 \cdot V_{sal}$ for class 5P CTs, and
- $V_k \approx 0.75 \cdot V_{sal}$ for class 10P CTs, respectively.

Theoretically, the specifications of the current transformer could be calculated to avoid saturation by inserting its maximum value, instead of the required over-dimensioning factor K_d :

$$K_d = K_{\max} \approx 1 + \frac{X_p}{R_p} = 1 + \omega \cdot T_p$$

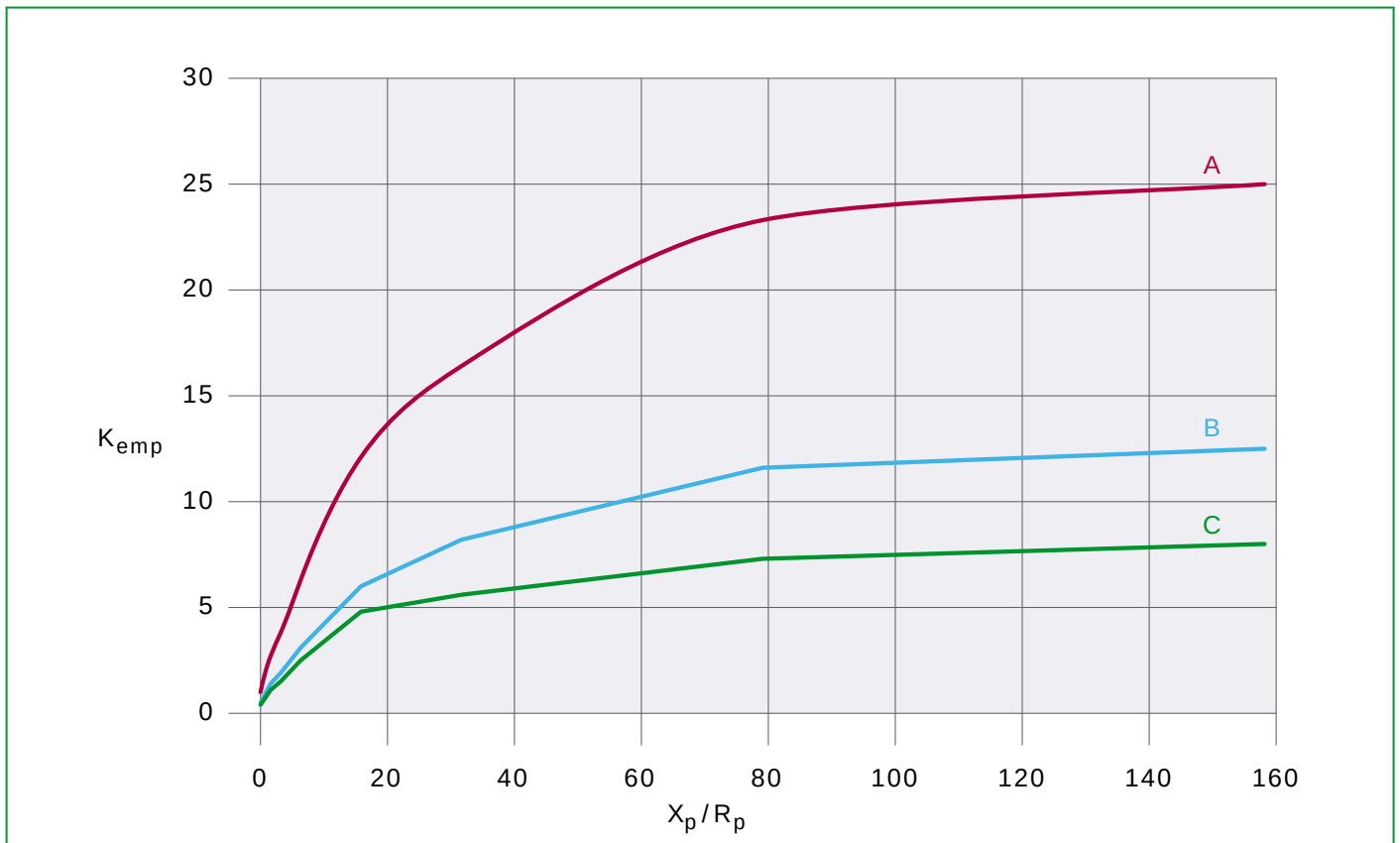
However, this is not necessary. Instead, it is sufficient to consider an empirically determined dimensioning factor $K_d = K_{\text{emp}}$ such that the appropriate operation of the protection function is ensured under the given conditions. This factor depends on application and relay type, as outlined in the following.

2.13.3

Distance Protection

For the P433, the empirical dimensioning factor $K_d = K_{\text{emp}}$ can be taken from the following diagram, which shows three practical curves:

- Curve A (red): Choosing K_{emp} according to this line assures that transient CT saturation practically does not affect distance protection: Distance (instantaneous) zone trip is assured within $-0/+40$ ms for up to 95% of the set zone reach.
- Curve B (blue): Choosing K_{emp} according to this line allows transient CT saturation to slightly affect distance protection: Distance (instantaneous) zone trip is assured within $-0/+50$ ms for up to 90% of the set zone reach.
- Curve C (green): Choosing K_{emp} according to this line allows transient CT saturation to affect distance protection: Distance zone trip is assured for up to 85% of the set zone reach.



As per IEC 60255-121 (draft 2011), the following 4 fault conditions have to be checked to determine the required CT dimensioning.

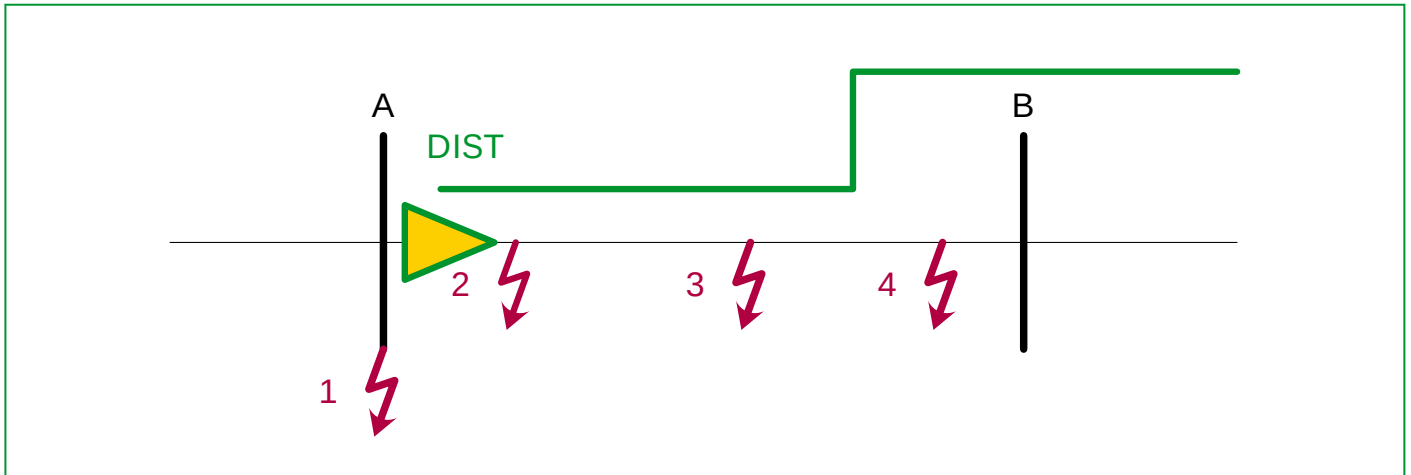


Fig. 2-2: Check conditions.

Case 1:

- Close-up backward short-circuit (security case)
Acceptance criteria: Stable backward direction decision, no trip
Select required K_{emp} per curve C

Case 2:

- Close-up forward short-circuit (dependability case)
Acceptance criterion: Instantaneous trip with less than 1 period add. delay
Required $K_{emp} = 1.5$

Case 3:

- Short-circuit at 80% of Zone 1 reach limit (dependability case)
Acceptance criterion: Trip with less than 3 periods add. delay
Select required K_{emp} per curve B

Case 4:

- Short-circuit at 110% of Zone 1 reach limit (security case)
Acceptance criterion: Correct time delayed zone 2 trip
Select required K_{emp} per curve C

Depending on the fault location, different maximum short-circuit currents and primary system X/R ratios apply! Therefore the required CT dimensioning has to be calculated separately for all 4 cases. The biggest sizing from all 4 cases then has to be used.

It is recommended to use CTs of accuracy class 5P (or equivalent).

3 Operation

3.1 Modular Structure

The P433 is a numerical device out of Schneider Electric's family of devices named "Easergy MiCOM 30". The device types included in this family are built from identical uniform hardware modules. The figure below shows the basic hardware structure of the P433.

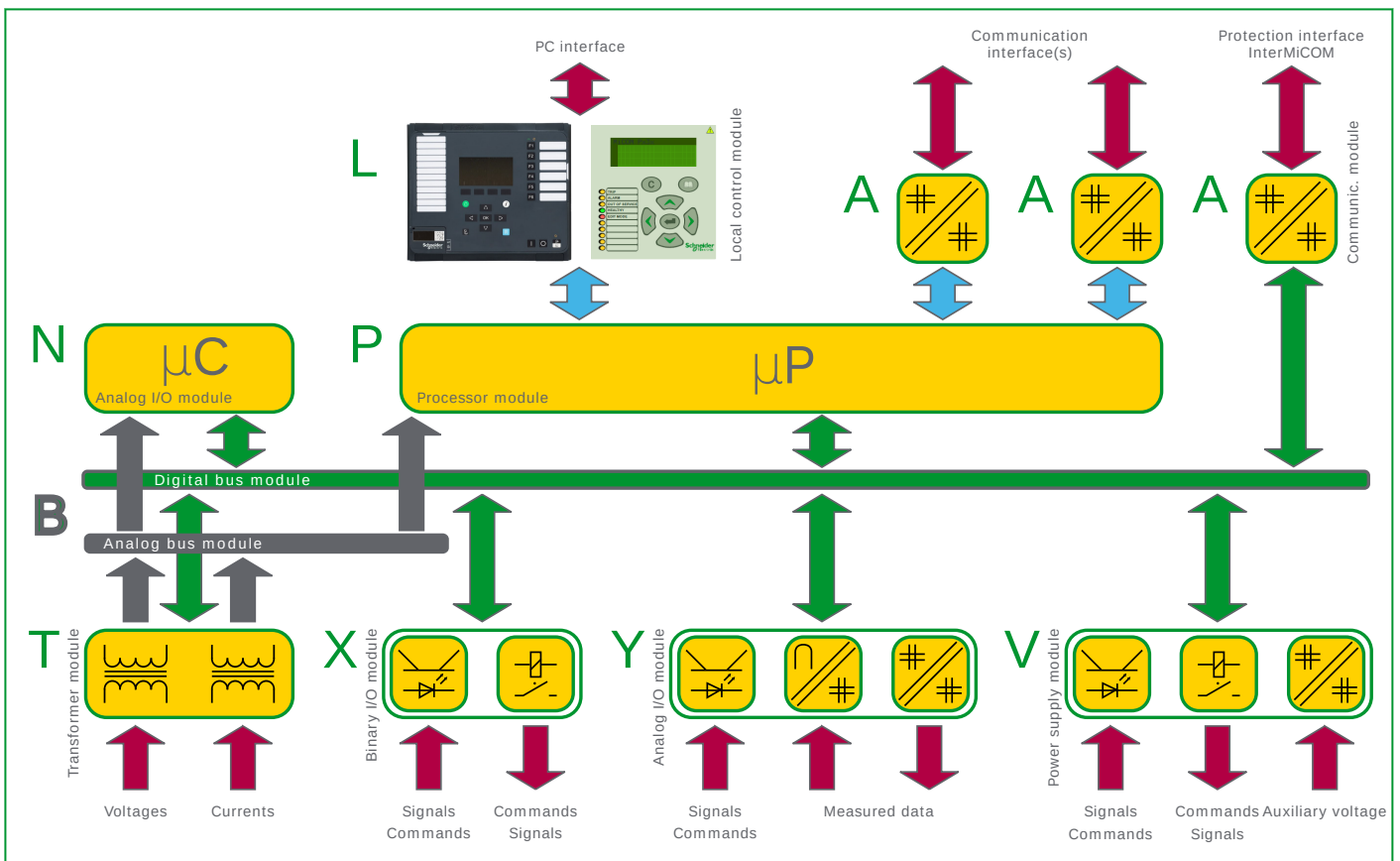


Fig. 3-1: Basic hardware structure.

External analog quantities and binary quantities – electrically isolated – are converted to the internal processing levels by the peripheral modules T, Y, and X. The optional binary I/O modules X are equipped with optical couplers for binary signal input as well as output relays for the output of signals and commands or combinations of these.

The external auxiliary voltage is applied to the power supply module V, which supplies the auxiliary voltages that are required internally.

Analog data is transferred from the transformer module T via the analog bus module B to the processor module P. The processor module contains all the elements necessary for the conversion of measured analog variables, including multiplexers and analog/digital converters. The analog data conditioned by the analog I/O module Y is transferred to the processor module P via the digital bus module. The optional transient ground fault module N evaluates the measured variables according to the transient ground fault evaluation scheme.

The processor handles the processing of digitized analog variables and of binary signals, generates the protective trip and signals, and transfers them to the binary I/O modules X via the digital bus module. The processor module also handles overall device communication.

The optional communication modules provide one or two serial communication interfaces for the integration of the protection and control unit into a substation control system and for remote access respectively a protection communication interface for the transfer of digital information between two protection devices. The local control module L is located behind the front panel and connected to the processor module via a ribbon cable. It encompasses all control and display elements as well as a PC interface for running the operating program Easergy Studio.

3.2 Operator-Machine Communication

The following interfaces are available for the exchange of information between the user and the P433:

- Integrated user interface (LOC: local control panel)
- PC interface
- Communication interface

All settings and signals as well as all measurements and control functions are arranged within the branches of the menu tree following a scheme that is uniform throughout the device family. The main branches are:

“Parameters” Branch

All settings are contained in this branch. This branch carries all settings, including the identification data of the P433, the configuration parameters for adapting the P433 interfaces to the system, and the function parameters for adapting the device functions to the process. All values in this group are stored in non-volatile memory, which means that the values will be preserved even if the power supply fails.

“Operation” Branch

This branch includes all information relevant for operation such as measured operating data and binary signal states. This information is updated periodically and consequently is not stored. In addition, various controls are grouped here, for example those for resetting counters, memories and displays.

“Events” Branch

The third branch is reserved for the recording of events. All information in this group is therefore stored. In particular, the start/end signals during a fault, the measured fault data, and the sampled fault waveforms are stored here and can be read out when required.

Display of Settings and Signals

Settings and signals are displayed either in plain text or as addresses, in accordance with the user's choice. All settings and signals of the P433 are documented in a separate collection of documents, the so-called “DataModelExplorer”. The “Addresses” document (being part of the “DataModelExplorer”) is complete in the sense that it contains all settings, signals and measured variables that are relevant for the user of the P433.

The configuration of the local control panel also permits the installation of Measured Value “Panels” on the LCD display. Different Panels are automatically displayed for specific system operating conditions. Priority increases from normal operation to operation under overload conditions and finally to operation following a short circuit in the system. Thus the P433 provides the measured data relevant for the prevailing conditions.

3.3 Cyber Security (Function Group CS)

This product contains a Cyber Security function, which manages the encryption of the data exchanged through some of the communication channels. The aim is to protect the data (configuration and process data) from any corruption, malice, attack. Subsequently, this product might be subject to control from customs authorities, and it might be necessary to request special authorization from these customs authorities before any export/import operation. For any technical question relating to the characteristics of this encryption please contact your Customer Care Centre - <http://www.schneider-electric.com/CCC>.

*For devices of the Easergy MiCOM 30 platform, Cyber Security is available as of software version -660.
Please refer to separately available "Cyber Security" Technical Manual for all details.*

Cyber Security is based on the model of Role Based Access Control (RBAC) which is a method to restrict resource access to authorized users. One role can have one and more access rights, one user (subject) can have several roles. A user (subject) is based on a session. This session controls for example the activity of the user. If the user is inactive for 15 minutes (default setting) the user will be locked out automatically.

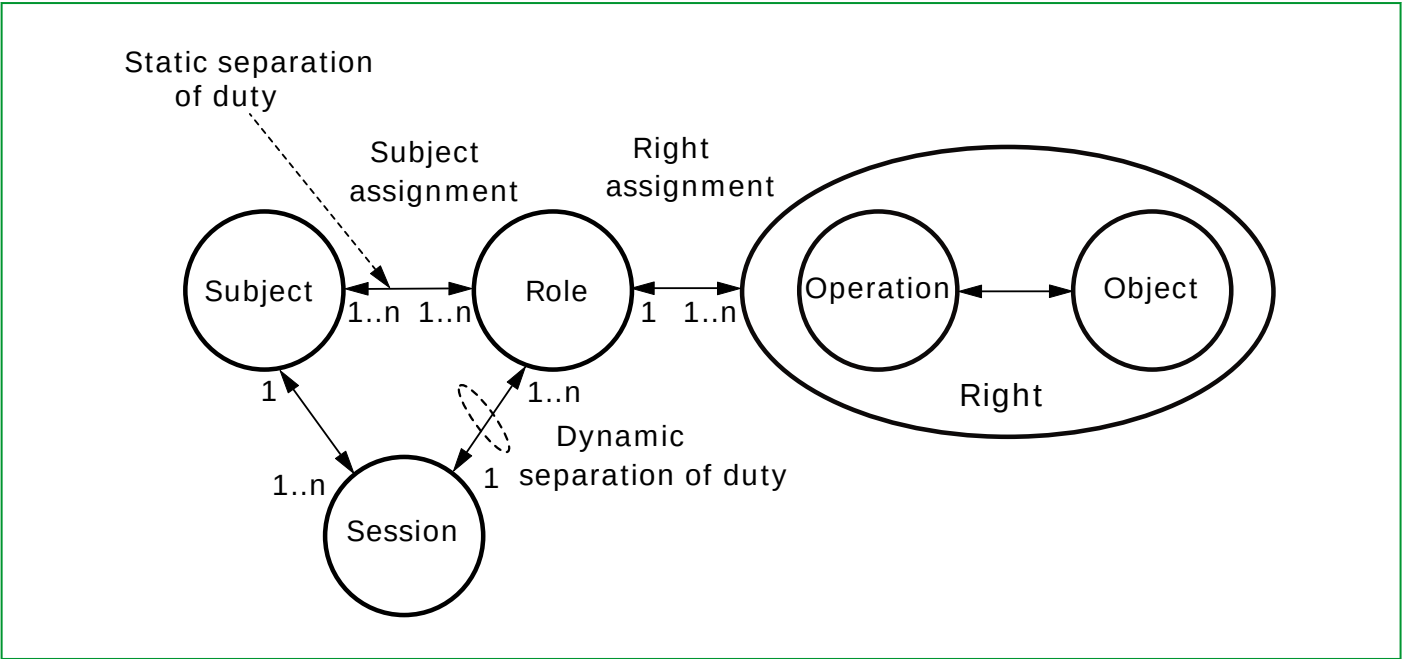


Fig. 3-2: RBAC model.

NOTICE**CYBER SECURITY HAZARD**

To improve Cyber Security:

- Change all passwords from their default values when taking the protection device into use.
- Change all passwords regularly.

Failure to follow these instructions can increase the risk of unauthorized access.

3.3.1

Users, Roles and Rights for Easergy MiCOM P30

User accounts

When the user tries to access an IED, they need to login using their own username and their own password. The username/ password combination is then checked against the records stored on the IED. It is the role that defines their access to the relevant parts of the system.

The default user accounts for Easergy MiCOM P30 is as below:

Schneider Electric points out that changing default users and default passwords constitutes an important security measure for the product. Therefore Schneider Electric recommends to change the default passwords after the first usage of the device. Not changing the default passwords can lead to the risk of undesirable changes by third parties.

User Accounts	Roles			
	ENGINEER	OPERATOR	VIEWER	SECADM
DefaultEngineer	x	x	x	
DefaultOperator		x	x	
DefaultViewer			x	
SecurityAdmin (for CAE only)				x
DefaultUser (for HMI only)			x	

Tab. 3-1: Default user accounts for Easergy MiCOM P30.

Roles

Different named roles are associated with different access rights. Roles and Rights are setup in a pre-defined arrangement, according to the IEC 62351 standard, but customized to the Easergy MiCOM P30 equipment.

The default roles for Easergy MiCOM P30 is as below:

Role	Description
VIEWER	Can View what objects are present within a Logical-Device by presenting the type ID of those objects.
OPERATOR	An Operator can view what objects and values are present within a Logical-Device by presenting the type ID of those objects as well as perform control actions.
ENGINEER	An Engineer can view what objects and values are present within a Logical-Device by presenting the type ID of those objects. Moreover, an engineer has full access to Datasets and Files and can configure the server locally or remotely.
SECADM	Security Administrator can change subject-to-role assignments (outside the device) and role-to-right assignment (inside the device) and security policy setting; change security setting such as certificates for subject authentication and access token verification.

Tab. 3-2: Default roles summary for Easergy MiCOM P30.

Rights

In a similar way in which a set of pre-defined Roles have been created, a predefined set of Rights have been created.

The reason why these are described as Default, is that it is possible to change the definitions of Roles and Rights, by using the CAE software. Depending on the work done by the system administrator, it is possible that your own situation may vary from these initial recommendations.

3.3.2

Cyber Security Types and Communication Protocols (Based on Order Number)

Considered some users may not want to use the Cyber Security, Schneider Electric offers Easergy MiCOM 30 Series with or without CS as below: (See [Chapter 15, \(p. 15-1\)](#) for the order information.)

- Default CS: Default RBAC configuration with simple password management, no CAE (EcoStruxure™ Cybersecurity Admin Expert) required.
- Advanced CS: Advanced cyber security, CAE required.
Complete security configuration via CAE (e.g. user and passwords, type of password complexity) and security services (e.g. Security logs).

Order number	Communication	Security types	Security conf.	Supported protocols	Configuration protocols
97 (1-4)	Ethernet module	Default security	-	IEC 61850 Ed1/ IEC 61850 Ed2/ IEC 60870-5-104	IEC 60870-5-103 TLS and SSH/SFTP and Webservices OR serial IEC 60870-5-103 serial and Firmware update and file transfer
99 (1-4)	Ethernet module	Advanced security	With CAE	IEC 61850 Ed1/ IEC 61850 Ed2/ IEC 60870-5-104	IEC 60870-5-103 TLS and SSH/SFTP and Webservices OR serial IEC 60870-5-103 serial and Firmware update and file transfer
92 x	Serial module	Default security	-	IEC 60870-5-103/ IEC 60870-5-101/ Modbus/ DNP	Serial only: IEC 60870-5-103 serial and Firmware update and file transfer
0	Without communication module	Default security	-	-	Serial only: IEC 60870-5-103 serial and Firmware update and file transfer
97 (5-8)	Ethernet + serial module	Default security	-	IEC 61850 Ed1/ IEC 61850 Ed2/ IEC 60870-5-104 AND IEC 60870-5-103/ IEC 60870-5-101/ Modbus/ DNP	IEC 60870-5-103 TLS and SSH/SFTP and Webservices OR serial IEC 60870-5-103 serial and Firmware update and file transfer
99 (5-8)	Ethernet + serial module	Advanced security	With CAE	IEC 61850 Ed1/ IEC 61850 Ed2/ IEC 60870-5-104 AND IEC 60870-5-103/ IEC 60870-5-101/ Modbus/ DNP	IEC 60870-5-103 TLS and SSH/SFTP and Webservices OR serial IEC 60870-5-103 serial and Firmware update and file transfer

Tab. 3-3: CS types and supported protocols for Easergy MiCOM P30.

The configuration interface can be chosen by the user either serial or via Ethernet. For security reasons it can be important to update for example the Ethernet module via the serial interface, therefore all maintenance and configuration services are available over serial. For convenience the important update functions are also over Ethernet available.

Configuration	Security types	Ethernet	Serial
Firmware update ethernet board (if available)	SSH/SFTP or serial file transfer	X	X
Firmware update main board	Serial file transfer		X
Configuration of the main device function	IEC 60870-5-103 via TLS or serial	X	X
User defined control pictures	Serial file transfer		X
User defined data model	Serial file transfer		X
Security configuration	Webservices	X	X ¹

Tab. 3-4: Configuration of Easergy MiCOM P30.

(x¹) In the case of without security or without the Ethernet module, the device provides the default security. With the default security configuration, only passwords can be changed.

NOTICE
CYBER SECURITY HAZARD • Except for IEC 60870-5-103 via TLS and SFTP/SSH, the device does not have the capability to transmit data encrypted using the following protocols: IEC 61850 Ed1, IEC 61850 Ed2, IEC 60870-5-104, IEC 60870-5-103 serial, IEC 60870-5-101 serial, Modbus serial, and DNP3 serial. • If other users gained access to your network, transmitted information can be disclosed or subject to tampering. • For transmitting data over an internal network, physically or logically segment the network and restrict access using standard controls such as firewalls and other relevant features supported by your device such as IPTable whitelisting. • For transmitting data over an external network, encrypt protocol transmissions over all external connections using an encrypted tunnel, TLS wrapper or a similar solution. Failure to follow these instructions can increase the risk of unauthorized access.

3.3.3

Cyber Security Password Policy Recommendation

The Schneider Electric password policy is one of the key elements of the Cyber Security Policy.

Good Practice to Improve Password Definition

- Use common Cyber Security Good Practice for password complexity definition by using strong passwords.
- Change all passwords from default values when taking the protection device into use. (User must change password after first login).
- Change passwords regularly. (User must update password after a certain period of time).
- Use NERC compliant password as much as possible.
- Enforce the use of strong and complex password as: Caps characters + Lowercases characters + Numbers + Special characters in one password.
- Set the minimum password length to 10 characters.
- Switch off all communication ports that are not used on the device, if possible.
- Do not reuse old passwords.

Best Practice Concerning Passwords

- Not sharing personal passwords.
- Not displaying passwords during password entry.
- Not transmitting passwords in email or by other means.
- Not saving the passwords on PC's or other devices.
- Not writing password on any supports.
- Regularly reminding users about best practices concerning password.

3.4 Configuration of the Local Control Panel (Function Group LOC)

The configuration of the Local Control Panel includes the configuration of the Bay Panel and of the Measured Value Panels, and the selection of the control point.

On the text display, the Bay Panel will display switching state signals from external devices (closed, open, intermediate position) and the active control site (local or remote).

In addition the P433 offers Measured Value Panels, which display the measured values relevant at a given time.

During normal power system operation; the Bay Panel or – if activated – the Operation Panel is displayed. If the Operation Panel is activated as an event occurs, the display switches to the appropriate Event Panel – provided that measured values have been selected for the Event Panels. In the event of overload or ground fault events, the display will automatically switch to the Operation Panel at the end of the event. In the event of a fault, the Fault Panel remains active until the LED indicators or the fault memories are reset.

If the change enabling command has been issued (LOC: Param. change enabl.) it will be cancelled after the time period, defined by setting LOC: Hold-time for Panels has elapsed and the Bay Panel will be called up.

3.4.1 Bay Panel

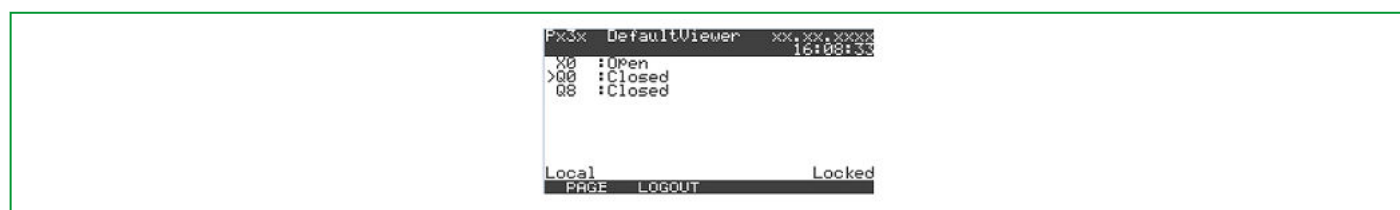


Fig. 3-3: Example of a Bay Panel (with text display)

Note: Not available for 24 TE case.

The P433 offers a selection from pre-defined bay types.

The activation of the Bay Panel display is described in [Chapter 6, \(p. 6-1\)](#).

Each external device represented in the Bay Panel is identified by an external device designation (see [Section 3.54.3, \(p. 3-493\)](#)).

The display of external device designations can be disabled (at LOC: Display L/R). The display of the control point (local or remote control) and interlocking can also be disabled (at LOC: Displ. interl. stat.).

The switchgear unit to be controlled needs to be selected first. The selection is cancelled if the return time for illumination (LOC: Return time illumin.) or the return time for selection (LOC: Return time select.) has elapsed.

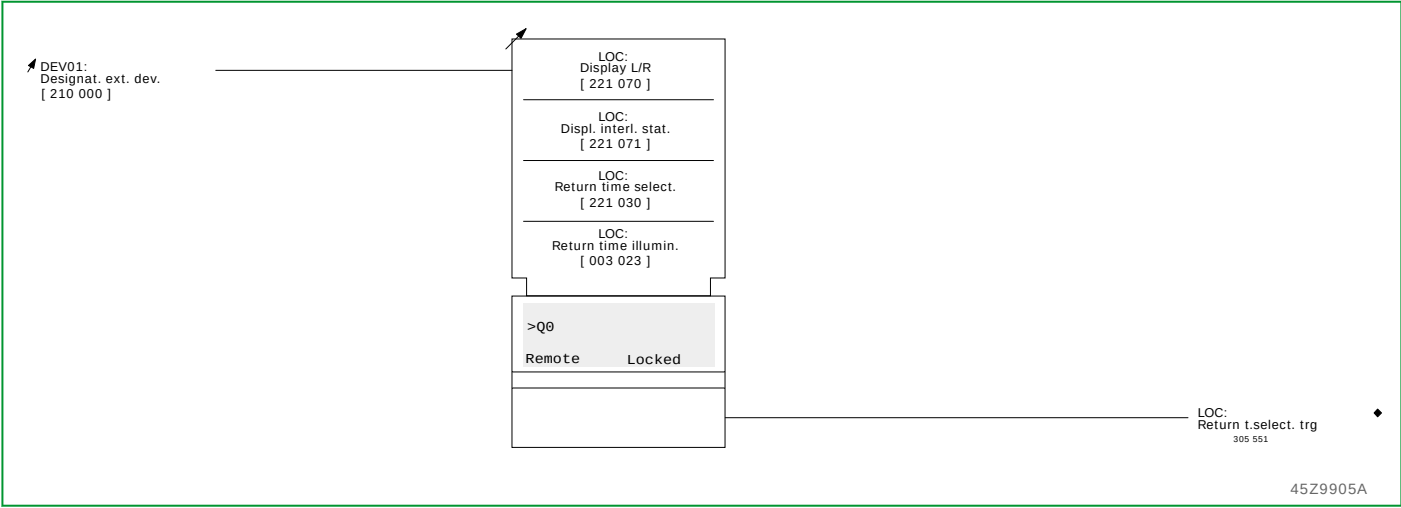


Fig. 3-4: Bay panel (text display)

3.4.2 Operation Panel

The Operation Panel is displayed after the set return time has elapsed, provided that at least one measured value has been configured.

The user can select which of the measured operating values will be displayed on the Operation Panel by means of an “m out of n” parameter. When more measured operating values are selected for display than the LC display can accommodate, then the display will either switch to the next set of measured operating values at intervals defined by the setting for LOC: Hold-time for Panels or when the appropriate key on the local control panel is pressed.

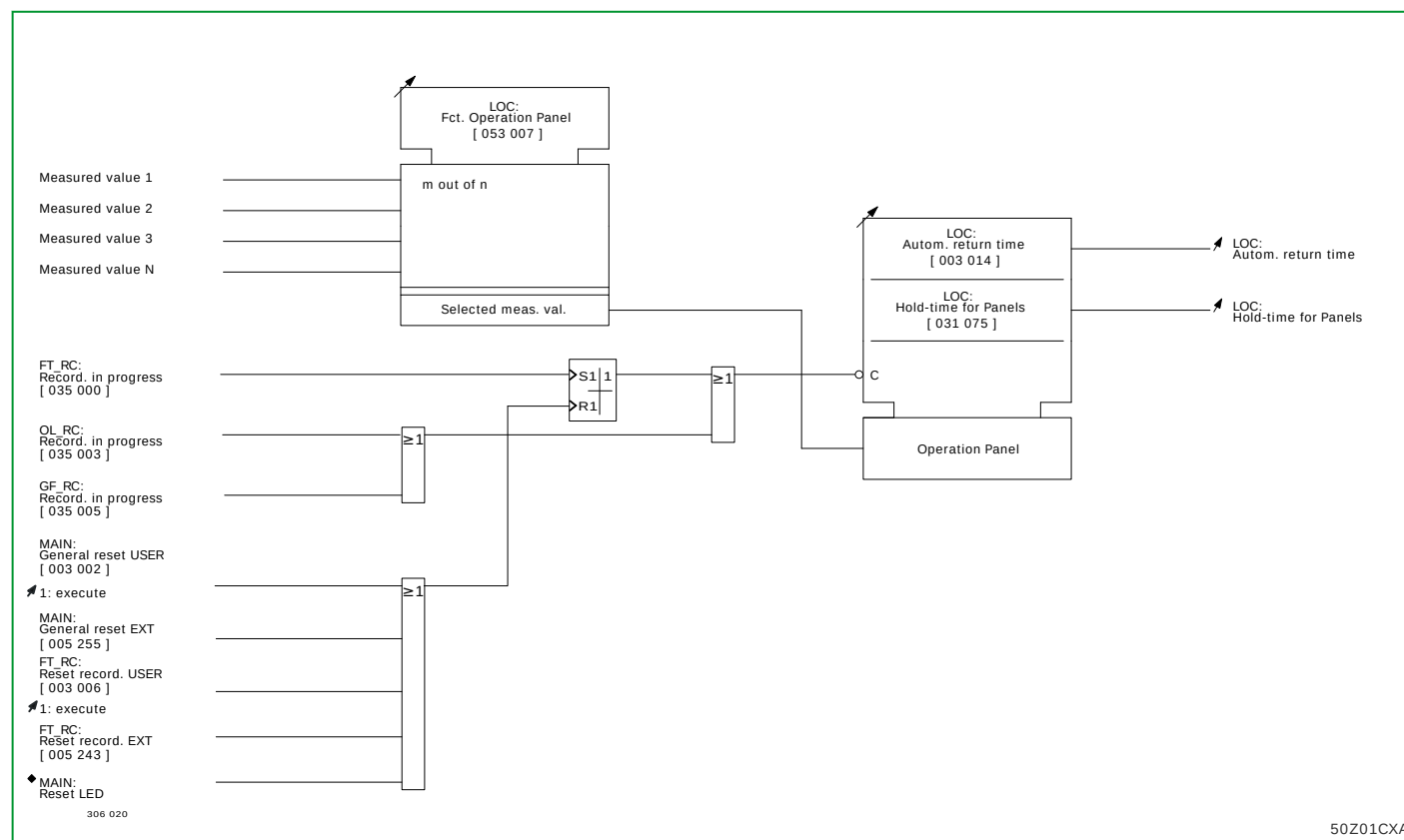


Fig. 3-5: Operation Panel.

3.4.3 Fault Panel

The Fault Panel is displayed in place of another data panel when there is a fault, provided that at least one measured value has been configured. The Fault Panel remains on display until the LED indicators or the fault memories are cleared.

The user can select the measured fault values that will be displayed on the Fault Panel by setting an “m out of n” parameter. When more measured fault values are selected for display than the LC display can accommodate, then the display will either switch to the next set of measured fault values at intervals defined by the setting for LOC: Hold-time for Panels or when the appropriate key on the local control panel is pressed.

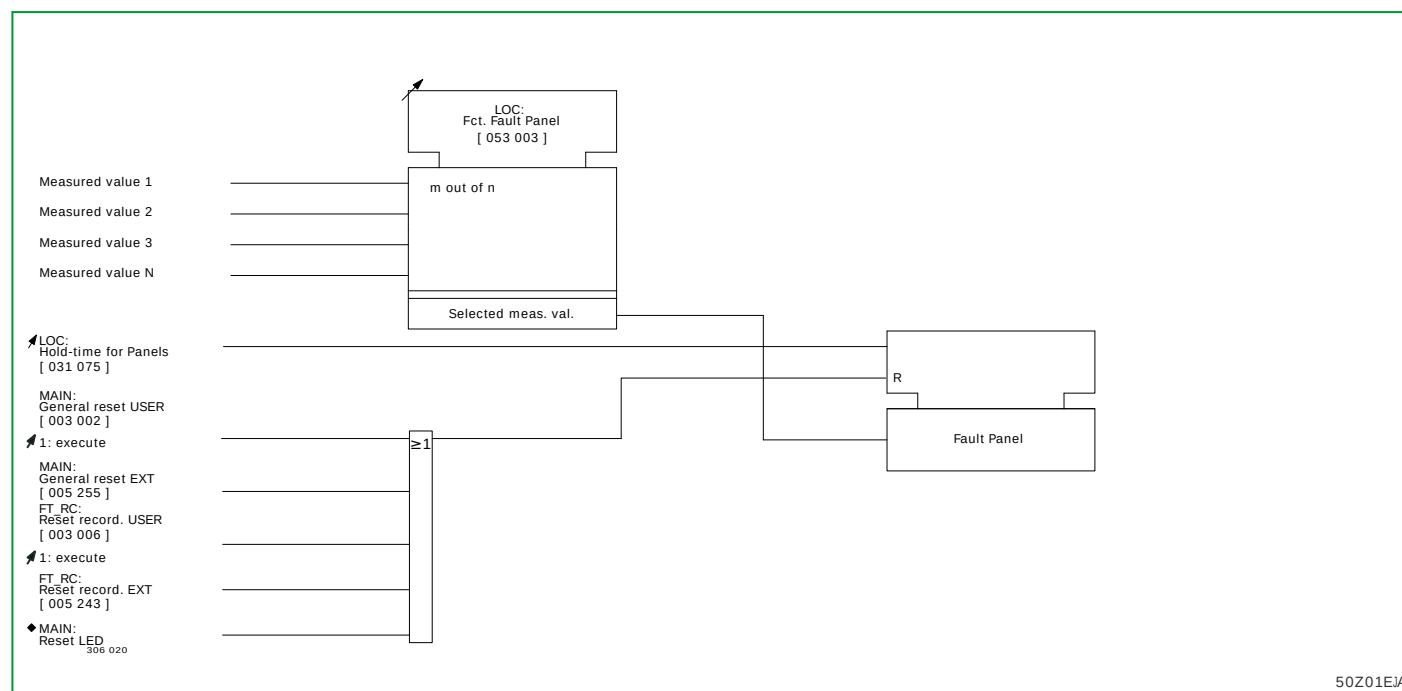


Fig. 3-6: Fault panel.

3.4.4 Ground Fault Panel

The Ground Fault Panel is automatically displayed in place of another data panel when there is a fault, provided that at least one measured value has been configured. The Ground Fault Panel remains on display until the ground fault ends, unless a fault occurs. In this case the display switches to the Fault Panel. The user can select the measured values that will be displayed on the Ground Fault Panel by setting an “m out of n” parameter. When more measured fault values are selected for display than the LC display can accommodate, then the display will either switch to the next set of measured fault values at intervals defined by the setting for LOC: Hold-time for Panels or when the appropriate key on the local control panel is pressed.

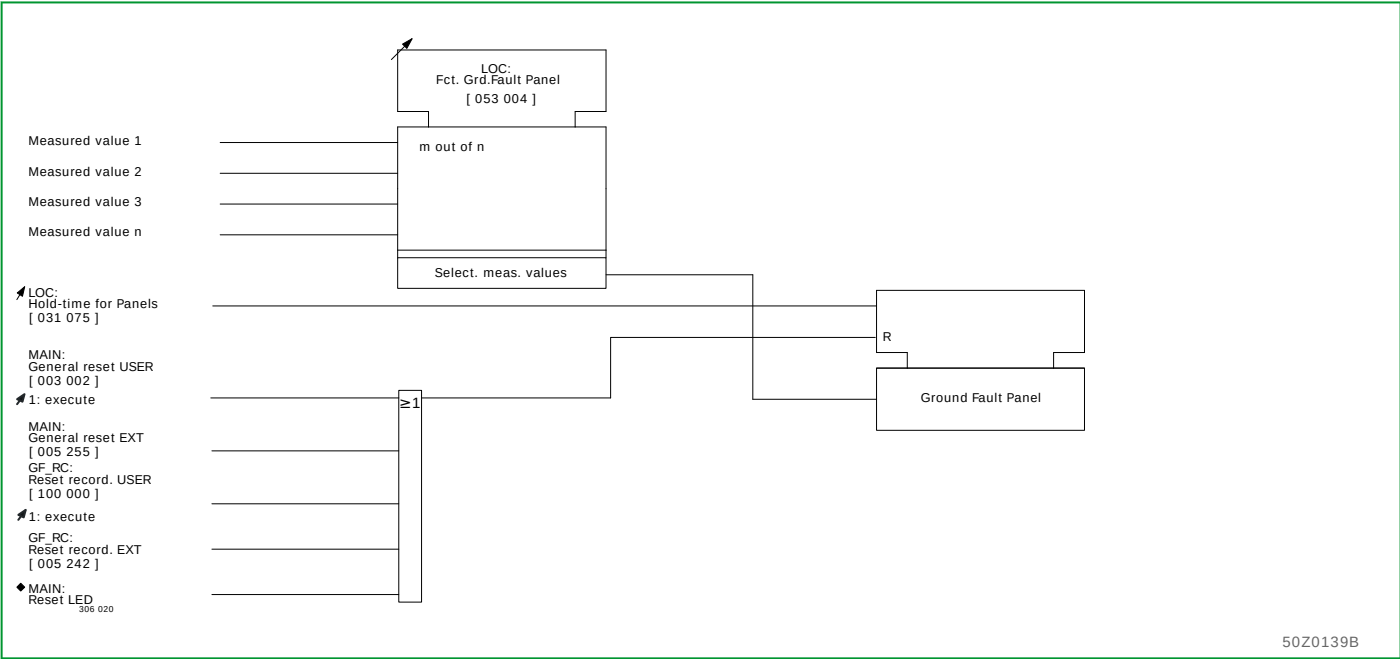


Fig. 3-7: Ground Fault Panel.

3.4.5 Overload Panel

The Overload Panel is automatically displayed in place of another data panel when there is an overload, provided that at least one measured value has been configured. The Overload Panel remains on display until the overload ends, unless a fault occurs. In this case the display switches to the Fault Panel.

The user can select the measured values that will be displayed on the Overload Panel by setting a “m out of n” parameter. When more measured fault values are selected for display than the LC display can accommodate, then the display will either switch to the next set of measured fault values at intervals defined by the setting for LOC: Hold-time for Panels or when the appropriate key on the local control panel is pressed.

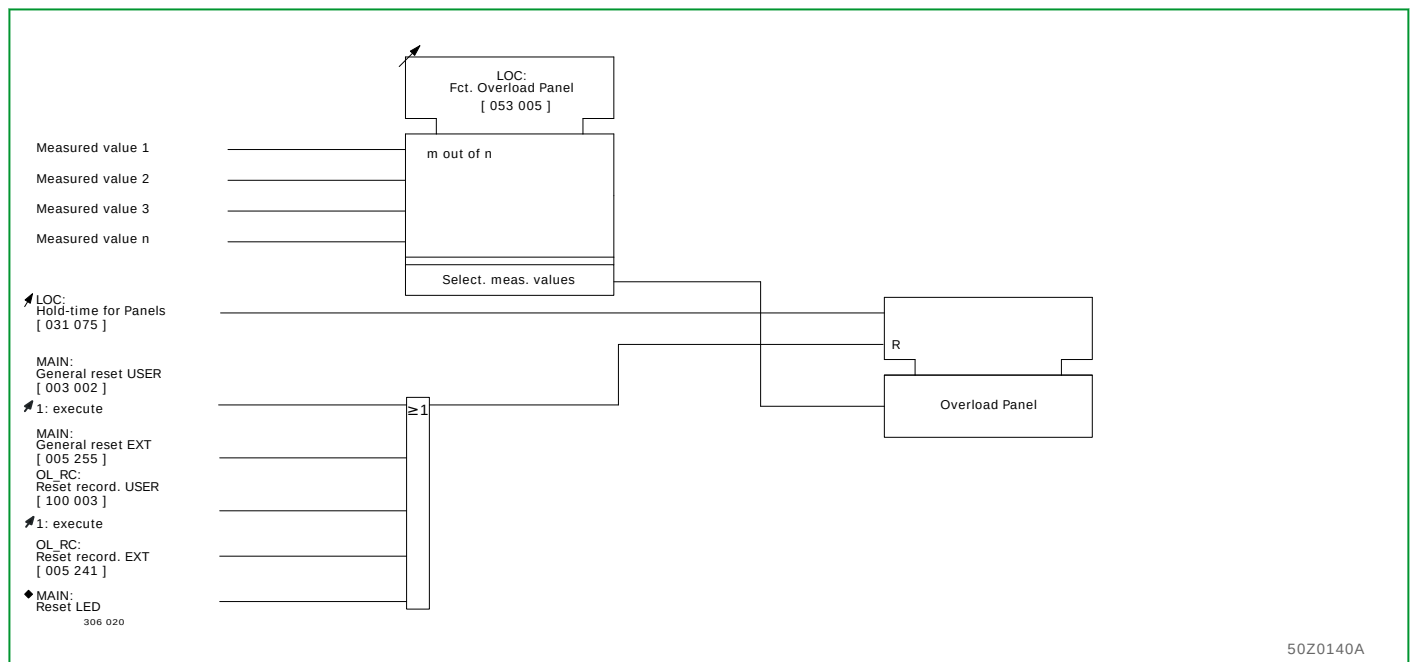


Fig. 3-8: Overload Panel.

3.4.6 Selection of the Control Point

Switchgear units can be controlled from a remote location or locally. Switching between local and remote control is achieved by using either the L/R key on the local control panel or an external key switch. The position of this external key switch is checked by an appropriately configured binary signal input (configuration at MAIN: Inp.asg. L/R key sw.).

If the binary signal input is configured to *L/R key switch* then the L/R key on the local control panel is without function when the graphic display is fitted.

This setting for LOC: Fct. assign. L/R key determines whether the switching using either the L/R key or the key switch is between local and remote control (L↔R) or between local+remote and local control (R&L↔L).

If only remote control is enabled then there will be a local access blocking. If only local control is enabled then there will be a remote access blocking.

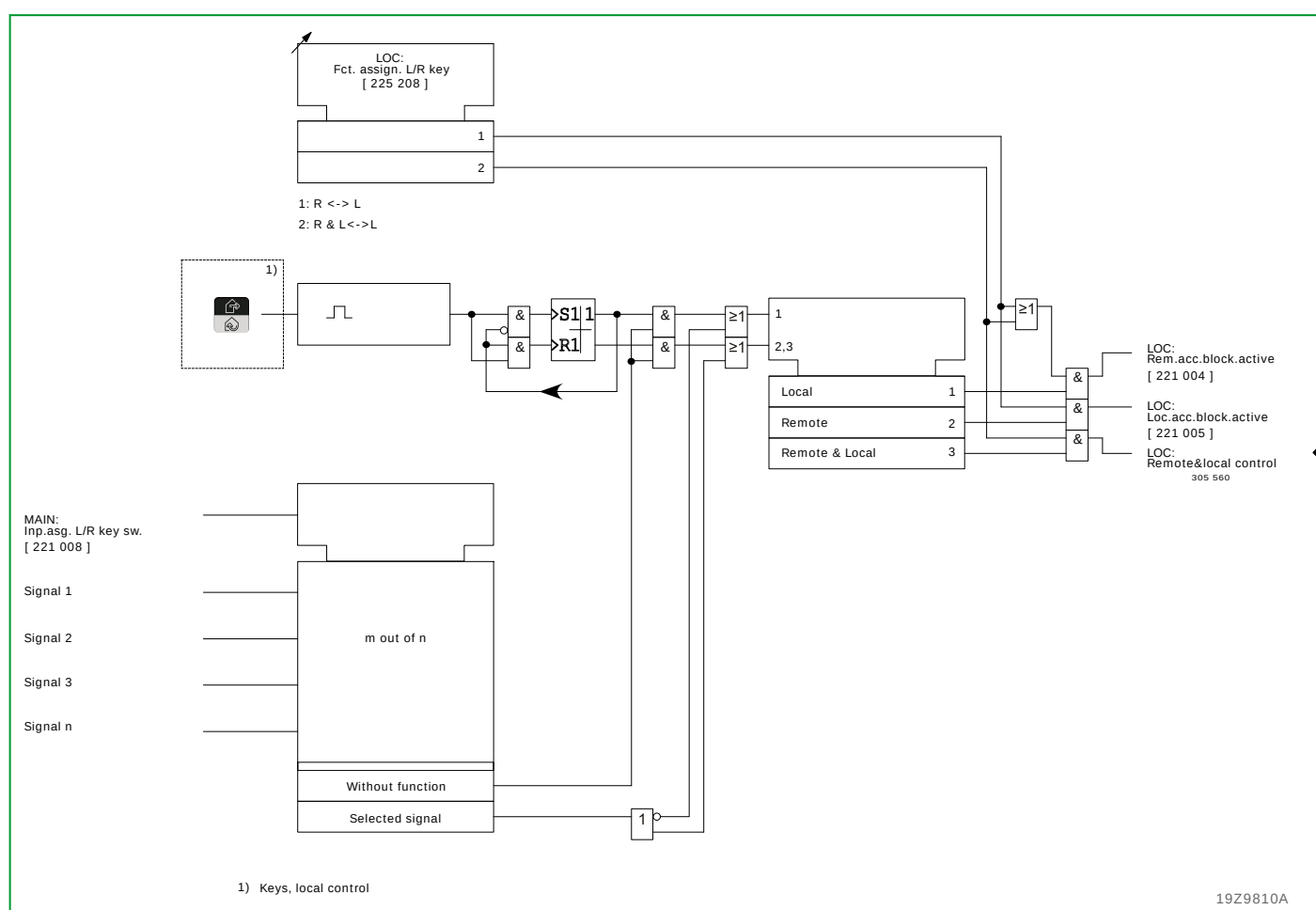


Fig. 3-9: Selection of the control point.

3.4.7 Configurable Reset Key

The P433 has a reset key (clear key in 24 TE case), to which one or more reset functions can be assigned by selecting the required functions at LOC: Assignment reset key. Details on the functions' resetting features are given in [Section 3.13.19, \(p. 3-134\)](#).

3.5 Communication Interfaces

The P433 has a PC interface as a standard component. Communication module A is optional and can be provided with one or two communication channels – depending on the design version. Communication between the P433 and the control station's computer is through the communication module A. Setting and interrogation is possible through all the P433's interfaces.

If the communication module A with two communication channels is installed, settings for two communication interfaces will be available. The setting of communication interface 1 (COMM1) may be assigned to the physical communication channels 1 or 2 (see [Section 3.13.20, \(p. 3-136\)](#)). If the COMM1 settings have been assigned to communication channel 2, then the settings of communication interface 2 (COMM2) will automatically be active for communication channel 1.

COMM2 can only be used to transmit data to and from the P433 if its PC interface has been de-activated. As soon as the PC interface is used to transmit data, COMM2 becomes “dead”. It will only be enabled again when the “time-out” period for the PC interface has elapsed.

If tests are run on the P433, the user is advised to activate the test mode. In this way the PC or the control system will recognize all incoming test signals accordingly (see [Section 3.13.21, \(p. 3-137\)](#)).

Ethernet communication module is optional and can be provided with following options:

- 1 RJ45
- 1 RJ45 + 1 Fiber
- 1 RJ45 + 2 Fiber
- 3 RJ45

When Ethernet communication module is installed, IEC settings will be available and can be configured via Easergy Studio. Communication between the P433 and the control station can be through Ethernet protocols.

Parallel communication modules (serial communication module combined with Ethernet module) can be selected for P433 (see [Chapter 15, \(p. 15-1\)](#) and [Section 5.7, \(p. 5-32\)](#)).

NOTICE

CYBER SECURITY HAZARD

- To improve Cyber Security, disable the Ethernet communication in environments where effective anti malware solutions have not been taken into use.

Failure to follow these instructions can increase the risk of unauthorized access.

3.5.1 PC Interface (Function Group PC)

Communication between the P433 and a PC is through the PC interface. In order for data transfer between the P433 and the PC to function, several settings must be made in the P433.

There is support software available as an accessory for P433 control.

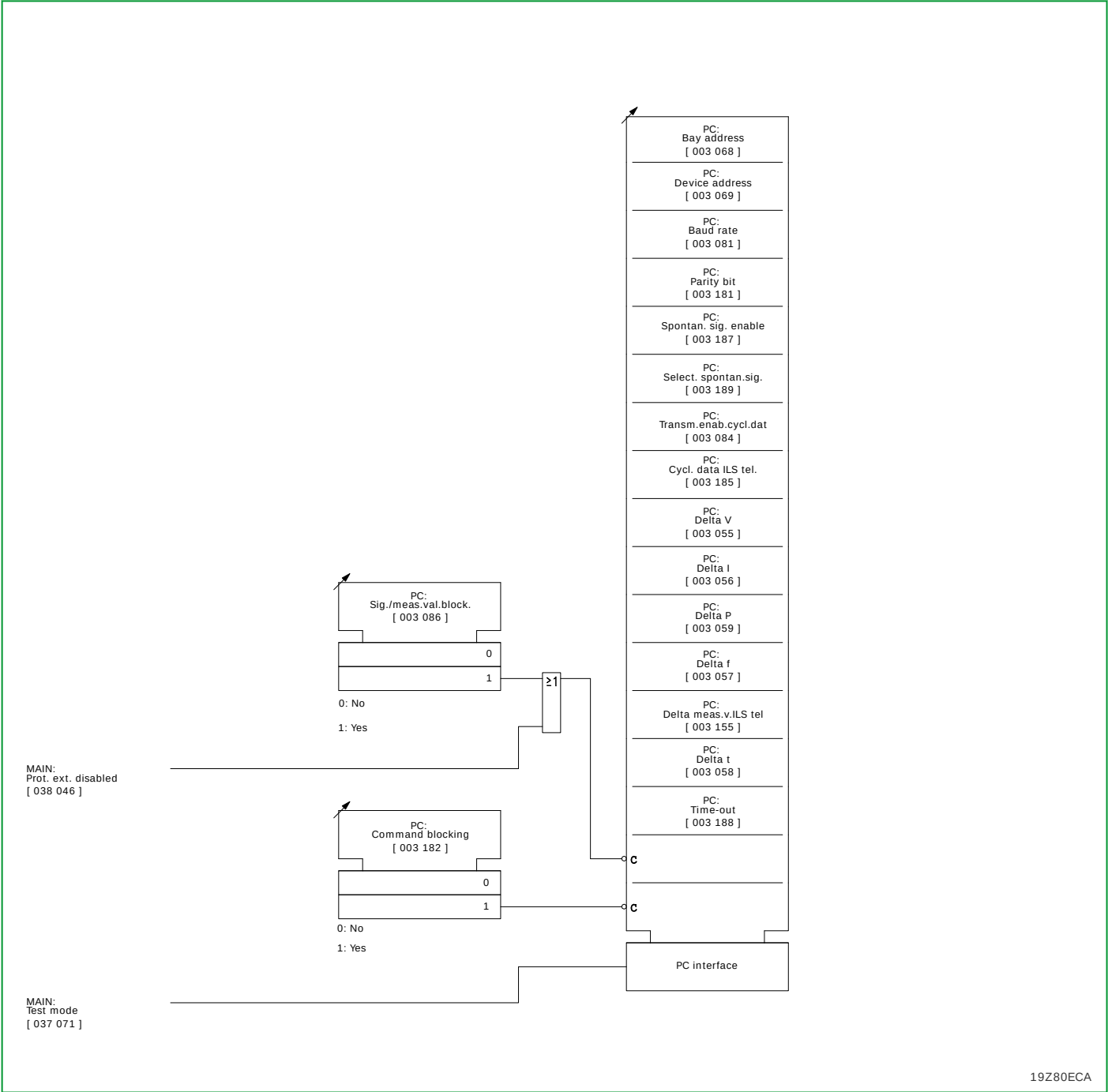


Fig. 3-10: PC interface settings.

3.5.2 Communication Interface 1 (Function Group COMM1)

There are several different interface protocols available at the communication interface 1. The following user-selected interface protocols are available for use with the P433:

- IEC 60870-5-103, "Transmission protocols - Companion standard for the informative interface of protection equipment, first edition, 1997-12 (corresponds to VDEW / ZVEI Recommendation, "Protection communication companion standard 1, compatibility level 2", February 1995 edition) with additions covering control and monitoring
- IEC 870-5-101, "Telecontrol equipment and systems - Part 5: Transmission protocols - Section 101 Companion standard for basic telecontrol tasks," first edition 1995-11
- ILS-C, proprietary protocol of Schneider Electric
- MODBUS
- DNP 3.0
- COURIER

In order for data transfer to function properly, several settings must be made in the P433.

Communication interface 1 can be blocked through a binary signal input. In addition, a signal or measured-data block can also be imposed through a binary signal input.

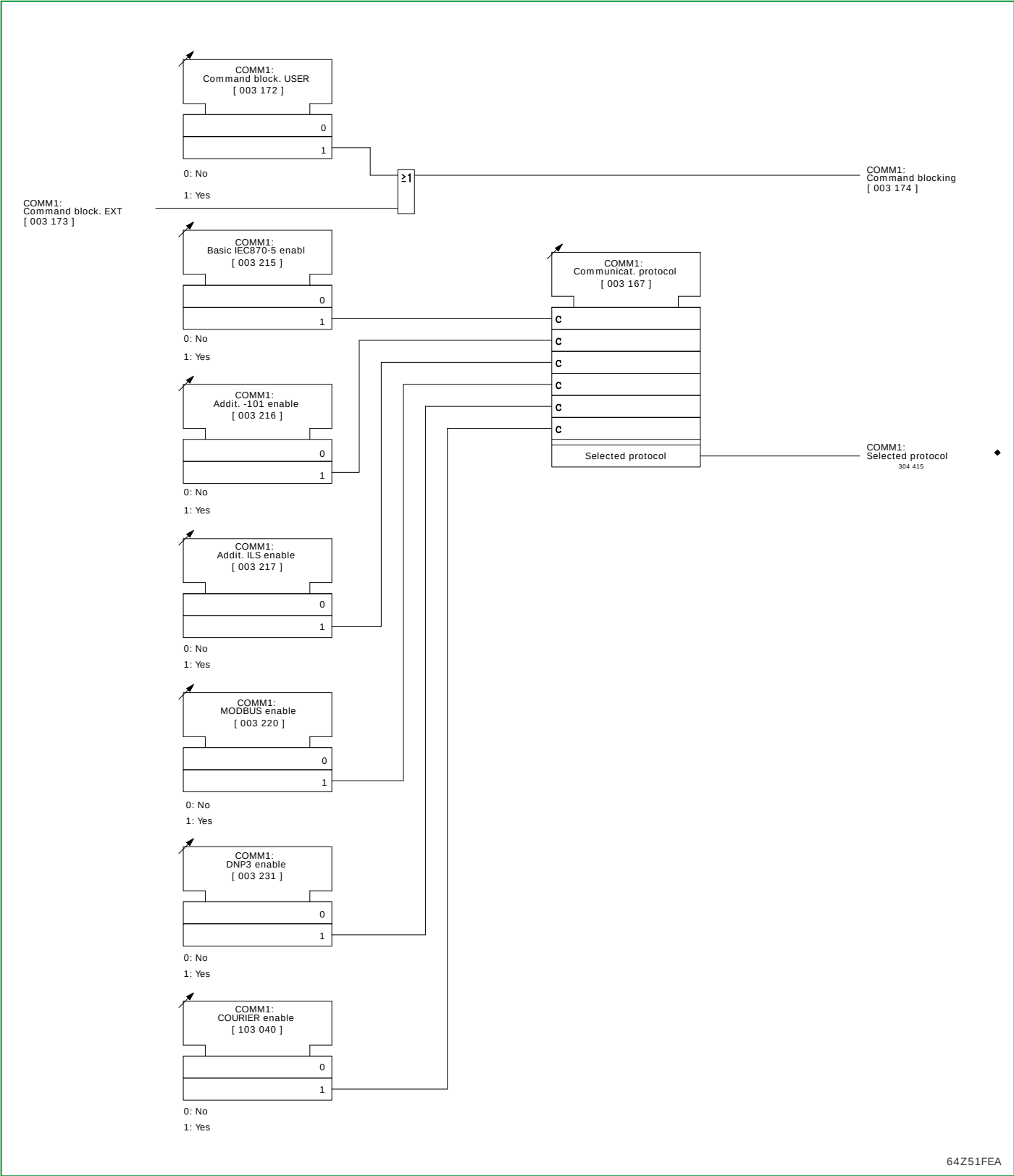


Fig. 3-11: Communication interface 1, selecting the interface protocol.

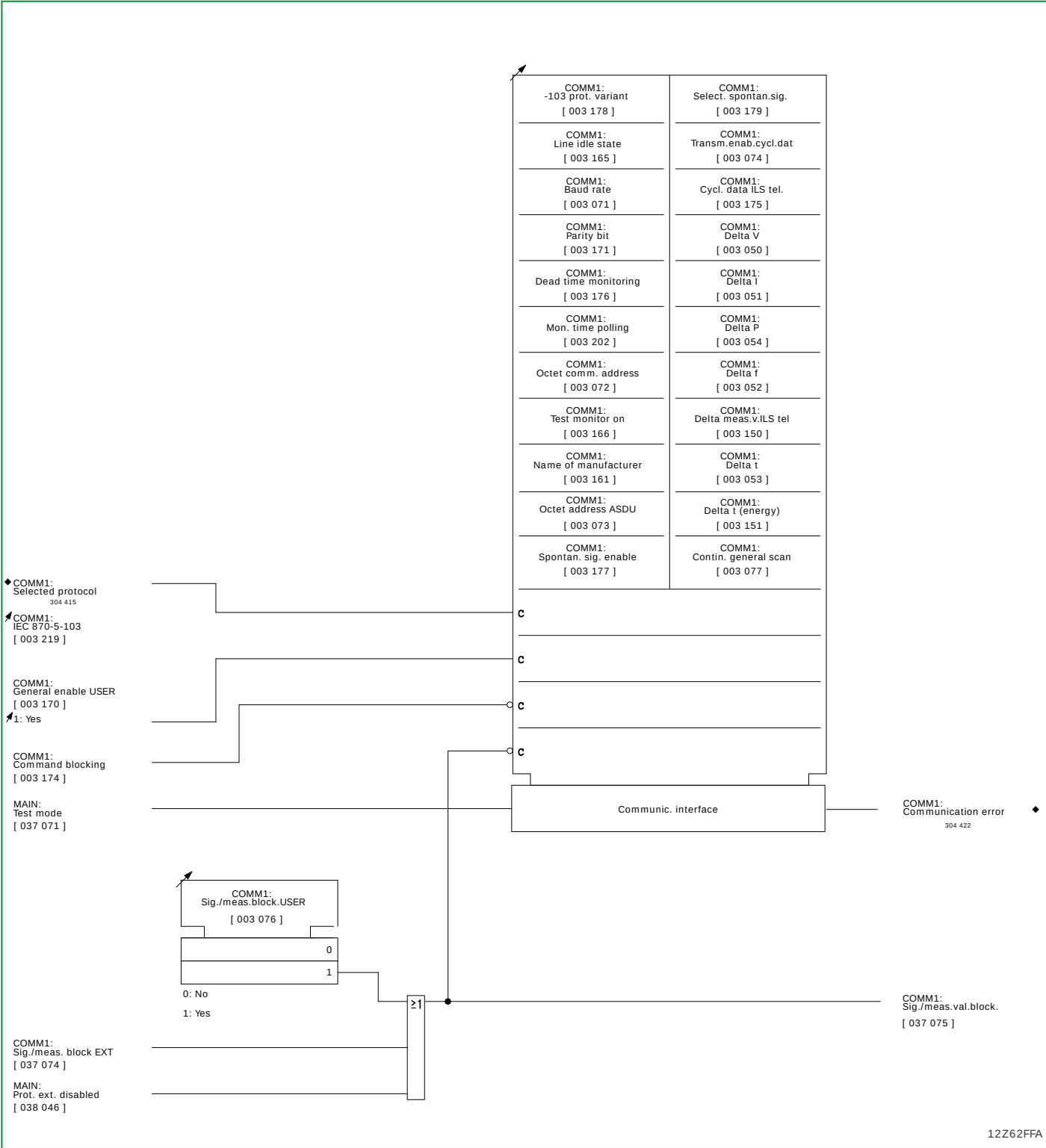


Fig. 3-12: Communication interface 1, settings for the IEC 60870-5-103 interface protocol.

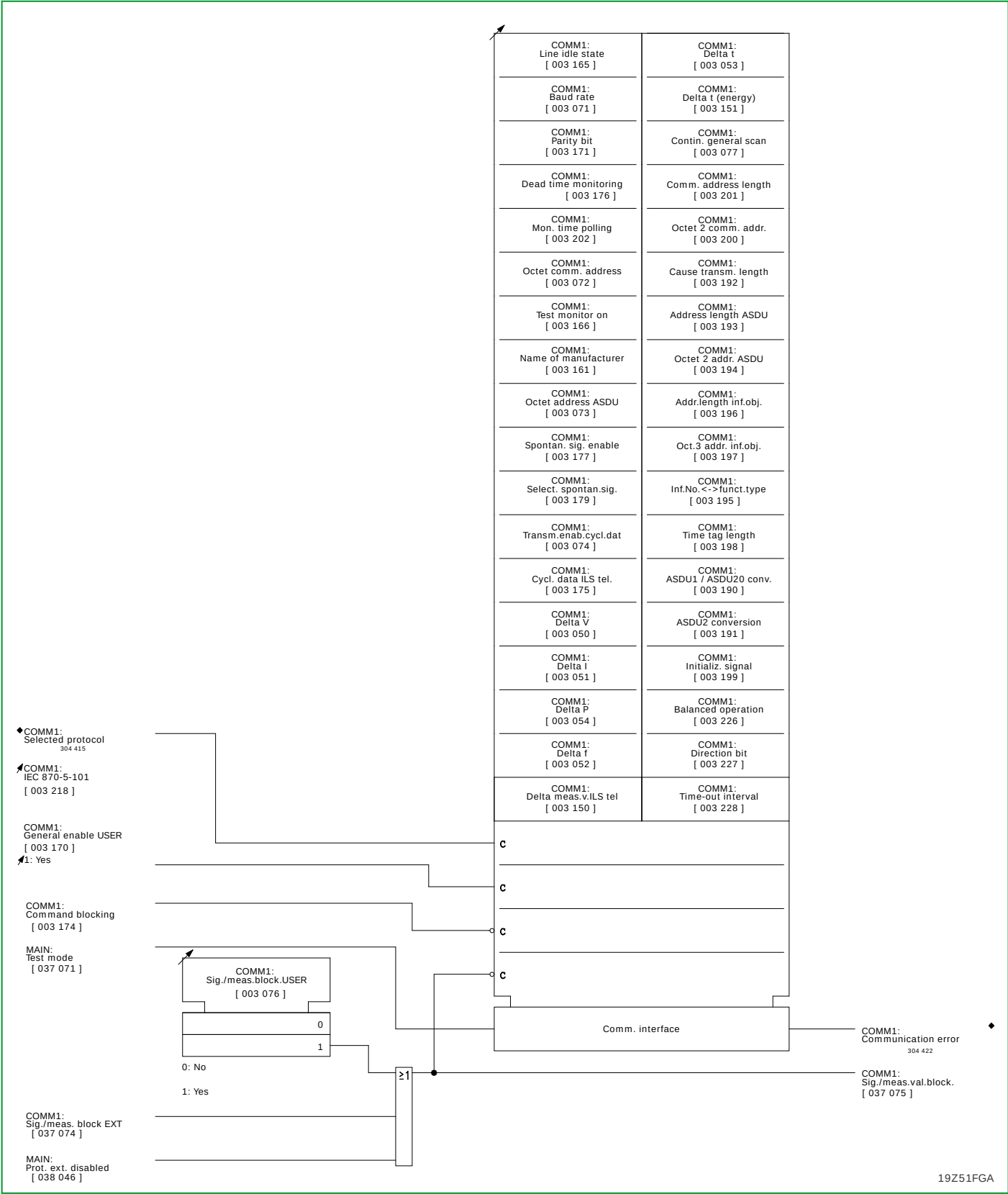


Fig. 3-13: Communication interface 1, settings for the IEC 870-5-101 interface protocol.

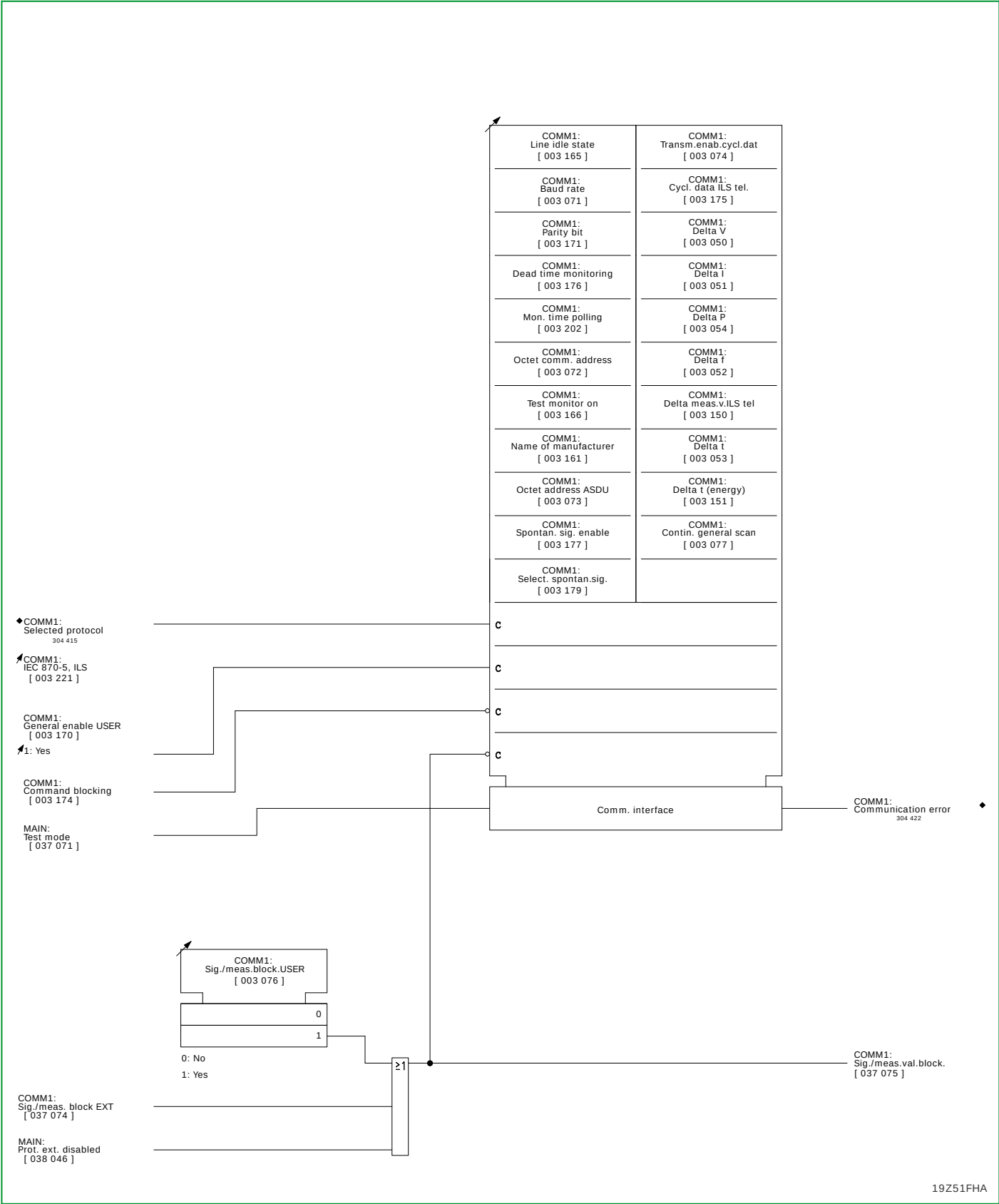


Fig. 3-14: Communication interface 1, settings for the ILS-C interface protocol.

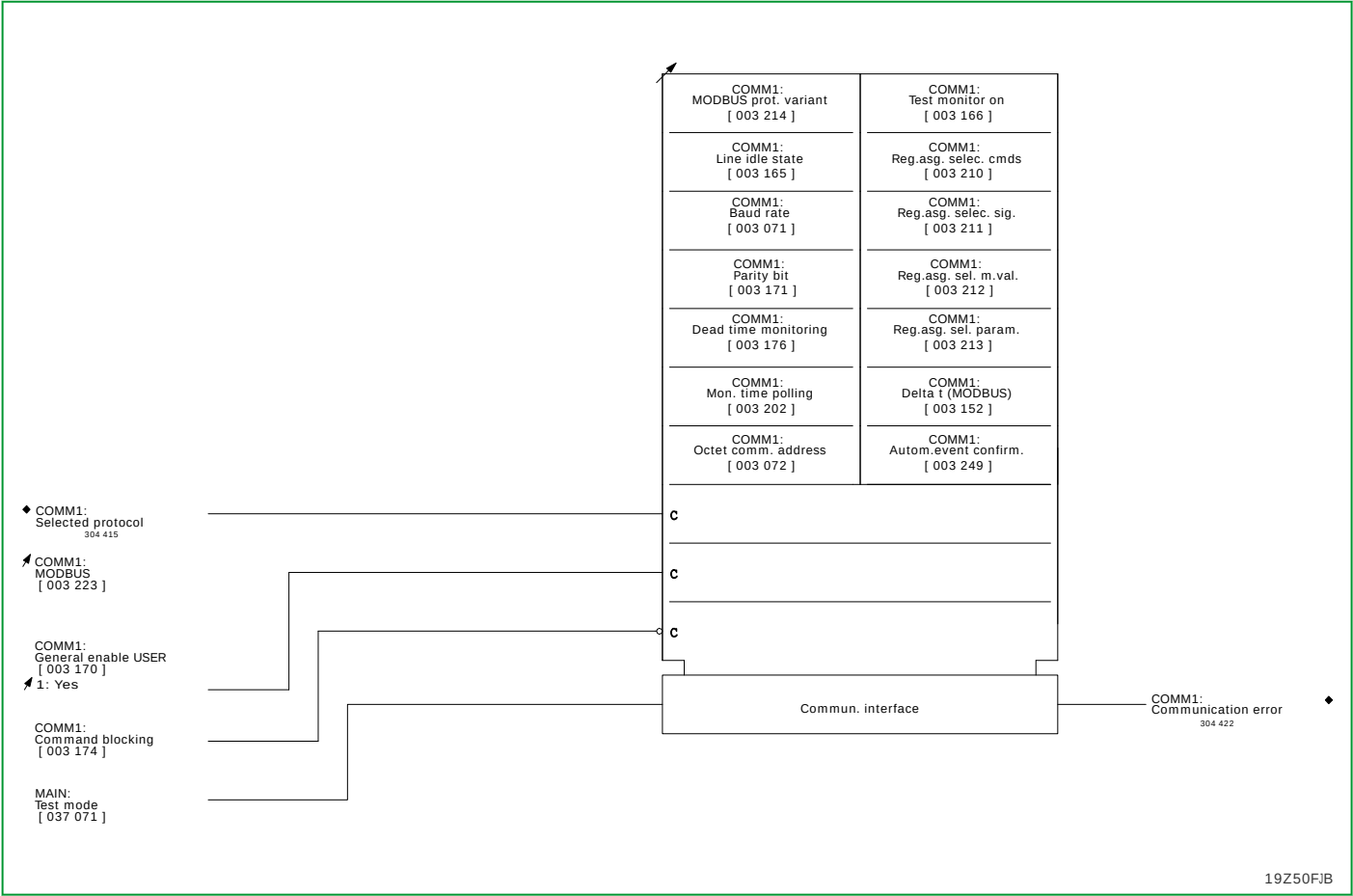


Fig. 3-15: Communication interface 1, settings for the MODBUS protocol.

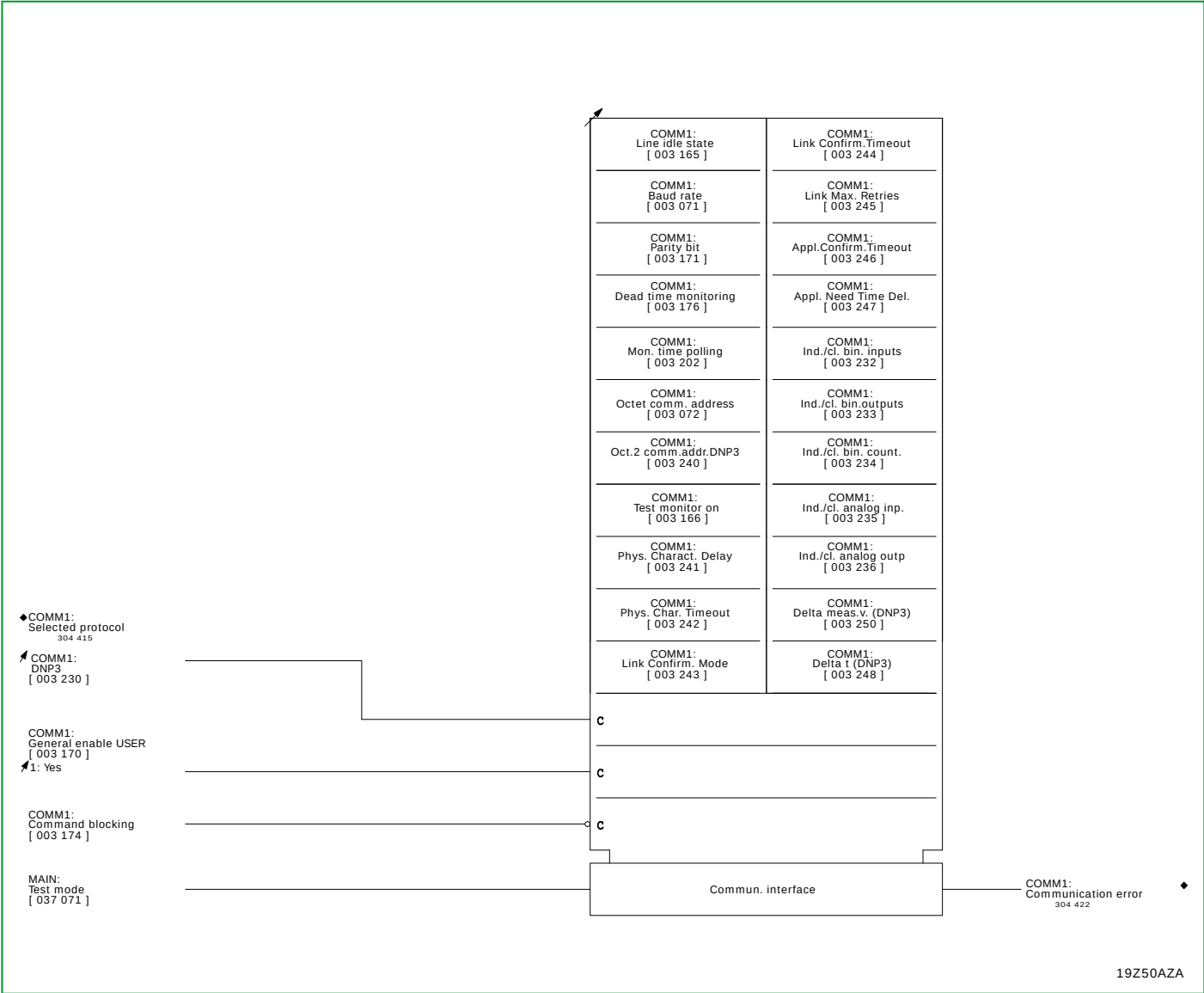


Fig. 3-16: Communication interface 1, settings for the DNP 3.0 protocol.

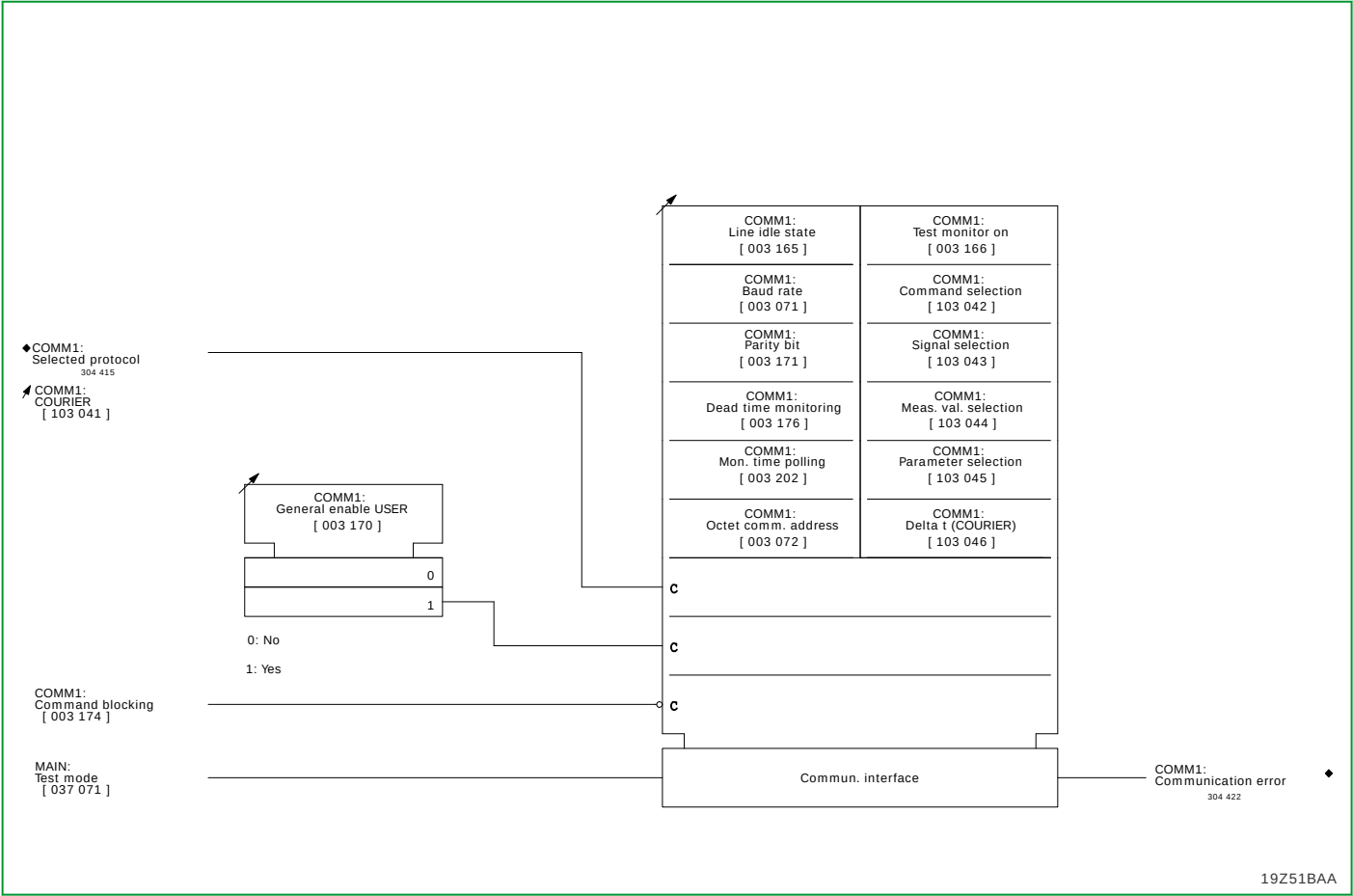


Fig. 3-17: Communication interface 1, settings for the COURIER protocol.

3.5.2.1 COMM1 – Checking Spontaneous Signals

For interface protocols based on IEC 60870-5-103, IEC 870-5-101, or ILS-C it is possible to select a signal for test purposes. The transmission of this signal to the control station as 'sig. start' or 'sig. end' can then be triggered using setting parameters.

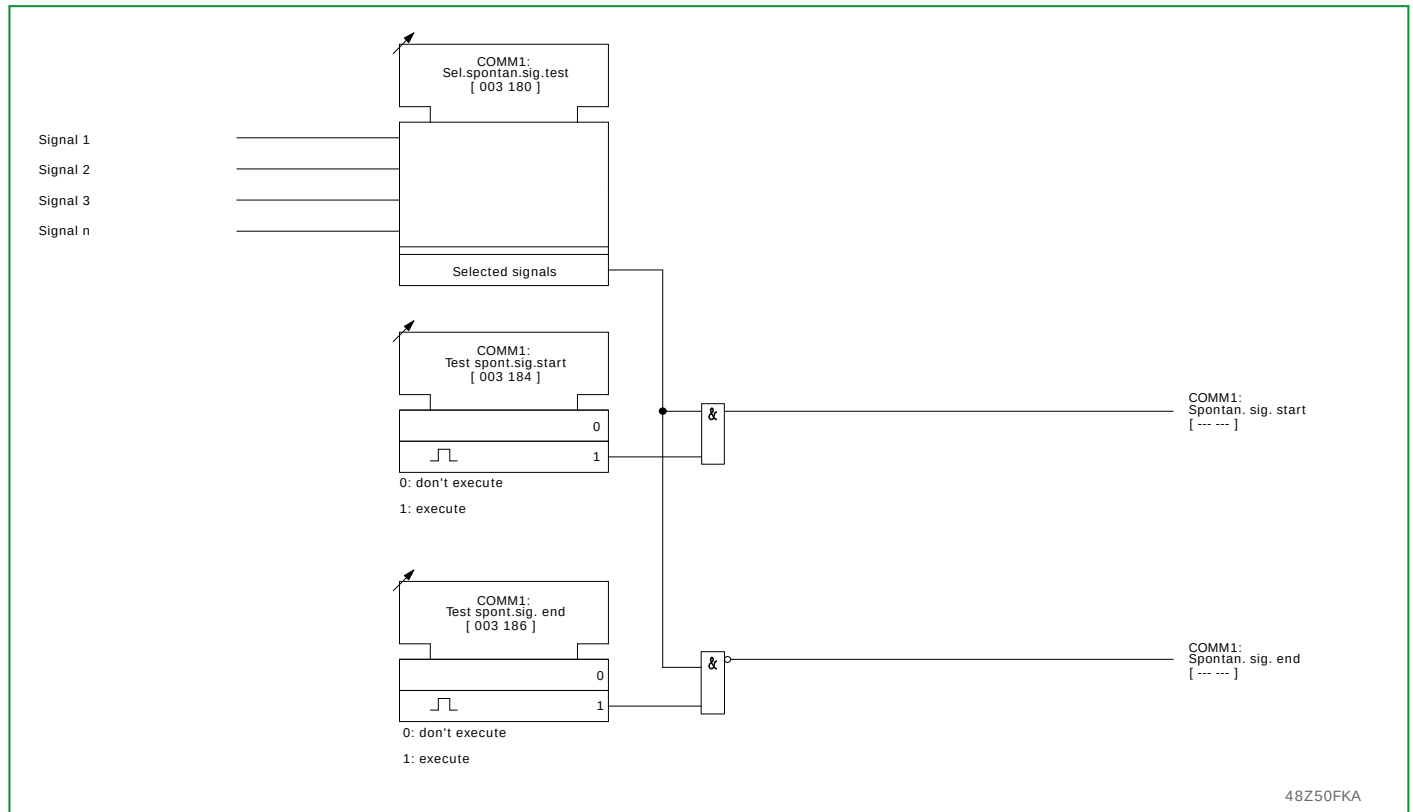


Fig. 3-18: COMM1 – Checking spontaneous signals.

3.5.2.2 Checking Switchgear Contact Positions and Signals

When checking during test operations with the interface protocols based on IEC 60870-5-103 it is possible to trigger signals (SIG) and contact positions (DEV) from the control part.

The following parameters are available:

- (221 105) COMM1: Sel. pos. dev.test
Selection possibilities:
 - *Not assigned*
 - *DEV01 ... DEV03*
- (221 106) COMM1: Test position dev.
Selection possibilities:
 - *don't execute*
 - *execute open*
 - *execute close*
 - *execute intermed.*

3.5.3

Communication Interface 2 (Function Group COMM2)

Communication interface 2 supports the IEC 60870-5-103 interface protocol.

It is provided only on the Serial communication module. It is intended for remote setting access only.

In order for data transfer to function properly, several settings must be made in the P433.

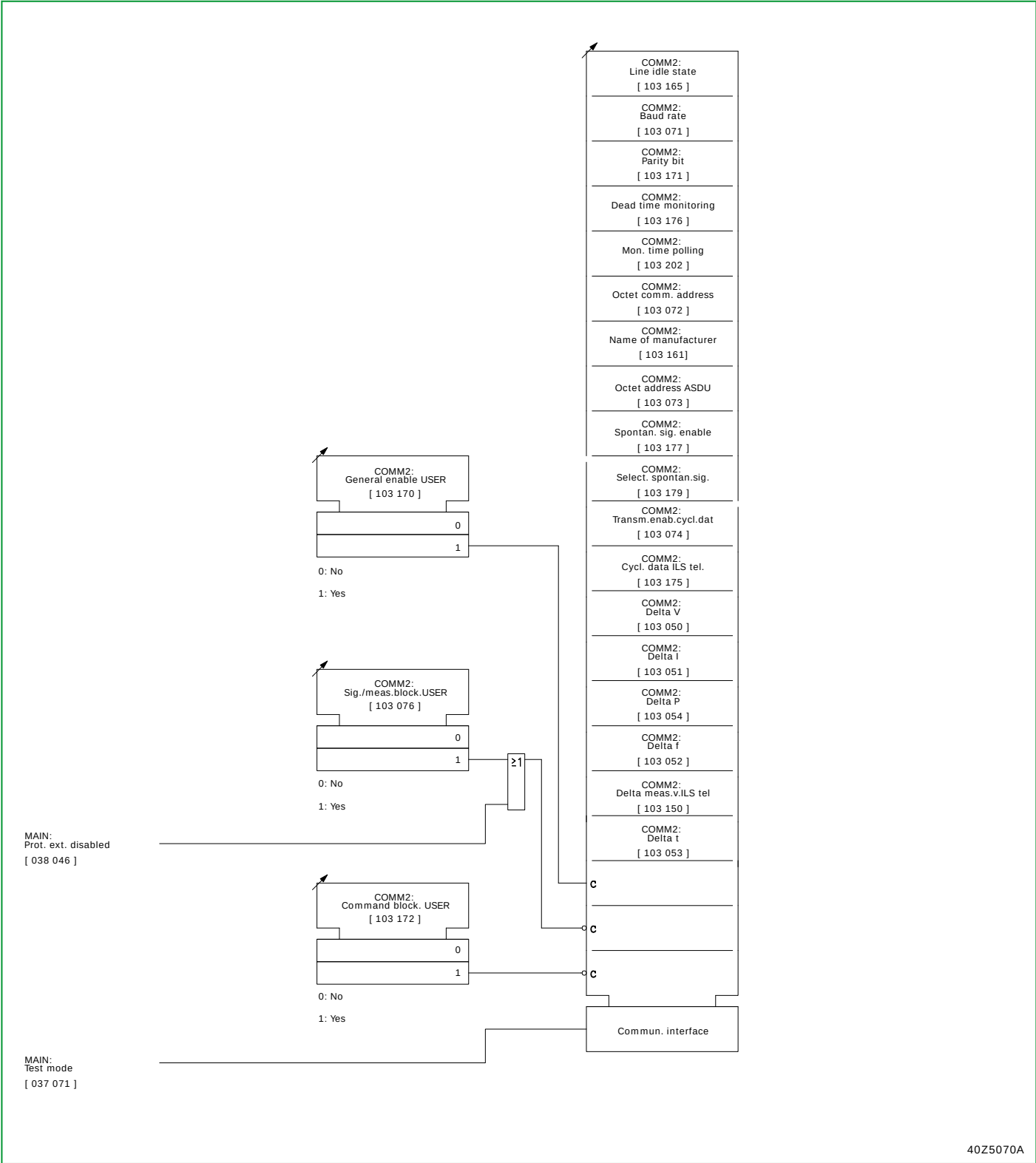


Fig. 3-19: Settings for communication interface 2.

3.5.3.1

COMM2 – Checking Spontaneous Signals

It is possible to select a signal for test purposes. The transmission of this signal to the control station as 'sig. start' or 'sig. end' can then be triggered via the local control panel.

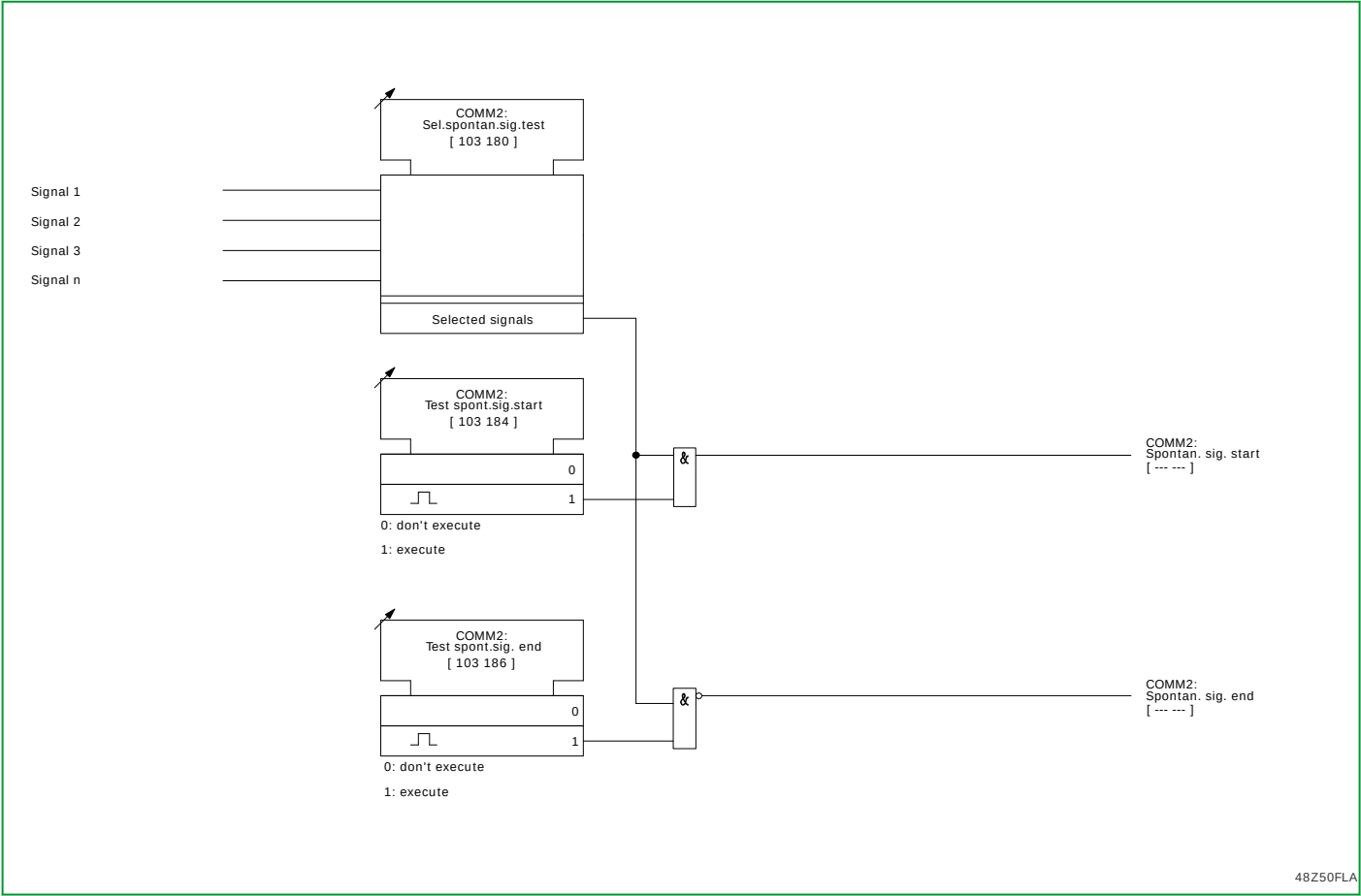


Fig. 3-20: COMM2 – Checking spontaneous signals.

3.5.4 Communication Interface 3 (Function Group COMM3)

3.5.4.1 Application

Communication interface 3 is designed to establish a digital communication link between two devices from Schneider Electric's device family "Easergy MiCOM 30".

Over this communication link can be transmitted up to 8 binary protection signals. Whereas communication interfaces 1 and 2 are designed as information interfaces to connect to data acquisition subsystems and for remote access, communication interface 3 is designed as a protection signaling interface that will transmit real time signals (InterMiCOM protection signaling interface). Its main application is to transmit signals from protective signaling (function group PSIG). In addition, any other internal or external binary signals may also be transmitted.

3.5.4.2 Physical Medium

COMM3 is provided as an asynchronous, full-duplex communication interface. To transmit data the following physical media are available:

Direct link without use of external supplementary equipment:

- Glass fiber (e.g. via 2 x G62.5/125 up to max. 1.4 km)
- Twisted pair (RS 422 up to max. 1.2 km)

Use of external transmission equipment:

- FO module (e.g. OZD 485 G12 1300 / Hirschmann up to max. 8/14/20 km)
- Universal modem (e.g. PZ 511 via twisted pair 2x2x0.5 mm up to max. 10 km)
- Voice frequency modem (e.g. TD-32 DC / Westermo up to max. 20 km)

Digital network:

- Asynchronous data interface of primary multiplexing equipment

3.5.4.3 Configuration and Enabling

In order to use InterMiCOM, the communication interface COMM3 has to be configured using the parameter COMM3: Function group COMM3. This setting parameter is only visible if the relevant optional communication module is fitted. After activation of COMM3, all addresses associated to this function group (setting parameters, binary state signals etc.) become visible.

The function can then be enabled or disabled by setting COMM3: General enable USER.

3.5.4.4 Telegram Configuration

The communication baud rate is settable (COMM3: Baud rate) to adapt to the transmission channel requirements. Sending and receiving addresses COMM3: Source address and COMM3: Receiving address can be set to different values, thus avoiding that the P433 communicates with itself.

The InterMiCOM protection signaling interface provides independent transmission of eight binary signals in each direction. For the send signals COMM3: Fct. assignm. send 1, ...) any signal from the selection table of the binary outputs (OUTP) can be chosen. For the receive signals (COMM3: Fct. assignm. rec. 1, ...) any signal from the selection table of the binary inputs (INP) can be chosen.

For each receive signal, an individual operating mode can be set (COMM3: Oper. mode receive 1, ...), thus defining the required checks for accepting the received binary signal. In addition a specifically selected telegram structure subdivides the 8 binary signals into two groups. The signal encoding along with the set operating mode for the telegram check defines the actual balance of “Speed”, “Security” and “Dependability” for each signal:

- Binary signals 1 to 4:
Operating mode settable to *Blocking* or *Direct intertrip*
- Binary signals 5 to 8:
Operating mode settable to *Permissive* or *Direct intertrip*

EN 60834-1 classifies 3 categories of command based teleprotection schemes according to their specific requirements (see Fig. 3-21, (p. 3-33)). By selection of a binary signal and by setting its operating mode appropriately, these requirements can be fulfilled as follows:

Direct transfer trip or intertripping:

Preference:	Security.
Implication:	No spurious pickup in the presence of channel noise.
Recommended setting:	Select binary signal from groups 1 to 4 or 5 to 8 and set operating mode <i>Direct intertrip</i> .

Permissive teleprotection scheme:

Preference:	Dependability.
Implication:	Maximizes probability of signal transmission in the presence of channel noise.
Recommended setting:	Select binary signal from group 5 to 8 and set operating mode <i>Permissive</i> .

Blocking teleprotection scheme:

Preference:	Speed.
Implication:	Fast peer-to-peer signal transfer.
Recommended setting:	Select binary signal from group 1 to 4 and set operating mode <i>Blocking</i> .

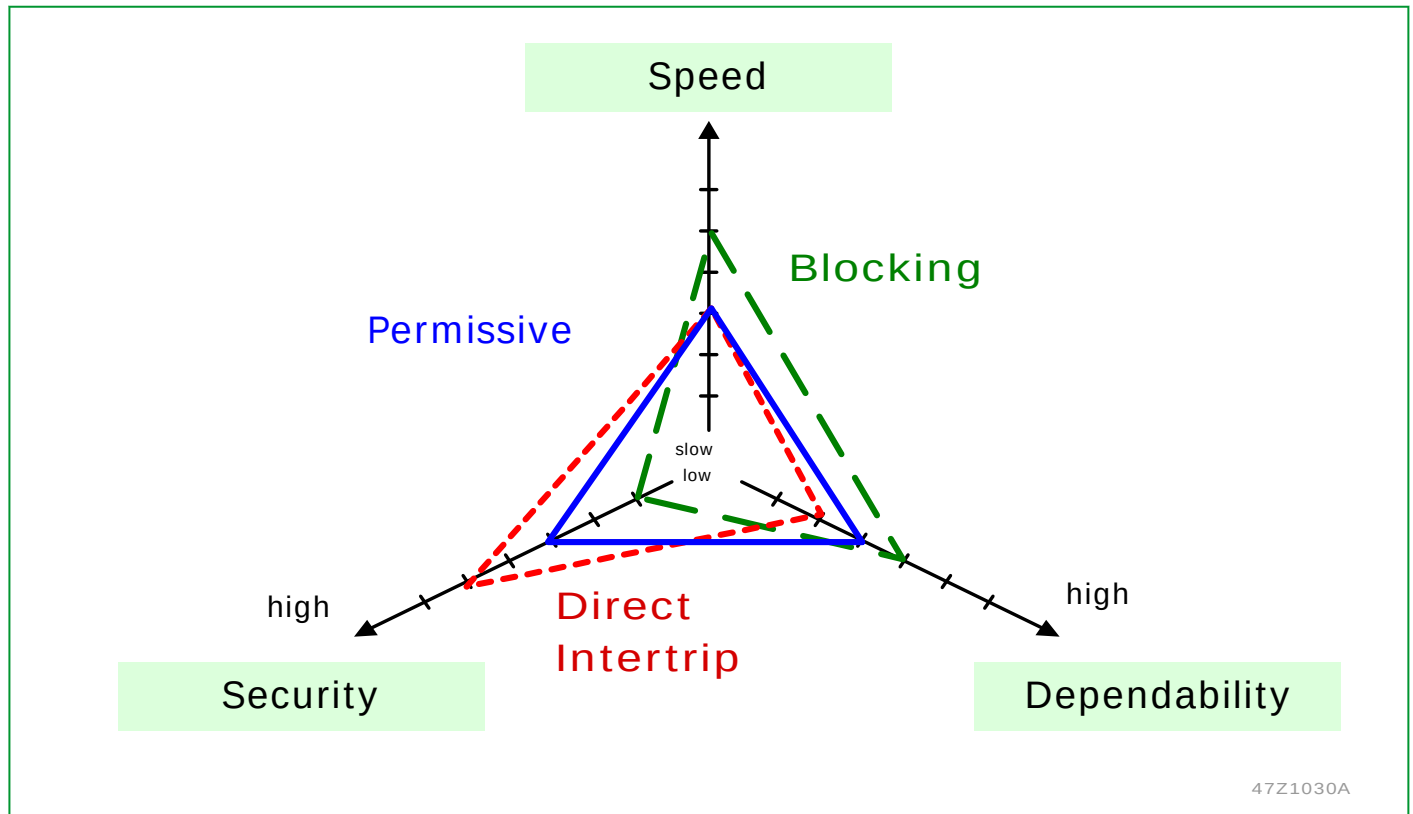


Fig. 3-21: Comparison of speed, security and dependability offered by the three operating modes.

3.5.4.5

Communication Monitoring

Timer stage COMM3: Time-out comm.fault is used for monitoring the transmission channel (this timer is re-triggered with each complete and correct received telegram). The wide setting range allows adaptation to the actual channel transmission times and above all this is needed for time-critical schemes such as the blocking scheme. After the timer has elapsed, signals

COMM3: Communications fault and SFMON: Communic.fault COMM3 are issued and the received signals are automatically set to their user-defined default values (COMM3: Default value rec. 1, ..., COMM3: Default value rec. 8). As the main application for this protective signaling the fault signal may be mapped to the corresponding input signal in function group PSIG with the COMM3: Sig.asg. comm.fault setting.

Timer stage COMM3: Time-out link fail.. is used to determine a persistent failure of the data transmission channel. After the timer has elapsed, signals COMM3: Comm. link failure and SFMON: Comm.link fail.COMM3 are issued.

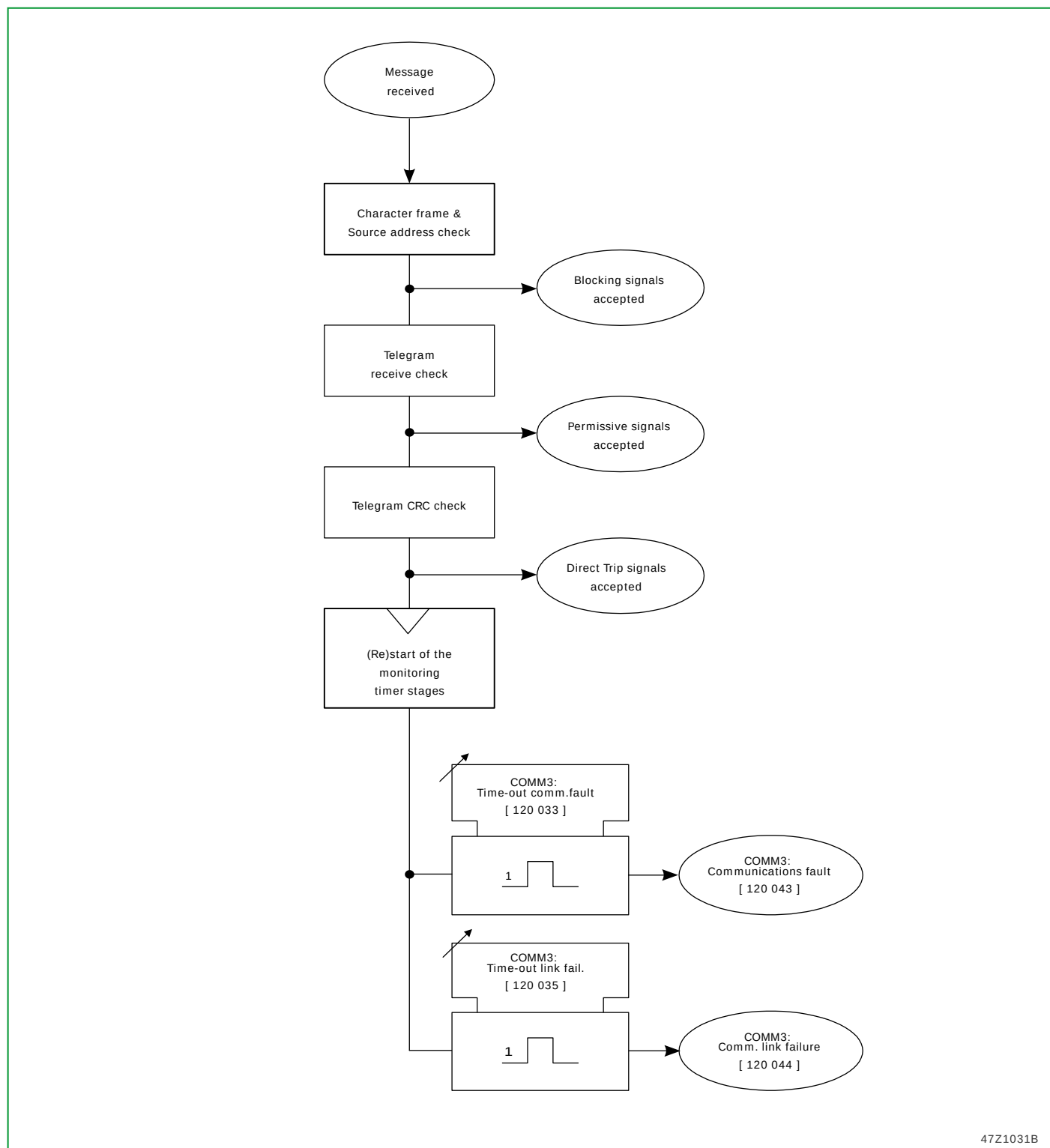


Fig. 3-22: Message processing and communication monitoring.

3.5.4.6 Supervision of Communication Link Quality

After a syntax check of each received message, InterMiCOM updates the ratio of incorrectly received messages, based on a total of the last 1000 received messages. The result is provided as an updating measurand COMM3: No. tel. errors p.u.. and the overall maximum ratio can be read from COMM3: No.t.err.,max,stored.

If the set threshold COMM3: Limit telegr. errors is exceeded the corresponding signals COMM3: Lim.exceed.,tel.err. and SFMON: Lim.exc.tel.er.COMM3 will be issued. All corrupted telegrams are counted (COMM3: No. telegram errors). This counter as well as the stored maximum ratio of corrupted messages can be reset via COMM3: Rset No.tlg.err.USER (as well as via the binary signal COMM3: Reset No.tlg.err.EXT).

3.5.4.7 Commissioning Tools

The actual values of send and receive signals can be read from the P433 as physical state signals (COMM3: State send 1 and COMM3: State receive 1, with x = 1 to 8). In addition, InterMiCOM provides 2 test facilities for commissioning of the protection interface.

For a loop-back test, the send output is directly linked back to the receive input. After setting the bit pattern wanted (as an equivalent decimal number at COMM3: Loop back send) the test can be triggered via COMM3: Loop back test. This bit pattern is sent for the duration of the hold time set at COMM3: Hold time for test. For this test only, the source address is set to '0'; this value is not used for regular end-to-end communication. The test result can be checked as long as the hold-time is running by reading the measured operating data COMM3: Loop back result and COMM3: Loop back receive. As soon as the hold-time has expired, the loopback test is terminated and InterMiCOM reverts to the normal sending mode (e.g. sending the actual values of the configured send signals, using the set source address).

Thus, in case of problems with the InterMiCOM protection signaling interface, the loopback test can be used to verify or to exclude a defective device. The transmission channel including the receiving device can be checked manually by setting individual binary signals (COMM3: Send signal for test) to user-defined test values (COMM3: Log. state for test). After triggering the test by COMM3: Send signal, test, the preset binary signal is sent with the preset value for the set hold time COMM3: Hold time for test. The 7 remaining binary signals are not affected by this test procedure and remain to be sent with their actual values. During the hold time, a received signal can be checked at the receiving device, e.g. by reading the physical state signal. After the hold time has expired, the test mode is reset automatically and the actual values of all 8 signals are transmitted again.

3.5.5 Communication Interface Ethernet (Function Groups IEC, GOOSE and VINP)

NOTICE

CYBER SECURITY HAZARD

- Substation communication via Ethernet interface is without encryption. User is requested to secure the network communication according to applicable standards.

Failure to follow these instructions can increase the risk of unauthorized access.

3.5.5.1 Communication Module

From the software version -660, the Single Ethernet module and Redundant Ethernet module are available for the devices of the Easergy MiCOM 30 Series. To get information of the former Ethernet module, please refer to the manuals before -660.

The P433 Distance Protection and Control Unit can be fitted with new communication module, the Single Ethernet module or Redundant Ethernet module. (See [Chapter 15, \(p. 15-1\)](#) for the exact order information and [Section 5.7, \(p. 5-32\)](#) for the location and connection diagrams.)

The Ethernet modules are developed to support PRP/HSR/RSTP redundancy protocol as well as Dual-IP communication mode, conformance of IEC 61850 edition 1 and 2, Cyber Security (CS) and Flexible Product Naming (fPN).

3.5.5.1.1 Hardware Modules

Four modules are available for Ethernet communication, two Single Ethernet Boards (SEB) and two Redundant Ethernet Boards (REB). *Easergy MiCOM 30* Series are constructed from standard hardware modules.

The Ethernet module is fitted into Slot 2 of the P433. For REB, each module has three MAC addresses, one for the managed embedded switch and two for the P433. The following table lists the item numbers of the Ethernet module variants:

Type	Item number	Description	Width
A	9652161	SEB copper: 1 * RJ45 + 1 * IRIG-B	4 TE
A	9652162	SEB fiber: 1 * RJ45 + 1 * SFP-LC + 1 * IRIG-B	4 TE

Tab. 3-5: Single Ethernet Module variants.

Type	Item number	Description	Width
A	9652159	REB copper: 3 * RJ45 + 1 * IRIG-B	4 TE
A	9652160	REB fiber: 1 * RJ45 + 2 * SFP-LC + 1 * IRIG-B	4 TE

Tab. 3-6: Redundant Ethernet Module variants.

Only Redundant Ethernet module can support PRP/HSR/RSTP protocol.

3.5.5.1.2

Redundancy Protocols

The following list shows Schneider Electric's implementation of Ethernet redundancy, which has three variants with embedded IEC 61850, plus PRP, HSR and RSTP redundancy protocols.

Parallel Redundancy Protocol (PRP IEC 62439-3 (2012))

- The PRP uses two independent Ethernet networks that operate in parallel. The PRP is a “redundancy in the devices” method that provides bumpless switchover in case of failure or reintegration. Furthermore, it provides the shortest Ethernet network reconfiguration time as network reconfiguration is seamless.

High-availability Seamless Redundancy Protocol (HSR IEC 62439-3 (2012))

- HSR method is independent of any industrial Ethernet protocol and typically used in a ring topology. Nodes within the ring are restricted to be HSR-capable bridging nodes, thus avoiding the use of dedicated bridges. A simple HSR network consists of doubly attached bridging nodes, each having two ring ports, interconnected by full-duplex links.

Rapid Spanning Tree Protocol (RSTP IEEE 802.1w)

- This protocol variant offers compatibility with any RSTP device. RSTP is a standard used to quickly reconnect a network fault by finding an alternative path, allowing loop-free network topology. Although RSTP can recover network faults quickly, the fault recovery time depends on the number of devices and the topology.

Configuration of RSTP protocol can be set via Easergy Studio.

3.5.5.1.3

Generic Functions for All Redundant Ethernet Modules

Ethernet 100Base Fx/Tx

The fiber optic ports are full duplex 100 Mbps LC connectors or wire RJ45 supports 100 Mbps.

Forwarding

The devices from the families Easergy MiCOM 30, 40, the C264 and the MiCOM H switches support store and forward mode. The MiCOM switch forwards messages with known addresses to the appropriate port. The messages with unknown addresses, the broadcast messages and the multicast messages are forwarded out to all ports except the source port. MiCOM switches do not forward error packets, 802.3x pause frames or local packets.

Forwarding is active when HSR or RSTP protocol is selected.

Priority Tagging

802.1p priority is enabled on all ports.

Simple Network Management Protocol – SNMP

Simple Network Management Protocol (SNMP) is the network protocol developed to manage devices in an IP network. SNMP relies on a Management Information Base (MIB) that contains information about parameters to supervise. The MIB

format is a tree structure, with each node in the tree identified by a numerical Object Identifier (OID). Each OID identifies a variable that can be read or set using SNMP with the appropriate software. The information in the MIBs is standardized.

Various SNMP client software tools can be used with the Series 30, 40, C264 and Hx5x range. Schneider Electric recommends using an SNMP MIB browser which can perform the basic SNMP operations such as *GET*, *GETNEXT*, *RESPONSE*. To access the network using SNMP, use the IP address of the embedded switch in the Redundant Ethernet module.

For further information, please contact Schneider Electric.

Dual Ethernet Communication – Dual IPs

Dual IP means the IED provides two independent IEC 61850 interfaces, and both these interfaces support MMS and GOOSE message.

The IED which supports Dual IP can provide the customer with more flexible network connections: two fully segregated Station BUS networks, or one Station Bus and one Process Bus (for GOOSE message transmission).

Dual IP is not mutually exclusive with PRP/HSR/RSTP - Dual IP is automatically supported even if the IED is operate under HSR/PRP/RSTP mode. Setting (104 080) IEC: ETH COMM Mode is provided to switch the operation mode between PRP/HSR/RSTP/Dual IP.

Network Time Protocol – NTP

Network Time Protocol is supported by both the P433 and the Redundant Ethernet switch. NTP is used to synchronize the clocks of computer systems over packet-switched, variable-latency data networks. A jitter buffer is used to reduce the effects of variable latency introduced by queuing in packet switched networks, ensuring a continuous data stream over the network.

The P433 receives the synchronization from the NTP server. This is done using the IP address of the NTP server entered into the P433 from the *IED Configurator* software.

3.5.5.2 Communication Protocols

3.5.5.2.1 IEC 61850

IEC 61850 was created jointly by users and manufacturers as an international standard. The main target of IEC 61850 is interoperability of devices. This includes the capability of two or more intelligent electronic devices (IED), manufactured by the same company or different companies, to exchange data for combined operation.

This communication standard IEC 61850 has now created an open and common basis for communication from the process control level down to the network control level, for the exchange of signals, data, measured values and commands.

For a standardized description of all information and services available in a field device, a data model, which lists all visible functions, is created. Such a data model, specifically created for each device, is used as a basis for an exchange of data between the devices and all process control installations interested in such information. In order to facilitate engineering at the process control level a standardized description file of the device, based on XML, is created with the help of the data model. This file can be imported and processed further by the relevant configuration program used by the process control device. This makes possible an automated creation of process variables, substations and signal images.

Available is the following documentation providing the description of the IEC 61850 data model which is used with the P433:

- ICD file based on XML in the SCL (Substation Configuration Description Language) with a description of data, properties and services, available from the P433, that are to be imported into the configuration tool “IED Configurator” or into a system configurator.
- PICS_MICS_ADL file with the following contents:
 - PICS (Protocol Implementation Conformance Statement) with an overview of available services.
 - MICS (Model Implementation Conformance Statement) with an overview of available object types.
 - ADL (Address Assignment List) with an overview of the assignment of parameter addresses (signals, measuring values, commands, etc.) used by the P433 with the device data model as per IEC 61850.

3.5.5.2.1.1

Client Log-on

Communication in Ethernet no longer occurs in a restrictive master slave system, as is common with other protocols. Instead, server or client functionalities, as defined in the “Abstract Communication Service Interface” (ACSI, IEC 61850-7-2), are assigned to the devices. A “server” is always that device which provides information to other devices. A client may log on to this server in order to receive information, for instance “reports”. In its function as server the P433 can supply up to 16 clients, linked into the network, with spontaneous or cyclic information.

3.5.5.2.1.2

Clock Synchronization

With IEC 61850 clock synchronization is effected via the SNTP protocol, defined as standard for Ethernet. Here the P433 functions as an SNTP client.

For clock synchronization one can choose between the operating modes *Anycast* from SNTP Server or *Request from Server*. With the first operating mode synchronization occurs by a broadcast message sent from the SNTP server to all devices in the network, and in the second operating mode the P433 requests a device-specific time signal during a settable cycle.

Two SNTP servers may be set. In this case, clock synchronization is preferably performed by the first server. The second server is only reverted to if no signal is received from the first server.

When looking at the source priority for clock synchronization, which is set at the MAIN function then, by selecting *IEC*, synchronization per IEC 61850 is automatically active but only if this communication protocol is applied.

3.5.5.2.1.3

Transmitting Modeled Signals Not Provided by the IEC 61850 Data Model

In addition to the information included in the IEC 61850 data model an optional number of up to 16 signals can be selected from all the signals available in the P433 to be transmitted via reporting. A selection of state signals (shuttling to communications) is made by setting IEC: SigGGIO1 selection. The data object indexes defined for SigGGIO1 must follow the sequence given for the ‘m out of n’ selection for the state signals. The indexes SigGGIO1.ST.ind1 to SigGGIO1.ST.ind16 may then be included in the datasets just as the other data objects.

3.5.5.2.1.4

Fault Transmission

Transmission of fault files is supported per “File Transfer”. COMTRADE fault files in the P433 are transmitted uniformly either as ASCII or binary formatted files.

3.5.5.2.1.5

High Priority Transmission of Information

Whereas normal server-client services are transmitted at the MMS and TCP/IP level the high priority transmission of information is carried out directly at Ethernet level. Furthermore messages in such a particular form can be received by all participants in the relevant sub-network, independent of their server or client function. They are deployed in instances where high speed transmission of information is wanted between two or more devices. Applications, for example, are reverse interlocking, transfer trip or decentralized substation interlock.

The standard IEC 61850 provides the Generic Object Oriented Substation Event (GOOSE) for high priority transmission of information. The GOOSE enables transmission of all data formats available in the data model, such as binary information, integer values, two-pole contact position signals or analog measured values. The P433 supports receipt and evaluation of GOOSE including binary information and two-pole contact position signals from external devices.

3.5.5.2.1.6

Generating Datasets, Reporting

The specific project related feature of the P433's communications behavior is determined by the configuration of datasets, reports and high priority transmission methods. A piece of information must be included in a dataset so as to be transmitted as a signal. A dataset is a list to transmit certain data objects. The selection of data objects and the resulting length of the dataset is determined by the application; merely the GOOSE capacity, i.e. the maximum size of a dataset to be transmitted by GOOSE, is limited to 1500 bytes.

It is not possible to read the IEC configuration back from the P433 if the "Dataset" sizes exceed the GOOSE size limit significantly. Therefore it is recommended to limit the "Dataset" size(s) to 100% of the GOOSE capacity. Too large a dataset can spoil IEC 61850 communication. Hence, the dataset size limit of 100% of the GOOSE capacity should not be exceeded, neither for GOOSE nor for reports.

Data objects provided by the P433 are available for selection with a structure as specified by IEC 61850. Within the quality descriptor for each piece of information the invalid bit and the test bit are served according to the P433's state; the other attributes are not set. Any number of datasets may be created with the IED Configurator. Saving datasets at System\LLN0 is compulsory. The knowledge of dataset content is imperative for decoding and evaluating received signals. Configuration files possess a listing of all datasets with a description of all data objects included.

Next to their use with high priority transmission methods (see [Section 3.5.5.2.1.5, \(p. 3-40\)](#)) datasets are used mainly for reporting. The P433 provides up to 16 unbuffered reports and 8 buffered reports independent of the number of clients logged-on. Management is arranged into 16 Unbuffered Report Control Blocks (urcbA to urcbP) and 8 Buffered Report Control Blocks (brcbA to brcbH). Whereas with unbuffered reporting pieces of information may be lost during a communications failure, the buffered report control blocks support a buffered transmission which is required for the uninterrupted writing of events. A pre-defined dataset may be assigned to each report which will then determine which data object will be transmitted with the relevant report. Assigning datasets is not limited; the same dataset may be referenced in various reports or even in GOOSEs.

The P433 can serve up to 16 clients. Each client can log-on to any number of available reports. One unbuffered report can be allocated to max. 8 clients, and one buffered report can be allocated to max. 4 clients. A client is then able to activate the wanted report for himself and to set the transmission behavior to his

requirements. The system concept with intended clients must be taken into account when datasets are assigned to the reports.

Reports are not received by the P433.

3.5.5.2.1.7

Single Commands

Single commands (e.g. short command, long command, persistent command) are configured with the operating program. Sending commands to the P433 can be carried out from all clients that have previously logged-on to the P433. But only one command at a time is carried out. The operating mode *Direct control with normal security* is provided for single commands.

3.5.5.2.1.8

Control and Monitoring of Switchgear Units

Configuration of control of switchgear devices for the IEC 61850 is only possible with a special configuration software, the *IED Configurator*.

Control of switchgear units can be carried out from all clients that have previously logged on to the P433. Only one control command is executed at a time, i.e. further control requests issued by other clients during the execution of such a command are rejected. The following operating modes [IC]: `ctlModel` are available to control external devices by clients and they can be individually set for each switchgear device:

- *Status only*
- *Direct control with enhanced security*
- *SBO (Select before operate) with enhanced security*

When set to the operating mode *Select before operate* the switchgear unit is selected by the client before the control command is issued. Because of this selection the switchgear unit is reserved for the client. Control requests issued by other clients are rejected. If after a selection no control command is issued by the client the P433 resets this selection after a settable timeout period [IC]: `sboTimeout` (default: 2 minutes) has elapsed.

If with a system application it must be ensured that only one control command at a time is being processed system wide ("uniqueness") then interlocking of secondary devices among themselves is setup with GOOSE. For further details see description of function group GOOSE.

The switchgear device's contact positions are signaled to the clients with the reports.

Setting parameters labeled with brackets – i. e. "[IC]:..." – instead of a normal function group are set with the "IED Configurator". They cannot be modified from the local control panel (HMI), nor with the operating program.

There is a separate Chapter "IEC 61850 Settings via IED Configurator" with a description of all such setting parameters.

3.5.5.2.1.9

Originator Category

The *Originator* is an information type defined by IEC 61850, which is sent with switch commands and position signals of switchgear units. This kind of data consists of two information items:

- *Originator Identification*: This is text describing the originator of the switch command. (If unknown, then an empty text string is sent.)
- *Originator Category*: This is the originator of the command according to a list of standardized categories.

The range of values of the *Originator Category*, as listed in the following table, is supported.

	Originator category	Originator Identification	Use Case / Comment
1	<i>remote-control</i>	See note [1] (at the end of this table).	The control command is sent by an operator at station level.
2	<i>automatic-remote</i>	See note [1].	The control command is sent by an automatic function at station level.
3	<i>station-control</i>	See note [1].	The control command is sent by an operator at network level.
4	<i>automatic-station</i>	See note [1].	The control command is sent by an automatic function at network level.
5	<i>bay-control</i>	<i>Local HMI Control</i>	The control command is generated at the local HMI of the P433.
6	<i>bay-control</i>	<i>Local EXT Control</i>	The control command is sent via binary input (see note [2]) by an operator at an external local control panel, using the setting ● (221 061) MAIN: Electrical control = <i>Local</i> and any of the following input signals: ● DEVxx: Inp.asg.el.ctrl.open ● DEVxx: Inp.asg.el.ctr.close.
7	<i>remote-control</i>	<i>Remote EXT Control</i>	The control command is sent via binary input (see note [2]) by an operator at an external local control panel, using the setting ● (221 061) MAIN: Electrical control = <i>Remote</i> and any of the following input signals: ● DEVxx: Inp.asg.el.ctrl.open ● DEVxx: Inp.asg.el.ctr.close.
8	<i>process</i>	<i>Spontaneous Process Event</i>	A trip or close command which is generated by a protection function. Usually this is a circuit breaker trip or a close command from the ARC function, regardless whether originating from an internal function of the P433, from external devices or a manual command. The internal commands are as follows: ● (035 071) MAIN: Gen. trip command ● (037 009) MAIN: Close command Examples of external signals that can be assigned to these two commands: ● (037 019) MAIN: Parallel trip EXT ● (037 018) MAIN: Man. trip cmd. EXT ● (041 022) MAIN: Man. close cmd. EXT (See also note [2].)

	Originator category	Originator Identification	Use Case / Comment
9	<i>process</i>	<i>Spontaneous Process Event</i>	There is a spontaneous position change of the switchgear device. Possible causes: ● A manual switch command ● The operation of another protection and control device Further possible causes: ● Loss of supply voltage of electrical input signals ● Faulty wiring ● Faulty switchgear device (However, this usually results in an intermediate position 00 or 11 of the switchgear device.)
10	<i>process</i>	<i>IED Restart</i>	Power-up or restart of the P433, intentionally or spontaneously. Possible causes: ● Loss of the auxiliary supply voltage of the P433 ● Commissioning activities ● Operation of self-monitoring of the P433
11	<i>maintenance</i>	<i>Test Mode Operation</i>	The P433 is in test mode. The test mode can be activated either by setting parameter ● (003 012) MAIN: Test mode USER or by the binary signal ● (037 070) MAIN: Test mode EXT (See also note [2].)

[1]: The P433 copies the Originator Identification from the command request into the information report.

[2]: External binary signals can be received via various interfaces:

- Opto-coupler inputs
- InterMiCOM protection communication
- GOOSE substation communication
- Assignment of LOGIC outputs

The P433 does never send the *Originator Category* “automatic-bay”. In all protection devices from the *Easergy MiCOM 30* family, Automatic Reclose is implemented as part of the protection functionality, and therefore it is treated as *process*, see table row No. 8 above.

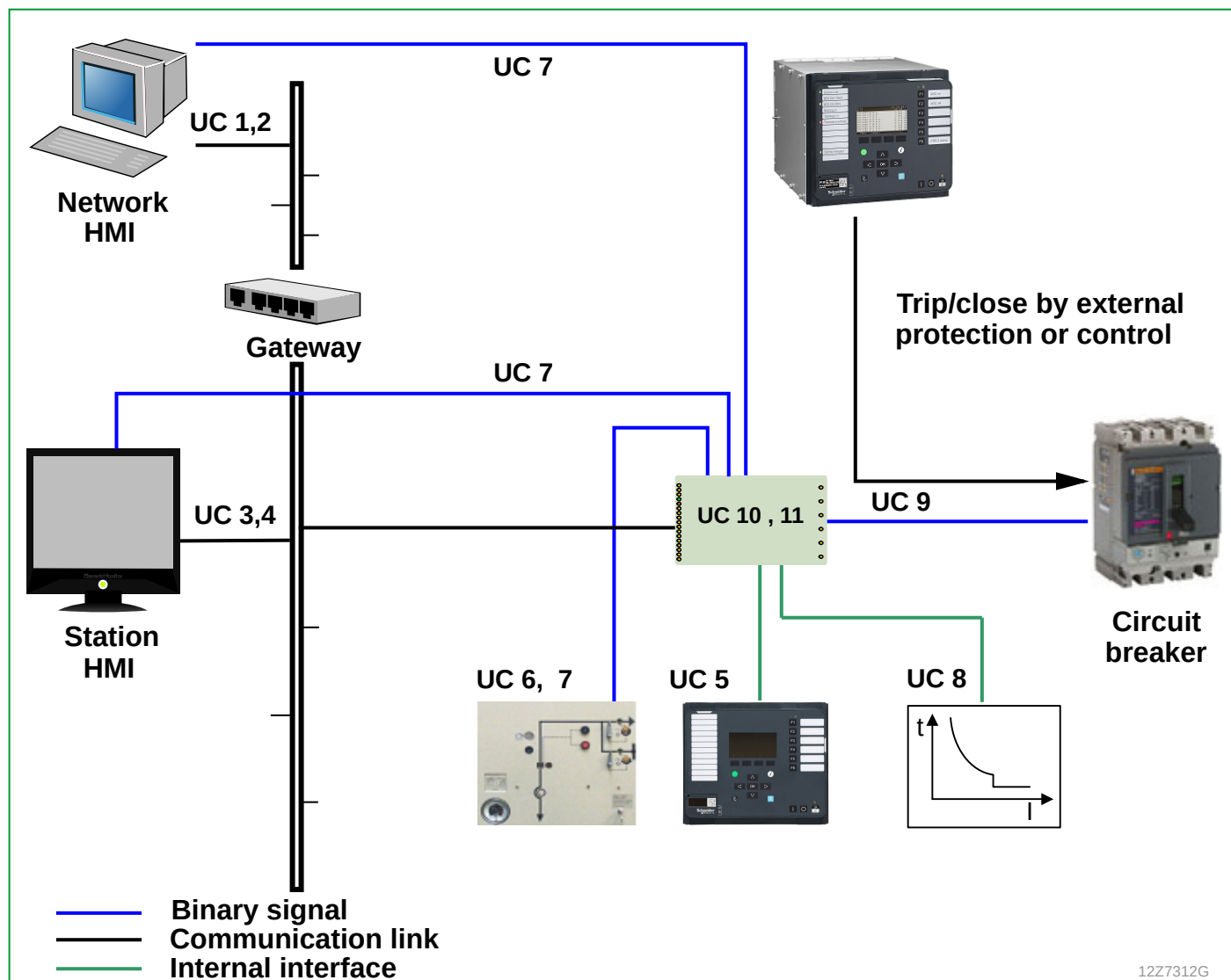


Fig. 3-23: Use cases in the network context. The "UC" numbers refer to Originator Categories in the table above.

3.5.5.2.1.10

Setting Group Control Block

The setting-group-control-block (SGCB) model allows for an instance to have several values that can be used one at a time. The SGCB provides mechanisms to switch between several values of one or more data objects. Values that belong together build the setting group.

3.5.5.2.2 IEC 60870-5-104

3.5.5.2.2.1 Overview

The IEC 60870-5-104 “Network access for IEC 60870-5-101 using standard transport profiles” is based on IEC 60870-5-101 “Transmission protocols – Companion standard for telecontrol tasks”, and was originally intended for SCADA applications but it is also applied in station bus communication.

The IEC 60870-5-104 implementation in Easergy MiCOM 30 relays includes server and client functionality with multiple connections. For every connection the types and addressing of every ASDU can be configured in data models. The data models also include a logic module to manipulate the data and to realize logical functions e.g. batch messages.

A Easergy MiCOM 30 bay unit can also act as a central unit. For this more complex logical functions two additional programs may be started: the logic and the boolean interlocking. These programs are used for functions like calculation of busbar voltage or substation interlocking.

The configuration for IEC 60870-5-104 is done with a special configuration tool which will be integrated in Easergy Studio like the IED Configurator.

In this manual only a short description of the IEC 60870-5-104 functions is possible. For detailed description, please refer to IEC 60870-5-104 Application Guide. Because the implementation of IEC 60870-5-104 is configurable, there is also a standardized interoperability document, the IEC 60870-5-104 Interoperability Guide.

3.5.5.2.2.2 Integration

After setting IEC: General enable USER, the protocol IEC 60870-5-104 can be selected in Function group IEC by switching on IEC: IEC60870-5-104enable and selecting IEC 60870-5-104 in IEC: IEC prot. variant. The other settings visible for IEC 60870-5-104 protocol are functioning like described for IEC 61850, see [Section 3.5.5.3, \(p. 3-50\)](#):

- IEC: ETH COMM Mode
- IEC: Block Port A/B
- IEC: Block Port C

The protocol IEC 60870-5-104 also uses two configuration banks, one active and one standby bank. The configuration bank switching with IEC: Switch Config. Bank is functioning like in IEC 61850.

All settings in the IEC function group concerning the time zone and summer time are working like described for IEC 61850.

The setting IEC 60870-5-104 in IEC: IEC prot. variant selects only the communication protocol. The additional services on the Ethernet module working like described for IEC 61850:

- Checking Spontaneous Signals, see [Section 3.5.5.3.1, \(p. 3-53\)](#)
- Checking Switchgear Device Positions and Signals, see [Section 3.5.5.3.2, \(p. 3-54\)](#)
- Clock Synchronization, see [Section 3.5.5.2.1.2, \(p. 3-39\)](#)
- Virtual Local Area Network, see [Section 3.5.5.2.3, \(p. 3-48\)](#)
- Port Assignment, see [Section 3.5.5.2.4, \(p. 3-48\)](#)
- Secure Communication with the Easergy Studio via the Ethernet Interface, see [Section 3.5.5.2.6, \(p. 3-50\)](#)

3.5.5.2.2.3

Engineering

The communication function in IEC 60870-5-104 are configurable by the IEC 60870-5-104 configuration tool. The maximum configuration is:

- 5 IEC 60870-5-104 server connections
- 2 IEC 60870-5-104 clients

For usage in central functions additional programs may be started to compute more complex logical functions:

- Logic
- Boolean station interlocking

The setting of the IEC 60870-5-104 is done in the following steps:

- Configuration
The first step is to configure the module, means to choose how many server lines are needed, how many servers need to be connected and whether logic and Boolean interlocking is needed.
- Setting of parameters
In this step the main parameters for IEC 60870-5-104 and installed services will be set, e.g.
 - Port assignment, which service runs on which Ethernet port.
 - Network configuration, VLANs, IP-addresses, subnetwork masks, ...
 - IEC 60870-5-104 parameters, server and client addresses, ...
- Mapping data
The incoming data from the device or any IEC 60870-5-104 connection may be mapped to any server or client connection of the module. The type and addressing of the IEC 60870-5-104 messages is individual configurable. In addition to the mapping data can be manipulated and linked together through functions, for example:
 - Logical functions (negation, and, or, ...),
 - Arithmetical functions (multiply, division, ...),
 - Time functions (on delay, off delay, ...),
 - Set functions for data and cause of transmission,
 - Filter functions (deadband, average, ...).

The mapping and manipulating of the data can be done individually in all IEC 60870-5-104 servers lines and clients.
- Generate and upload data bank
The generated data bank file is an archive of all IEC 60870-5-104 project data. It can be uploaded to the device via Ethernet service port or serial front interface.

For detailed description of IEC 60870-5-104 engineering and functions, please refer to IEC 60870-5-104 Application Guide.

3.5.5.2.2.4

IEC 60870-5-104 Server and Client Functions

The IEC 60870-5-104 server connections can work in two modes:

- IEC 60870-5-104 Station Bus

In this mode one client can connect to the server. Redundancy is not used.

- IEC 60870-5-104 SCADA connection

In this mode up to 8 clients can connect to the server in one redundancy group. The redundancy can be configured in 2 modes:

- Redundancy defined in IEC 60870-5-104

In this mode one connection is active. Data messages are transmitted and received over this link. The other connections are passive, no data is transmitted. The links will be supervised by sending test frames.

- Multiple active connections

In this mode all connections transmit and receive data messages. It is up to the client to choose the active connection by processing the data.

One IEC 60870-5-104 client can connect to maximum 32 servers. Two IEC 60870-5-104 client processes can run on the communication module. The information of each connected servers can be mapped individually.

In IEC 60870-5-104 server and client include the following protocol related functions:

- Separation of communication layers in two processes, one for link and transport layer and one for application layer.
- Queues for priority controlled transmission of commands, signals and measurements.
- Packing and unpacking of messages with multiple information objects.
- Sending and receiving of ASDUs in reverse direction, signals in command direction and commands in monitor direction.
- Supervision and conversion of command procedures Direct Execute and Select and Execute (server only).
- Supervision of control uniqueness (server only).

For detailed list of supported IEC 60870-5-104 protocol function, please refer to IEC 60870-5-104 Interoperability Guide.

3.5.5.2.3 Virtual Local Area Network

From the software version -661, VLAN is available for the devices of the Easergy MiCOM 30 Series.

Configuration of VLAN features is done with IED Configurator.

A virtual LAN (VLAN) is any broadcast domain that is partitioned and isolated in a computer network at the data link layer (OSI layer 2). VLANs work through tags within network packets and tag handling in networking systems - recreating the appearance and functionality of network traffic that is physically on a single network but acts as if it is split between separate networks. It is possible to assign traffic to different VLANs to allow the separation of the traffic while using a single physical network.

In the table below shows the link between the Hardware modules/ ports and IED configurator inclusive requested VLAN support capability. Only physical interface 1 is to support VLANs in fixed number (2 VLANs for physical interface 1).

Module Type	Interface 1	Interface 2	Interface 1 & VLAN support	Interface 2 & VLAN support
REB fiber	Port A/B	Port C	Yes	No
REB copper	Port A/B	Port C	Yes	No
SEB fiber	Port A	Port C	Yes	No
SEB copper	Port C	-	Yes	-

Tab. 3-7: VLAN support capability.

3.5.5.2.4 Port Assignment

Port assignment is the capability to assign TCP/IP services to a dedicated communication interface. The communication interface can be a physical interface or a virtual interface of the communication module. The port assignment can be configured for physical Ethernet interfaces as well as for VLANs.

Port assignment allows to configure TCP/IP services of networks for the customer needs.

Default configuration

In general the Ethernet communication module is designed that all TCP/IP services are working on all physical / virtual interfaces. The factory delivers a communication module without any specific port assignment. In this case – without port assignment and without VLAN – the communication services are available without restriction on the physical Ethernet Interfaces. Depending on the physical module type all services are working on A/B and C for redundant modules or A and C for the single fiber module or only C for the single copper module.

There is one exception the Web services for the CAE tool are only available on one interface at a time. Please find the details in [Section 3.5.5.2.5, \(p. 3-50\)](#).

Port assignment example

With the port assignment the user can choose which services shall work on which physical/ virtual interface. This allows for example to configure two networks,

where one network is dedicated to the station bus and the related services and the second network is dedicated for maintenance services. The user can configure configuration / administration services (configuration bus) as available on physical port C and the client application services (station bus) as available on port A/B.

The port assignment feature is available together with the VLAN feature since the firmware version 661. The same scenario as above can be configured with VLAN together. For example VLAN1 as station bus and VLAN2 as configuration bus.

TCP/IP service

The following list of TCP/IP services can be assigned to interfaces.

Services	Description
IEC 61850 (MMS) ¹⁾	All MMS services including report
Network time protocol (NTP)	NTP Service
IED configuration (TLS)	Services via TLS to configure the device from Easergy Studio
Basic administration (SSH/SFTP) ¹⁾	Update firmware, Read/Write MAC addresses
User management via RBAC (Webservice) ²⁾	Web services for the CAE tool to configure security and the RBAC
1) Minimum configuration: at least ONE "IEC 61850 (MMS)" and at least ONE "Basic administration (SSH/SFTP)" should be enabled across all interfaces 2) "User management via RBAC (Webservice)" option can be fully disabled or only enabled on ONE of the available interfaces	

Tab. 3-8: TCP/IP service in port assignment.

Configured example

The screenshot shows the 'Address Configuration' window. At the top, there are two checked options: 'Enable VLANs' and 'Enable Port Assignment'. Below this, the configuration is divided into two main sections: 'Interface 1' and 'Interface 2 (If fitted)'. Under 'Interface 1', there are two sub-sections: 'VLAN1' and 'VLAN2'. For 'VLAN1', the 'VLAN Id' is set to 1, and for 'VLAN2', it is set to 3E. Below these, there are input fields for IP Address, SubNet Mask, and Gateway Address for each VLAN. At the bottom, there are checkboxes for various services: IEC 61850 (MMS), Network time protocol (NTP), IED Configuration (TLS), Basic administration (SSH/SFTP), and User mgmt via RBAC (Webservice). The checkboxes for IEC 61850 (MMS), IED Configuration (TLS), and Basic administration (SSH/SFTP) are checked for both VLAN1 and VLAN2. The checkboxes for Network time protocol (NTP) and User mgmt via RBAC (Webservice) are checked for Interface 2.

Fig. 3-24: VLANs and port assignment configured example for IEC 61850 Ed.2.

Note that the "VLAN Id" is configured in HEX.

3.5.5.2.5

CAE-Tool Connectivity (w/wo Port Assignment)

The CAE (EcoStruxure™ Cybersecurity Admin Expert) allows to configure security rights for the IEDs, e.g. the user names and passwords, access rights and roles for the user. The CAE tool is working with Web services.

The communication between CAE and IED is restricted to one interface at the same time. The interface can be changed via port assignment configuration. The default behaviour of the CAE tool – without port assignment is described in the following table:

Port Assignment Active	VLAN Active	Behavior CAE Web services are available on:	Toggle Mode (physical Ethernet port A/B or C)
No	No	Depending on the plugged cable to the physical interfaces the services switch between the physical Ethernet port A/B and C. ● Preferred is physical Ethernet port C	Yes
No	Yes	Fixed port assignment ● Physical Ethernet port C or VLAN1 or VLAN2	No
Yes	No	One of the available physical interface is assigned via configuration for the Web services ● Physical Ethernet port A/B or C	No
Yes	Yes	One of the available physical and possible virtual interfaces is assigned via configuration for the Web services ● Physical Ethernet C or VLAN1 or VLAN2	No

Tab. 3-9: CAE Web services behavior.

3.5.5.2.6

Secure Communication with the Easergy Studio via the Ethernet Interface

*The secure communication is valid for IEC 61850 Ed.2.
The communication will be done using port 4422. Ensure this port is left unblocked on the network.*

When P433 and Easergy Studio are connected via the Ethernet interface, they will communicate securely using SSH (Secure Shell). The benefits of secure communication are:

- Help in the prevention of unwanted eavesdropping between Easergy Studio and the IED.
- Help in the prevention of modification of data between Easergy Studio and the IED.
- Ensure integrity of data.
- Help to prevent replay of data at a later data.

3.5.5.3

Configuration and Enabling

The IEC function group can be included in the configuration by setting the parameter IEC: Function group IEC. This parameter is only visible if the optional Ethernet communication module is fitted to the P433. After activation of

IEC, all data points associated with this function group (setting parameters, IEC prot.variant etc.) become visible.

The function can then be enabled or disabled by setting IEC: General enable USER. IEC 60870-5-104, IEC 61850 Edition 1 or Edition 2 can be selected by setting IEC: IEC prot. variant. When Redundant Ethernet module is used, the redundancy protocols PRP/HSR/RSTP can be switched via IEC: ETH COMM Mode. Port A/B and service port C can be blocked with IEC: Block Port A/B and IEC: Block Port C.

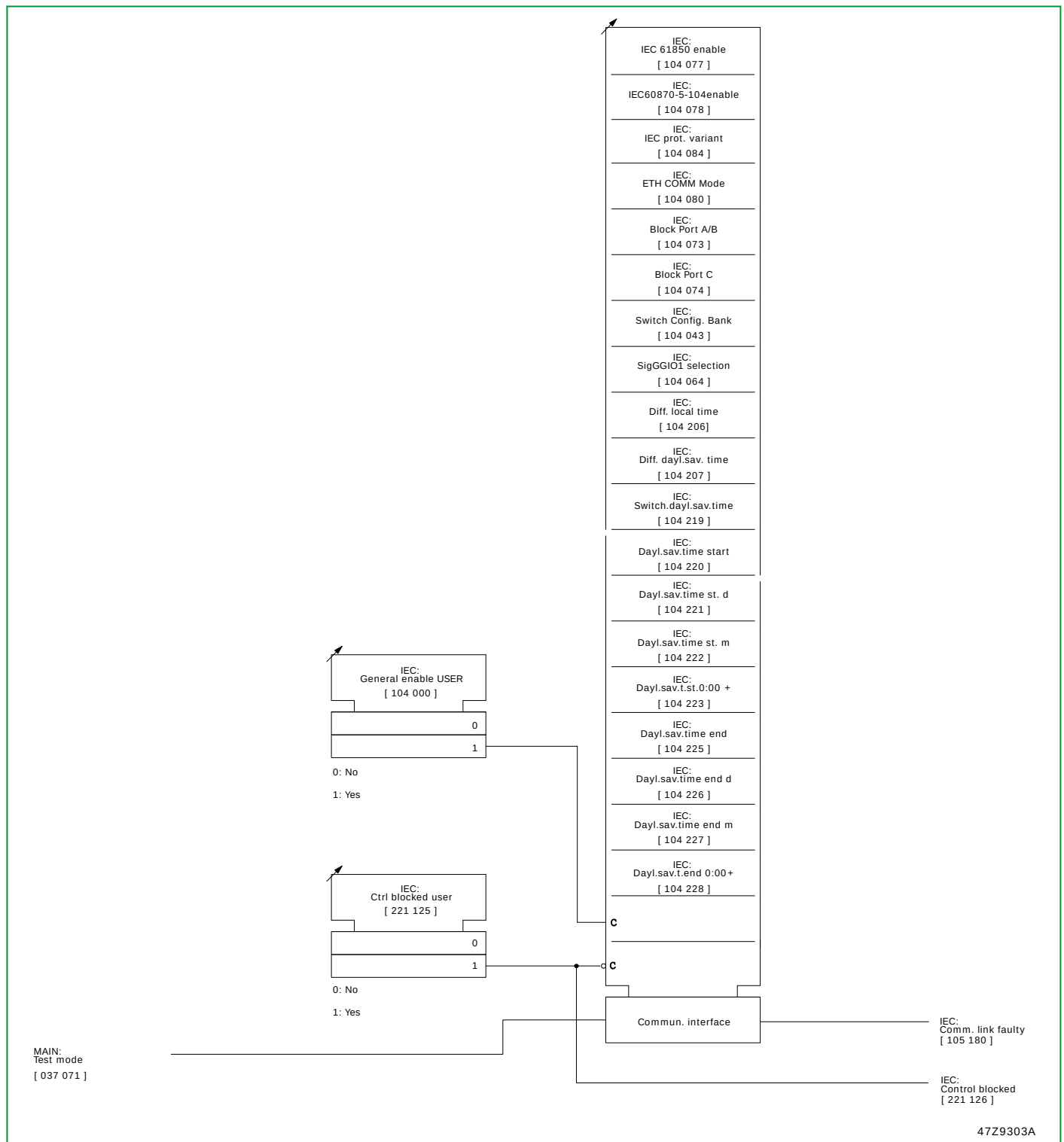


Fig. 3-25: Settings for communication interface IEC 61850.

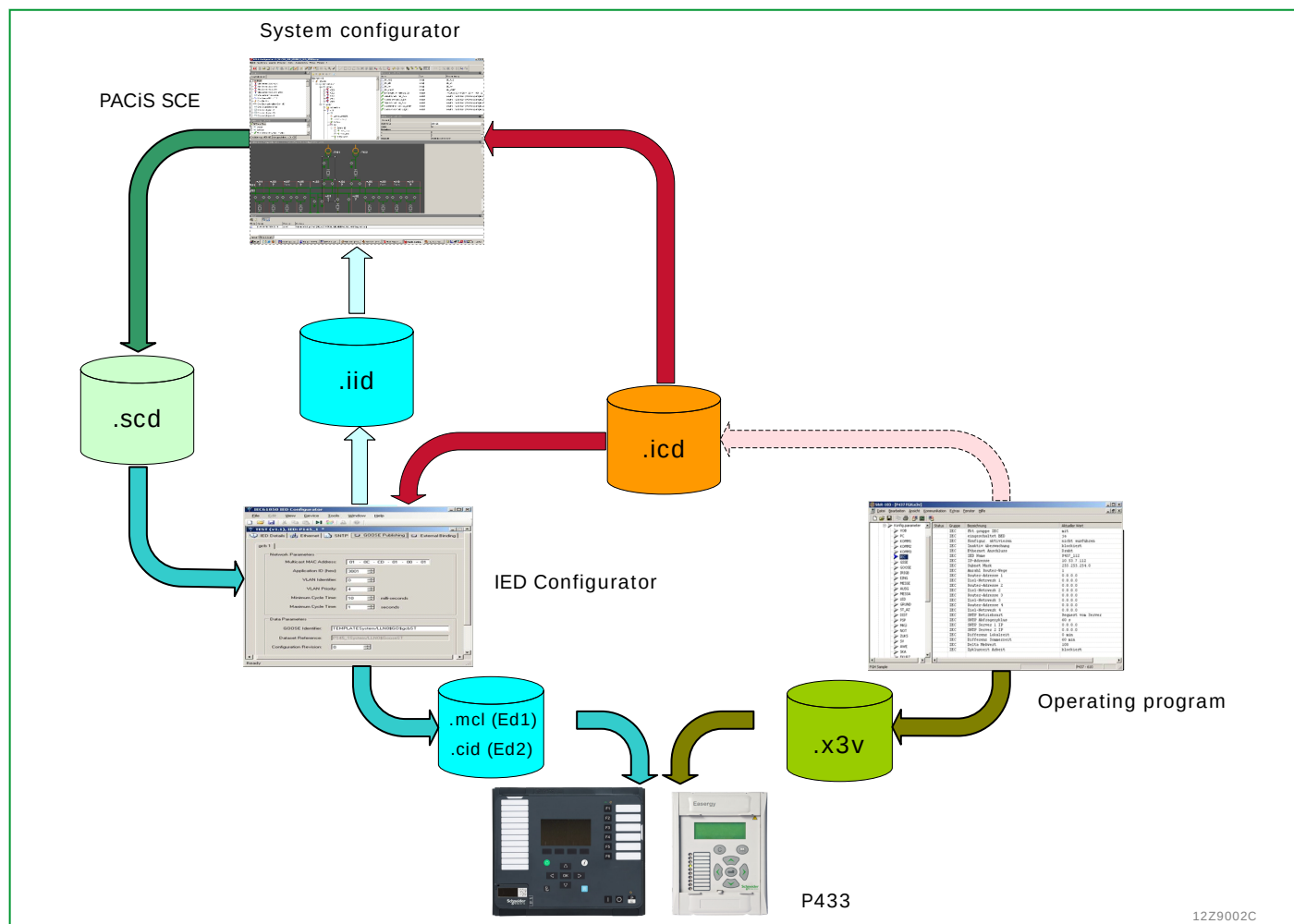


Fig. 3-26: Configuration according to IEC 61850-6.

The setting parameters from the IEC function group as well as the related GOOSE function group are not automatically active in the P433. The P433 features two memory “banks” one of which includes the active setting parameters. The other memory bank is used with the configuration procedure for parameters from the *IED Configurator* and the operating system. Specific project-related extensions of the IEC 61850 parameters from the *IED Configurator* are loaded into the P433 by downloading a .MCL file (Ed1) or .CID file (Ed2). The inactive communication parameters are activated by executing the command IEC: Switch Config. Bank. This command may also be issued from the *IED Configurator*.

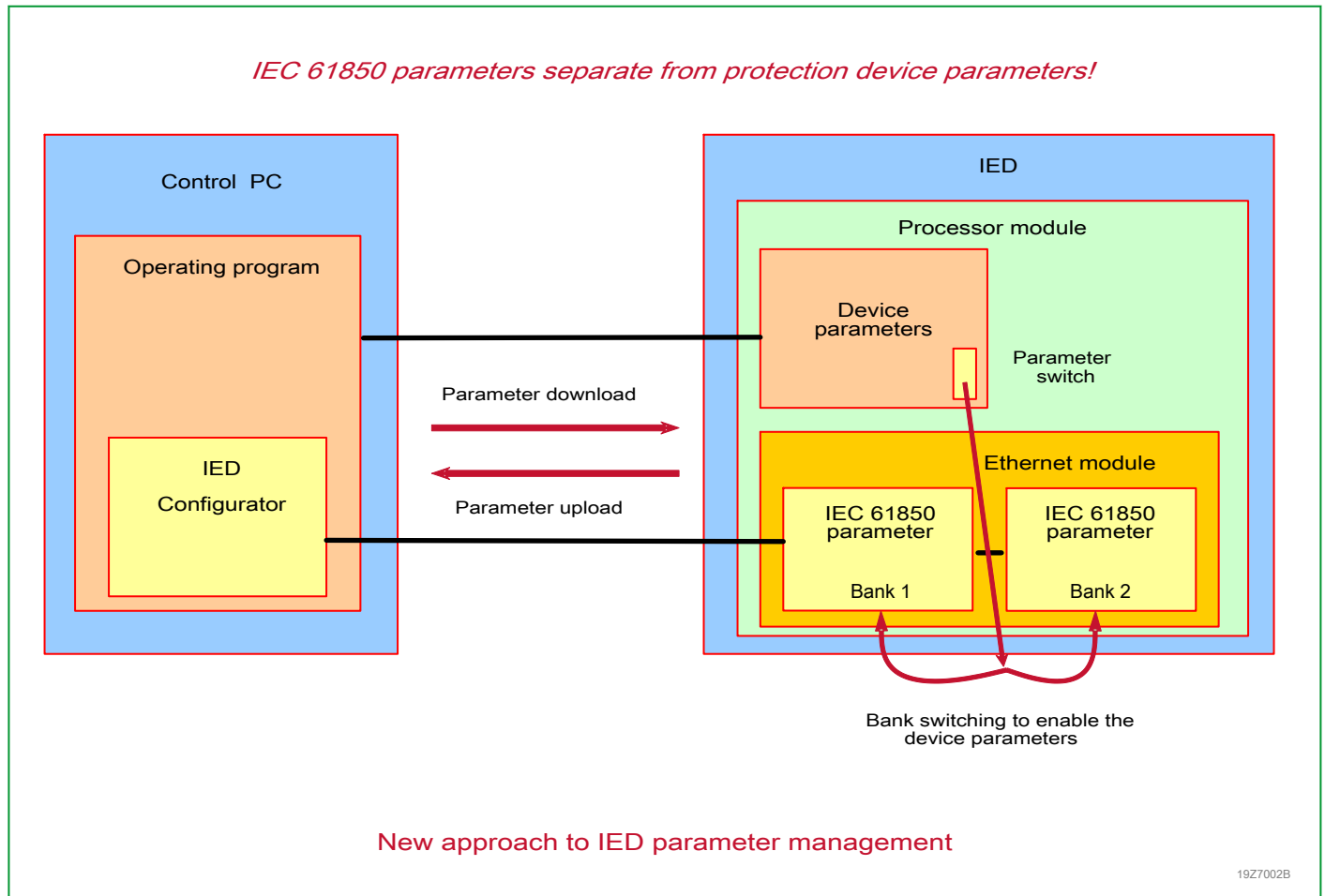


Fig. 3-27: Saving configuration parameters.

3.5.5.3.1

IEC – Checking Spontaneous Signals

It is possible to select a signal for test purposes. The transmission of this signal to the control station as 'sig. start' or 'sig. end' can then be triggered via the local control panel.

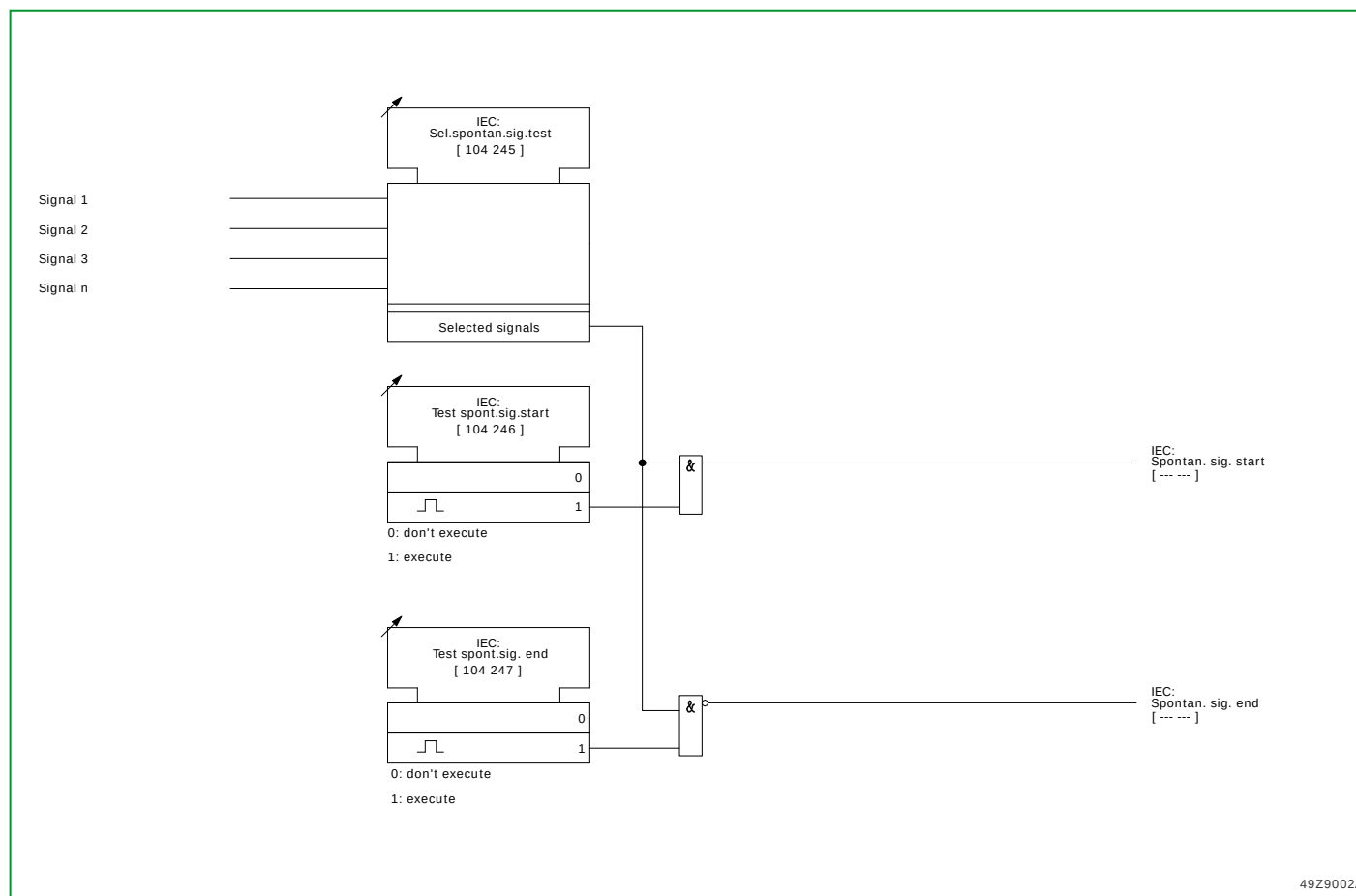


Fig. 3-28: IEC – Checking spontaneous signals.

3.5.5.3.2

Checking Switchgear Contact Positions and Signals

When checking during test operations with the interface protocols based on IEC 61850 it is possible to trigger signals (SIG) and contact positions (DEV) from the control part.

The following parameters are available:

- (104 248) IEC: Sel. pos. dev.test
Selection possibilities:
 - *Not assigned*
 - DEV01 ... DEVxx
- (104 249) IEC: Test position DEV
Selection possibilities:
 - *don't execute*
 - *execute open*
 - *execute close*
 - *execute intermed.*

3.5.5.4

Communication Interface (Function Group GOOSE)

For high priority exchange of information between individual devices (IEDs) in a local network, the P433 provides the function group GOOSE as defined in the standard IEC 61850. GOOSE features high-speed and secure transmission of information for reverse interlocking, decentralized substation interlock, trip commands, blocking, enabling, contact position signals and other signals.

GOOSE Messages are only transmitted by switches but not by routers. GOOSE messages therefore remain in the local network to which the P433 is connected.

This function group is only visible if IEC: IEC 61850 enable is set to Yes. After having configured the GOOSE: Function group GOOSE, all parameters associated to this function group are then visible and ready to be configured.

Further setting parameters from function group GOOSE are set with the IED Configurator, but they cannot be modified from the local control panel (MMI) or with the operating program.

The function can then be enabled or disabled by setting GOOSE: General enable USER.

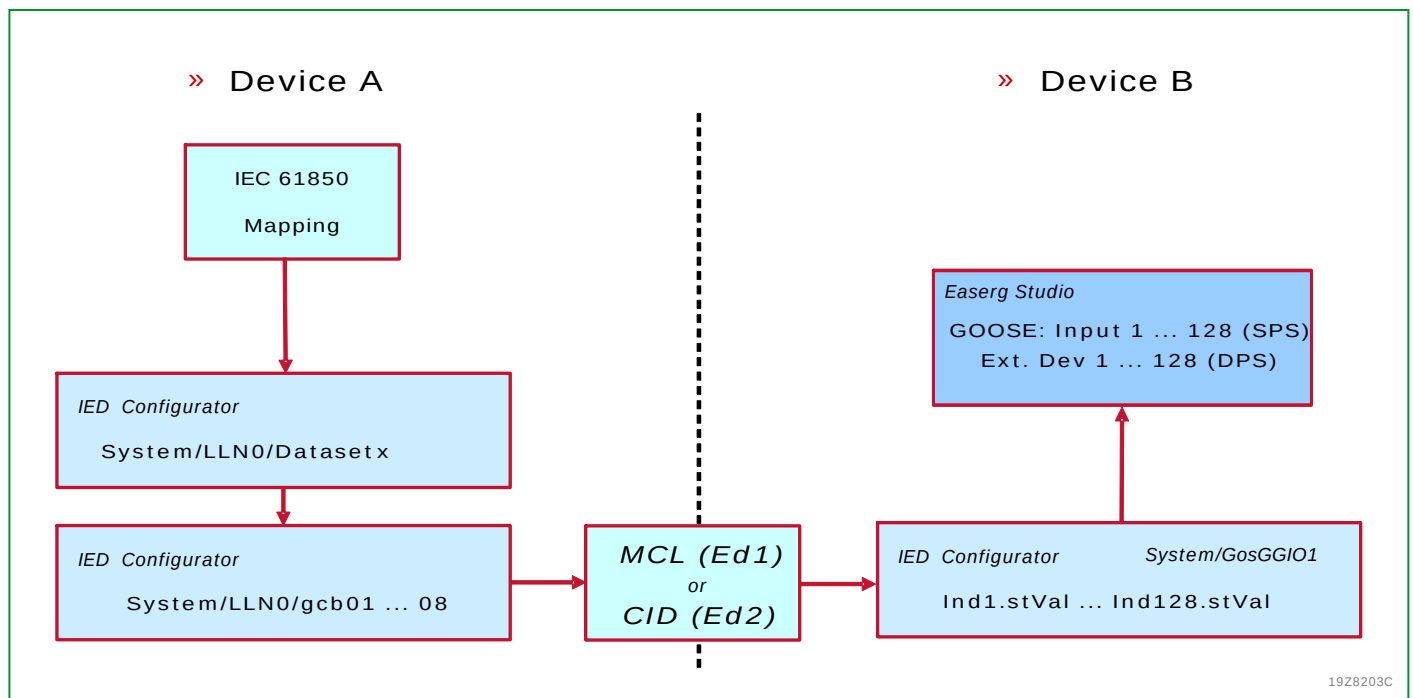


Fig. 3-29: GOOSE configuration.

3.5.5.4.1

Sending GOOSE

The GOOSE can send up to 8 different GOOSE messages which are managed in 8 GOOSE Control Blocks (gcb01 to gcb08). Information content depends on the respective dataset assigned to GOOSE. The maximum size of a dataset to be sent by GOOSE is limited to 1500 bytes. A control display is shown by the IED Configurator to check this limit.

It is not possible to read the IEC configuration back from the P433 if the "Dataset" sizes exceed the GOOSE size limit significantly. Therefore it is recommended to limit the "Dataset" size(s) to 100% of the GOOSE capacity. Too large a dataset can spoil IEC 61850 communication. Hence, the dataset size limit of 100% of the GOOSE capacity should not be exceeded, neither for GOOSE nor for reports.

When defining the datasets for GOOSE it is advised to select the individual data attributes and not the overlapping data objects. By this the amount of data is kept within a limit and decoding is guaranteed on the receiving end.

When a state change occurs with a selected state signal or a measured value changes which is greater than the dead band set for the relevant data point then the complete GOOSE is sent. There will be multiple send repetitions at ascending time periods. The first send repetition occurs at the given cycle time set with the parameter [IC]: Minimum Cycle Time. The cycles for the following send repetitions result from a conditional equation with the increment set with the parameter [IC]: Increment. Should no further state changes occur up to the time when the maximum cycle time has elapsed [IC]: Maximum Cycle Time, then GOOSE will be sent cyclically at intervals as set for the maximum cycle time.

In order to have unambiguous identification of a GOOSE sent, characteristics such as [IC]: Multicast MAC Address, [IC]: Application ID (hex), [IC]: VLAN Identifier (hex), [IC]: VLAN Priority and [IC]: GOOSE Identifier must be entered in the *IED Configurator* settings. Further characteristics are [IC]: Dataset Reference and [IC]: Configuration Revision.

Each GOOSE is given the state change index and the number of send repetitions.

3.5.5.4.2

Receiving GOOSE

With GOOSE up to 128 logic binary state signals as well as 128 two-pole contact position signals from external devices (Ext.Devxx) can be received. For each state signal or contact position signal to be received a specific GOOSE message is to be selected, which will contain the information wanted, by setting [IC]: Multicast MAC Address, [IC]: Application ID (hex), [IC]: Source Path, [IC]: GOOSE Identifier and [IC]: DataSet Reference. With the further setting of [IC]: Data Obj Index / Type, which corresponds to the GOOSE position index and the information structure of the sending device, the required information from the chosen GOOSE will be selected. The identification features "VLAN identifier" and [IC]: Configuration Revision that are also included in the GOOSE received will not be evaluated.

These parameters characterizing the information may be taken either from device or project planning documentation of the sending device or from a configuration file which is conform to IEC 61850. The *IED Configurator* will support the import of .IID, .SCD, .MCL (Ed1) and .CID (Ed2) files when the "browse function" (virtual key) is applied. The selection and acceptance of parameters from an existing project planning is distinguished by a simplified and very reliable data input.

Each GOOSE includes time information on the duration of validity of its information. This corresponds to the double time period to the next GOOSE repetition. If the duration of validity has elapsed without having received this GOOSE again (i.e. because of a fault in communications), the signals received will automatically be set to their respective default value

[IC]: Default Input Value. Which of the possible state values will set the wanted security grade is dependent on the relevant application.

The following configuration (shuttling to the device functions) of the logic state signals received from the logic node GosGGIO1 (GOOSE: Input 1 fct. assig. (or Input 2, ..., Input 128)) is made on the basis of the selection table of the binary signal inputs (opto-coupler inputs).

3.5.5.4.3 Uniqueness of Control within a System

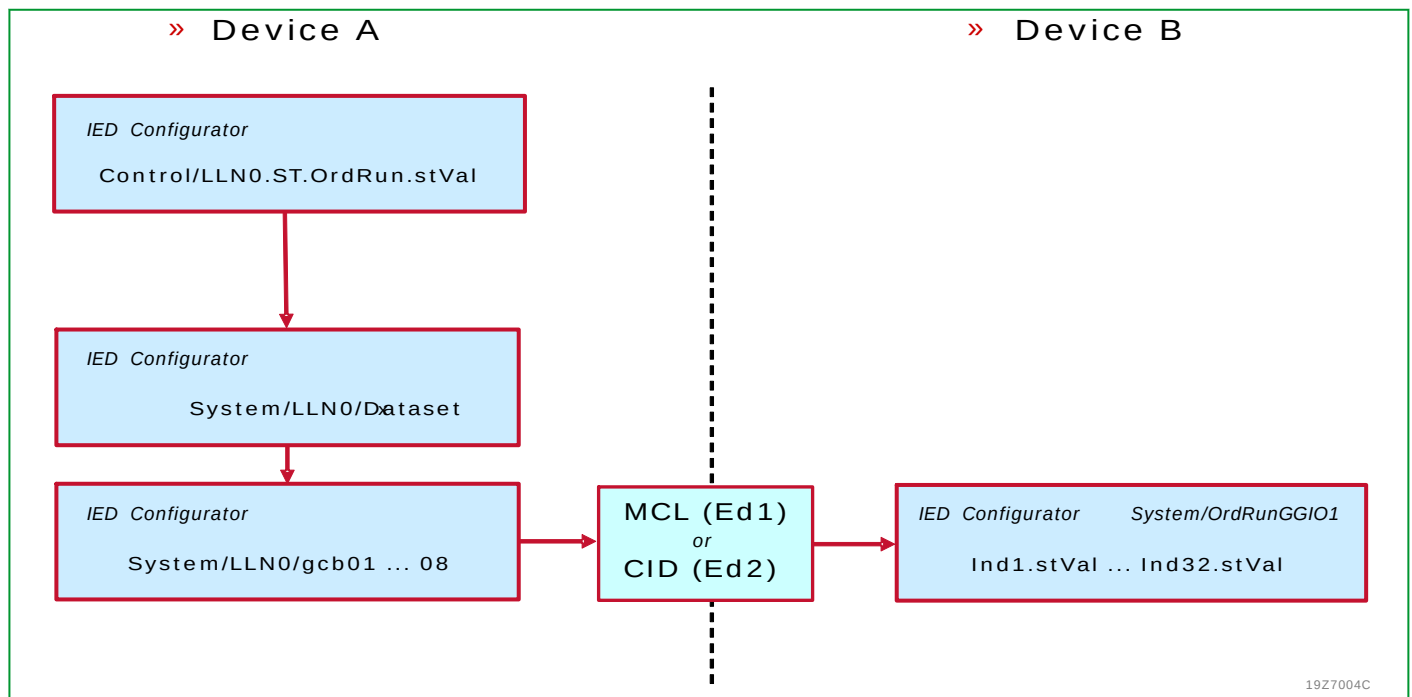


Fig. 3-30: Uniqueness of Control.

If with a system application it must be ensured that only one control command at a time is being processed system wide (“uniqueness”) then interlocking of secondary devices among themselves is setup with GOOSE. The P433 sets the status information `Control/LLN0.ST.OrdRun.stVal`. when it has received a control command. This information – stored in a dataset – is distributed in the system by GOOSE and is therefore available to all other devices as an interlocking condition. The state information is reset and accordingly signaled after termination of the command sequence.

The P433 is capable to monitor the command status of up to 32 further devices. With the *IED Configurator* `OrdRunGGIO1.ind1.stVal` to `OrdRunGGIO1.ind32.stVal` are configured in a similar way to the other GOOSE inputs. A shuttling to the interlocking equations is not necessary as their consideration within command checking is automatically enabled when the first binary signal input is configured. During a signaling receipt phase command effecting will be rejected.

3.5.5.5 Virtual Inputs (Function Group VINP)

This function group is only visible if IEC: `IEC60870-5-104enable` is set to Yes. This functional group includes 64 virtual inputs and is intended to process binary information from the Ethernet module running with protocol IEC 60870-5-104. These inputs may be used e.g. in logic functions, signals or displayed on LEDs by assigning it to functions in Config. Parameters/VINP.

On Ethernet module, any binary information available may be mapped to these inputs. This may be status information of the module or any information received over a IEC 60870-5-104 connection.

The current state of the virtual inputs is visible under Operation/Phys. state signals/VINP.

The quality of the virtual inputs is visible under Operation/Log. state signals/VINP. The signal Input xx faulty is set to Yes if the quality “invalid” or “not topical” is set on the Ethernet module side.

3.5.6 Communication Interface Serial and Ethernet in Parallel

The serial communication module supporting IEC 60870-5-103, IEC 60870-5-101, Modbus and DNP 3.0 are able to work in parallel with the Ethernet module supporting IEC 61850 Ed1, Ed2 and IEC 60870-5-104 when parallel communication modules are ordered and fitted for P433.

The serial module shall be equipped on slot 2, while preferred and alternative slots for Ethernet module are defined in order information [Chapter 15, \(p. 15-1\)](#) and shown in location diagrams [Section 5.7, \(p. 5-32\)](#). Two Ethernet modules are not supported for P433.

Configuration and Recognition

If the serial and Ethernet modules are assembled correctly and firmware is loaded both on the serial module and on the Ethernet module after startup, the function groups for COMM1/COMM2 and IEC are available and can be configured independently.

Both software versions for the serial module (002 103) DVICE: SW version COMM1/2 and Ethernet module (025 185) DVICE: SW vers. Ethernet are visible.

Assignment of Remote Control

It is possible to switch the remote control functionality from the serial communication to the Ethernet by setting (104 242) MAIN: Fct.assignm. control to ensure that only one remote control center is connected. Parallel connection is not possible.

After changing the setting, a warm restart is needed. The remote control function is available only after the warm restart.

If only one communication module is fitted, the remote control is automatically assigned to the installed module and the content of the setting is ignored (even if the setting is still visible).

Assignment of Time Synchronization

Time synchronization is carried out over IEC 60870-5-103 serial telegram or Ethernet NTP protocol. The selection of the time synchronization source can be done with (103 210) MAIN: Prim.Source TimeSync and (103 211) MAIN: BackupSourceTimeSync.

3.6 IRIG-B Clock Synchronization (Function Group IRIGB)

If, for example, a GPS receiver with IRIG-B connection is available, the internal clock of the P433 can be synchronized to run on GPS time using the optional IRIG-B interface. It should be noted that the IRIG-B signal holds information on the day only (day of the current year). Using this information and the year set at the P433, the P433 calculates the current date (DD.MM.YY).

Disabling and Enabling the IRIG-B Interface

The IRIG-B interface can be disabled or enabled using a setting parameter.

Synchronization Readiness

If the IRIG-B interface is enabled and receiving a signal, the P433 checks the received signal for plausibility. Implausible signals are rejected by the P433. If the P433 does not receive a correct signal in the long run, synchronization will not be ready any longer.

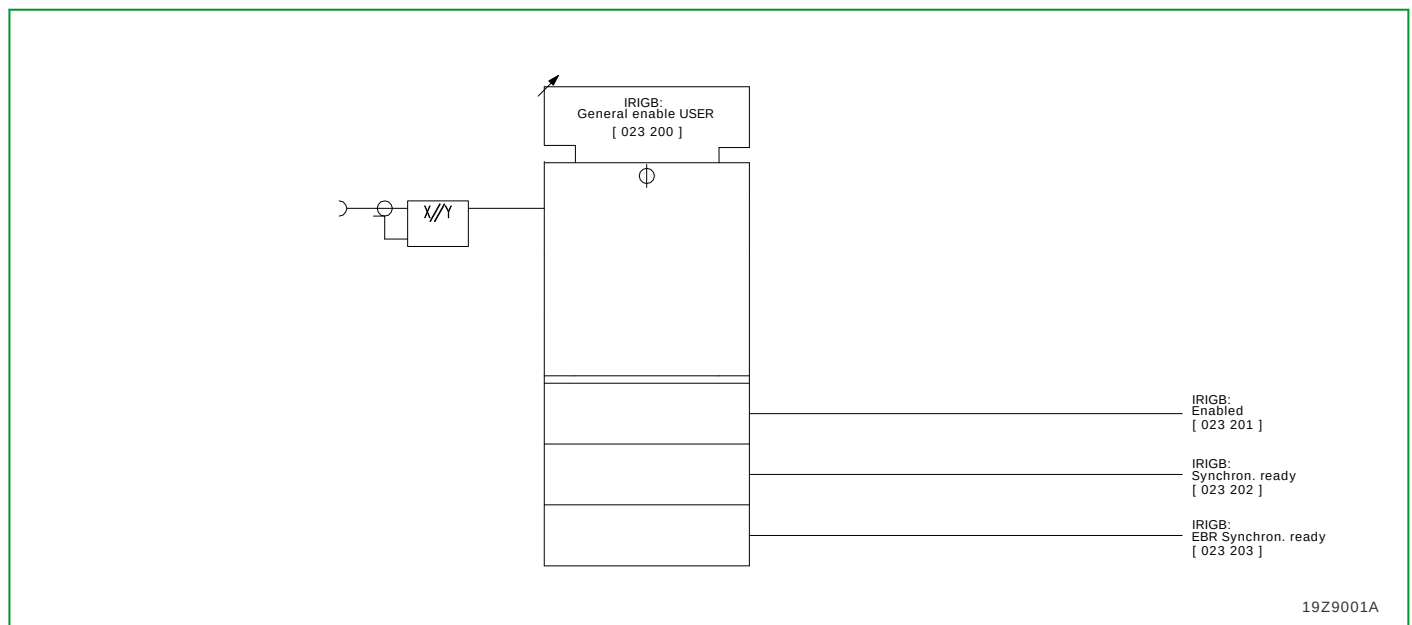


Fig. 3-31: IRIG-B interface.

IRIG-B interface should be connected to only one IRIG-B connector on the serial or Ethernet module.

3.7 Configurable Function Keys (Function Group F_KEY)

The P433 provides six freely configurable function keys.

Note: F_KEY is not available for 24 TE case.

Configuration of function keys with a single function

One function may be assigned to each function key (e.g. for F1) at F_KEY: Fct. assignm. F1 by selecting a logic state signal (except LOC: Trig. menu jmp 1 EXT and LOC: Trig. menu jmp 2 EXT). The assigned function is triggered by pressing the respective function key on the P433.

Configuration of function keys with menu jump lists

Instead of a single function each function key may have one of the two menu jump lists assigned (e.g. for F1) at F_KEY: Fct. assignm. F1 by selecting the listing at LOC: Trig. menu jmp 1 EXT or LOC: Trig. menu jmp 2 EXT. The functions of the selected menu jump list are triggered in sequence by repeated pressing of the assigned function key.

Both menu jump lists are assembled at LOC: Fct. menu jmp list 1 or LOC: Fct. menu jmp list 2. Up to 16 functions such as setting parameters, event counters and/or event logs may be selected.

LED indicators including the six positioned directly next to the function keys are configured independently and in this respect there is no relationship to the respective function key configuration.

Configuration of the READ key

As with LOC: Fct. menu jmp list 1 or LOC: Fct. menu jmp list 2 up to 16 functions may also be selected from the same menu jump list at LOC: Assignment read key. They are triggered in sequence by repeated pressing of the "READ" key.

Operating mode of the function keys

For each function key the operating mode may be selected (e.g. for F1) at F_KEY: Operating mode F1. Here it is possible to select whether the function key operates as a key or as a switch. In the *Key* operating mode the selected function is active while the function key is pressed. In the *Switch* operating mode the selected function is switched on or off every time the function key is pressed. The state of the function keys can be displayed.

Handling keys

If backlighting for the LC display is switched off it will automatically light up when a function key or the "READ" key is pressed. The assigned function will only be triggered when the respective key is pressed a second time. This is also valid for the other keys.

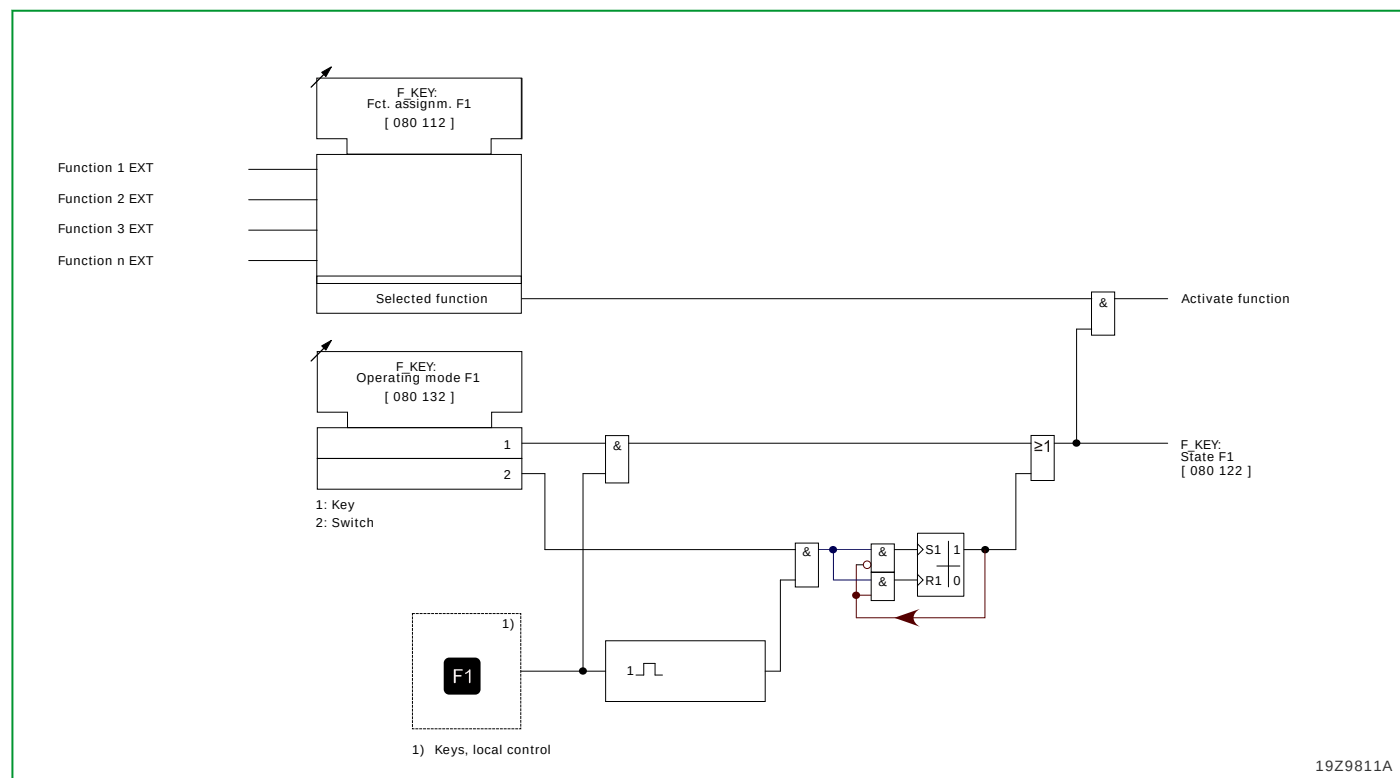


Fig. 3-32: Configuration and operating mode of function keys. The assigned function is either a single function or a menu jump list.

3.8 Configuration and Operating Mode of the Binary Inputs (Function Group INP)

The P433 has opto coupler inputs for processing binary signals from the substation. The functions that will be activated in the P433 by triggering these binary signal inputs are defined by the configuration of the binary signal inputs. In order to ensure that during normal operation the P433 will recognize an input signal, the input signal must persist for at least 8 ms plus the set filter time (provided that *Active "high", filt.* or *Active "low", filt.* has been selected for INP: Oper. mode U xxx).

Configuring the Binary Inputs

One function can be assigned to each binary signal input by configuration. The same function can be assigned to several signal inputs. Thus one function can be activated from several control points having different signal voltages.

It should be noted that time-critical applications such as time synchronization commands should not be mapped to the binary signal inputs of the analog I/O module as these have an increased reaction time due to internal processing.

In this technical manual, it is assumed that the required functions (marked "EXT" in the address description) have been assigned to binary signal inputs by configuration.

Operating Mode of the Binary Inputs

The operating mode for each binary signal input can be defined. The user can specify whether the presence (*Active "high" mode*) or absence (*Active "low" mode*) of a voltage shall be interpreted as the logic '1' signal. The display of the state of a binary signal input – "low" or "high" – is independent of the setting for the operating mode of the signal input.

Filter Function

An additional filter function may be enabled in order to suppress transient interference peaks at the logic signal inputs (operating modes *Active "high", filt.* or *Active "low", filt.*). With this function enabled a status change at the binary logic input is only signaled when the input signal remains at a steady signal level during a set number of sampling steps (sampling step size = period / 20). The number of sampling steps is set at parameter INP: Filter.

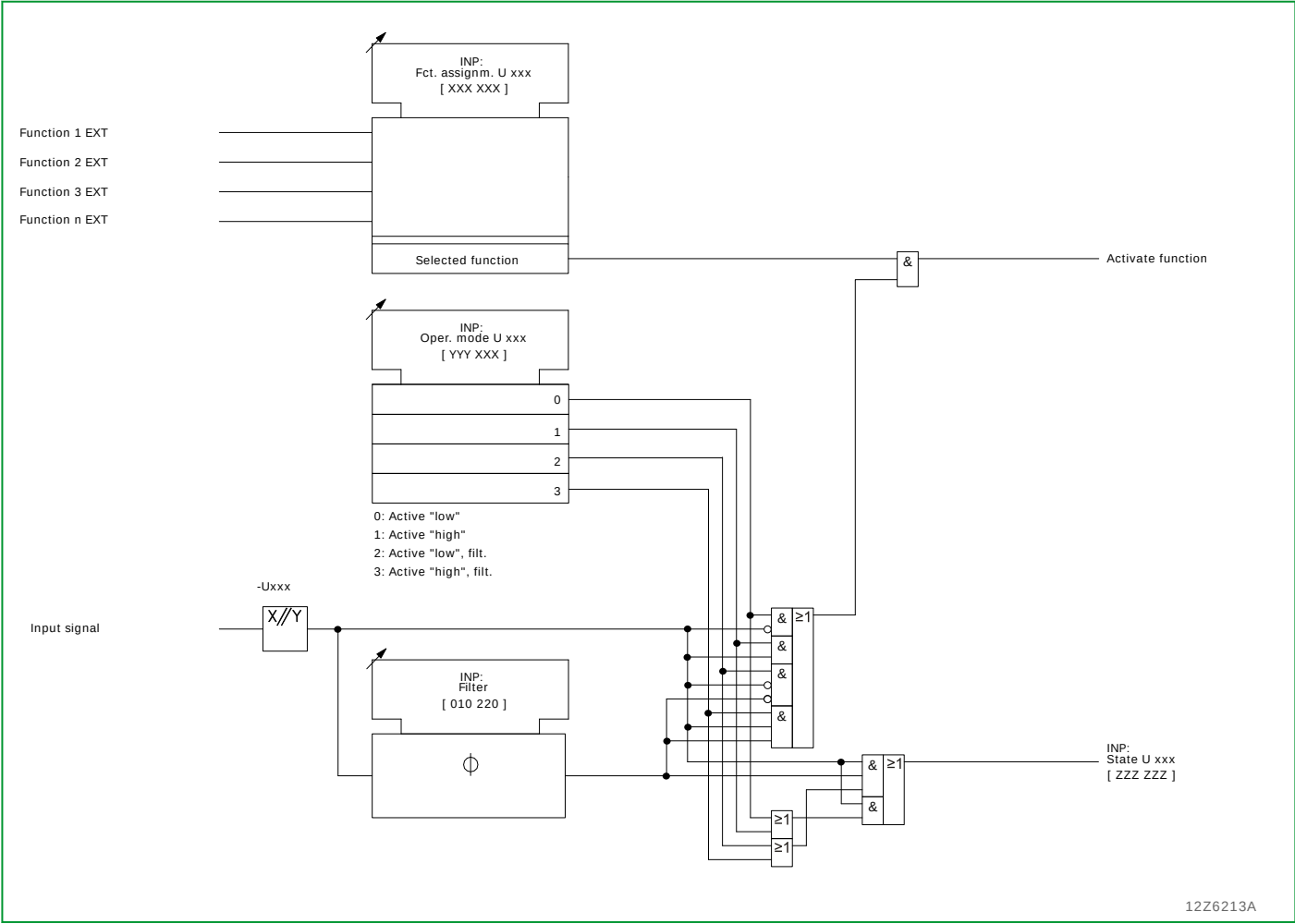


Fig. 3-33: Configuration and operating mode of the binary signal inputs.

3.9 Measured Data Input (Function Group MEASI)

The P433 has a measured data input function involving two inputs. Direct current is fed to the P433 through one of the inputs. The other input is designed for connection of a resistance thermometer.

The input current I_{DC} present at the analog (I/O) module Y is displayed as a measured operating value. The current that is conditioned for monitoring purposes ($I_{DC,lin}$) is also displayed as a measured operating value. In addition, it is monitored by the Limit Value Monitoring function to detect whether it exceeds or falls below set thresholds (see [Section 3.51, \(p. 3-473\)](#)).

The measured temperatures are also displayed as measured operating values and monitored by the Limit Value Monitoring function to determine whether they exceed or fall below set thresholds (see [Section 3.51, \(p. 3-473\)](#)).

Disabling or Enabling the Measured Data Input Function

The Measured Data Input function can be disabled or enabled via setting parameters.

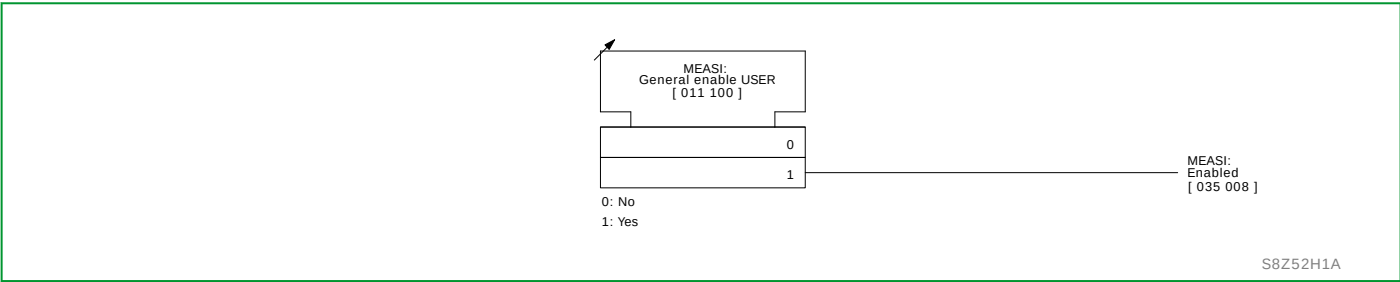


Fig. 3-34: Disabling or enabling the measured data input function.

3.9.1 Direct Current Input on the Analog (I/O) Module Y

External measuring transducers normally supply an output current of 0 to 20 mA that is directly proportional to the physical quantity being measured – the temperature, for example.

If the output current of the measuring transducer is directly proportional to the measured quantity only in certain ranges, linearization can be arranged, provided that the measured data input is set accordingly. Furthermore, for certain applications it may be necessary to limit the range being monitored or to monitor certain parts of the range with a higher or lower sensitivity.

By setting the value pair MEASI: IDC 1 and MEASI: IDC,lin 1, the user specifies which input current I_{DC} will correspond to the current that is monitored by the Limit Value Monitoring function, i.e. $I_{DC,lin}$. (These two setting parameters refer to value pair number 1; setting parameters for value pairs 2 to 20 are available, too.)

The resulting points, called “interpolation points”, are connected by straight lines in an I_{DC} - $I_{DC,lin}$ diagram. In order to implement a simple characteristic, it is sufficient to specify two interpolation points, which are also used as limiting values (see Fig. 3-35, (p. 3-65)). Up to 20 interpolation points are available to implement a complex characteristic.

When setting the characteristic the user must remember that only a rising/rising or falling/falling curve sense is allowed (no peak or vee-shapes). If the setting differs, the signal SFMON: Invalid scaling IDC will be generated.

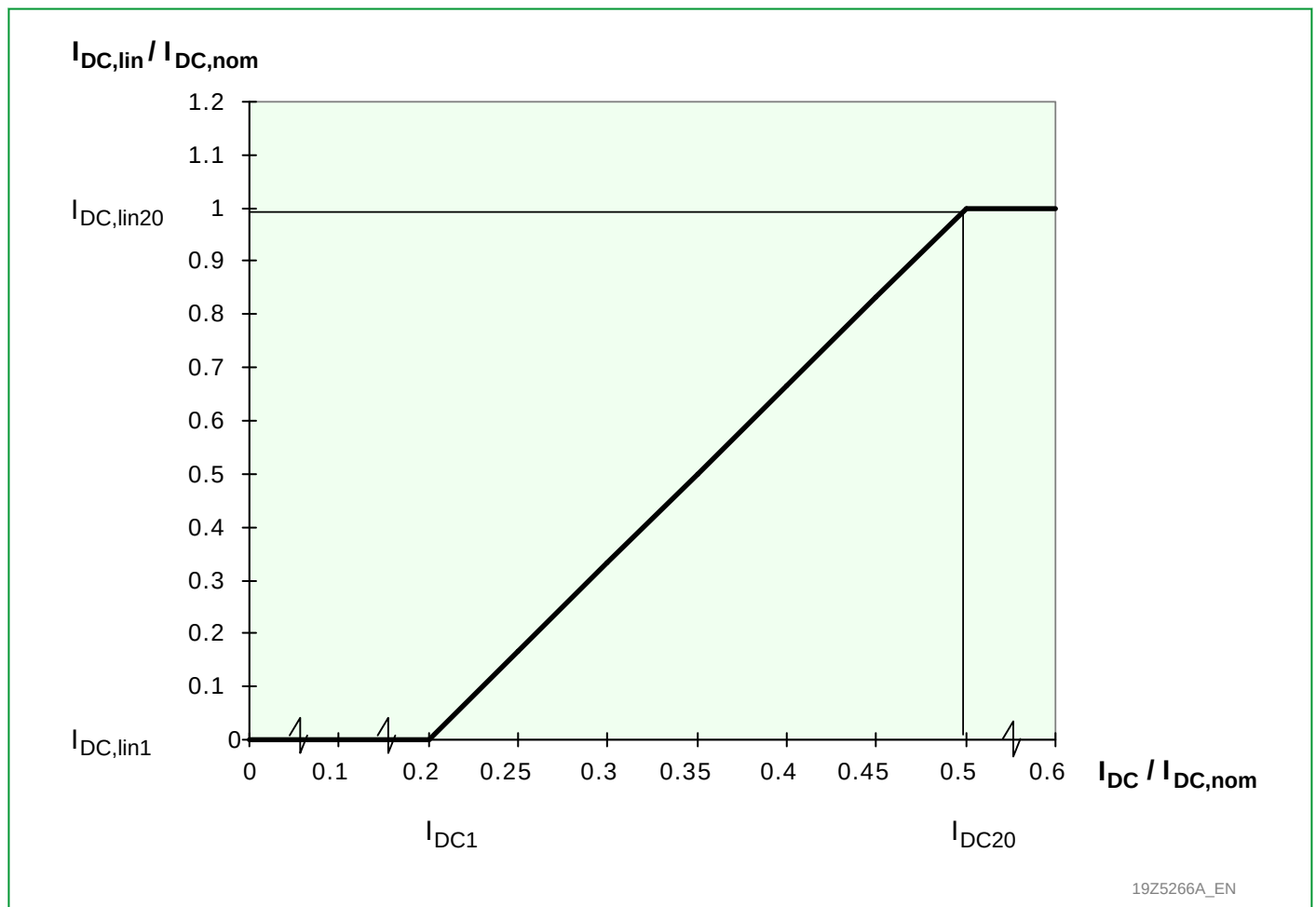


Fig. 3-35: Example of the conversion of 4 to 10 mA input current to 0 to 20 mA monitored current, $I_{DC,lin}$.

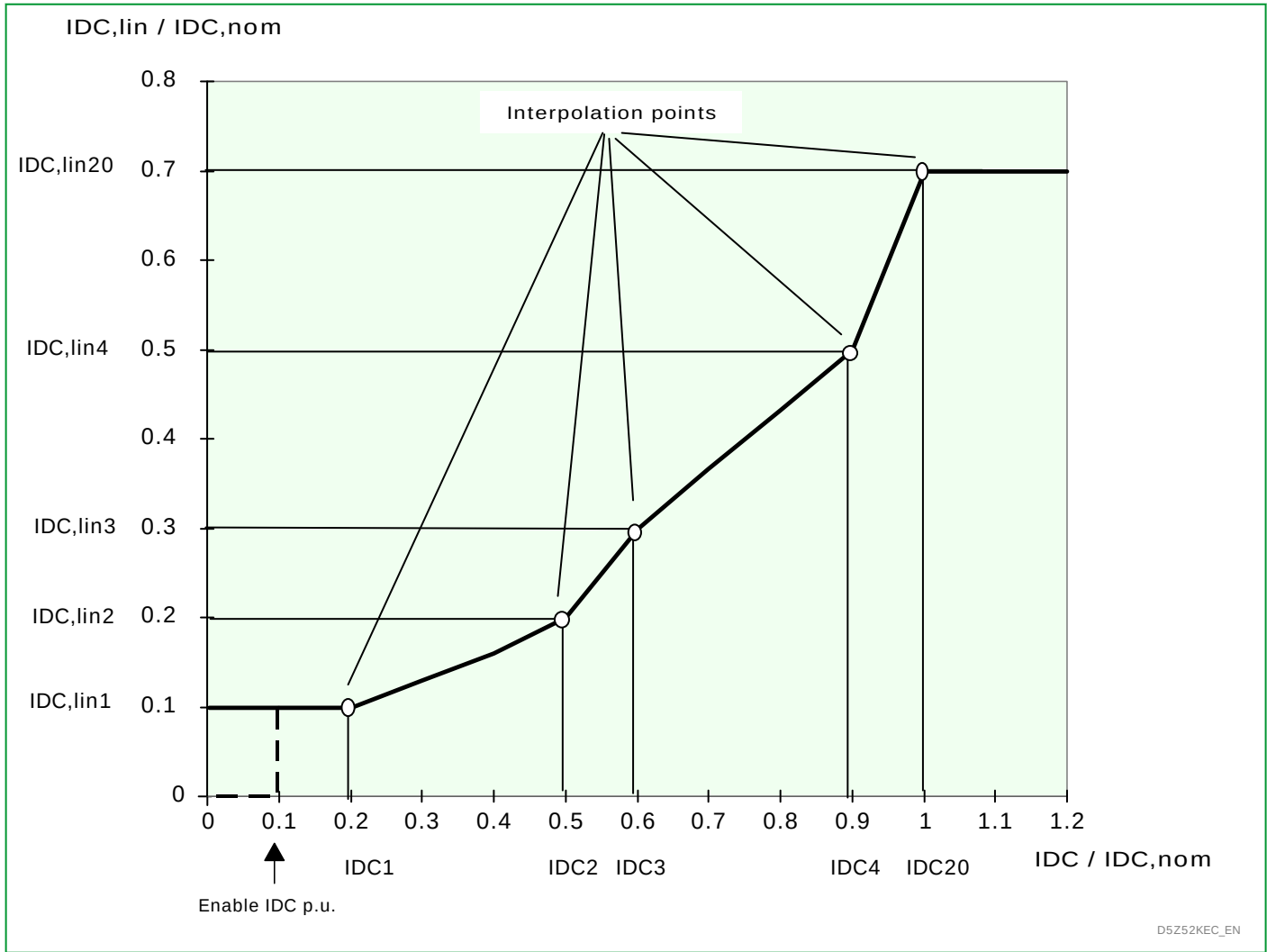


Fig. 3-36: Example of a characteristic with five interpolation points (characteristic with zero suppression setting of $0.1 I_{DC,nom}$ is shown as a broken line).

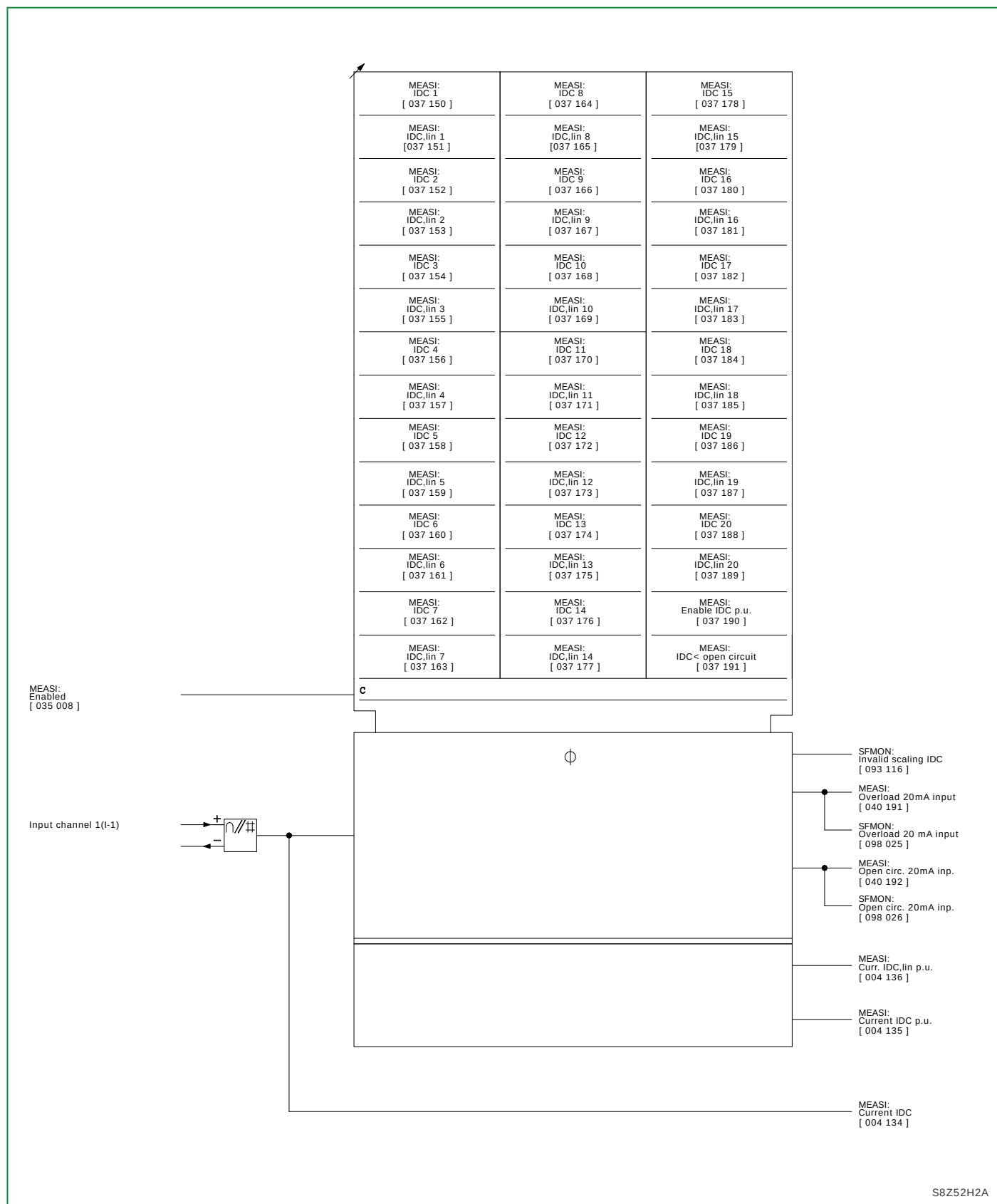


Fig. 3-37: Analog direct current input.

Beyond the linearization described above, the user has the option of scaling the linearized values. Thereby negative values, for example, can be displayed as well and are available for further processing by protection functions.

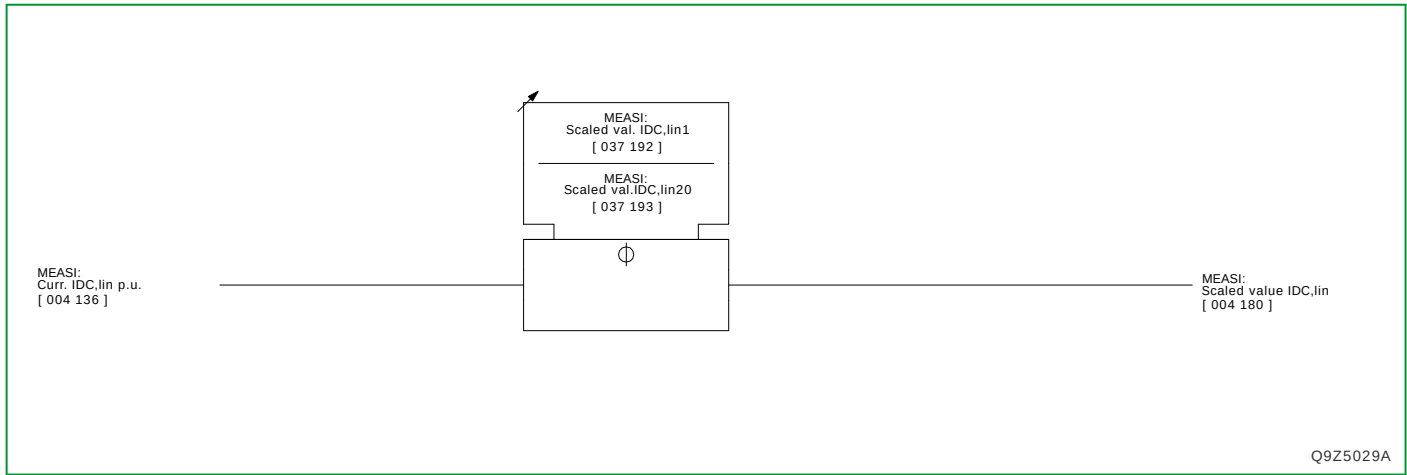


Fig. 3-38: Scaling of the linearized measured value.

3.9.1.1 Zero Suppression

Zero suppression is defined by setting MEASI: Enable IDC p.u. If the direct current does not exceed the set threshold, the per-unit input current $I_{DC\text{ p.u.}}$ and the current $I_{DC,lin}$ will be displayed as having a value of “0”.

3.9.1.2 Open-Circuit and Overload Monitoring

The P433 is equipped with an open-circuit monitoring function. If current I_{DC} falls below the set threshold MEASI: IDC < open circuit, the signal MEASI: Open circ. 20mA inp. is issued.

The input current is monitored in order to protect the 20 mA analog input against overloading. If it exceeds the set threshold of 24.8 mA, the signal MEASI: Overload 20mA input is issued.

3.9.2 Connecting a Resistance Thermometer to the “PT 100 Analog Input” on the Analog (I/O) Module Y

This analog input on the analog (I/O) module Y is designed to connect a PT 100 resistance thermometer. The mapping curve $R = f(T)$ of PT 100 resistance thermometers is defined in standard IEC 751. If the PT 100 resistance thermometer is connected using the 3-wire method, then no further calibration is required.

The result of a temperature measurement can be read out as a direct measurand (temperature T), a normalized value (temperature norm. T), and as the maximum value since the last reset.

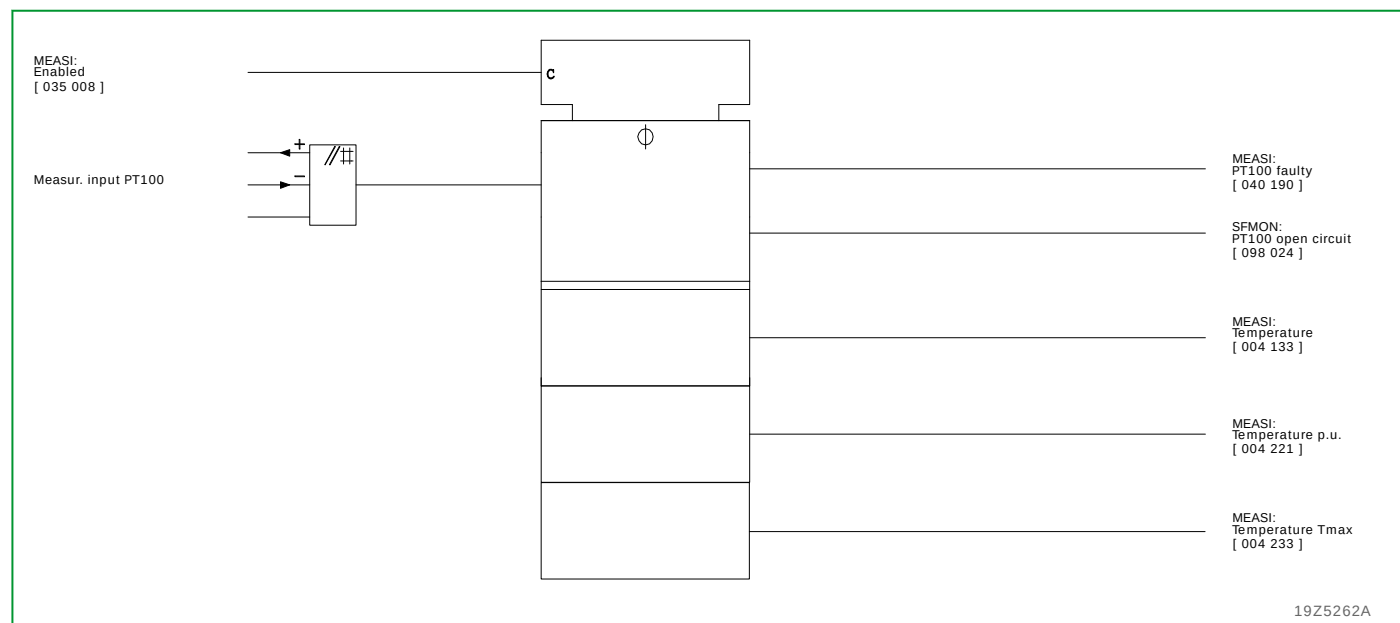


Fig. 3-39: Temperature measurement using a PT 100 resistance thermometer connected to the analog (I/O) module.

3.9.2.1

Open-Circuit Monitoring

If there is an open measuring circuit due to a broken wire, the signal MEASI: PT100 faulty is issued.

3.10 Configuration, Operating Mode, and Blocking of the Output Relays (Function Group OUTP)

The P433 has output relays for the output of binary signals. The binary signal assignment is freely configured by the user.

Configuration of the Output Relays

One binary signal can be assigned to each output relay. The same binary signal can be assigned to several output relays by configuration.

Operating Mode of the Output Relays

The user can set an operating mode for each output relay that determines whether the output relay operates in a normally open arrangement (NO) or normally closed arrangement (NC) and whether it operates in latching mode. Depending on the selected operating mode, latching can be disabled, either manually using a setting parameter or by an appropriately configured binary signal input at the start of a new fault, signaled by the onset of a general starting, or of a new system disturbance.

Blocking the Output Relays

The P433 offers the option of blocking all output relays via setting parameters or by way of an appropriately configured binary signal input. The output relays are likewise blocked if the P433 is disabled via appropriately configured binary inputs or if self-monitoring detects a hardware fault. Any output relay configured for MAIN: Blocked/faulty will not be included in the blocking signals.

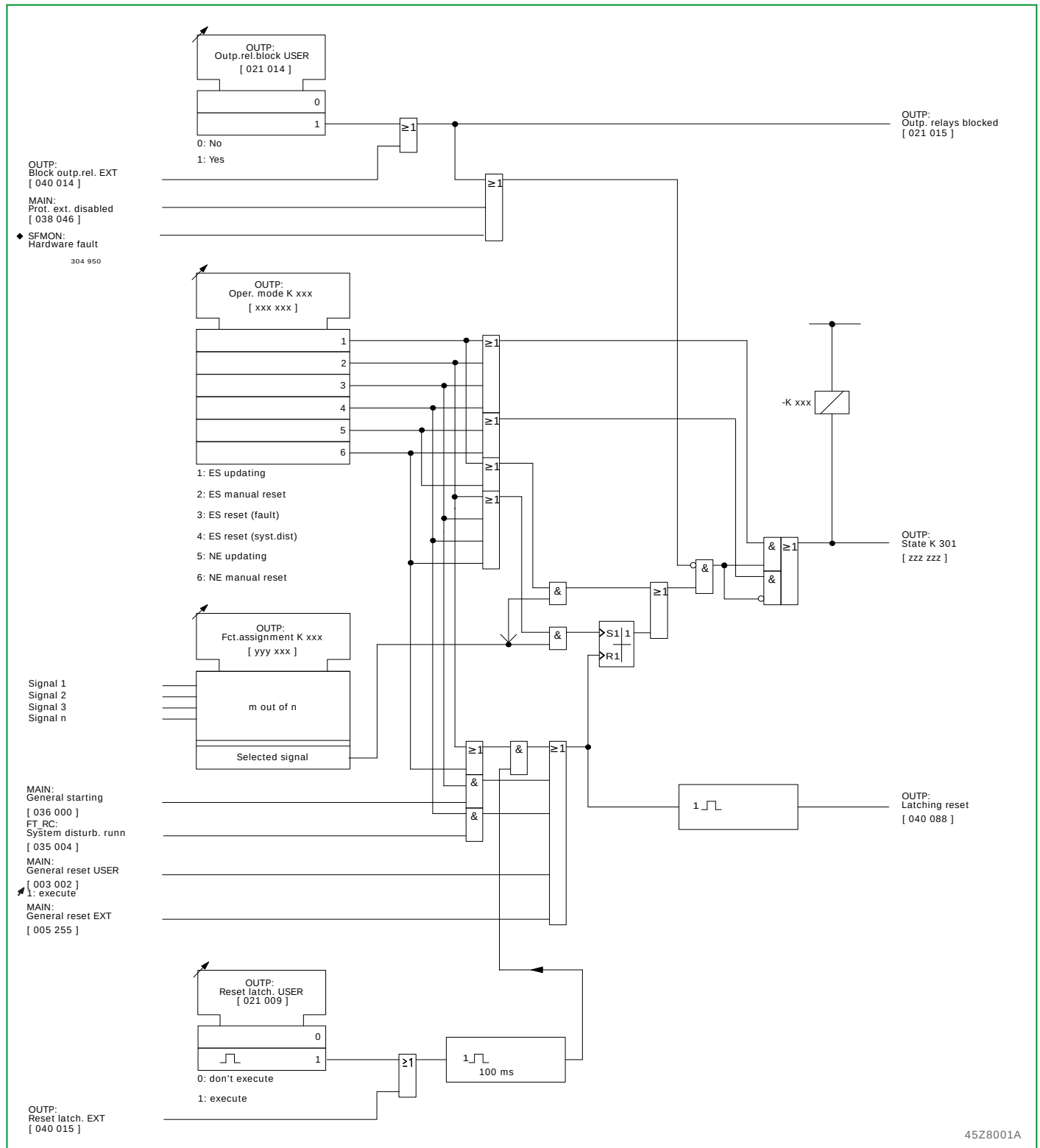


Fig. 3-40: Configuration, setting the operating mode, and blocking the output relays.

Testing the Output Relays

For testing purposes, the user can select an output relay and trigger it via setting parameters. Therefore the P433 must be switched to “off-line”. Triggering persists for the duration of the set hold time.

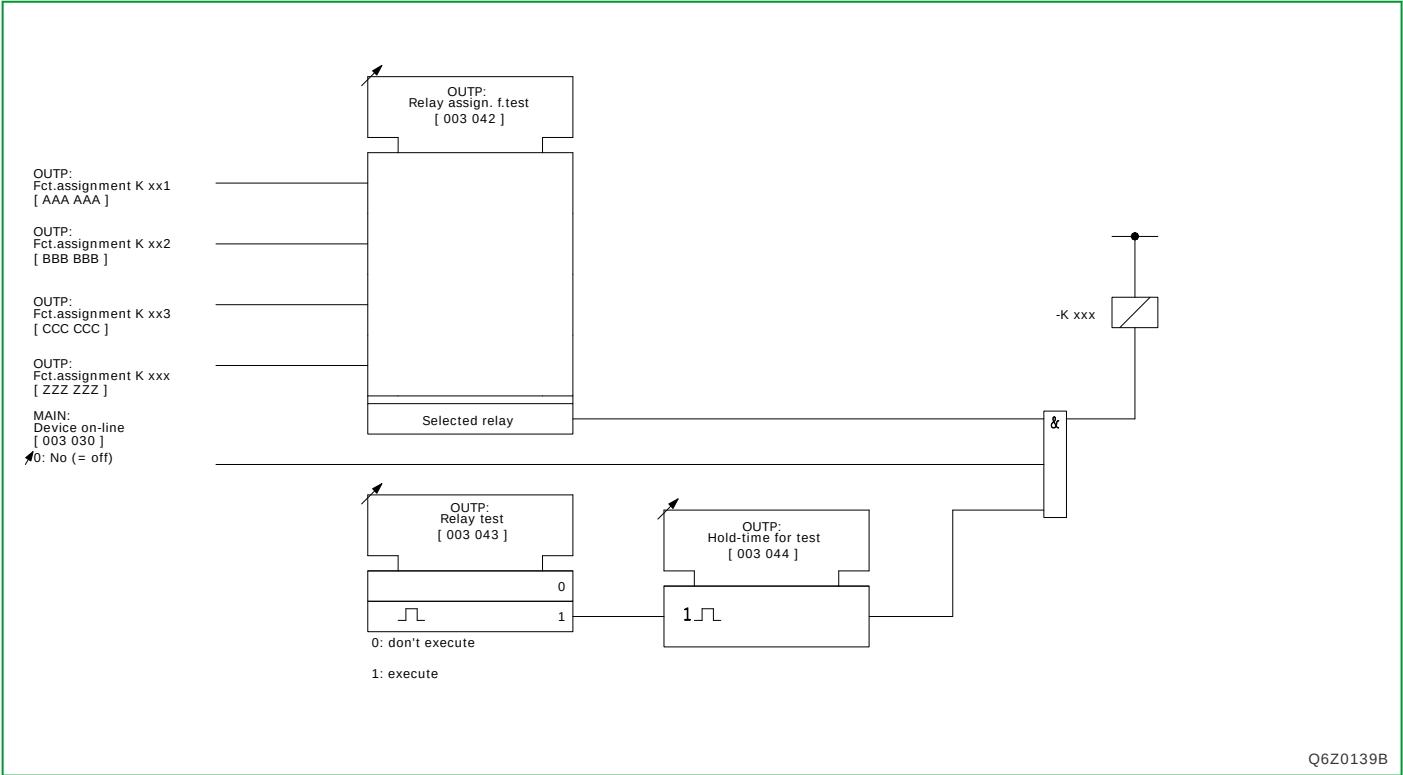


Fig. 3-41: Testing the output relays.

3.11 Measured Data Output (Function Group MEASO)

Measurands made available by the P433 can be provided in BCD (binary coded decimal) form through output relays or in analog form as direct current output. Output as direct current can only occur if the P433 is equipped with analog module Y. BCD output is always possible, whether the P433 is equipped with analog module Y or not.

3.11.1 General Settings

3.11.1.1 Disabling or Enabling the Measured Data Output Function

The Measured Data Output function can be disabled or enabled via setting parameters.

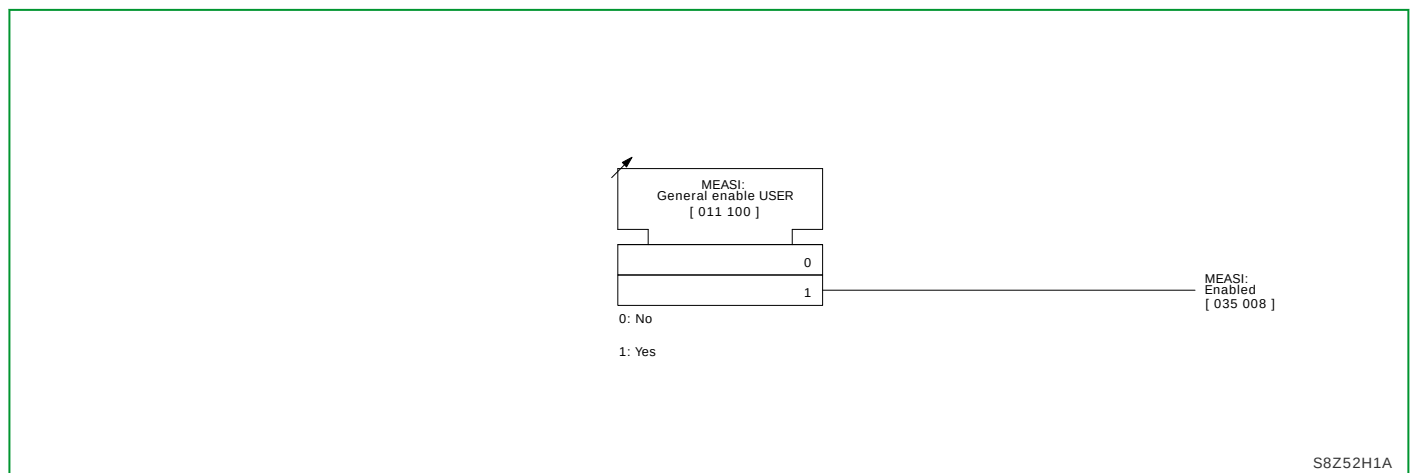


Fig. 3-42: Disabling or enabling the measured data output function.

3.11.1.2 Enabling Measured Data Output

The measured data output can be enabled through a binary signal input, provided that the function MEASO: Outp. enabled EXT has been configured. If the function MEASO: Outp. enabled EXT has not been configured to a binary signal input, then the measured data output is always enabled.

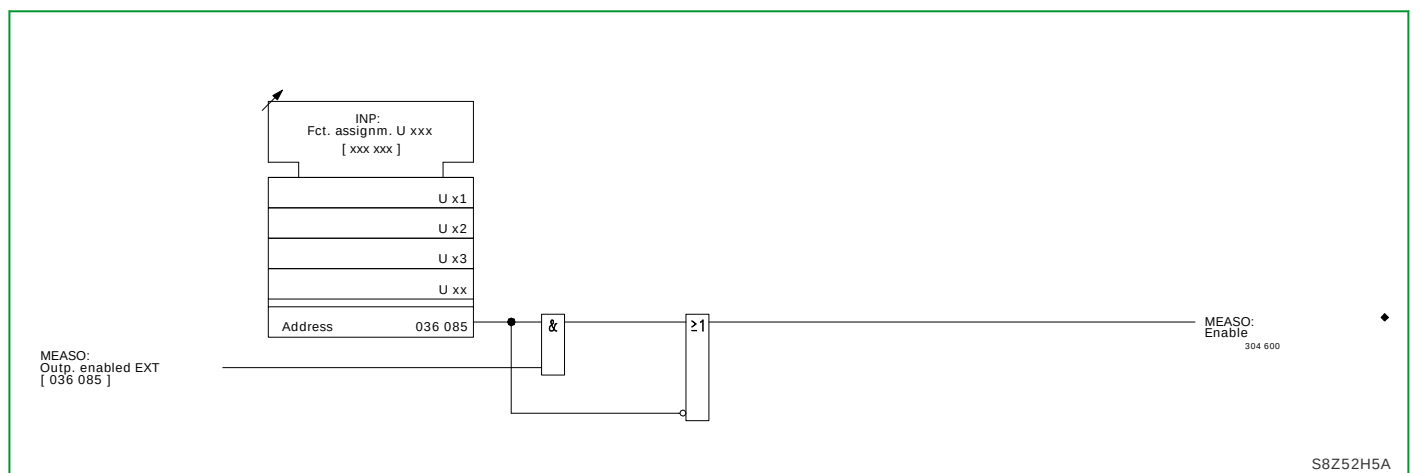


Fig. 3-43: Enabling measured data output.

3.11.1.3 Resetting the Measured Data Output Function

BCD or analog output of measurands is terminated for the duration of the hold time if one of the following conditions is met:

- The measured data output function is reset from the integral local control panel or through an appropriately configured binary signal input.
- There is a general reset.
- LED indicators reset

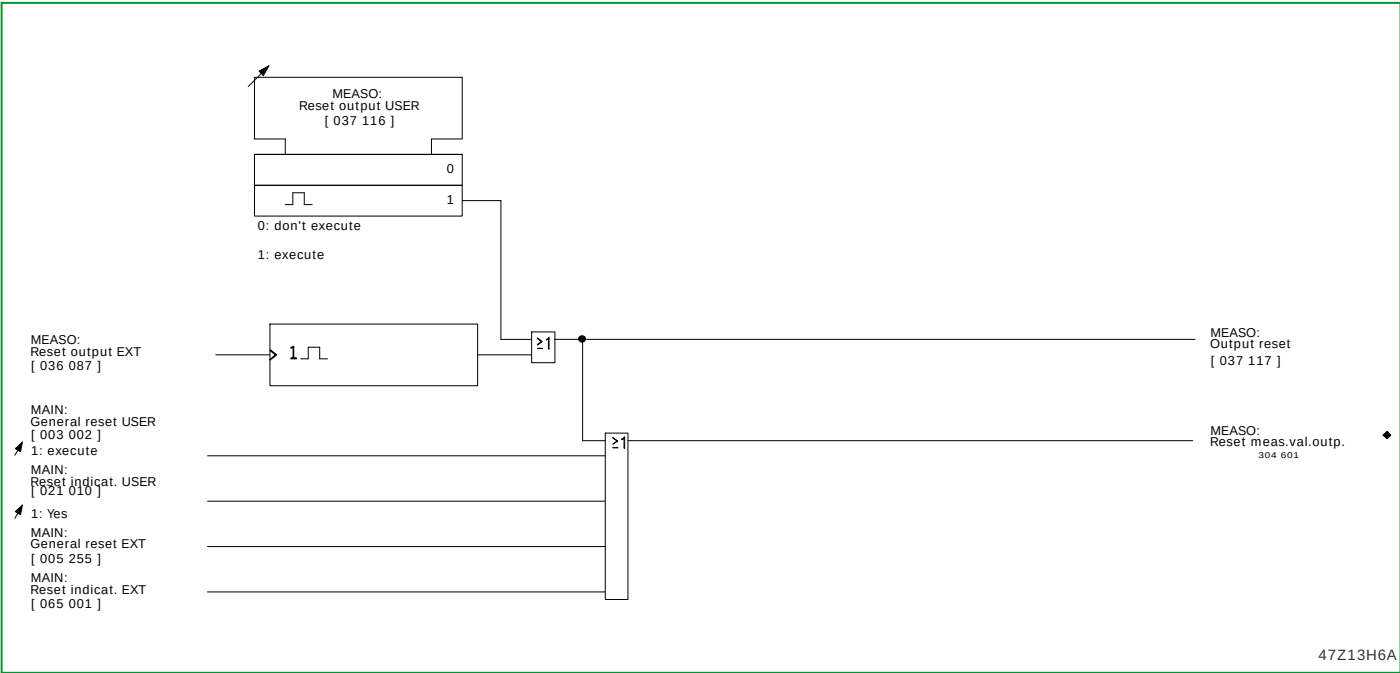


Fig. 3-44: Resetting the measured data output function.

3.11.1.4 Scaling

Scaling is used to map the physical measuring range to the P433 inherent setting range.

Scaling of analog output is also suited for directional-signed output of some fault measurands, in particular fault location in percent.

3.11.2 BCD Measured Data Output

The user can select a measurand for output in BCD form by assigning output relays.

The selected measurand is available in BCD-coded form for the duration of the set hold time MEASO: Hold time output BCD. If the selected variable was not measured, then there is no output of a measurand value.

3.11.2.1 Output of Measured Event Values

If the measured event value is updated during the hold time, the measurand output memory is cleared and the hold time is re-started. This leads to an immediate availability at the output of the updated value.

3.11.2.2 Output of Measured Operating Values

The selected measured operating value is available for the duration of the set hold time. After the hold time has elapsed, the current value is saved and the hold time is re-started. If the hold time has been set to *blocked*, the measured operating value that has been output will be stored until the measured data output function is reset.

3.11.2.3 Scaling of BCD Output

In order to define the resolution for measured data output the measurand range (Mx,min ... Mx,max) in scaled form (as Mx,scal,min ... Mx,scal,max) and the associated BCD display range (BCD,min ... BCD,max) have to be set.

- MEASO: Scaled min. val. BCD
- MEASO: Scaled max. val. BCD
- MEASO: BCD-Out min. value
- MEASO: BCD-Out max. value

The BCD display range should be set so that the value 399 is never exceeded. If this should occur or if the measurand is outside the acceptable measuring range, then the value for "Overflow" (all relays triggered) is transmitted.

Measurands	Range
Measurands of the variable Mx	Mx,RL1 ... Mx,RL2
Associated scaled measurands	0 ... 1

Scaling is made with reference to the complete range of values for the selected measurand (variable Mx). The complete range of values is defined by their end values Mx,RL1 and Mx,RL2. (Mx,RL1 and Mx,RL2 are listed in the operating program - Easergy Studio - under "minimum" and "maximum".)

Measurands to be output	Range
Measurands to be output	Mx,min. ... Mx,max.
Scaled measurands to be output	Mx,scal,min ... Mx,scal,max with: $Mx,scal,min = (Mx,min - Mx,RL1) / (Mx,RL2 - Mx,RL1)$ $Mx,scal,max = (Mx,max - Mx,RL1) / (Mx,RL2 - Mx,RL1)$
Designation of the set values in the data model	"Scaled min. val. BCD" ... "Scaled max. val. BCD"

Measurands	BCD display values
Measurands in the range "Measurands to be output"	<i>BCD-Out min. value ... BCD-Out max. value</i> (Valid BCD value)
Measurands: Mx,RL1 = Mx = Mx,min	<i>BCD-Out min. value</i> (BCD value not valid)
Measurands Mx: Mx,max = Mx = Mx,RL2	<i>BCD-Out max. value</i> (BCD value not valid)
Measurands Mx: Mx < Mx,RL1 or Mx > Mx,RL2	<i>BCD-Out max. value</i> (Overflow)

3.11.2.4 Example for Scaling of BCD Output

The value range for the fault measurand is set from -320.00% to +320.00%.

The PU fault location is given in the range from 0% to 200%.

Measurands	Range
Fault measurand: FT_DA: Fault locat. percent	-320.00% ... +320.00%
Associated scaled measurands	0 ... 1

Measurands to be output	Range
Measurands to be output	0% ... 200%
Scaled measurands to be output	0.5 ... 0.813 with: $0.500 = 320/640$ $0.813 = 520/640$

Measurands	BCD display values
Measurands in the range “Measurands to be output”	0 ... 200

In this example the following P433 settings are selected:

Address	Description	Current value
056 020	MEASO: Function group MEASO	<i>With</i>
031 074	MEASO: General enable USER	Yes
053 002	MEASO: Fct. assignm. BCD	FT_DA: Fault locat. percent
010 010	MEASO: Hold time output BCD	1.00 s
037 140	MEASO: Scaled min. val. BCD	0.500
037 141	MEASO: Scaled max. val. BCD	0.813
037 142	MEASO: BCD-Out min. value	0
037 143	MEASO: BCD-Out max. value	200

The following figure displays the values output as a function of the fault location. The BCD value and the signal MEASO: Valid BCD value = Yes are only issued in the value range 0% to 200%.

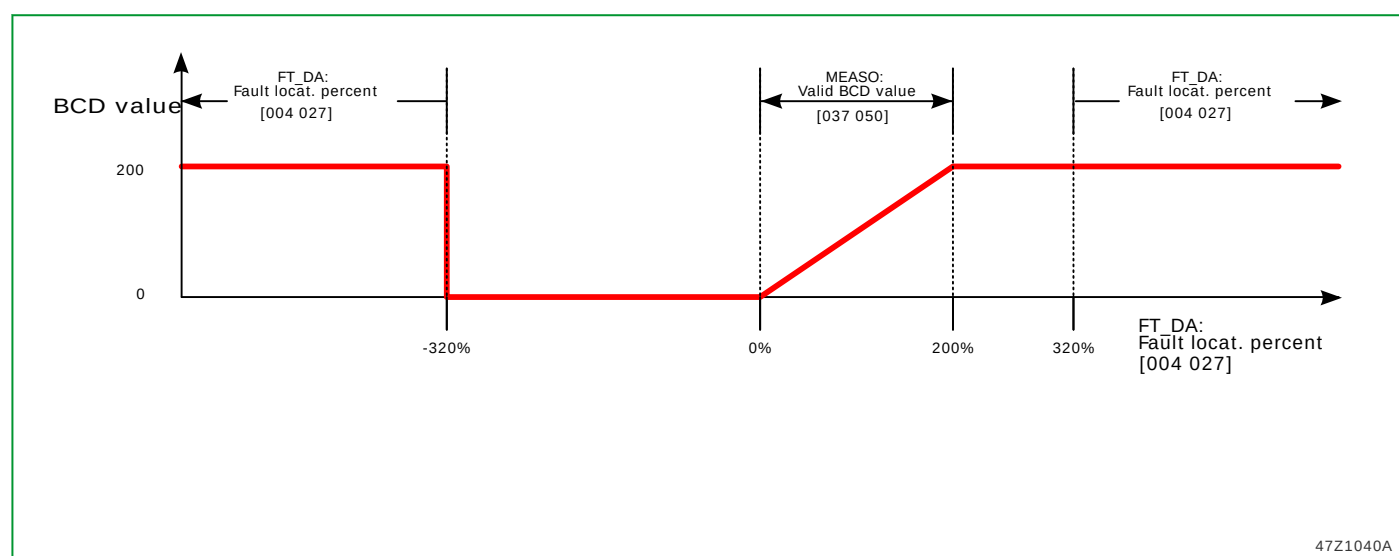


Fig. 3-45: Example of BCD output of fault location.

Except from radial, single circuit lines the fault location value gives a reasonable value only for faults up to the line end. For any fault on a subsequent line the fault location is more or less incorrect due to unknown fault current infeed in the remote substation.

It is recommended to limit the calculation of a fault location to a practical and sensible range on the line by setting FT_DA: Outp. flt.locat. PSx = Only aft.tr.t1/t1,ze.

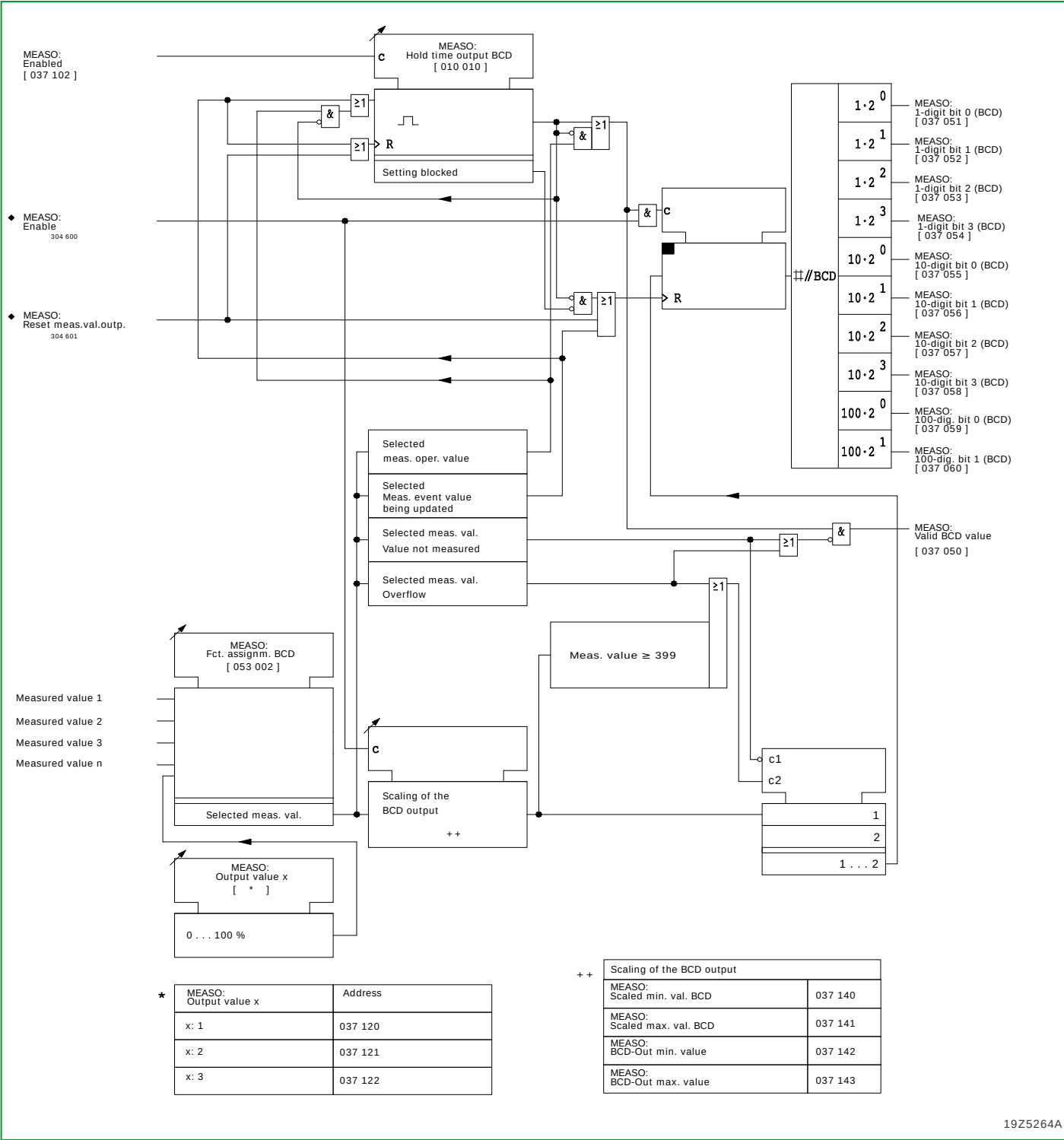


Fig. 3-46: BCD measured data output. Overflow behavior is displayed in BCD example (see previous figure).

3.11.3 Analog Measured Data Output

Analog output of measured data is two-channel.

The user can select two of the measurands available in the P433 for output in the form of load-independent direct current. Three interpolation points per channel can be defined for specific adjustments such as adjustment to the scaling of a measuring instrument. The direct current that is output is displayed as a measured operating value.

The selected measurand is output as direct current for the duration of the set hold time MEASO: Hold time output A-1. If the selected variable was not measured, then there is no output of a measurand value.

3.11.3.1 Output of Measured Event Values

If the measured event value is updated during the hold time, the measurand output memory is cleared and the hold time is re-started. This leads to an immediate availability at the output of the updated value.

3.11.3.2 Output of Measured Operating Values

The selected measured operating value is available for the duration of the set hold time. After the hold time has elapsed, the current value is saved and the hold time is re-started. If the hold time has been set to *blocked*, the measured operating value that has been output will be stored until the measured data output function is reset.

3.11.3.3 Configuration of Output Relays Assigned to the Output Channels

The user must keep in mind that direct current output only occurs when the output relays assigned to the output channels are configured for MEASO: Value A-1 output, since the output channels would otherwise remain short-circuited (see the terminal connection diagrams, [Section 5.7, \(p. 5-32\)](#)).

3.11.3.4 Scaling the Analog Display

In order to define the resolution for measured data output the measurand range in scaled form and the associated display range have to be set. One additional value for the knee point must also be defined. In this way the user can obtain an analog output characteristic similar to the characteristic shown in [Fig. 3-47, \(p. 3-83\)](#).

3.11.3.5 Measurand Range to be Output

The measurand range to be output is (Mx,min ... Mx,knee ... Mx,max), with:

- Mx,min: minimum value to be output
- Mx,knee: Knee-point value for the measurand range to be output
- Mx,max: maximum value to be output

This measurand range to be output is defined by setting the following parameters:

- MEASO: Scaled min. val. A-1 or MEASO: Scaled min. val. A-2, resp.
- MEASO: Scaled knee val. A-1 or MEASO: Scaled knee val. A-2, resp.
- MEASO: Scaled max. val. A-1 or MEASO: Scaled max. val. A-2, resp.

Scaling is made with reference to the complete range of values for the selected measurand (variable Mx). The complete range of values is defined by their end

values $M_{x,RL1}$ and $M_{x,RL2}$. ($M_{x,RL1}$ and $M_{x,RL2}$ are listed in the operating program – Easergy Studio – under “minimum” and “maximum”.)

Measurands	Range
Measurands of the variable M_x	$M_{x,RL1} \dots M_{x,RL2}$
Associated scaled measurands	0 ... 1

Measurands to be output	Range
Measurands with knee-point to be output	$M_{x,min} \dots M_{x,knee} \dots M_{x,max}$
Scaled measurands with a scaled knee-point to be output	$M_{x,scal,min} \dots M_{x,scal,knee} \dots M_{x,scal,max}$ with: $M_{x,scal,min} = (M_{x,min} - M_{x,RL1}) / (M_{x,RL2} - M_{x,RL1})$ $M_{x,scal,knee} = (M_{x,knee} - M_{x,RL1}) / (M_{x,RL2} - M_{x,RL1})$ $M_{x,scal,max} = (M_{x,max} - M_{x,RL1}) / (M_{x,RL2} - M_{x,RL1})$
Designation of the set values in the data model	"Scal. min. value A_x " "Scal. knee-point A_x " ... "Scaled max. val. A_x "

3.11.3.6

Associated Display Range

The associated display range is defined by setting the following parameters:

- MEASO: AnOut min. val. A-1 or MEASO: AnOut min. val. A-2, resp.
- MEASO: AnOut knee point A-1 or MEASO: AnOut knee point A-2, resp.
- MEASO: AnOut max. val. A-1 or MEASO: AnOut max. val. A-2, resp.

Measurands	Analog display values
Measurands in the range "Measurands to be output"	"AnOut min. val. A_x " "AnOut knee point A_x " "AnOut max. val." (Value A_x valid)
Measurands: $M_{x,RL1} = M_x = M_{x,min}$	"AnOut min. val." (Value A_x not valid)
Measurands M_x : $M_{x,max} = M_x = M_{x,RL2}$	"AnOut max. val." (Value A_x not valid)
Measurands M_x : $M_x < M_{x,RL1}$ or $M_x > M_{x,RL2}$	"AnOut max. val." (Overflow)

3.11.3.7

Example for Scaling of Analog Display Ranges

Voltage A-B is selected as the measurand to be transmitted by channel A-1.

The measuring range is from 0 to 1.5 V_{nom} with $V_{nom} = 100\text{ V}$.

The range to be transmitted is from 0.02 to 1 V_{nom} with the associated display range from 4 mA to 18 mA.

The knee-point of the characteristic is 0.1 V_{nom} with an associated display of 16 mA.

Measurands	Range
Measurands of the variable Mx	0 V ... 150 V
Associated scaled measurands	0 ... 1

Measurands to be output	Range
Measurands with knee-point to be output	2 V ... 10 V ... 100 V
Associated scaled measurands	0.013 ... 0.067 ... 0.67 with: $M_{x,scal,min} = (2\text{ V} - 0\text{ V}) / (150\text{ V} - 0\text{ V}) = 0.013$ $M_{x,scal,knee} = (10\text{ V} - 0\text{ V}) / (150\text{ V} - 0\text{ V}) = 0.067$ $M_{x,scal,max} = (100\text{ V} - 0\text{ V}) / (150\text{ V} - 0\text{ V}) = 0.67$

Measurands	Analog display values
Measurands in the range "Measurands to be output" 0.02 ... 0.1 V_{nom} ... 1 V_{nom}	4 mA ... 16 mA ... 18 mA

In this example the following P433 settings are selected in the menu branch Parameter/Config. parameters:

Address	Description	Current value
056 020	MEASO: Function group MEASO	<i>With</i>
031 074	MEASO: General enable USER	Yes
053 000	MEASO: Fct. assignm. A-1	MAIN: Voltage A-B p.u.
010 114	MEASO: Hold time output A-1	1.00 s
037 104	MEASO: Scaled min. val. A-1	0.013 (corresponds with 0.02 Vnom)
037 105	MEASO: Scaled knee val. A-1	0.067 (corresponds with 0.10 Vnom)
037 106	MEASO: Scaled max. val. A-1	0.667 (corresponds with 1.00 Vnom)
037 107	MEASO: AnOut min. val. A-1	4 mA
037 108	MEASO: AnOut knee point A-1	16 mA
037 109	MEASO: AnOut max. val. A-1	18 mA

By setting MEASO: AnOut min. val. A-1, the user can specify the output current that will be output when values are smaller than or equal to the set minimum measured value to be transmitted. The setting at MEASO: AnOut max. val. A-1 defines the output current that is output for the maximum measured value to be transmitted. By defining the knee-point, the user can obtain two characteristic curve sections with different slopes. When entering this setting the user must keep in mind that only a rising/rising or falling/falling curve sense is permitted (peaky or vee shapes not allowed). If the setting was not properly entered, the signal SFMON: Invalid scaling A-1 will be issued.

A check of the set characteristic and its acceptance by the P433, if the setting was properly entered, will only occur after the P433 is switched on-line again (with the setting MAIN: Device on-line).

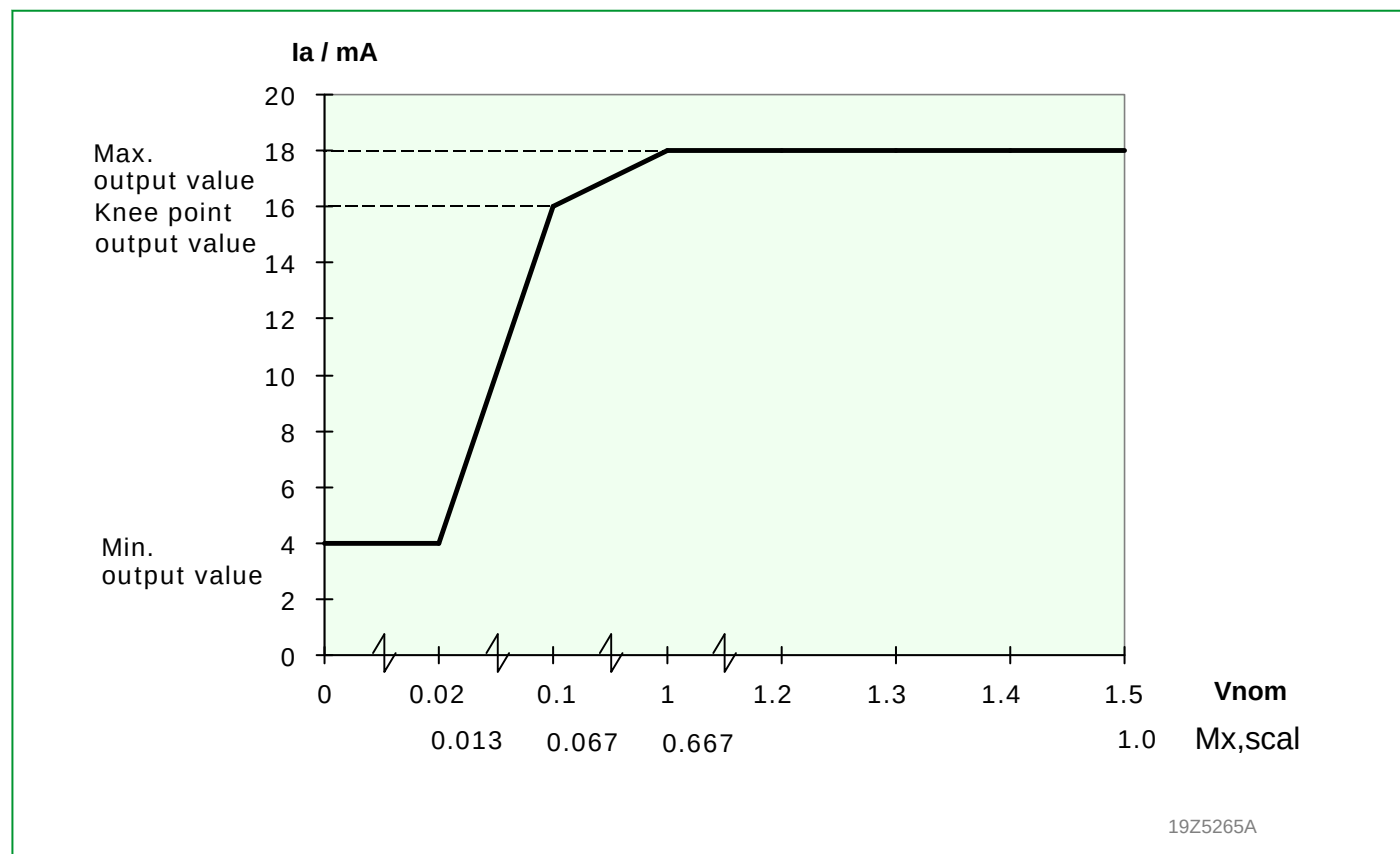
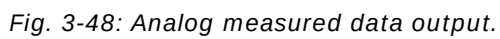


Fig. 3-47: Example of a characteristic curve for analog measured data output . In this example the range starting value is = 0; also possible is directional-signed output (see corresponding example in section BCD Measured Data Output).



3.11.4 Output of “External” Measured Data

Measured data from external devices, which must be scaled to 0 ... 100%, can be written to the following parameters of the P433 via the communications interface.

- MEASO: Output value 1
- MEASO: Output value 2
- MEASO: Output value 3

These “external” measured values are output by the P433 either in BCD data form or as load-independent direct current, provided that the BCD measured data output function or the channels of the analog measured data output function are configured accordingly.

3.12 Configuration and Operating Mode of the LED Indicators (Function Group LED)

The P433 has LED indicators for the indication of binary signals. Some of the LED indicators are permanently assigned to fixed functions. The other LED indicators are freely configurable. These freely configurable LEDs will emit either red or green or amber light (amber is made up of red and green light and may not be configured independently).

3.12.1 Layout of the LED Indicators

The following figures illustrate the layout of LED indicators situated on the local control panel.

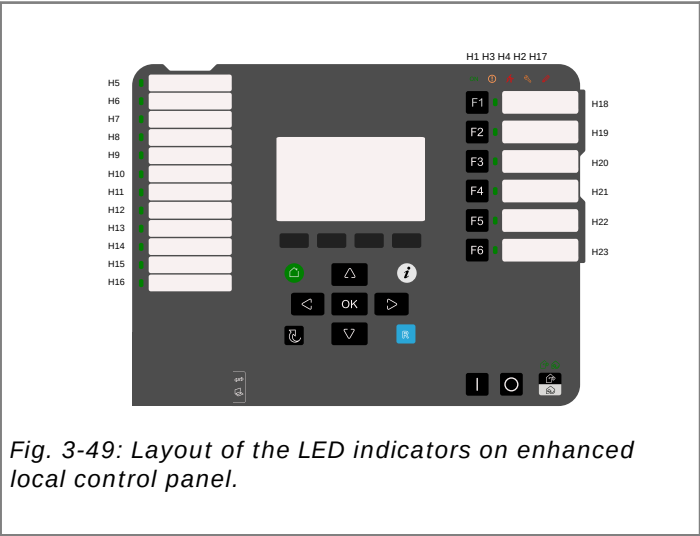


Fig. 3-49: Layout of the LED indicators on enhanced local control panel.

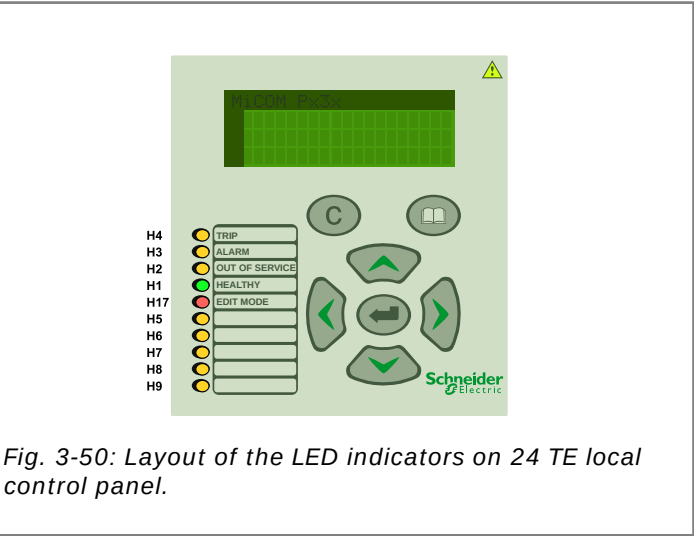


Fig. 3-50: Layout of the LED indicators on 24 TE local control panel.

3.12.2 Configuring the LED Indicators

One binary signal can be assigned to each of the red and green LED color indications. The same binary signal can be assigned to several LED indicators (or colors), if required.

LED indicator	Description	Configuration
H 1 (green)	HEALTHY	Not configurable. H 1 indicates the operational readiness of the P433 (supply voltage is present).
H 3 (amber)	ALARM	Permanently configured with function SFMON: Warning (LED).
H 4 (red)	TRIP	With the P433 this LED indicator is customarily configured with function MAIN: Gen. trip signal, but the configuration may be modified.
H 4 (green)	—	Function assignment to this green LED indicator is freely configurable.
H 2 (amber)	OUT OF SERVICE	Permanently configured with function MAIN: Blocked/faulty.
H 17 (red)	EDIT MODE	Not configurable. H 17 indicates the input (edit) mode. Only when the P433 is in this mode, can parameter settings be changed by pressing the “Up” and “Down” keys. (See Section 6.2, (p. 6-2))
H 5 to H 16 H 18 to H 23	—	For each of these LED indicators both colors (red & green) may be configured freely and independently.
Local and Remote LEDs	Local/Remote status	Not configurable. These two LED indicators are for states of Remote (left LED with amber color), Local (right LED with red color) and Local&Remote (both LEDs).

3.12.3 Configuring the LED Indicators (24 TE case)

LED indicator	Label	Configuration
H 4 (red)	TRIP	The H1 to H4 and H17 LED indicators are similar to the enhanced local control panel.
H 4 (green)	—	
H 3 (amber)	ALARM	
H 2 (amber)	OUT OF SERVICE	
H 1 (green)	HEALTHY	
H 17 (red)	EDIT MODE	
H 5 to H 9	—	For each of these LED indicators both colors (red & green) may be configured freely and independently.

3.12.4 Operating Mode of the LED Indicators

For each of the freely configurable LED indicators, the operating mode can be selected separately. This setting will determine whether the LED indicator will operate either in energize-on-signal (ES) or normally-energized (NE) mode, whether it will be flashing and whether it will be in latching mode.

Latching is disabled, depending on the selected operating mode:

- either manually via setting parameters or by an appropriately configured binary signal input (see [Section 3.13.19, \(p. 3-134\)](#))
- or at the onset of a new fault, signaled by the onset of a general starting or of a new system disturbance.

Therefore there are eight operating modes available, which are built from combinations of the following components:

		updating	latching with manual reset
continuous (i.e. not flashing)	energize-on-signal (ES)	<i>ES updating</i>	<i>ES manual reset</i>
	normally-energized (NE)	<i>NE updating</i>	<i>NE manual reset</i>
flashing	energize-on-signal (ES)	<i>ES updating bl</i>	<i>ES manual reset bl</i>
	normally-energized (NE)	<i>NE updating bl</i>	<i>NE manual reset bl</i>

In addition to these there are the following 4 operating modes:

	energize-on-signal (ES) with reset after new fault	energize-on-signal (ES) with reset after new system disturbance
continuous (i.e. not flashing)	<i>ES reset (fault)</i>	<i>ES reset (syst.dist)</i>
flashing	<i>ES reset (fault) bl</i>	<i>ES rst (syst.dst) bl</i>

Finally, as the 13th operating mode, every LED (except the permanently configured ones, see [Section 3.12.3, \(p. 3-87\)](#)) can be set to the mode *ES Alarmunit*. This mode has the following flashing behavior:

- The LED starts flashing with the first starting of the signal that has been assigned to it.
The LED assumes the color that has been assigned via setting parameter. If both colors (red and green) have been configured to different signals, and these two signals both become active then the LED flashes in amber color.
- If an LED reset is executed and the configured signal is still active the LED changes to continuous light.
Important: If the LED was flashing in amber color then this color is kept, even if one of the two signals is no longer active.
- If all the configured signals are no longer active at the time of the LED reset, or become inactive at a later time, the LED goes out.
- If later, after the LED has gone out, any of the configured signals becomes active again then the LED starts flashing again (in the assigned color).
If both colors have been configured and the LED shines continuously in amber color, then it is possible that one of these two signals becomes inactive and active again whilst the other signal stays active all the time. In this case the LED starts flashing again with the starting of that signal. But since the LED permanently keeps the amber color it is no longer possible to tell the two signals from each other. Therefore general caution is recommended whenever two different signals are configured to an LED with this operating mode.

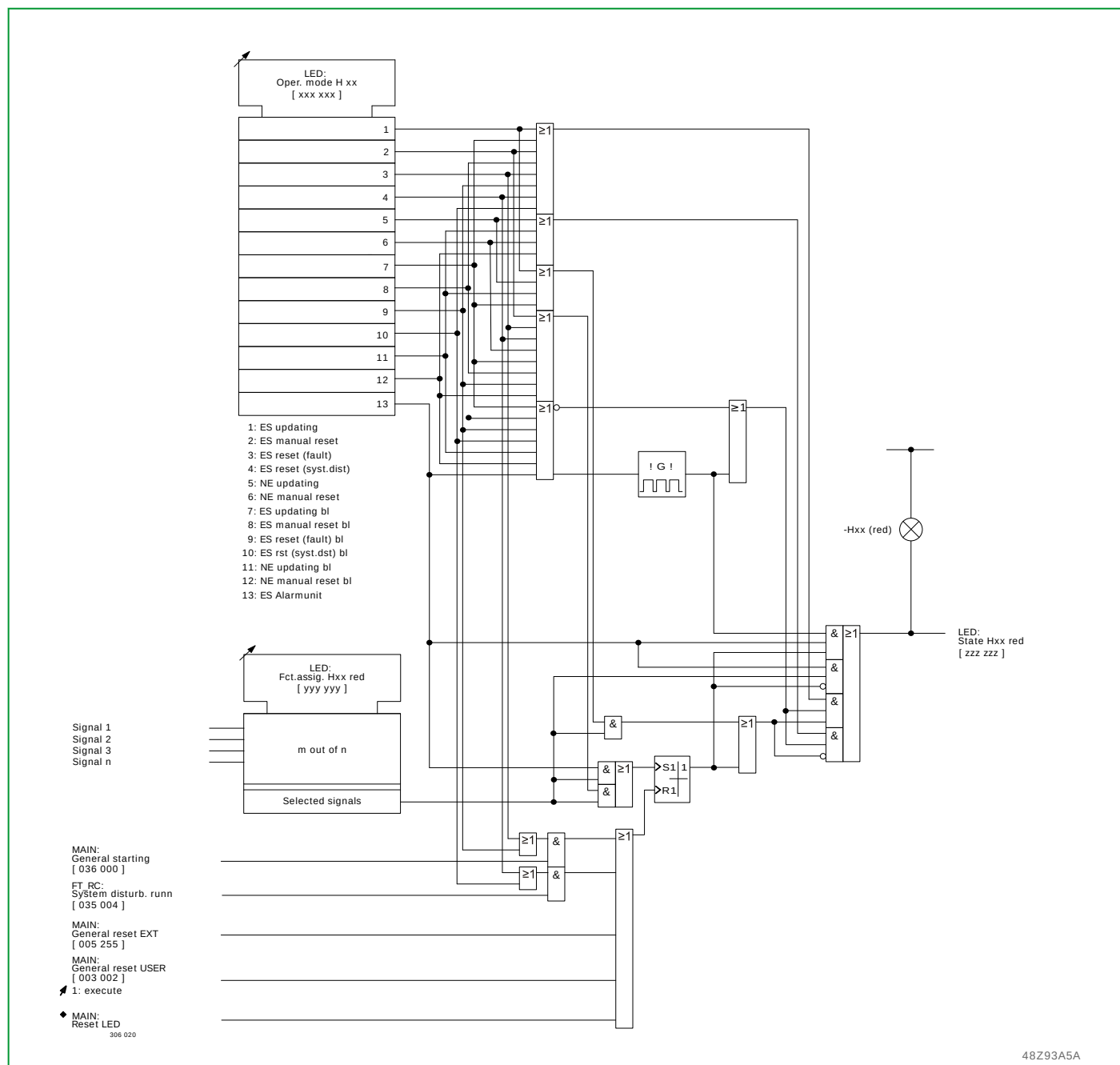


Fig. 3-51: Configuration and Operating Mode of the LED Indicators.

3.13 Main Functions of the P433 (Function Group MAIN)

3.13.1 Conditioning of the Measured Variables

The secondary phase currents of the system transformers are fed into the P433 and are – electrically isolated – converted to normalized electronics levels. Air-gap transformers are used in the phase current path to suppress low frequency (DC decays and offsets) signal components. The analog quantities are digitized and are thus available for further processing.

Settings that do not refer to nominal quantities are converted by the P433 to nominal quantities. The user must therefore set the secondary nominal currents and voltages of the system transformers.

The connection direction of the measuring circuits on the P433 must also be set. [Fig. 3-52, \(p. 3-92\)](#) shows the standard connection. By this setting the phase of the digitized currents is rotated by 180°.

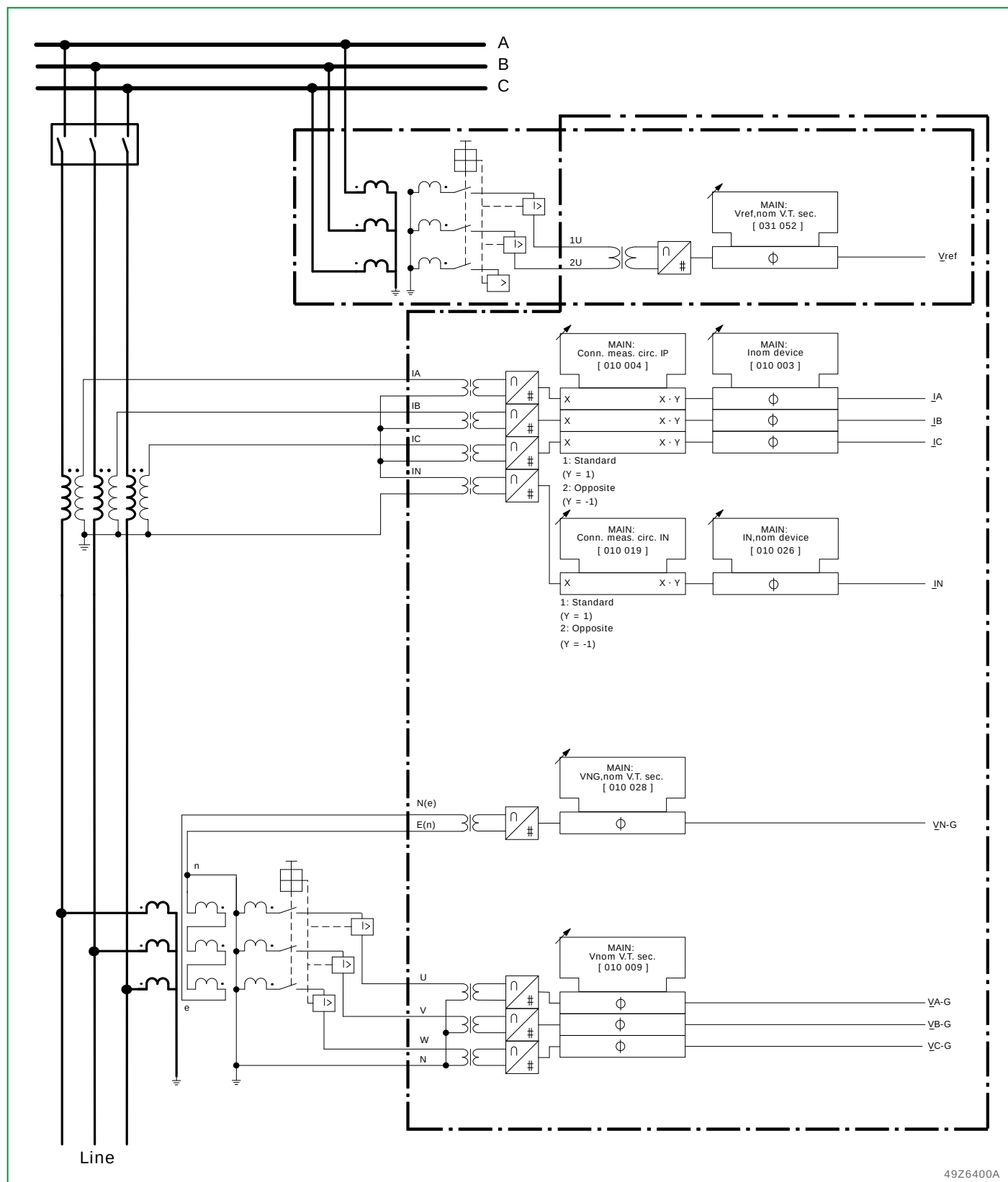


Fig. 3-52: Connecting the P433 measuring circuits.

3.13.2 Operating Data Measurement

The P433 has an operating data measurement function for the display of currents and voltages measured as well as quantities derived from these measured values. For the display of measured values, set lower thresholds need to be exceeded, to avoid fluctuating small values from noise. If these lower thresholds are not exceeded, the value *Not measured* is displayed. The following measured variables are displayed:

- Phase currents for all three phases
- Delayed and stored phase currents for all three phases – demand values for the three phases
- Minimum and maximum phase current
- Delayed and stored maximum phase current – maximum demand values
- Residual current measured by the P433 at the T 4 transformer, and calculated resultant current
- Calculated unfiltered resultant current
- Phase-to-ground voltages
- Sum of the three phase-to-ground voltages and neutral-point displacement voltage measured by the P433 at the T 90 transformer
- Reference voltage measured by the P433 at the T 15 transformer
- Phase-to-phase voltages
- Minimum and maximum phase-to-phase voltage and minimum and maximum phase-to-ground voltage
- Positive-sequence current and negative-sequence current (in units of I_{nom}), taking into account the set phase sequence
- Positive-sequence voltage and negative-sequence voltage (in units of V_{nom})
- Active, reactive and apparent power
- Active power factor
- Active and reactive energy output and input
- Load angle ϕ in all three phases
- Angle between measured residual current and measured neutral-point displacement voltage
- Phase relation between measured neutral current and calculated residual current (binary indication of equal or reverse phase)
- System frequency
- All three phase-to-phase impedances as primary and secondary values with magnitude and angle.

The measured data are updated at approx. 1 s intervals. Updating is interrupted if the self-monitoring function detects a hardware fault.

3.13.2.1

Measured Current Values

The measured current values are displayed both as per-unit quantities referred to the nominal quantities of the P433 and as primary quantities. To allow display in primary values, the primary nominal current of the system current transformer should be set in the P433.

Phase sequence A-B-C (clockwise rotating field)

- Negative-sequence current:

$$I_{\text{neg}} = \frac{1}{3} \cdot | (I_A + \underline{a}^2 \cdot I_B + \underline{a} \cdot I_C) |$$

- Positive-sequence current:

$$I_{\text{pos}} = \frac{1}{3} \cdot | (I_A + \underline{a} \cdot I_B + \underline{a}^2 \cdot I_C) |$$

Phase sequence A-C-B (anti-clockwise rotating field)

- Negative-sequence current:

$$I_{\text{neg}} = \frac{1}{3} \cdot | (I_A + \underline{a} \cdot I_B + \underline{a}^2 \cdot I_C) |$$

- Positive-sequence current:

$$I_{\text{pos}} = \frac{1}{3} \cdot | (I_A + \underline{a}^2 \cdot I_B + \underline{a} \cdot I_C) |$$

- Symbols used:

$$\underline{a} = e^{2\pi j/3} = e^{j \cdot 120^\circ}$$

$$\underline{a}^2 = e^{4\pi j/3} = e^{j \cdot 240^\circ}$$

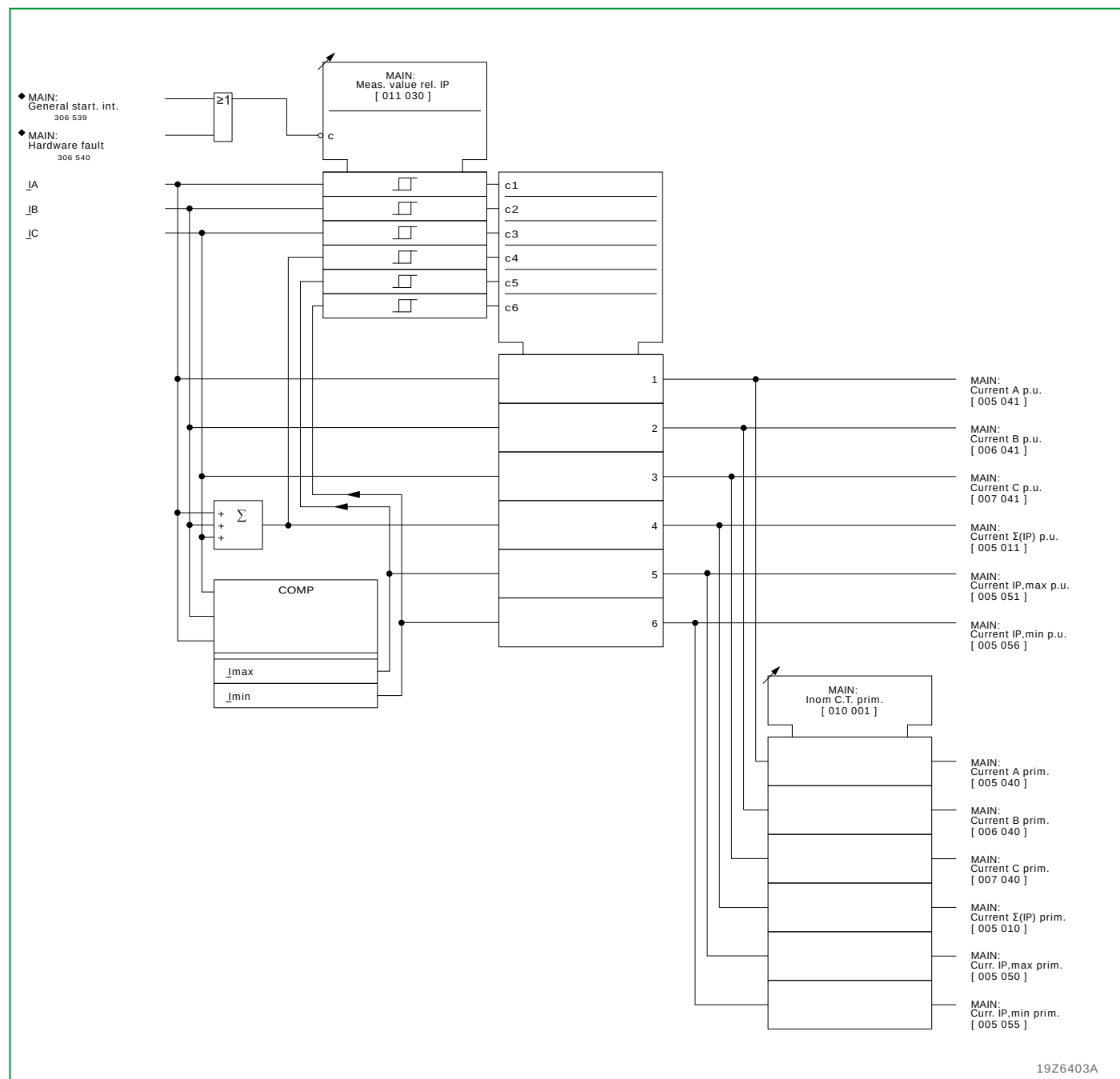


Fig. 3-53: Measured operating data - phase current, part 1.

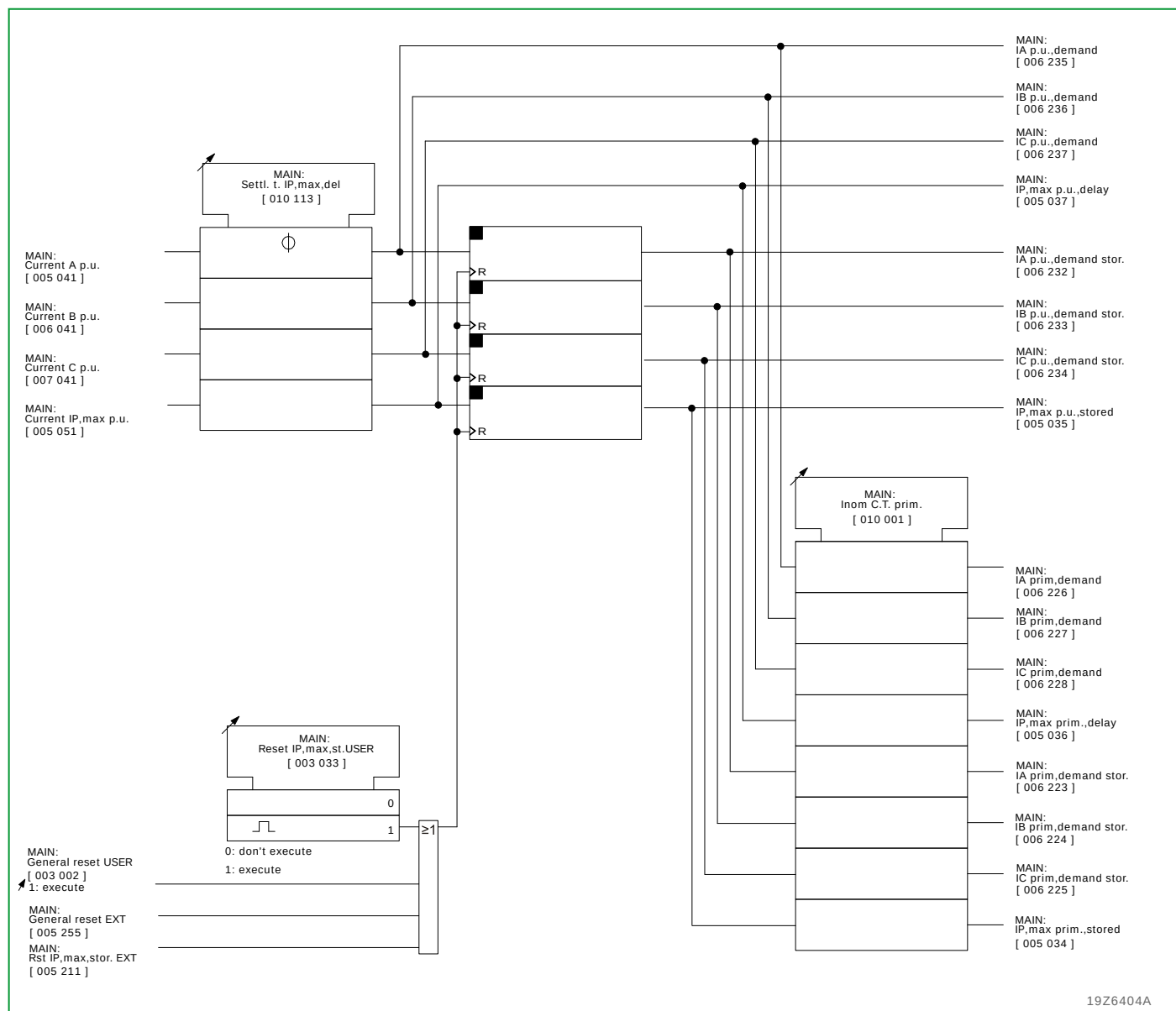


Fig. 3-54: Measured operating data - phase current, part 2: demand values (delayed and stored phase currents and maximum phase current).

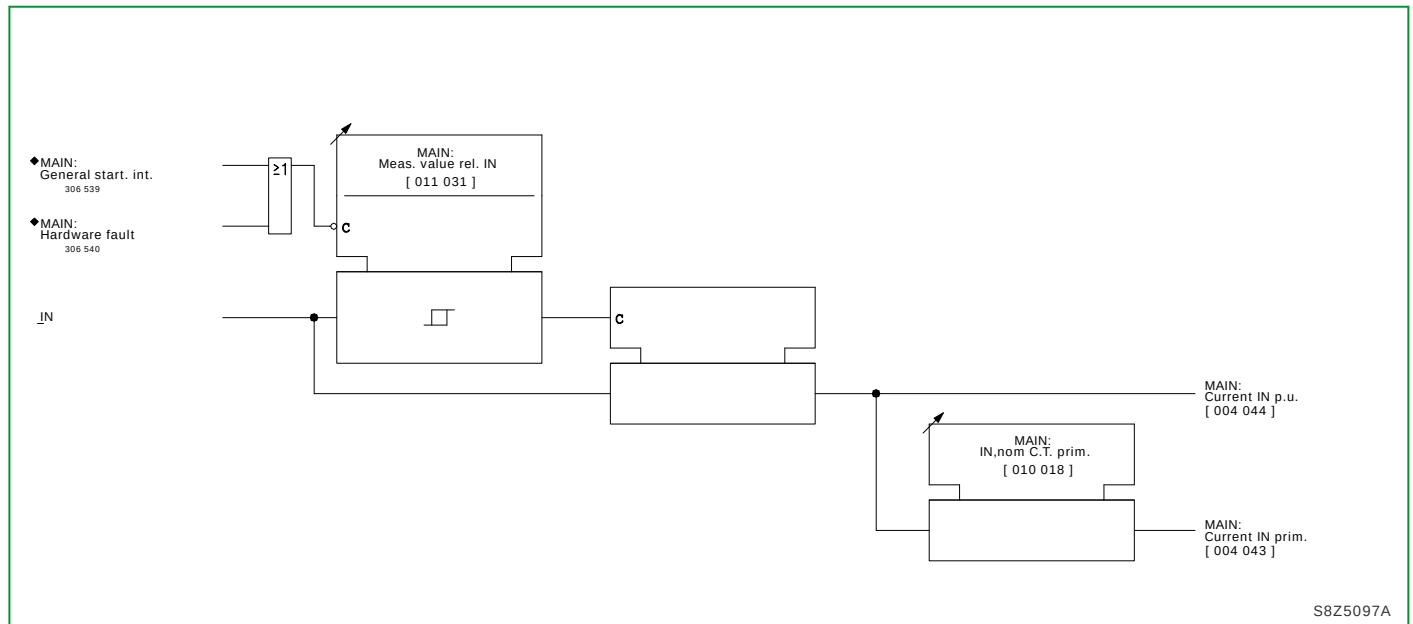


Fig. 3-55: Measured operating data - residual current.

3.13.2.2 Display of Demand Values – Delayed Maximum Phase Current

The P433 offers the option of a delayed display of the maximum value of the three phase currents (thermal ammeter function). The delayed maximum phase current display is an exponential function of the maximum phase current $I_{p,max}$ (see upper curve in Fig. 3-56, (p. 3-98)). The time after which the delayed maximum phase current display will have reached 95 % of maximum phase current $I_{p,max}$ is set at MAIN: SettI. t. $I_{p,max,del}$.

3.13.2.3 Display of Demand Values – Stored Maximum Phase Current

The stored maximum phase current follows the delayed maximum phase current. If the value of the delayed maximum phase current is declining, then the highest value of the delayed maximum phase current remains stored. The display remains constant until the actual delayed maximum phase current exceeds the value of the stored maximum phase current (see middle curve in Fig. 3-56, (p. 3-98)). The stored maximum phase current to the actual value of the delayed maximum phase current is set at MAIN: Reset $I_{p,max,st.USER}$ (see lower curve in Fig. 3-56, (p. 3-98)).

3.13.2.4 Display of Demand Values – Delayed and Stored Values of the Three Phase Currents

The P433 offers the option of a delayed display of the three phase currents. This functionality is equivalent to the display of the maximum value of the three phase currents (see description above, Fig. 3-56, (p. 3-98) and Fig. 3-54, (p. 3-96)). However, in this case, the delayed phase current display will have reached 90 % (not 95 %) of I_A , I_B or I_C , respectively, after the set delay.

The stored phase currents are implemented as for the stored maximum phase current.

The delay for these six operating data values is set at MAIN: SettI. t. $I_{p,max,del}$ as for the delayed maximum phase current.

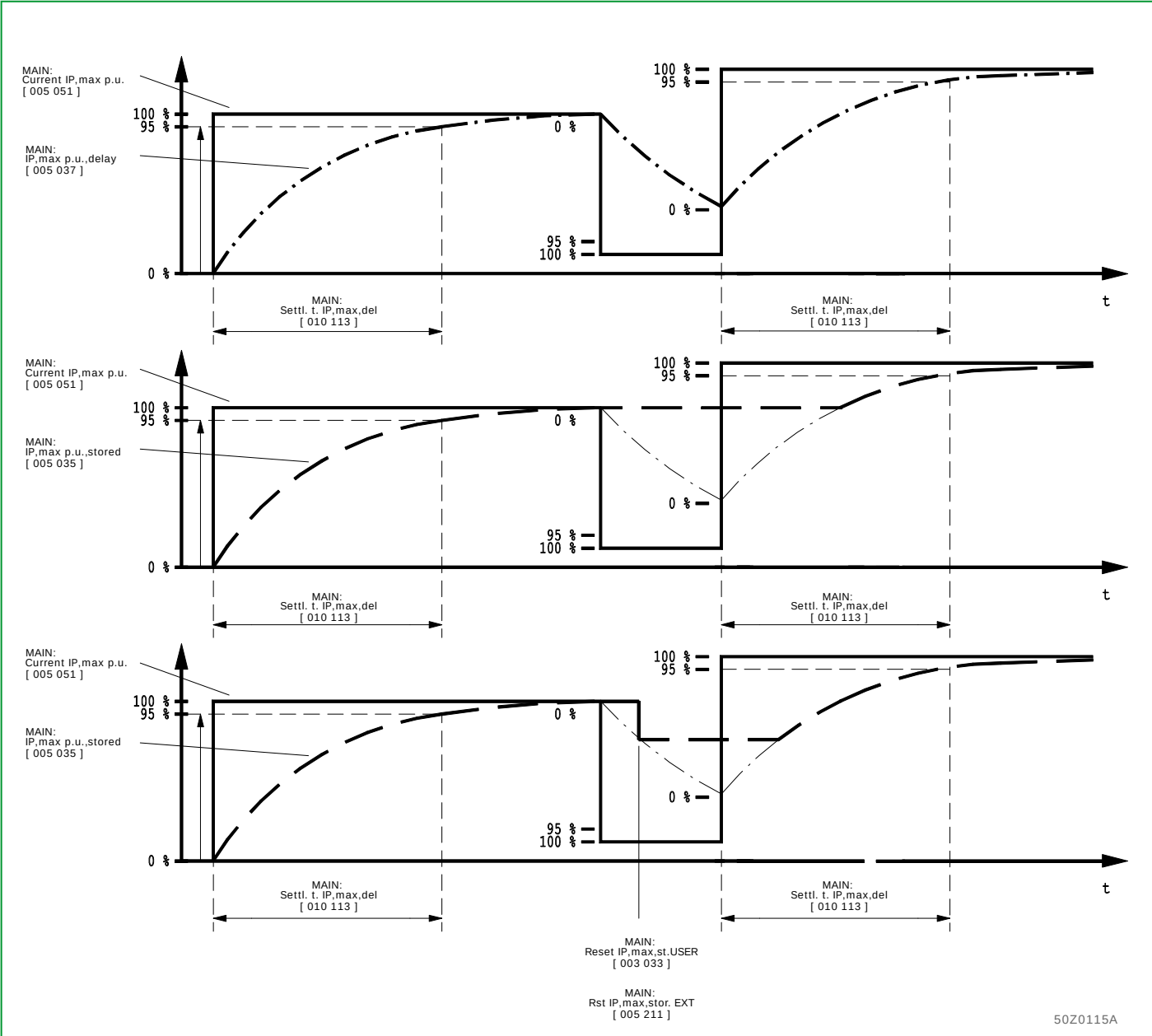


Fig. 3-56: Operation of delayed and stored maximum phase current display – display of demand values.

3.13.2.5 Measured Voltage Values

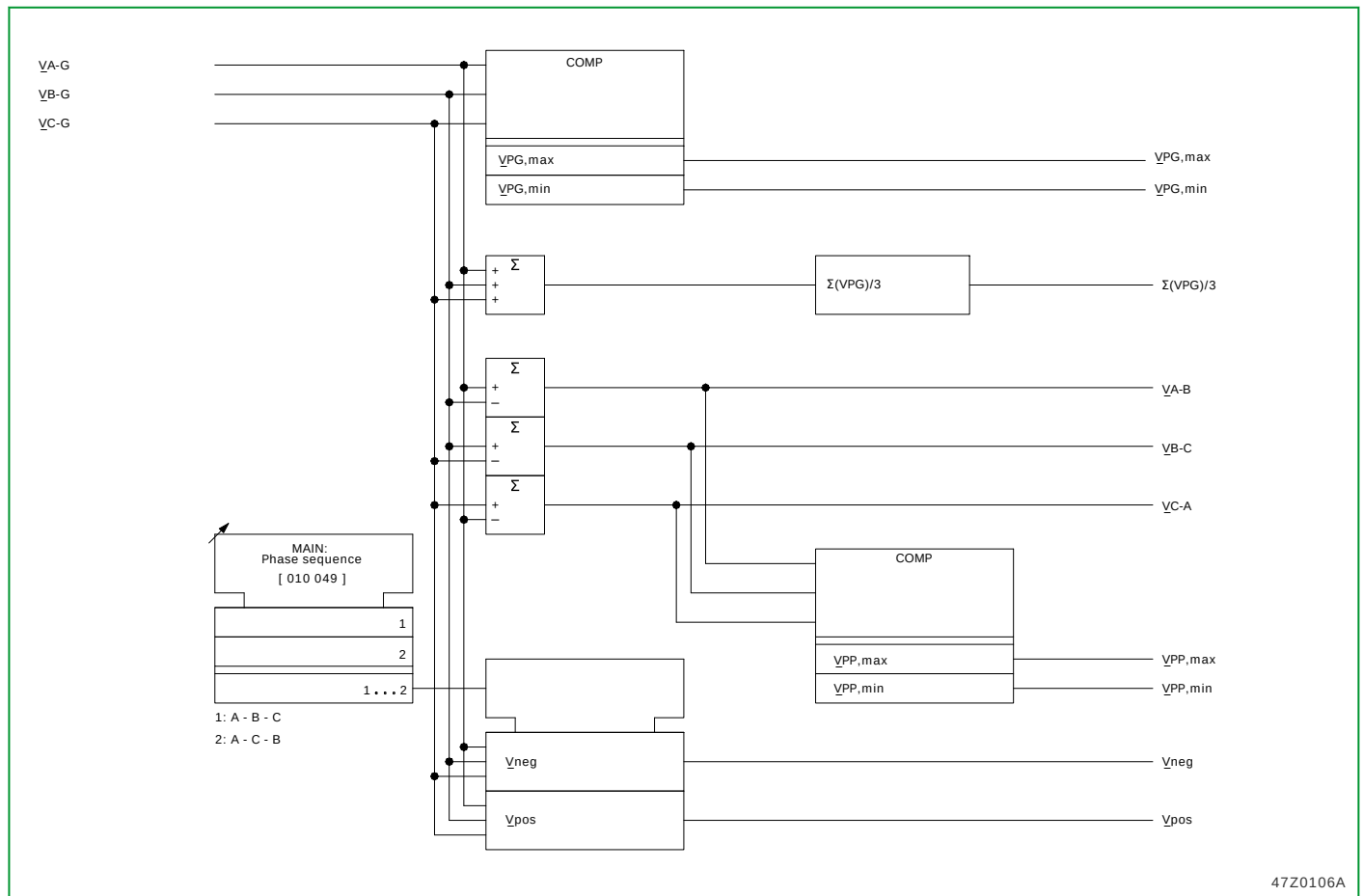


Fig. 3-57: Determining the minimum and maximum phase-to-ground and phase-to-phase voltages as well as the negative-sequence and positive-sequence voltages.

The measured voltage values are displayed both as per-unit quantities referred to the nominal quantities of the P433 and as primary quantities. To allow a display in primary values, the primary nominal voltage of the system transformer needs to be set in the P433.

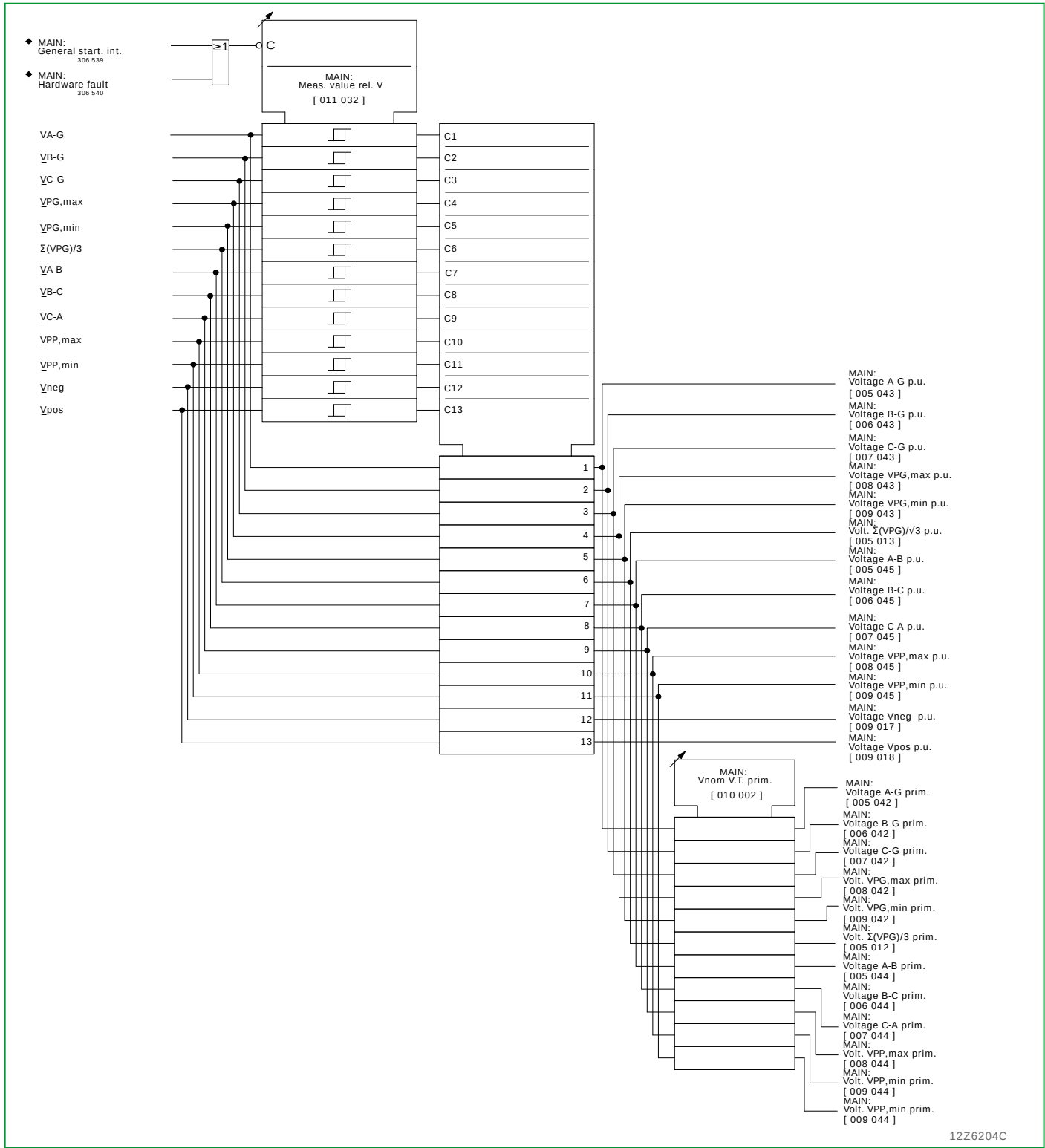


Fig. 3-58: Measured operating data – phase-to-ground and phase-to-phase voltages.

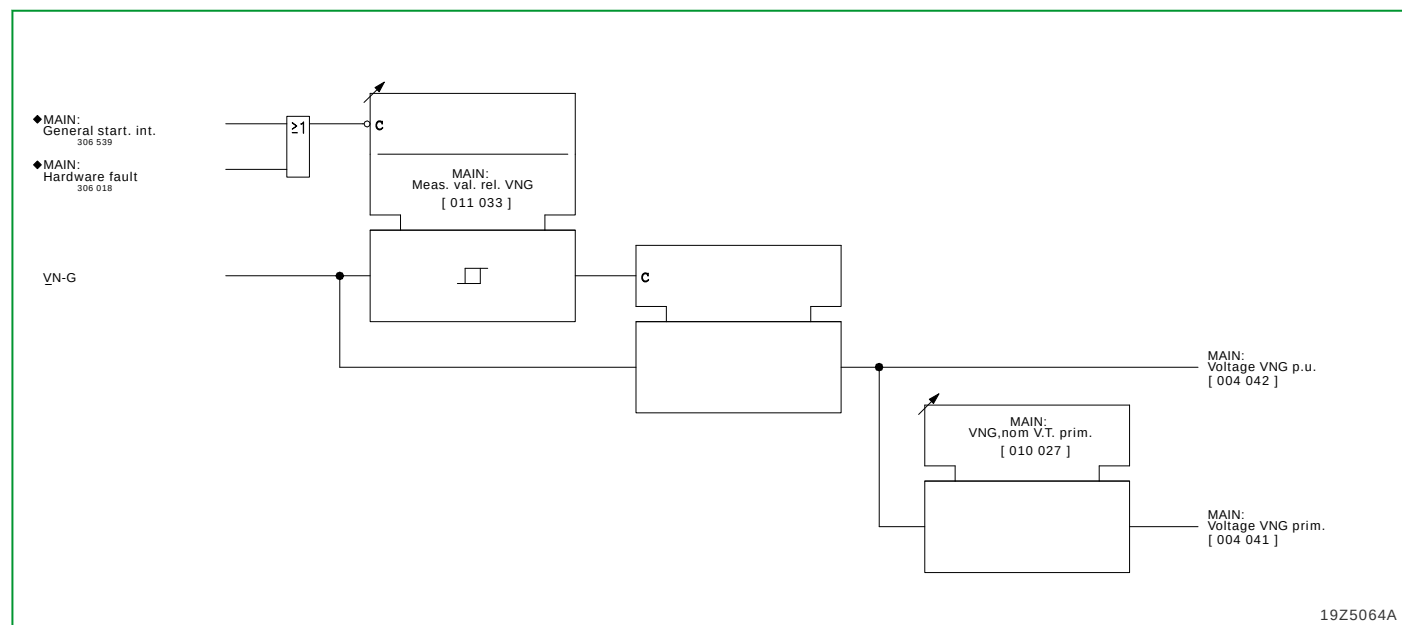


Fig. 3-59: Measured operating data – neutral-point displacement voltage.

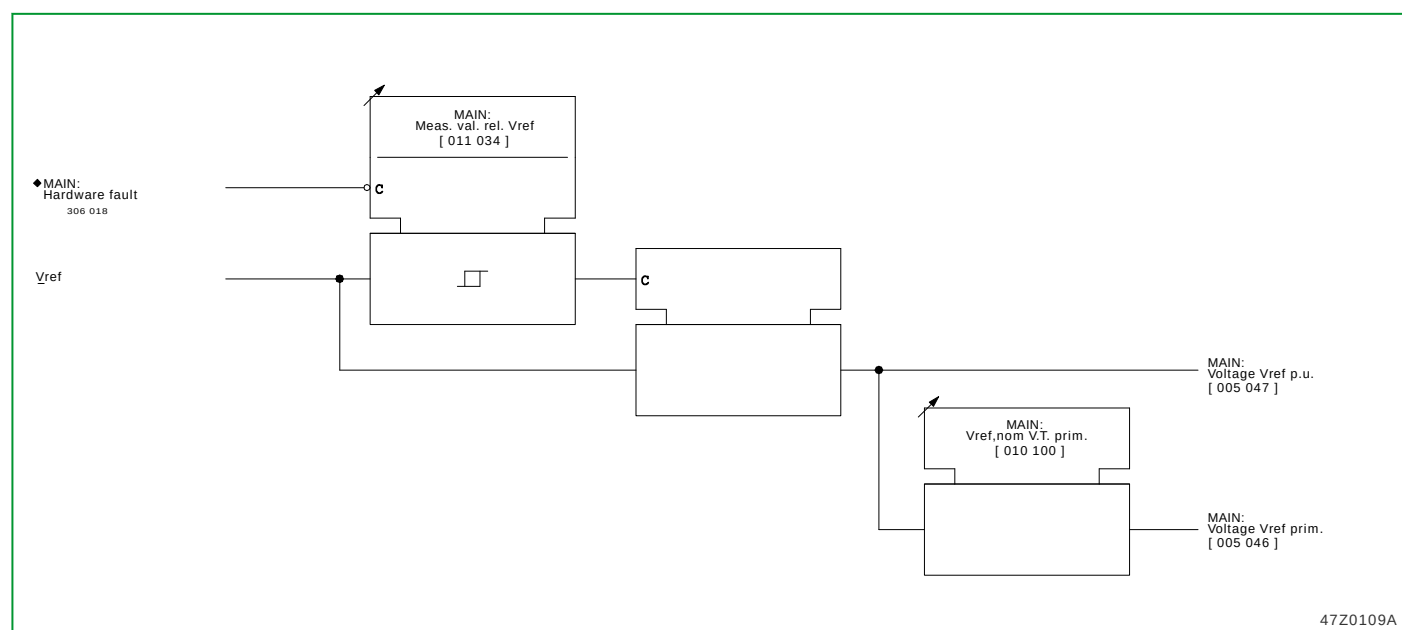


Fig. 3-60: Measured operating data – reference voltage.

3.13.2.6

Measured Values for Power, Active Power Factor, and Angle

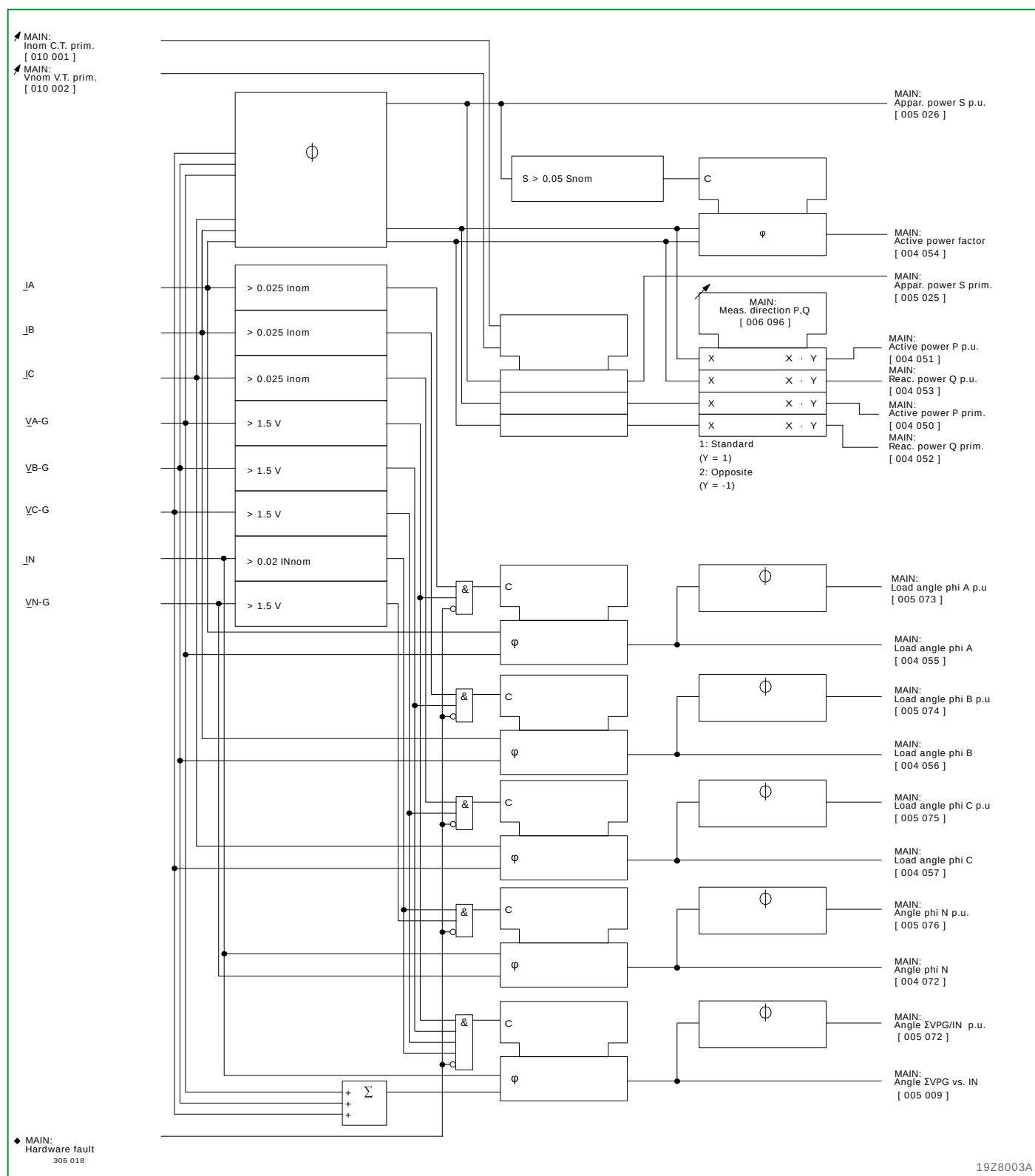


Fig. 3-61: Measured operating data – power, active power factor, and angle.

Calculation of these derived operating quantities is subject to the following conditions:

- Values for active and reactive power will always be calculated and displayed as these quantities are required for the subsequent energy measurement. Greater deviations in measurements may occur with low phase currents or a critical power factor value.
- The active power factor will be calculated only if the apparent power value exceeds 5% of the nominal apparent power S_{nom} .
- Load angles will be displayed only if the respective phase current exceeds $0.1 \cdot I_{nom}$ and if the phase-to-ground voltage exceeds 1.5 V.
- The angle between the measured values for the residual current and the neutral-point displacement voltage will only be displayed if the residual current exceeds $0.02 \cdot I_{N,nom}$ and the neutral-point displacement voltage exceeds 1.5 V.

The setting for MAIN: Meas. direction P,Q may be changed from *Standard* to *Opposite* if the user wishes to have the following measured operating data displayed with the opposite sign (see Fig. 3-61, (p. 3-102)):

- MAIN: Active power P p.u.
- MAIN: Reac. power Q p.u.
- MAIN: Active power P prim.
- MAIN: Reac. power Q prim.

This setting parameter does not influence the remaining measured operating data. It must be noted that inverting the sign will only affect the display of measured operating data, all protection functions will internally use non-inverted measured values.

3.13.2.7

Phase Relation I_N

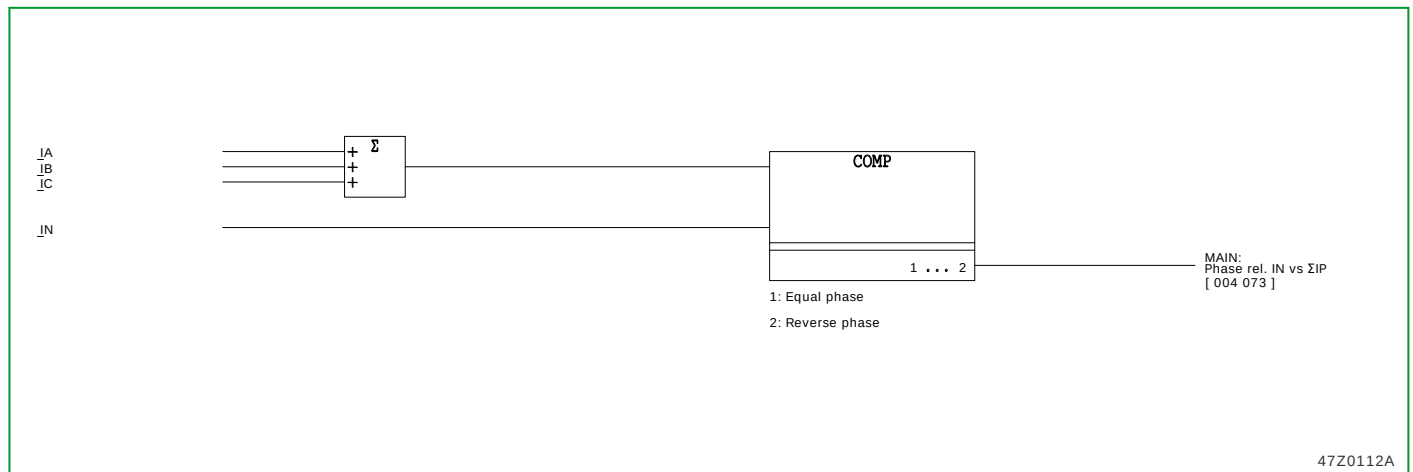


Fig. 3-62: Phase relation between calculated and measured residual current.

The P433 checks if the phase relations of calculated residual current and measured residual current are coherent. If the phase displacement between the two currents is $\leq 45^\circ$, then the indication *Equal phase* is displayed.

3.13.2.8 Frequency

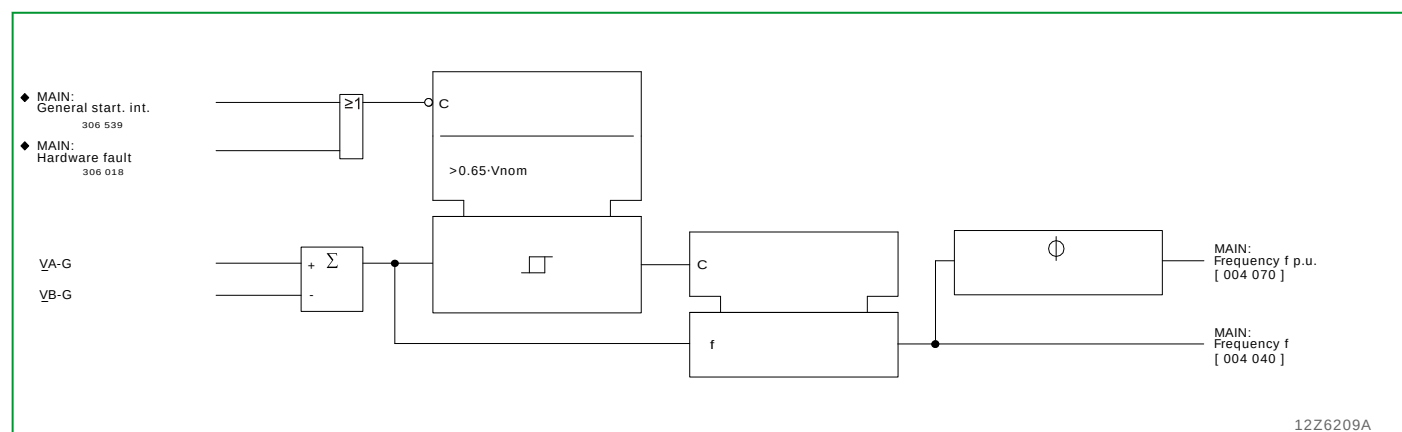


Fig. 3-63: Frequency measurement.

The P433 determines the frequency from the voltage V_{A-B} . This voltage needs to exceed a minimum threshold of $0.65 V_{nom}$ in order for frequency to be determined.

3.13.2.9 Impedances

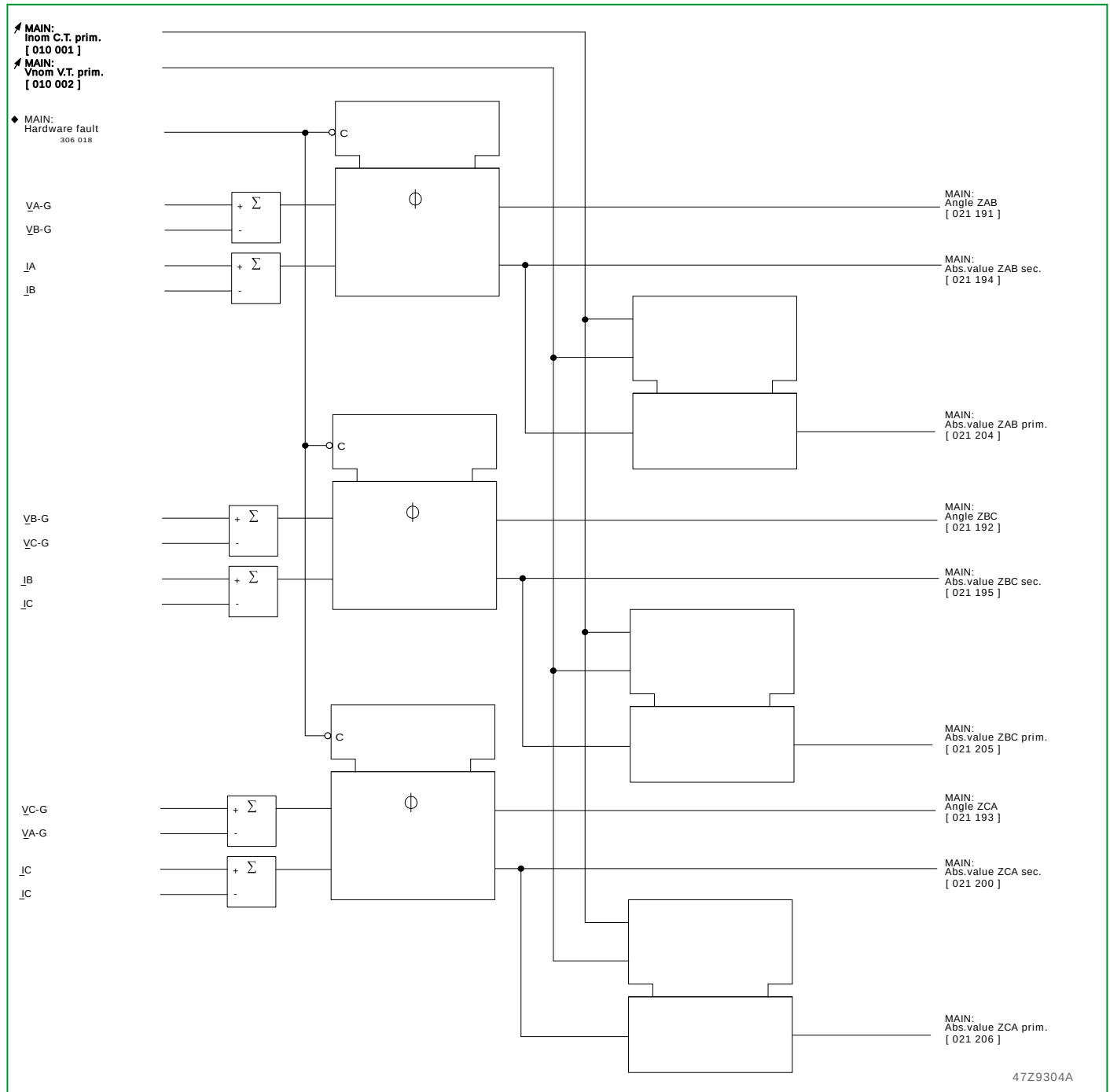


Fig. 3-64: Phase-to-phase Impedances.

The 3 phase-phase impedances (absolute value and angle) are cyclically calculated as metering values. No restrictions are applied to the calculation, i.e. it is not blocked by protection starting, auto-reclosing dead times or even an m.c.b.operation/fuse failure condition.

No minimum current or voltage checks are applied, yet accordingly the accuracy is normally degraded for small currents. For very small currents impedance gets bigger than the given value range and is indicated with "overflow" value.

Even if the secondary value is still calculated with reasonable value, the primary value could be already at "overflow" according to the impedance transfer ratio value.

3.13.2.10

Active and Reactive Energy Output and Input

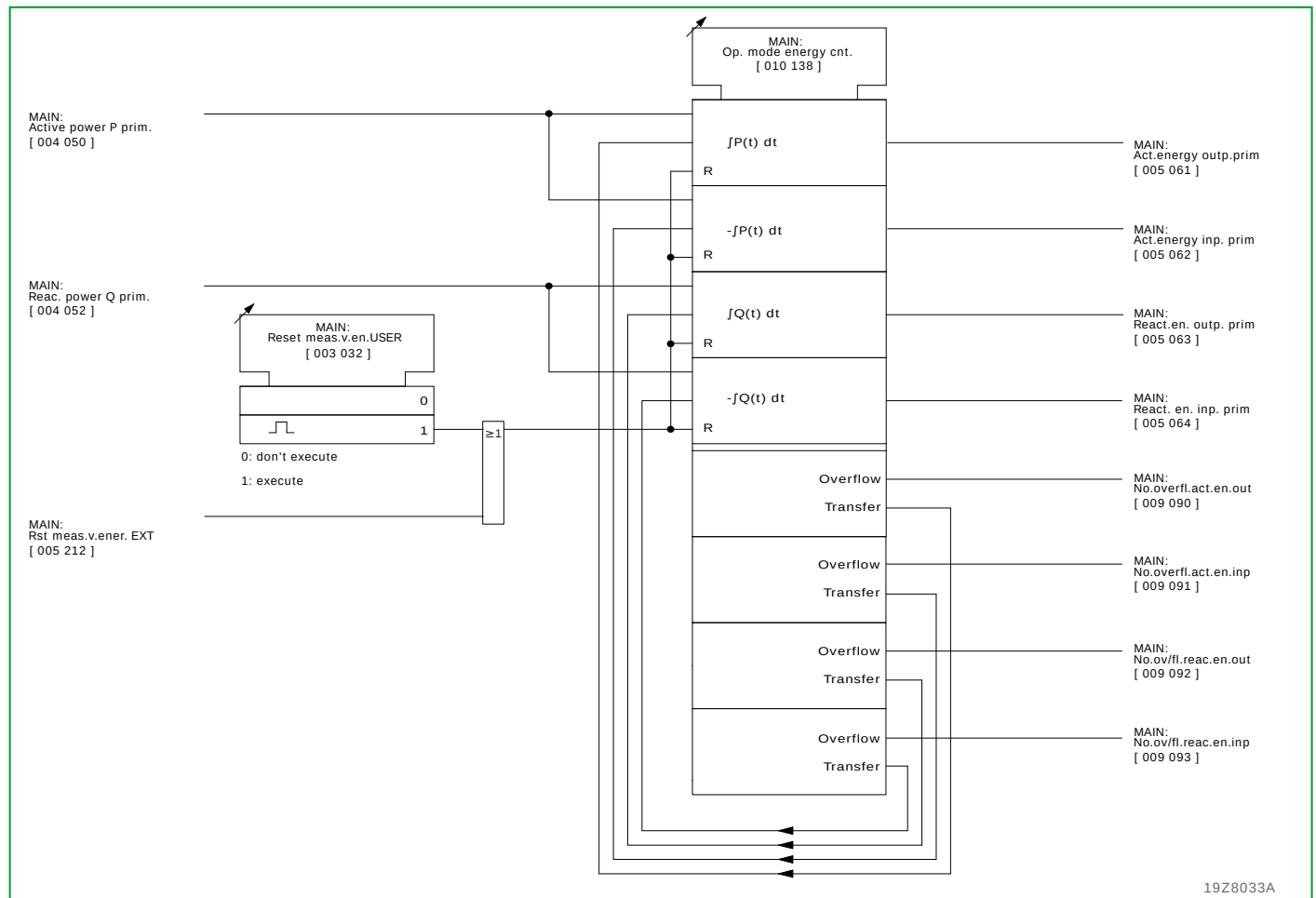


Fig. 3-65: Determining the active and reactive energy output and input.

The P433 determines the active and reactive energy output and input based on the primary active or reactive power.

There are two procedures available to determine active and reactive energy. If procedure 1 is selected, active and reactive energy are determined every 2 s (approximately). If procedure 2 is selected, active and reactive energy are determined every 100 ms (approximately). In this way higher accuracy is achieved.

Measured energy values are presented as text parameters with a value range of about 0 ... 6.5 TWh and a resolution of 10 kWh. In addition, 16 bit values and overflow counters are provided, which are needed for transmission via serial protocols (e.g. Modbus, DNP3, Courier).

Energy values as 32 bit / text values Value range: 0 ... 6553500.00 MWh	Energy values as 16 bit values Value range: 0 ... 655,35 MWh	Overflow counters for the 16 bit energy values Value range: 0 ... 10000
(008 065) MAIN: Act.energy outp.prim	(005 061) MAIN: Act.energy outp.prim	(009 090) MAIN: No.overfl.act.en.out
(008 066) MAIN: Act.energy inp. prim	(005 062) MAIN: Act.energy inp. prim	(009 091) MAIN: No.overfl.act.en.inp
(008 067) MAIN: React.en. outp. prim	(005 063) MAIN: React.en. outp. prim	(009 092) MAIN: No.ov/fl.reac.en.out
(008 068) MAIN: React. en. inp. prim	(005 064) MAIN: React. en. inp. prim	(009 093) MAIN: No.ov/fl.reac.en.inp

The total energy is calculated as follows:

Total energy = number of overflows · 655.36 + current count

For example:

(MAIN: Act.energy outp.prim) = (MAIN: No.overfl.act.en.out) · 655.36 + (MAIN: Act.energy outp.prim)

3.13.2.11 Selection of the Procedure to Determine Energy Output

Procedure	Characteristics	Applications
1	● Determination of the active and reactive energy every 2 s (approximately) ● Reduced system loading	● Constant load and slow load variations (no significant load variations within 1 second). ● Phase angles below 70° ($\cos \varphi > 0.3$).
2	● Determination of the active and reactive energy every 100 ms (approximately). ● Increased system loading	● Fast load variations ● Phase angles below 70° ($\cos \varphi > 0.3$).

The maximum phase-angle error of the P433 of 1° leads to greater errors in measurement when the phase angle increases, as shown (for the range $0^\circ \leq \varphi < 90^\circ$) in the following diagram.

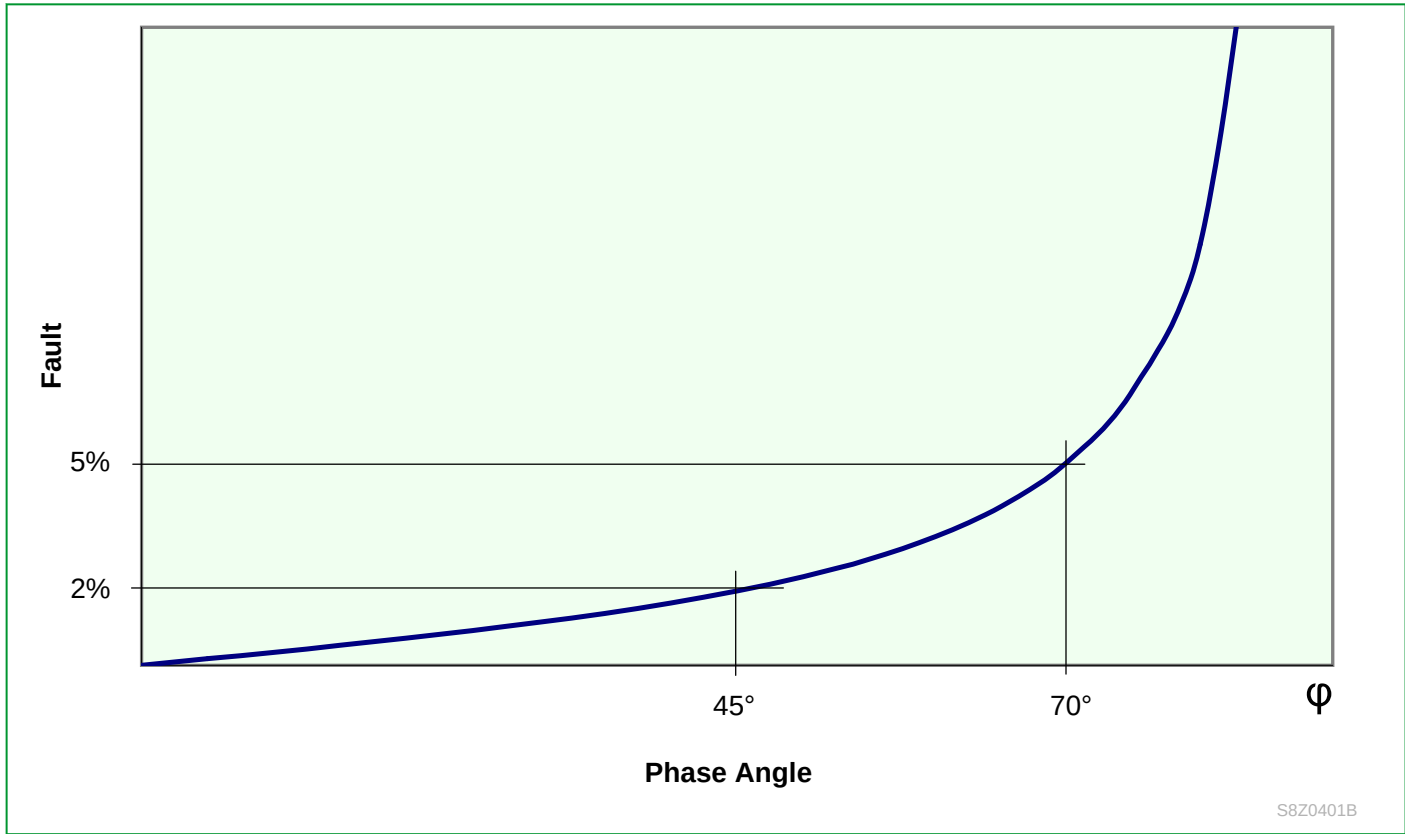


Fig. 3-66: Error of measurement in the determination of energy output resulting from the phase angle error of the P433.

Error of measurement:

- Approx. $\pm 2\%$ of the measured value for $|\cos \varphi| \geq 0.7$
- Approx. $\pm 5\%$ of the measured value for $|\cos \varphi| \geq 0.3$
- where the whole measuring range is $-180^\circ \leq \varphi \leq 180^\circ$.

For phase angles φ with $|\cos \varphi| < 0.3$, or when the error of measurement resulting from the maximum phase-angle error is not acceptable, external counters should be used to determine the energy output.

3.13.3 Configuring and Enabling the Device Functions

The P433 can be adapted to the requirements of a specific high-voltage system by configuring the available function range. By including the desired P433 functions in the configuration and canceling all other, the user creates an individually configured device appropriate to the specific application. Parameters, signals and measured values of cancelled device functions are not displayed on the local control panel. Functions of general applicability such as operating data recording (OP_RC) or main functions (MAIN) cannot be cancelled.

3.13.3.1 Canceling a Device Function

The following conditions must be met before a P433 function can be cancelled or removed:

- The P433 function must be disabled.
- None of the functions of the P433 function to be cancelled can be assigned to a binary input.
- None of the signals of the P433 function can be assigned to a binary output or an LED indicator.
- None of the functions of the P433 function to be cancelled may be selected in a list parameter setting.

If the above conditions are met, proceed through the “Configuration” branch of the menu tree to access the setting relevant for the P433 function to be cancelled. If, for example, the “LIMIT” function group is to be cancelled, the setting of LIMIT: Function group LIMIT is set to *Without*. To re-include the “LIMIT” function in the P433 configuration, the same setting is accessed and its value is changed to *With*.

The P433 function to which a setting, a signal, or a measured value belongs is defined by the function group designation (example: “LIMIT”). In the following description of the P433 functions, it is presumed that the corresponding P433 function is included in the configuration.

3.13.3.2 Enabling or Disabling a Device Function

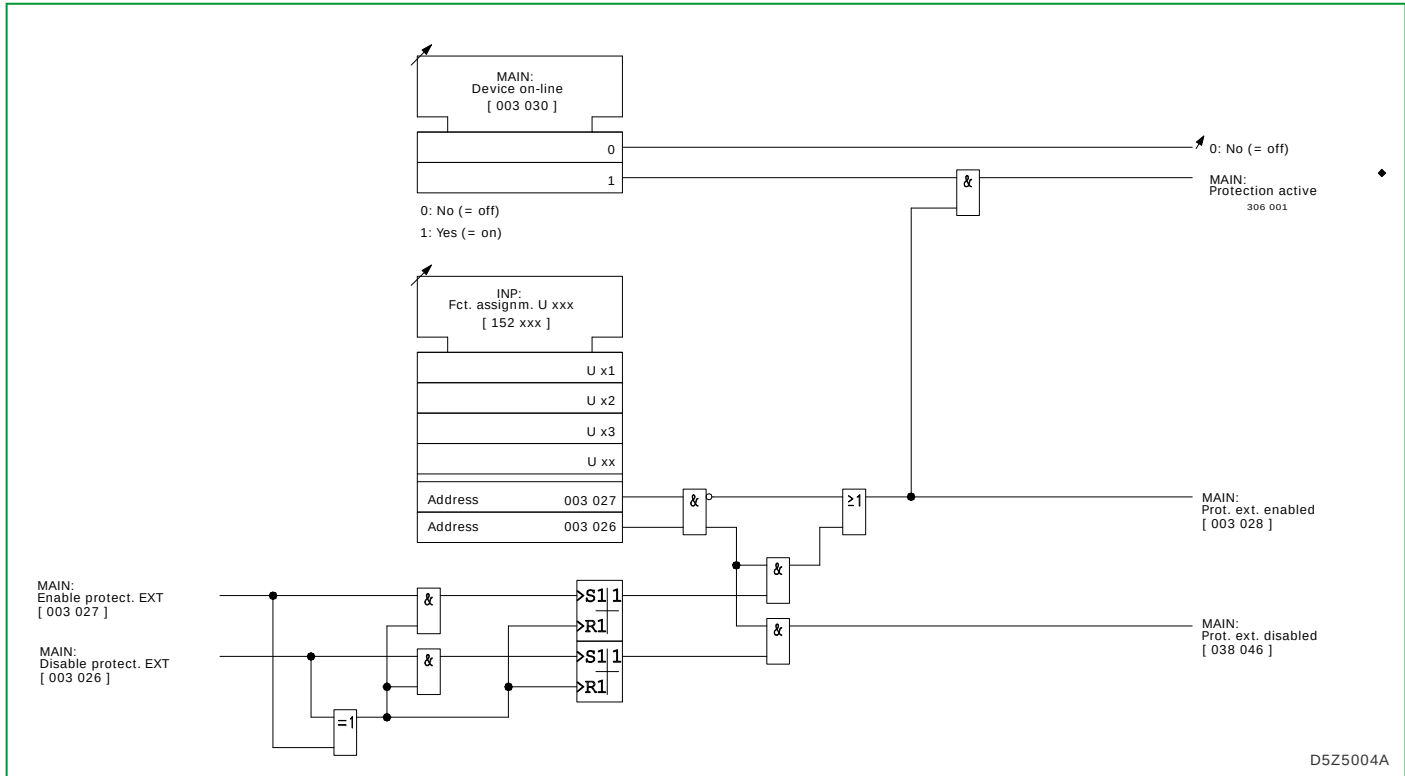


Fig. 3-67: Enabling or disabling a device function.

Besides cancelling P433 functions from the configuration, it is also possible to disable protection via a function parameter or binary signal inputs. Protection can only be disabled or enabled through binary signal inputs if the MAIN: Disable protect. EXT and MAIN: Enable protect. EXT functions are both configured. When neither or only one of the two functions is configured, the condition is interpreted as “Protection externally enabled”. If the triggering signals of the binary signal inputs are implausible – i.e. both are at logic level = “1” – then the last plausible state remains stored in memory.

If the protection is disabled via a binary signal input that is configured for MAIN: Disable protect. EXT, the signal MAIN: Blocked/faulty is not issued.

3.13.4 Current Flow Monitoring

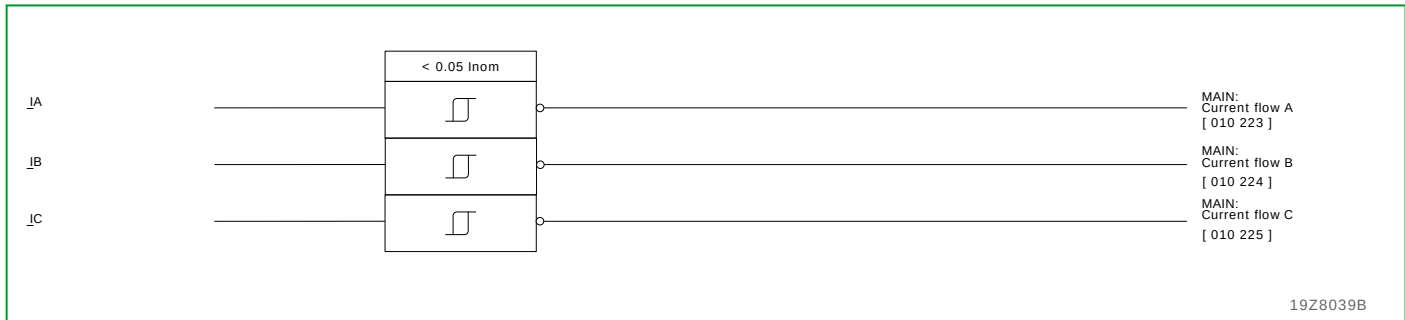


Fig. 3-68: Current flow monitoring.

The current flow is monitored continuously and pole-selectively, independent of the current flow monitoring performed by the CBF function. The sampled current values are continuously compared with the fixed threshold value $0.05 \cdot I_{nom}$.

As long as current flow criteria are met the monitoring function will continuously issue the phase selective signals MAIN: Current flow A, MAIN: Current flow B, MAIN: Current flow C.

3.13.5 Inrush Stabilization (Harmonic Restraint)

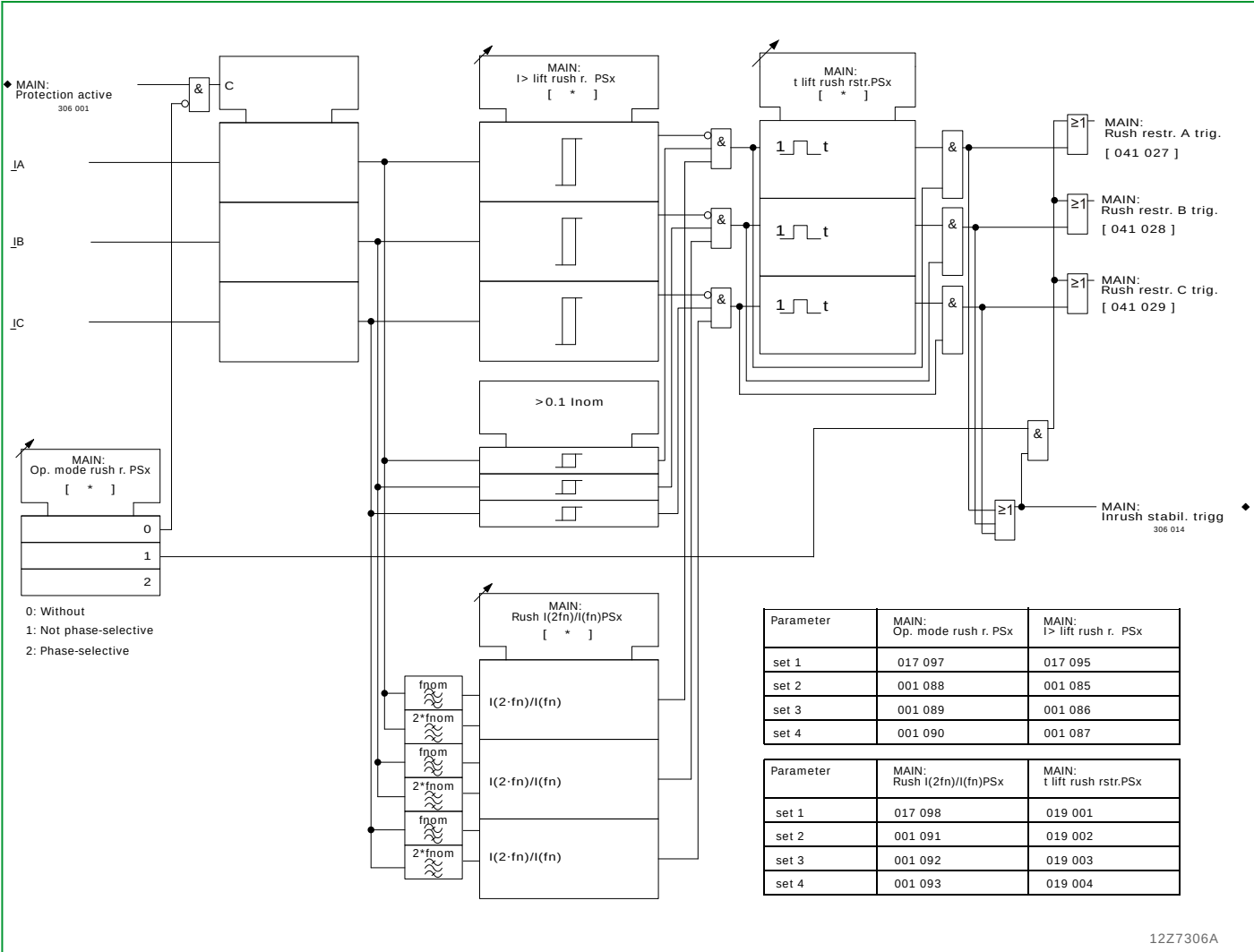


Fig. 3-69: Inrush stabilization.

The inrush stabilization function detects high inrush current flows that occur when transformers or machines are switched on. For all selected stages of the Definite-Time and Inverse-Time Overcurrent Protection (DTOC, IDMT), of the Backup Overcurrent Protection (BUOC), of the Distance Protection (DIST) and of the QV protection, the selective starting will be blocked if an inrush current flow is detected.

The inrush stabilization function detects an inrush current by evaluating the ratio of the second harmonic current component to the fundamental. If this ratio exceeds the threshold that can be set with the parameter MAIN: Rush $I(2fn)/I(fn)PSx$, then the inrush stabilization operates.

The current trigger MAIN: $I > \text{lift rush r. PSx}$ and a fixed threshold of $0.1 \cdot Inom$ define the range in which the inrush stabilization operates. If the current is outside of this range then the inrush stabilization is blocked.

The parameter MAIN: $t \text{ lift rush rstr.PSx}$ defines the maximum hold-time for the inrush stabilization.

Note: Protection function elements, that are subject to inrush blocking (per selection) start with an intentional time delay of about 15...30 ms to secure potential inrush blocking.

3.13.5.1 Selection of Functions

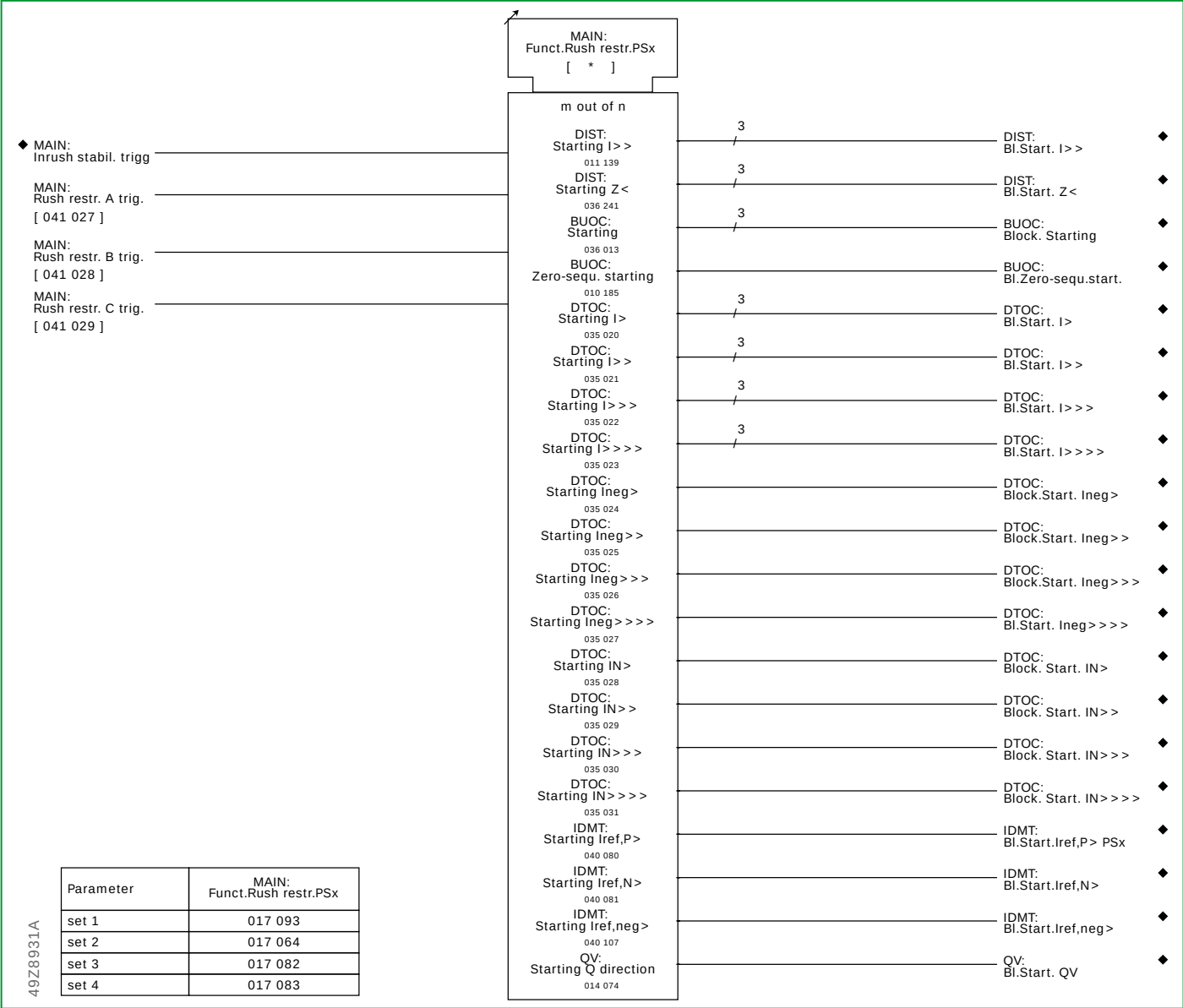


Fig. 3-70: Selection of the stabilization criteria for the inrush stabilization.

The inrush stabilization is designed with respect to function groups DIST, BUOC, DTOC, IDMT and QV. Depending on the parameter MAIN: Funct.Rush restr.PSx the starting of these function groups is blocked selectively.

3.13.6 Measurement of Frequency

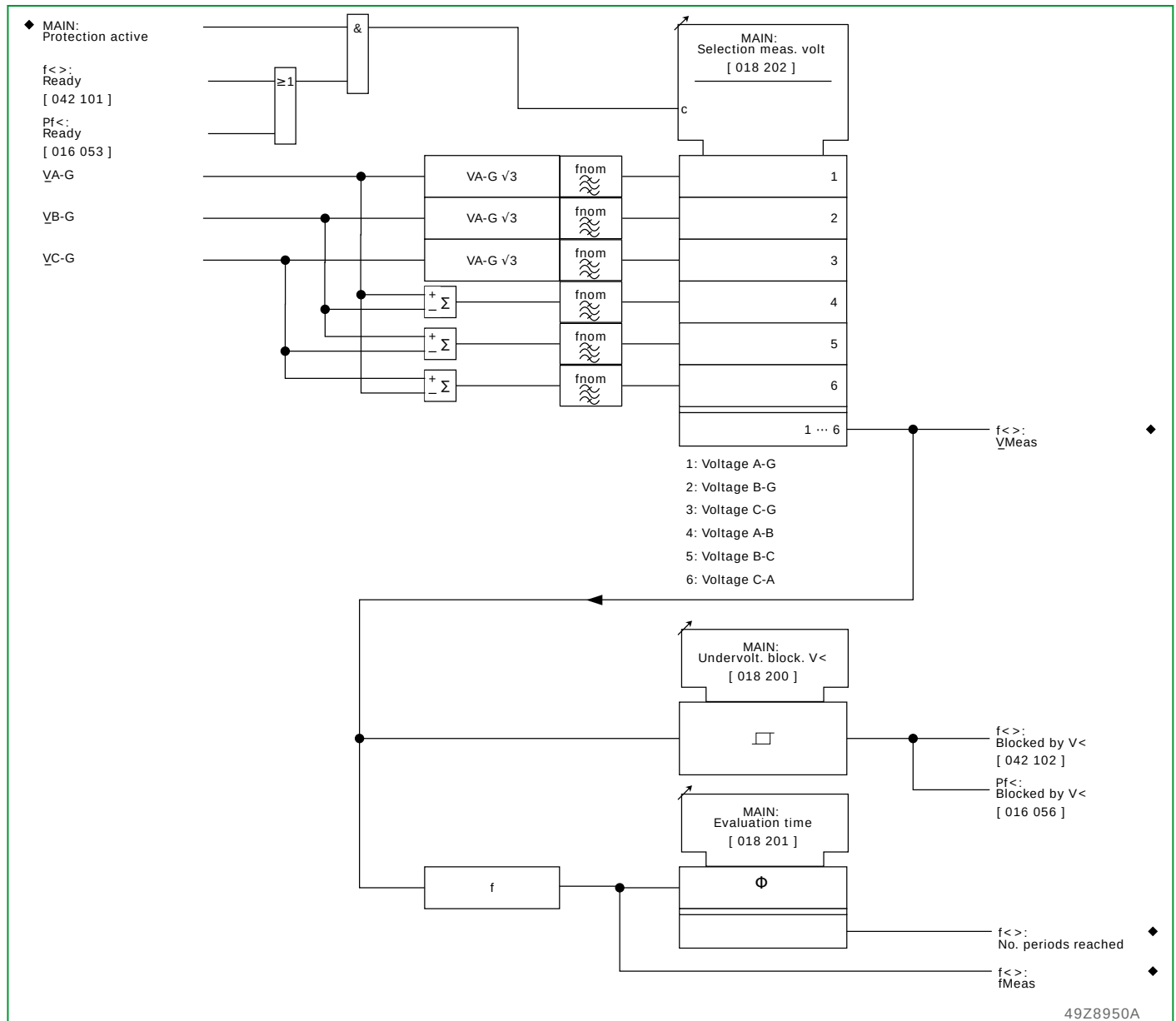


Fig. 3-71: Measurement of frequency: measuring voltage, evaluation time, undervoltage blocking.

The over-/underfrequency protection f<> and the underfrequency load shedding protection Pf< share some common settings which are used for the frequency measurement:

- the selection of measuring voltage
- the evaluation time
- the undervoltage blocking

By selecting a measuring voltage setting, the user defines the voltage that is used by the over-/underfrequency protection function and underfrequency load shedding function for measurement purposes. This can be either a phase-to-ground voltage or a phase-to-phase voltage.

Over-/underfrequency protection and underfrequency load shedding function requires a measuring voltage of sufficient magnitude. Over-/underfrequency protection and underfrequency load shedding function will be blocked

instantaneously if the measuring voltage falls below the set threshold of the undervoltage stage.

In order to avoid frequency stage starting caused by brief frequency fluctuations or interference, the evaluation time can be set by the user. The operate conditions must be satisfied for at least the duration of the set evaluation time in order for a signal to be issued.

3.13.7 Function Blocks

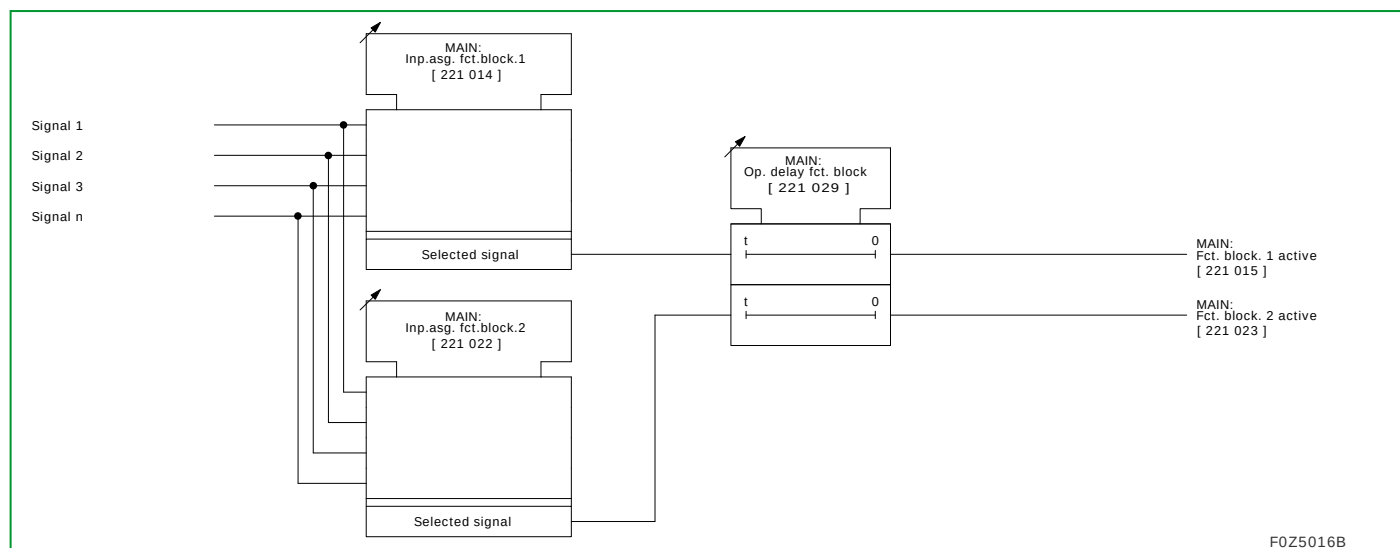


Fig. 3-72: Function blocks.

By including function blocks in the bay interlock conditions, switching operations can be prevented independent of the switching status at the time, for example, by an external signal “CB drive not ready” or by the trip command from an external protection device.

Binary input signals conditioned by debouncing and chatter suppression or output signals from the programmable logic function can be assigned to the function blocks 1 and 2 by setting a “1 out of n” parameter. The input signal from the function blocks starts a timer stage and after it has elapsed, the signal MAIN: Fct. block. 1 active is issued.

3.13.8 Multiple Blocking

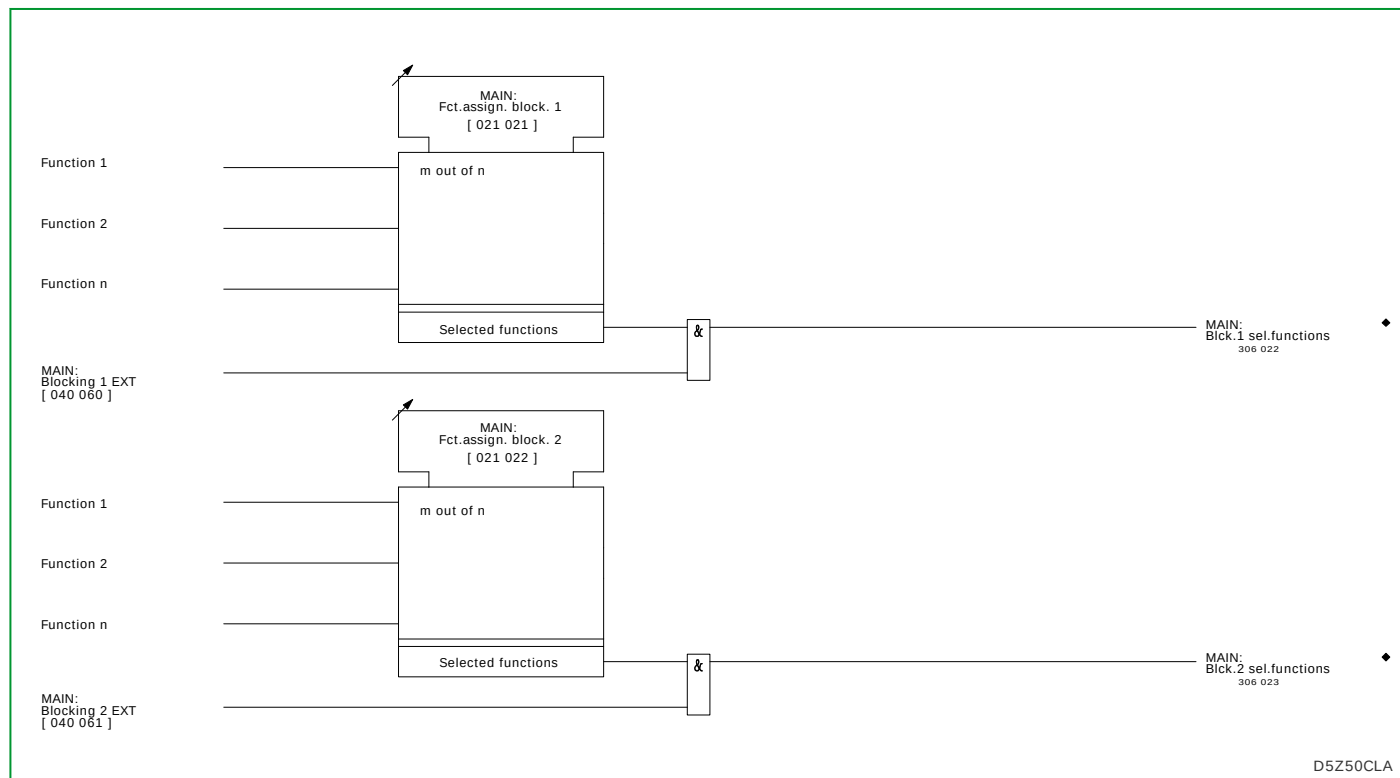


Fig. 3-73: Multiple blocking.

Two multiple blocking conditions can be defined via “m out of n” parameters. The functions defined by selection may be blocked via an appropriately configured binary signal input.

3.13.9 Blocked/Faulty

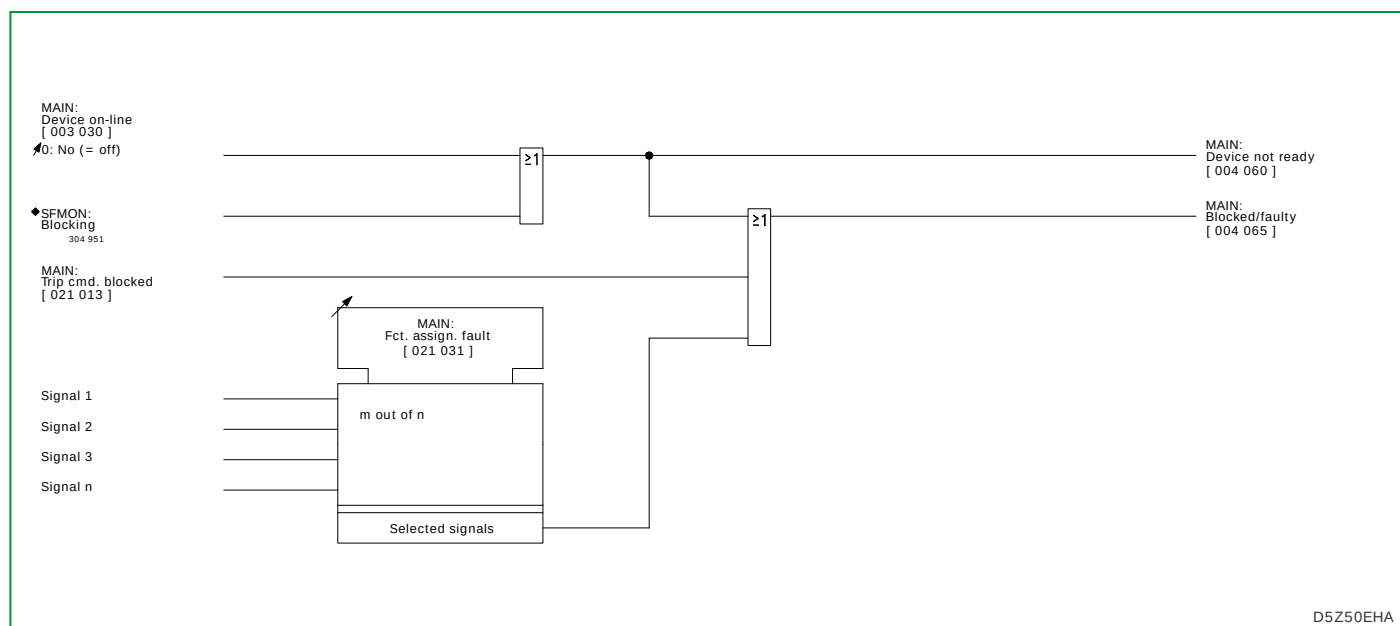


Fig. 3-74: “Blocked/Faulty” signal.

If the protective functions are blocked, the condition is signaled by continuous illumination of the amber LED indicator H 2 on the local control panel and by a signal from an output relay configured MAIN: Blocked/faulty. In addition

functions can be selected that will issue the MAIN: Blocked/faulty signal by setting a “m out of n” parameter.

3.13.10 Coupling between Control and Protection for the CB Closed Signal

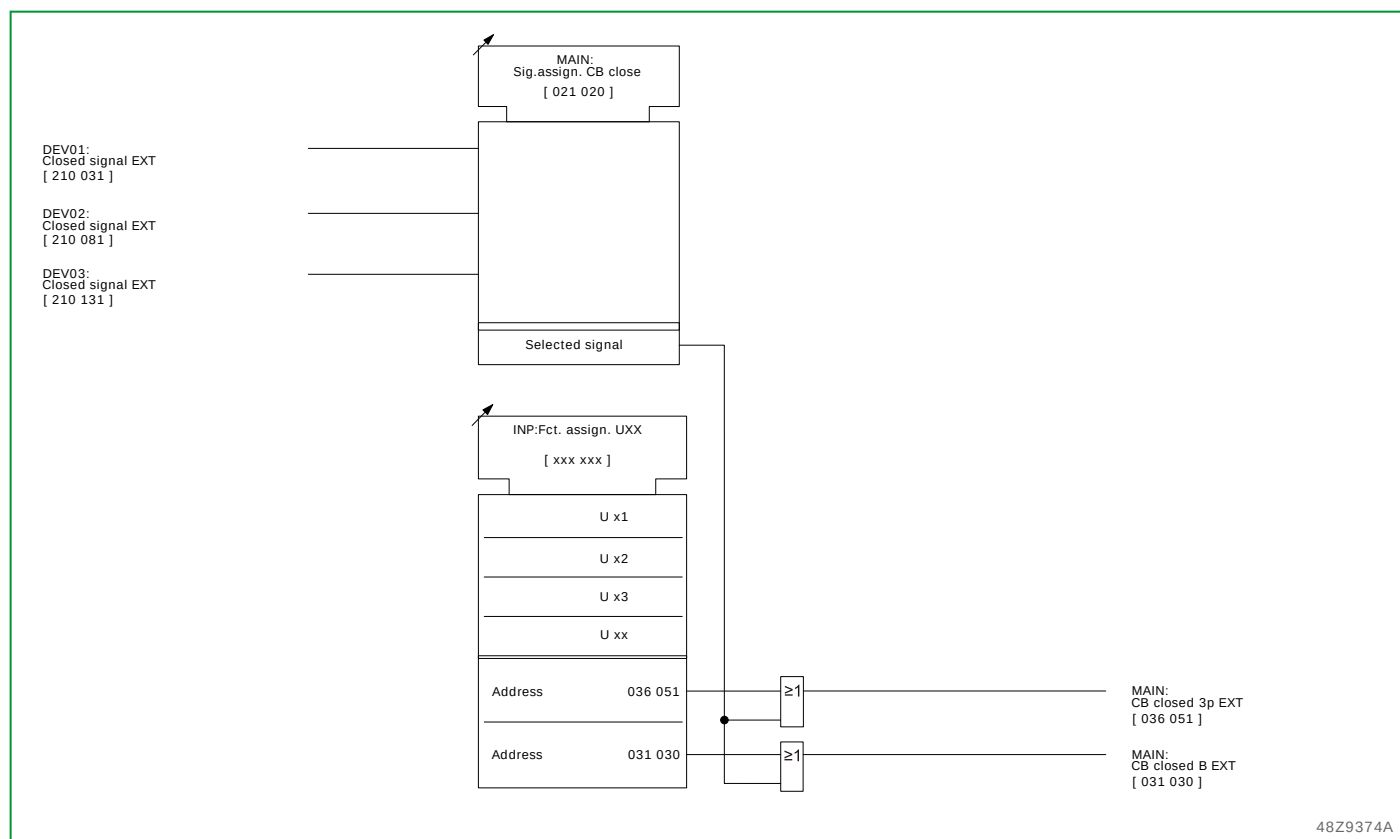


Fig. 3-75: Coupling between control and protection for the CB closed signal.

Bay type selection defines the external device (DEV01 or DEV02 or ...) that represents the circuit breaker. Coupling between control and protection for the “Closed” position signal is made by the setting MAIN: Sig.assign. CB close. As a result, the CB status signal needs to be assigned to one binary signal input only if this coupling is implemented.

3.13.11 Monitoring and Processing of CB Status Signals

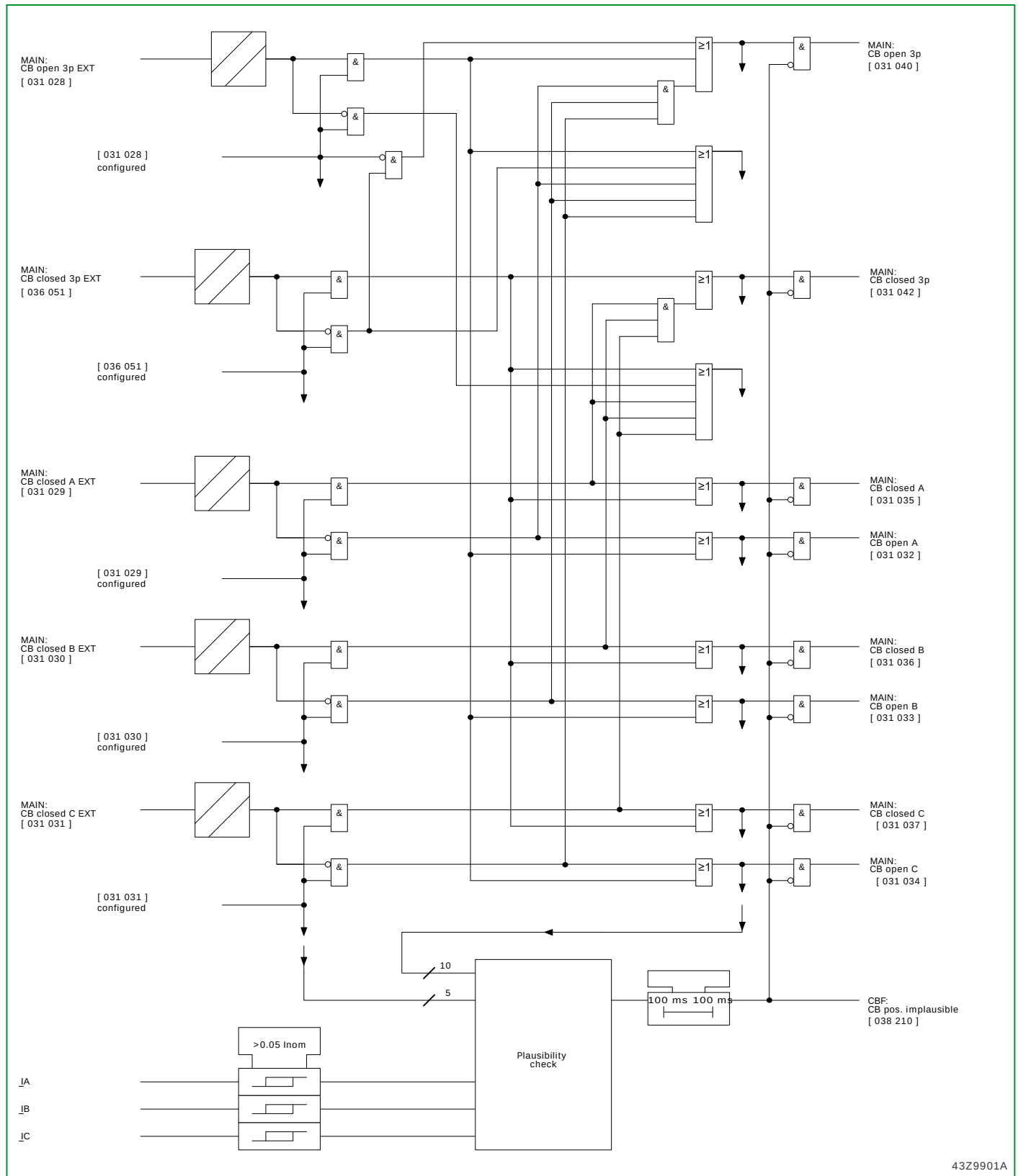


Fig. 3-76: Monitoring of CB status signals.

Extended CB Status Signals

An extended monitoring of the circuit breaker (CB) status signals is available in the main function group. It is possible to select whether the P433 shall monitor

either the pole-selective signals (MAIN: CB closed A EXT, MAIN: CB closed B EXT, MAIN: CB closed C EXT) or the multiple signals (MAIN: CB closed 3p or MAIN: CB open 3p, respectively). Any simultaneous use of all status signals in an application is not expedient and should therefore not be undertaken.

These signals are usually determined directly via binary inputs, but it is also possible to link them to LOGIC signals. For example, this can be useful to implement required operate and release delays.

If only the MAIN: CB closed 3p EXT binary signal input has been configured then the MAIN: CB open 3p signal will also be issued (see Fig. 3-76, (p. 3-117)).

Fig. 3-76, (p. 3-117) shows the logical processing of the various input signals. The plausibility logic will be triggered should one of the following discrepancies be detected:

- A minimum of one 3-pole monitoring signal and one 1-pole monitoring signal are configured at the same time.
- Both multiple signals MAIN: CB closed 3p EXT and MAIN: CB open 3p EXT are present simultaneously.

The plausibility logic has been modified accordingly to permit that the binary signal input only be configured at MAIN: CB closed 3p EXT. This makes a backward compatible operation possible (for example in an existing plant where only this signal has been wired).

In order to suppress triggering during transient actions, the signal issued when a plausibility discrepancy is detected has a generally delayed pickup of 100 ms.

Besides monitoring for signaling purposes, status signals are also processed in these functions:

- MAIN: Ending a CB (re-)close command.
If the (re-)close command is to be terminated by the "CB closed" signal (setting at MAIN: RC inhib.by CB close = Yes) then the resulting MAIN: CB closed 3p signal is interrogated).
- ARC: Ready indication.
If the ARC should only be available when the circuit breaker has already been closed (setting at ARC: CB clos.pos.sig. PSx = *With*) then the resulting signal MAIN: CB closed 3p is interrogated.
- PSIG and CSCSG: Un-delayed echo if CB is open.
If the CB is open, the echo signal (if enabled) is issued without additional delay. For this the MAIN: CB open 3p signal is used.
- MCMON: Release of negative-sequence voltage protection using CB status indication.
The internally generated MAIN: CB closed 3p signal is used with the operating mode set to *Vneg w.CB cont.enab.*, and for enabling the "Fuse Failure" monitoring of the reference voltage.
- GFTRP: Release of the trip signal.
The internally generated MAIN: CB closed 3p signal is used as the trip enabling criterion.

3.13.12 Close Command

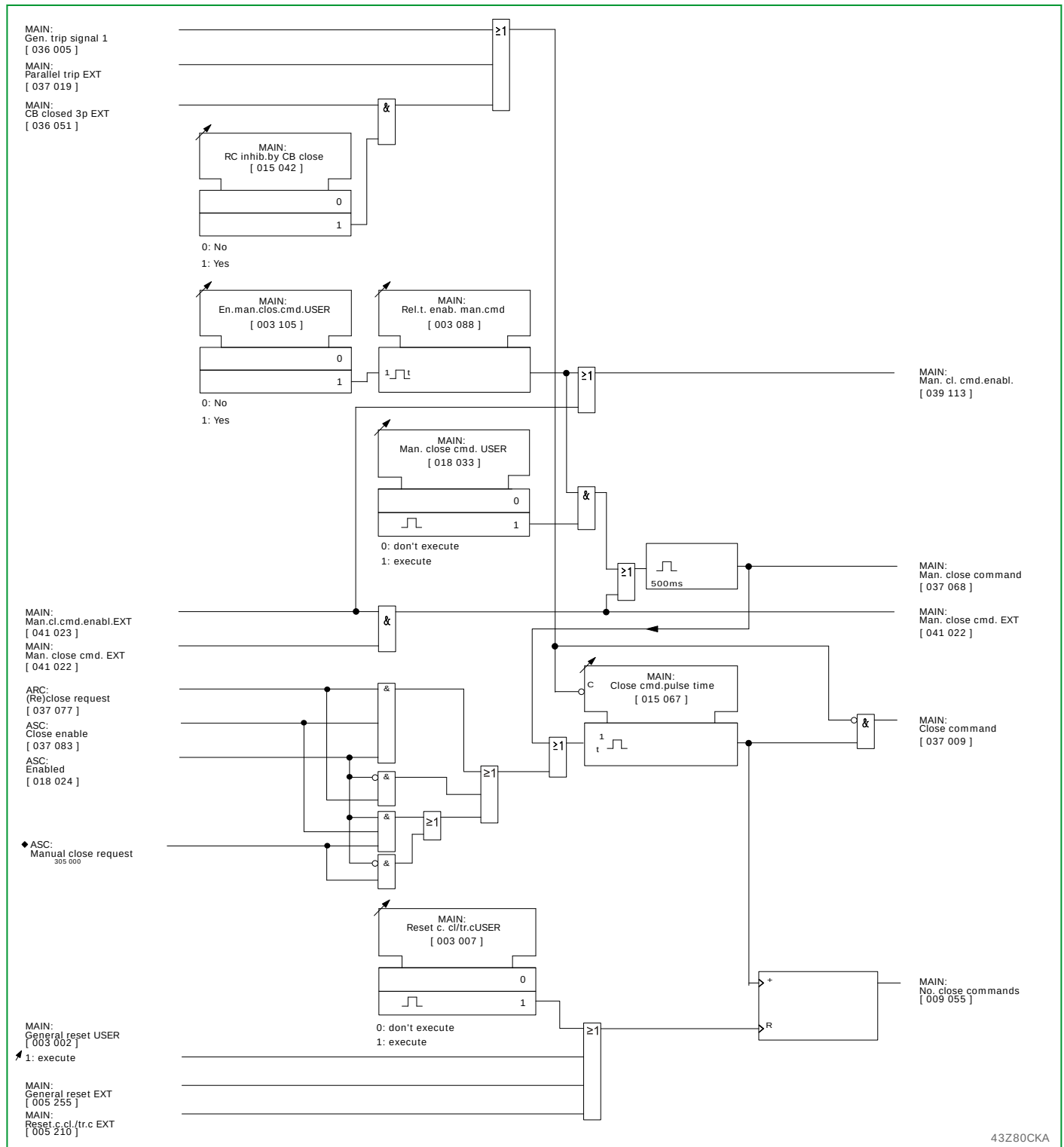


Fig. 3-77: Close command.

The circuit breaker can be closed by the auto-reclosing control function (ARC), by the automatic synchronism check (ASC), by parameters or via an appropriately configured binary signal input. The close command by parameters or a binary signal input is only executed if there is no trip command 1 present and no trip has been issued by a protection device operating in parallel. Moreover, with the setting of MAIN: RC inhib.by CB close to Yes, the close command is not

select up to 32 internal signals and freely combine them using Boolean operators NOT, AND, OR (settings MAIN: Fct.asg. grp.sig. 01 to MAIN: Fct.asg. grp.sig. 08), as described for configuration of LOGIC outputs (see Fig. 3-405, (p. 3-483)).

These state signals are continuously updated. They provide no latching and no settable pick up/ release delay timers. If such timed signaling is required, the function groups LOGIC or LOG_2 shall be used.

3.13.14

Ground Fault Signaling

If a ground fault has been detected by either the GFDSS function (ground fault direction determination by steady-state values) or the TGFDD function (transient ground fault direction determination), the P433 analyzes the phase-to-ground voltages and identifies the phase on which the ground fault has occurred.

The P433 will first determine the lowest phase-to-ground voltage. Then it will check whether the other two phase-to-ground voltages exceed a threshold of $0.2 V_{nom}$. In addition, the two highest phase-to-ground voltages must exceed the lowest phase-to-ground voltage by a factor of 1.5. If these conditions are met, a ground fault signal is issued for the phase with the lowest phase-to-ground voltage.

During a ground fault in Petersen coil-compensated power systems, the faulted phase determination process is stopped as soon as the faulted phase is determined. Then there will be no further measuring done until the end of the ground fault. Thus erroneous signaling at the end of the ground fault is avoided, as the voltages of the healthy phases may transiently fulfill the faulty phase criteria.

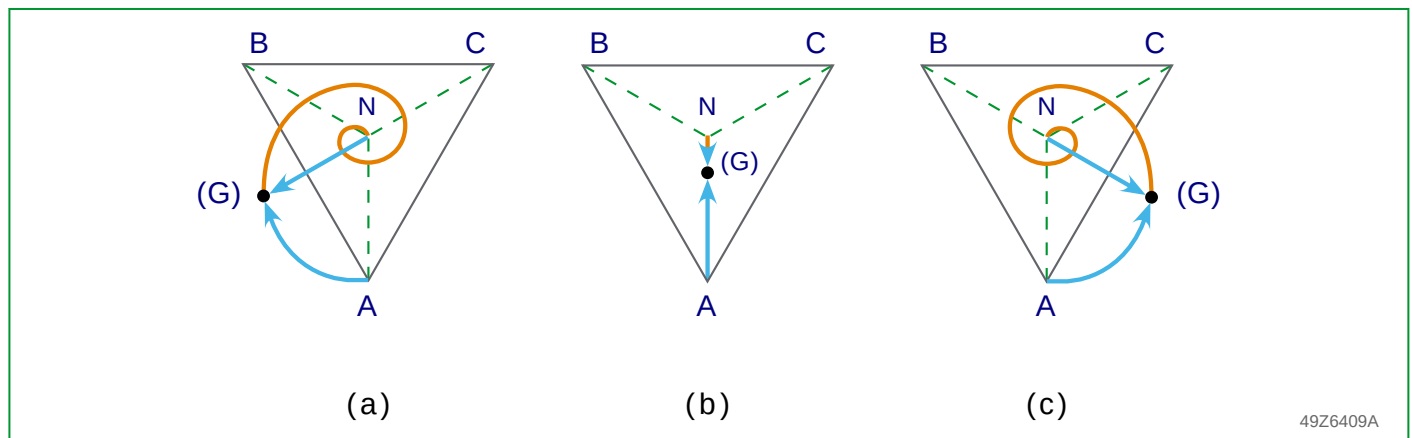


Fig. 3-79: Transient condition of ground potential from faulted phase A back to the neutral point in Petersen coil-grounded systems. (Petersen coil and ground-capacitance of the system form a 50 Hz resonant circuit.) — (a) = under-compensation (A-B-C-A). (b) = tuned circuit. (c) = over-compensation (A-C-B-A).

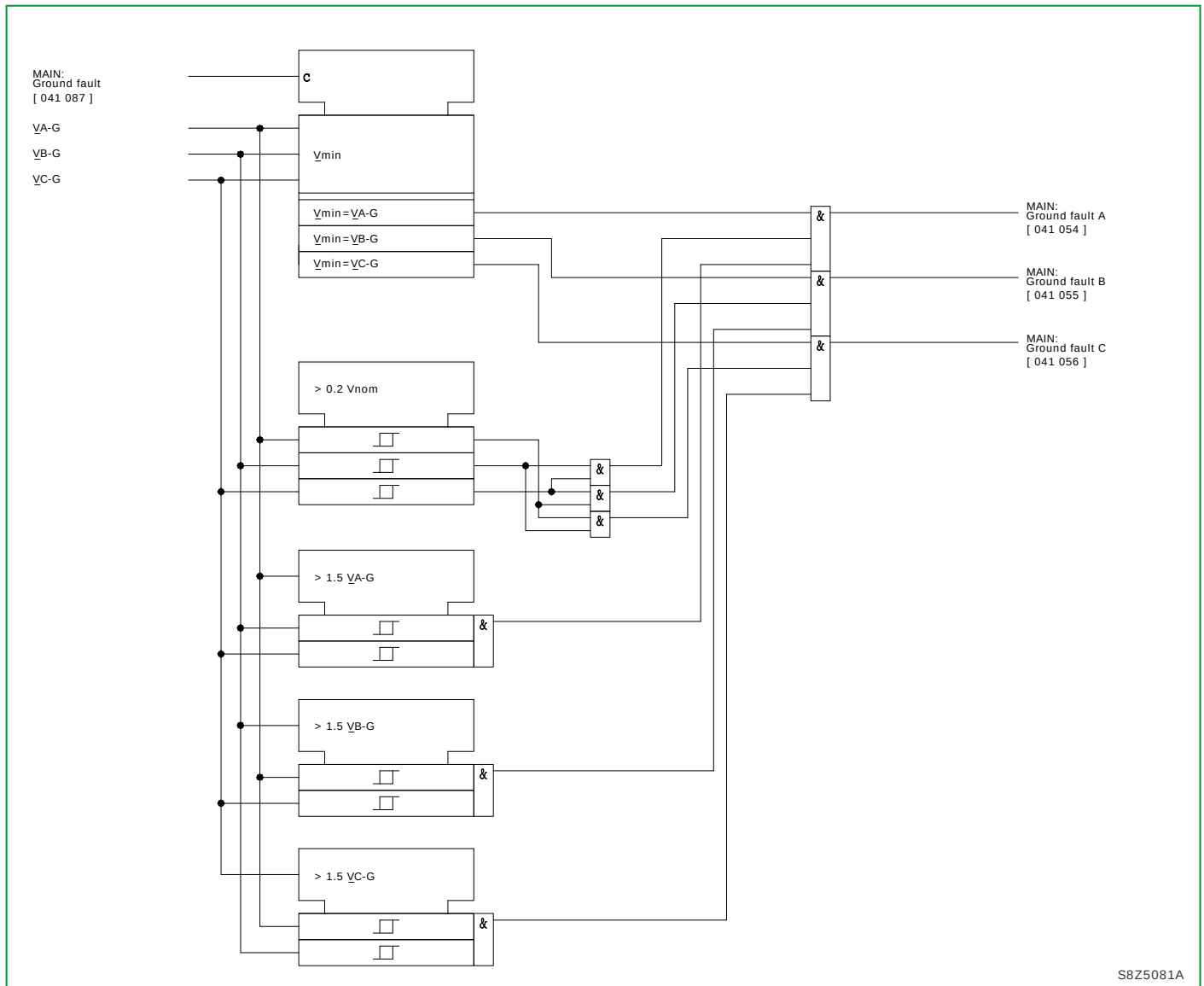


Fig. 3-80: Phase-selective ground fault signaling.

Ground fault signals generated by ground fault direction determination using steady-state values (GFDSS), transient ground fault direction determination (TGFD) or pulse detection (PULSE) are grouped together to form multiple signaling.

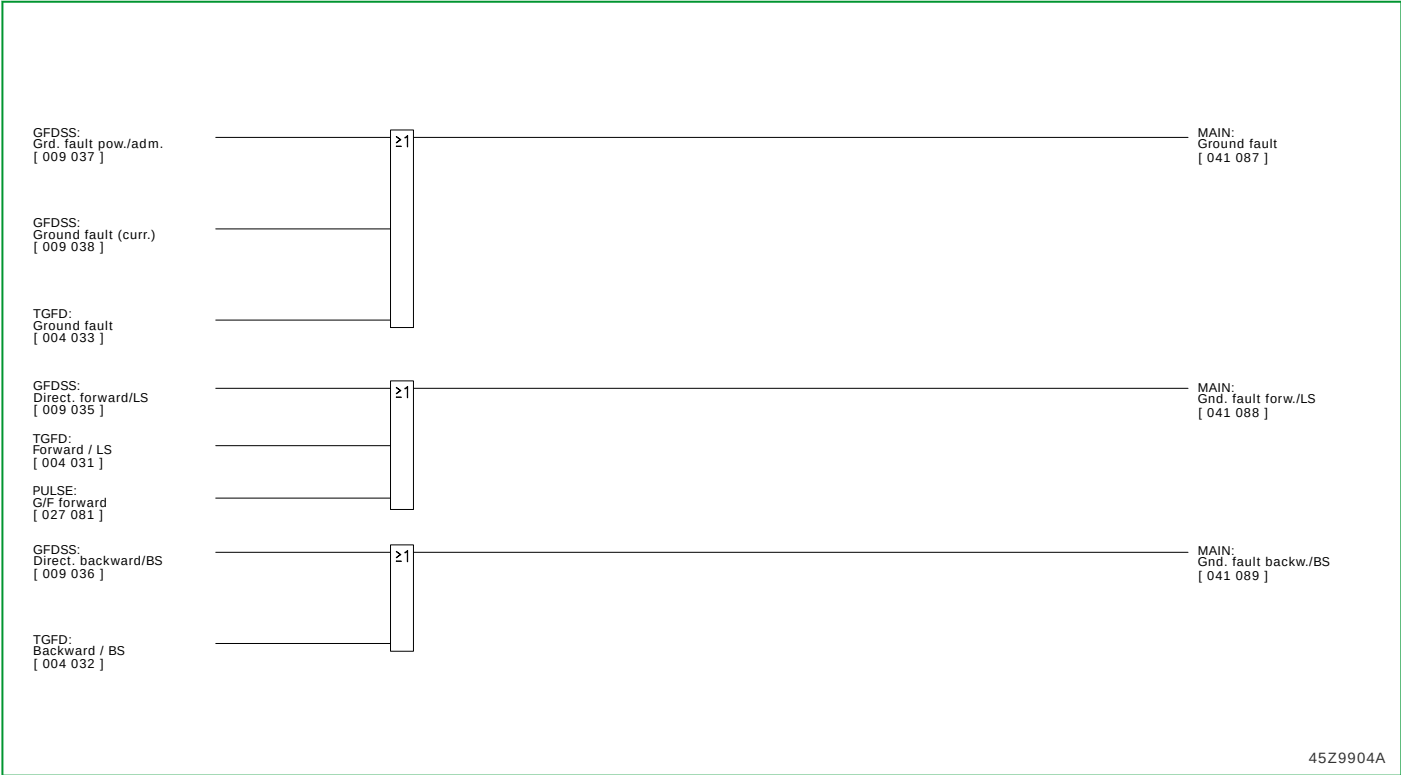


Fig. 3-81: Multiple Signaling of ground faults.

3.13.15 Starting Signals and Tripping Logic

3.13.15.1 Starting Signals

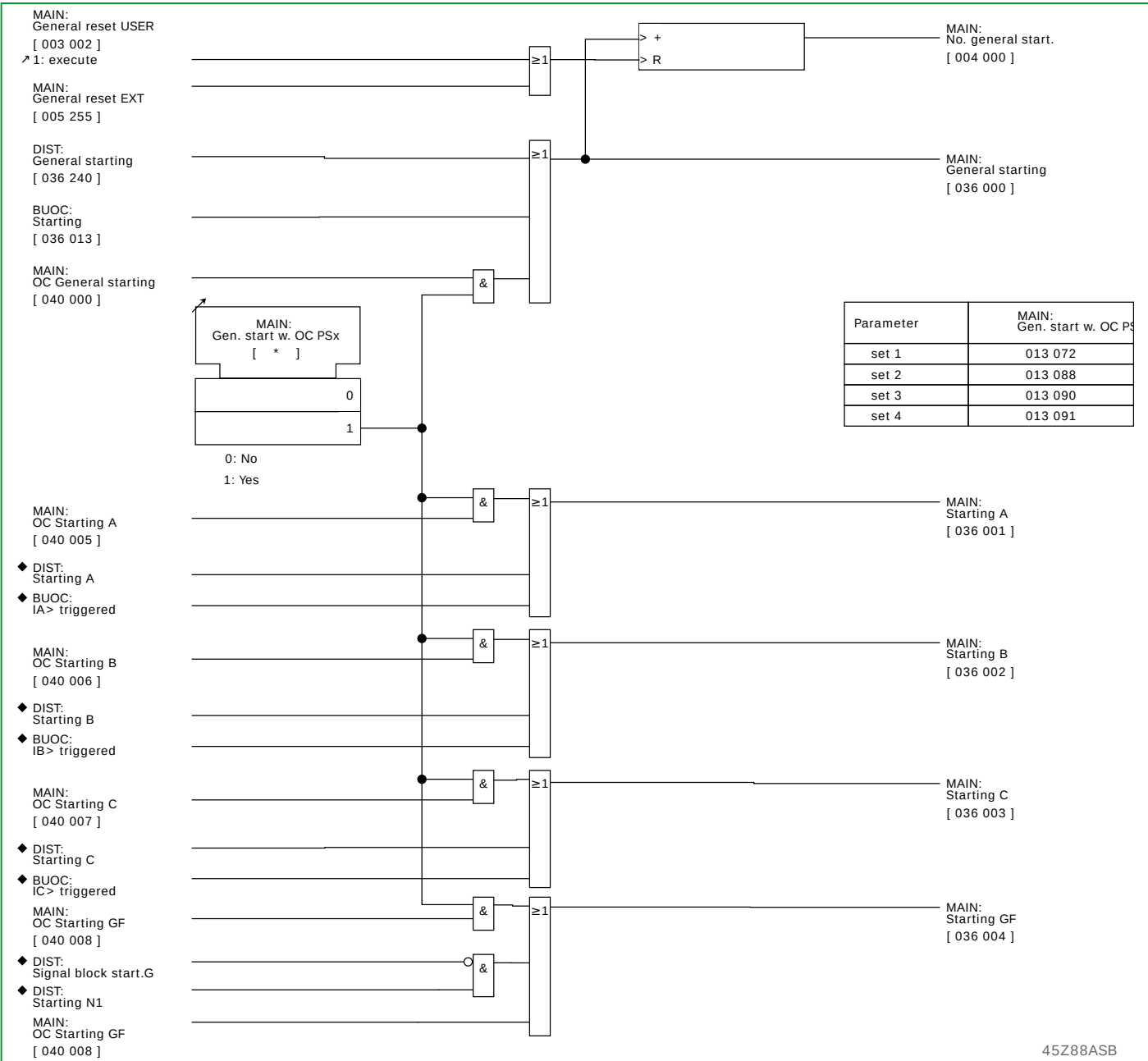


Fig. 3-82: Fault detection signals of the P433.

The starting signals of the distance protection, definite-time overcurrent protection, inverse-time overcurrent protection and backup overcurrent time protection functions are linked to form common starting signals. The number of general starting signals (GS) is counted.

For solidly grounded systems (setting MAIN: Neutr.pt. treat. PSx = *Low-imped. grounding*), it can be selected whether a ground fault is determined by an “OR”-linked or an “AND”-linked condition of the $I_{N>}$ and $V_{NG>}$ detectors in the distance protection. The parameter setting MAIN: Ground starting PSx may then be used.

3.13.15.2 Trip Command

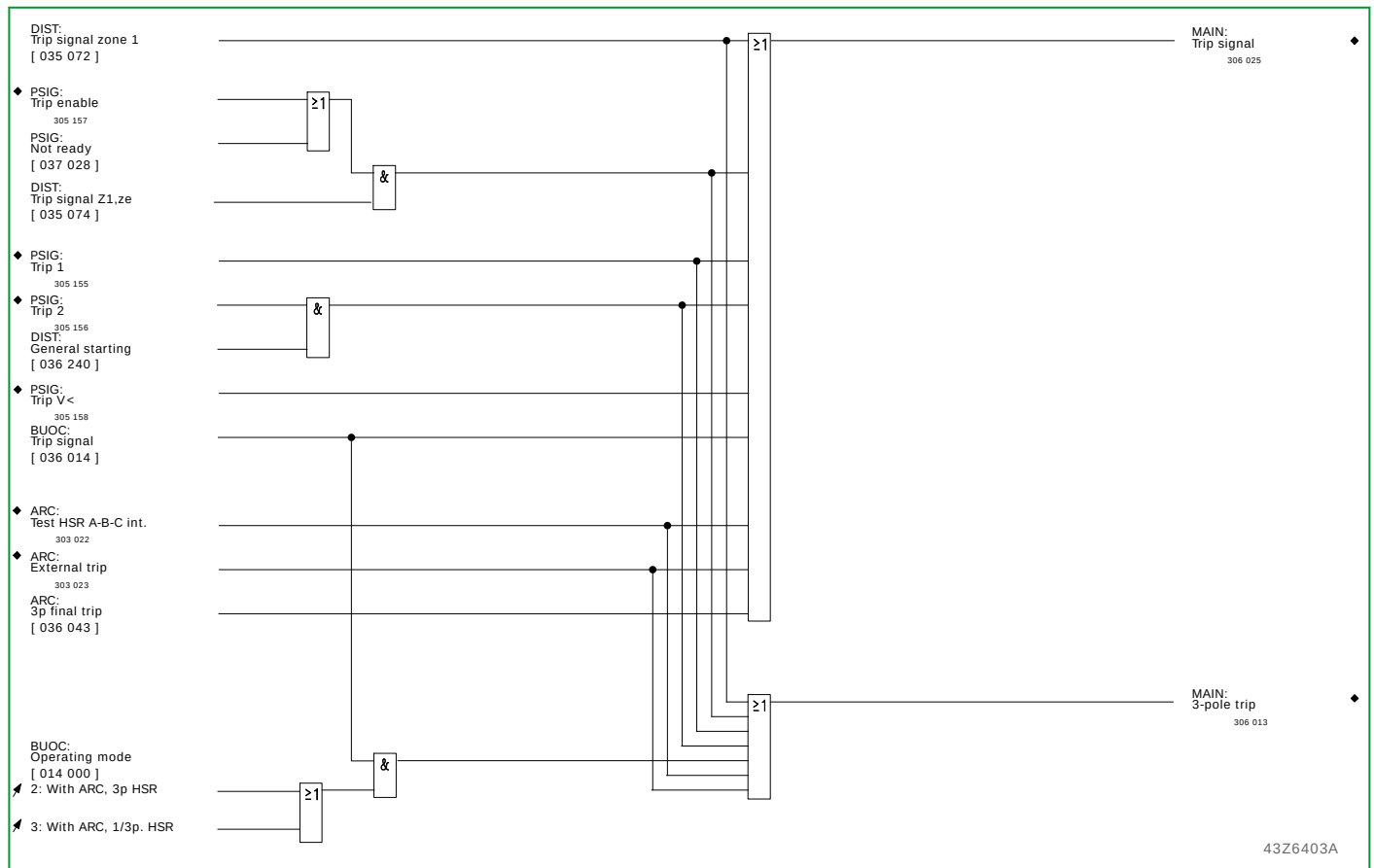


Fig. 3-83: Trip in Zone 1.

The P433 provides four trip commands. The functions required to trip can be selected by setting an “m out of n” parameter independently for each of the trip commands. The minimum trip command time is settable. The trip signals are present only as long as the conditions for the signal are met.

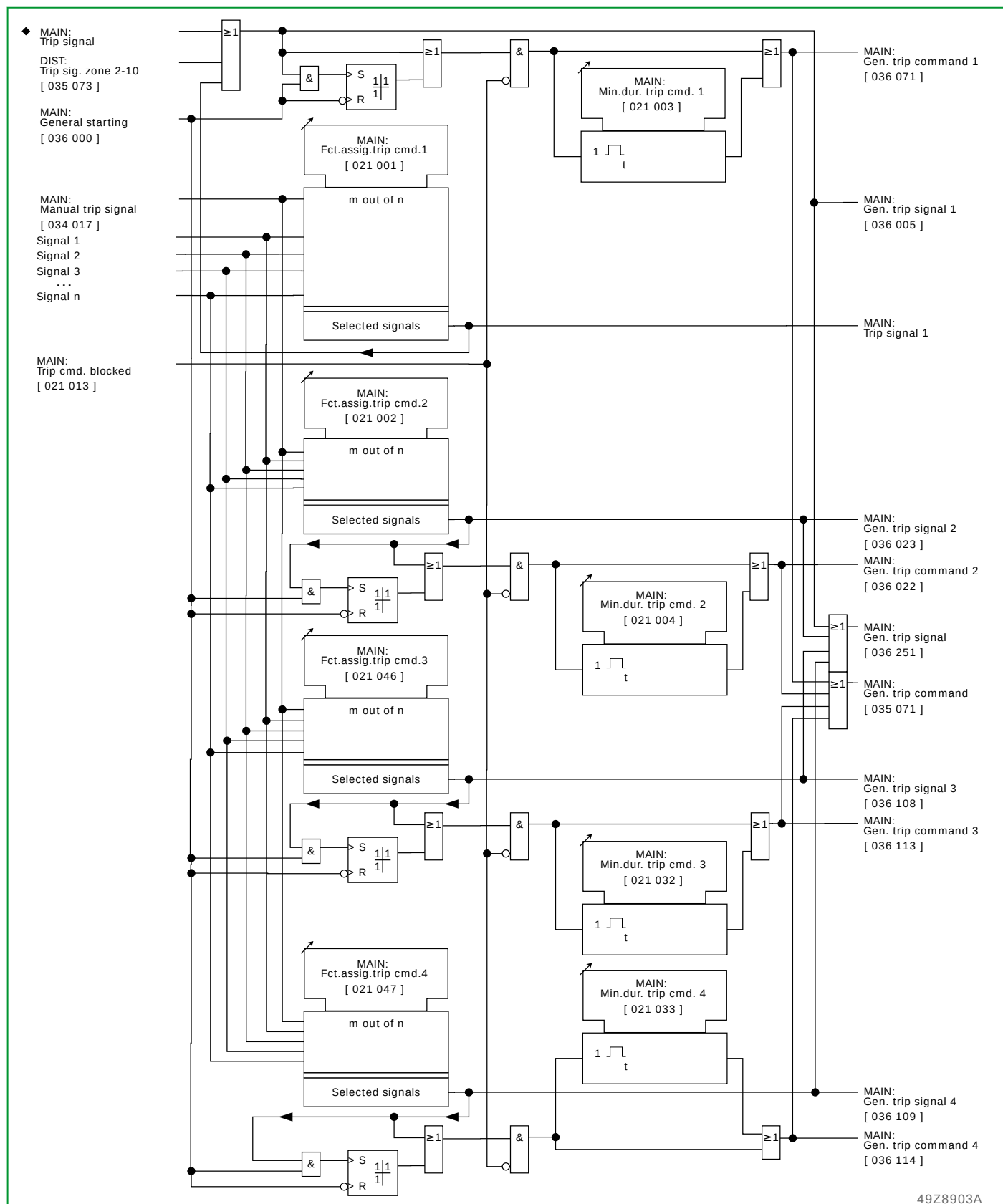


Fig. 3-84: Forming of trip commands.

3.13.15.2.1 Latching of the Trip Commands

Each of the trip commands can be individually set to operate in the latching mode. The following parameters are available for this setting: (via or , respectively).

- (021 023) MAIN: Latching trip cmd. 1
- (021 024) MAIN: Latching trip cmd. 2
- (021 025) MAIN: Latching trip cmd. 3
- (021 026) MAIN: Latching trip cmd. 4

The trip command, set to latch mode, will remain active until reset by parameter (MAIN: Rset.latch.trip USER) or reset through an appropriately configured binary signal input (MAIN: Reset latch.trip EXT).

3.13.15.2.2 Blocking of the Trip Commands

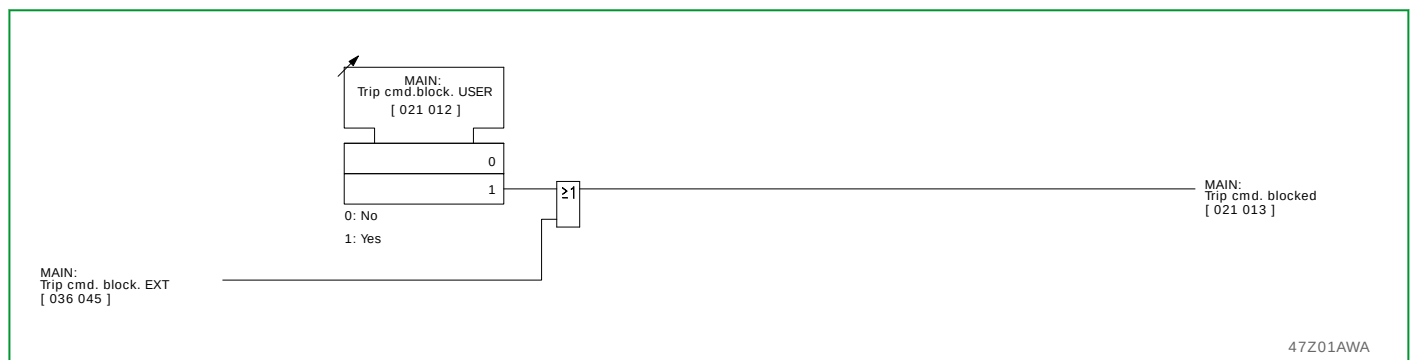


Fig. 3-85: Blocking of the trip commands.

The trip commands can be blocked via parameters or an appropriately configured binary signal input. This blocking is then effective for all trip commands. The trip signals are not affected by this blocking. If the trip commands are blocked, it is indicated by the continuously illuminated amber LED indicator H 2 on the local control panel and by a signal from an output relay configured to “Blocked/Faulty”.

3.13.15.2.3

Counter of Trip Commands

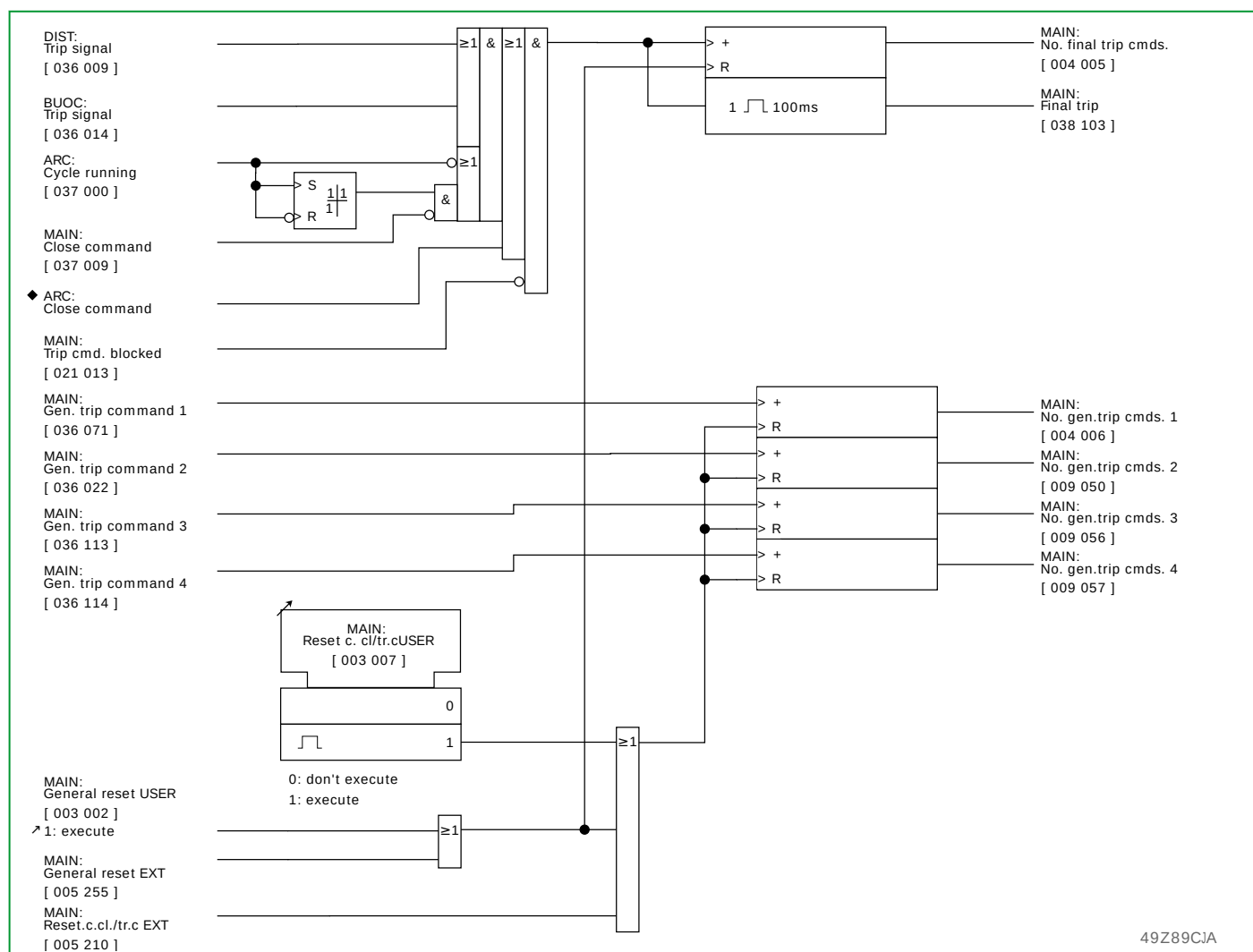


Fig. 3-86: Trip command counters.

The number of trip commands is counted (individually for each of the trip commands).

The counters can be reset either individually or as a group.

3.13.15.3

Direct Underreaching Transfer Trip

Direct transfer tripping independently of the protective signaling scheme logic (function group PSIG) is possible by using the following input signal:

- MAIN: Transfer trip. EXT

This feature makes it possible to use direct transfer tripping and any classical scheme logic (such as permissive or blocking schemes) concurrently.

3.13.15.4 Direct Transfer Trip

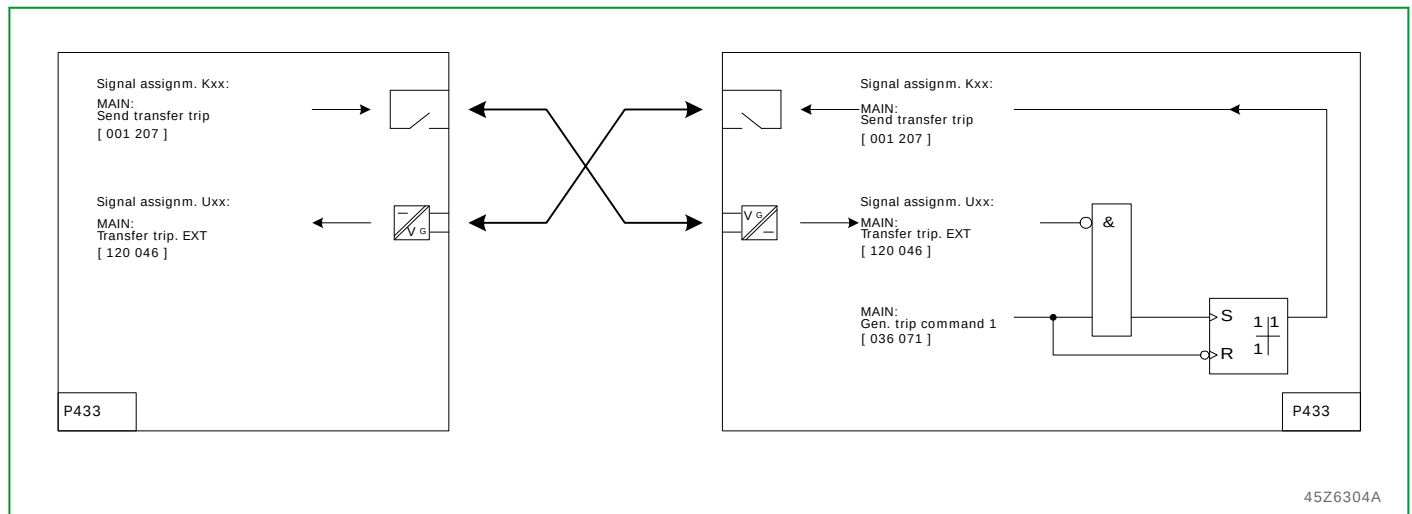


Fig. 3-87: 3-pole transfer trip.

There is a special send signal for the direct transfer trip of the switch at the remote end: MAIN: Send transfer trip. This send signal was designed for applications with bi-directional transfer tripping so as to avoid that, for instance, a transfer trip signal is sent only because such a transfer trip signal was received from the remote station.

With a 3-pole trip, the MAIN: Send transfer trip signal is sent as soon as the MAIN: Gen. trip command 1 signal has been issued, except when this trip command was caused by receiving the MAIN: Transfer trip. EXT signal (see Fig. 3-87, (p. 3-129)).

3.13.15.5 Manual Trip Command

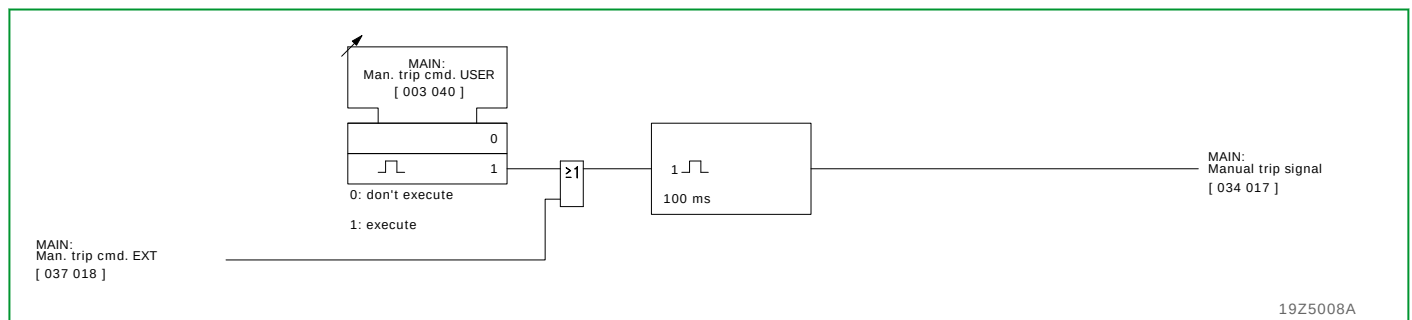


Fig. 3-88: Manual trip command.

A manual trip command may be issued via a parameter or a binary signal input configured accordingly, but it is not executed unless the manual trip is included in the selection of possible functions to cause a trip.

3.13.16

CB Trip Signal

The signal "CB tripped" depends on the mode of operation and is based on different events:

Mode of operation: "*ALSTOM D*" (MAIN: Oper. mode CB Trip, 221 080):

In this mode of operation, in addition the MAIN: CB trip internal (221 006) signal is formed.

The signal MAIN: CB trip internal is issued if the following conditions are met simultaneously:

- The binary signal input configured for "tripping" is set to a logic value of "1" or the selected trip command from the P433 is present.
- At the binary signal input configured as "CB trip" a logic value of "1" is present.

Mode of operation: "*W/o command*" (MAIN: Oper. mode CB Trip, 221 080):

The MAIN: CB tripped signal will only be issued, if the circuit breaker is tripping without any command issued by the P433. Commands via communication interfaces, local control panel or binary inputs are treated in the same manner. This mode of operation disables the MAIN: CB trip internal signal.

The CB trip signal of an external device can also be signaled. For this task, one input needs to be configured for "MAIN: Inp.asg.CB tr.en.ext", a further input for "MAIN: Inp.asg. CB trip ext".

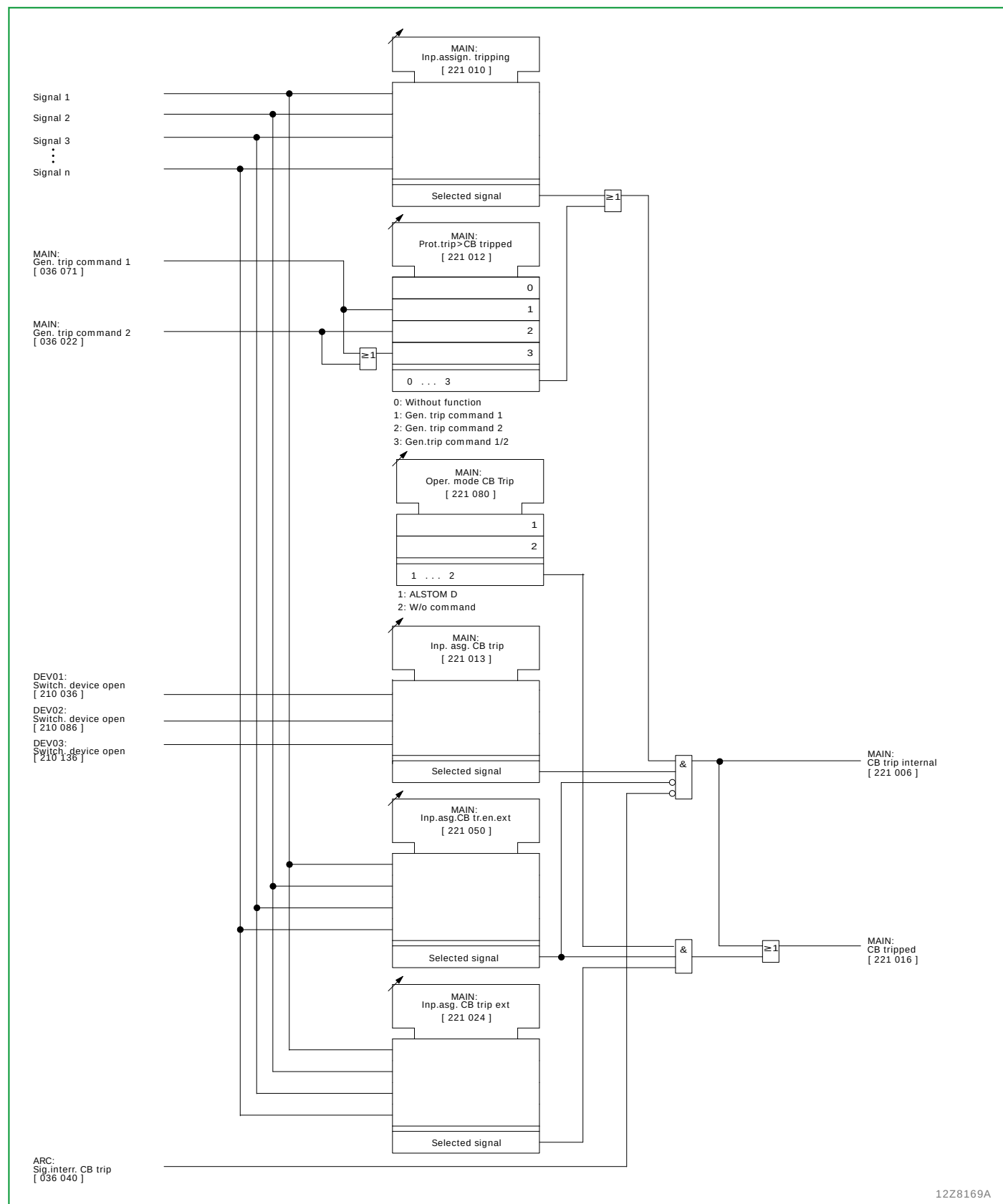


Fig. 3-89: CB trip signal.

3.13.17 Communication Error

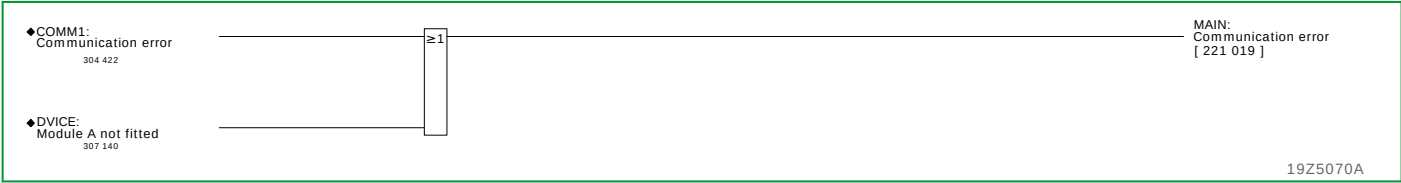


Fig. 3-90: Communication Error.

If a link to the control station cannot be established or if the link is interrupted, the signal “*Communication error*” will be issued. This signal will also be issued if communication module A is not fitted.

3.13.18 Time Tagging and Clock Synchronization

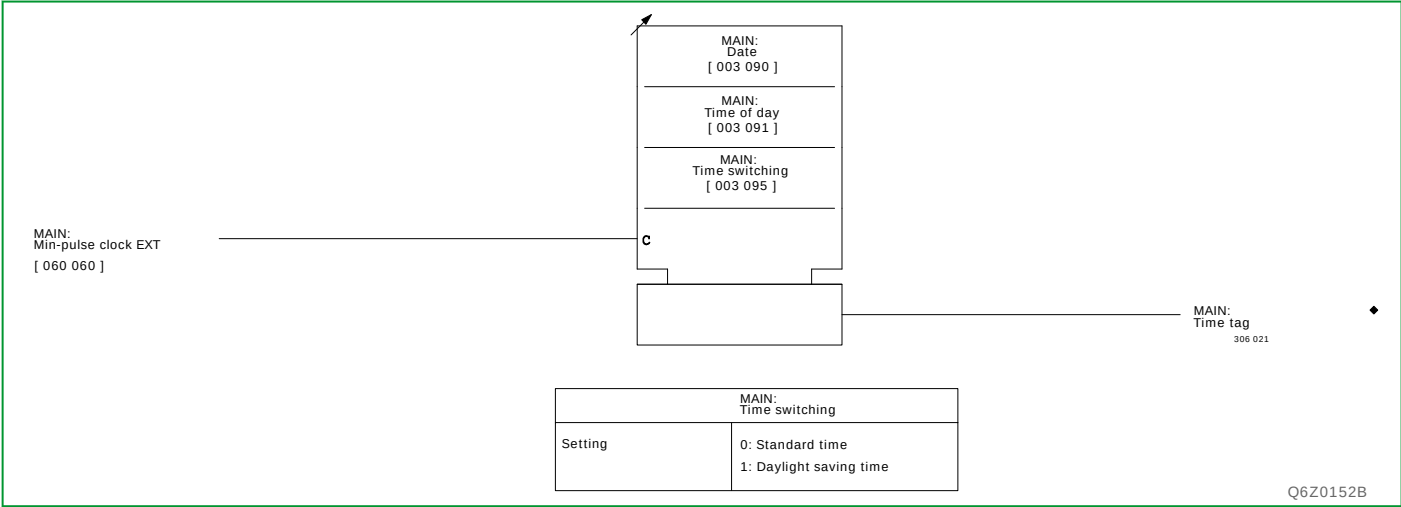


Fig. 3-91: Date/time setting and clock synchronization with minute pulses presented at a binary signal input.

Switching from standard to daylight saving time or back requires correct time setting frames from the time synchronization master (according the applied communication protocol).

The data stored in the operating data memory, the monitoring signal memory and the event memories are date- and time-tagged. For correct tagging, the date and time need to be set in the P433.

The time of different devices may be synchronized by a pulse given to an appropriately configured binary signal input. The P433 evaluates the rising edge. This will set the clock to the nearest full minute, rounding either up or down. If several start/end signals occur (bouncing of a relay contact), only the last edge is evaluated.

3.13.18.1

Synchronization Source

The P433 provides numerous options to synchronize the internal clock:

- Telegram with the time of day via the communication interface COMM1/IEC (full time)
- Telegram with the time of day via the communication interface COMM2/PC (full time)
- IRIG-B Signal (IRIGB; time of day only)
- Minute pulse presented at a binary signal input (MAIN), see [Fig. 3-91](#), (p. 3-132) and previous paragraph

With older P433 versions these interfaces had equal ranking i.e. clock synchronization was carried out regardless of which sub-function initiated triggering. No conflicts have to be taken into account as long as synchronization sources (communication master, IRIG-B and minute pulse source) operate at the same time of day. Should the synchronization sources operate with a different time basis unwanted step changes in the internal clock may occur. On the other hand a redundant time of day synchronization is often used so as to sustain time synchronization via IRIG-B interface even if and while the SCADA communication is out of service.

With the current P433 versions a primary and a backup source for time of day synchronization may now be set, where both provide the four options listed in the above.

MAIN: Prim.Source TimeSync

MAIN: BackupSourceTimeSync

With this feature synchronization occurs continuously from the primary source as long as time synchronization telegrams are received within a time-out period set at MAIN: Time sync. time-out The backup source is required if after the set time-out there is no synchronization through the primary source.

When selecting the time telegram via IEC as the primary source the P433 will expect time synchronization telegrams from server SNTP2 after server SNTP 1 has become defective, before it will switch over to the backup source.

Time synchronization occurs solely from the primary source when the time-out stage is blocked.

3.13.19

Resetting Actions

Stored data such as event logs, measured fault data etc, can be cleared in several ways. The following types of resetting actions are possible:

- Automatic resetting of the event signals provided by LED indicators (given that the LED operating mode has been set accordingly) and of the display of measured event data on the local control panel LCD whenever a new event occurs. In this case only the displays on the local control panel LCD are cleared but not the internal memories such as the fault memory.
- Resetting of LED indicators and measured event data displayed on the local control panel LCD by pressing the “Reset” key  located on the local control panel. By selecting the required function at LOC: Assignment reset key further memories may be assigned which will then also be cleared when the “Reset” key is pressed.
- Selective resetting of a particular memory type (e.g. only the fault memory) via setting parameters. (For this example: Navigate to menu point FT_RC: Reset record. USER and set to *execute*, see also the exact step-by-step description in [Section 6.14.8, \(p. 6-48\)](#).)
- Selective resetting of a particular memory type (e.g. only the fault memory) through appropriately configured binary signal inputs. (For this example: Assign parameter FT_RC: Reset record. EXT to the relevant binary signal input e.g. INP: Fct. assignm. U 301 .)
- Group resetting by setting parameters, by navigating to menu point MAIN: Group reset 1 USER (or MAIN: Group reset 2 USER) and setting it to *execute*. For this the relevant memories (i.e. those to be reset) must be assigned to parameter MAIN: Fct.assign. reset 1 (or MAIN: Fct.assign. reset 2, resp.)
- Group resetting through appropriately configured binary signal inputs. (That is assign parameter MAIN: Group reset 1 EXT (or MAIN: Group reset 2 EXT) to the relevant binary signal input, e.g. INP: Fct. assignm. U 301 after memories to be reset have been assigned to parameter MAIN: Fct.assign. reset 1 (or MAIN: Fct.assign. reset 2).
- General resetting by setting parameters (menu point MAIN: General reset USER). All memories, counters, events etc. are reset without any special configuration options.
- General resetting through appropriately configured binary signal inputs. (MAIN: General reset EXT is assigned to the relevant binary signal input.) All memories, counters, events etc. are reset without any special configuration options.

Should several resetting actions have been configured for one particular memory then they all have equal priority.

In the event of a cold restart or simultaneous failure of both internal battery and substation auxiliary supply, all stored counter values will be lost.

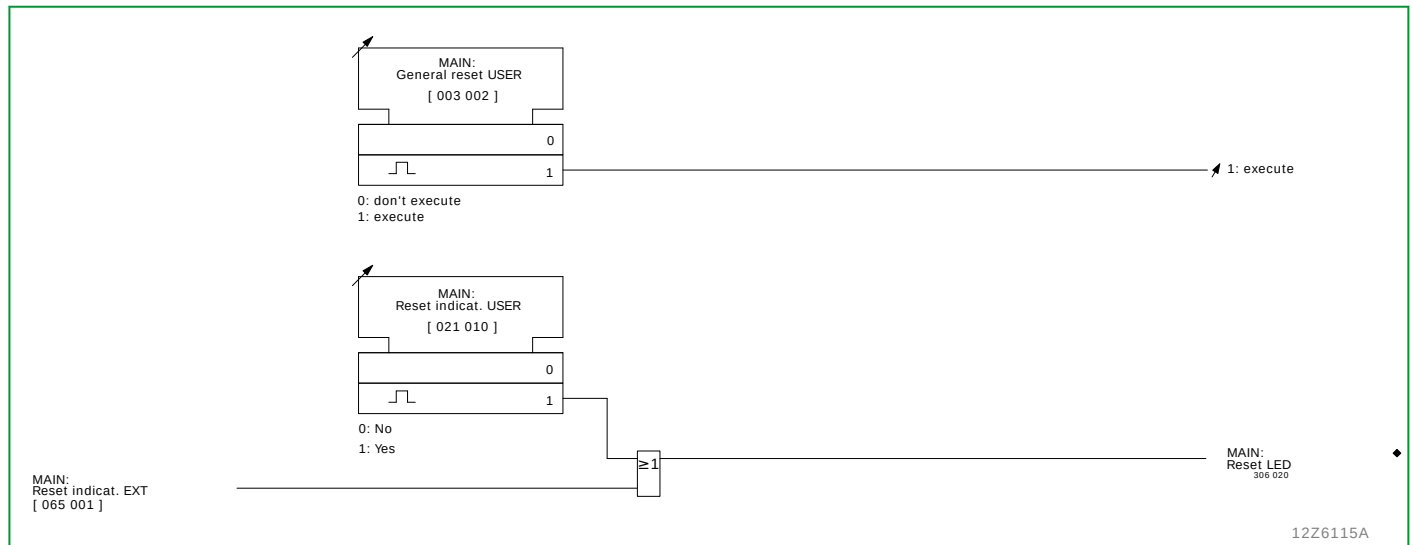


Fig. 3-92: General reset, LED reset and measured event data reset from the local control panel.

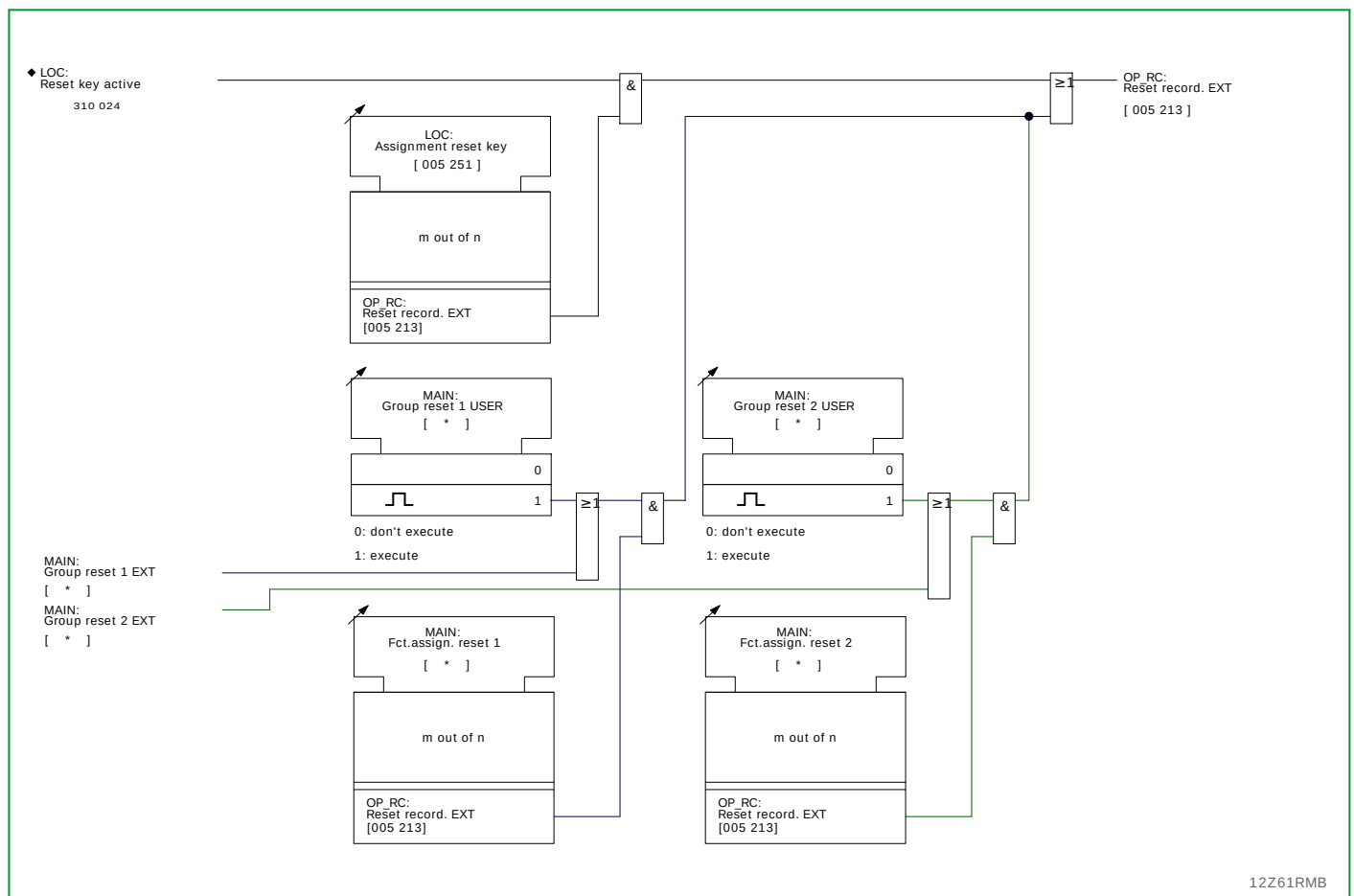


Fig. 3-93: "Reset" key on the local control panel and, as an example, group resetting of the operating data recording (e.g. as an example for the reset signal OP_RC: Reset record. EXT).

A complete list of all resetting parameters that can be used in the way shown in [Fig. 3-93, \(p. 3-135\)](#) can be obtained from the separately available DataModelExplorer: Look up the setting parameter MAIN: Fct.assign. reset 1 in the file *P433-671_en_Addresses.pdf*, and there follow the link to the referenced config. table.

3.13.19.1

Resetting Actions through Keys on the Local Control Panel

Further resetting possibilities are basically not distinct resetting actions but make access especially easy to one of the resetting actions described above i.e. by configuring them to a function key.

- Function keys may be configured such that resetting of a specific memory is assigned. Technically this is similar to resetting through an appropriately configured binary signal input. When a function key is pressed a signal to a binary signal input is simulated. (See [Section 3.7, \(p. 3-60\)](#).)
- Alternatively one can assign one of the two menu jump lists (LOC: Trig. menu jmp 1 EXT or LOC: Trig. menu jmp 2 EXT) to a function key and include the relevant resetting action in the definition (LOC: Fct. menu jmp list 1 or LOC: Fct. menu jmp list 2) of the selected menu jump list.
- The same may be achieved with the “READ” (🔍) key by assigning it a menu point for a resetting action through LOC: Assignment read key.

3.13.20

Assigning Communications Interfaces to Physical Communications Channels

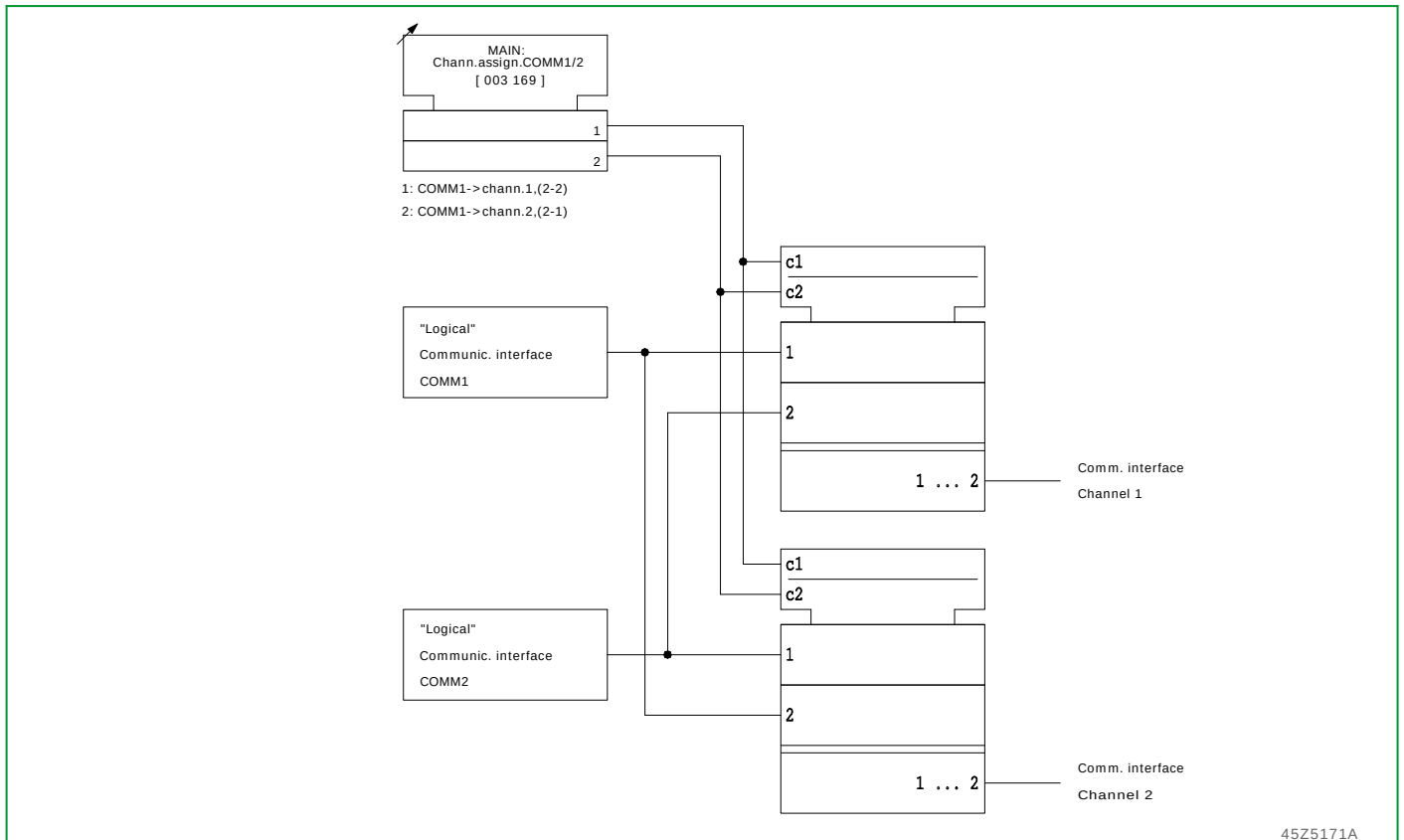


Fig. 3-94: Assignment of communication interfaces to physical communication channels.

Depending on the design version of the communications module A there are up to two communications channels available (see “Technical Data”, [Chapter 2, \(p. 2-1\)](#)). These physical communications channels may be assigned to communications interfaces COMM1 and COMM2.

If communications interface COMM1 is assigned to communications channel 2, then the settings of communications interface COMM2 are automatically assigned to communications channel 1.

COMM2 can only be used to transmit data to and from the P433 if its PC interface has been de-activated. As soon as the PC interface is used to transmit data, COMM2 becomes “dead”. It will only be enabled again when the “time-out” period for the PC interface has elapsed.

3.13.21 Test Mode

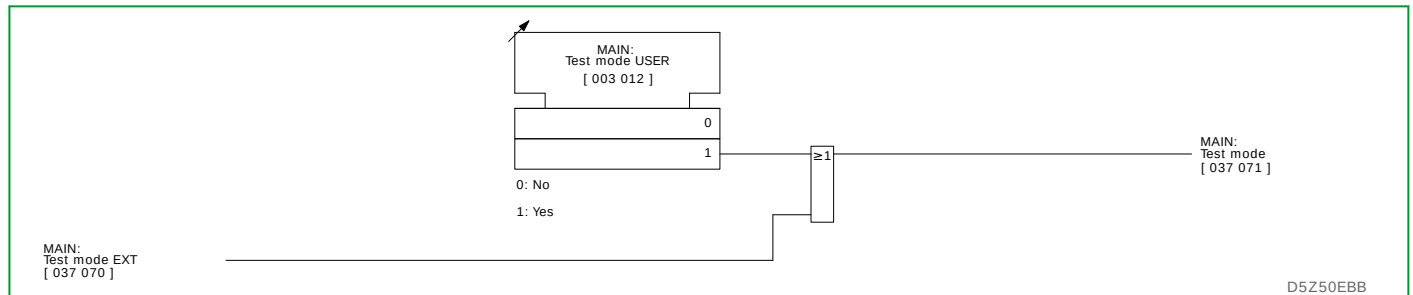


Fig. 3-95: Setting the test mode.

If tests are run on the P433, the user is advised to activate the test mode so that all incoming signals via the serial interfaces will be identified accordingly.

3.14 Parameter Subset Selection (Function Group PSS)

With the P433, four independent parameter subsets may be pre-set. The user may switch between parameter subsets during operation without interrupting the protection function.

Selecting the Parameter Subset

The control path determining the active parameter subset (function setting or binary signal input) may be selected via the function setting PSS: Control via USER or via the external signal PSS: Control via user EXT. Correspondingly, the parameter subset is selected either in accordance with the pre-set function setting PSS: Param.subs.sel. USER or in accordance with external signals. Which parameter subset is actually active at a particular time may be determined by scanning the logic state signals PSS: Actual param. subset or PSS: PS 1 active.

Selecting the Parameter Subset via Binary Inputs

If the binary signal inputs are to be used for parameter subset selection, then the P433 first checks to determine whether at least two binary inputs are configured for parameter subset selection. If this is not the case, then the parameter subset selected via the function setting will be active. The P433 also checks whether the signals present at the binary signal inputs allow an unambiguous parameter subset selection. This is only true when only one binary signal input is set to a logic level of "1". If more than one signal input is set to a logic level of "1", then the parameter subset previously selected remains active. Should a dead interval occur while switching between parameter subsets (this is the case if all binary signal inputs have a logic level of "0"), then the stored hold time is started. While this timer stage is running, the previously selected parameter subset remains active. As soon as a signal input has a logic level of "1", the associated parameter subset becomes active. If, after the stored time has elapsed, there is still no signal input with a logic level of "1", the parameter subset selected via the function parameter becomes active.

If, after the supply voltage is turned on, no logic level of "1" is present at any of the binary signal inputs selected for the parameter subset selection, then the parameter subset selected via the function parameter will become active once the stored time has elapsed. The previous parameter subset remains active while the stored hold timer stage is running.

Parameter subset selection may also occur during a starting condition. When subset selection is handled via binary signal inputs, a maximum inherent delay of approximately 100 ms must be taken into account.

Settings for which only one address is given in the following sections are equally effective for all four parameter subsets.

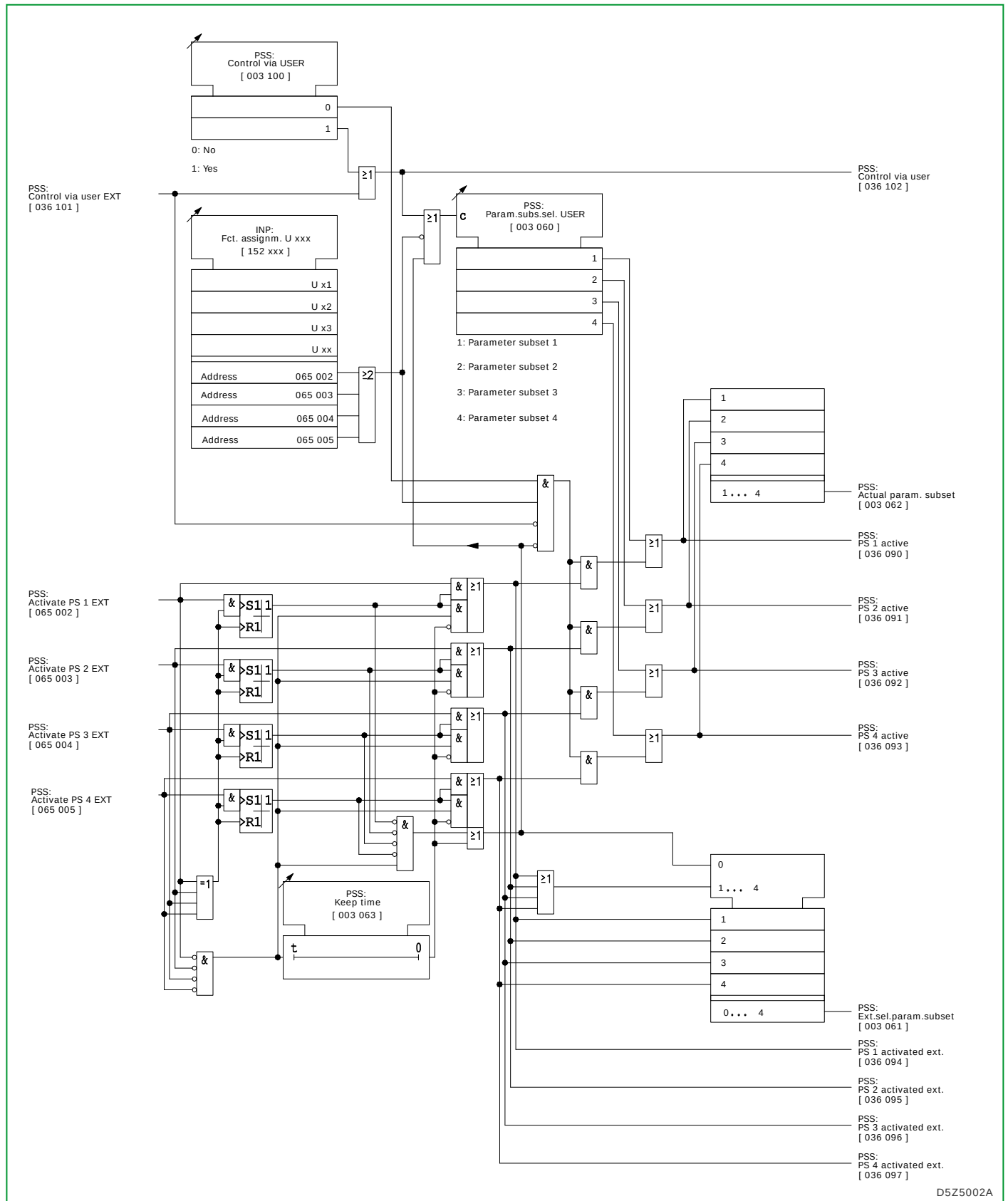


Fig. 3-96: Activating the parameter subsets.

3.15 Self-Monitoring (Function Group SFMON)

Comprehensive monitoring routines in the P433 ensure that internal faults are detected and do not lead to malfunctions. The selection of function assignments to the alarm signal includes, among others, self-monitoring signals from the communications monitor, measuring-circuit monitoring, open-circuit monitoring and the logic outputs.

3.15.1 Tests During Start-up

After the supply voltage has been turned on, various tests are carried out to verify full operability of the P433. If the P433 detects a fault in one of the tests, then start-up is terminated. The display shows which test was running when termination occurred. No control actions may be carried out. A new attempt to start up the P433 can only be initiated by turning the supply voltage off and then on again.

3.15.2 Cyclic Tests

After start-up has been successfully completed, cyclic self-monitoring tests will be run during operation. In the event of a positive test result, a specified monitoring signal will be issued and stored in a non-volatile(NV) memory – the monitoring signal memory – along with the assigned date and time (see [Section 3.17, \(p. 3-144\)](#)).
The self-monitoring function monitors the built-in battery for any drop below the minimum acceptable voltage level. If the associated monitoring signal is displayed, then the power supply module should be replaced within a month, since otherwise there is the danger of data loss if the supply voltage should fail. [Section 12.1, \(p. 12-2\)](#) gives further information on maintenance procedures.

3.15.3 Signals

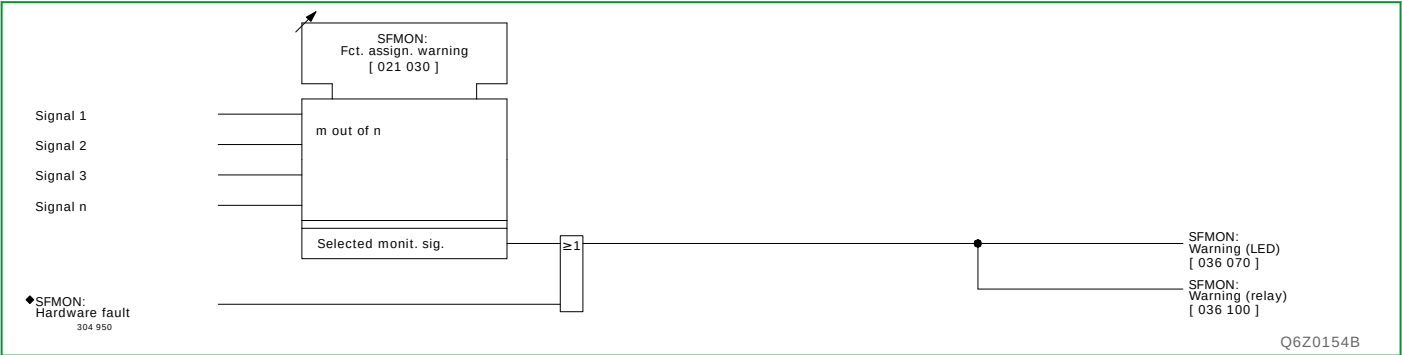


Fig. 3-97: Monitoring signals.

The monitoring signals are also signaled via the output relay configured SFMON: Warning (relay). The output relay operates as long as an internal fault is detected.

Note: It is strongly recommended to use an output relay of the power supply module for signaling “blocked/faulty” state (so-called watchdog relay).

3.15.4 Device Response

The response of the P433 is dependent on the type of monitoring signal. The following responses are possible:

- Signaling Only

If there is no malfunction associated with the monitoring signal, then only a signal is issued, and there are no further consequences. This situation exists, for example, when internal data acquisition memories overflow.

- Selective Blocking

If a fault is diagnosed solely in an area that does not affect the protective functions, then only the affected area is blocked. This would apply, for example, to the detection of a fault on the communication module or in the area of the PC interface.

- Warm Restart

If the self-monitoring function detects a fault that might be eliminated by a system restart – such as a fault caused by excessive electro-magnetic interference –, then a procedure called a warm restart is automatically initiated. During this procedure, as with any start-up, the computer system is reset to a defined state. A warm restart is characterized by the fact that no stored data and, in particular, no setting parameters are affected by the procedure. A warm restart can also be triggered manually by control action. During a warm restart sequence the protective functions and the communication through serial interfaces will be blocked.

If the same fault is detected after a warm restart has been triggered by the self-monitoring system within the set SFMON: Mon.sig. retention, then the protective functions remain blocked but communication through the serial interfaces will usually be possible again.

If a corrupted setting is diagnosed during the checksum test, which is part of the self-monitoring procedure, settings are restored from an internal back-up memory. Nevertheless, in order to get the device back to well defined operation conditions a warm restart is executed.

For any warm restart initiated by self-monitoring, the root cause (alarm event) is logged in the monitoring buffer.

- Cold Restart

In case the recovery of corrupted settings failed (e.g. because of an electrical defect of the memory chip), then a cold restart is carried out. This is necessary because the P433 cannot identify which parameter in the subset is corrupted. A cold restart causes all internal memories to be reset to a defined state. This means that all the protection device settings are also erased after a cold restart. In order to establish a safe initial state, the default values have been selected so that the protective functions are blocked. Both the monitoring signal that triggered the cold restart and the value indicating parameter loss are entered in the monitoring signal memory.

A cold restart can also be triggered manually by control action (to intentionally erase all memories and reset the device to default settings).

3.15.5 Monitoring Signal Memory

Depending on the type of internal fault detected the P433 will respond by trying to eliminate the problem with a warm restart. (See above; for further details read also about P433 behavior with problems in [Chapter 11, \(p. 11-1\)](#).) Whether or not this measure will suffice can only be determined if the monitoring signal has not already been stored in the monitoring signal memory because of a previous fault. If it was already stored and a second fault is detected then, depending on the type of fault detected, the P433 will be blocked after the second warm restart.

In order to better monitor this behavior the parameter at SFMON: Mon.sig. retention is applied. This parameter may either be set to '*Blocked*' or to a time duration (in hours). (It is, however, discouraged to set it to 0, because in this case, there would be no blocking at all, so that there would be the danger of maloperation in case of a permanent failure.)

The default for this timer stage is *Blocked*, i.e. blocking of the protection device with two identical faults occurs independently of the time elapsed since the first fault monitoring signal was issued.

The behavior caused by sporadic faults could lead to an unwanted blocking of the P433 if the monitoring signal memory had not been reset in the interim, for example, because the substation is difficult to reach in wintertime or reading-out and clearing of the monitoring signal memory via the communication interfaces was not enabled. To defuse this problem it is suggested to set the function parameter to a specific time period so that blocking will only occur if the same fault occurs again within this time period. Otherwise, the P433 will continue to operate normally after a warm restart.

3.15.6 Monitoring Signal Memory Time Tag

The time when the device fault occurred last is recorded.

3.16 Operating Data Recording (Function Group OP_RC)

For the continuous recording of processes in system operation as well as of events, a battery backed memory is provided (cyclic buffer). The “operationally relevant” signals, each fully tagged with date and time at signal start and signal end, are entered in chronological order. The signals relevant for operation include control actions such as function disabling and enabling and triggers for testing and resetting. The start and end of system loggings and recordings that represent a deviation from normal operation such as overloads, ground faults or short-circuits are also recorded. The overload or fault events itself are stored in the relevant event recordings only. The operating data memory can be cleared/reset.

Counter for Signals Relevant to System Operation

The signals stored in the operating data memory are counted.

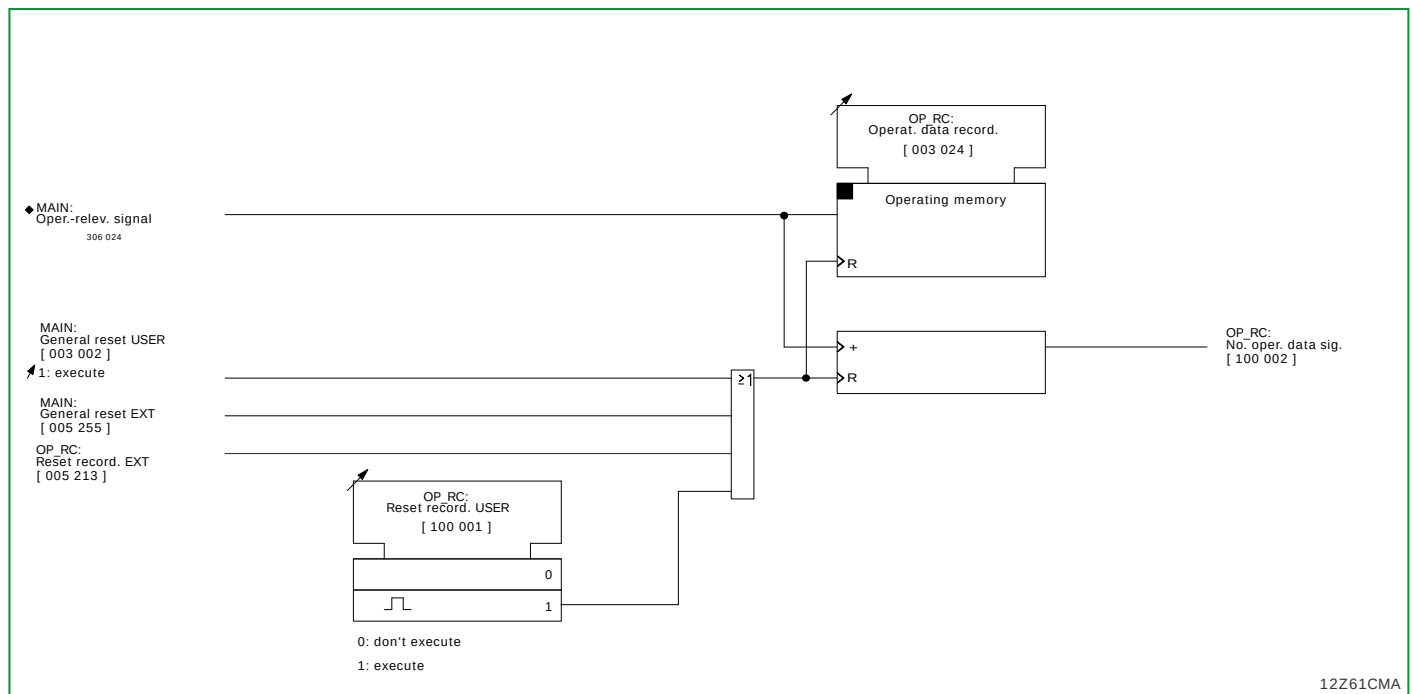


Fig. 3-98: Operating data recording and counter for signals relevant to system operation.

3.17 Monitoring Signal Recording (Function Group MT_RC)

The monitoring signals generated by the self-monitoring function are recorded in the monitoring signal memory. The memory buffer allows for a maximum of 30 entries. If more than 29 monitoring signals occur without interim memory clearance, the SFMON: Overflow MT_RC signal is entered as the last entry. Monitoring signals prompted by a hardware fault in the unit are always entered in the monitoring signal memory. Monitoring signals prompted by a peripheral fault can be entered into the monitoring signal memory, if desired. The user can select this option by setting an “m out of n” parameter (see [Section 3.15, \(p. 3-140\)](#)).

If at least one entry is stored in the monitoring signal memory, this fact is signaled by the red LED indicator H 3 on the local control panel. Each new entry causes the LED to flash (on/off/on....).

The monitoring signal memory can only be cleared manually by a control action. Entries in the monitoring signal memory are not cleared automatically, even if the corresponding test in a new test cycle now shows the P433 to be healthy. The contents of the monitoring signal memory can be read from the local control panel or through the PC or communication interface. The time and date information assigned to the individual entries can be read out through the PC or communication interface or from the local control panel.

Monitoring Signal Counter

The number of entries stored in the monitoring signal memory is displayed on the monitoring signal counter (MT_RC: No. monit. signals).

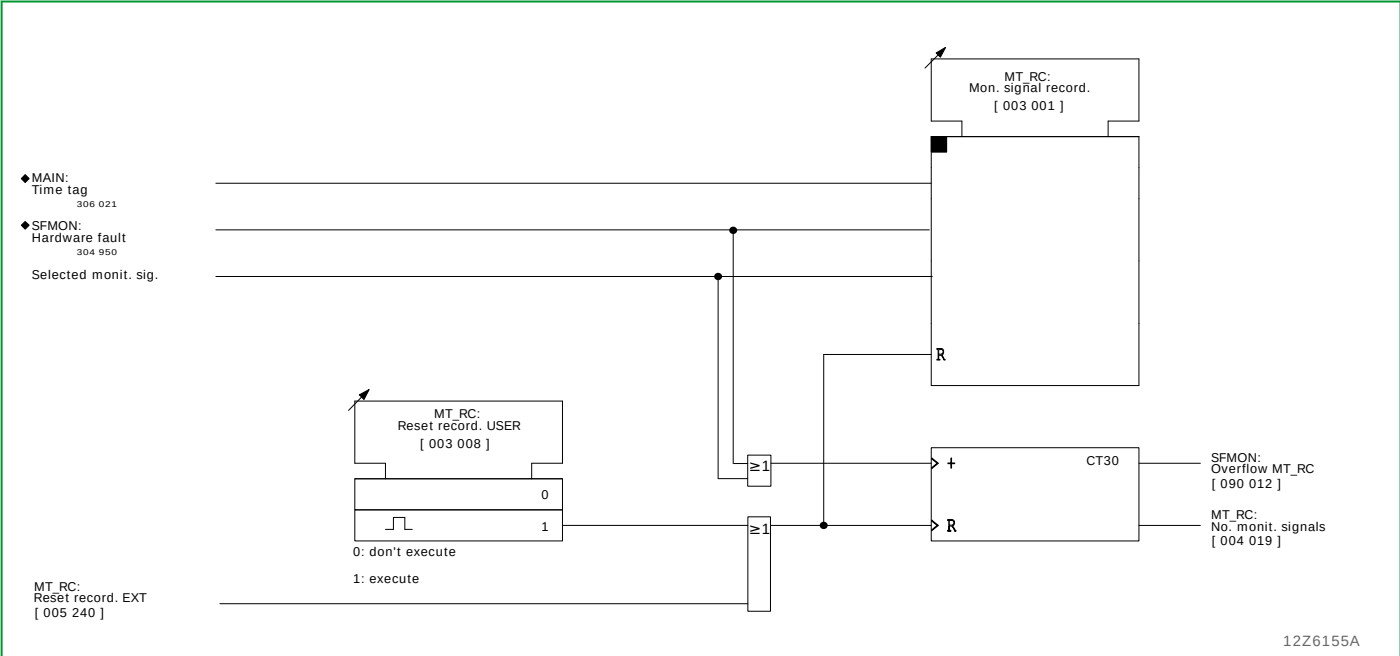


Fig. 3-99: Monitoring signal recording and the monitoring signal counter.

3.18 Overload Data Acquisition (Function Group OL_DA)

3.18.1 Overload Duration

In the event of an overload, the P433 determines the overload duration. The overload duration is defined as the time between the start and end of the OL_RC: Record. in progress signal.

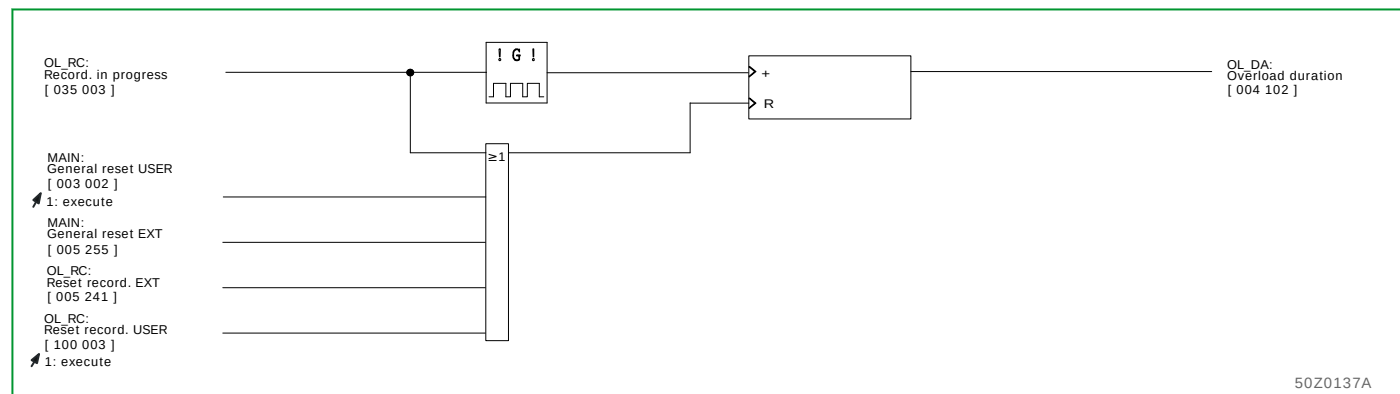


Fig. 3-100: Overload duration.

3.18.2 Acquiring Measured Overload Data from the Thermal Overload Protection

Measured overload values are derived from the thermal overload protection's measured operating data. They are stored at the end of an overload event.

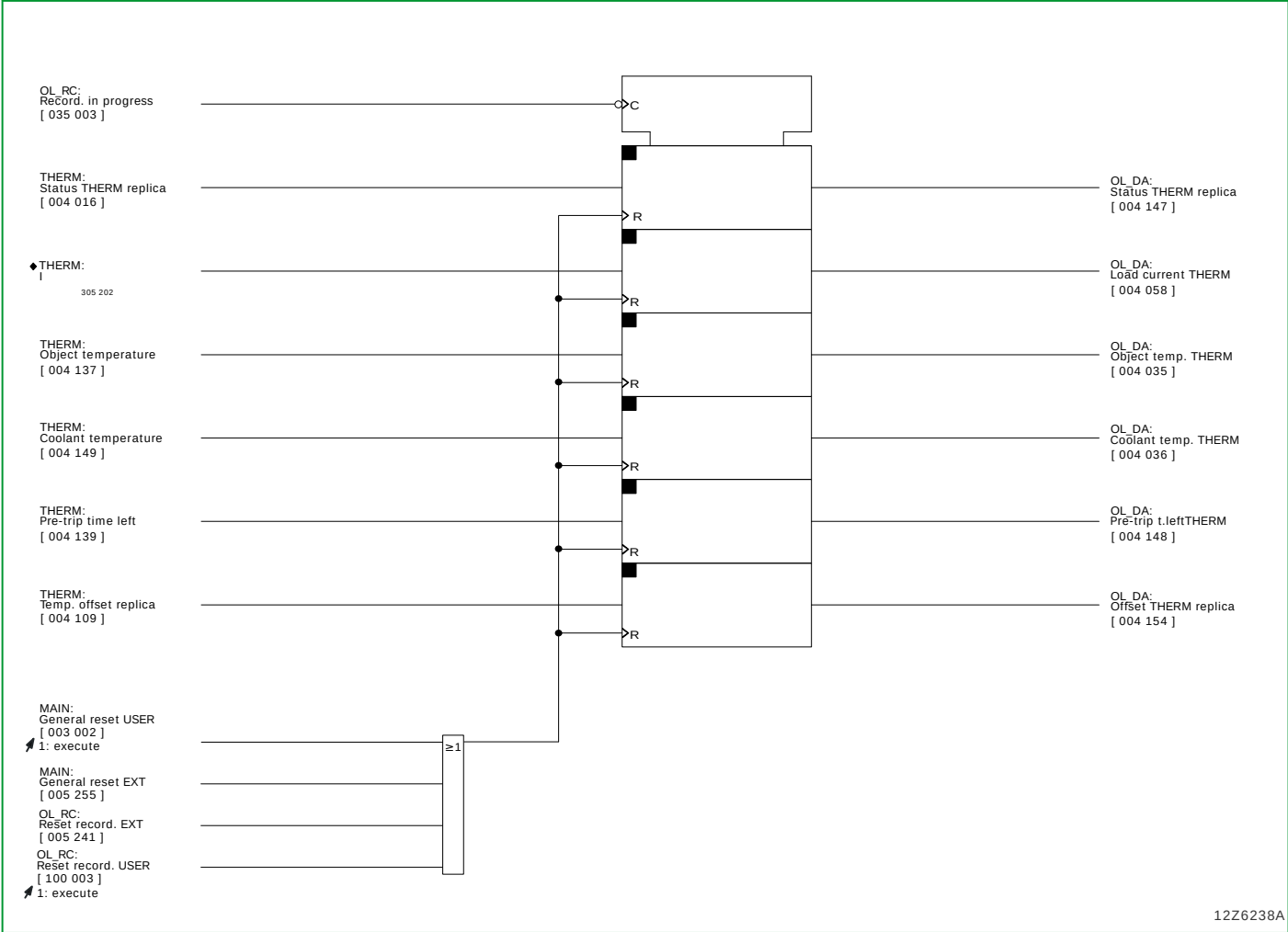


Fig. 3-101: Measured overload values from the thermal overload protection.

3.19 Overload Recording (Function Group OL_RC)

3.19.1 Start of Overload Recording

An overload exists – and consequently overload recording begins – if at least the signal THERM: Starting $k \cdot I_{ref}$ is issued.

3.19.2 Counting Overload Events

Overload events are counted and identified by sequential numbers.

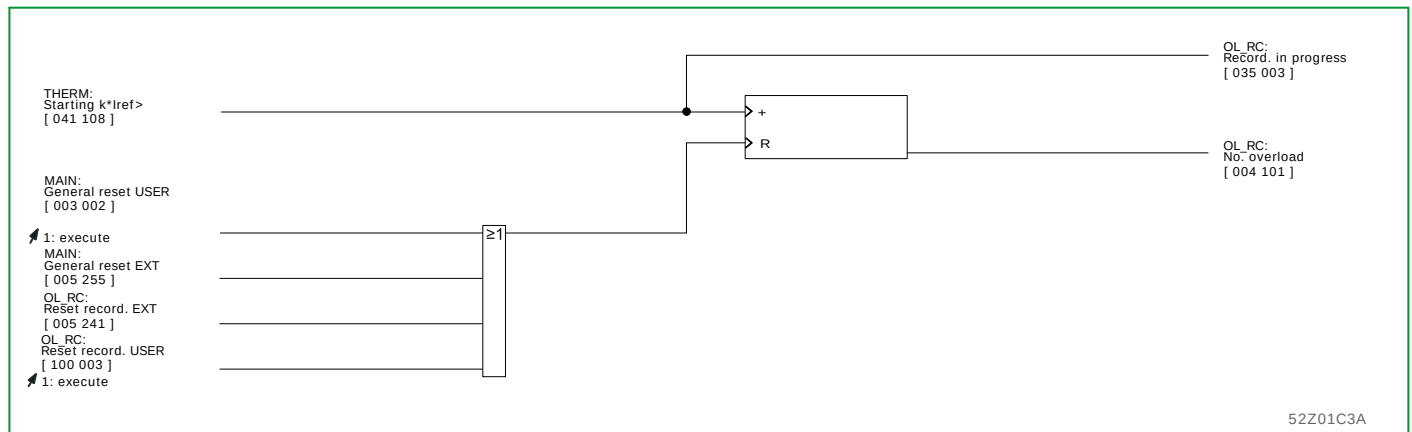


Fig. 3-102: Counting overload events.

3.19.3 Time Tagging

The date of each overload event is stored. The overload start or end signals are likewise time-tagged by the internal clock. The date and time assigned to an overload event when the event begins can be read out from the overload memory on the local control panel or through the PC and communication interfaces. The time information (relative to the onset of the overload) can be retrieved from the overload memory or through the PC or one of the communication interfaces.

3.19.4 Overload Logging

Protection signals during an overload event are logged in chronological order with reference to the specific event. A total of eight overload events, each involving a maximum of 200 start or end signals, can be stored in the non-volatile overload memories. After eight overload events have been logged, the oldest overload log will be overwritten, unless memories have been cleared in the interim. If more than 199 start or end signals have occurred during a single overload event, then OL_RC: Overl. mem. overflow will be entered as the last signal.

In addition to the signals, the measured overload data will also be entered in the overload memory.

The overload logs can be read from the local control panel or through the PC or communication interfaces.

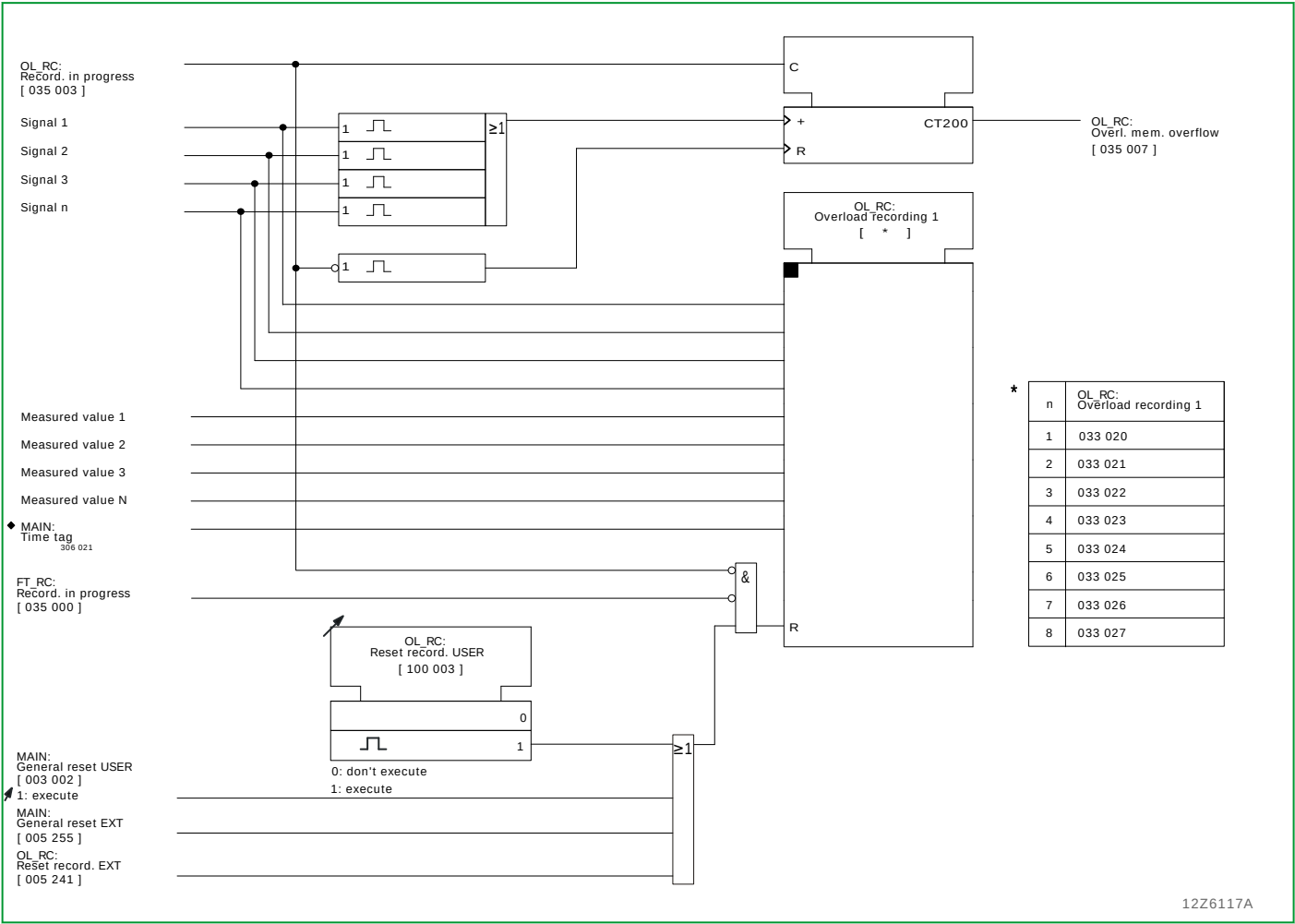


Fig. 3-103: Overload memory.

3.20 Ground Fault Data Acquisition (Function Group GF_DA)

In the event of a ground fault, the P433 acquires the following measured ground fault data:

- Duration of ground fault recording
- When ground fault direction determination using steady-state values (GFDSS) is enabled
 - Duration of the ground fault with steady state value evaluation, steady state power evaluation or admittance evaluation
 - Neutral-point displacement voltage V_{NG} with steady state value evaluation or admittance evaluation
 - Residual current I_N
 - Active component of the residual current as determined by steady state power evaluation
 - Reactive component of the residual current as determined by steady state power evaluation
 - Filtered ground fault from steady state power evaluation
 - Admittance, conductance and susceptance with admittance evaluation.

3.20.1 Resetting Measured Ground Fault Data

After pressing the reset key (clear key in 24 TE case) on the local control panel, the measured ground fault data value is displayed as *Not measured*. However, the values are not erased and can continue to be read out through the PC and communication interfaces.

3.20.2 Duration of Ground Fault Recording

The duration of ground fault recording is defined as the time between the start and end of the GF_RC: Record. in progress signal.

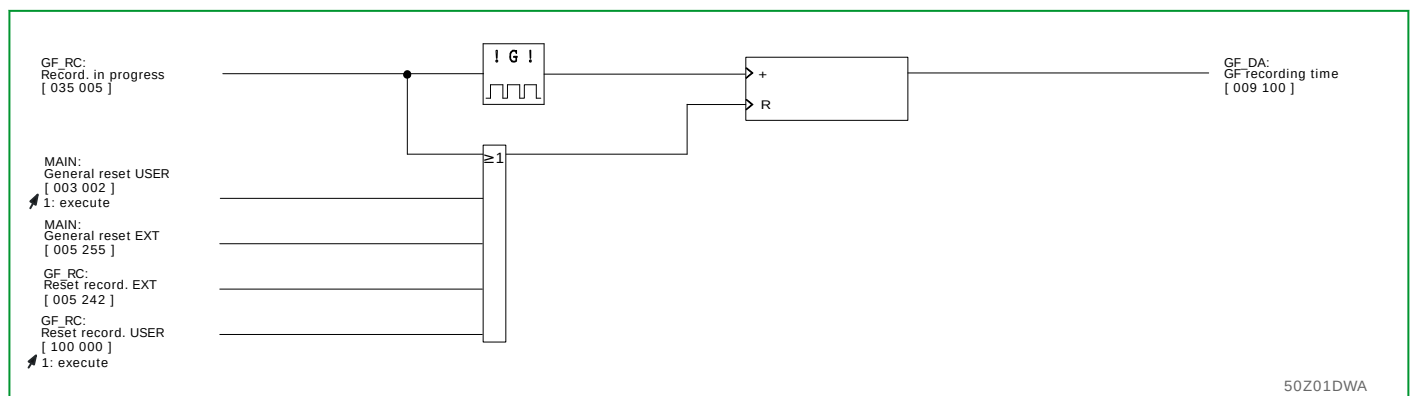


Fig. 3-104: Duration of ground fault recording.

3.20.3 Measured Ground Fault Data from Steady-State Value Evaluation

3.20.3.1 Ground Fault Duration

The ground fault duration is defined as the time between operation and dropout of the GFDSS: VNG > PSx trigger. However, a time is only output after the end of the ground fault if the GFDSS: VNG > PSx trigger has operated for at least the duration of set timer stage GFDSS: tVNG > PSx. Once GFDSS: tVNG > PSx has elapsed the display of the ground fault duration for the last ground fault is cleared automatically.

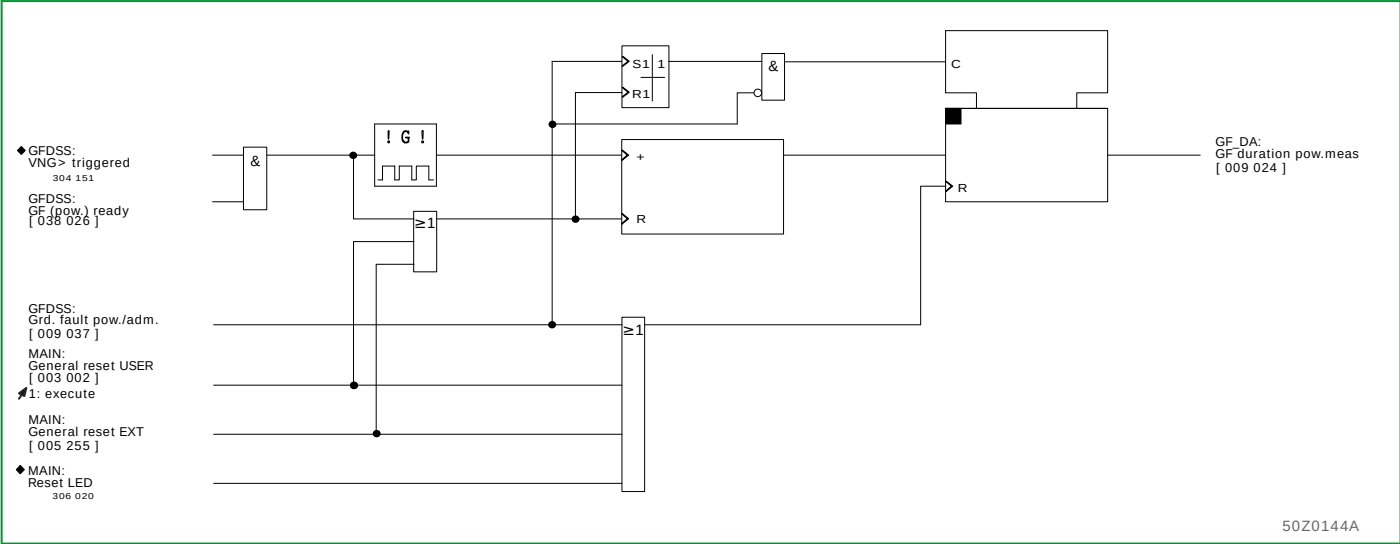


Fig. 3-105: Measurement and storage of the ground fault duration from steady state power evaluation.

3.20.3.2 Residual Current

The residual current flowing when timer stage GFDSS: $t_{VNG} > PSx$ elapses is stored in memory. Also stored is the active and reactive component of the residual current determined at the time when the directional decision is output. All measured values are output as per-unit quantities referred to the P433's nominal current I_{nom} .

3.20.3.3 Neutral-Point Displacement Voltage

The neutral-point displacement voltage present when timer stage GFDSS: $t_{VNG} > PSx$ elapses is stored in memory.

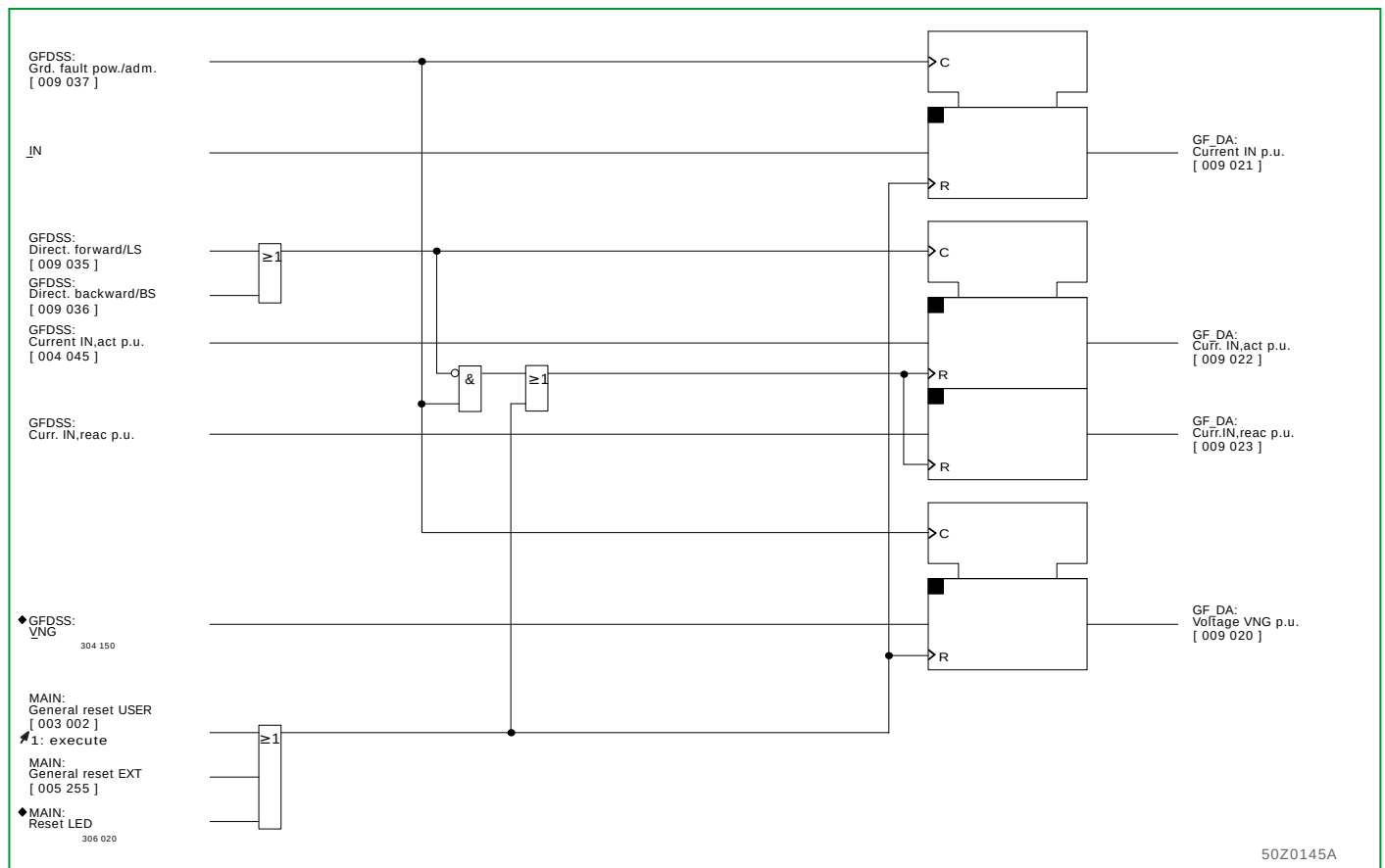


Fig. 3-106: Residual current and neutral-point displacement voltage from steady state value evaluation.

3.20.4 Measured Ground Fault Data from Steady-State Power Evaluation

3.20.4.1 Ground Fault Duration

The ground fault duration is defined as the time between operation and dropout of the GFDSS: IN > PSx trigger. However, a time is only output after the end of the ground fault if the GFDSS: IN > PSx trigger has operated for at least the duration of the set operate delay (GFDSS: Operate delay IN PSx). Once the operate delay has elapsed, the display of the ground fault duration of the last ground fault is automatically cleared.

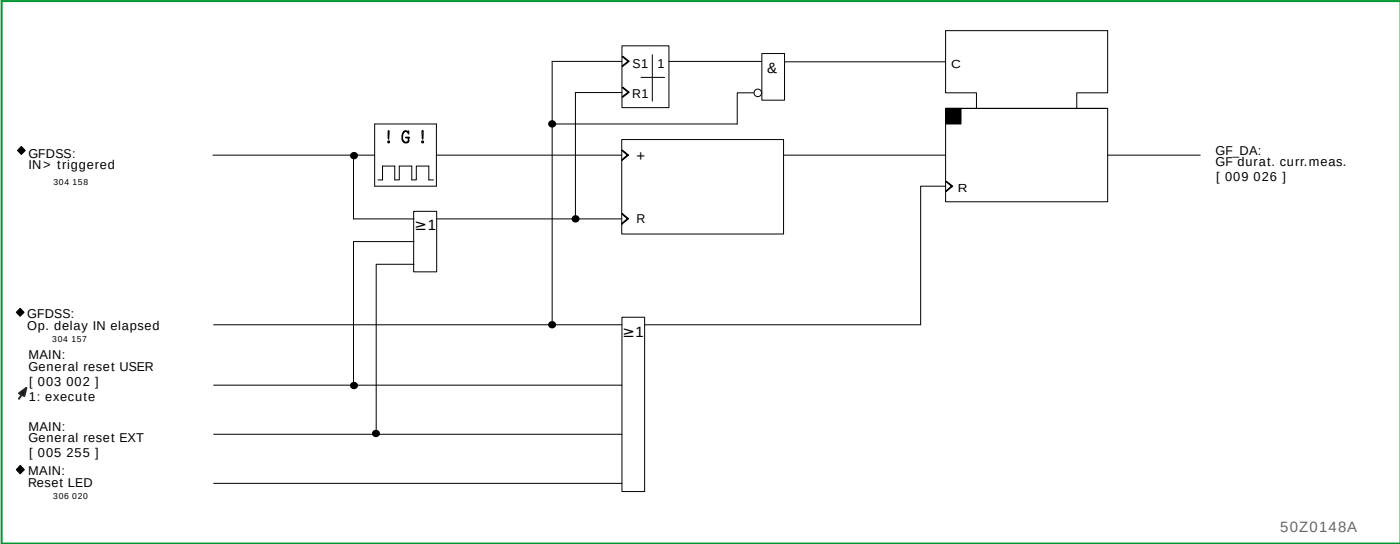


Fig. 3-107: Measurement and storing the ground fault duration as determined by steady state current evaluation.

3.20.4.2 Residual Current

The unfiltered and filtered residual currents that are present when the operate delay elapses (GFDSS: Operate delay IN PSx) are stored.

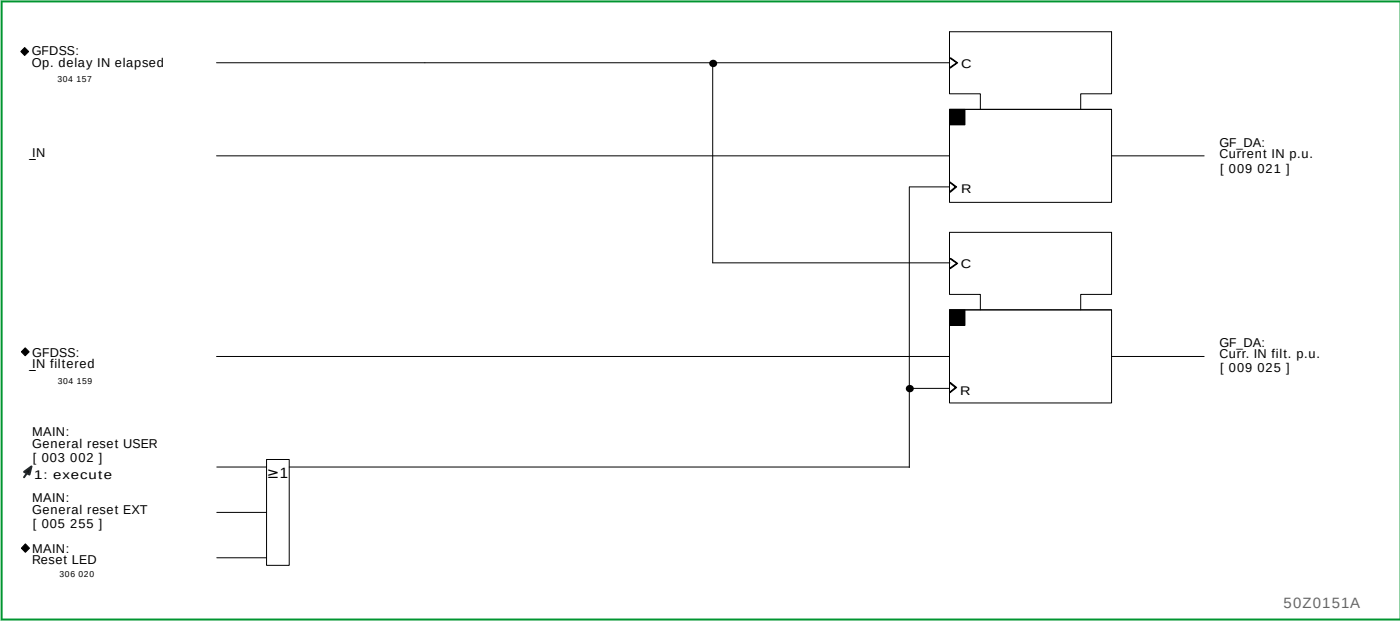


Fig. 3-108: Ground fault as determined by steady state current evaluation.

3.20.5 Measured Ground Fault Data from Admittance Evaluation

Ground Fault Duration

The ground fault duration is defined as the time between operation and dropout of the GFDSS: VNG > PSx trigger. A time value will only be issued if the trigger GFDSS: VNG > PSx has operated for at least the timer period set at GFDSS: tVNG > PSx. Once GFDSS: tVNG > PSx has elapsed the display of the ground fault duration for the last ground fault is cleared automatically.

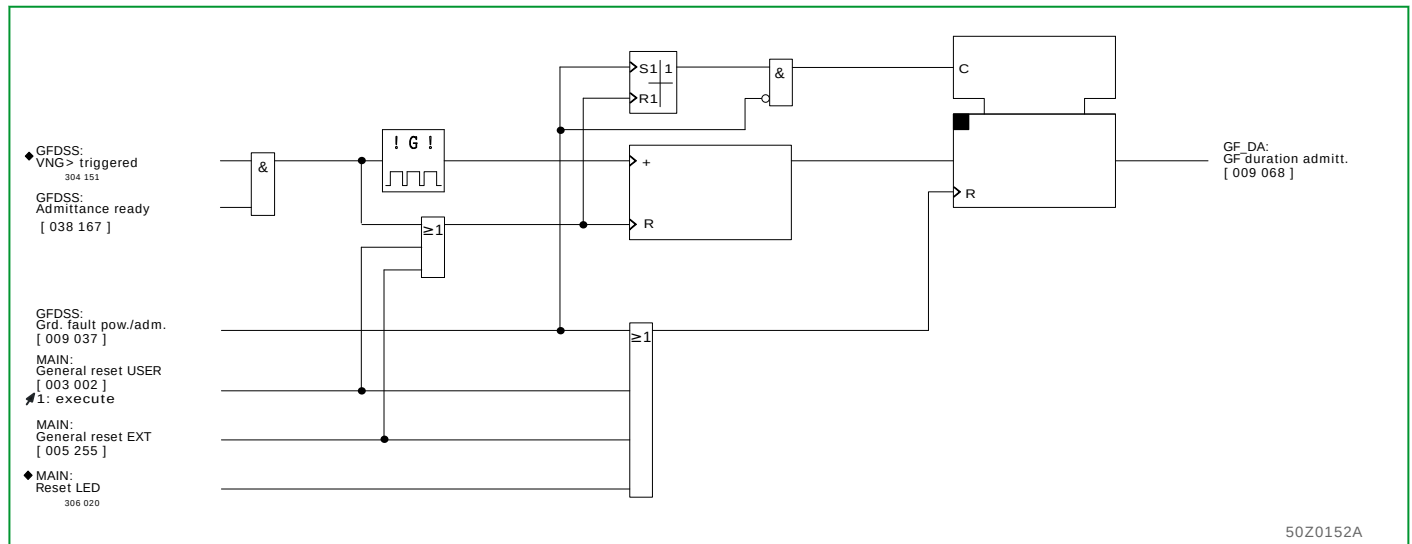


Fig. 3-109: Measurement and storing the ground fault duration from admittance evaluation.

3.20.5.1 Admittance, Conductance and Susceptance

Conductance and susceptance are stored at the time when the directional decision is issued. The admittance value is measured at the time when the timer period set at GFDSS: Oper.delay Y(N) > PSx has elapsed.

3.20.5.2 Residual Current

The residual current flowing when timer stage GFDSS: tVNG > PSx elapses is stored in memory. This measured value is issued as a per-unit quantity referred to the P433's nominal current I_{nom} .

3.20.5.3 Neutral-Point Displacement Voltage

The neutral-point displacement voltage present when timer stage GFDSS: tVNG > PSx elapses is stored in memory.

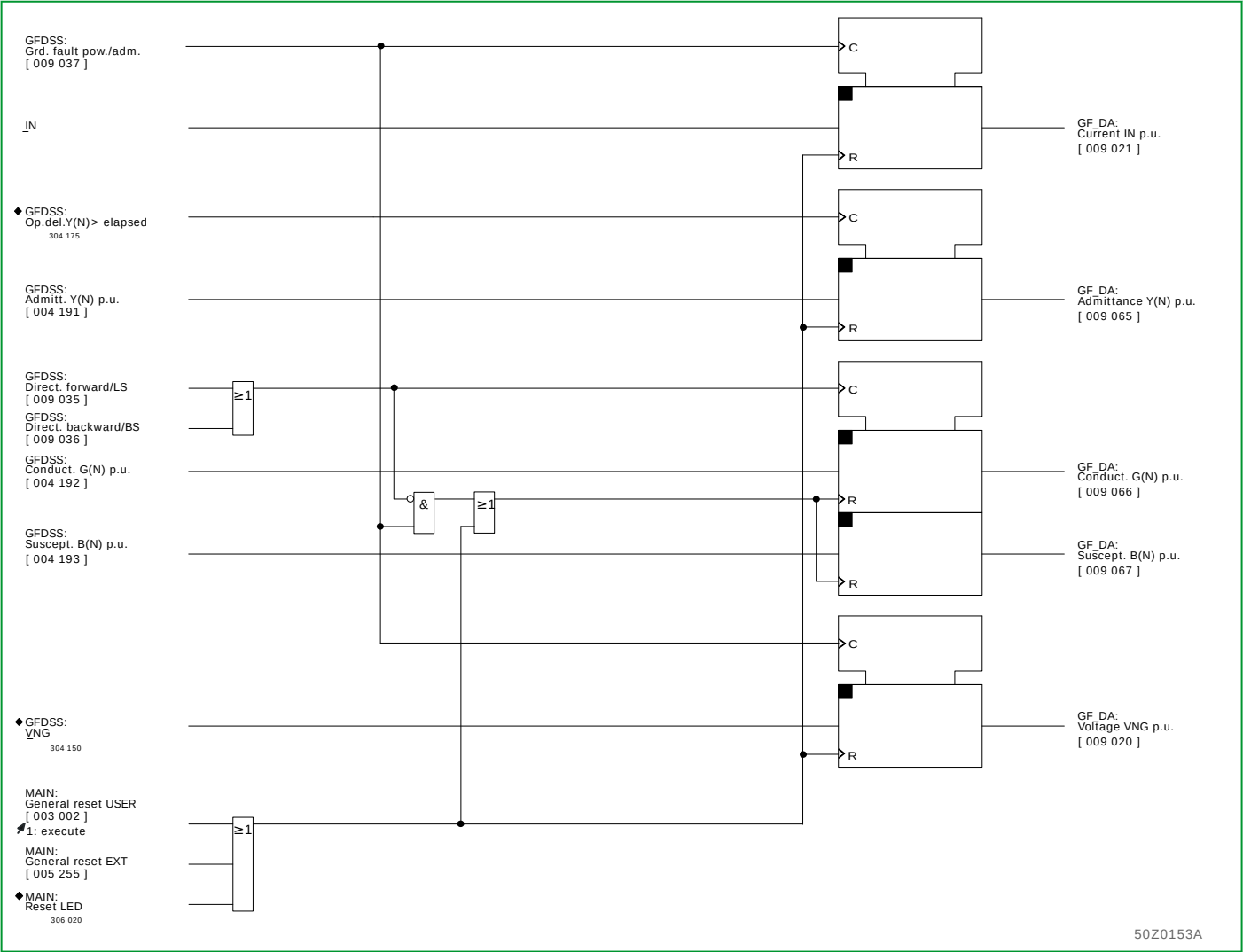


Fig. 3-110: Measured ground fault data from admittance evaluation.

3.21 Ground Fault Recording (Function Group GF_RC)

3.21.1 Start Ground Fault Recording

A ground fault exists and ground fault recording begins if at least one of the following conditions is met:

- A ground fault has been detected by ground fault direction determination using steady-state values (GFDSS).
- A ground fault has been detected by transient ground fault direction determination (TGFD).

3.21.2 Counting Ground Fault Events

Ground fault events are counted and identified by sequential numbers.

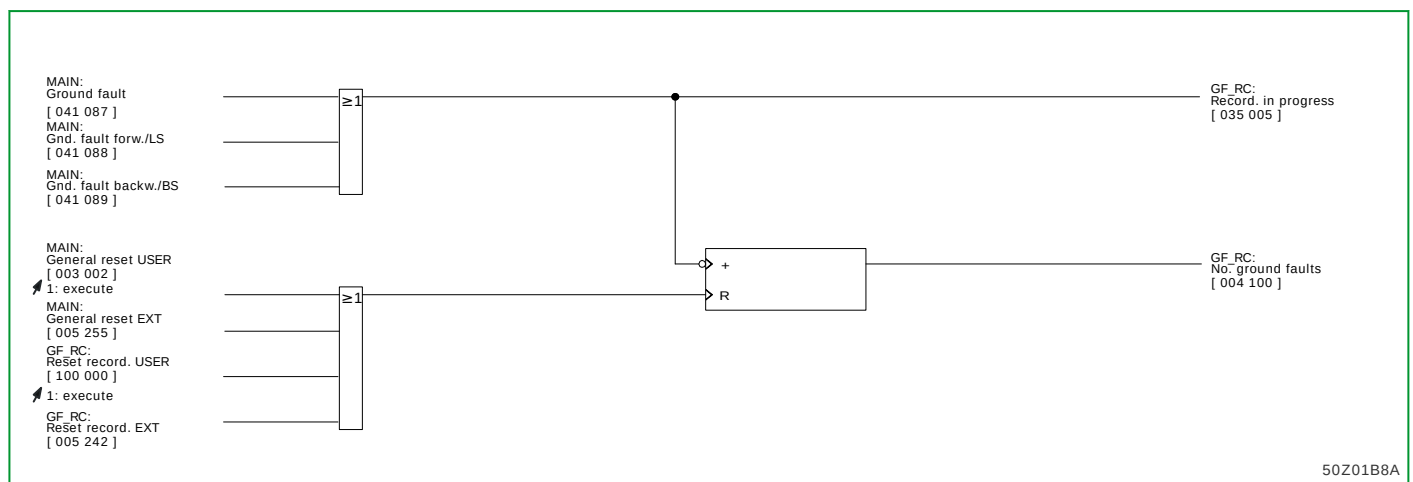


Fig. 3-111: Counting ground fault events.

3.21.3 Time Tagging

The date of each ground fault event is stored. A ground fault's individual start or end signals are likewise time-tagged. The date and time assigned to a ground fault event when the event begins can be read out from the ground fault memory on the local control panel or through the PC and communication interfaces. The time information (relative to the onset of the ground fault) that is assigned to the signals can be retrieved from the ground fault memory or through the PC or communication interfaces.

3.21.4 Ground Fault Logging

Protection signals during a ground fault event are logged in chronological order with reference to the specific ground fault event. A total of eight ground fault logs, each involving a maximum of 200 start or end signals, can be stored in the non-volatile ground fault memories. After eight ground fault events have been logged, the oldest ground fault log will be overwritten, unless memories have been cleared in the interim. If more than 199 start or end signals have occurred during a single ground fault, then GF_RC: GF memory overflow is stored as the final signal.

In addition to the signals, the measured ground fault data will also be entered in the ground fault memory.

The ground fault logs can be read from the local control panel or through the PC or communication interfaces.

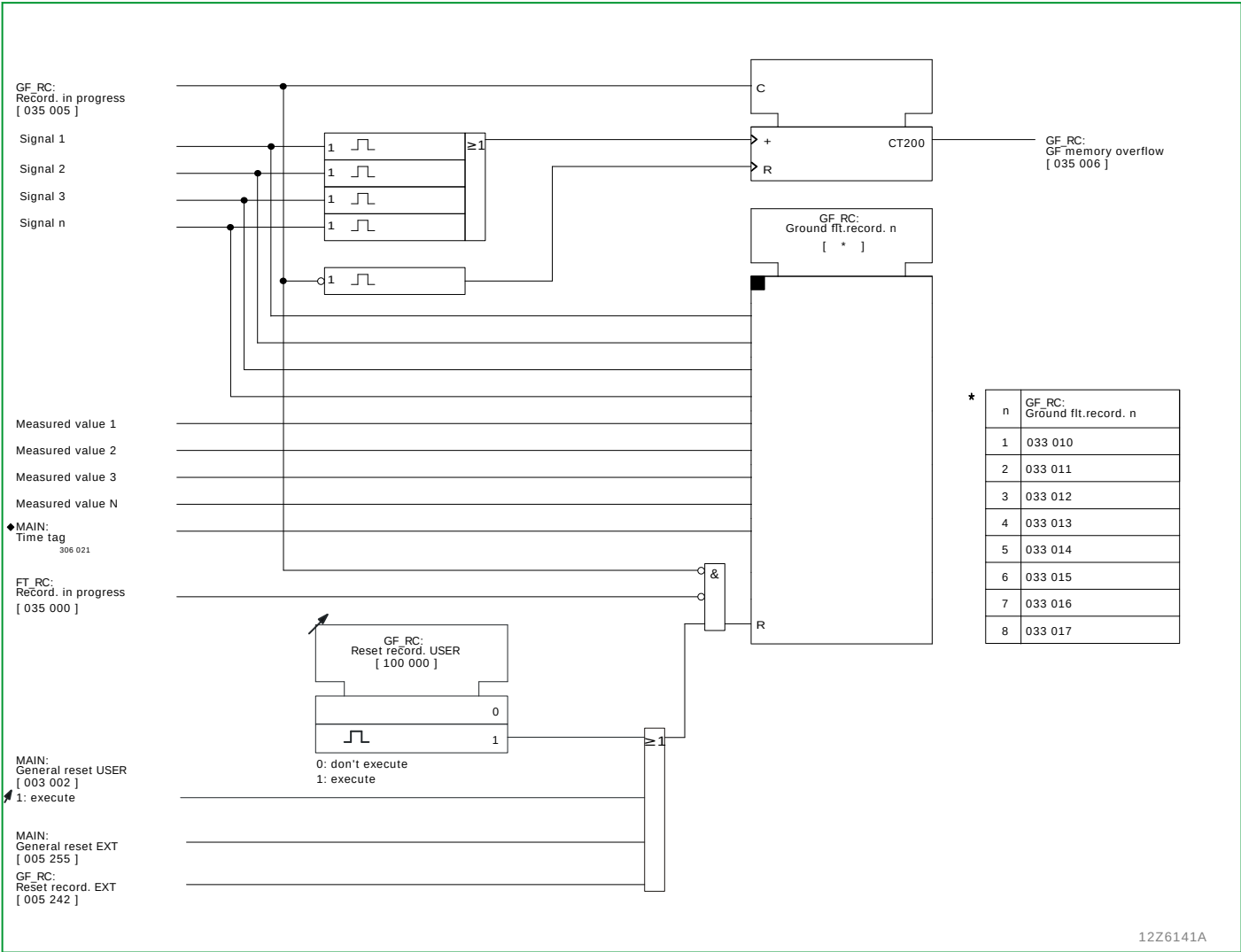


Fig. 3-112: Ground fault memory.

3.22 Fault Data Acquisition (Function Group FT_DA)

When there is a primary system fault, the P433 collects the following measured fault data (Events/Measured fault data/FT_DA):

General data:

(008 010)	FT_DA: Fault duration
(004 021)	FT_DA: Running time
(010 198)	FT_DA: Fault type
(004 079)	FT_DA: Meas. loop selected

p.u. values:

(004 026)	FT_DA: Flt.volt. PG/PP p.u.
(004 025)	FT_DA: Fault current P p.u.
(004 024)	FT_DA: Fault loop angle P
(004 049)	FT_DA: Fault curr. N p.u.
(004 048)	FT_DA: Fault loop angle N
(004 028)	FT_DA: Fault reactance, sec.
(004 023)	FT_DA: Fault impedance, sec

Fault location:

(004 027)	FT_DA: Fault locat. percent
(004 022)	FT_DA: Fault location

Primary values:

(010 217)	FT_DA: Flt.volt. PG/PP prim
(010 199)	FT_DA: Fault current P prim
(010 216)	FT_DA: Fault curr. N prim.
(004 029)	FT_DA: Fault react., prim.
(024 004)	FT_DA: Fault impedance, prim

Settings:

(024 130)	FT_DA: Start current P prim
(024 098)	FT_DA: Xv prim.
(024 125)	FT_DA: Rfw, PP prim.
(024 123)	FT_DA: Rfw, PG prim.
(024 127)	FT_DA: Zfw, PP prim.
(024 126)	FT_DA: Zfw, PG prim.
(024 128)	FT_DA: β
(024 129)	FT_DA: Zbw/Zfw

3.22.1 Running Time and Fault Duration

The running time is defined as the time between the start and end of the general starting signal, and the fault duration is defined as the time between the start and end of the FT_RC: Record. in progress signal.

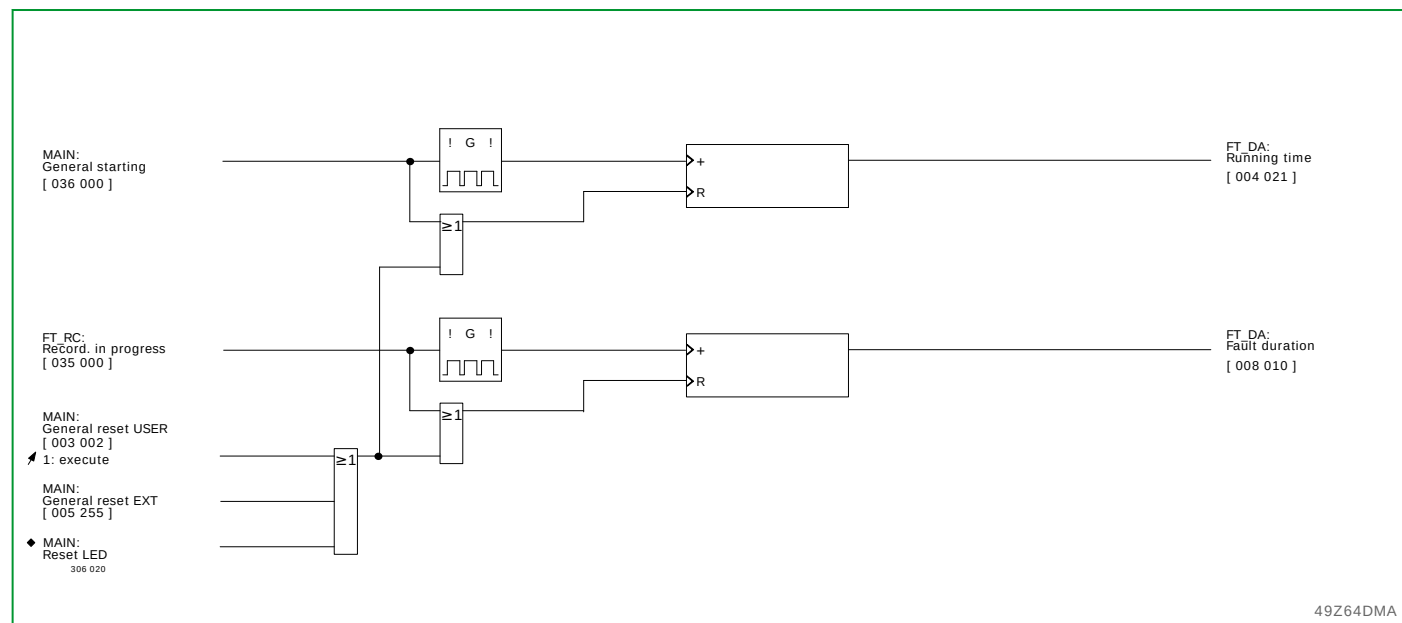


Fig. 3-113: Running time and fault duration.

3.22.2 Fault Data Acquisition Time

Fault data acquisition is always triggered by general starting.

By setting (008 007) FT_DA: Flt.loc. determ. PSx) fault data acquisition can additionally be triggered by sole neutral starting. In this case the P433 determines all three phase-to-ground loop impedances, and then provides the fault data and location based on the reactance of the measurement loop with the lowest impedance value.

The setting at FT_DA: Start data acqu. PSx determines at which time during a fault the acquisition of fault data takes place. The following settings are possible:

- *End of fault* – Acquisition at the end of the fault.
- *Trigger/Trip/End* – Acquisition at the following points:
 - when an appropriately configured binary signal input is triggered during a general starting state,
 - when a general trip signal is issued,
 - at the end of the fault.

The setting at FT_DA: Outp. flt.locat. PSx determines the conditions under which calculation and output of the fault location occur. The following settings are possible:

- *Always*: Calculation and output of the fault location always occurs if the other measured fault data are also being determined.
- *Only after trip t1*: Calculation and output of the fault location occurs if the P433 decides in favor of a trip in impedance zone 1 with standard reach (non-extended zone).
- *Only aft.tr.t1/t1,ze*: Calculation and output of the fault location occurs if the P433 decides in favor of a trip in impedance zone 1 with standard and extended reach.

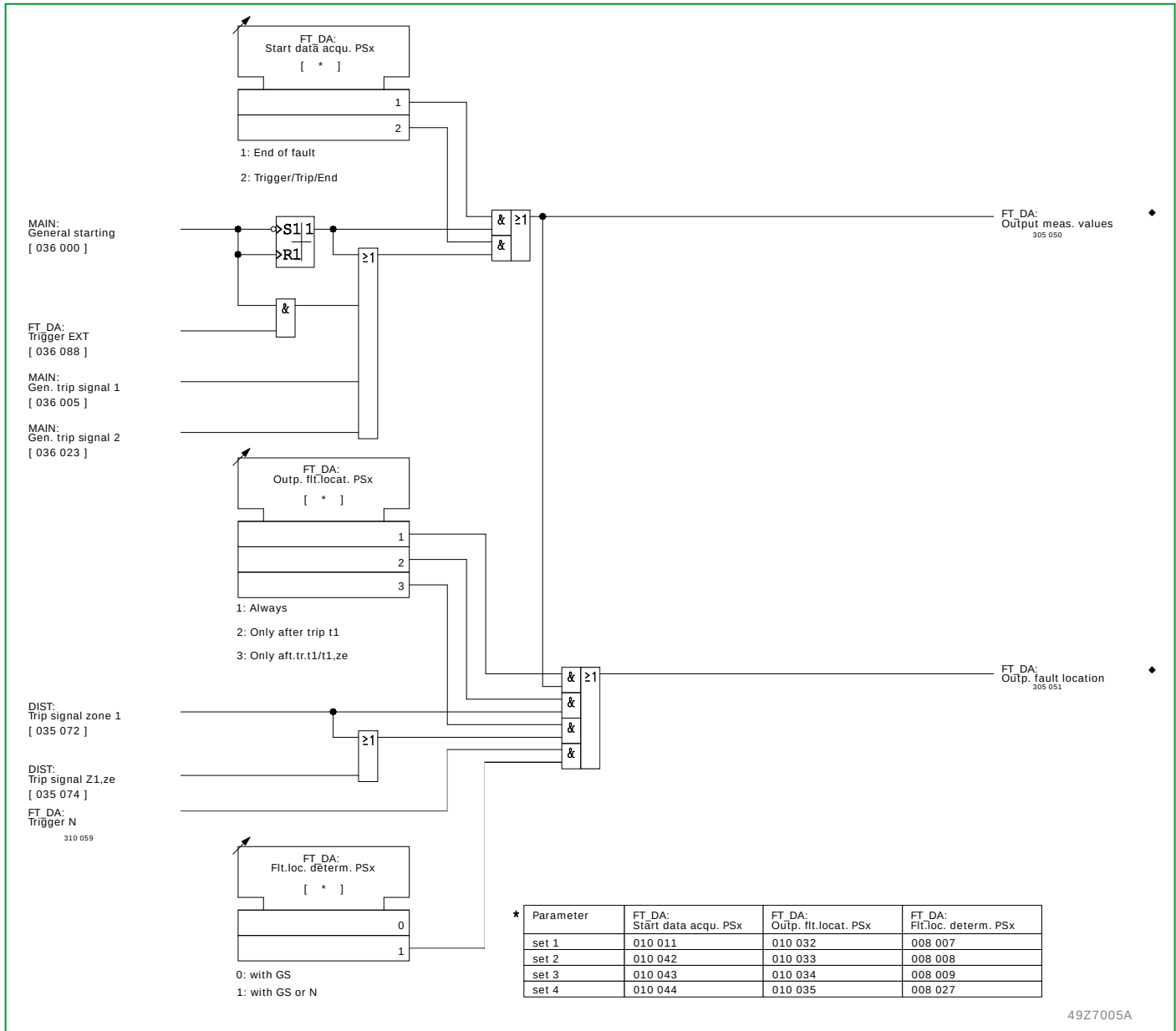


Fig. 3-114: Enabling of measured fault data acquisition and fault location output.

3.22.3

Acquisition of Fault Data (Short Circuit Data)

The fault data (short-circuit data) are determined using the measured values I_{meas} and V_{meas} selected by the distance protection function if the fault is detected by distance protection. One phase current is selected as the fault current in accordance with the selected measuring loop. In the case of multi-phase starting, this is the current of the leading phase in the cycle. When measuring voltage $V_{meas} < 0.2 V$ the set angle α is used for fault reactance calculation. Then the set angle α is also displayed as the fault loop angle. The primary fault reactance is calculated from the per-unit fault reactance using the nominal data for the set primary current and voltage transformers.

The ground fault data are only determined if a phase-to-ground loop has been selected for measurement by the distance protection function. The geometric sum of the three phase currents is displayed as the ground fault current. The ground fault angle is the phase displacement between the ground fault current and the selected measuring voltage.

If the fault is detected by the backup overcurrent-time protection function, then only the fault current can be determined. The maximum phase current is displayed.

Fault current and voltage are displayed as per-unit quantities referred to I_{nom} and V_{nom} . If the measured or calculated values are outside the acceptable measuring range, the *Overflow* indication will be displayed.

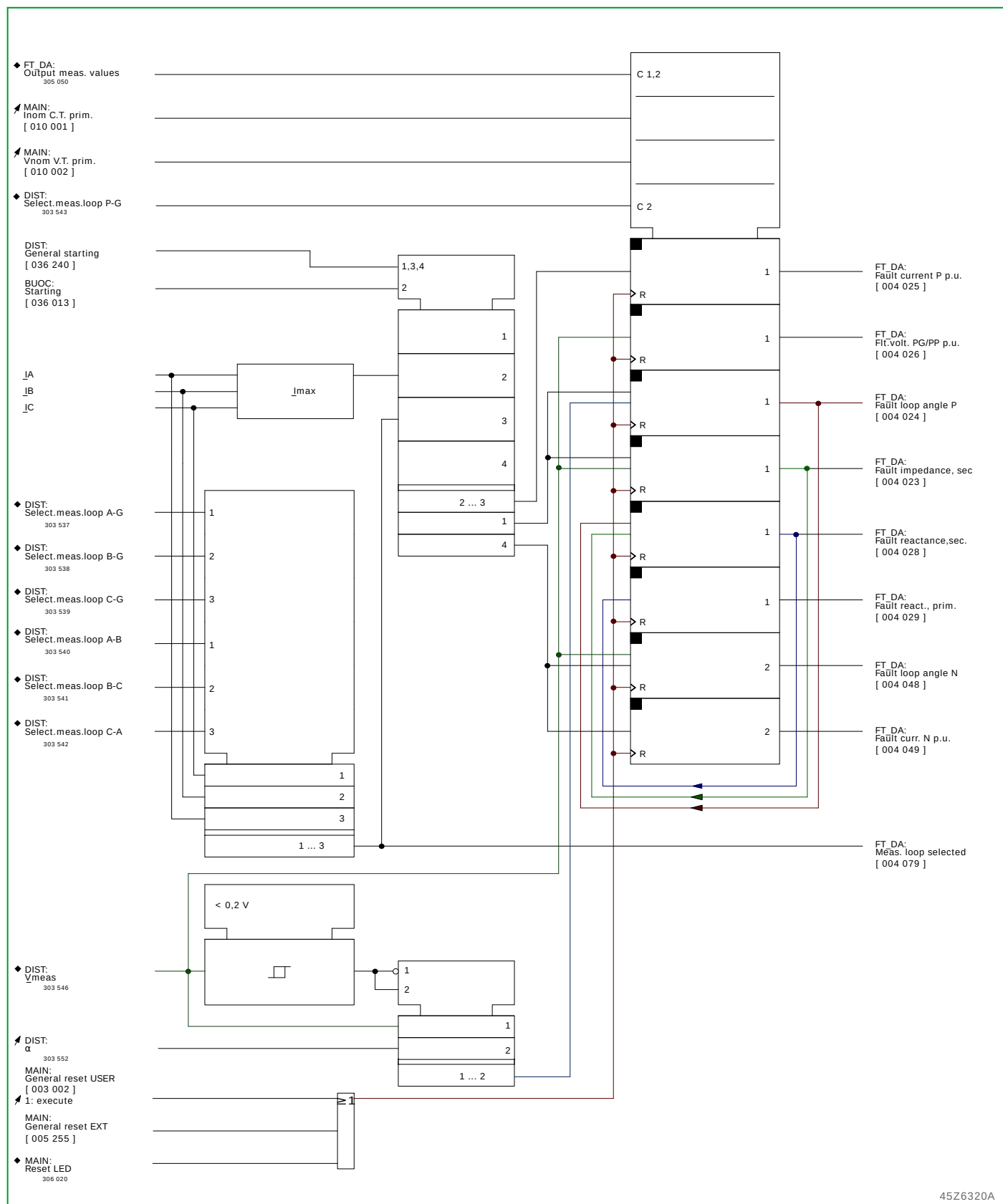


Fig. 3-115: Acquisition of fault data (short circuit data).

3.22.4 Acquisition of Fault Location

In order to determine the fault location as a percentage of the line length and in km, the value of the line reactance, which corresponds to 100% of the monitored line section, as well as the corresponding line length in km, must be set.

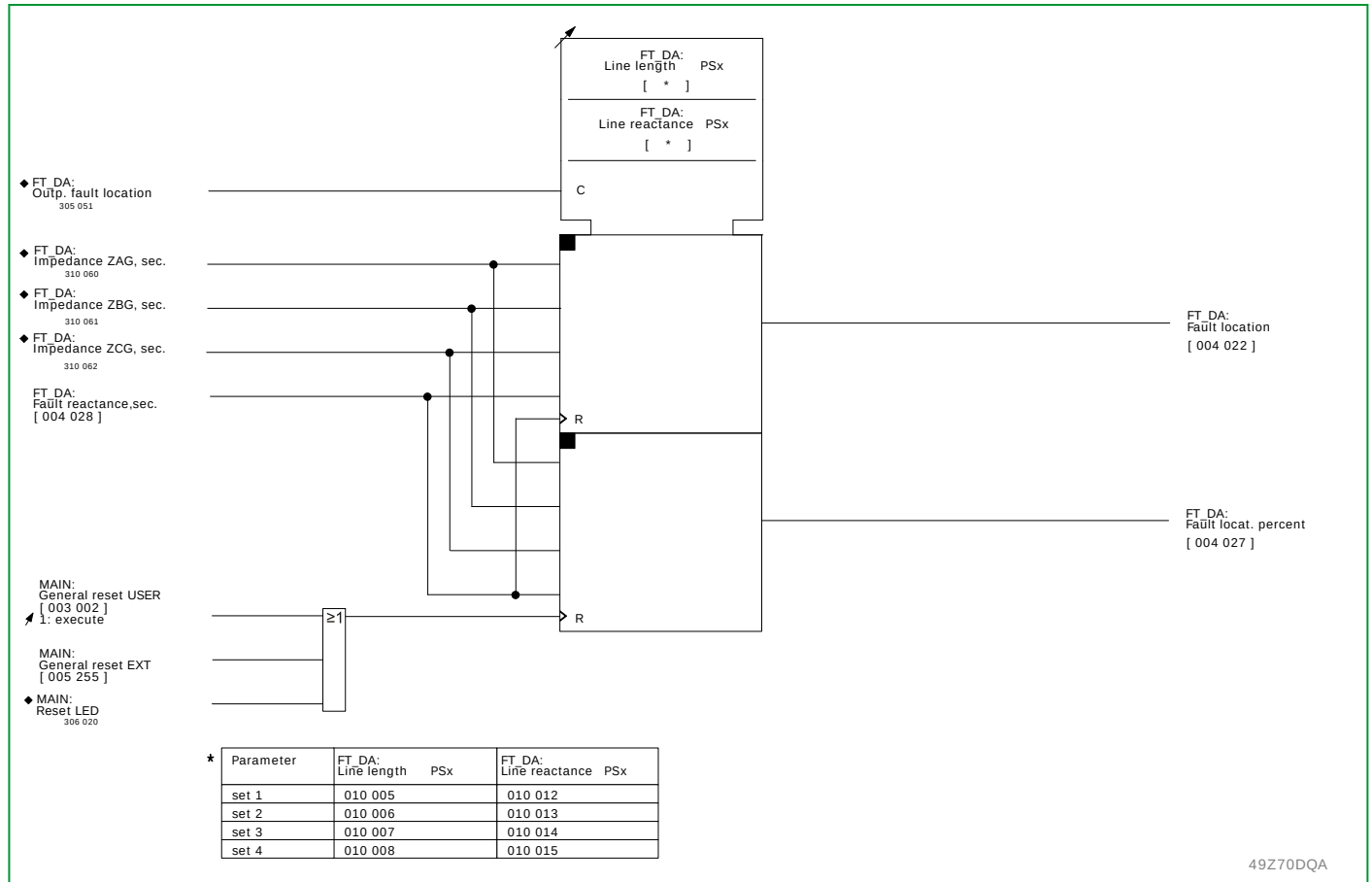


Fig. 3-116: Acquisition of fault location.

3.22.4.1 Calculation of the Fault Location after a Short-Duration Grounding

The P433 will calculate the fault location after a short-duration grounding (e.g. a grounding through a relatively large resistor, possibly without a DIST phase starting or a general starting). This is done by determining all three phase-to-ground impedance values and then calculating the fault location based on the measuring loop reactance with the lowest impedance value.

This mode of calculating a fault location is enabled by setting FT_DA: Flt.loc. determ. PSx to *with GS or N* (see Fig. 3-114, (p. 3-160)). Then fault recording together with fault location will be started by an internal trigger signal. This internal trigger signal, with a fixed operate delay time of 100 ms, will be issued after a measured ground starting ($I_{N>}$ and $V_{NG>}$) with the neutral point treatment set to “isolated/compensated”. This internal trigger signal (given in Fig. 3-124, (p. 3-174) as: FT_RC: Trigger N or FT_DA: Trigger N) is independent of the preset delay time $t_{IN>}$ (DIST: $t_{IN>} PSx$).

In this case (e.g. ground fault without a general starting) the P433 will first calculate all three phase-to-ground loop impedance values. The phase-to-ground loop with the lowest impedance value will be selected as faulty. All measured fault data will be issued with reference to this phase-to-ground loop.

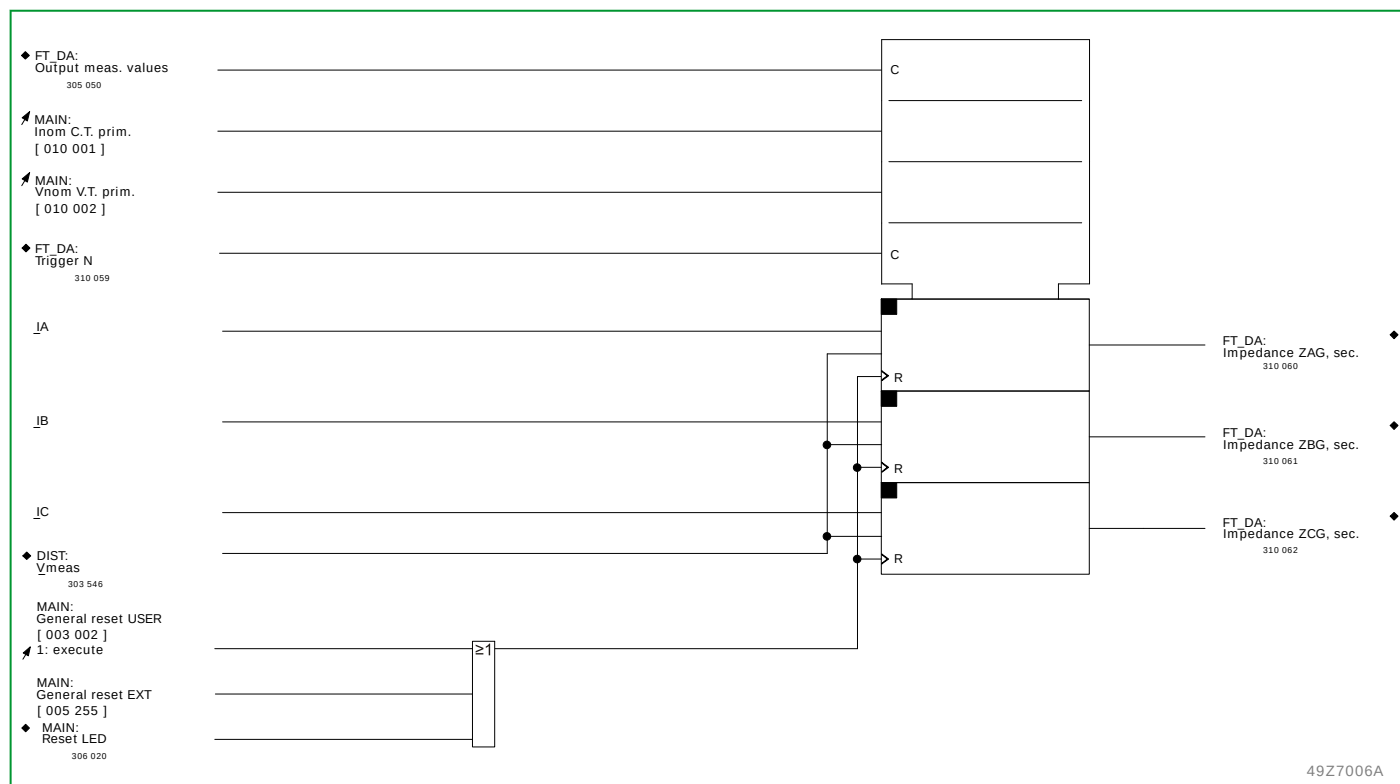


Fig. 3-117: Determining the phase-to-ground loop impedances.

3.22.5

Fault Data Reset

After pressing the reset key (clear key in 24 TE case) on the local control panel, the fault data value is displayed as *Not measured*. However, the values are not erased and can still be read out through the PC and communication interfaces.

3.23 Fault Recording (Function Group FT_RC)

3.23.1 Start of Fault Recording

A fault exists and fault recording begins if at least one of the following signals is present:

- MAIN: General starting
- MAIN: Gen. trip signal 1
- MAIN: Gen. trip signal 2
- FT_RC: Trigger
- FT_RC: I> triggered

In addition, the user can set a logical “OR” combination of logic signals (*m out of n* parameter) whose appearance will trigger fault recording.

The maximum duration of each recording is limited to 1 minute, even if a permanent trigger condition is present, to avoid 'endless' recordings.

3.23.2

Fault Counting

Faults are counted and identified by sequential numbers.

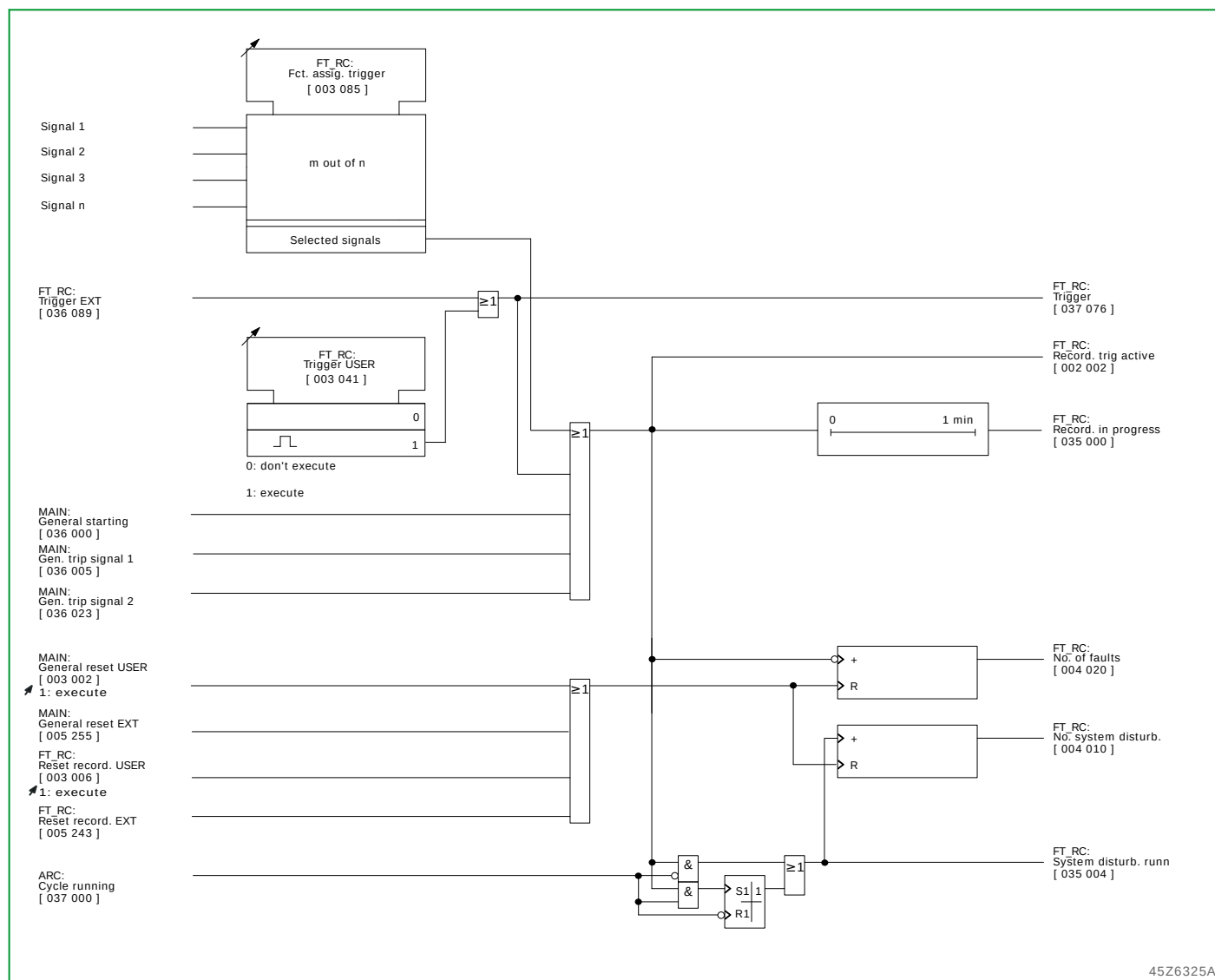


Fig. 3-118: Start of fault recording and fault counter.

3.23.3

Time Tagging

The date that is assigned to each fault by the internal clock is stored. A fault's individual start or end signals are likewise time-tagged. The date and time assigned to a fault when the fault begins can be read out from the fault memory on the local control panel or through the PC and communication interfaces. The time information (relative to the onset of the fault) that is assigned to the signals can be retrieved from the fault memory or through the PC or communication interfaces.

3.23.4 Fault Recordings

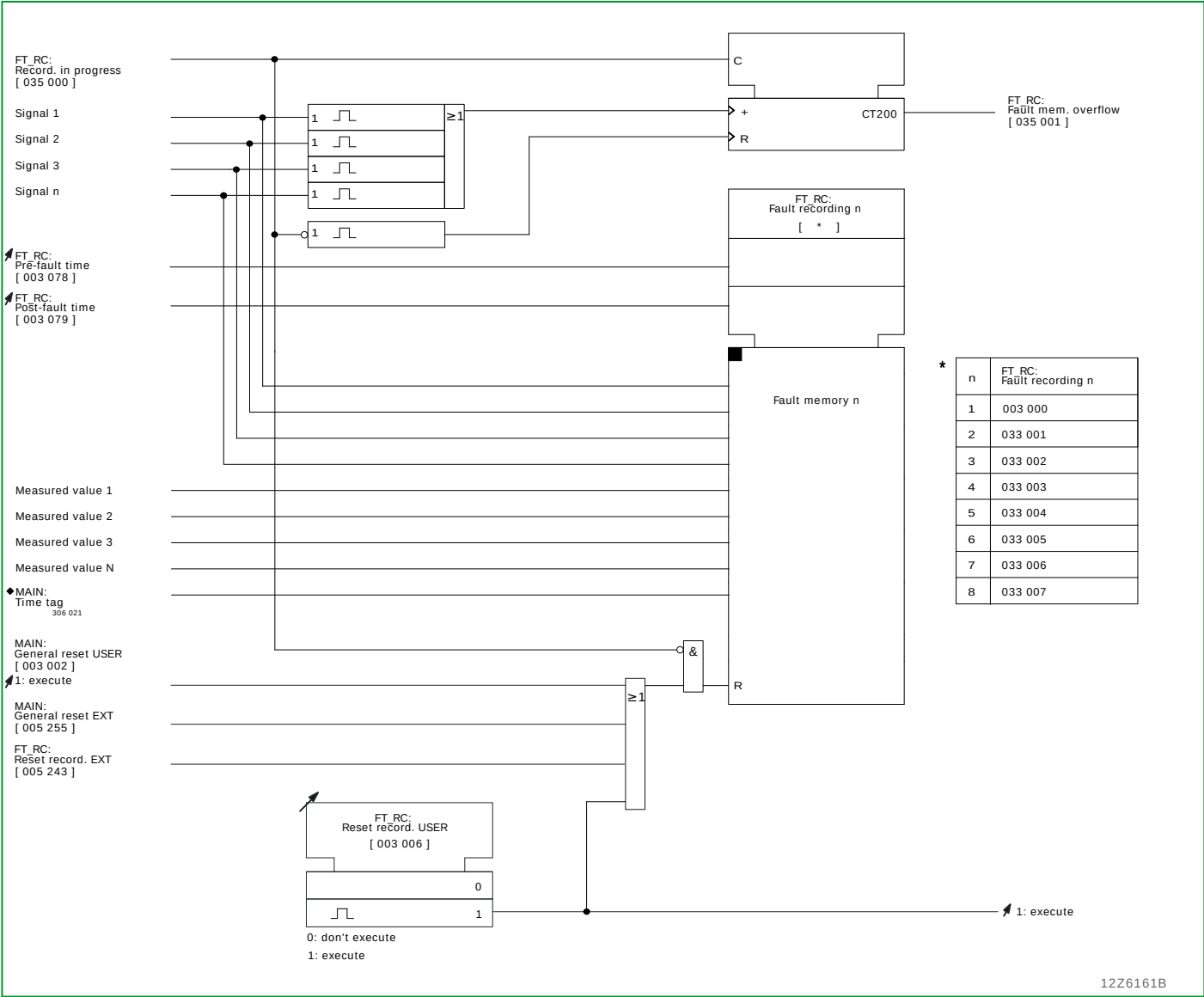


Fig. 3-119: Fault memory.

Protection signals, including the signals during the settable pre-fault and post-fault times, are logged in chronological order with reference to the specific fault. A total of eight faults, each involving a maximum of 200 start or end signals, can be stored in the non-volatile fault memories. After eight faults have been recorded, the oldest fault recording will be overwritten, unless memories have been cleared in the interim. If more than 199 start or end signals have occurred during a single fault, then FT_RC: Fault mem. overflow will be entered as the last signal. If the time and date are changed during the pre-fault time, the signal FT_RC: Faulty time tag is generated.

In addition to the fault signals, the measured fault data will also be entered in the fault memory.

The fault recordings can be read from the local control panel or through the PC or communication interfaces.

3.23.5 Fault Value Recording

The following analog signals are recorded:

- Phase currents
- Phase-to-ground voltages
- Residual current measured by the P433 at the T 4 transformer
- Neutral-point displacement voltage measured by the P433 at the T 90 transformer
- Reference voltage V_{ref} (when a synchrocheck VT is fitted).
- Frequency.

The signals are recorded before, during and after a fault. The window length for oscillography recording before and after the fault can be set. A maximum time period of 16.4 s is available for recording. This period can be divided among a maximum of eight faults. The maximum recording time per fault can be set. If a fault, including the set pre-fault and post-fault times, lasts longer than the set maximum recording time, then recording will terminate when the set maximum recording time is reached.

The pre-fault time is exactly adhered to if it is shorter than the set maximum recording time. Otherwise the pre-fault time is set to the maximum recording time minus a sampling increment, and the post-fault time is set to zero.

If the maximum recording time of 16.4 s is exceeded, the analog values for the oldest fault are overwritten, but not the binary values. If more than eight faults have occurred since the last reset, then all data for the oldest fault are overwritten.

The analog oscillography data of the fault record can only be read out through the PC or communication interfaces.

When the supply voltage is interrupted or after a warm restart, the values of all faults remain stored.

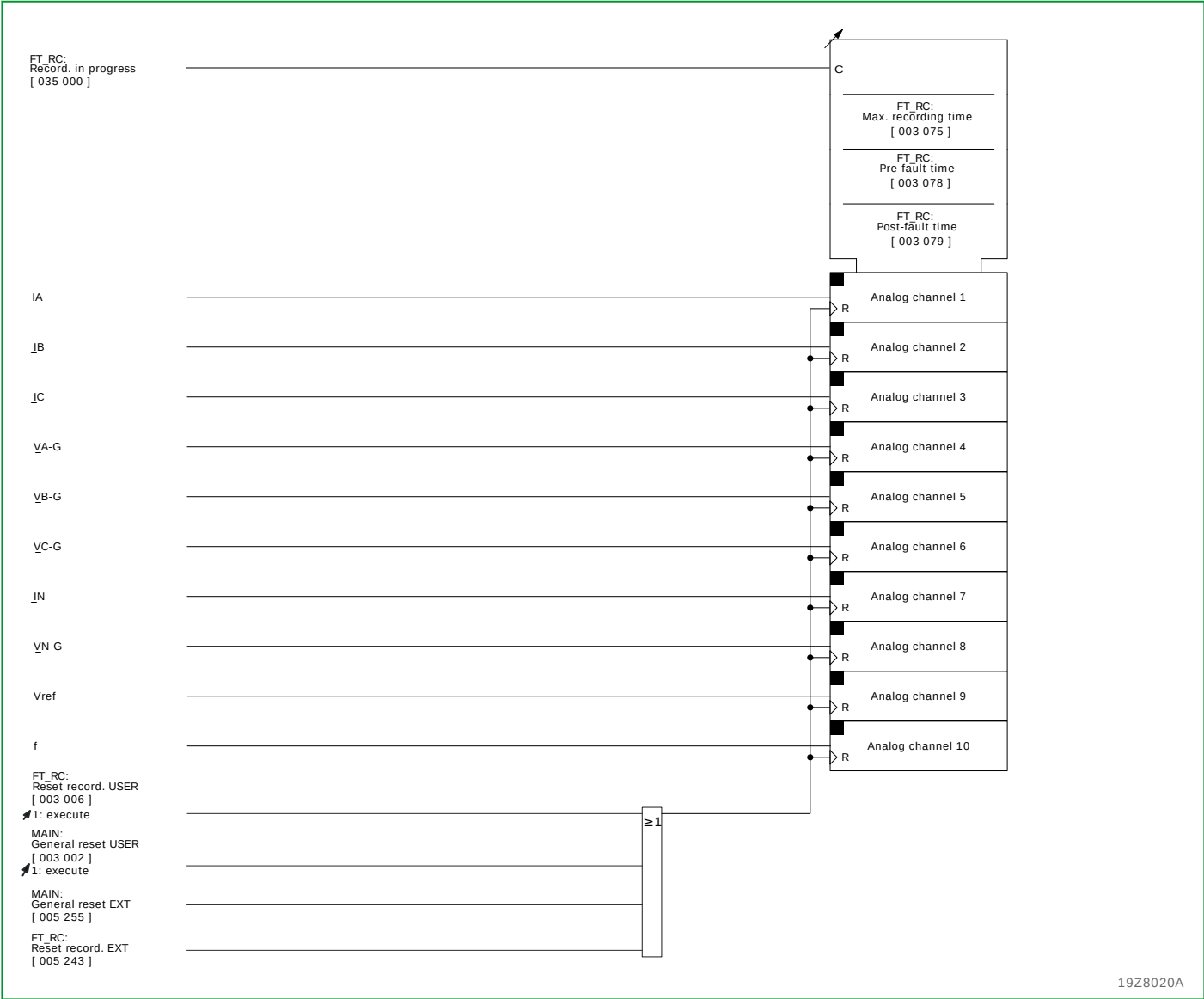


Fig. 3-120: Fault value recording.

3.24 Distance Protection (Function Group DIST)

3.24.1 Enable/Disable the Distance Protection

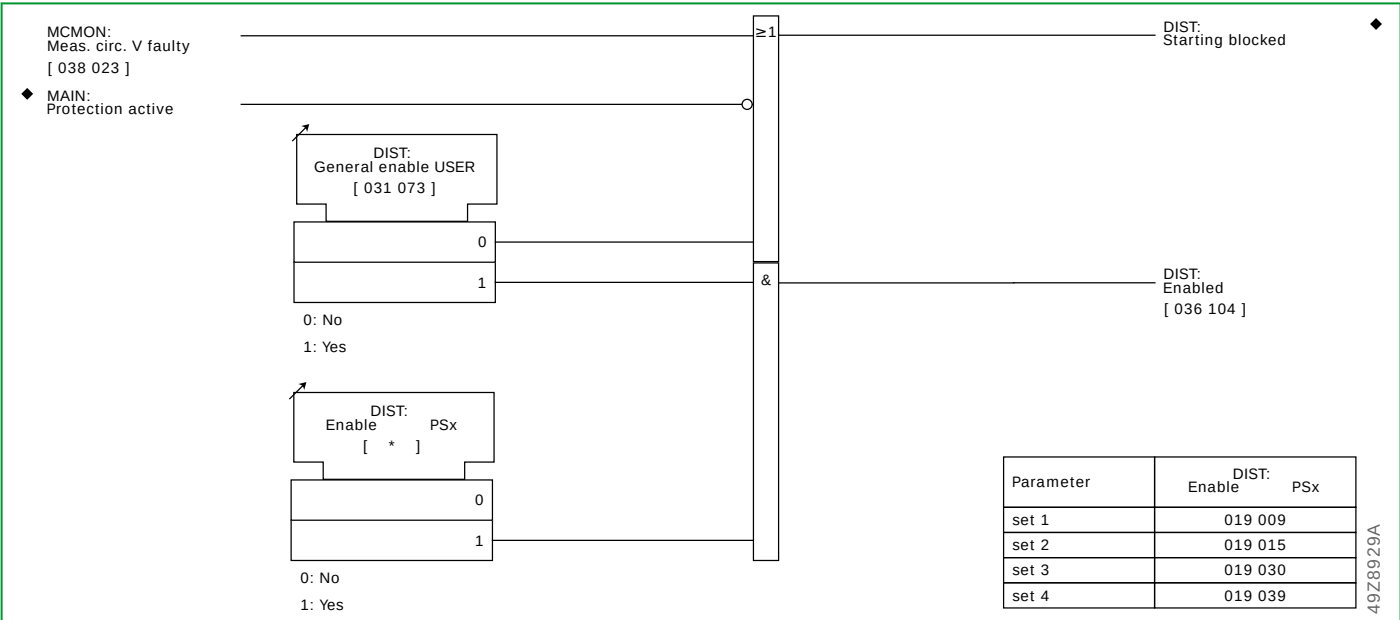


Fig. 3-121: Enable/disable the distance protection and fault detection blocking.

The distance protection can be disabled or enabled via setting parameters. Moreover, enabling can be carried out separately for each parameter subset.

3.24.2 Fault Detection Logic

The fault detection logic in distance protection serves to detect short-circuits phase-selectively (see Fig. 3-121, (p. 3-170)).

Fault detection logic is divided into the following areas:

- Overcurrent detection
- Ground fault detection
- Undervoltage detection
- Underimpedance fault detection

The fault detection decisions of the individual areas are linked by the fault detection logic.

Short-circuit currents that are greater than the maximum operating load currents can be detected by the overcurrent detection logic. Undervoltage detection logic is provided for short circuits that cannot be identified by overcurrent detection. In order to control difficult conditions for fault detection, the P433 is also equipped with a highly angle-dependent ‘true’ underimpedance detection logic function. Ground fault detection logic distinguishes between grounded and ungrounded faults.

The fault detection logic starts the timer stages of the trigger levels and – as a function of the phase-selective fault detection decision – selects the measuring loops in which the fault impedances are determined. The fault detection logic is blocked if one of the following conditions is met:

- The protection function is disabled using setting parameters or appropriately configured binary signal inputs.
- Monitoring (VT supervision) detects a fault in the voltage-measuring circuit.

If distance protection is blocked, the user may switch to backup overcurrent-time protection provided that the appropriate setting has been selected.

3.24.2.1

Overcurrent Detection

Overcurrent fault detection monitors the phase currents for values in excess of the threshold values $I_{>>}$ and $I_{>>>}$. The $I_{>>}$ threshold can be set. $I_{>>>}$ is equal to $2I_{>>}$. The thresholds are identical for all three phases.

The output signals of the $I_{>>}$ trigger assume a logic value of "1" if the threshold is exceeded in two consecutive half-waves. In the case of the $I_{>>>}$ trigger only one half-wave must exceed the threshold for the output signals to assume a logic value of "1". Triggering of inrush stabilization prevents operation of the $I_{>>}$ trigger.

If $I_{>>}$ is exceeded in one phase, then it is sufficient for overcurrent detection if $I_{>>>}$ is exceeded in the other phases. In this case the fault detection time is shortened since there is no longer any need to wait for the second half-wave.

Evaluation of the trigger decisions is a function of the type of neutral-point treatment set in the P433. If *isolated neutral/resonant grounding* or *short-duration grounding* is set, then $I_{>>}$ overcurrent detection occurs in the phase(s) in which the $I_{>>}$ threshold is exceeded. With the setting *Low-imped. grounding* the following condition must also be satisfied:

$$I \geq \frac{2}{3} \cdot |I_{\max}|$$

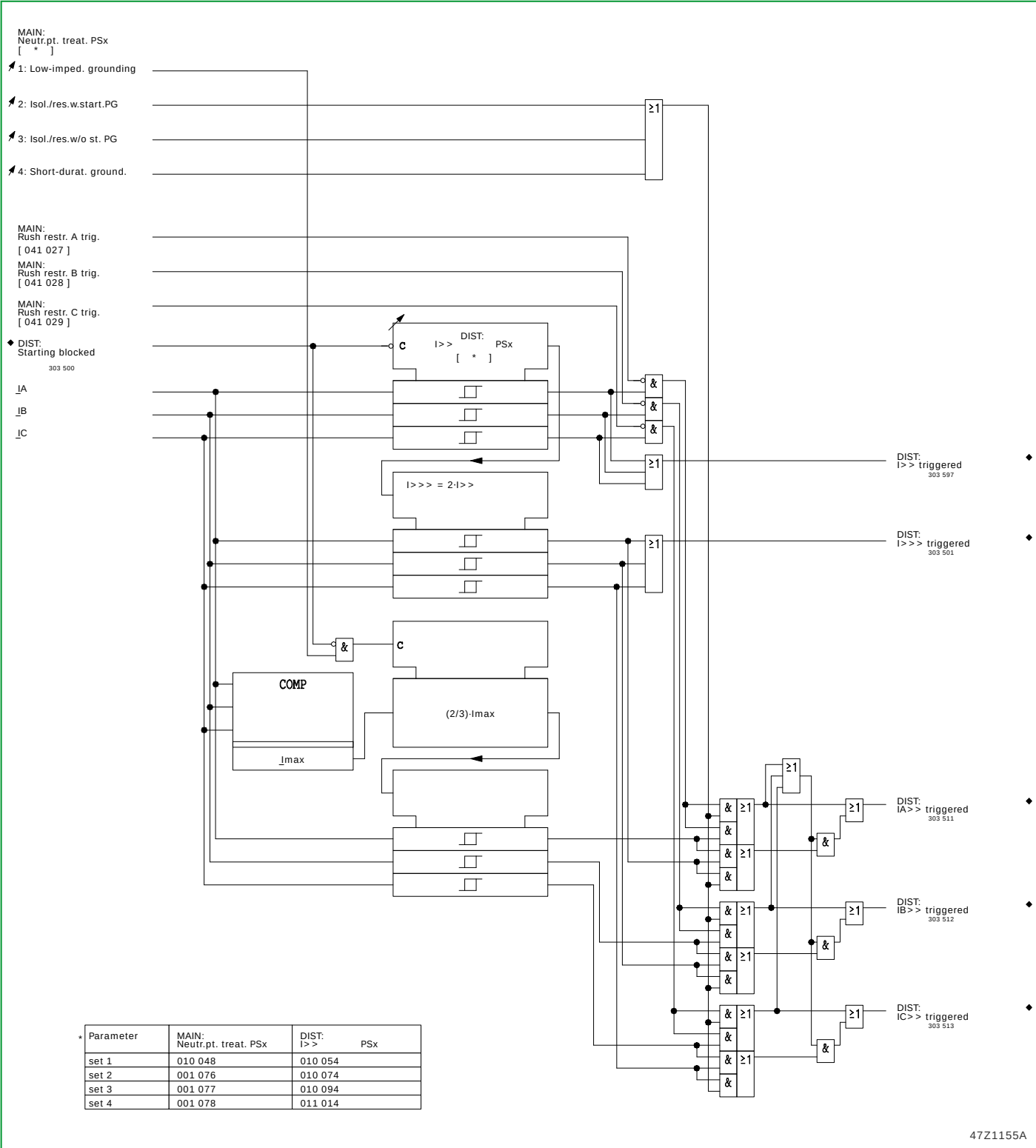


Fig. 3-122: Overcurrent detection.

3.24.2.2 Ground Fault Detection

To detect ground faults, the ground fault detection function monitors the average magnitude of the residual current calculated from the phase currents and the neutral-displacement voltage calculated from the phase-to-ground voltages for values exceeding set thresholds.

5% of the current maximum phase current is added to the set threshold $I_{N>}$, which means that the operate value of the ground current function increases with an increasing phase current level as a form of stabilization.

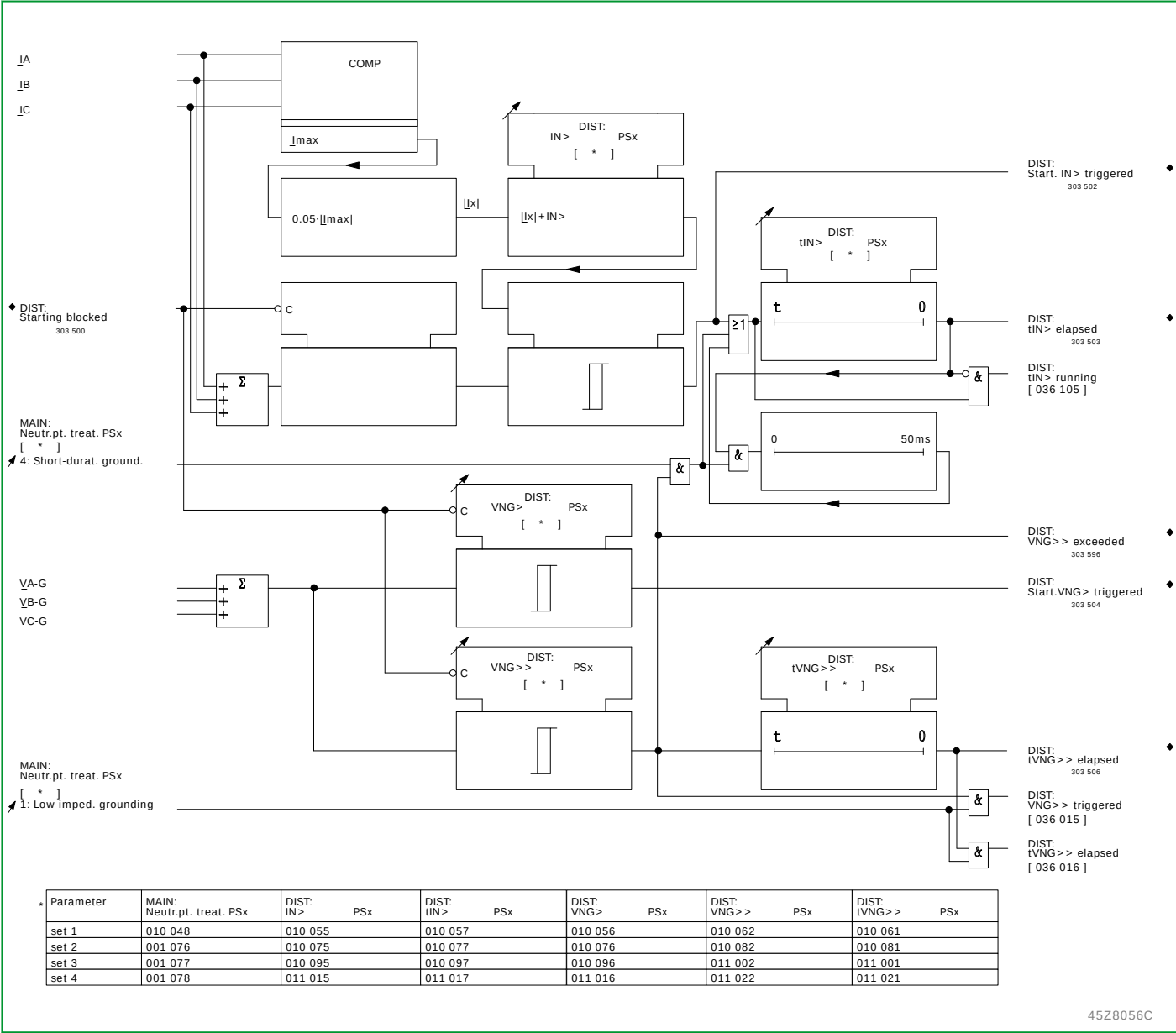


Fig. 3-123: Monitoring the residual current and the neutral-displacement voltage.

The ground fault detection mode is a function of the neutral-point treatment set in the P433.

- MAIN: Neutr.pt. treat. PSx = *Low-impd. grounding*
 With this setting ground fault detection DIST: Starting G further depends on setting MAIN: Ground starting PSx:
 - if "*IN> OR VNG>*" is selected, DIST: Starting G occurs as soon as any of threshold triggers, $I_{N>}$ OR $V_{NG>}$ is exceeded.
 - if "*IN> AND VNG>*" is selected, DIST: Starting G occurs only when both thresholds trigger, $I_{N>}$ AND $V_{NG>}$ are exceeded.
 Furthermore, triggering of stage $V_{NG>>}$ and the elapse of timer stage $t_{VNG>>}$ is signaled (see Fig. 3-124, (p. 3-174)).
 Note: Setting MAIN: Ground starting PSx is only relevant, if neutral point treatment is set to low-impedance grounding.
- MAIN: Neutr.pt. treat. PSx = *Isol./res.w.start.PG*
 MAIN: Neutr.pt. treat. PSx = *Isol./res.w/o st. PG*
 If any of these two settings is selected, instantaneous ground fault detection DIST: Starting G operates in the event of multiple phase-to-ground fault detection when the thresholds of the $I_{N>}$ and $V_{NG>}$ triggers are exceeded. Even in the case of a single-phase fault, that is, in the event that only one base point is detected, ground fault detection will operate, but not until $t_{IN>}$ has elapsed.
- MAIN: Neutr.pt. treat. PSx = *Short-durat. ground.*
 Operation here corresponds to operation with the setting *Isol./res.w.start.PG* or *Isol./res.w/o st. PG* except that in the case of a sustained ground fault the timer stage $t_{IN>}$ remains activated due to the operating trigger $V_{NG>>}$ and therefore no longer has any effect in the event of subsequent short-duration grounding.

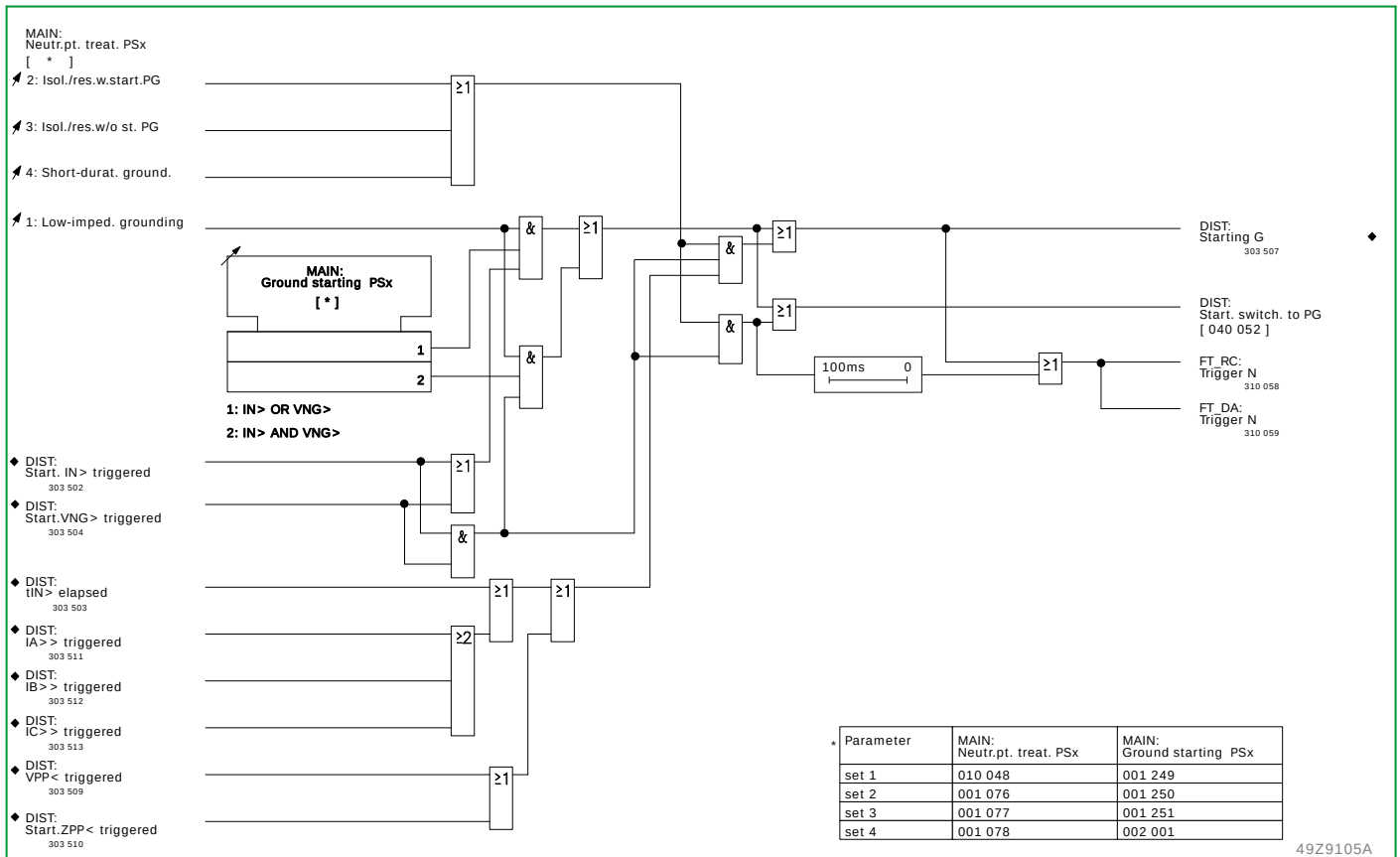


Fig. 3-124: Evaluation of trigger signals.

3.24.2.3 Enabling Undervoltage and Underimpedance Fault Detection

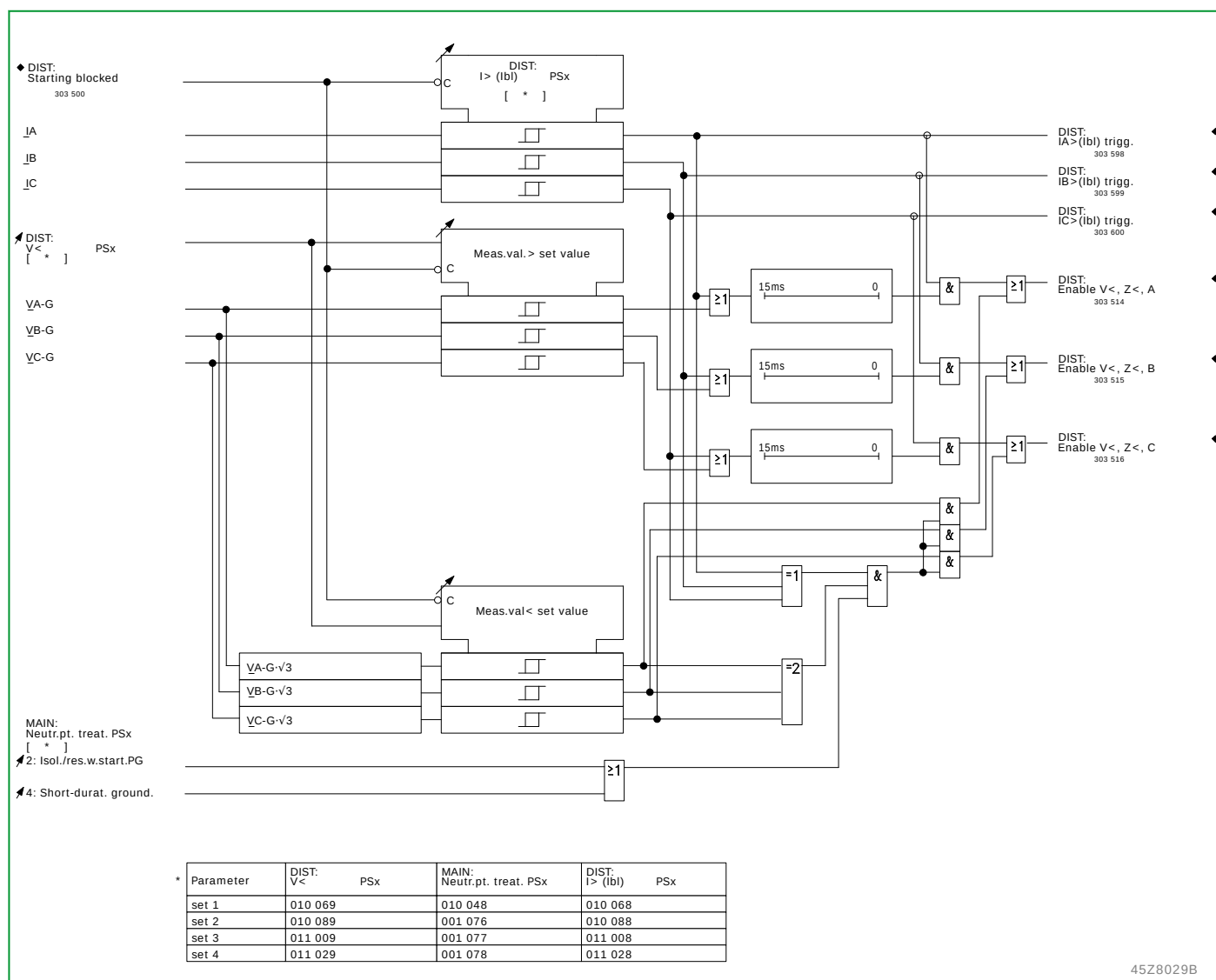


Fig. 3-125: Enabling undervoltage and underimpedance fault detection.

The undervoltage and underimpedance fault detection functions are enabled by $I > (I_{min})$ in the corresponding measuring systems. In order to control contention problems when current and voltage appear at the same time (branch voltage transformers), measuring system enabling is delayed by 15 ms.

For sensitive detection of double ground faults with isolated neutral/resonant grounding, the P433 checks to determine whether the base point current $I > (I_{min})$ is exceeded in one phase only and whether the measured value falls below the set threshold for underimpedance fault detection in two phases. Enabling proceeds in the phases where the voltage is below the set threshold.

2-Pole Faults

Moreover, a plausibility check for 2-pole faults without (simultaneous) ground fault is performed: The P433 decides in favor of an “only 2-pole” fault, if exactly one phase voltage is considerably smaller than the other two, and at the same time the opposite phase-ground voltage has a value in the normal range. This

means, for example, that an “only 2p–AB” fault is detected if the following occurs:

- $V_{AB} < 0.5 \cdot V_{BC}$ and $V_{AB} < 0.5 \cdot V_{CA}$ and $V_{CG} > 0.8 \cdot V_{nom}$

This condition is constantly checked for all three phase-phase measuring loops.

The test of the “opposite” phase-ground voltage prevents a false decision in case of a nearby occurring 3-pole fault, with 3 phase-phase voltages which are small but different from each other (due to usual system unbalance or different fault resistances).

As soon as this “only 2-pole” condition is fulfilled for any of the phase-phase measuring loops, the V< and Z< startings are blocked for the other two phase-phase loops.

3.24.2.4

Undervoltage Detection

Undervoltage fault detection monitors the phase-to-ground voltages or the phase-to-phase voltages to determine whether they fall below the set threshold $V_{<}$.

Operation of undervoltage fault detection can be determined by selecting the operating mode. The following operating modes are possible:

- Undervoltage fault detection is disabled.
- The undervoltage fault detection function evaluates only the decisions of the phase-to-ground loops, once these functions have been enabled by ground fault detection.
- Ground fault detection brings about a switch from phase-to-phase to phase-to-ground loops.

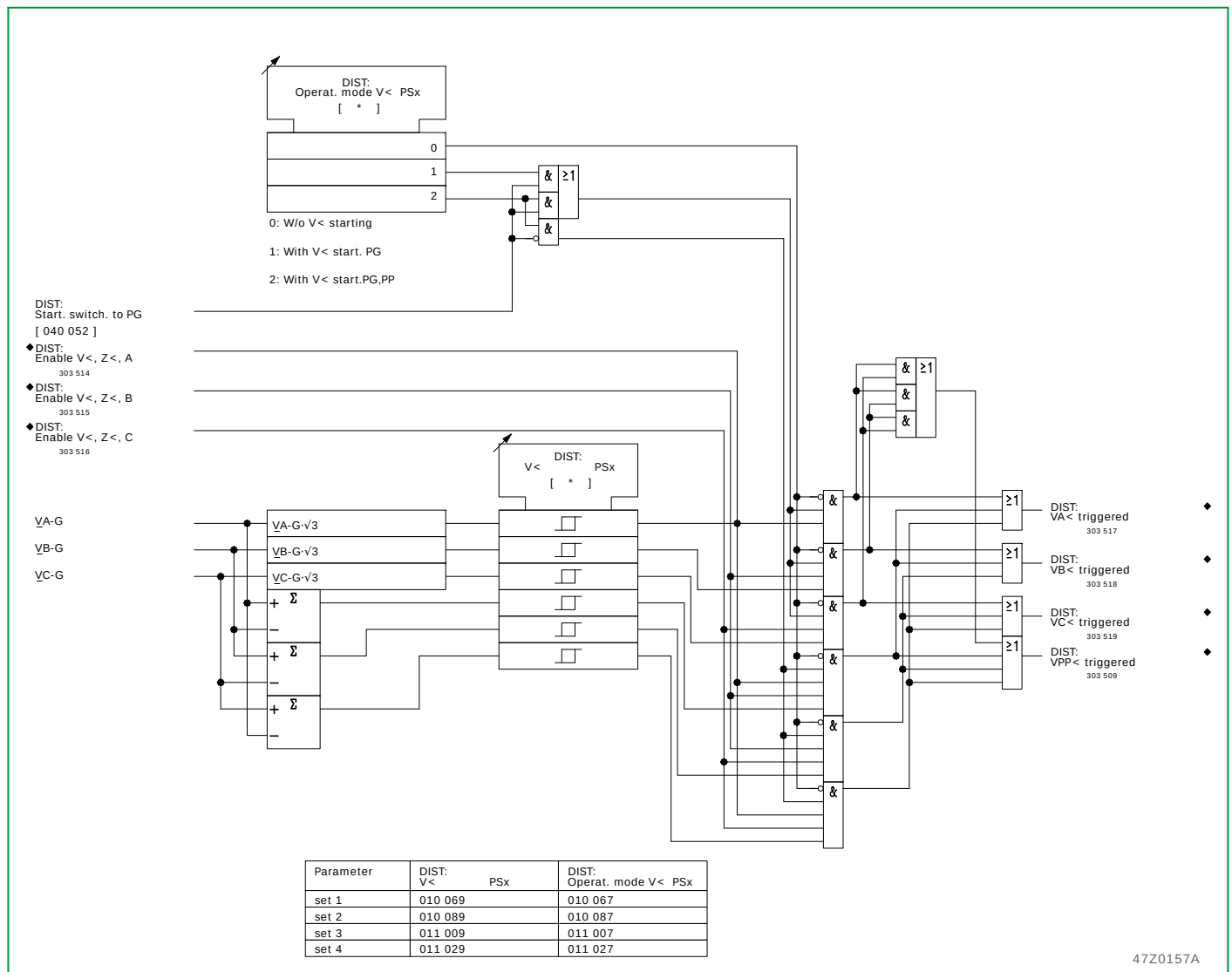


Fig. 3-126: Undervoltage detection.

3.24.2.5

Underimpedance Fault Detection

Underimpedance fault detection determines the impedances of the phase-to-ground or phase-to-phase loops.

The underimpedance fault detection mode can be set by selecting the operating mode via DIST: Operat. mode Z< PSx. The following operating modes are possible:

- *W/o Z< starting*: Underimpedance fault detection is disabled.
- *With Z< starting P-G*: The underimpedance fault detection function evaluates only the decisions of the phase-to-ground loops, once these functions have been enabled by ground fault detection.
- *With Z< start.PG,PP*: Ground fault detection brings about a switch from phase-to-phase to phase-to-ground loops.

All underimpedance fault detection measuring loops are blocked when the I_{>>>} trigger operates (see [Section 3.24.2.1, \(p. 3-171\)](#)). When overcurrent or undervoltage fault detection operates, the corresponding measuring loops are blocked phase-selectively.

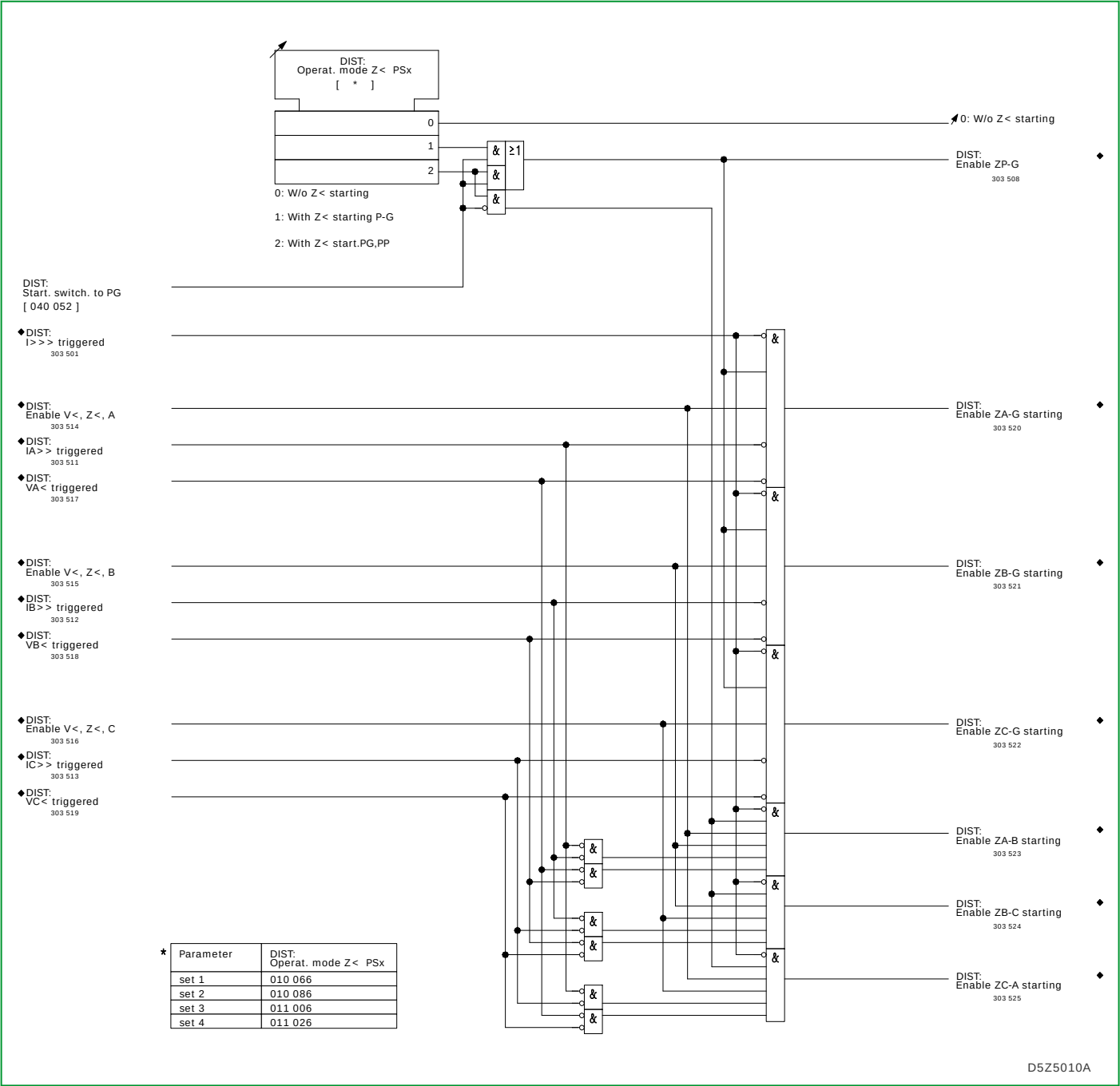


Fig. 3-127: Enabling underimpedance fault detection.

If measurement is enabled, the loop impedance is determined and compared to ascertain that it is within the set impedance range. The loop impedance of the phase-to-ground loops is determined, depending on the setting DIST: Z evaluation PSx, by using the ground current corrected by the set ground factor k_G or by using the phase current multiplied by 2 or by $(1 + k_G)$.

- Setting $Z_{PG} = V_{PG} / (I_P + k_G \cdot I_N)$: The calculation is carried out using the ground current corrected by the set ground factor k_G :

$$Z_{PG} = \frac{V_{PG}}{I_P + k_G \cdot I_N}$$

- Setting $Z_{PG} = V_{PG} / 2 \cdot I_P$: The calculation is carried out using the phase current multiplied by 2:

$$Z_{PG} = \frac{V_{PG}}{2 \cdot I_P}$$

- Setting $Z_{PG} = V_{PG} / I_P \cdot (1 + k_G)$: The calculation is carried out using the phase current and the ground factor k_G :

$$Z_{PG} = \frac{V_{PG}}{I_P \cdot (1 + k_G)}$$

The following values must be set in order to determine the underimpedance fault detection characteristic:

- Reactance in forward direction X_{fw}
- Load angle β
- Ratio Z_{bw} / Z_{fw} , where
 - Z_{bw} : Impedance in backward (reverse) direction;
 - Z_{fw} : Impedance in forward direction)
- Phase-to-ground impedance in forward direction $Z_{fw,PG}$
- Phase-to-phase impedance in forward direction $Z_{fw,PP}$
- Phase-to-ground resistance in forward direction $R_{fw,PG}$
- Phase-to-phase resistance in forward direction $R_{fw,PP}$

If, on the basis of the settings, the reach in the backward (reverse) direction is greater than $3 \cdot Z_{nom}$, then the range is limited to $3 \cdot Z_{nom}$ (where $Z_{nom} = V_{nom} / I_{nom}$).

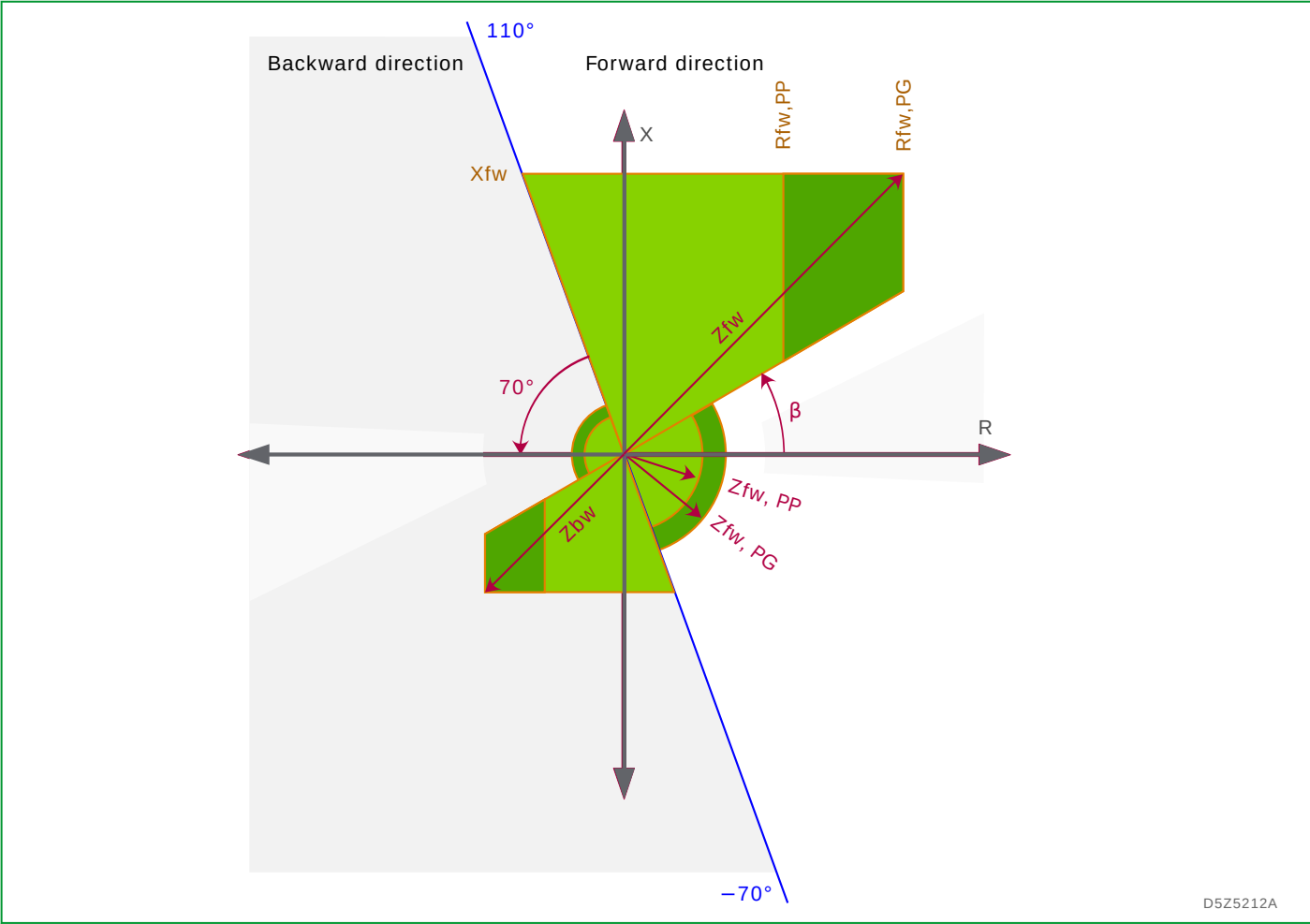


Fig. 3-128: Fault detection characteristic of the underimpedance fault detection function.

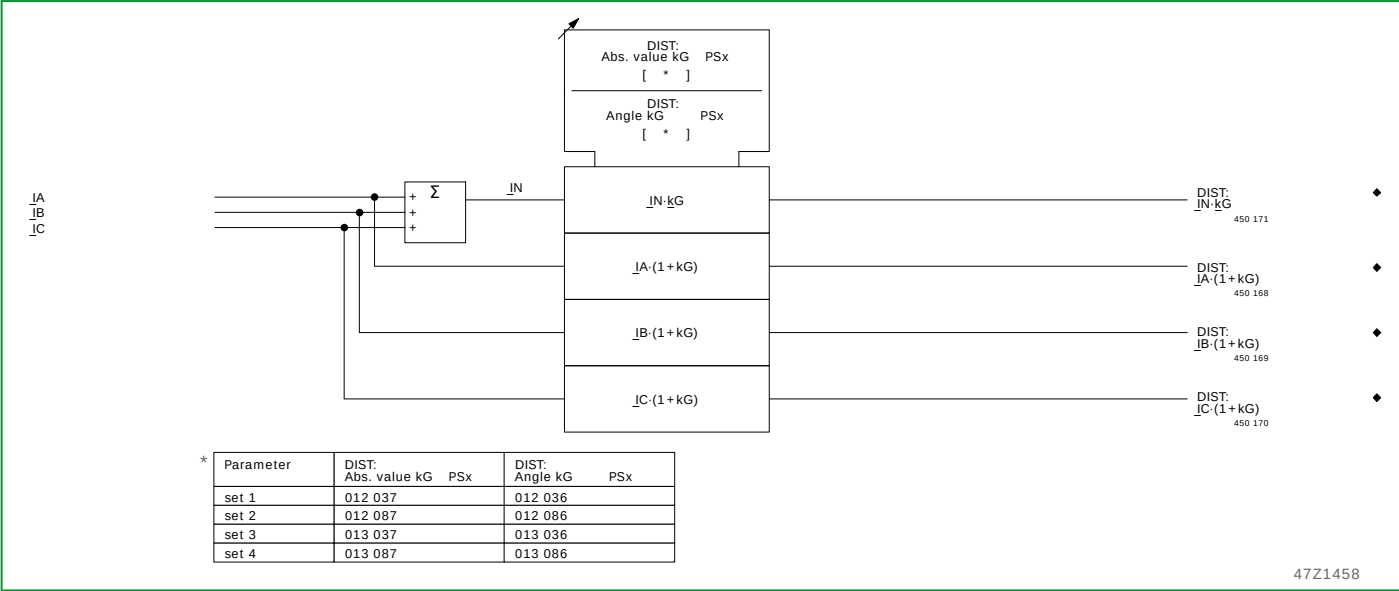


Fig. 3-129: Formation of currents corrected by the ground factor.



Fig. 3-130: Underimpedance detection.

3.24.2.6

Fault Detection Logic

The fault detection logic links the phase-selective output signals from the following fault detections to form common phase-selective starting decisions (S_A , S_B , and S_C) and S_{N1} :

- Overcurrent detection ($I_{>}$)
- Ground fault detection
- Undervoltage detection ($V_{<}$)
- Underimpedance detection ($Z_{<}$)

The phase-selective starting decisions are combined to form “general starting” – and thus produce the MAIN: General starting signal. Ground fault detection alone does not bring about general starting.

If fault detection operates via overcurrent fault detection, single-phase fault detection may operate without ground fault detection. In order for the measuring loops for distance and directional measurement to be properly selected even in this case, either S_{N1} or starting in another phase must be triggered as well. It is possible to specify whether, in the case of single-phase starting, S_{N1} will always be triggered or whether – depending on the magnitude of the phase currents – S_{N1} or starting in one phase will be transfer-triggered.

- MAIN: Transfer for 1p PSx = *Ground*

With single-phase overcurrent fault detection, S_{N1} is started and transferred after the timer stage $t_{IN>}$ has elapsed (see [Section 3.24.2.2, \(p. 3-172\)](#) for setting).

If there is a change from single-phase overcurrent fault detection without ground to multi-phase fault detection or single-phase-to-ground fault detection, starting will occur instantaneously.

- MAIN: Transfer for 1p PSx = *P or G = f(I_{med}, I_{max})*

For single-pole overcurrent fault detection, the decision as to whether starting in one phase or S_{N1} starting will be transferred depends on the I_{med} / I_{max} ratio. The magnitude of the medium phase current must be more than 2/3 the magnitude of the maximum current for the phase to be transfer-triggered. If the current with the medium-sized magnitude is smaller, S_{N1} will be triggered after timer stage $t_{IN>}$ has elapsed.

If there is a change from single-phase overcurrent fault detection without ground to multi-phase fault detection or single-phase-to-ground fault detection, starting will occur instantaneously.

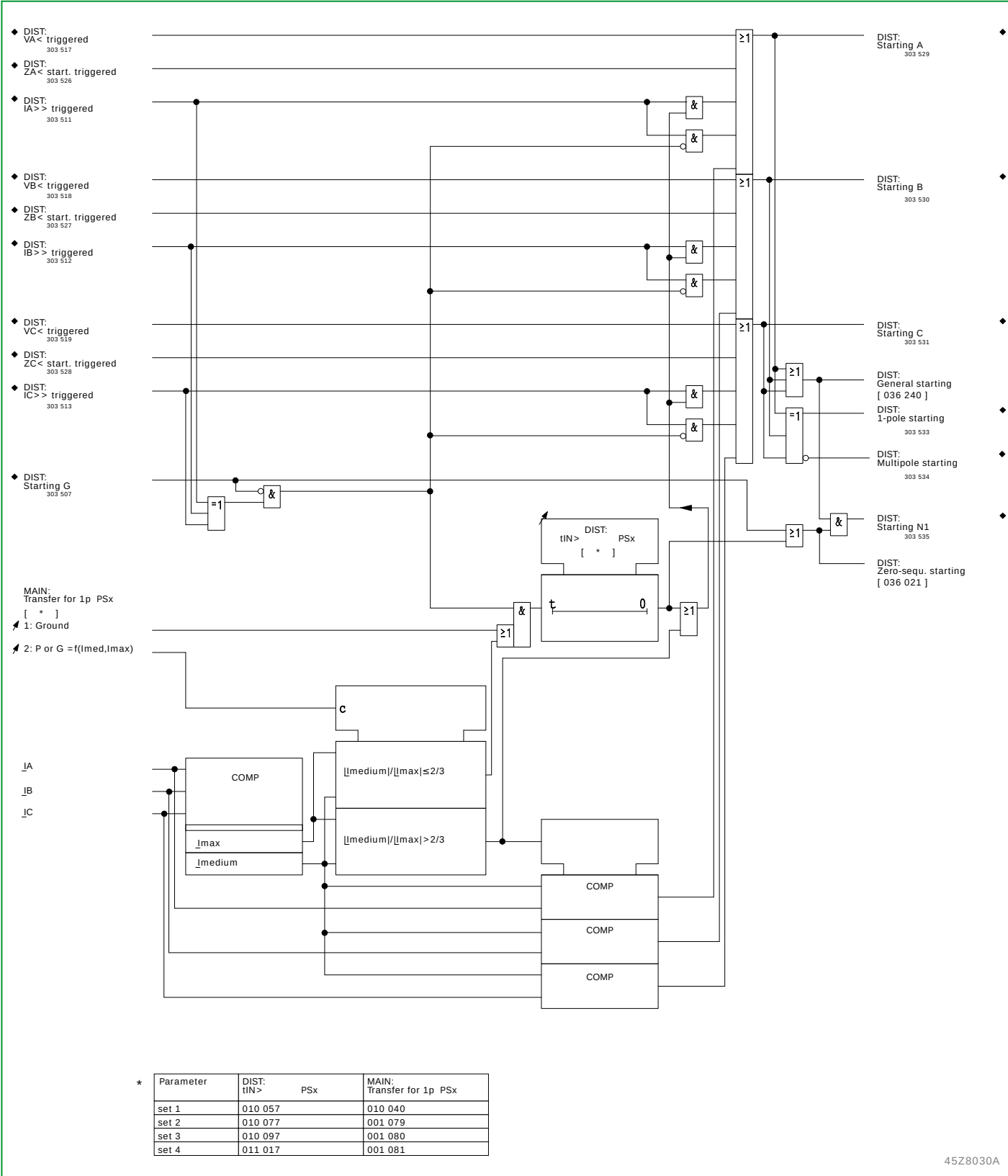


Fig. 3-131: Fault detection and starting logic.

If a general starting condition is present, then the decisions of the following systems are signaled:

- Overcurrent fault detection
- Undervoltage fault detection
- Underimpedance fault detection

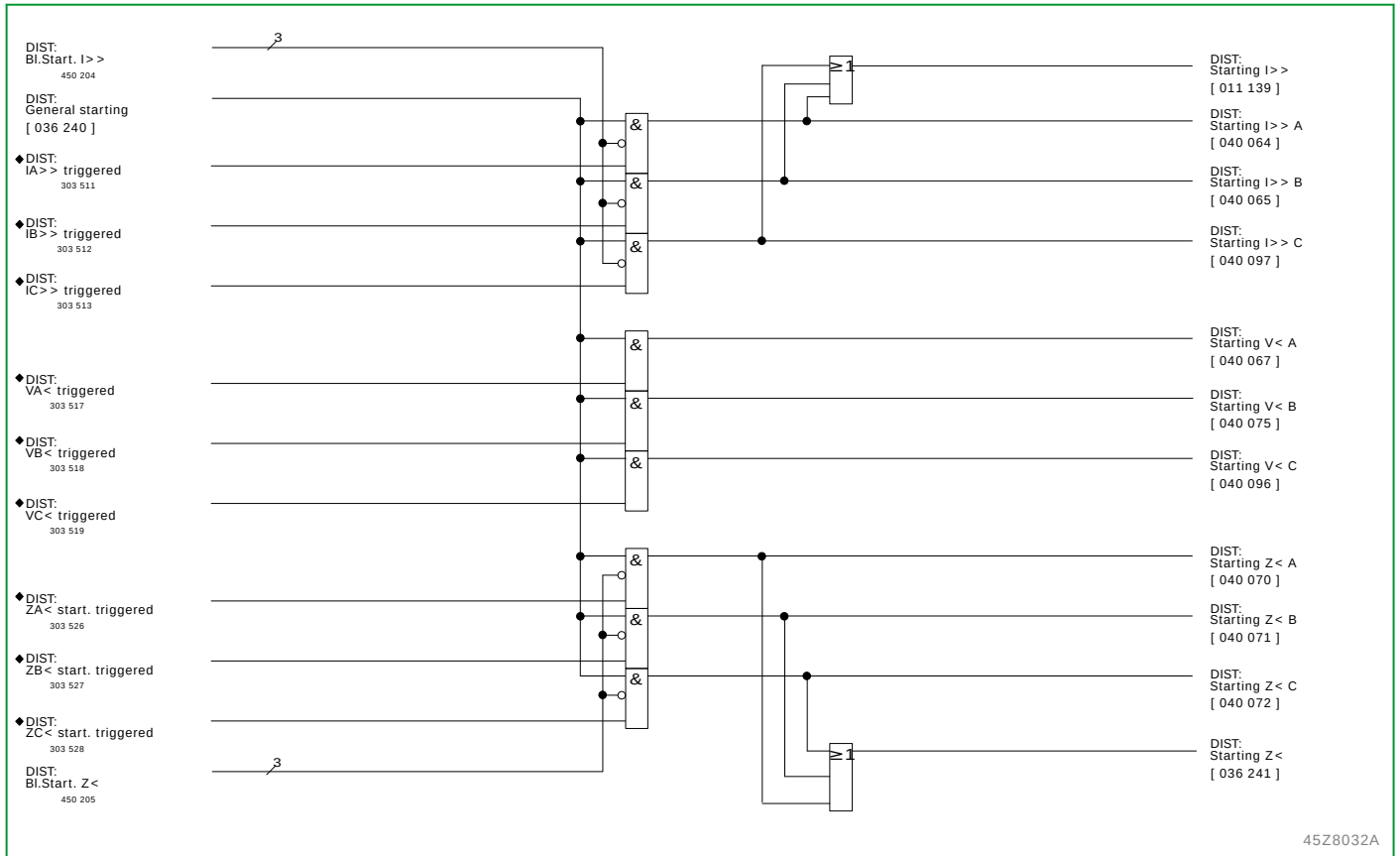


Fig. 3-132: Fault detection signals of distance protection.

3.24.3 Selection of Measured Values

The P433 selects a measuring loop based on the phase-selective starting decision and the phase preference selected. The fault impedance (short-circuit impedance) and the fault direction are determined from the voltage and current values collected from these measuring loops.

For three-phase starting signals with or without ground the minimum voltage value and the associated phase-to-phase current are selected from the phase-to-phase voltages as measured values. In case of a two-phase to ground fault detection the set phase preference is decisive for the selection of the measured values.

Only the fundamental of the selected measured voltage is evaluated. If stabilization for capacitive voltage transformers (CVT stabilization) has been enabled, the device checks to determine whether the second harmonic exceeds the $0,01V_{nom}$ threshold. If so, a special filter designed specifically for CVTs is activated.

[illegible]

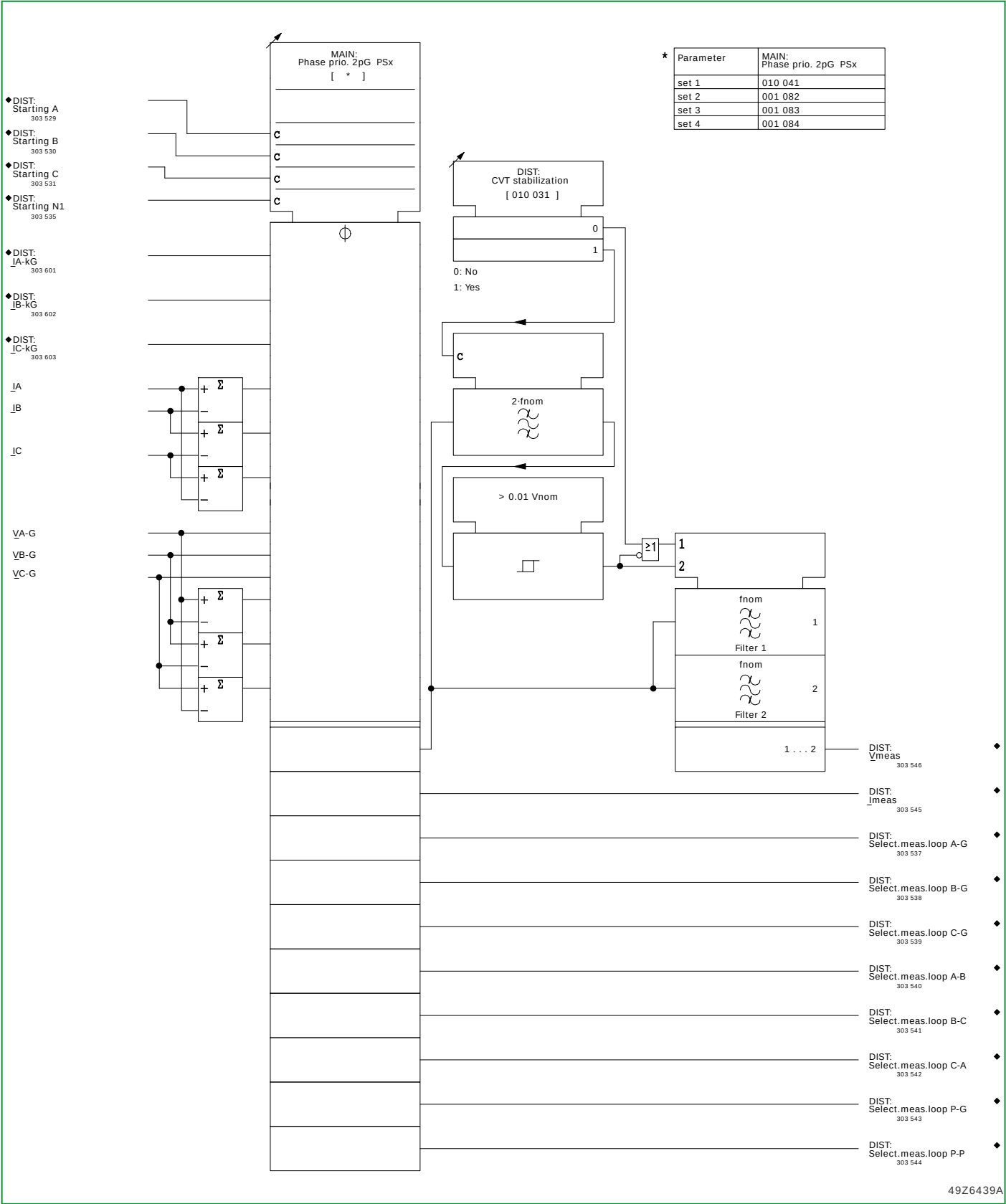


Fig. 3-133: Selection of the measured values.

3.24.4 Distance and Directional Measurement

The P433 determines the fault impedance and the fault direction on the basis of the selected measured values. A voltage memory is available so that measurement will function correctly, even with very low fault voltages.

To improve stability of directional measurement, this voltage memory is also always used during initial fault inception transients, regardless the absolute value of the fault voltage.

3.24.4.1 Voltage Memory

Voltage V_{A-B} is the reference voltage for the voltage memory. If the voltage exceeds the fixed value of $0.65V_{nom}$ and there is no starting of the distance protection function, then the voltage memory will be synchronized. Synchronization requires approximately 300 ms. Then a check is carried out to determine whether the frequency satisfies the following condition:

$$0.95f_{\text{nom}} < f < 1.05f_{\text{nom}}$$

If the condition is satisfied, the voltage memory is enabled. The frequency condition is checked cyclically. As soon as the frequency condition is no longer met, the enable is canceled.

If the magnitude of the reference voltage drops below $0.65V_{nom}$ or if a starting of the distance protection function occurs, synchronization of the voltage memory will be terminated. The voltage memory is then free-running and remains enabled for 2 s.

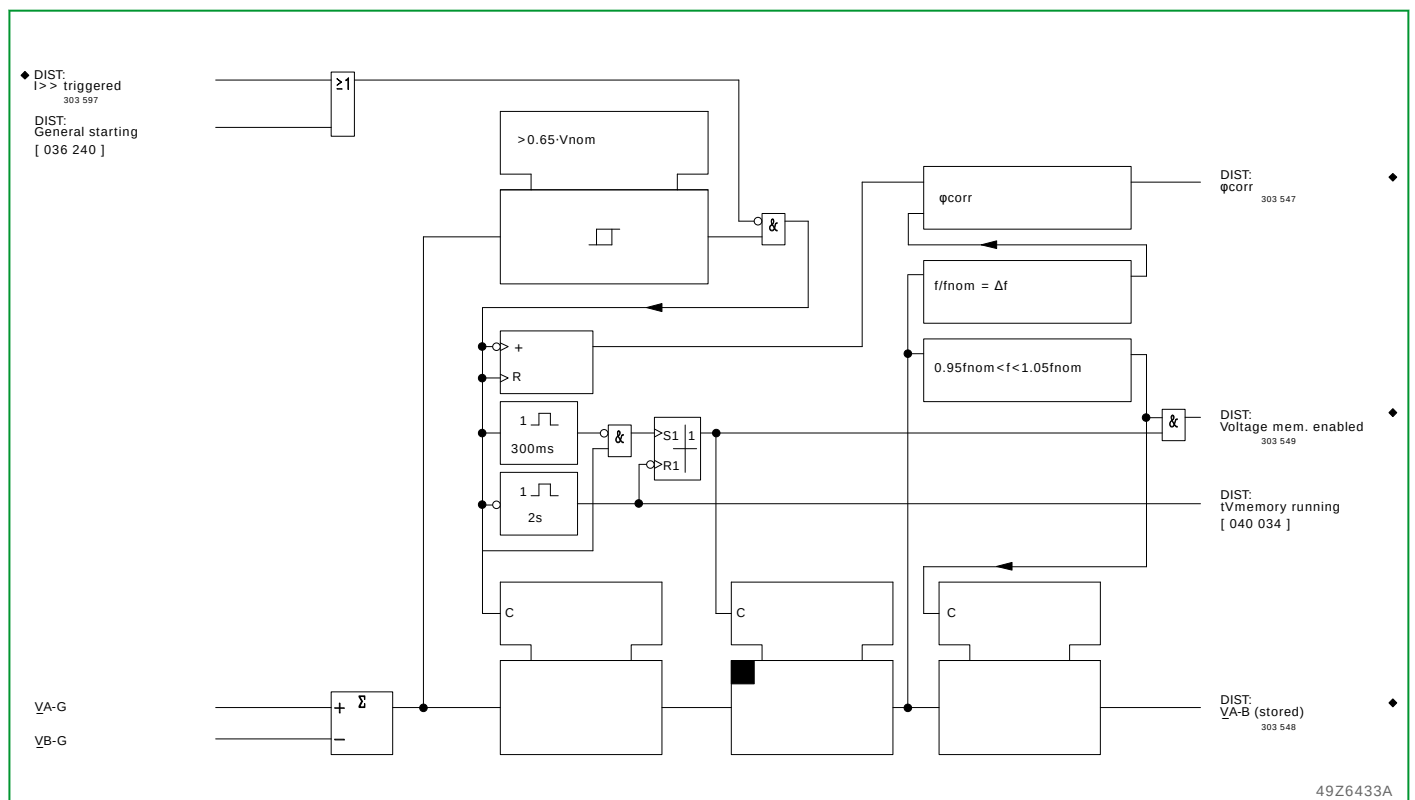


Fig. 3-134: Storing the reference voltage in memory.

3.24.4.2 Angle Determination

When general starting of distance protection occurs, the angles φ_F and φ_S are determined. Angle φ_F is the fault angle that is determined using the selected measuring voltage V_{meas} and the selected measuring current I_{meas} . Angle φ_S is

determined on the basis of the voltage stored in memory and the selected measuring current I_{meas} . Since the frequency of the stored voltage can differ from the nominal frequency, a phase correction must be made. This correction is determined by the frequency deviation and the time that has elapsed since synchronization was terminated. Furthermore, an angle correction based on the selected measuring loop and the setting at MAIN: Phase sequence is required. The resulting angle, ϕ_X , is used for further processing.

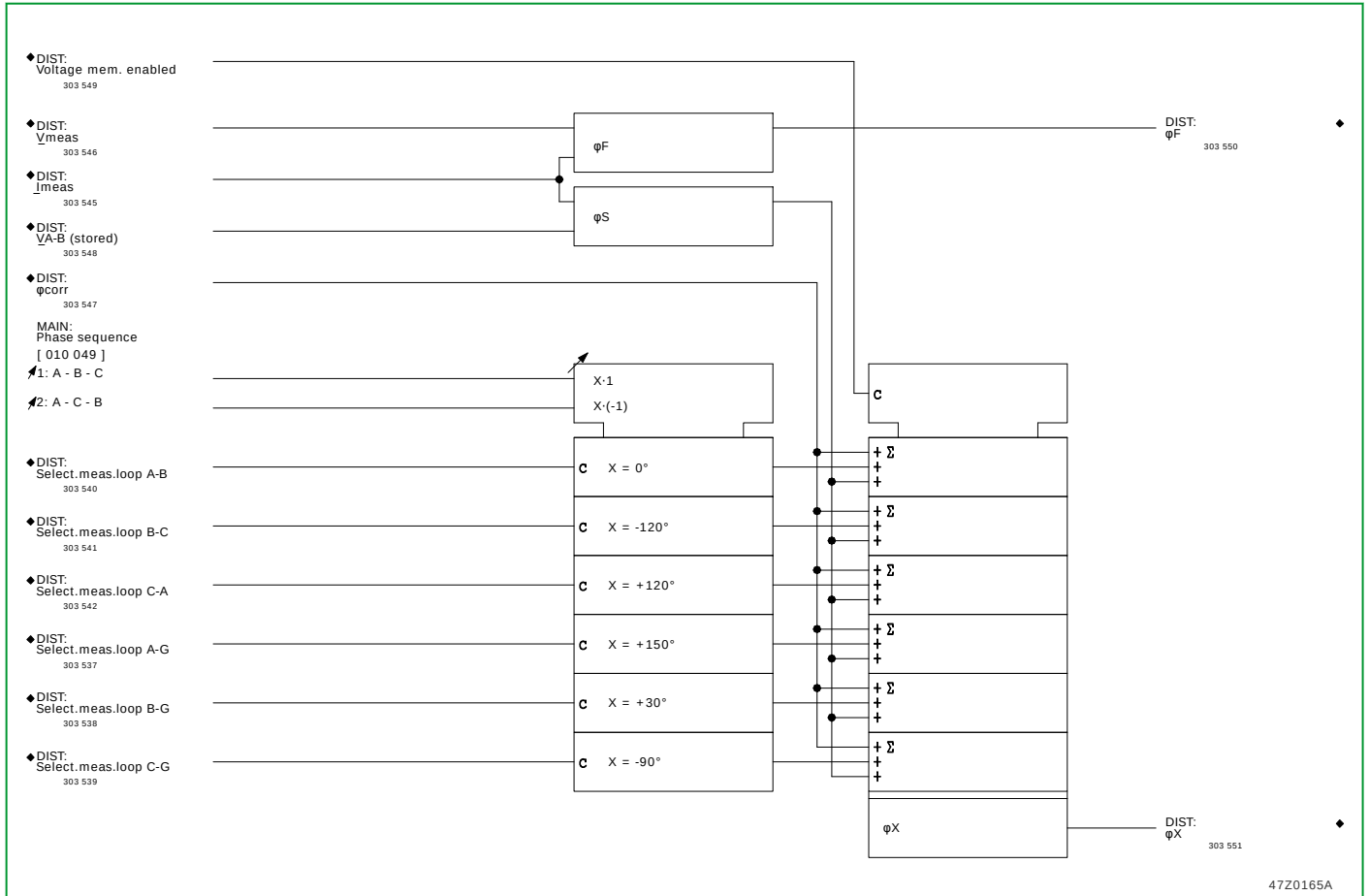


Fig. 3-135: Angle determination.

3.24.4.3

Selecting the Angle for Direction Determination

For distance and directional measurement, the following angles are used – as a function of the magnitude of the selected measuring voltage and the fault duration:

- Fault angle ϕ_F
- Angle ϕ_X
- Set angle α

If the selected measuring voltage V_{meas} is above the threshold set at DIST: Oper.val.Vmemory PSx when the fault occurs, then the direction is determined using fault angle ϕ_F . If the measuring voltage is below the threshold set at DIST: Oper.val.Vmemory PSx then angle ϕ_X is used for directional measurement. If the voltage memory is not enabled, angle ϕ_X cannot be determined. In this case the P433 checks whether the measuring voltage V_{meas} is within this range:

$$0.002V_{nom} < V_{meas} < \text{DIST: Oper.val.Vmemory PSx}$$

If such is the case then the direction is determined with fault angle φ_F . Direction determination using φ_X or φ_F is not possible if the voltage memory is not enabled or if the measuring voltage is less than $0.002V_{nom}$. In these cases, set angle α is used for directional measurement. This means that a decision is made for the forward direction.

Angle for Direction Determination:

V memory	$V_{meas} < 0.002V_{nom}$	$0.002V_{nom} < V_{meas} < DIST: Oper.val.Vmemory PSx$
freigegeben	φ_X	φ_X
nicht freigegeben	α	φ_F

A decision is made for the forward direction if the angle φ selected for direction determination is in this range:

$$-45^\circ < \varphi < +135^\circ$$

In the case of angles outside this range, a decision is made for the backward (reverse) direction.

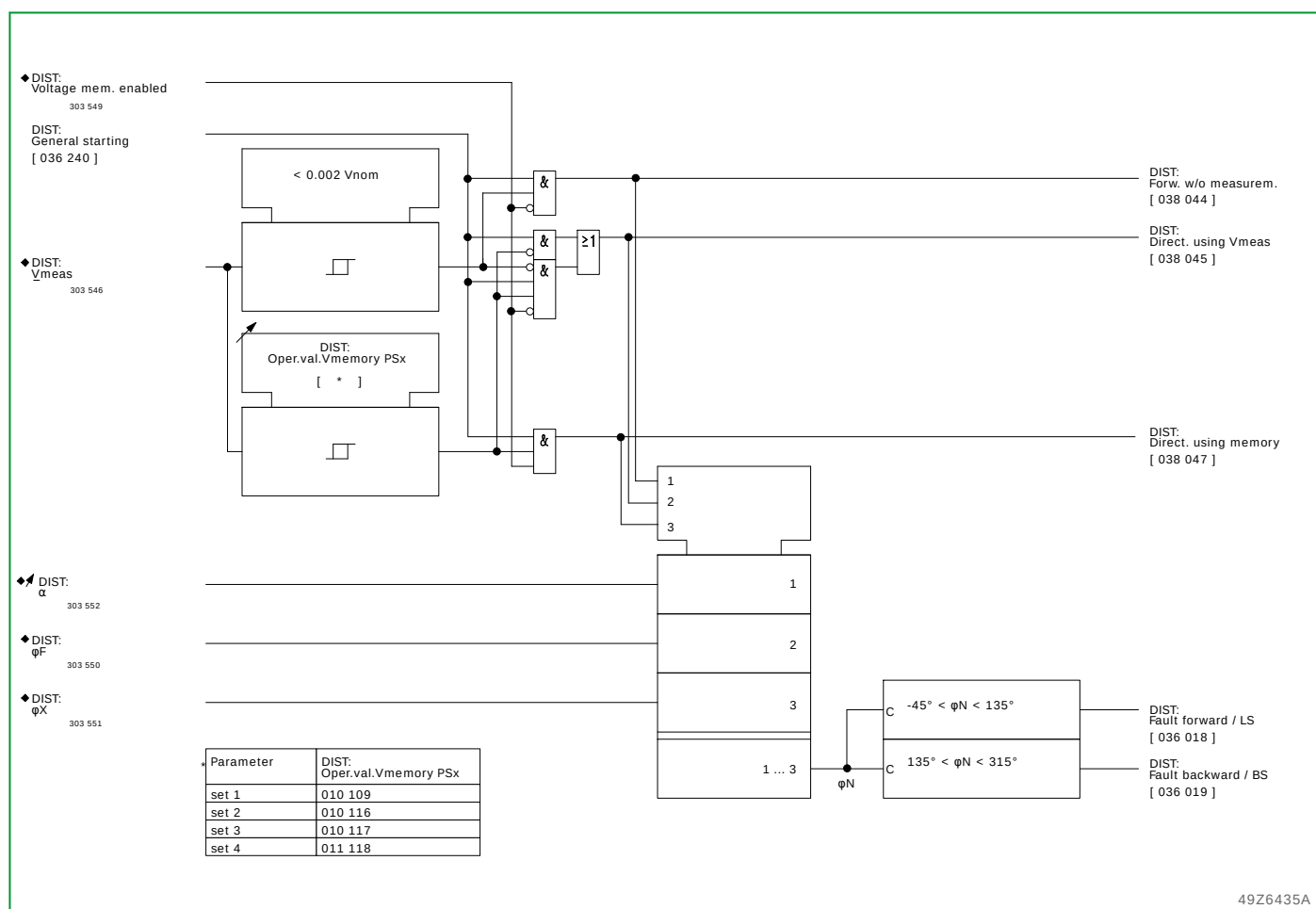


Fig. 3-136: Direction determination.

3.24.4.4

Selecting the Angle for Impedance Calculation

The angle that is used to calculate fault impedance is selected according to the following criteria:

- If the measuring voltage V_{meas} is greater than the set threshold (DIST: Oper.val.Vmemory PSx) when the fault occurs, then fault angle φ_F is used to calculate fault impedance.
- If the fault voltages are lower than the set threshold (DIST: Oper.val.Vmemory PSx) and the voltage memory is enabled, a check is made to determine whether angles φ_F and φ_X are in the forward direction, i.e.: $-45^\circ < \varphi < +135^\circ$
 - If both angles are in the same direction, either forward or backward, then fault angle φ_F is selected for distance measurement.
 - If angle φ_F is in the forward direction and angle φ_X is in the backward direction, then an angle of $(180^\circ + \alpha)$ is specified for the calculation.
 - If angle φ_X is in the forward direction and angle φ_F is in the backward direction, then set angle α is used for distance measurement.
- If voltage memory is not enabled, the P433 checks whether:
 - ...the measuring voltage V_{meas} is within this range:
 $0.002V_{\text{nom}} < V_{\text{meas}} < \text{DIST: Oper.val.Vmemory PSx}$
 If such is the case then the impedance is calculated using fault angle φ_F .
 - ...the selected measuring voltage $V_{\text{meas}} < 0.002V_{\text{nom}}$. In this case, the impedance is calculated using set angle α .

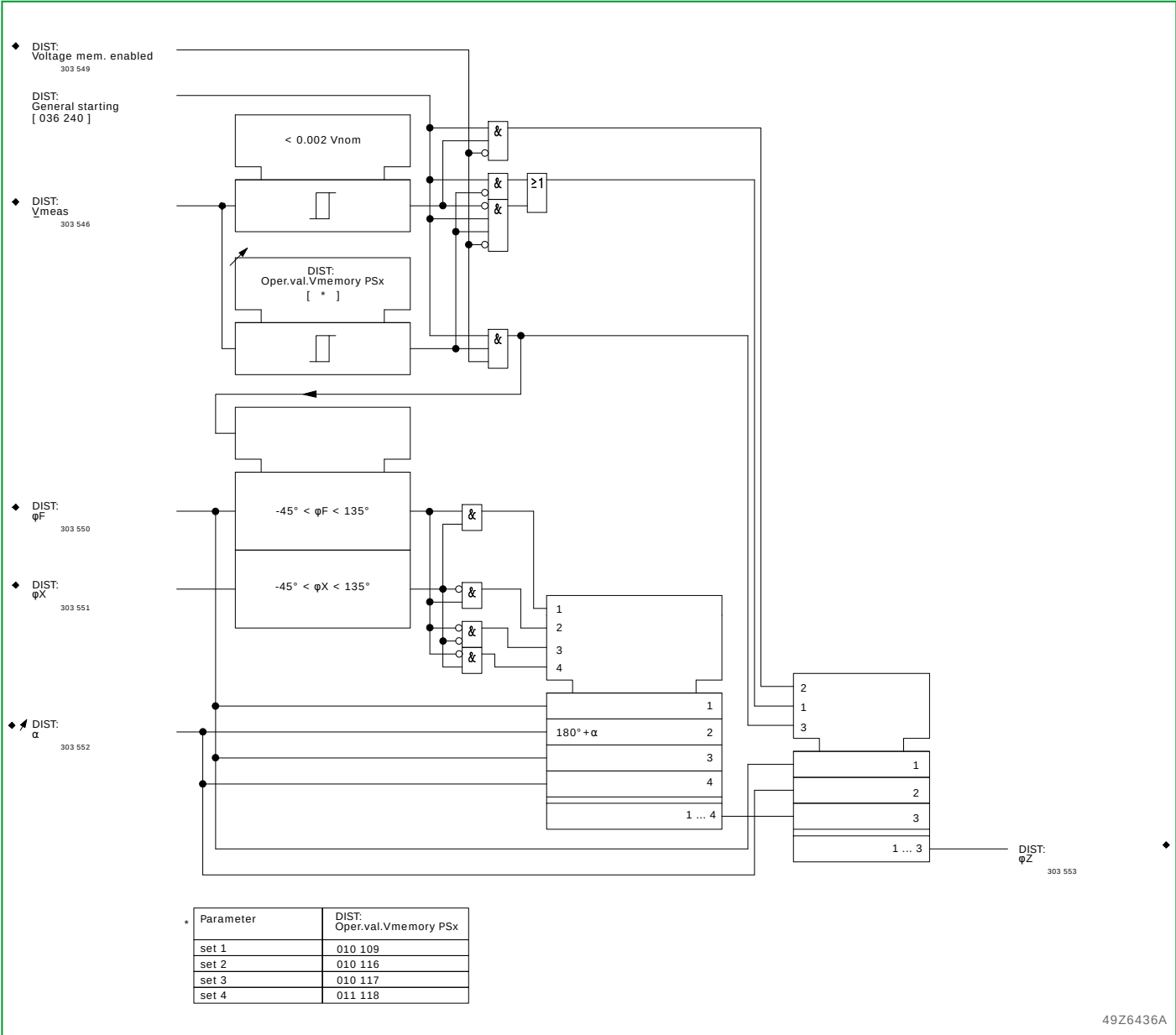


Fig. 3-137: Selecting the angle for impedance calculation.

3.24.4.5 Distance Measurement

For distance zone decision, the loop impedance is determined and compared to the set zone(s).

- The loop impedance of the phase-to-phase loops is determined using the geometric differences of voltages and currents,
e.g. for loop A-B: $Z_{AB} = (V_{AG} - V_{BG}) / (I_A - I_B)$
- The loop impedance of the phase-to-ground loops is determined using the ground current corrected by the set ground factor k_G ,
e.g. for loop A-G: $Z_{AG} = V_{AG} / (I_A + k_G \cdot I_N)$

One of the following types of characteristics may be selected for distance measurement by way of the setting at DIST: Characteristic PSx:

- Circle
- Polygon

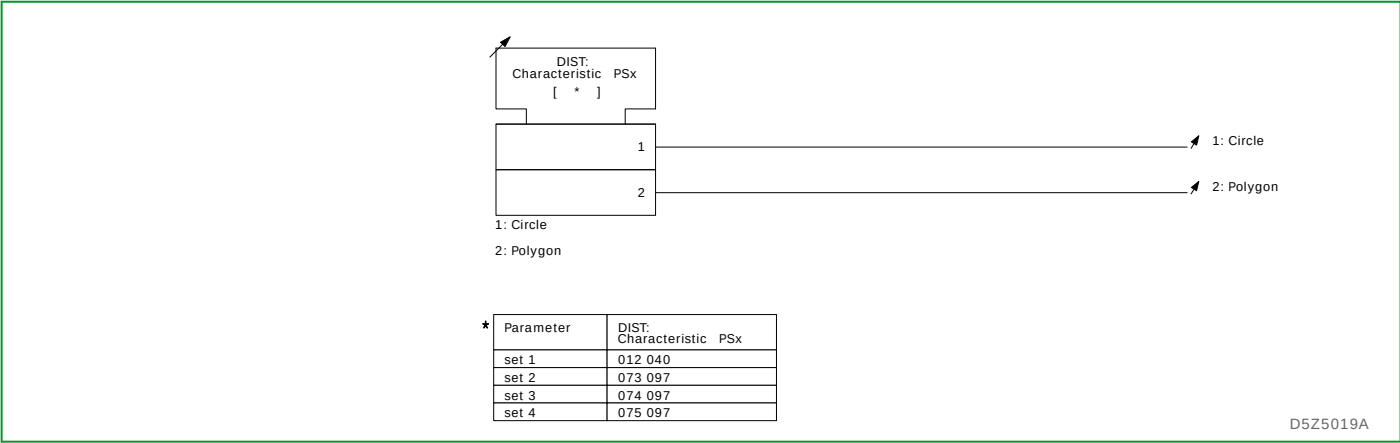


Fig. 3-138: Selecting the characteristic.

3.24.4.5.1 Circle Characteristic

The fault impedance value Z_F is determined using the selected measuring quantities V_{meas} and I_{meas} . If the setting *Arc compensation* has been chosen (DIST: Arc comp. circle PSx = Yes), then a correction to the measured fault impedance is calculated for angles φ_Z in the range of $-45^\circ < \varphi_Z < \alpha$ or $135^\circ < \varphi_Z < (\alpha + 180^\circ)$ as follows:

$$\left| \frac{Z}{Z_{F,corr}} \right| = \frac{\left| \frac{Z}{Z_F} \right|}{1 + \sin \delta}$$

The following relation applies in the range $-45^\circ < \varphi_Z < \alpha$:

$$\delta = \alpha - \varphi_Z$$

The following relation applies in the range $135^\circ < \varphi_Z < (\alpha + 180^\circ)$:

$$\delta = \alpha - \varphi_Z + 180^\circ$$

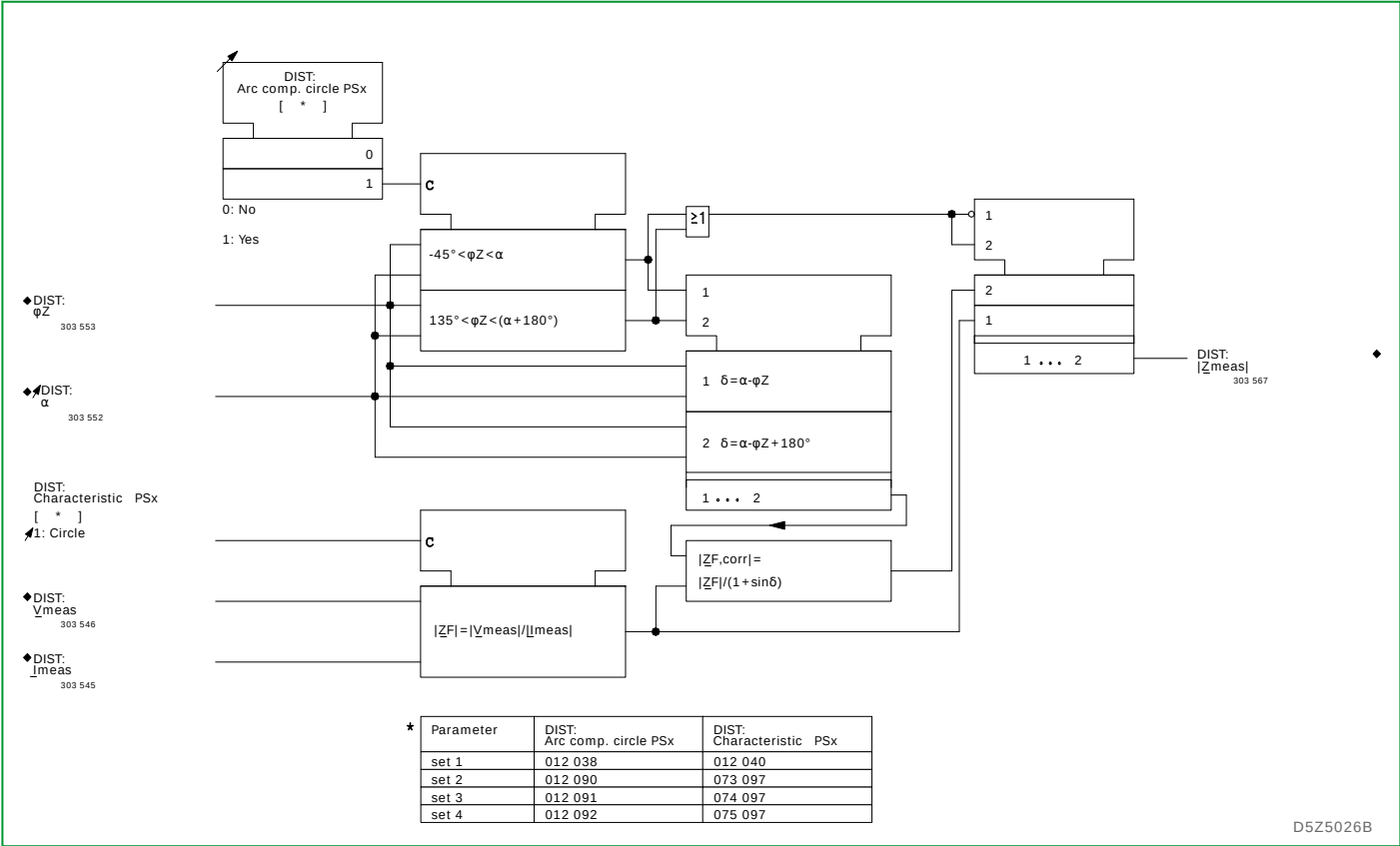


Fig. 3-139: Impedance measurement with the circle characteristic.

In the R-X diagram, the characteristic shown in the following figure is obtained. If the characteristic were to be measured with sine variables for the setting *Arc compensation*, the dot-dash line would be obtained.

In this diagram, the following example settings have been used: $n = 1$ to 8 , $\alpha = 60^\circ$; dot-dash line: *with arc compensation*; dashed line: $k_{ze} = 1.2$ (adjustable in Zone 1 only).

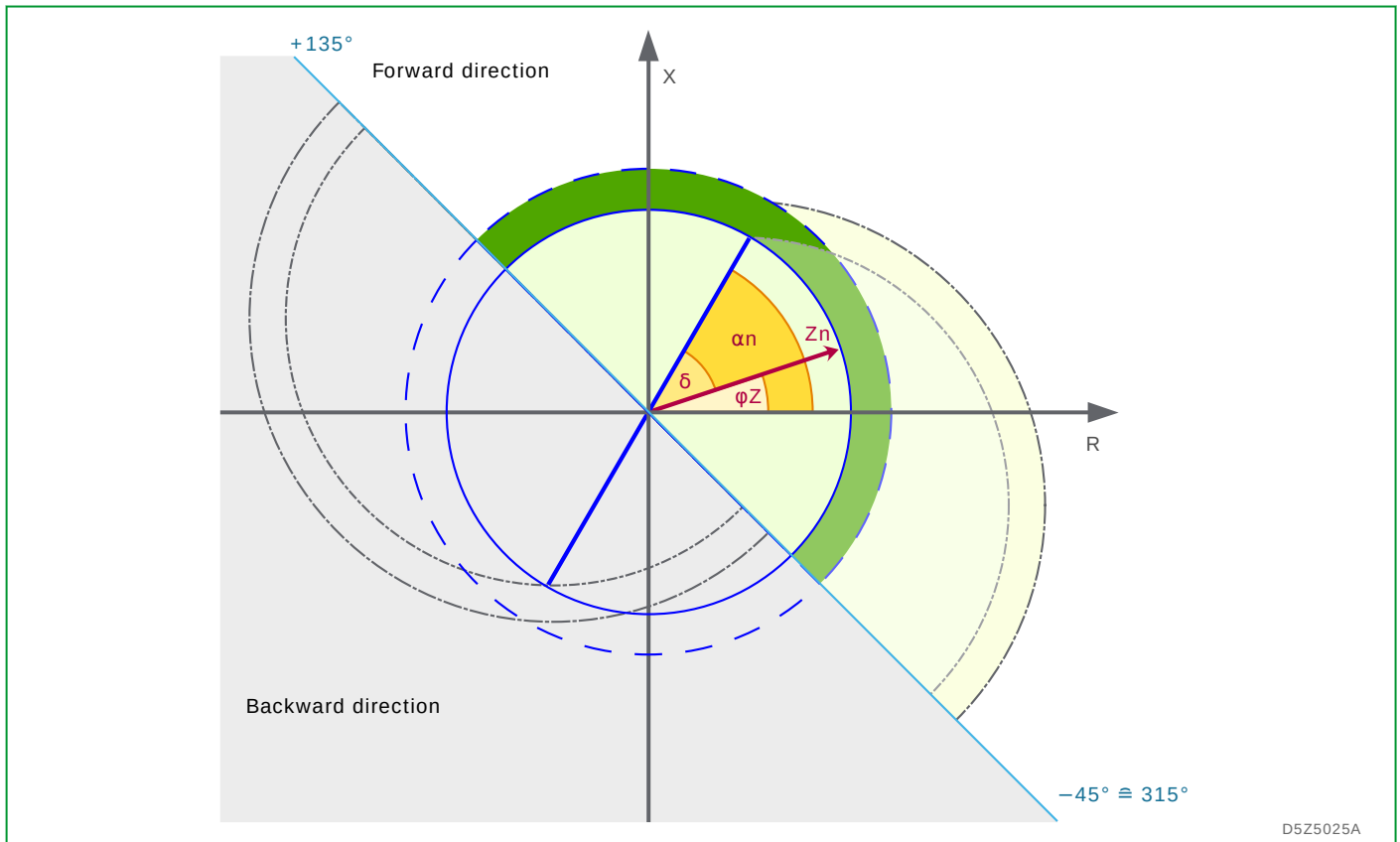


Fig. 3-140: P433 impedance and direction characteristic for the "Circle" setting.

The calculated impedance $|Z_{\text{meas}}|$ is compared with the set impedance in the eight impedance zones. If the measured impedance is smaller than or equal to the set impedance, then a distance decision is made for the corresponding zone(s).

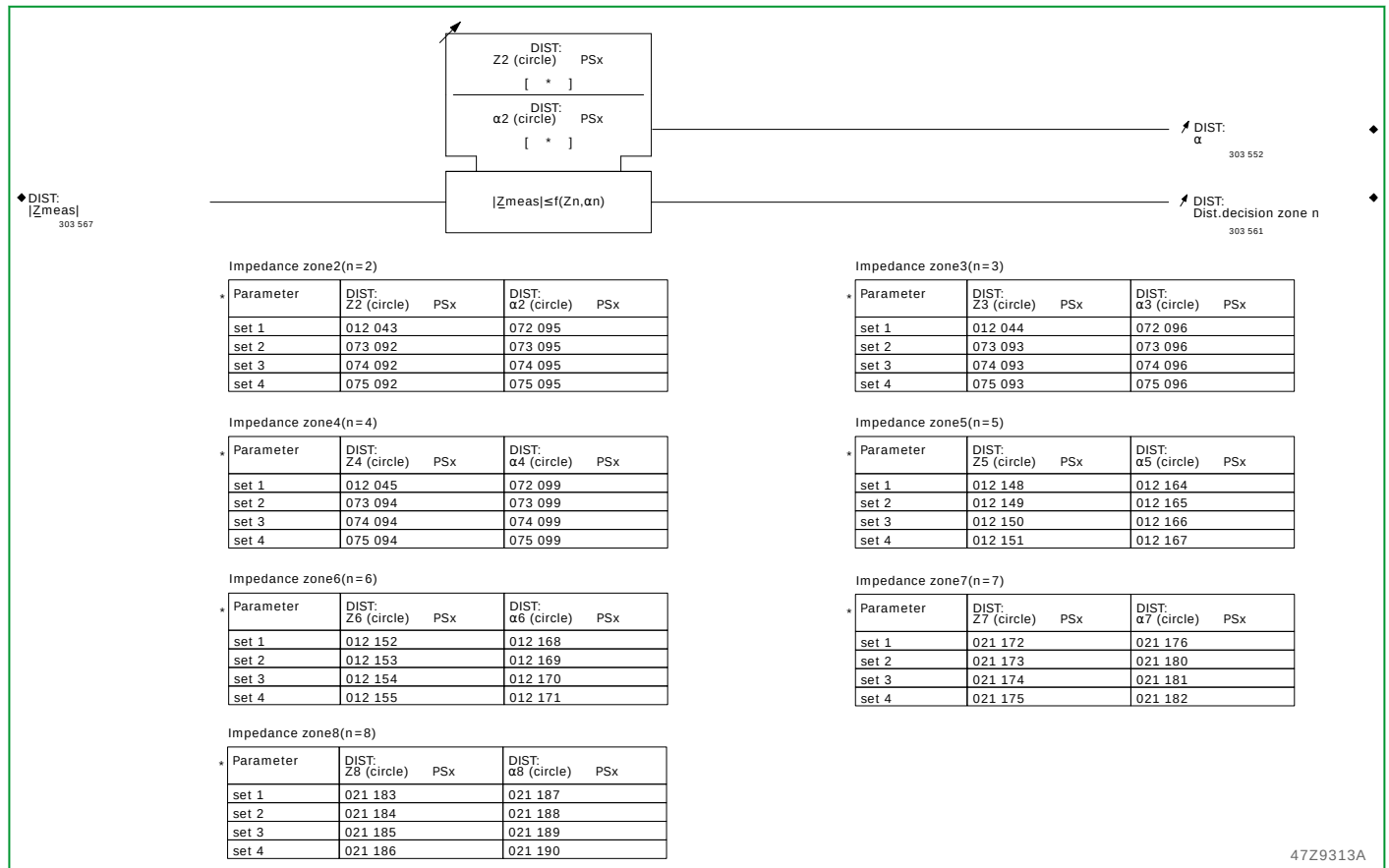


Fig. 3-141: Setting impedance zones 2 to 6 and distance measurement.

In addition to the settings described above, the zone extension factors k_{ze} for high-speed reclosure (HSR) and time-delay reclosure (TDR) can also be set separately for phase-to-ground (PG) and phase-to-phase (PP) loops for impedance zone 1. The impedances modified by zone extension factor k_{ze} are calculated as follows:

$$Z_{1,kze} = k_{ze} \cdot Z_1$$

The increase in reach by zone extension factor k_{ze} HSR is controlled by the following:

- Protective signaling (PSIG: Z1 extended)
- Internal auto-reclosing control, if protective signaling is not ready or – irrespective of the readiness of protective signaling – during the reclose command.
- Switch on to fault protection (SOTF: Z1 extended)
- An external signal (DIST: Zone extension EXT).

The impedance characteristic is extended by zone extension factor k_{ze} TDR if a time-delay reclosure is carried out by internal auto-reclosing control.

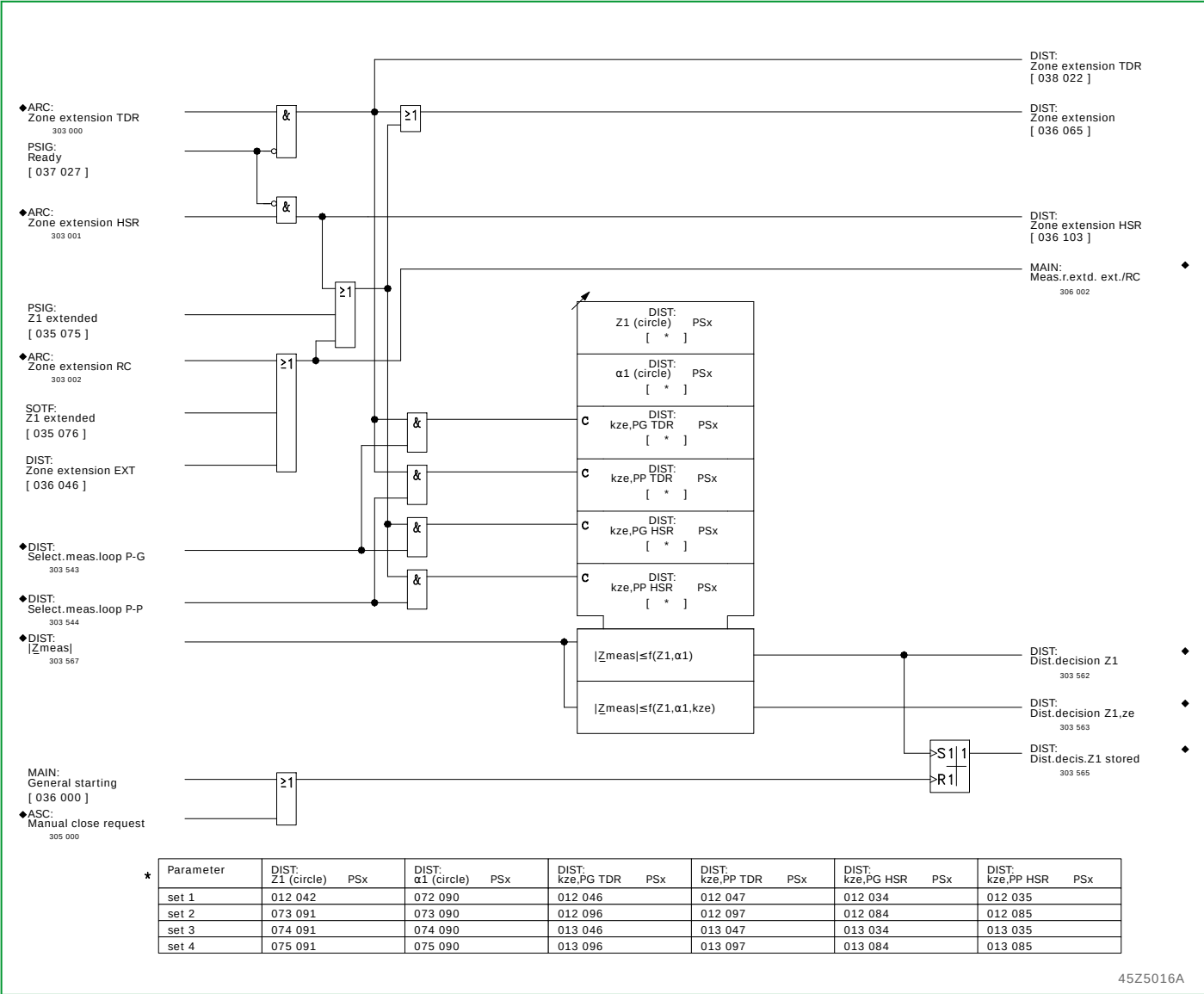


Fig. 3-142: Setting impedance Zone 1 and distance measurement.

3.24.4.5.2 Polygon (Quadrilateral) Characteristic

The $\underline{Z}_F$ fault impedance value is determined using the selected measuring quantities: $\underline{V}_{meas}$ and $\underline{I}_{meas}$. By multiplying this value by the cosine or sine of the angle selected for distance measurement, φ_Z , we then calculate the fault resistance R_F or fault reactance X_F .

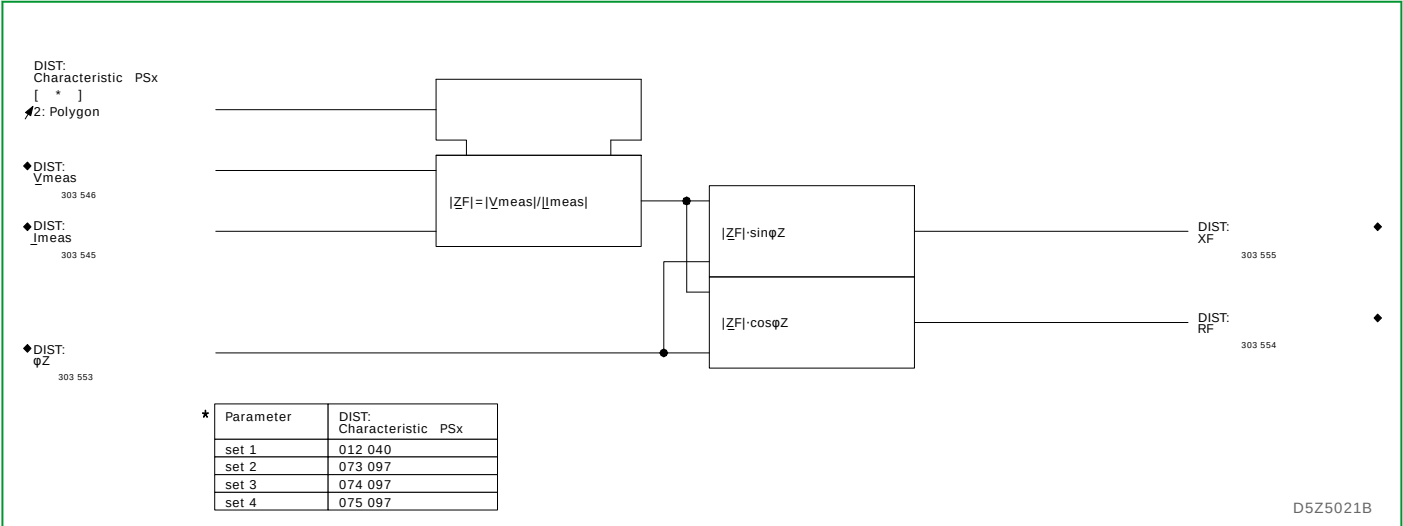


Fig. 3-143: Impedance measurement with the polygon characteristic.

The calculated quantities, R_F and X_F , are compared with the reference quantities, R_{ref} and X_{ref} , of the four impedance zones. The reference quantities are determined using the settings for determining the impedance zone(s). If both quantities lie within the set impedance zone(s), then a distance decision is made for the corresponding zone(s).

The impedance zones are determined by the following settings:

- Reactance X, separately for phase-to-ground and phase-to-phase loops
- Resistance R, separately for phase-to-ground and phase-to-phase loops
- Angle α
- Angle σ

*Note that the specified precision of measurement can only be reached if the ratio R / X is less than 8:
 $R_{n,PG} / X_n < 8$, and
 $R_{n,PP} / X_n < 8$
If the ratio is greater than this (i.e. the polygon becomes extremely “flat”), the measurement conditions for high fault resistances become quite bad, because in this case, the angle of the fault impedance gets small, which results in quite big measurement deviations for the reactance.*

Using these settings in the R-X diagram we obtain the characteristic shown in the following figure.

In this diagram, the following example settings have been used: $n = 1$ to 8, $X_n = 6.5 \, \Omega$, $R_n = 2.0 \, \Omega$, $\alpha_n = 50^\circ$, $\sigma_n = -15^\circ$; dashed line: $k_{ze} = 1.2$ (adjustable in Zone 1 only).

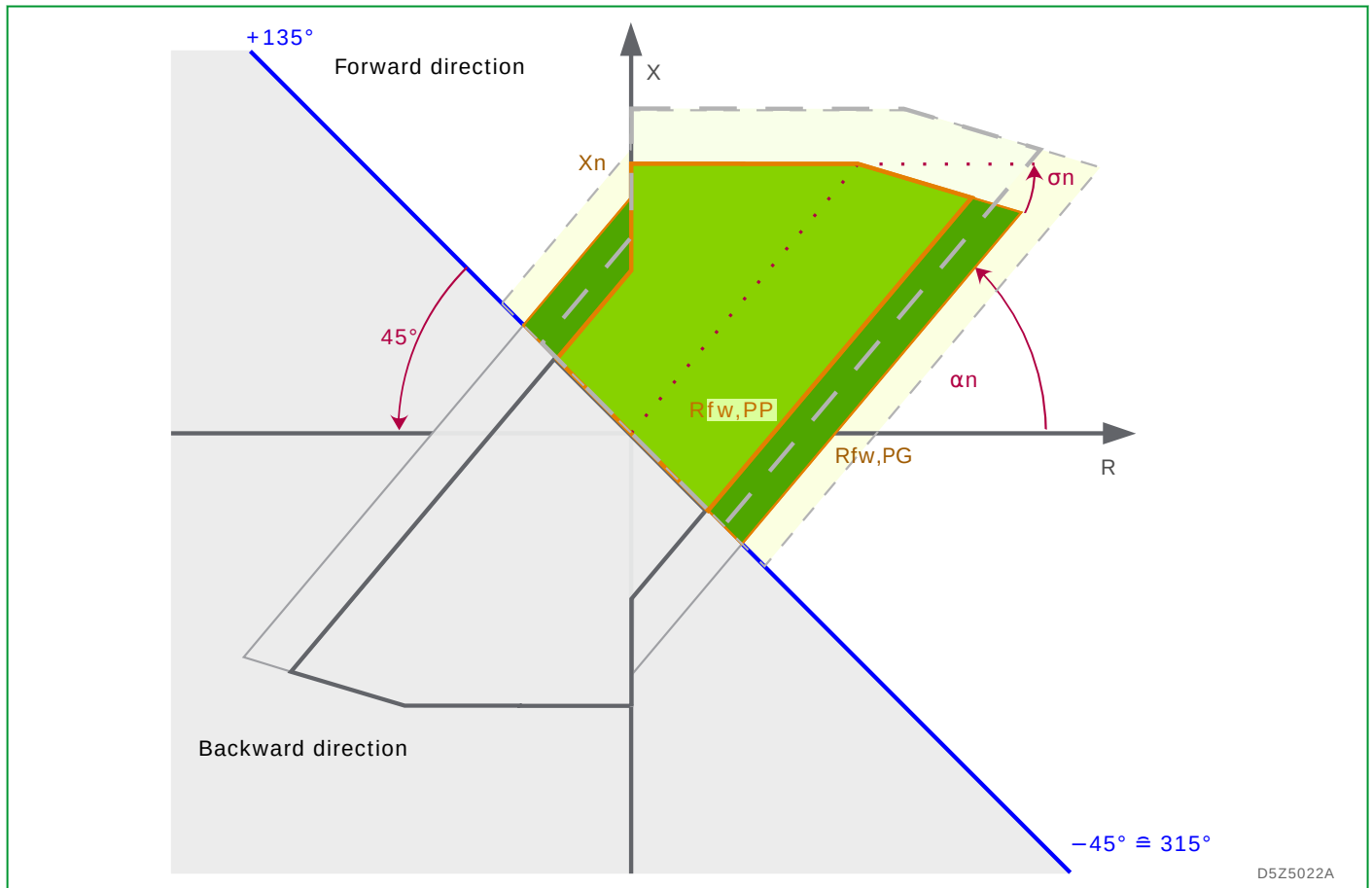


Fig. 3-144: P433 impedance and directional characteristics for the "Polygon" setting.

The resistances for phase-to-ground and phase-to-phase loops can be set separately for each zone. The different impedances are therefore compared with different impedance characteristics.

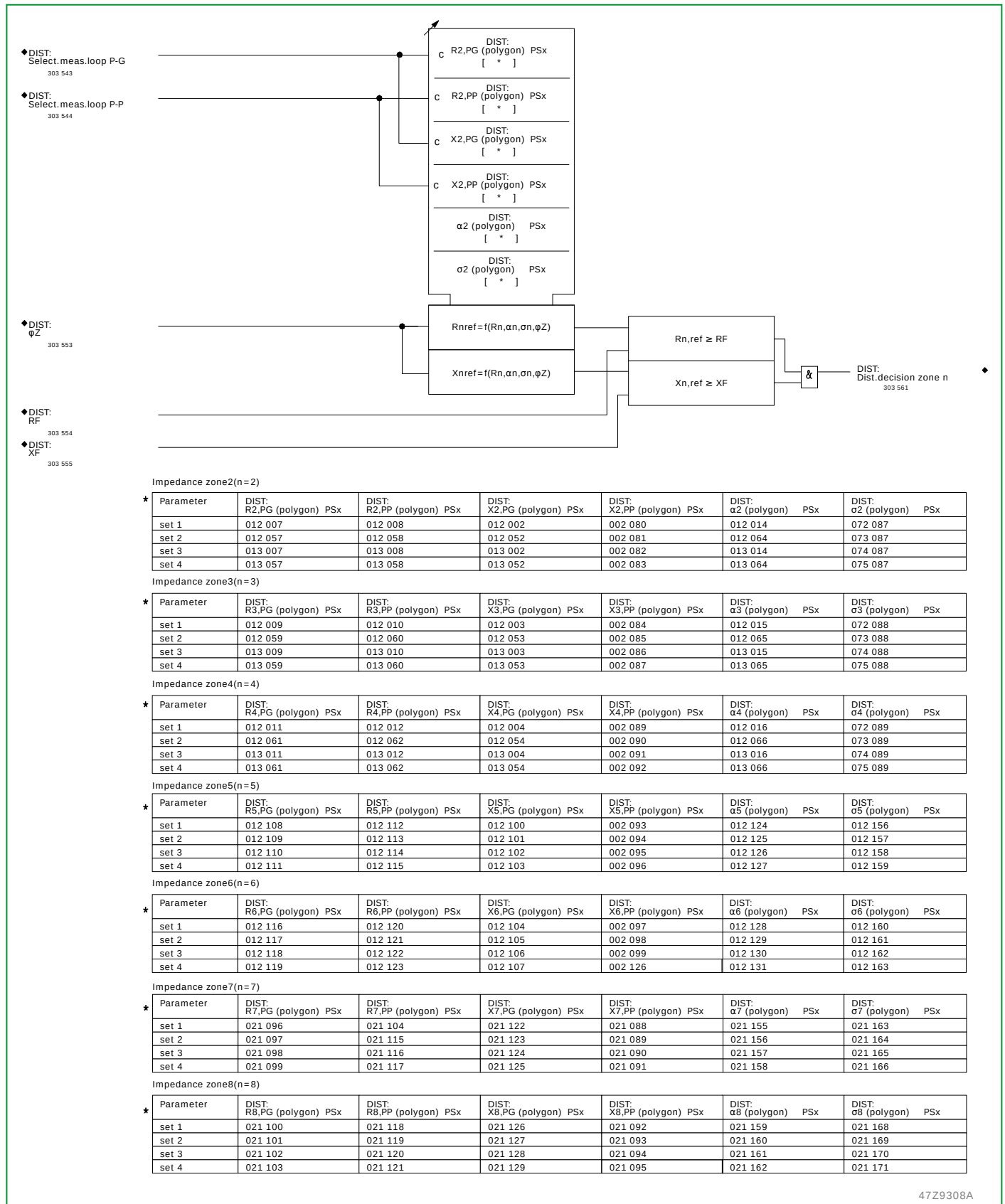


Fig. 3-145: Setting impedance zones 2 to 8 (showing the example of zone 2) and distance measurement.

In addition to the settings described above, the k_{ze} zone extension factors for high-speed reclosure (HSR) and time-delay reclosure (TDR) can also be set

separately for phase-to-ground (PG) and phase-to-phase (PP) loops for impedance zone 1.

As a result of these settings, impedance zone 1 is extended accordingly in the R and X directions. The R and X values modified by the k_{ze} zone extension factor are calculated according to the following equations:

$$R_{1,kze} = k_{ze} \cdot R_1$$

$$X_{1,kze} = k_{ze} \cdot X_1$$

The increase in reach by zone extension factor k_{ze} HSR is controlled by the following:

- Protective signaling (PSIG: Z1 extended)
- Internal auto-reclosing control, if protective signaling is not ready or – irrespective of the readiness of protective signaling – during the reclose command.
- Switch on to fault protection (SOTF: Z1 extended)
- An external signal (DIST: Zone extension EXT).

The impedance characteristic is extended by zone extension factor k_{ze} TDR if a time-delay reclosure is carried out by internal auto-reclosing control.



3.24.5 Impedance-Time Characteristics

Impedance-Time Characteristics

A maximum of eight impedance zones and ten timer stages are available for impedance time grading. All impedance zones can be operated in a forward

direction, backward (reverse) direction, or non-directionally. Distance-independent timer stage t9 can also operate forward-directionally, backward-(reverse-) directionally, or non-directionally. Timer stage t10 operates independently of distance and direction. All timer stages are started by the general starting of distance protection.

3.24.5.1 Timer Stage Logic for Extended Zone 1

The measuring range of zone 1 can be extended by the set zone extension factors. The timer stage logic for the device is described below.

If neither protective signaling nor auto-reclosing control (ARC) is active or if zone extension proceeds while the ARC close command is present, then tripping in the extended zone takes place once the set time (DIST: t1,ze PSx) has elapsed. If protective signaling is ready, there is a trip in the extended zone after the protective signaling tripping time has elapsed.

If protective signaling is not ready but ARC is active, then a trip is issued in extended zone 1 once the ARC tripping time has elapsed, whereas with standard reach (non-extended zone) it is issued after timer stage t1 of distance protection has elapsed or after the HSR tripping time of ARC has elapsed. (The shortest time setting is dominant.)

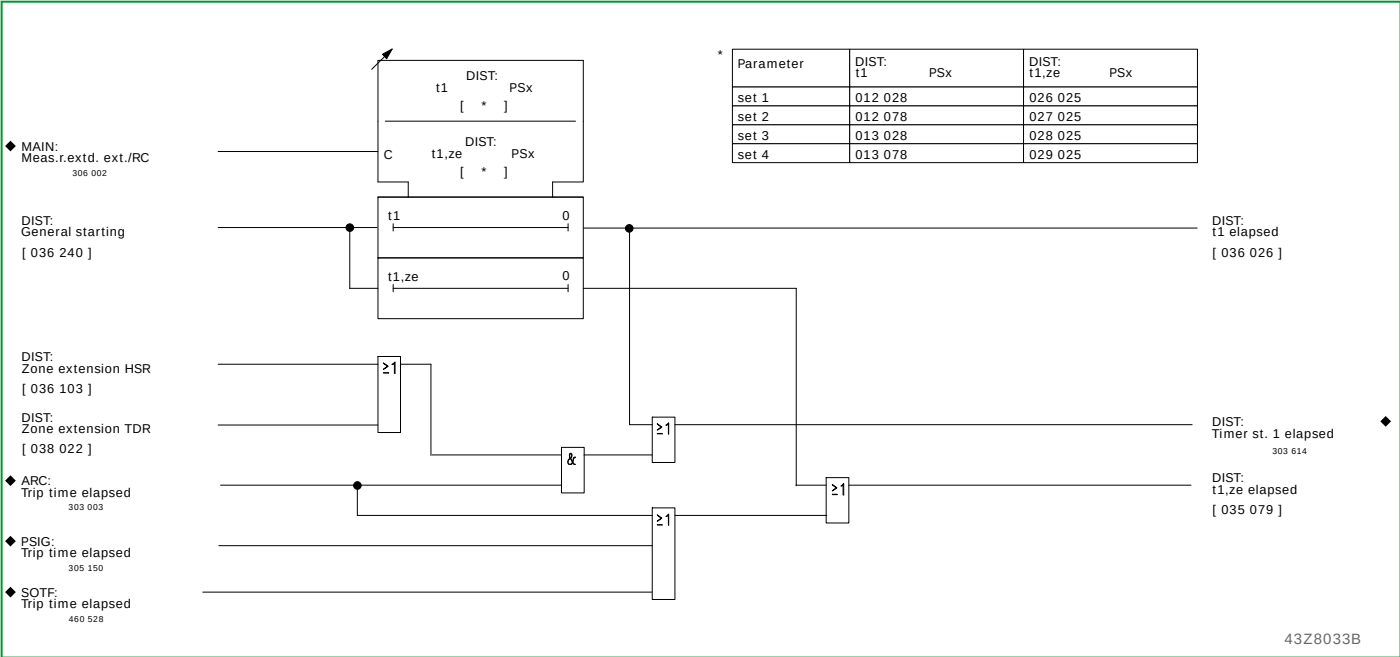
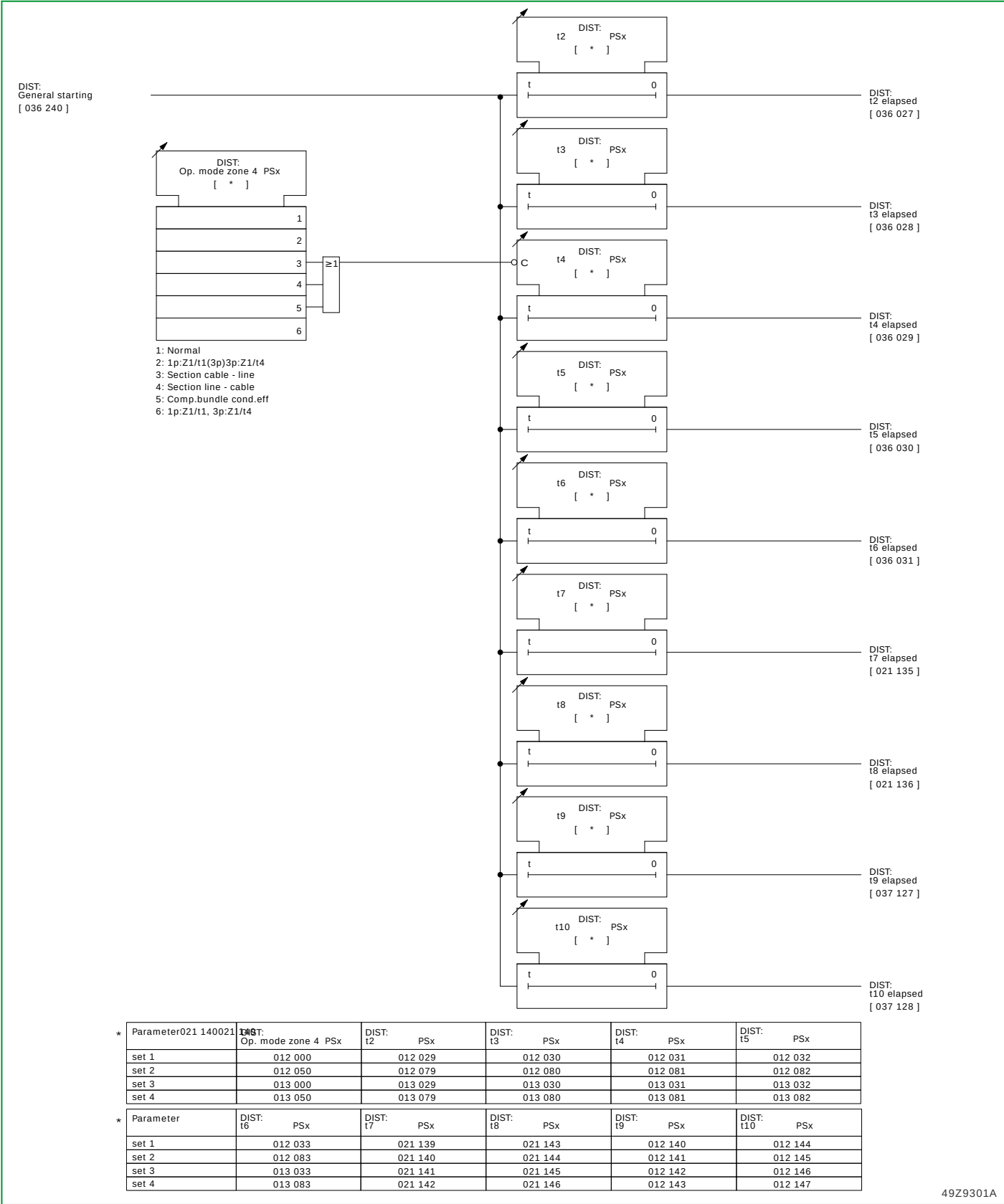


Fig. 3-147: Timer stage logic for impedance zone 1.



49Z9301A

Fig. 3-148: Time settings for timer stages 2 to 10.

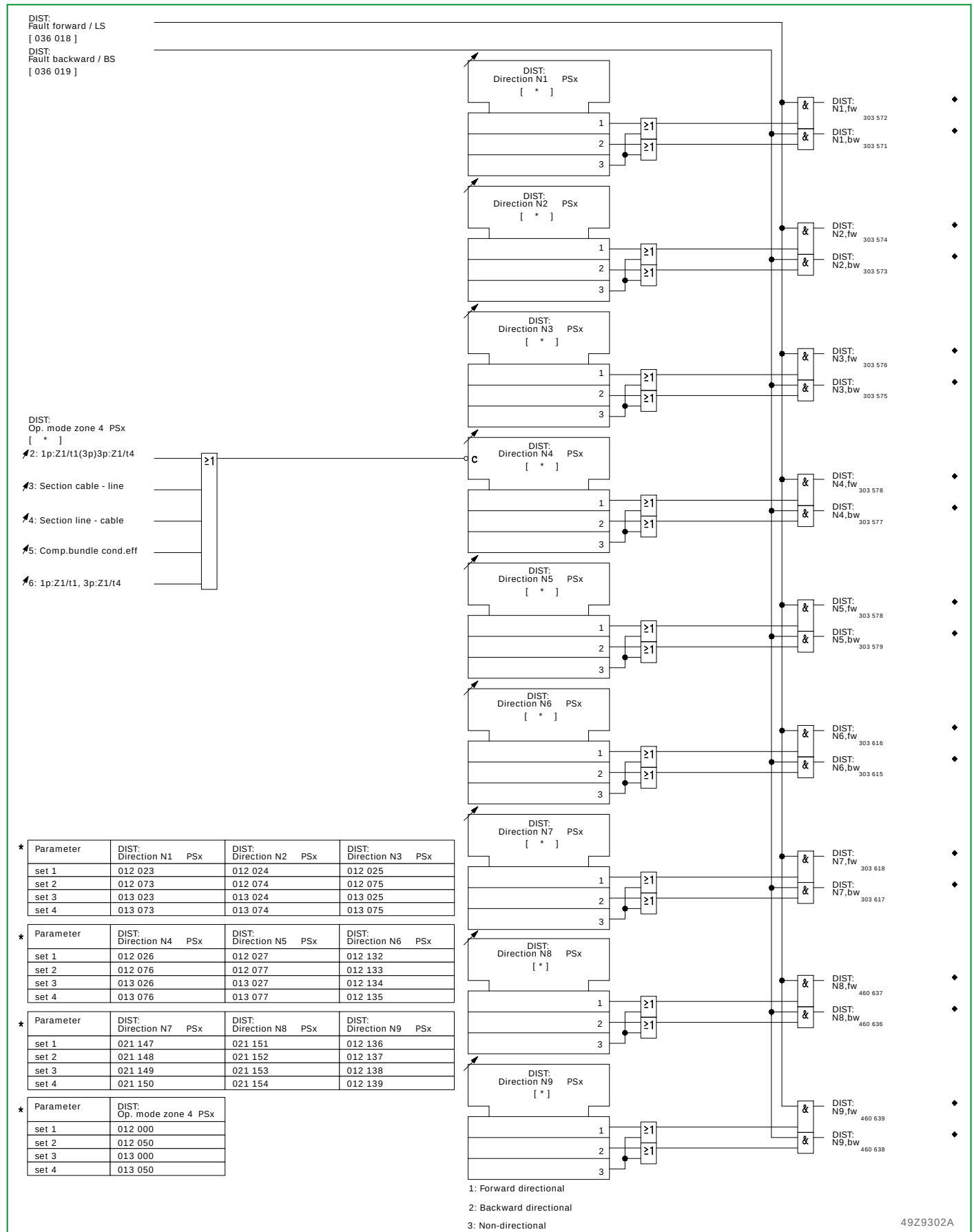


Fig. 3-149: Directional settings.

3.24.5.2 Zone 4 Operating Modes

Zone 4 can be used as a special zone by means of the DIST: Op. mode zone 4 PSx setting. This makes it possible to implement special characteristics for applications in cable/line systems or for compensating bundle conductor effects. The following operating modes can be set for zone 4:

- *Normal*
- *1p:Z1/t1(3p)3p:Z1/t4*
- *Section cable - line*
- *Section line - cable*
- *Comp.bundle cond.eff*
- *1p:Z1/t1, 3p:Z1/t4*

3.24.5.2.1 DIST: Op. mode zone 4 PSx = *Normal*

A trip signal is issued in zones 1 to 8 when the following criteria are satisfied simultaneously:

- A distance decision exists for the zone.
- The timer stage of this impedance zone has elapsed.
- The measured direction matches the directional setting of this impedance zone.

If several timer stages and directions are set to the same values, a distance trip occurs in the zone having the highest number.

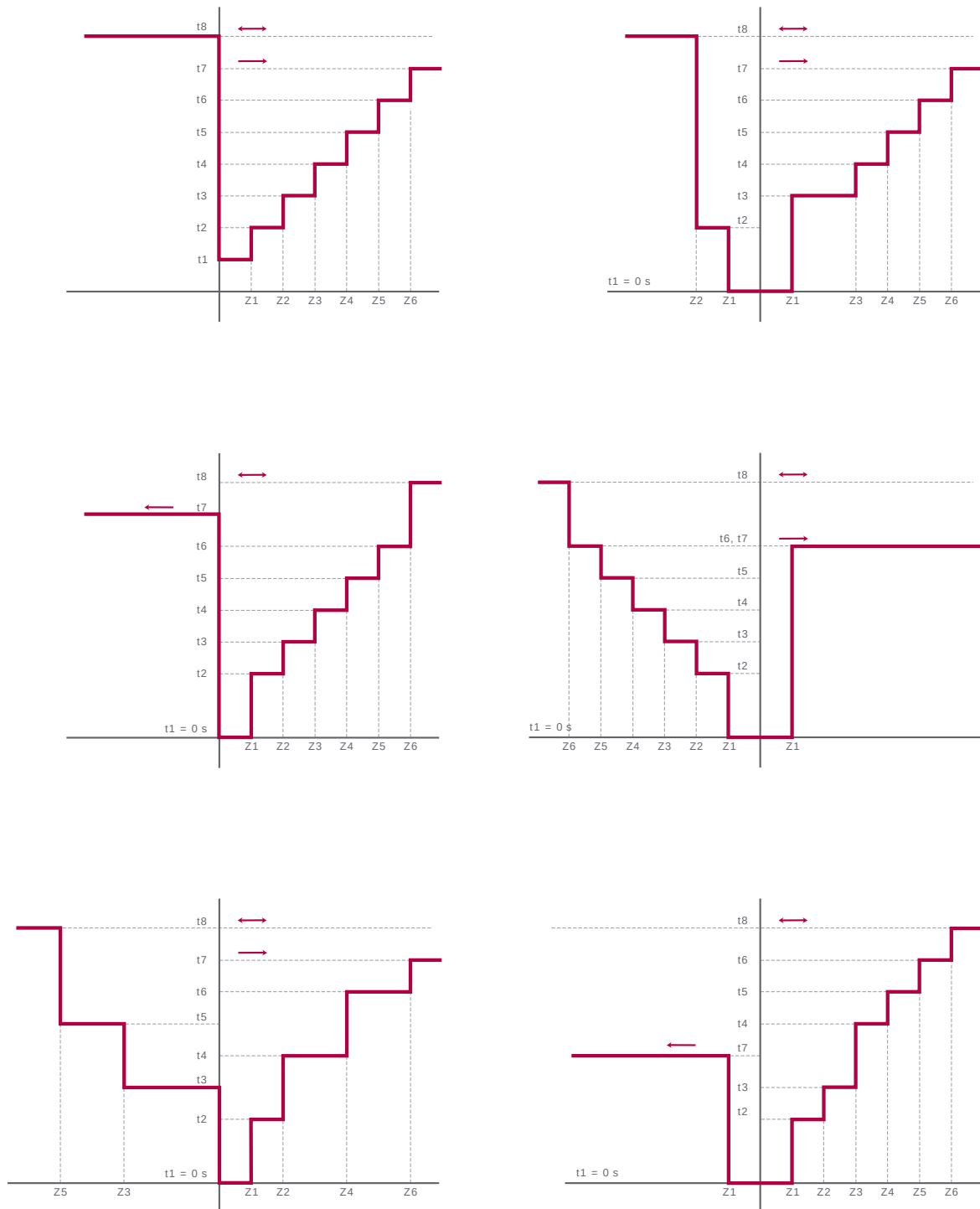
A trip signal is issued in zone 9 if the following conditions are satisfied simultaneously:

- Timer stage t9 has elapsed.
- The measured direction matches the direction of measurement setting for N9.

After timer stage t10 has elapsed, a trip signal for zone 10 is issued.

With the P433 distance trips from zones 1 to 9 that are used to form the trip command may be blocked by the power swing blocking function.





47Z0176A

Fig. 3-151: Examples of feasible impedance-time characteristics.

3.24.5.2.2

DIST: Op. mode zone 4 $PSx = 1p:Z1/t1(3p)3p:Z1/t4$

With this setting, timer stage t_4 is assigned to impedance zone 1. All other settings for impedance zone 4 are irrelevant in this operating mode and thus inactive.

For single-pole starting, a zone 1 trip signal will be issued once timer stage t1 has elapsed; for multi-pole starting, it is issued once t4 has elapsed.

If t2 or t3 = t4 and N2 or N3 = N1 have been set, then timer stage t4 is set to ∞ .

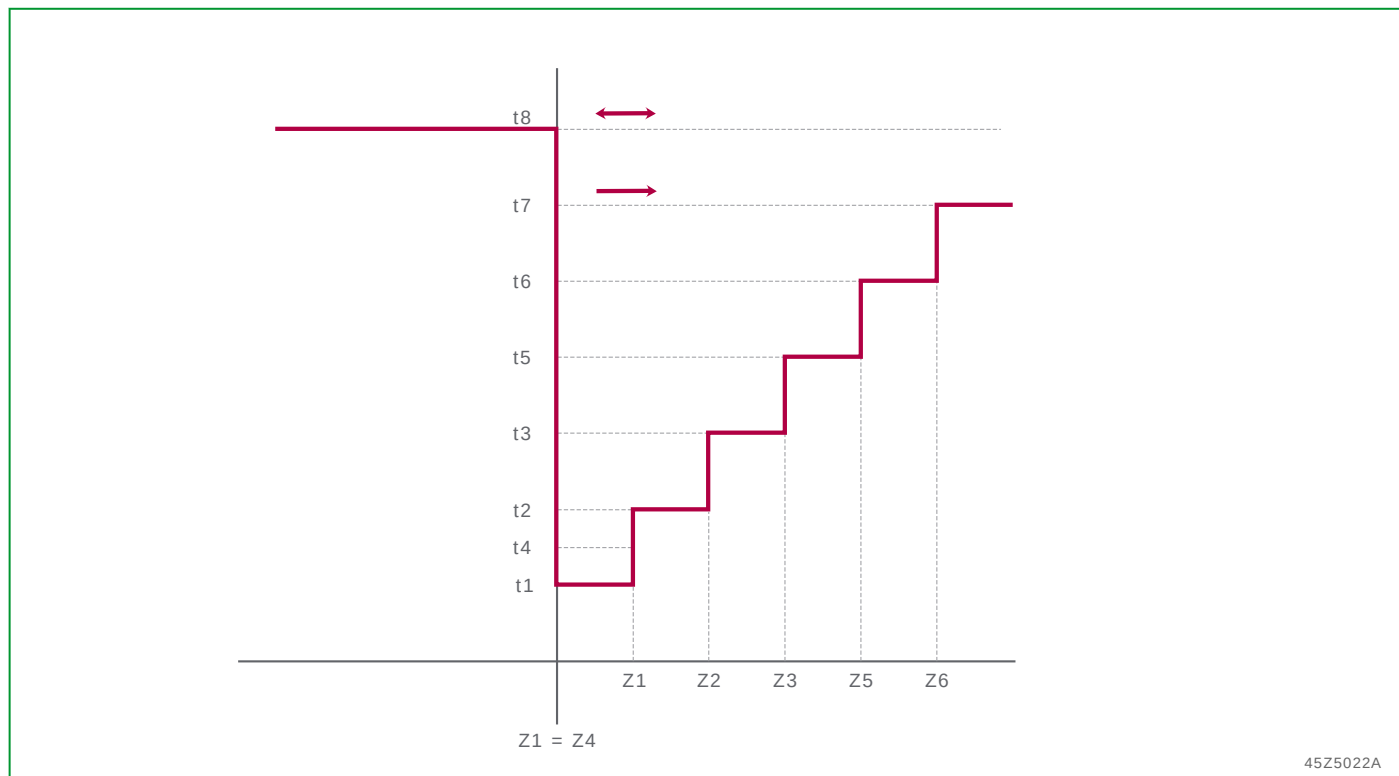


Fig. 3-152: Example of a feasible impedance-time characteristic.

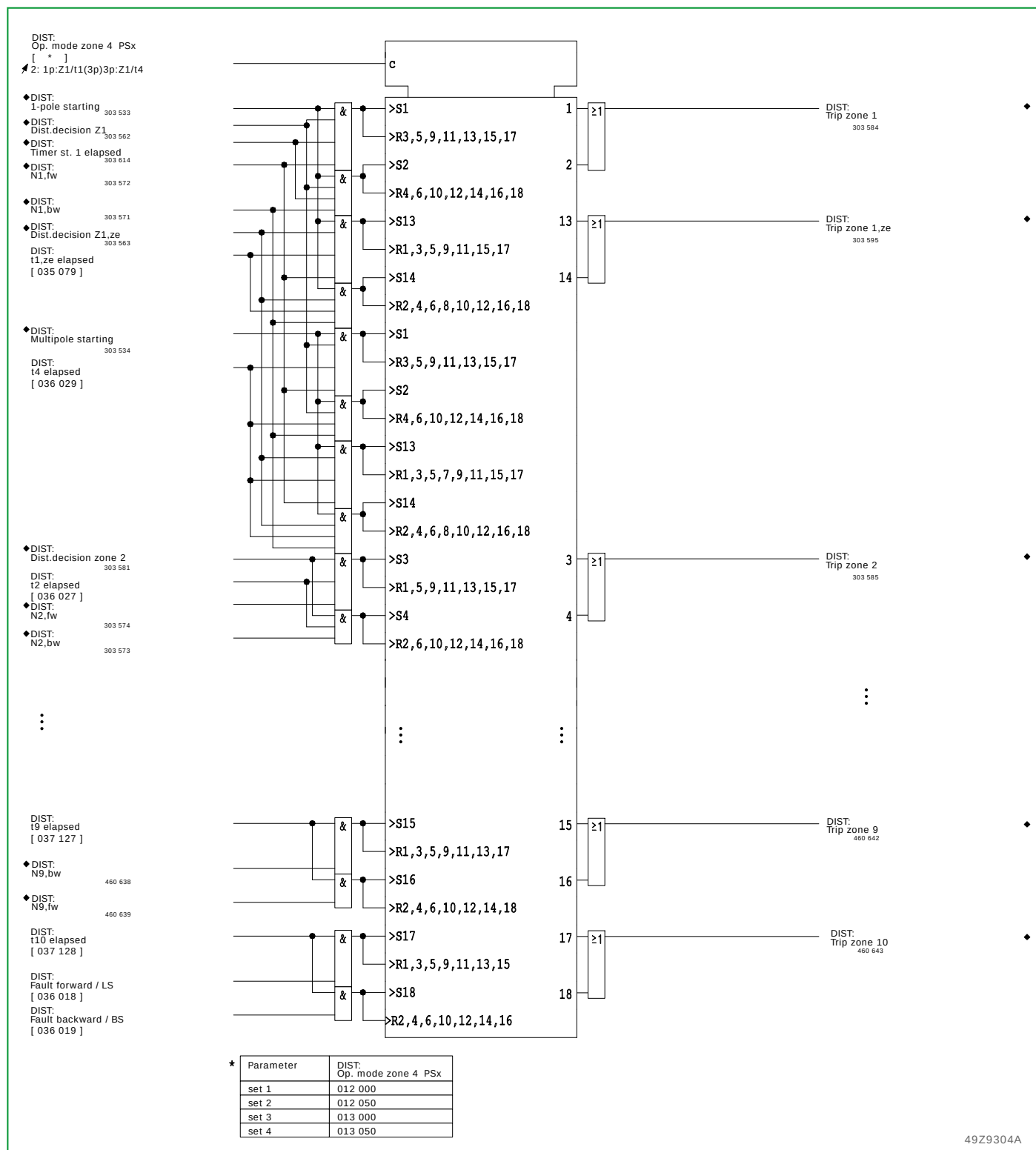


Fig. 3-153: Distance protection trip signals, zone 4 operating mode: 1p:Z1/t1(3p)3p:Z1/t4

3.24.5.2.3

DIST: Op. mode zone 4 PSx = *Section cable - line*

This setting is selected for a mixed cable-line section provided that auto-reclosing will occur only when there is a fault in the line area. For this mode, the cable must form the front part of the transmission section and the line the rear part.

Timer stage t1 and direction setting N1 are assigned to impedance zones 1 and 4. Timer stage t4 setting and direction setting N4 are inactive.

A zone 1 or zone 4 trip signal is issued if the following conditions are satisfied:

- A distance decision exists for zone 1 or zone 4.
- The measured direction matches direction setting N1.
- Timer stage t1 has elapsed.

In order for the P433 to be able to determine the section in which the fault is located, impedance zone 1 must be set to the total length of the power transmission section (e.g. cable plus line) and impedance zone 4 to the cable length. If a distance trip for zones 1 and 4 occurs after t1 has elapsed, the auto-reclosing function will be blocked because the fault lies in the cable section.

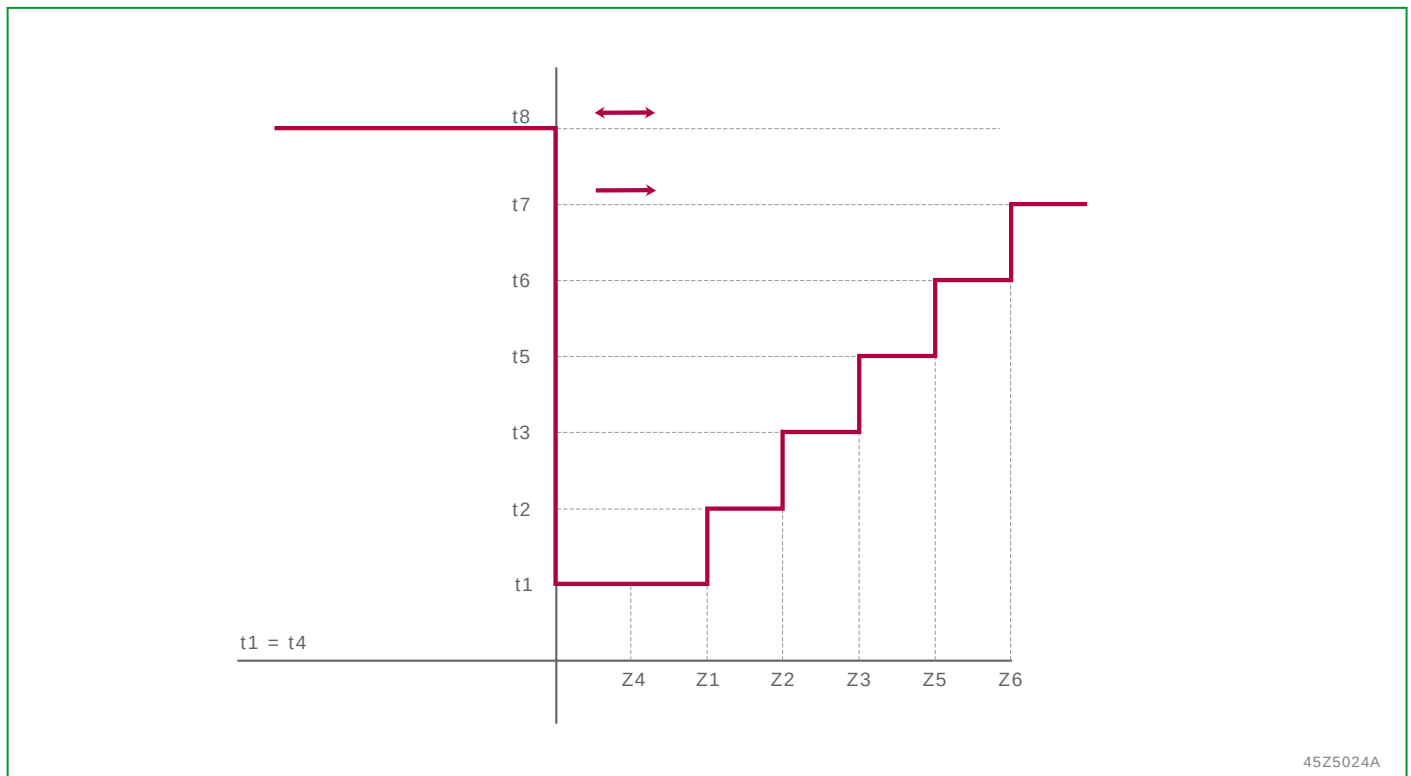
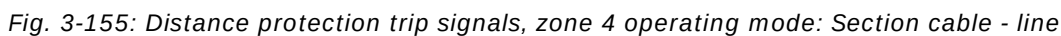


Fig. 3-154: Example of a feasible impedance-time characteristic.



DIST: Op. mode zone 4 PSx = *Section line - cable*

The “Distance trip Zone 1” or “Distance trip Zone 4” decision is reached if the following conditions are satisfied:

- A distance decision exists for zone 1 or zone 4.
- The measured direction matches direction setting N1.
- Timer stage t1 has elapsed.

In order for the P433 to determine the section in which the fault is located, impedance zone 1 must be set to the total length of the transmission section and impedance zone 4 for the length of the line. If a distance trip occurs only in after t1 has elapsed, the auto-reclosing function will be blocked because the fault lies in the cable section.

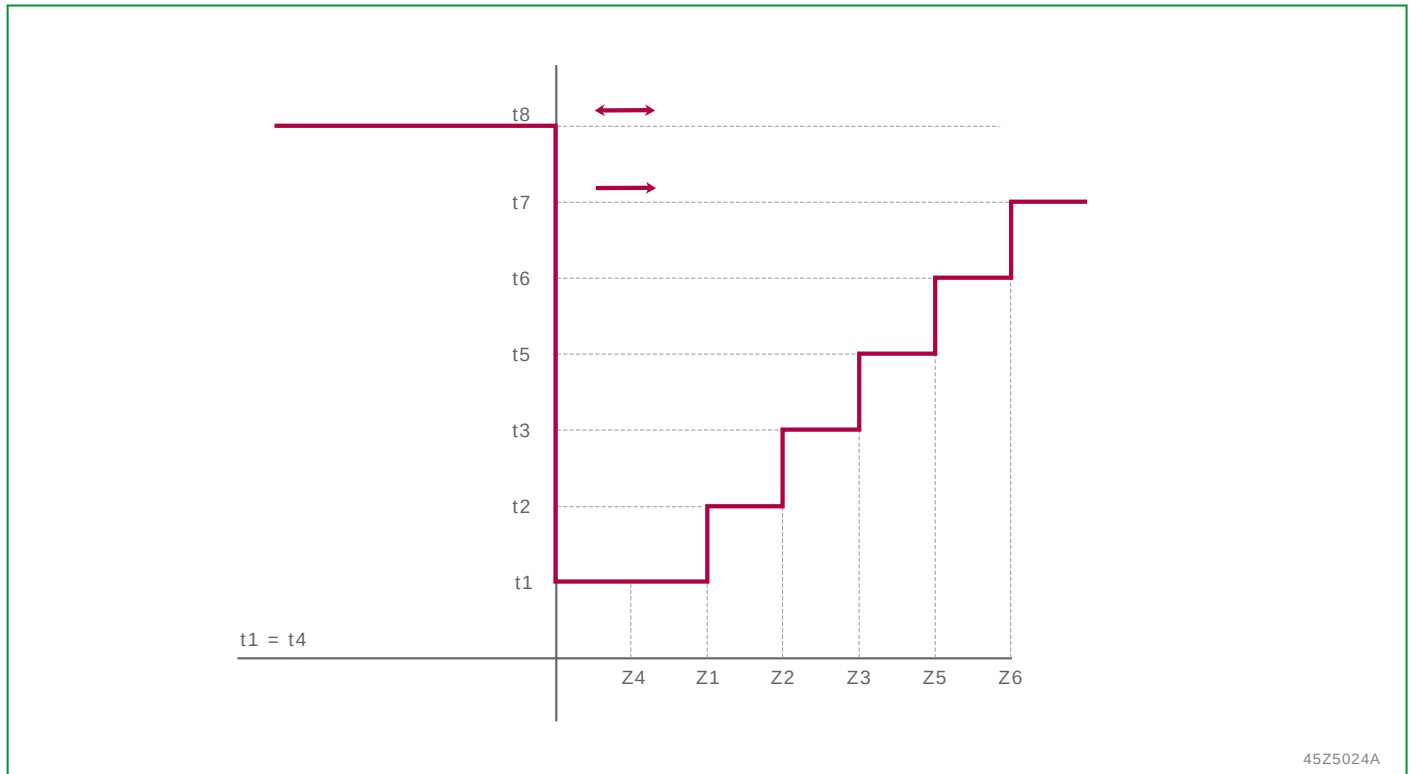


Fig. 3-156: Example of a feasible impedance-time characteristic.

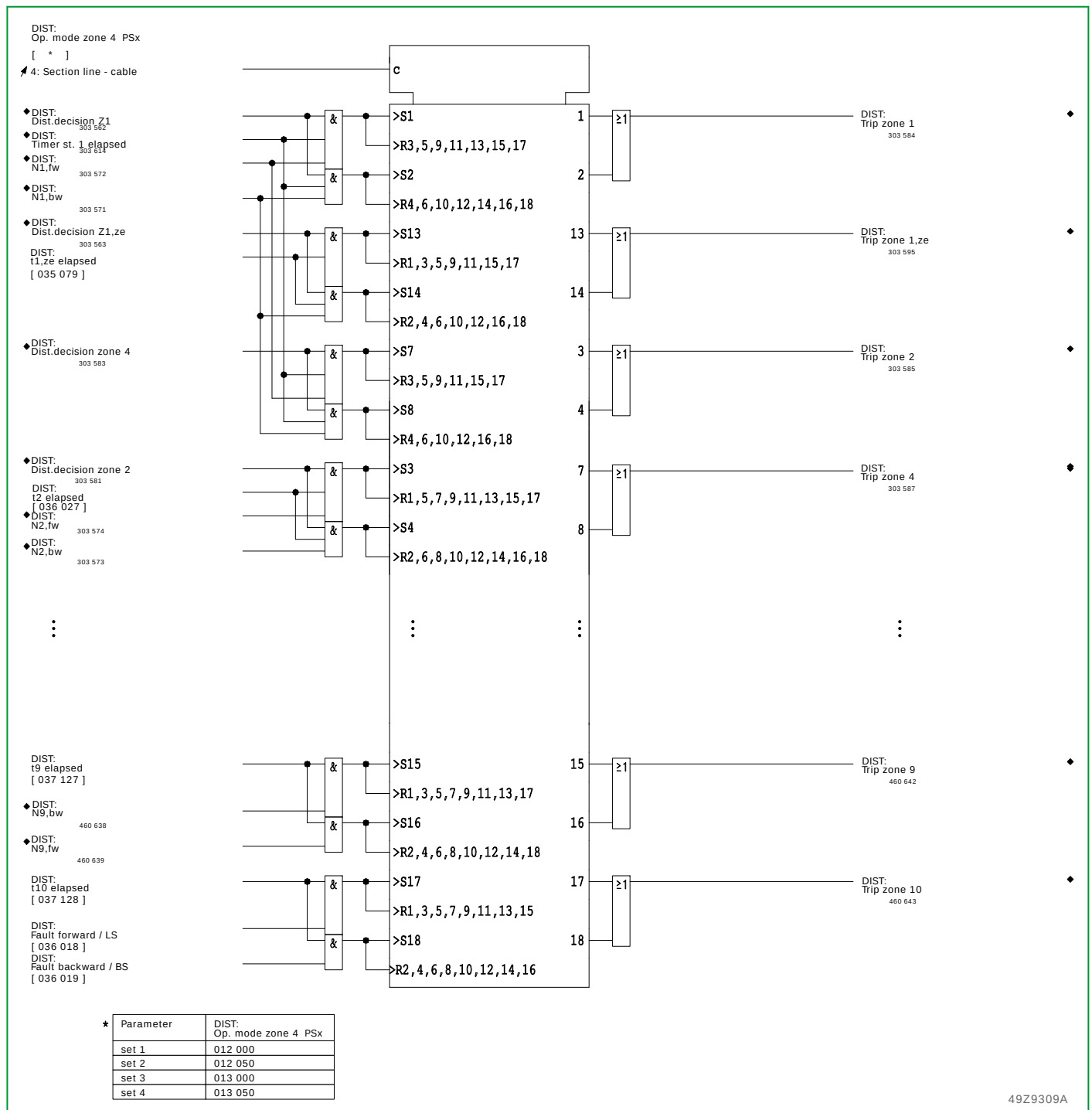


Fig. 3-157: Distance protection trip signals, zone 4 operating mode: Section line - cable

3.24.5.2.5

DIST: Op. mode zone 4 PSx = *Comp.bundle cond.eff*

In the event of a short circuit, the distance between the conductors of a bundle is reduced and the line impedance is increased. This is known as the *bundle conductor effect*. Since the effect occurs approximately 70 ms after the onset of the fault, it is not a factor in impedance zone 1 (where $t_1 = 0$ s). Compensation therefore takes place during impedance measurement in zone 2 – with assistance from impedance zone 4.

Timer stage t_2 and direction setting N2 are assigned to impedance zones 2 and 4. Timer stage t_4 setting and direction setting N4 are inactive.

The settings for impedance zone 2 need to be made without regard to the bundle conductor effect. The setting values for impedance zone 4, on the other hand, need to take the bundle conductor effect into account.

The P433 checks 30 ms after distance protection has started to determine whether the following conditions are satisfied:

- A distance decision exists for zone 2.
- The measured direction matches direction setting N2.

This information is then stored. The zone 4 trip signal is issued if the following conditions are satisfied:

- A distance decision exists for zone 4.
- The measured direction matches direction setting N2.
- The buffer has been initiated 30 ms after distance protection has started.

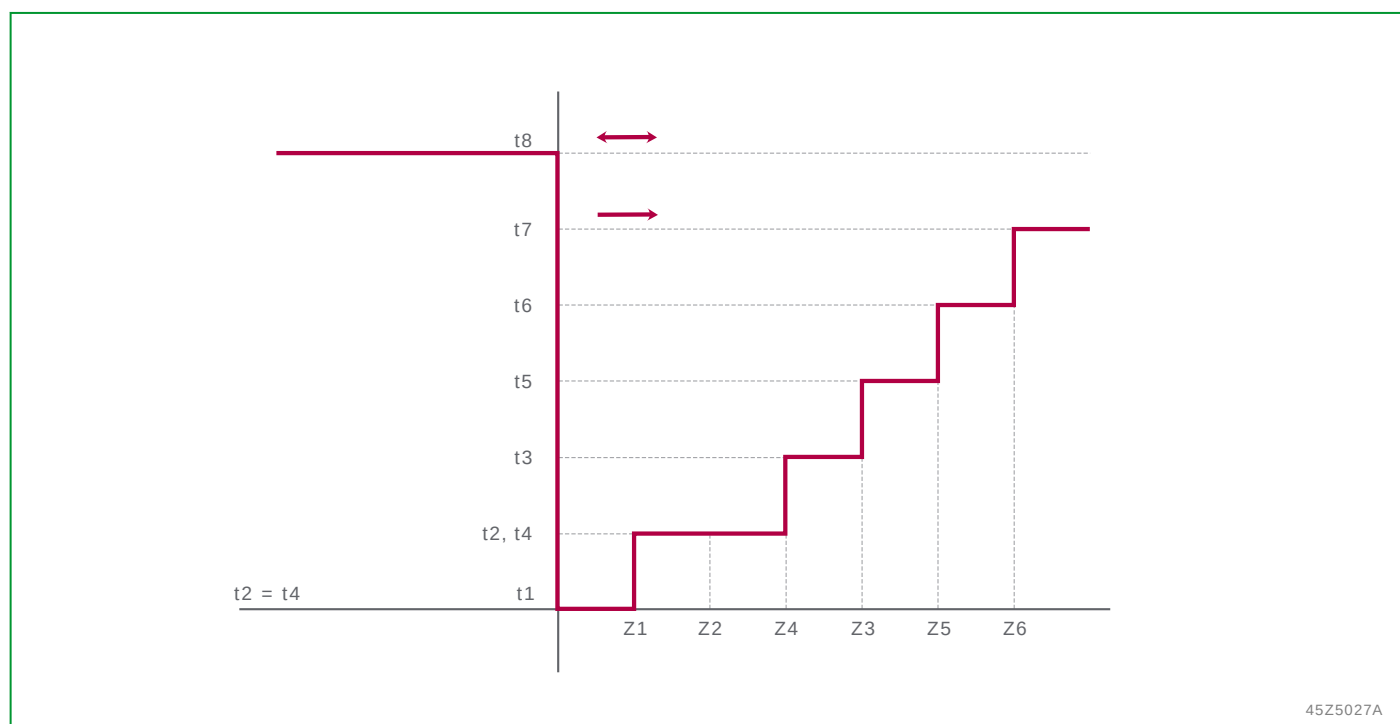


Fig. 3-158: Example of a feasible impedance-time characteristic.

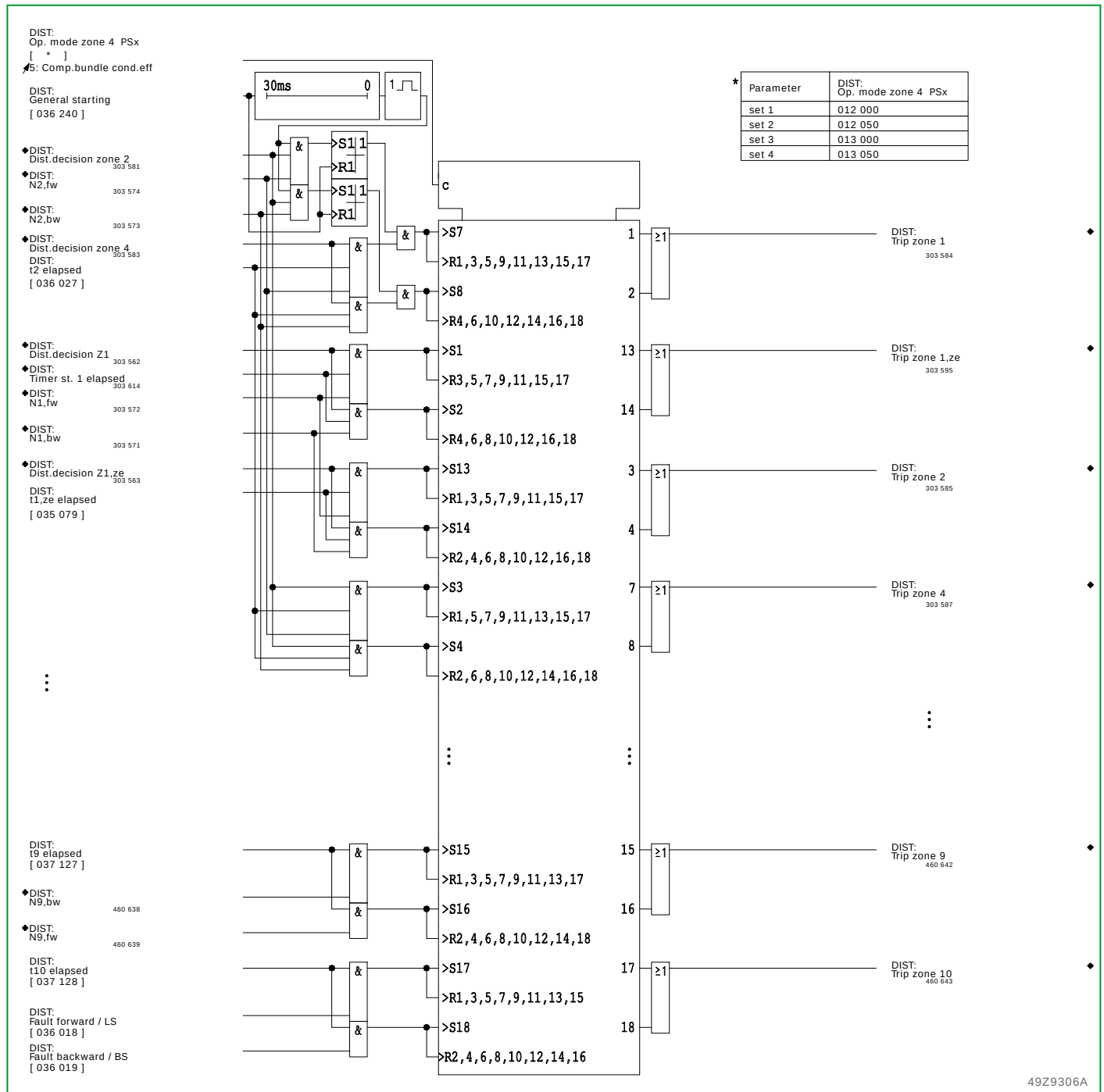


Fig. 3-159: Distance protection trip signals, zone 4 operating mode: Comp.bundle cond.eff

3.24.5.2.6

DIST: Op. mode zone 4 PSx = 1p:Z1/t1, 3p:Z1/t4

With this setting, timer stage t4 is assigned to impedance zone 1. All other settings for impedance zone 4 are irrelevant in this operating mode and thus inactive.

For single-pole starting, a distance trip signal is issued in zone 1 once timer stage t1 has elapsed; for multi-pole starting, it is issued once t4 has elapsed.

If t2 or t3 = t4 and N2 or N3 = N1 have been set, then timer stage t4 is set to ∞.

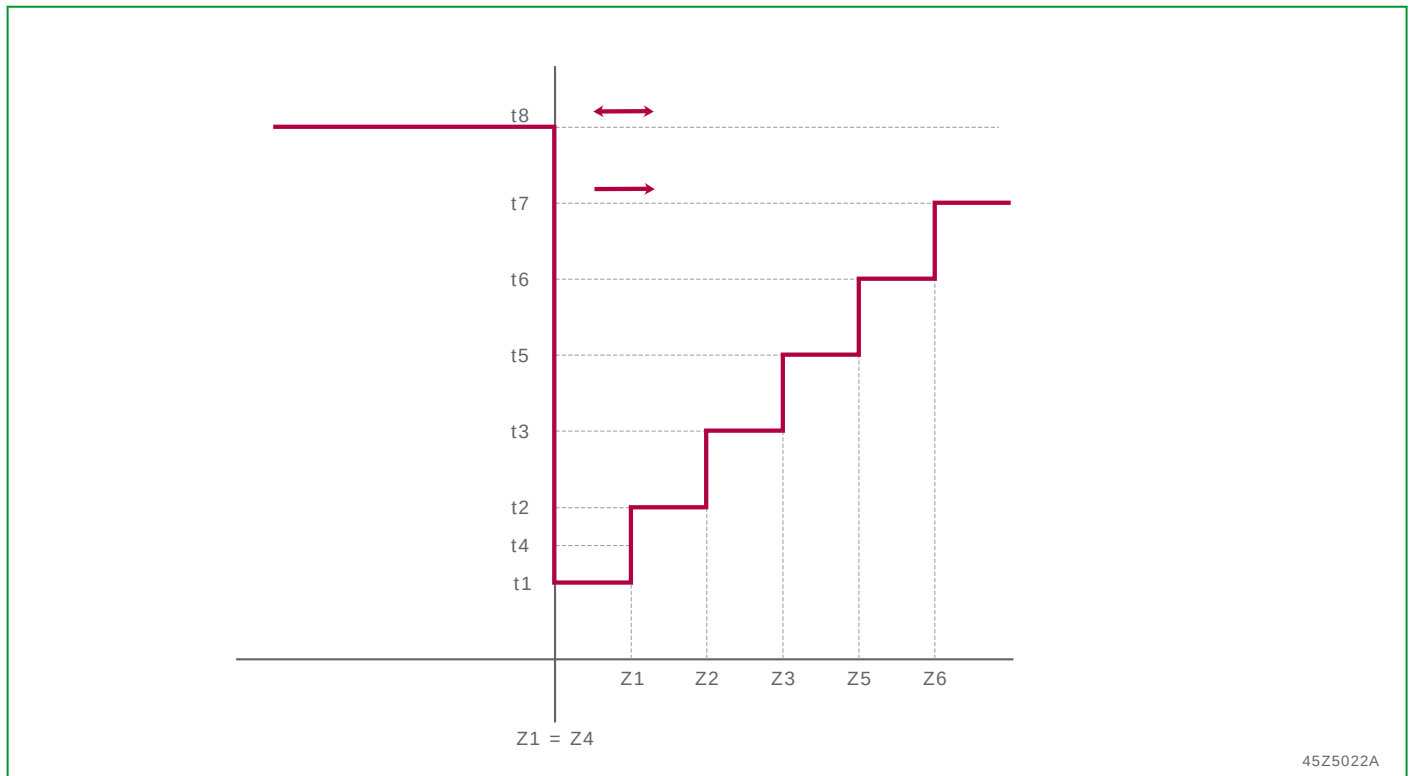
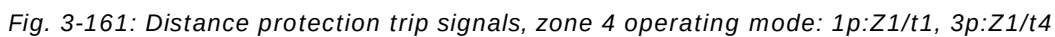


Fig. 3-160: Example of a feasible impedance-time characteristic.



Distance Protection Trip Signals

The P433 issues the trip signals shown in the following diagram:

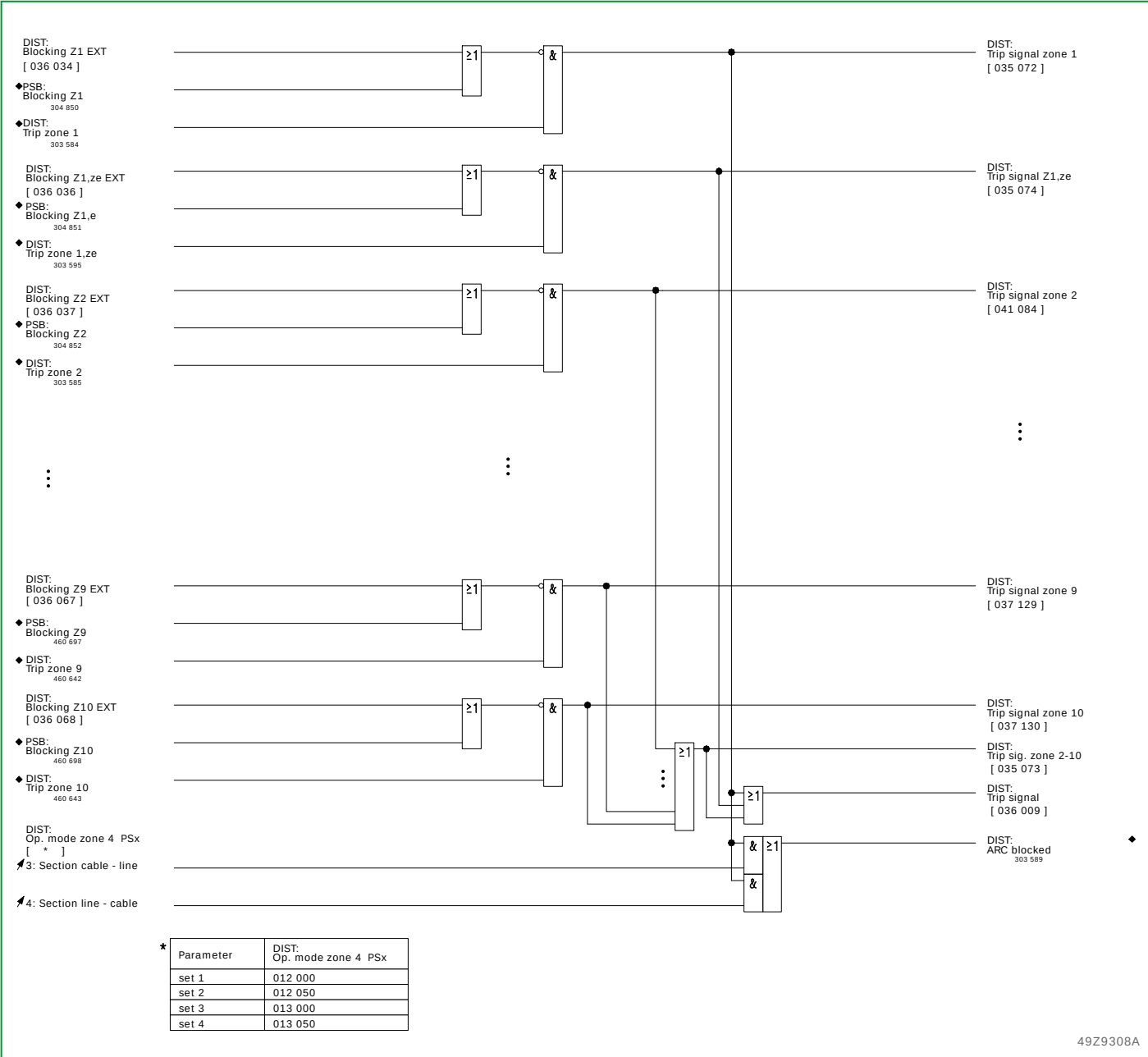


Fig. 3-162: Distance protection trip signals

For special applications, the P433 issues the DIST: Impedance in zone 6 signal if the following conditions are met simultaneously:

- A distance decision exists for zone 6.
- The measured direction matches the direction setting for zone 6.

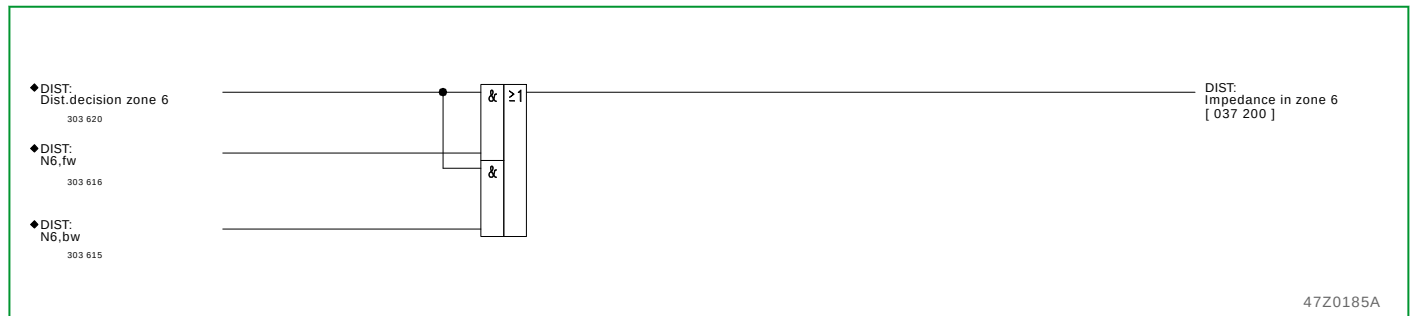


Fig. 3-163: DIST: Impedance in zone 6 signal

A special case of a distance protection trip signal is the trip signal that is issued in combination with the SOTF operating mode *Trip with overreach*.

While the SOTF function is active, the measuring range of the impedance zone 1 is extended (SOTF: Z1 extended). A distance protection starting with the measured impedance within the extended zone 1 causes a trip command with the tripping time as defined by the SOTF function (SOTF: Tripping time PSx). This trip command is an inherent part of the general trip command 1. (See also [Section 3.28, \(p. 3-244\).](#))

3.25 Power Swing Blocking (Function Group PSB)

This function serves to detect power swings in the power system.

The PSB function offers these options should a power swing occur:

- Power swing blocking, that is selective blocking of undesired distance trip signals due to apparent low impedances or undervoltage stages during a power swing. Distance zones and undervoltage stages can be selected by PSB: Fct. assign. block..
- Out-of-step (OOS) tripping, i.e. a trip signal can be generated under certain, settable conditions so as to end a power swing by initiation of power system splitting at the electrical center of the swing.

Disabling or Enabling Power Swing Blocking

The power swing blocking function can be disabled or enabled individually in each parameter subset via the setting parameter PSB: Enable PSx.

The PSB function will be blocked, when either the monitoring of the voltage-measuring circuit is triggered, the blocking signal (008 248) PSB: Blocking EXT is activated, or other internal conditions are present; see [Section 3.25.5](#), (p. 3-226).

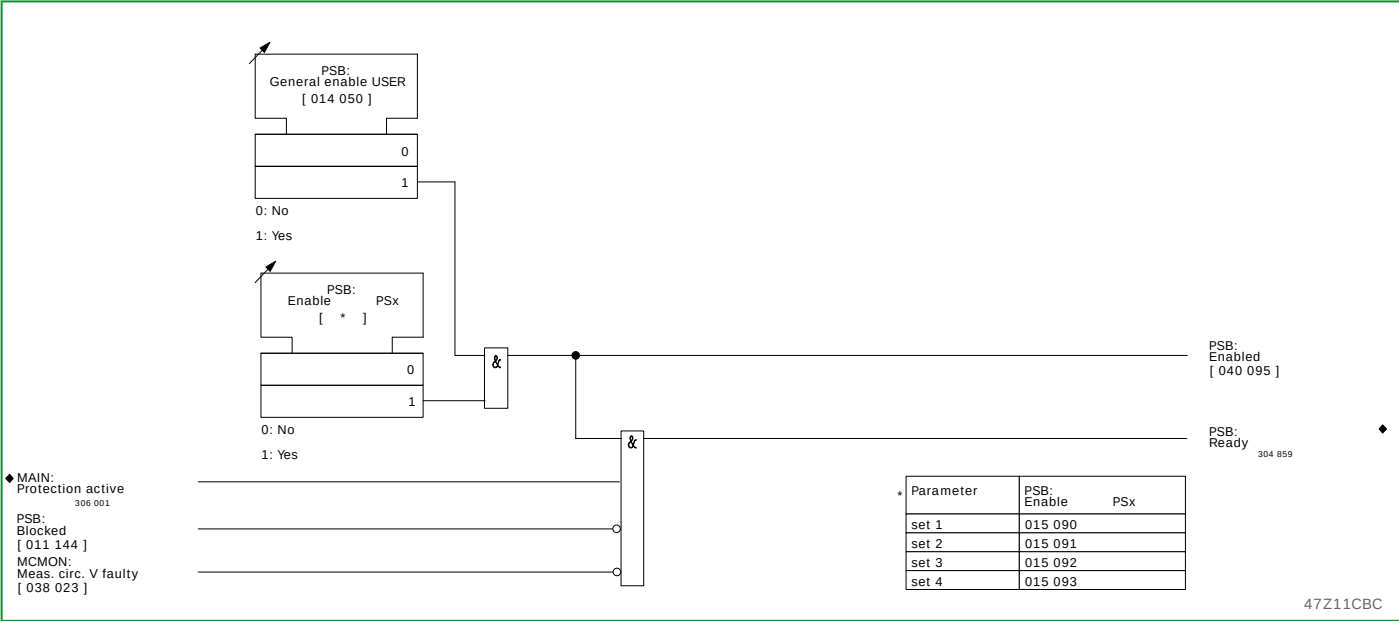


Fig. 3-164: Disabling or enabling power swing blocking.

3.25.1 Measurement

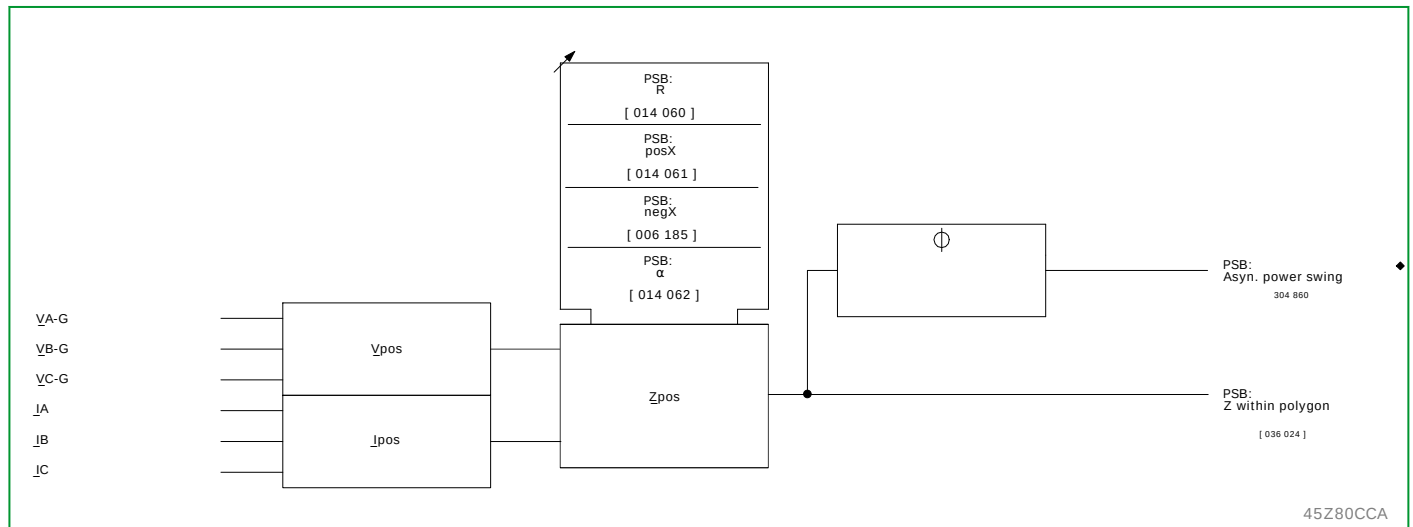


Fig. 3-165: Measurement

The P433 continuously measures the positive-sequence impedance. Because of this measurement in the positive-sequence system, the function is also available during a single-pole HSR.

A power swing blocking or out-of-step tripping occurs only when the measured positive-sequence impedance lies within the settable power swing polygon.

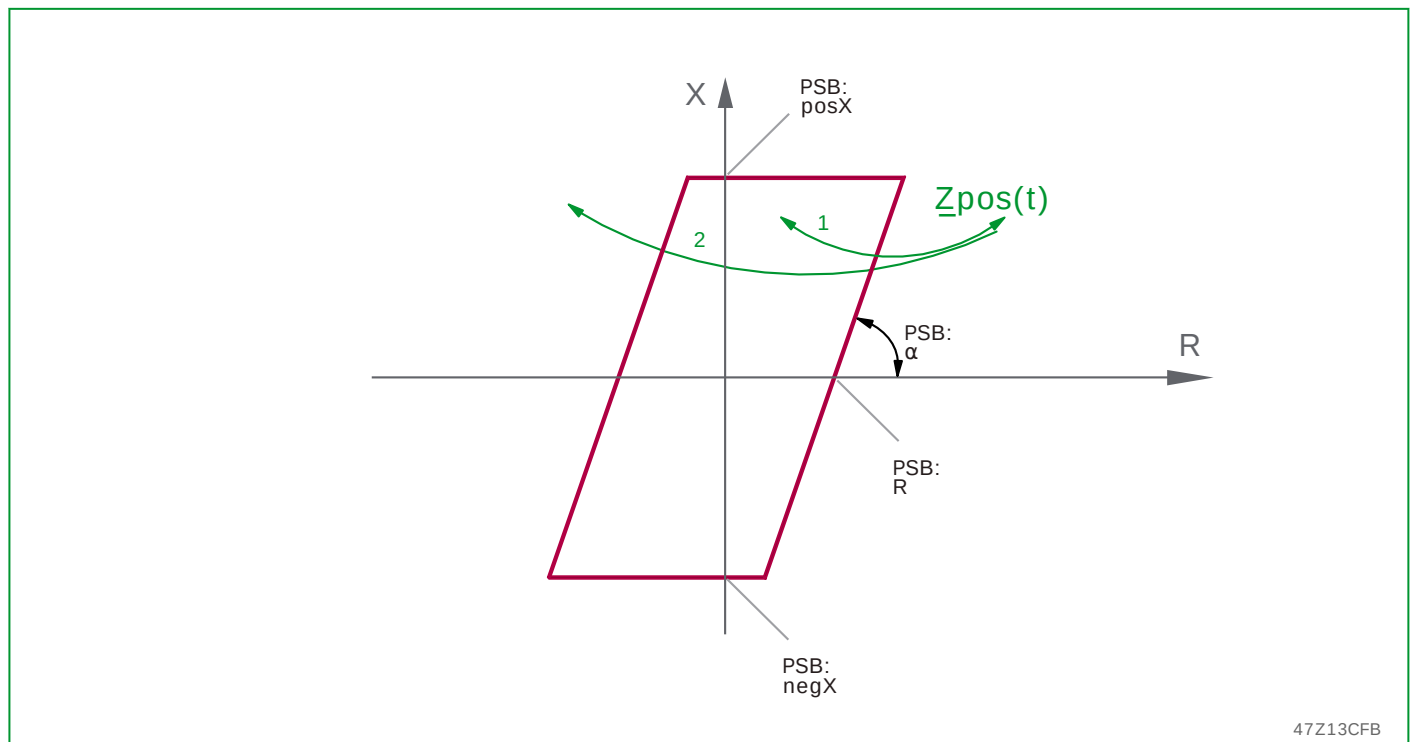


Fig. 3-166: Power swing detection polygon and examples of trajectories of the positive-sequence impedance during a power swing. ①: Example trajectory of a stable power swing. ②: Example trajectory of an instable power swing.

3.25.2 Power Swing Detection

Power swing detection is based on impedance variation (ΔZ).

The rate of change of the resistance component of positive-sequence impedance R_{pos} , when entering the power swing polygon, is measured and interpreted. The

function decides on power swing only if the rate of change is smaller than the set threshold $\Delta R_x / \Delta T$ and subsequently blocks all selected zones.

The threshold ΔR_x has a fixed value:

- $\Delta R_x = 5 \Omega$ for $I_{nom} = 1 \text{ A}$
- $\Delta R_x = 1 \Omega$ for $I_{nom} = 5 \text{ A}$.

Timer stage ΔT can be set at PSB: Oper. value Delta T.

A power swing decision once made is stored until one of the following conditions is met:

- The positive-sequence impedance exits the power swing polygon.
- The expected maximum power swing duration (PSB: Max. PS cycle dur.) or permitted maximum duration of power swing blocking (PSB: Max. blocking time) has elapsed.
- One of the PSB current stages has started.

MiCOM P433 operates task oriented. The PSB task is processed approximately every 6 ms. The internal ΔR_x threshold value will be adapted according to the measured actual time delay between 2 consecutive measurements. With each processing step, the impedance Z_{pos} is determined and stored. Thus ΔR_{pos} is calculated from 2 consecutive processing steps:

$$\Delta R_{pos} = R_{pos}(n) - R_{pos}(n-1),$$

Where:

- $R_{pos}(n)$: the first measurement inside the power swing detection polygon
- $R_{pos}(n-1)$: the previous measurement outside the power swing detection polygon

3.25.3

Load Blinding

In the case of parallel lines (i.e. double-circuit lines) with a high rate of power transmission to neighboring networks the failure of one three-phase system may lead to a short-time (typically 20 to 30 minutes) increase in the power flow rate on the remaining line. Here the positive-sequence impedance locus will then lie within the load blinding area of the distance protection starting characteristic. The load blinding area is the area in the underimpedance polygon (starting characteristic) where no starting occurs (settable via (010 063) DIST: β PSx and (010 105) DIST: Zfw,PP PSx).

This is displayed in the figure below, with the following fault sequence:

1. Operation under load conditions (blue area, "2 operational systems").
2. Fault on the parallel line will lead to a selective disconnection of this parallel line.
3. Operation under overload conditions on the remaining system (red area, "1 faulted system").
4. Start of a power swing due to instable network conditions.

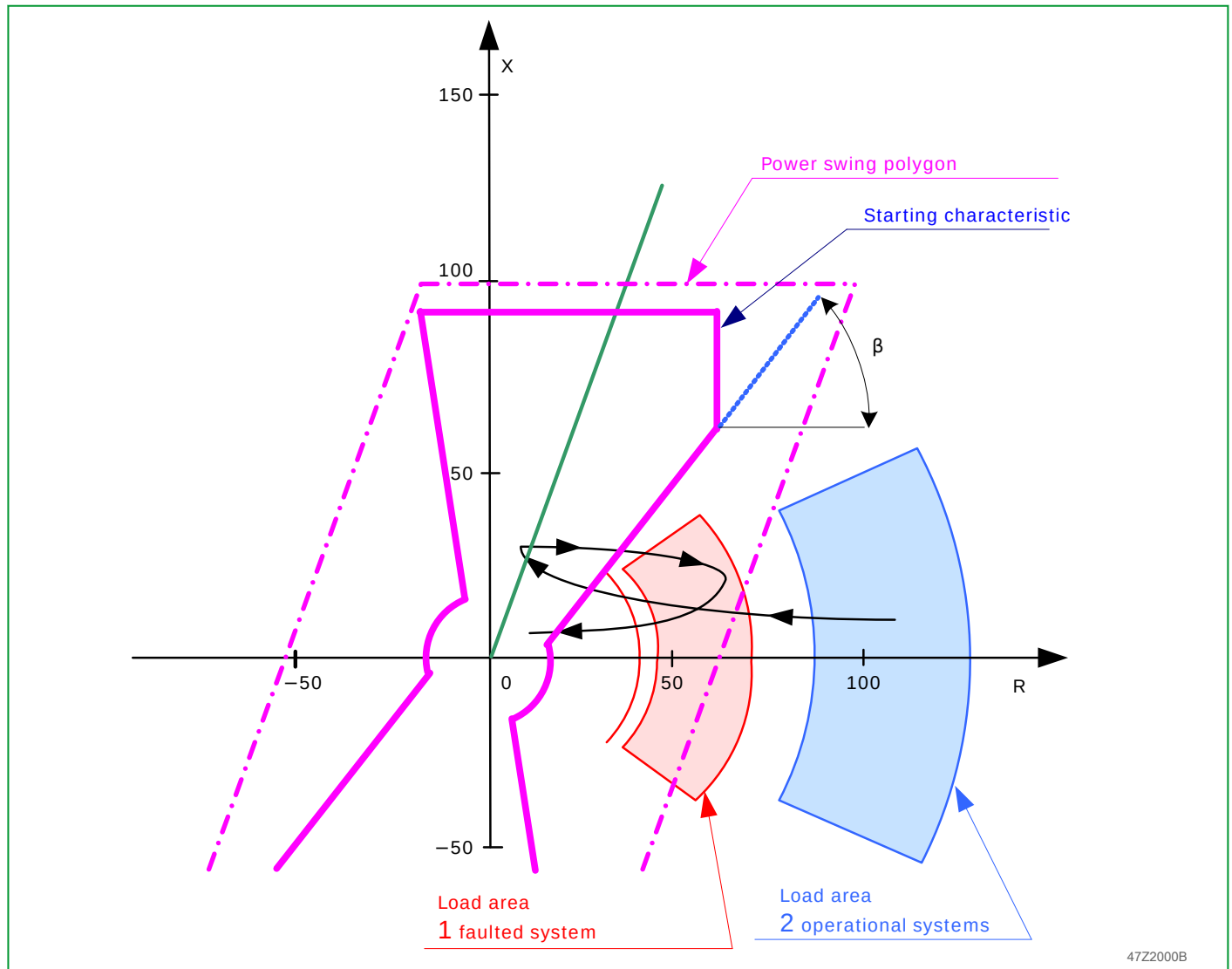


Fig. 3-167: Impedance trajectory with a fault on a parallel line.

It is therefore not possible to selectively set the resistive reach, where:

- The setting for the resistance reach R_{fwd} of the starting polygon (i.e. (010 052) DIST: Rfw,PP PSx) is such that the impedance locus could possibly not leave the power swing polygon after the initial short-circuit fault has been cleared, and therefore power swing blocking cannot be enabled when a power swing occurs.

It is also possible that because of load variations the impedance locus will leave the power swing polygon for a short-time and then return, which could cause power swing blocking to be enabled erroneously (resulting in a protection malfunction if a short-circuit fault should then occur).

- The setting for the starting impedance in the load area Z_{fwd} (minimum load impedance) is such that power swing blocking may occur too late if a power swing has started in the normal blue area and then crosses the starting characteristic in the power swing polygon area (above the angle β).

To cope with this problem a load blinding feature is available for the power swing polygon:

The time for a measurement sample to be taken to determine the speed of resistance change may be set at PSB: Activation cond. dZ (with two selection options *Power Swing polygon* and *PS-polygon + 3pStart*):

With the *Power Swing polygon* setting ("entry into the power swing polygon"), the function will operate when the positive-sequence impedance enters the power swing polygon, the speed of change of the positive-sequence impedance's real component is measured and evaluated.

With the *PS-polygon + 3pStart* setting ("power swing polygon + 3-phase start"), the speed of change of the positive-sequence impedance's real component is measured under the following conditions only:

[The updated positive-sequence impedance locus determined lies within the power swing polygon]

AND([A 3-phase - without ground - start has occurred]

OR([A 2-phase - without ground - start has occurred]

AND ["The negative-sequence current value is sufficiently small"]))

The result is that the state "positive-sequence impedance locus in the power swing polygon" will now just be an enabling condition. In this case it is irrelevant whether the positive-sequence impedance is now being measured for the first time within the power swing polygon or it was already there during a previous measurement.

Crucial for a measurement decision is the onset of the (distance) general start.

In theory, a 3-phase start (without ground) is to be expected, as power swing occurrences are symmetrical (i.e. the same measurement conditions are to be found in all 3 phases). The result is that with the onset of a phase-ground start there will be no power swing occurrence (i.e. when with the onset of a start there is also a phase-ground start or it is already present, then the blocking effect can no longer be set).

In practice all currents and voltages will be unbalanced (mainly because of unbalanced lines, but asymmetrical loads and infeeds, as well as measurement errors by transformers and even by the protection device itself are also to be considered) so that possibly one of the three phase-phase starting systems will trigger first. Therefore, with a high R1 reach for zone 1 (i.e. the resistance reach of DIST zone 1: (012 006) DIST: R1,PP (polygon) PSx or (012 005) DIST: R1,PG (polygon) PSx), the 2-phase start may have already led to a trip command during a power swing event, even before a 3-phase start has activated power swing blocking. Therefore, in order to also have control of this state, the power swing blocking function carries out the R measurement at the onset of the 2-phase start, but only if currents are adequately balanced. To ensure this, the negative-sequence current is measured continuously. With the onset of the first 2-phase start, caused by a power swing event, the I_{neg} value must not be significant, i.e. in this case:

$$I_{neg} < 0.1 \cdot I_{nom} + 0.2 \cdot I_{p,max}$$

On the other hand, the device will make a (2-phase) short-circuit decision when the negative-sequence current value exceeds this value.

This is the preferred approach when looking at a parallel undervoltage start. The reach of the undervoltage start is basically not definable in the impedance plane and can therefore not be covered safely by a purely impedance-defined power swing polygon. Since it is now possible to select the decision moment of power swing events, the first occurrence of the undervoltage condition can be ascertained in time if the power swing polygon is set to a sufficient size. Overlapping of the power swing polygon with the area of minimum load impedance is permitted.

According to the basic ΔZ principle, the decision is taken only once (in this case with the onset of above mentioned starting conditions). If a power swing event is detected, power swing blocking is set and stored until the reset condition is met. The power swing blocking is adapted (extended) when this new acquisition method is used.

The blocking effect is lifted if one of the following conditions is met:

- The general start is terminated (only with the setting *PS-polygon + 3pStart*), or (as before)
- the positive-sequence impedance leaves the power swing polygon, or
- (at least) one current trigger (*IP>*, *Ineg>*, *IN>*) is triggered, or
- the maximum duration of a power swing period has been reached.

3.25.4

Behavior with a Short-Circuit Fault During a Power Swing Event

A short-circuit fault condition may occur during a power swing event. Blocking is lifted because one current trigger (*IP>*, *Ineg>*, *IN>*) has operated. Until now this would occur instantaneously. As distance measurement was already active during the blocking the following problems could be encountered:

1. The zone-time grading measurement is already running (since the general start or since the zone entry because of the power swing event). For example a short-circuit fault has occurred in backup zones (backup zones are time-shifted distance protection zones that serve to provide a remote backup protection): this will then lead to an instantaneous triggering when power swing blocking is lifted (which is an overreaction).
2. When a general starting is present for a length of time the measurement window of the distance measurement is shifted backwards in time so as to prevent incorrect decisions at fault clearance (tripping by an upstream protection device).

If no change in starting occurs when power swing blocking is lifted, (i.e. a 3-pole fault is detected) then distance measurement operates, for the time being, with the previous measured values from the power swing area which were collected before the short-circuit fault had occurred. Therefore distance and zone decisions are of no use.

With protection systems where line-differential protection is applied along with distance protection, the overreaction as given under item "1." can be avoided if, after the current short-circuit trigger has operated, blocking of distance protection is lifted with a short release delay (100 ms), which will then give preference to the selective differential operation.

Such a short release delay is of no use with protection systems where two distance protection devices are used.

For this a new release delay for blocking is available. It is set at PSB: Abort delay (in the range from 0.00 s to 1.00 s with the default value = 0.00 s). This release delay will become active when blocking is lifted because a current trigger has operated (*IP>*, *Ineg>*, *IN>*). For technical reasons this release delay will also be activated when the maximum blocking time has elapsed so that, including this release delay, the set maximum blocking time may be exceeded.

3.25.5 PSB Blocking

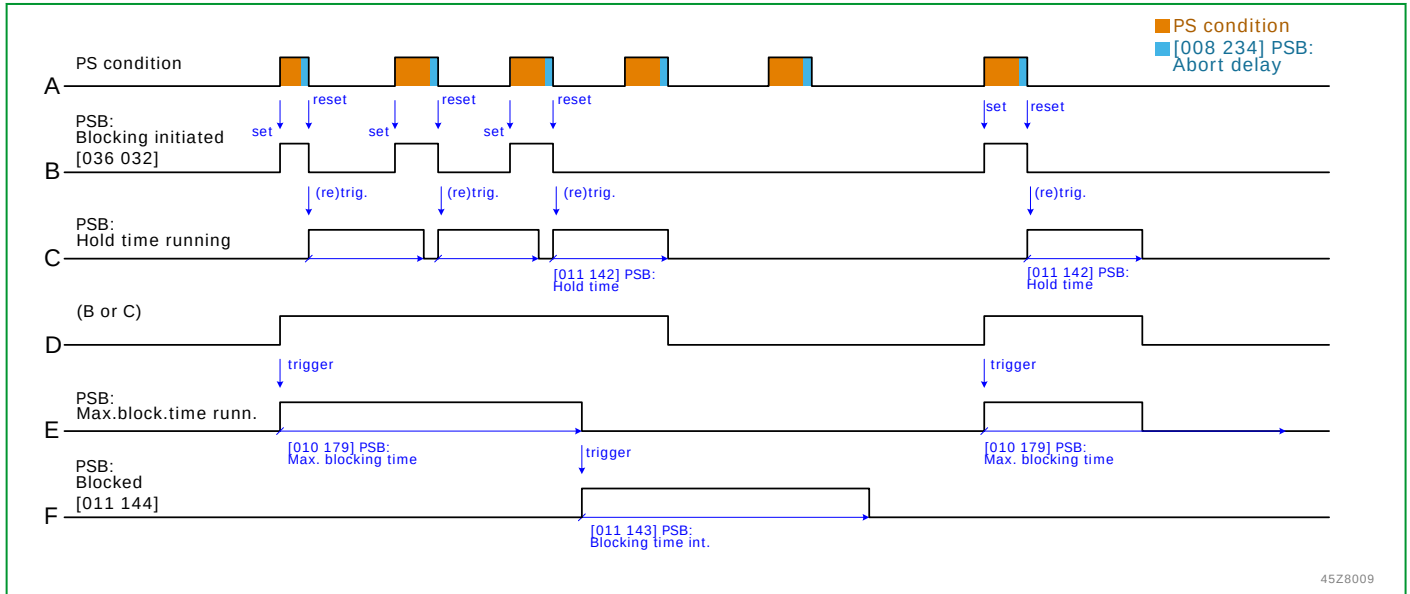


Fig. 3-168: Signal flow diagram for PSB: Blocked, showing the relationship between the PSB timer stages and signals.

Power swing blocking is blocked when one the following conditions is present:

- An external blocking signal (008 248) PSB: Blocking EXT is present.
- The set maximum permissible duration of power swing blocking has been exceeded.
- A short circuit has been detected by one of the following overcurrent stages:
 - (036 012) PSB: IP > triggered
 - (036 011) PSB: Ineg > triggered
 - (036 010) PSB: IN > triggered

PSB blocking is reported by using the signal PSB: Blocked. The blocking of the distance zones and undervoltage stages that have been selected via PSB: Fct. assign. block. is reset as soon as the signal PSB: Blocked is issued.

The permissible duration of power swing blocking can be limited using (010 179) PSB: Max. blocking time. When the maximum permissible duration of power swing blocking is exceeded, then power swing blocking is blocked for the set time period (011 143) PSB: Blocking time int..

PSB: Blocked has no influence on out-of-step tripping functions unless it is caused from external blocking signal ((008 248) PSB: Blocking EXT), which forces the whole PSB function to blocked state.

If only the maximum blocking time has expired or one of its overcurrent stages has operated, the function continues to process its data for determination of Z_{pos} , the detection of a power swing condition, or the counting of power swings. When dedicated counts are reached, still out of step or power swing tripping can be issued.

The signal flow diagram is based on the assumption that PSB is enabled and not blocked by an external input signal (i.e. by PSB: Blocking EXT = Yes).

- A: The first line in the signal flow diagram represents the basic relevant measuring and logic condition that is used to establish the power swing blocking condition (i.e. Z_{pos} is within the power swing polygon, the PSB activation condition was fulfilled, and no unblocking condition is present, or abort delay PSB: Abort delay).
- B: If PSB is not blocked, the signal PSB: Blocking initiated is issued. This signal is the condition used to block the selected DIST zones and $V < >$ stages.
- C: When the signal PSB: Blocking initiated falls back to No, a settable hold timer is triggered or retriggered. It does not matter, whether the reset of power swing blocking was caused because Z_{pos} has left the power swing polygon, or because of any unblocking condition (current triggers or PSB: Max. PS cycle dur. elapsed).
- D: Signal D is the result of a logical OR operation: B or C.
- E: The raising edge of the signal D (i.e. the beginning of a measured power swing condition) triggers a timer. If this timer reaches the set PSB: Max. blocking time a further pulse timer (=signal F) is triggered, which is running for the set time PSB: Blocking time int..
- F: While this pulse timer is elapsing (i.e. during the time interval PSB: Blocking time int.) the signal PSB: Blocked is issued.

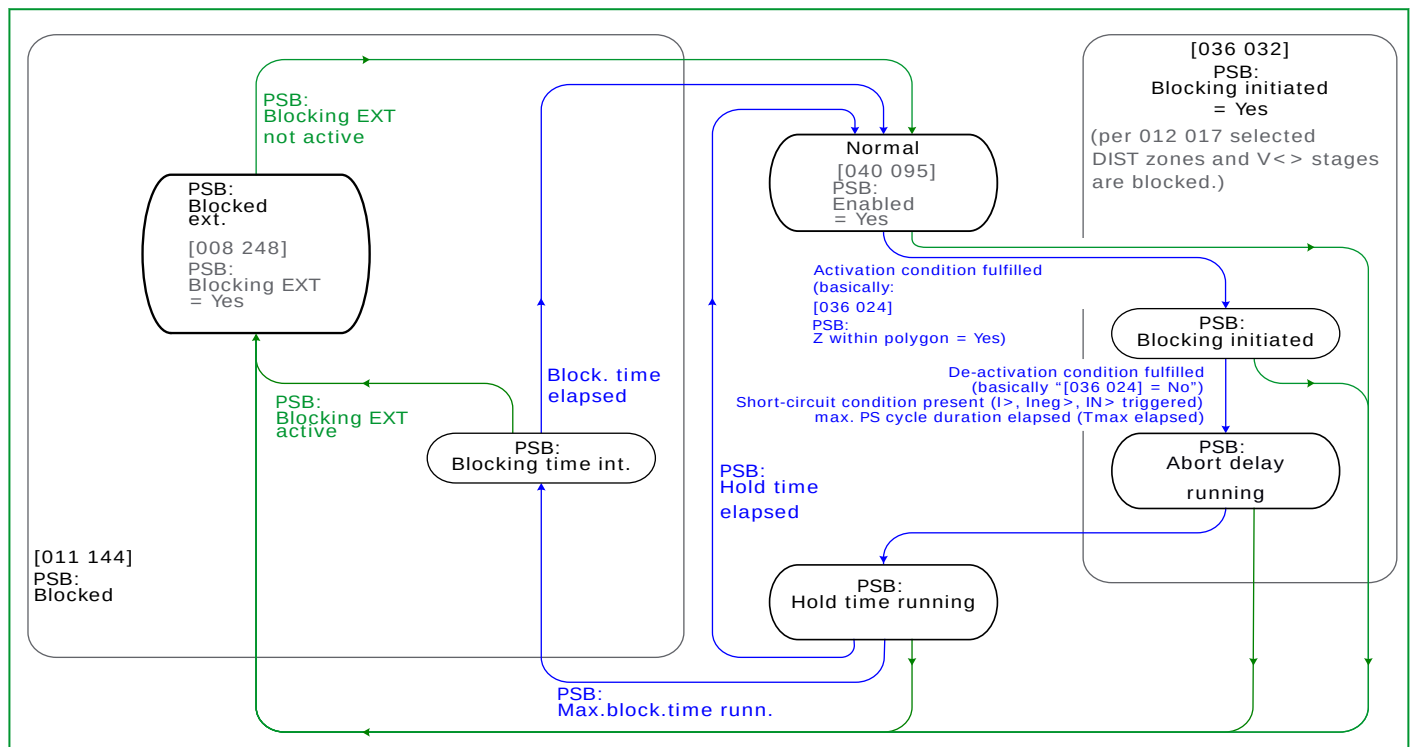


Fig. 3-169: PSB state diagram

3.25.6 Out-of-Step Tripping

An out-of-step tripping may become necessary when a power swing with low damping has to be terminated by deliberately splitting system sections. For such a procedure the device has two independent methods available:

- 1st criterion – for a safe system split at an instable power swing.
The positive-sequence impedance leaves the power swing polygon on the opposite side (see impedance trajectory ② in Fig. 3-166, (p. 3-221)).
The sign for the positive-sequence impedance's resistive component is stored when the measured positive-sequence impedance enters the power swing polygon. This stored sign is compared with the sign when crossing the R(OOS) boundary (description of R(OOS) below). Should the signs differ, a trip signal is issued immediately.
When this criterion is applied an instable power swing will be determined, regardless of swing frequencies.
- 2nd criterion – Enhanced counting-based tripping.
Detailed description follows below.

The trip signal of the 1st criterion is issued as PSB: Trip signal.

The counting-based trip signals per 2nd criterion are available as individual signals, described below. They are not linked into this PSB: Trip signal, but could be individually linked into the general trip commands.

3.25.7 Enhanced Counting-Based Trip Logic

The basic considerations could be discussed on a simple (simplified) 2-machine power system as shown in Fig. 3-170, (p. 3-228). Sources A and B represent power system equivalents, impedance A–B represents (positive sequence) line impedance. The distance protection to be discussed is located on the line at end A.

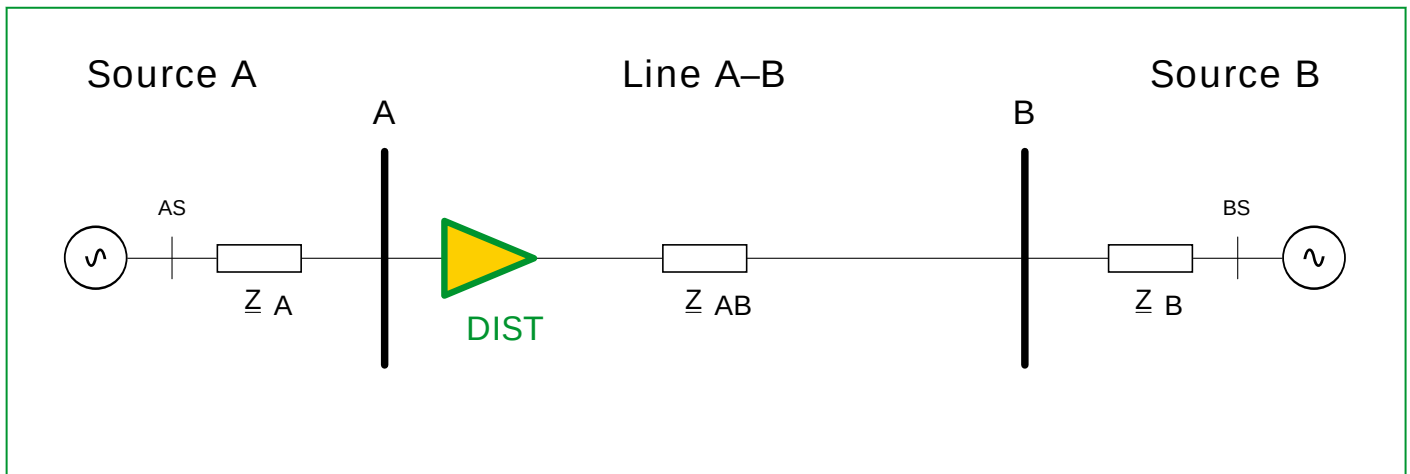


Fig. 3-170: Power system equivalent circuit.

Based on this equivalent circuit, the impedance plot per Fig. 3-171, (p. 3-229) could be drawn. The origin of the complex plane is put at the location of the distance protection device, that is at busbar A.

For this simplified description any apparent impedance $\underline{Z}$ measured from the distance protection during a steady-state out-of-step condition moves along circles with its origin in either AS or BS source, depending on the ratio of the absolute values of the 2 source voltages. The rotation sense further depends on which source is leading.

This description of power swings is rather simplified but sufficient to describe the functionality as implemented in the P433.

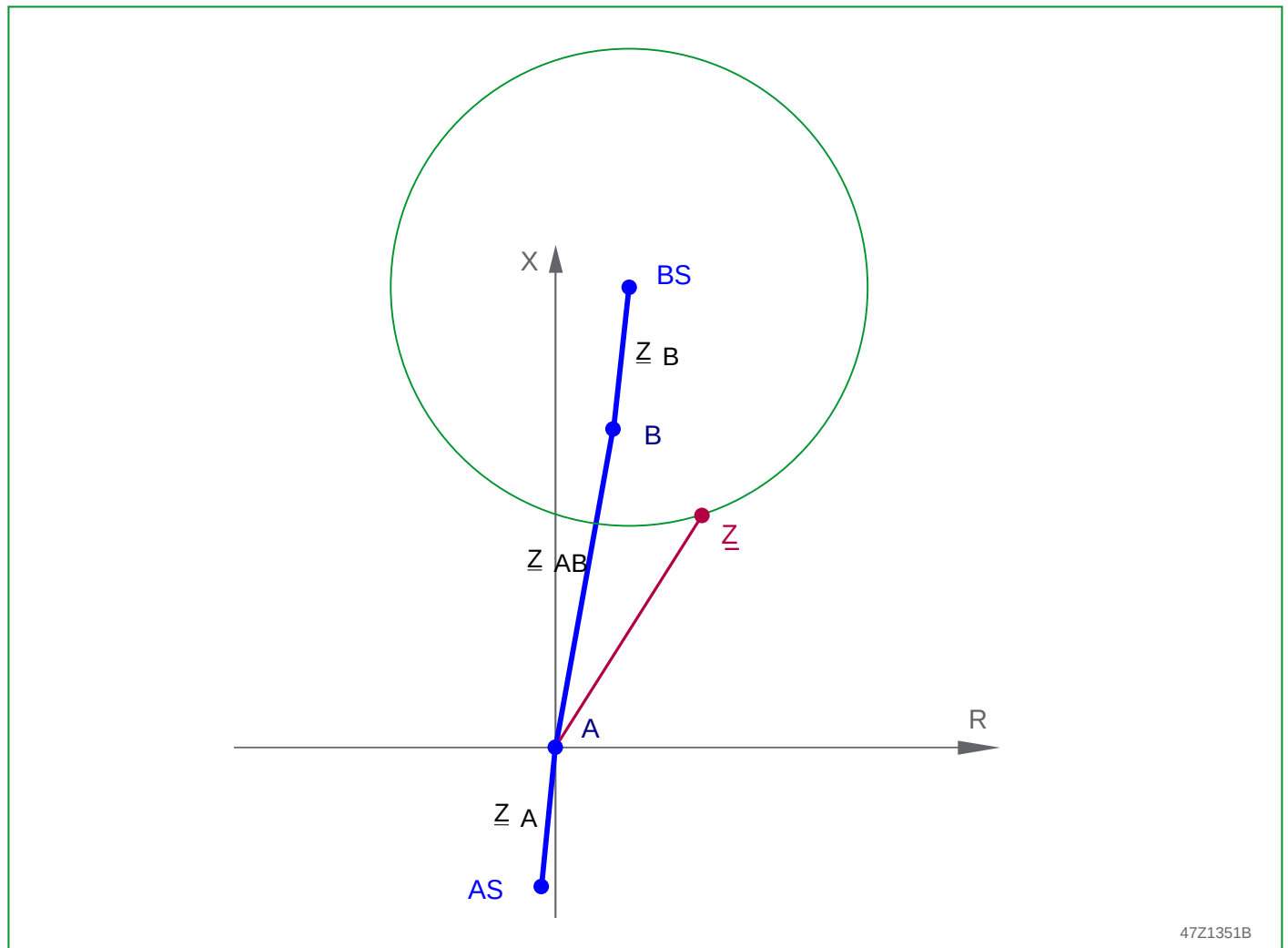


Fig. 3-171: Power system equivalent impedances.

The basic power swing detection zone of P433 is of quadrilateral shape. While resistive reach in forward and backward direction is equal, the reactive reaches can be set independently to provide coverage adjustable to the power system impedances (essentially to cover differences in reverse source impedance and forward line plus remote source impedances).

Power swing detection is achieved by measuring the rate of change of the resistance (real part) of the positive sequence impedance when entering the power swing polygon (see [Section 3.25.2, \(p. 3-221\)](#)) or upon general starting (see [Section 3.25.3, \(p. 3-222\)](#)).

Inside the power swing detection zone, 2 more lines are defined by a settable resistance PSB: R (OOS) to determine an out-of-step condition (see [Fig. 3-172, \(p. 3-231\)](#)). Thus this decision could be taken before leaving the power swing detection zone.

The relay checks that settings are valid:

- The resistive lines have to be inside the power swing detection zone:
 $R_{\text{instab.}} \leq R_{\text{stab.}}$
 Otherwise the internal R(OOS) variable is limited to the R(PSB) value as per Fig. 3-173, (p. 3-231) (left-hand part).
- The resistive lines must not cross the X-axis.
 Otherwise the lines are limited to the X-axis as per Fig. 3-173, (p. 3-231) (right-hand part).

3.25.7.1

Counters

An out-of-step condition is determined if the apparent positive-sequence impedance moves along its trajectory from the right side into the power swing detection zone and then crosses the left side OOS detection line (trajectory ① in Fig. 3-172, (p. 3-231) below), or vice versa (trajectory ②). In both cases the out-of-step counter n_{OOS} is incremented by 1.

If the apparent positive-sequence impedance leaves the power swing detection zone on the same side as it entered, a stable power swing is determined (e.g. trajectory ③). In this case the power swing counter n_{PSB} is incremented by 1.

By this definition, the counter values are only available during a power swing or out-of-step condition, respectively. As it is desirable to have the counter values available for post-mortem analysis, the values are stored as event counters, too.

The following counters are implemented to count unstable and stable swings as described above:

- $n_{\text{instab.}}$: PSB: No. OOS-Swing
- $n_{\text{stab.}}$: PSB: No. stab. PSwing

3.25.7.2

Counter Reset

During a power swing a dedicated timer stage is triggered upon each incrementing the counter. If this timer elapses while no further incrementing of the same counter takes place, then it is assumed that the power swing condition has stopped and this counter is reset to 0.

For this timer stage the setting PSB: Max. PS cycle dur. is used, which is recommended to be set to the anticipated maximum power swing cycle time.

The counters are reset automatically with the detection of a new power swing. A manual reset of the counters, however, can also be done by setting the parameter PSB: Reset counters to *execute*.

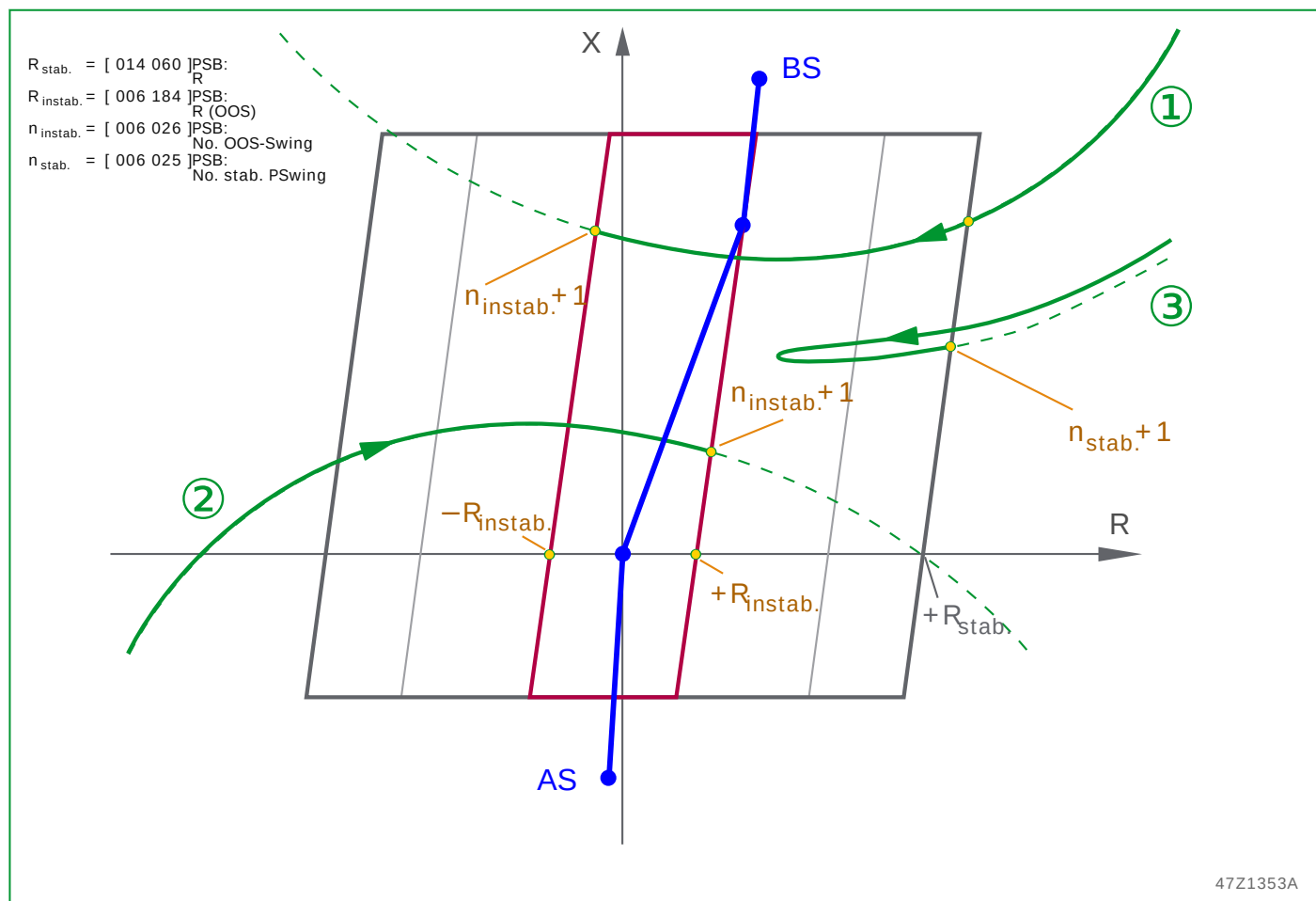


Fig. 3-172: Out-of-step detection and counter incrementing conditions.

Left: Limiting at $\pm R_{stab}$, if $R_{inst} > R_{stab}$; right: Limiting X-axis.

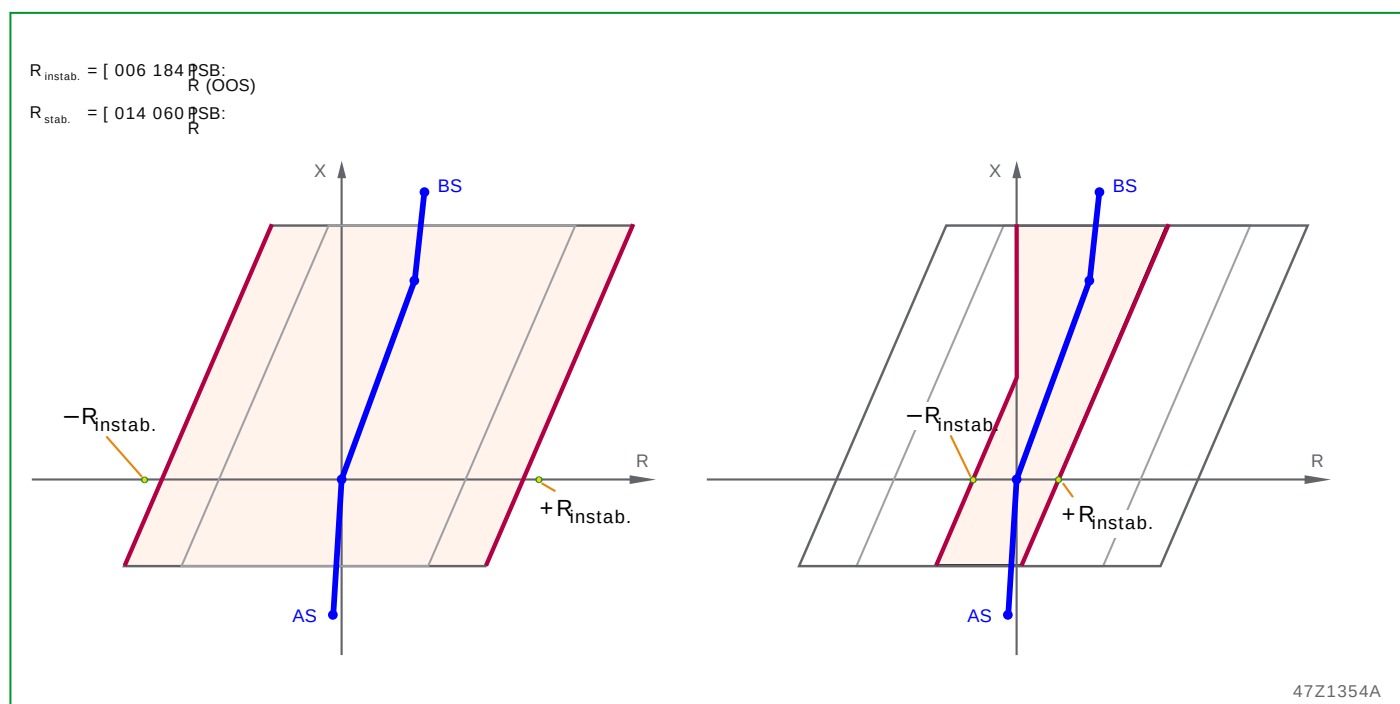


Fig. 3-173: Automatic limiting for the position of the resistive lines.

3.25.7.3

Counter Comparators

Out-of-step tripping is raised, if the number of counted out-of-step swings n_{OOS} reaches a settable limit.

In order to take into account the electrical center of the power swing, the impedance area between the OOS detection lines inside the power swing detection zone is split into 3 areas, divided by 2 settable reactances as per Fig. 3-174, (p. 3-233). The reactances are set at:

- PSB: posX (OOS)
- PSB: negX (OOS)

The inner main area is used to identify swings with electrical center on the line. The back-up area is the remaining part of this corridor. Typically the back-up area counter is set to a higher number of swings to provide only back-up tripping (system splitting) in case the protection system closest to the electrical center of the oscillation failed to operate.

As the OOS counter is incremented when the positive-sequence impedance trajectory crosses the resistive detection lines, the decision which counter limit to compare with is practically linked to the section on this resistive detection line rather than the area the impedance moved through.

Fig. 3-174, (p. 3-233) shows 2 cases:

- ① OOS tripping as n_{OOS} reaches $n_{OOS, trp, a}$.
- ② OOS tripping as n_{OOS} reaches $n_{OOS, trp, b}$.

In the same way, an additional power swing tripping is raised if the number of counted stable power swings n_{PSB} reaches a settable limit $n_{PSB, trp}$ (case ③). This feature may be used to detect badly damped stable or increasingly oscillating power swings and initiate a system splitting (or islanding).

These counter thresholds are also known as permissible number of unstable or stable power swings, respectively.

- $n_{instab, a}$ is set at PSB: Perm. No. OOS (a).
- $n_{instab, b}$ is set at PSB: Perm. No. OOS (b).
- n_{stab} is set at PSB: Perm. No. stab. PS.

3.25.7.4

Counting Based Trip Signals

The following individual tripping signals are issued:

- PSB: Trip signal OOS (a)
- PSB: Trip signal OOS (b)
- PSB: Trip signal stab. PS

These binary signals remain active for a pulse duration of 100 ms.

All out-of-step and power swing trip signals are available in the selection list of the general trip commands of the relay.

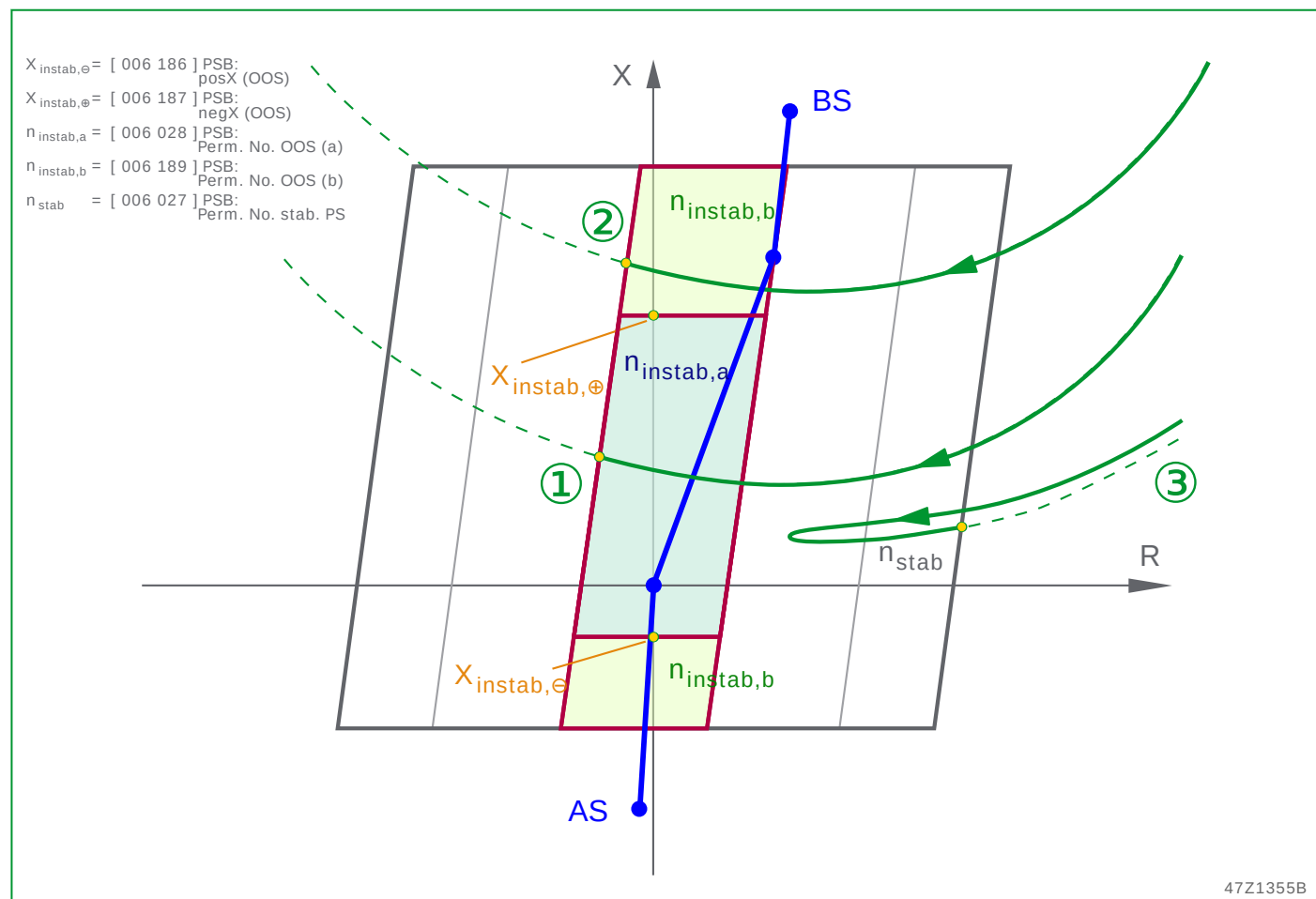


Fig. 3-174: Out-of-step tripping conditions

3.26 Measuring-Circuit Monitoring (Function Group MCMON)

The P433 monitors the phase currents and the voltages for balance during healthy system operation. If either unbalance or the lack of measuring voltage is detected, action is taken to prevent the unit from malfunctioning.

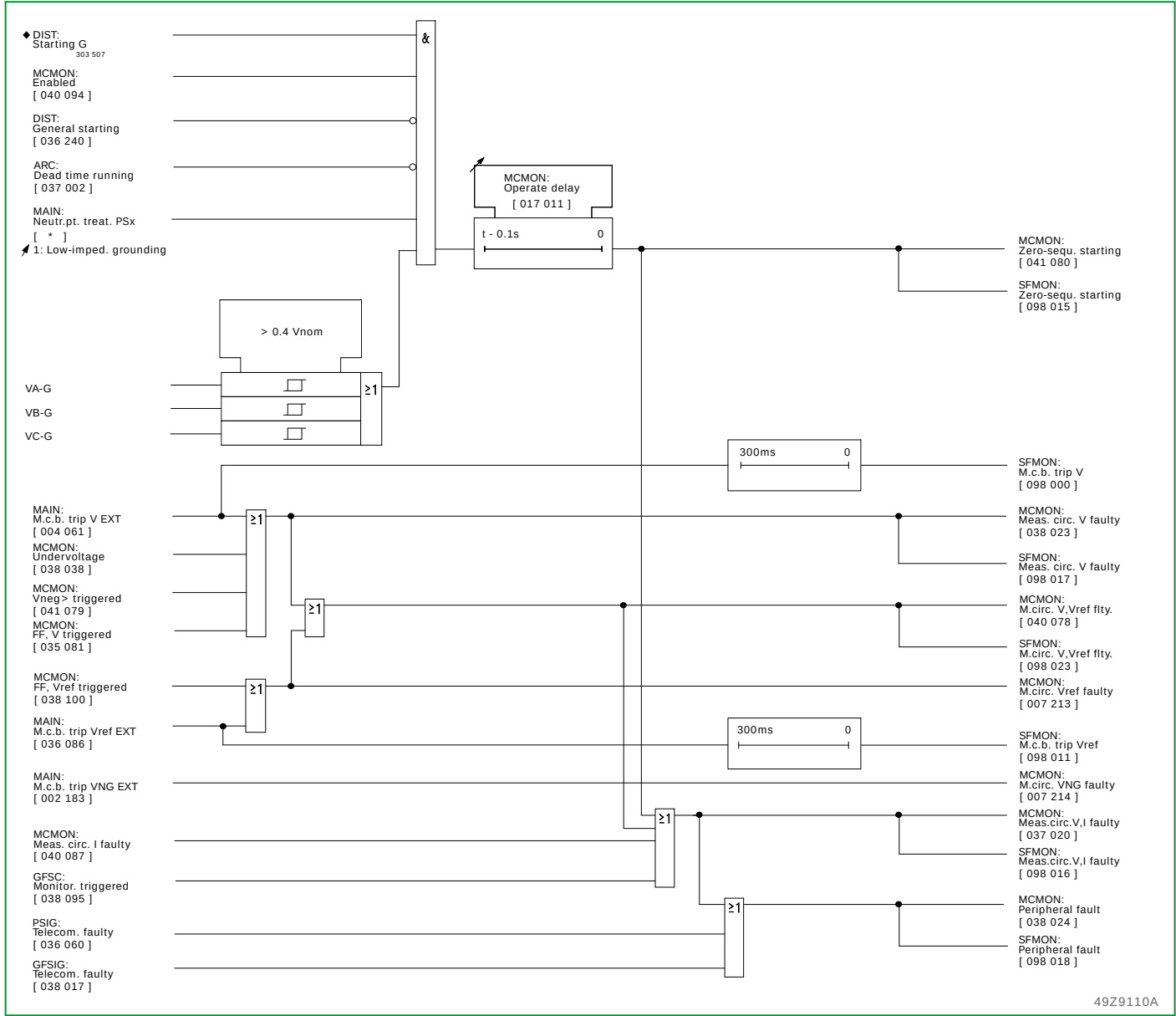


Fig. 3-175: Monitoring signals.

If during normal power system operating conditions ground starting S_G is present for more than set time (017 011 MCMON: Operate delay - 0.1 s) without phase starting, the following monitoring signal is issued: MCMON: Zero-sequ. starting

Measuring-circuit monitoring can be disabled by the appropriate setting. In the event of a fault, measuring-circuit monitoring is blocked.

3.26.1 Current Monitoring

The current-measuring circuit monitoring function is enabled when the current exceeds the settable value MCMON: Imin curr. monitor. in at least one

phase. Once monitoring is enabled, the absolute value of the negative-sequence component of the current system is determined in accordance with the definition of the symmetrical components. This is based on the setting at MAIN: Phase sequence.

Phase sequence A-B-C

- (Alternative terminology: clockwise rotating field)

$$|I_{\text{neg}}| = \frac{1}{3} \cdot |I_A + \underline{a}^2 \cdot I_B + \underline{a} \cdot I_C|$$

Phase sequence A-C-B

- (Alternative terminology: anti-clockwise rotating field)

$$|I_{\text{neg}}| = \frac{1}{3} \cdot |I_A + \underline{a} \cdot I_B + \underline{a}^2 \cdot I_C|$$

- Symbols used:

$$\underline{a} = e^{2\pi j/3} = e^{j \cdot 120^\circ}$$

$$\underline{a}^2 = e^{4\pi j/3} = e^{j \cdot 240^\circ}$$

This value is divided by the maximum phase current $|I_{\text{max}}|$ and compared with the set threshold operate value. If the set operate value is exceeded, a monitoring signal is issued once the operate delay + 300 ms have elapsed.

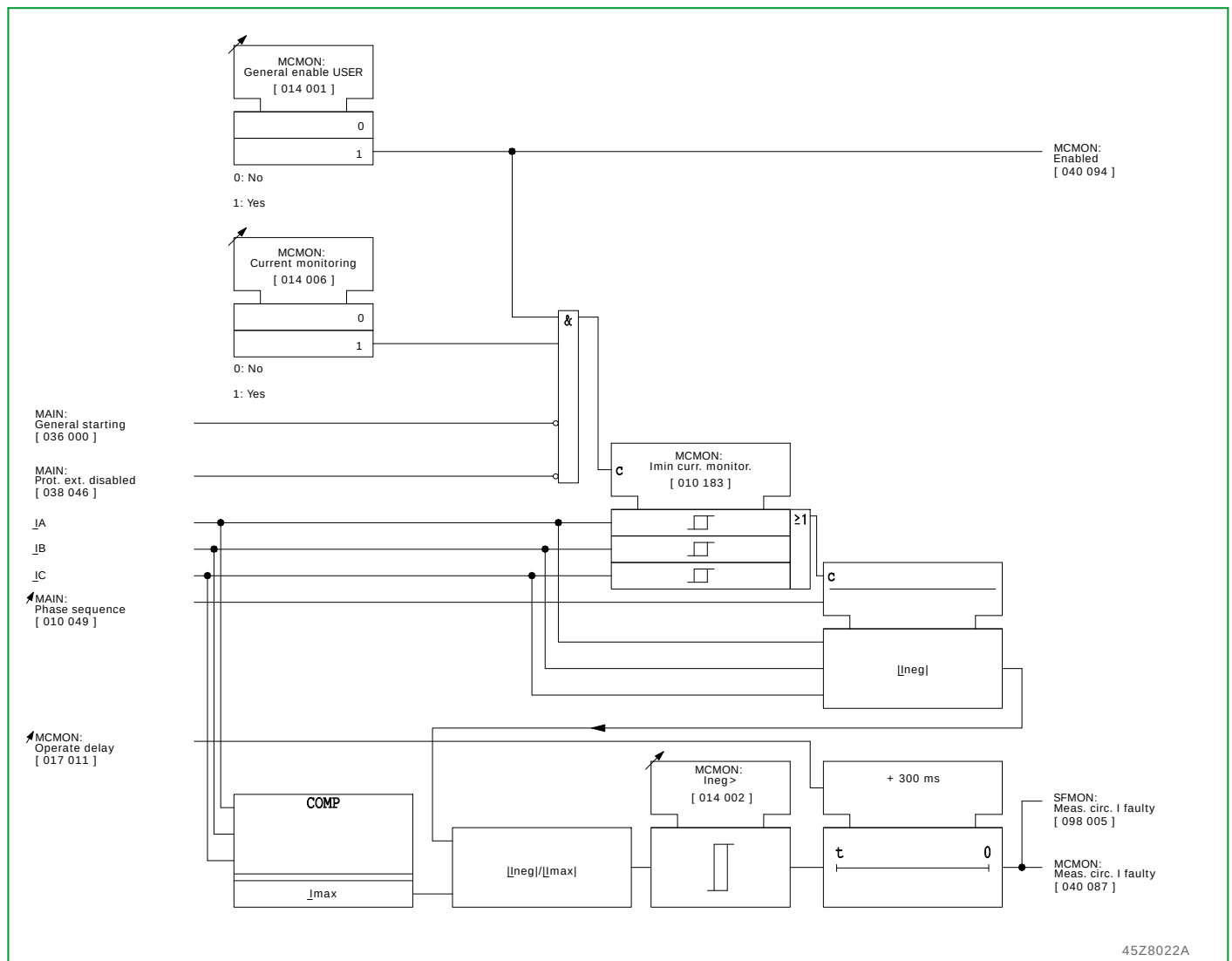


Fig. 3-176: Monitoring the current-measuring circuits.

3.26.2 Voltage Monitoring

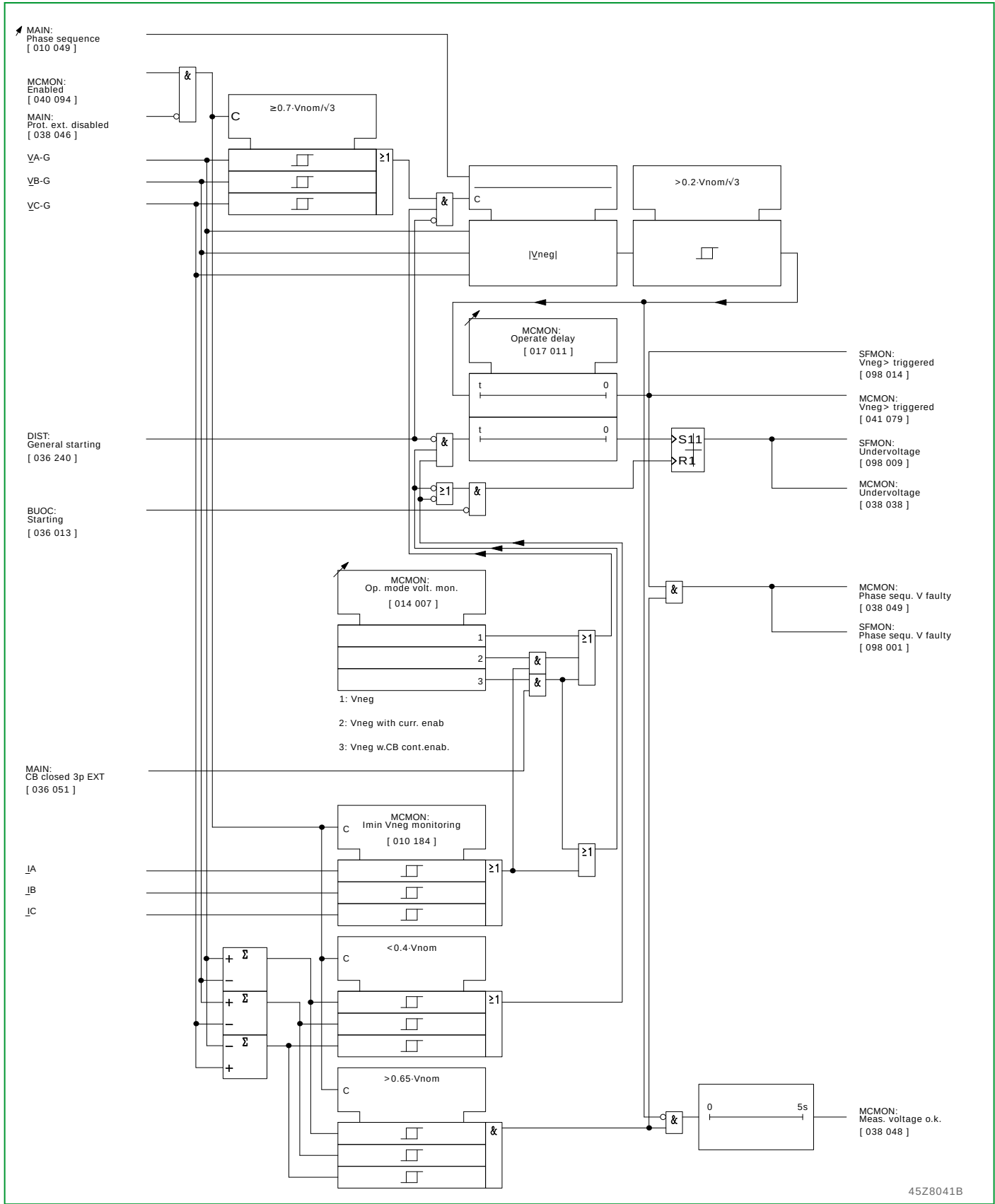


Fig. 3-177: Monitoring the voltage-measuring circuit.

The voltages used by distance protection as measured values are monitored for plausibility by the voltage-measuring-circuit monitoring function.

Monitoring of voltage-measuring circuits is based on the following criteria:

- Phase-to-phase voltages are monitored for voltages that fall below the default threshold of $0.4 \cdot V_{nom}$. This monitoring function is enabled when the current exceeds MCMON: Imin Vneg monitoring in one phase.
- The negative-sequence component of phase-to-ground voltages is monitored in accordance with the definition of symmetrical components. Monitoring is enabled when a phase-to-ground voltage exceeds the default threshold of $0.7 \cdot V_{nom} / \sqrt{3}$.

In addition to these conditions, either a settable minimum current ((010 184) MCMON: Imin Vneg monitoring) or the closed position of the circuit breaker contacts can be used as enabling criteria. If there is an enable, the absolute value of the negative-sequence component of the voltage system is determined in accordance with the definition of symmetrical components. This is based on the MAIN: Phase sequence setting.

Phase sequence A-B-C (alternative terminology: clockwise rotating field)

- Negative-sequence voltage

$$|V_{neg}| = \frac{1}{3} \cdot |(V_{A-G} + \underline{a}^2 \cdot V_{B-G} + \underline{a} \cdot V_{C-G})|$$

Phase sequence A-C-B (alternative terminology: anti-clockwise rotating field)

- Negative-sequence voltage

$$|V_{neg}| = \frac{1}{3} \cdot |(V_{A-G} + \underline{a} \cdot V_{B-G} + \underline{a}^2 \cdot V_{C-G})|$$

- Symbols used:

$$\underline{a} = e^{2\pi j/3} = e^{j \cdot 120^\circ}$$

$$\underline{a}^2 = e^{4\pi j/3} = e^{j \cdot 240^\circ}$$

This value is compared with the default threshold operate value $0.2 \cdot V_{nom} / \sqrt{3}$. If the threshold operate value is exceeded, a monitoring signal is issued after the operate delay has elapsed.

If one of the monitoring functions described above operates, then all phase voltage based protection functions (e.g. DIST, V<>, f<>, SCDD) are blocked, and the device activates backup overcurrent time protection – provided the appropriate setting has been selected.

In addition, the MCMON: Meas. voltage o.k. monitoring signal is issued if all phase-to-phase voltages exceed the default threshold of $0.65 \cdot V_{nom}$ and negative-sequence monitoring has not operated.

3.26.3

Phase-Sequence Monitoring

Phase-sequence monitoring is enabled only if the following conditions are simultaneously met:

- Measuring circuit monitoring is enabled.
- Phase-sequence monitoring is enabled.
- All three phase-to-ground voltages exceed $0.4 \cdot V_{nom}$.
- No general starting signal is present.

In order to suppress short-term transients, the phase-sequence monitoring trigger is followed by a set time-delay of 1 s. Once the time-delay has elapsed, the signal MCMON: Phase sequ. V faulty is issued.

3.26.4

Fuse Failure Monitoring of Phase-to-Ground Voltages

In addition to monitoring the voltage-measuring circuits, as described above, the P433 also provides for fuse failure monitoring. This function is used in particular when there is no voltage transformer m.c.b. auxiliary contact. If fuse failure monitoring is not desired it can be disabled by setting parameters.

The fuse failure monitoring function must distinguish between a short circuit in the three-phase current system and a lack of measuring voltage due to a short circuit or open circuit (broken wire) in the secondary circuit of the voltage transformer.

A short circuit exists in the three-phase current system being monitored, if one of the following conditions is satisfied:

- Distance protection has started. (This signal has a time delayed reset of 30 ms so as to avoid startings by transients that may occur at the end of a short circuit.)
- Major current variations occur:
 - The current increases by more than +5% in at least one phase.
 - The current decreases by more than –10% in at least two phases.
 - The current increases by more than +5% in the positive-sequence current system.

The P433 uses different criteria to detect single- or two-phase faults or three-phase faults in the secondary circuit of the voltage transformer.

- A single- or two-phase fault is present in the secondary circuit of the voltage transformer if the following conditions are satisfied simultaneously:
 - The phase currents exceed the distance protection's $I >$ threshold either in none or in all of the three phases (= symmetrical load condition).
 - A current increase $\Delta I / \Delta t > 10\%$ occurs during 3 cycles (= $3 \cdot T$) in not exactly one phase.
 - The negative-sequence current does not exceed the threshold $I_{neg} >$.
 - The negative-sequence voltage has exceeded the threshold $V_{neg} >$.
- A three-phase fault is present in the secondary circuit of the voltage transformer if the following conditions are satisfied simultaneously:
 - At least one of the phase currents exceeds the distance protection's $I >$ threshold.
 - The positive-sequence voltage has fallen below the $V_{pos} <$ threshold.
 - The positive-sequence current may only vary less than –10% or +5% within 3 cycles after the positive-sequence voltage has fallen below this threshold.

Fuse failure monitoring for 3-phase faults in the measuring circuit is only active within a 50 ms time window after a positive sequence undervoltage condition is detected.

If the above conditions are satisfied, a memory is set. The previously settable operate delay timer should remain at its default value of 0 s to ensure that fuse failure monitoring is able to prevent false pick up of distance protection.

The memory is reset when the positive-sequence voltage exceeds the fixed threshold of $0.5 \cdot V_{nom}$ and the negative-sequence voltage falls below the $V_{neg} <$ threshold.

If the buffer memory has been set the P433 decides that the secondary circuit of the voltage transformer is faulty if the following conditions are met:

- At least one of the phase currents exceeds the $I >$ threshold, or:
- The set threshold of the negative-sequence voltage has been exceeded and three cycles previously at least one phase-to-ground voltage had been above $50\% V_{nom}/\sqrt{3}$.

In this case distance protection is blocked, and the device switches to backup overcurrent time protection – provided that the appropriate setting has been selected.

From Version -650 the Fuse Failure threshold and timer settings have been made invisible as their default values have proven to be the best solution. By default, the following values are active and recommended:

(031 053) MCMON: $V_{pos}<$, FF = 0.05 V_{nom}

(031 056) MCMON: $V_{neg}>$, FF = 0.16 V_{nom}

(031 054) MCMON: $V_{neg}<$, FF = 0.05 V_{nom}

(031 057) MCMON: $I_{neg}>$, FF = 0.10 I_{nom}

(031 058) MCMON: Operate delay FF, V = 0.00 s

Nevertheless, these addresses internally still exist and when converting an old setting file to version -650 or later, the values from that old file get active in the new setting, too.

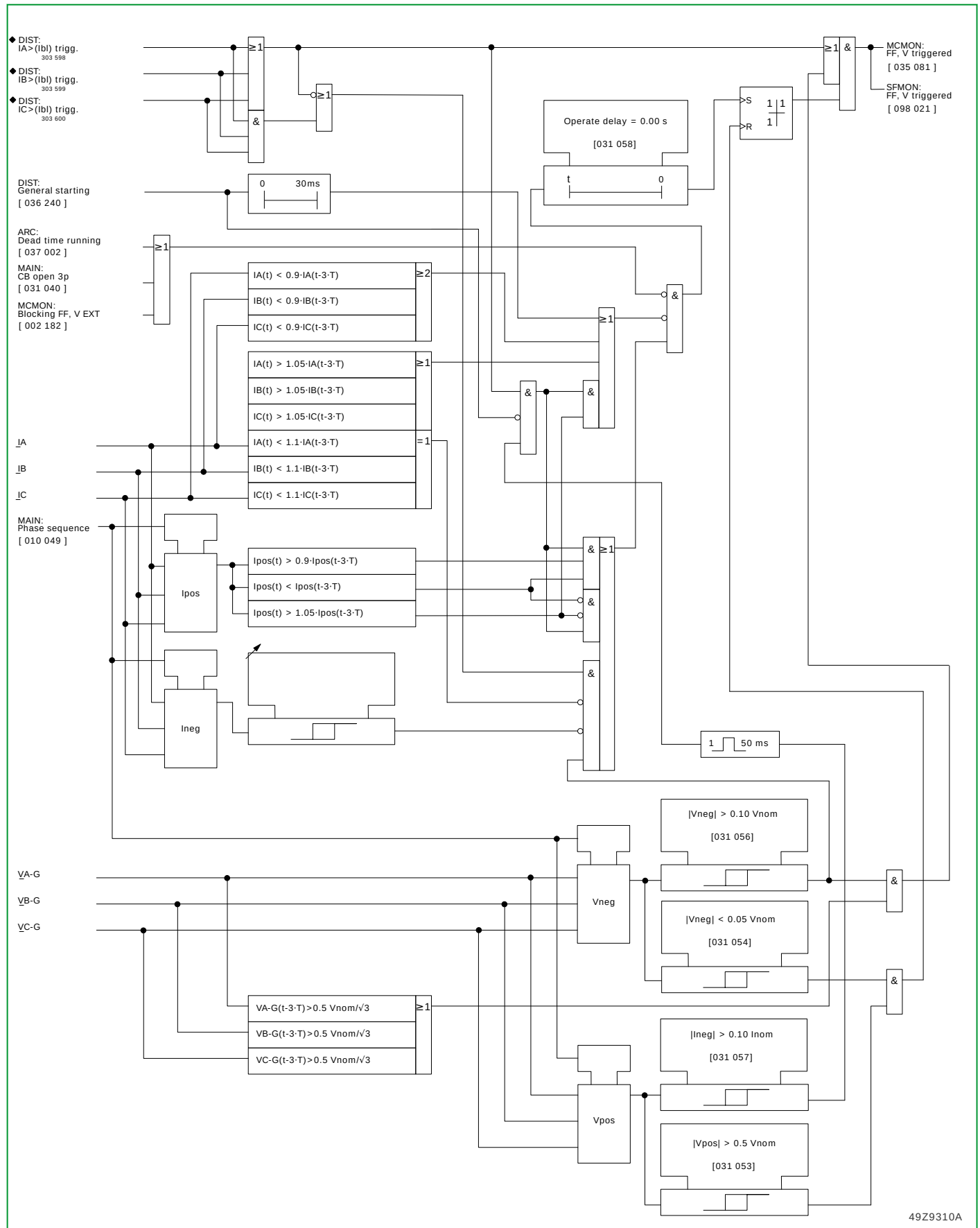


Fig. 3-178: Fuse failure monitoring (after setting MCMON: FF, V enabled USER = Yes).

3.26.4.1 Extended Fuse Failure Blocking Condition

Fuse failure determination is prohibited under the following conditions, to avoid false operation due to voltage transients during de-energized line conditions:

- The dead time of the internal auto-reclosing control (ARC) is running.
- The local CB is not 3p-closed i. e. MAIN: CB closed 3p = No.
This blocking prevents false operation based on discharge-transients of line reactors, or if the line is energized from the remote end while the fault is still present. The device at the end of the CB being not 3p-closed may then determine a fuse failure condition due to a sudden asymmetric change of voltage with no current. This operation of fuse failure monitoring is basically non-critical (as the local CB is still open), but jeopardizes faster fault clearance at the remote end, aided by protection signaling, because PSIG/Echo logic is also blocked, if MCMON determines a voltage measuring circuit failure.
- A fuse failure blocking input signal is activated (MCMON: Blocking FF, V EXT).

This signal is implemented to establish further flexible blocking conditions, e.g. through the LOGIC function.

3.26.5 “Fuse Failure” Monitoring of the Reference Voltage

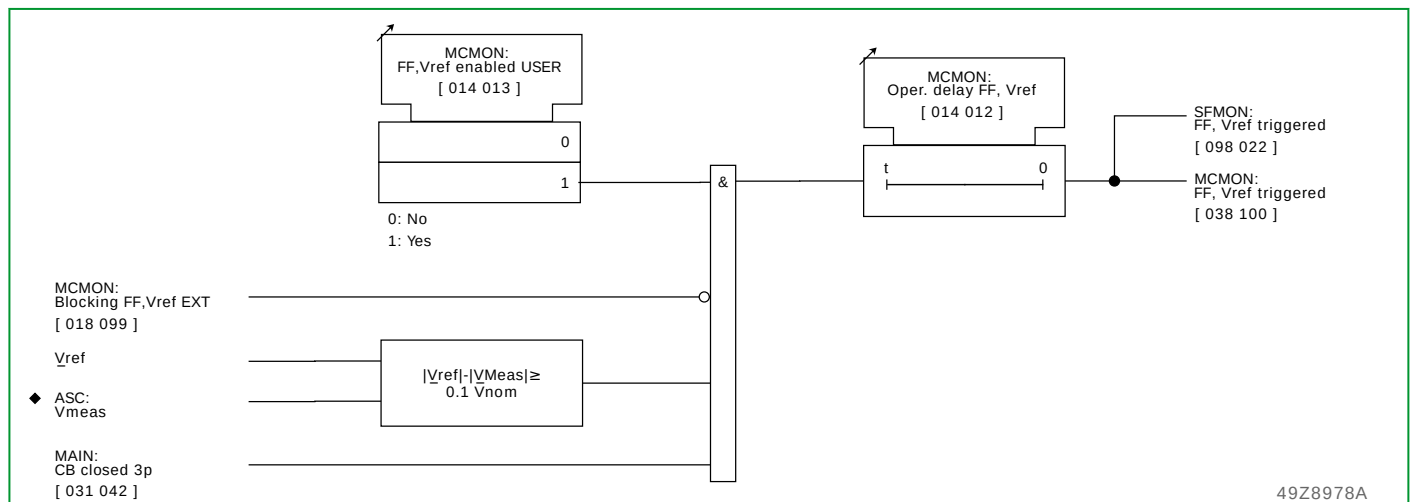


Fig. 3-179: “Fuse Failure” monitoring of the reference voltage.

The P433 includes “Fuse Failure” monitoring of the reference voltage function, which is required by the “Automatic Synchronism Check” (ASC).

Fuse Failure monitoring of the reference voltage is only possible if the ASC function has been configured. This is specifically applied when no auxiliary contact is available on the voltage transformer m.c.b. If fuse failure monitoring is not desired it can be disabled by setting parameters.

Fuse Failure monitoring must be able to discriminate between a short circuit in the three-phase network being monitored and a reference voltage missing because of a short circuit or an open circuit in the secondary circuits of the reference voltage.

A short circuit or an open circuit in the secondary circuits of the reference voltage is present when the following conditions are met:

- The circuit breaker is closed.
- The voltage difference between the line side and the busbar must exceed $0.1 \cdot V_{nom}$.

3.27 Backup Overcurrent-Time Protection (Function Group BUOC)

If there is a fault in the voltage-measuring circuit, distance protection is blocked, since accurate impedance measurement is not possible. Backup overcurrent-time protection (BUOC) is then automatically activated – if set accordingly.

Backup overcurrent-time protection (BUOC) is enabled if there is a fault in the voltage-measuring circuit. It monitors the phase currents for overcurrents exceeding the set values $I_{>}$. If a phase current exceeds the set value, timer stage $t_{I>}$ is started. After the set time period has elapsed, a trip signal is issued.

Inrush stabilization blocks the phase starting of BUOC protection if included in the selection, see [Section 3.13.5.1, \(p. 3-112\)](#).

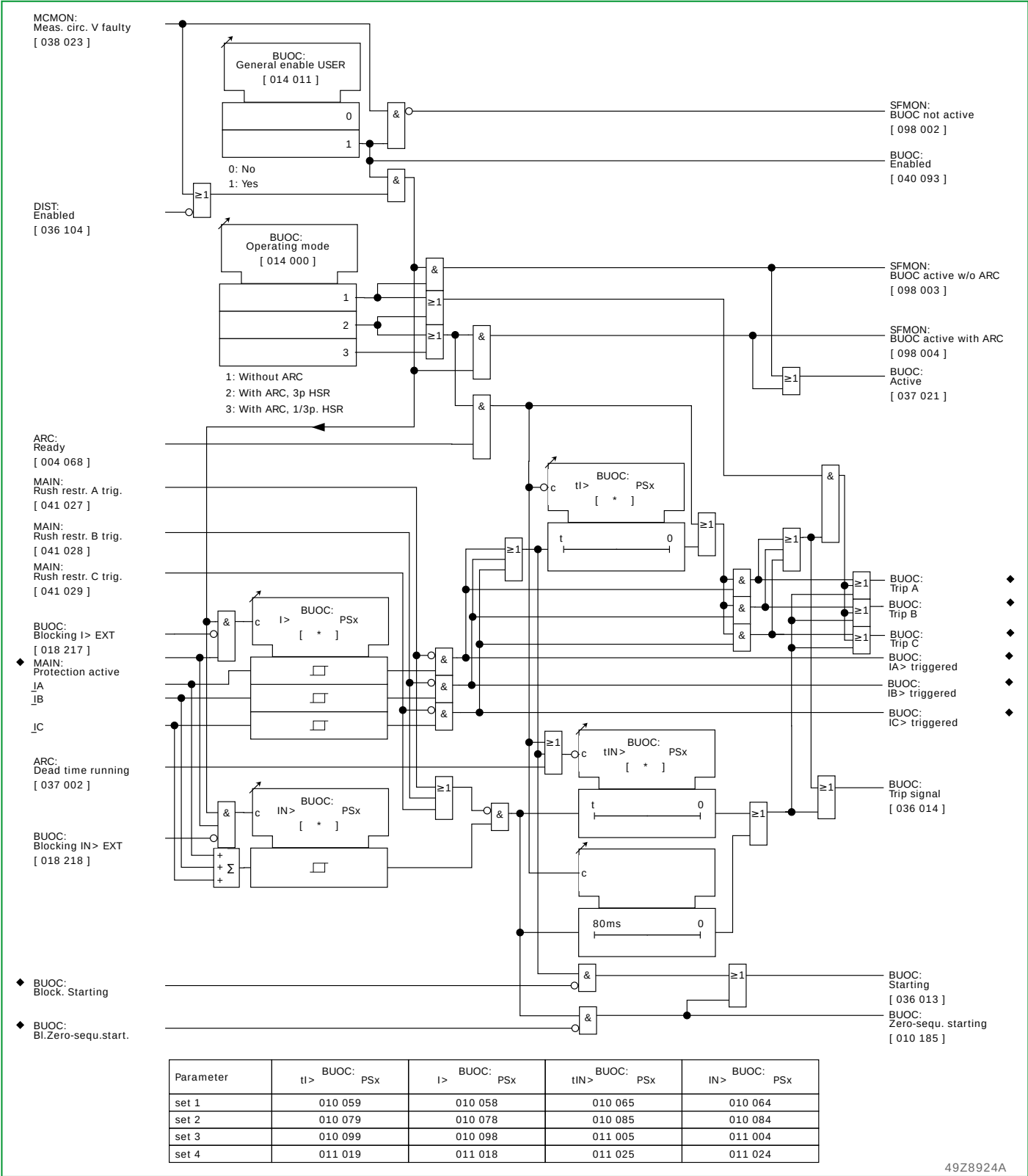
In previous versions of the P433, the residual current stage was active only if the “Low impedance-grounding” setting had been selected for the neutral point treatment. Beginning with software version -650, the dependence on the neutral point setting has been removed, the residual current stage is active for all neutral point settings. However, the residual current stage may also be set to “Blocked” to deactivate it, if necessary.

When converting an existing setting file from a former software release using the operating program, then “Blocked” has to be set manually in case the neutral point setting is “isolated” or “compensated” in order to retain the previous functionality.

Inrush stabilization blocks the ground starting of BUOC protection if included in the selection, see [Section 3.13.5.1, \(p. 3-112\)](#).

The setting for the operating mode controls whether the BUOC protection function will trigger an auto-reclosure (ARC). If auto-reclosure is desired, timer stages $t_{I>}$ and $t_{IN>}$ will be blocked when the ARC function is ready. With phase starting, the trip signal will then be issued instantaneously; with ground starting, it will be issued after an 80 ms delay. Timer stage $t_{IN>}$ (or fixed 80 ms starting time in case of ARC) is also blocked by phase starting.

If auto-reclosure is not required or if auto-reclosure with three-pole HSR is required, then the trip signal is always three-pole.



49Z8924A

Fig. 3-180: Backup overcurrent-time protection (BUOC).

3.28 Switch on to Fault Protection (Function Group SOTF)

When the circuit breaker is closed manually, it is possible to switch on to an existing fault (for example a forgotten grounding after work carried out on a primary conductor). This is especially critical if a maintenance ground clamp were inadvertently left connected at the remote end of the line, since the distance protection function would not clear the fault until zone 2 delay t_2 had elapsed. In this situation, however, the fastest possible clearance is desired which can be achieved by means of the “switch on to fault protection” function.

The following SOTF activation modes are available:

- SOTF activation mode = *Trigger*

This requires a binary trigger signal (MAIN: Manual close EXT or SOTF: Trigger EXT) which has to be configured in parallel to the close command of the P433.

The trigger signal is converted to an internal pulse. The pulse time can be set (SOTF: Man. close timer PSx), a signal is issued when the pulse time is running (SOTF: tManual-close runn.).

Note: The trigger signal must be configured separately to a binary signal input (and triggered during the closing action) even if the close command is issued via the P433.

- SOTF activation mode = *Line Dead State*

SOTF becomes permanently active during “dead line” condition.

A dead line condition is detected if the following applies:

- All three phase-to-ground voltages are less than $0.7 \cdot U_{nom} / \sqrt{3}$.
- All three phase currents are less than $0.05 \cdot I_{nom}$.

The SOTF function becomes active with the set operate delay (SOTF: Operate delay PSx) after the dead line condition had been recognized. SOTF: Operate delay PSx should be greater than the ARC dead time.

When an energized line is detected, the set release delay (SOTF: Release delay PSx) is started. SOTF is then deactivated after the release delay has elapsed.

Activation of the SOTF function via trigger signal can also be made dependent on the line energized state by setting SOTF: With V < enable PSx to Yes. Then, SOTF is activated only with the first close command at one end of a line. This excludes an over reaction in case of a sensitive SOTF configuration and heavy transients due to load currents when the second close command is issued at the other end of the line.

On the other hand, CT failures may occur from picking up load current. For such cases it is not desirable to inhibit SOTF, even if the line is already energized. To take care for this condition, too, the dead line inhibit logic can be disabled by setting SOTF: With V < enable PSx to No.

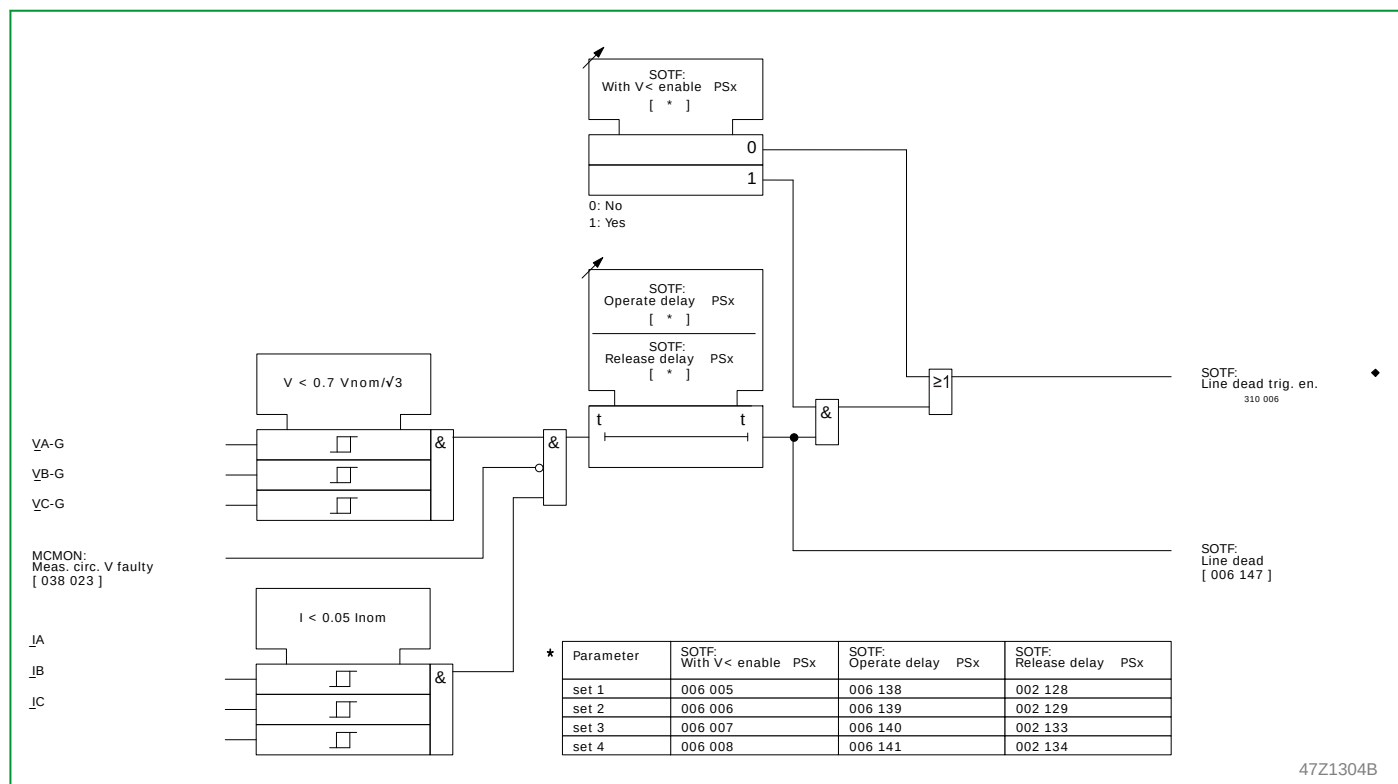


Fig. 3-181: Decision "Line dead" in the SOTF function.

Regarding the SOTF trip signal, one of the following operating modes can be selected:

- SOTF operating mode = *Trip with starting*
While the SOTF function is active, the occurrence of a general trip command of distance protection or backup overcurrent protection immediately causes the SOTF trip signal to be issued which has to be configured to the general trip command 1 in that operating mode.
- SOTF operating mode = *Trip with overreach*
While the SOTF function is active, the measuring range of the impedance zone 1 is extended (SOTF: Z1 extended). A distance protection starting with the measured impedance within the extended zone 1 causes a trip command with the tripping time as defined by the SOTF function (SOTF: Tripping time PSx). This trip command is an inherent part of the general trip command 1.

Furthermore, the SOTF function provides a single-stage overcurrent protection for phase as well as residual currents. This allows for a fully functional current-based SOTF protection function even if voltage measurement fails. Separate overcurrent stages and associated timer stages can be defined for phase currents and residual currents. When the threshold of an overcurrent stage is exceeded then a corresponding signal is issued, and the timer stage is started; see Fig. 3-182, (p. 3-246). When timer stages have elapsed, the SOTF trip signal is issued.

3.28.1

Interaction between SOTF and ARC

The "switch on to fault protection" (SOTF) function and the "auto-reclosing control" (ARC) function interact as follows:

- While the SOTF function is active, the built-in ARC function is automatically blocked. This is to avoid that a SOTF trip command causes an ARC cycle to start. An external ARC device can be blocked the same way by using the SOTF: Active status signal.
- While the ARC function is active, in general it is not necessary to activate the SOTF function because the line was already energized prior to the beginning of the ARC cycle. Therefore, the built-in ARC function automatically blocks the triggering of the SOTF function. To generate the same functionality with an external ARC device, the auto-reclosing command of the external ARC device has to be configured to the SOTF: Par. ARC running EXT binary input signal. The condition-based activation of the SOTF function has then to be ensured by means of correspondingly long operate delays.

In some applications, a “zone extension during reclosure” is required. With the built-in ARC function this can be configured in a straightforward manner (ARC: Zone ext.dur. RC PSx). With an external ARC device, the SOTF activation mode *Trigger* can be used, or, as an alternative, the SOTF operate delay has to be set shorter than the ARC dead time.

3.28.2 Current Monitoring and Starting Signal

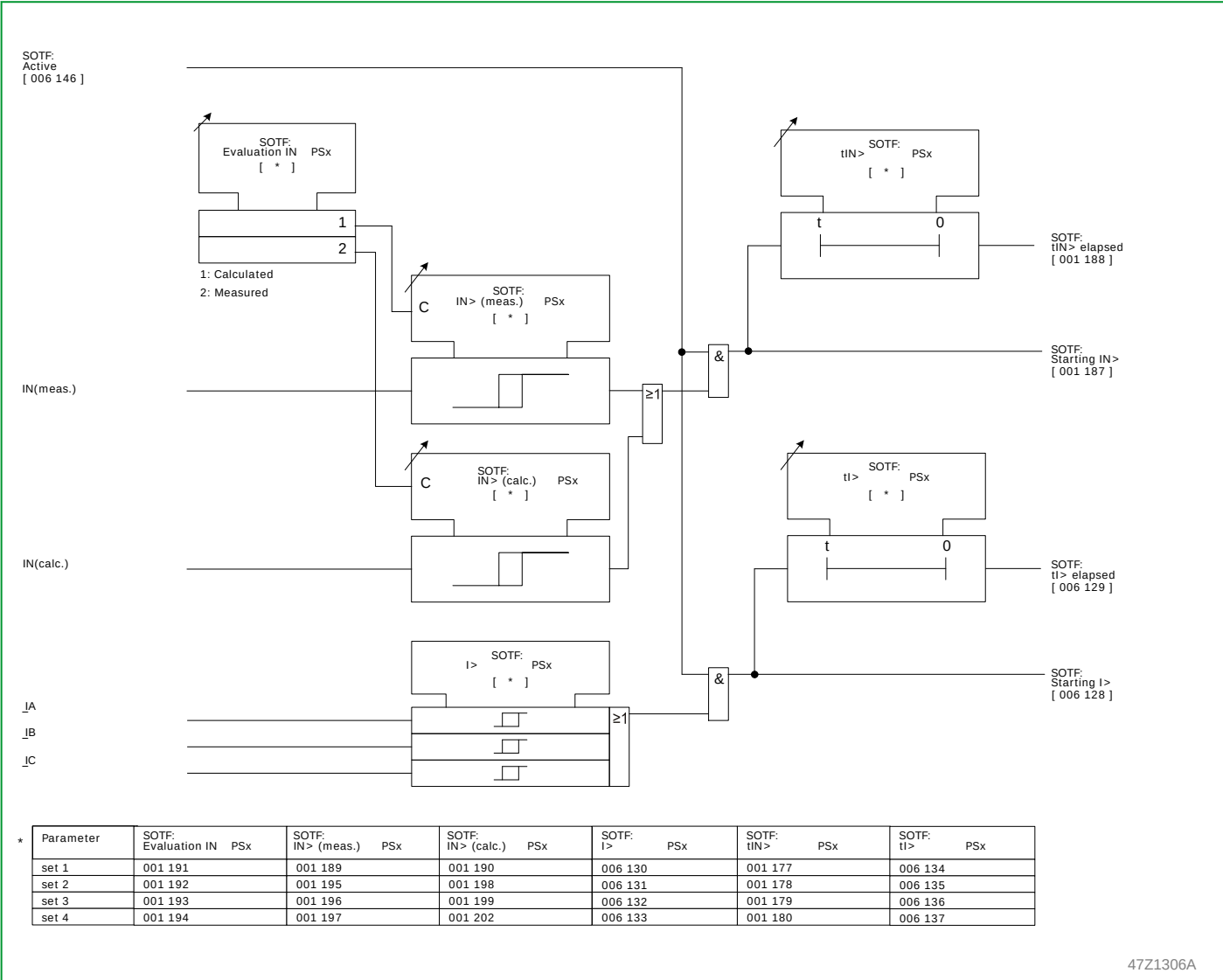


Fig. 3-182: SOTF overcurrent stages.

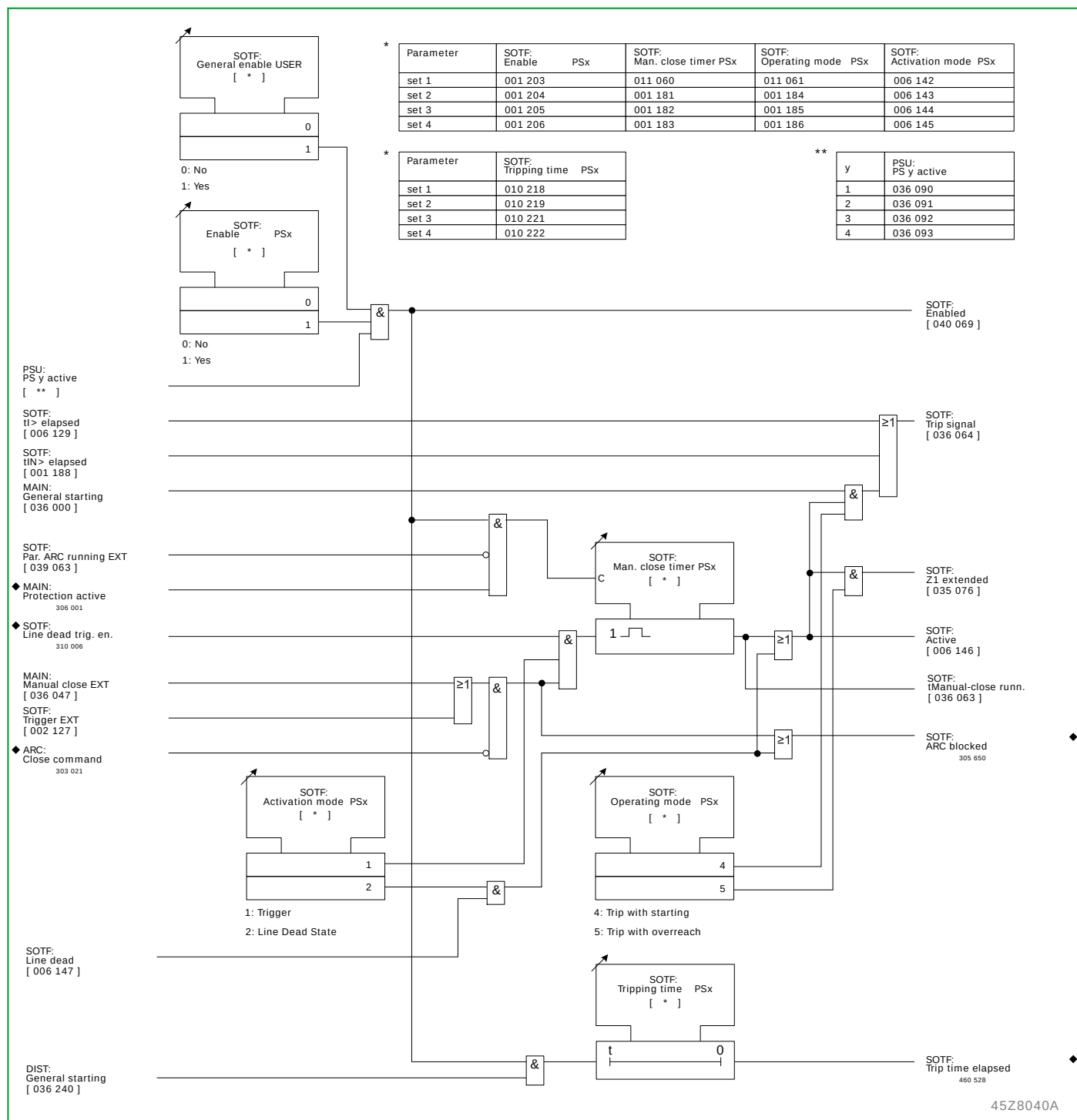


Fig. 3-183: Switch on to fault protection.

Bug notice:

SOTF in operating mode Trip with starting still does operate upon DIST and BUOC starting only, irrespective of setting to include DTOC/IDMT starting in general starting. In order to accomplish OC trip the SOTF OC stages have to be used.

3.29 Protective Signaling (Function group PSIG)

The reach of the first impedance zone of the distance protection function is normally set for values less than 100%. Protective signaling is used to extend protection to 100% of the line section. This is achieved by logical linking of the signals that are transmitted by the remote station's protection device.

3.29.1 Disabling and Enabling Protective Signaling

The function can be disabled or enabled using setting parameters or through binary signal inputs.

The function is enabled independently of parameter subsets via PSIG: General enable USER. It is enabled as a function of a parameter subset via PSIG: Enable PSx. If these enabling functions have been activated, protective signaling can be disabled or enabled using setting parameters or through appropriately configured binary signal inputs. Parameters and configured binary signal inputs have equal status. If only the PSIG: Enable EXT function is assigned to a binary signal input, then protective signaling is enabled by a positive edge of the input signal and it is disabled by a negative edge. If only the PSIG: Disable EXT function is assigned to a binary signal input, then a signal at this input will have no effect.

3.29.2 Readiness of Protective Signaling

In order for protective signaling (PSIG) to function, the following requirements must be satisfied:

- It must be enabled.
- There must be no external block.
- There must be no transmission fault.

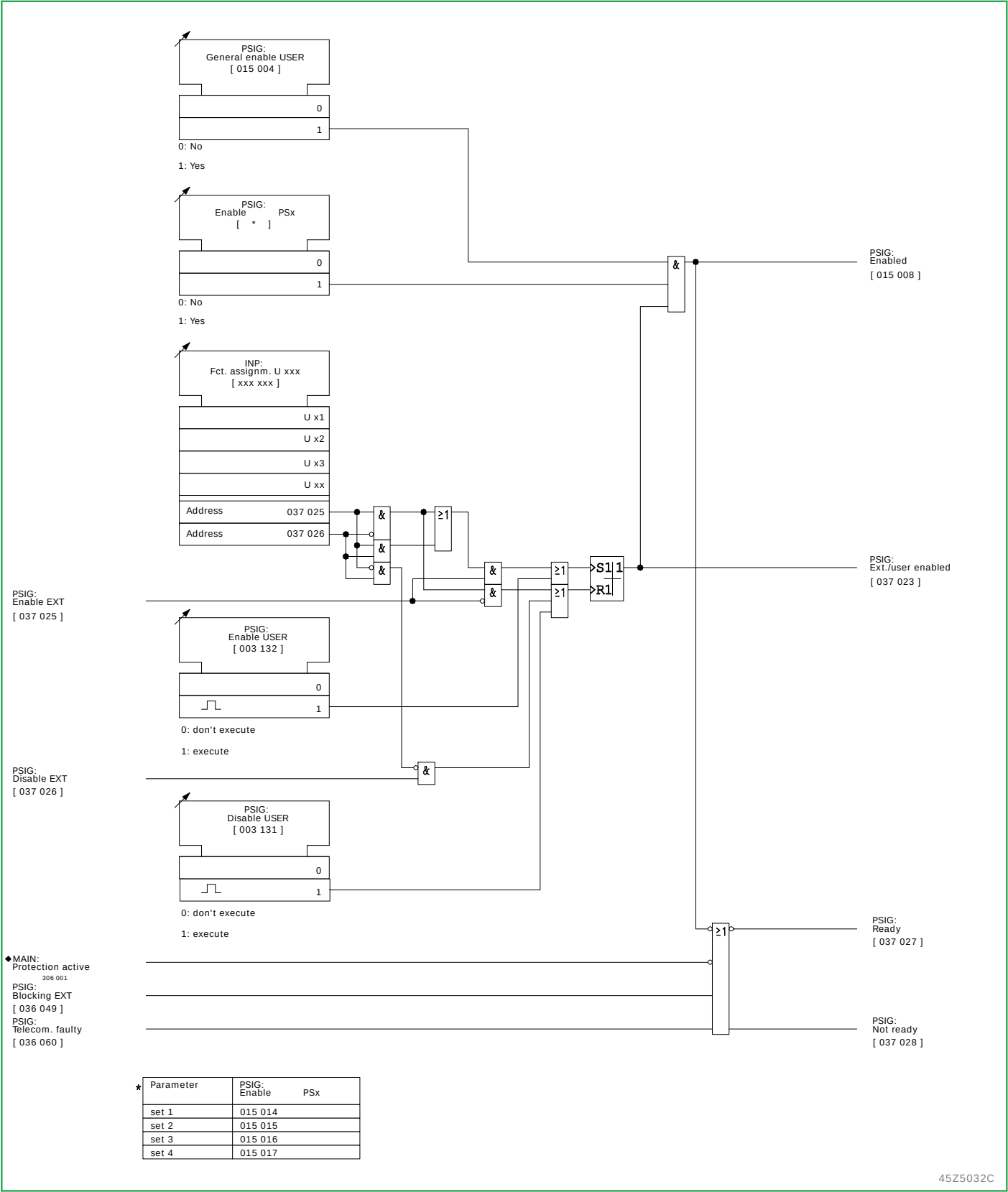


Fig. 3-184: Enabling, disabling and readiness of protective signaling.

- If protective signaling is ready, distance protection tripping takes place in zone 1.
- With normal reach: After distance protection stage t1 has elapsed.
 - With extended reach: after the protective signaling tripping time has elapsed.

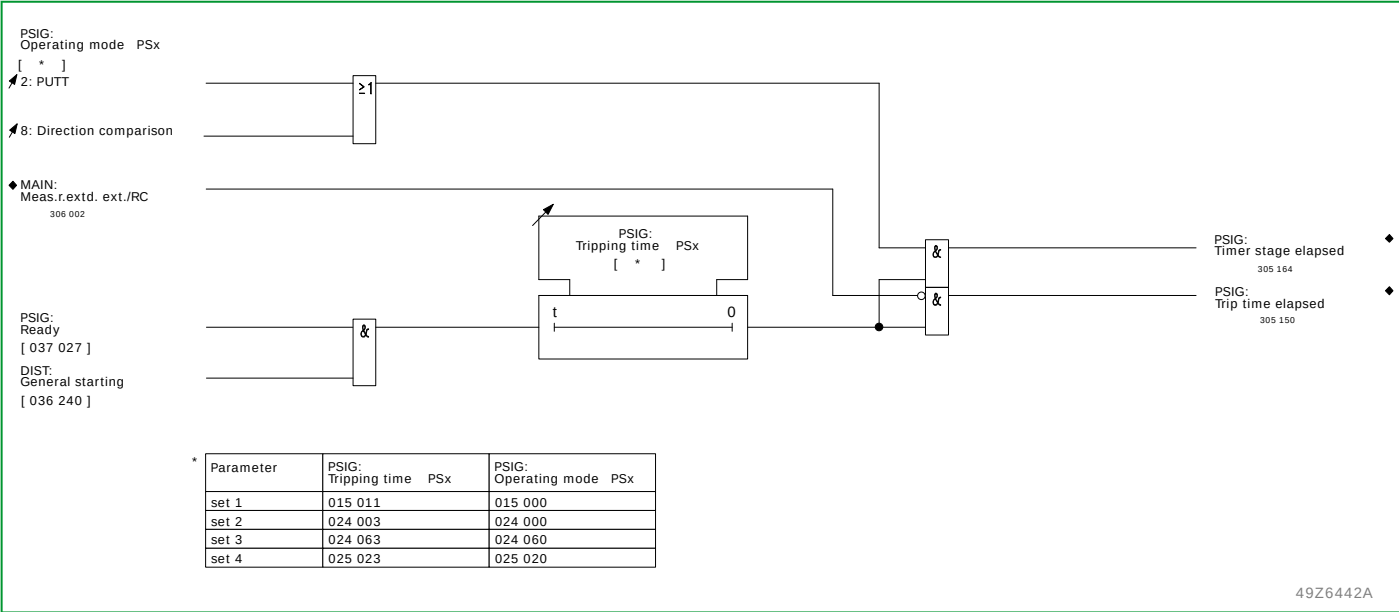


Fig. 3-185: Protective signaling tripping time.

3.29.3 Three-Ended Line Application

In general the PSIG: Receive (A) EXT or PSIG: Receive (B) EXT signals are simply used in an “OR” combination.

In case a permissive scheme is applied to 3-ended lines, the permissive signals from both remote end units must be received, and these two signals have then to be used in an “AND” combination.

Forming such an “AND” combination externally would mean having to accept additional delays and loss of data with respect to the transmitted signals. In order to have this operation available and overcome the shortcomings of the usual single channel data transmission links, the P433 features the possibility to use these two signals directly by setting parameters PSIG: 3ended line prot PSx to Yes.

These two signals are further processed as shown in the figure below to create a new signal PSIG: Receive, which is used in the various PSIG operating modes. (This new signal replaces the PSIG: 3ended line prot PSx signal previously available in software versions up to -611.)

If 3-ended line protection is enabled then both receive signals are linked in an “AND” gate, otherwise they are linked in an “OR” gate. The latter permits the use of either the A or the B signal, or even both signals in case of redundant signaling channels on 2-ended lines.

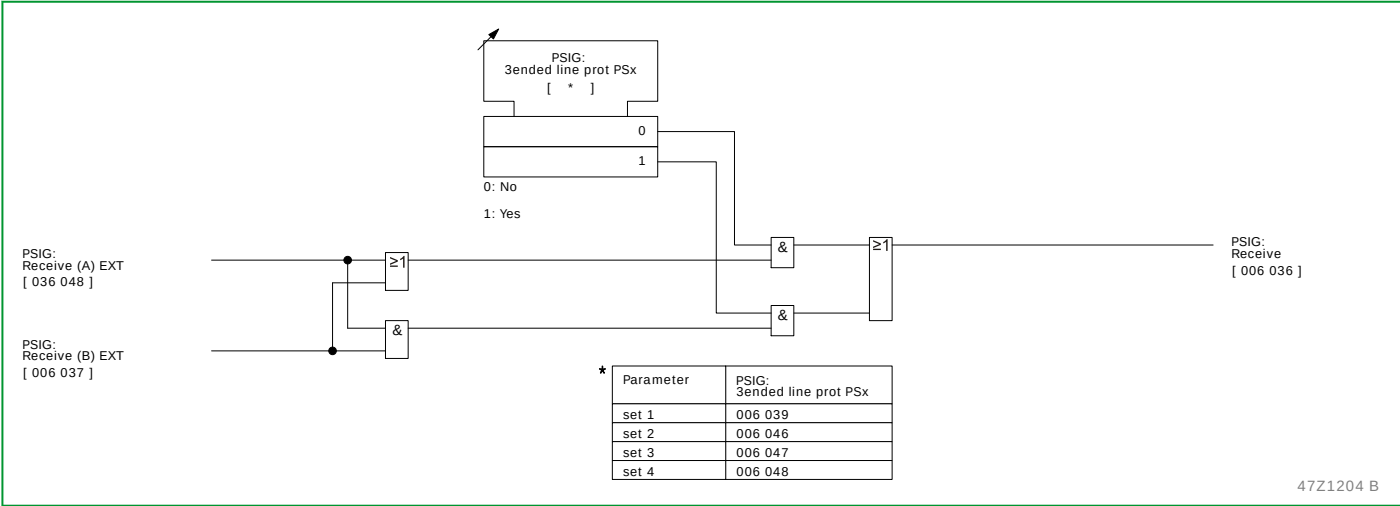


Fig. 3-186: Three-ended line protection.

3.29.4 Monitoring the Transmission Channel

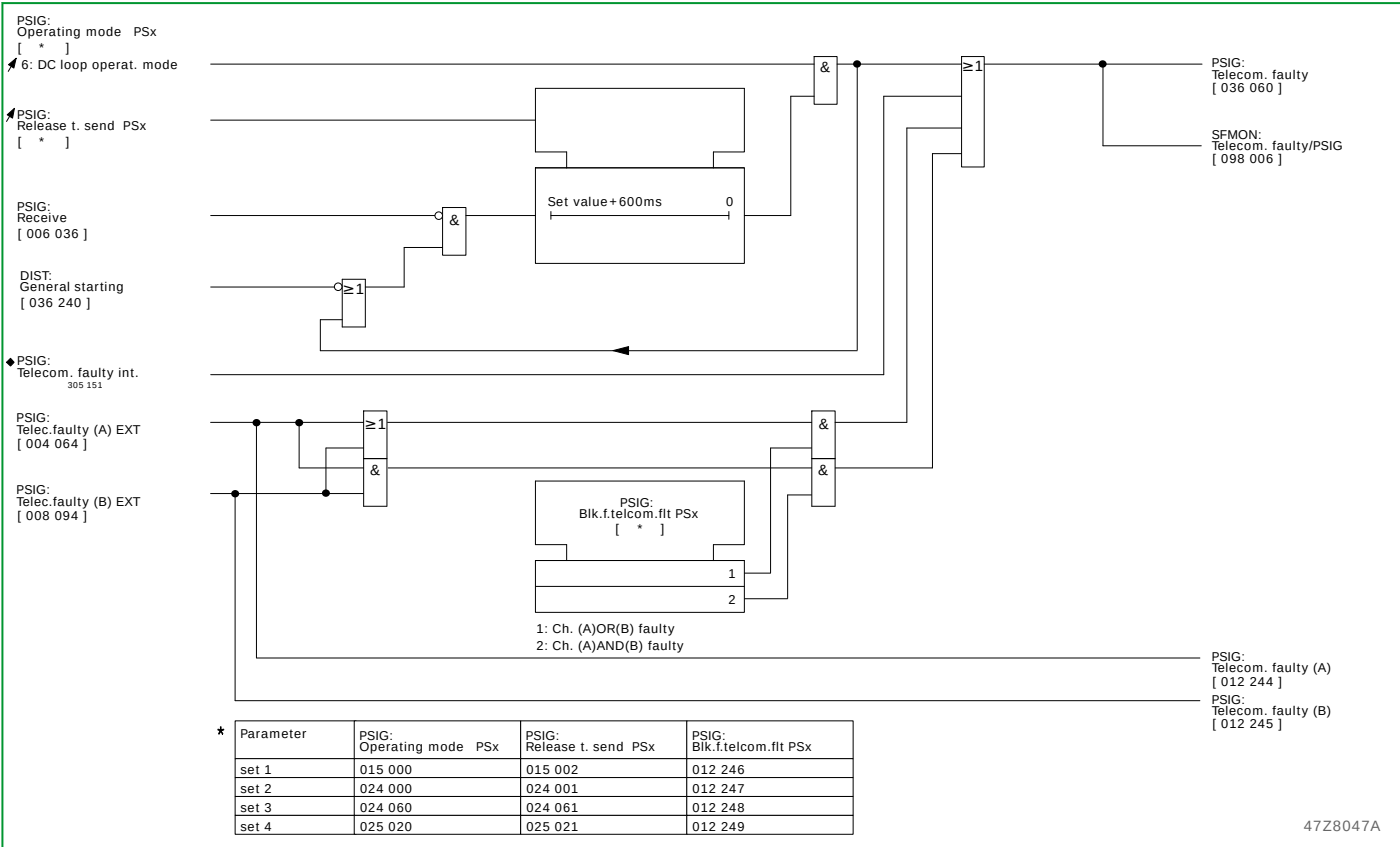


Fig. 3-187: Transmission fault.

A transmission fault leads to a blocking of the protective signaling function (see diagram above). With protective signaling via inbuilt InterMiCOM communication (COMM3), its communication monitoring will detect a fault in the transmission channel.

3.29.5 Frequency Monitoring

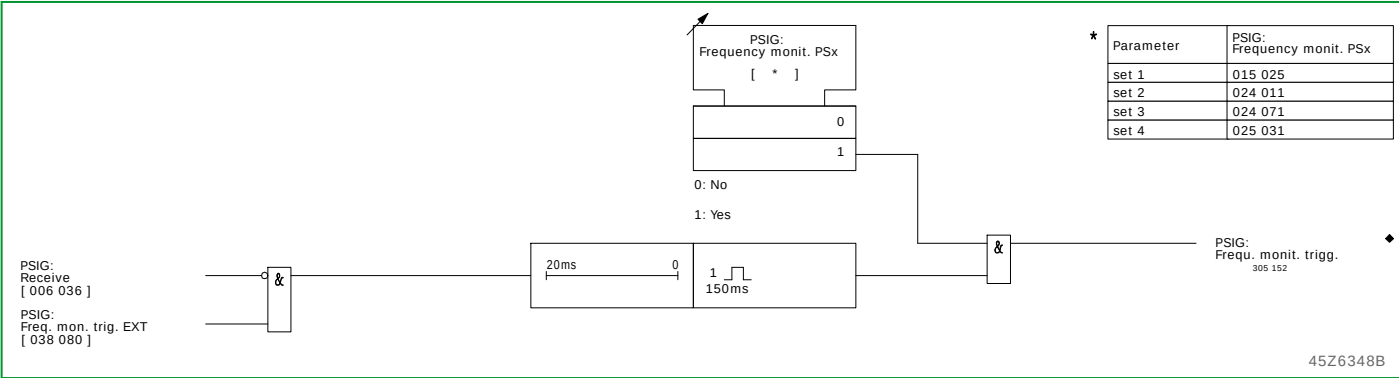


Fig. 3-188: Frequency monitoring.

Failure of frequency transmission may be signaled to the P433 via an appropriately configured binary signal input (PSIG: Freq. mon. trig. EXT). If frequency monitoring is enabled, the P433 – once a time-delay of approximately 20 ms has elapsed – will generate a receive signal for a duration of 150 ms.

3.29.6 Transient Blocking

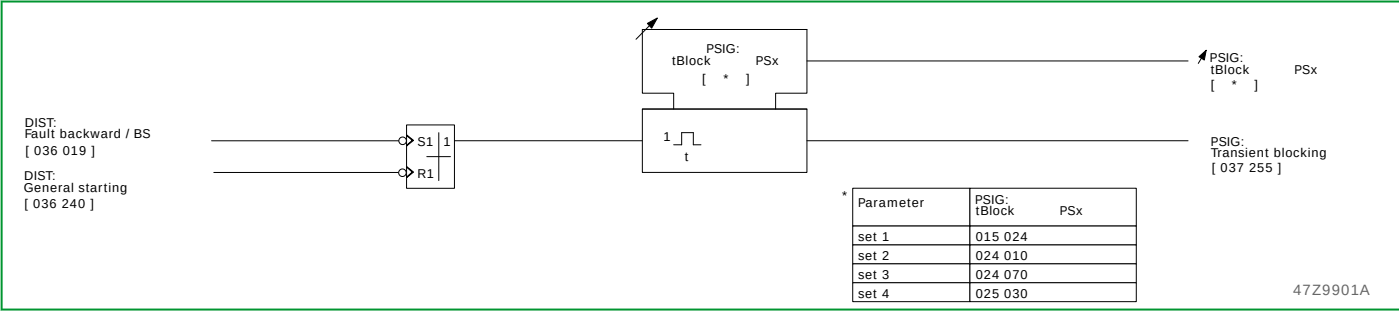


Fig. 3-189: Transient blocking.

In the event of a reset of the distance protection fault backward direction decision, protective signaling will be blocked for the time set at PSIG: tBlock PSx.

3.29.7 Adaptation of the Transmitted Signal

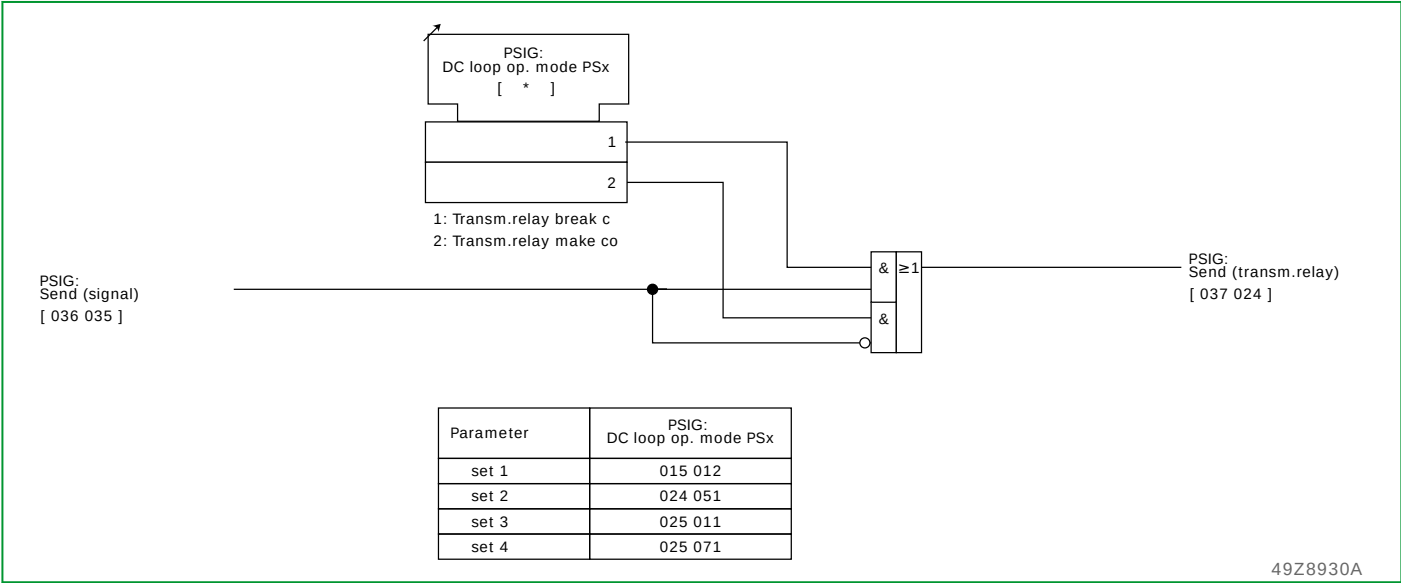


Fig. 3-190: Transmitted signal.

Depending on the contact of the output relays that is used the logical signal is inverted for transmission. Although this feature is required only in case of the wire-based DC loop, it is always enabled, independent of the PSIG operating mode and even if the integrated InterMiCOM interface is used. As a consequence, the setting PSIG: DC loop op. mode PSx must be set to its default value, “Transm.relay break c”, whenever a DC loop is not used.

3.29.8 Protective Signaling Operating Modes

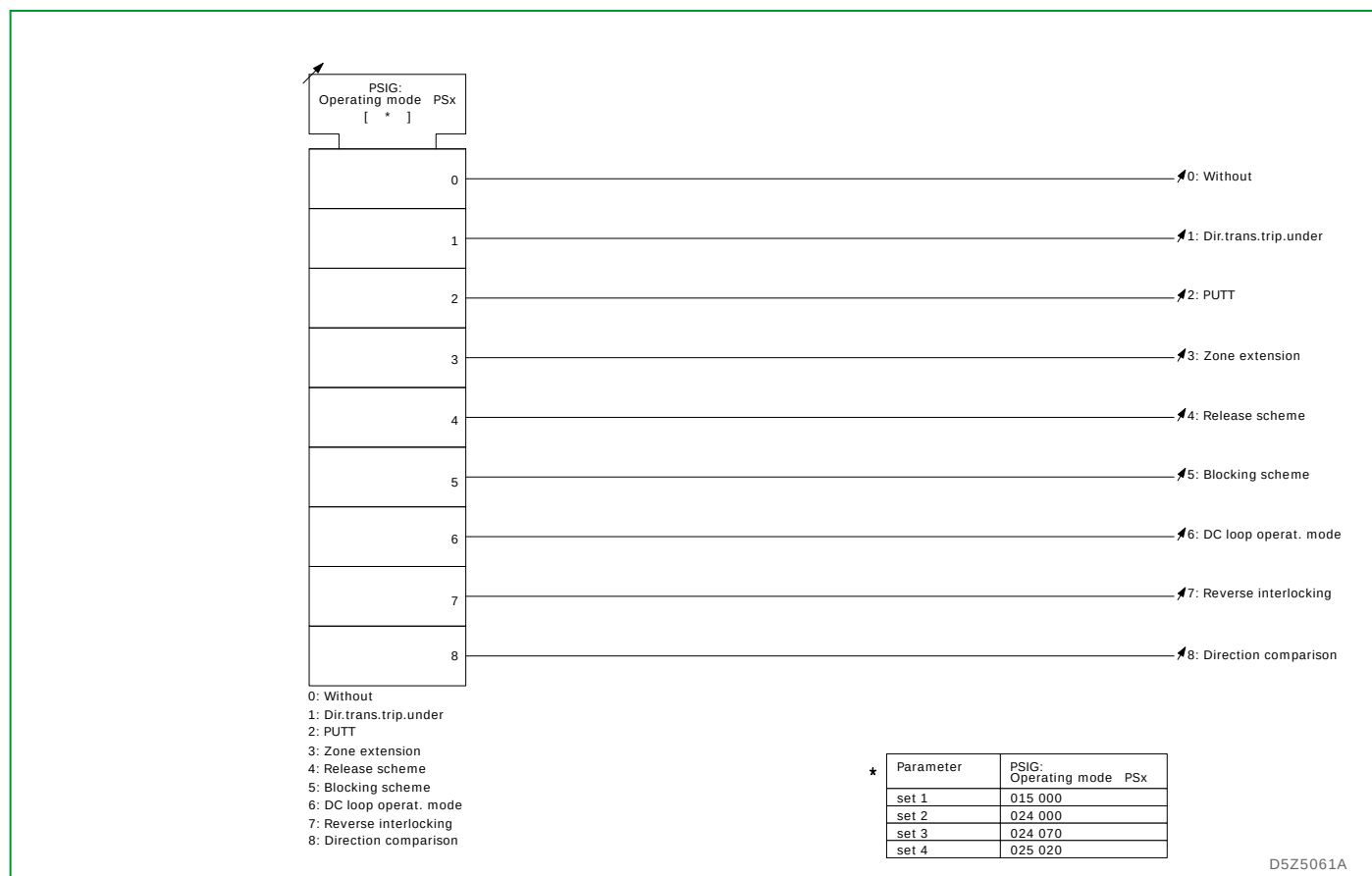


Fig. 3-191: Setting the protective signaling operating modes.

Protective signaling can be operated in eight different modes, which can be selected with the setting PSIG: Operating mode PSx:

- Direct underreaching transfer trip (setting: *Dir.trans.trip.under*, see [Section 3.29.8.3, \(p. 3-256\)](#))
- Permissive underreaching transfer trip (setting: *PUTT*, see [Section 3.29.8.4, \(p. 3-257\)](#))
- Zone extension (setting: *Zone extension*, see [Section 3.29.8.5, \(p. 3-258\)](#))
- Release (permissive) scheme (setting: *Release scheme*, see [Section 3.29.8.6, \(p. 3-260\)](#))
- Blocking scheme (setting: *Blocking scheme*, see [Section 3.29.8.7, \(p. 3-262\)](#))
- DC loop operating mode (setting: *DC loop operat. mode*, see [Section 3.29.8.8, \(p. 3-264\)](#))
- Reverse interlocking (setting: *Reverse interlocking*, see [Section 3.29.8.9, \(p. 3-266\)](#))
- Direction comparison (setting: *Direction comparison*, see [Section 3.29.8.10, \(p. 3-268\)](#))

The operating mode *DC loop operating mode* is a special variant of the *Blocking scheme* and uses pilot wires for signal transmission.

All other operating modes transmit binary signals. These are exchanged either via the integrated InterMiCOM interface, or via binary inputs / output relays (directly using pilot wires in case of short distances, otherwise using external signal transmission devices).

3.29.8.1 Checking the Operating Mode Setting

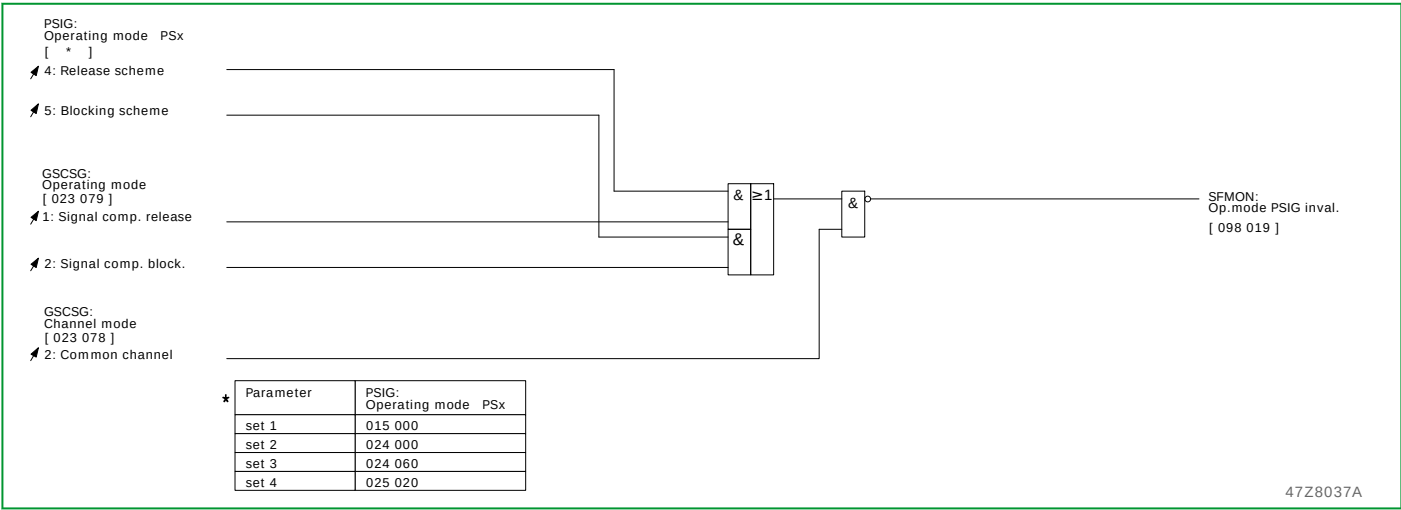


Fig. 3-192: Checking the operating mode setting.

The P433 features protective signaling and ground fault (short-circuit) protection signaling. If the P433 is operating with protective signaling and ground fault protective signaling, then the user has the option to specify whether ground fault protective signaling will share the channel used by protective signaling (distance schemes) for signal transmission. If this is the case, the operating modes for protective signaling and ground fault protection signaling must be set identically. Otherwise a signal will be issued.

3.29.8.2 Limiting to Weak-Infeed Logic or Echo Function

If only the weak-infeed logic or the echo function will be used and no other protective signaling functions, then this can be implemented by setting the operating mode to *Without*.

3.29.8.3 Operating Mode “Direct Transfer Trip Underreaching”

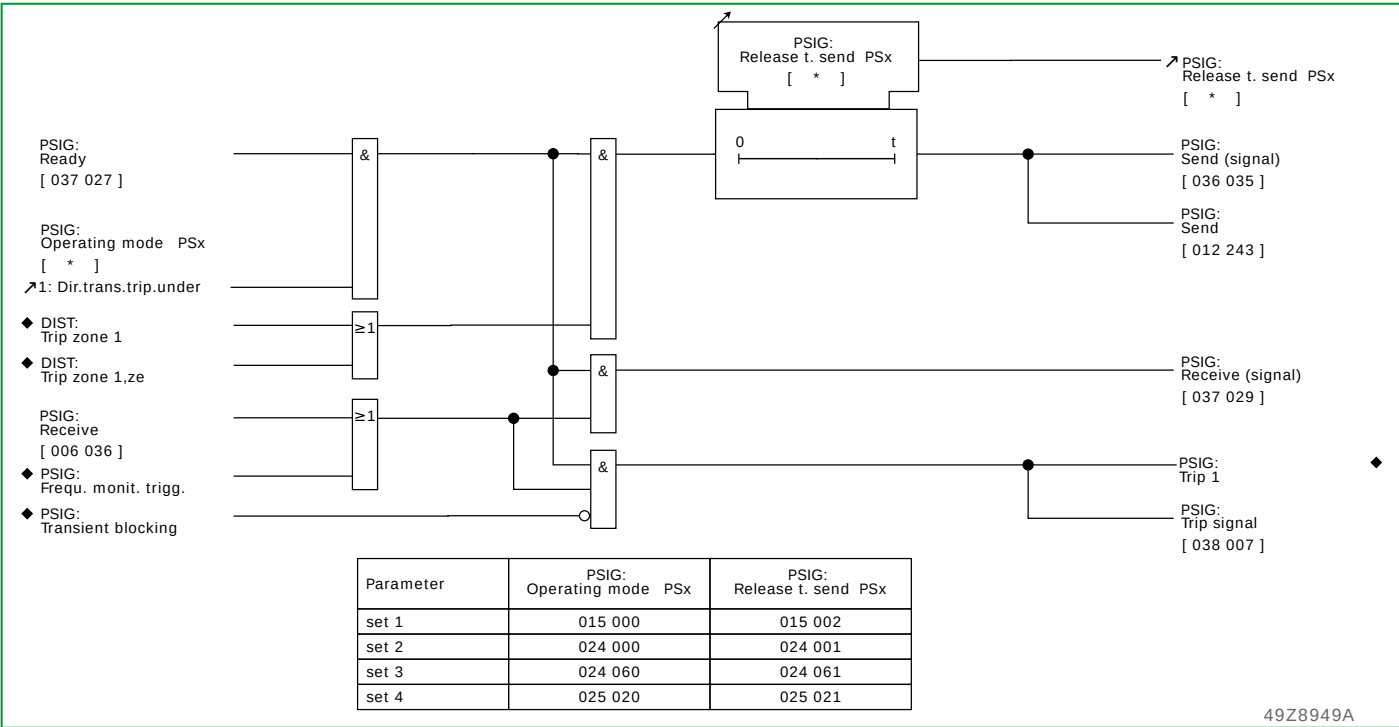


Fig. 3-193: PSIG send signal and trip signal by protective signaling in the “Dir.trans.trip.under” operating mode.

When a distance protection trip zone 1 has occurred, a signal is sent to the remote station’s protection device.

Upon receipt of the signal from the remote station, the circuit breaker is tripped.

If transient blocking is operating, then the receive signal will be ignored.

3.29.8.4 Operating Mode “Permissive Underreaching Transfer Trip”

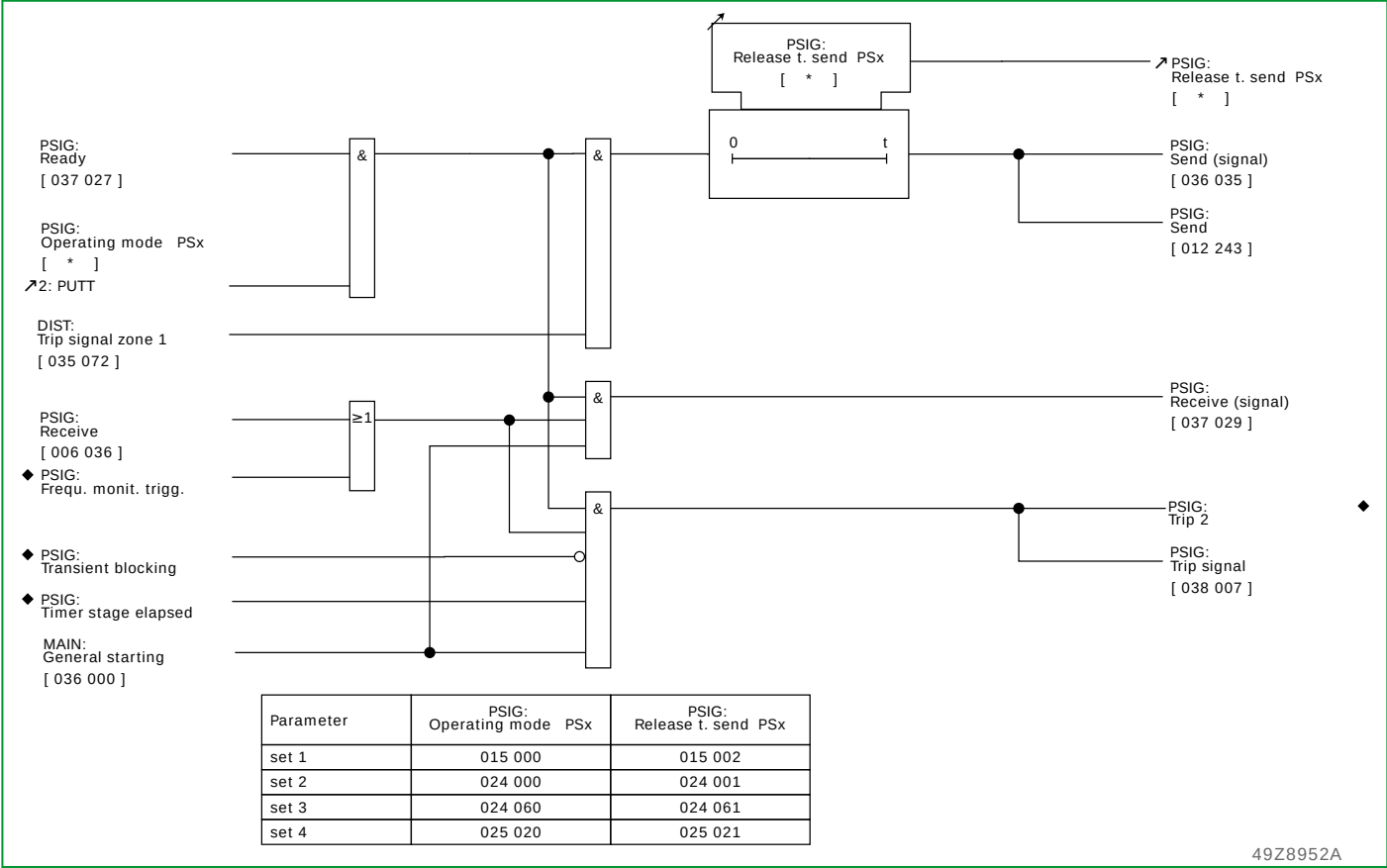


Fig. 3-194: PSIG send signal and trip signal by protective signaling in the “PUTT” operating mode.

When a distance protection trip zone 1 has occurred, a signal is sent to the remote station’s protection device. On receipt of the signal by the remote station, the remote station’s circuit breaker is subject to permissive underreaching transfer tripping (PUTT) once the protective signaling tripping time has elapsed. If transient blocking is operating, then the receive signal will be ignored.

3.29.8.5

Operating Mode "Zone Extension"

When a distance protection trip has occurred in zone 1, a signal is sent to the remote station's protection device. Upon receipt of the transmitted signal, the measuring range of zone 1 in the remote station is increased by the zone extension factor k_{ze} HSR.

The PSIG trip upon receiving a signal from the remote station is determined by the setting at PSIG: Oper. mode trip PSx.

- *Direct.-dependent*

Tripping occurs if there is a receive signal after the protective signaling tripping time has elapsed and if distance protection has decided in favor of *forward direction*.

- *Dist.-dependent*

Tripping occurs if there is a receive signal after the protective signaling tripping time has elapsed and if distance protection has decided in favor of *a fault in extended zone 1*.

The receive signal is ignored during transient blocking.

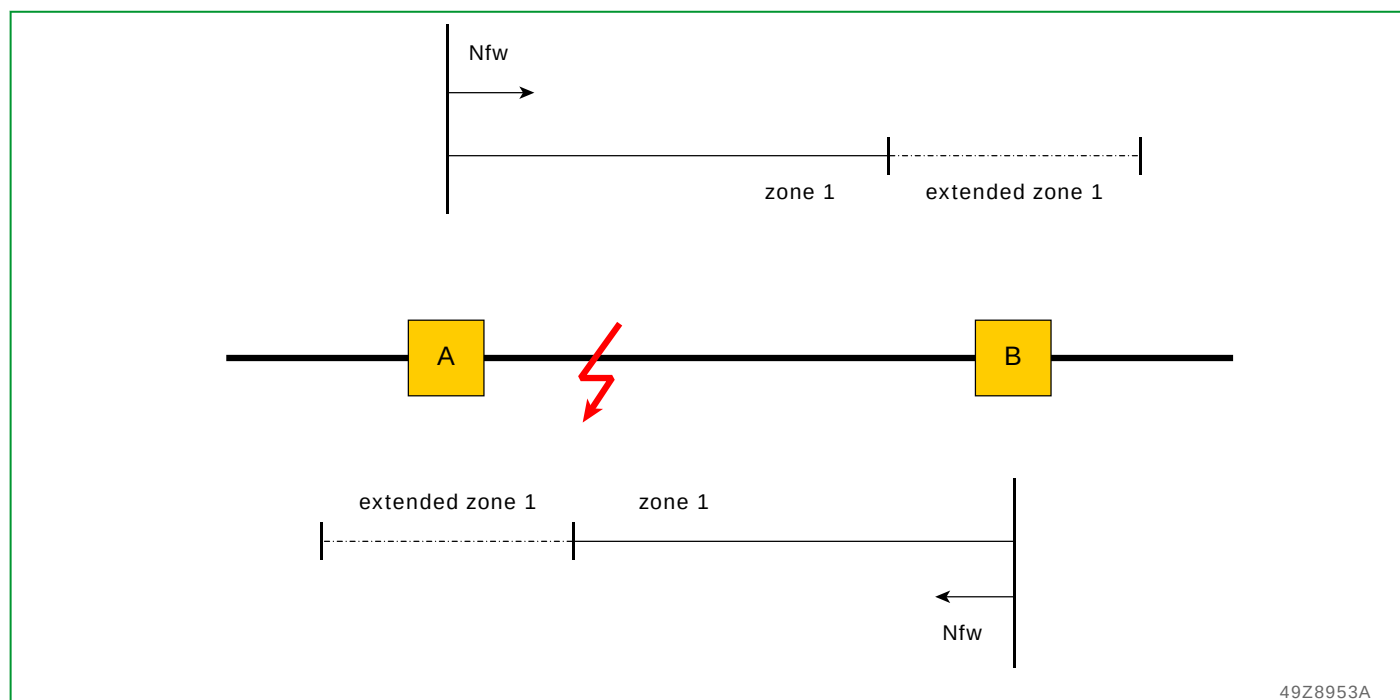


Fig. 3-195: Reaches with zone extension. Dashed line: measuring range extended by zone extension factor k_{ze} HSR.

If DIST: Op. mode zone 4 PSx was set to $1p:Z1/t1(3p)3p:Z1/t4$ or $1p:Z1/t1, 3p:Z1/t4$, the receive signal is stored until the general starting condition of distance protection drops out. In order to be stored, the receive signal must persist for at least 40 ms. This function is important for backup protection.

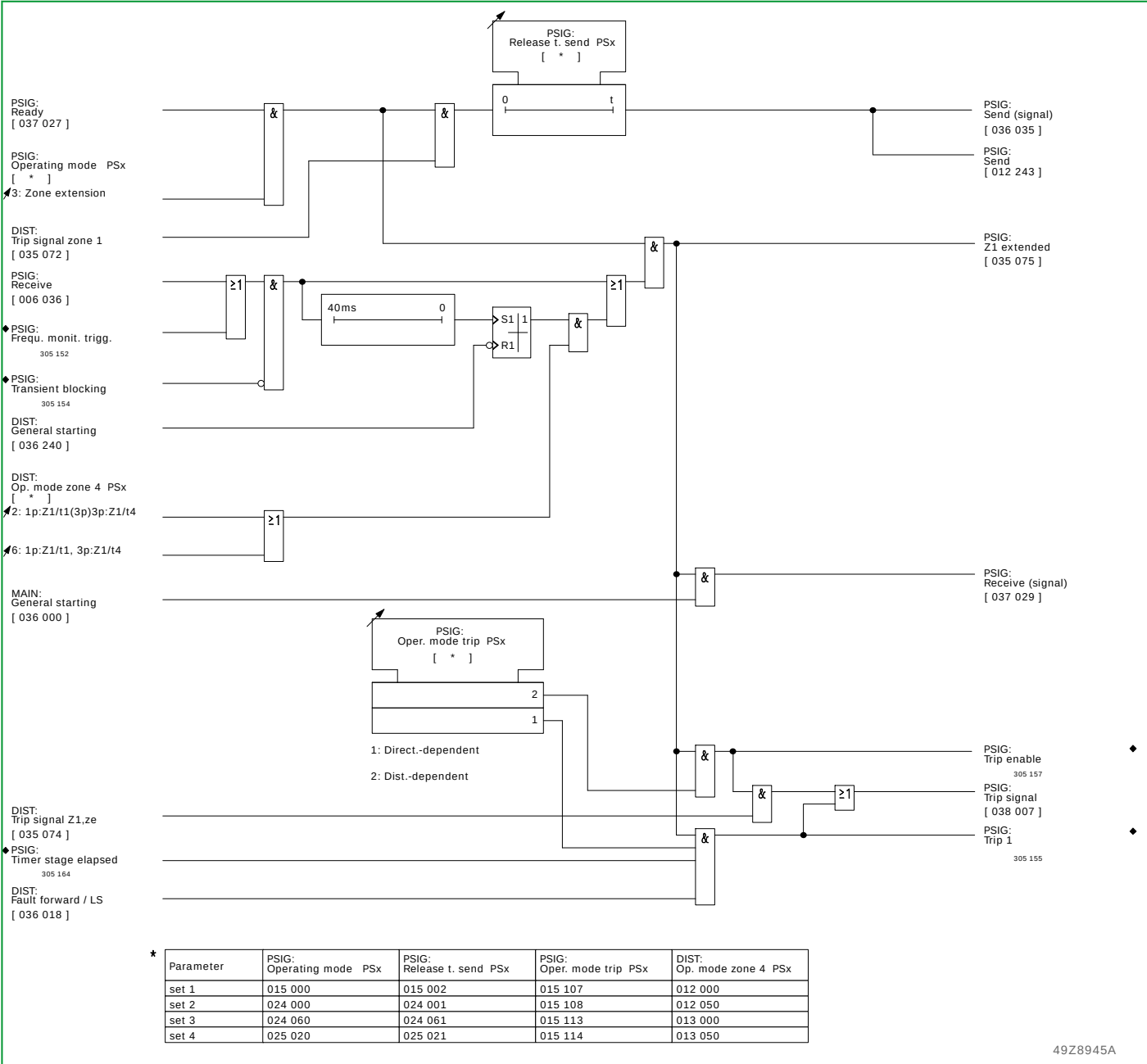


Fig. 3-196: PSIG send, zone extension, trip and trip enable signals issued by protective signaling in the “Zone extension” operating mode.

3.29.8.6

Operating Mode “Release Scheme”

Zone extension in zone 1 of distance protection is a function of the setting at PSIG: Oper. mode send PSx.

- “Direct.-dependent”

The measuring range of zone 1 of distance protection is not extended.

- “Dist.-dependent”

In the idle state, the measuring range of zone 1 in both protection devices is extended by the zone extension factor k_{ze} HSR. The distance protection trip in extended zone 1 is blocked in both protection devices.

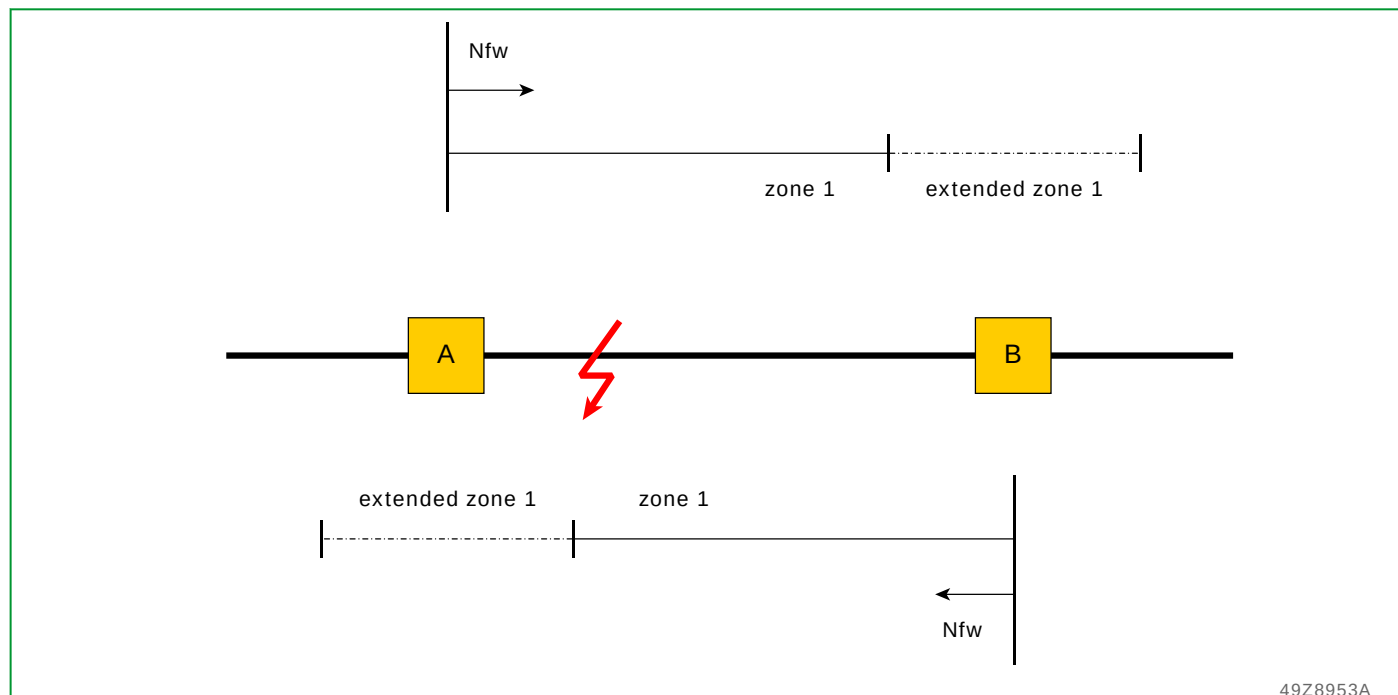


Fig. 3-197: Zone reaches with the release (permissive) scheme. Dashed line: measuring range extended by zone extension factor k_{ze} HSR.

The setting at PSIG: Oper. mode send PSx defines when the P433 sends a signal to the remote station.

- “Direct.-dependent”

If the distance protection function detects a fault in the forward direction, the P433 sends a signal to the remote station.

- “Dist.-dependent”

If the distance protection function detects a fault within extended zone 1, the P433 sends a signal to the remote station.

The PSIG trip upon receiving a signal from the remote station is determined by the setting at PSIG: Oper. mode trip PSx.

- “Direct.-dependent”

Tripping occurs if there is a receive signal after the protective signaling tripping time has elapsed and if distance protection has decided in favor of “forward direction”.

- “Dist.-dependent”

Tripping occurs if there is a receive signal after the protective signaling tripping time has elapsed and if distance protection has decided in favor of a “trip in extended zone 1”.

The receive signal is ignored during transient blocking.

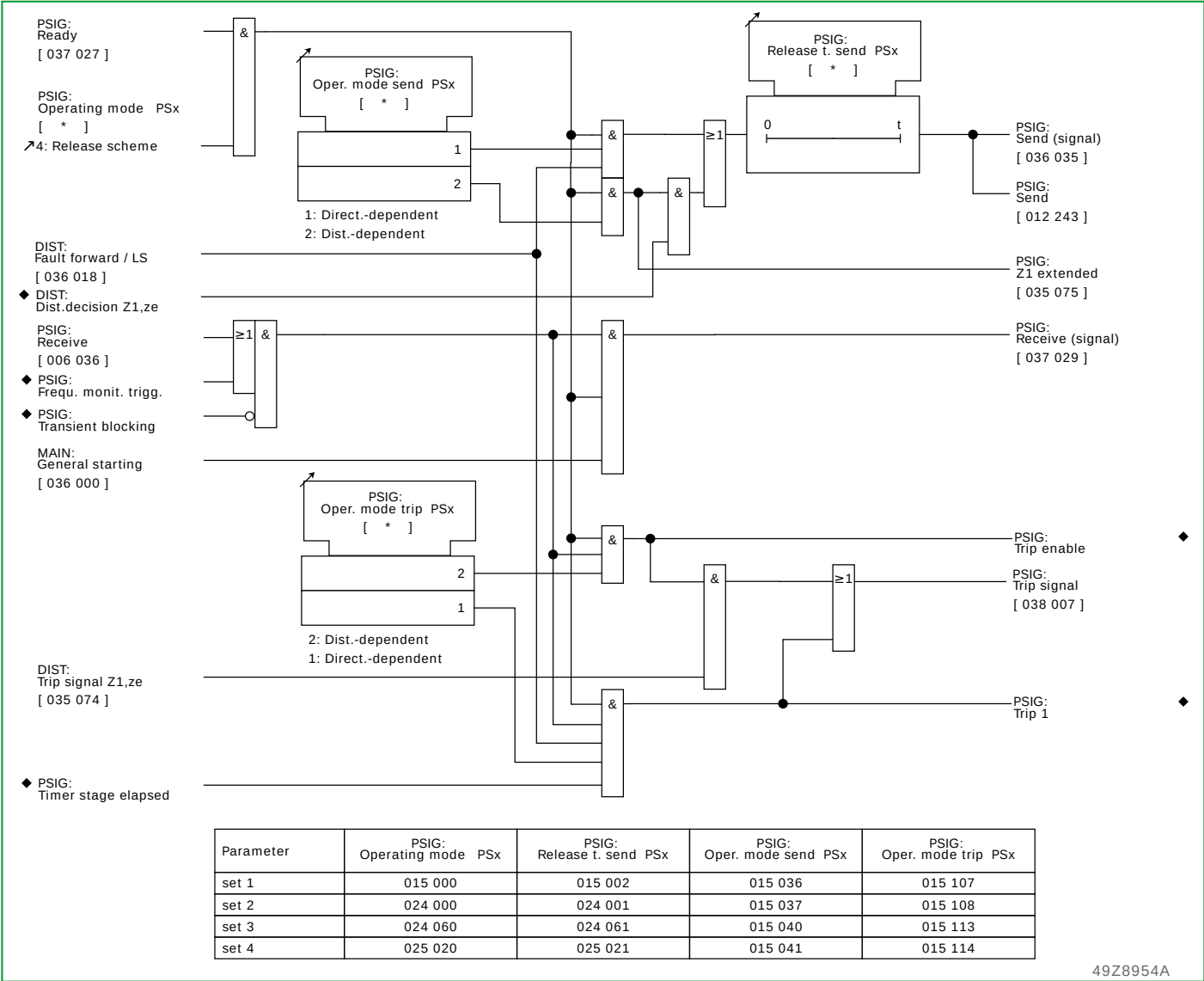


Fig. 3-198: PSIG send, zone extension, trip and trip enable signals issued by protective signaling in the “Release scheme” (permissive) operating mode.

3.29.8.7 Operating Mode “Blocking scheme”

Zone extension in zone 1 of distance protection is a function of the setting at PSIG: Oper. mode send PSx.

- “Direct.-dependent”

The measuring range of zone 1 of distance protection is not extended.

- “Dist.-dependent”

In the idle state, the measuring range of zone 1 in both protection devices is extended by the zone extension factor k_{ze} HSR. The distance protection trip in extended zone 1 is enabled in both protection devices.

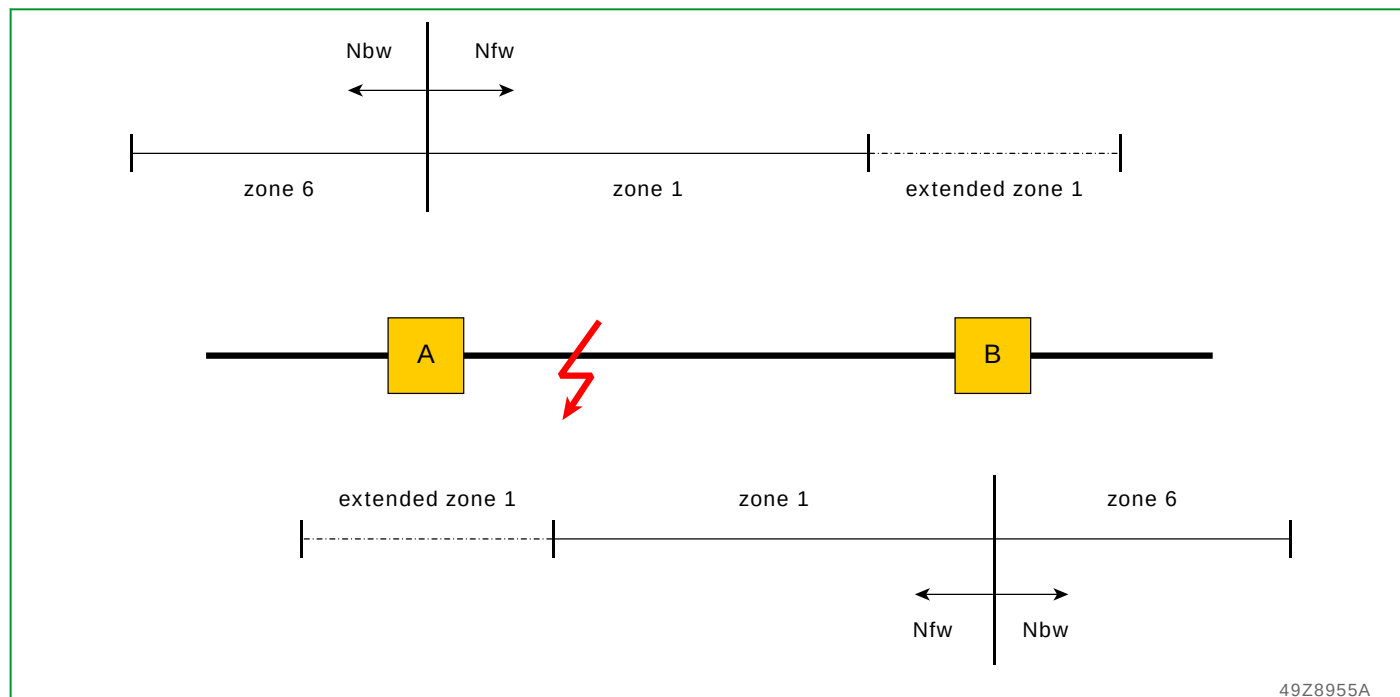


Fig. 3-199: Zone reaches with the blocking scheme. Dashed line: measuring range extended by zone extension factor k_{ze} HSR.

The setting at PSIG: Oper. mode send PSx defines when the P433 sends a signal to the remote station.

- “Direct.-dependent”

If distance protection detects a fault in the backward (reverse) direction a signal is sent to the remote station.

- “Dist.-dependent”

If the distance protection function detects a fault within zone 6 and if the measured direction matches the direction set for zone 6, then the P433 sends a signal to the remote station.

A signal is always sent to the remote station during transient blocking.

- Protective signaling trip is determined by the setting at PSIG: Oper. mode trip PSx.
- “Direct.-dependent”
Tripping occurs if there is no receive signal after the protective signaling tripping time has elapsed and if distance protection has decided in favor of a “trip in forward direction”.
 - “Dist.-dependent”
Tripping occurs if there is no receive signal after the protective signaling tripping time has elapsed and if distance protection has decided in favor of a “trip in extended zone 1”.

During transient blocking no trip will be raised.

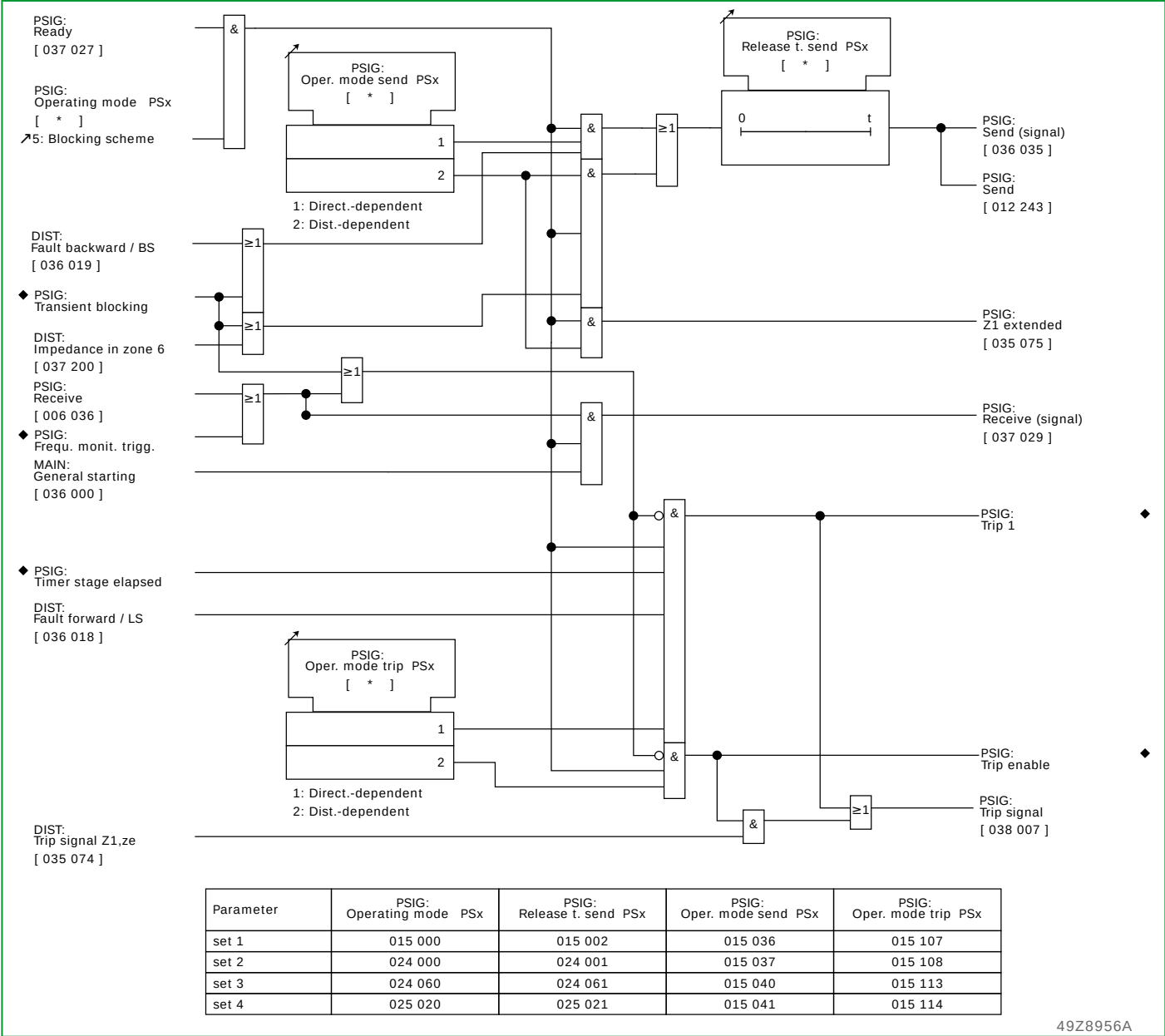


Fig. 3-200: PSIG send, zone extension, trip and trip enable signals issued by protective signaling in the “Blocking scheme” operating mode.

3.29.8.8 Operating Mode “DC Loop”

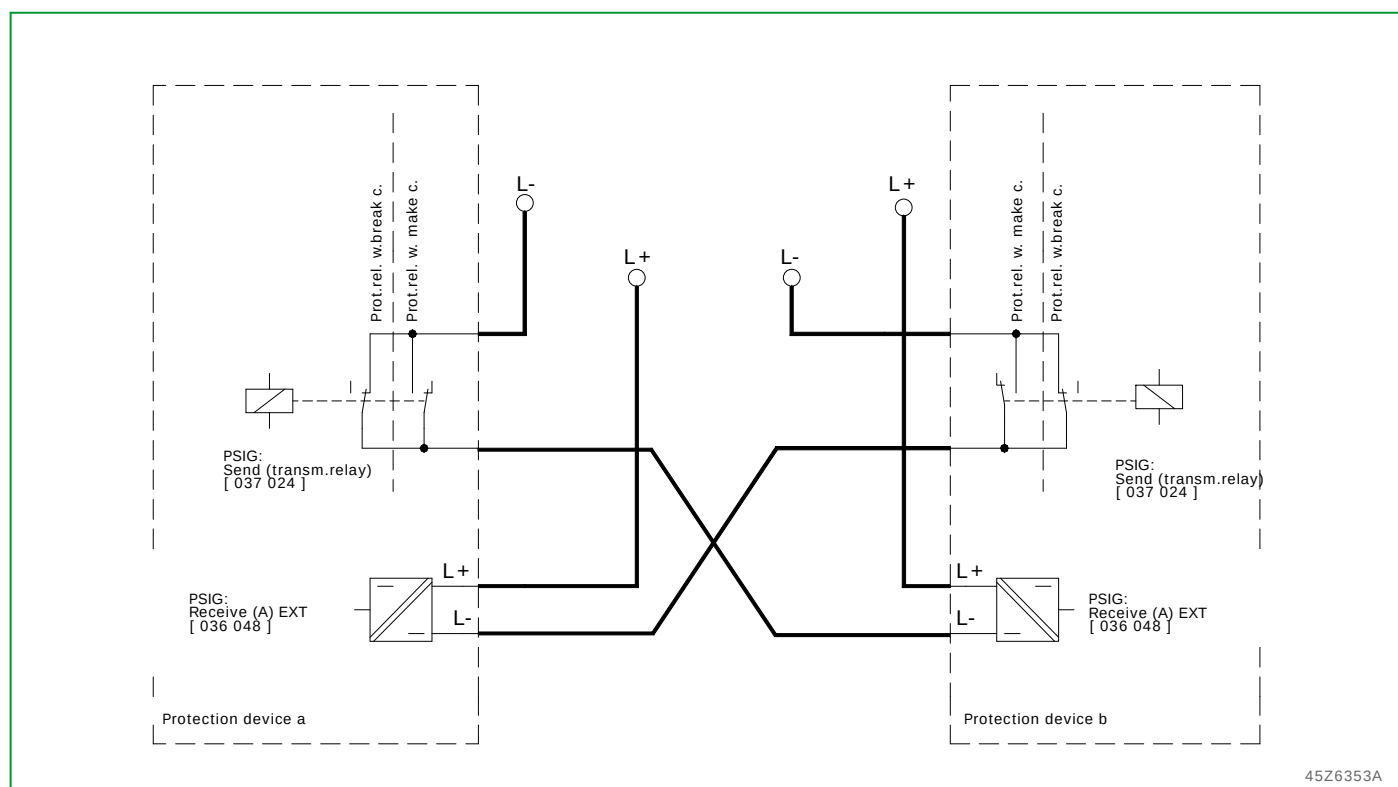


Fig. 3-201: Protective signaling over pilot wires.

To set up a communications link, it is necessary to connect either the break contact or the make contact of the transmitting relay according to the selected transmitting relay mode (*Transm.relay make co* or *Transm.relay break c*), to the PSIG: Receive (A) EXT input of the remote station by installing pilot wires.

In the idle state a receive signal is present at both protection devices (DC loop closed) and the measuring range of zone 1 is extended by the zone extension factor k_{ze} HSR. The distance protection trip in extended zone 1 is enabled in both protection devices.

If distance protection detects a fault in the backward (reverse) direction, a signal is sent to the remote station (DC loop open). The overcurrent fault detection logic of the distance protection function immediately opens the DC loop without waiting for the transfer trip timer stage to elapse or for a direction decision to be issued. The DC loop is immediately closed again – without taking into account the reset time of the send signal – if distance protection detects the fault to be in forward direction.

A distance protection trip in extended zone 1 is issued only after the protective signaling tripping time has elapsed, provided that no receive signal is present (open loop).

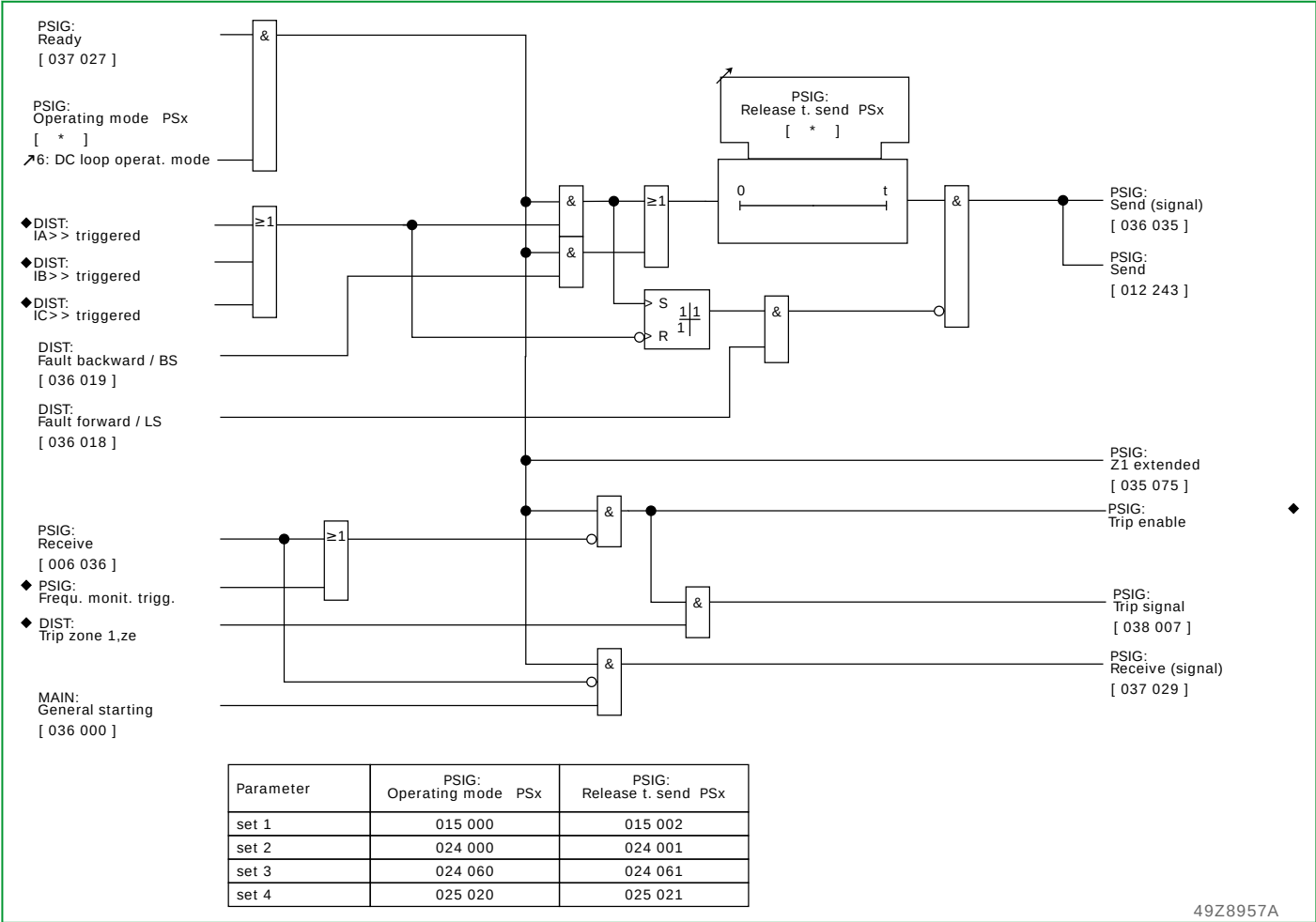


Fig. 3-202: PSIG send, zone extension and trip enable signals by protective signaling in the “DC loop operat. mode” operating mode.

The pilot wires are monitored for interruptions. If, during a fault-free operation, i.e. with no distance protection general starting condition present, no signal is received from the DC loop for a period longer than the set transmitted signal reset time plus 600 ms, then the PSIG: Telecom. faulty signal is issued (see Fig. 3-187, (p. 3-251)) and protective signaling is blocked.

3.29.8.9

Operating Mode “Reverse Interlocking”

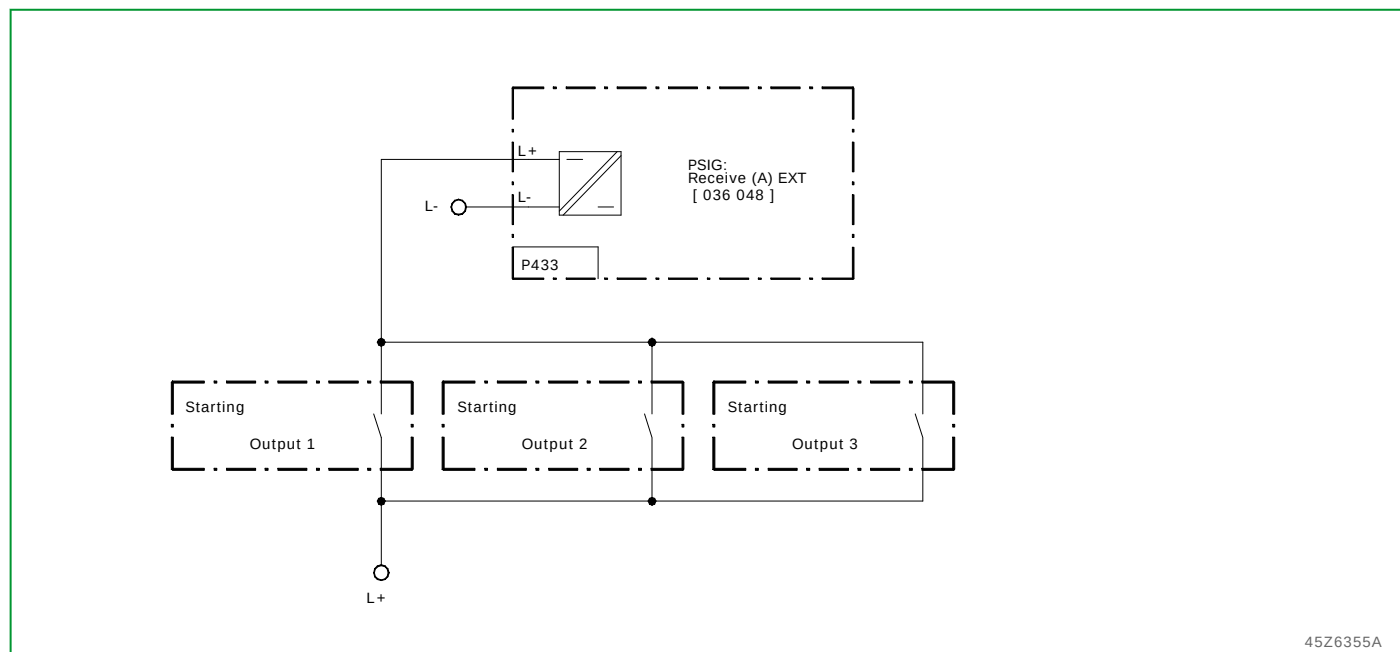


Fig. 3-203: Reverse interlocking

In radial networks with single-side infeed, it is possible under certain conditions for busbar protection to be configured by sampling the starting of feeder protection devices. By means of appropriate interconnection, a send signal is then formed when a feeder protection device starts. When the P433 receives this signal, distance protection tripping in extended zone 1 is blocked. The blocking signal has a reset time delay set at PSIG: tBlock PSx.

The pilot wires are monitored. If a receive signal is present for more than 10 s without any general starting of distance protection, then blocking of the distance protection trip in extended zone 1 is cancelled. No new block can occur until the receive signal has dropped out.

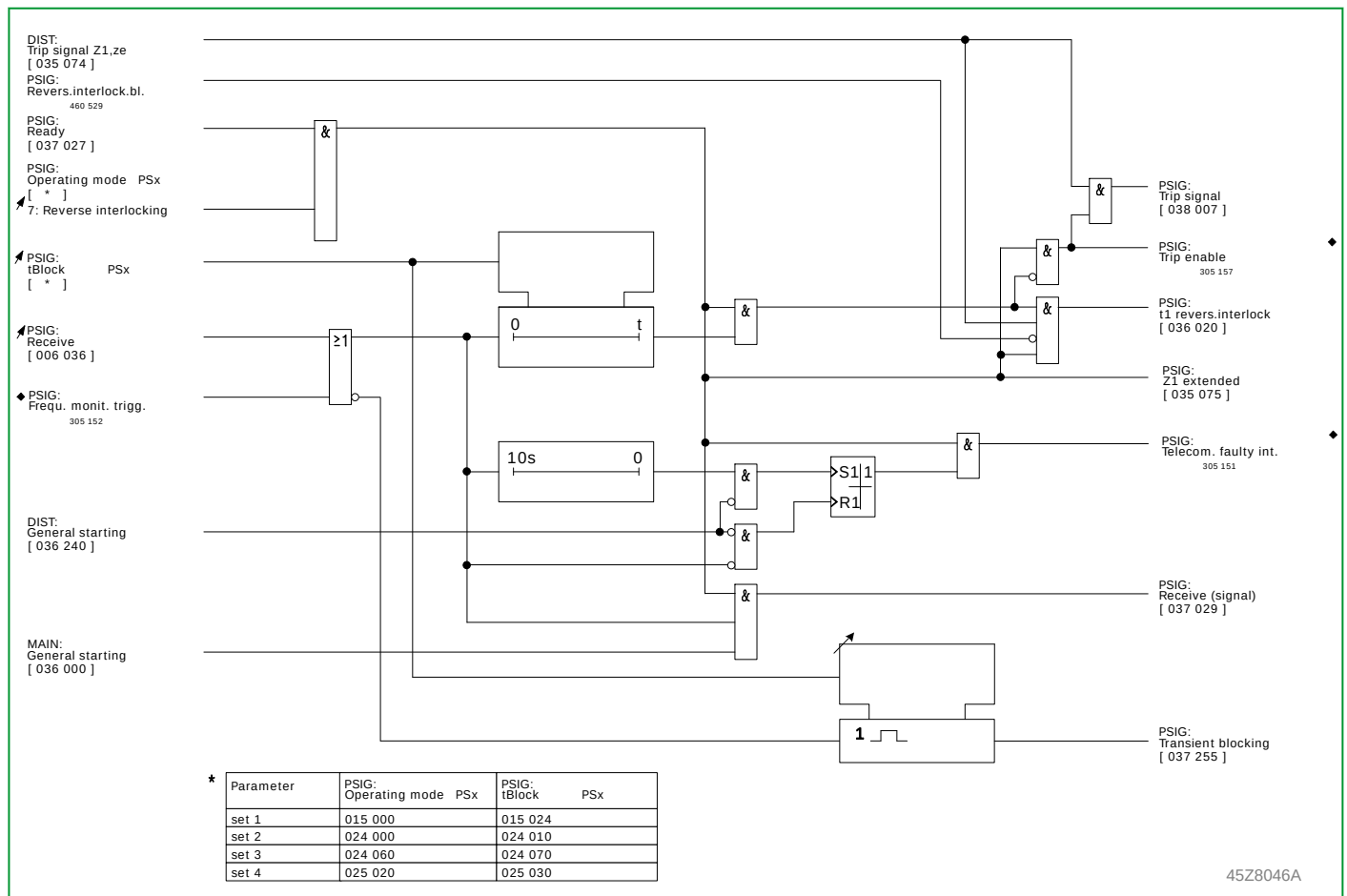


Fig. 3-204: Trip enable and trip signal in the "Reverse interlocking" operating mode.

The signal PSIG: t1 revers.interlock is triggered only if there is a potential starting in the extended zone, i. e. if the measured impedance is in the extended zone and the timer of the extended zone has elapsed. (This timer then corresponds to the tripping time of the PSIG.)

Reverse interlocking is blocked (which corresponds to the situation that in the diagram above the internal signal PSIG: Revers.interlock.bl. is active) whenever any of the following conditions are met:

- There is a trip in zone 1 (DIST: Trip signal zone 1),
- there is a trip in any of the zones 2 ... 10 (DIST: Trip sig. zone 2-10),
- there is a manual trip signal (MAIN: Manual trip signal),
- there is a zone extension by any of the following signals:
 - SOTF: Operating mode PSx (zone extension by the SOTF protection),
 - ARC: Zone ext.dur. RC PSx (zone extension by the ARC protection),
 - DIST: Zone extension EXT (zone extension via binary input).

3.29.8.10 Operating Mode “Direction Comparison”

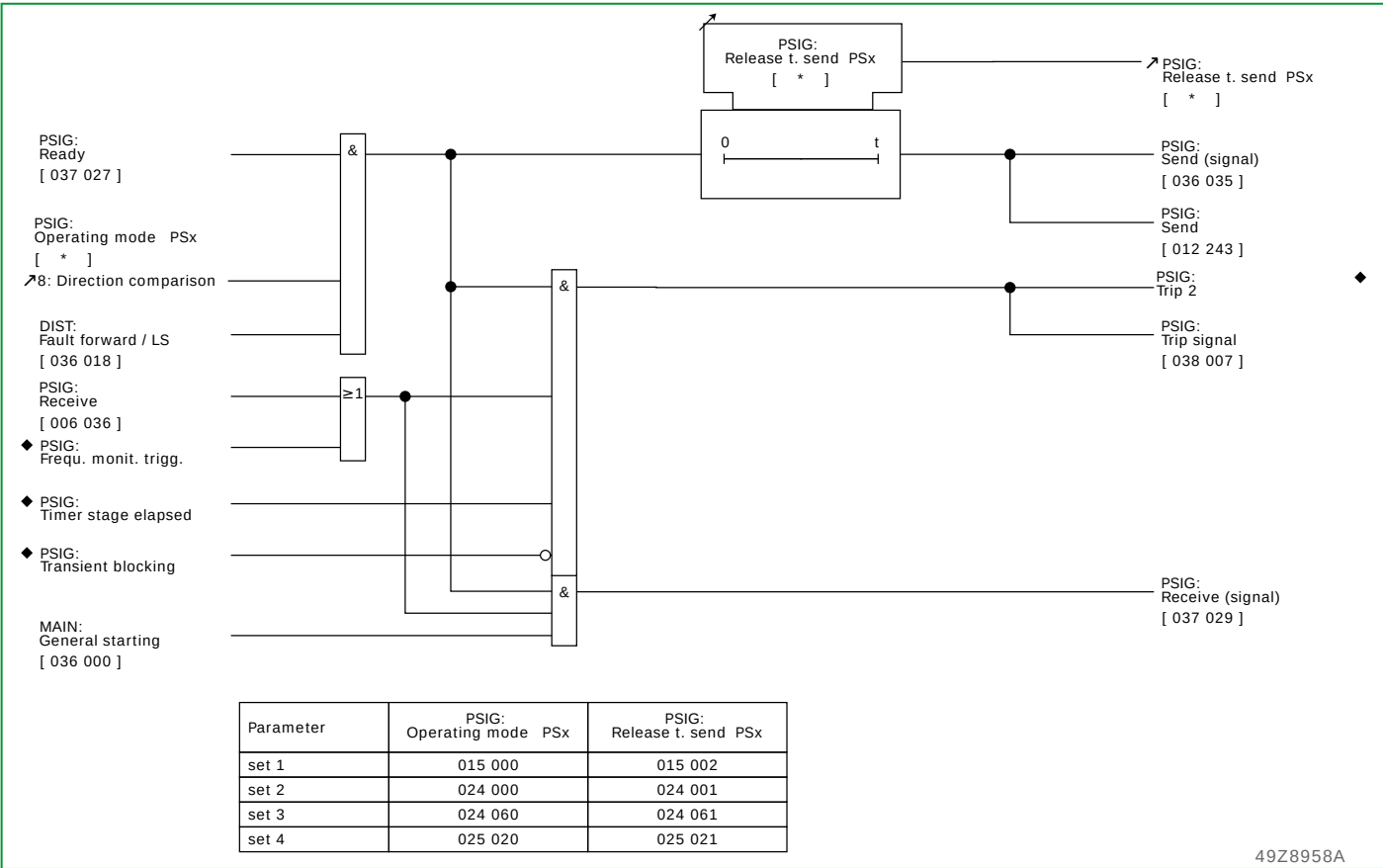


Fig. 3-205: PSIG send signal and trip signal by protective signaling in the “Direction comparison” operating mode.

A signal is sent to the remote station if distance protection detects a fault in the forward direction.

Once the tripping time has elapsed, protective signaling issues a trip decision if a receive signal is present and distance protection detects a fault in the forward direction. In the event of a direction change, the receive signal is ignored for the PSIG: tBlock PSx set time (“transient blocking”) so as to avoid unwanted tripping in the protection of double circuit lines.

3.29.9 Weak-Infeed Logic

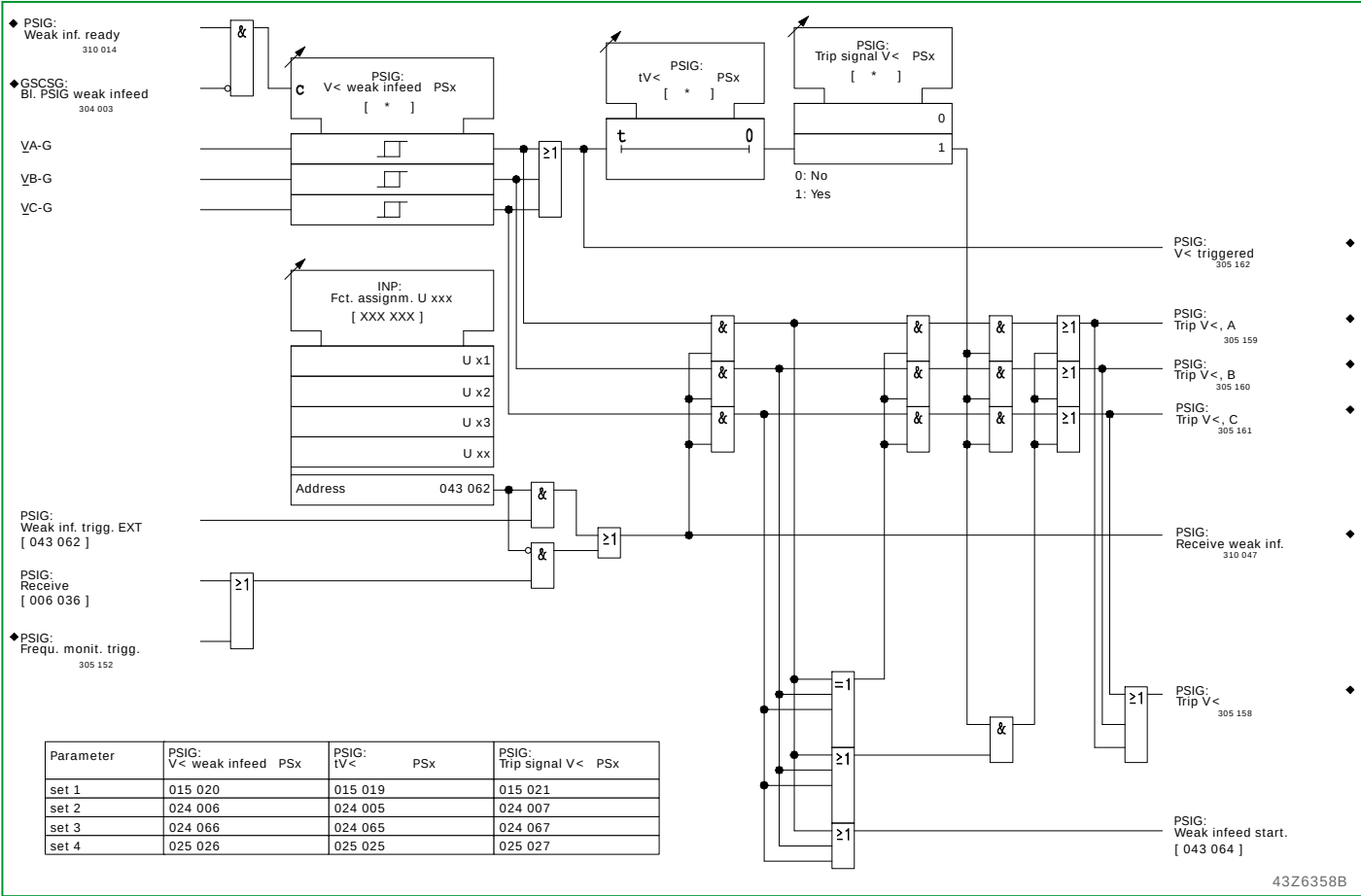


Fig. 3-206: Weak-infeed logic.

The P433 features a “weak-infeed logic” function. Weak-infeed logic shall be used with overreaching permissive schemes only. It can be triggered either by 037 029 PSIG: Receive (signal), or by a dedicated binary input signal 043 062 PSIG: Weak inf. trigg. EXT.

The weak-infeed logic checks the phase-to-ground voltages to determine whether they fall below the PSIG: V< weak infeed PSx set threshold. If the voltage in one phase falls below the set threshold, then a timer stage is started. Once it has elapsed – provided that the appropriate setting has been selected – a protective signaling trip is issued.

3.29.9.1 Enable for the Weak-Infeed Logic

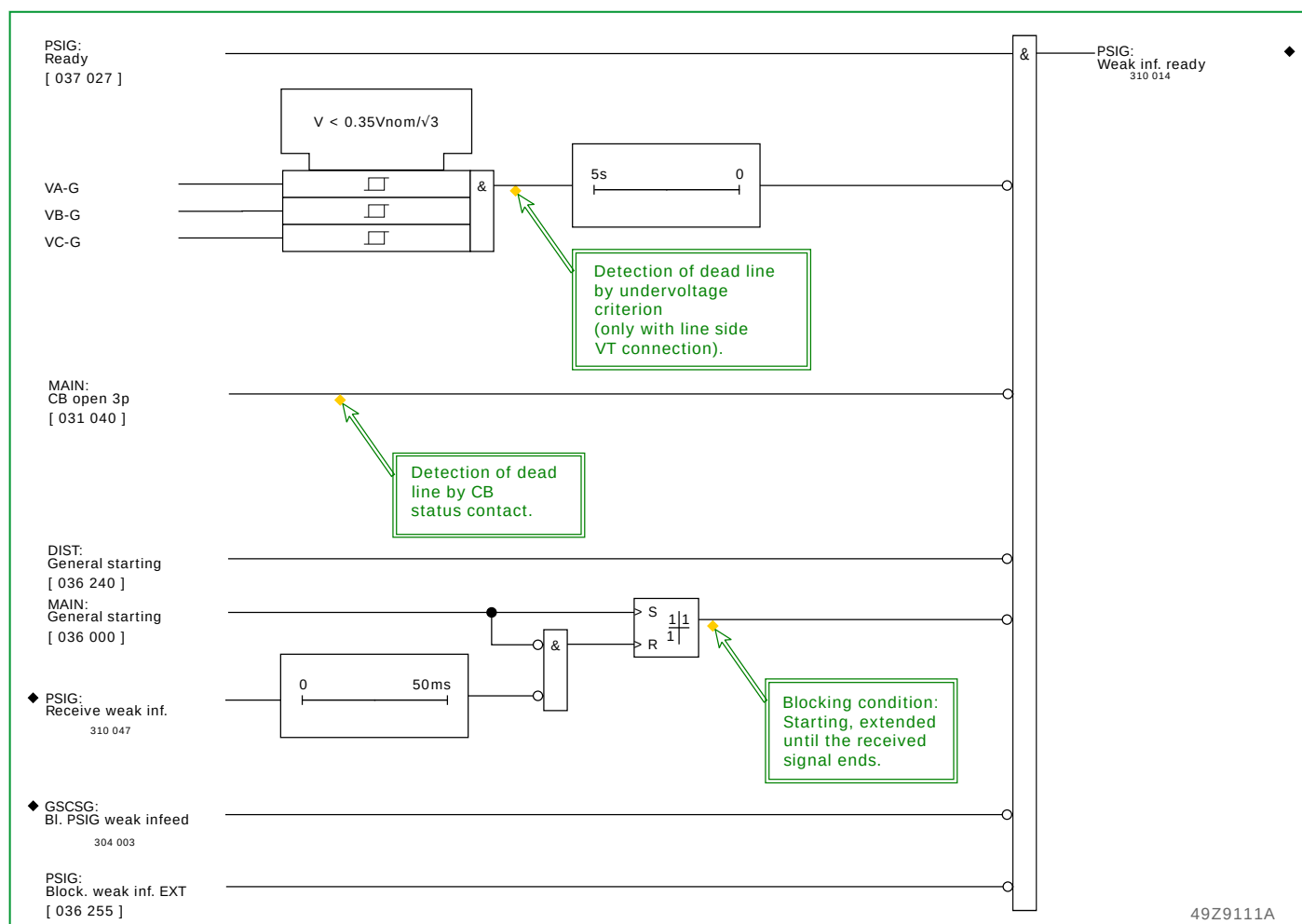


Fig. 3-207: Enabling of weak-infeed logic.

The following is relevant to enable the weak-infeed logic:

- The function is blocked by an idle feeder if the newly implemented monitoring function detects this state from a 3-pole undervoltage condition.
- The function is blocked by a signal present at an appropriately configured binary signal input PSIG: Block. weak inf. EXT.
- The general starting signal is stored in an RS flip-flop that is only reset after the received signal has ended. This excludes an over reaction during a reset of its own starting when the received signal from the other end is still present.

3.29.10 Echo Function

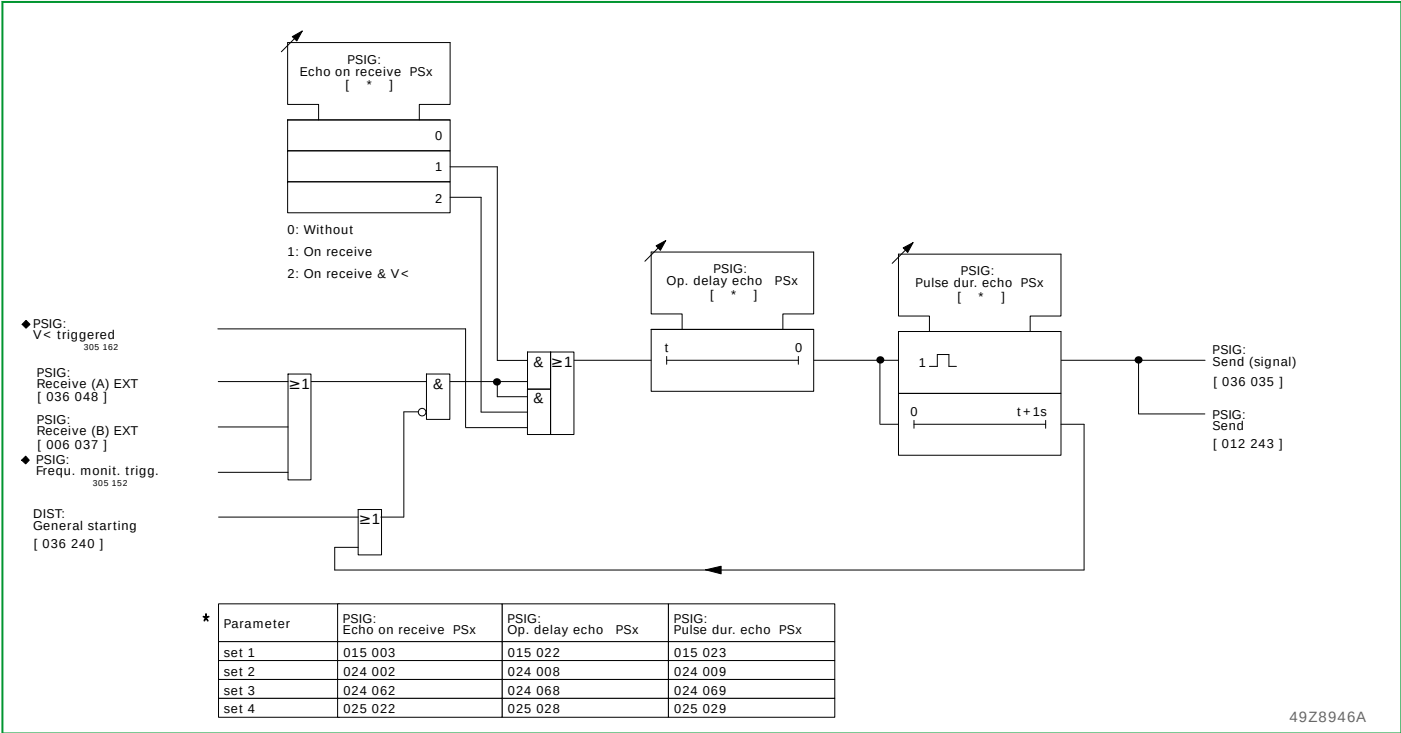


Fig. 3-208: Echo function.

If operation with the echo function is desired along with permissive overreaching schemes, then the user may specify whether the receive signal alone is to be employed in activating the echo pulse or whether the receive signal and the triggering signal of the weak-infeed logic are to be used. The conditions for activation of the echo pulse must persist for a period in excess of the set time-delay, and distance protection starting must be absent for the echo pulse to be activated. The echo pulse is then transmitted to the remote station for the set pulse duration. Thereafter, the transmission of the receive signal is blocked for the set pulse duration + 1 s. This prevents a permanent signal from being transmitted.

The echo function may be disabled.

3.29.11 Testing the Communication Channel

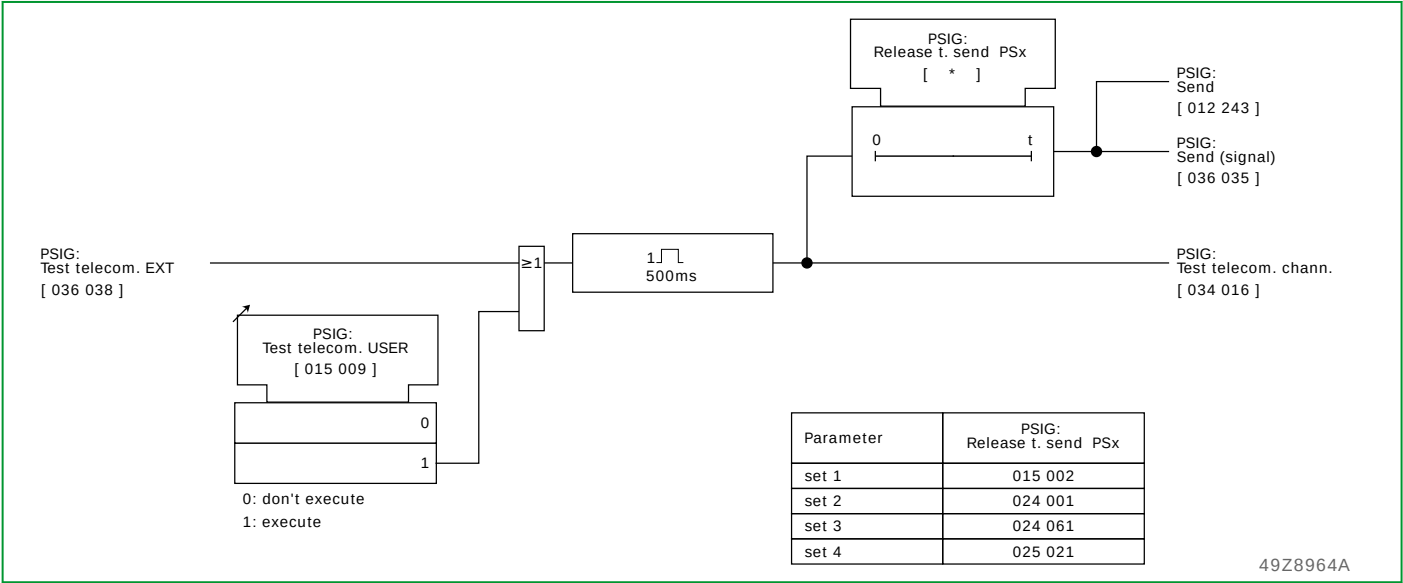


Fig. 3-209: Testing the communication channel.

The communications link can be tested. For this purpose a 500 ms send signal is issued through a binary signal input or by a setting parameter. It is extended by the reset time-delay of the send signal. The remote station receives this signal if the transmission link is in order.

3.30 Auto-Reclosing Control (Function Group ARC)

After certain faults, the auto-reclosing control function (ARC) brings about automatic reclosing of the line section that was interrupted by a protection device.

3.30.1 ARC Operating Modes

The integral ARC function in the P433 offers the possibility of multiple reclosures. When the ARC operating mode has been set accordingly, multiple reclosures first begin with a high-speed reclosure (HSR). If the fault is not cleared after reclosure by an HSR, then another attempt can be made to clear the fault with a time-delayed reclosure (TDR). Multiple reclosures using only TDRs are also possible if the ARC operating mode is set accordingly.

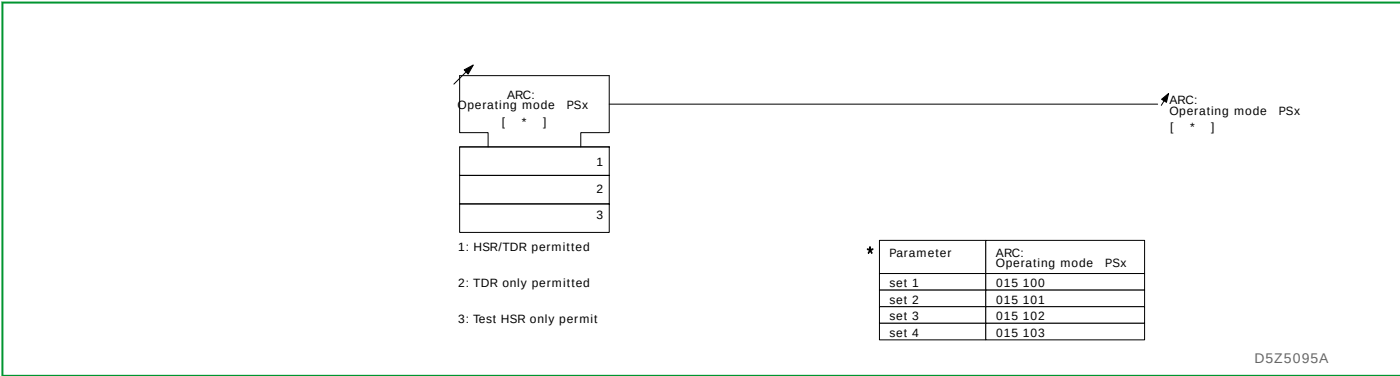


Fig. 3-210: Setting the ARC operating mode in the P433.

3.30.2 Enabling and Disabling the ARC Function

The function can be disabled or enabled using setting parameters or through binary signal inputs.

The activation of the function is enabled generally (independently of parameter subsets) via ARC: General enable USER. It is enabled as a function of a parameter subset via ARC: Enable PSx. If these enabling functions have been activated, the auto-reclose control function can be disabled or enabled using setting parameters or through appropriately configured binary signal inputs. Parameters and configured binary signal inputs have equal status. If only the ARC: Enable EXT function is assigned to a binary signal input, then ARC will be enabled by a positive edge of the input signal and disabled by a negative edge. If only the ARC: Disable EXT parameter has been assigned to a binary signal input, then a signal at this input will have no effect.

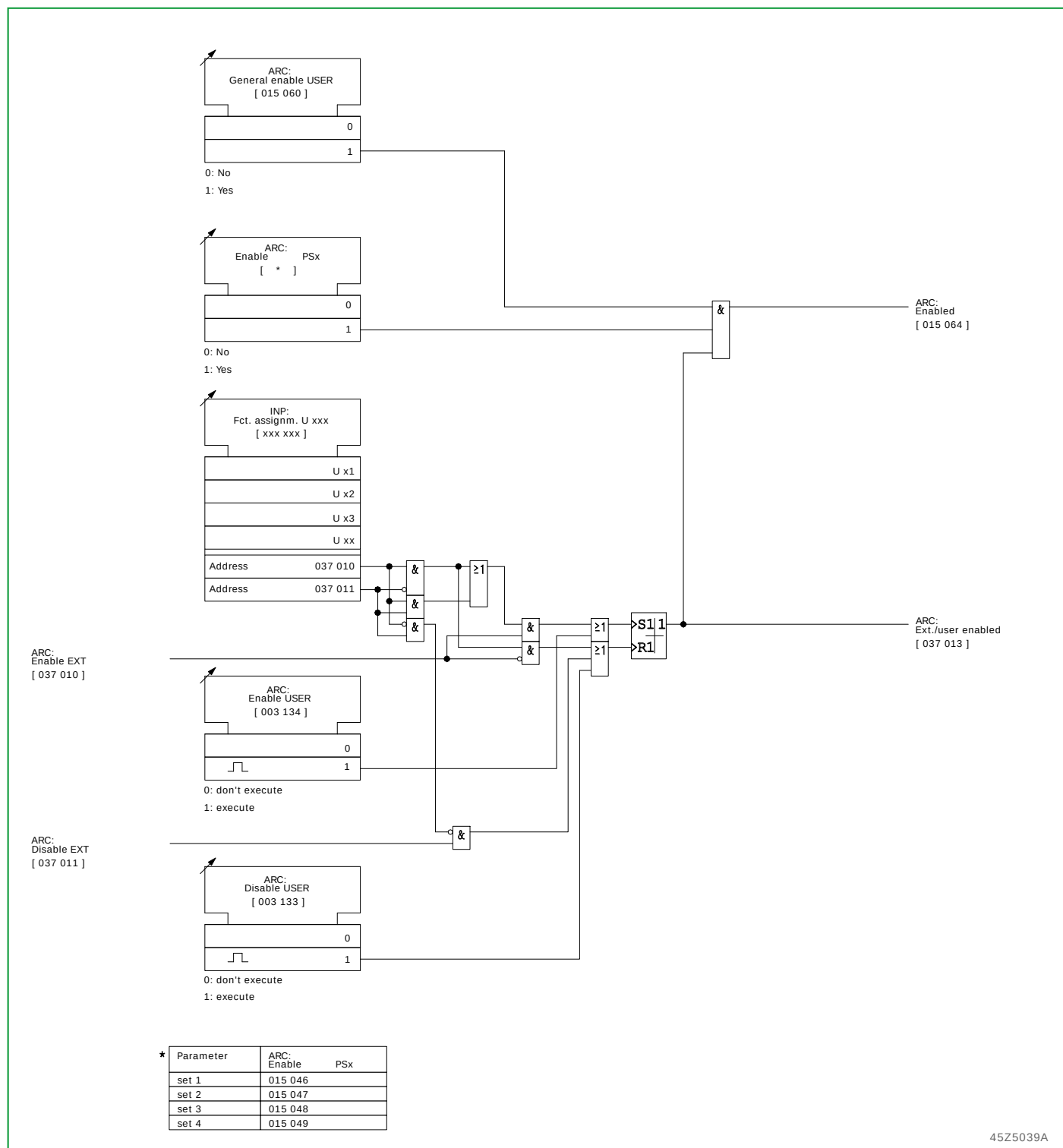


Fig. 3-211: Disabling and enabling auto-reclosing control in the P433.

ARC is ready when the following conditions are satisfied:

- Protection is activated (on).
- ARC is not blocked.
- No ARC cycle is running.
- The circuit breaker must be capable of opening and closing again (CB opening and closing mechanism ready).
- The circuit breaker is in closed position. (Position scanning is optional.)
- No automatic synchronism check cycle is running.

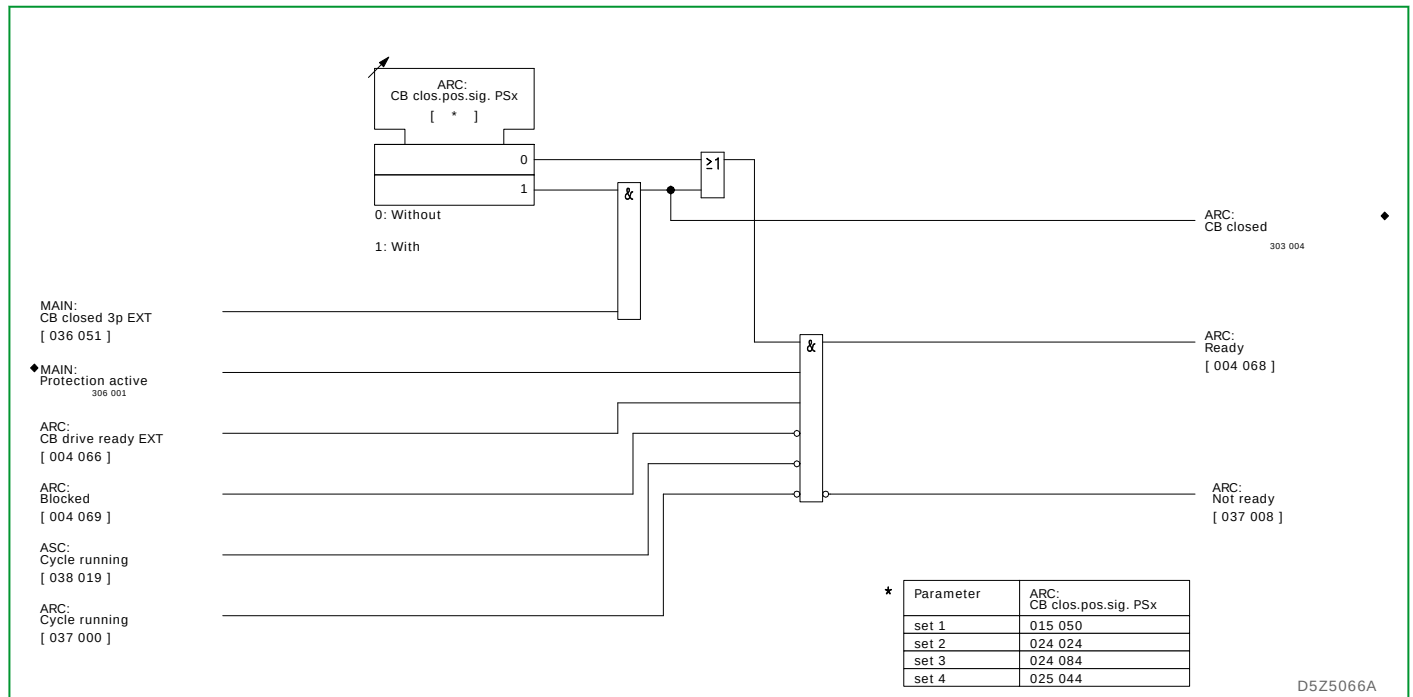


Fig. 3-212: ARC readiness in the P433.

3.30.3 ARC Blocked

ARC will be blocked if one of the following conditions applies:

- Distance protection detects a fault in the cable section of the transmission section.
- A manual close is carried out.
- A switch to backup overcurrent time protection (BUOC) is made, but no ARC is to be carried out.
- A trip signal is issued by ground fault (short-circuit) protection.
- A ground fault (short-circuit) protection signaling trip occurs, but no auto-reclosing is to occur.
- A manual open command is issued.
- A trip signal is issued by circuit breaker failure protection.
- A trip signal is issued by ground fault protective signaling.
- A trip signal is issued by ground fault tripping.
- The binary signal input configured to ARC: Blocking EXT is triggered.

After all blocking conditions have dropped out, the relevant blocking time is started, and when this time has elapsed, the block is canceled.

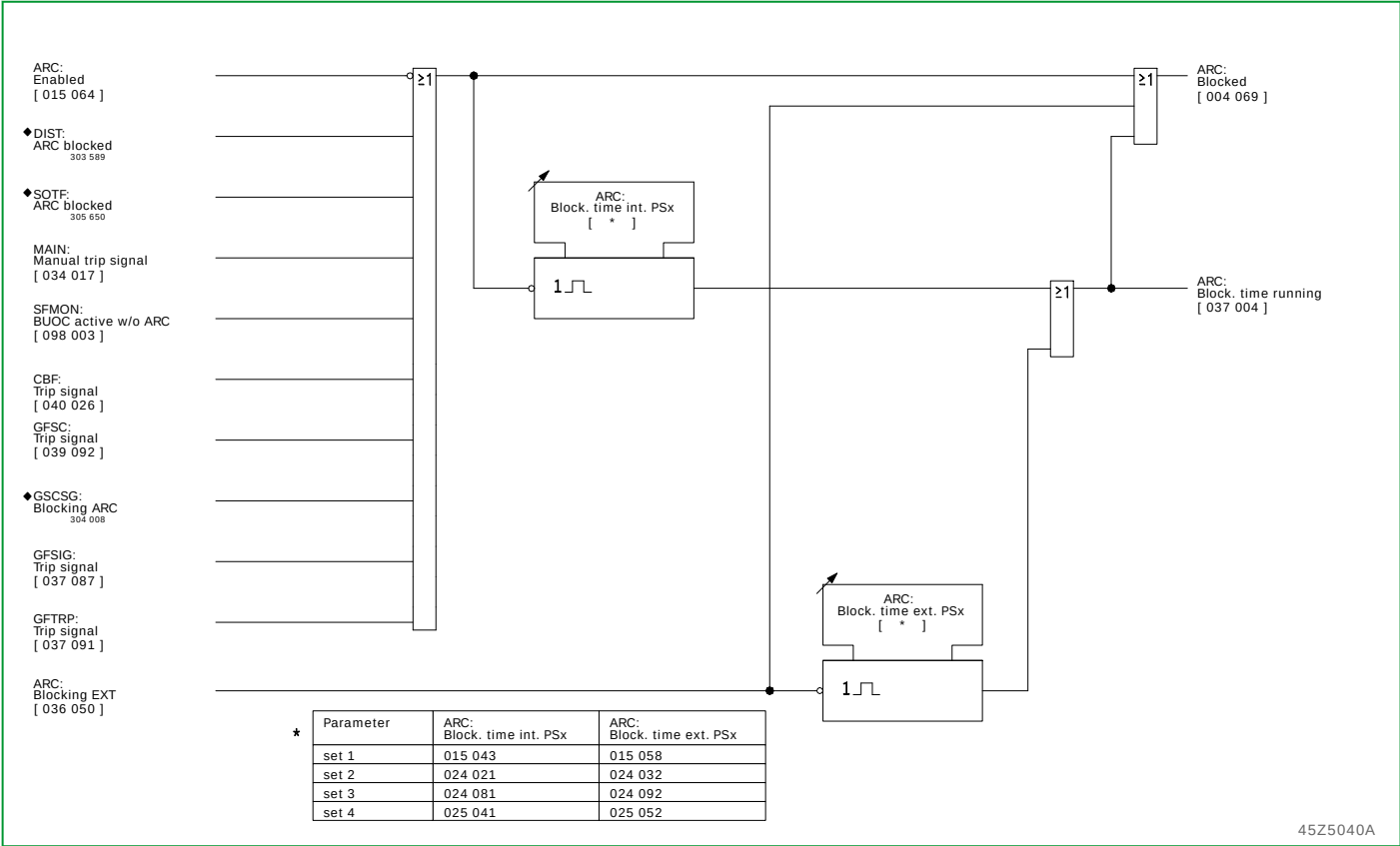


Fig. 3-213: ARC blocking in the P433.

3.30.4 ARC Tripping Times

If protective signaling is not ready, the HSR or TDR tripping times of the ARC function are initiated by the general starting condition. These tripping times replace distance protection timer stage t1,ze of or backup overcurrent-time protection (BUOC) timer stages.

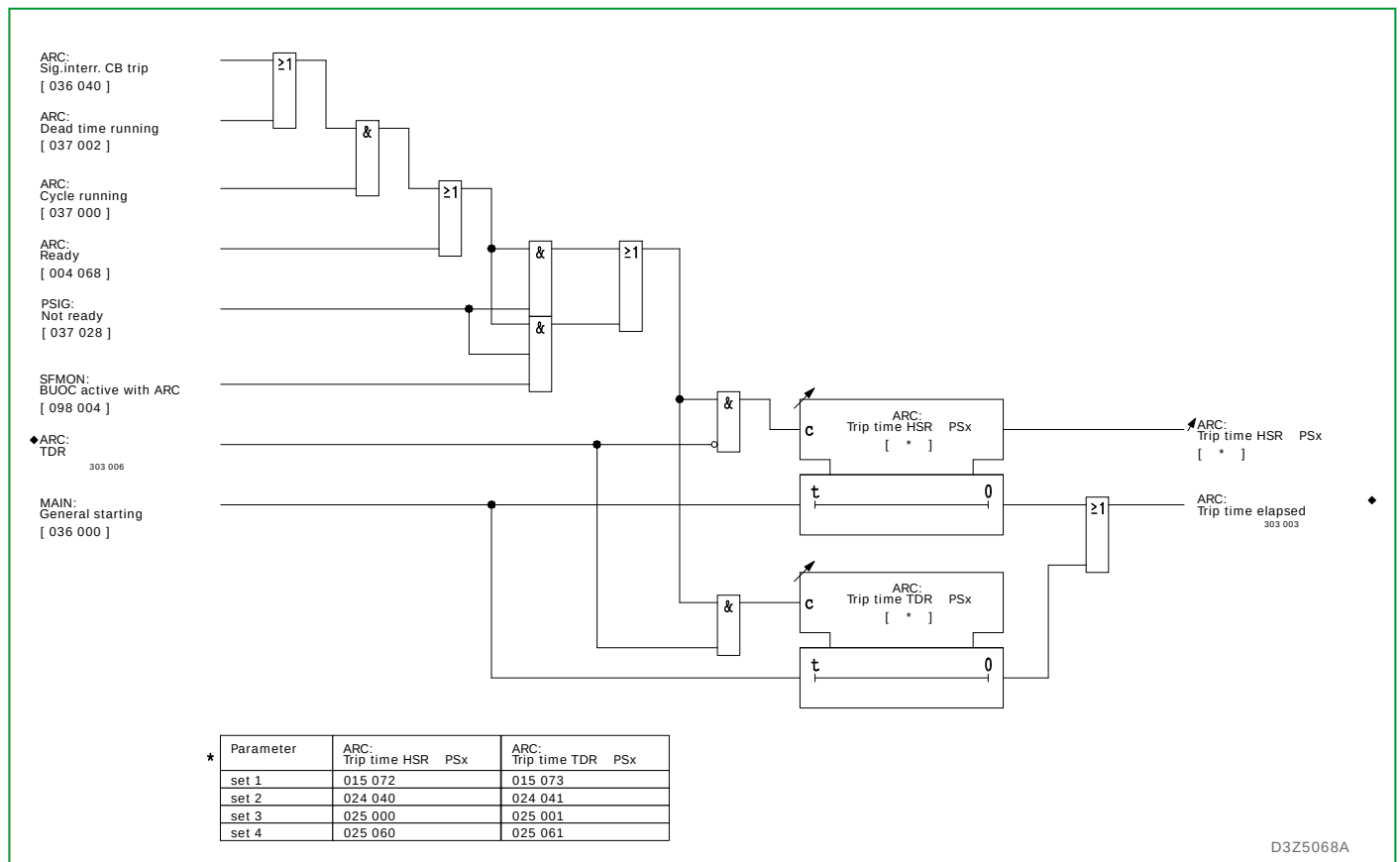


Fig. 3-214: ARC tripping times in the P433.

3.30.5

Starting the ARC Cycle

When the ARC function is ready, an ARC cycle is started by one of the following functions:

- The general starting state formed internally or the general starting signal of a parallel protection device, provided that a binary signal input has been configured accordingly.
- A distance protection trip (possible without general starting, such as through the protective signaling direct transfer trip underreaching mode).
- A backup overcurrent-time protection trip (BUOC trip), provided that the ARC is to be activated by the BUOC function.
- The trip signal of ground fault (short-circuit) protection signaling, provided that the ARC is to be activated by ground fault protection signaling.
- The trip signal of an external protection device, provided that the parameters of this device have been set accordingly (ARC: Parallel trip PSx).
- A user-specific condition defined within the programmable logic applies, i.e. the LOGIC output becomes true, which is assigned as trigger (015 033 ARC: Fct.assgn. tLOGIC), see [Section 3.30.13, \(p. 3-287\)](#).
- The DTOC stage trips, that is assigned as trigger (013 127 DTOC: Funct. start ARC PSx).
- A test HSR.

The ARC cycle is completed after the last reclaim time has elapsed.

3.30.6 High-Speed Reclosure (HSR)

When the ARC cycle starts, operative time 1 is started. The starting conditions for the ARC cycle must drop out while the operative time is elapsing. This means that the circuit breaker must have opened so that the dead time is started. If the operative time is set at ≤ 25 ms, then ARC will not be ready in the event of starting; in the event of a trip, the reclaim time is started.

The three-pole dead time (ARC: Operative time 1 PSx) is started if the starting conditions for an ARC cycle drop out while operative time 1 is elapsing. After the dead time has elapsed, a close request is sent to the automatic synchronism check function (ASC). The ASC checks to determine whether reclosure is possible. If a positive decision is reached during the ASC operative time, then there is a close enable, and the close command is issued.

If the ASC is disabled or deactivated, or if its decisions are to be ignored, then a close command is issued immediately.

If the starting conditions for an ARC cycle drop out after operative time 1 has elapsed but during operative time 2, then the maximum dead time (ARC: Dead time max PSx) is started. When the dead time is started, a close request is sent to the ASC. The ASC checks to determine whether reclosure is possible. If a positive decision is reached during the ASC operative time and while the dead time is elapsing, then there is a close enable, and the close command is issued.

If the ASC function determines that reclosing may not occur, then the reclaim time is started after the dead time has elapsed and the "final trip" signal is issued.

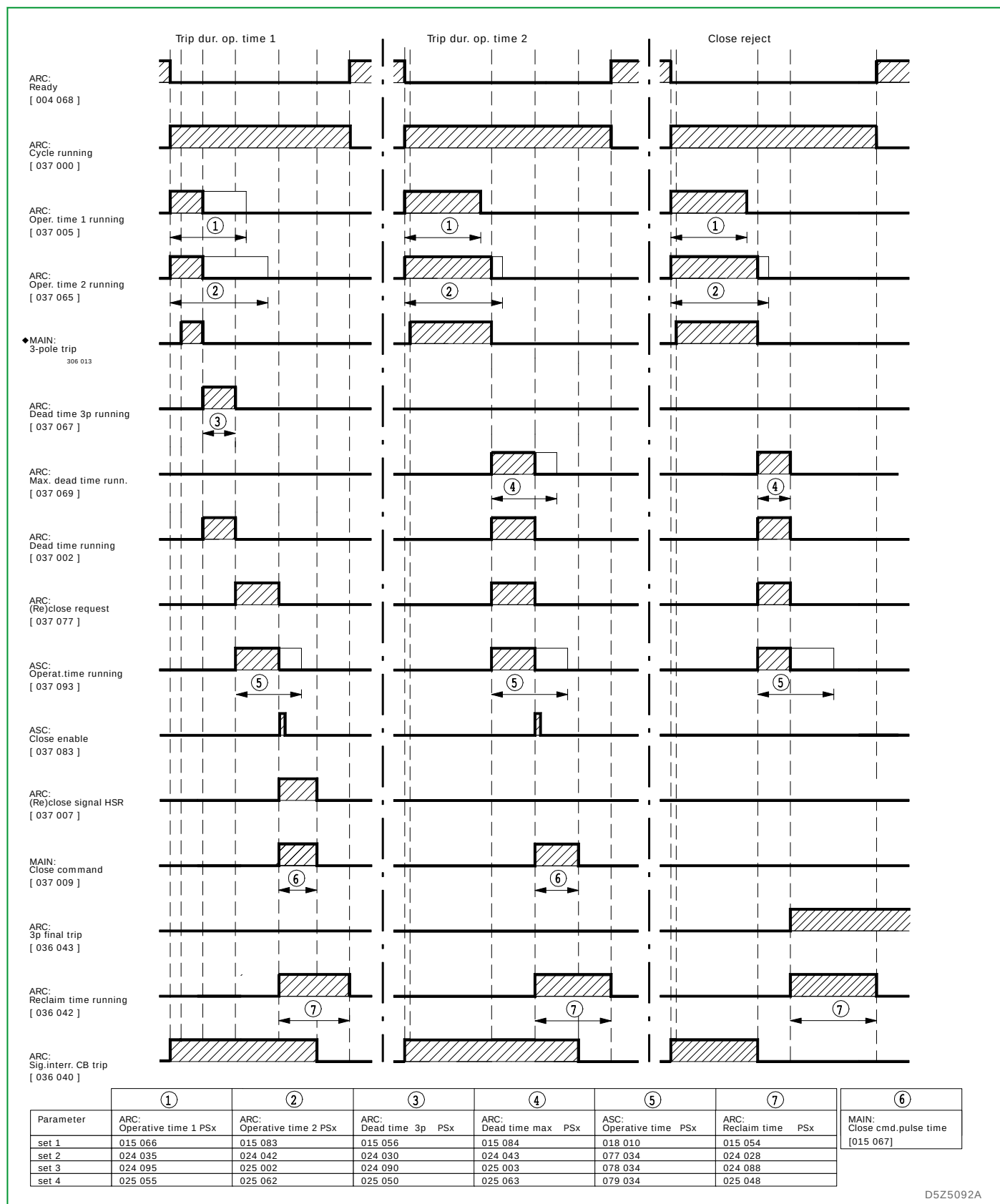


Fig. 3-215: Signal sequence for high-speed reclosure (HSR).

3.30.6.1 Test HSR

A test HSR can be carried out using setting parameters or through an appropriately configured binary signal input.

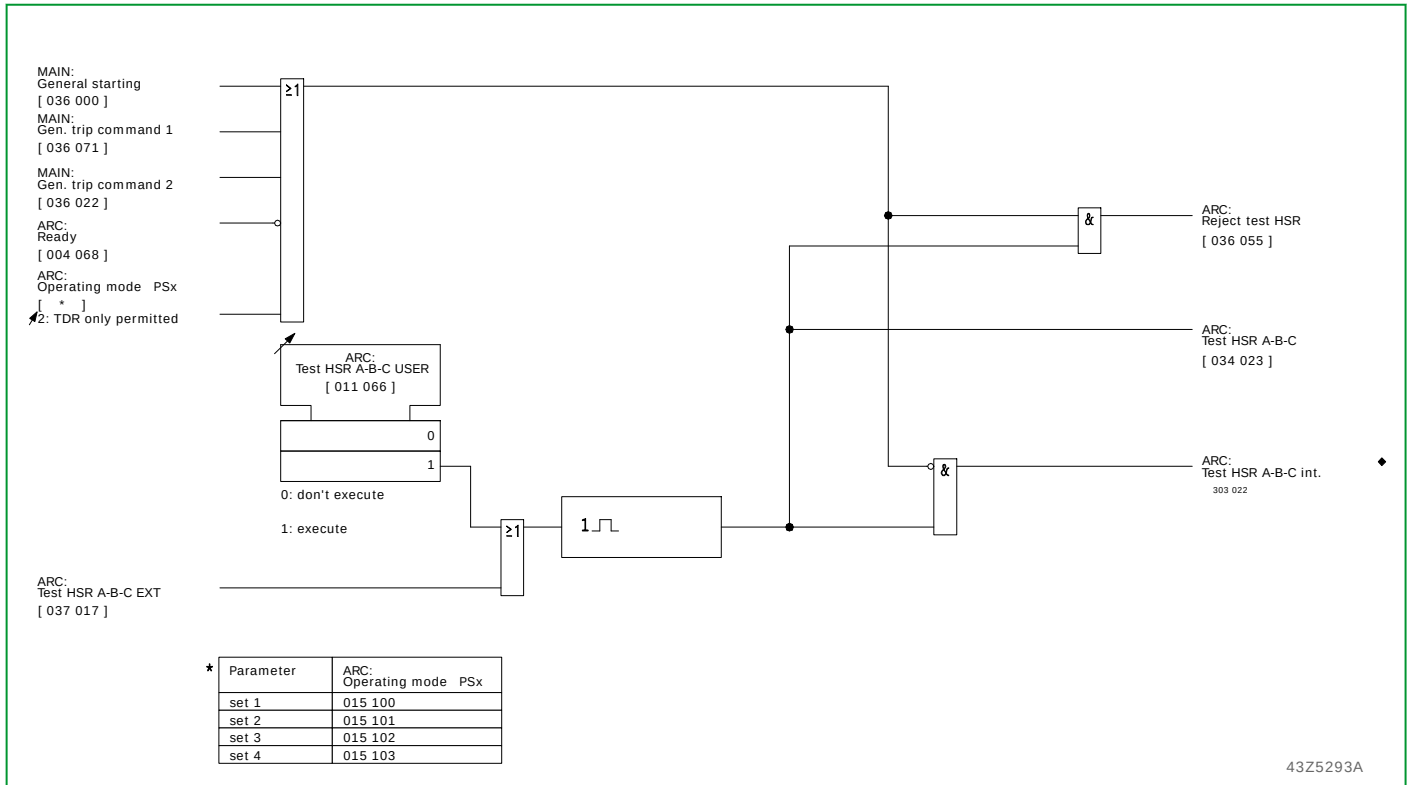


Fig. 3-216: Test HSR.

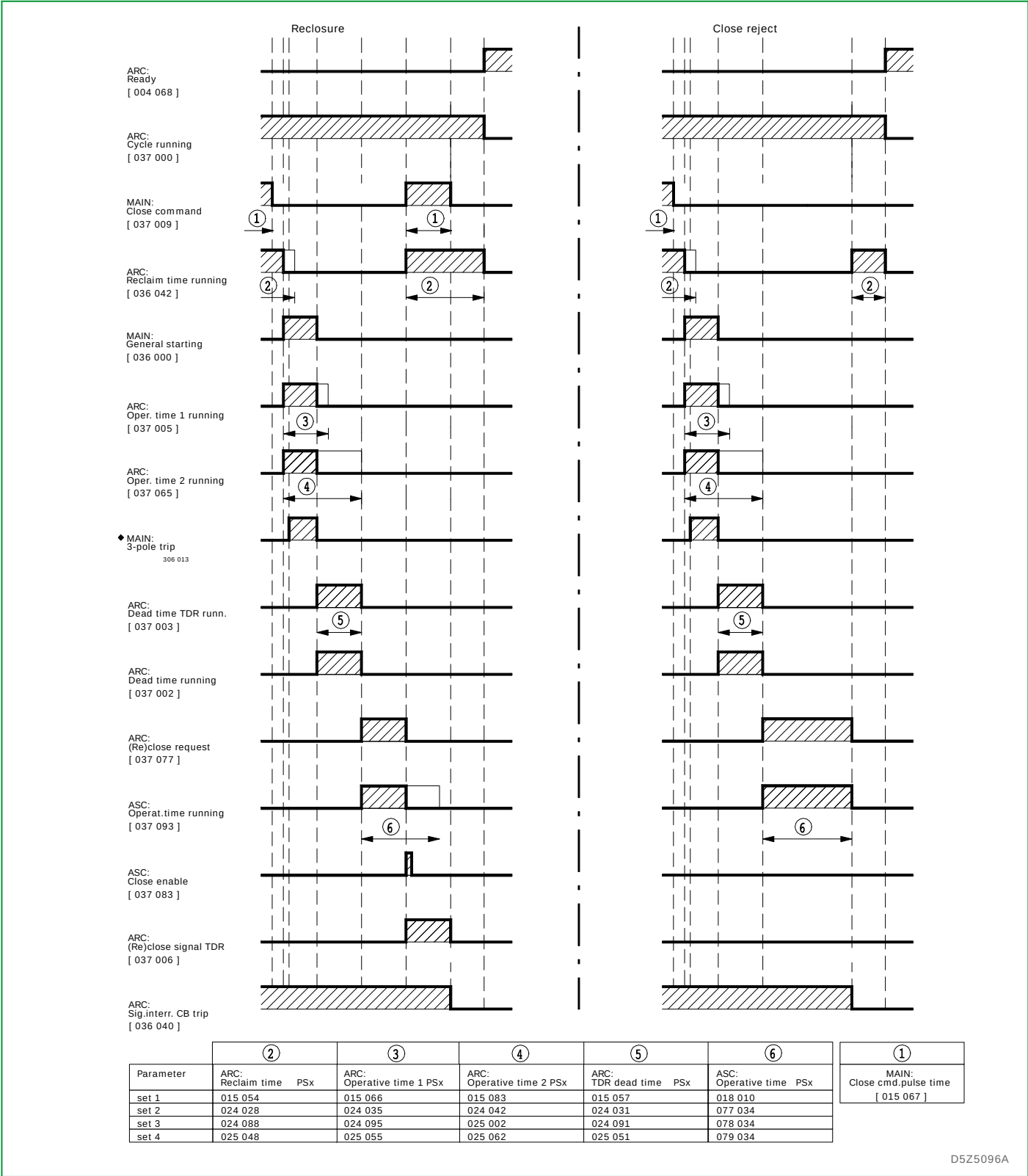
3.30.7

Time-Delay Reclosure (TDR)

A TDR may occur after an HSR if reclosure has occurred as the result of the HSR or if the operating mode set for the ARC allows only TDRs. This is possible only if the setting for ARC: No. permit. TDR PSx (number of permitted TDRs) is not zero.

The TDR is started if either a new general starting condition or the trip of an external protection device (if configured accordingly) occurs while the reclaim time is elapsing. Operative times 1 and 2 are started. If the starting conditions for the TDR drop out while operative time 1 or 2 is elapsing, then the TDR dead time is started. After the dead time has elapsed, a close request is sent to the automatic synchronism check function (ASC). The ASC checks to determine whether reclosure is possible. If a positive decision is reached during the ASC operative time, then there is a close enable, and the close command is issued. If the ASC function determines that reclosing may not occur, then a final trip occurs after the ASC operative time has elapsed, and the ARC reclaim time is started.

If the fault is still present even after another reclosing, the TDR can be started again. This process can be repeated as often as allowed by the number of permitted TDRs. If the fault is still present after that, then a final trip occurs.



If the setting at MAIN: Neutr.pt. treat. PSx is *Low-imped. grounding*, then both phase-to-ground and phase-to-phase voltages are checked. If the setting is either *Isol./res.w.start.PG*, *Isol./res.w/o st. PG* or *Short-durat. ground.*, then only the phase-to-phase voltages are checked.

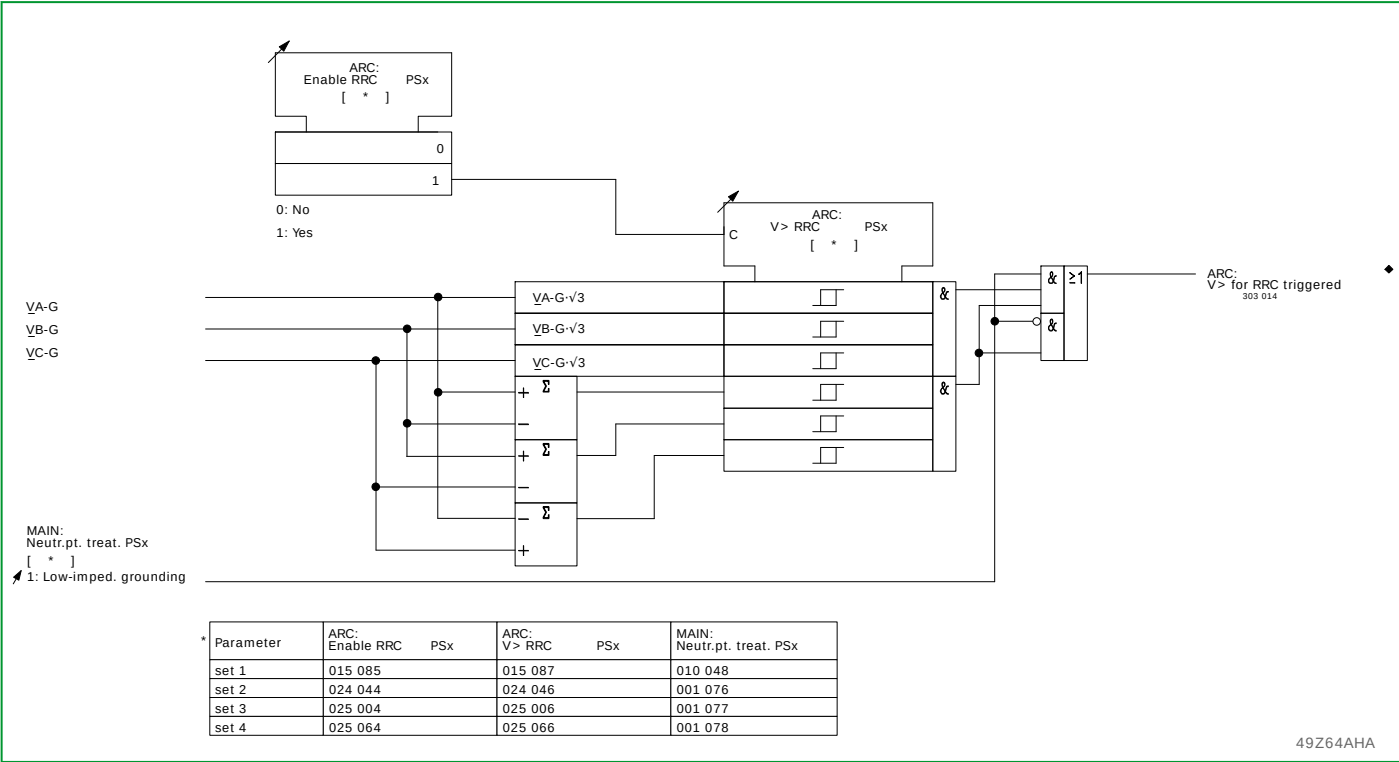


Fig. 3-218: Voltage monitoring for RRC.

If the starting conditions for rapid reclosing drop out during operative time 1, the RRC timer stage t_{RRC} is started. After the timer stage has elapsed, the P433 checks to determine whether the voltages measured by distance protection were greater than or equal to the set threshold value (ARC: V > RRC PSx) during the last 100 ms. If this was the case, then a close request is sent to the automatic synchronism check function (ASC).

The ASC checks to determine whether reclosing can occur. If the ASC decision is positive, a close enable and then a close command are issued. If reclosing is not permitted, there is a final trip.

If the ASC is disabled or deactivated or if its decisions are to be ignored, then the close request is immediately acknowledged and a close command is issued.

If it is determined after timer stage t_{RRC} has elapsed that the voltages were not greater or equal to the set threshold (ARC: V > RRC PSx), then the ARC cycle is continued by the HSR or TDR.

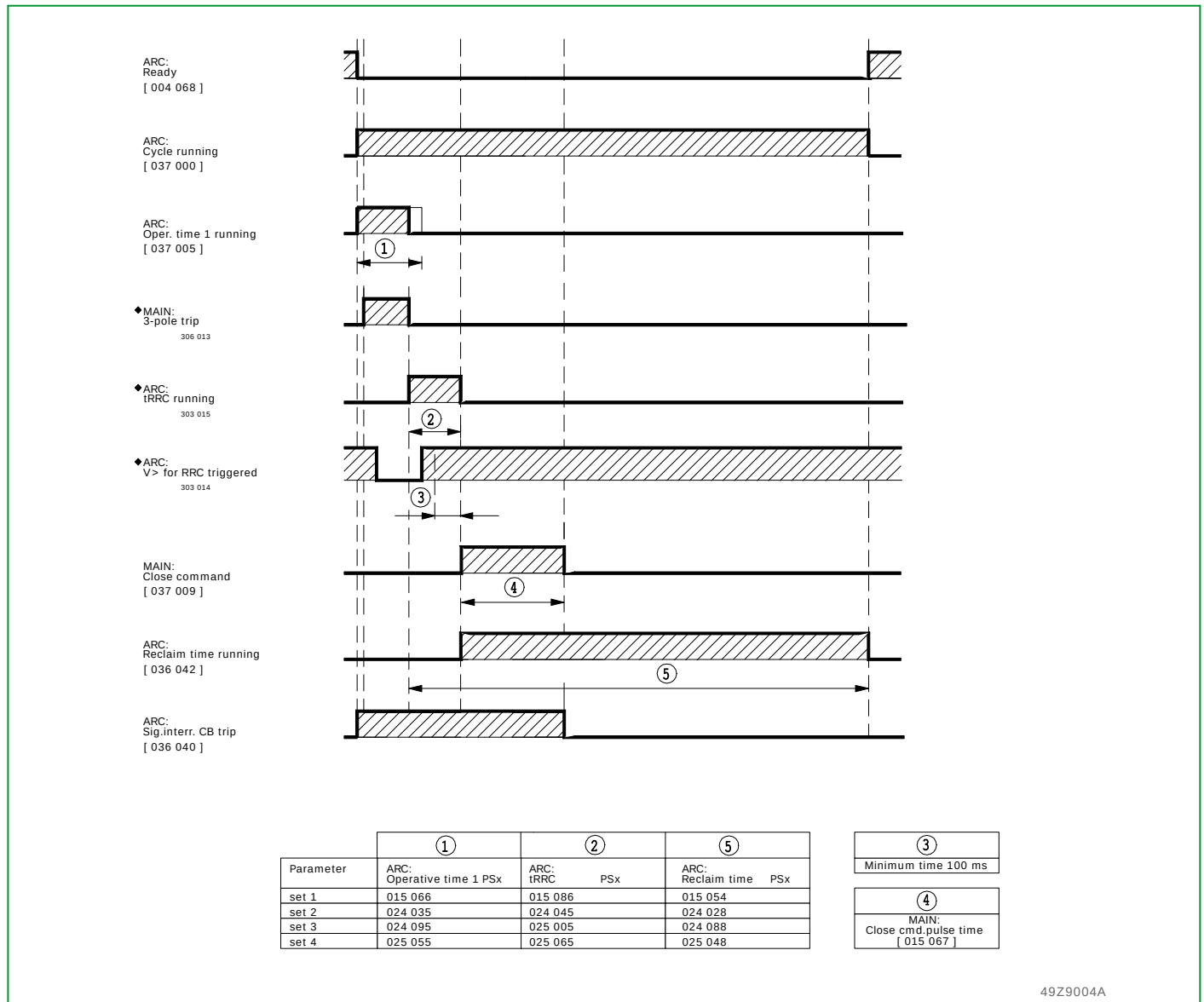


Fig. 3-219: Signal sequence for rapid reclosure (RRC).

3.30.9

Parallel Blocking

If a second protection device is operating in parallel with the P433, then the trip from this protection device can be integrated into the ARC functional sequence – provided that the binary signal inputs have been configured appropriately. The effect exercised by the trip of the parallel protection device depends on the setting at ARC: Parallel trip PSx (see Fig. 3-222, (p. 3-286) for setting).

- ARC: Parallel trip PSx = *Without function*

The trip of the external protection device does not intervene in the functional sequence.

- ARC: Parallel trip PSx = *Parall. bloc.w/o ini*

The trip of the external parallel protection device does not intervene in the TDR, HSR or RRC functional sequence.

- ARC: Parallel trip PSx = *Parall. bloc.w. init*

The trip of the external protection device starts a TDR, HSR or RRC. The sequence is the same as with initiation by the P433.

3.30.10 Zone Extension

Zone extension (ZE) of impedance zone 1 of the distance protection function is only initiated by the ARC if protective signaling is not ready.
HSR and TDR activate different zone extension factors.

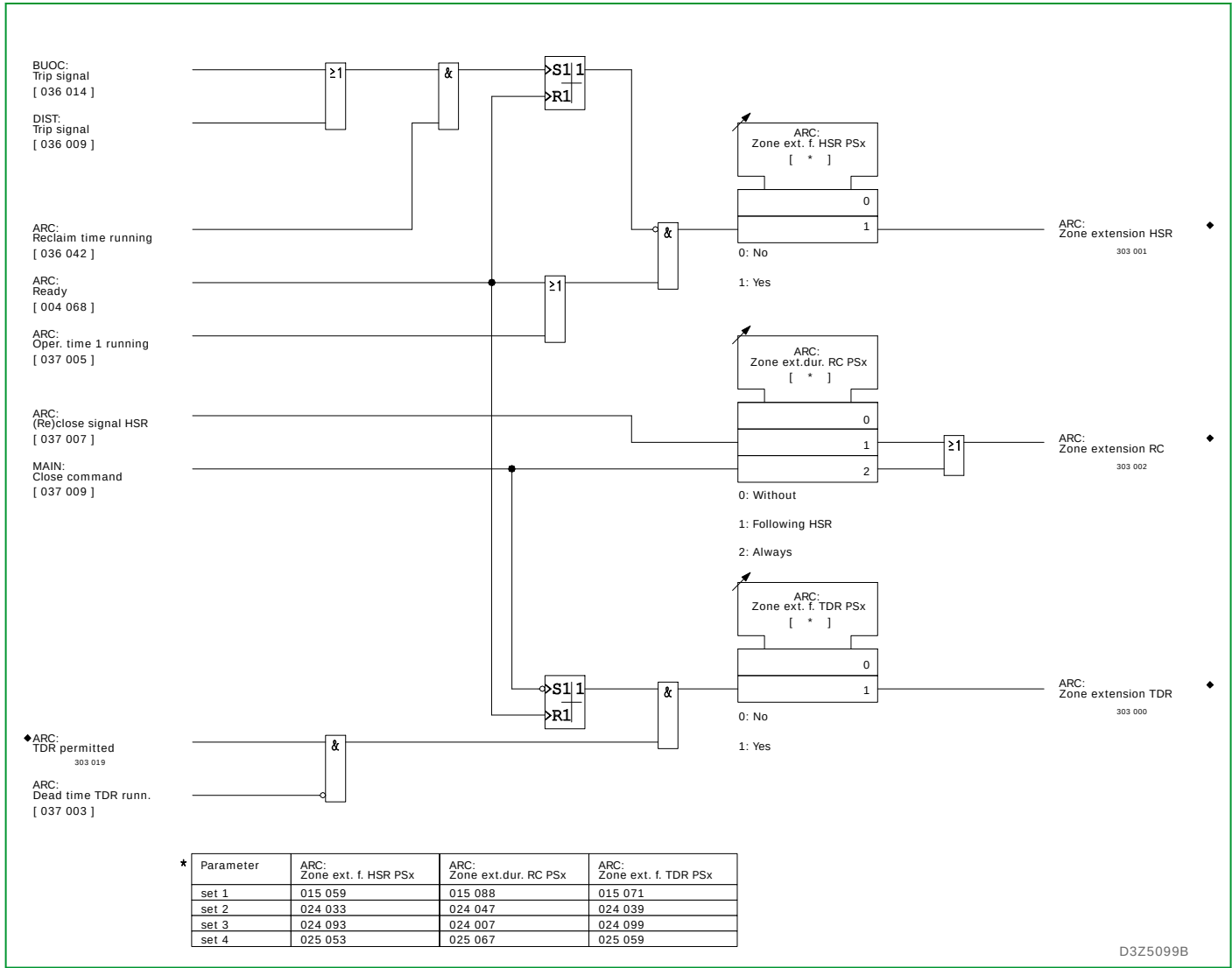


Fig. 3-220: Zone extension by ARC.

3.30.10.1 Zone Extension by k_{ze} HSR

Zone extension by the zone extension factor k_{ze} HSR is affected by the following settings:

- Setting for ARC: Zone ext. f. HSR PSx Yes
The measuring range is extended when the ARC is ready and while operative time 1 is elapsing.
- Setting for ARC: Zone ext.dur. RC PSx
 - *Following HSR*
The measuring range is extended while the close command time is elapsing if the close command is issued by an HSR.
 - *Always*
The measuring range is extended while the close command time is elapsing. How the close command is triggered is not important.

If the two parameters are set for *No* or *Without*, respectively, then there is no zone extension.

3.30.10.2 Zone Extension by k_{ze} TDR

The measuring range of impedance zone 1 is extended by the zone extension factor k_{ze} HSR after a close command is issued by the TDR function, as long as another TDR is permitted and the setting for ARC: Zone ext. f. TDR PSx is Yes. Zone extension is canceled during the course of the TDR dead time. If the setting is *No*, there is no zone extension.

3.30.11 General ARC Control Functions

3.30.11.1 Monitoring the Receive Signals of Protective Signaling

The user can specify whether there will be intervention in the ARC sequence when a signal is received by protective signaling. If this is desired, then the ARC cycle is continued in different ways depending on the number of receive signals that are received by the P433 while operative time 1 or the single- or three-pole dead times are elapsing.

At the end of the dead time, the P433 checks to determine whether protective signaling has received one signal while the above-mentioned times are elapsing. If this is the case, then the HSR is terminated normally. If protective signaling receives no signal or more than one signal, the HSR is terminated as if the fault had been cleared during operative time 2. This means that even with single-pole starting signals or trips reclosing is preceded by a synchronism check by ASC.

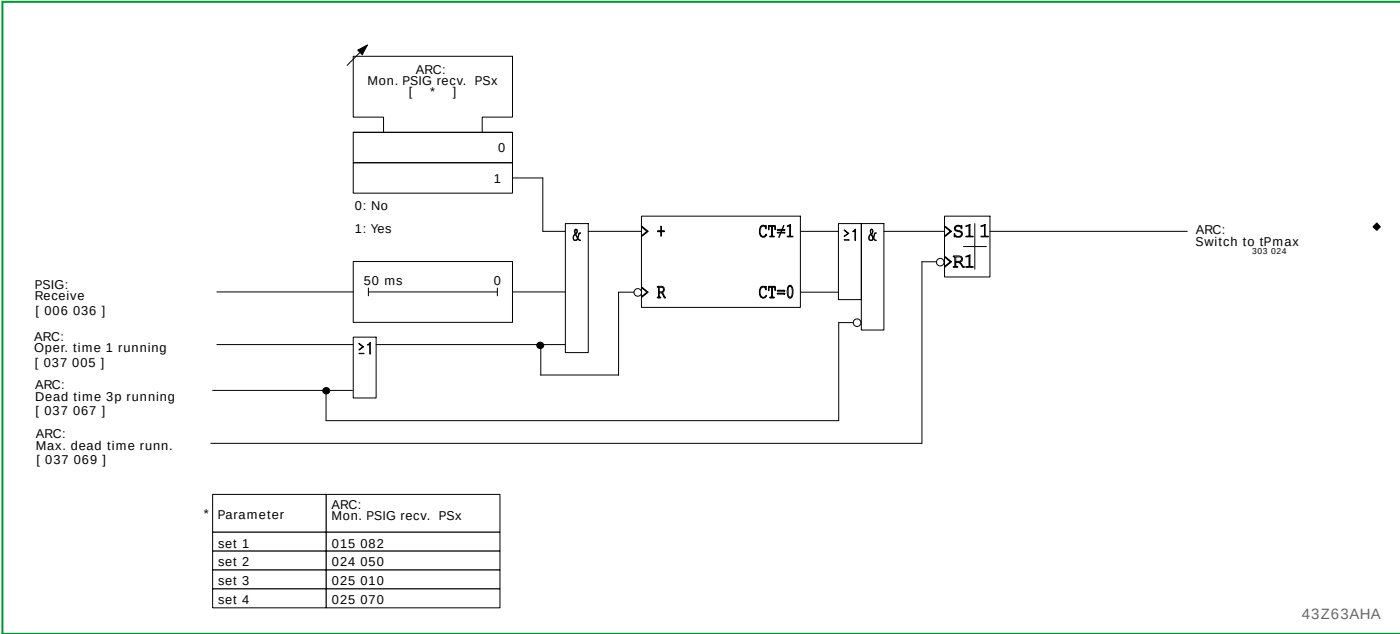


Fig. 3-221: Monitoring the receive signals of protective signaling.

3.30.11.2 ARC Sequence Control

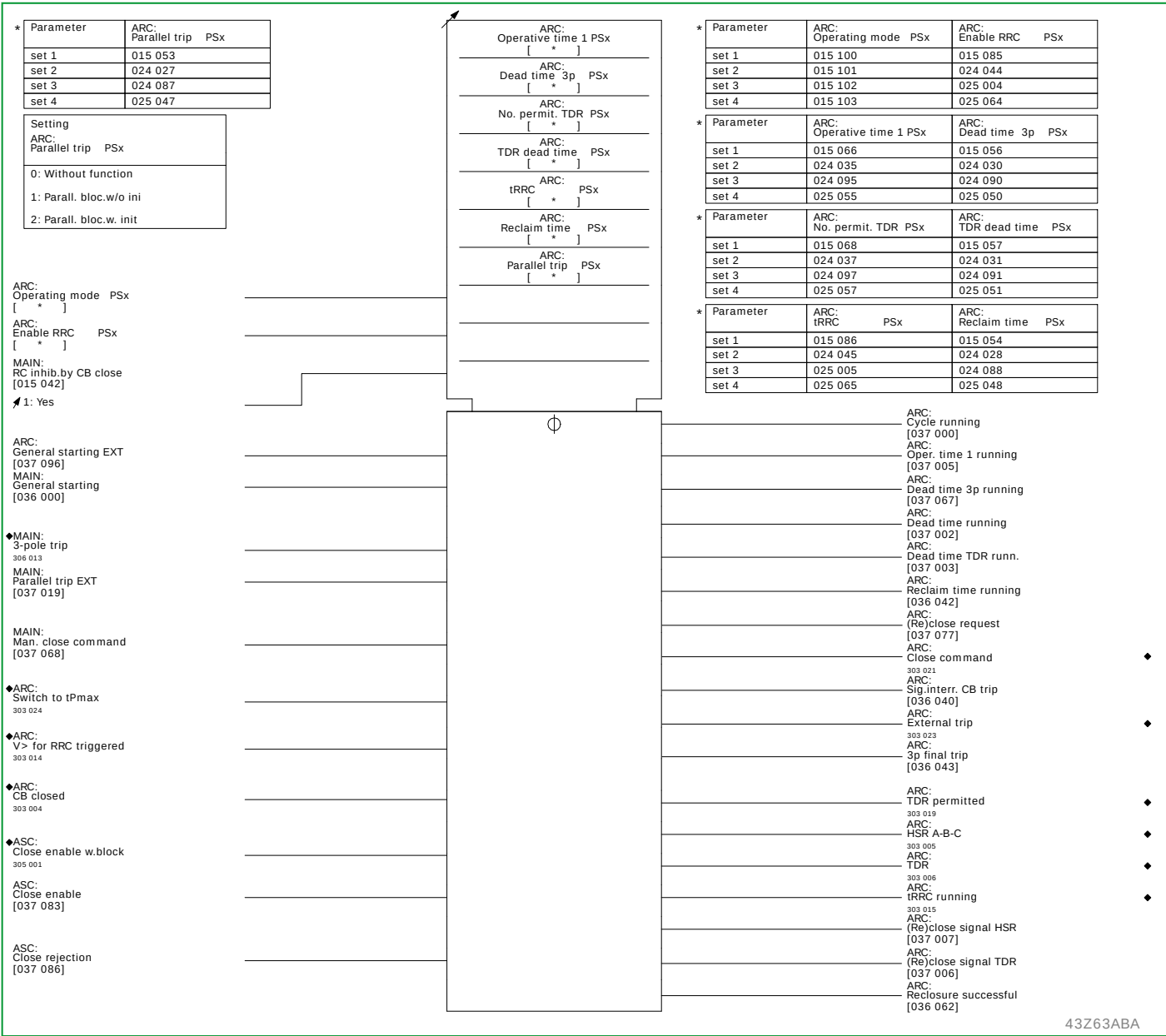


Fig. 3-222: ARC sequence control.

3.30.12 ARC Counters

The following ARC signals are counted in the P433:

- Number of high-speed reclosures.
- Number of time-delayed reclosures.

The counters can be reset either individually or as a group.

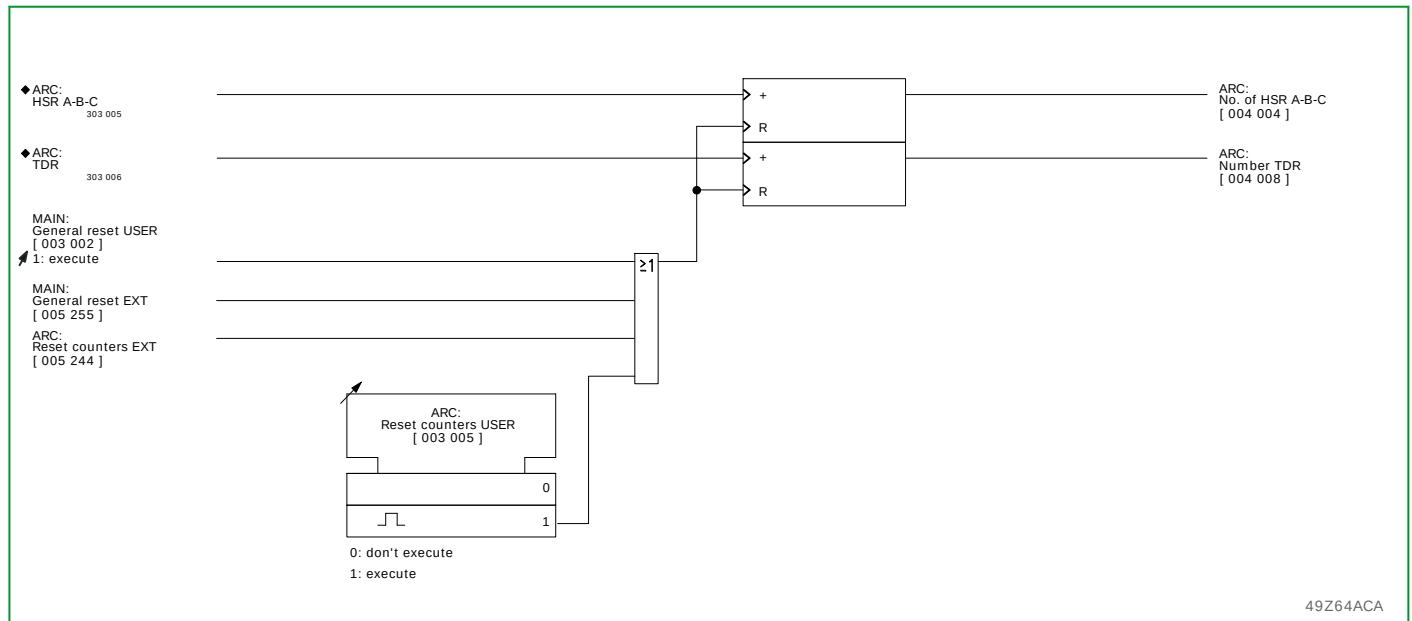


Fig. 3-223: ARC Counters.

3.30.13 Start of Operative Time Using Programmable Logic

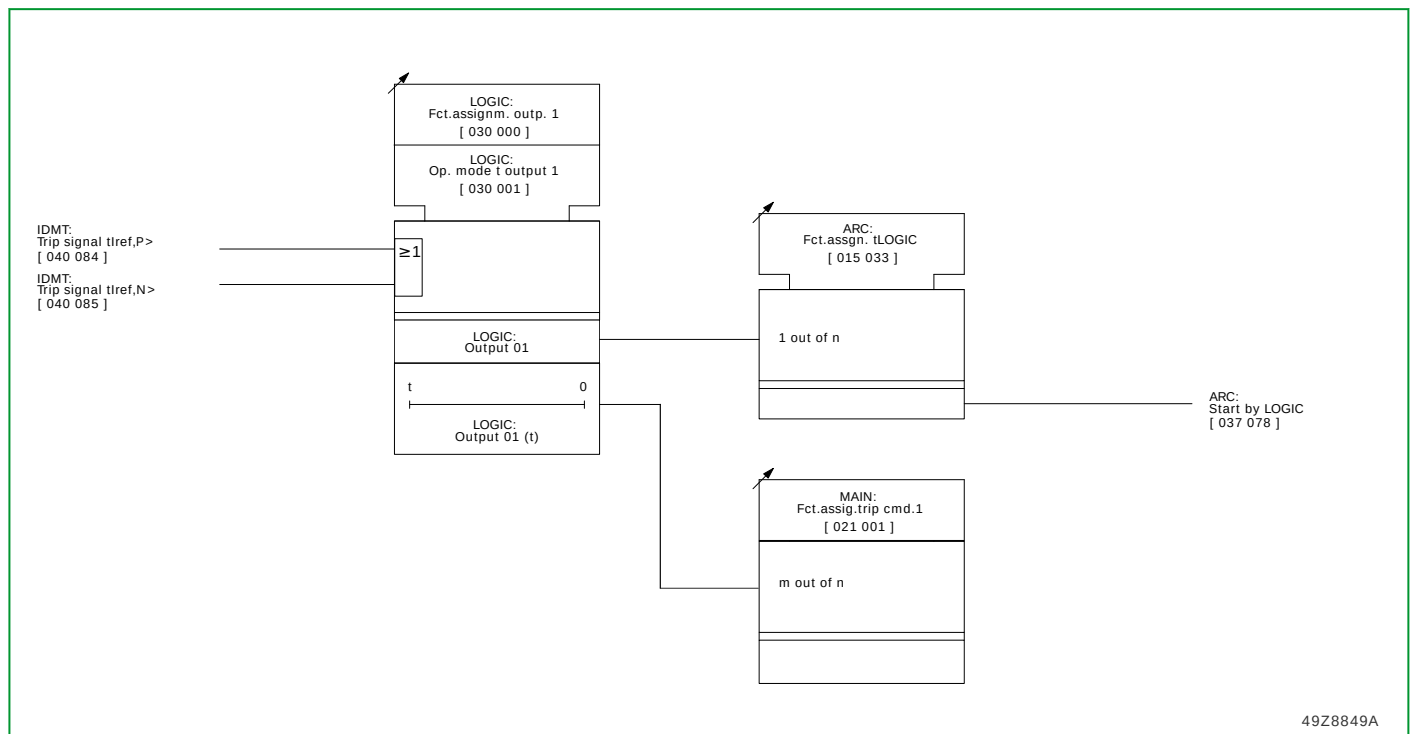


Fig. 3-224: Example: Start of the ARC operative time using output 01 of the programmable logic.

By using the assignment (015 033) ARC: Fct. assign. tLOGIC, additional user-specific conditions for starting an ARC cycle can easily be defined within the programmable logic.

All internal signals (for example an IDMT trip signal or a ground fault direction determination decision) and all external conditions fed in by means of binary input signals are available for that purpose (unless for the latter the equivalent signal (037 096) ARC: General starting EXT is to be used). With the logical operators and time stages of the programmable logic, even complex dependencies can be realized.

Under the precondition that the auto-reclosing control function (ARC) is ready, the ARC operative time is started as soon as the assigned logical output enters the active state.

Note that this signal assignment does not automatically lead to a trip. A trip has to be defined separately in the programmable logic. In the simplest case, this can be achieved by linking the logical signal (with or without an appropriate delay) to the general trip command 1. Solely the successful execution of this trip command (more precisely, the raise and termination of the general trip signal 1 prior to the operative time 1 or 2 have elapsed) lead to the start of the dead time.

The example in [Fig. 3-224, \(p. 3-287\)](#) illustrates a possible configuration.

In general, any equation within the programmable logic function can be used to start the ARC tripping time.

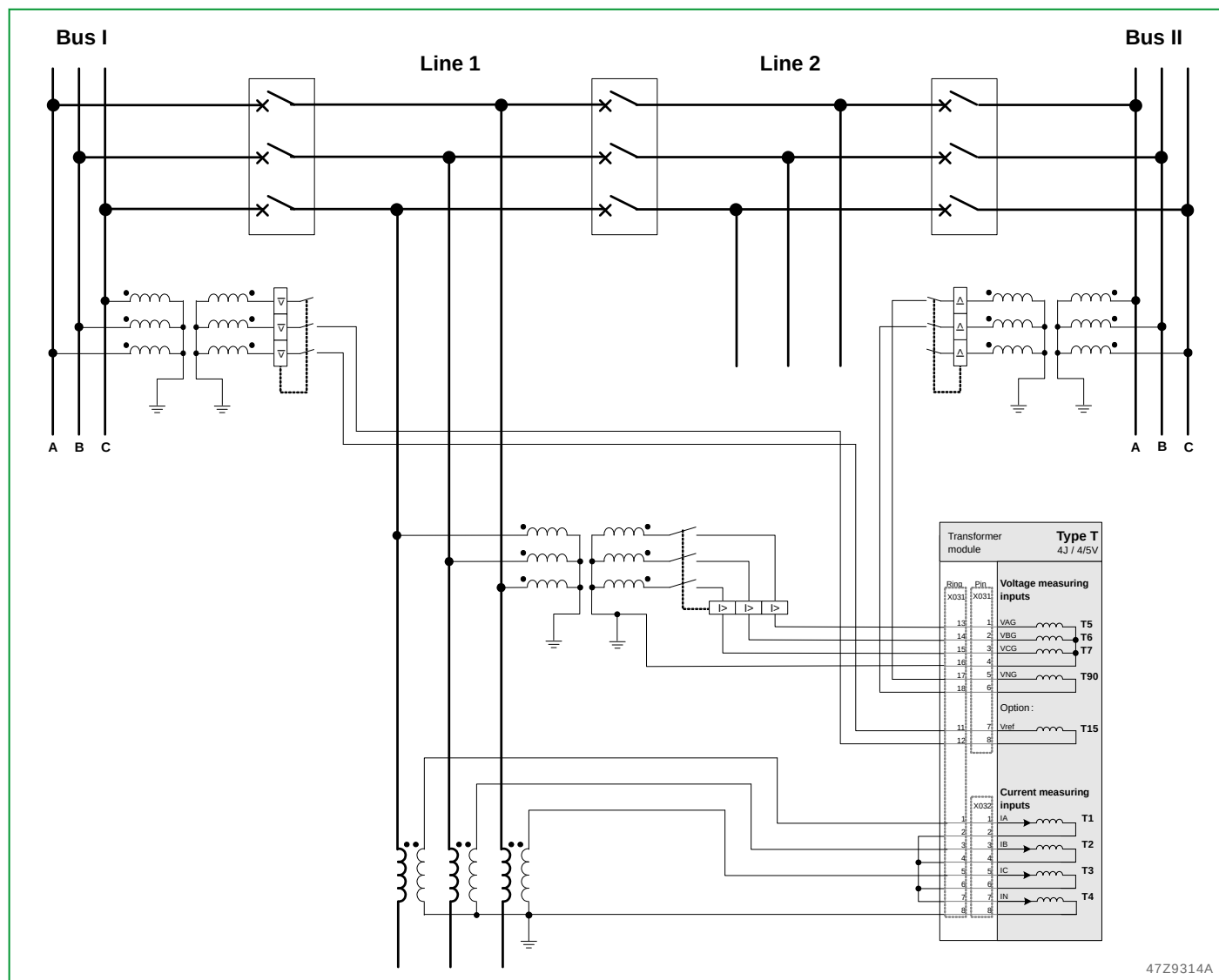
3.31 Automatic Synchronism Check (Function Group ASC)

The automatic synchronism check (ASC) function allows the P433 to verify that before a close or reclose command is issued synchronism exists between system sections that are to be synchronized (paralleled) or whether one of the system sections is de-energized. In order to check for synchronism, two voltages – generally the voltages on the line and busbar sides – are compared for differences in frequency, angle, and voltage. Connecting the reference voltage transformer will determine which of the system sections will provide the reference voltage (e.g. the line side or the busbar side). The measurement loop must be set to correspond to the reference voltage connection (ASC: Measurement loop PSx) so that the correct measuring voltage is selected for the comparison. In the connection example shown in section “Conditioning of the Measured values” (see [Section 3.13, \(p. 3-91\)](#)), the busbar voltage V_{A-B} is the reference voltage.

Alternatively the P433 can be set to compare the voltage measured at the T90 voltage transformer against the reference voltage, see connection example below.

Note: In this context, the voltage measured at the T90 is called "V(T90)" to avoid mixing it up with V_{NG} which is in most applications measured through T90.

This feature is enabled by setting ASC: Meas.V(T90) USER PSx to Yes, or by configuring the parameter ASC: Meas.V(T90) EXT to some binary input, or a communication protocol signal or programmable logic. Note, however, that in this case it is still the responsibility of the system engineering to make sure that the proper voltage (according to the setting ASC: Measurement loop PSx, see [Fig. 3-226, \(p. 3-291\)](#)) is indeed connected to transformer T90. Of course, monitoring T90 instead of the three phase-to-ground voltages means to have a single-phase-check instead of three phases.



47Z9314A

Fig. 3-225: Connecting the P433 measuring circuits for Synchronism Check 1.5CB application.
(If markings "P1" – "P2" and "S1" – "S2" are used for CT polarity then the dots shown here represent the "P1" and "S1" terminals.)

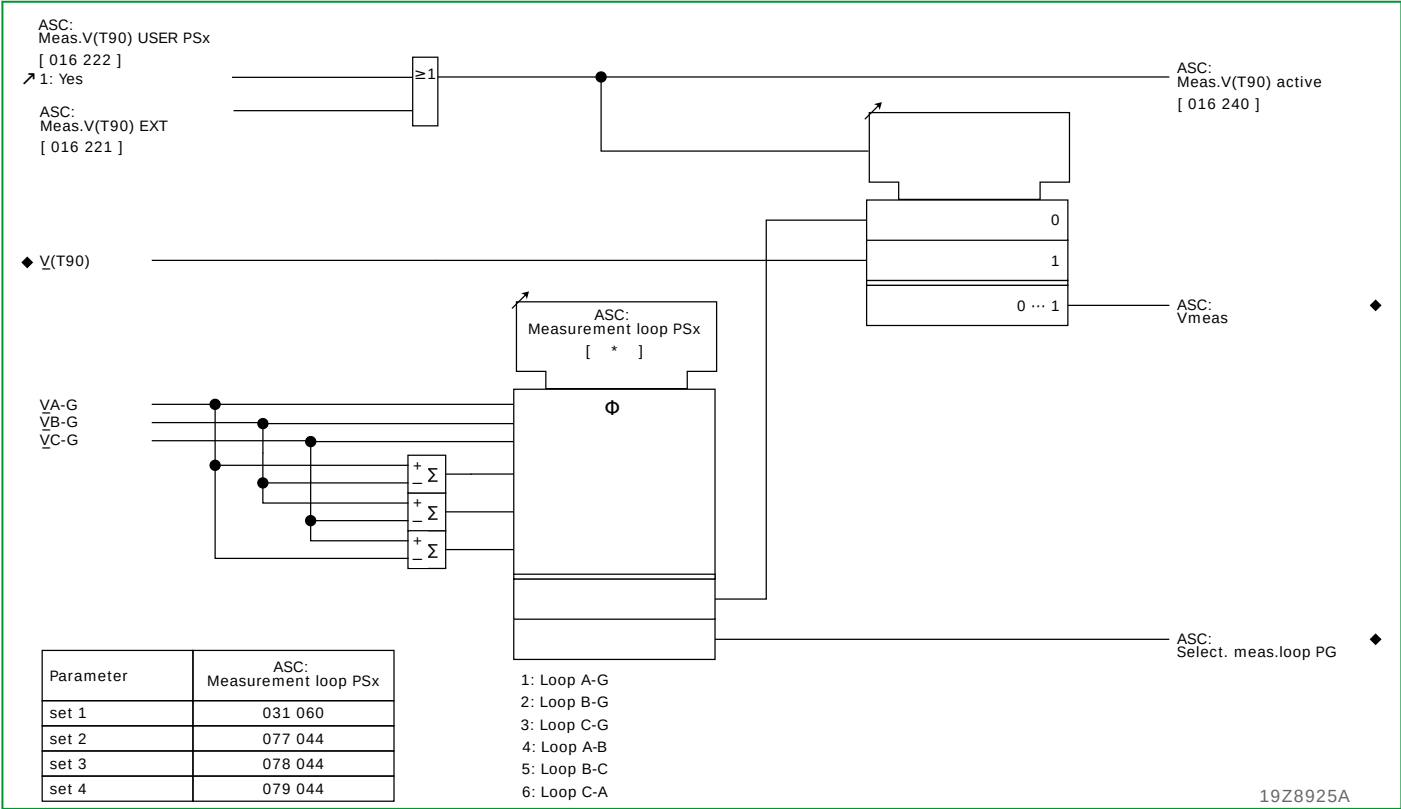


Fig. 3-226: Selecting the measurement loop.

3.31.1 Disabling and Enabling the ASC Function

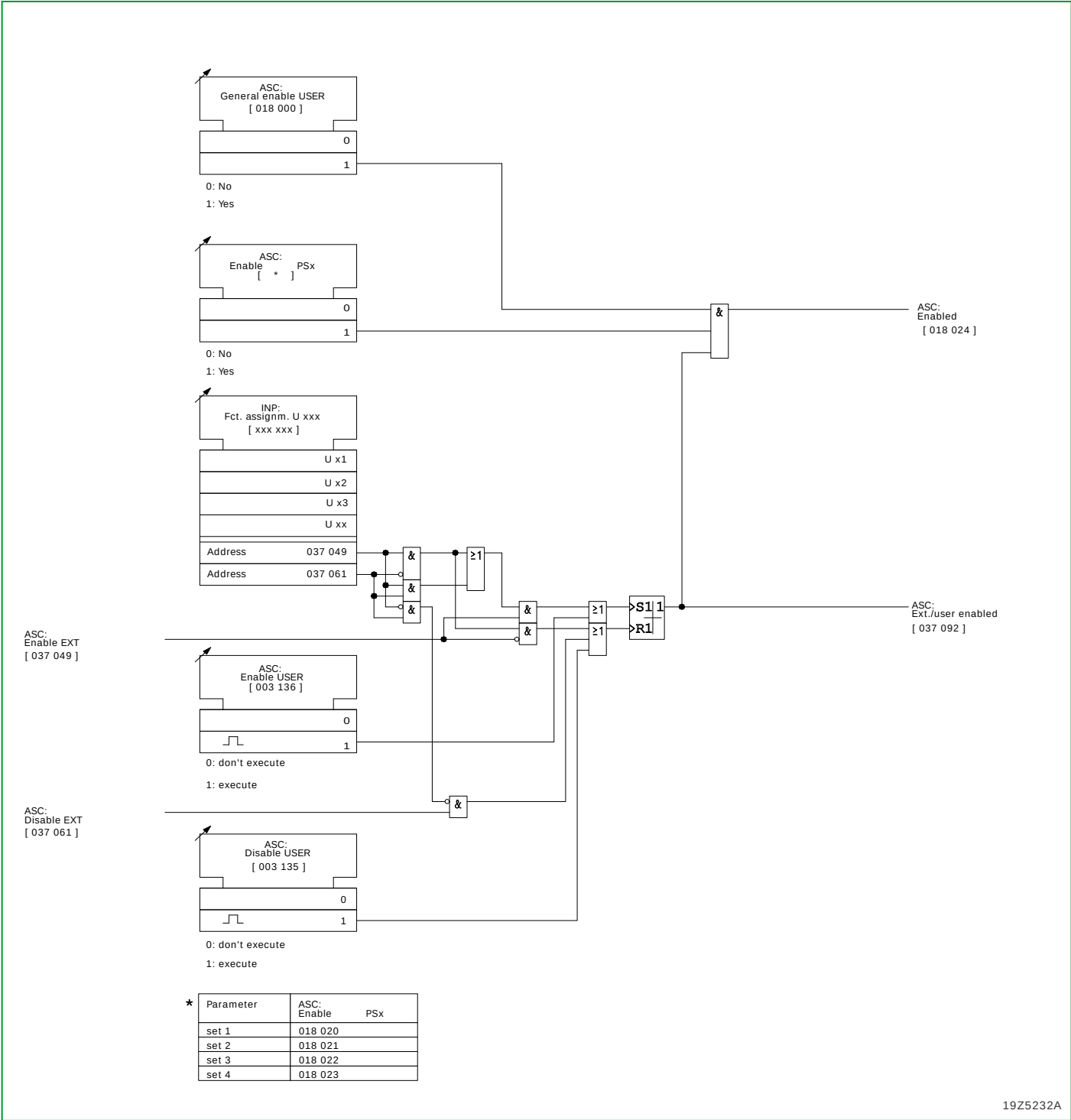


Fig. 3-227: Enabling/disabling the Automatic Synchronism Check function.

The function can be disabled or enabled using setting parameters or through binary signal inputs.

The function is enabled generally (independently of the parameter subsets) at ASC: General enable USER. It is enabled as a function of a parameter subset via ASC: Enable PSx. If these enabling functions have been activated, ASC can be disabled or enabled using setting parameters or through appropriately configured binary signal inputs. Parameters and configured binary signal inputs have equal status. If only the ASC: Enable EXT function is assigned to a binary

signal input, then the ASC will be enabled by a positive edge of the input signal and disabled by a negative edge. If only the ASC: Disable EXT function has been assigned to a binary signal input, then a signal at this input will have no effect.

If the ASC function is disabled an activation enable will always be issued.

3.31.2 ASC Readiness and Blocking

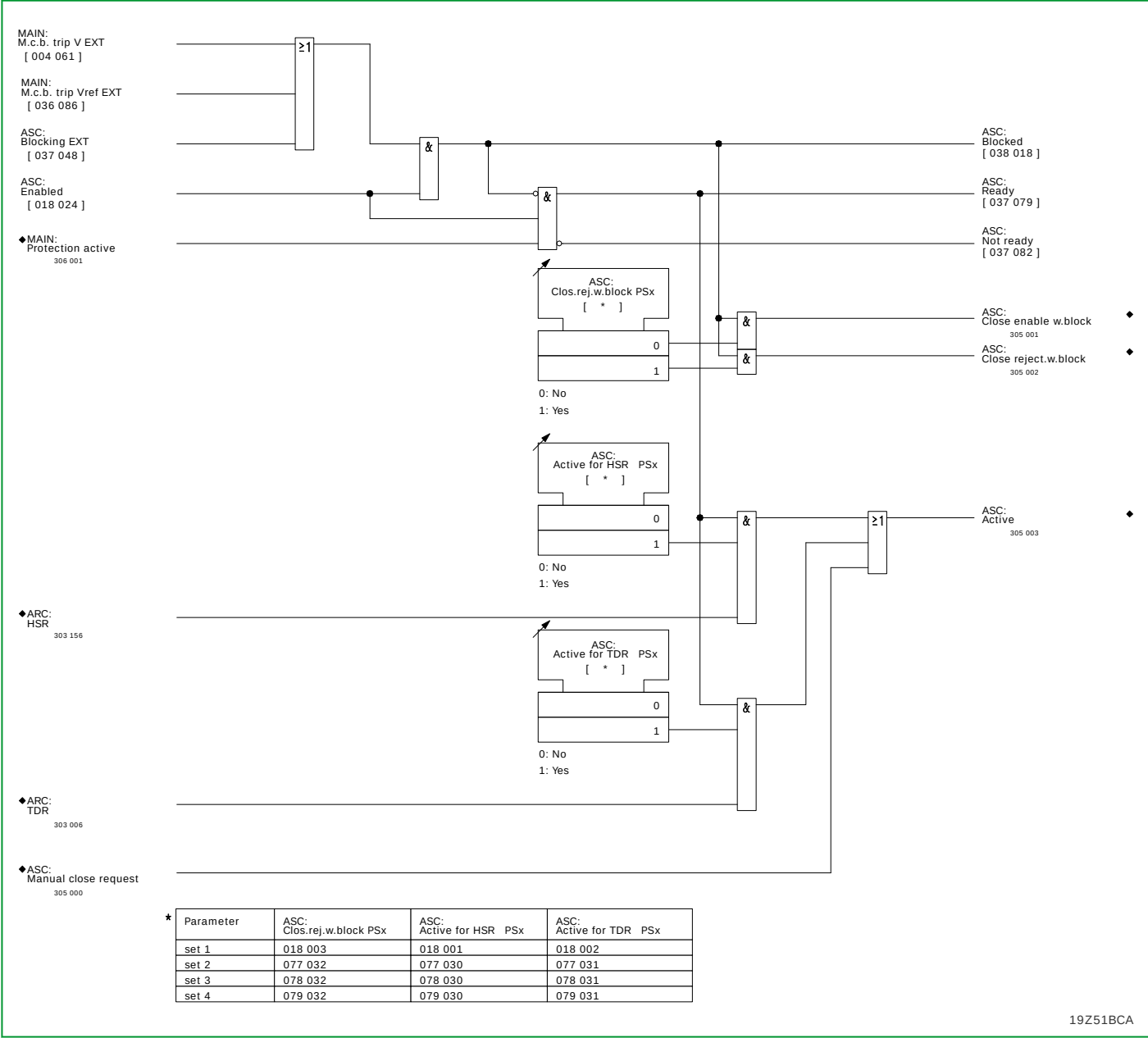


Fig. 3-228: ASC readiness and blocking.

The ASC function is ready if it is activated and enabled and if there is no blocking. Blocking can be brought about if a voltage transformer m.c.b. was tripped or by an appropriately configured binary signal input. The user can specify whether closing or reclosing will always be enabled or not (reclosure with or without a check) when the ASC function is blocked.

The user can also specify separately for high-speed reclosures (HSR) and time-delayed reclosures (TDR) whether reclosure will be carried out with or without a check.

3.31.3 Close Request

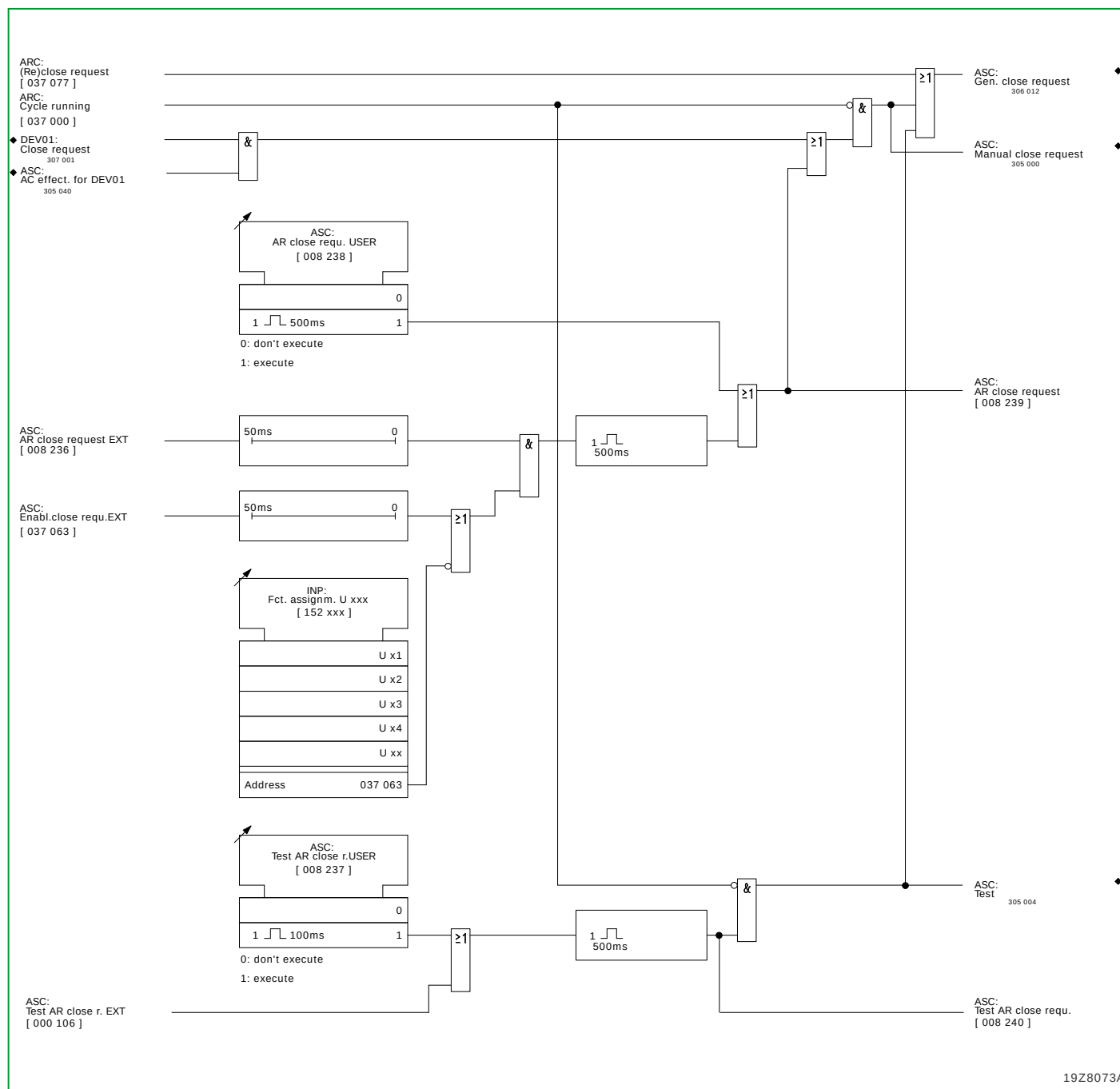


Fig. 3-229: Close request for autoreclose control.

The ASC function can be triggered by ARC, via setting parameters, from an appropriately configured binary signal input (ASC: Enabl.close requ.EXT), or via a close request from the control function. Close requests via a setting parameter, the binary signal input or the control function are accepted only if no ARC cycle is running.

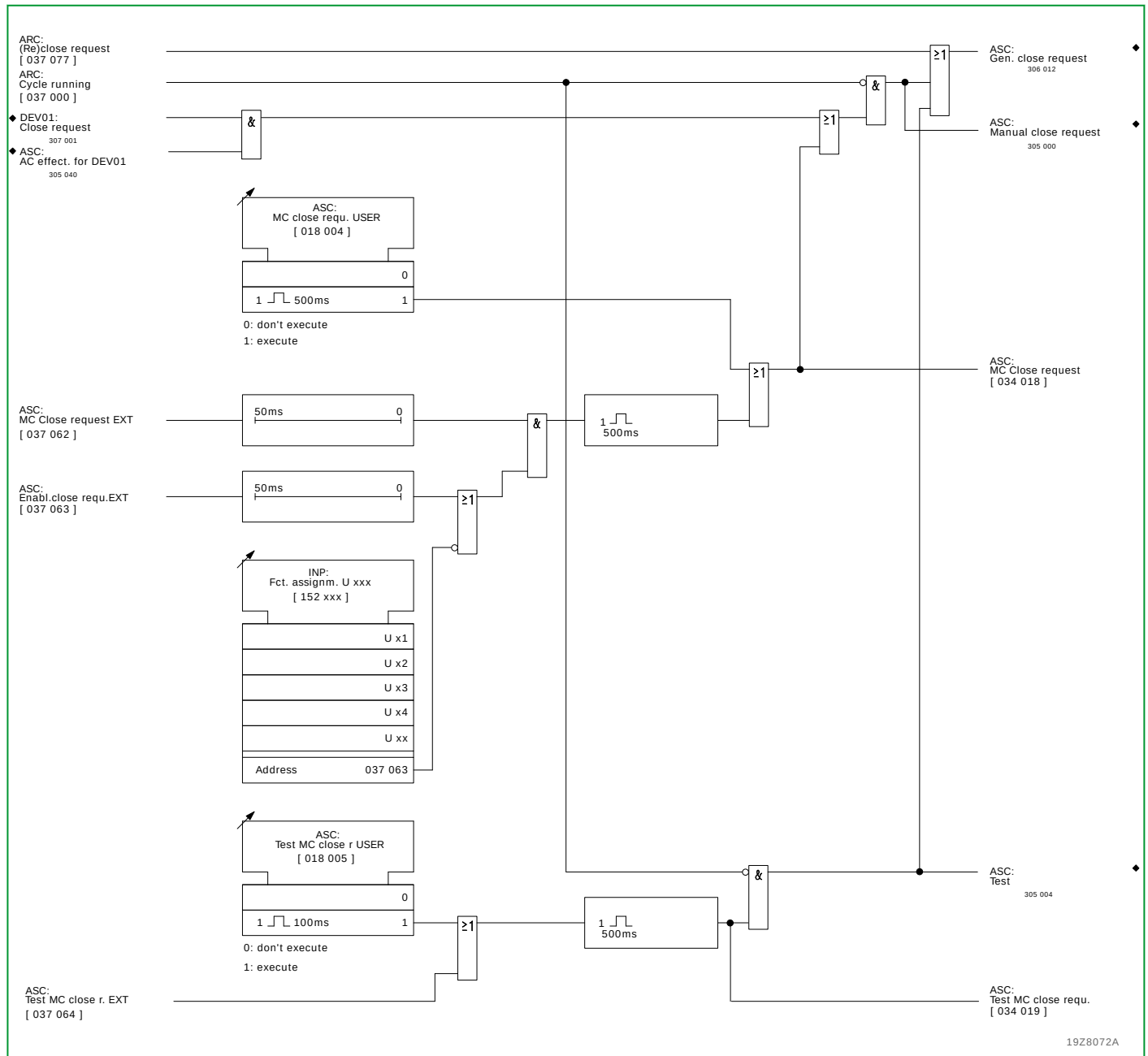


Fig. 3-230: Close request for manual close command.

The ASC operative time is started with the close request. If the close enable is issued before the ASC operative time has elapsed, the close command is issued. Otherwise an ASC: Close rejection signal is generated for 100 ms.

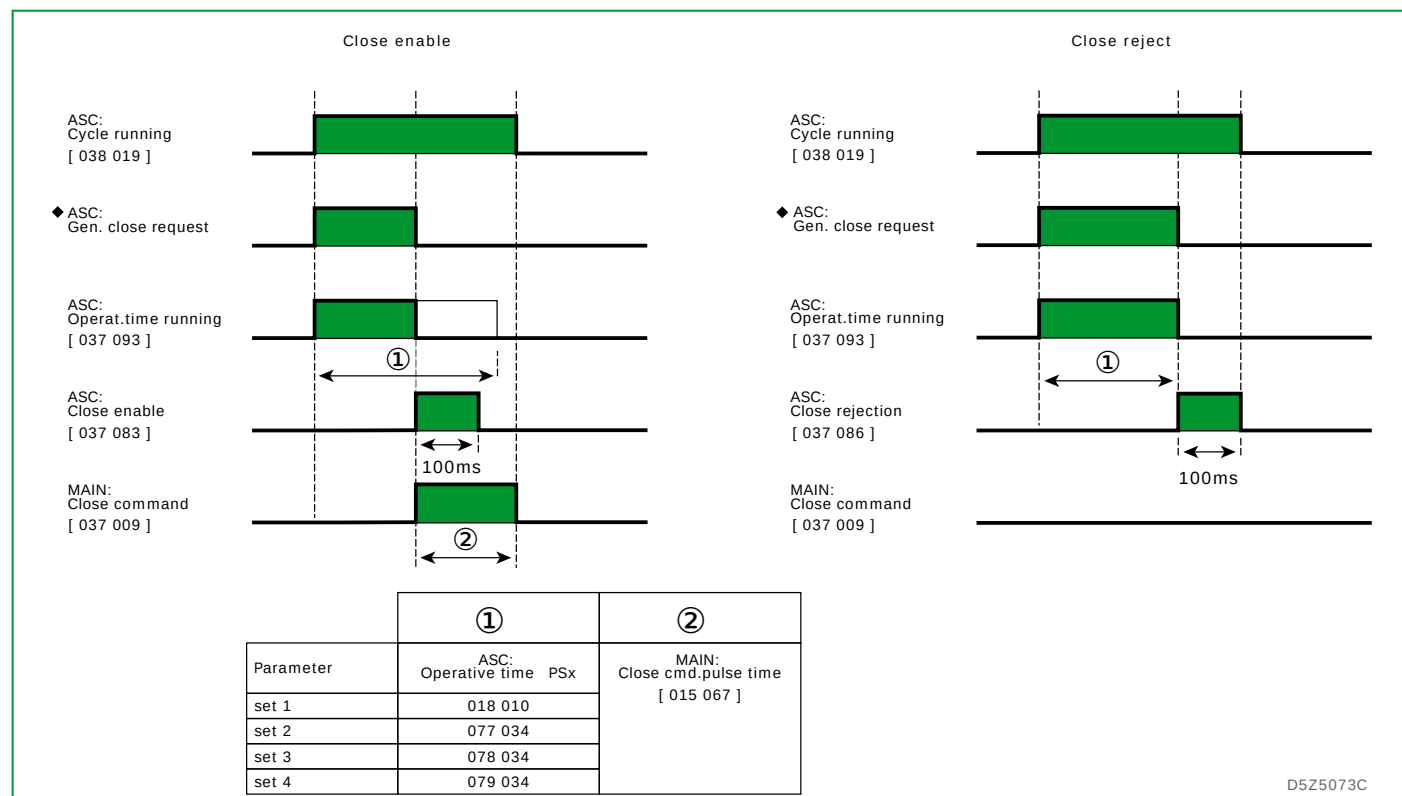


Fig. 3-231: Signal flow for a close enable and a close rejection.

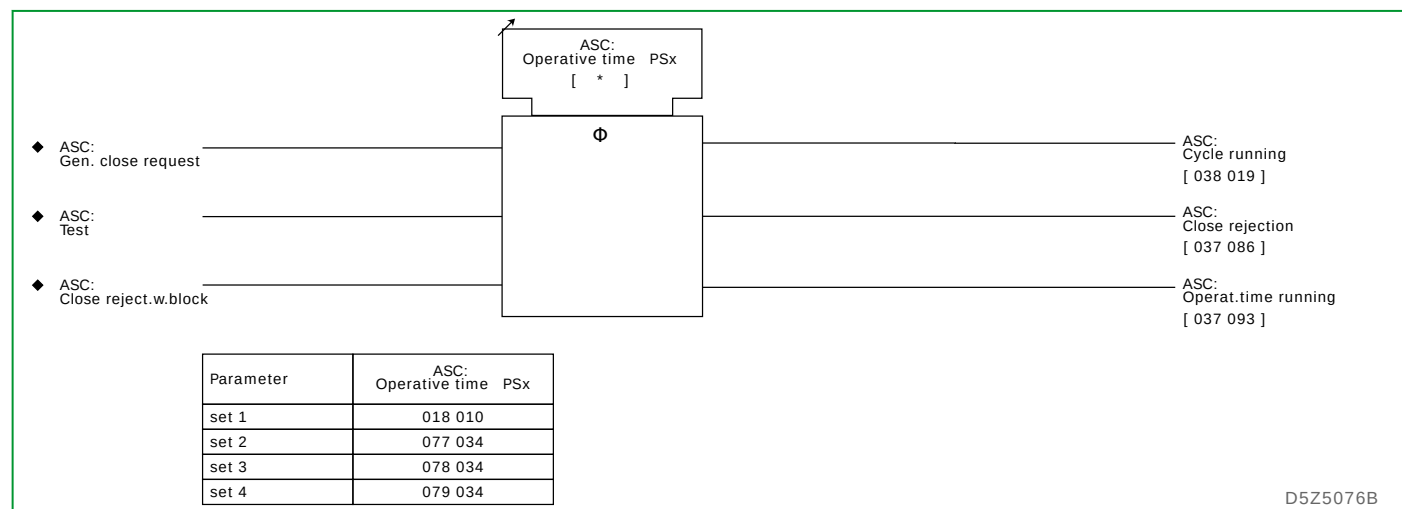


Fig. 3-232: ASC sequence control.

3.31.4

Extended Settings for the Close Enable Conditions

The close enable conditions can now be set separately for auto-reclose control and manual close command. This makes it possible to select different operating modes as well as different tolerance ranges.

Close enable conditions for Auto-reclose control	Close enable conditions for Manual close command
ASC: AR op. mode PSx	ASC: MC op. mode PSx
ASC: AR with tCB PSx	ASC: MC with tCB PSx
ASC: AR Op.mode v-chk.PSx	ASC: MC op.mode v-chk.PSx
ASC: AR V> volt.check PSx	ASC: MC V> volt.check PSx
ASC: AR V< volt.check PSx	ASC: MC V< volt.check PSx
ASC: AR tmin v-check PSx	ASC: MC tmin v-check PSx
ASC: AR V> sync.check PSx	ASC: MC V> sync.check PSx
ASC: AR delta Vmax PSx	ASC: MC delta Vmax PSx
ASC: AR delta f max PSx	ASC: MC delta f max PSx
ASC: AR delta phi max PSx	ASC: MC delta phi max PSx
ASC: AR tmin sync.chk PSx	ASC: MC tmin sync.chk PSx

The automatic reclosure setting parameters become active when a close request is issued by the integrated ARC (for an RRC, HSR or TDR) or by a close request from an external ARC device sent to the binary signal input function ASC: AR close request EXT.

3.31.5 Considering the CB Close Time

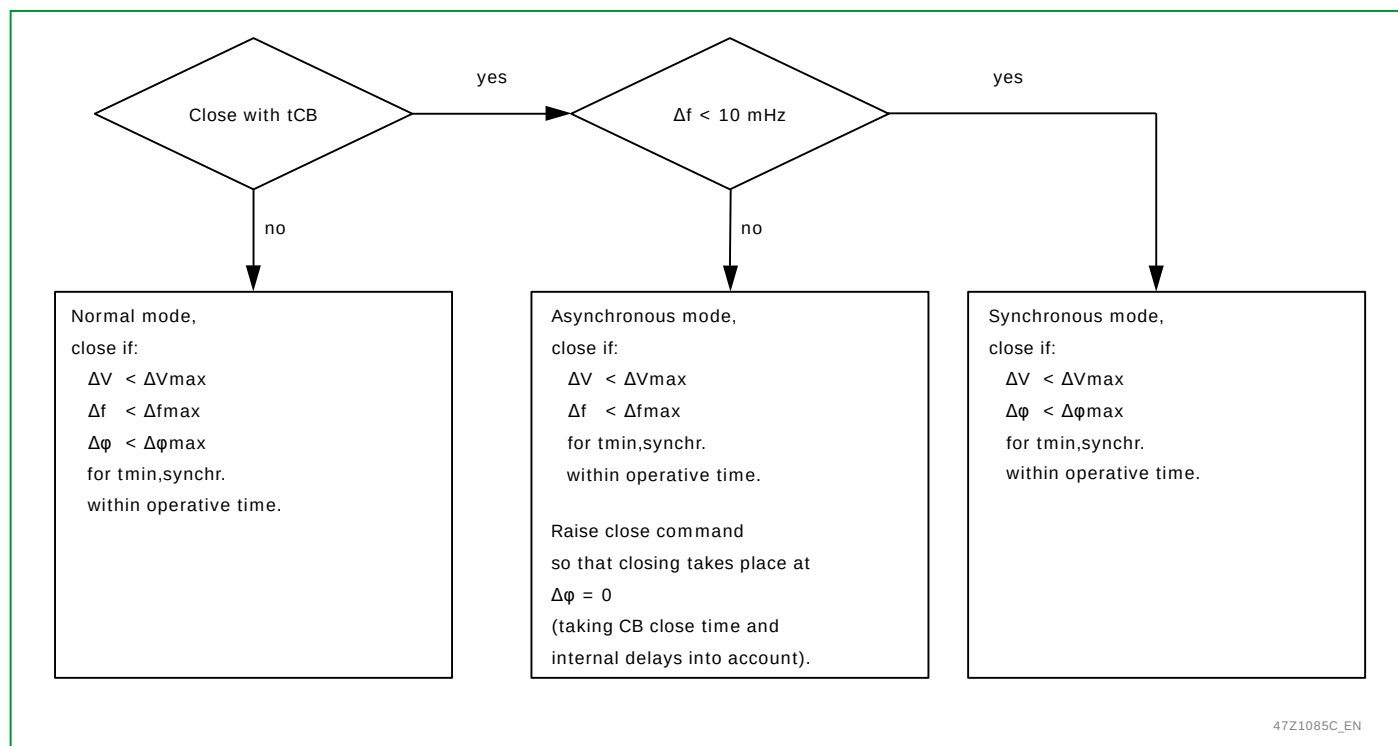


Fig. 3-233: Functional sequence and close conditions for the Synchronism check.

In slightly asynchronous power systems, setting ASC: AR with tCB PSx to Yes makes it possible to consider the circuit breaker closing time when issuing a close command.

The condition for “slightly asynchronous power systems” is given if the difference in frequencies lies within the range of $10 \text{ mHz} < \Delta f < \Delta f_{\max}$. If this condition and the voltage condition ($\Delta V < \Delta V_{\max}$) are met then the next point in time is continuously calculated at which the phasors for V_{ref} and the corresponding voltage of the three-phase system are in phase (e.g. difference in voltage phase angles approaches 0°). The close command, allowing for the set CB close time MAIN: tCB,close is then issued sooner.

3.31.6 ASC Operating Modes

The criteria for a close enable are determined by the ASC operating mode setting – (018 025) ASC: AR op. mode PSx or (000 056) ASC: MC op. mode PSx, resp.

The following operating mode settings are possible:

- Voltage-checked (see [Section 3.31.6.1, \(p. 3-299\)](#))
- Synchronism-checked (see [Section 3.31.6.2, \(p. 3-302\)](#))
- Voltage/synchronism-checked (see [Section 3.31.6.3, \(p. 3-305\)](#))

3.31.6.1 Voltage-Checked Close Enable

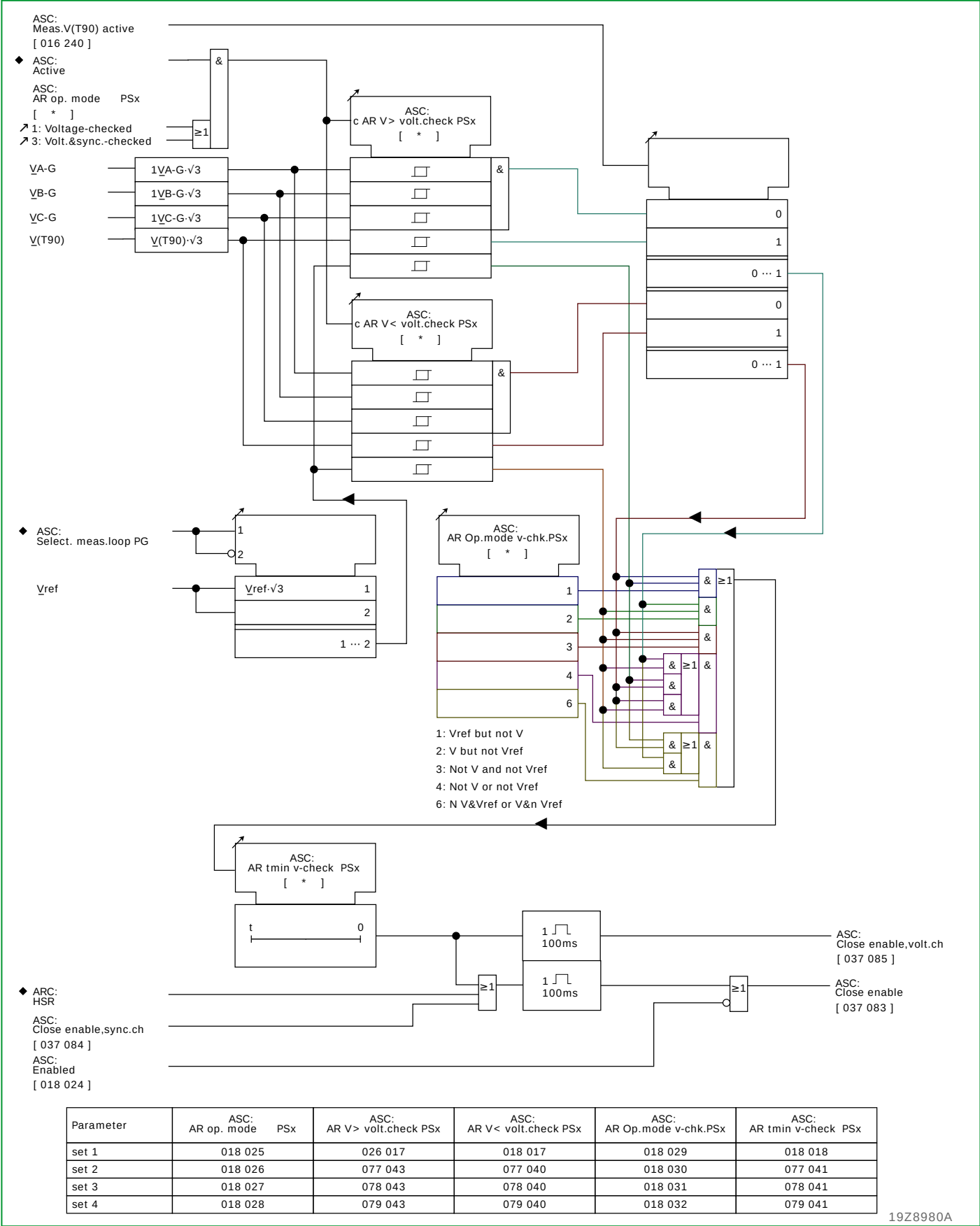


Fig. 3-234: Voltage-checked close enable for autoreclose control.

The synchronism-checked close enable can be bypassed using the voltage-checked close enable without affecting the former.
 For this purpose the voltages are monitored to determine whether they exceed or fall below the set threshold values.

ASC: AR V> volt.check PSx	ASC: MC V> volt.check PSx
ASC: AR V< volt.check PSx	ASC: MC V< volt.check PSx

Depending on the operating mode selected for the voltage check, all three phase-to-ground voltages (or – alternatively, see above – the voltage measured at T90) need to exceed or fall below the set value in order to meet the condition for voltage-checked closing. If the conditions corresponding to the set operating mode for the voltage synchronism check are met, then the close enable is issued after the set minimum time has elapsed.

ASC: AR tmin v-check PSx	ASC: MC tmin v-check PSx

The following operating modes for voltage checking can be selected separately for each parameter subset:

- *Vref but not V*
- *V but not Vref*
- *Not V and not Vref*
- *Not V or not Vref*
- *N V&Vref or V&n Vref*

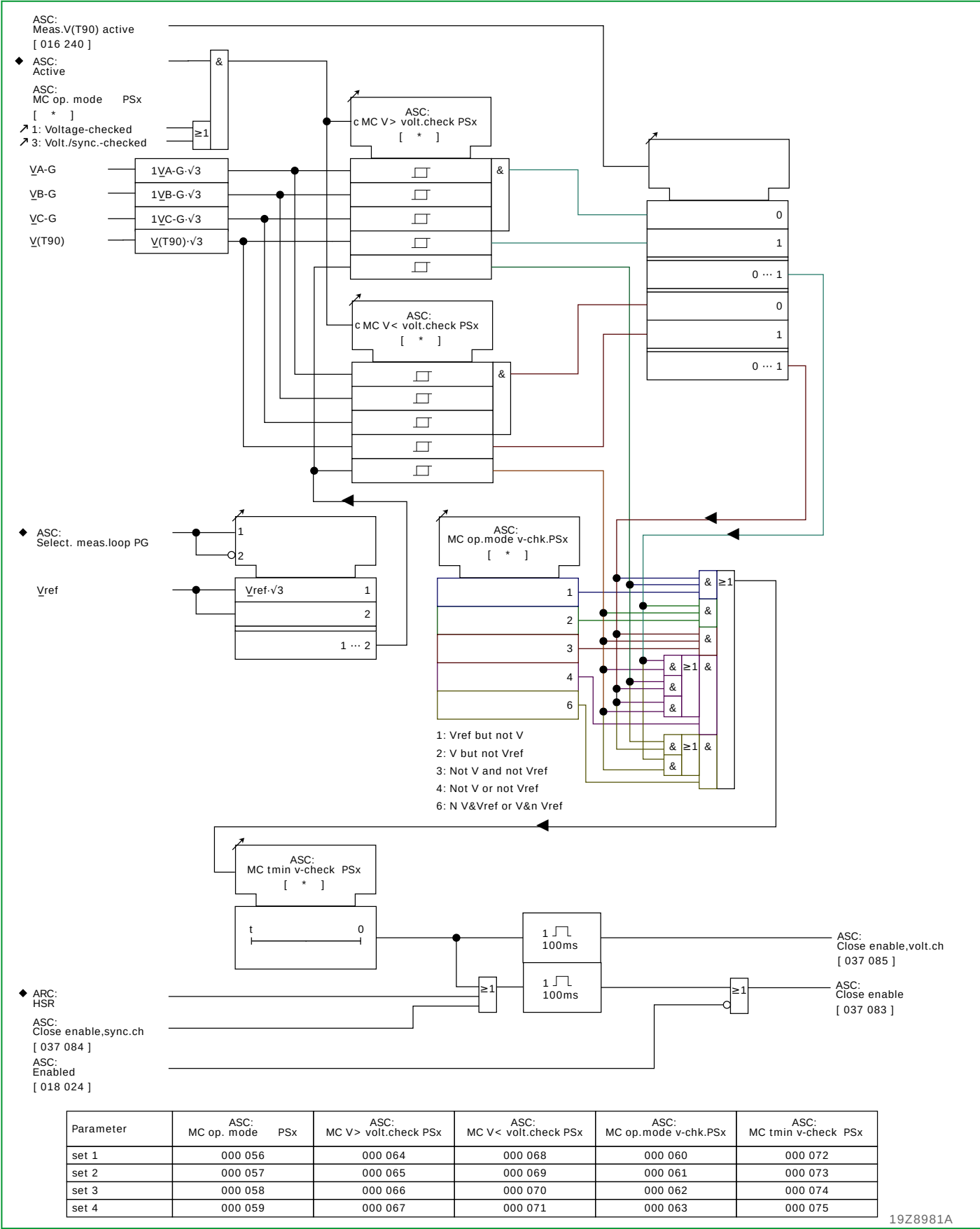


Fig. 3-235: Voltage-checked close enable for autoreclose control for manual close control.

3.31.6.2 Synchronism-Checked Close Enable

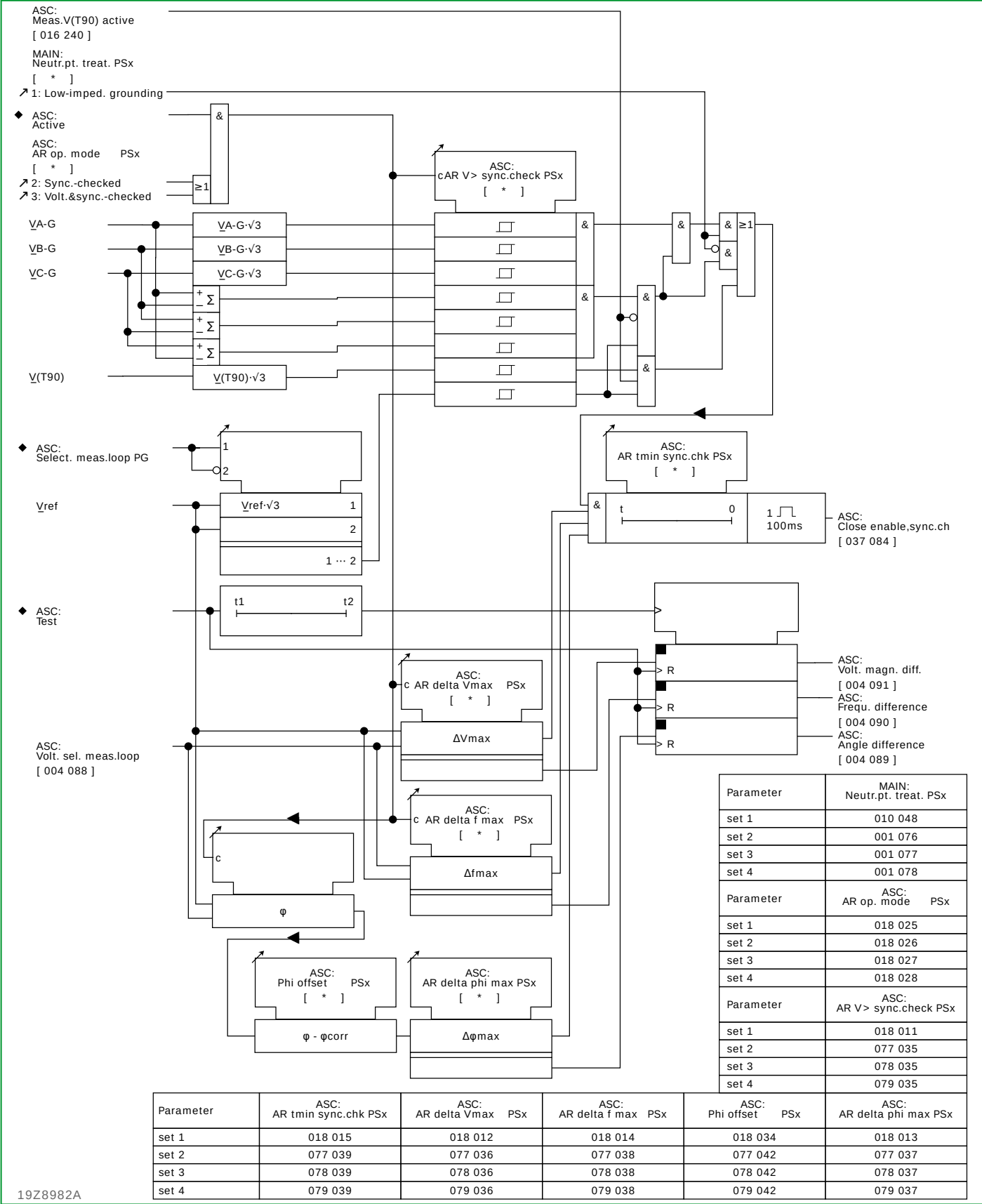


Fig. 3-236: Synchronism-checked close enable for auto-reclose control.

Before a close enable signal is issued, the ASC checks the voltages for synchronism. Synchronism is recognized if the following conditions are met simultaneously:

- The three phase voltages and the reference voltage must exceed the set threshold value.

When with a three-phase voltage the setting of MAIN: Neutr.pt. treat. PSx is *Low-imped. grounding* both the phase-to-ground and the phase-to-phase voltages are checked.

If the setting is *Isol./res.w.start.PG* only the phase-to-phase voltages are checked.

If the ASC is set to use the T90 voltage instead of the phase voltages (see [Fig. 3-226](#), (p. 3-291), [Section 3.31.6.1](#), (p. 3-299)), then the voltage measured at T90 and the reference voltage must exceed the set threshold value.

ASC: AR V> sync.check PSx	ASC: MC V> sync.check PSx

- The difference in magnitude between measuring voltage and reference voltage must not exceed the set threshold value.

ASC: AR delta Vmax PSx	ASC: MC delta Vmax PSx

- The frequency difference between measuring voltage and reference voltage must not exceed the set threshold value.

ASC: AR delta f max PSx	ASC: MC delta f max PSx

- The angle difference between measuring voltage and reference voltage must not exceed the set threshold value. (In these comparisons the set offset angle ASC: Phi offset PSx is taken into account.)

ASC: AR delta phi max PSx	ASC: MC delta phi max PSx

If these conditions are met for at least the set time ASC: AR tmin sync.chk PSx or ASC: MC tmin sync.chk PSx, respectively, then a close enable signal is issued. The ASC operating time for the determination of differences in voltage, angle, and frequency is approximately 100 ms.

The voltage magnitude difference, angle difference, and frequency difference are stored as measured synchronism data at the time the close request is issued. In the event of another close request, they are automatically overwritten by the new data.

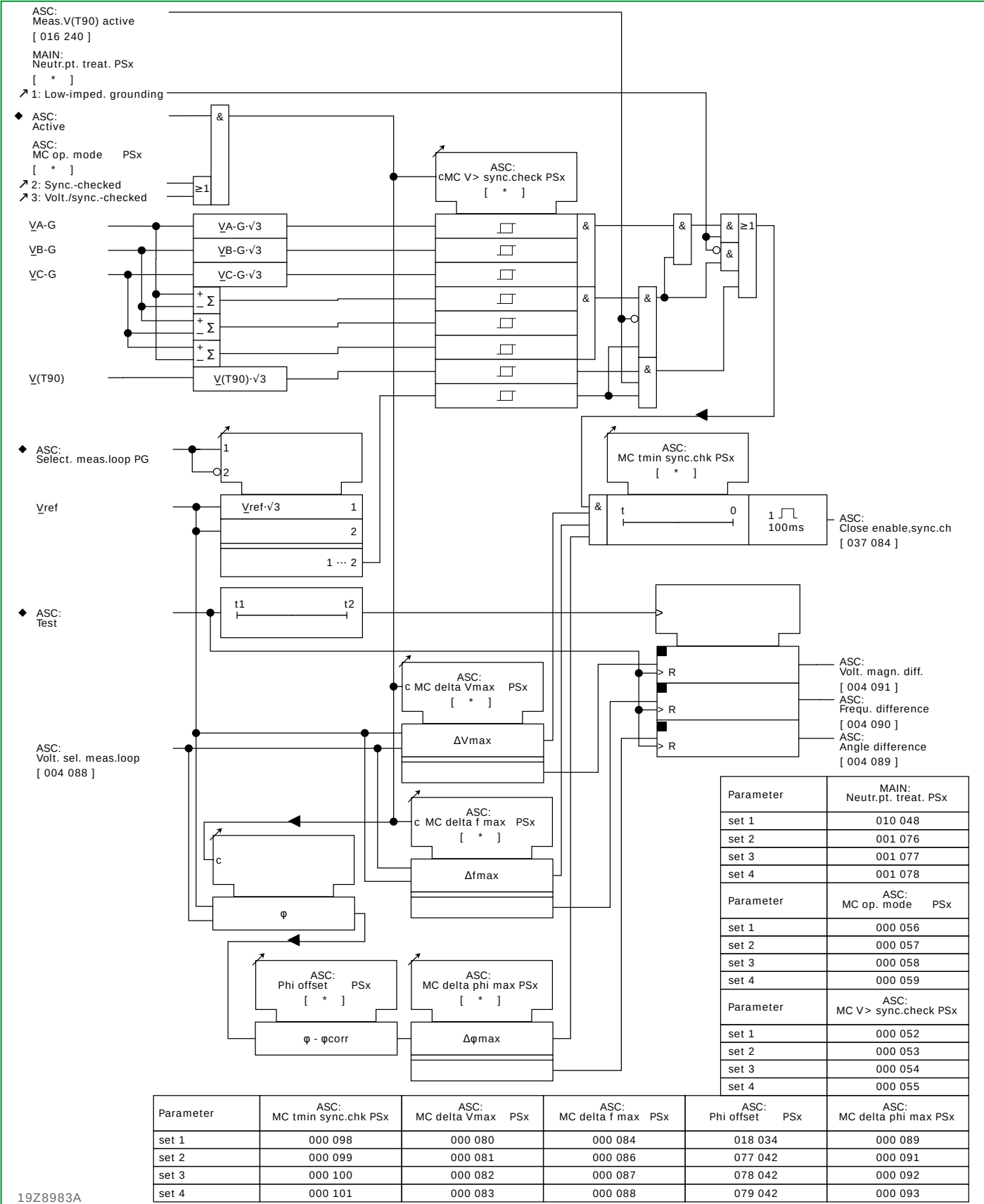


Fig. 3-237: Synchronism-checked close enable for manual close command.

3.31.6.3 Voltage/Synchronism-Checked Close Enable

If this setting has been selected, then the close enable signal is issued if the conditions for voltage- or synchronism-checked closing are met.

3.31.7 Testing the ASC Function

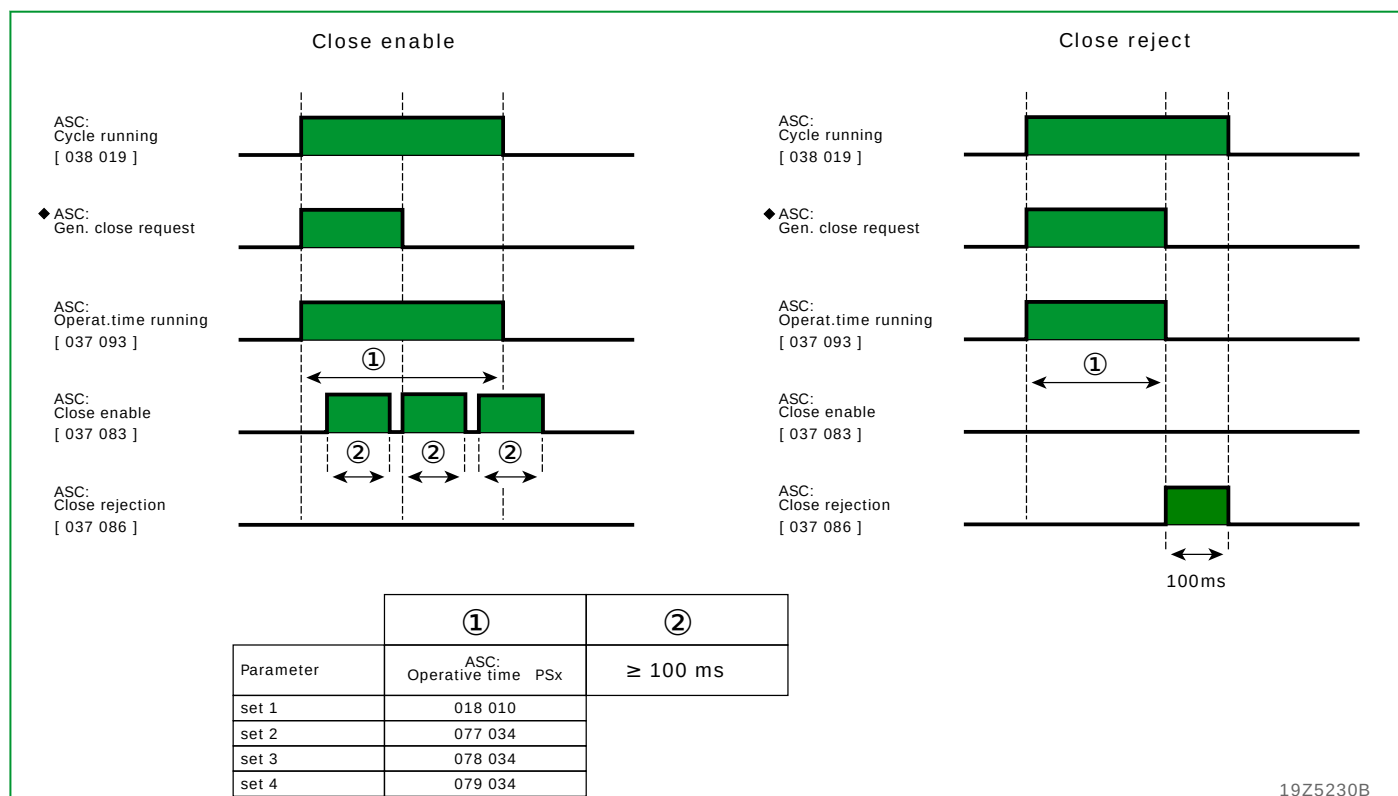


Fig. 3-238: ASC sequence during testing.

For test purposes a close request can be issued via a setting parameters or an appropriately configured binary signal input (see Fig. 3-238, (p. 3-305)). In this case no close command is issued and it is not counted.

Separate triggering parameters are available for testing the function with parameters for manual (MC) and automatic (AR) reclosure.

Triggering parameter for auto-reclose control	Triggering parameter for manual close command
ASC: AR close requ. USER	ASC: MC close requ. USER
ASC: AR close request EXT	ASC: MC Close request EXT
ASC: AR close request	ASC: MC Close request
ASC: Test AR close r. USER	ASC: Test MC close r. USER
ASC: Test AR close r. EXT	ASC: Test MC close r. EXT
ASC: Test AR close requ.	ASC: Test MC close requ.

The ASC cycle and the operating time are started by the test close request. The network synchronism is checked during the whole operating time and ASC: Close enable is set accordingly. If at the end of the operate time no network synchronism is registered, a 100 ms signal ASC: Close rejection is issued.

3.31.8 Integrating the ASC Function into the Control and Monitoring of Switchgear Units

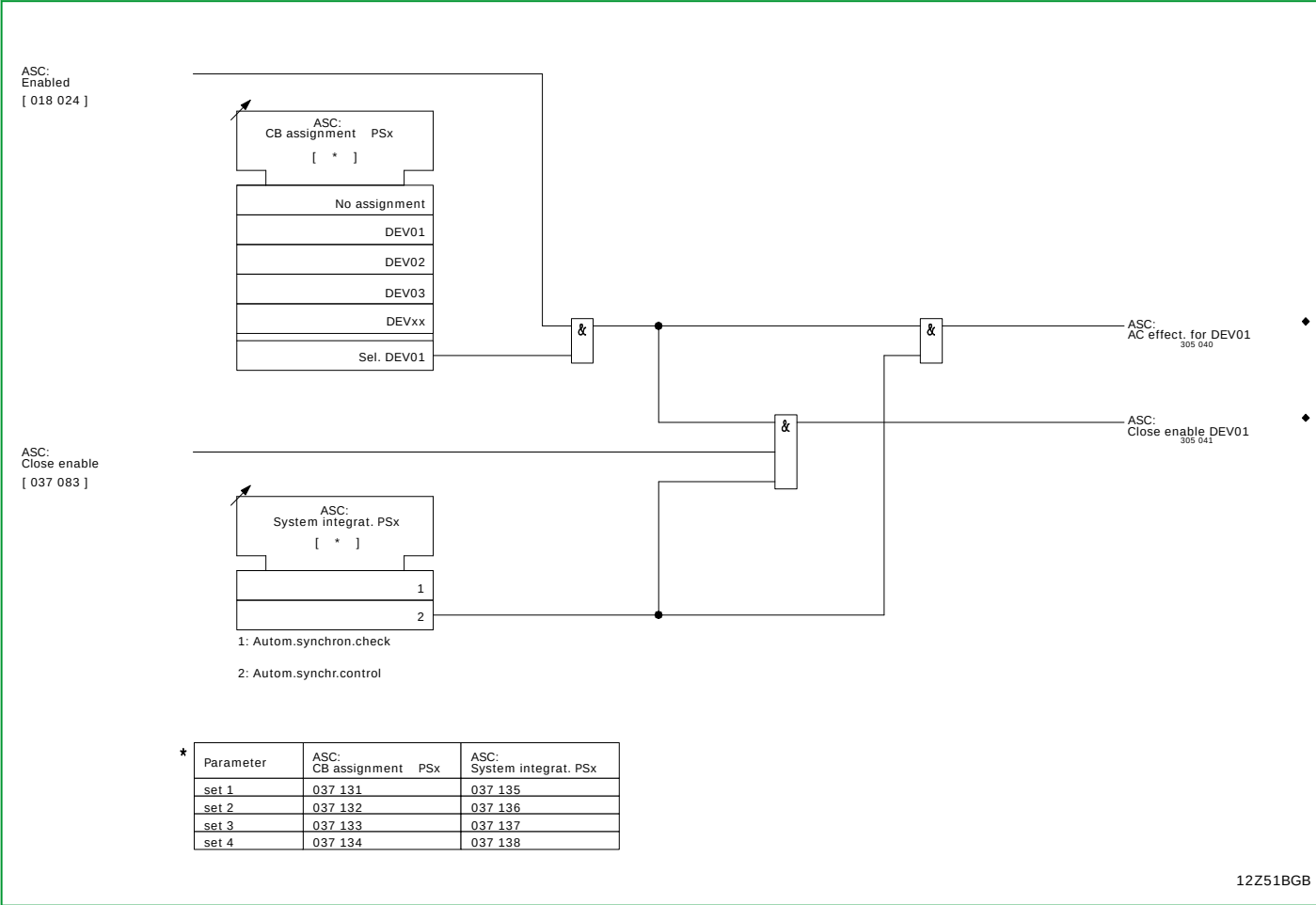


Fig. 3-239: Integrating the ASC function into the control and monitoring of switchgear units.

ASC triggering by a close request from the control functions is also possible. This requires that the circuit breaker is assigned to an external device and that the ASC system integration is set to *Autom.synchr.control*. If the control function issues a close request then the close command for the circuit breaker requires the ASC: Close enable (see Section 3.54.6.6, (p. 3-501)).

However if ASC: System integrat. PSx is set to *Autom.synchron.check* ASC will not interfere with any switching commands. Data generated and continuously updated by the ASC function is transmitted – when configurations have been set accordingly – to the central control station, where operators may make decisions as to which external device is to be given a switching command.

3.31.9 Measured Values Obtained by ASC

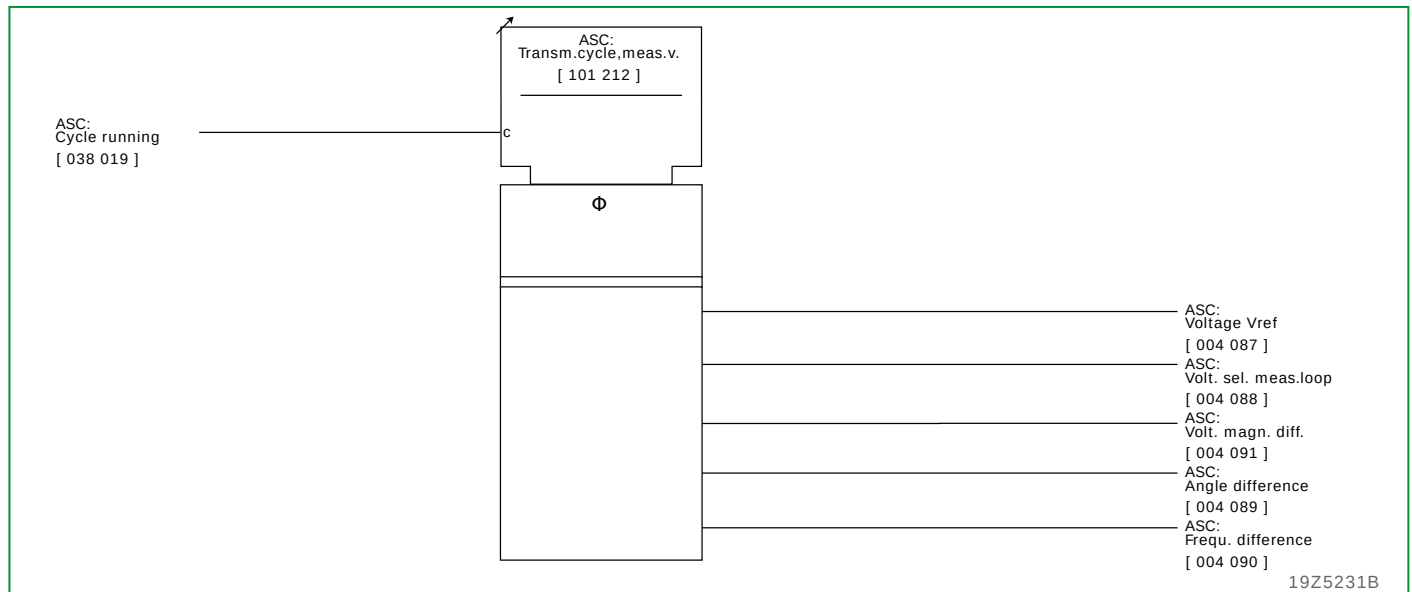


Fig. 3-240: Measured values obtained by ASC.

The following measured values are obtained and calculated during an ASC cycle and are transmitted during a set cycle time:

- Voltage from the reference voltage channel
- Voltage from the selected measuring loop
- Difference in phase voltage magnitudes
- Difference in phase angles
- Frequency difference

Outside of the ASC cycle the measured values have the status of *Not measured*.

3.31.10 ASC Counters

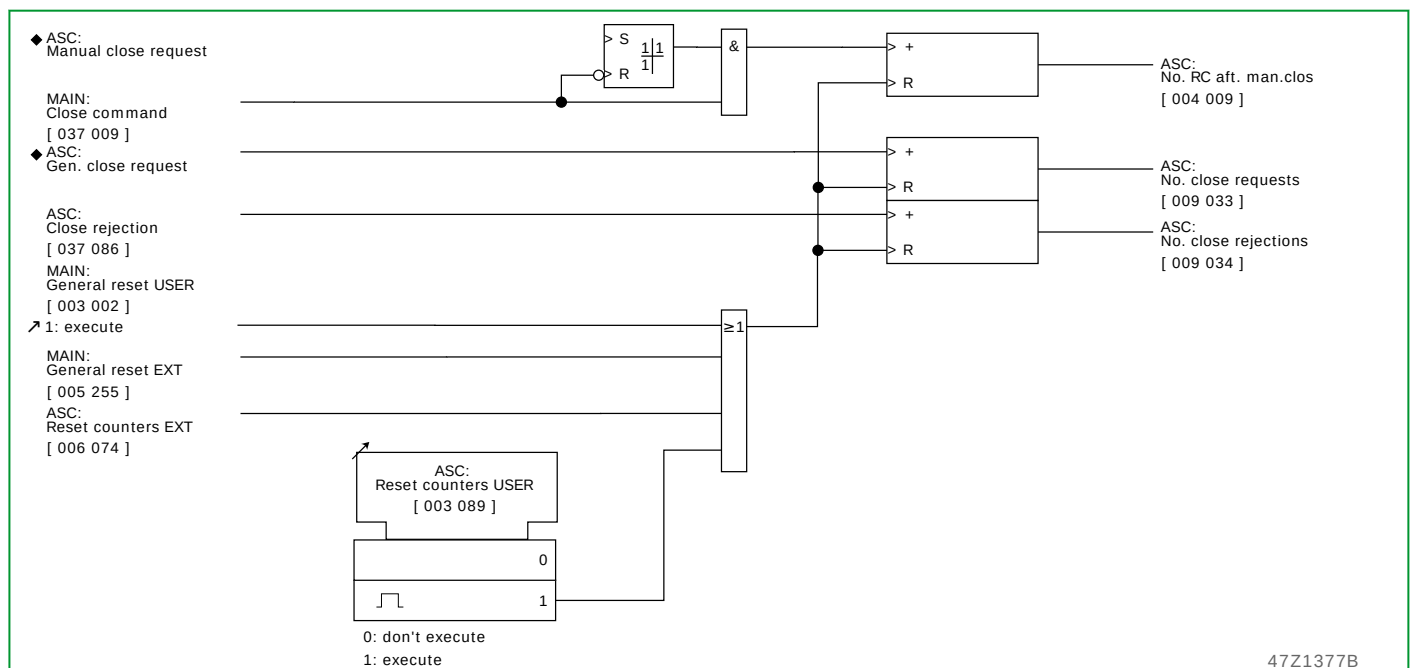


Fig. 3-241: ASC counters.

The following ASC signals are counted:

- Number of reclosures after a close request via setting parameters or an appropriately configured binary signal input
- Number of close requests
- Number of close rejections

The counters can either be reset individually (at the address at which they are displayed) or as a group.

3.32 Ground fault (short-circuit) protection (Function Group GFSC)

In the event of single-phase high-resistance faults, the measured fault data are often insufficient for fault detection and selective clearing by the distance protection function. To cover for this situation, 'ground fault (short-circuit) protection' is integrated into the protection device as a highly sensitive backup protection function. Consequently, ground fault (short-circuit) protection is operating in parallel with and independently of distance protection.

3.32.1 Disabling or Enabling Ground Fault (Short-Circuit) Protection

The function can be disabled or enabled using setting parameters or through binary signal inputs.

The activation of the function is enabled generally (independently of parameter subsets) via GFSC: General enable USER. It is enabled as a function of a parameter subset at GFSC: Enable PSx. If these enabling functions have been activated, ground fault (short-circuit) protection (GFSC) can be disabled or enabled via setting parameters or through appropriately configured binary signal inputs. The local control panel or operating program and the binary signal inputs have equal status in this regard. If only the GFSC: Enable EXT function is assigned to a binary signal input, then ground fault (short-circuit) protection (GFSC) is enabled by a positive edge of the input signal and it is disabled by a negative edge. If only the GFSC: Disable EXT function is assigned to a binary signal input, then a signal at this input will have no effect.

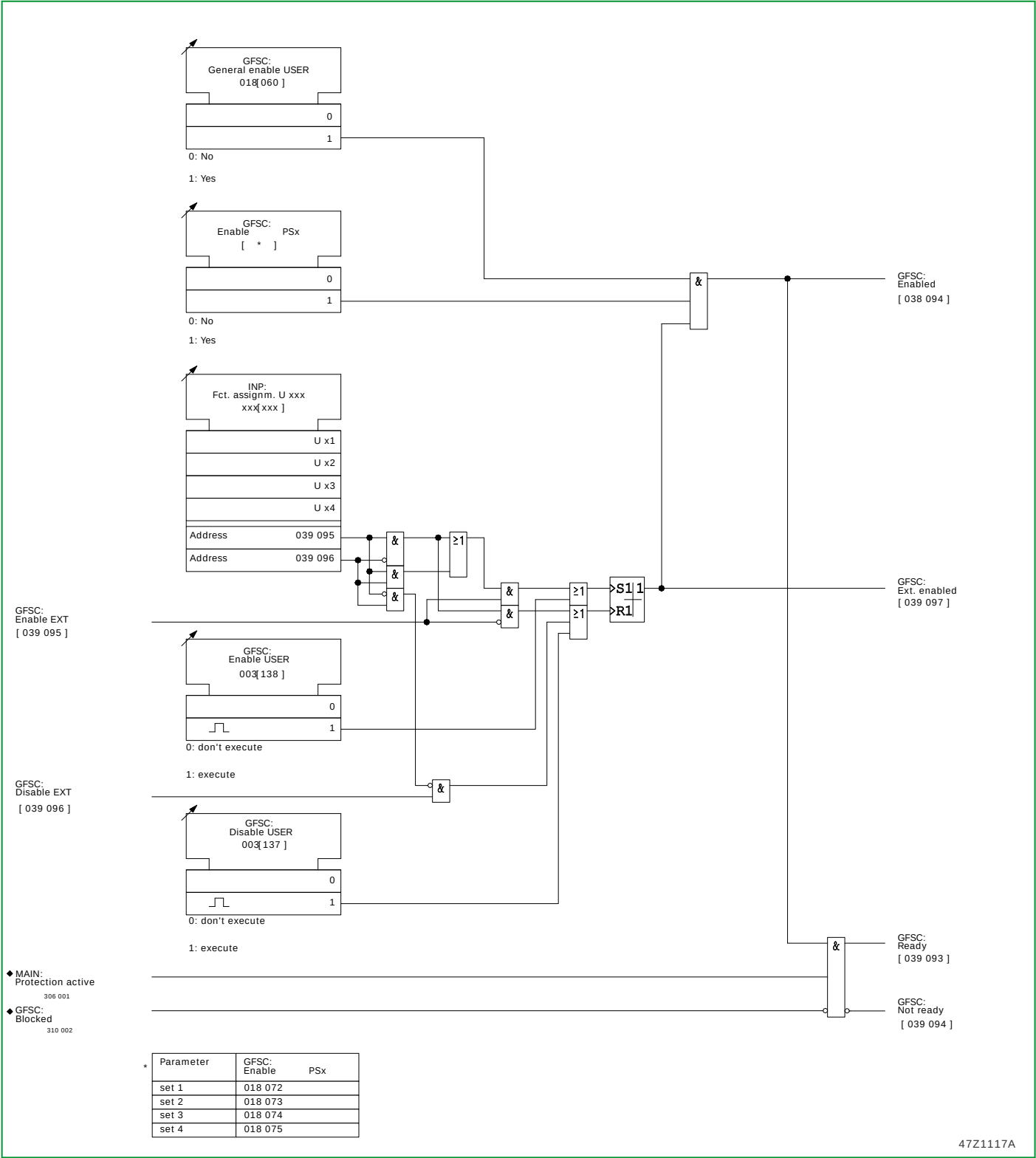


Fig. 3-242: Disabling or enabling ground fault (short-circuit) protection.

3.32.2 Measured Values from the Ground Fault (Short-Circuit) Protection

Measured variables for the GFSC function

Depending on the setting the neutral-displacement voltage used is either the value calculated by the P433 or the measured value of the neutral-point displacement voltage.

As a value for the calculated neutral-displacement voltage, ground fault (short-circuit) protection uses measurements of the same phase-to-ground voltages measured by distance protection. From these voltages the P433 calculates the neutral-displacement voltage V_{NG} .

With the second option (measured value), it is possible to establish ground fault (short-circuit) protection (GFSC) and its associated ground fault (short-circuit) protection signaling (GSCSG) irrespective of the installed system voltage transformers.

As the measured value for the neutral-point displacement voltage, ground fault (short-circuit) protection (GFSC) uses the neutral-displacement voltage formed externally via the fourth voltage measuring input, for example the neutral-displacement voltage from the open delta winding of the voltage transformers (see [Section 3.13.1, \(p. 3-91\)](#))

The residual current I_N is drawn from a separate transformer in the P433 that is looped into the phase current transformer neutral or connected to a Holmgreen group. The connection example shown in [Section 3.13.1, \(p. 3-91\)](#) shows the transformer looped into the current transformer neutral.

3.32.3

Blocking Ground Fault (Short-Circuit) Protection

If the calculated value for the neutral-displacement voltage is used then ground fault (short-circuit) protection is blocked should the signal MCMON: Meas. circ. V faulty = Yes is present.

With the second option (measured value) GFSC is not blocked by this signal as an other measuring circuit is used. The signal MAIN: M.c.b. trip VNG EXT is used instead.

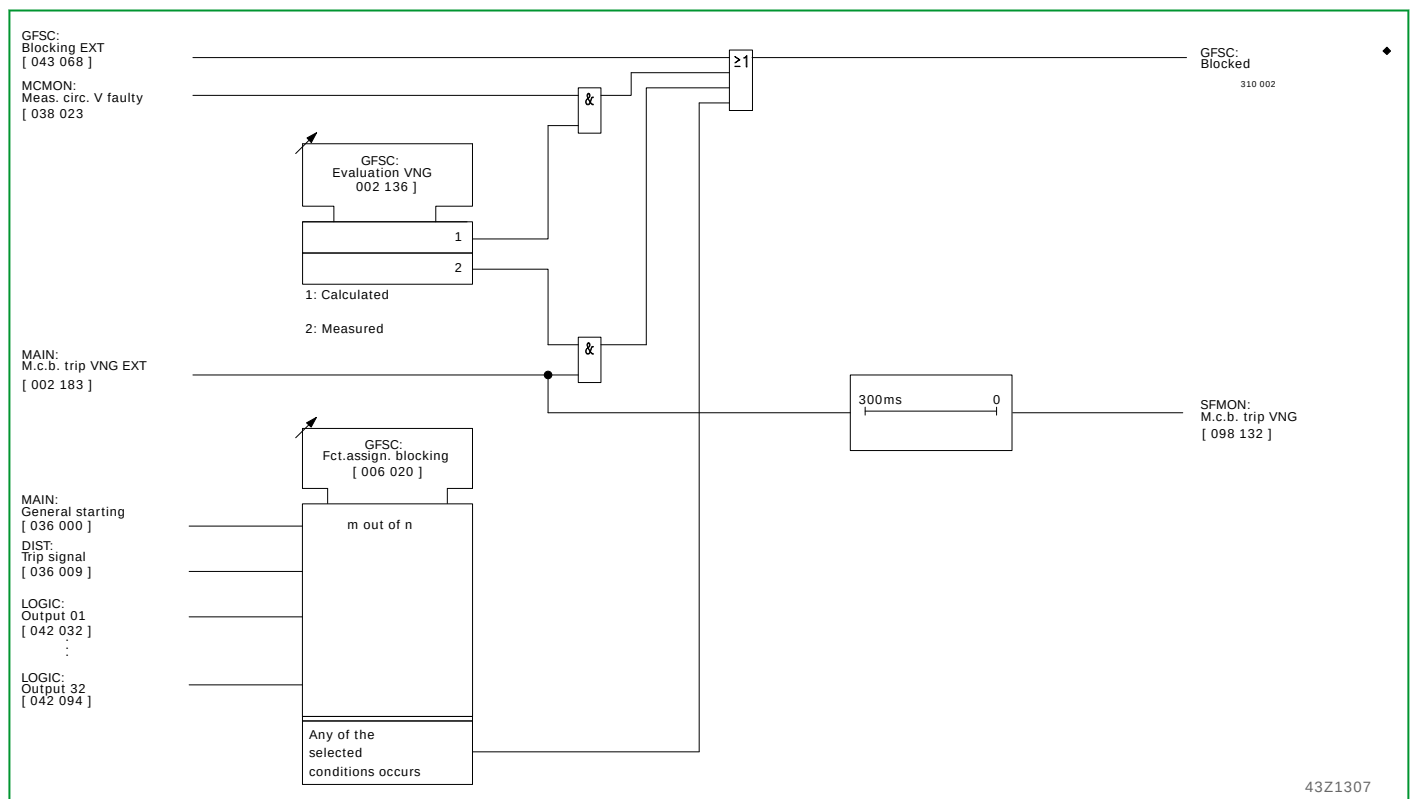


Fig. 3-243: Blocking ground fault (short-circuit) protection.

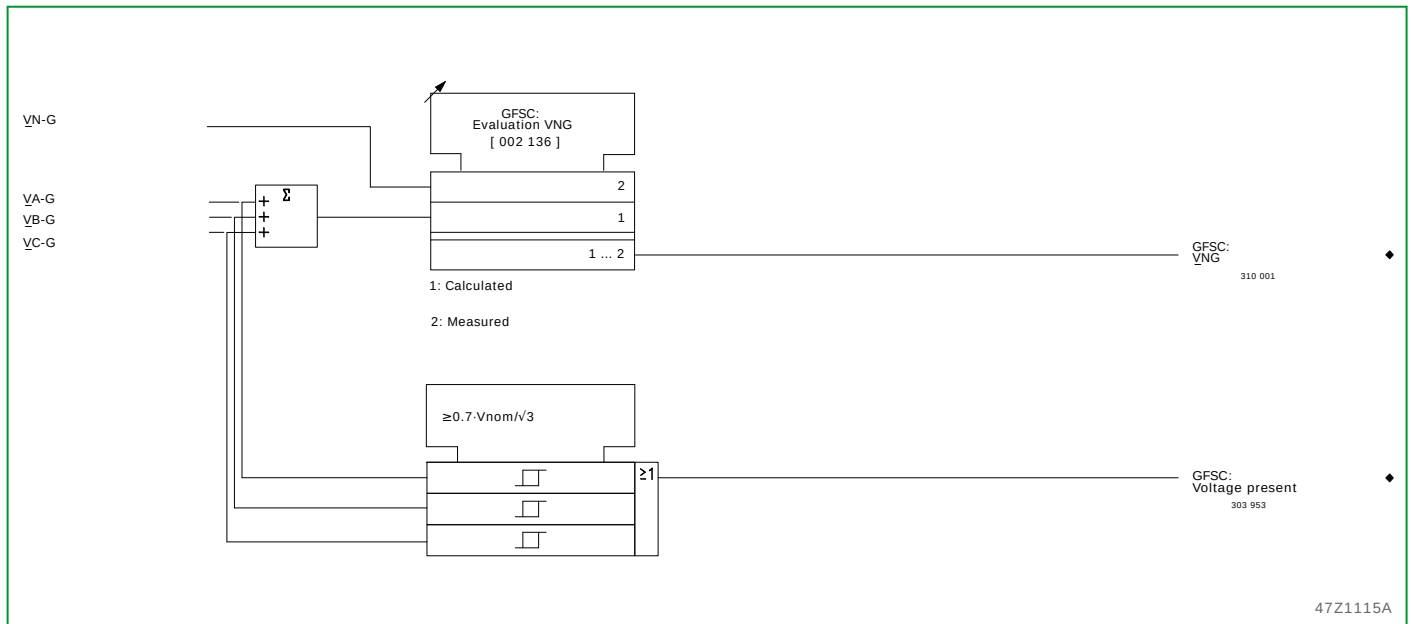


Fig. 3-244: Selecting the measured variable.

3.32.4

Starting

The digitally filtered fundamental waves of current and voltage are measured. They are monitored to determine whether they exceed set thresholds (GFSC: IN > and GFSC: VNG >). If both thresholds have been exceeded, a settable timer stage (GFSC: Start. oper. delay) is started. Once the trigger has dropped out, the starting persists until the settable release delay (GFSC: Start. releas. delay) has elapsed. Directional measurement is enabled if the current reaches 70% of the set threshold (GFSC: IN >) and the voltage exceeds the trigger threshold (GFSC: VNG >).

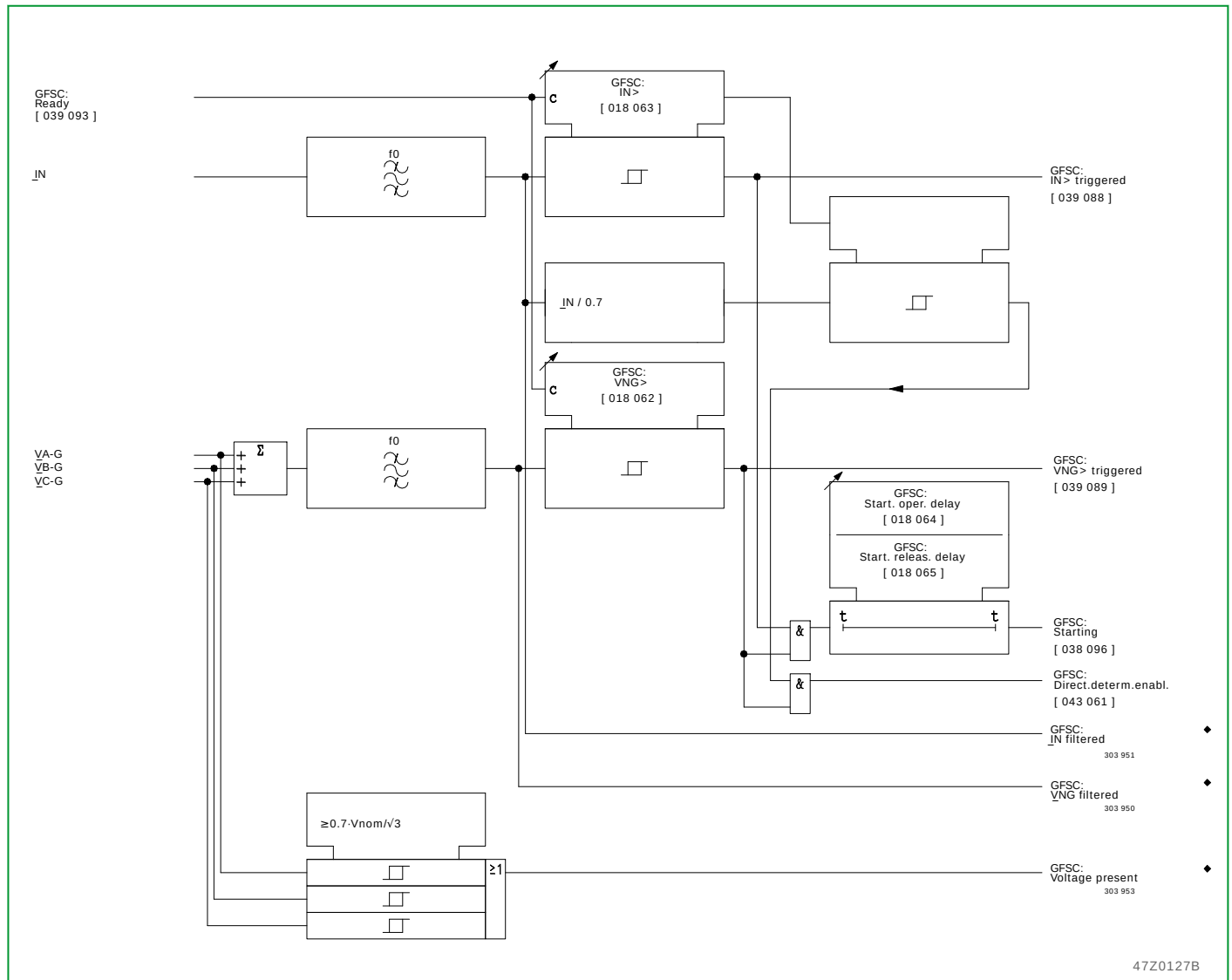


Fig. 3-245: Starting.

3.32.5

Directional Tripping

The P433 determines the angle between the residual current and the neutral-displacement voltage for the direction determination. The measured angle is displayed. The position of the straight line separating forward and backward (reverse) directions is determined by setting GFSC: Angle phi N. A forward or backward (reverse)-directional decision results if the following angle conditions are met:

Forward direction: $(90^\circ + \varphi_G) \leq \varphi < (270^\circ + \varphi_G)$

Backward (reverse) direction: $(90^\circ + \varphi_G) \geq \varphi > (270^\circ + \varphi_G)$

where:

φ : Measured angle between the residual current and the neutral-point displacement voltage

φ_G : Setting for GFSC: Angle phi N

The directional decisions (GFSC: Fault forward / LS and GFSC: Fault backward / BS) are followed by timer stages GFSC: t1 (forward) and GFSC: t2 (backward). Once the timer stages have elapsed, a trip signal is issued.

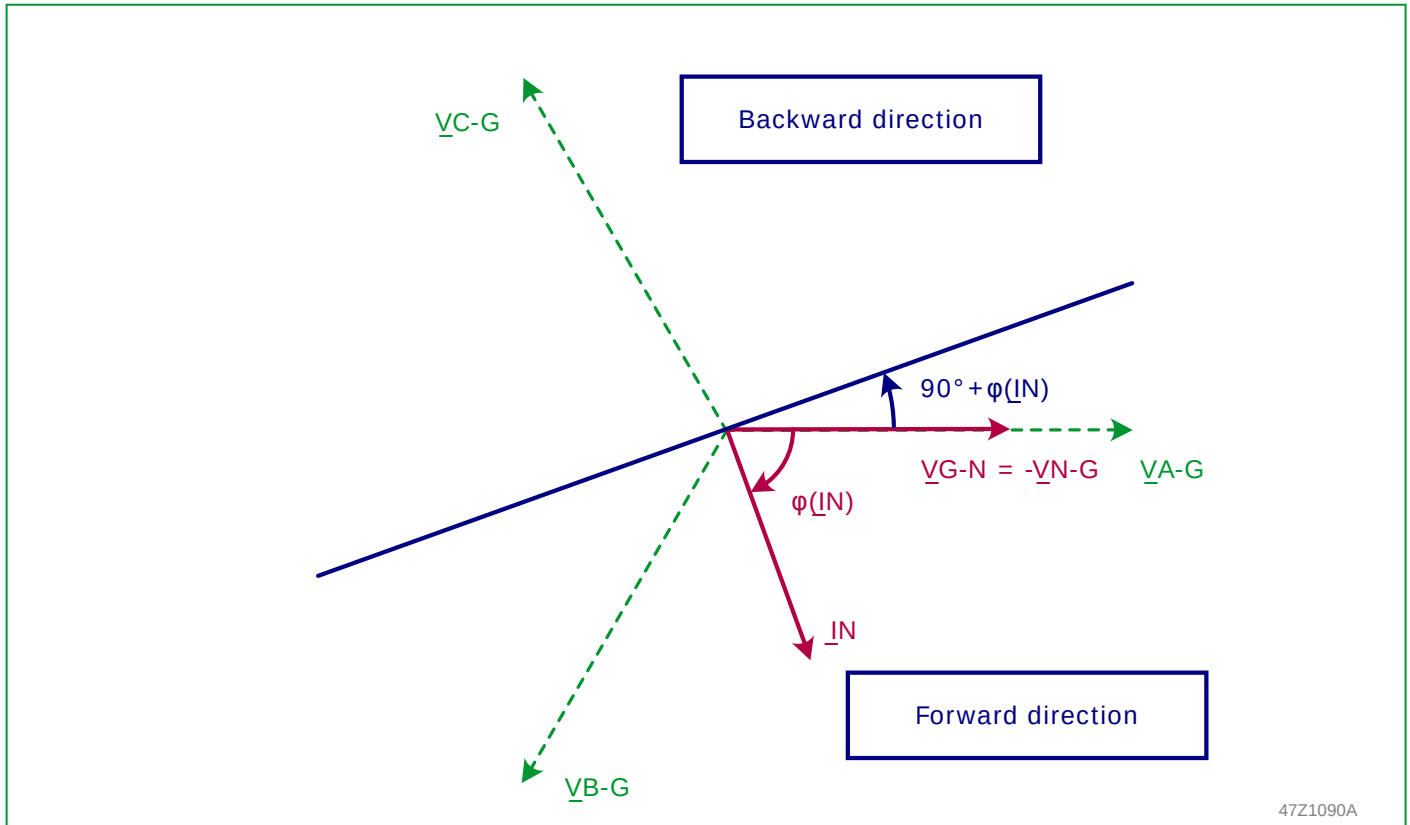


Fig. 3-246: Directional characteristic.

3.32.6

Improved Directional Measurement for Series-Compensated Line Applications

Ground fault protection is based on the assumption of inductive zero-sequence source impedances. In case of series compensated lines with a high compensation degree this condition may not be fulfilled.

The following figures show the measuring conditions of GFSC for forward and backward (reverse) short-circuits. Problematic is the measurement of line side faults: Due to the line side VT, the measured voltage results from the voltage drop caused by the zero-sequence current across the (inductive) equivalent source impedance $Z_{S0(fwd)}$ and the series-capacitance X_{C0} . Depending on whether the source reactance is bigger or smaller than the series capacitance the voltage is inductive or capacitive versus the zero-sequence current. Problems will occur for a high compensation degree (big X_{C0}) and for strong sources (small $X_{S0(fwd)}$). The fault location or distance to the fault does not matter at all.

For backward (reverse) faults, this problem needs not to be considered, as the source impedance then is always inductive.

Adding a current-proportional voltage to the measured voltage ("cross-polarization") as follows solved this problem:

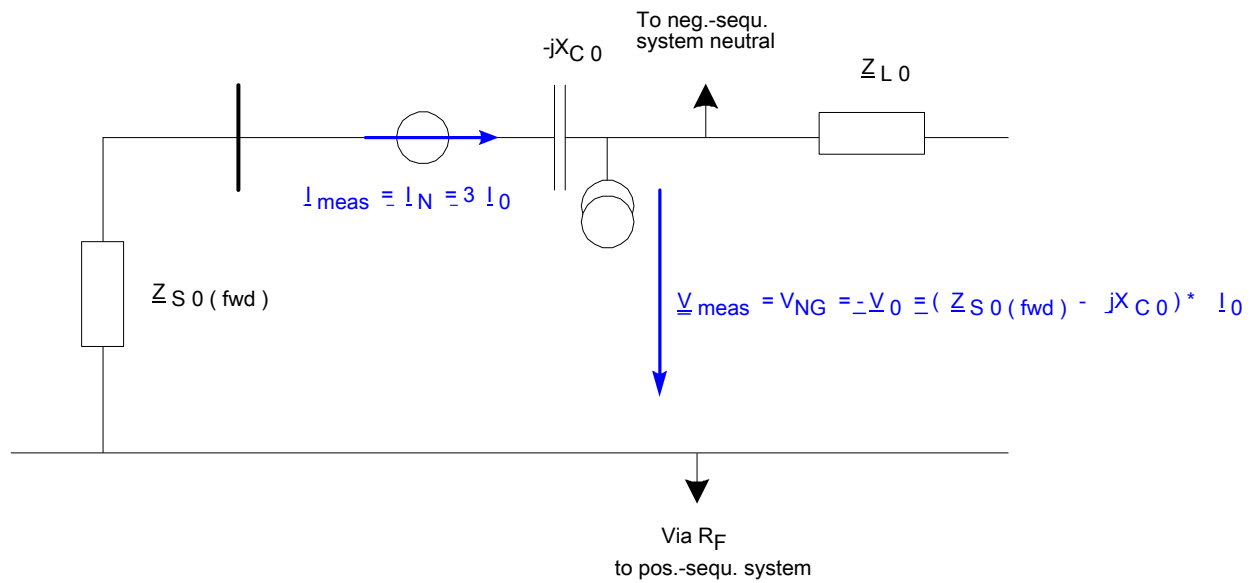
$$\underline{V}_{(GFSC)} = \underline{V}_{meas} + jX_0 \cdot \underline{I}_0 = (Z_{S0(fwd)} - jX_{C0} + jX_0) \cdot \underline{I}_0$$

X_0 is settable at GFSC: Comp. reactance X_0 , the recommended setting is $X_0 = X_{C0}$, so that the same condition as on a normal inductive line is obtained:

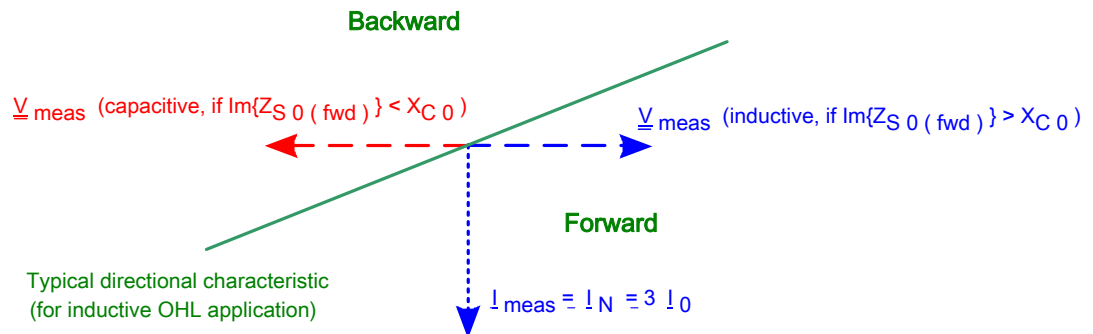
$$\underline{V}_{(GFSC)} = Z_{S0(fwd)} \cdot \underline{I}_0$$

The ground fault starting condition $V_{NG>}$ remains using the directly measured neutral displacement voltage. In order to secure that directional measurement is only done with a reliably high absolute value of the line-to-line voltage $V_{(GFSC)}$, this value must always exceed a minimum of 50 mV.

1 pG faults forward (on the line)



Zero-sequence equivalent network and measurands

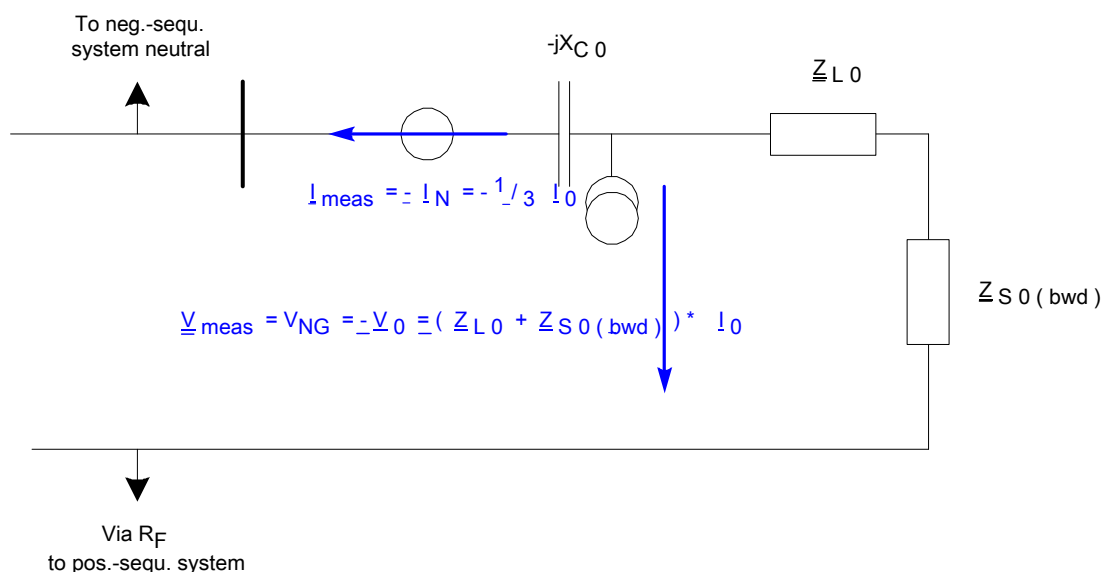


Phasor relations (resistances neglected)

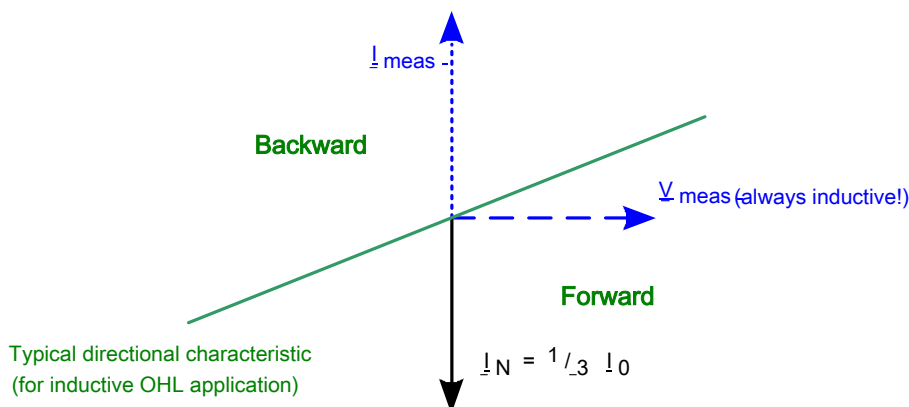
47Z11X1A_EN

Fig. 3-247: Zero-sequence fault measurands on series compensated lines, faults in forward direction.

1 pG faults backward



Zero-sequence equivalent network and measurands



Phasor relations (resistances neglected)

47Z11X2A_EN

Fig. 3-248: Zero-sequence fault measurands on series compensated lines, faults in backward (reverse) direction.

3.32.7 Improved Phase Selection

In cases with very high fault resistances the neutral displacement voltage is too small to get a starting of P433 ground fault protection.

To resolve these issues, there are the following concepts:

3.32.7.1 Faulty Phase Selection

If neutral overcurrent starting (GFSC $I_{N>}$) operates, then the relay checks whether the faulty phase could be determined based on a delta-current measurement (where the delta is calculated over a 5 cycle period). This delta measurement is only done at the $I_{N>}$ starting. Its valid result is memorized until the $I_{N>}$ trigger resets.

The phase selection is further depending on the operation of the distance function:

- If DIST has identified a multi-phase(-to-ground) fault, then the above phase selection is disabled.
- If DIST has identified a single phase-to-ground fault, then this phase is used.

These signals are used to signal the faulty phase (state signals MAIN: Short circuit AG ... MAIN: Short circuit CG). They are also used to apply the “virtual current polarization” technique (Section 3.32.7.2, (p. 3-317)).

3.32.7.2

Virtual Current Polarization

If sufficient neutral displacement voltage is present ($V_{NG} > \text{starting}$), then GFSC uses this voltage for directional measurement.

Otherwise, “virtual current polarization” is applied, i.e. based on the determination of the faulty phase the relay calculates the polarizing voltage as sum of the 2 healthy phase voltages, e.g. for an AG fault:

$$V_{pol} = V_{BN} + V_{CN}$$

This V_{pol} is equal to the inverted faulty-phase voltage, so it is clearly high enough to secure reliable measurement.

Ideally, for $V_{NG} = 0$ this polarizing voltage gets $V_{pol} = V_{BN} + V_{CN} = -V_{AN}$ where the “-” sign is automatically taken into consideration in the direction determination.

To provide backwards compatible operation, this method needs to be enabled by user, setting GFSC: Virtual current pol. to Yes.

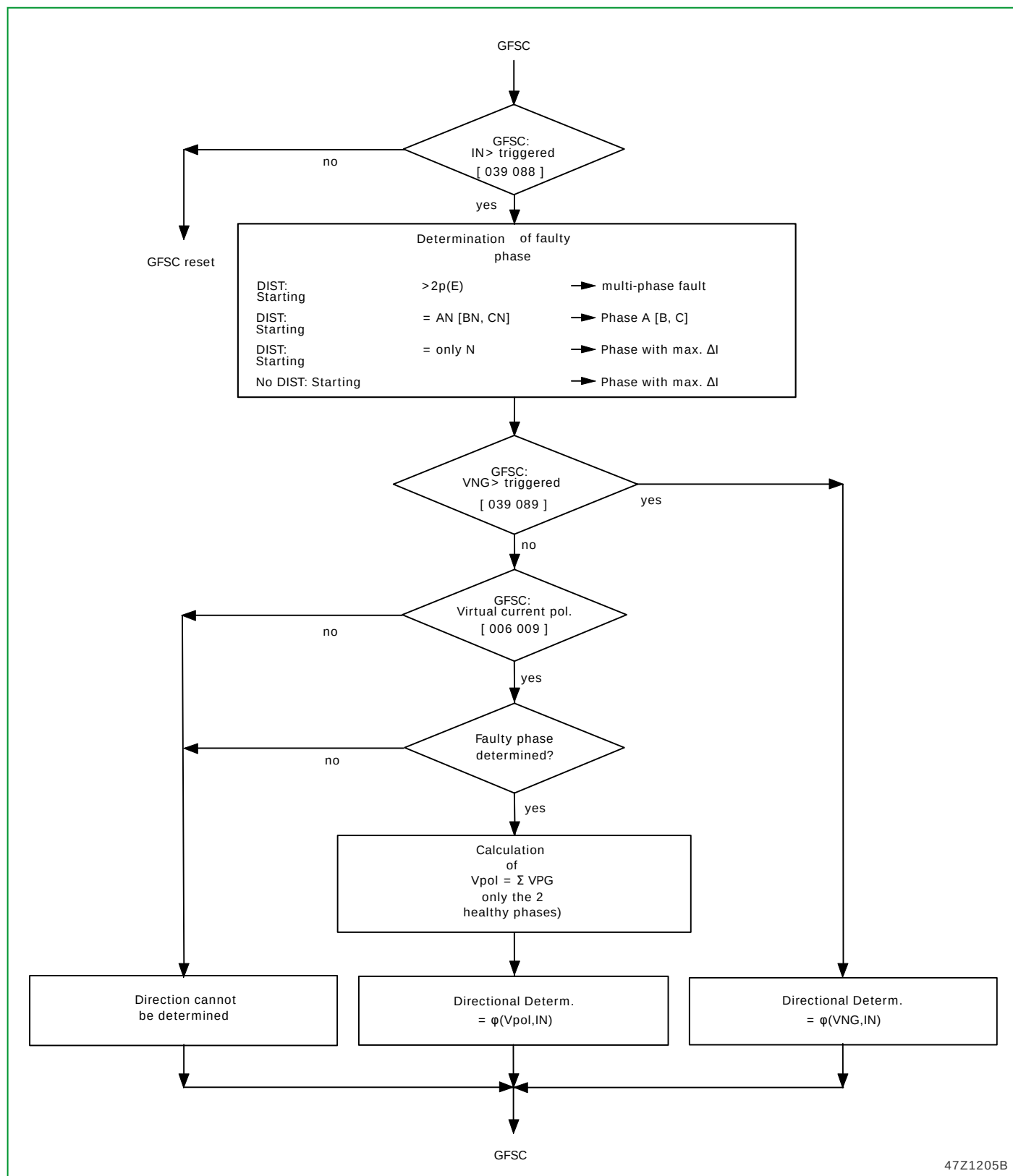


Fig. 3-249: GFSC Phase selection and optional virtual current polarization.

3.32.8

Voltage-Dependent or Current-Dependent Tripping

By setting operating mode t_s , the user can choose between voltage-dependent or current-dependent tripping. After the voltage-dependent or current-dependent time has elapsed, a trip signal is issued either independently of the directional

decision or when there is a directional decision for the forward direction – depending on the setting at GFSC: Criteria tS active.

3.32.8.1 Voltage-Dependent Tripping

Starting of ground fault (short-circuit) protection enables determination of the voltage-dependent tripping time. Tripping time t_S is calculated as follows.

$$t_S = \frac{2s}{10 \cdot \frac{|V_{N-G}|}{0.6364 \cdot 1.1 \cdot \frac{V_{nom}}{\sqrt{3}}} - 0.2}$$

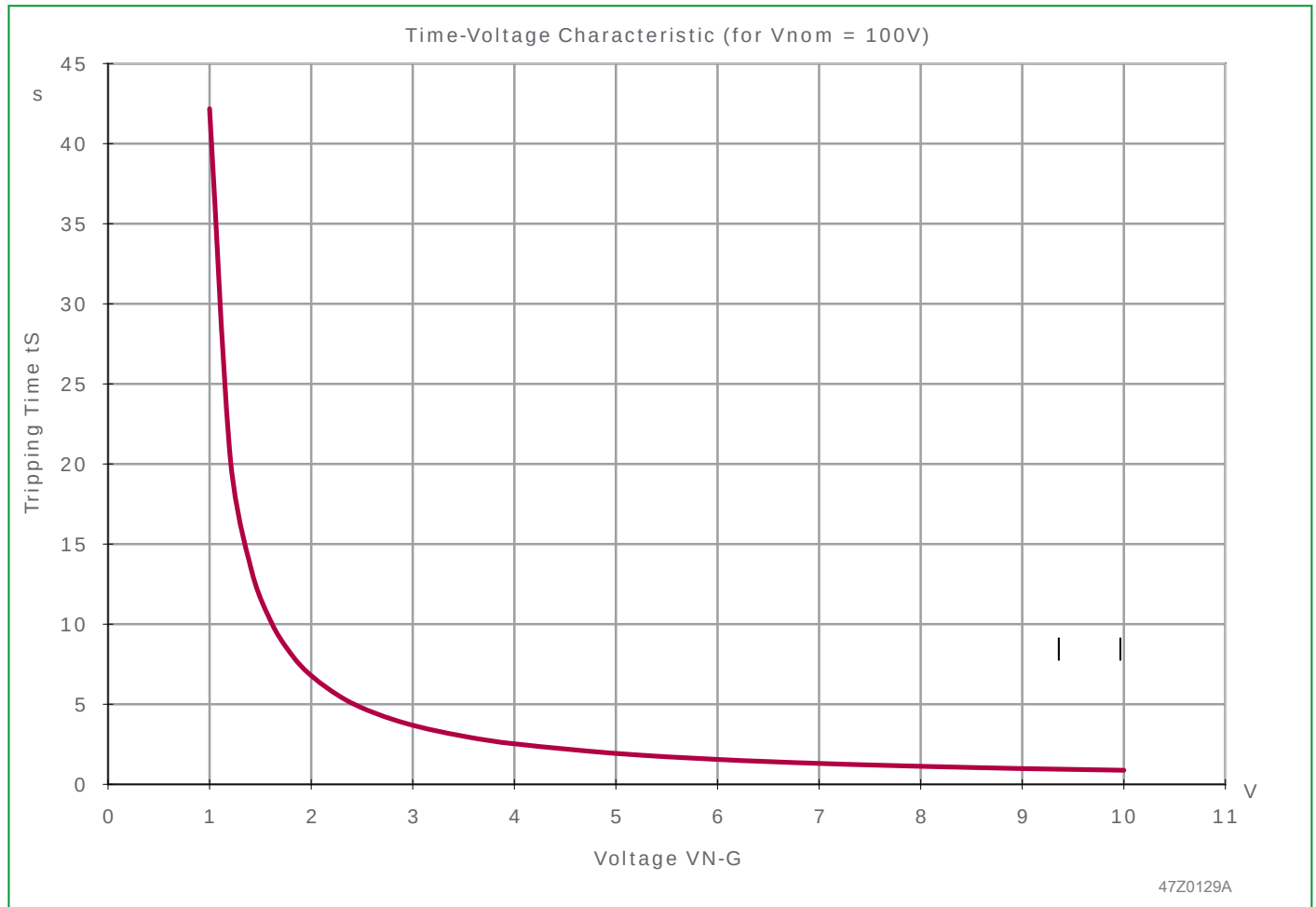


Fig. 3-250: Voltage-time characteristic.

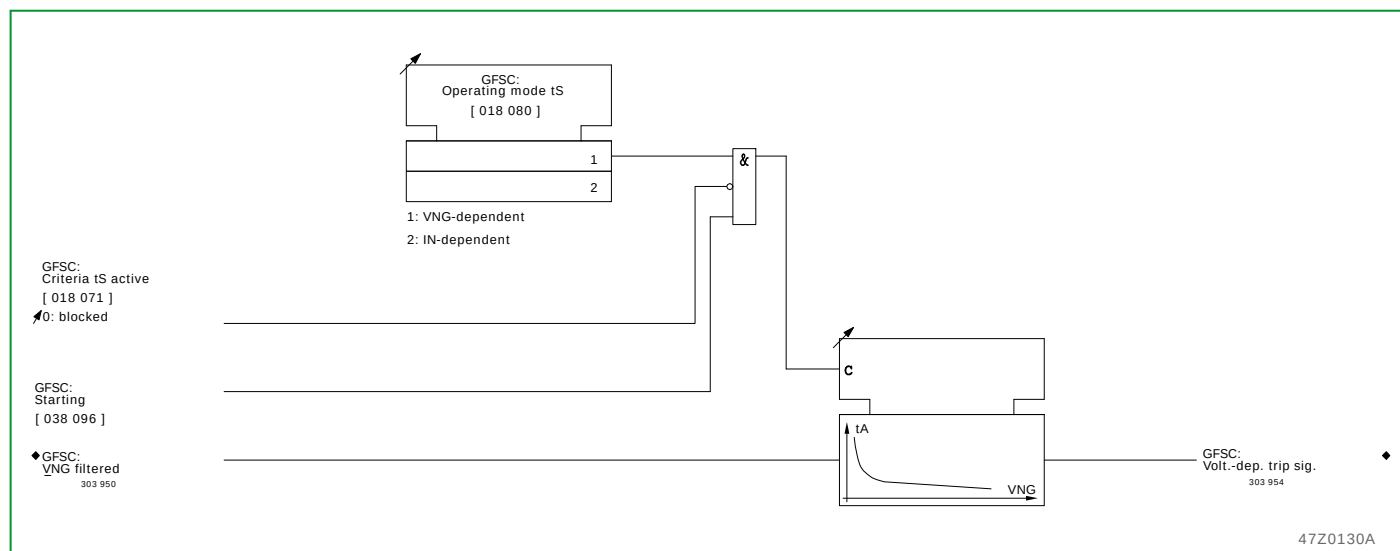


Fig. 3-251: Forming the voltage-dependent trip signal.

3.32.8.2

Current-Dependent Tripping

Starting of ground fault (short-circuit) protection enables determination of the current-dependent tripping time. The user can select from a large number of characteristics (see table below). If the current exceeds 1.05 times the set reference current, calculation of the tripping time begins. A trip signal is issued as a function of the set characteristic. The tripping characteristics available for selection are shown in figures Fig. 3-252, (p. 3-322) to Fig. 3-255, (p. 3-324).

No.	Tripping Characteristic	Formula for the Tripping Characteristic	Constants			Formula for the Reset Characteristic	R
			a	b	c		
	Characteristic settable factor: $k = 0.05 \dots 10.00$						
0	Definite Time	$t = k$					
	Per IEC 255-3	$t = k \cdot \frac{a}{(\frac{I}{I_{ref}})^b - 1}$					
1	Standard Inverse		0.14	0.02			
2	Very Inverse		13.50	1.00			
3	Extremely Inverse		80.00	2.00			
4	Long Time Inverse		120.00	1.00			
	Per IEEE C37.112	$t = k \cdot (\frac{a}{(\frac{I}{I_{ref}})^b - 1} + c)$				$t_r = \frac{k \cdot R}{1 - (\frac{I}{I_{ref}})^2}$	
5	Moderately Inverse		0.0515	0.0200	0.1140		4.85
6	Very Inverse		19.6100	2.0000	0.4910		21.60
7	Extremely Inverse		28.2000	2.0000	0.1217		29.10
	Per ANSI	$t = k \cdot (\frac{a}{(\frac{I}{I_{ref}})^b - 1} + c)$				$t_r = \frac{k \cdot R}{1 - (\frac{I}{I_{ref}})^2}$	
8	Normally Inverse		8.9341	2.0938	0.17966		9.00
9	Short Time Inverse		0.2663	1.2969	0.03393		0.50
10	Long Time Inverse		5.6143	1.0000	2.18592		15.75
11	RI-Type Inverse	$t = k \cdot \frac{1}{0.339 - \frac{0.236}{(\frac{I}{I_{ref}})}}$					
12	RXIDG-Type Inverse	$t = k \cdot (5.8 - 1.35 \cdot \ln \frac{I}{I_{ref}})$					

For a ratio I/I_{ref} greater than 40, the tripping time is determined as for $I/I_{ref} = 40$.

For currents exceeding the dynamic range limit the tripping time is approximately determined as for the limit value.

The following limits apply: 2 $I_{N,nom}$ (only measured I_N).

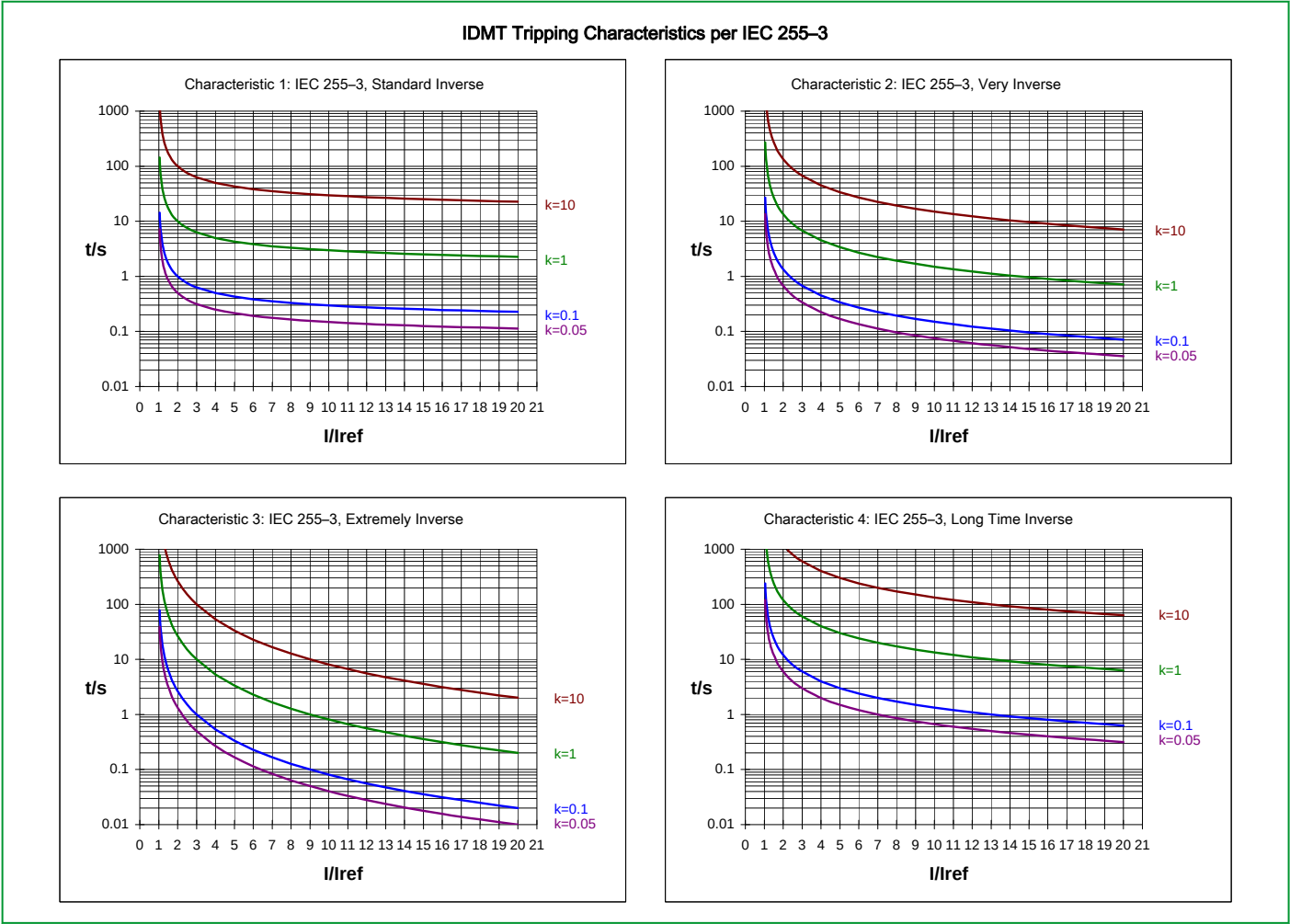


Fig. 3-252: Tripping characteristics as per IEC 255-3.

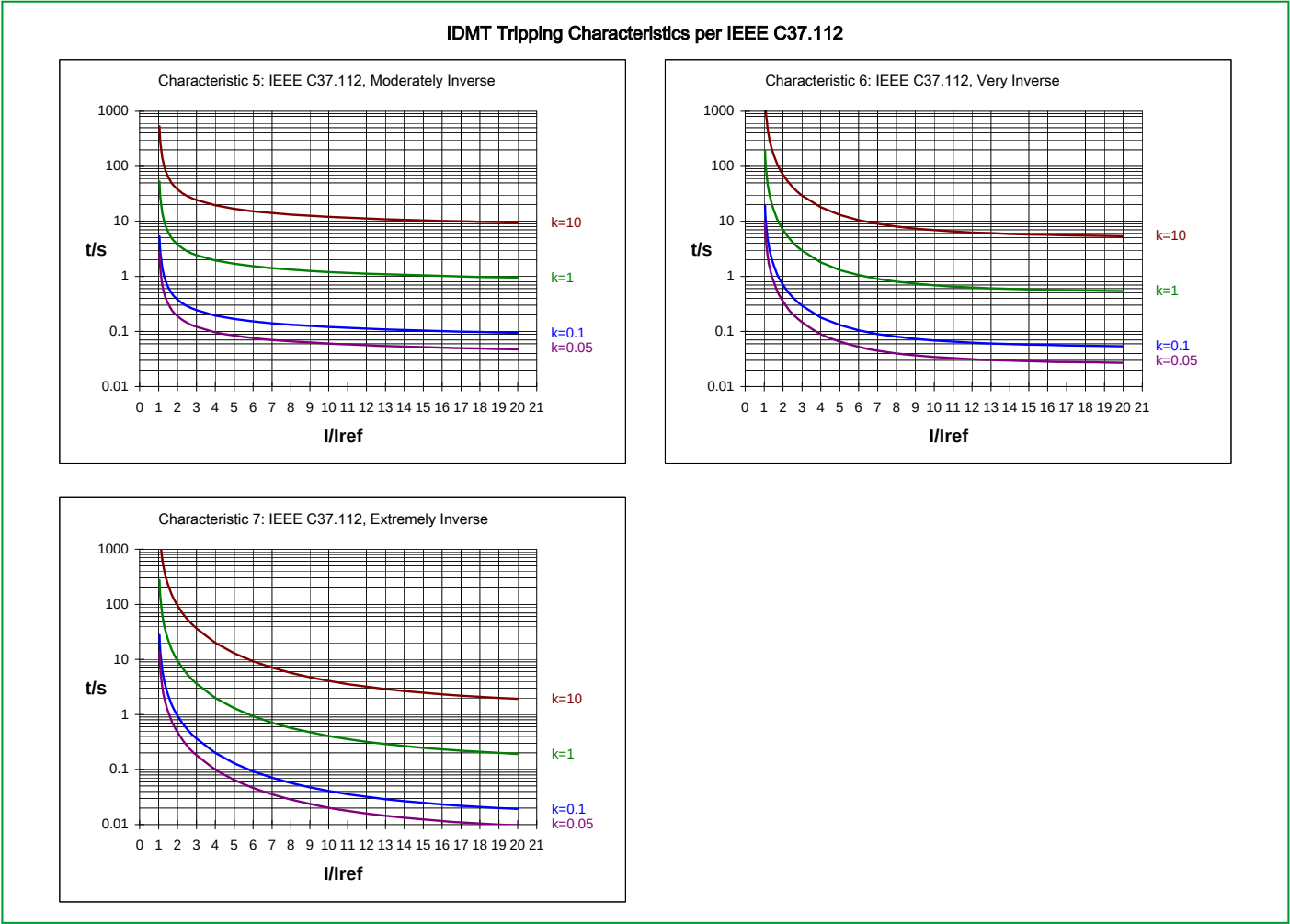


Fig. 3-253: Tripping characteristics as per IEEE C37.112.

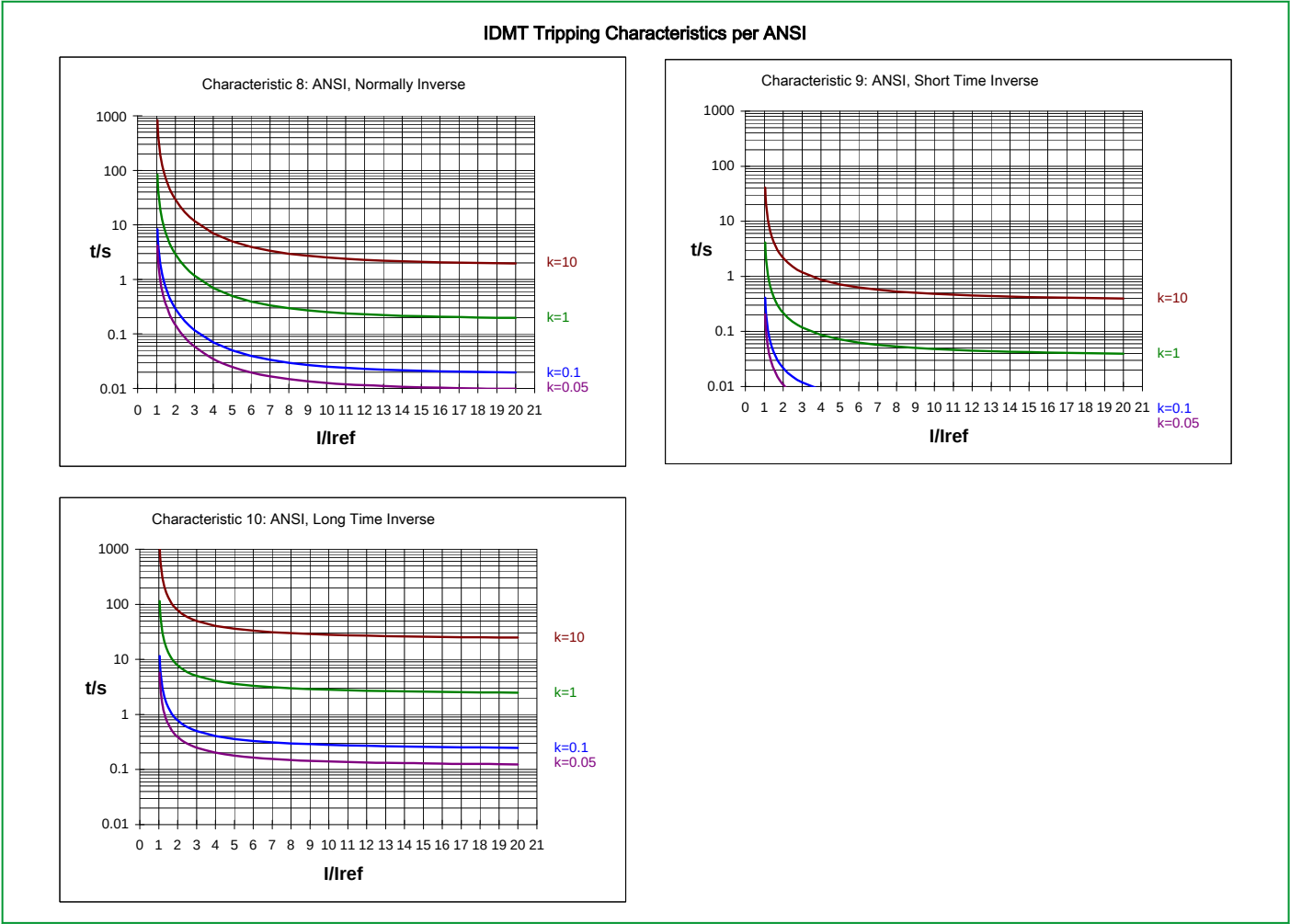


Fig. 3-254: Tripping characteristics as per ANSI.

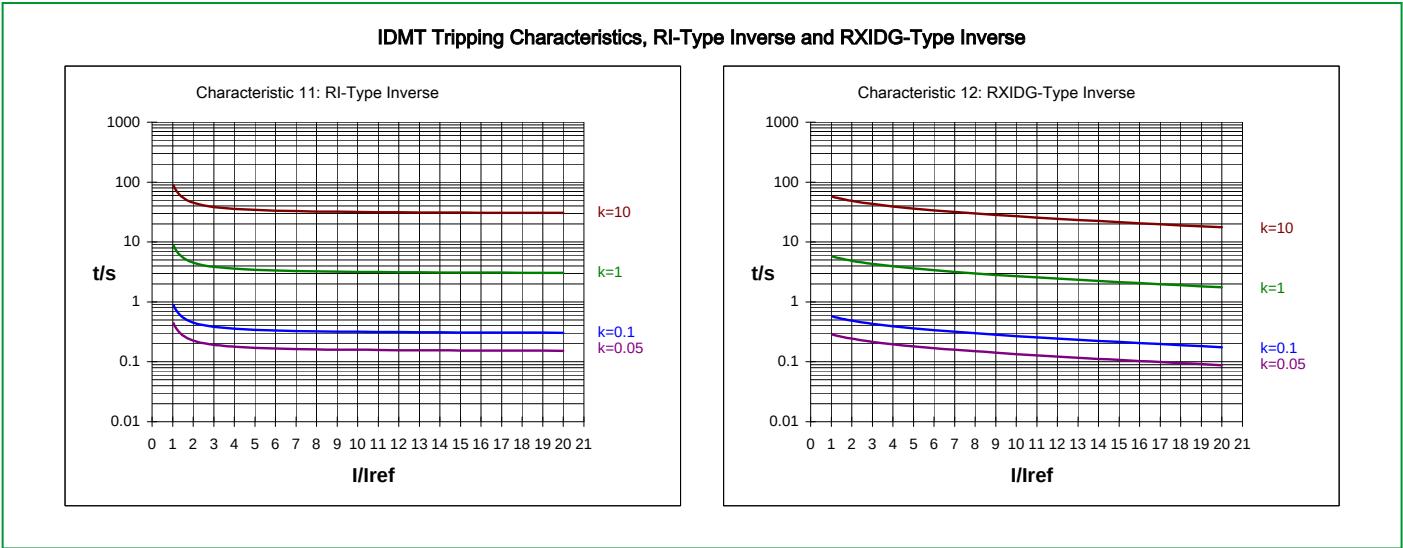


Fig. 3-255: RI-type inverse and RXIDG-type inverse tripping characteristics.

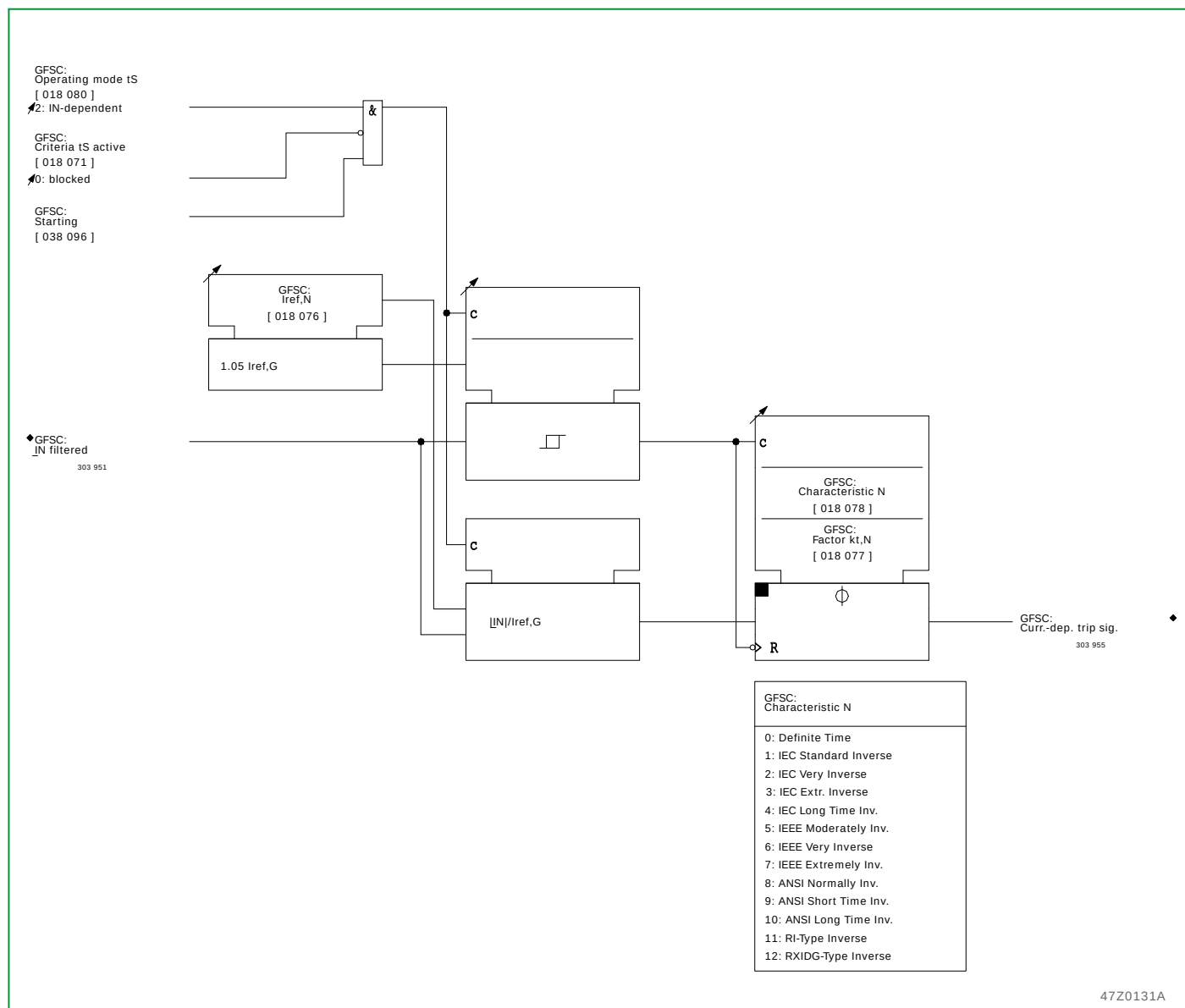


Fig. 3-256: Forming the current-dependent trip signal.

3.32.9 Non-Directional Tripping

Starting of ground fault (short-circuit) protection starts settable timer stage t3. Once t3 and t_S have elapsed, a trip signal is issued by ground fault (short-circuit) protection.

Note: After timer stage t1 or t2 has elapsed, a trip signal is issued and remains present until the starting drops off – even if the direction decision changes or is reset. This latching is not shown in the diagram.

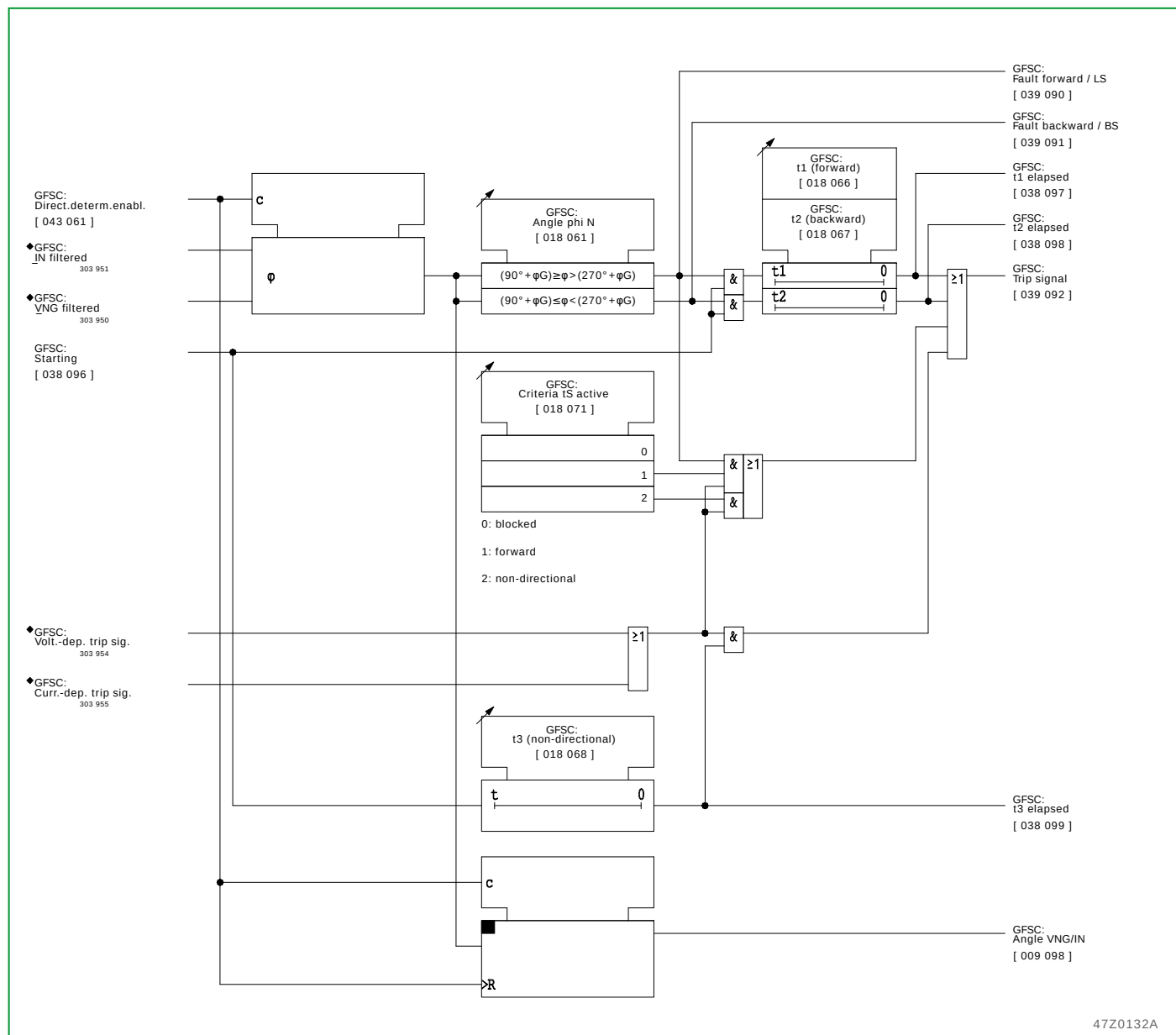


Fig. 3-257: Forming the trip signal.

3.32.10

Counters

The trip signals issued by ground fault (short-circuit) protection are counted. The counter can be reset either at the counter address or by a general reset action.

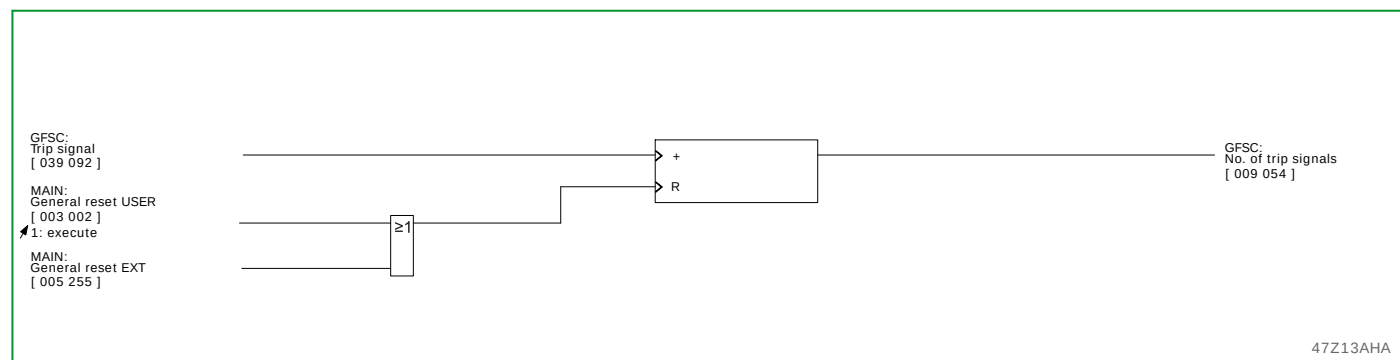


Fig. 3-258: Counting the trip signals.

3.32.11 Monitoring the Measured Values

If only one of the two triggers has responded ($I_{N>}$ or $V_{NG>}$), and if at least one of the phase-to-ground voltages exceeds $0.7 V_{nom}/\sqrt{3}$, a signal will be issued after 10 s.

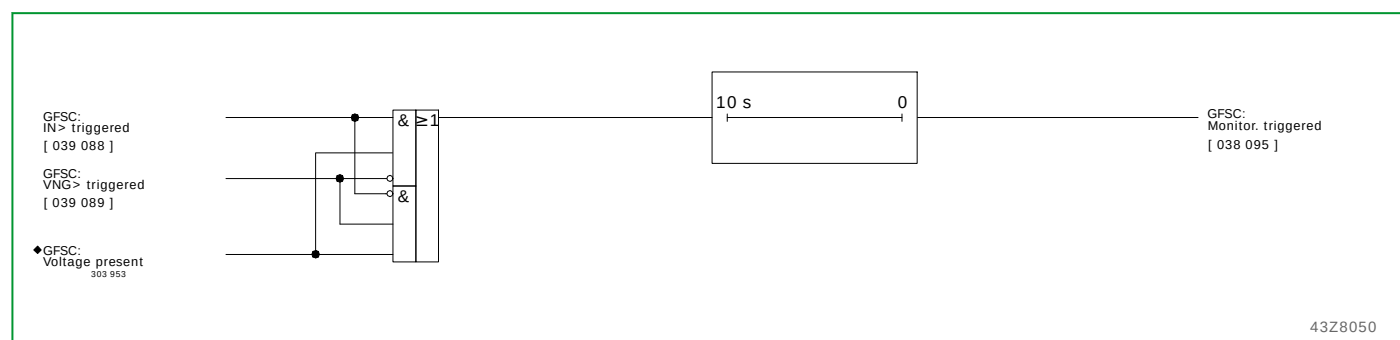


Fig. 3-259: Monitoring the measured values.

3.33 Ground Fault (Short-Circuit) Protection Signaling (Function Group GSCSG)

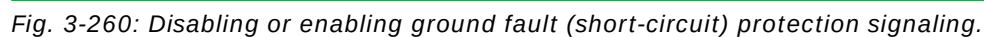
In order to make selective instantaneous tripping possible ground fault (short-circuit) protection includes the ground fault (short-circuit) protection signaling function. Ground fault (short-circuit) protection signaling operates in parallel with and independently of the protective signaling function of distance protection. Only when a common communication channel is used is it necessary to block the protective signaling echo. Furthermore, measures for blocking the weak-indeed logic of distance protection protective signaling are implemented in the *Signal comp. release* operating mode. Ground fault (short-circuit) protection signaling is coordinated with distance protection protective signaling through appropriate time delays.

An external signal transmission device is required for operation of ground fault (short-circuit) protection signaling.

3.33.1 Disabling or Enabling Ground Fault (Short-Circuit) Protection Signaling

The function can be disabled or enabled using setting parameters or through binary signal inputs.

The activation of the function is enabled generally (independently of parameter subsets) via GSCSG: General enable USER. It is enabled as a function of a parameter subset via GSCSG: Enable PSx. If these enabling functions have been activated, ground fault (short-circuit) protection signaling can be disabled or enabled via setting parameters or through appropriately configured binary signal inputs. Parameters and configured binary signal inputs have equal status. If only the PSIG: Enable EXT function is assigned to a binary signal input, then protective signaling is enabled by a positive edge of the input signal and it is disabled by a negative edge. If only the GSCSG: Disable EXT function is assigned to a binary signal input, then a signal at this input will have no effect.



3.33.2 Readiness of Ground Fault (Short-Circuit) Protection Signaling

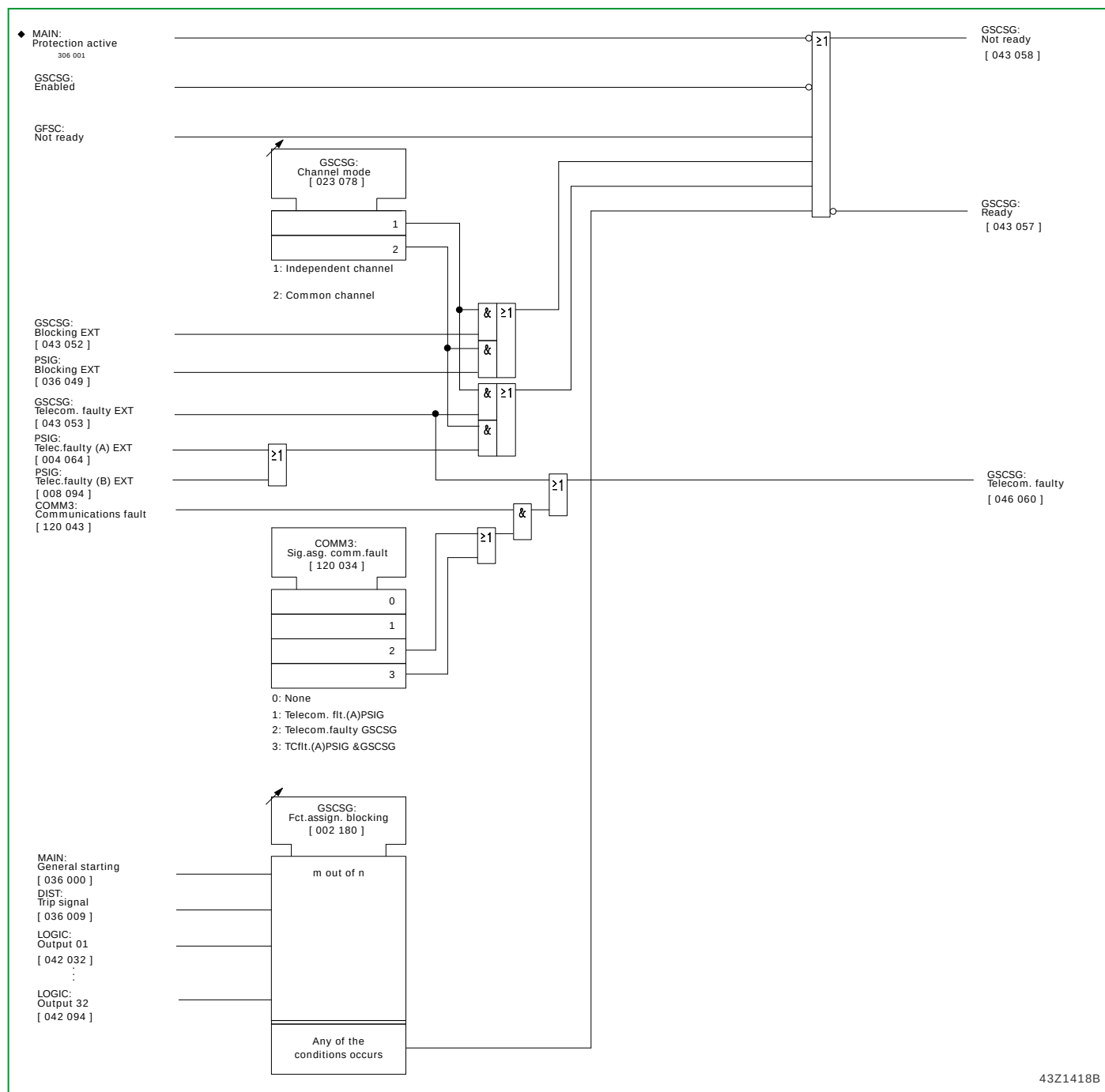


Fig. 3-261: Readiness of ground fault (short-circuit) protection signaling.

Ground fault (short-circuit) protection signaling is ready if the following conditions are satisfied:

- Ground fault (short-circuit) protection signaling is enabled.
- Ground fault (short-circuit) protection is ready.
- There is no external blocking.
- No fault has been detected in the communication channel.
- The GFSC function is not inhibited by either MCMON: Meas. circ. V faulty (in case GFSC: Evaluation VNG = *Calculated*) or by MAIN: M.c.b. trip VNG EXT (in case GFSC: Evaluation VNG = *Measured*).
- None of the conditions selected with GFSC: Fct.assign. blocking has been detected.

External blocking is carried out either via a binary signal input configured for GSCSG: Blocking EXT or via a binary signal input configured for PSIG: Blocking EXT, depending on the operating mode setting for the communication channel.

The fault signal from the external signal transmission device can be either connected to a binary signal input, configured for GSCSG: Telecom. faulty EXT or to a binary signal input, configured for PSIG: Telec.faulty (A) EXT or PSIG: Telec.faulty (B) EXT depending on the operating mode setting for the communication channel.

The condition for blocking the ground fault protection scheme logic is user settable at GSCSG: Fct.assign. blocking because of sometimes conflicting application restraints. Some considerations about the various blocking conditions are given below:

- No instant blocking with distance trip:
If one (strong infeed) end issues a fast zone 1 distance trip, then previously GSCSG was blocked almost immediately. At the remote (weak infeed) end only GFSC senses the fault. In order to allow a fast tripping of GSCSG at the remote end under this condition, the function must remain active at the strong infeed end as long as possible, i.e. until a "CB open" condition is signaled.

3.33.3

Communication Link Faulty Signal

The GSCSG: Telecom. faulty status signal is available in conjunction with the implementation of the protective interface.

This signal is set by the GSCSG: Telecom. faulty EXT logic binary input function as well as by COMM3: Communications fault if the COMM3: Sig.asg. comm.fault parameter has been set accordingly.

3.33.4

Tripping Time

If ground fault (short-circuit) protection signaling is ready, then the tripping timer is started by ground fault (short-circuit) protection starting.

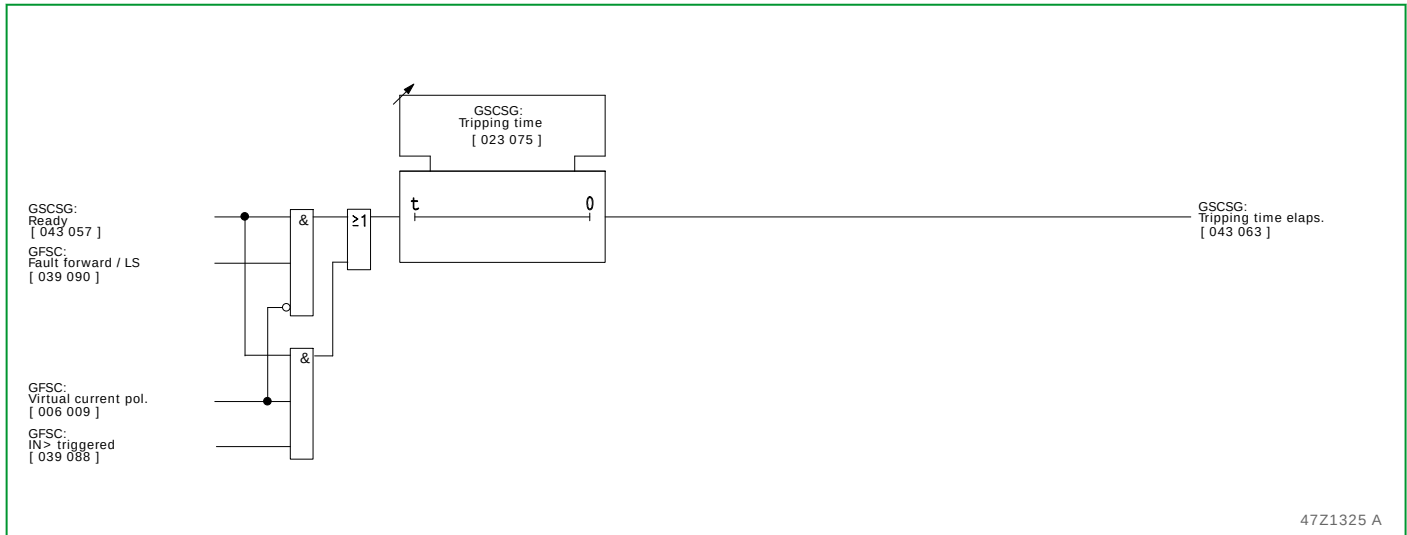


Fig. 3-262: Tripping time of ground fault (short-circuit) protection signaling.

3.33.5 Frequency Monitoring

Failure of frequency transmission can be signaled to the P433 via an appropriately configured binary signal input. Which inputs are activated is determined by the channel operating mode setting at GSCSG: Channel mode. If ground fault (short-circuit) protection signaling uses a different communication channel than protective signaling, then the following occurs, as long as frequency monitoring has been enabled: when the binary signal input configured for GSCSG: Frequ.mon.trigd. EXT is triggered, the P433 allows an operate delay of approximately 20 ms to elapse and then generates a receive signal for 150 ms.

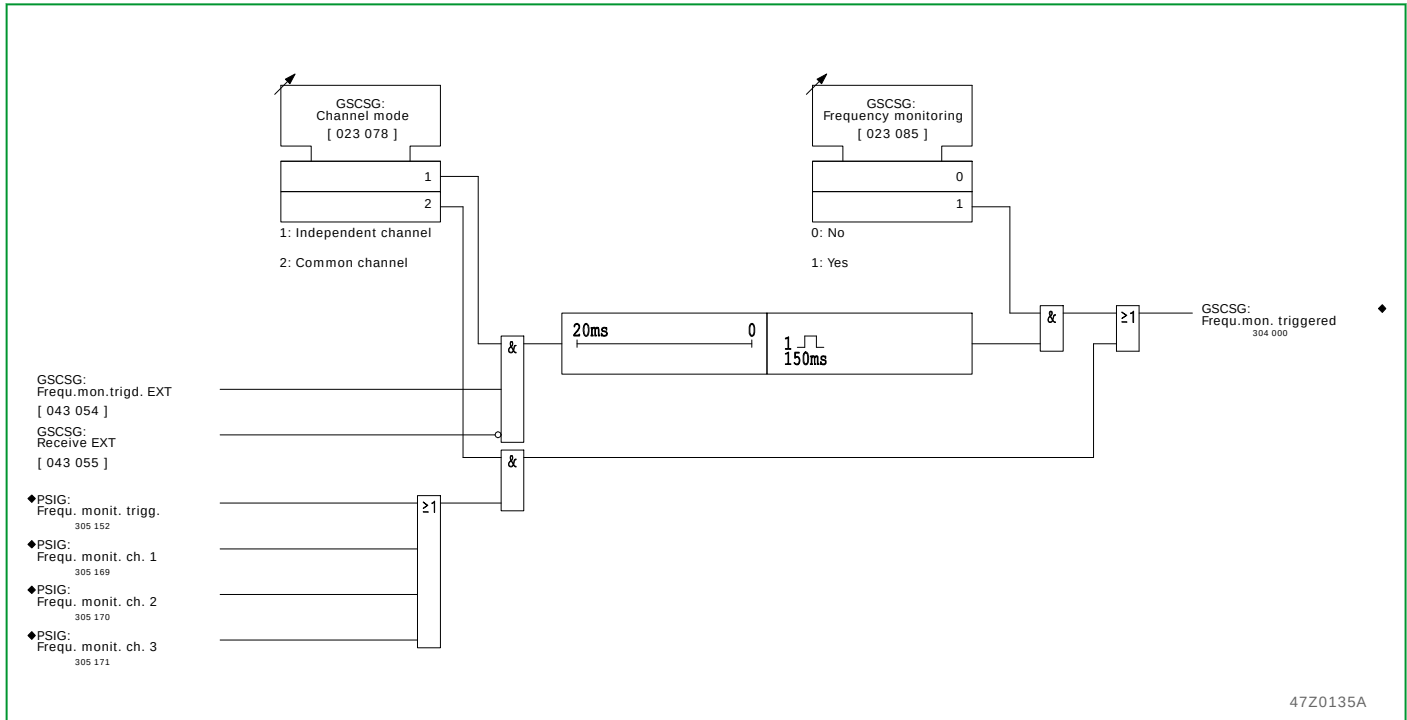


Fig. 3-263: Frequency monitoring.

3.33.6 Transient Blocking

In the event of a directional change of ground fault (short-circuit) protection from backward (reverse) to forward, ground fault (short-circuit) protection signaling will generate a blocking signal for the time period set at GSCSG: tBlock.

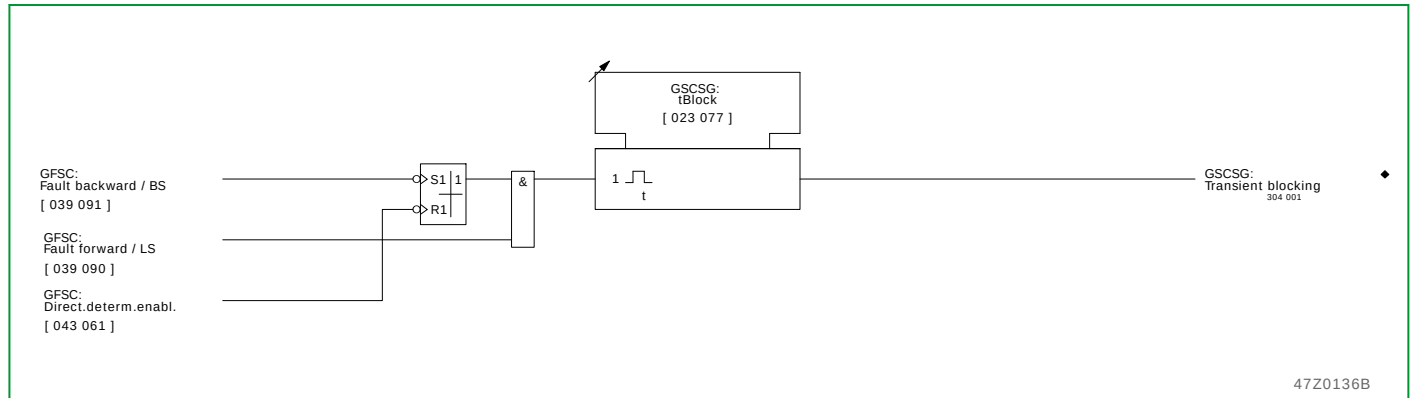


Fig. 3-264: Transient blocking.

3.33.7 Operating Modes of Ground Fault (Short-Circuit) Protection Signaling and the Communication Channel

Ground fault (short-circuit) protection signaling can be operated in two different modes: *Signal comparison release* or *Signal comparison blocking*. For the communication channel, the user can specify whether ground fault (short-circuit) protection signaling will use a different communication channel than distance protection protective signaling or whether the same channel will be used. If the same communication channel is being used, then the operating mode settings for protective signaling and ground fault (short-circuit) protection signaling must be identical. Otherwise there will be a fault signal (see [Section 3.29, \(p. 3-248\)](#)).

3.33.8 Signal Comparison Release Scheme

If ground fault (short-circuit) protection detects a fault in the forward direction, a signal is sent to the remote station once the tripping time of ground fault (short-circuit) protection signaling has elapsed. In the event of a directional change from backward (reverse) to forward, the send signal is blocked for the duration of transient blocking.

The circuit breaker in the remote station is tripped if the following conditions are satisfied:

- There is a receive signal.
- The ground fault (short-circuit) protection function has detected a fault in the forward direction.
- The tripping time of the ground fault (short-circuit) protection signaling function has elapsed.
- No transient blocking has been set.

If ground fault (short-circuit) protection signaling and distance protection protective signaling use a common communication channel, then blocking of the weak indeed logic of distance protection protective signaling will be implemented if the following conditions are satisfied:

- The tripping time of the ground fault (short-circuit) protection signaling function has elapsed.
- Ground fault (short-circuit) protection has detected a fault in the backward (reverse) direction.

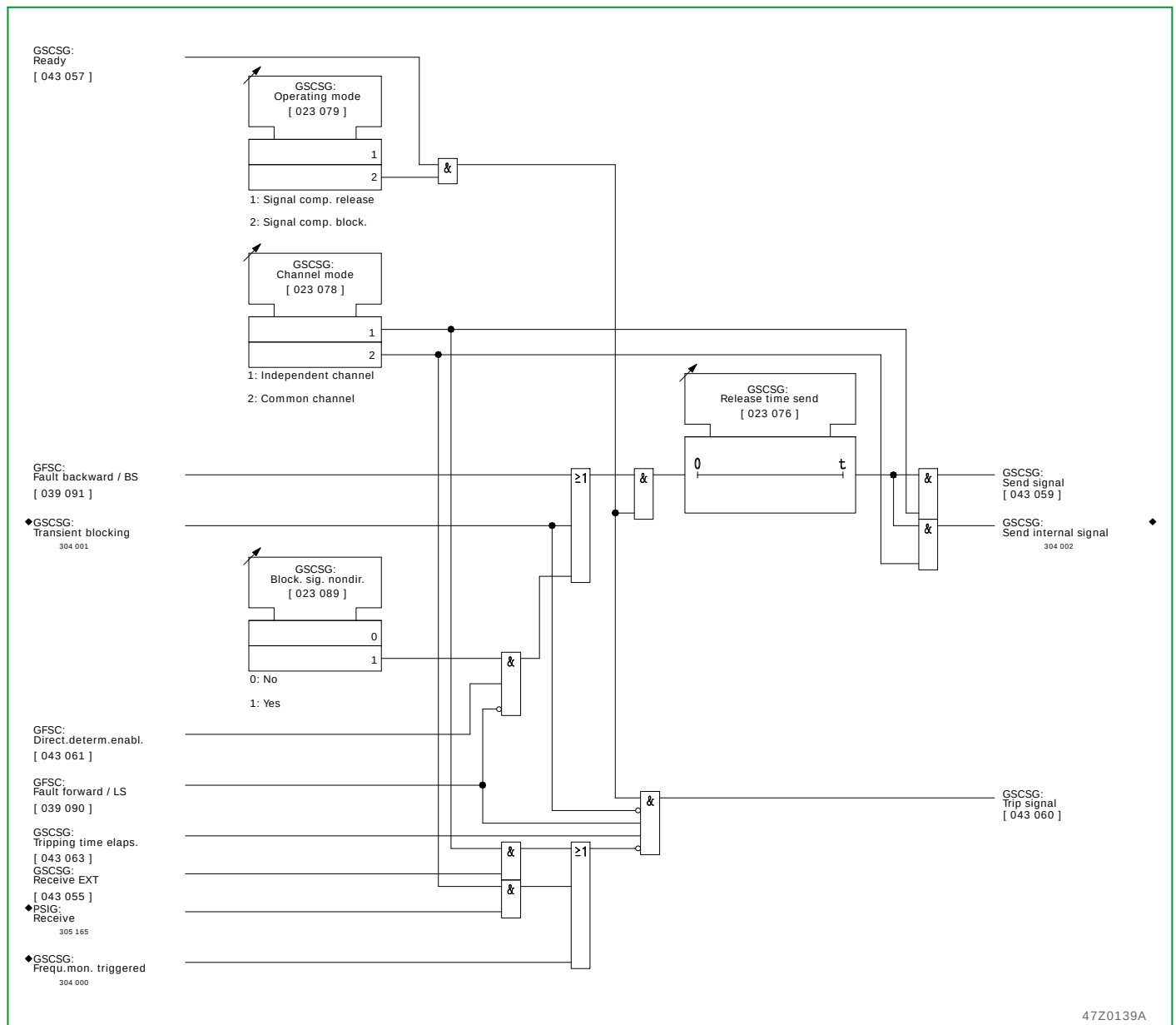


Fig. 3-266: Send signal and trip signal in the operating mode "Signal comp. block."

3.33.10 Weak-Infeed Logic

Ground fault (short-circuit) protection signaling has a “weak-infeed logic” function that makes tripping possible if ground fault (short-circuit) protection does not start. The user has the option to choose whether in this case the trip signal will be issued by ground fault (short-circuit) protection signaling when there is a directional decision by ground fault (short-circuit) protection in the forward direction or when the GFSC: VNG> trigger value is exceeded.

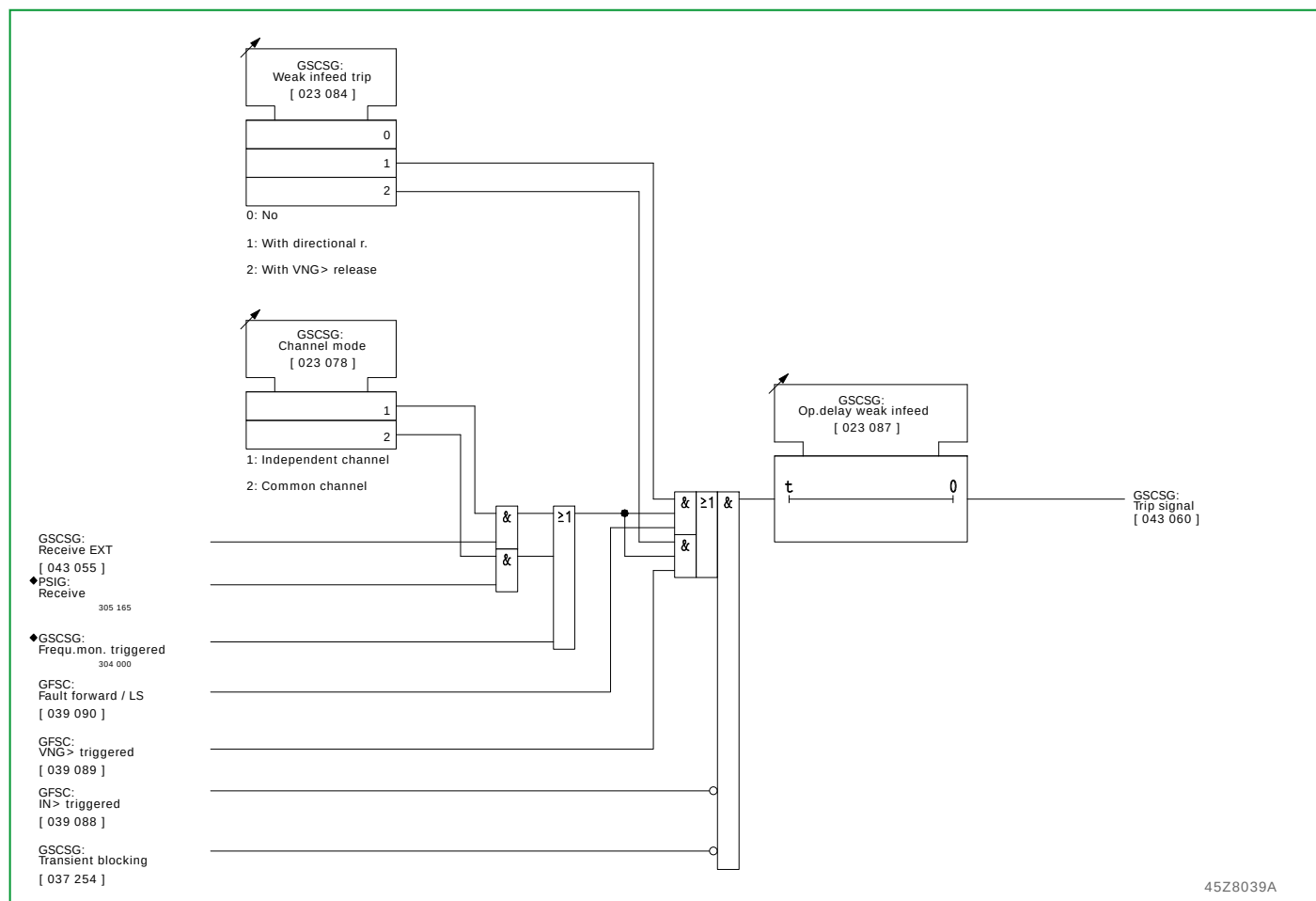


Fig. 3-267: Weak-infeed logic.

3.33.11

Trip Mode

Depending on the GSCSG: Trip mode setting, ground fault (short-circuit) protection signaling can trigger a single-pole or three-pole trip that can activate the ARC function. If the trip mode setting is *1/3-pole trip w.HSR* then when there is single-pole starting of the distance protection function there will be a trip in the phase in which the starting condition is present. When there is multi-pole starting of the distance protection function, ground fault (short-circuit) protection signaling will reach a three-pole trip decision. If one of the other two operating modes has been set, then ground fault (short-circuit) protection signaling always generates a three-pole trip. If the operating mode is *3p-pole trip w/o.HSR*, then the ARC will be blocked by a trip generated by ground fault (short-circuit) protection signaling.

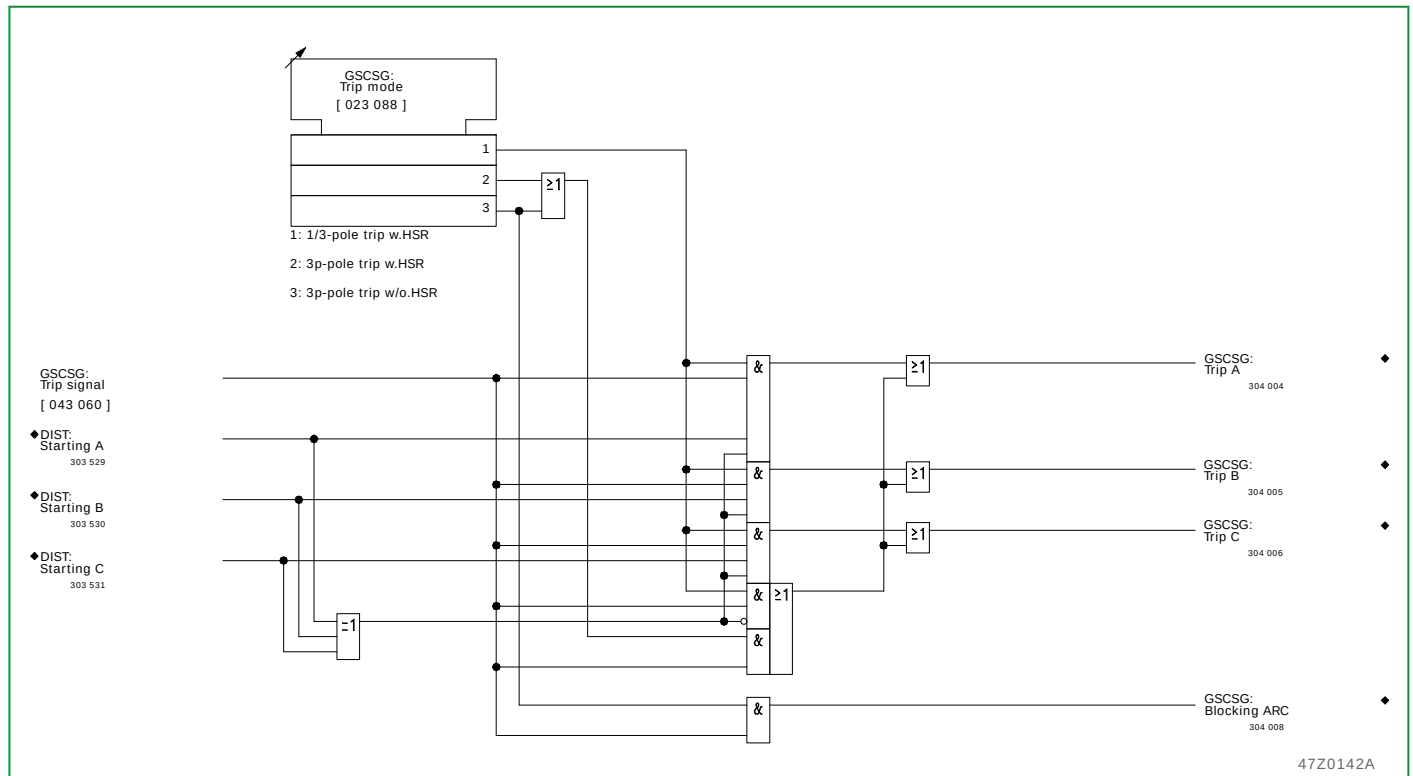


Fig. 3-268: Operating mode trip.

3.33.12 Echo Function

When a signal is received, an echo pulse can be formed – depending on the setting – if ground fault (short-circuit) protection has not detected a fault in the backward direction. The receive signal must be present for a period longer than the set operate delay in order for the echo pulse to be activated. If the circuit breaker is in the open position, then the operate delay is not active. The echo pulse is transmitted to the remote station for the set pulse duration. When the echo pulse is activated, a set blocking time is also started, during the course of which a new echo pulse is prevented. This prevents a permanent signal from being transmitted.

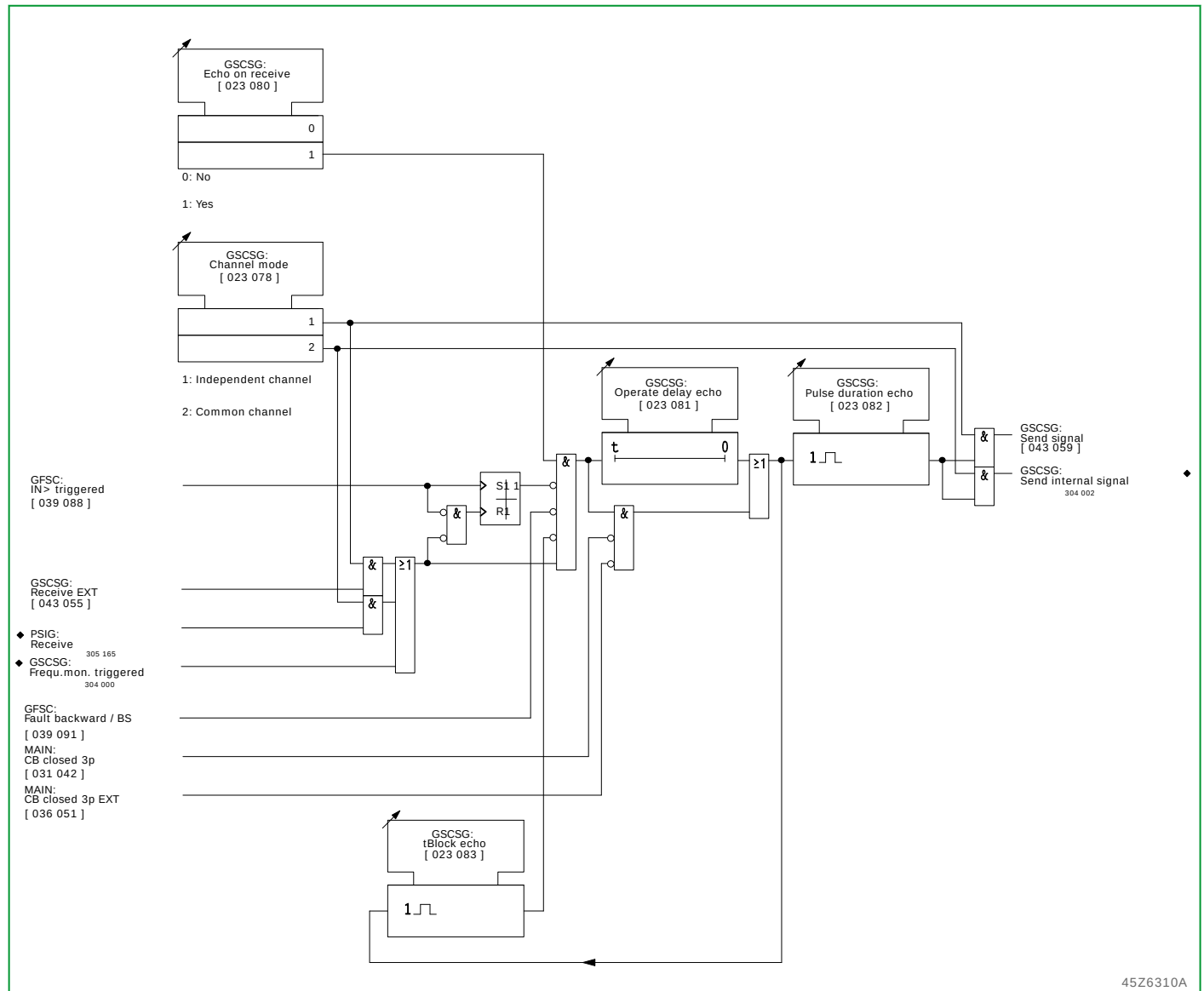


Fig. 3-269: Echo function.

3.33.13

Testing the Communication Channel

The communications link can be tested. For this purpose a 500 ms send signal is issued through a binary signal input or from the local control panel. It is extended by the reset time-delay of the send signal. The remote station receives this signal if the transmission link is in order.

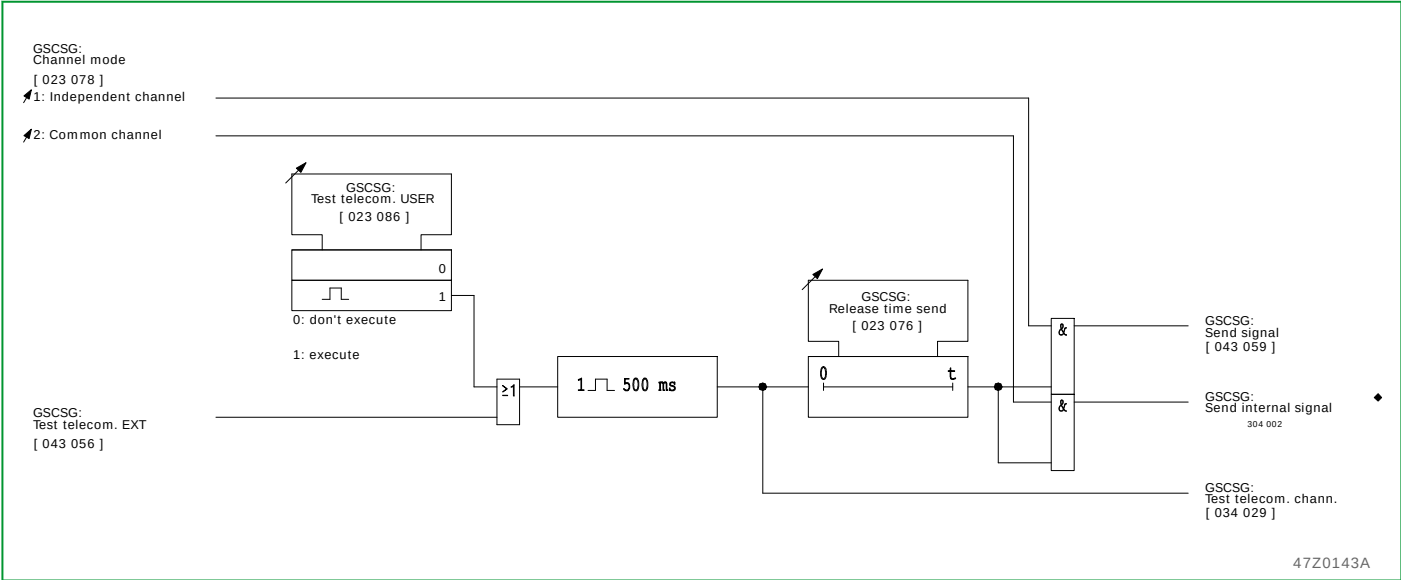


Fig. 3-270: Testing the communication channel.

3.34 Definite-Time Overcurrent Protection (Function Group DTOC)

A four-stage definite-time overcurrent protection function (DTOC) can be enabled concurrently with distance protection. Three separate measuring systems are available for this purpose for:

- Maximum phase current
- Negative-sequence current
- Residual current

For each phase or residual current stage, a selection can be made regarding the measured value. The following options are available for selection:

- *Fundamental*
- *r.m.s. value*
- *Peak-Peak*

For the negative-sequence stages, the starting decision is always based on the fundamental.

In addition to the residual current stages, now the phase current stages can also be operated in a directional manner. For that purpose, the short circuit direction determination (SCDD) function has been implemented; see [Section 3.36, \(p. 3-364\)](#).

Furthermore, it is now possible to select whether the timer stages for phase or residual current stages are triggered with the starting (*With starting*, i.e. with exceeding of the operate value) or are direction-dependent (*With direction*, i.e. starting condition and current flow in the set direction are present at the same time).

Inrush stabilization blocks the selected DTOC overcurrent stages (see [Section 3.13.5, \(p. 3-111\)](#)).

3.34.1 Enabling or Disabling DTOC Protection

DTOC protection can be disabled or enabled via parameter settings. Moreover, enabling can be carried out separately for each parameter subset.

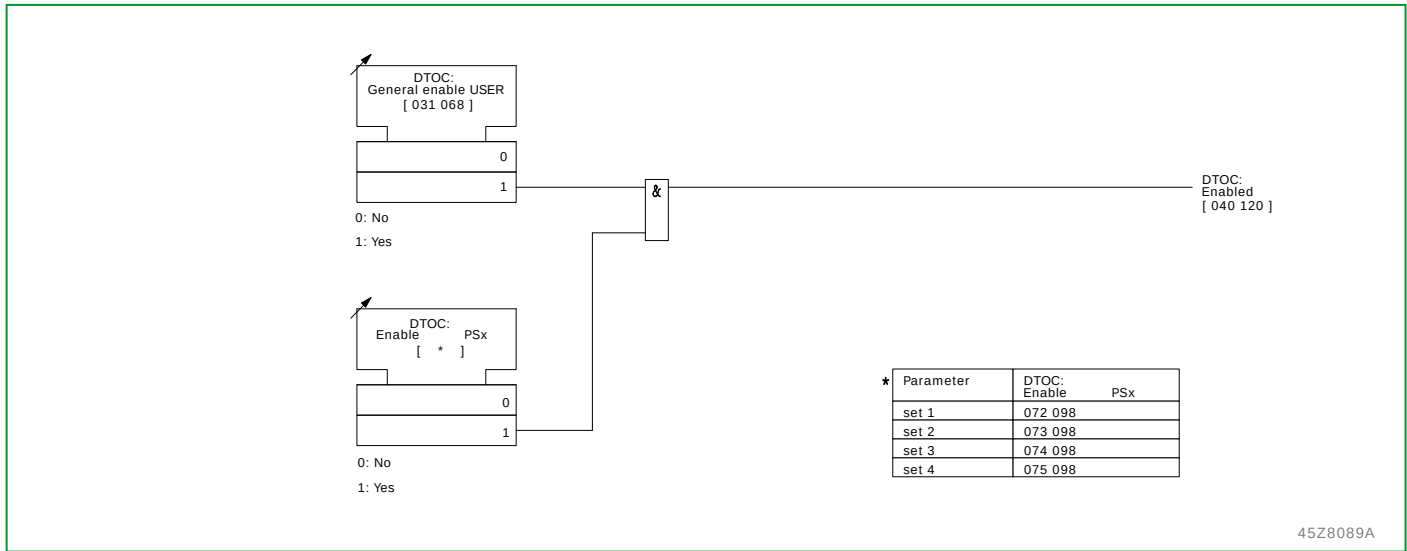


Fig. 3-271: Disabling or enabling DTOC protection.

3.34.2 Monitoring the Maximum Phase Current

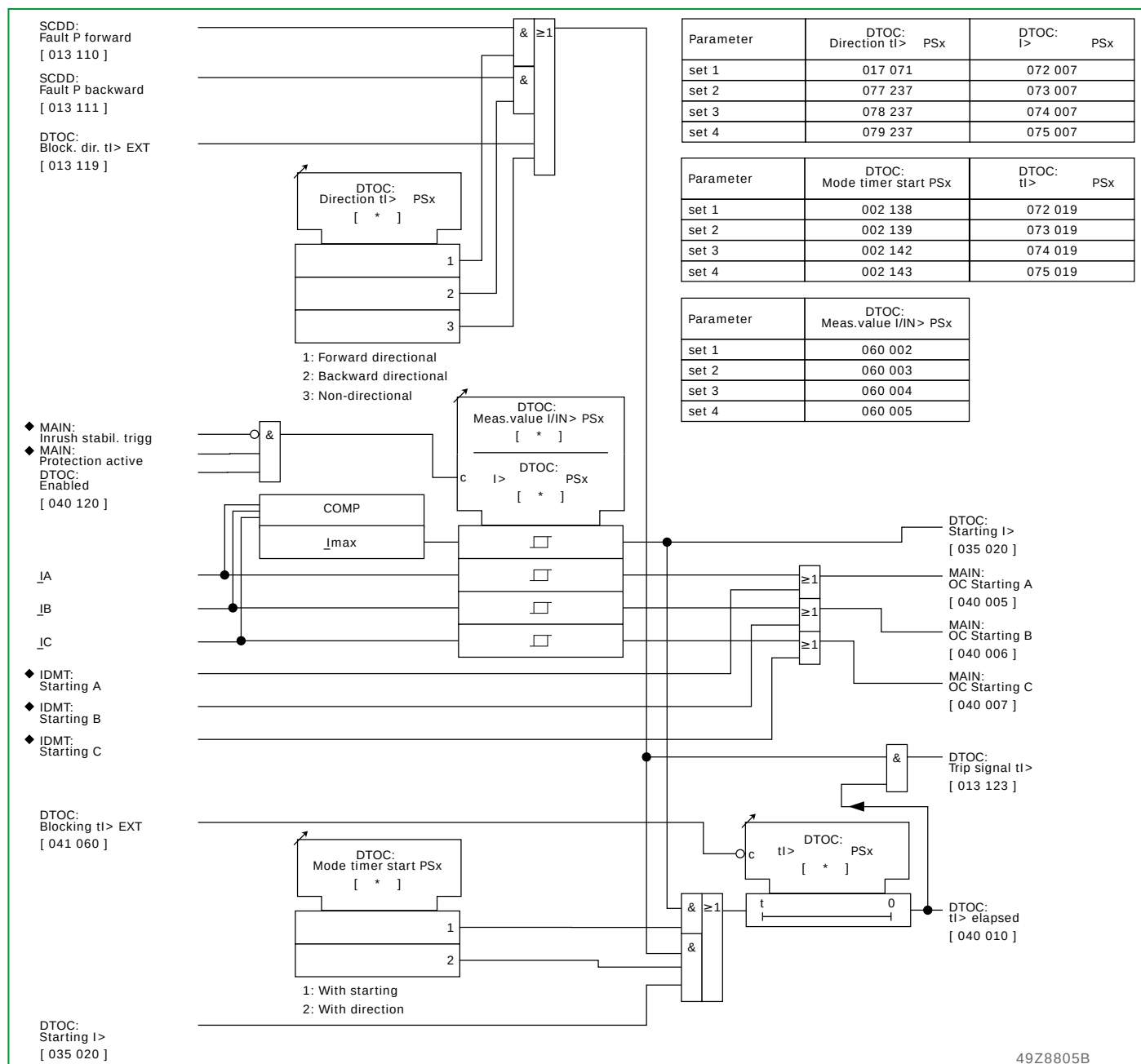


Fig. 3-272: Monitoring the phase currents (using the first overcurrent stage as an example, other stages analogously)

The selected measured values of the three phase currents (DTOC: Meas.value I/IN > PSx) are monitored by the P433 to detect when they exceed the set thresholds. When the thresholds are exceeded, a starting signal is issued (for example (035 020) DTOC: Starting I > = Yes).

Depending on the setting DTOC: Mode timer start PSx, the timer stages for the phase current stages are triggered with the starting (*With starting*, i.e. with exceeding of the operate value) or are direction-dependent (*With direction*, i.e. starting condition and current flow in the set direction are present at the same time). After the set operate delays have elapsed, a signal is issued (for example (040 010) DTOC: tl > elapsed = Yes). The elapsing of the operate delays may be blocked via appropriately configured binary signal inputs (for example (041 060) DTOC: Blocking tl > EXT = Yes).

The directional operation mode of the overcurrent stages can be blocked via appropriately configured binary signal inputs (for example (013 119) DTOC: Block. dir. $tl > EXT = Yes$). Then the overcurrent stage operates non-directional.

This input function may also be applied to block the directional operation should a measuring circuit failure occur (by using the signal from the associated m.c.b.).

After the set operate delays have elapsed, a tripping signal is issued for the respective phase current stage if the measured direction matches the set direction (for example (013 123) DTOC: Trip signal $tl > = Yes$).

3.34.3

Monitoring the Negative-Sequence Current

The P433 calculates the negative-sequence current from the three phase current values according to this formula. The result depends on the MAIN: Phase sequence setting.

Phase sequence A-B-C

- (Alternative terminology: clockwise rotating field)

$$|I_{neg}| = \frac{1}{3} \cdot |I_A + \underline{a}^2 \cdot I_B + \underline{a} \cdot I_C|$$

Phase sequence A-C-B

- (Alternative terminology: anti-clockwise rotating field)

$$|I_{neg}| = \frac{1}{3} \cdot |I_A + \underline{a} \cdot I_B + \underline{a}^2 \cdot I_C|$$

Symbols used:

$$\underline{a} = e^{2\pi j/3} = e^{j \cdot 120^\circ}$$

$$\underline{a}^2 = e^{4\pi j/3} = e^{j \cdot 240^\circ}$$

The negative-sequence current is monitored by the P433 to detect when it exceeds the set thresholds. After the set operate delays have elapsed, a signal is issued. The operate delays may be blocked via appropriately configured binary signal inputs (for example (041 102) DTOC: Blocking $tl_{neg} > EXT = Yes$).

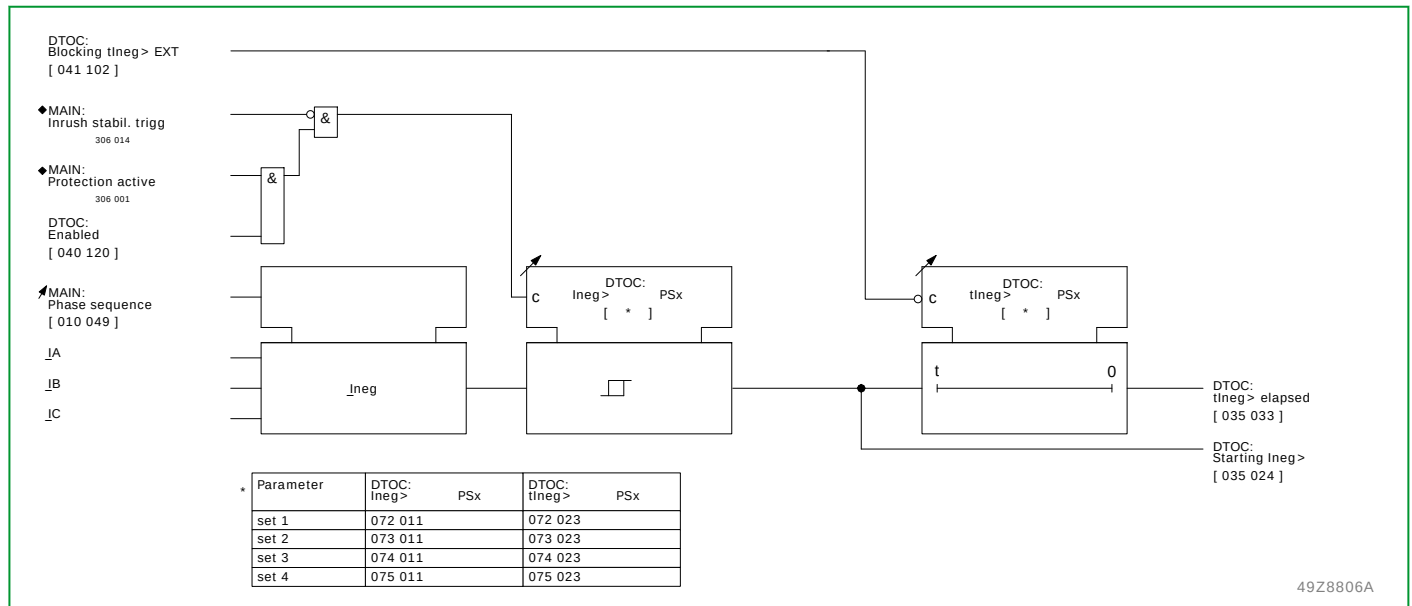


Fig. 3-273: Monitoring the negative-sequence current (using the first overcurrent stage as an example, other stages analogously)

3.34.4 Monitoring the Residual Current

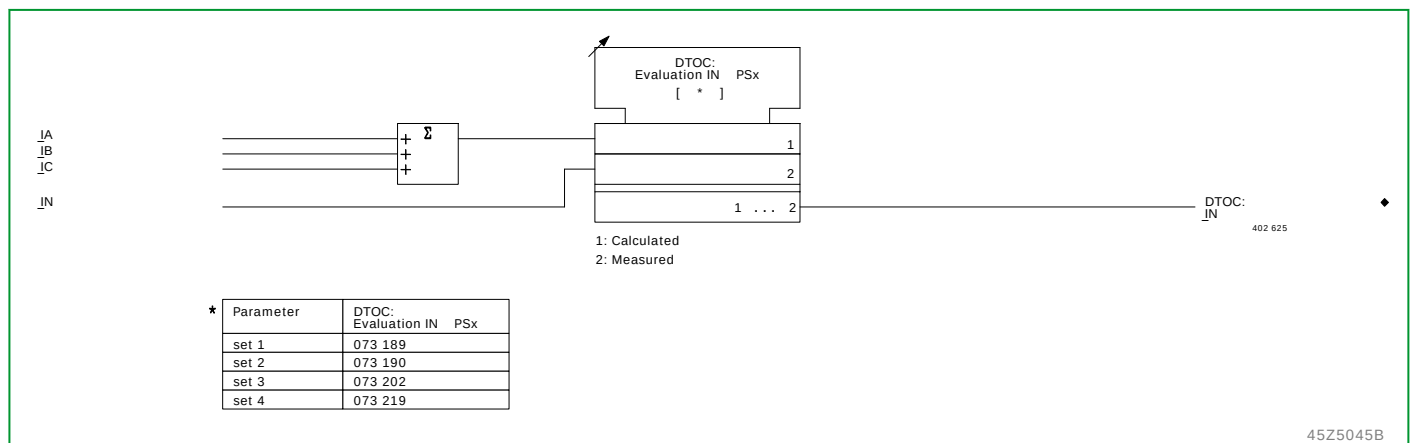


Fig. 3-274: Selecting the measured value

Depending on the setting, the P433 monitors the residual current, calculated from the three phase currents or measured at the current transformer T4.

The selected measured value of the residual current (DTOC: Meas.value I/IN > PSx) is monitored by the P433 to detect when it exceeds the set threshold. When the threshold is exceeded, a starting signal is issued (for example for the first stage: (035 028) DTOC: Starting IN >).

Moreover, the P433 determines the angle between the residual current and the neutral-displacement voltage for the direction determination. The direction determination is enabled when a current stage is started and the neutral-displacement voltage exceeds the set threshold SCDD: VNG > PSx. See [Section 3.36.5, \(p. 3-370\)](#), in particular [Fig. 3-299, \(p. 3-372\)](#). After the operate delay has elapsed, a trip signal of the respective residual current stage is issued if the set direction matches the measured direction.

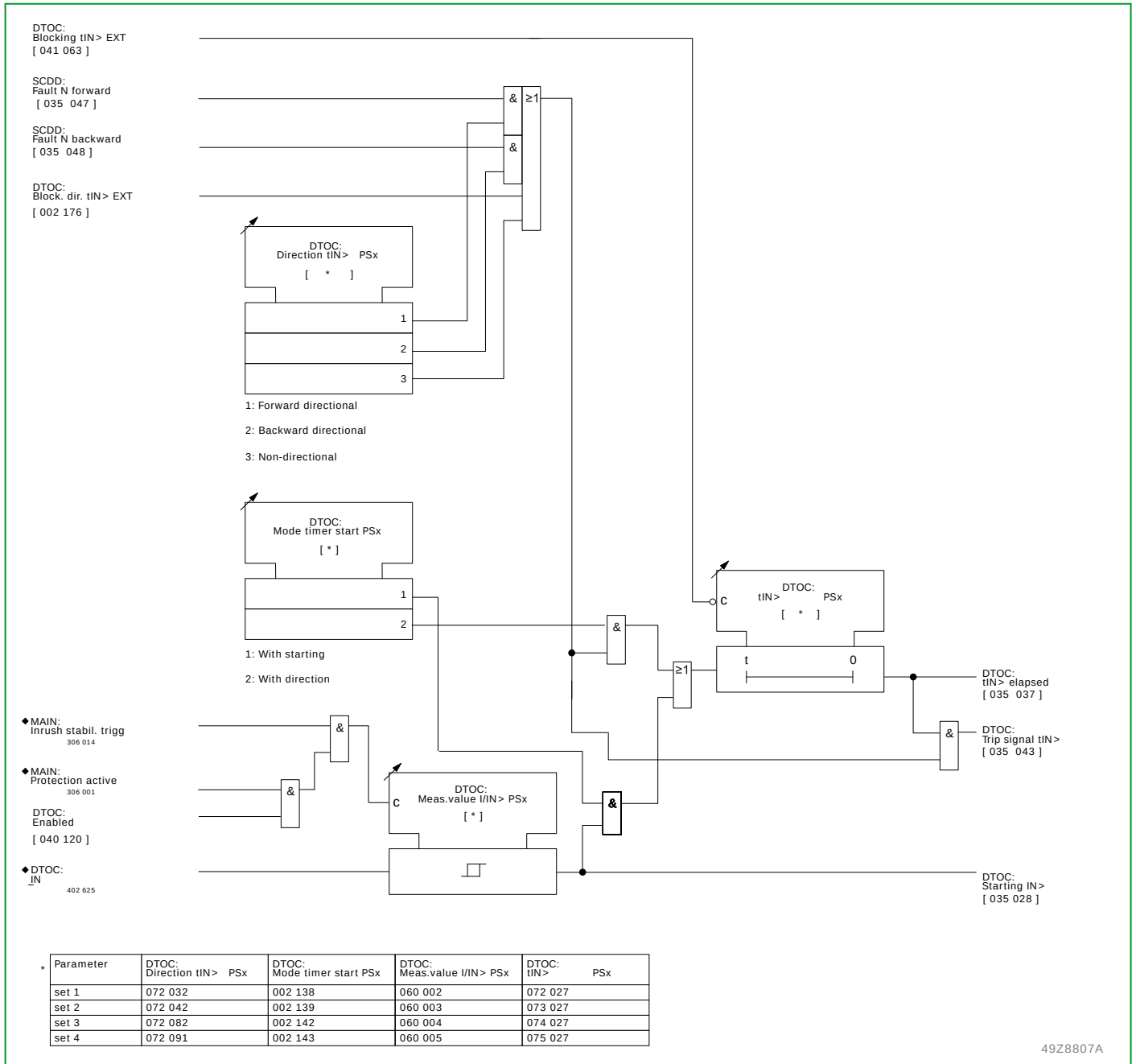


Fig. 3-275: Monitoring the residual current (using the first overcurrent stage as an example, the other stages analogical).

Depending on the setting DT0C: Mode timer start PSx, the timer stages for the neutral current stages are triggered with the starting (i.e. with exceeding of the operate value), or are direction-dependent (i.e. starting condition and current flow in the set direction are present at the same time).

After the set operate delays have elapsed, a signal is issued (for example for the first stage: (035 037) DT0C: tIN > elapsed).

The elapsing of the operate delays may be blocked via appropriately configured binary signal inputs (for example by the signal (041 063) DT0C: Blocking tIN > EXT).

The directional operation mode of the overcurrent stages can be blocked via appropriately configured binary signal inputs (for example by the signal (002 176) DT0C: Block. dir. tIN > EXT). In this case the overcurrent stage operates non-directional.

This input function may also be applied to block the directional operation should a measuring circuit failure occur (by using the signal from the associated m.c.b.).

After the set operate delays have elapsed, a tripping signal is issued for the respective phase current stage if the measured direction matches the set direction (for example for the first stage: (035 043) DTOC: Trip signal tIN>).

3.34.5 Current Monitoring and Starting Signals

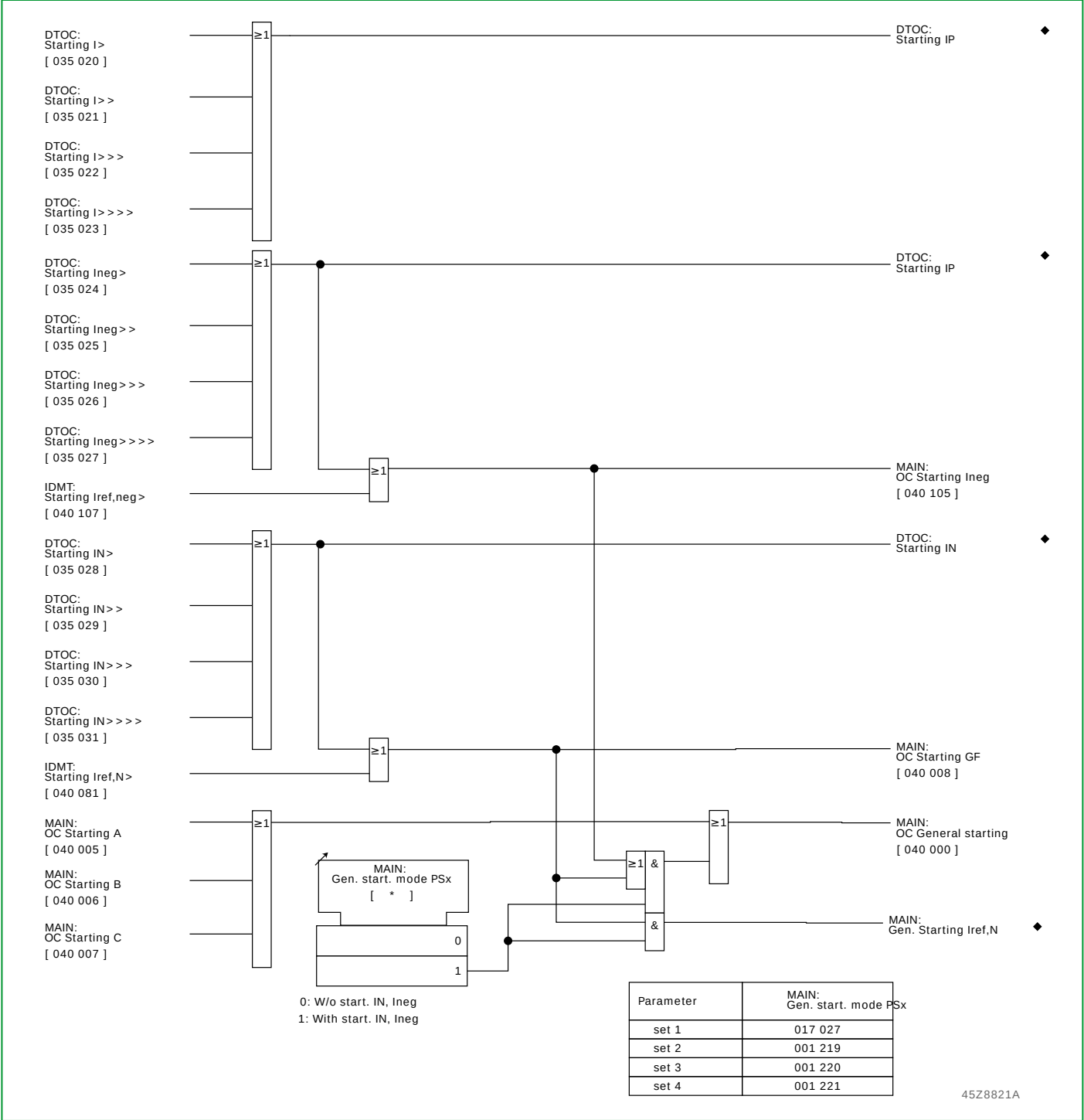


Fig. 3-276: DTOC and IDMT starting signals.

The starting signals for all overcurrent stages – including IDMT stages (see [Section 3.35, \(p. 3-350\)](#)) – are grouped to form dedicated starting signals. The setting MAIN: Gen. start w. OC PSx allows for the three starting signals (phase currents – MAIN: OC General starting, residual current – MAIN: OC Starting GF and negative-sequence current – MAIN: OC Starting Ineg) to trigger the general starting of the P433, see [Section 3.13.15.1, \(p. 3-124\)](#).

3.34.6

Hold-Time Logic for Intermittent Ground Faults

A hold-time logic for the treatment of intermittent ground faults is available in the P433.

- As the $I_{N>}$ starting in the residual current stage commences, the hold time is reset. At the same time, the starting time is accumulated when $I_{N>}$ starting commences.
- As $I_{N>}$ starting ends, the timer stage DTOC: Puls.prol. $I_{N>}$,intPSx is started and the charging of the accumulation buffer is thereby lengthened by the set value of the timer stage.
- The accumulation result is compared to the settable limit value at DTOC: tIN>,interm. PSx.
- If the limit value is reached and a general starting is present, then a trip results (DTOC: Trip sig. tIN>,intm.), which can be configured to the trip commands 1 and 2.
 - MAIN: Fct.assig.trip cmd.1 (Address 021 001)
 - MAIN: Fct.assig.trip cmd.2 (Address 021 002)
- If the limit value is reached while the timer stage DTOC: Puls.prol. $I_{N>}$,intPSx is running, then a trip will occur when the next general starting phase commences.
- With each release of the trigger stage $I_{N>}$, the set hold-time DTOC: Hold-t. tIN>,intmPSx is restarted. When the hold time has elapsed or after the hold-time logic has issued a trip (DTOC: Trip sig. tIN>,intm.) accumulation is stopped and the accumulation buffer is cleared.

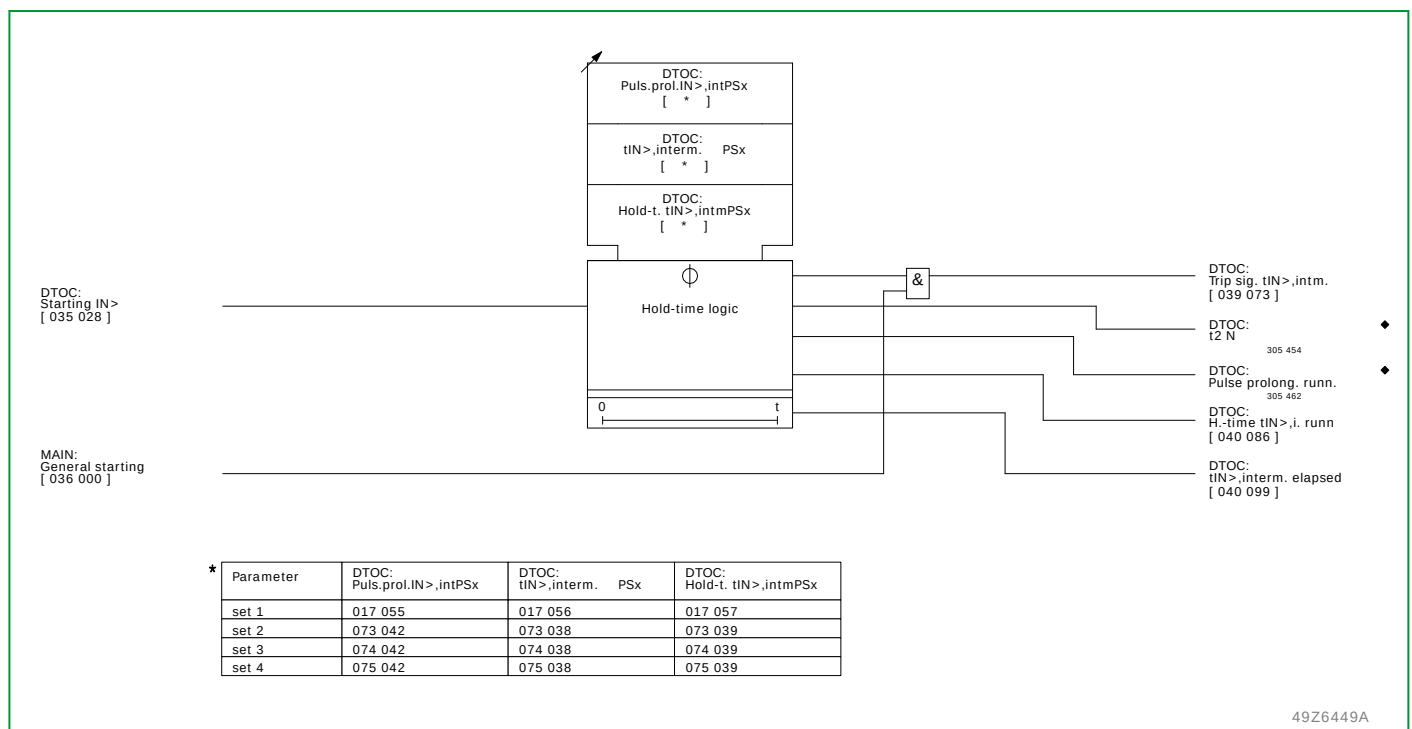


Fig. 3-277: Hold-time logic for definite-time characteristics.

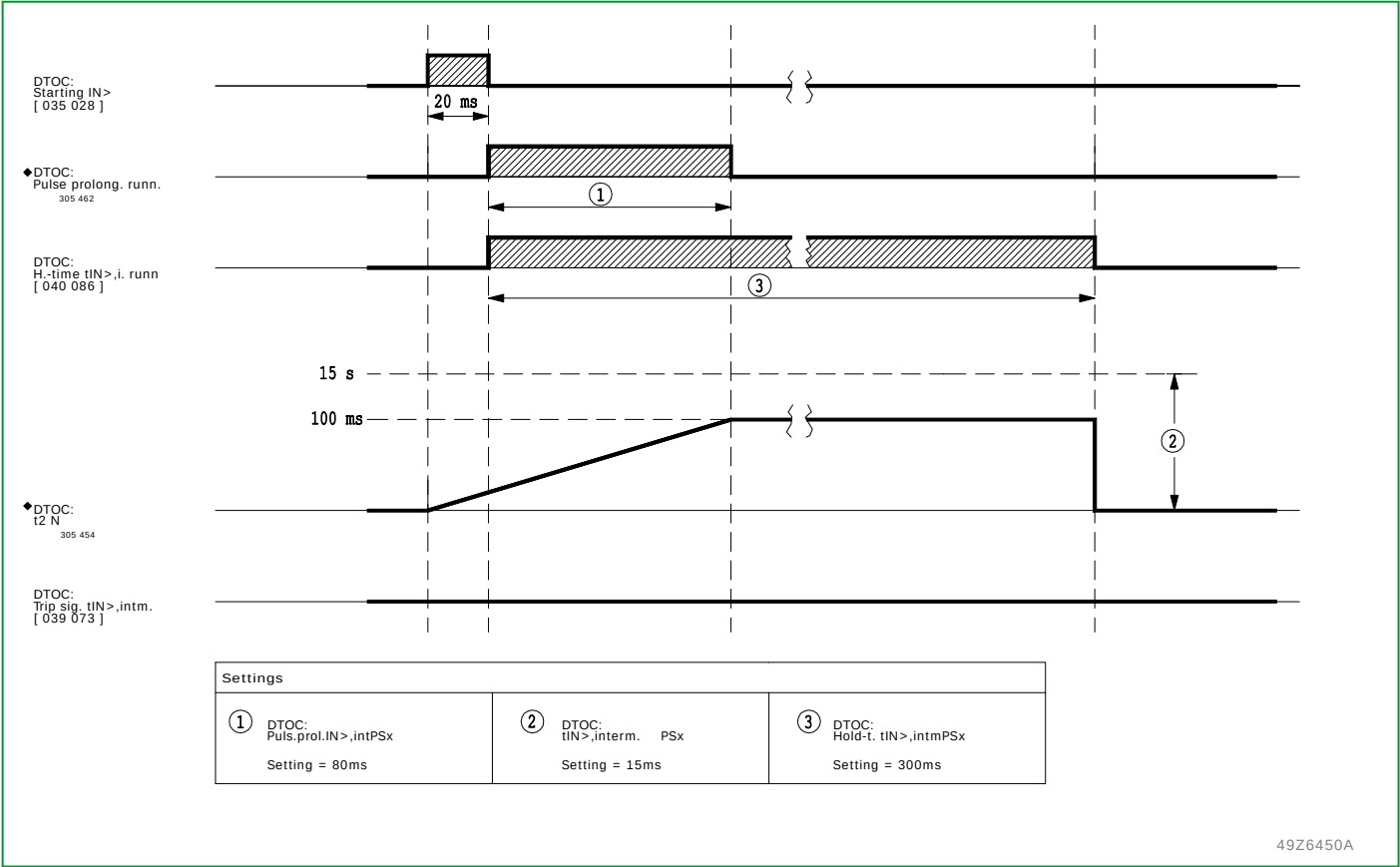


Fig. 3-278: Signal flow for values below the accumulation limit value.

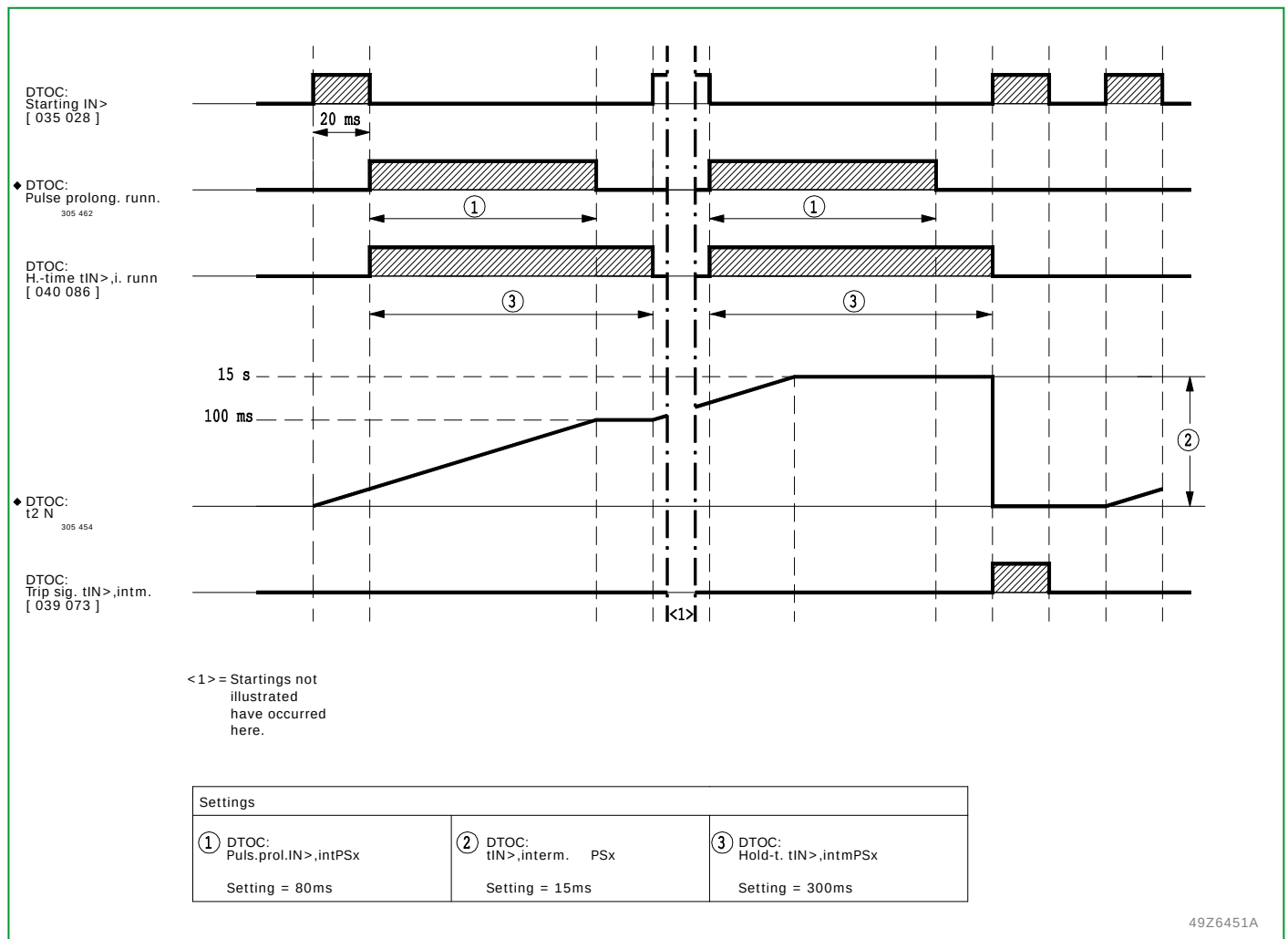


Fig. 3-279: Signal flow for values at the accumulation limit value.

3.34.7

ARC Startup

By using the setting parameter (013 127) DTOC: Funct. start ARC PSx, DTOC starting signals can be used to start operative times and thus start an ARC cycle. The start of an ARC dead time still depends on the termination of the general trip signal 1:

- If the general trip signal 1 terminates within the operative time 1, then the fix dead time 3p is started.
- If the general trip signal 1 terminates within the operative time 2 (and operative time 1 has already elapsed), then the maximum dead time is started.

Dead times and reclosure conditions in combination with the automatic synchronism check (ASC) function are not affected.

There are no separate start times for the DTOC overcurrent stages, i.e. DTOC tripping occurs independently of an ARC start after the set operate delays have elapsed. Thus, to successfully start an ARC cycle, either the operative time has to be set longer than the DTOC operate delay, or an overcurrent stage with a short tripping time needs to be defined. If no such overcurrent stage is available anymore, an ARC startup can also be achieved using the programmable logic; see also [Section 3.30.13, \(p. 3-287\)](#).

3.35 Inverse-Time Overcurrent Protection (Function Group IDMT)

The inverse-time overcurrent protection function (IDMT) operates with three separate measuring systems for:

- Phase currents system
- Negative-sequence current
- Residual current.

The inrush stabilization function may intervene in the functional sequence of the IDMT function.

3.35.1 Disabling and Enabling IDMT Protection

IDMT protection can be disabled or enabled using setting parameters. Moreover, enabling can be carried out separately for each parameter subset.

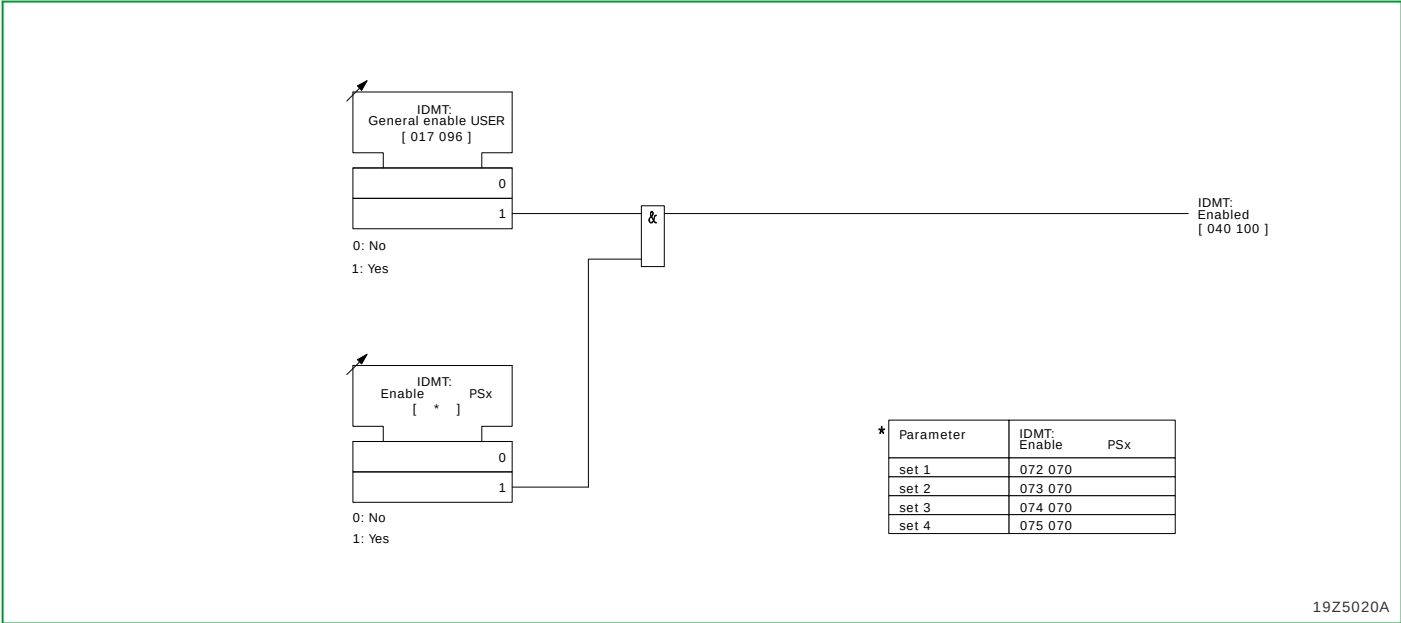


Fig. 3-280: Disabling or enabling IDMT protection. (Only IDMT1 is shown; the logic, however, also applies to IDMT2 with different numerical addresses.)

3.35.2 Time-Dependent Characteristics

The measuring systems for phase currents, residual current and negative-sequence current operate independently of each other and can be set separately. The user can select from a large number of characteristics (see table below). The measured variable is the maximum phase current, the negative-sequence current, or the residual current, depending on the measuring system. The tripping characteristics available for selection are shown in the following figures (Fig. 3-281, (p. 3-353) to Fig. 3-284, (p. 3-355)).

Time calculation begins with the starting of the respective IDMT stage. The setting (013 143) IDMT: Time Correction PSx allows for correcting the tripping time by the duration that has been needed to measure and recognize the starting. This can optimize the accuracy of time in case the tripping characteristic leads to short tripping times (< 200 ms).

As an alternative, it is also possible to set IDMT: Time Correction PSx to some negative value. This extends the tripping time accordingly, which might be required to synchronize tripping with other devices needing more time for the starting.

No.	Tripping Characteristic	Formula for the Tripping Characteristic	Constants			Formula for the Reset Characteristic	R
			a	b	c		
	Characteristic settable factor: $k = 0.05 \dots 10.00$						
0	Definite Time	$t = k$					
	Per IEC 255-3	$t = k \cdot \frac{a}{(\frac{I}{I_{ref}})^b - 1}$					
1	Standard Inverse		0.14	0.02			
2	Very Inverse		13.50	1.00			
3	Extremely Inverse		80.00	2.00			
4	Long Time Inverse		120.00	1.00			
	Per IEEE C37.112	$t = k \cdot (\frac{a}{(\frac{I}{I_{ref}})^b - 1} + c)$				$t_r = \frac{k \cdot R}{1 - (\frac{I}{I_{ref}})^2}$	
5	Moderately Inverse		0.0515	0.0200	0.1140		4.85
6	Very Inverse		19.6100	2.0000	0.4910		21.60
7	Extremely Inverse		28.2000	2.0000	0.1217		29.10
	Per ANSI	$t = k \cdot (\frac{a}{(\frac{I}{I_{ref}})^b - 1} + c)$				$t_r = \frac{k \cdot R}{1 - (\frac{I}{I_{ref}})^2}$	
8	Normally Inverse		8.9341	2.0938	0.17966		9.00
9	Short Time Inverse		0.2663	1.2969	0.03393		0.50
10	Long Time Inverse		5.6143	1.0000	2.18592		15.75
11	RI-Type Inverse	$t = k \cdot \frac{1}{0.339 - \frac{0.236}{(\frac{I}{I_{ref}})}}$					
12	RXIDG-Type Inverse	$t = k \cdot (5.8 - 1.35 \cdot \ln \frac{I}{I_{ref}})$					

For a ratio I/I_{ref} greater than 40, the tripping time is determined as for $I/I_{ref} = 40$.

For currents exceeding the dynamic range limit the tripping time is approximately determined as for the limit value.

The following limits apply:

IP, Ineg, IN,calc: 100 Inom;

IN,meas: 16 IN,nom.

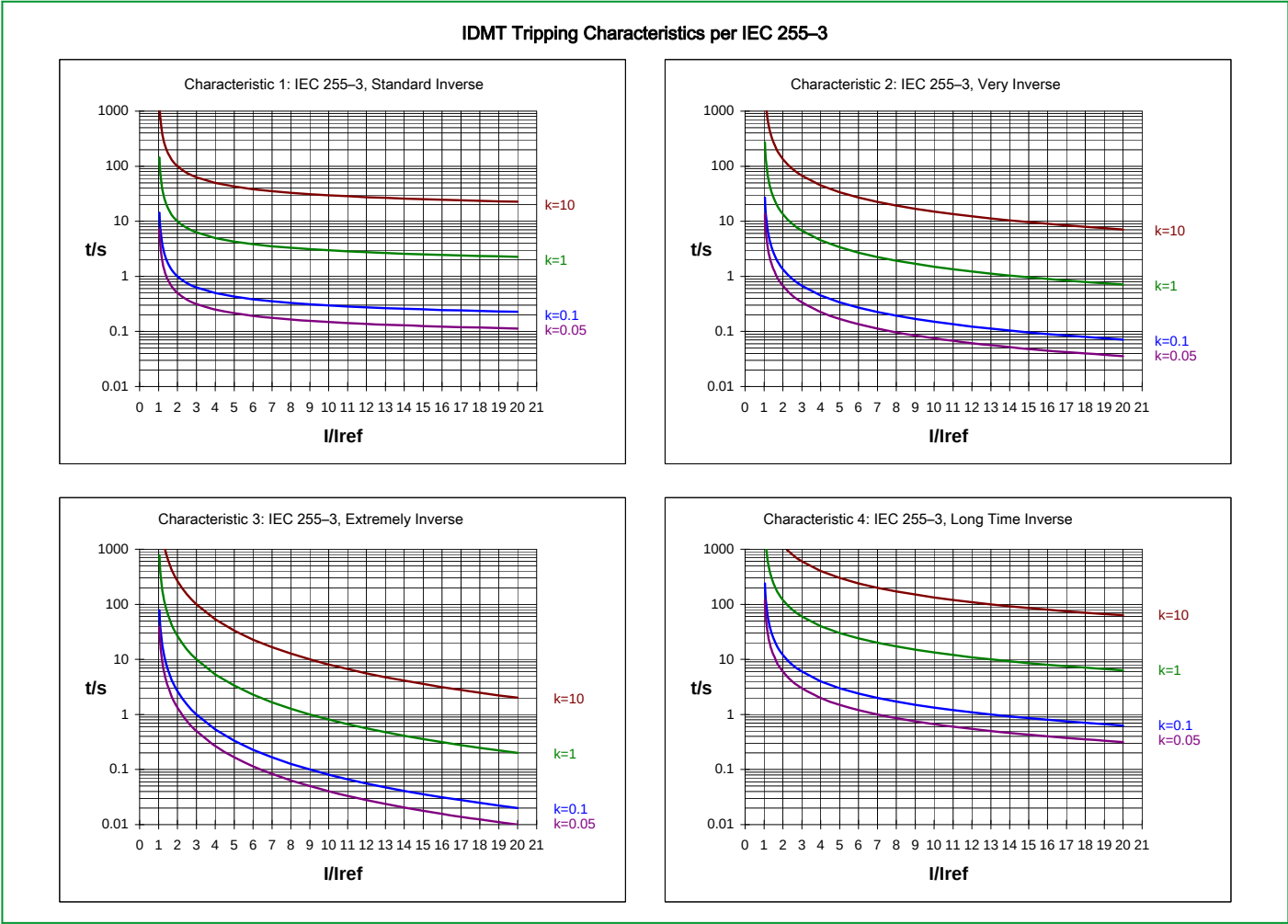


Fig. 3-281: Tripping characteristics as per IEC 255-3.

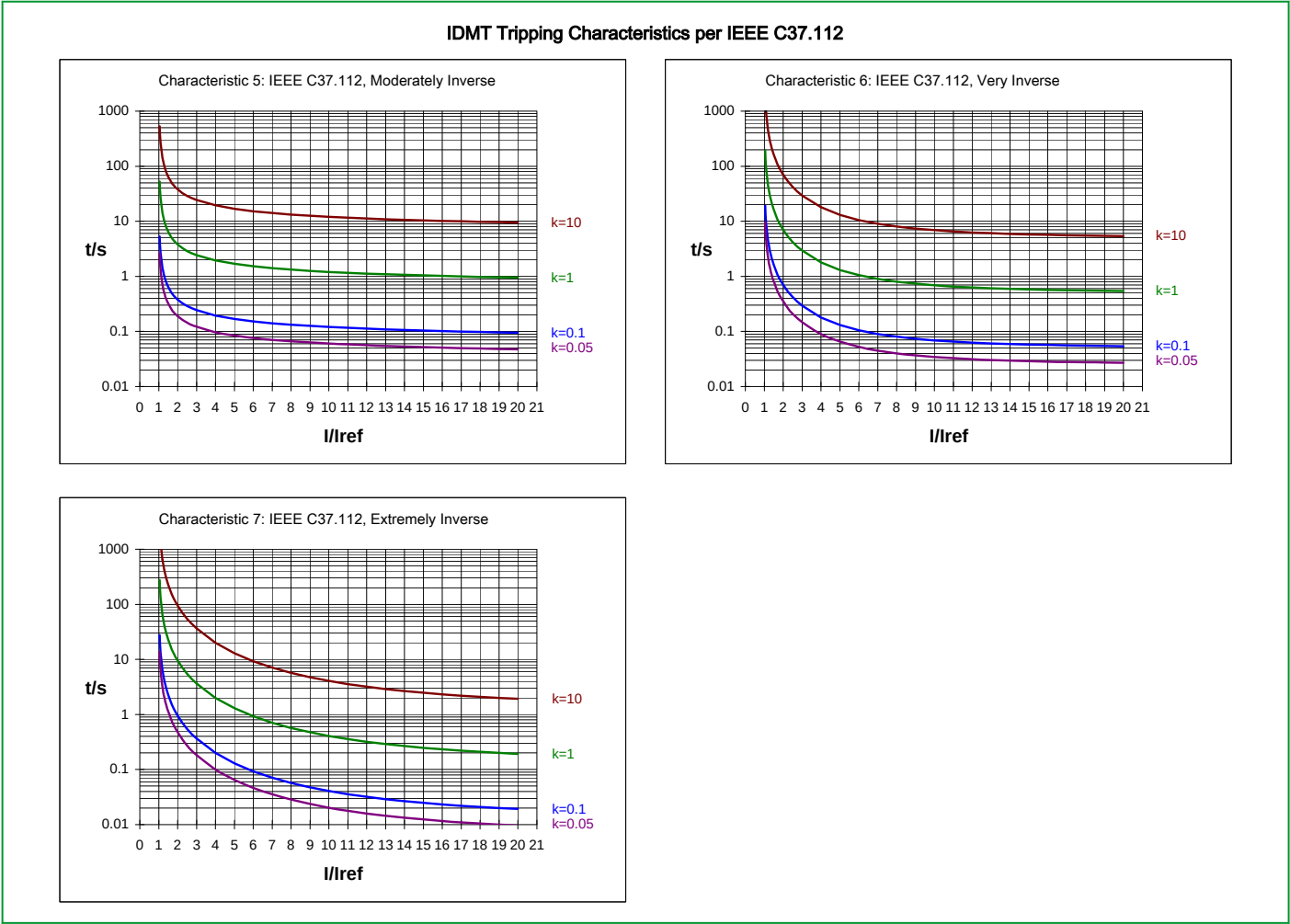


Fig. 3-282: Tripping characteristics as per IEEE C37.112.

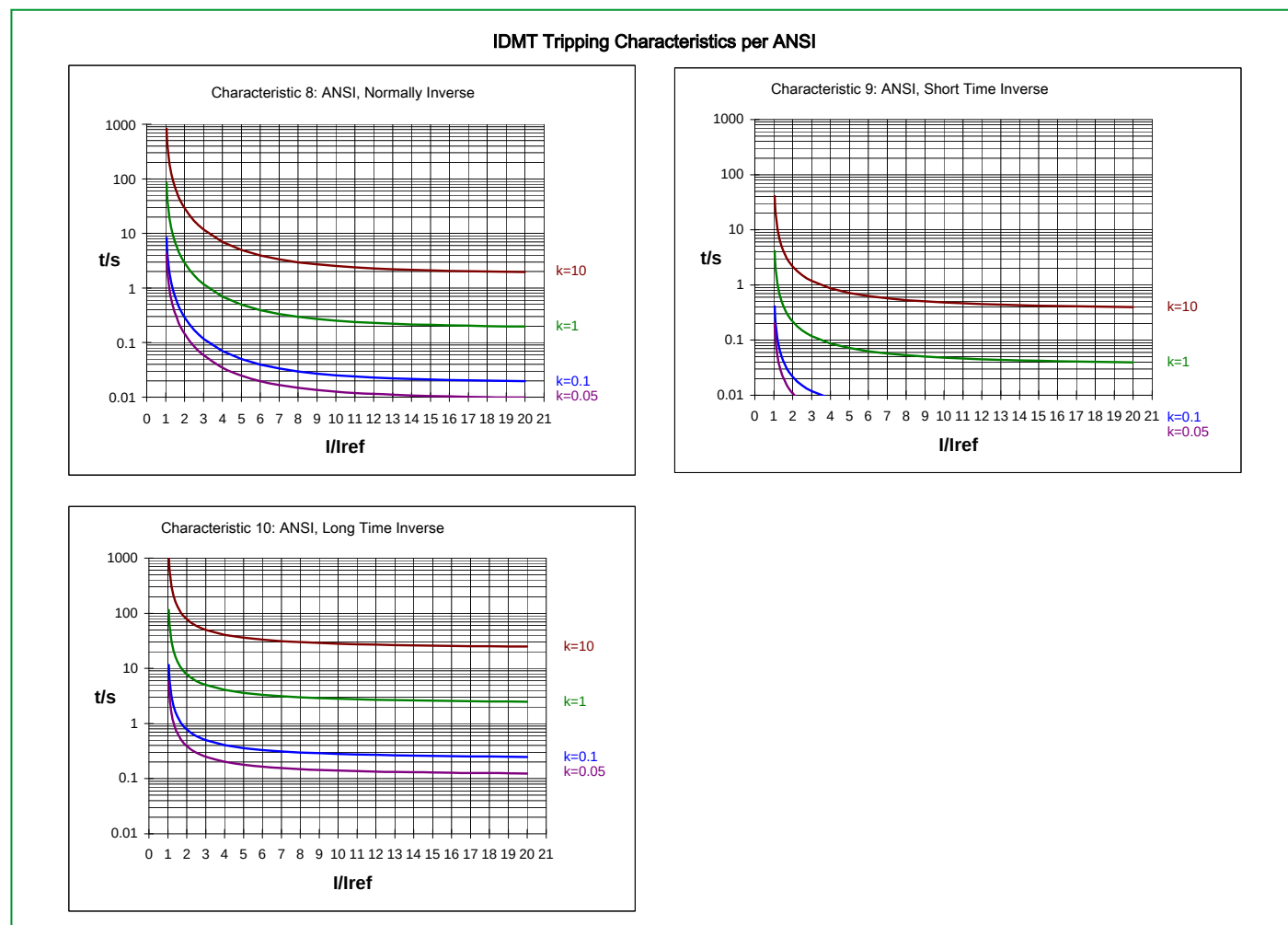


Fig. 3-283: Tripping characteristics as per ANSI.

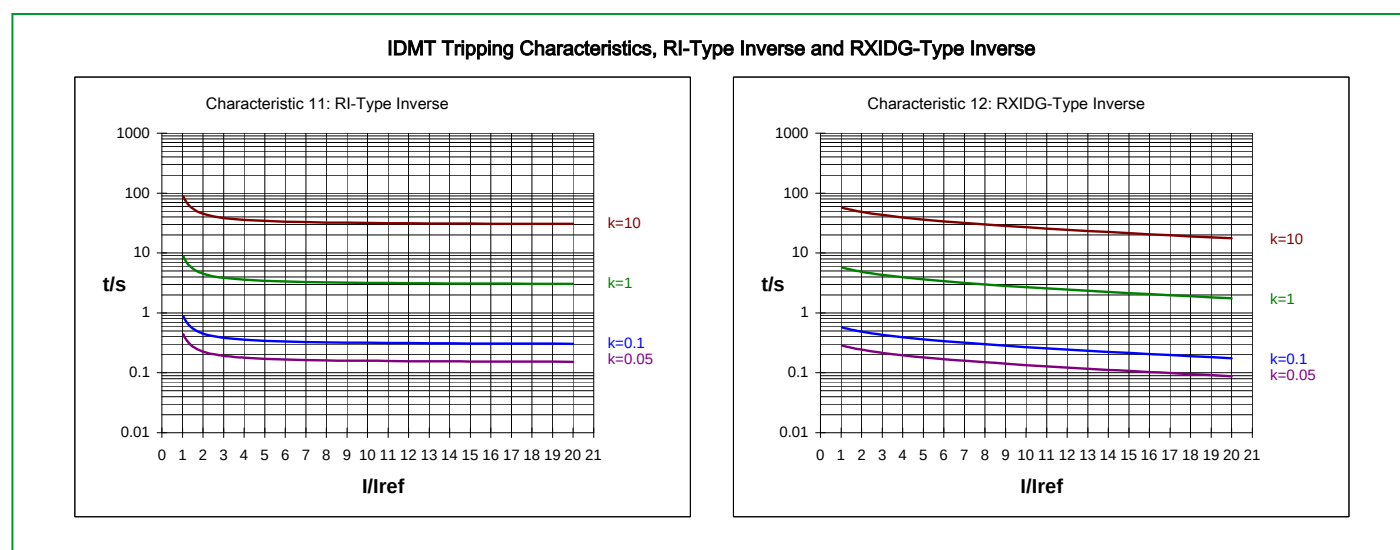


Fig. 3-284: RI-type inverse and RXIDG-type inverse tripping characteristics.

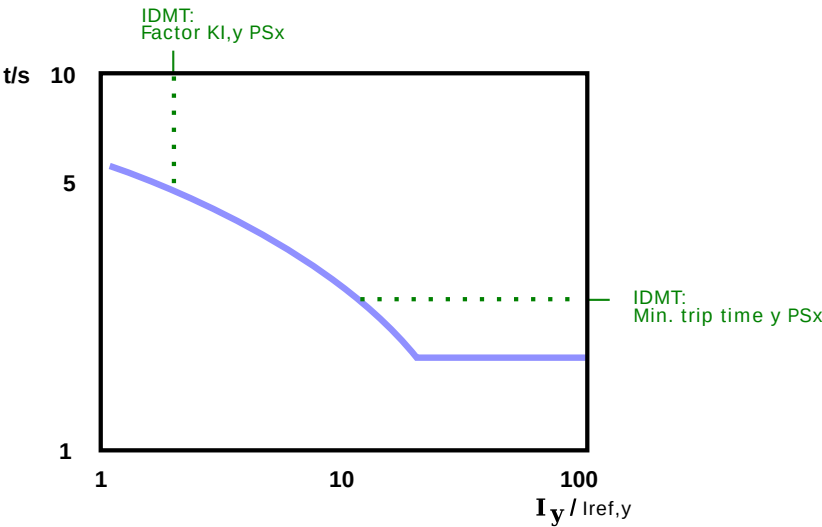
3.35.3 Enable Thresholds

Minimum Operate Value

A minimum operate value (threshold) may be defined for each of the phase currents, the residual current and the negative-sequence current, valid for function group IDMT. Each factor IDMT: Factor KI,y PSx (y=“P” for the phase currents, y=“N” for the residual current, y=“neg” for the negative-sequence current) is multiplied by the reference quantity ($I_{ref,P}$ or $I_{ref,N}$ or $I_{ref,neg}$, respectively) in order to form the minimum operate value. The timer stage is triggered only when the current exceeds the set threshold.

Minimum Trip Time

A minimum trip time IDMT: Min. trip time y PSx may be defined (y=“P” for the phase currents, y=“N” for the residual current, y=“neg” for the negative-sequence current). The respective minimum trip timer stage is started with the starting signal IDMT: Starting $I_{ref,y} >$. As long as the minimum trip timer is running, the IDMT: $tI_{ref,y} >$ elapsed and IDMT: Trip signal $tI_{ref,y} >$ are blocked. When the minimum trip time timer has elapsed, IDMT: $tI_{ref,y} >$ elapsed and the IDMT: Trip signal $tI_{ref,y} >$ are released.



y	P	N (neutral current)	neg
Parameter	IDMT: Factor KI,P PSx	IDMT: Factor KI,N PSx	IDMT: Factor KI,neg PSx
set 1	007 250	001 173	007 254
set 2	007 251	001 174	007 255
set 3	007 252	001 175	008 002
set 4	007 253	001 176	008 005

y	P	N (neutral current)	neg
Parameter	IDMT: Min. trip time P PSx	IDMT: Min. trip time N PSx	IDMT: Min. trip time negPSx
set 1	072 077	072 079	072 078
set 2	073 077	073 079	073 078
set 3	074 077	074 079	074 078
set 4	075 077	075 079	075 078

45Z8004A

Fig. 3-285: Influence of the minimum operate value and the minimum trip time on the IDMT characteristics

3.35.4 Phase Current Stage

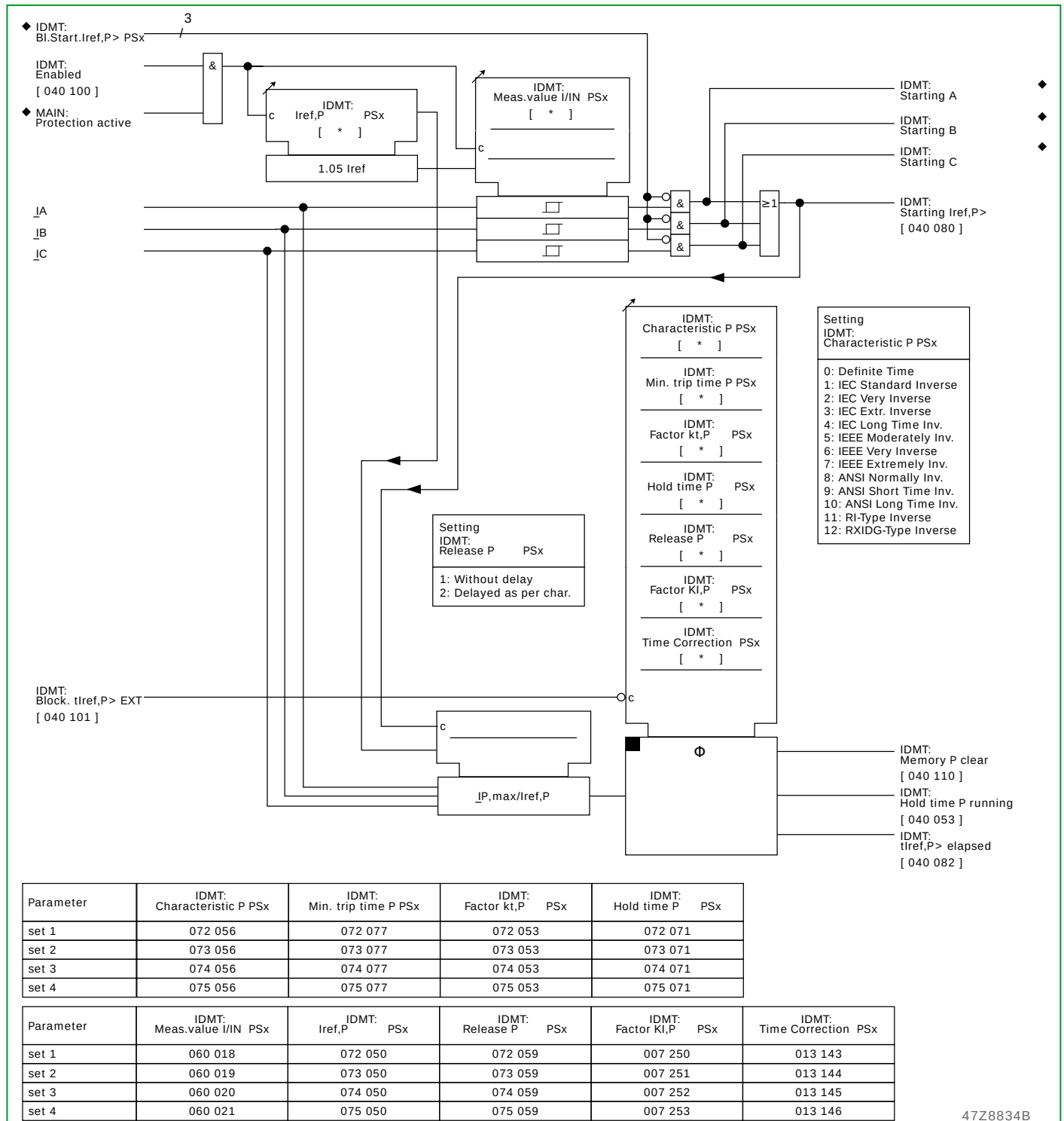


Fig. 3-286: Phase current stage for IDMT.

The three phase currents are monitored by the P433 to detect when they exceed the set thresholds. The IDMT protection will trigger when the 1.05-fold of the set reference current value is exceeded in one phase. The P433 will then determine the maximum current flowing in the three phases and this value is used for further processing. Depending on the characteristic selected and the current magnitude the P433 will determine the tripping time. Moreover the tripping time will under no circumstances fall below a settable minimum time threshold irrespective of the current flow magnitude.

When the inrush stabilization function (see [Section 3.13.5, \(p. 3-111\)](#)) is triggered, the phase current stage as well as the residual current stage is blocked. However, when a phase starting is present then no subsequent triggering of the inrush stabilization will be taken into account. (When a change from a single-phase fault to a two-phase fault or from a two-phase fault to a three-phase fault had occurred, it was possible that, because of transients during the change, the inrush stabilization was momentarily triggered which would reset the starting and the timer.)

The inverse-time stage can be blocked by an appropriately configured binary signal input.

3.35.5 Negative-Sequence Current Stage

According to the following formulas the P433 will determine the negative-sequence current and positive-sequence current, taking into account the set phase sequence (alternative terminology: Rotary field):

Phase sequence A-B-C (alternative terminology: clockwise rotating field):

$$|\underline{I}_{\text{neg}}| = \frac{1}{3} \cdot |\underline{I}_A + \underline{a}^2 \cdot \underline{I}_B + \underline{a} \cdot \underline{I}_C|$$

Phase sequence A-C-B (alternative terminology: anti-clockwise rotating field):

$$|\underline{I}_{\text{neg}}| = \frac{1}{3} \cdot |\underline{I}_A + \underline{a} \cdot \underline{I}_B + \underline{a}^2 \cdot \underline{I}_C|$$

$$\underline{a} = e^{2\pi j/3} = e^{j \cdot 120^\circ}$$

$$\underline{a}^2 = e^{4\pi j/3} = e^{j \cdot 240^\circ}$$

The negative-sequence current is monitored by the P433 to detect when it exceeds the set thresholds. The IDMT protection will trigger when the 1.05-fold of the set reference current value is exceeded by the negative-sequence current. Depending on the characteristic selected and the residual current magnitude the P433 will determine the tripping time. Moreover the tripping time will under no circumstances fall below a settable minimum time threshold irrespective of the negative-sequence current flow magnitude.

When the inrush stabilization function ([Section 3.13.5, \(p. 3-111\)](#)) is triggered, the negative-sequence current stage is blocked.

The inverse-time stage can be blocked by an appropriately configured binary signal input. In addition the inverse-time stage can also be automatically blocked by single-pole or multi-pole starting (depending on the setting).

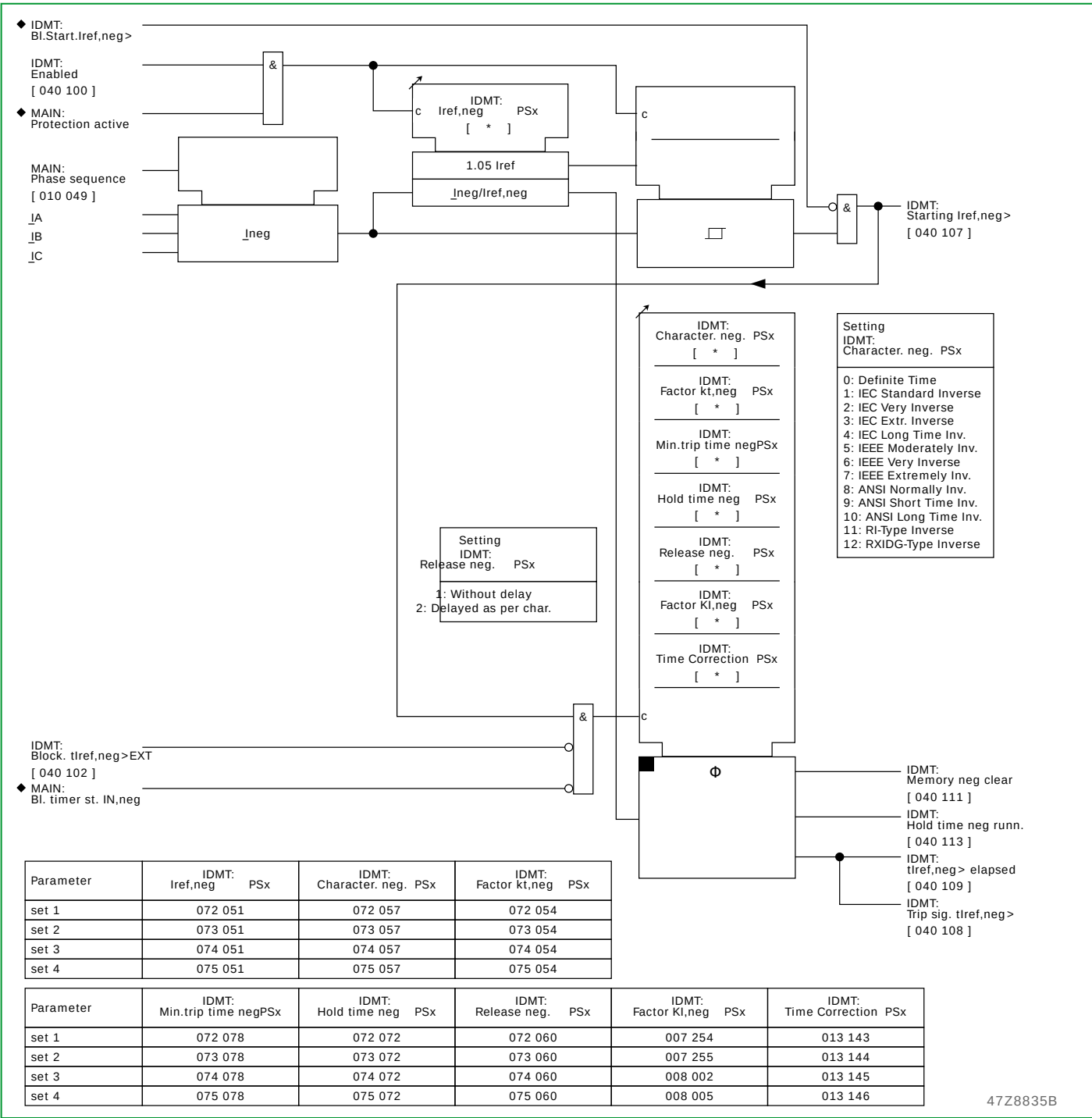


Fig. 3-287: Negative-sequence current stage.

3.35.6 Selecting the Measured Variable for the Residual Current Stage

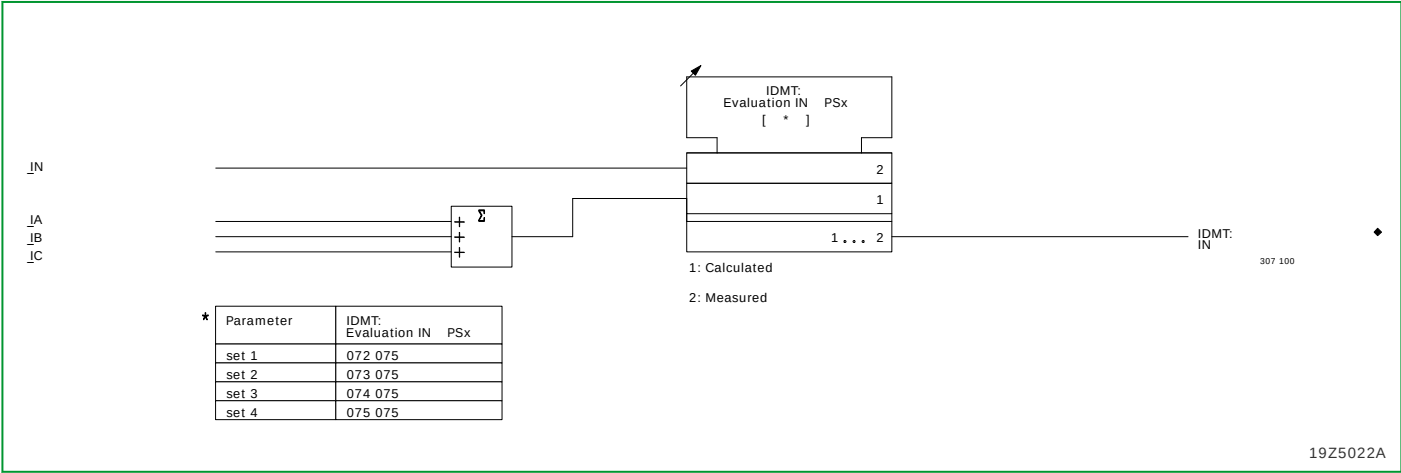


Fig. 3-288: Selecting the measured variable.

A setting specifies which current will be used by the P433 as the residual current: either the residual current calculated from the three phase currents or the residual current directly measured at the fourth current transformer (T 4).

3.35.7 Residual Current Stage

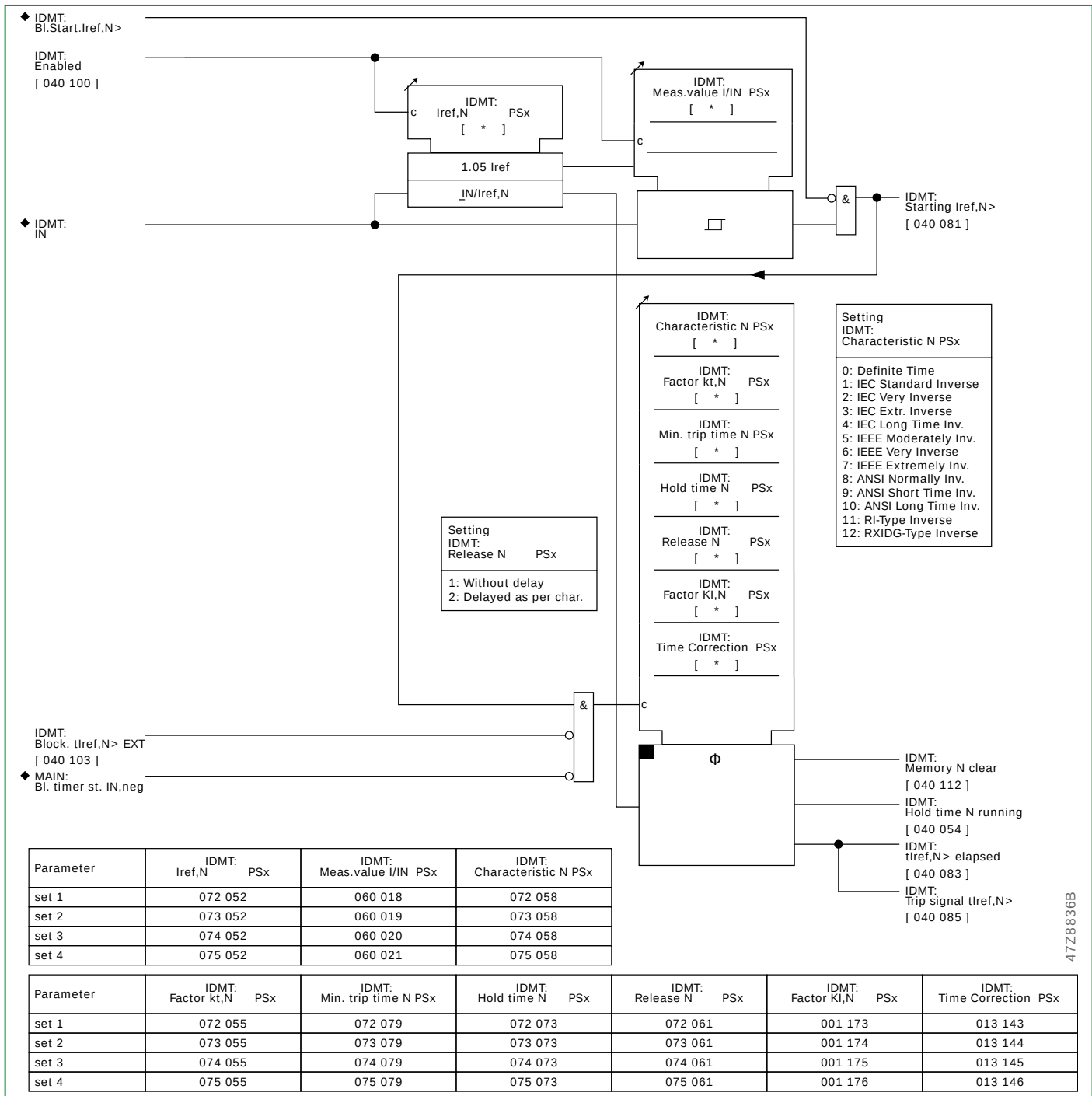


Fig. 3-289: Residual current stage for IDMT.

The residual current is monitored by the P433 to detect when it exceeds the set thresholds. The IDMT protection will trigger when the 1.05-fold of the set reference current value is exceeded by the residual current. Depending on the characteristic selected and the residual current magnitude the P433 will determine the tripping time. Moreover the tripping time will under no circumstances fall below a settable minimum time threshold irrespective of the residual current flow magnitude.

The inverse-time stage can be blocked by an appropriately configured binary signal input. In addition the inverse-time stage can also be automatically blocked by single-pole or multi-pole starting (depending on the setting).

3.35.8 Holding Time

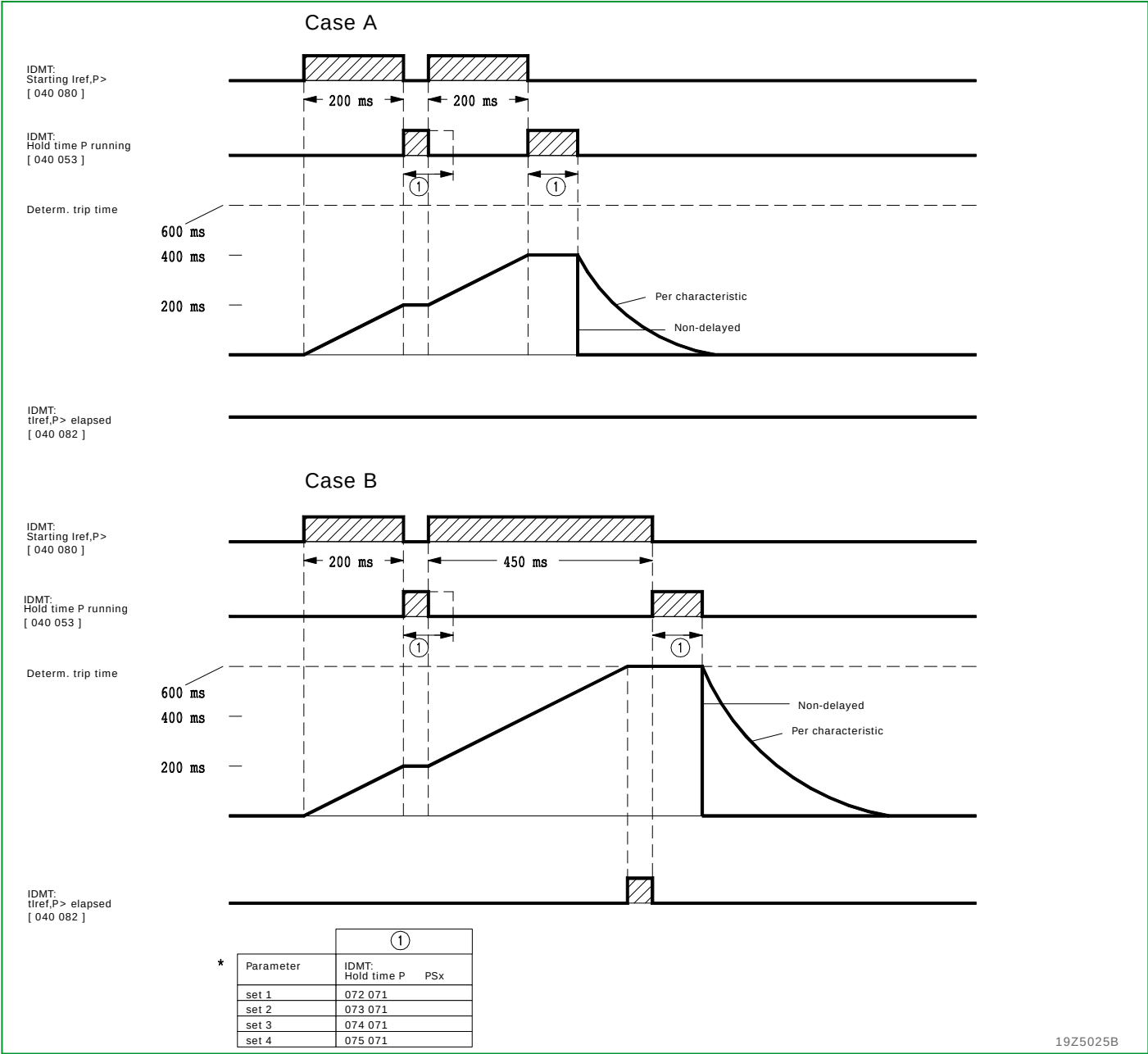


Fig. 3-290: Effect of hold time shown with a phase current stage as an example. Example A: Hold time determined is not reached. Example B: Hold time determined is reached.

Depending on the current flow the P433 will determine the tripping time and a timer stage is started. The setting of the hold time defines the time period during which the IDMT protection starting time is stored after the starting has dropped out. Should starting recur during the hold time period then the time of the renewed starting will be added to the time period stored. When the starting times sum reach the tripping time value determined by the P433 then the corresponding signal will be issued. Should starting not recur during the hold time period then, depending on the setting, the memory storing the accumulated starting times value will either be cleared without delay or according to the characteristic set. In Fig. 3-290, (p. 3-363), the effect of hold time is shown by the example of a phase current stage.

3.36 Short-Circuit Direction Determination (Function Group SCDD)

The P433 provides a short circuit direction determination (SCDD) function. With this feature it is possible to use the definite-time overcurrent protection and the inverse-time overcurrent protection with direction determination. For this purpose, two separate measuring systems are available for:

- the phase currents system,
- the residual current system.

3.36.1 Enable/Disable the Short-Circuit Direction Determination

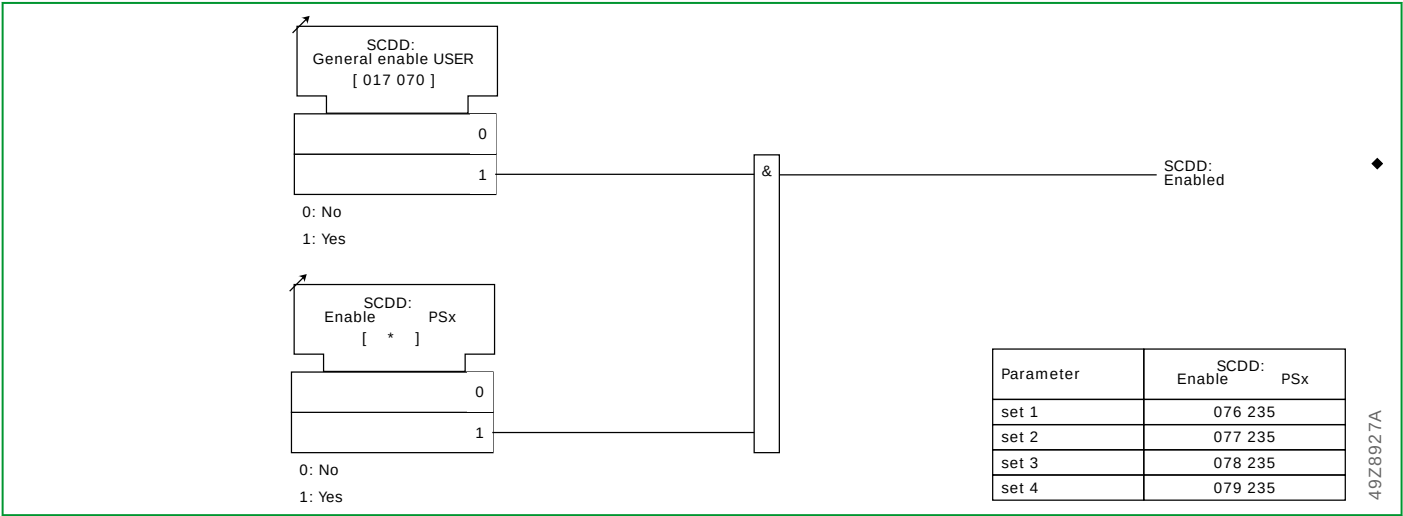


Fig. 3-291: Enable/disable the short-circuit direction determination.

The short-circuit direction determination can be disabled or enabled via setting parameters. Moreover, enabling can be carried out separately for each parameter subset.

3.36.2 Phase Current Stages

To determine direction in the phase current stages and depending on the type of fault a phase current and the opposed phase-to-phase voltage as well as the respective optimum characteristic angle are used.

As an example for a single-pole fault in phase A to ground the phase A current value (I_A), the phase B to phase C voltage value (V_{B-C}) and the characteristic angle $\alpha_P = +45^\circ$ are selected as measured variables (see Fig. 3-292, (p. 3-365)).

The vector of the selected phase-to-phase voltage is the reference quantity. Beginning with the reference quantity the characteristic angle α_P will determine the measuring relation. Depending on the type of fault the P433 will present various characteristic angles. The measuring relation is defined as the angle bisector for the directional zone "Forward". Forward directional is apparent if the vector of the selected phase current lies in the range between -90° and $+90^\circ$ of the measuring relation.

Backward directional is apparent if the vector of the selected phase current lies in the complementary range, i.e. less than -90° or greater than $+90^\circ$ of the measuring relation.

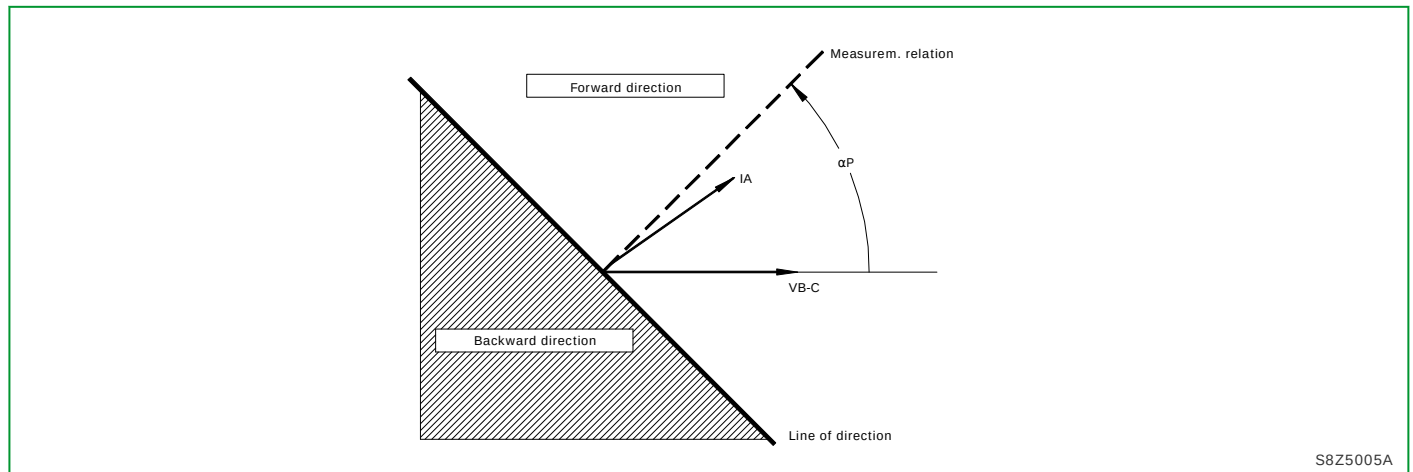


Fig. 3-292: Example for the forming of a directional phase current stage decision with a single-pole fault in phase A to ground (A-G) and with an inductive system and a phase sequence A-B-C (clockwise rotary field direction)

3.36.2.1 Short-Circuit Direction Determination Using Voltage Memory

For direction determination in a phase system the SCDD function uses the fault-dependent short-circuit current and – in general – the phase-to-phase, un-faulted voltages (not involved in the short-circuit) assigned to the type of fault. This ensures that with single-pole and two-pole faults there is always sufficient voltage available for direction determination.

This procedure can also be applied to three-pole faults with a phase-to-phase voltage greater than 200 mV.

Should a three-pole fault occur close to the point of measurement, there could be such a large 3-phase voltage drop, that direction determination on the above basis is no longer possible. For such fault occurrences there is a voltage memory available from which the SCDD function can obtain the necessary voltage information for direction determination.

With a three-pole fault in the phase-current stage the measurement loop voltage (V_{meas}) is compared to the selected operate value ($V_{op.Val.}$) of the voltage memory set by the user at DIST: Oper.val.Vmemory PSx. If the measured voltage is less than the set threshold ($V_{meas} < V_{op.Val.}$) then the SCDD function

will not use V_{ABmeas} but will revert to the voltage memory, if it has been enabled.

The following signal is issued: SCDD: Direct. using memory

If the voltage memory has not been enabled (e.g. $|\Delta f| > 2.5 \text{ Hz}$) the SCDD function will check if V_{meas} is sufficient for direction determination.

Should the result with a disabled voltage memory be $V_{meas} > 200 \text{ mV}$ the direction will be determined on the basis of V_{meas} . The following signal is issued: SCDD: Direct. using Vmeas

If $V_{meas} < 200 \text{ mV}$, a forward fault is detected if the voltage memory is disabled and if the pre-orientation is active (set under SCDD: Trip bias PSx), otherwise the directional decision is blocked. The following signal is issued: SCDD: Forw. w/o measurem.

These signals are additionally delivered to the following signals:

- SCDD: Fault P forward
- SCDD: Fault P backward
- SCDD: Fault P or G forwd.
- SCDD: Fault P or G backw.

3.36.3 Enabling for Phase Current Stages

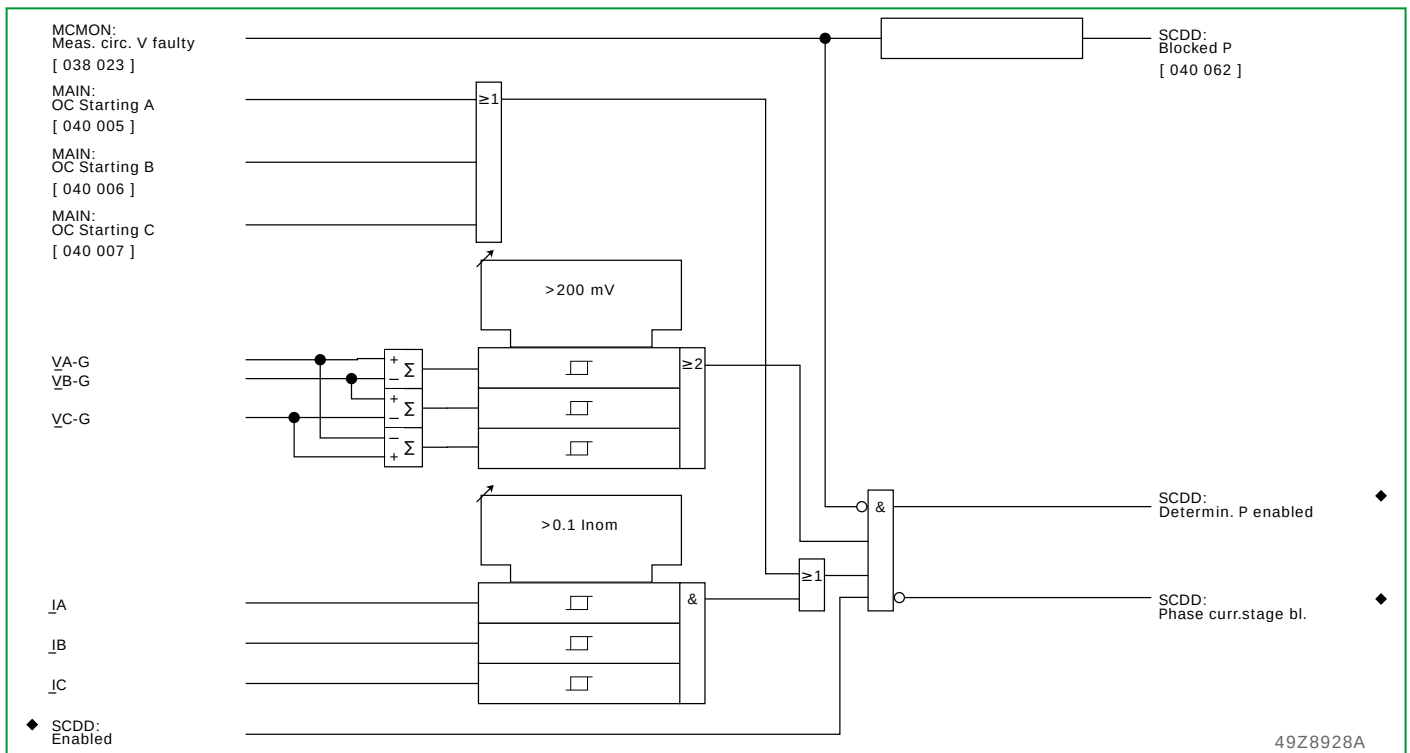


Fig. 3-293: Enabling direction determination for phase current stages.

Direction determination for phase current stages is only enabled if the following conditions are met simultaneously:

- Measuring-circuit monitoring has detected no faults in the voltage measuring loop (see [Section 3.26, \(p. 3-234\)](#)).
- A phase current starting signal is present.
- At least two phase-to-phase voltages exceed 200 mV.
- All three phase current values exceed $0.1 I_{nom}$.

Voltage memory can be applied when 3-pole faults have occurred (see [Section 3.36.2.1, \(p. 3-365\)](#)).

- After being enabled and depending on the direction determination decision one of the following signals will be issued:
- With a fault in forward direction, SCDD: Fault P forward
 - With a fault in backward (reverse) direction, SCDD: Fault P backward

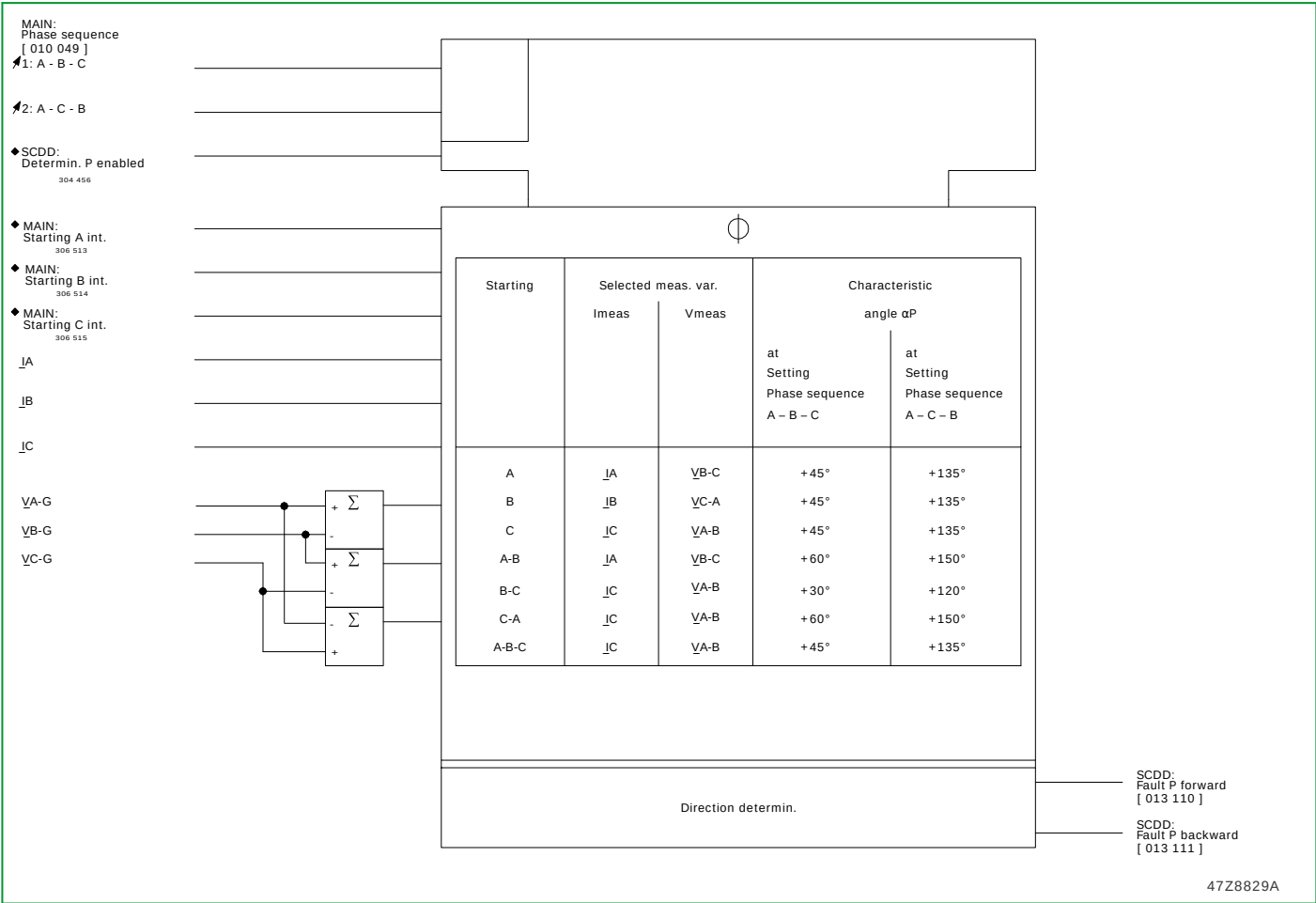


Fig. 3-294: Direction determination for phase current stages.

3.36.4 Forming the Blocking Signal for the Phase Current Stages

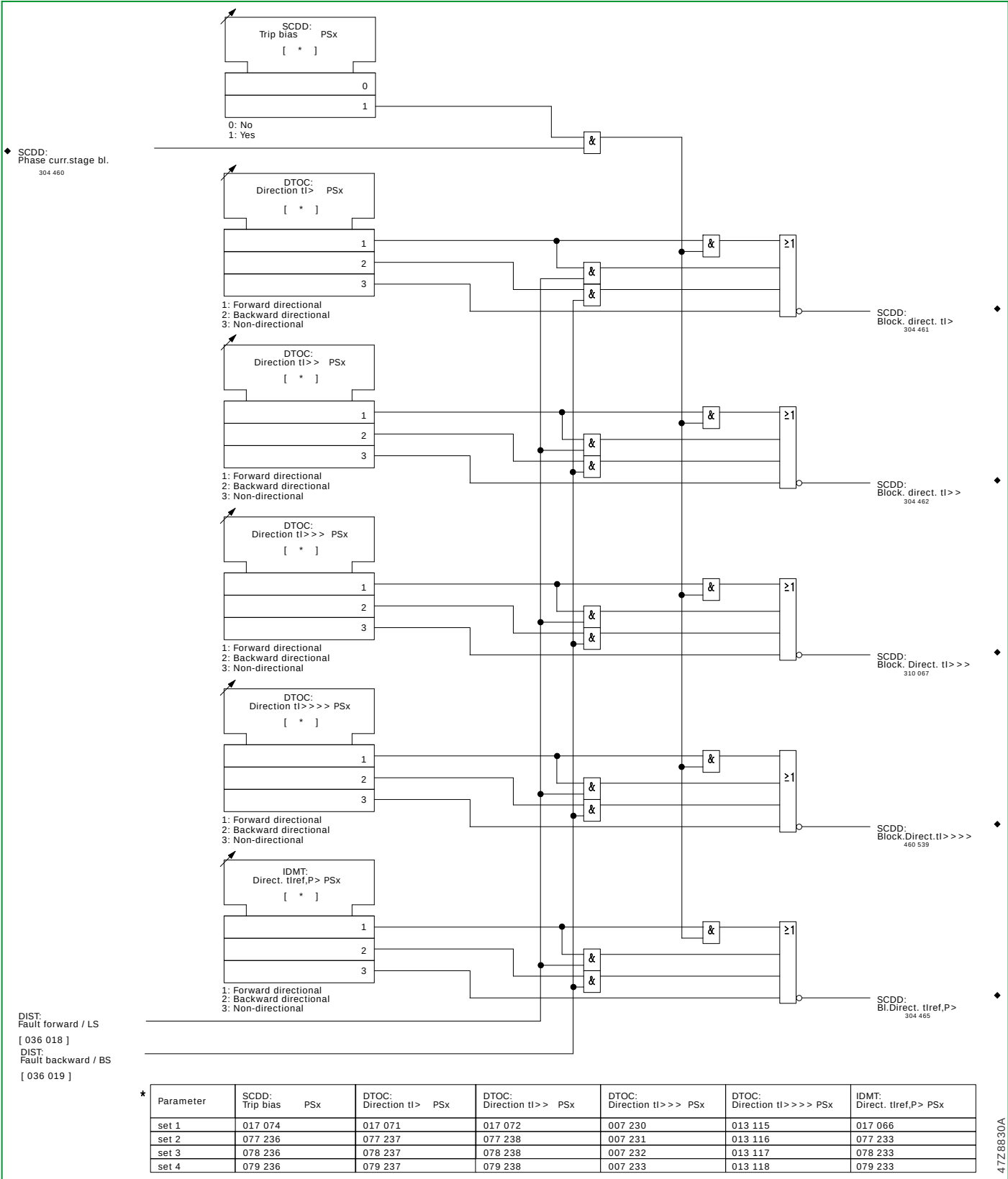


Fig. 3-295: Forming the blocking signals for the phase current stages

To form the blocking signal for the DTOC phase current stages and the IDMT phase current stage the fault direction to evaluate the measuring decision may

be set separately for each of the stages to either “Forward directional”, “Backward directional” or “Non-directional”.

A blocking signal for the phase current stage is formed when one of the following conditions is met:

- The direction for the phase current stage is set to *Forward directional* and the short-circuit direction determination detects a fault in backward direction.
- The direction for the phase current stage is set to *Backward directional* and the short-circuit direction determination detects a fault in forward direction.

In case the direction determination function is not enabled (e.g. with a M.c.b. trip) it is possible to select whether stages set to *Forward directional* may be operated with biased tripping by enabling SCDD: Trip bias PSx.

3.36.5 Residual Current Stages

To determine direction in the residual current stages the residual current, either calculated from the three phase currents or measured, and the neutral-point displacement voltage ($V_{N-G} = -V_{G-N}$) are used, see [Section 3.36.6, \(p. 3-371\)](#). The specification of a good characteristic angle is carried out by the user according to the neutral-point treatment of the system. The characteristic angle α_N may be set in the range: -90° to $+90^\circ$.

The reference quantity is the neutral-point displacement vector. Beginning with the reference quantity the characteristic angle will determine the measuring relation. The measuring relation is defined as the angle bisector for the directional zone "Forward". Forward directional is apparent if the vector of the residual current lies in the range between -90° and $+90^\circ$ of the measuring relation.

Backward directional is apparent if the vector of the residual current lies in the complementary range, i.e. less than -90° or greater than $+90^\circ$ of the measuring relation.

In the following example the system neutral is grounded with a relatively low resistance. Here the residual current apparent with a single-pole fault in phase A to ground (A-G) and a forward directional fault will take up the approximate position as shown in [Fig. 3-296, \(p. 3-370\)](#). With the characteristic angle $\alpha_N = -45^\circ$ a forward directional decision will be issued.

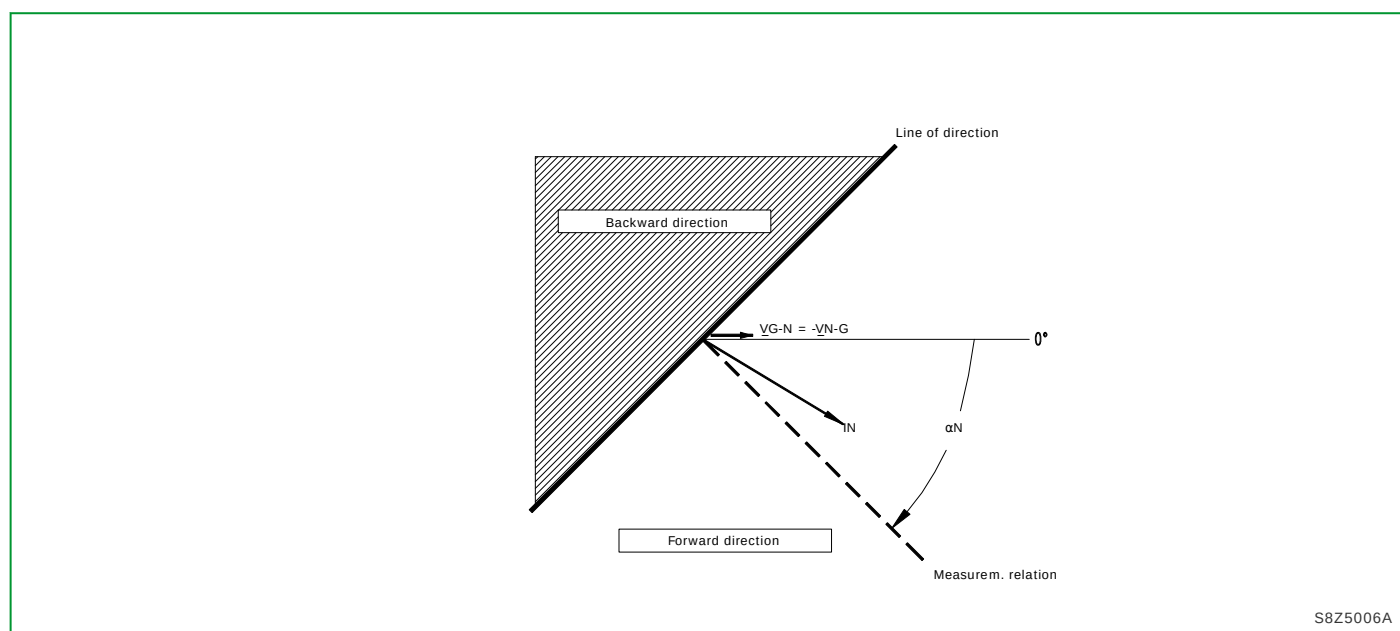


Fig. 3-296: Example for forming a directional decision in the residual current stage

3.36.6 Conditioning and Selecting the Measured Variables

For the short-circuit direction determination it is possible to use either the neutral-point displacement voltage calculated by the P433 from the three phase-to-ground voltages or the displacement voltage measured at the T 90 transformer.

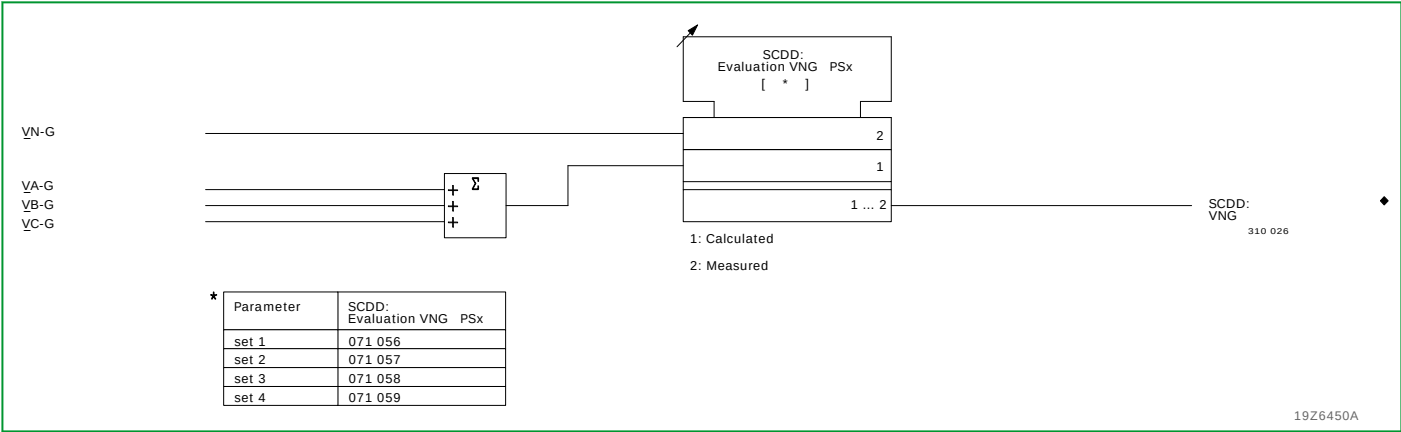


Fig. 3-297: Selecting the measuring voltage

Moreover, it is possible to select whether the measured or the calculated residual current value is to be used for the SCDD residual current stages.

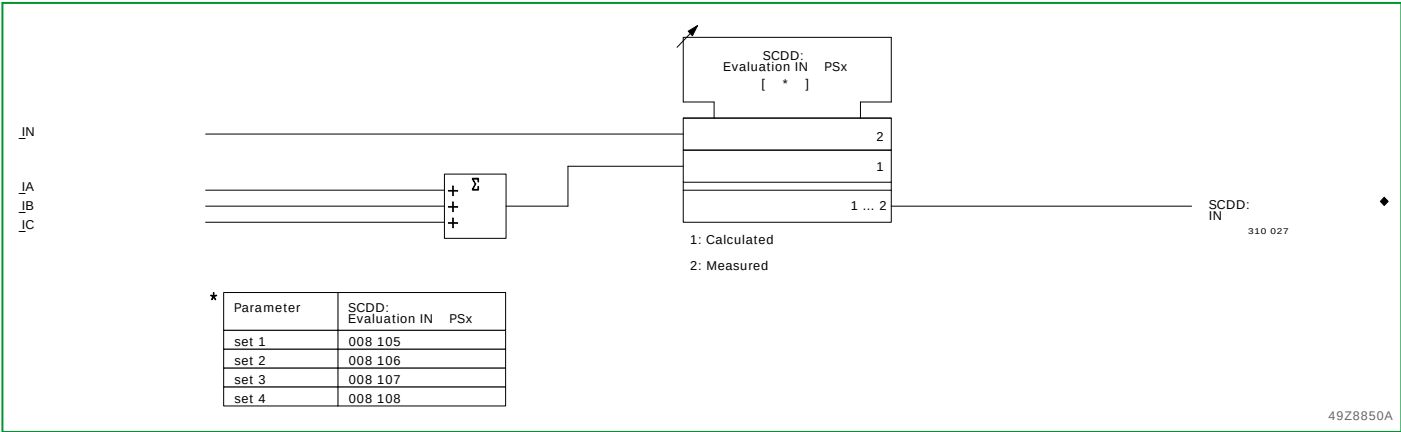


Fig. 3-298: Selecting the residual current

3.36.7 Enabling for Residual Current Stages

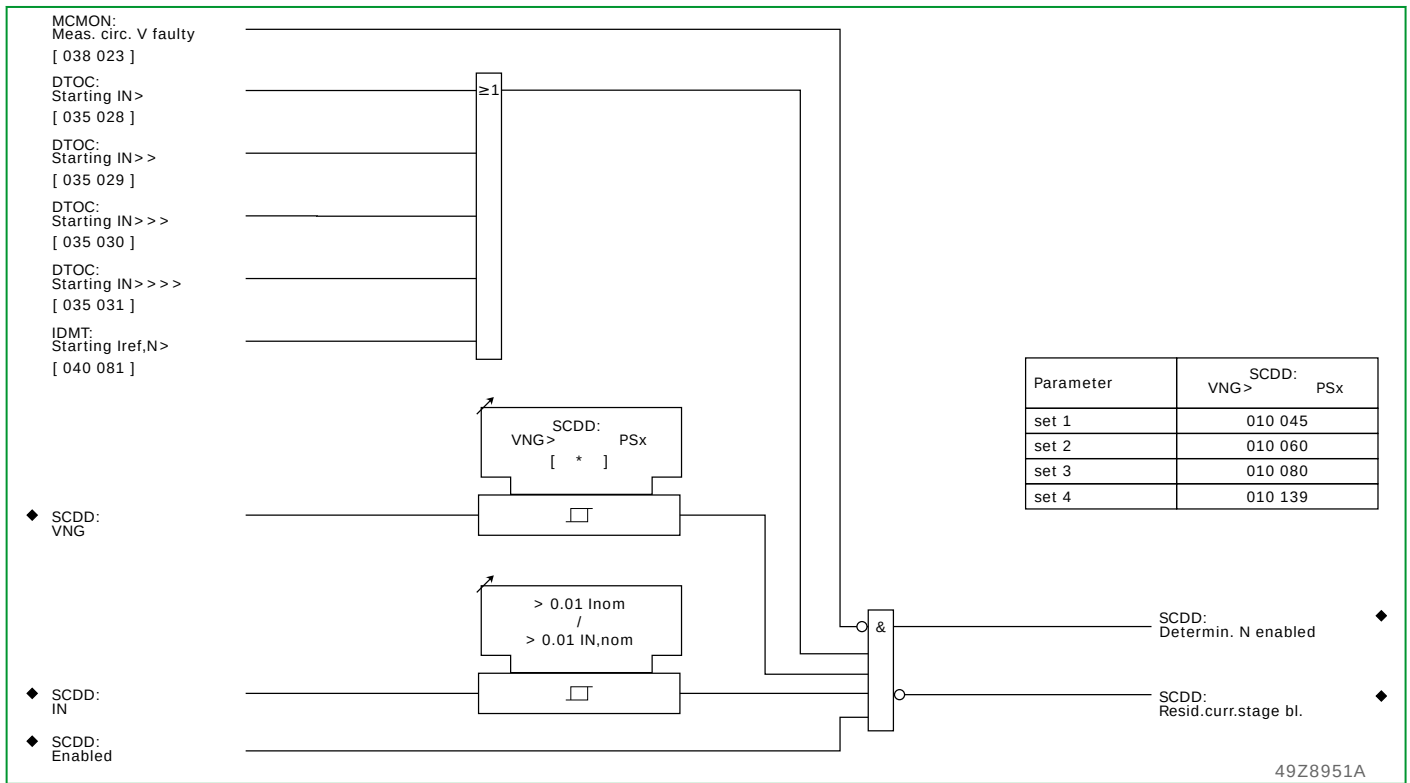


Fig. 3-299: Enabling direction determination for residual current stages.

Direction determination for residual current stages is only enabled if the following conditions are met simultaneously:

- The short-circuit direction determination is not blocked by the measuring-circuit monitoring (see [Section 3.26, \(p. 3-234\)](#))
- A residual current starting signal is present
- The residual current exceeds 0.01 I_{nom} (for calculated residual current) or 0.01 I_{N,nom} (for measured residual current)
- The neutral-point displacement voltage exceeds the minimum value set at SCDD: VNG > PSx.

After being enabled and depending on the direction determination decision one of the following signals will be issued:

- With a fault in forward direction: SCDD: Fault N forward
- With a fault in backward direction: SCDD: Fault N backward

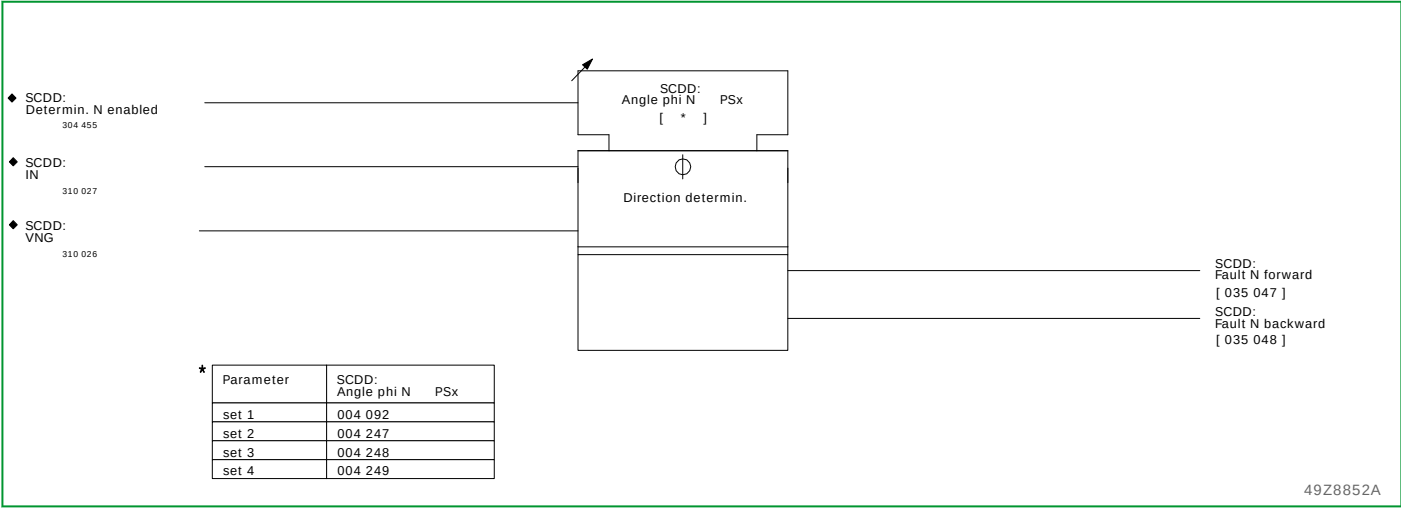
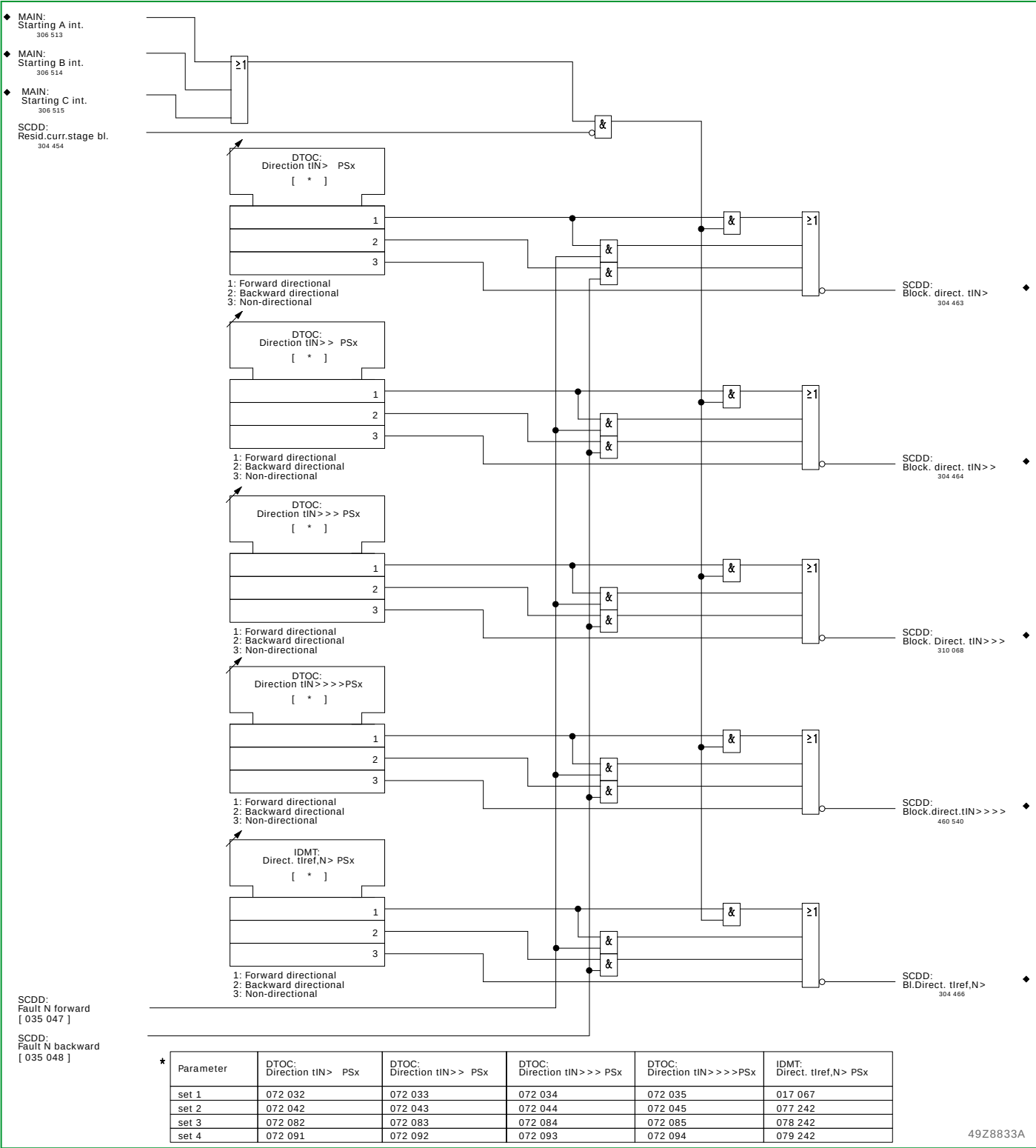


Fig. 3-300: Direction determination for residual current stages.

3.36.8 Forming the Blocking Signal for the Residual Current Stages



- The direction for the residual current stage is set to *Forward directional* and the short-circuit direction determination detects a fault in backward direction.
- The direction for the residual current stage is set to *Backward directional* and the short-circuit direction determination detects a fault in forward direction.

3.36.9 Signaling Logic

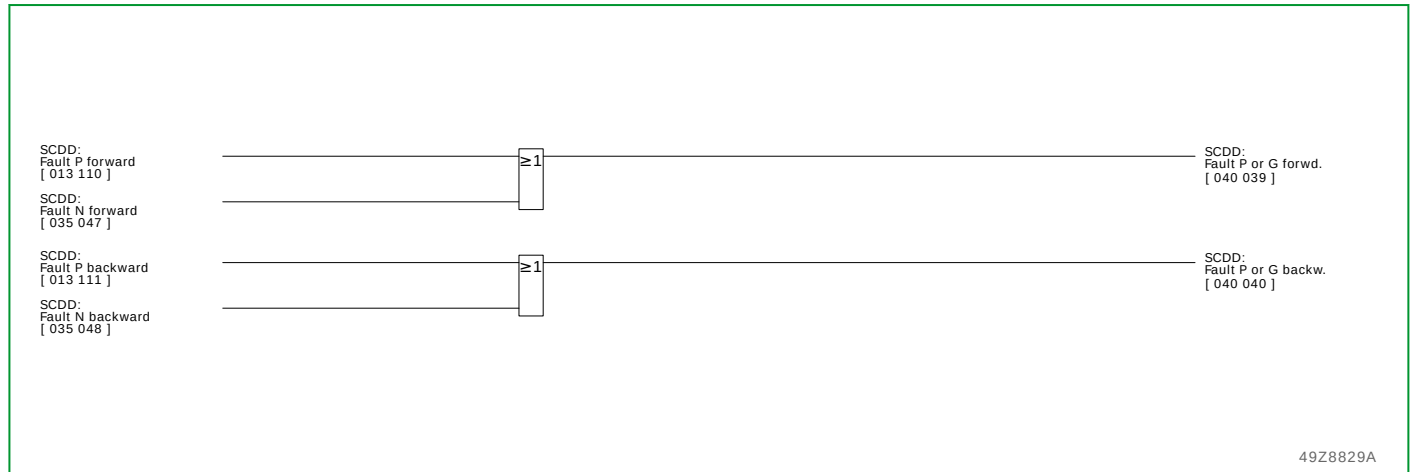


Fig. 3-302: Fault signals from phase or residual current stages forward or backward directional.

Fault directional signals generated by the directional determination function of the phase and residual current stages are grouped together to a combined signal.

3.37 Ground Fault Direction Determination Using Steady-State Values (Function Group GFDSS)

Ground fault direction determination is carried out by evaluating the neutral-point displacement voltage and the residual current using the steady-state power evaluation mode or, as an alternative, the admittance evaluation mode. Also possible is a steady-state current evaluation only. In this case only the filtered residual current is used as a criterion for a ground fault. Ground fault direction determination is then not possible.

By using the ARC function it is possible to intervene in the functional sequence of ground fault direction determination using steady-state values.

3.37.1 Disabling and Enabling Ground Fault Direction Determination Using Steady-State Values

The ground fault direction determination using steady-state values can be disabled or enabled using setting parameters. Switching over to *Steady-state current* evaluation is made by setting parameters or an appropriately configured binary signal input. Moreover, enabling can be carried out separately for each parameter set.

3.37.2 Ground Fault Direction Determination Using Steady-State Values Is Ready

A ready signal is issued for the evaluation mode selected if the protection and the ground fault direction determination using steady-state values are enabled.

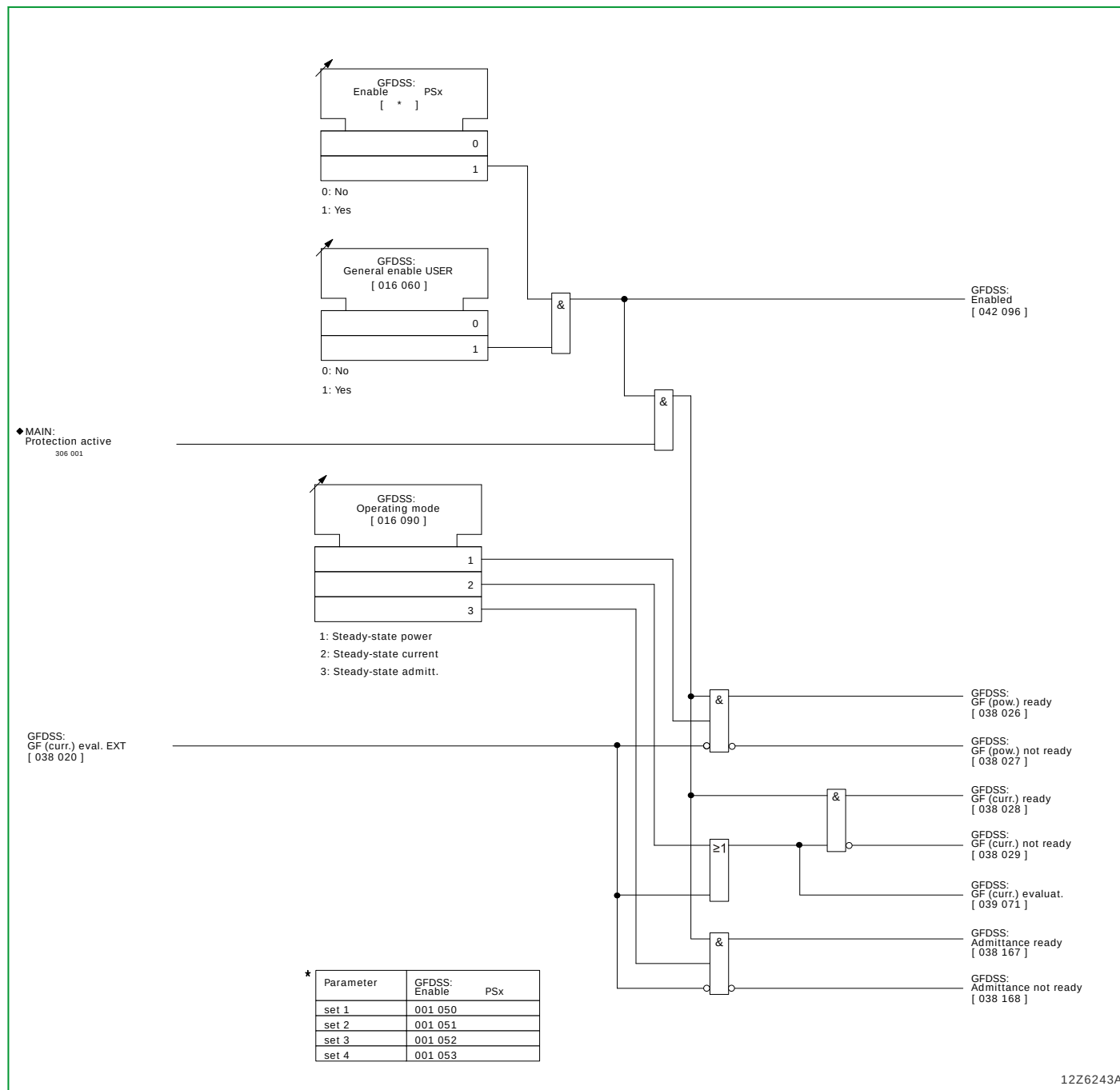


Fig. 3-303: Enabling, disabling and readiness of the ground fault direction determination using steady-state values.

3.37.3 Conditioning and Selecting the Measured Values

For the conditioning of measured values the P433 is fitted with integrated transformers. As an alternative it is possible to use the neutral-point displacement voltage calculated by the P433 from the three phase-to-ground voltages or the displacement voltage measured at the T 90 transformer for steady-state power evaluation. The current transformer has been especially designed for this application so that it will perform with a very small phase-angle error.

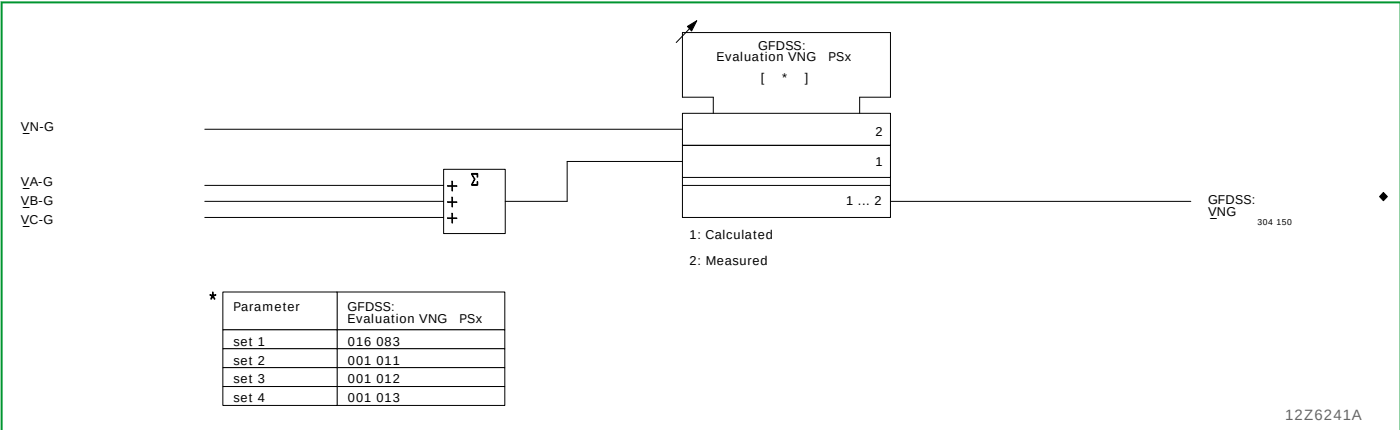


Fig. 3-304: Selecting the measuring voltage.

3.37.4 Steady-State Power Evaluation

Ground fault direction determination using steady-state values requires the neutral-point displacement voltage and the residual current values to be able to determine a ground fault direction. The frequency provided by the setting f/f_{nom} is filtered from these values by using a Fourier analysis. Three periods are used for evaluation if the time stage GFDSS: VNG > PSx has been set to a time delay equal to or greater than 60 ms. This will result in the suppression of typical ripple-control frequencies in addition to all integer-frequency harmonics. If the time stage was set to a time delay less than 60 ms only one period will be used for filtering.

The measurement is enabled when the time delay set at GFDSS: VNG > PSx and which was triggered by VNG > has elapsed. Depending on the selected operating mode (*cos phi circuit* or *sin phi circuit*) the sign of the active power (GFDSS: Op.m.GF pow./adm PSx = *cos phi circuit*) or of the reactive power (GFDSS: Op.m.GF pow./adm PSx = *sin phi circuit*) is used to determine the direction. The connection of the measuring circuits is taken into account by the setting at GFDSS: Meas. direction PSx. When the *Standard* connection has been made a ground fault on the line side will issue the decision "LS" and a ground fault on the busbar side will issue the decision "BS".

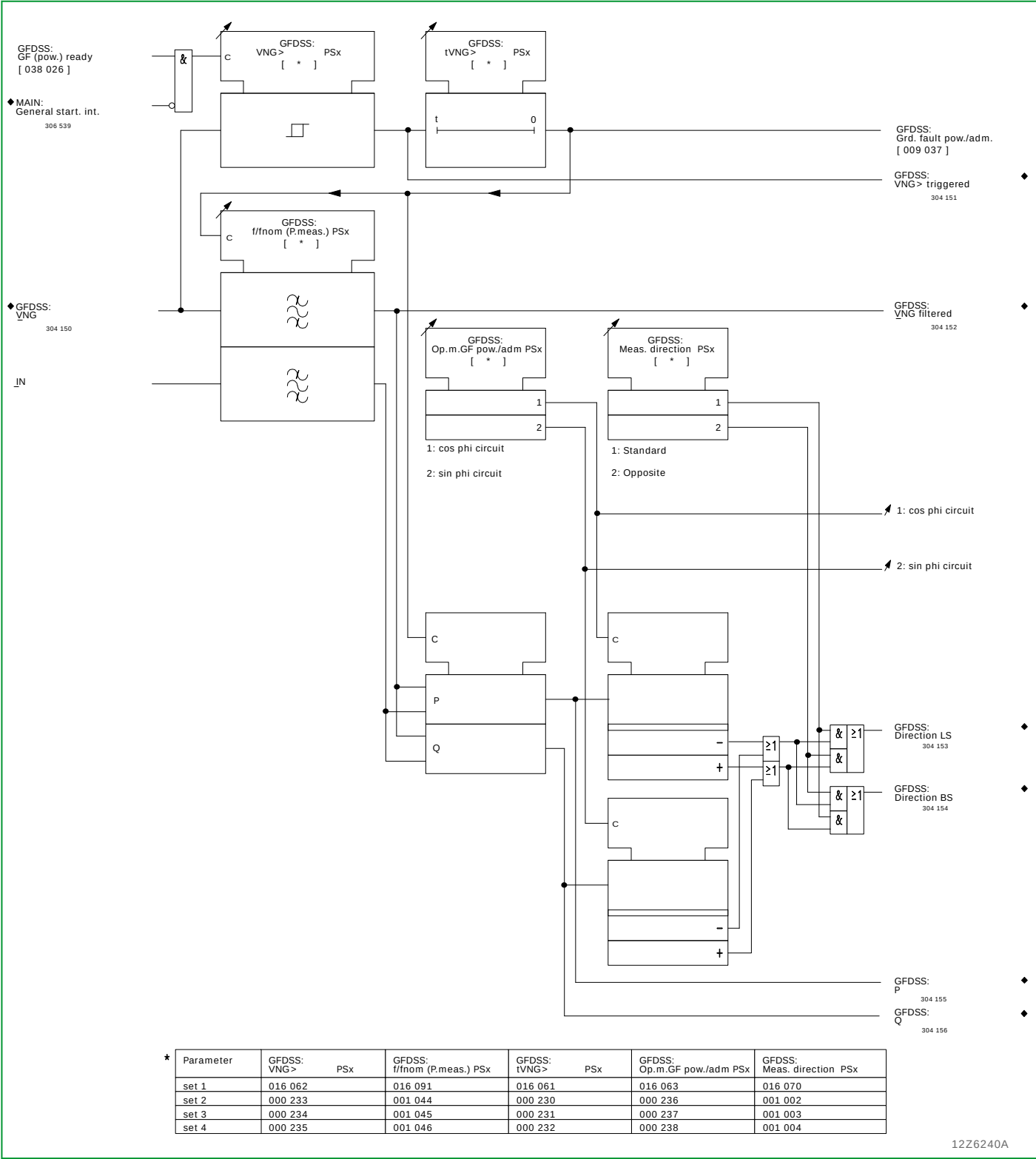


Fig. 3-305: Direction determination with the “Steady-state power” operating mode.

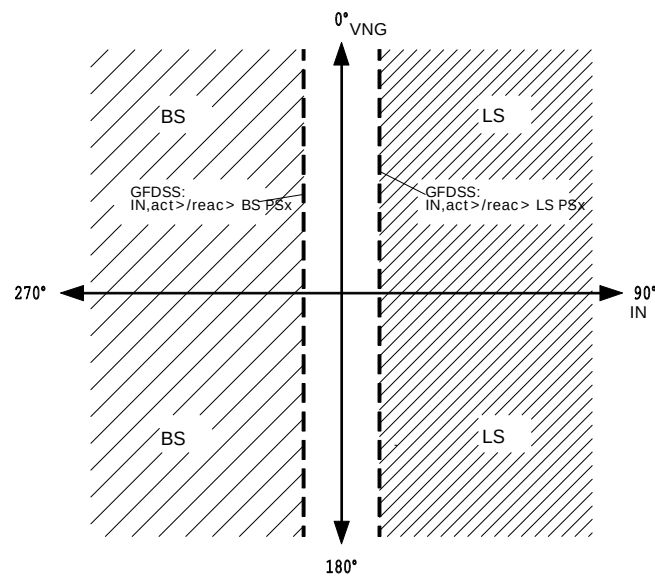
3.37.4.2

 $\sin \varphi$ Circuit

The direction decision is enabled if the reactive component of the residual current has exceeded the set threshold operate value. This setting makes it possible to achieve the characteristic shown in Fig. 3-307, (p. 3-381).

Output of the direction decisions is operate- and reset-delayed.

The “forward directional” trip signal issued by the ground fault direction determination using steady-state values (GFDSS) is blocked by the auto-reclosing control function (ARC) when this function is able to issue a trip command.



D5Z50BMA

Fig. 3-307: Characteristic of the ground fault direction determination using steady-state values, “ $\sin \varphi$ ” operating mode.

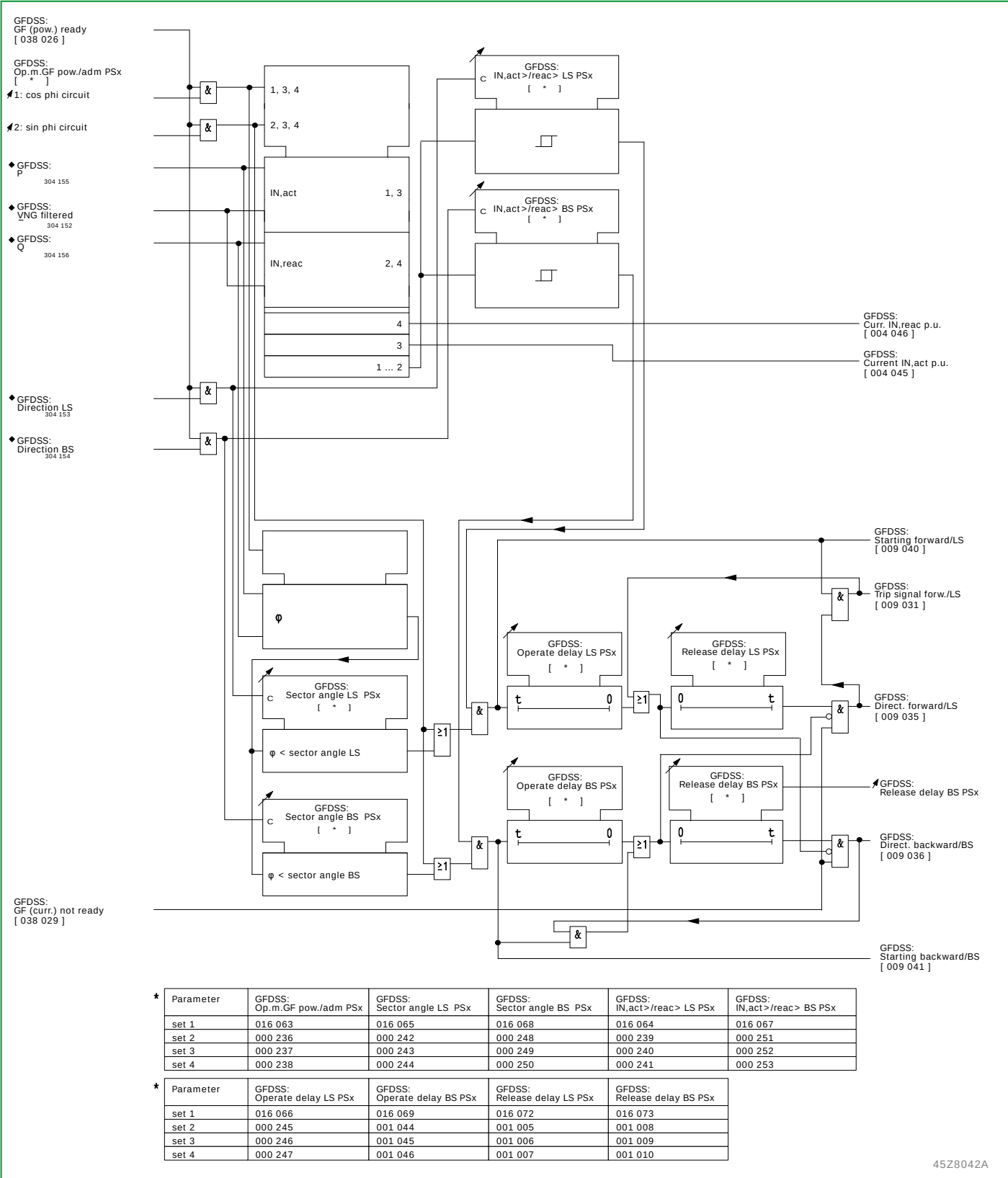


Fig. 3-308: Output of the direction decisions with the “steady-state power” operating mode.

3.37.5 Steady-State Current Evaluation

The frequency provided by the setting f/f_{nom} is filtered from the residual current value by using a Fourier analysis. Three periods are used for evaluation. If the residual current value exceeds the set threshold a ground fault signal is issued after the settable operate delay has elapsed.

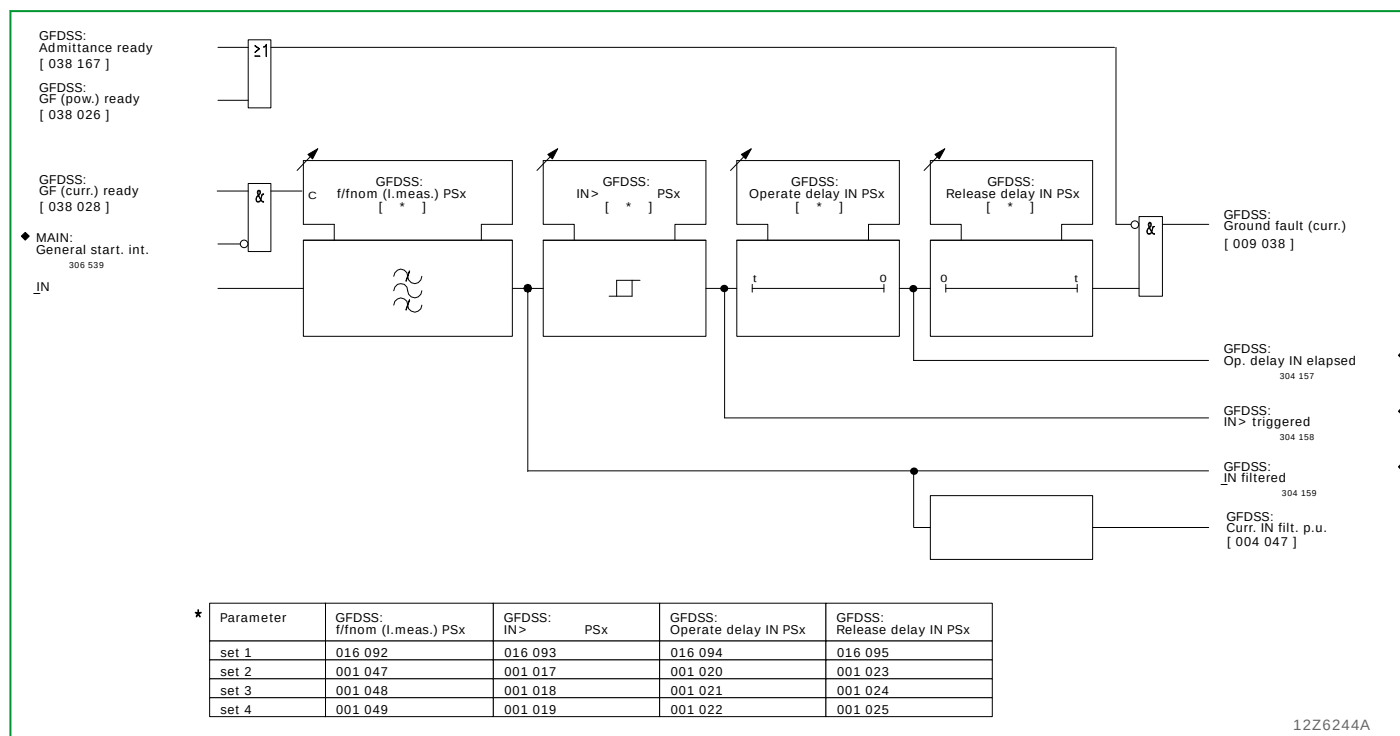


Fig. 3-309: Evaluation of the residual current.

Counting Ground Faults

The number of ground faults is counted. The counter may be reset either individually or together with other counters.

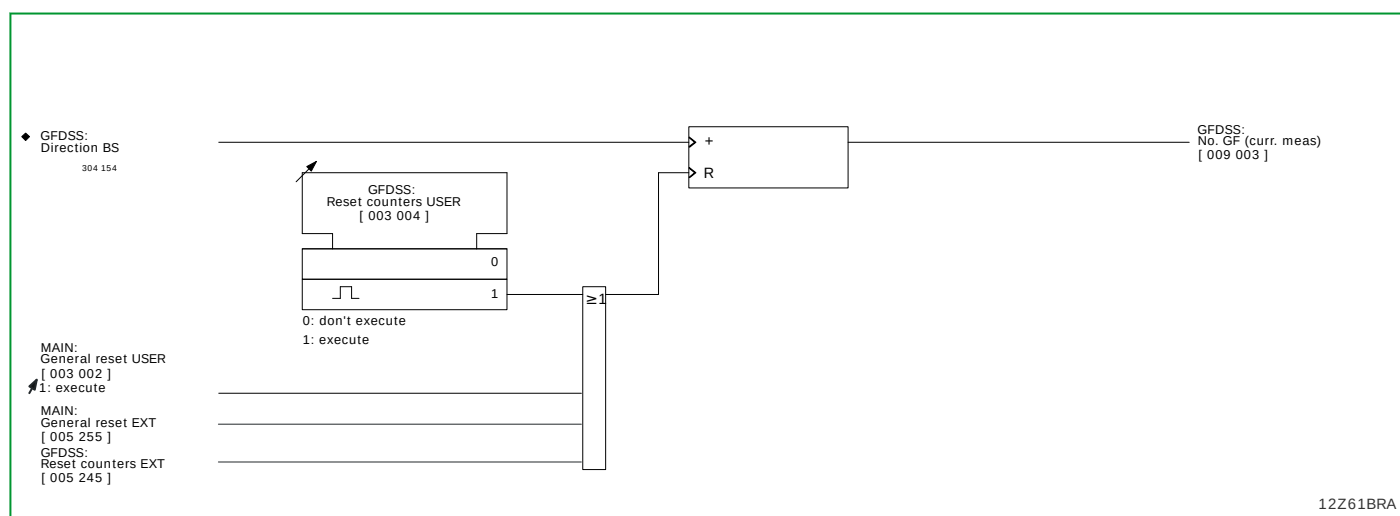


Fig. 3-310: Counting ground faults.

3.37.6 Steady-State Admittance

To determine a ground fault direction the steady-state admittance evaluation requires the neutral-point displacement voltage and the residual current values.

The frequency provided by the setting f/f_{nom} is filtered from these values by using a Fourier analysis.

The measurement is enabled when the time delay set at GFDSS: $t_{VNG} > PSx$ and which was triggered by $VNG >$ has elapsed. Depending on the selected operating mode (*cos phi circuit* or *sin phi circuit*) the sign of the active power (GFDSS: Op.m.GF pow./adm $PSx = \cos \phi$ circuit) or of the reactive power (GFDSS: Op.m.GF pow./adm $PSx = \sin \phi$ circuit) is used to determine the direction. The connection of the measuring circuits is taken into account by the setting at GFDSS: Meas. direction PSx . When the *Standard* connection has been made a ground fault on the line side will issue the decision "LS" and a ground fault on the busbar side will issue the decision "BS". Phase-angle errors of the system transformers can be compensated with the setting at GFDSS: Correction angle PSx .

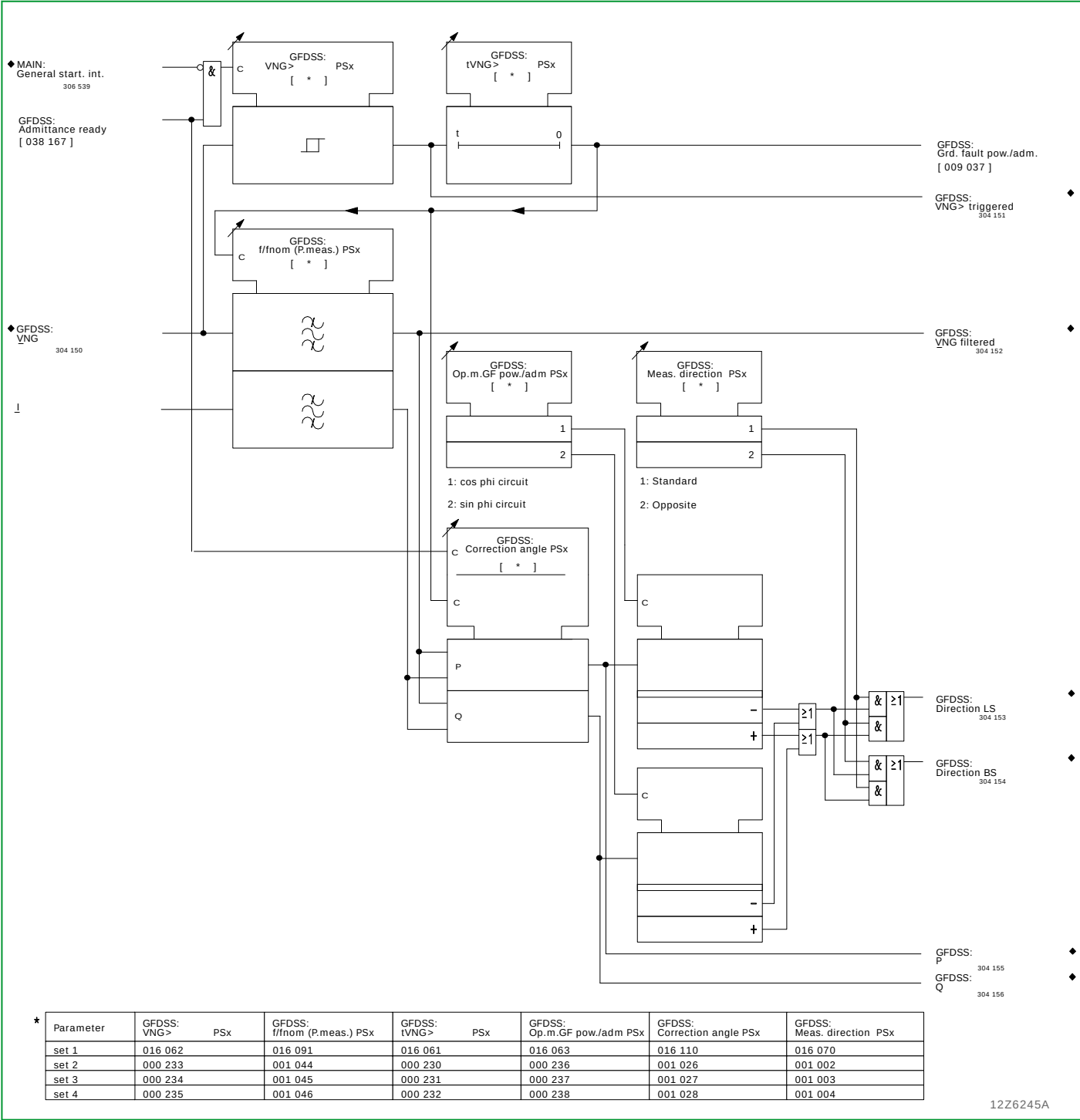


Fig. 3-311: Direction determination with the "Steady-state admittance" operating mode.

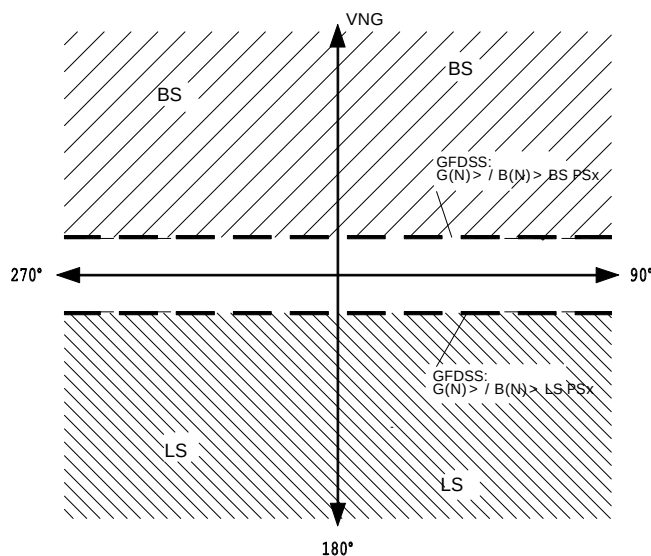
3.37.6.1

 $\cos \varphi$ Circuit

Direction determination is enabled when the conductance value (conductance $G(N)$) on the ground return exceeds the set threshold. This setting makes it possible to achieve the characteristic shown in Fig. 3-312, (p. 3-386).

Output of the direction decisions is operate- and reset-delayed.

The trip signal in forward direction issued by the ground fault direction determination using steady-state values (GFDSS) is blocked by the auto-reclosing control function (ARC) when this function is able to issue a trip command.



19Z5059A

Fig. 3-312: Characteristic for ground fault direction determination using steady-state admittance, “ $\cos \varphi$ ” operating mode.

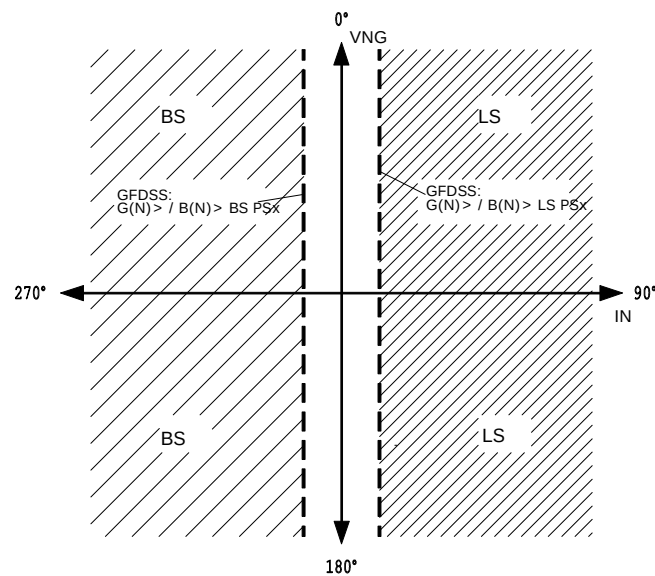
3.37.6.2

 $\sin \varphi$ Circuit

Direction determination is enabled when the conductance value (susceptance $B(N)$) on the ground return exceeds the set threshold. This setting makes it possible to achieve the characteristic shown in Fig. 3-313, (p. 3-387).

Output of the direction decisions is operate- and reset-delayed.

The trip signal in forward direction issued by the ground fault direction determination using steady-state values (GFDSS) is blocked by the auto-reclosing control function (ARC) when this function is able to issue a trip command.



19Z5060A

Fig. 3-313: Characteristic for ground fault direction determination using Steady-state admittance, " $\sin \varphi$ " operating mode.

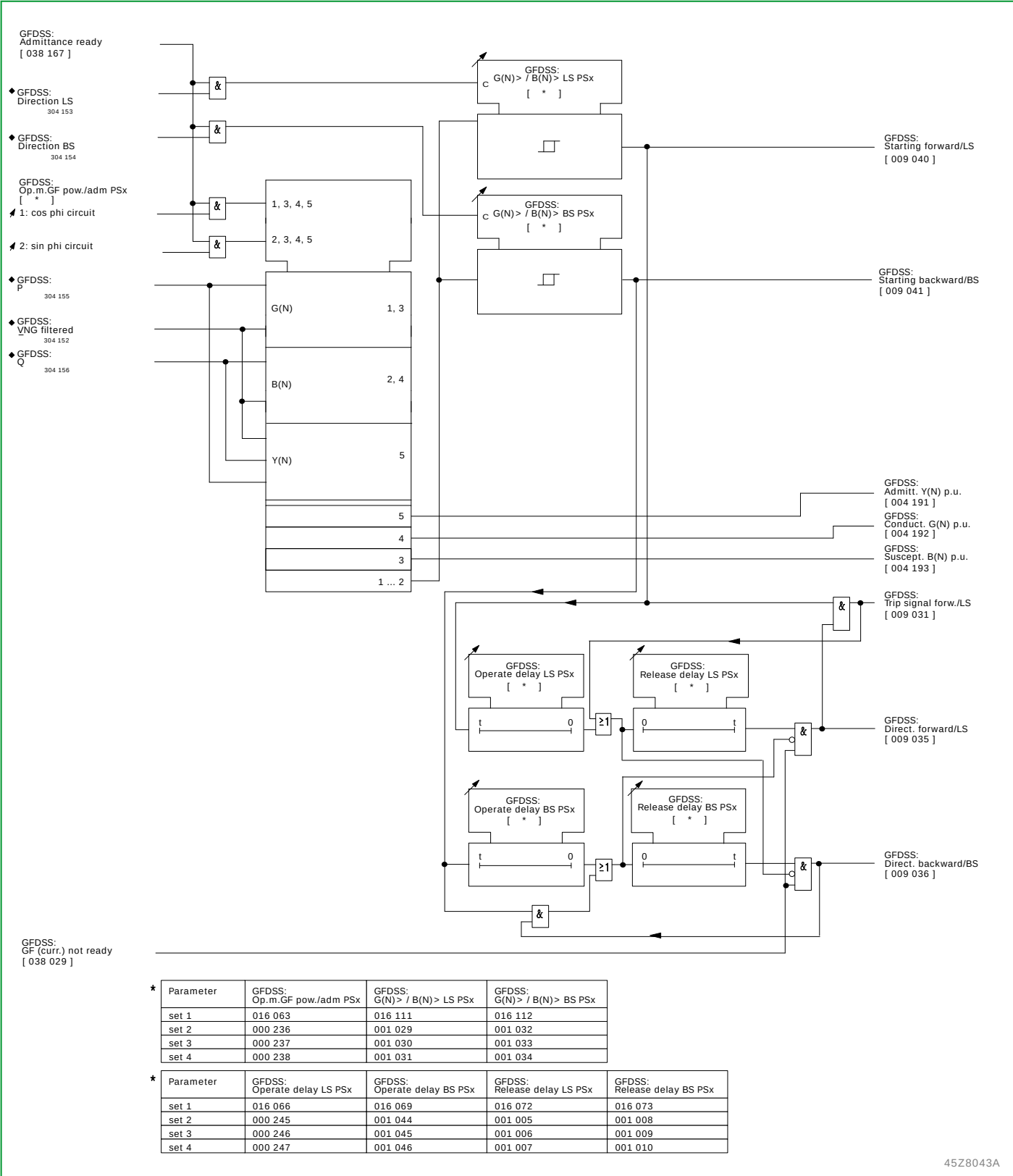


Fig. 3-314: Output of the direction decisions with the “Steady-state admittance” operating mode.

3.37.6.3 Non-Directional Ground Fault Determination

The admittance value from the ground return is used for evaluation. If the admittance value exceeds the set threshold a ground fault signal is issued after the settable operate delay has elapsed.

The trip signal from the non-directional ground fault determination is blocked by the auto-reclosing control function (ARC) when this function is able to issue a trip command.

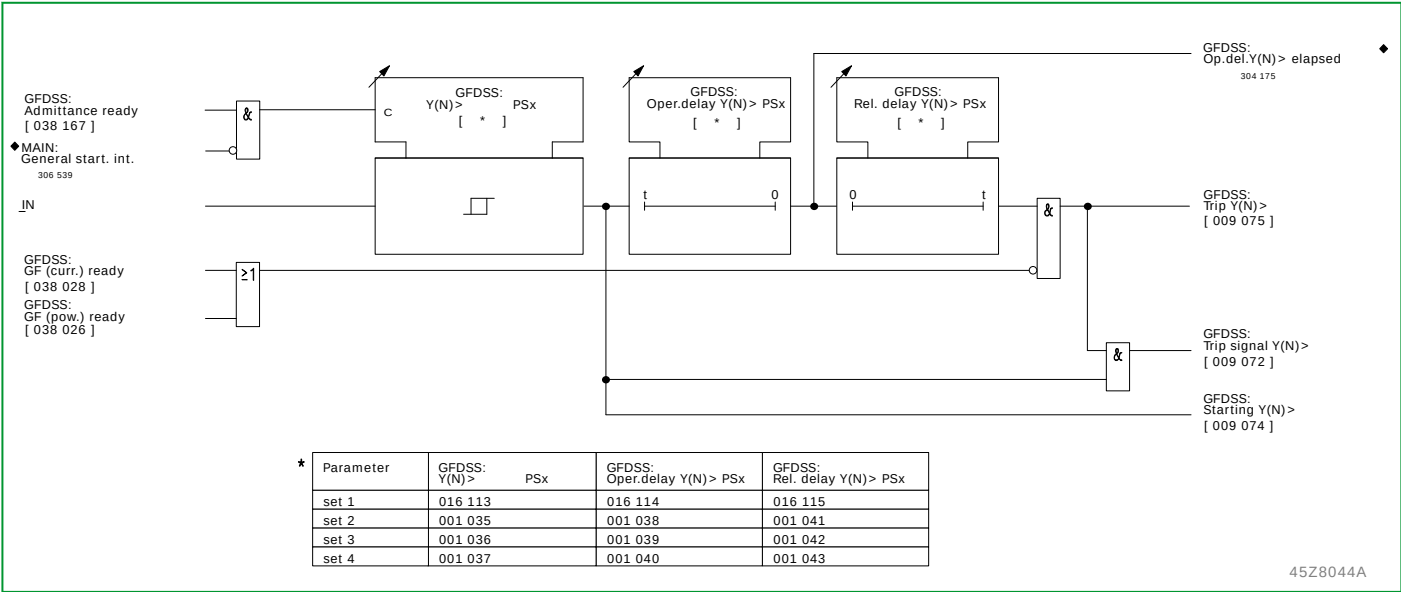


Fig. 3-315: Evaluating admittance.

3.37.7 Counting the Ground Faults Detected by Steady-State Power and Admittance Evaluation

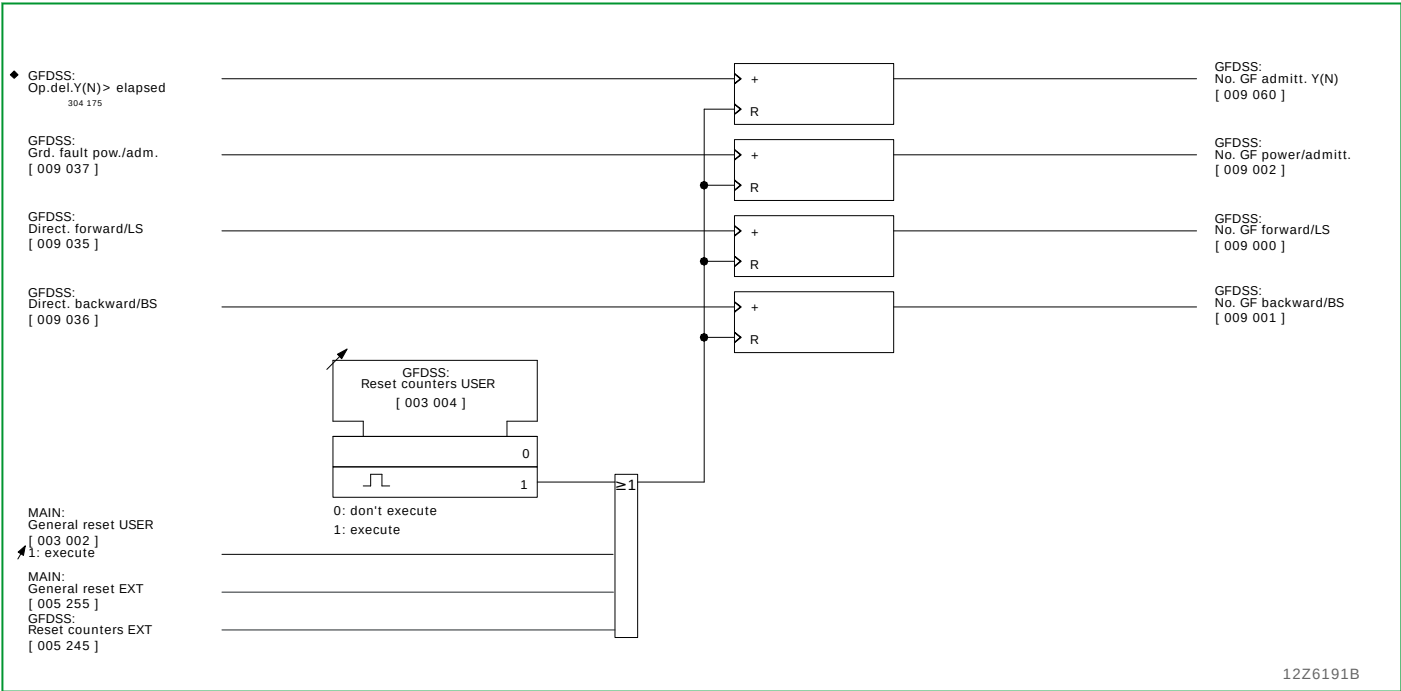


Fig. 3-316: Counting ground faults.

The number of ground faults and directional decisions are counted. The counters may be reset individually or together with other counters (see [Section 3.13.19](#), (p. 3-134)).

3.38 Pulse Detection (Function Group PULSE)

Detection of ground fault direction or even ground faulted line can be done by pulse detection. Precondition for this function is the availability of equipment to modulate the magnitude of ground fault current. For this purpose usually a capacitor in parallel to the Petersen coil is switched on and off periodically when a steady-state ground fault is present.

Accordingly, the pulse detection function gets activated if either the neutral displacement voltage or the neutral current exceed user set trigger thresholds. When being in active state, the function continuously monitors the magnitude of neutral current to detect the pulses caused by switching on/off the capacitor.

3.38.1 Disabling, Enabling and Readiness

Pulse detection can be disabled or enabled using setting parameters. Moreover, enabling can be carried out separately for each parameter subset.

Pulse detection is ready if it is enabled and none of the blocking conditions is present.

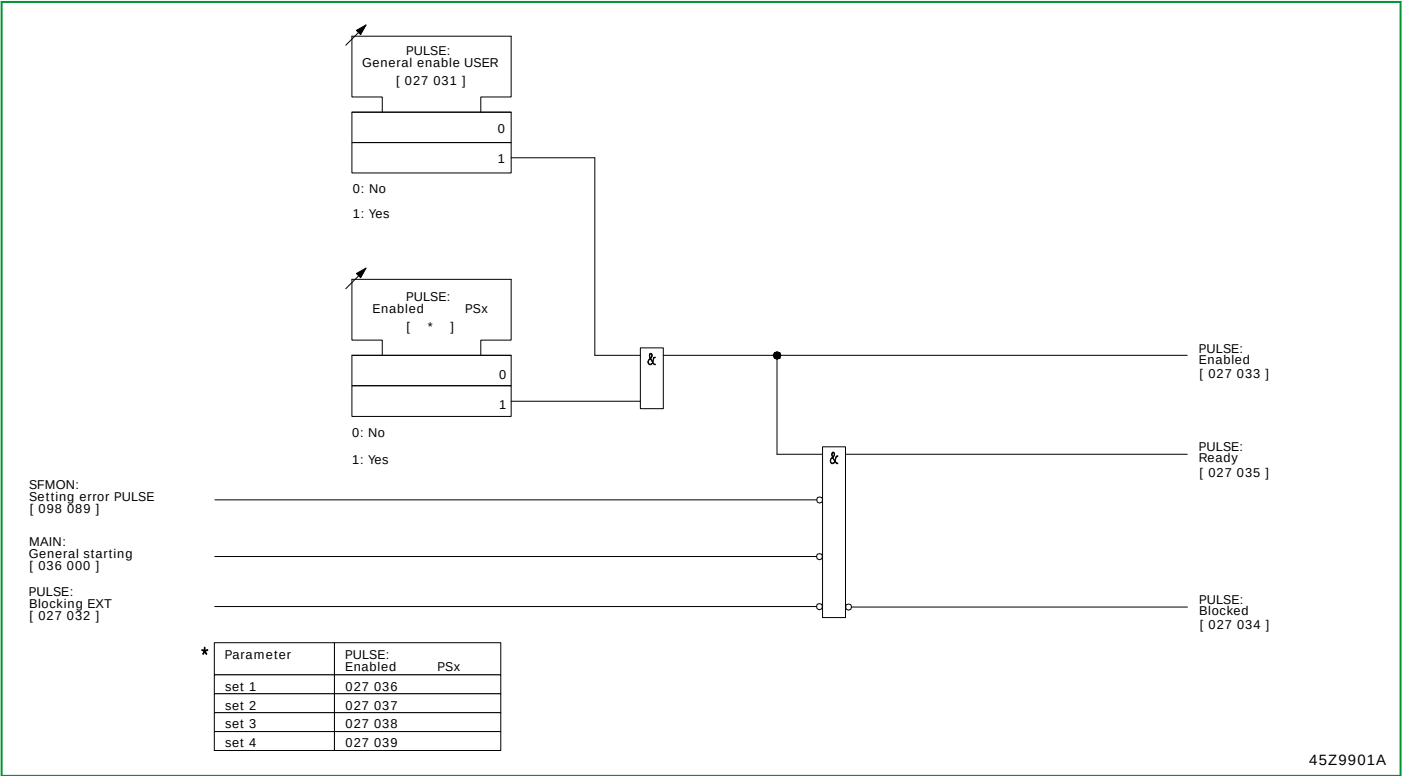


Fig. 3-317: PULSE enabling and readiness.

3.38.2 Measured Signals and Function Activation

Pulse detection gets optionally only active if triggered from a neutral displacement voltage VNG> detector or from a neutral current detector IN>.

Triggering from VNG> has priority. The user can disable the VNG trigger by setting the threshold to “blocked”.

The neutral displacement voltage can be either measured at the T 90 transformer or calculated as geometric sum of the three phase to ground voltages. In each case, the fundamental r.m.s. value gets evaluated.

If the neutral displacement voltage drops below the reset threshold, a short, fix time delay of 100 ms gets applied before the reset signal is issued and the pulse detection resets.

The neutral current I_N is always measured at the current transformer T4. Likewise the function evaluates the fundamental r.m.s. value of current I_N .

If the neutral current drops below the reset threshold, a time delay T_r gets applied (= sum of (027 052) PULSE: Close Time PSx and (027 056) PULSE: Open Time PSx), before the reset signal is issued and the pulse detection resets. This time delay is essential, because upon switching the capacitor parallel to the Petersen coil the neutral current drops in the faulty line, and that is exactly the condition, which has to be determined by pulse detection.

In order to prevent false triggering e.g. from switching transients, both trigger thresholds operate with a time delay of 100 ms. Only if the trigger condition is continuously present for at least 100 ms the function gets activated.

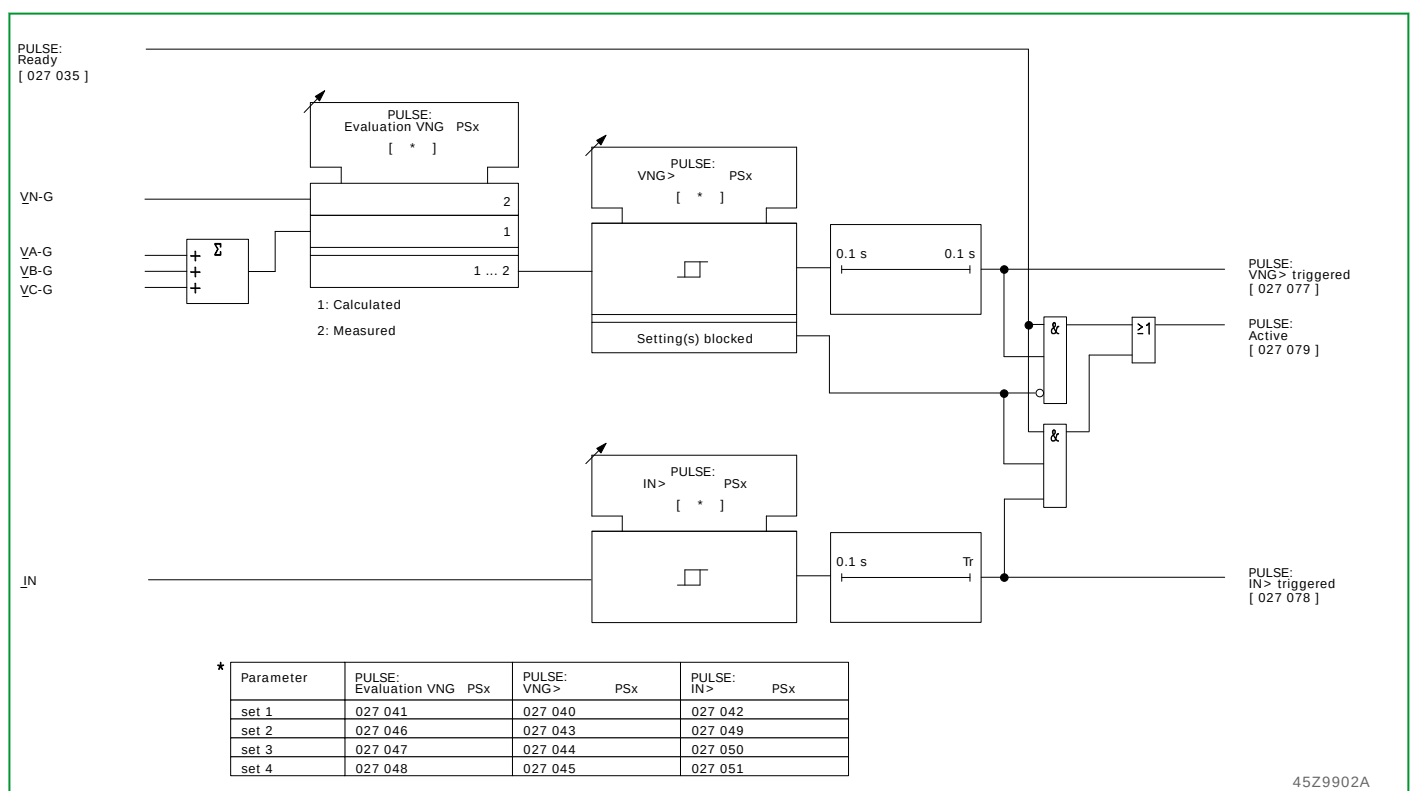


Fig. 3-318: PULSE trigger and activation.

3.38.3 Pulse Monitoring

While pulse detection is in active state the function continuously monitors the neutral current to eventually detect a pulsing of the current magnitude with pre-defined (set) low/high ratio, caused by switching on/off a capacitor in parallel to the Petersen coil.

When capacitor is switched in parallel to the Petersen coil (with duration of (027 052) PULSE: Close Time PSx), the magnitude of neutral current in the faulty feeder will drop (system overcompensated); when it is switched off (with duration of (027 056) PULSE: Open Time PSx) neutral current magnitude will raise again.

In case of high resistance ground faults, also the magnitude of neutral current in the healthy feeders will change, but not as much and with opposite timing.

Thus the monitoring of amount of change of neutral current (bigger than (027 064) PULSE: Delta IN> PSx) and the checking of proper (close/open) timing is used to identify pulses on the faulty feeder.

If the set number of pulses gets detected within a given time window, a ground fault forward will be signaled.

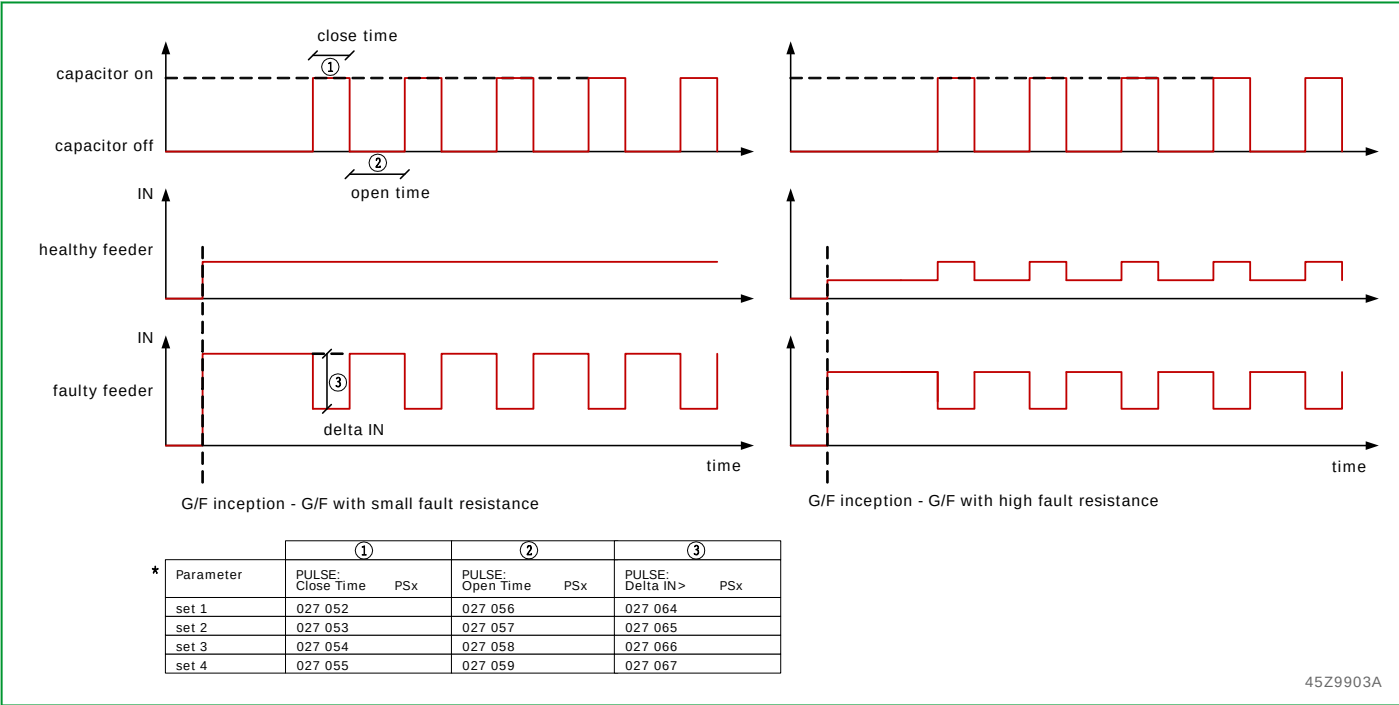


Fig. 3-319: IN pulse monitoring (Petersen coil overcompensated).

3.38.4 Pulse Signaling

In order to provide a reliable detection method, the time tolerance (027 061) PULSE: Zeittoleranz PSx must not exceed 10% of the total impulse duration.

If the actual time tolerance setting exceeds 10% a warning (098 089) SFMON: Setting error PULSE is raised and the function gets blocked.

Pulse detection operates, if the set number of pulses (027 068) PULSE: Number of pulses PSx gets detected within a given time window which is set as multiple (027 072) PULSE: Mon.time(pulses) PSx of the total impulse duration.

Pulse detection starting is signaled if a first pulse with correct close/open time duration is detected. As soon as the set number of pulses matching the off/on duration is detected within the measuring window, ground fault forward (027 081) PULSE: G/F forward is signaled.

The ground fault forward directional signal forms part of the existing group signal (041 088) MAIN: Gnd. fault forw./LS, refer to Fig. 3-81, (p. 3-123).

3.39 Ground Fault Tripping (Function Group GFTRP)

The ground fault tripping function is used to immediately switch off a line after it is connected if it is unbiased and contains a ground fault. If the line is biased, then no trip occurs.

In order to determine whether the line is biased, the P433 monitors the phase-to-phase voltage V_{A-B} on the line side for values exceeding the fixed threshold of $0.7 V_{nom}$. The neutral-point displacement voltage, V_{N-G} , on the busbar and the line sides is used as the criterion for a ground fault. The neutral-displacement voltage on the line side is monitored by the P433. The threshold can be set (see [Section 3.24.2.2, \(p. 3-172\)](#)). On the busbar side, monitoring must be handled by an external device. The signal from this external device is passed on to the P433 through an appropriately configured binary signal input (GFTRP: VNG > triggered EXT).

A trip occurs if the following conditions are satisfied simultaneously within 100 ms after voltage recovery:

- Ground faults are detected on the line and busbar sides.
- One of the following additional conditions is satisfied:
 - The ARC dead time is running.
 - The circuit breaker close signal, which is picked up through an appropriately configured binary signal input, is present.
 - The timer stage started by a “manual close” to the circuit breaker is running (see [Section 3.28, \(p. 3-244\)](#)).
 - A close command is issued by the ARC function.

Ground fault tripping will be blocked if there is a fault in the voltage measuring circuits.

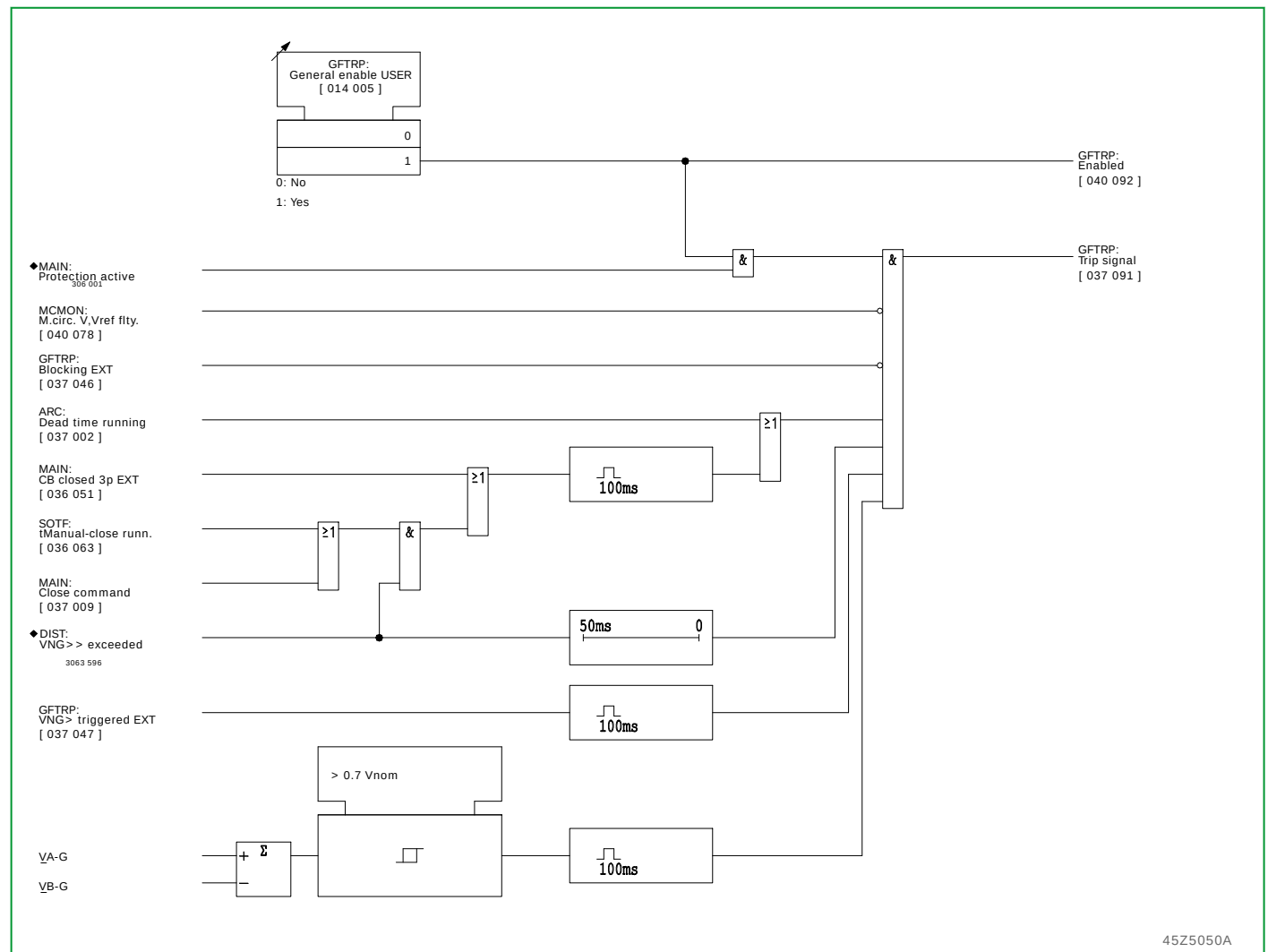


Fig. 3-320: Ground fault tripping.

3.40 Ground Fault Protection Signaling (Function Group GFSIG)

Ground fault protection signaling (GFSIG) operates only in conjunction with ground fault direction determination using steady-state values (GFDSS). The GFSIG function is used for selective clearance of ground faults. The directional decisions issued by the GFDSS function are transmitted to the device at the remote station.

They can be transmitted by way of a signal transmission device or over pilot wires. If pilot wires are used for ground fault protection signaling, they are continuously checked by an internal monitoring function. The communication link involving pilot wires is formed by linking either the make contact or the break contact of the transmitting relay, depending on the transmitting relay mode selected (*Transm.relay make co* or *Transm.relay break c*), to the GFSIG: Receive EXT, GSCSG: Receive EXT input of the remote station.

The pilot wire loop is closed during normal operation of the power system. If both devices detect a ground fault in the forward direction (LS), the pilot wire loop remains closed. A trip signal is issued once the set operate delay has elapsed.

The pilot wire DC loop will be opened if the GFDSS function detects a ground fault in backward (reverse) direction (BS). If the device at the remote station detects a ground fault in forward direction (LS), the protection device does not trip as the pilot wire DC loop is already open. The send signal is reset after a settable time delay has elapsed.

Monitoring the Pilot Wires

The pilot wires are monitored for interruptions. A GFSIG: Telecom. faulty signal will be issued during fault-free operation (i.e., when no ground fault is detected) if no signal is received from the remote station for a period longer than the set send signal reset time-delay plus the set reset time-delay for the ground fault signal in the BS direction plus 2 s.

If a single-pole ground fault occurs while the pilot wire DC loop is disrupted then a trip will occur, regardless of the received signal.

Testing the Communications Link

The communications link can be tested. For this purpose a 500 ms send signal is issued through a binary signal input or by means of a setting parameter. The remote station receives this signal if the transmission link is in order.

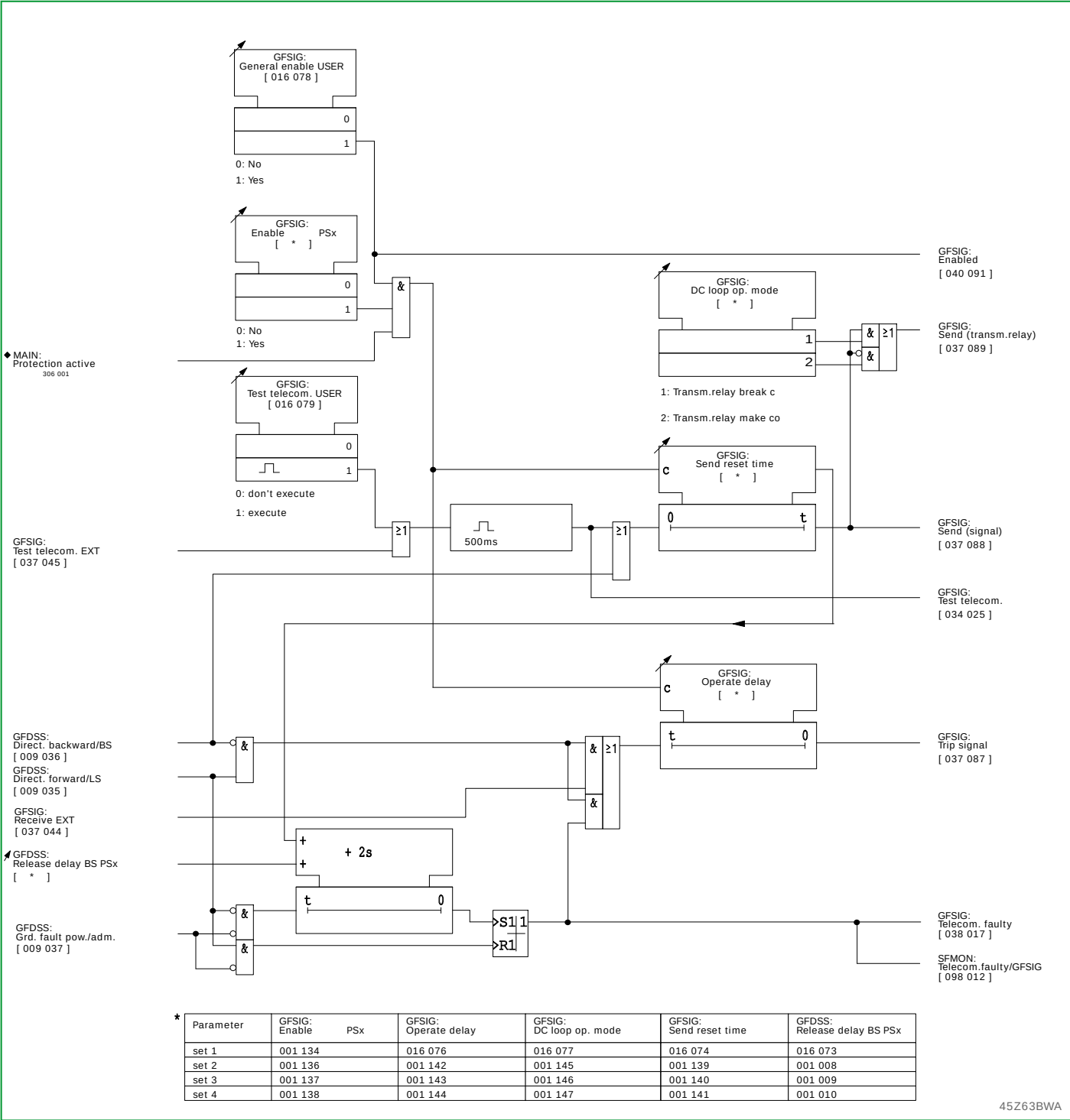


Fig. 3-321: Ground fault protective signaling.

3.41 Transient Ground Fault Detection (Function Group TGFD)

Ground fault direction is determined by evaluating the neutral-point displacement voltage and the residual current using the transient ground fault measurement method.

3.41.1 Disabling and Enabling the Transient Ground Fault Detection Function

The transient ground fault detection function is available where the P433 has been fitted with voltage transformers and with the transient ground fault evaluation module. In this case, the transient ground fault detection function can be disabled or enabled using setting parameters. Moreover, enabling can be carried out separately for each parameter set.

3.41.2 Readiness of the Transient Ground Fault Detection Function

A ready signal is issued if the following conditions are met:

- Protection is enabled.
- The transient ground fault detection function is enabled.
- The nominal frequency is set to 50 Hz.
- There is no external blocking.
- Transient ground fault detection has issued no directional decisions.
- Self-monitoring has detected no faults with transient ground fault detection.

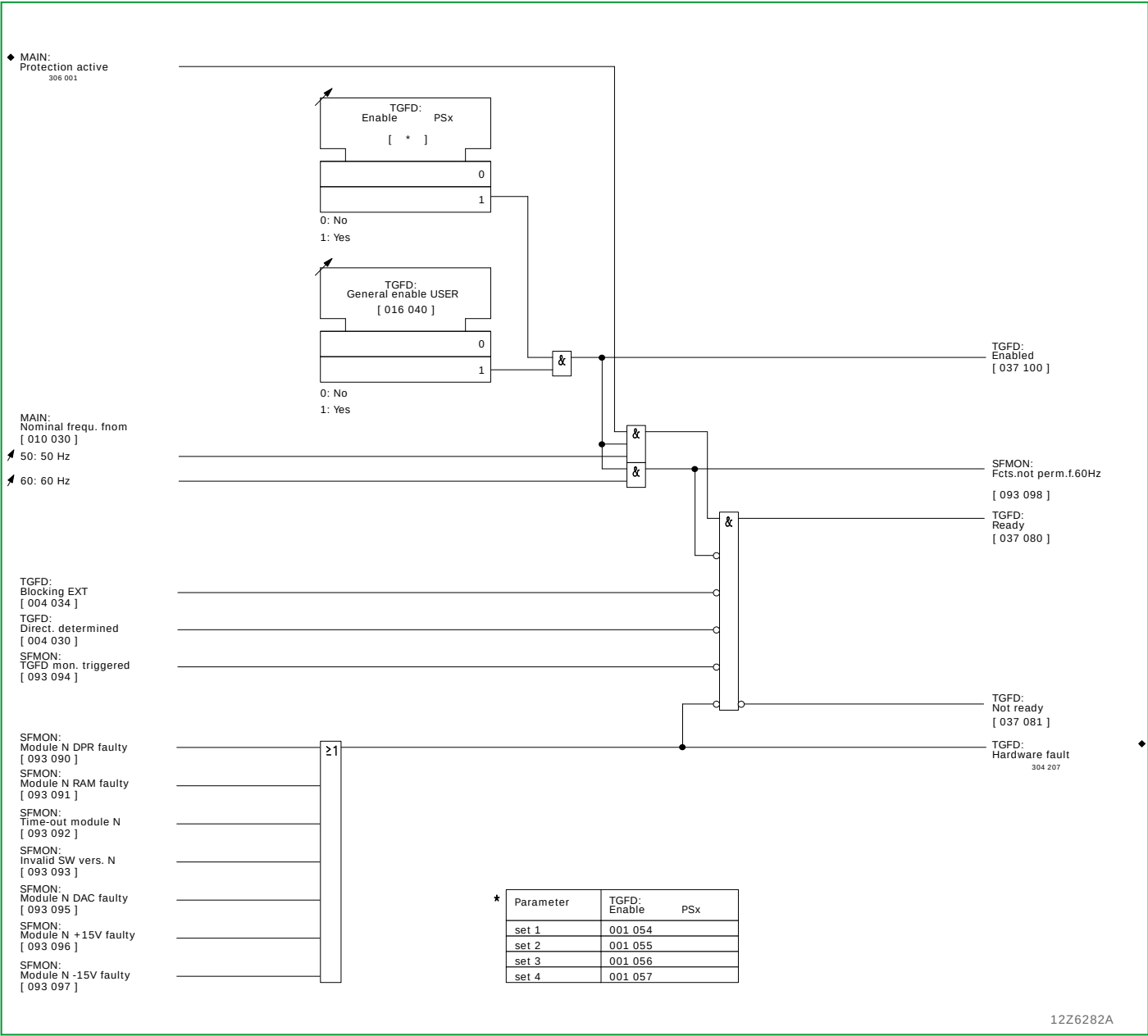


Fig. 3-322: Enabling, disabling and readiness of the transient ground fault detection function.

3.41.3 Conditioning and Selecting the Measured Values

To condition measured values V_{NG} and I_N the P433 is fitted with integrated transformers. As an alternative it is possible to use the neutral-point displacement voltage derived by the P433 from the three phase-to-ground voltages.

The connection of the measuring circuits is taken into account by the setting for TGFD: Measurem. direc. PSx. A pole reversal of the residual current measuring circuit through the global setting at MAIN: Conn. meas. circ. IN will in no way influence direction determination by the transient ground fault detection function.

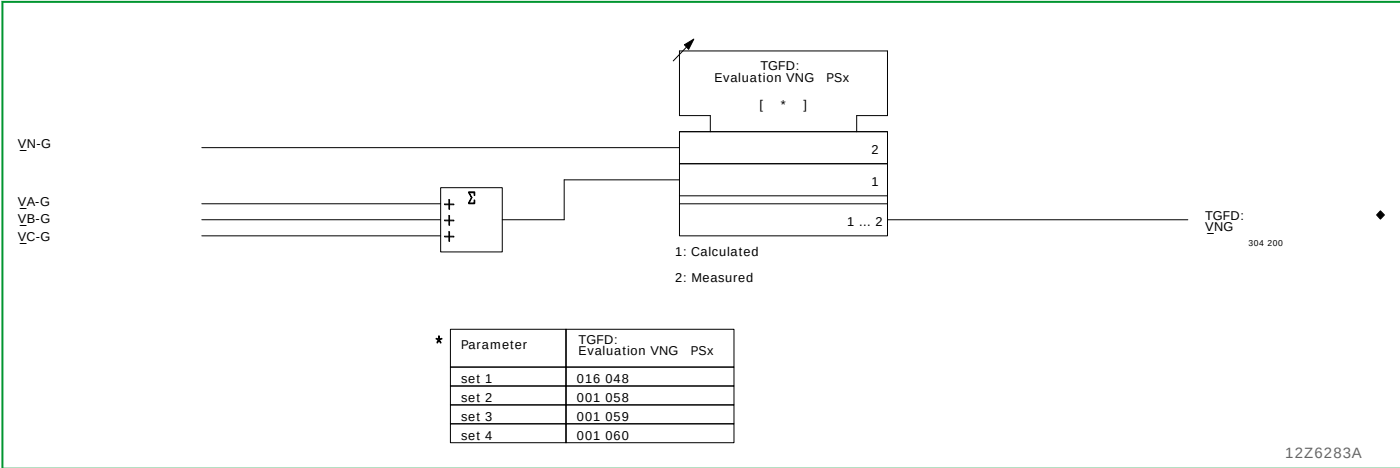


Fig. 3-323: Selecting the neutral-point displacement voltage.

3.41.4 Determining the Ground Fault Direction

A ground fault's direction can only be determined if the TGFD function is ready. Higher frequency components are filtered out of the measured values for residual current and neutral-point displacement voltage. Settable triggers monitor the magnitudes of the residual current and neutral-point displacement voltage harmonics as well as the neutral-point displacement voltage fundamental. To determine the ground fault direction the P433 will evaluate trigger decisions by the harmonics monitoring function, separately for the positive and negative half-waves.

The sign of the neutral-point displacement voltage's harmonic component is determined immediately after the current harmonic has exceeded the positive or negative threshold value. Trigger decisions for current and voltage are compared to determine the ground fault direction where, as a rule, evaluation depends on the connection of the measuring circuits. The connection of the measuring circuits is taken into account by the setting at TGFD: Measurem. direc. PSx. When the *Standard* connection has been made a ground fault on the line side will issue the decision "LS" and a ground fault on the busbar side will issue the decision "BS". The directional decision is enabled after the operate delay has elapsed, which follows monitoring of the neutral-point displacement voltage's fundamental.

Furthermore the operation of a current trigger will start a timer stage that, after it has elapsed, will enable the TGFD function to detect further transient ground faults. The time period after which a new transient ground fault may be detected is given by the setting of the operate delay +40 ms.

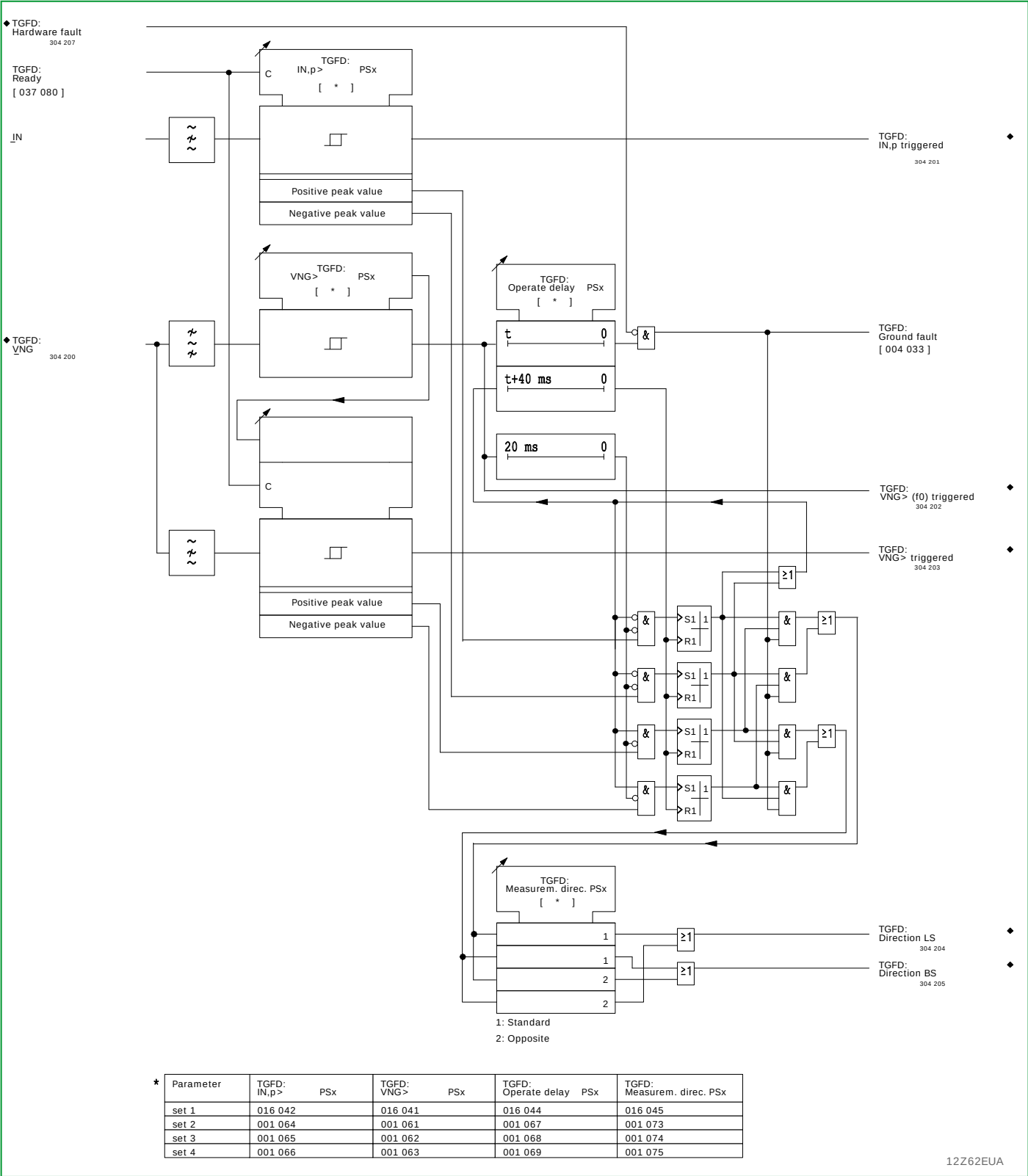


Fig. 3-324: Direction determination.

Directional decisions are output for the duration of the set buffer time. If buffer time is set to 0 s, directional decisions are output until the neutral-point displacement voltage's fundamental component no longer exceeds the trigger threshold set at TGFD: VNG > PSx.

If buffer time is set to blocked, directional decisions are stored until (manual) reset through TGFD: Reset signals USER or TGFD: Reset signals EXT.

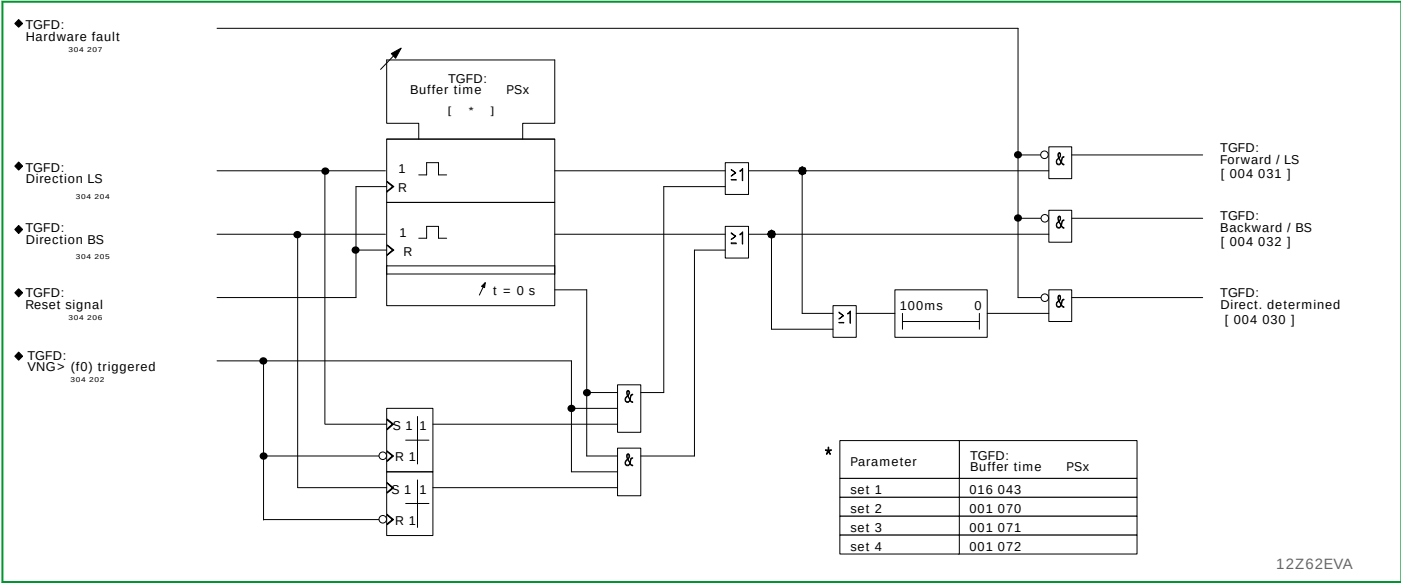


Fig. 3-325: Output of directional decisions.

3.4.1.5 Resetting a Directional Decision

While the buffer time is elapsing the directional decisions can be reset from the integrated local control panel, a setting parameter or through an appropriately configured binary signal input. Should the buffer time be set to ∞ ("infinity") the directional decision must be reset so that a new transient ground fault can be detected.

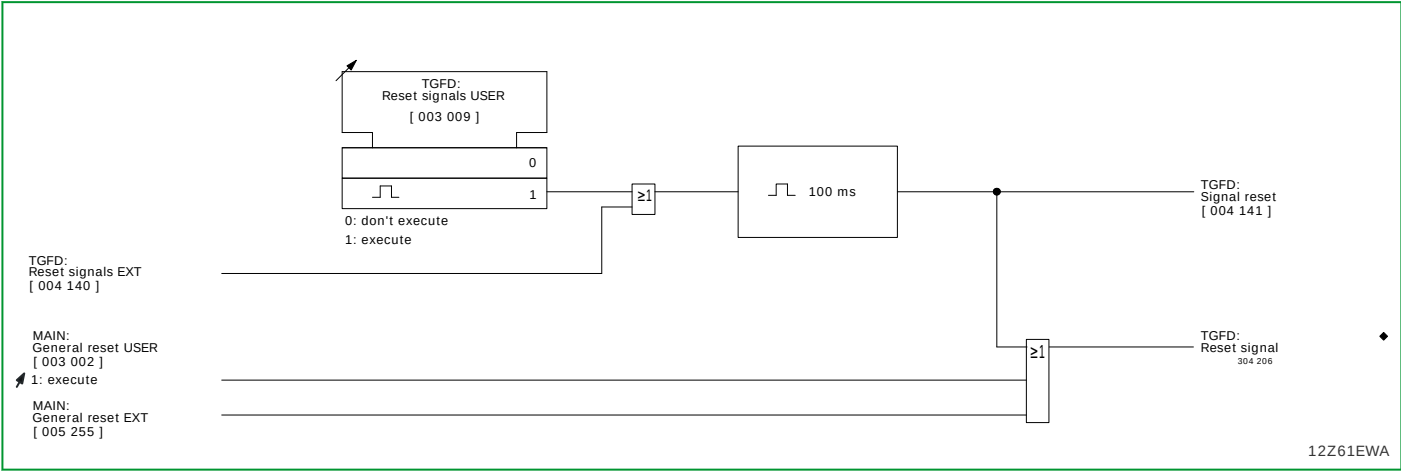


Fig. 3-326: Resetting directional decisions.

3.41.6 Monitoring the Measured Values

TGFD is blocked after 65 s if the respective set threshold value is exceeded by the current or the higher frequency content of the neutral-point displacement voltage in the absence of a ground fault (that is while the neutral-point displacement voltage fundamental stays below the set trigger threshold).

The SFMON: TGFD mon. triggered can be reset from the integrated local control panel, a setting parameter or through an appropriately configured binary signal input.

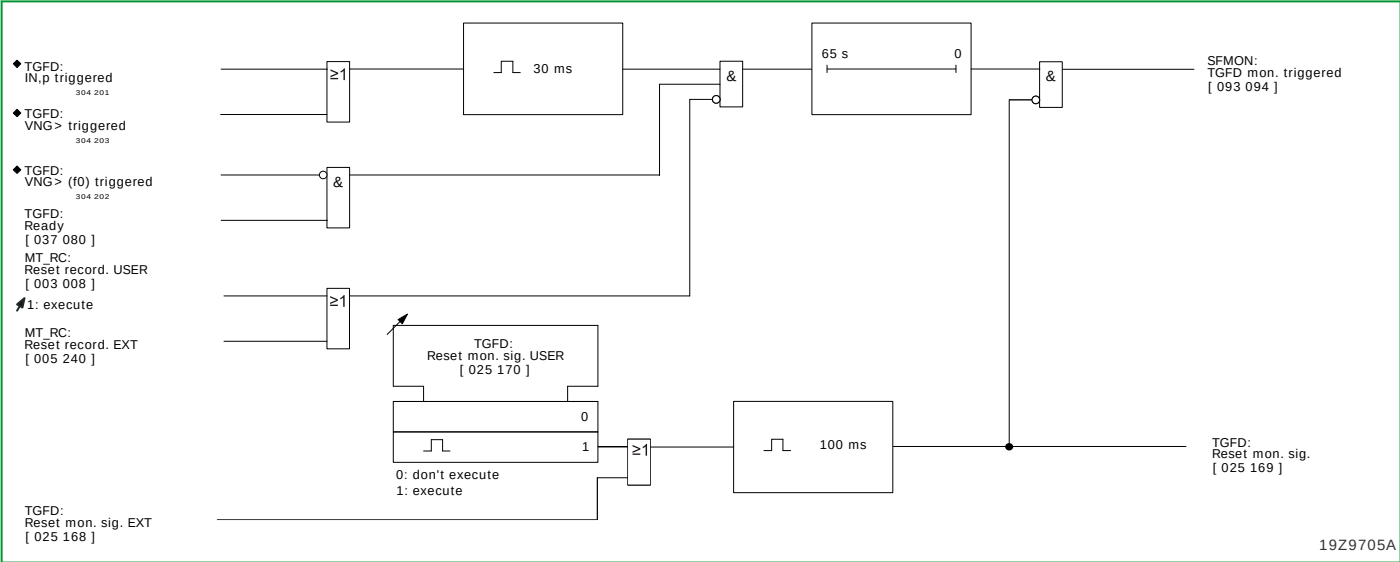


Fig. 3-327: Monitoring the measured values.

3.41.7 Counting the Transient Ground Faults

The number of transient ground faults and directional decisions are counted. The counters can be reset either individually or as a group.

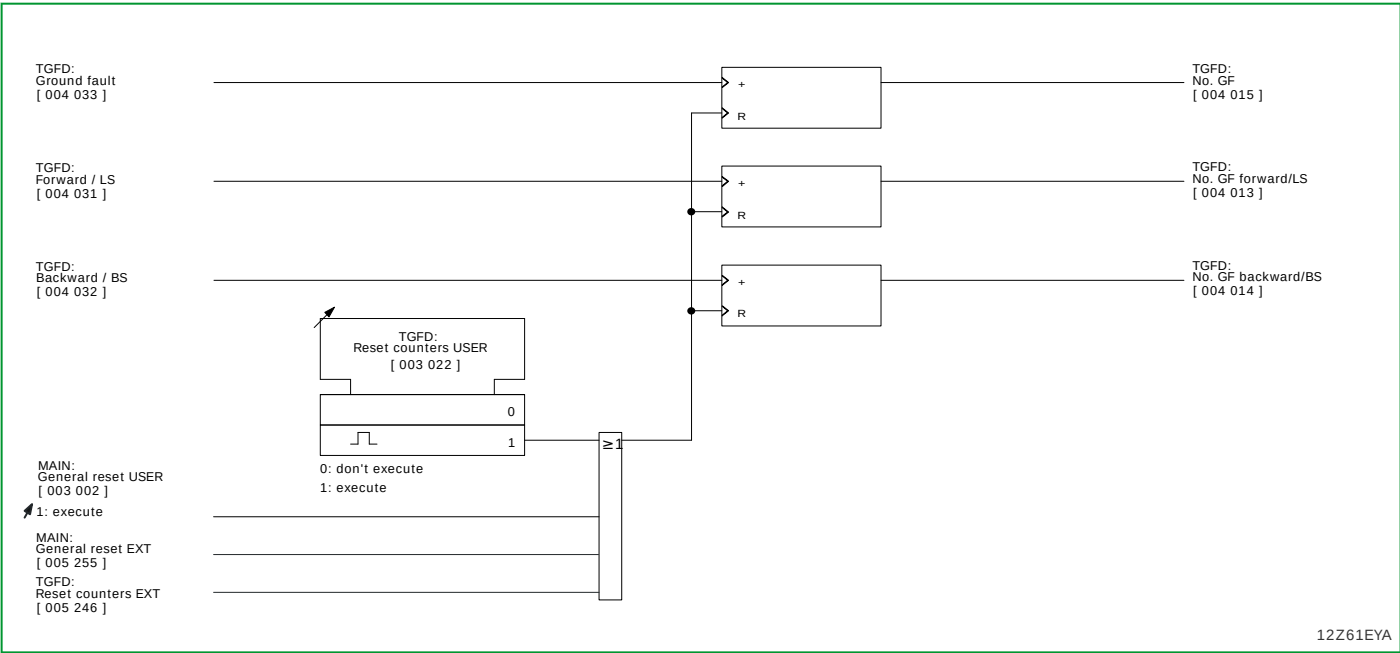


Fig. 3-328: Counting the transient ground faults.

3.42 Thermal Overload Protection (Function Group THERM)

Using this function, thermal overload protection can be implemented.

Disabling and Enabling Thermal Overload Protection

Thermal overload protection may be disabled or enabled by setting parameters. Moreover, enabling can be carried out separately for each parameter subset.

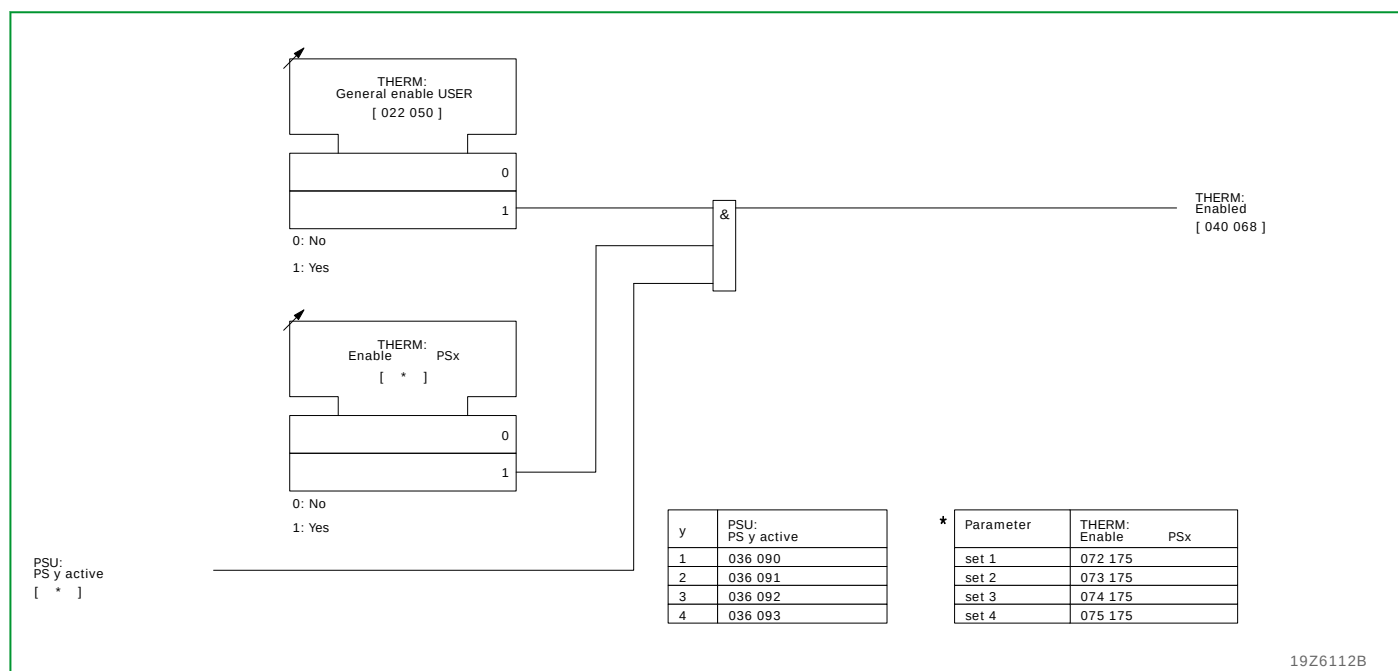


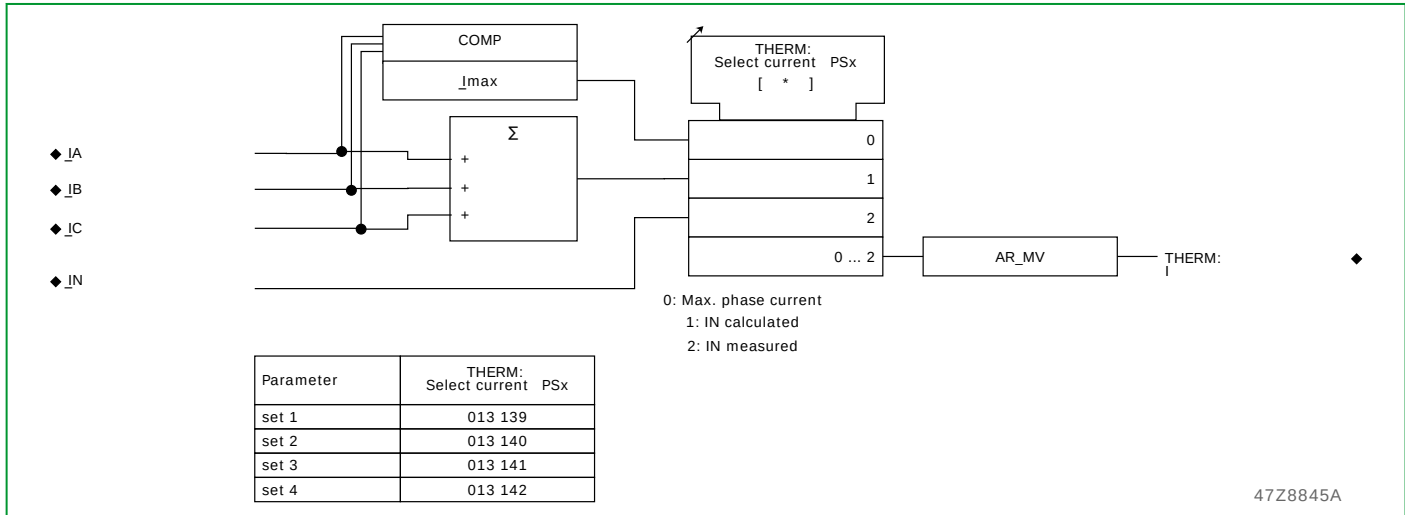
Fig. 3-329: Disabling or enabling thermal overload protection.

3.42.1 Readiness of Thermal Overload Protection

Thermal overload protection is not ready (THERM: Not ready) if one of the following conditions applies:

- Thermal overload protection is disabled.
- Thermal overload protection is blocked because of a fault in the coolant temperature (ambient) acquisition.
- Thermal overload protection is blocked because of an incorrect setting.
- The thermal replica is blocked via an appropriately configured binary signal input.

3.42.2 Selection of Current



A setting specifies which current will be used by the P433 for the Thermal Overload Protection: either the maximum RMS phase current, or the residual current calculated from the three phase currents or the residual current directly measured at the fourth current transformer (T 4).

3.42.3 Operating Modes

Two operating modes can be selected for thermal overload protection.

- Relative replica
- Absolute replica

Either operating mode can be enabled or disabled individually. Only one of the operating modes may be enabled for thermal overload protection. However, if both operating modes are enabled at the same time, the thermal overload protection is blocked and the error message THERM: Setting error,block. is generated by the P433.

3.42.4 Coolant Temperature Effect

To permit coolant temperature (ambient) acquisition, the analog (I/O) module Y(4I) with a 20 mA current input and the “PT100” input must be fitted. Thus, two measuring inputs are available.

One of these measuring inputs is selected for the primary measurement of coolant temperature by setting the parameter THERM: Select meas.inputPSx.

If the parameters THERM: Select meas.inputPSx have been set incorrectly the thermal overload protection is blocked and the error message THERM: Setting error,block. is generated.

An open measuring circuit, due to a broken wire, is determined by the measured value inputs (function group MEASI). This will result in the issuance of these signals:

- MEASI: Open circ. 20mA inp.
- MEASI: PT100 faulty

The thermal model uses these signals as a criterion to determine a fault in the coolant temperature measurement. A fault at both measured value inputs selected will lead to the issuance of the signal THERM: CTA error.

The setting for THERM: Funct.f.CTA fail.PSx determines how the thermal overload protection is to continue functioning when the coolant temperature

measurement has failed. The following functions can be selected to guarantee continued and stable performance of the thermal overload protection when the coolant temperature measurement has failed.

- Default temperature value:
The coolant temperature set at THERM: Coolant temp. PSx is applied. The thermal overload protection function is not blocked.
- Last measured temperature:
As a rule there is an erratic change of the measured value when a fault has occurred in the coolant temperature measurement. The temperature measured before such an erratic change is stored and applied. The thermal overload protection function is not blocked.
The coolant temperature set at THERM: Coolant temp. PSx is applied if no last measured values are available because a device warm restart or a parameter subset selection was carried out.
- Blocking:
The signals THERM: Warning and THERM: Trip signal are reset and blocked. The thermal model will then be continued and displayed on the basis of the measured current alone. All further measured values are issued as *Not measured*.

All parameters relevant to coolant temperature (ambient) acquisition are hidden if the analog module Y has not been fitted in the P433. The tripping time is calculated by including the setting for THERM: Coolant temp. PSx.

3.42.5 Thermal Overload Protection Operation without Coolant Temperature (Ambient) Acquisition

In order to ensure thermal overload protection, without taking into account an offset due to a variable coolant temperature, it is recommended to set the THERM: Coolant temp. PSx parameter to the maximum permitted coolant temperature.

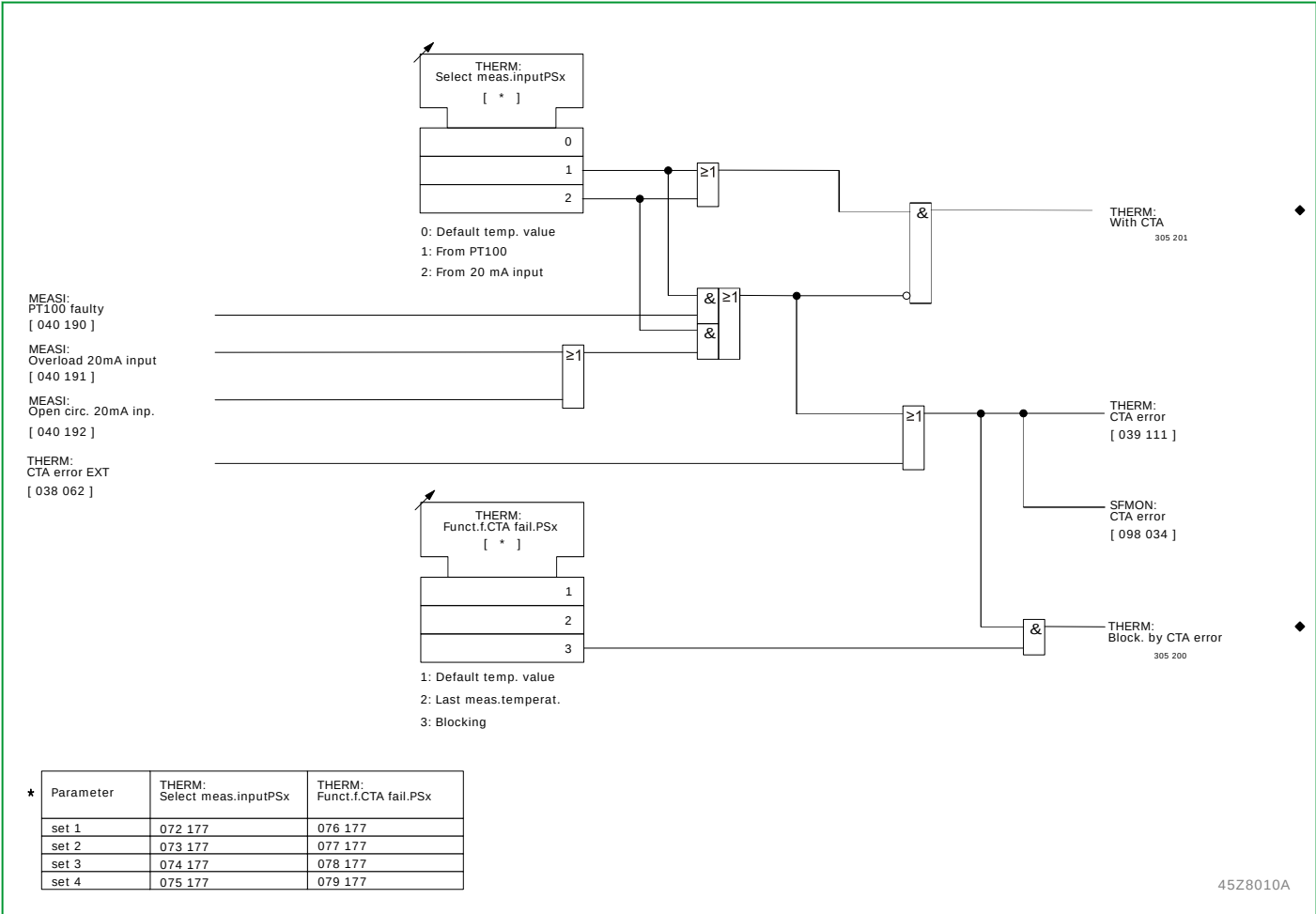


Fig. 3-330: Coolant temperature monitoring.

3.42.6 Relative Replica

The rated operating current of the protected object and its overload tolerance for maximum coolant (ambient) temperature are the basis of the relative thermal replica.

In the *Relative replica* operating mode, the following settings have to be made for thermal overload protection:

- The rated operating current of the protected object: THERM: Iref PSx
- The tripping threshold $\Delta\theta_{trip}$ is set at THERM: Θ_{trip} PSx.

If coolant temperature (ambient) acquisition is used, the following parameters must be set:

- The maximum permissible temperature of the protected object Θ_{max} , THERM: Max.object temp. PSx
- The maximum coolant temperature (maximum ambient) $\Theta_{c,max}$, THERM: Max. cool. temp. PSx

3.42.7

Absolute Replica

The thermal limit current of the protected object is the reference current of the absolute thermal replica. For this limit current, an overtemperature results at the maximum coolant temperature.

In the *Absolute replica* operating mode, the following parameters have to be set for thermal overload protection:

- The thermal limit current of the protected object: THERM: Iref PSx
- The limit temperature for tripping $\Theta_{\max}$, THERM: Max.object temp. PSx
- The overtemperature as a result of a persistent limit current ($\Theta_{\max} - \Theta_{c,\max}$), THERM: O/T f.Iref pers. PSx

The maximum permitted coolant temperature $\Theta_{c,\max}$ is derived from the difference between the THERM: Max.object temp. PSx and THERM: O/T f.Iref pers. PSx settings.

3.42.8

Tripping Characteristics

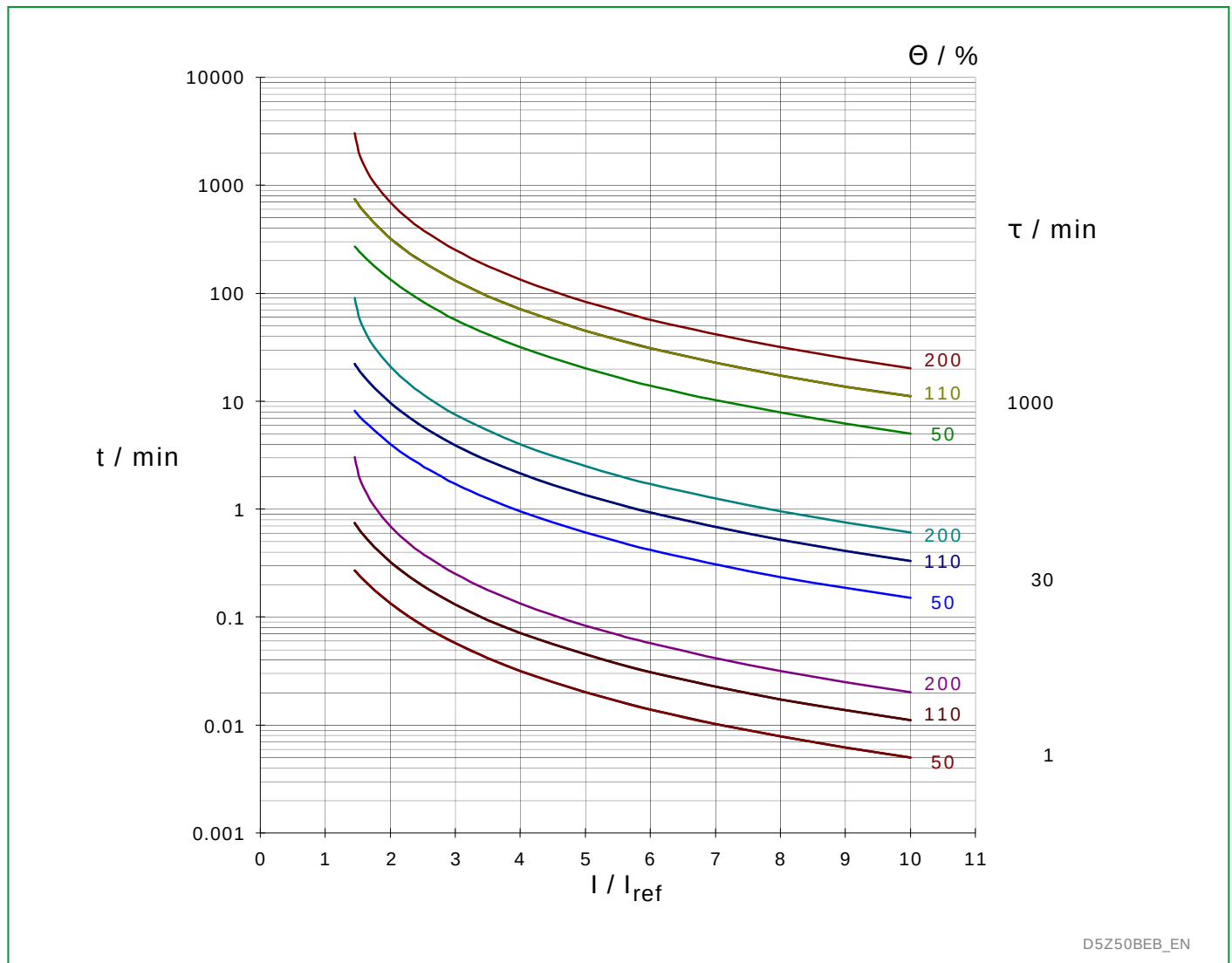


Fig. 3-331: Tripping characteristics of thermal overload protection (tripping characteristics apply to $\Delta\theta_p = 0\%$ and identical settings for the maximum permissible coolant temperature and coolant temperature).

The selected current (THERM: I, see [Section 3.42.2, \(p. 3-404\)](#)) is used to track a first-order thermal replica as specified in IEC 255-8. Other than the operating mode dependent settings the following parameters will govern the tripping time:

- The set thermal time constant τ of the protected object,
THERM: Tim.const.1, >|b| PSx
- The accumulated thermal load $\Delta\theta_0$
- The current measured coolant temperature Θ_c
- If the value of the selected current (THERM: I) is greater than $10 \cdot I_{ref}$ then only the fixed maximum value $10 \cdot I_{ref}$ is used for calculating the tripping time.

The tripping threshold in the two operating modes is calculated as follows:

$$t = \tau \cdot \ln \frac{\left(\frac{I}{I_{ref}}\right)^2 - \Delta\theta_0}{\left(\frac{I}{I_{ref}}\right)^2 - \Delta\theta_{trip} \cdot \left(1 - \frac{\Theta_a - \Theta_{a,max}}{\Theta_{max} - \Theta_{a,max}}\right)}$$

The $\Delta\theta_{trip}$ tripping threshold is set to a fixed value of 100% if the operating mode is *Absolute replica*.

3.42.9

Warning Signal

Depending on the selected operating mode, a warning signal can be set at one of the following parameters:

- Relative replica: THERM: Θ warning PSx
- Absolute replica: THERM: Warning temp. PSx

Additionally, a time-to-tripping threshold (pre-trip time) can be set. When the time left until tripping falls below this setting, a warning signal will be issued.

3.42.10 Trip

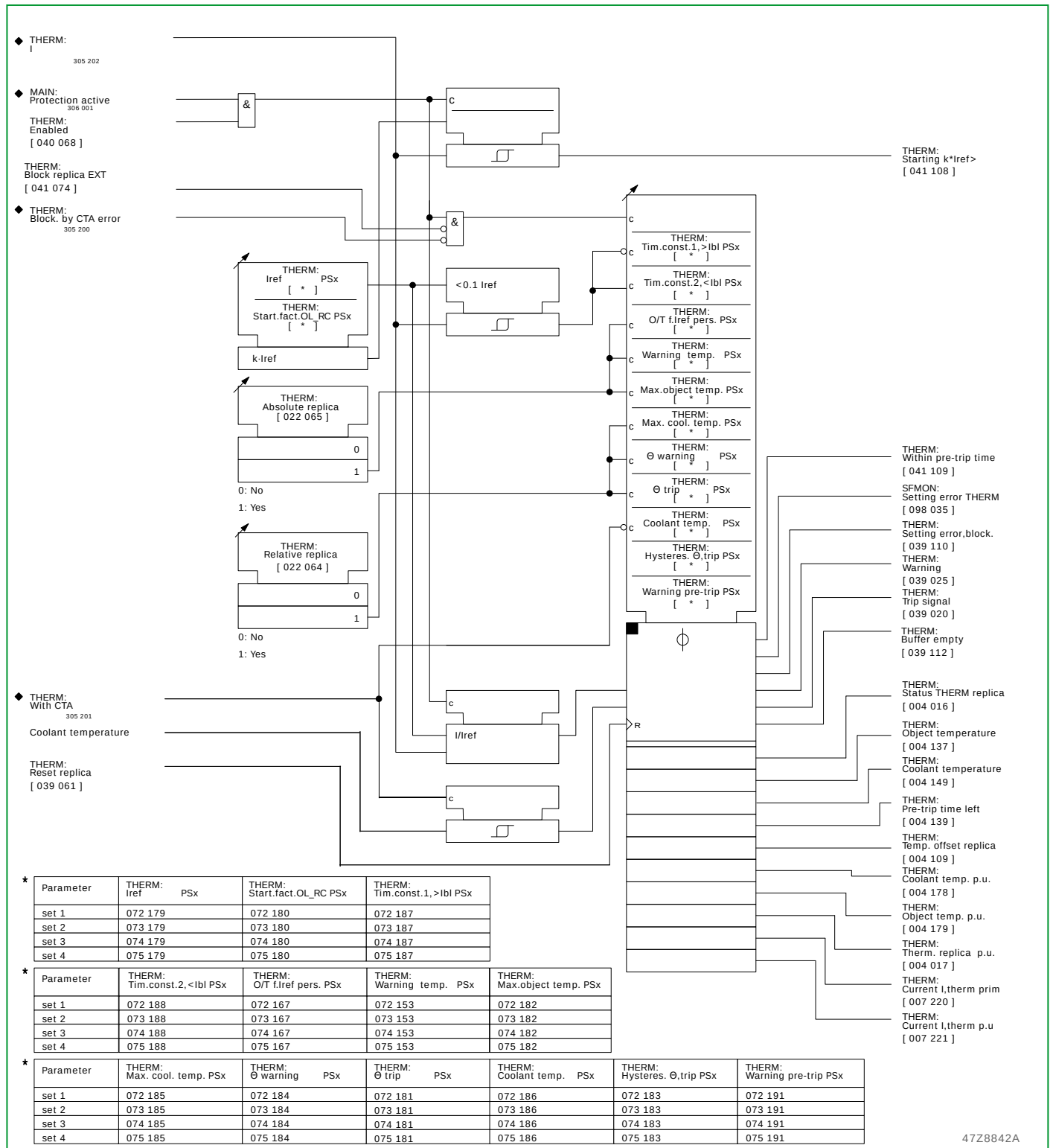


Fig. 3-332: Thermal overload protection.

The trip threshold is set according to the selected operating mode with the following parameters:

- Relative replica: THERM: Θ trip PSx
- Absolute replica: THERM: Max.object temp. PSx

If a trip command is issued, the trip signal is maintained until the status of the thermal replica has decreased by the value set at THERM: Hysteres. Θ , trip PSx, at least for a fixed time of 5 s.

3.42.11 Cooling

If the current falls below the default threshold of $0.1 I_{ref}$, the thermal replica is applied with the time constant set at THERM: Tim.const.2, <IbI PSx. This element in the thermal model takes account of the cooling characteristics of stopped motors.

The two time constants THERM: Tim.const.1, >IbI PSx and THERM: Tim.const.2, <IbI PSx should be set to identical values for transformers and power lines.

3.42.12 Resetting

The thermal replica may be reset either via a setting parameter or via an appropriately configured binary signal input. Resetting is possible even when thermal overload protection is disabled. Thermal overload protection can be blocked via an appropriately configured binary signal input.

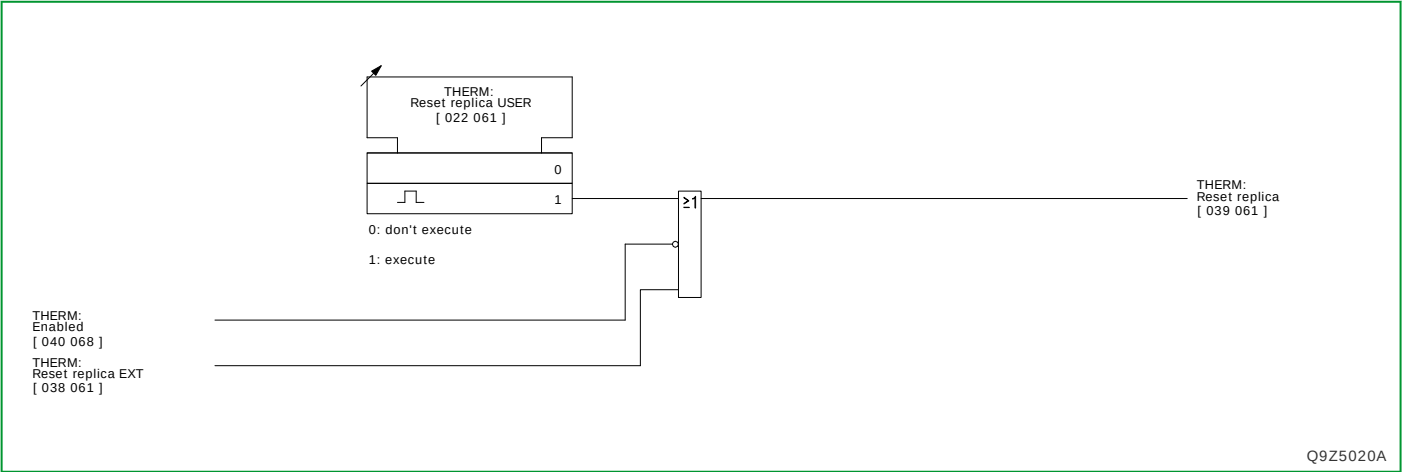


Fig. 3-333: Resetting the thermal replica.

3.43 Under and Overvoltage Protection (Function Group V<>)

The time-voltage protection function evaluates the fundamental wave of the phase voltages and of the neutral-point displacement voltage as well as the positive-sequence voltage and negative-sequence voltage obtained from the fundamental waves of the three phase-to-ground voltages.

3.43.1 Disabling and Enabling V<> Protection

V<> protection can be disabled or enabled using setting parameters. Moreover, enabling can be carried out separately for each parameter subset.

3.43.2 V<> Protection Readiness

V<> protection is ready if it is enabled and no fault has been detected in the voltage-measuring circuit by the measuring-circuit monitoring function.

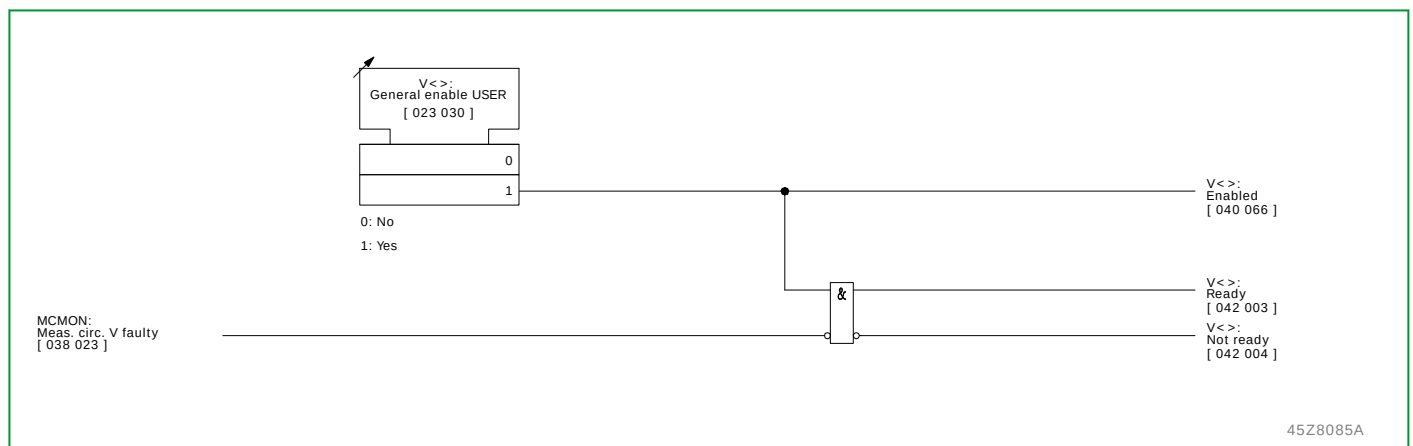


Fig. 3-334: Enabling, disabling and readiness of V<> protection.

3.43.3 Minimum Current Monitoring

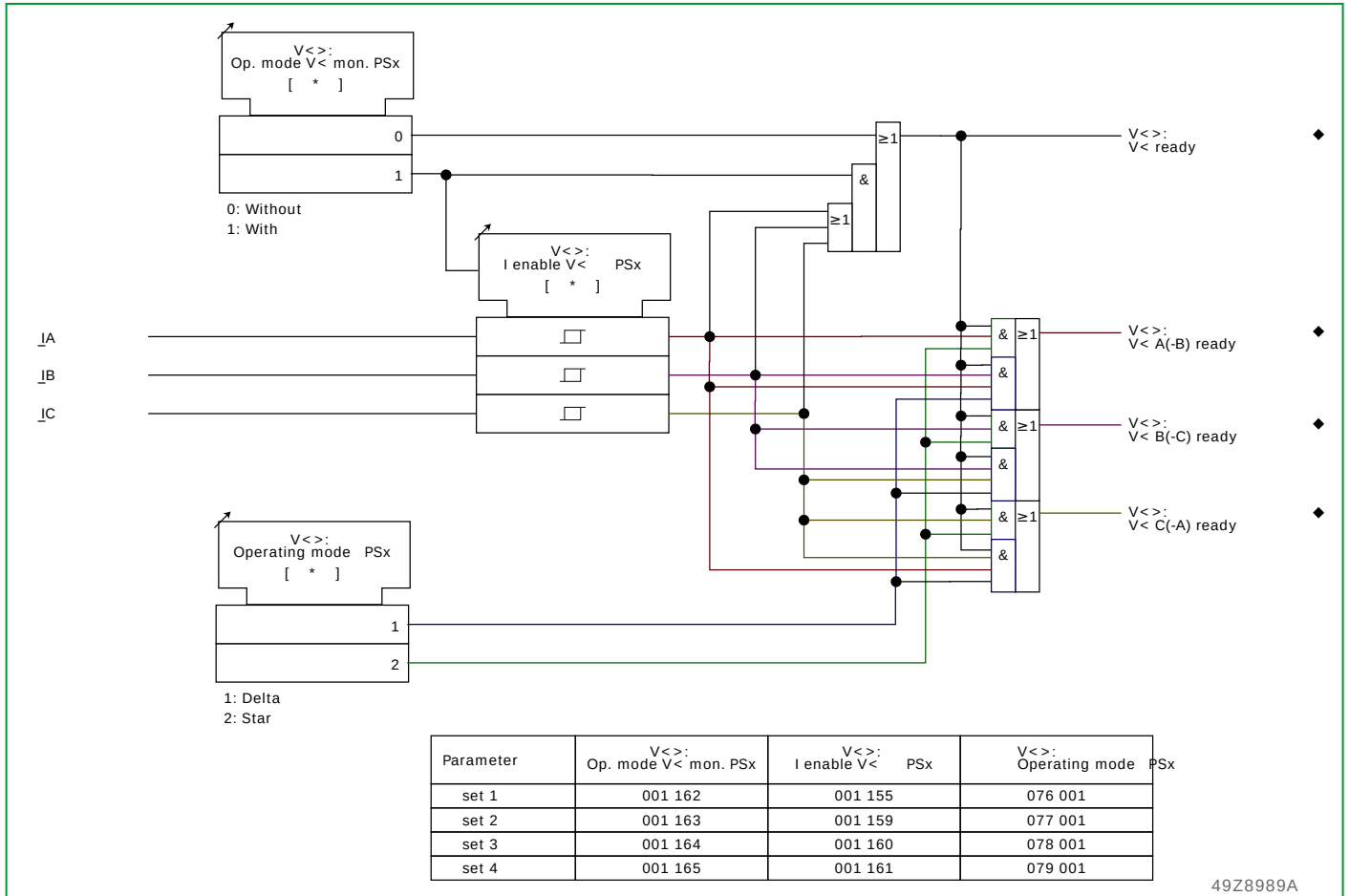


Fig. 3-335: Enabling threshold for the undervoltage stages.

There is an optional enabling threshold available with the V<> element which is based on minimum current monitoring for the undervoltage stages (V<, V<<, V<<<, Vpos<, Vpos<<).

The following two settings may be used to activate the operating mode for minimum current monitoring and to set the enabling threshold:

- V<>: Op. mode V< mon. PSx – activates the threshold if set to *With*.
- V<>: I enable V< PSx – defines the threshold value (in units of Inom).

If V<>: Op. mode V< mon. PSx = *With*, the undervoltage stages Vpos< and Vpos<< are enabled only if the phase current value of at least one phase is exceeding the set threshold.

Moreover, there is a phase-specific monitoring for the undervoltage stages V<, V<<, V<<<:

- For V<>: Operating mode PSx = *Star*, these stages are enabled for loop A–N, for example, only if the value of IA is exceeding the set threshold (and accordingly for the other two phases).
- For V<>: Operating mode PSx = *Delta*, these stages are enabled for loop A–B, for example, only if the values of both IA and IB are exceeding the set threshold (and accordingly for the other two loops).

3.43.4 Monitoring the Phase Voltages

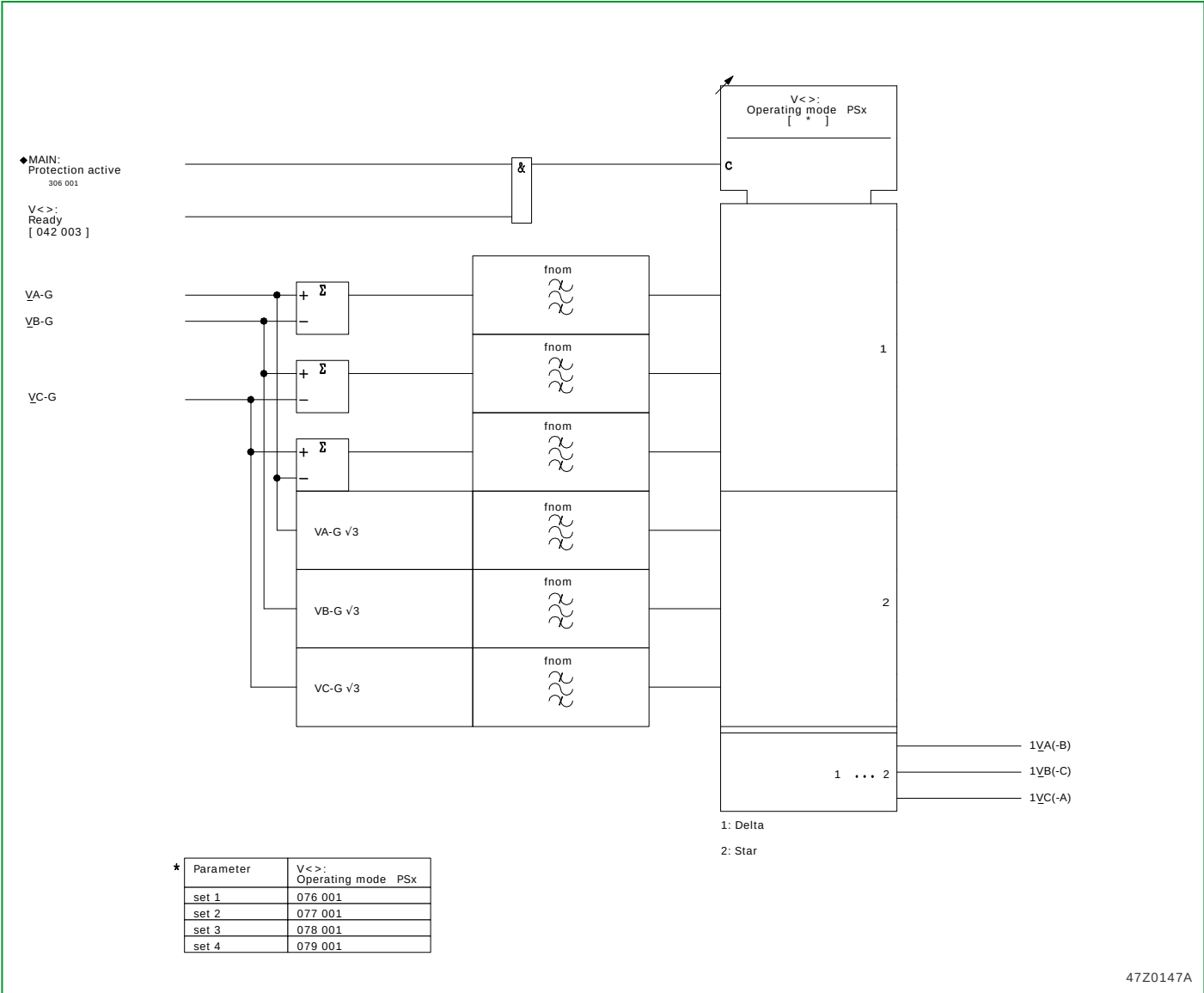


Fig. 3-336: Selection of the measured values.

The P433 checks the voltages to determine whether they exceed or fall below set thresholds. Dependent on the set operating mode of V<> protection, either the phase-to-ground voltages (*Star* operating mode) or the phase-to-phase voltages (*Delta* operating mode) are monitored. The triggers are followed by timer stages that can be blocked via appropriately configured binary signal inputs.

If undervoltage monitoring decisions are to be included in the trip commands, then it is recommended that transient signals be used. Otherwise the trip command would always be present when the system voltage was disconnected, and it would therefore not be possible to close the circuit breaker again.

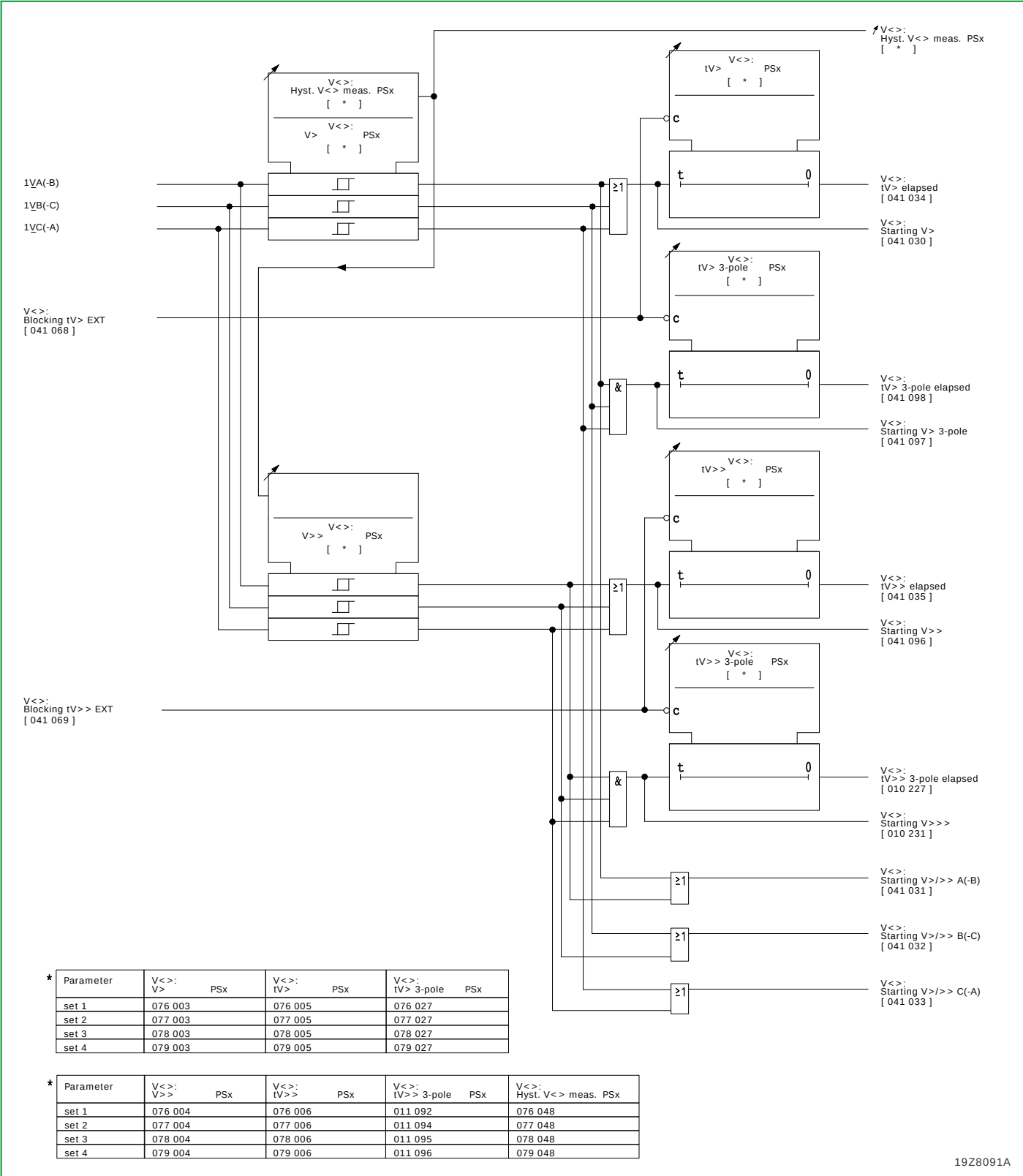


Fig. 3-337: Overvoltage monitoring, Part 1: stages V> and V>>.

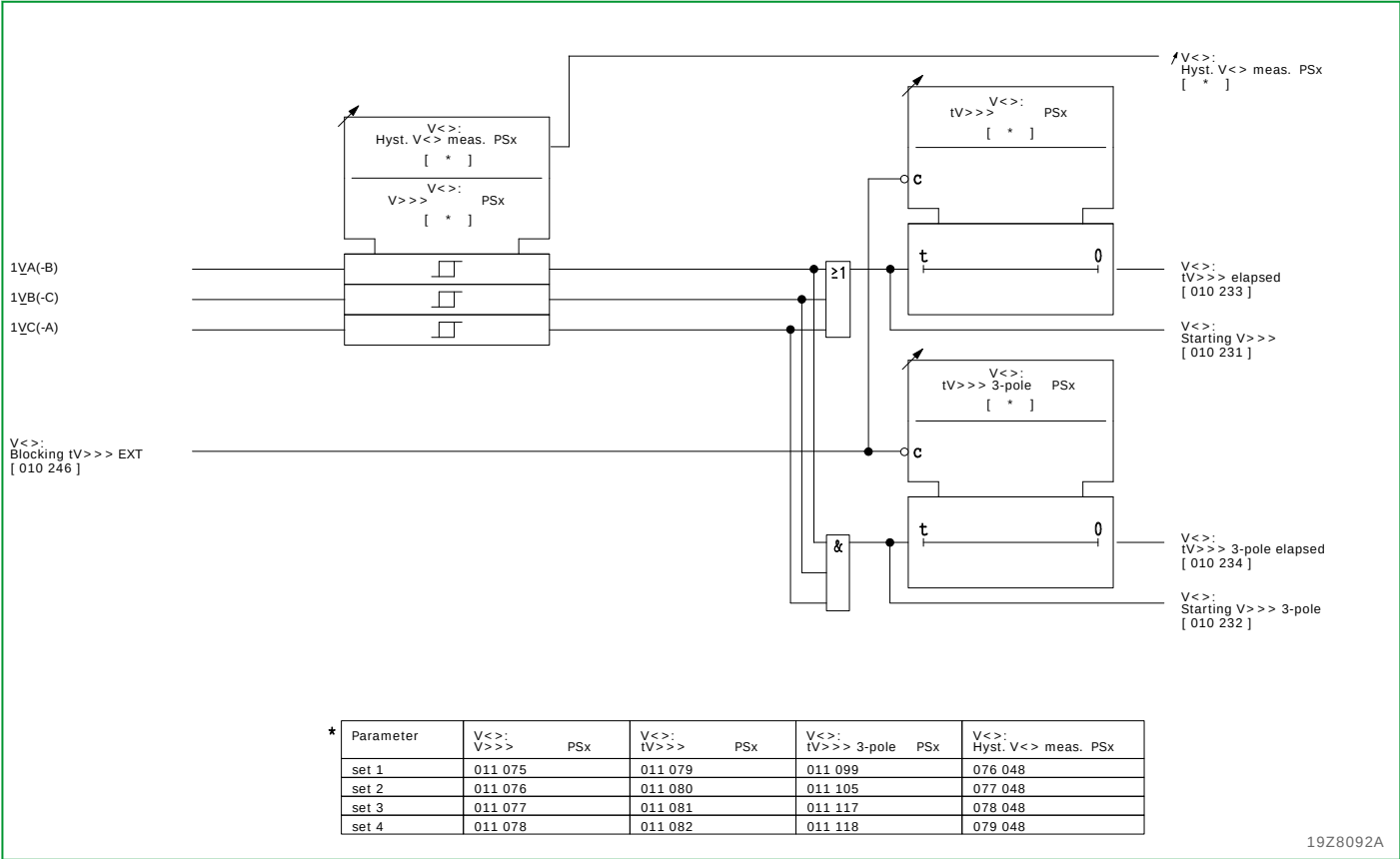


Fig. 3-338: Overvoltage monitoring, Part 2: stage V>>>.

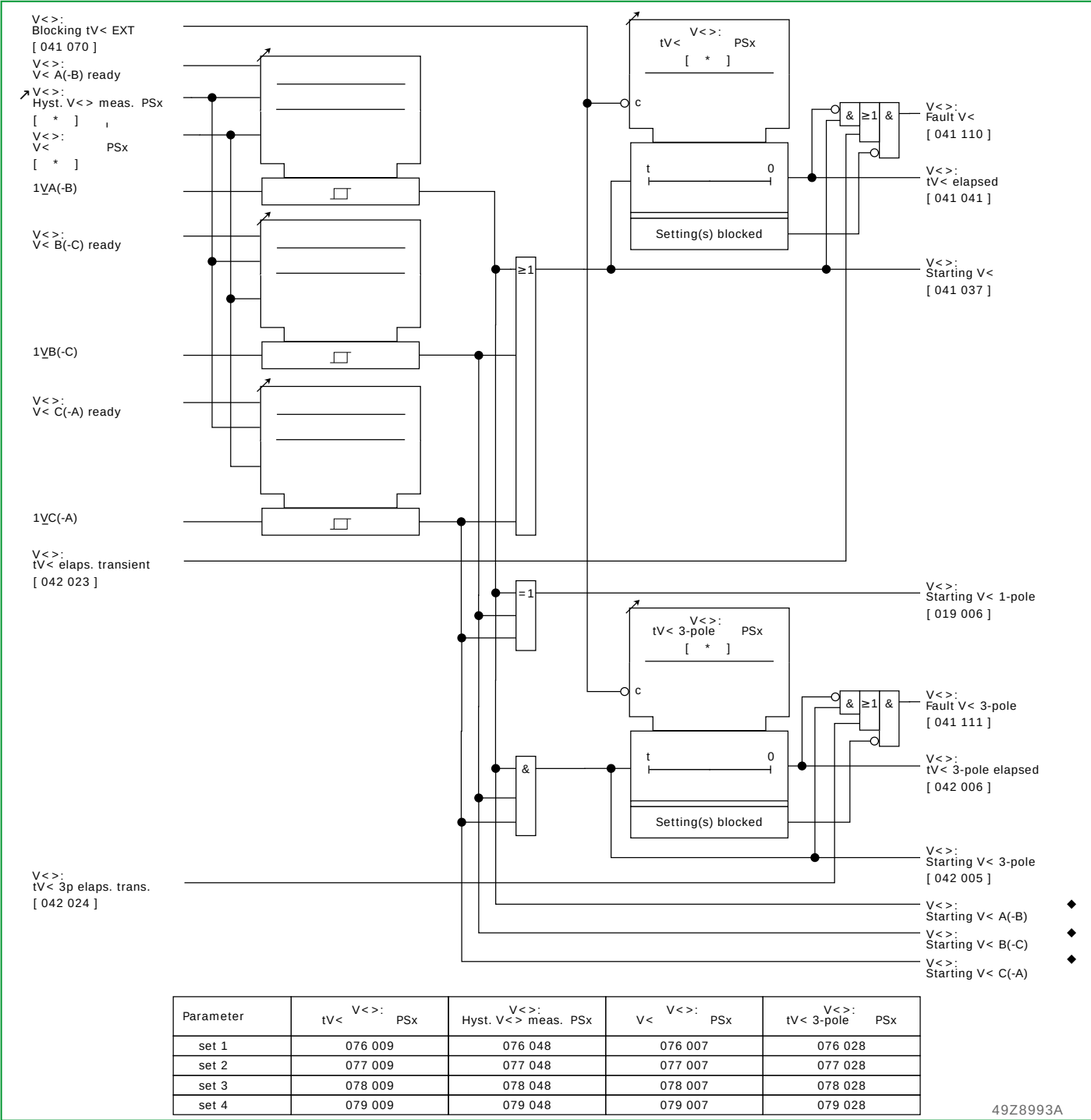


Fig. 3-339: Undervoltage monitoring, Part 1: stage V<. (Transient pulse: See diagram below.)

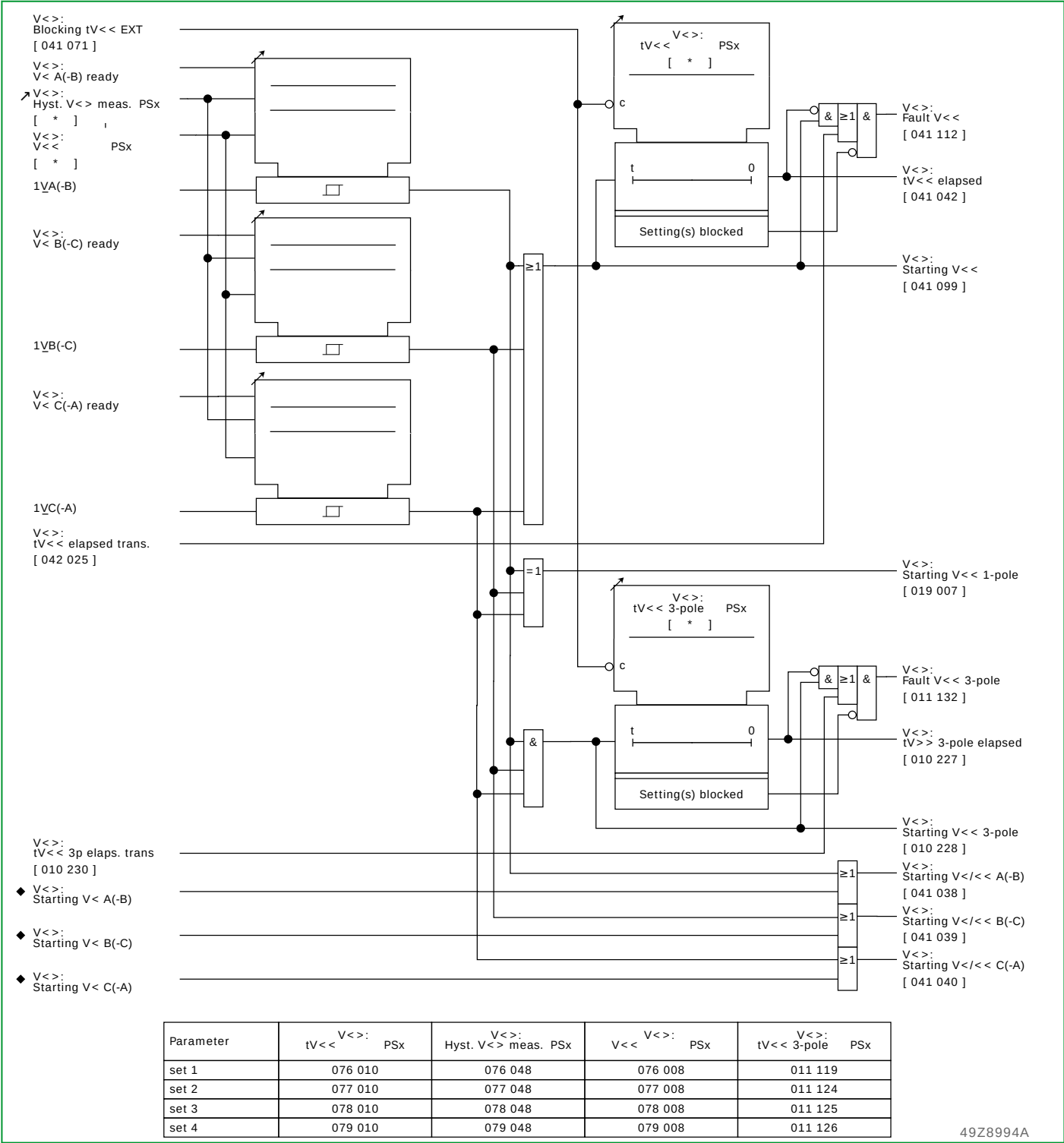


Fig. 3-340: Undervoltage monitoring, Part 2: stage V<>. (Transient pulse: See diagram below.)

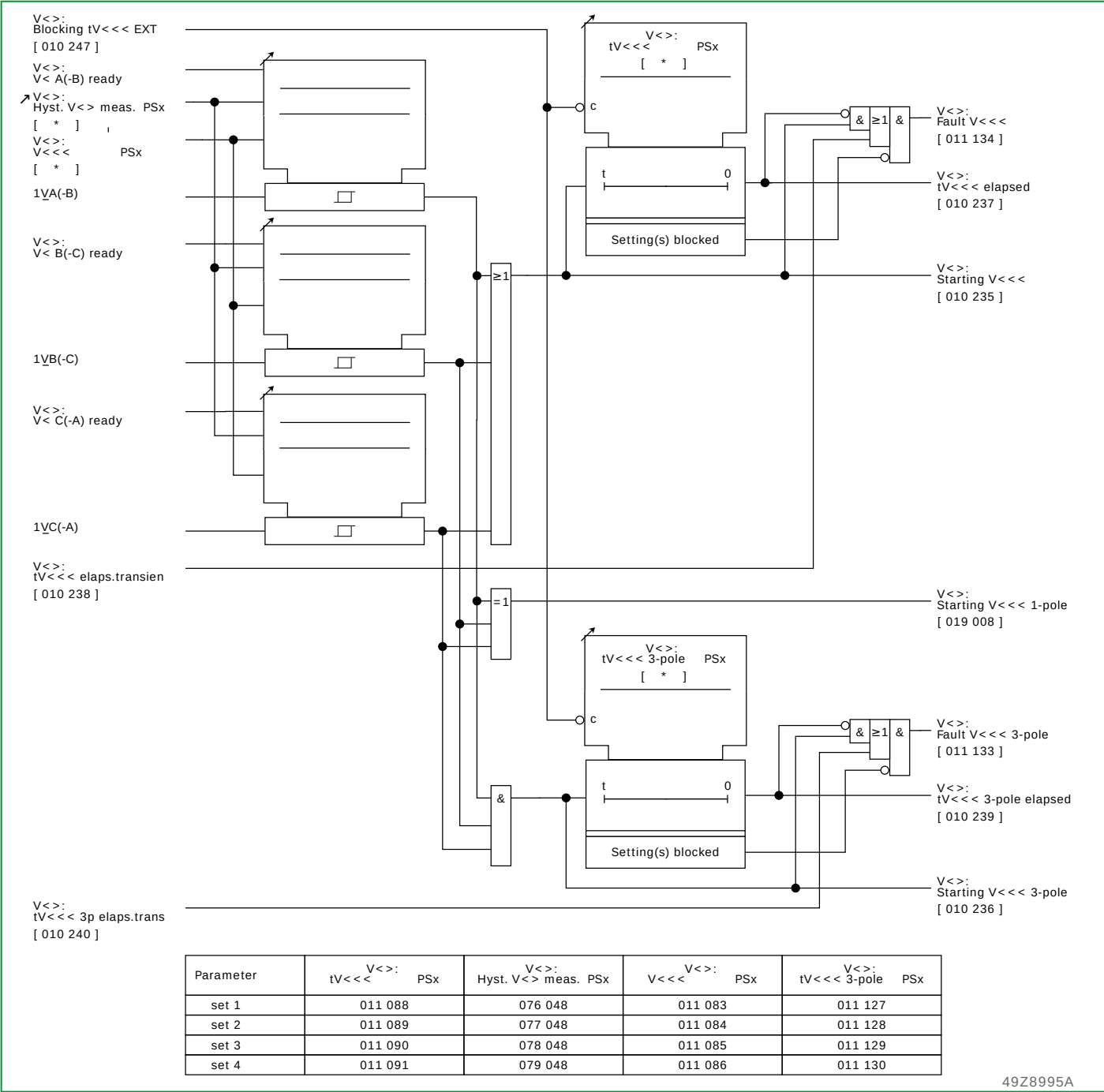


Fig. 3-341: Undervoltage monitoring, Part 3: stage V<<<. (Transient pulse: See following diagram.)

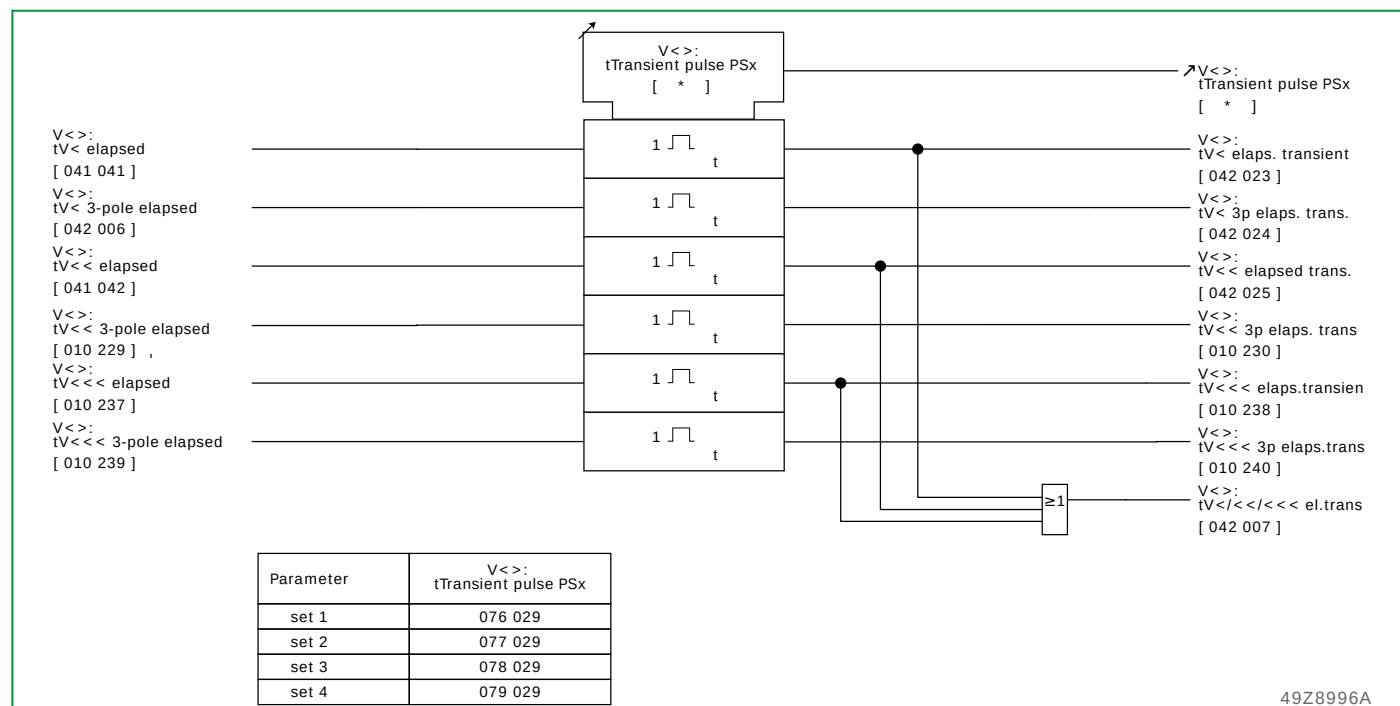


Fig. 3-342: Undervoltage monitoring, Part 4: Transient pulse for stages V</<</<<<.

3.43.5 Monitoring the Positive- and Negative-Sequence Voltages

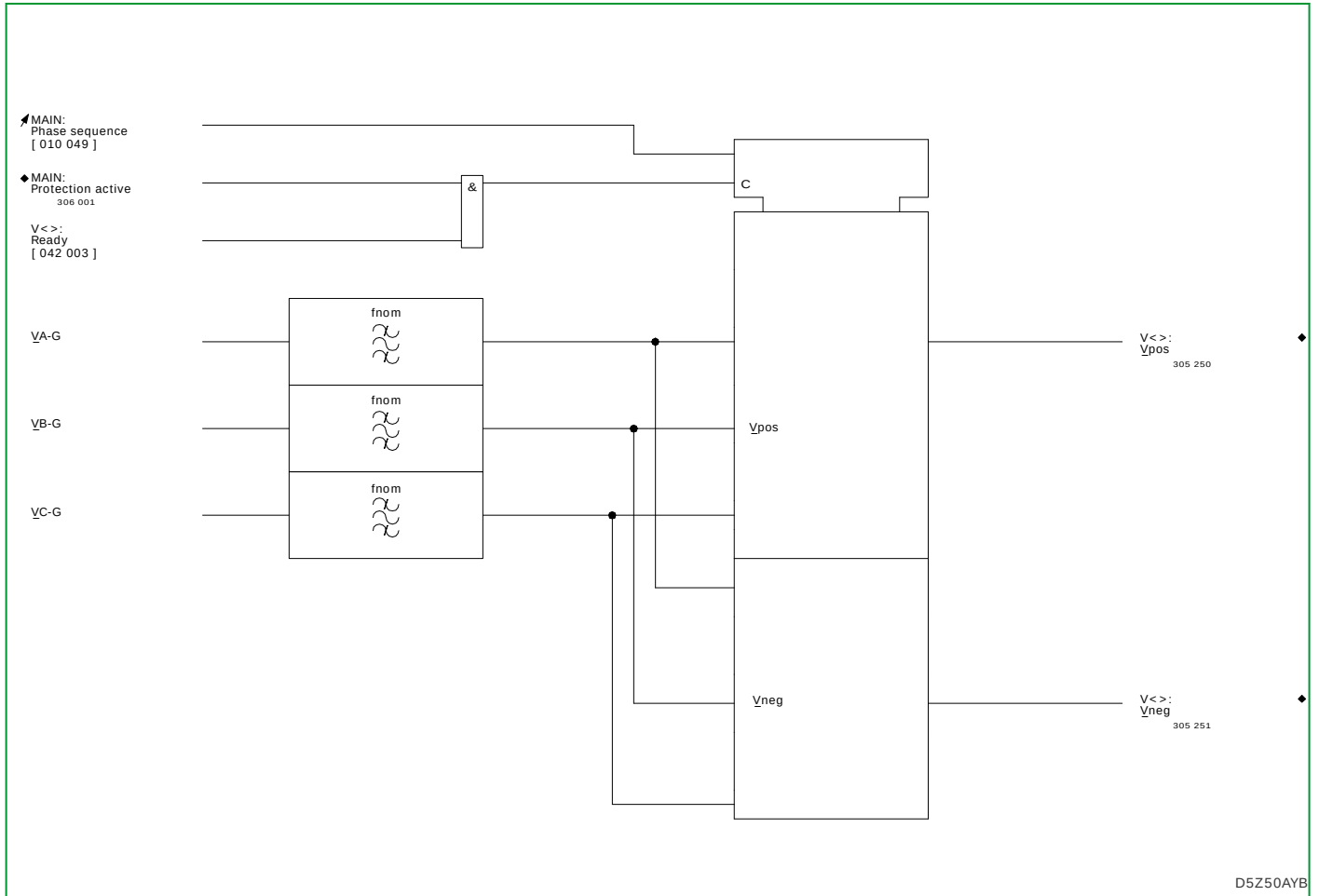


Fig. 3-343: Determination of positive- and negative-sequence voltages. (Note: The previous terminology for MAIN: Phase sequence was MAIN: Rotary field.)

The P433 determines the positive-sequence and negative-sequence voltages from the fundamental components of the phase-to-ground voltages according to the formulas given below. This is based on the MAIN: Phase sequence setting (alternative terminology: Rotary field).

Phase sequence A-B-C (clockwise rotating field)

- Negative-sequence voltage:

$$|V_{\text{neg}}| = \frac{1}{3} \cdot | (V_{\text{A-G}} + a^2 \cdot V_{\text{B-G}} + a \cdot V_{\text{C-G}}) |$$

- Positive-sequence voltage:

$$|V_{\text{pos}}| = \frac{1}{3} \cdot | (V_{\text{A-G}} + a \cdot V_{\text{B-G}} + a^2 \cdot V_{\text{C-G}}) |$$

Phase sequence A-C-B (anti-clockwise rotating field)

- Negative-sequence voltage:

$$| \underline{V}_{\text{neg}} | = \frac{1}{3} \cdot | (\underline{V}_{\text{A-G}} + \underline{a} \cdot \underline{V}_{\text{B-G}} + \underline{a}^2 \cdot \underline{V}_{\text{C-G}}) |$$

- Positive-sequence voltage:

$$| \underline{V}_{\text{pos}} | = \frac{1}{3} \cdot | (\underline{V}_{\text{A-G}} + \underline{a}^2 \cdot \underline{V}_{\text{B-G}} + \underline{a} \cdot \underline{V}_{\text{C-G}}) |$$

- Symbols used:

$$\underline{a} = e^{2\pi j/3} = e^{j \cdot 120^\circ}$$

$$\underline{a}^2 = e^{4\pi j/3} = e^{j \cdot 240^\circ}$$

The positive-sequence voltage is monitored to determine whether it exceeds or falls below set thresholds, and the negative-sequence voltage is monitored to determine whether it exceeds set thresholds. If the voltage exceeds or falls below the set thresholds, then a signal is issued once the set operate delays have elapsed. The timer stages can be blocked by appropriately configured binary signal inputs.

If undervoltage monitoring decisions are to be included in the trip commands, then it is recommended that transient signals be used. Otherwise the trip command would always be present when the system voltage was disconnected, and it would therefore not be possible to close the circuit breaker again.

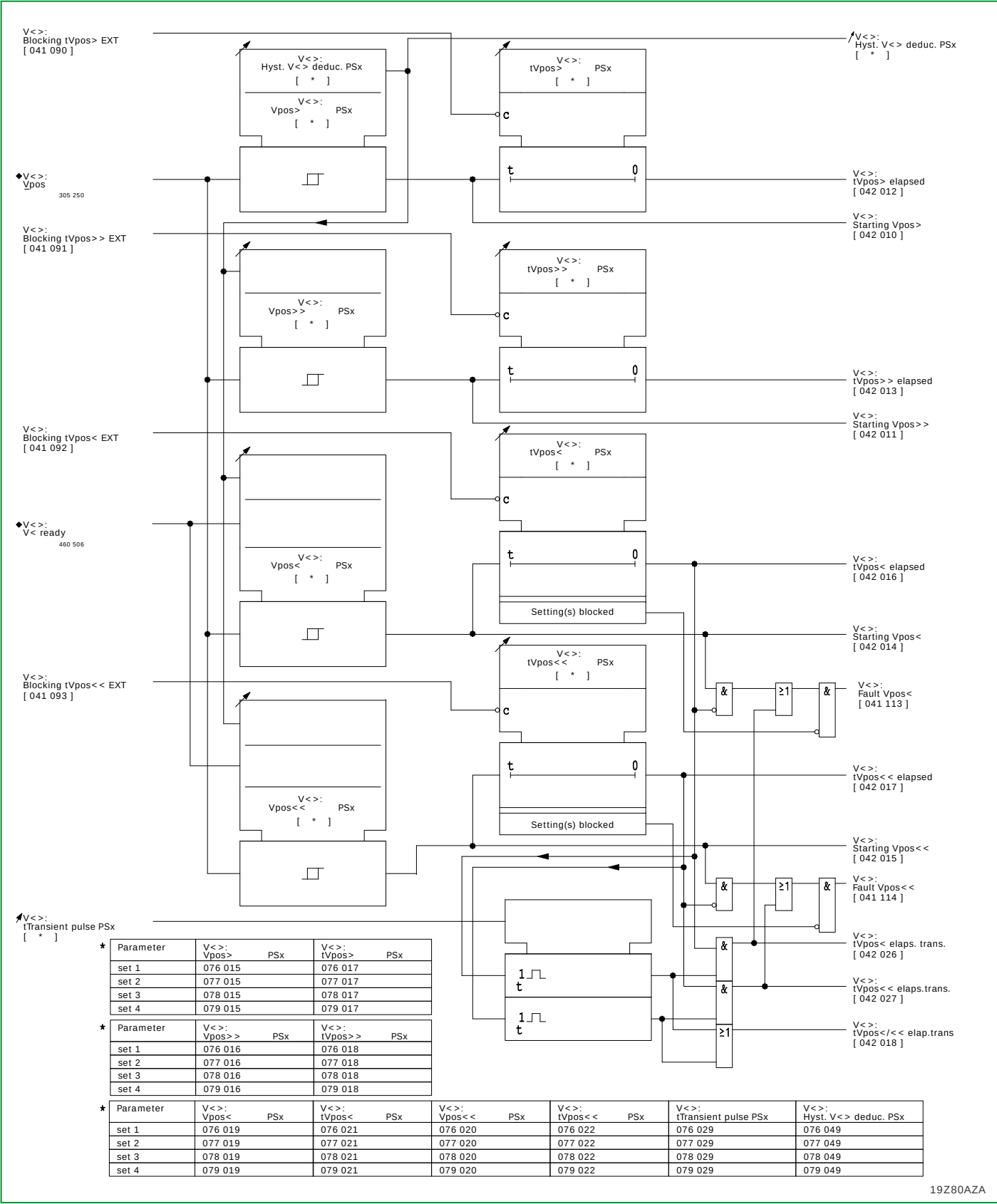


Fig. 3-344: Monitoring the positive-sequence voltage.

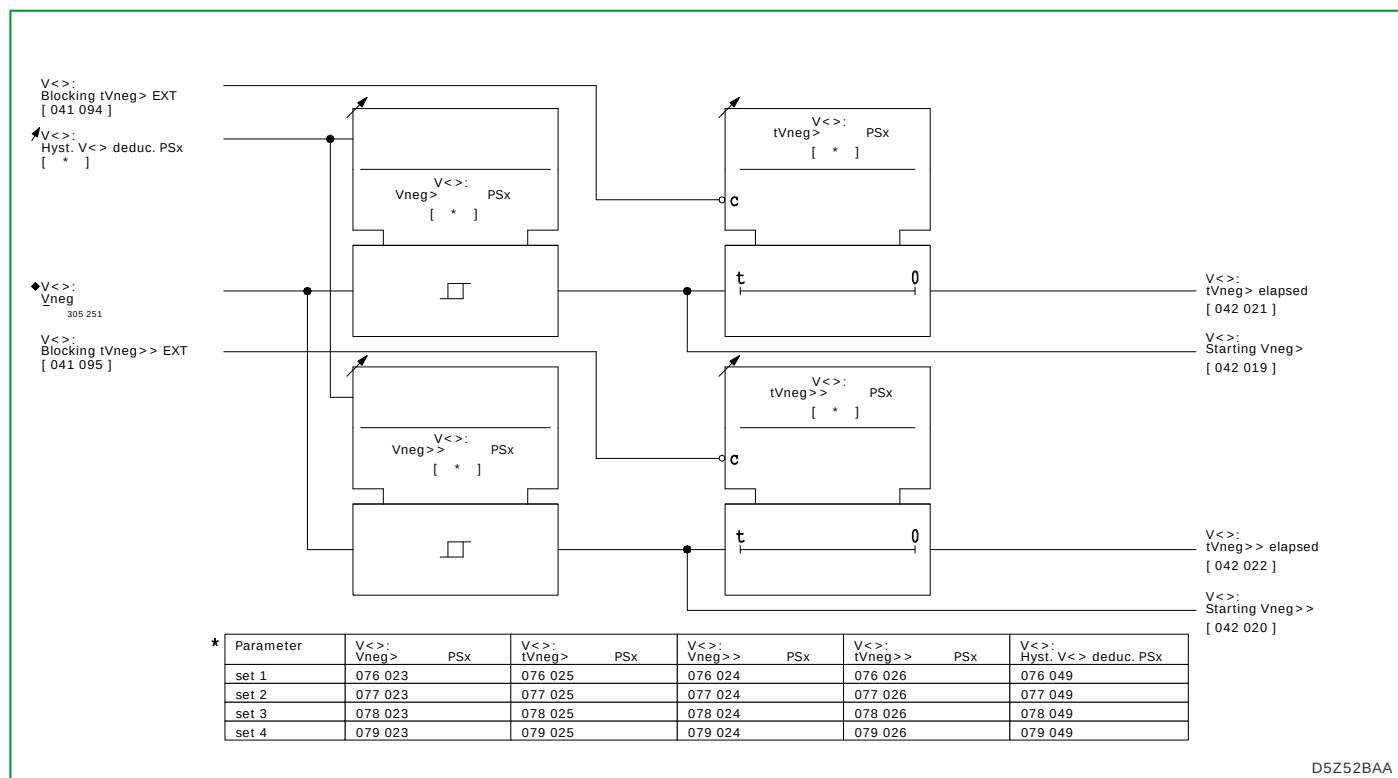


Fig. 3-345: Monitoring the negative-sequence voltage.

3.43.6 Monitoring the Neutral-Point Displacement Voltage

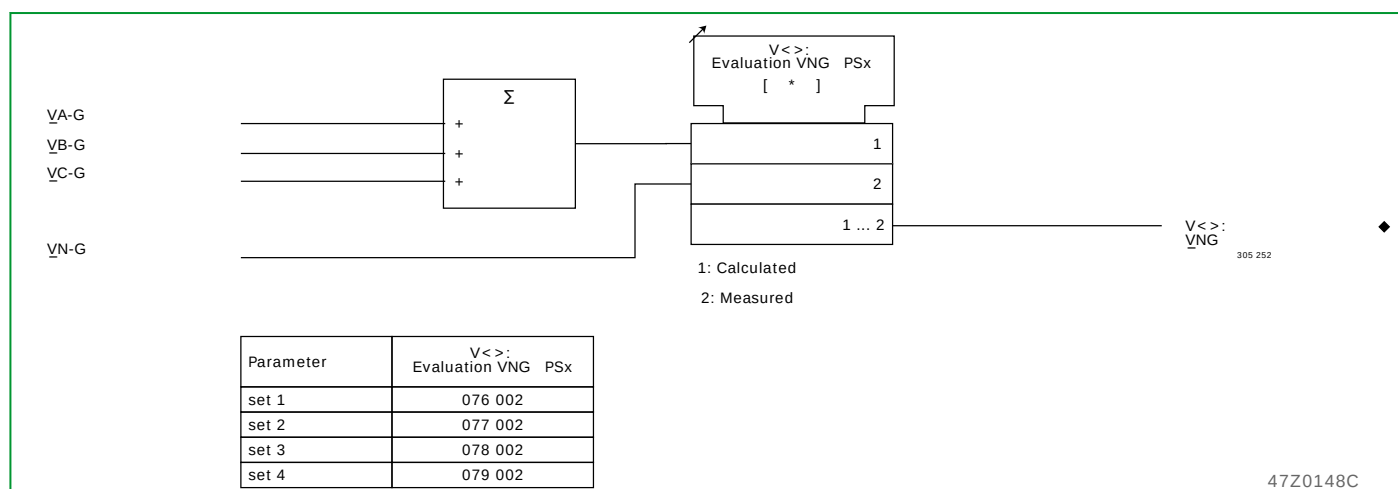


Fig. 3-346: Selecting the measured value.

Depending on the setting, the V<> function monitors either the neutral-point displacement voltage calculated by the P433 from the three phase-to-ground voltages or the neutral-point displacement voltage formed externally via the fourth voltage measuring input, for example the neutral-point displacement voltage from the open delta winding of the voltage transformers (see [Section 3.13, \(p. 3-91\)](#)).

The neutral-point displacement voltage is monitored to determine whether it exceeds set thresholds. This monitoring can be based either on the (Fourier-filtered) fundamental or on the r.m.s. value. This can be set independently for each stage with the settings V<>: Meas. Value VNG> PSx, V<>: Meas. Value VNG>>PSx and V<>: Meas.Value VNG>>>PSx.

The triggers are followed by timer stages that can be blocked via appropriately configured binary signal inputs.

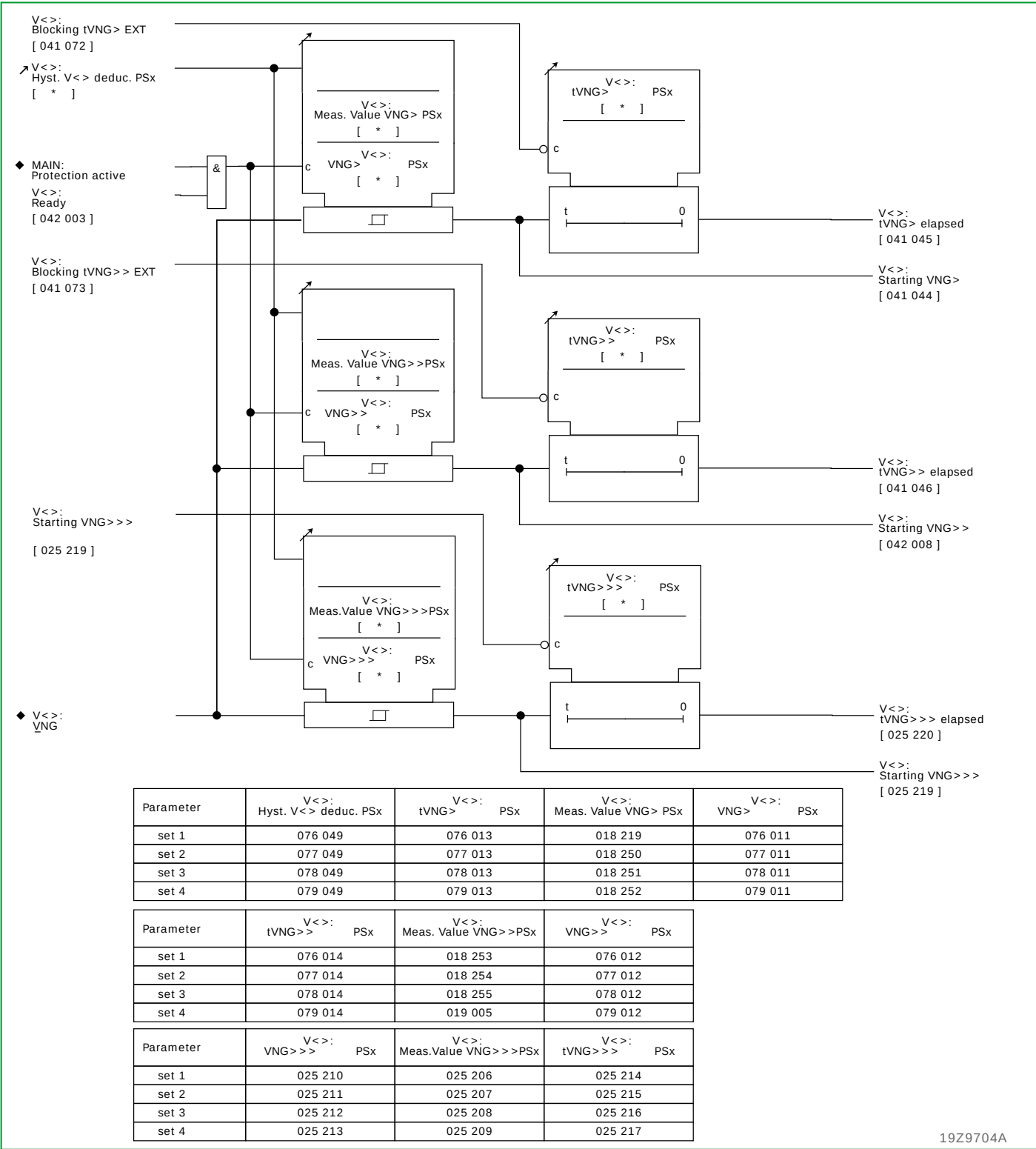


Fig. 3-347: Monitoring the neutral-point displacement voltage.

3.43.7 Monitoring the Reference Voltage

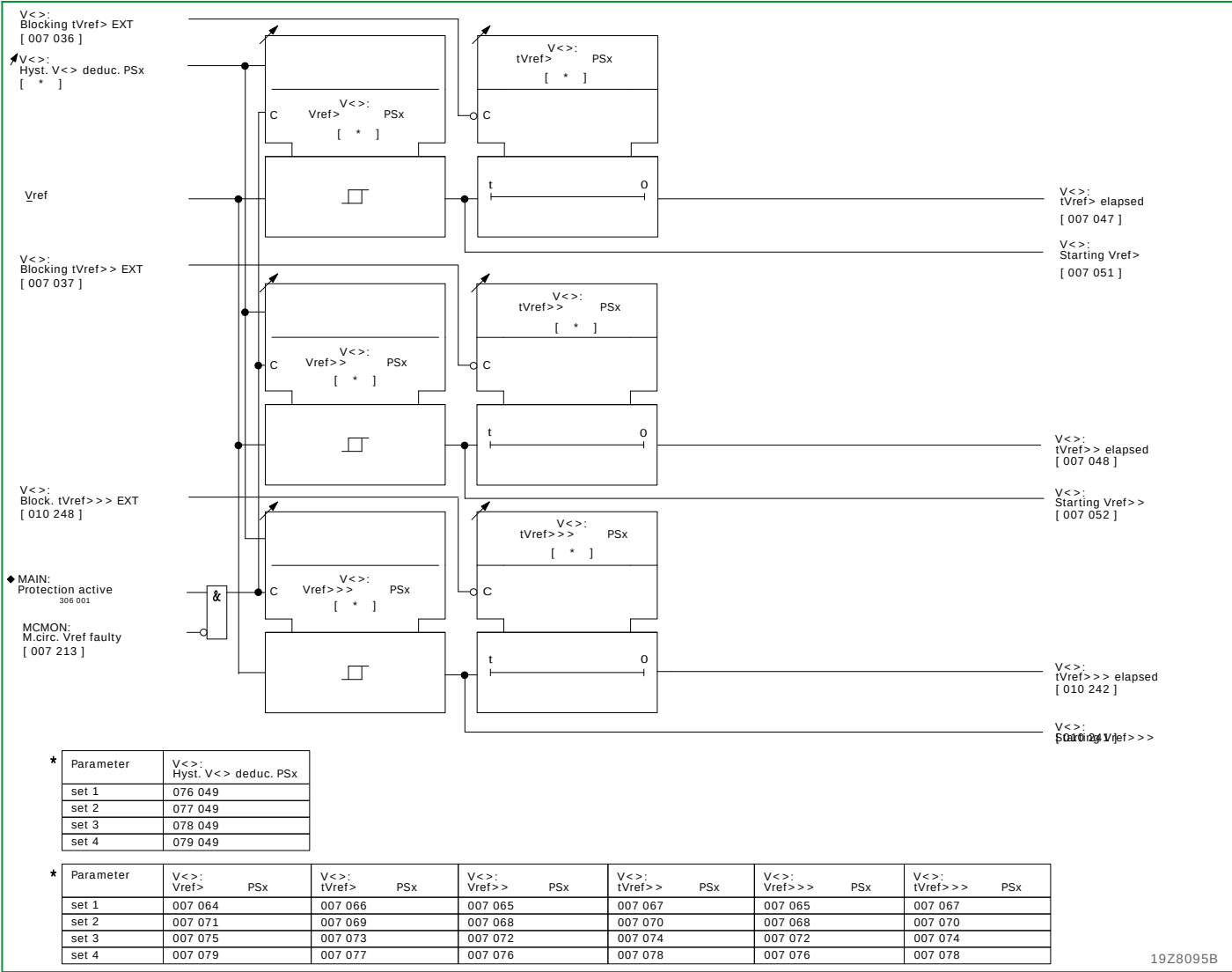


Fig. 3-348: Monitoring the reference voltage, part 1: stages Vref>/>>/>>>.

The reference voltage is monitored to determine whether it exceeds or falls below set thresholds. The triggers are followed by respective timer stages that can be blocked via appropriately configured binary signal inputs.

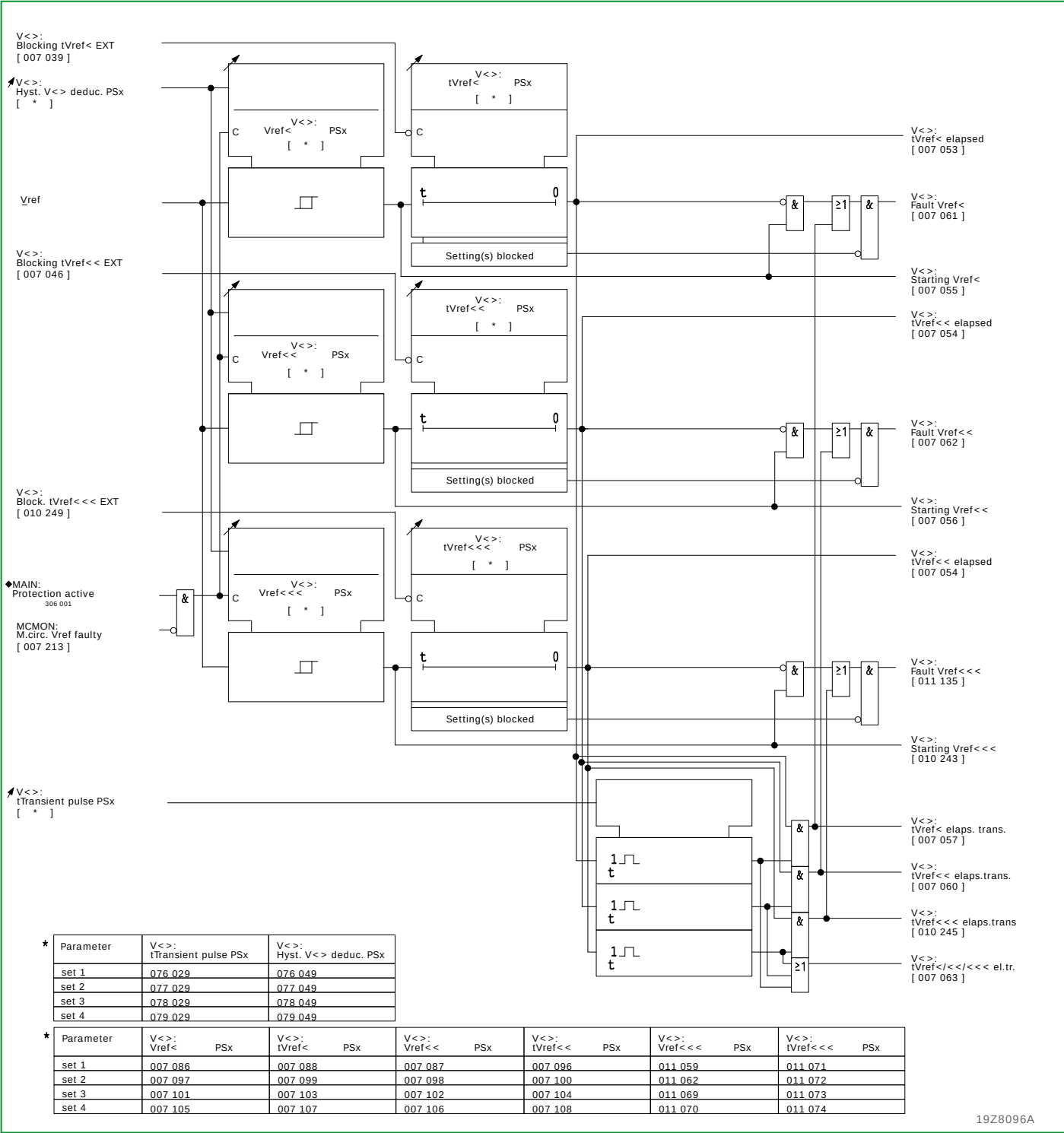


Fig. 3-349: Monitoring the reference voltage, part 2: stages Vref</<<<.

3.44 Over-/Underfrequency Protection (Function Group f<>)

The P433 monitors the voltage to determine whether it exceeds or falls below set frequencies.

The frequency is determined from the difference in time between the zero crossings of the voltage (voltage zeroes). The evaluation time and the measurement loop on which the frequency determination is based are settable. The evaluation is blocked if the voltage in the selected loop falls below a settable threshold, see [Section 3.13.6, \(p. 3-113\)](#).

The over-/underfrequency protection function has five stages. The operation of over-/underfrequency protection will be explained below using the first stage as an example.

3.44.1 Disabling or Enabling Over-/Underfrequency Protection

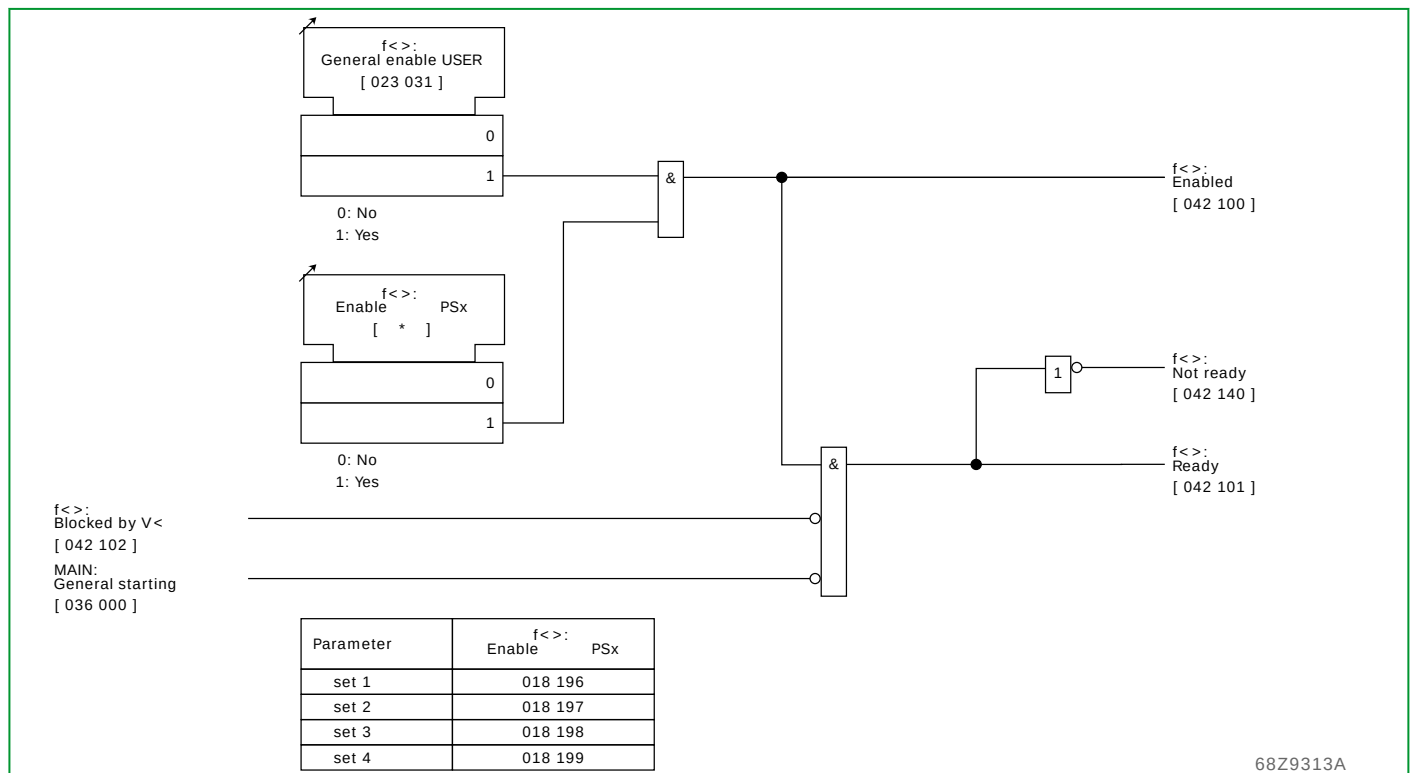


Fig. 3-350: Enabling, disabling and readiness of f<> protection.

The frequency protection can be disabled or enabled using setting parameters. Moreover, enabling can be carried out separately for each parameter subset.

3.44.2 Operating Modes of Over-/Underfrequency Protection

For each stage of the over-/underfrequency protection function, the user can choose between the following operating modes:

- Frequency monitoring
- Frequency monitoring combined with differential frequency gradient monitoring (df/dt)
- Frequency monitoring combined with mean frequency gradient monitoring ($\Delta f/\Delta t$)

3.44.3 Frequency Monitoring

Depending on the setting, the P433 monitors the frequency to determine whether it exceeds or falls below set thresholds. If an operate threshold in excess of the set nominal frequency is set, the P433 checks to determine whether the frequency exceeds the operate threshold. If an operate threshold below the set nominal frequency is set, the P433 checks to determine whether the frequency falls below the operate threshold. If it exceeds or falls below the set threshold, a set timer stage is started. The timer stage can be blocked by way of an appropriately configured binary signal input.

3.44.4 Frequency Monitoring Combined with Differential Frequency Gradient Monitoring (df/dt)

In this operating mode of the over-/ underfrequency protection function, the frequency is also checked to determine whether the set frequency gradient is reached (in addition to being monitored for exceeding or falling below the set threshold). Monitoring for overfrequency is combined with monitoring for a frequency increase; monitoring for underfrequency is combined with monitoring for a frequency decrease. If both operate conditions are satisfied, a set timer stage is started. The timer stage can be blocked by way of an appropriately configured binary signal input.

3.44.5 Frequency Monitoring Combined with Mean Frequency Gradient Monitoring ($\Delta f/\Delta t$)

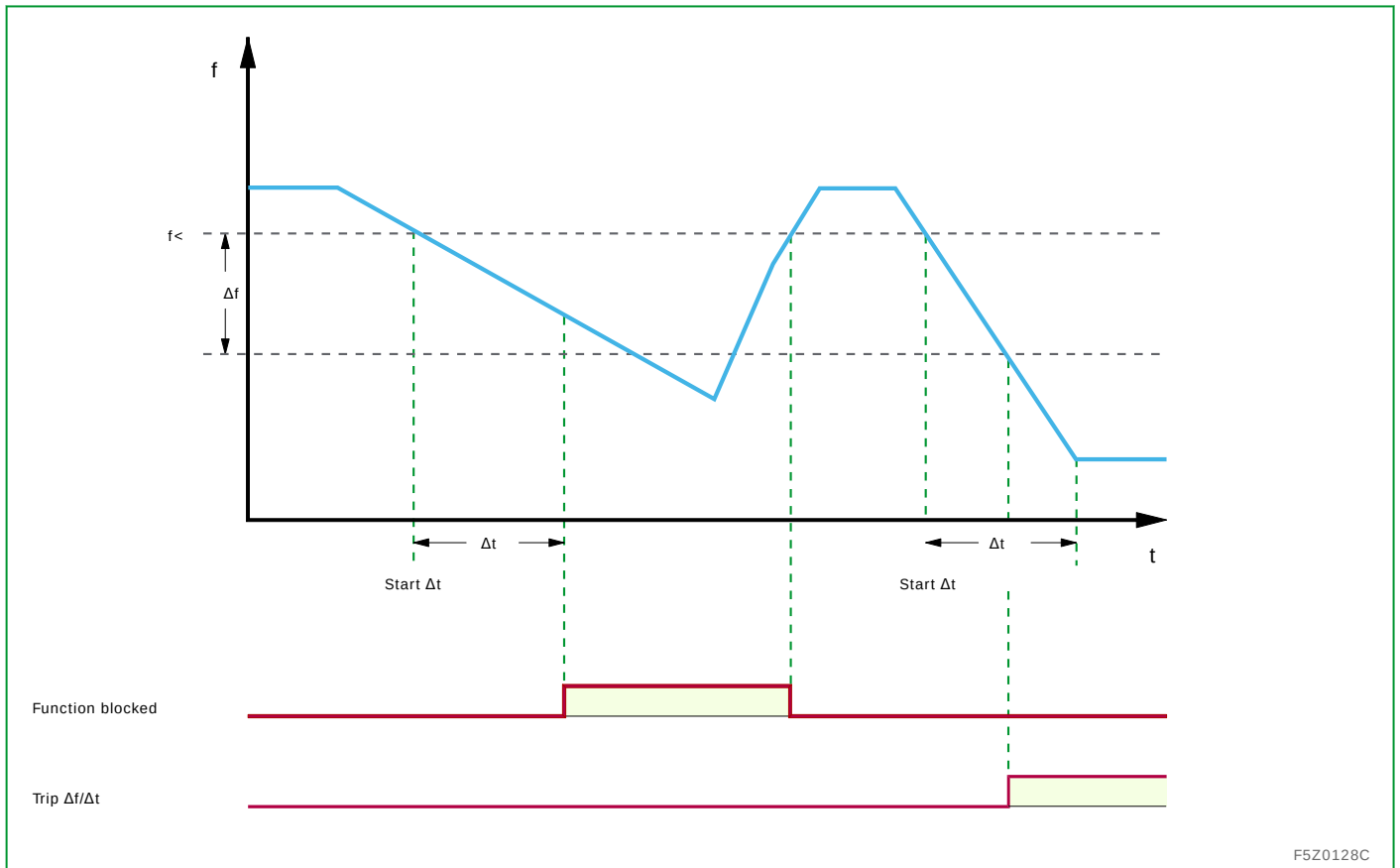


Fig. 3-351: Operation of frequency monitoring combined with $\Delta f/\Delta t$ monitoring.

The frequency gradient can differ for system disturbances in individual substations and may vary over time due to power swings. Therefore it makes

sense to take the mean value of the frequency gradient into account for load-shedding systems.

In this operating mode of over-/underfrequency protection, frequency monitoring must be set for “underfrequency monitoring”.

Monitoring the mean value of the frequency gradient is started with the starting of frequency monitoring. If the frequency decreases by the set value Δf within the set time Δt , then the $\Delta f/\Delta t$ monitoring function operates instantaneously and generates a trip signal. If a frequency change does not lead to an operate decision of the monitoring function, then the $\Delta f/\Delta t$ monitoring function will be blocked until the underfrequency monitoring function drops out. The trip signal can be blocked by way of an appropriately configured binary signal input.



Fig. 3-352: First stage of the over-/ underfrequency protection function.

3.44.6 $f_{\min}/f_{\max}$ Measurement

For the acquisition of the minimum frequency during an underfrequency condition and for the acquisition of the maximum frequency during an overfrequency condition, the two following measured event values are available:

- $f_{>}$: Max. frequ. for $f_{>}$
- $f_{<}$: Min. frequ. for $f_{<}$

Both measured event values are reset automatically at the onset of a new overfrequency or underfrequency situation. A manual reset is also possible:

- $f_{<}$: Reset meas.val. USER

3.45 Underfrequency Load Shedding Protection (Function Group Pf<)

Underfrequency load shedding is used to prevent an electrical network from outages (blackouts). If the system frequency is below a certain threshold, the connected loads are disconnected to prevent further frequency decay. The P433 monitors the frequency and active power to determine whether underfrequency load shedding will be operate.

The evaluation time and the measurement loop on which the frequency determination is based are settable. The evaluation is blocked if the voltage in the selected loop falls below a settable threshold, see [Section 3.13.6, \(p. 3-113\)](#).

The Pf< function has ten underfrequency stages. The operation of the Pf< function will be explained below using the first stage as an example.

3.45.1 Disabling or Enabling Pf< Protection

The underfrequency load shedding protection can be disabled or enabled using setting parameters. Moreover, enabling can be carried out separately for each parameter subset.

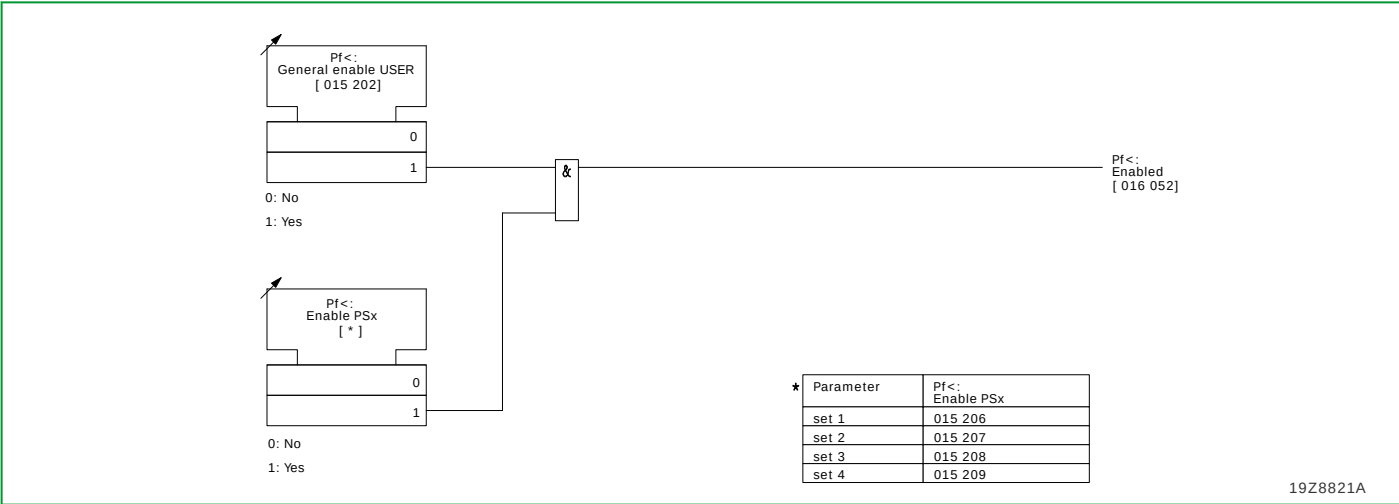


Fig. 3-353: Enabling or disabling Pf< protection.

3.45.2 Pf< Readiness and Blocking

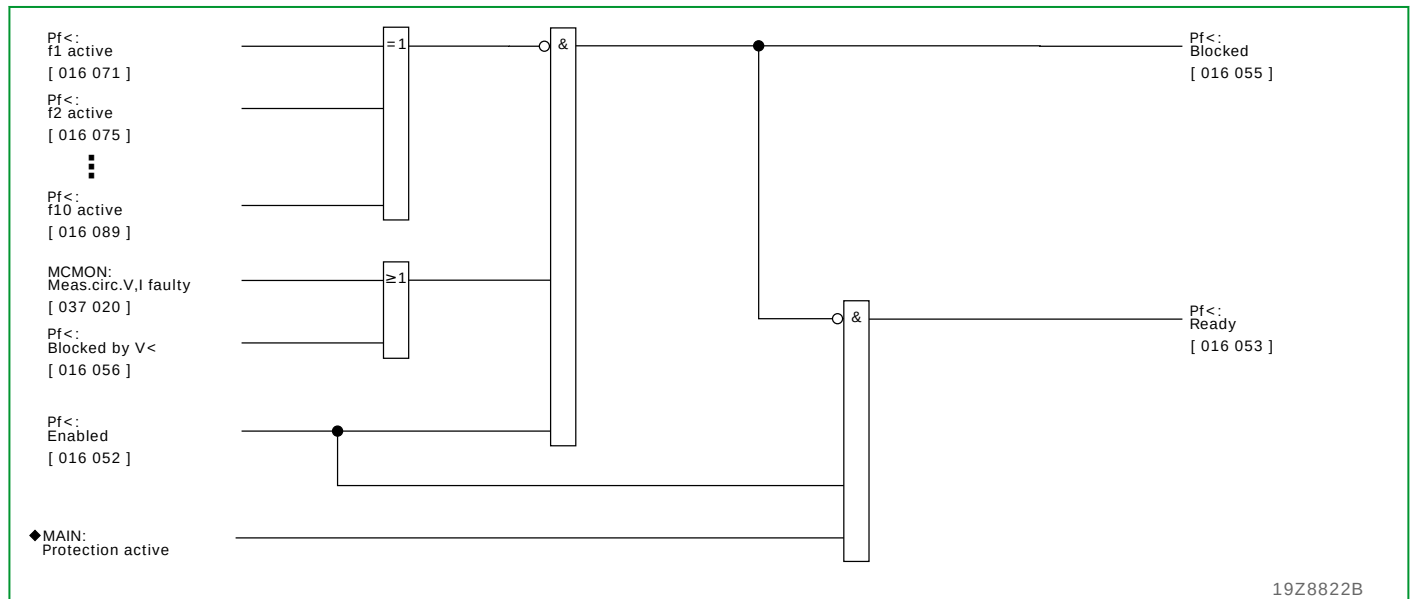


Fig. 3-354: Pf< readiness and blocking.

The frequency calculation depends on the measured voltages. The active power calculation depends on the measured voltages and currents. Therefore the function group Pf< can only be configured in devices with voltage and current inputs.

Under certain conditions the Pf< will be blocked and the signal Pf<: Blocked will be issued, provided that one of the following conditions is met:

- Frequency measurement is not possible. Pf<: Blocked by V< is issued.
- A voltage or current measuring circuits defect has been identified (by internal functions MCMON: Meas.circ.V,I faulty).
- No frequency stage has been activated.

Pf< protection can only start if the Pf< is ready. For the purpose the following conditions need to be met simultaneously:

- Protection is activated (on).
- Pf< is enabled.
- Pf< is not blocked.

3.45.3 Active Power Characteristic

The Pf< function monitors the system frequency and active power.

If the frequency drops below the active threshold the active power is evaluated.

The active power check is bypassed, if Pf<: Pmin PSx is set to blocked. Then underfrequency load shedding will operate evaluating frequency threshold only.

The directional active power decision blocks Pf<: Trip signal Pf<, if all 3 following conditions are present, as sketched in [Fig. 3-355](#), (p. 3-434):

- All three phase currents exceed $Pf < : I_{min} PSx$.
- The active power is above $Pf < : P_{min} PSx$.
- The angle of the apparent power is within the set $Pf < : \text{Sector angle } PSx$ for the set operation direction. (Power direction check see [Section 10.2.7, \(p. 10-10\)](#))

For forward directional setting: $-90^\circ + \varphi \leq \varphi_S \leq 90^\circ - \varphi$

For backward directional setting:

$90^\circ + \varphi \leq \varphi_S \leq 180^\circ$ or $-180^\circ \leq \varphi_S \leq -90^\circ - \varphi$

Sector angle: φ

Measured apparent power angle: φ_S

$Pf < :$ Starting $Pf < :$ is released, if no blocking by active power is evaluated.

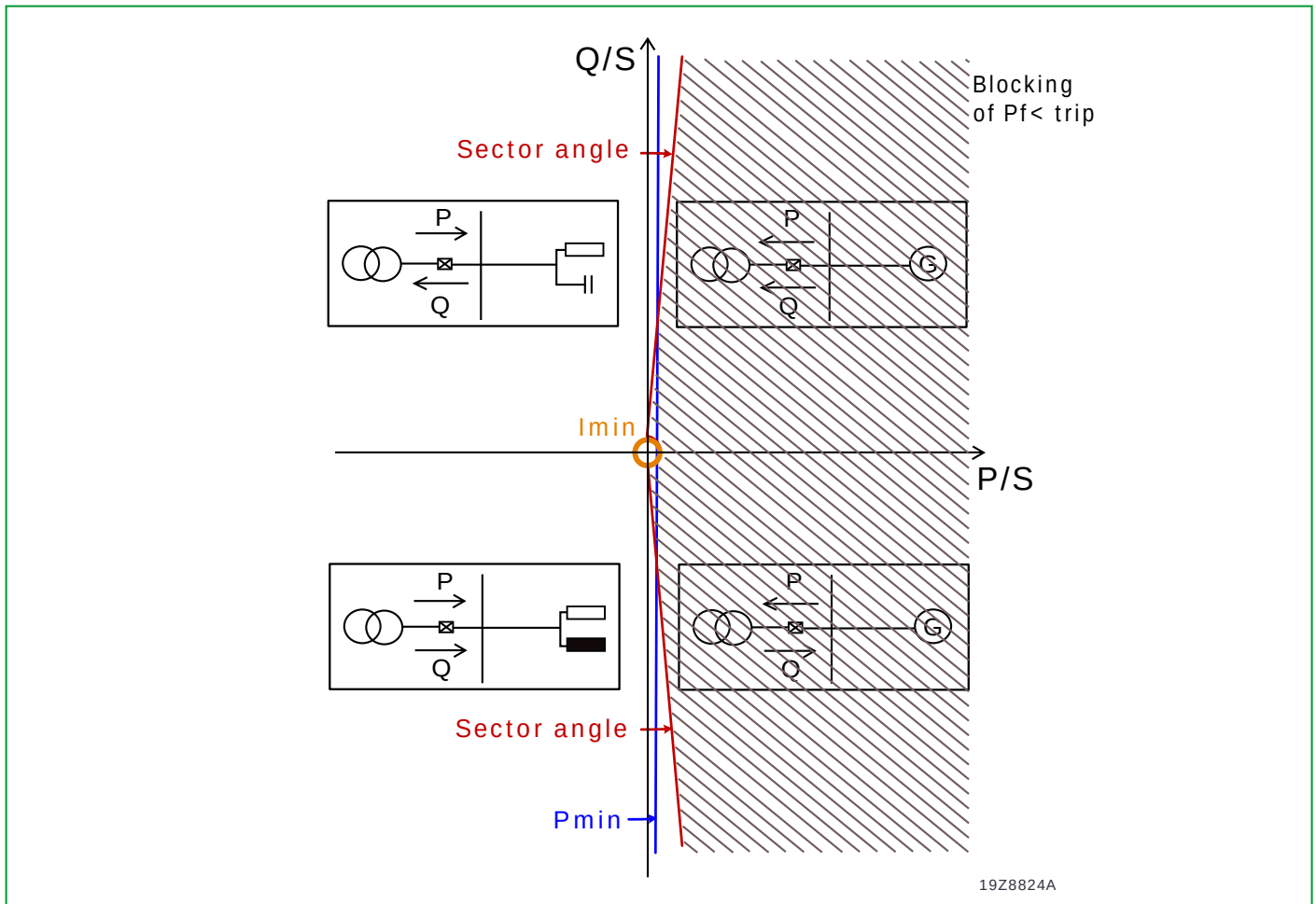
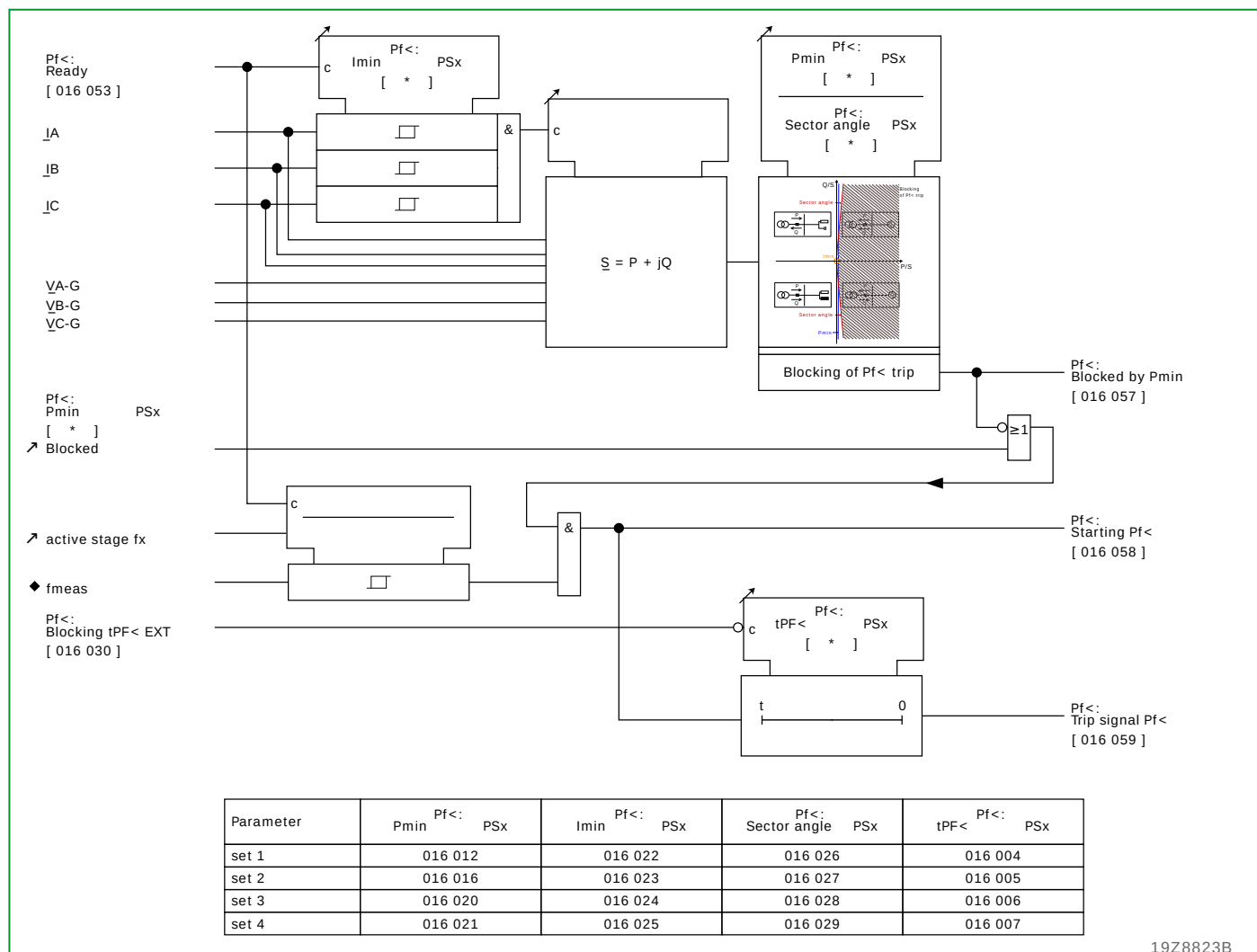


Fig. 3-355: Blocking of forward directional active power.

If the active power check generates a trip enabling decision then the starting of the underfrequency stage triggers the timer stage (016 004) $Pf < : tPF < PSx$. After the timer has elapsed the trip signal (016 059) $Pf < :$ Trip signal $Pf < :$ is issued. The timer stage can be blocked by the binary input signal (016 030) $Pf < : \text{Blocking } tPF < EXT$. Moreover, it is reset if the underfrequency decision or the active power decision is dropped.



19Z8823B

Fig. 3-356: Pf< tripping logic.

3.45.4

Remote and Local Choice of Active Frequency Stage

The active frequency stage can be selected using local inputs (e. g. function keys, binary inputs) or using remote access via communication (e. g. IEC 60870-5-103 controls, IEC 61850 GOOSE, ...).

The rising edge of an “Activate”-signal Pf<: Activate fx EXT or execution of a Pf<: Trigger fx command will trigger the activation. A permanently active binary input signal does not affect the selection. This is also true if there is already any number of “Activate”-signals present, i. e. only the last rising edge is processed. Only if several frequency stages get selected via binary inputs at the same time then all these selections are ignored and the last correctly enabled stage remains active.

In the same way does the rising edge of the input signal (016 051)

Pf<: Deactivate fn EXT or execution of the command (016 200)

Pf<: Trigger Deactivate deselect the selection, with the consequence that then no frequency stage is active and the signal (016 055) Pf<: Blocked is issued.

The information about the active stage is permanently stored by the P433 (i. e. in non-volatile memory) so that it gets activated again automatically after a warm restart.

3.46 Directional Power Protection (Function Group P<>)

The power directional protection function determines the active and reactive power from the fundamental currents and voltages. The sign of the active or the reactive power, respectively, is evaluated for direction determination

3.46.1 Disabling and Enabling P<> Protection

The power directional protection can be disabled or enabled via setting parameters. Moreover, enabling can be carried out separately for each parameter subset.

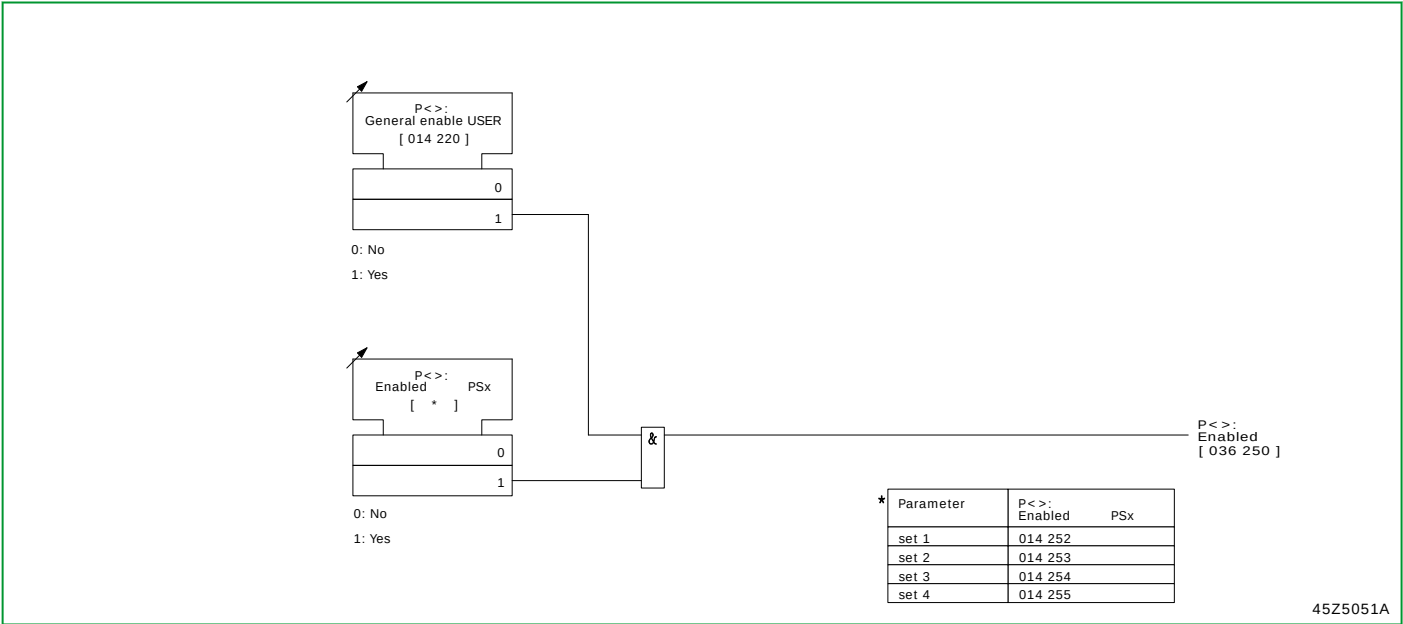


Fig. 3-357: Enabling or disabling power directional protection.

3.46.2 Power Determination

The P433 determines the active and reactive power from the three phase currents and the phase-to-ground voltages. If the measuring-circuit monitoring function detects malfunctioning in the voltage measuring circuit, power determination will be blocked.

3.46.3 Power Monitoring

The P433 checks the determined power values to detect whether they exceed or fall below set thresholds. The triggers are followed by timer stages that can be blocked via appropriately configured binary signal inputs.

If the decisions of power monitoring are to be included in the trip commands when values have fallen below set thresholds, then it is recommended that transient signals be used. Otherwise the trip command would always be present when the system voltage was disconnected, and it would therefore not be possible to close the circuit breaker again.

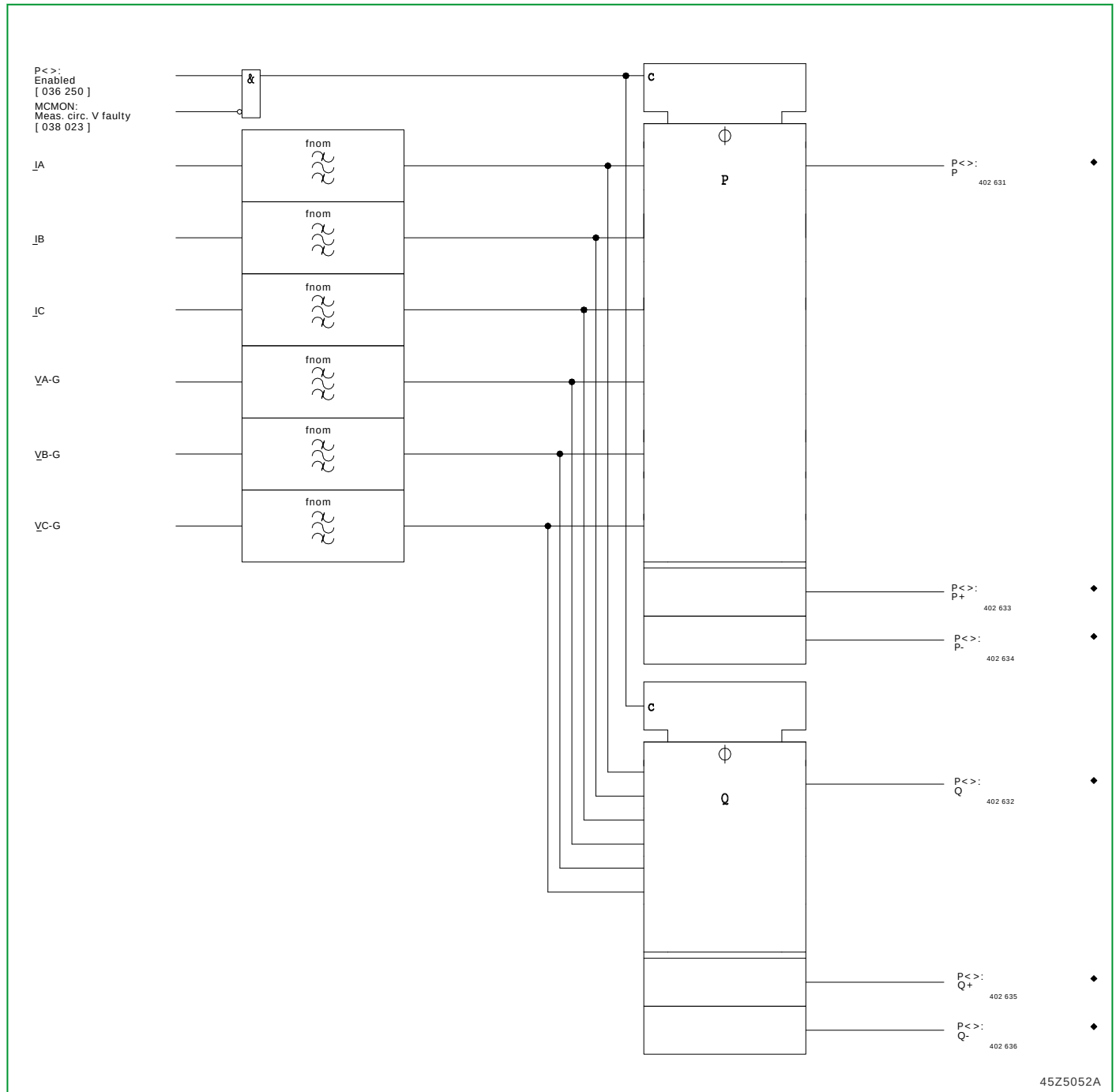


Fig. 3-358: Power determination.

3.46.4 Active Power P> Starting

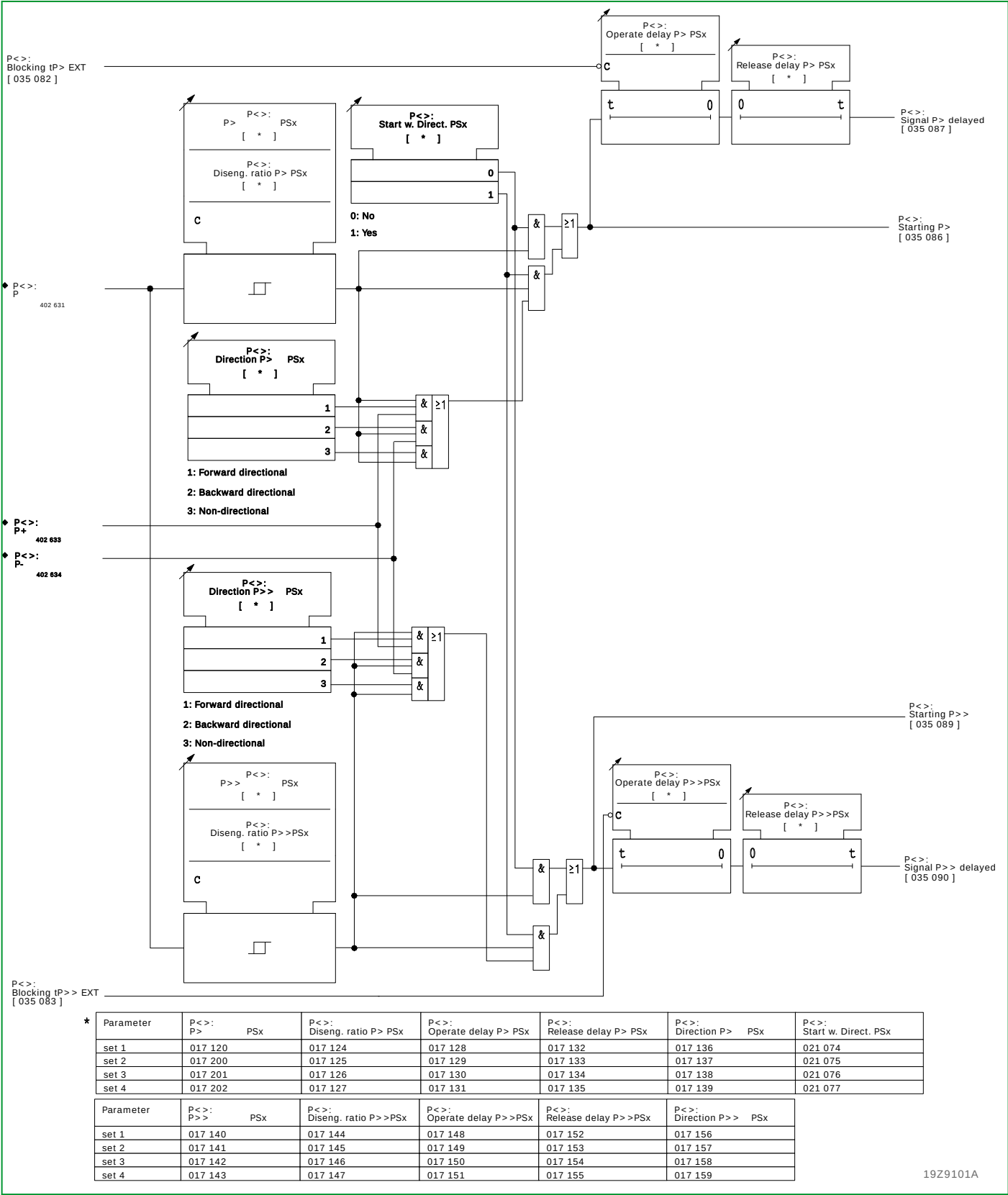


Fig. 3-359: Active power monitoring when the set thresholds are exceeded.

The P433 monitors the active power with two-stage functions to detect when it exceeds the set thresholds. The resetting ratio of the threshold stages can be set.

When the active power exceeds the set thresholds, a starting signal depends on the P<>: Start w. Direct. PSx. If P<>: Start w. Direct. PSx is set to yes, measured direction should match the set direction, or the starting signal will not issued. The starting signal is followed by the set operate and resetting delays.

3.46.5 Active Power P> Tripping

The P433 determines the sign of the active power. If the sign is positive, a forward-directional decision is issued; if it is negative, a backward- (reverse-) directional decision results. A setting determines whether a trip signal is triggered by a forward-directional, a backward- (reverse-) directional or a non-directional decision.

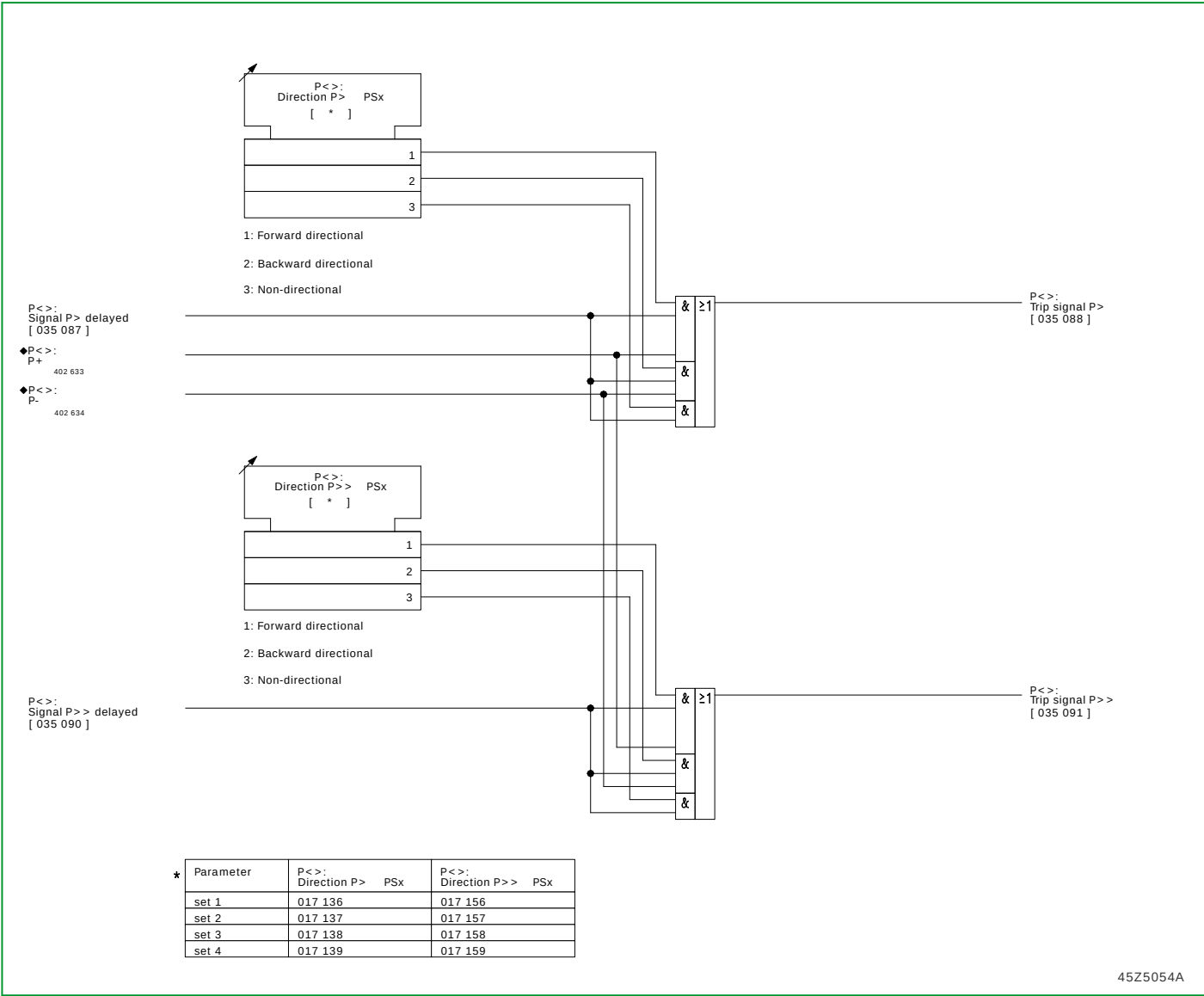


Fig. 3-360: Direction-dependent trip signal of the active power protection function when the set thresholds are exceeded.

3.46.6 Reactive Power Q> Starting

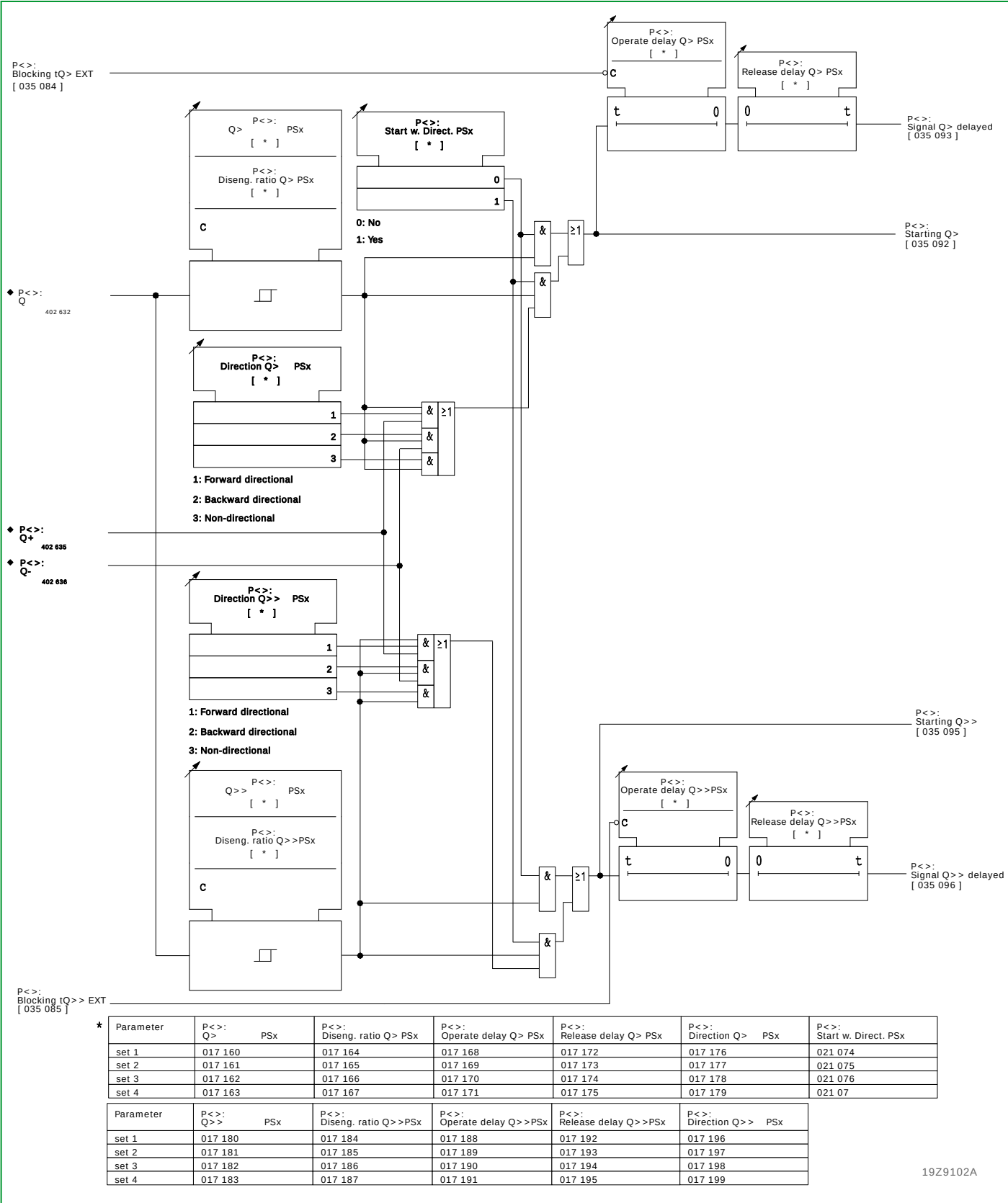


Fig. 3-361: Reactive power monitoring when the set thresholds are exceeded.

The P433 monitors the reactive power with two-stage functions to detect when it exceeds the set thresholds. The resetting ratio of the threshold stages can be set.

When the reactive power exceeds the set thresholds, a starting signal depends on the $P<>: \text{Start w. Direct. PSx}$. If $P<>: \text{Start w. Direct. PSx}$ is set to yes, measured direction should match the set direction, or the starting signal will not issued. The starting signal is followed by the set operate and resetting delays.

3.46.7 Reactive Power Q> Tripping

The P433 determines the sign of the reactive power. If the sign is positive, a forward-directional decision is issued; if it is negative, a backward- (reverse-) directional decision results. A setting determines whether a trip signal is triggered by a forward-directional, a backward- (reverse-) directional or a non-directional decision.

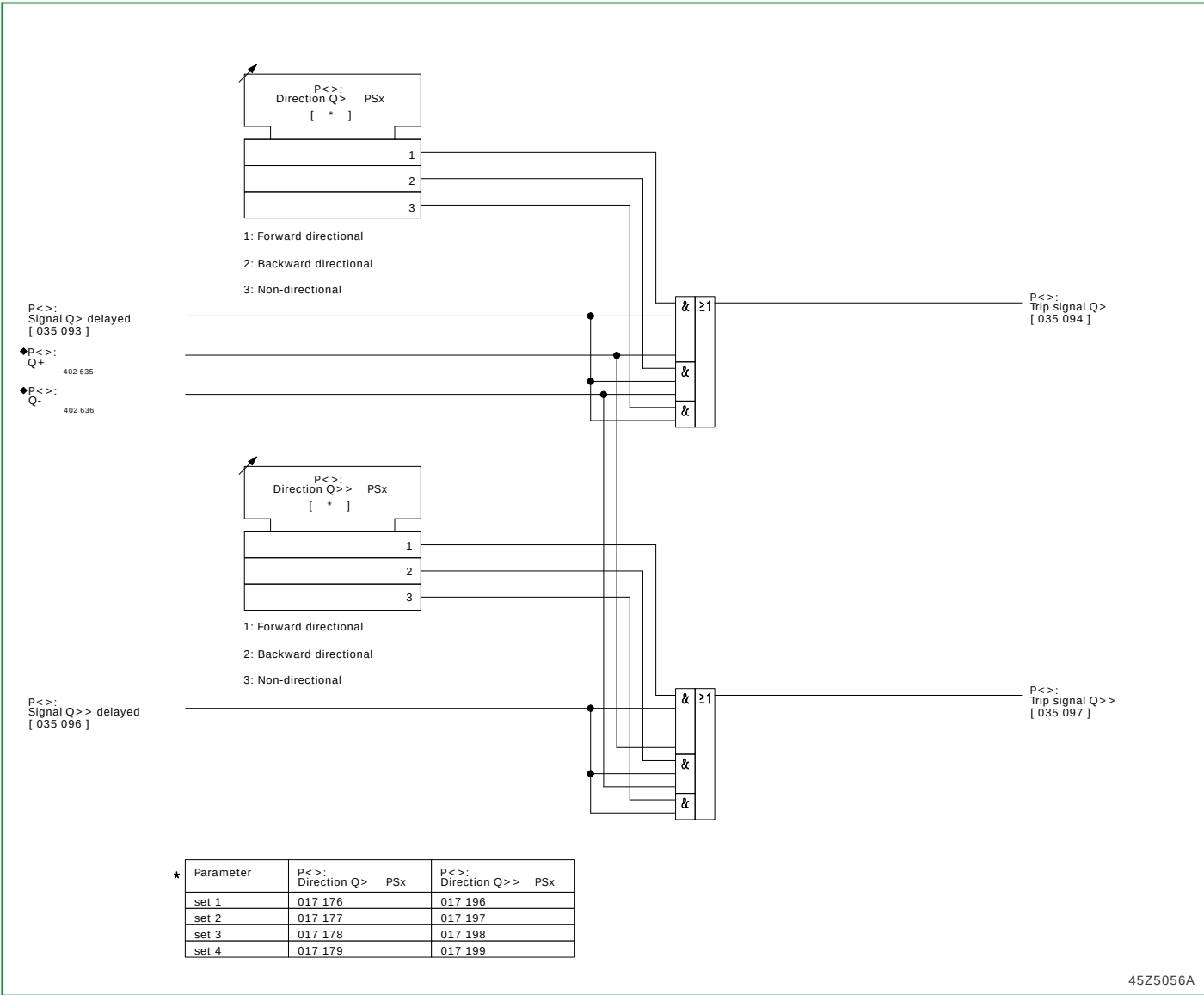


Fig. 3-362: The direction-dependent trip signal of the reactive power protection function when the set thresholds are exceeded.

3.46.8 Active Power P< Starting

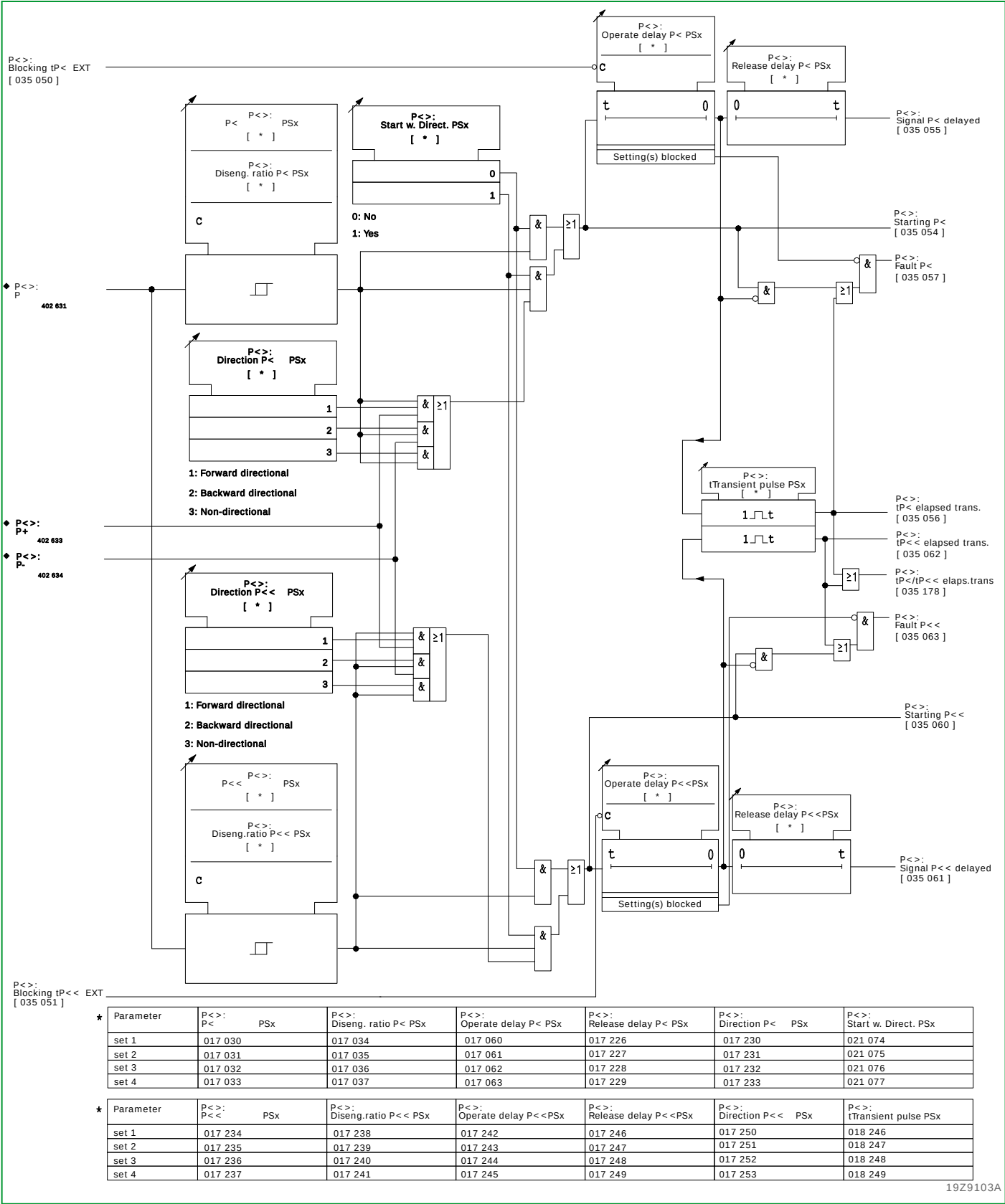


Fig. 3-363: Active power monitoring when values fall below set thresholds.

The P433 monitors the active power with two-stage functions to detect when it falls below the set thresholds. The resetting ratio of the threshold stages can be

set. When the active power falls below the set thresholds, a starting signal depends on the P<>: Start w. Direct. PSx. If P<>: Start w. Direct. PSx is set to yes, measured direction should match the set direction, or the starting signal will not issued. The starting signal is followed by the set operate and resetting delays.

3.46.9 Active Power P< Tripping

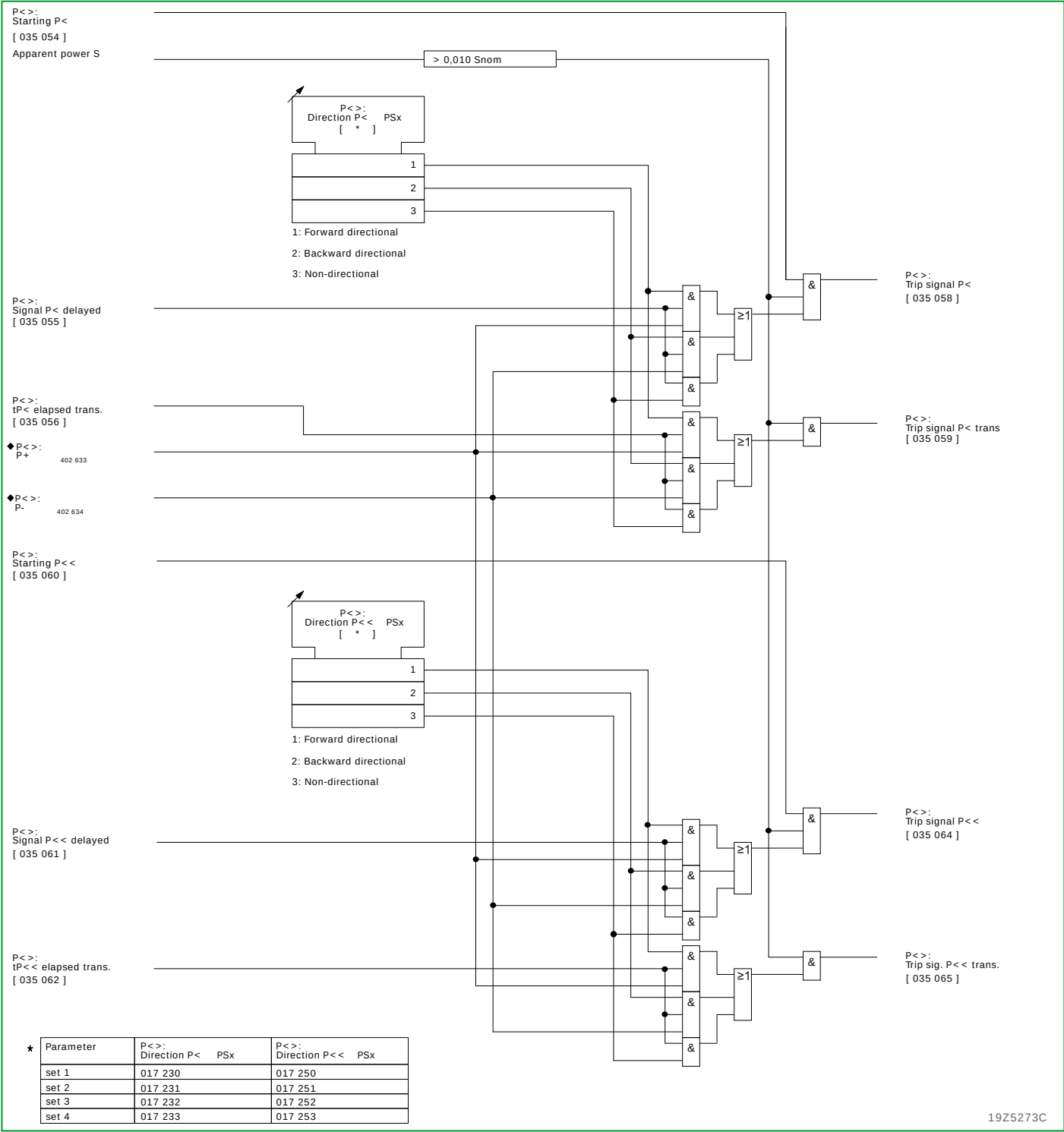


Fig. 3-364: The direction-dependent trip signal of the active power protection function when values fall below set thresholds.

The P433 determines the sign of the active power. If the sign is positive, a forward-directional decision is issued; if it is negative, a backward- (reverse-)

directional decision results. A setting determines whether a trip signal is triggered by a forward-directional, a backward- (reverse-) directional or a non-directional decision.

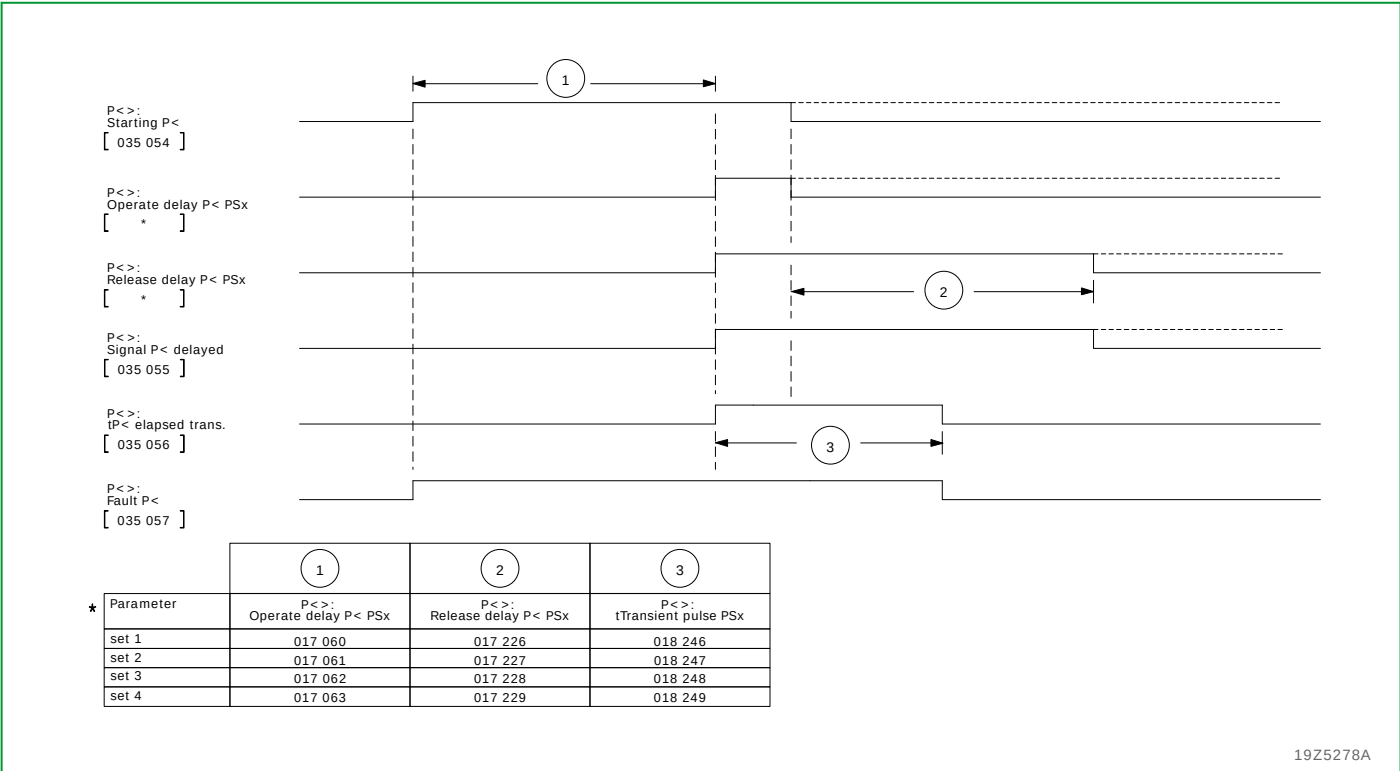


Fig. 3-365: Performance of the transient signal and the fault signal issued by the active power monitoring.

3.46.10 Reactive Power Q< Starting

The P433 monitors the reactive power with two-stage functions to detect when it falls below the set thresholds. The resetting ratio of the threshold stages can be set.

When the reactive power falls below the set thresholds, a starting signal depends on the P<>: Start w. Direct. PSx. If P<>: Start w. Direct. PSx is set to yes, measured direction should match the set direction, or the starting signal will not issued. The starting signal is followed by the set operate and resetting delays.

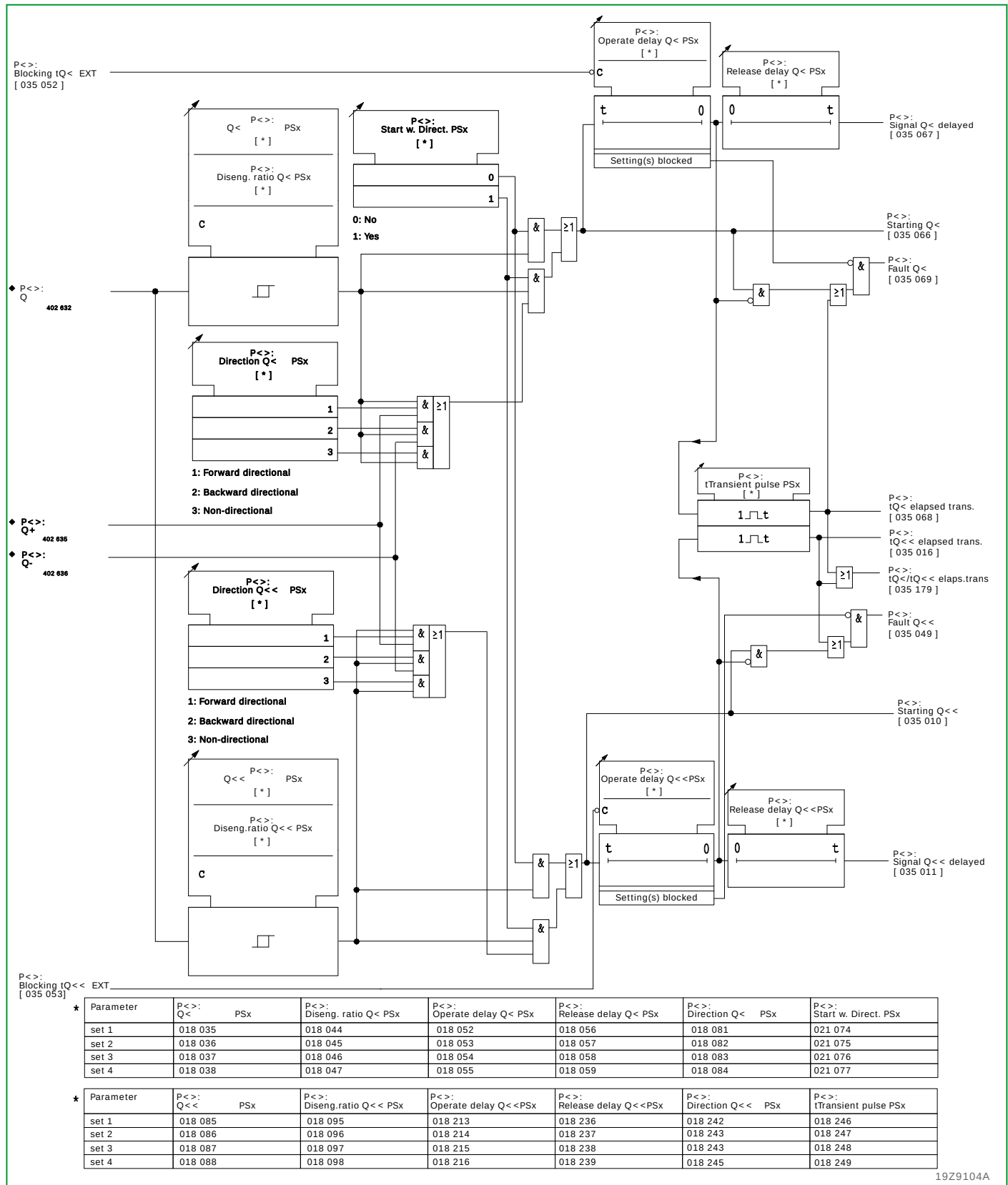


Fig. 3-366: Reactive power monitoring when values fall below set thresholds.

3.46.11 Reactive Power $Q<$ Tripping

The P433 determines the sign of the reactive power. If the sign is positive, a forward-directional decision is issued; if it is negative, a backward- (reverse-) directional decision results. A setting determines whether a trip signal is

triggered by a forward-directional, a backward- (reverse-) directional or a non-directional decision.

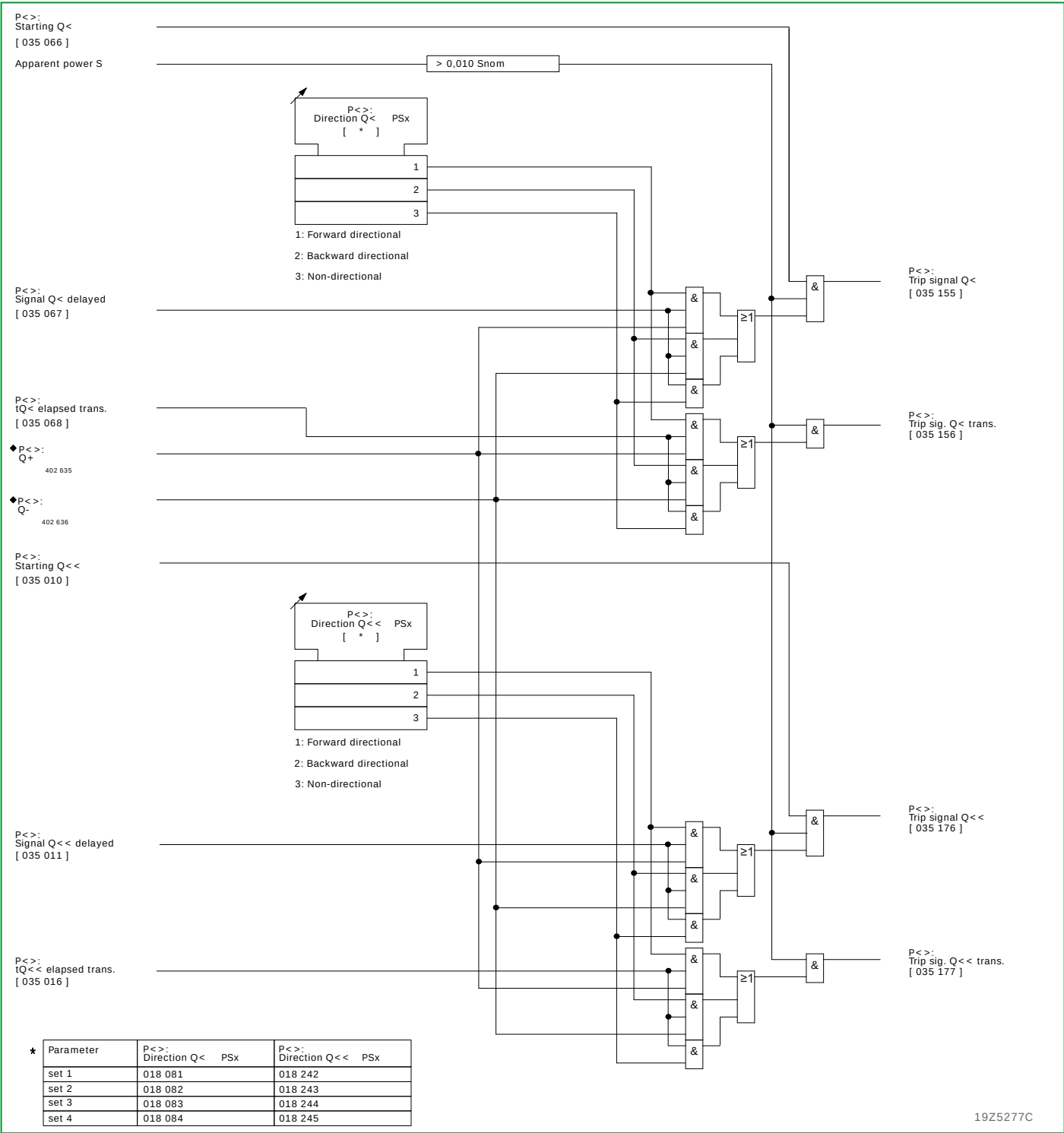


Fig. 3-367: Direction-dependent trip signal of the reactive power protection function when values fall below set thresholds.

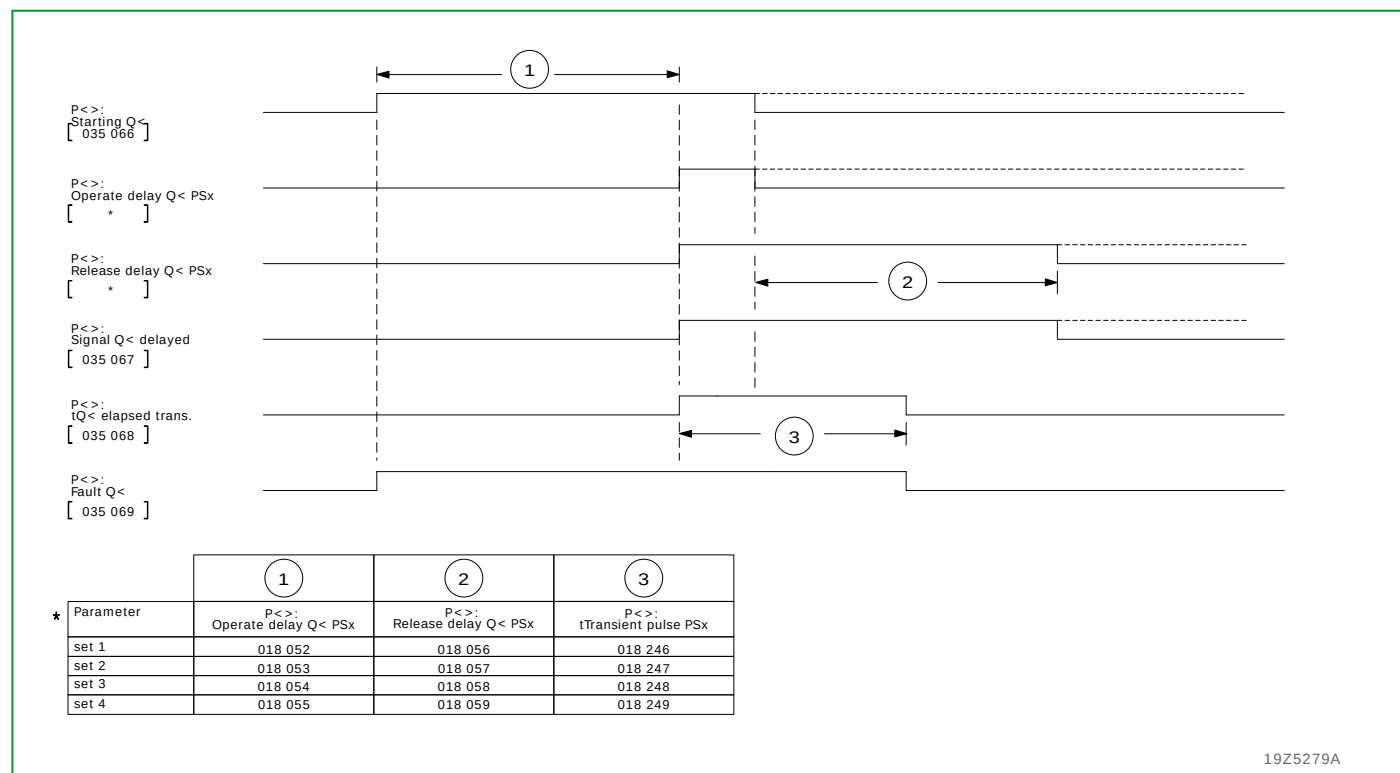


Fig. 3-368: Performance of the transient signal and the fault signal issued by the reactive power monitoring.

3.46.12 Direction Signaling

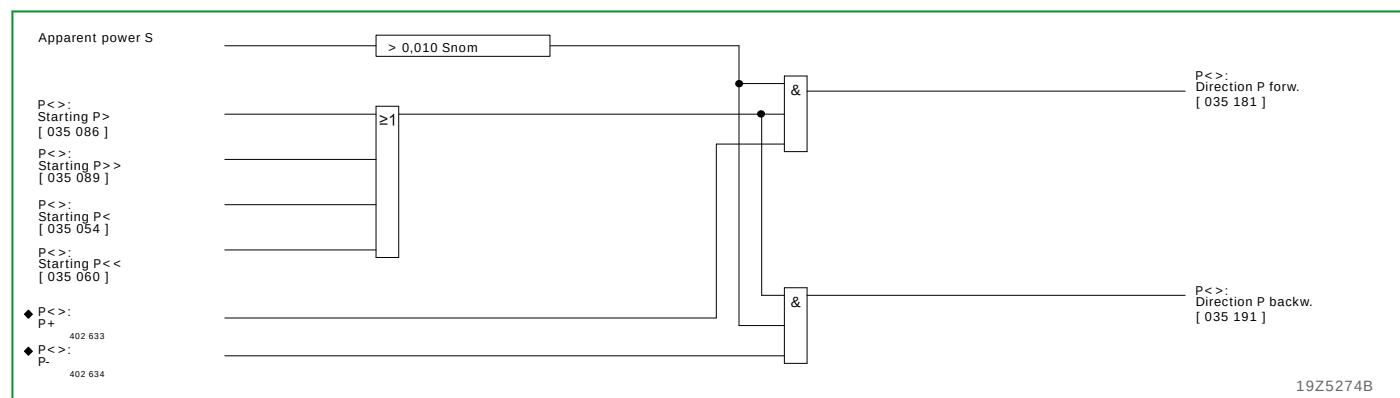


Fig. 3-369: Directional starting signal issued by the active power monitoring.

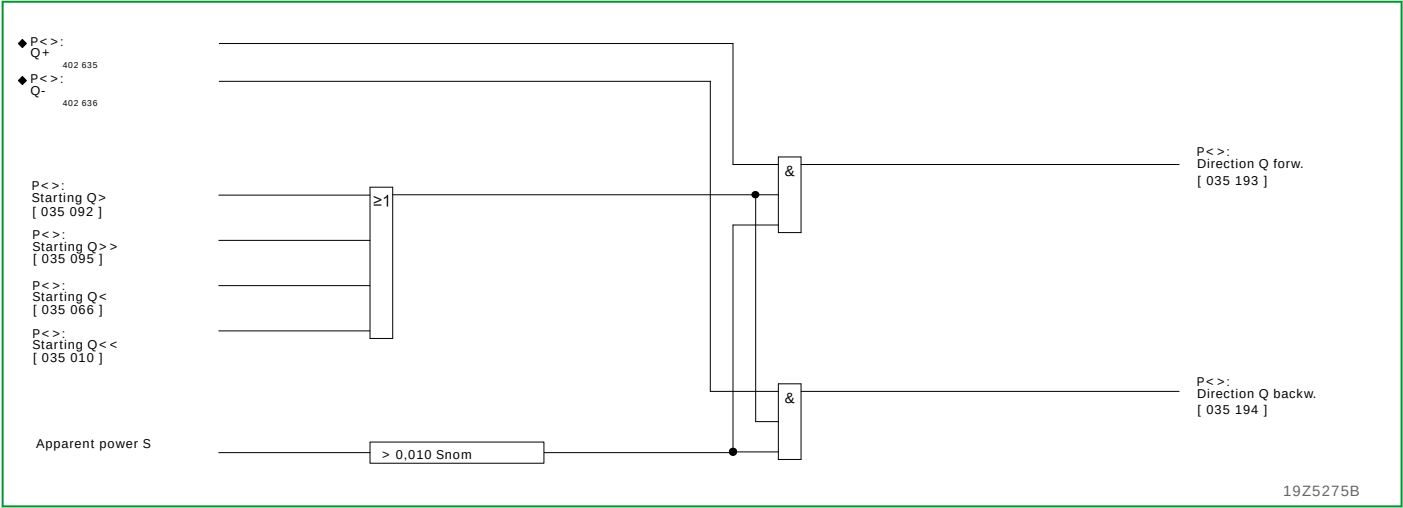


Fig. 3-370: Directional starting signal issued by the reactive power monitoring.

3.47 Voltage Controlled Directional Reactive Power Protection (Function Group QV)

QV protection is carried out by evaluating the directional reactive power and three phase-phase voltages. The function provides delayed disconnection from the power system and thus allows temporary support by means of longer feed-in on a defective power system. It is a disconnection protection system which not only takes into account voltage and current, but also assesses the reactive power direction of the distributed generation plant.

3.47.1 Disabling and Enabling QV Protection

The QV protection can be disabled or enabled via setting parameters. Moreover, enabling can be carried out separately for each parameter subset.

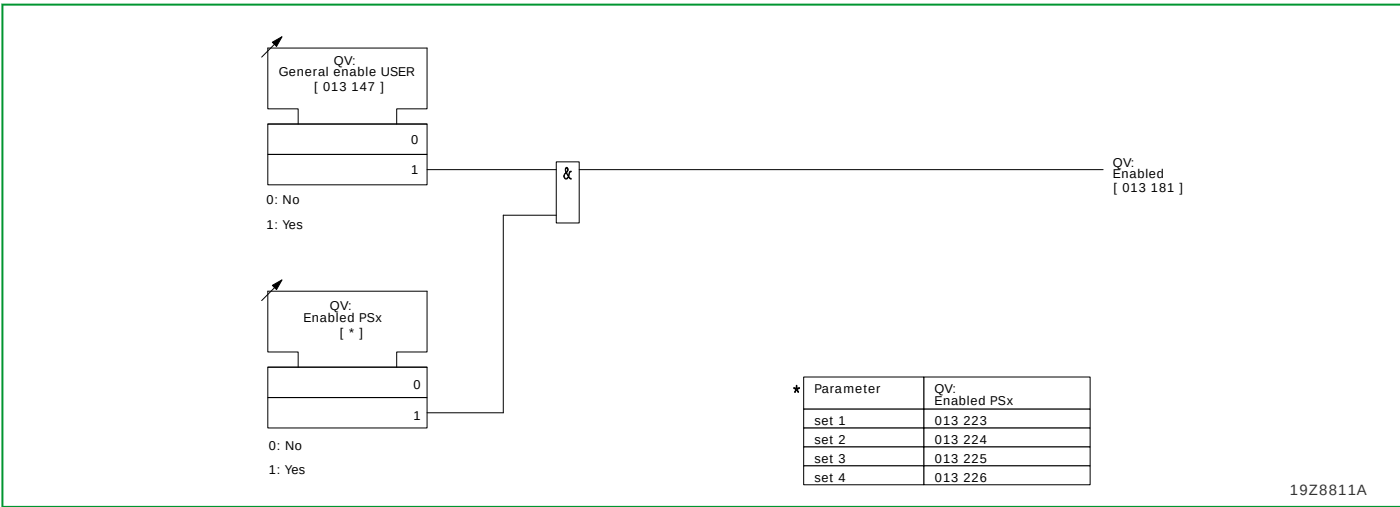


Fig. 3-371: Enabling or disabling QV protection.

3.47.2 QV Readiness and Blocking

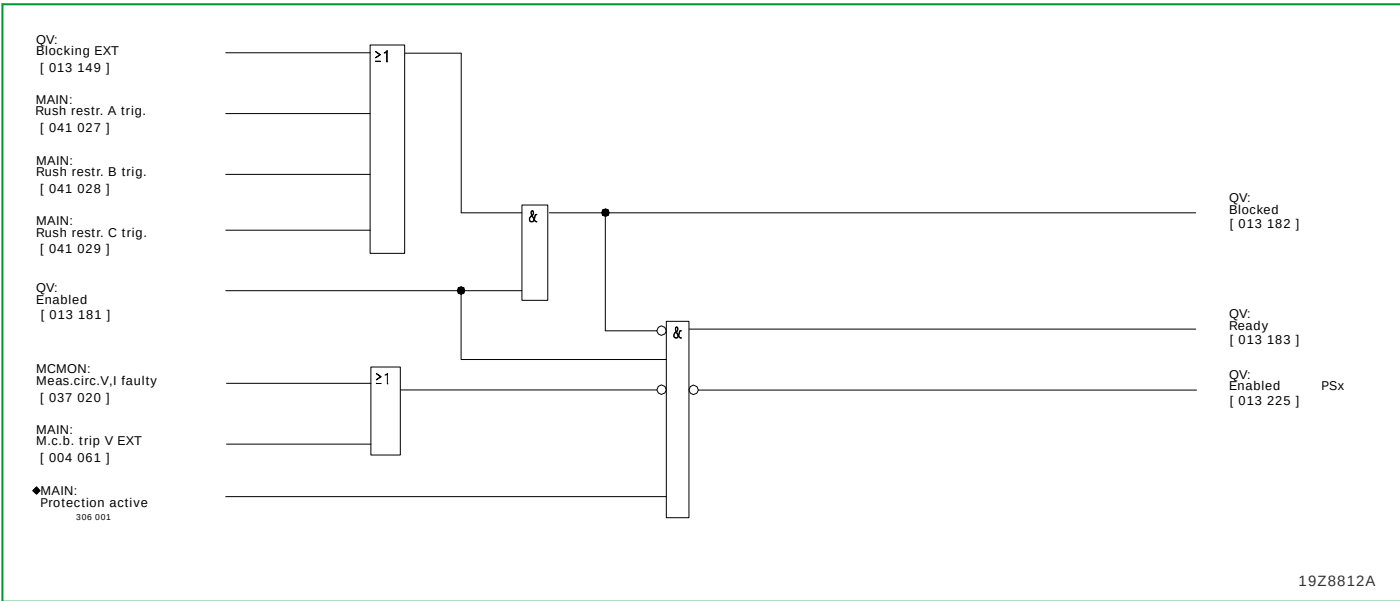


Fig. 3-372: QV readiness and blocking.

Under certain conditions the QV will be blocked and the signal QV: Blocked will be issued, provided that one of the following conditions is met:

- An external signal. QV: Blocking EXT is present.
- Inrush stabilization (QV protection should be selected in the list of MAIN: Funct.Rush restr.PSx).

QV protection can only start if the QV is ready. For this purpose the following conditions need to be present simultaneously:

- Protection is activated (on).
- QV is enabled.
- QV is not blocked.
- No voltage or current measuring circuits defect is either identified (by internal functions MCMON: Meas.circ.V,I faulty) nor signaled (through MAIN: M.c.b. trip V EXT).

3.47.3 Phase-Phase Undervoltage Monitoring

QV function monitors all three phase-phase voltages with an undervoltage threshold. When all three voltages drop below the set threshold, QV: Starting $V < 3p$ is issued. The resetting ratio of the threshold can be set.

3.47.4 Directional Reactive Power Characteristic

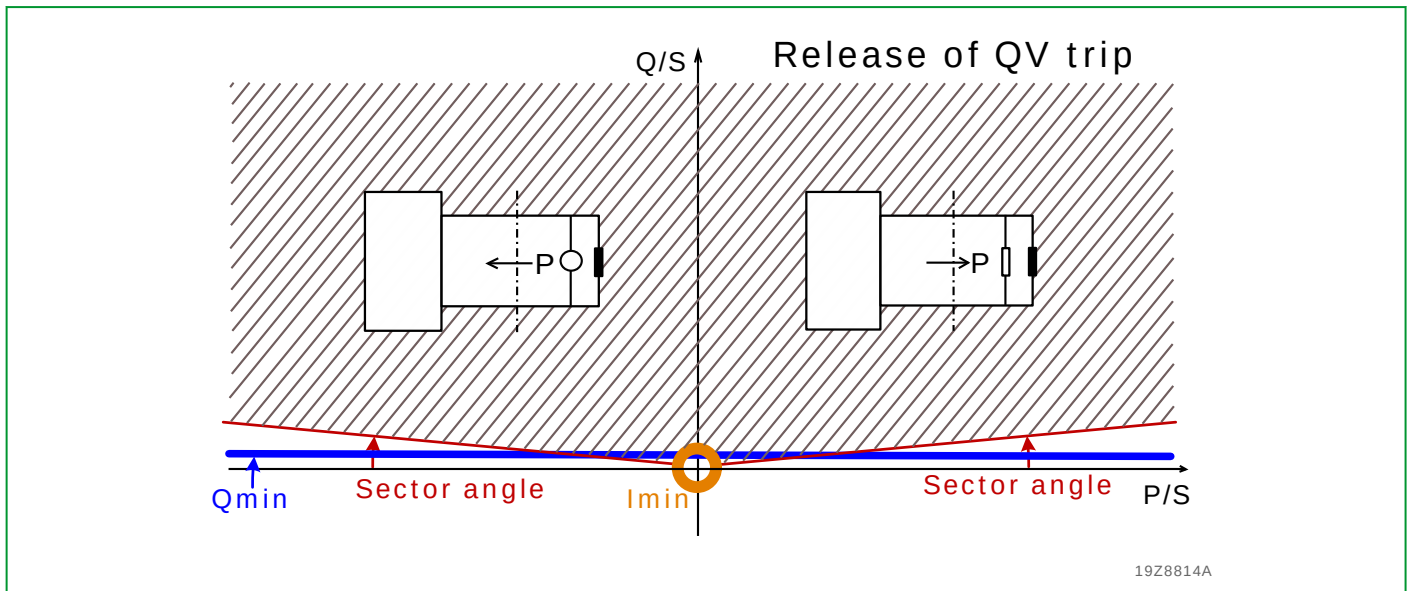


Fig. 3-373: Release of forward directional reactive power.

Reactive power is calculated based on all three phase currents and voltages. The reactive power threshold and reactive power flow are monitored to determine whether the reactive power is in operation area.

There are in total three conditions which must be present at the same time to release the directional reactive power condition.

- All three phase currents exceed QV: I_{min} PSx.
- The reactive power exceeds QV: Q_{min} PSx.
- The angle of the apparent power is within the set operation direction. (Power direction check see [Section 10.2.7, \(p. 10-10\)](#))

For forward directional setting: $\varphi \leq \varphi_S \leq 180^\circ - \varphi$

For backward directional setting: $-180^\circ + \varphi \leq \varphi_S \leq -\varphi$

with set sector angle: φ

Measured apparent power angle: φ_S

3.47.5 Timer and Trip Logic

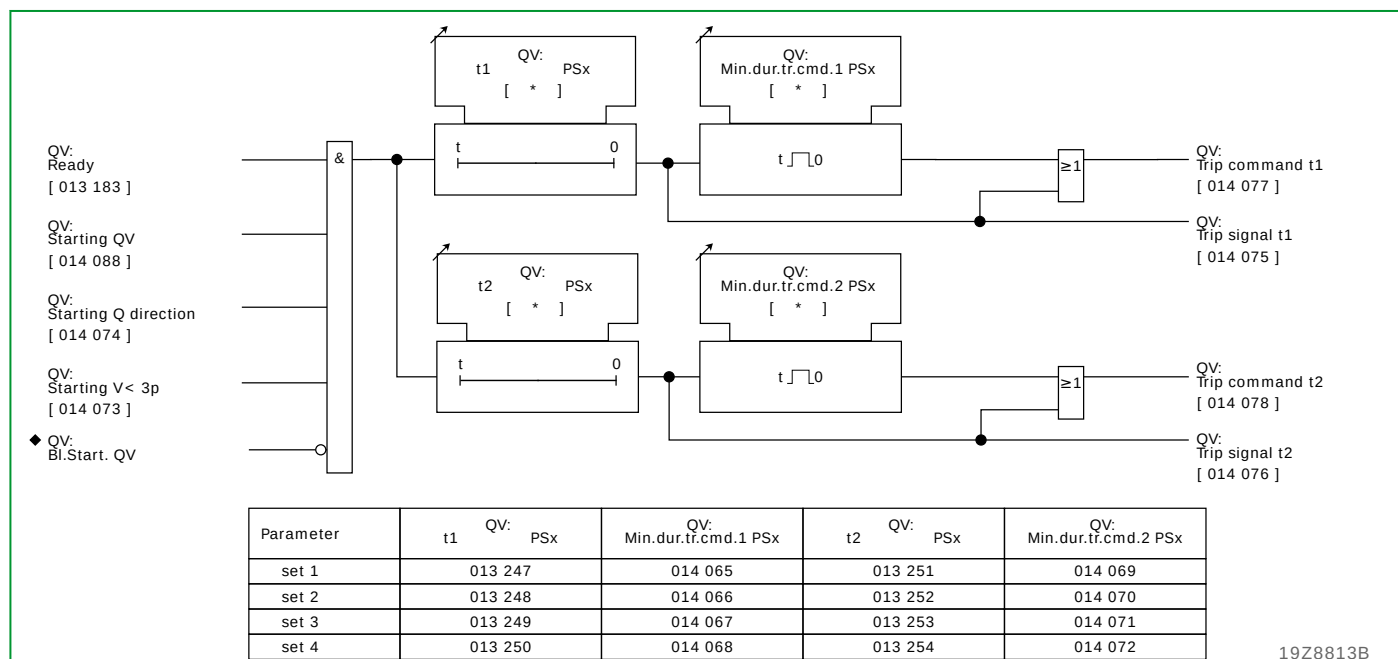


Fig. 3-374: QV timer and trip logic.

If the condition of undervoltage starting and directional reactive power characteristic are fulfilled and no blocking condition is present, the function operate delay timers are triggered.

There are two timer elements which provide trip signals and trip commands after settable operate delay time. (Usual application: the first trip is used to open the wind generator CB, the second is used to open the CB at the grid connection point).

The trip commands are provided to allow dedicated command outputs for the QV protection (like for example for CBF function). The trip commands are provided with settable minimum pulse timers. In addition, the trip signals are available for configuration in the general trip commands 1 and 2 of the global function.

3.48 Delta-I Protection (Function Group DELTA)

In the course of the expansion and conversion of medium voltage networks, it is noted that

- The nominal power of interconnecting power transformers is increasing.
- Switching stations (with protection and circuit breakers) in the course of medium voltage lines get eliminated for cost reasons.

In case of (“electrically”) long lines with short circuits at the line end or with high ground fault resistance fault currents may flow which are smaller than the rated current of the feeding transformer. Yet, in the event of a circuit breaker failure, the feeding transformer must be switched off. In this case however, conventional fault detection by overcurrent, undervoltage or even underimpedance may not detect the fault in all cases.

The Delta-I protection function is designed to detect faults based on a continuous monitoring of the currents for sudden significant changes, which can also be measured in the transformer current (superimposed by the remaining load current of the healthy outputs). Upon receiving the trip signal from the downstream (outgoing feeder) protection it provides a secure back up trip in case of a circuit breaker failure.

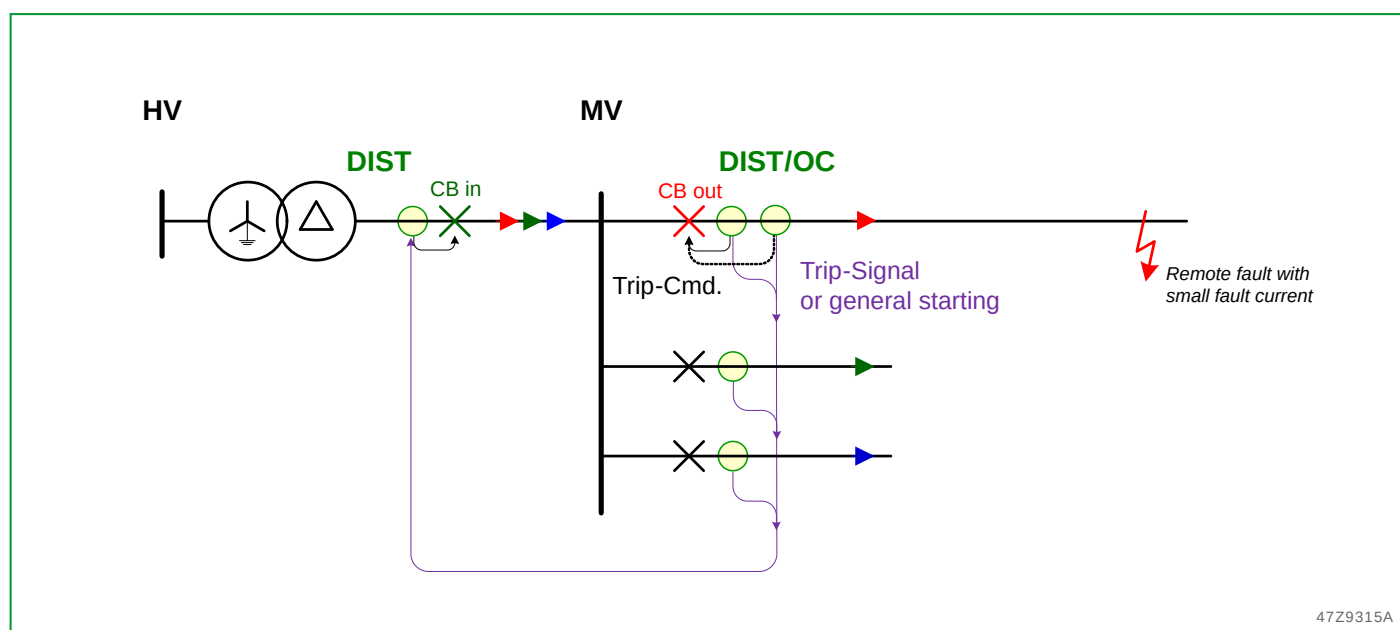


Fig. 3-375: DELTA application example.

3.48.1 Disabling and Enabling DELTA Protection

The DELTA protection can be disabled or enabled via setting parameters. Moreover, enabling can be carried out separately for each parameter subset.

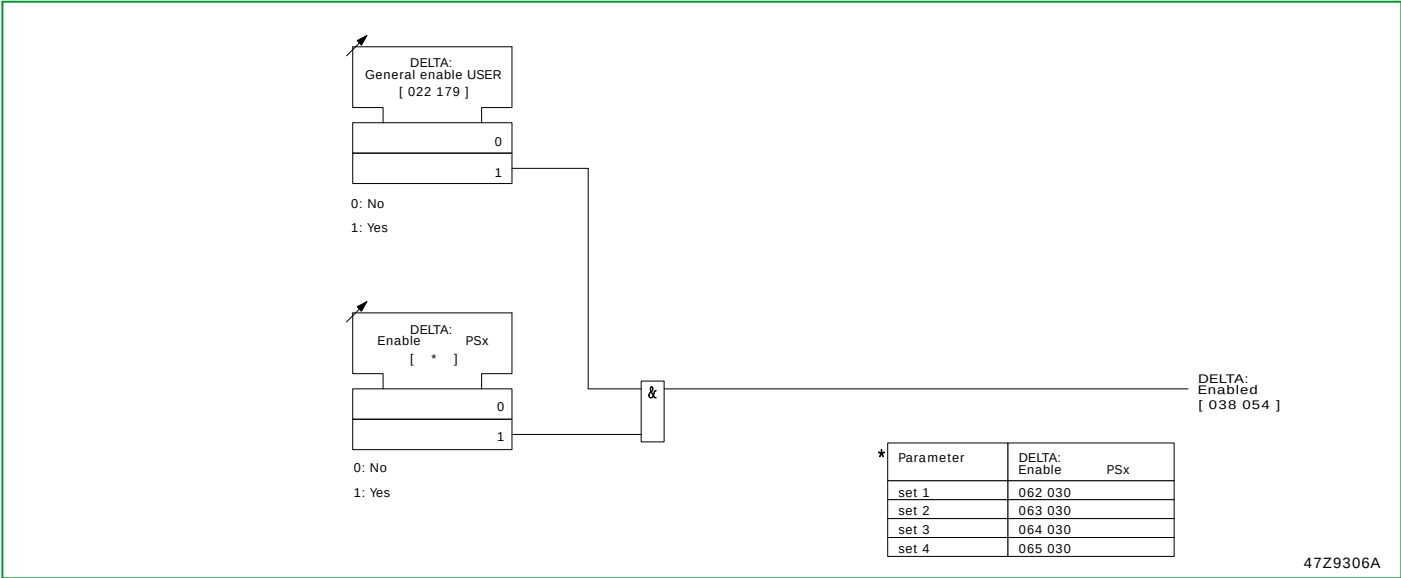


Fig. 3-376: Enabling or disabling DELTA protection.

3.48.2 Starting and Tripping Logic

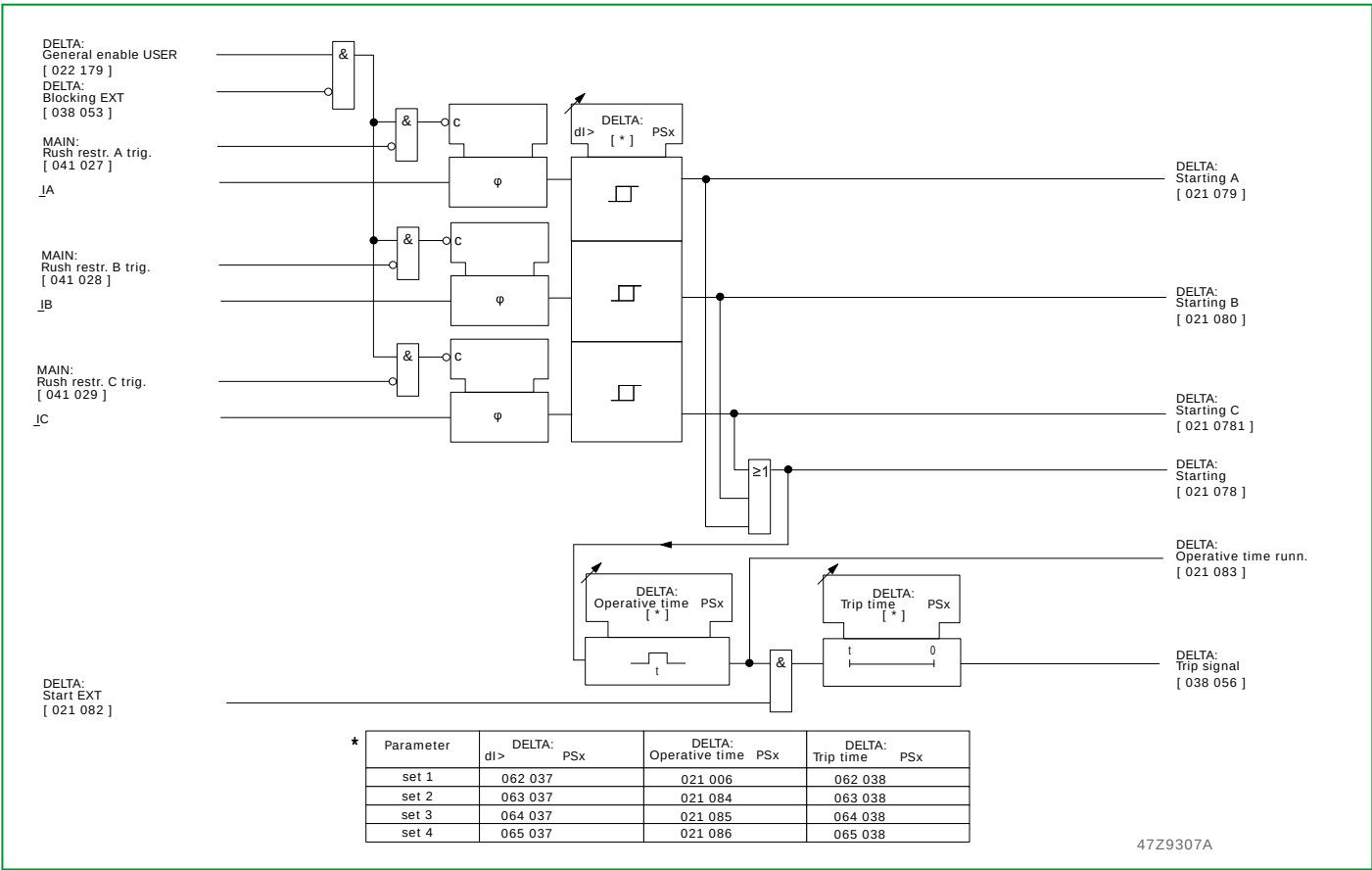


Fig. 3-377: Starting and tripping logic of DELTA protection.

The monitoring of current changes over time is phase-selective. It could be blocked by inrush stabilization (setting option).

The function evaluates the change of current over a time window of 3 periods. As soon as the value of the delta current of a phase exceeds the set threshold, phase-selective starting is signaled. Due to the measuring method, this will only occur for a short time.

The starting signals of the three phases are logically OR combined to form a general starting signal. The rising edge of the output signal of the OR (re-)triggers a timer stage. If now a binary input signal (trip signal from the downstream protection) occurs within this operative time, a trip timer stage is triggered. This timer stage is operate-delayed. It resets instantly if either the input signal resets or the operative time window elapses.

When the trip time expires, a trip signal is issued. This can be assigned to any of the general trip commands.

In the event of a correct fault clearance by the downstream protection, a "reverse" current change will occur, as in the case of fault detection. This retriggers the operative timer. Using retriggerable operative timer is beneficial, as it is also possible to consider unsuccessful automatic reclosing (ARC) on the faulty feeder without coordinating the operative time of this new function with the ARC dead time.

3.49 Circuit Breaker Failure Protection (Function Group CBF)

The P433 features the CB failure protection function. After a trip command has been issued the CBF function checks that the circuit breaker has actually been opened.

3.49.1 Disabling and Enabling Circuit Breaker Failure Protection

The function is enabled at CBF: General enable USER. If this parameter has been activated the CBF function may be enabled or disabled using setting parameters or through appropriately configured binary signal inputs. Parameters and configured binary signal inputs have equal status. If CBF: Enable USER is the only function assigned to a binary signal input, then circuit breaker protection will be enabled by a positive edge of the input signal and disabled by a negative edge. If CBF: Disable EXT is the only function assigned to a binary signal input, then a signal at this input will have no effect.

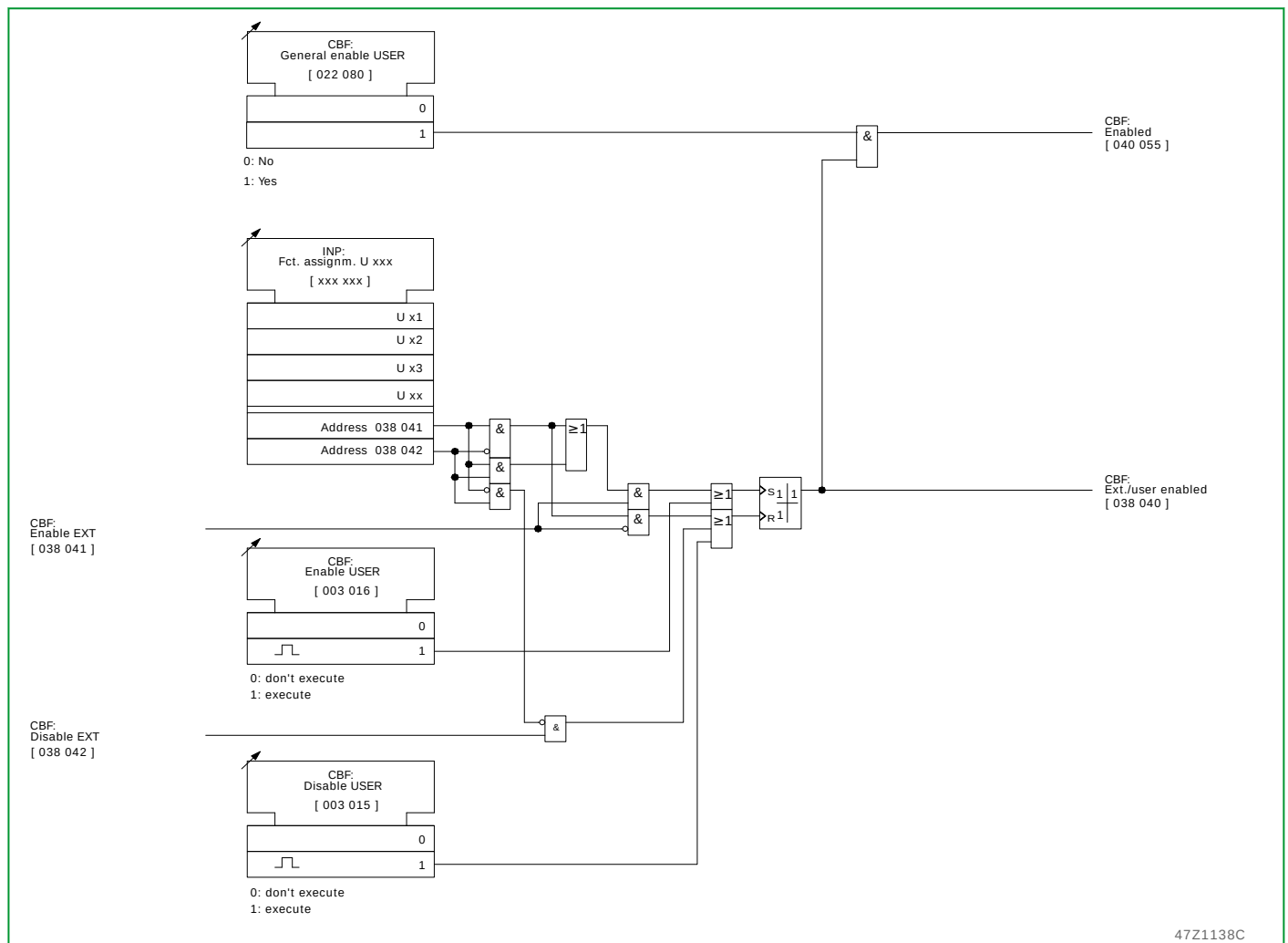


Fig. 3-378: Disabling or enabling circuit breaker failure protection.

3.49.2 Readiness of Circuit Breaker Protection

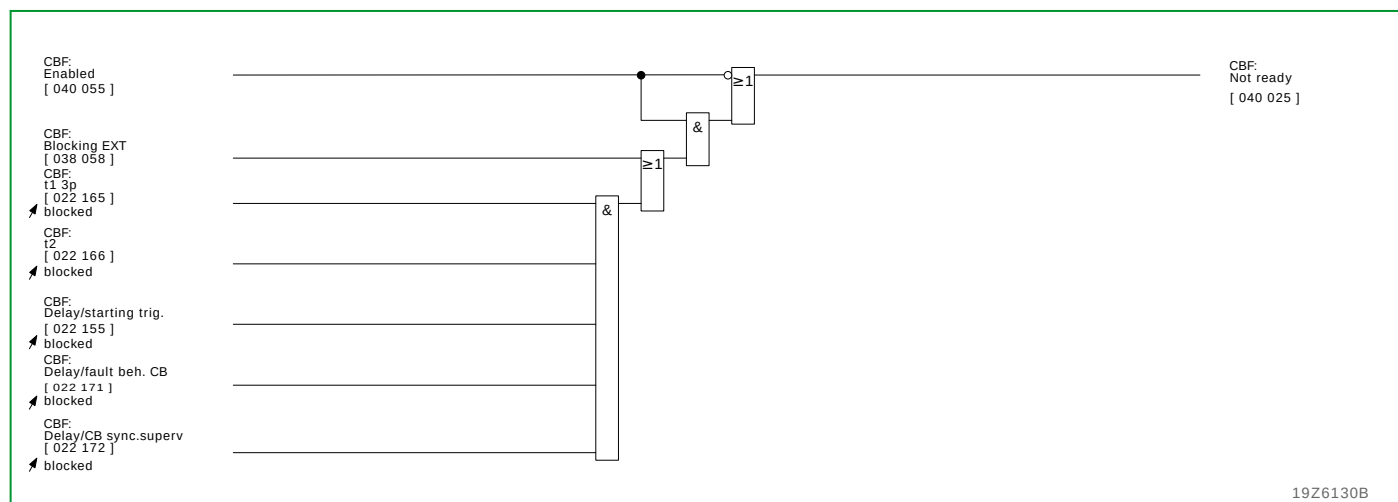


Fig. 3-379: Signal CBF: Not ready.

Circuit breaker failure protection will be unavailable under the following conditions:

- The CBF function is not activated.
- Circuit breaker protection is being blocked by an appropriately configured binary signal input.
- All CBF timer stages have been set to *blocked*.

3.49.3 Detecting a CB Tripping

A break in current flow is the preferred criterion to detect a successful CB tripping.

Protection functions that have tripping criteria not directly dependent on current flow may additionally be provided with status signals from CB auxiliary contacts for evaluation.

3.49.4 Current Flow Monitoring

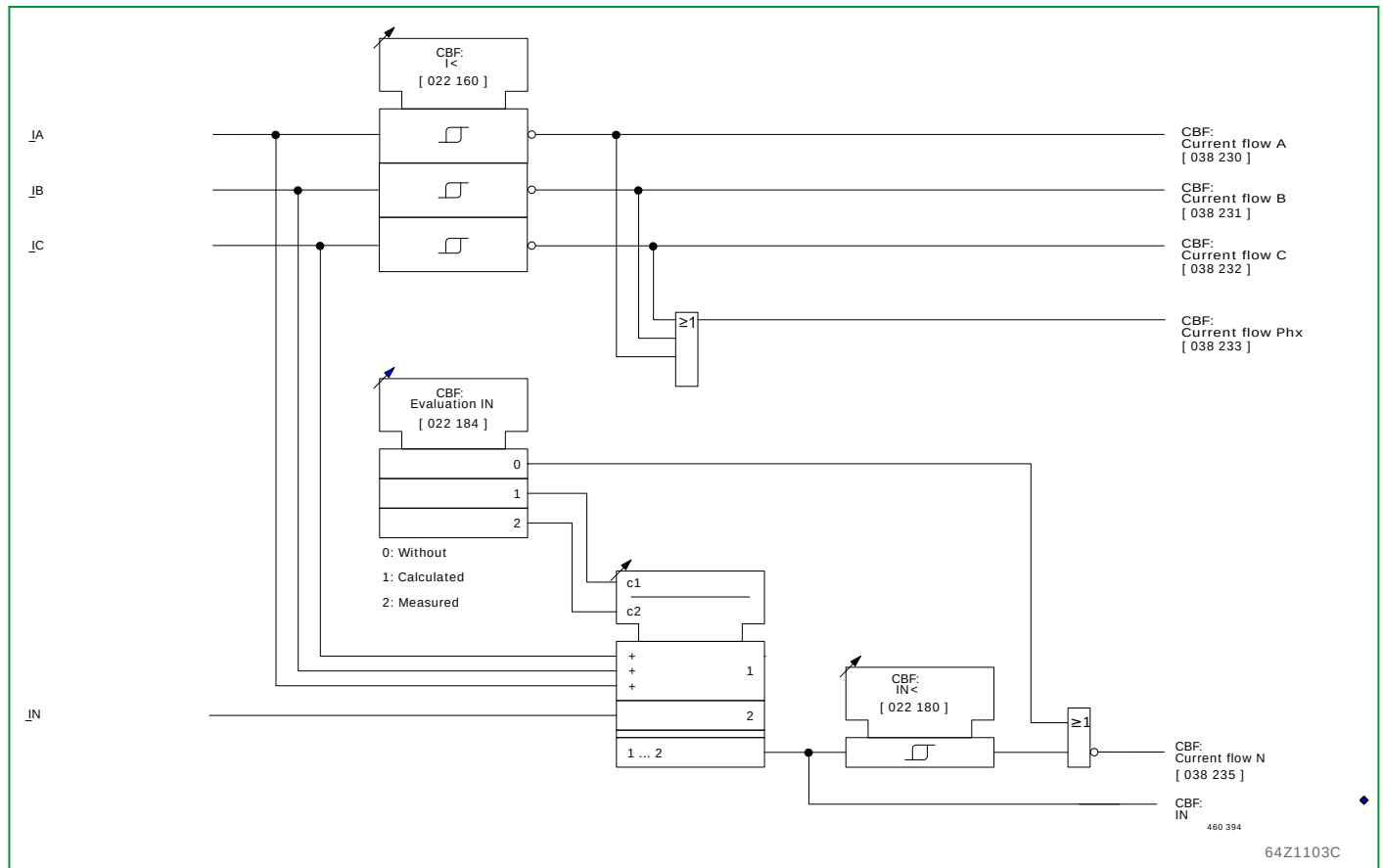


Fig. 3-380: Current flow monitoring.

This function is used to detect a break in current flow safely, immediately and pole-selectively. The CBF function continuously compares sampled current values with the set threshold value CBF: I<.

As long as current flow criteria are met the monitoring function will continuously issue the phase selective signals CBF: Current flow A, CBF: Current flow B, CBF: Current flow C and the multiple signal CBF: Current flow Phx.

Moreover, there is a residual current monitoring function which can be enabled/disabled. For this either the residual current value measured directly at the CT or the value derived from the three phase currents may be used.

As long as a residual current exceeding the comparator threshold is flowing, the current flow criterion is not met and the corresponding signal (CBF: Current flow N) is issued. When the residual current monitoring function is disabled, no monitoring is carried out and the CBF: Current flow N = No signal is issued continuously.

3.49.5 Evaluation of CB Status Signals

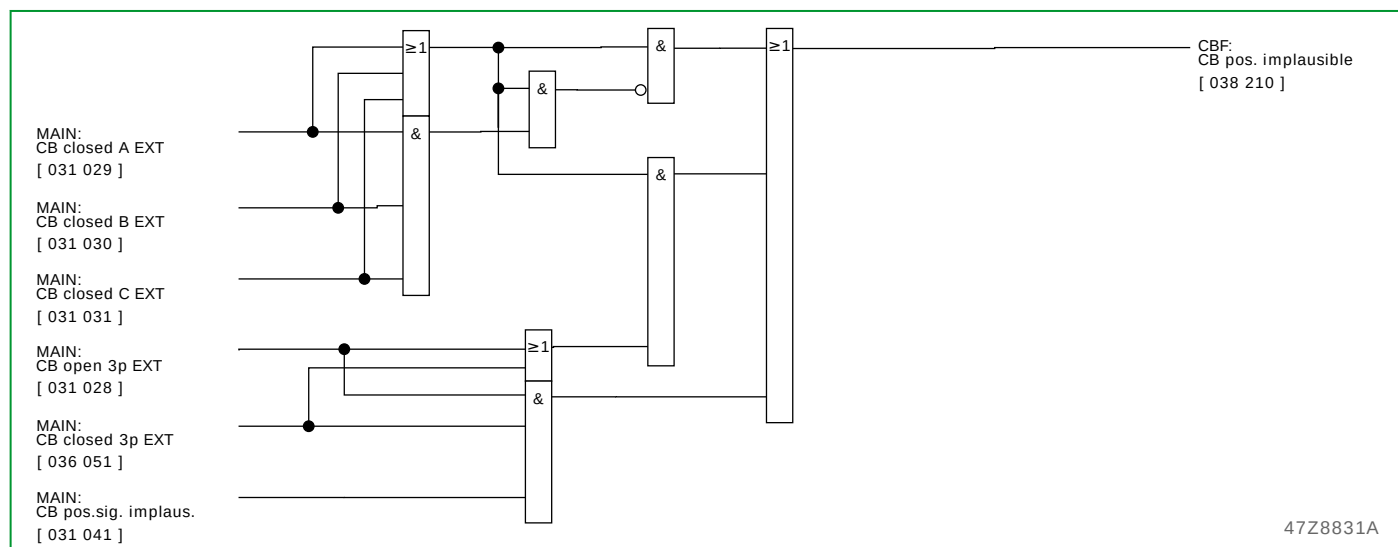


Fig. 3-381: Plausibility check of CB status signals.

Trip signals included in MAIN: Gen. trip command 1, which use CB status signals in addition to current flow monitoring, can be selected with the parameter CBF: Fct.assignm. CBAux..

Applying CB status signals depends on the type of auxiliary contacts available. The P433 can check the following CB status signals for plausibility and evaluate them as described in [Section 3.13.11, \(p. 3-117\)](#):

- The open signal from the circuit breaker, MAIN: CB open 3p EXT
- The closed signal from the circuit breaker, MAIN: CB closed 3p EXT
- The phase-selective CB status signals

The evaluation of the CB status signals is blocked, if the configuration of the respective binary signal inputs or the signal levels are not plausible. As a result, the P433 will issue the CBF: CB pos. implausible signal. The evaluation of current criteria is not affected by this blocking.

Bug notice:

In versions -650 ...-670 the CBF signal is erroneously linked to the timed MAIN signal, i.e. (038 210) CBF: CB pos. implausible = (031 041) MAIN: CB pos.sig. implaus..

The configuration or the CB status signals are considered not plausible, if:

- if at least one phase-selective CB status signal and a 3-pole CB status signal (e.g. MAIN: CB closed A EXT and MAIN: CB open 3p EXT) have been assigned to binary inputs
- or if only one or two phase-selective CB status signals have been assigned to binary inputs
- or if both MAIN: CB closed 3p EXT and MAIN: CB open 3p EXT have been configured and the signal MAIN: CB pos.sig. implaus. is issued.

As an alternative the status signals from the external device may be used by the P433. Assigning necessary for this is made with the parameters MAIN: Sig. asg. CB open or MAIN: Sig.assign. CB close. Status signals from external devices are processed similarly to the MAIN: CB open 3p EXT and MAIN: CB closed 3p EXT CB status signals.

3.49.6 Startup Criteria

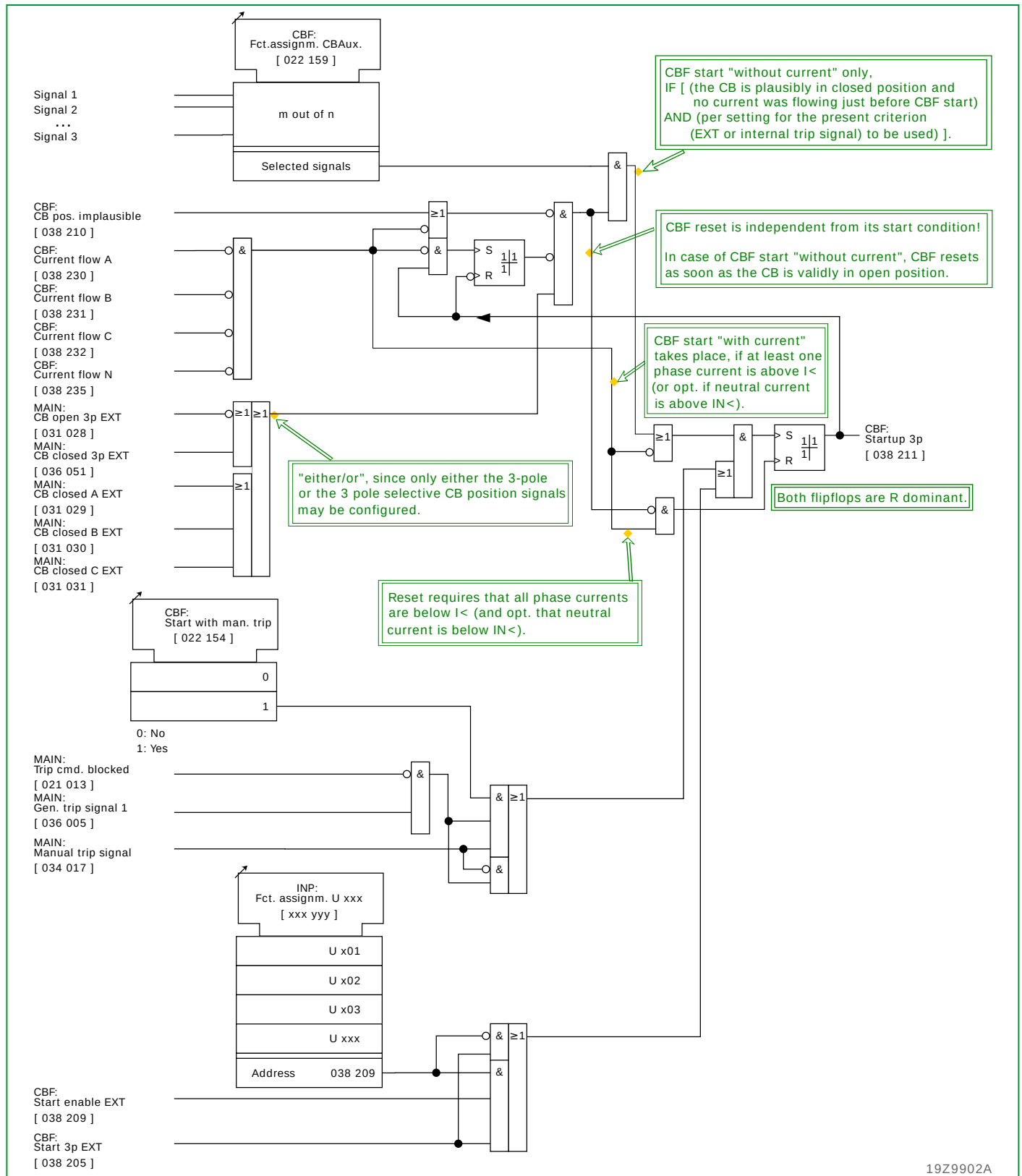


Fig. 3-382: 3-pole starting of circuit breaker failure protection.

Startup of the circuit breaker failure protection function will occur when the CB is recognized as closed during a startup criterion. The following criteria are evaluated as a startup criterion:

Internal startup criterion

- Generating the Gen. Trip signal 1 is considered a start criterion. In addition it may be selected, by setting the parameter CBF: Start with man. trip, that a manual trip signal will be used as a start criterion.

Current flow monitoring is the primary evaluation criterion. The CB auxiliary contacts are evaluated when no current flow is registered and the respective trip signal, included in the Gen. Trip command 1, has been selected from the protection function in parameter CBF: Fct.assign m. CBAux. for the evaluation of the CB auxiliary contacts.

External startup criterion

- Triggering by a protection device operating in parallel (CBF: Start 3p EXT) may be used as a start criterion. A false CBF operation due to spurious pick-up of this binary input signal is prevented as follows:
 - If only one input signal is available as trigger, this input must be active as long as the CBF timer is running. Otherwise CBF resets as soon as the trigger input signal resets.
 - Alternatively a two-pole trigger control may be implemented by applying the additional signal CBF: Start enable EXT.

Once started from internal trigger or external two-pole inputs, the CBF function will only drop out when a successful opening has been detected from the current flow monitoring (current values to fall below I_L with all three phases) or, in some cases, when the CB signals that its contacts are open.

3.49.7

Timer Stages and Output Logic

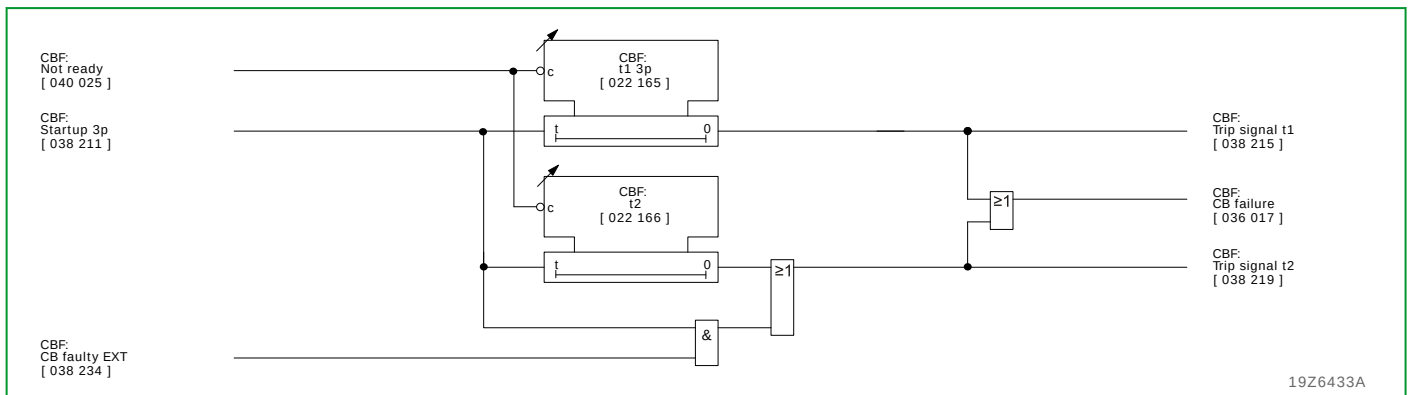


Fig. 3-383: Timer stages of circuit breaker failure protection.

Associated timer stages are started when a startup criterion is met.

- The CBF: Trip signal t1 signal will be issued if the startup criterion is still present when the time delay set at timer stage CBF: t1 3p, has elapsed. The output command from this timer stage is intended for a second CB trip coil.
- The CBF: Trip signal t2 signal will be issued if the startup criterion is still present when the time delay set at timer stage CBF: t2, has elapsed. The output command from this timer stage is intended for a backup circuit breaker or protection system.

The trip signals will be issued as long as the current criterion is not met or the CB's state is signaled as closed. Should a loss of gas pressure occur in the arcing chambers of installed type SF-6 circuit breakers then all surrounding circuit breakers must be immediately tripped without waiting for a reaction from the damaged switch. In case of an external CB fault the elapsing of timer stage t2

may be interrupted by a signal to a binary signal input appropriately configured at CBF: CB faulty EXT.

3.49.8 Trip Commands

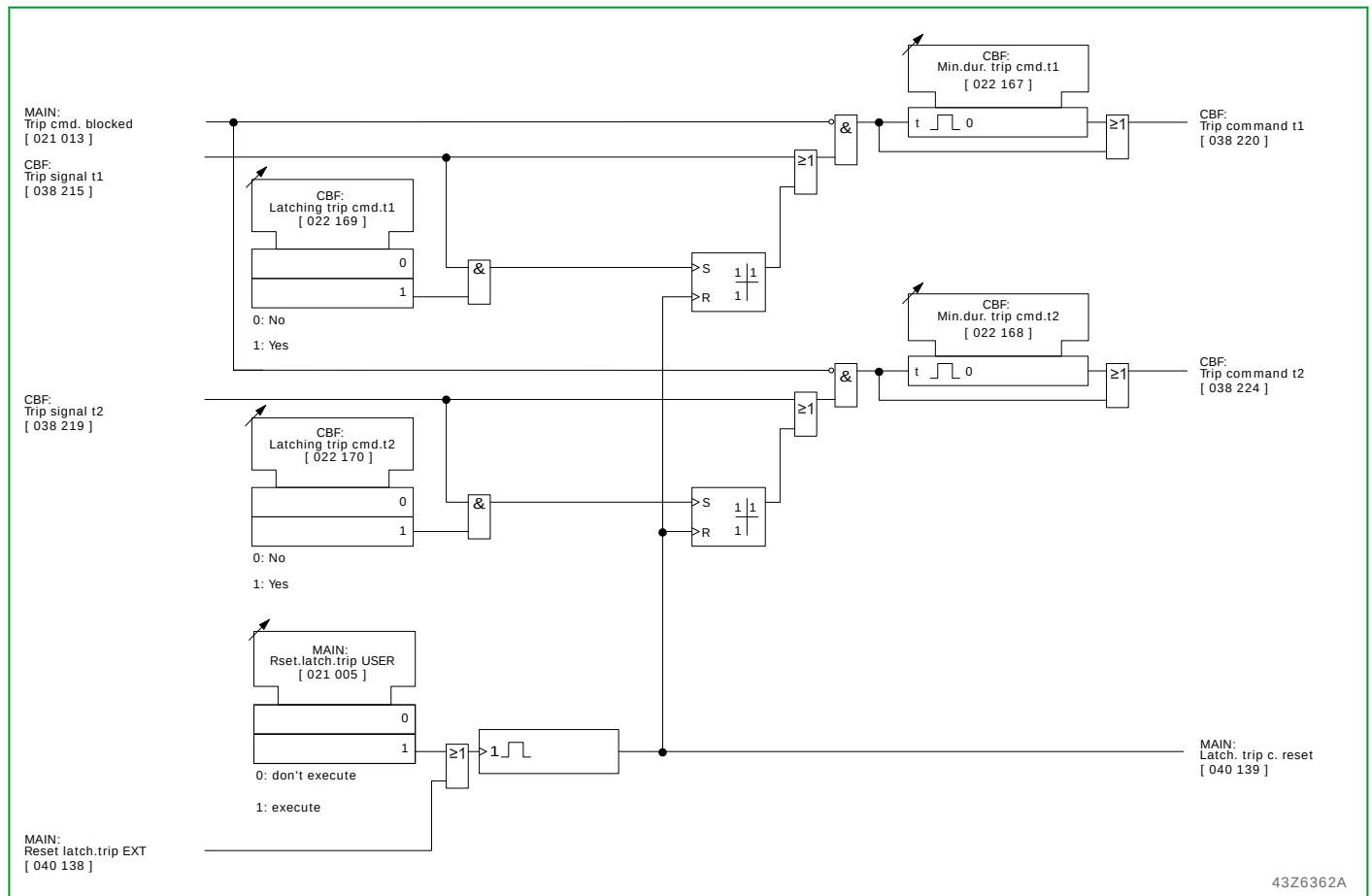


Fig. 3-384: CBF trip commands.

While trip signals issued by the CB failure protection have no timer stages available, the user can set minimum time-delays for trip commands.

By appropriate setting it can be selected that trip commands, issued by the CB failure protection function, will operate in latching mode. The corresponding trip command, set to latch mode, will remain active until reset by operating parameters or through an appropriately configured binary signal input.

3.49.9 Starting Trigger

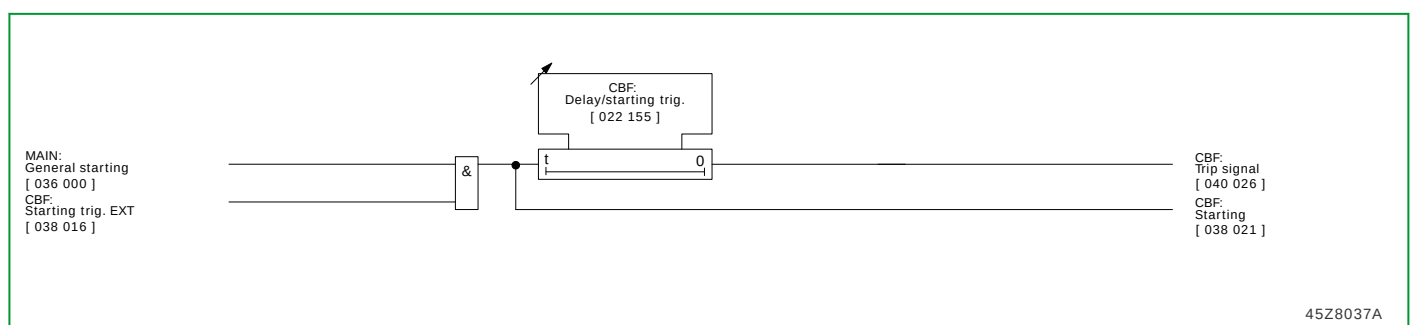


Fig. 3-385: Starting trigger.

The signal CBF: Starting will be issued when the signal CBF: Starting trig. EXT is presented to an appropriately configured binary signal input and a

general starting condition is present. The signal CBF: Delay/starting trig. will be issued after timer stage CBF: Trip signal. has elapsed.

3.49.10 Fault Behind CB Protection

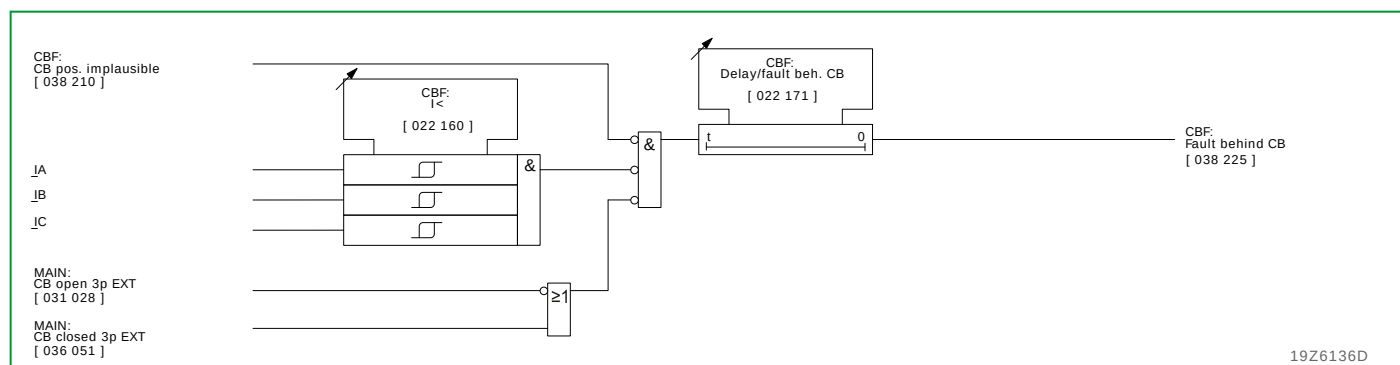


Fig. 3-386: Fault behind CB protection.

A fault behind a CB (downstream) is a fault that may occur between a circuit breaker already open and a CT, which is fed from the remote end.

Fault behind CB protection recognizes such faults through the current criterion if the circuit breaker does not indicate that it is closed after the time delay set at CBF: Delay/fault beh. CB has elapsed.

When such a fault is detected behind the CB the CBF: Fault behind CB signal is issued. In such a case the far end circuit breaker may be triggered by an InterMiCOM protective interface. This may also prevent unwanted triggering of the circuit breaker failure function.

3.49.11 CB Synchronization Supervision

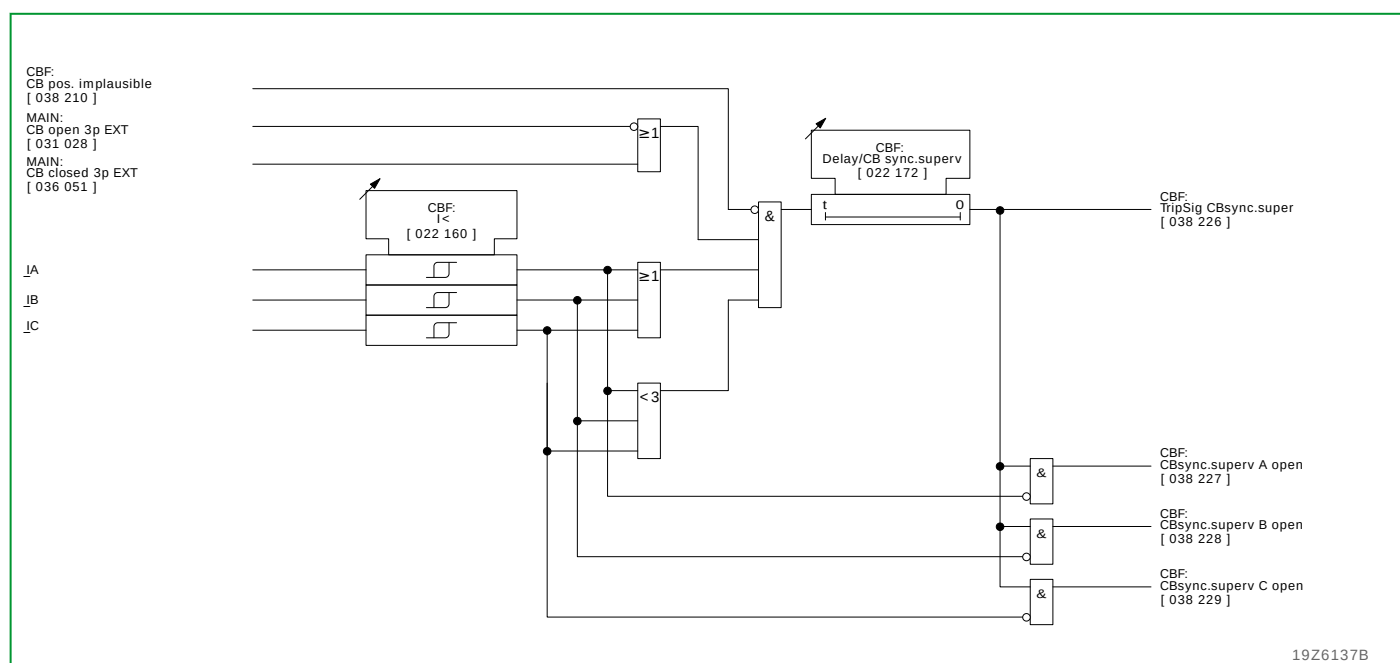


Fig. 3-387: CB synchronization supervision.

CB synchronization supervision recognizes states where not all circuit breaker contacts are open or closed. This function uses both current flow monitoring and evaluation of CB state signals to detect CB synchronization. In order to bridge CB operating times the time-delay CBF: Delay/CB sync.superv can be used.

When this time-delay has elapsed the signal CBF: TripSig Cbsync.super is issued. Poles that are recognized as being *open* will still be signaled.

3.50 Circuit Breaker Monitoring (Function Group CBM)

The P433 features a circuit breaker monitoring function. This function supports state-controlled maintenance of circuit breakers.

3.50.1 Disabling and Enabling Circuit Breaker Monitoring

Circuit breaker monitoring may be disabled or enabled using setting parameters.

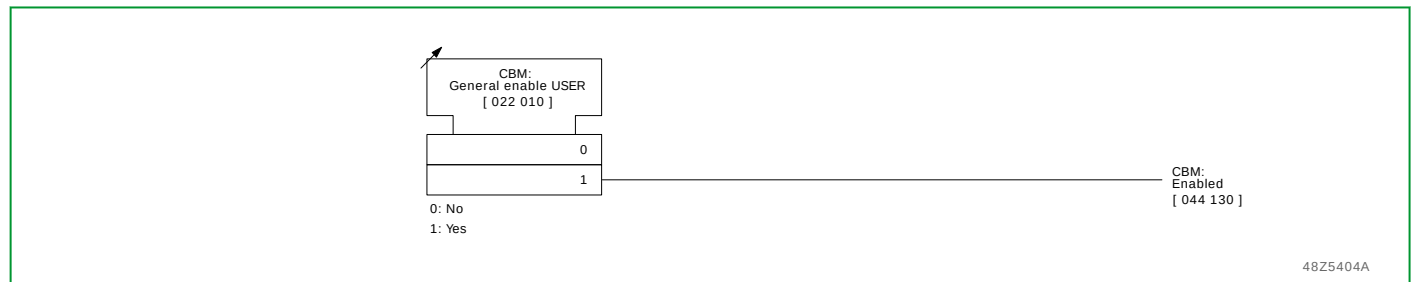


Fig. 3-388: Enabling or disabling circuit breaker monitoring.

3.50.2 Variants

The wear condition of a circuit breaker may be determined using a variety of methods:

- Monitoring the mechanical switching operations
- Accumulating ruptured current values
- Accumulating the squared ruptured current values
- Calculating the current-time integral of ruptured and accumulated current values
- Calculating the remaining switching operations with reference to the CB wear characteristic.

3.50.3 CB Wear Characteristic

Manufacturers of circuit breakers usually provide wear characteristics displaying the maximum number of permissible CB operations in relation to the ruptured current.

Fig. 3-389, (p. 3-465) displays the wear characteristics for a circuit breaker with a nominal current of 2000 A and a maximum ruptured current of 63 kA. The mean ruptured current is 48 kA.

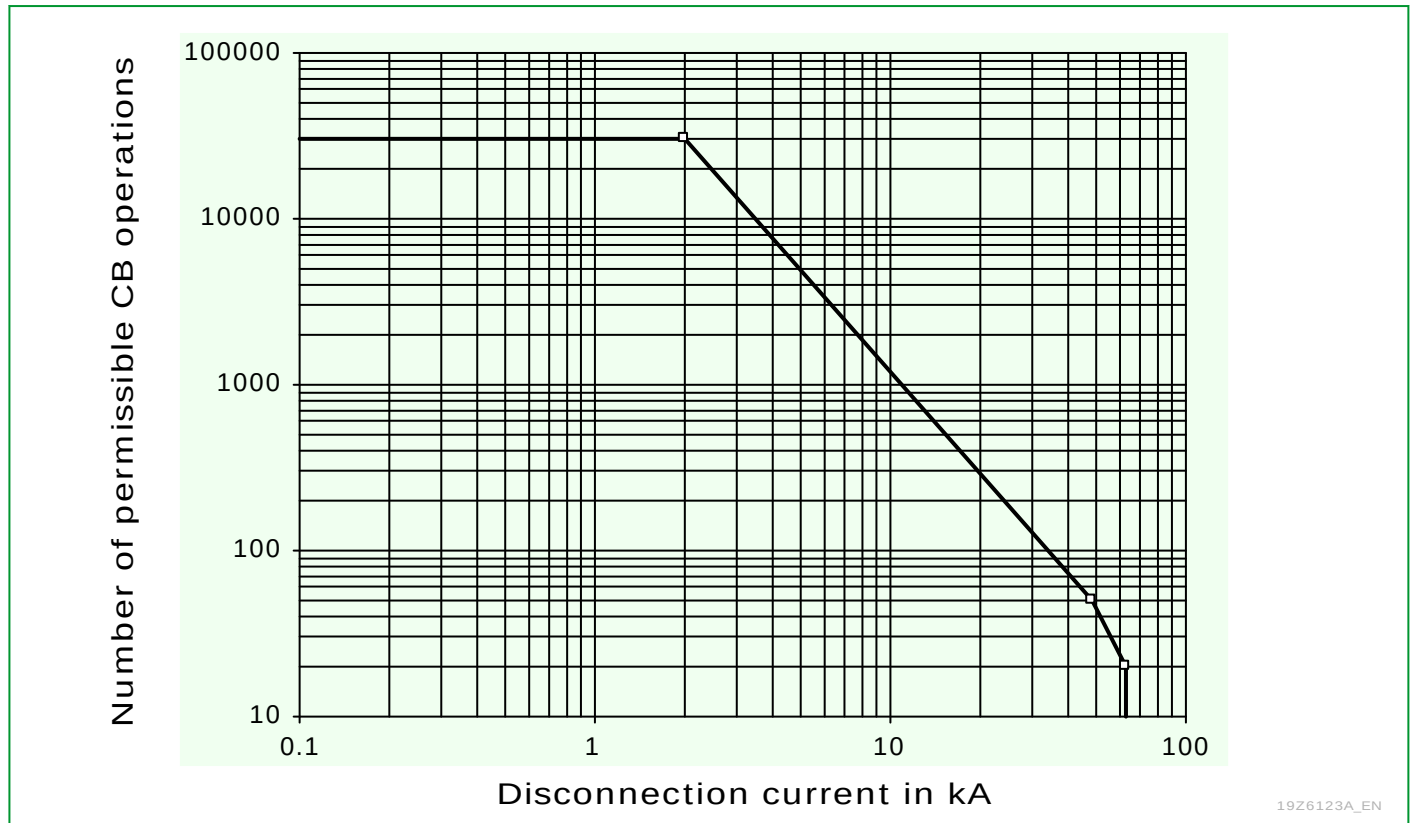


Fig. 3-389: Circuit breaker wear characteristic.

The knee points in Fig. 3-389, (p. 3-465) are necessary to set the wear characteristic for the circuit breaker:

- The circuit breaker's nominal current (CBM: Inom,CB) and the permitted number of CB operations at nominal current (CBM: Perm. CB op. Inom,CB)
- The circuit breaker's mean ruptured current (CBM: Med. curr. Itrip,CB) and the permitted number of CB operations at mean ruptured current (CBM: Perm. CB op. Imed,CB)
- The circuit breaker's maximum ruptured current (CBM: Max. curr. Itrip,CB) and the permitted number of CB operations at maximum ruptured current (CBM: Perm. CB op. Imax,CB)

The mean ruptured current is not available for all types of circuit breakers. In such a case the parameters for this knee point are to be set to *Blocked*. A knee point is not considered in the characteristic when at least one of the parameters for the knee point is set to *Blocked*.

For proper performance of circuit breaker monitoring it should be observed that the knee points must be applied in a logically correct sequence (continuously descending). When set currents and numbers of CB operations are not plausible according to the characteristic the P433 will issue an error message and block circuit breaker monitoring.

3.50.4 Calculating the CB Wear State

The current wear state of the circuit breaker is given as the number of remaining CB operations at nominal current conditions. The number of remaining CB operations $n_{\text{rem}}(I_{\text{nom,CB}})$ is calculated and displayed phase selectively after each disconnection by the P433.

Calculation is per this equation:

$$n_{\text{rem}}(I_{\text{nom,CB}}) = n_{\text{rem},0}(I_{\text{nom,CB}}) - \frac{n(I_{\text{nom,CB}})}{n(I_{\text{d,CB}})}$$

Where:

- $I_{\text{nom,CB}}$: Nominal current for the CB
- $n(I_{\text{nom,CB}})$: Max permitted number of CB operations at $I_{\text{nom,CB}}$
- $I_{\text{d,CB}}$: Ruptured current
- $n(I_{\text{d,CB}})$: Permitted number of CB operations at $I_{\text{d,CB}}$ according to wear characteristics
- $n_{\text{rem},0}(I_{\text{nom,CB}})$: Remaining permitted number of CB operations at $I_{\text{nom,CB}}$ before disconnection
- $n_{\text{rem}}(I_{\text{nom,CB}})$: Remaining permitted number of CB operations at $I_{\text{nom,CB}}$ after disconnection

3.50.5 Operating Modes

Setting the parameter CBM: Operating mode will select the condition under which the function will be triggered:

- *With trip cmd. only*: Function triggered only by the general trip command 1
- *With CB sig.EXT only*: Function triggered by the CB open signal generated by an auxiliary contact
- *CB sig. EXT or trip*: Function triggered by the general trip command 1 or CB open signal generated by an auxiliary contact

Measured values and counters are re-determined with each triggering and compared with set threshold values.

A correction value can be set in order to determine the trip time at CBM: Corr. acqu.time trip to be triggered by the open command. Another correction value can be set at CBM: Corr. acquis. time to be triggered by the position signal issued by the CB auxiliary contacts. This enables to correctly evaluate the leading or lagging auxiliary contacts or the delay between issuing the trip command and opening of the CB contacts. In addition differing inherent time delays from the two command chains can be configured independently of each other so as to achieve optimum time adjustment.

3.50.6 Cycle for Circuit Breaker Monitoring

The circuit breaker monitoring cycle is defined pole-selectively. During an active cycle the signals CBM: Cycle running A, CBM: Cycle running B or CBM: Cycle running C are issued.

The cycle is started by a trigger criterion. Definition for the end of a cycle: The remaining time of a power cycle duration has elapsed after the last detected current zero crossing. The CBM: Curr. flow ended A (CBM: Curr. flow ended B, CBM: Curr. flow ended C) signal is then issued.

The maximum cycle time duration is defined with 220 milliseconds. The start of the cycle time is corrected by the settable correction times. A fault on a CB pole is considered to be apparent if further current zero crossings are detected after

the maximum cycle time has elapsed. Measured values from the respective CB tripping are canceled and the CBM: $t_{max} > A$ (CBM: $t_{max} > B$, CBM: $t_{max} > C$) signal is issued.

3.50.7

Linking Control Functions with the Trip Command

With the P433, the trip command from the optional control function can be linked with the general trip command 1 of the protection, when setting external devices. In such a case the trip command from the control function must be associated by the parameter CBM: Sig. asg. trip cmd. so that operational trip commands, issued to the circuit breaker by the control function, are considered additionally to the general trip command 1.

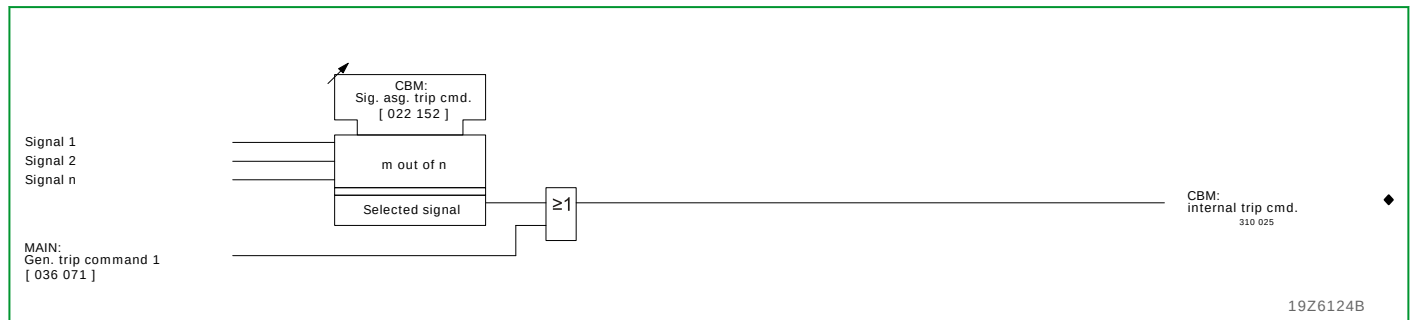


Fig. 3-390: Forming the linked trip commands.

The external devices' "open" state signal may be linked to the control function's "open" state signal by setting the CBM: Sig. asg. trip cmd.. parameter so that the function in the P433 will be triggered by CB auxiliary contacts.

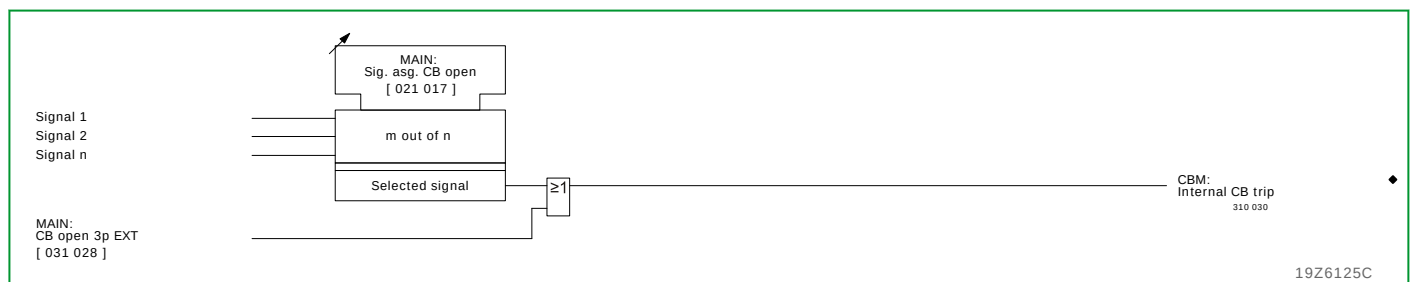


Fig. 3-391: Forming the linked "open" state signal.

3.50.8

Pole-Selective Counter Values and Measured Values

The P433 separately evaluates each phase current and generates an individual wear presentation for each CB pole.

The following counter values are presented pole-selectively:

- The number of mechanical switching operations made
- The number of remaining CB operations at CB nominal current
This value is derived by evaluating wear with reference to the CB's wear characteristic.

The following measured values are presented pole-selectively, and per-unit values refer to the CB's nominal current:

- Primary ruptured current
This value is applied to evaluate wear with reference to the CB's wear characteristic.
- Per-unit ruptured current
- Squared per-unit ruptured current
- Sum of the per-unit ruptured currents
- Sum of the squared per-unit ruptured currents
- Current-time integral of the per-unit ruptured current
- Sum of the current-time integrals of the per-unit ruptured currents

The ruptured current is derived from the RMS current value detected before a last zero crossing.

The integral of the current-time area is calculated between the trip time and the current's disappearance. The current's disappearance is recognized when no further current zero crossings are detected. An example for calculation of the current-time integral is displayed in Fig. 3-392, (p. 3-468).

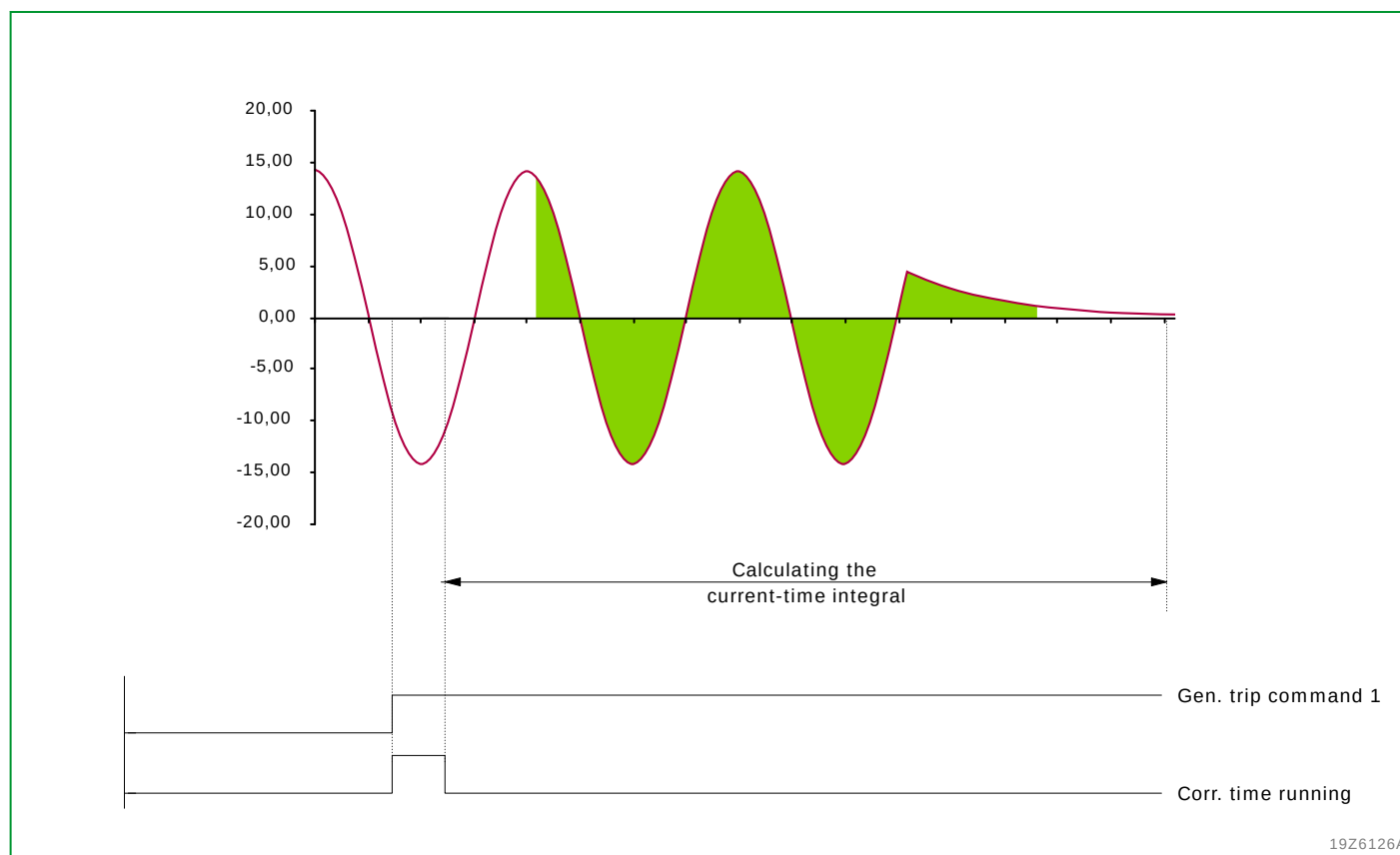


Fig. 3-392: Calculation of the current-time integral when CBM is triggered by a general trip command 1.

3.50.9

Resetting Measured Values

Measured values from the respective last CB trip may be reset via the interfaces on the P433. Accumulated measured values are not affected by such a reset operation.

3.50.10 Setting Measured Values

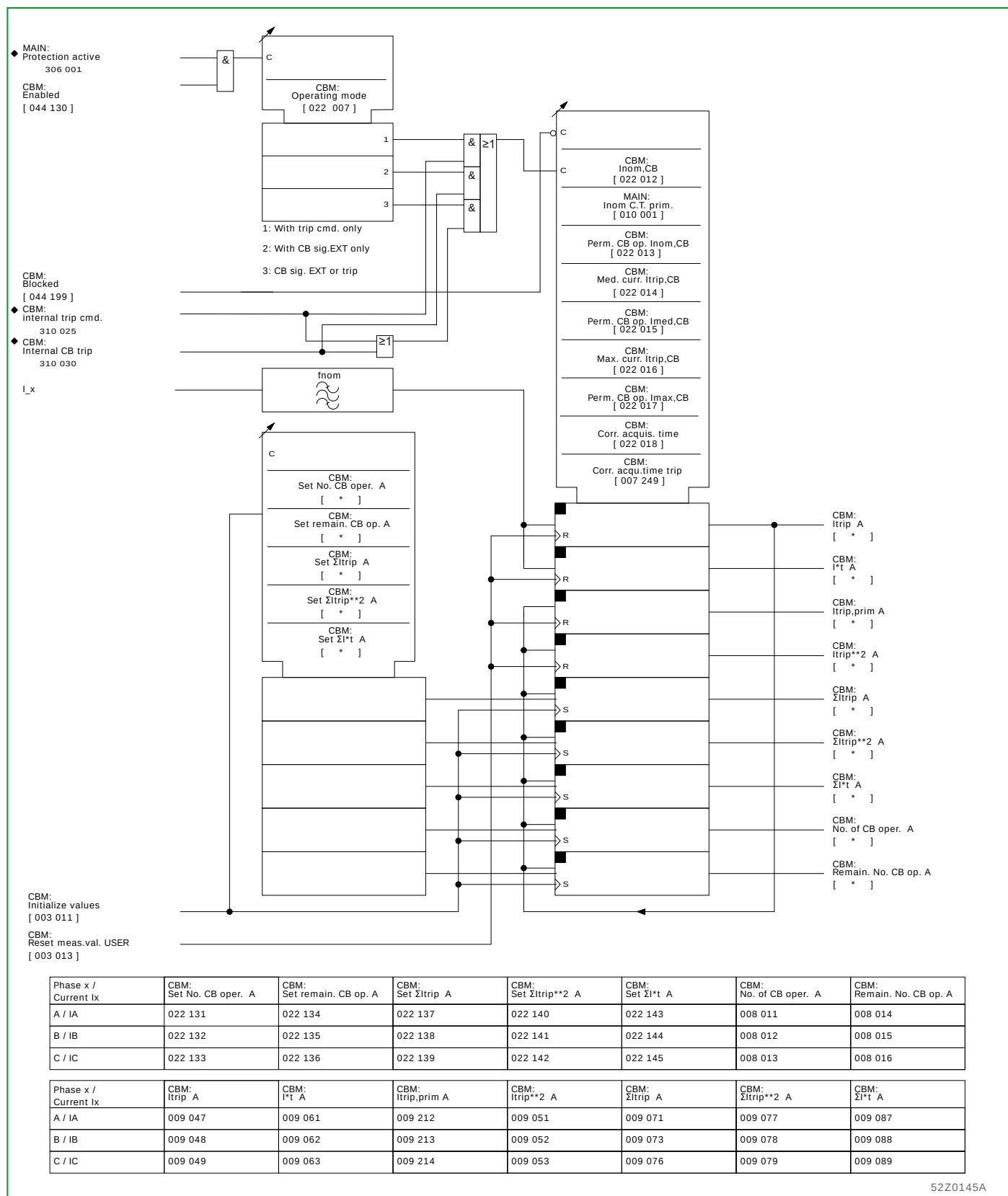


Fig. 3-393: Triggering and calculating circuit breaker monitoring.

Setting measured values in the circuit breaker monitoring function is necessary when the respective CB has already been exposed to operating conditions or has

been replaced. The available interfaces on the P433 may be used to set measured values in the circuit breaker monitoring function.

Only such measured values and counter values in the P433 may be set to new values that do not have their default values set to Blocked.

The stored value will remain unchanged if the default value is set to Blocked. Executing the set command results in initializing all default values in the P433 to Blocked.

3.50.11 Monitoring the Number of CB Operations

Depending on the selected operating mode the P433 will calculate the current wear state of the circuit breaker after each disconnection. The number of remaining CB operations at CB nominal current are calculated and displayed. A threshold value can be set with the parameter CBM: Remain No. CB op. <. An alarm is issued should the number of remaining CB operations drop below this threshold.

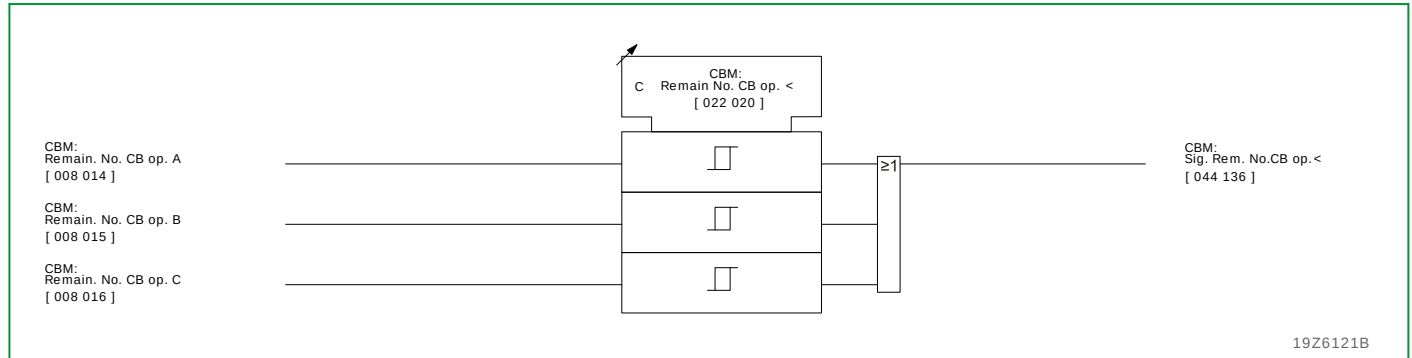


Fig. 3-394: Monitoring the remaining number of CB operations at nominal current.

At the same time each switching operation will increment the P433's counter for the number of CB operations. The number of CB operations performed is displayed. A threshold value can be set with the parameter CBM: No. CB operations >. An alarm is issued should the number of CB operations performed exceed this threshold.

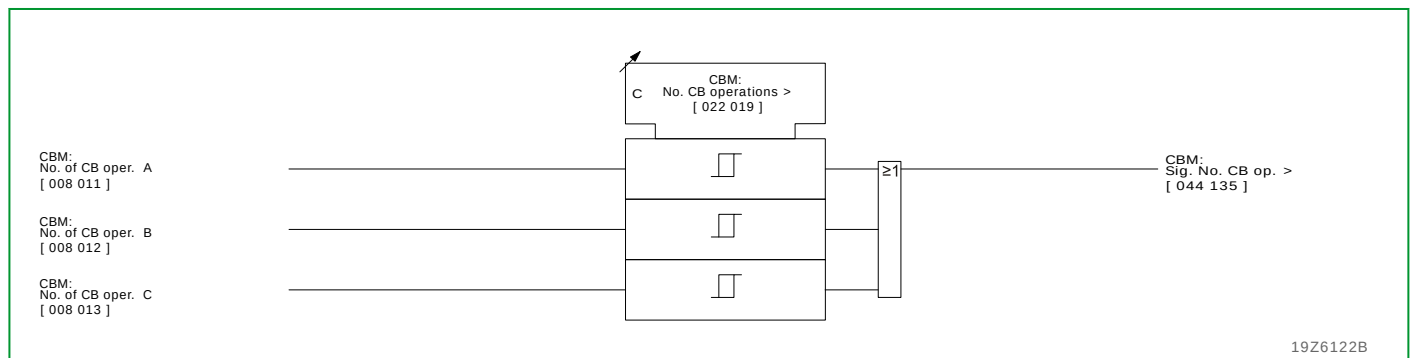


Fig. 3-395: Monitoring the number of CB operations performed.

3.50.12 Monitoring Ruptured Currents

In addition to the evaluation of the CB wear state and monitoring of the number of CB operations performed, the P433 features the means to accumulate and display the ruptured current values and the square of these values. Threshold values can be set with the parameters CBM: $\Sigma I_{trip} >$, CBM: $\Sigma I_{trip}^{**2} >$ and CBM: $\Sigma I \cdot t >$. An alarm is issued should the accumulated current values exceed any of these thresholds.

3.50.13 Blocking Circuit Breaker Monitoring

When protection injection testing is carried out the circuit breaker monitoring function should be blocked, so that such testing does not corrupt monitoring results. CBM protection is blocked if one of the following conditions is met:

- Circuit breaker monitoring is blocked by parameters.
- Circuit breaker monitoring is blocked by an appropriately configured binary signal input.

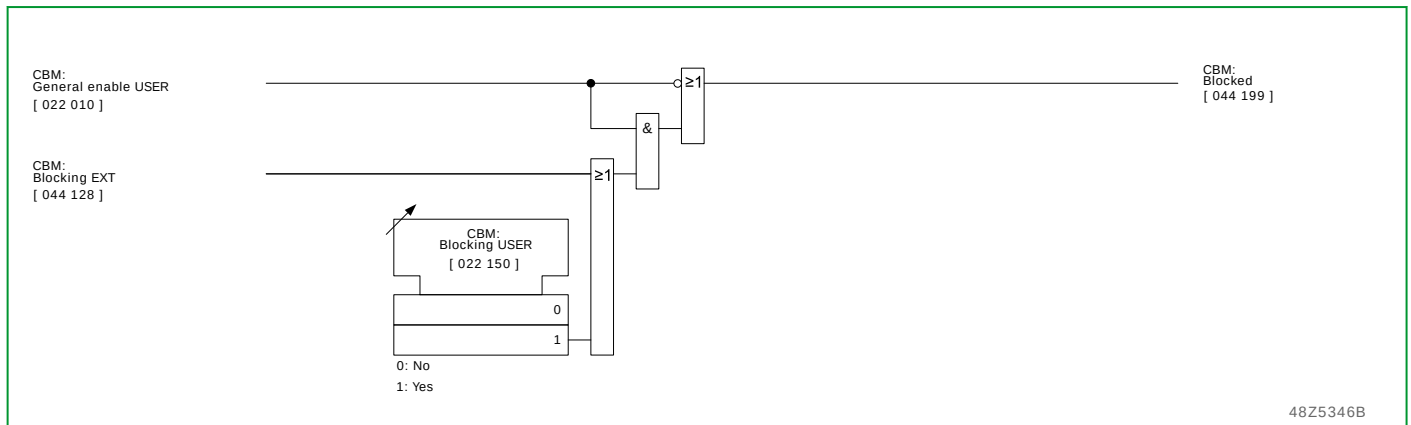


Fig. 3-396: Blocking circuit breaker monitoring.

3.51 Limit Value Monitoring (Function Group LIMIT)

Limit Value Monitoring is not designed to be a high-speed protection function; it is only applied for monitoring and signaling purposes as well as to monitor temperature limits.

3.51.1 Enable/Disable the Limit Value Monitoring Function

The Limit Value Monitoring function can be disabled or enabled via setting parameters.

3.51.2 Monitoring Phase Currents and Phase Voltages

With the P433 monitoring of the following measured values is possible in order to determine if they exceed set upper limit values or fall below set lower limit values:

- Maximum phase current
- Minimum phase current
- Maximum phase-to-phase voltage
- Minimum phase-to-phase voltage
- Maximum phase-to-ground voltage
- Minimum phase-to-ground voltage

If any of the measured values exceeds or falls below the corresponding upper or lower limit values, then a signal is issued after the associated time period has elapsed.

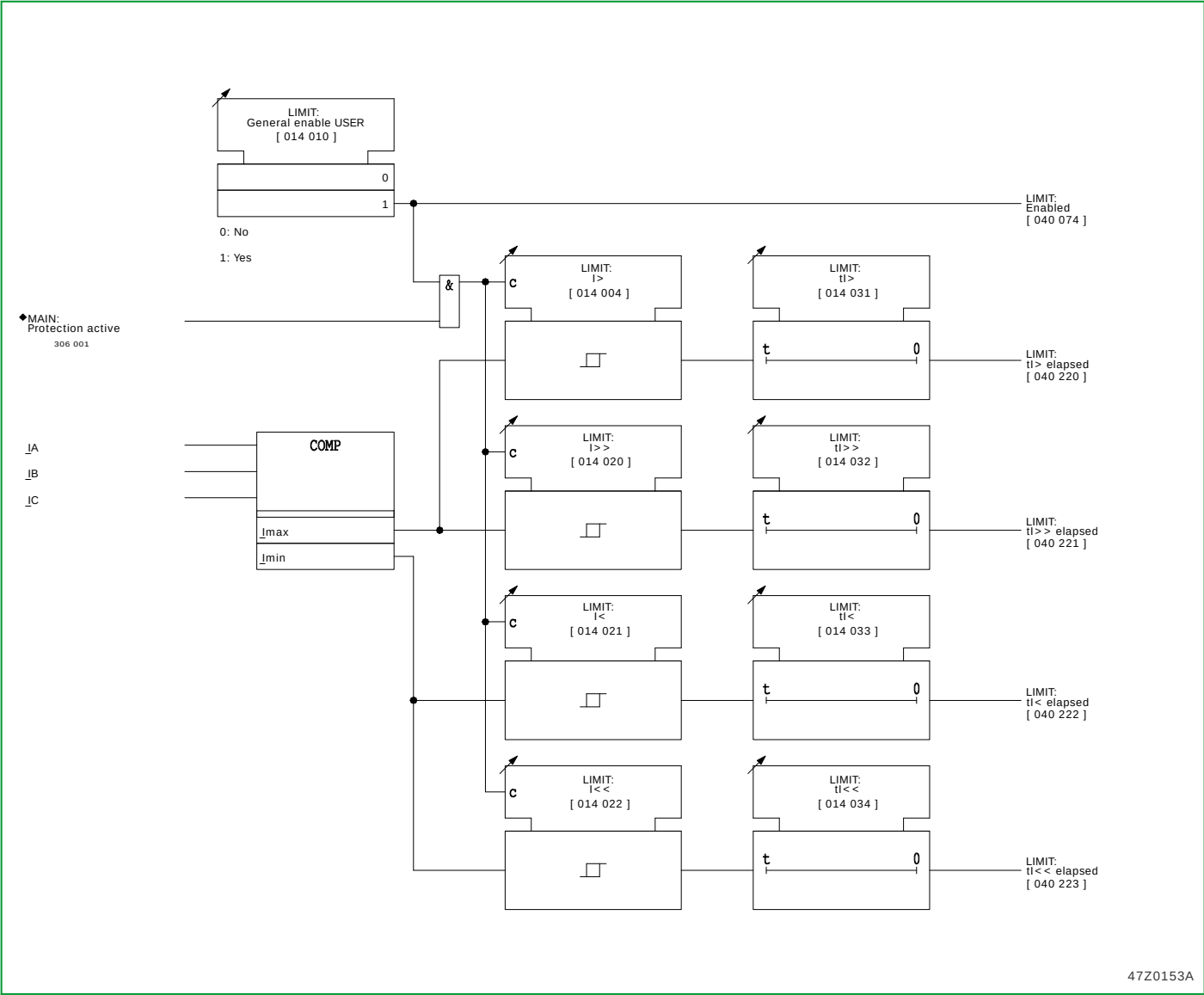


Fig. 3-397: Limit Value Monitoring of minimum and maximum phase current.

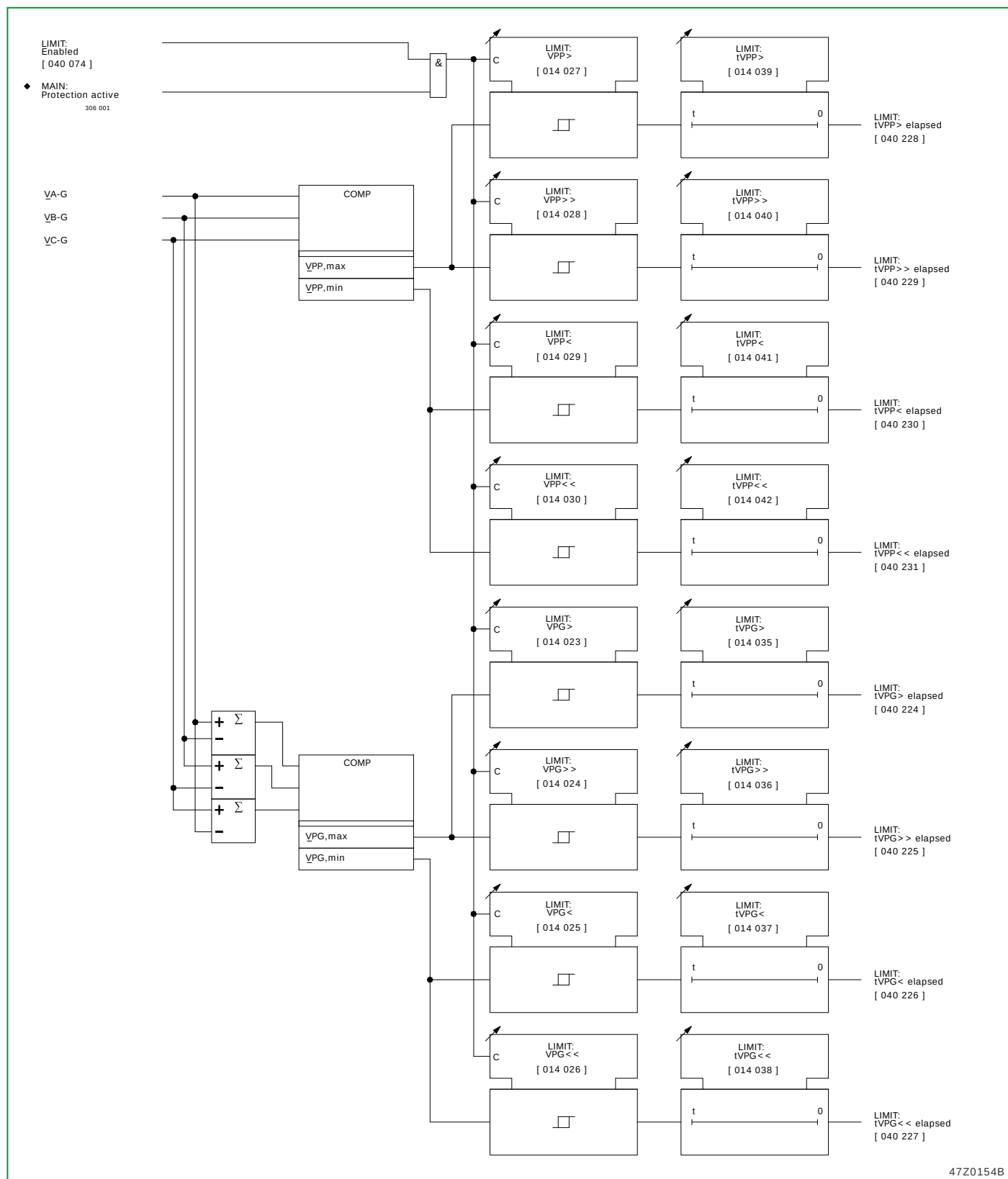


Fig. 3-398: Limit Value Monitoring of maximum and minimum phase-to-phase voltage and maximum and minimum phase-to-ground voltage.

3.51.3

Monitoring the Neutral-Point Displacement Voltage

The neutral displacement voltage, calculated from the three phase-to-ground voltages, is monitored by two stages to determine whether it exceeds set thresholds. If any of the thresholds are exceeded, then a signal is issued after the associated time period has elapsed.

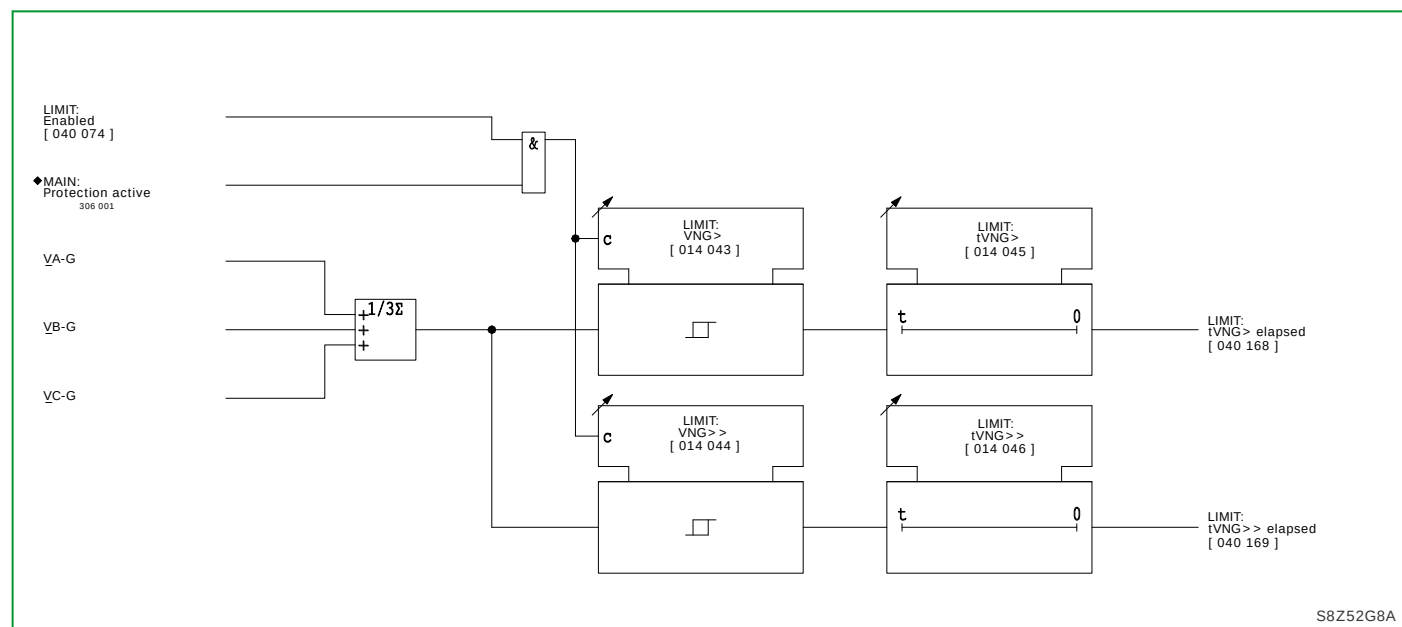


Fig. 3-399: Monitoring the neutral-point displacement voltage.

3.51.4

Monitoring the Linearized Measured DC Values

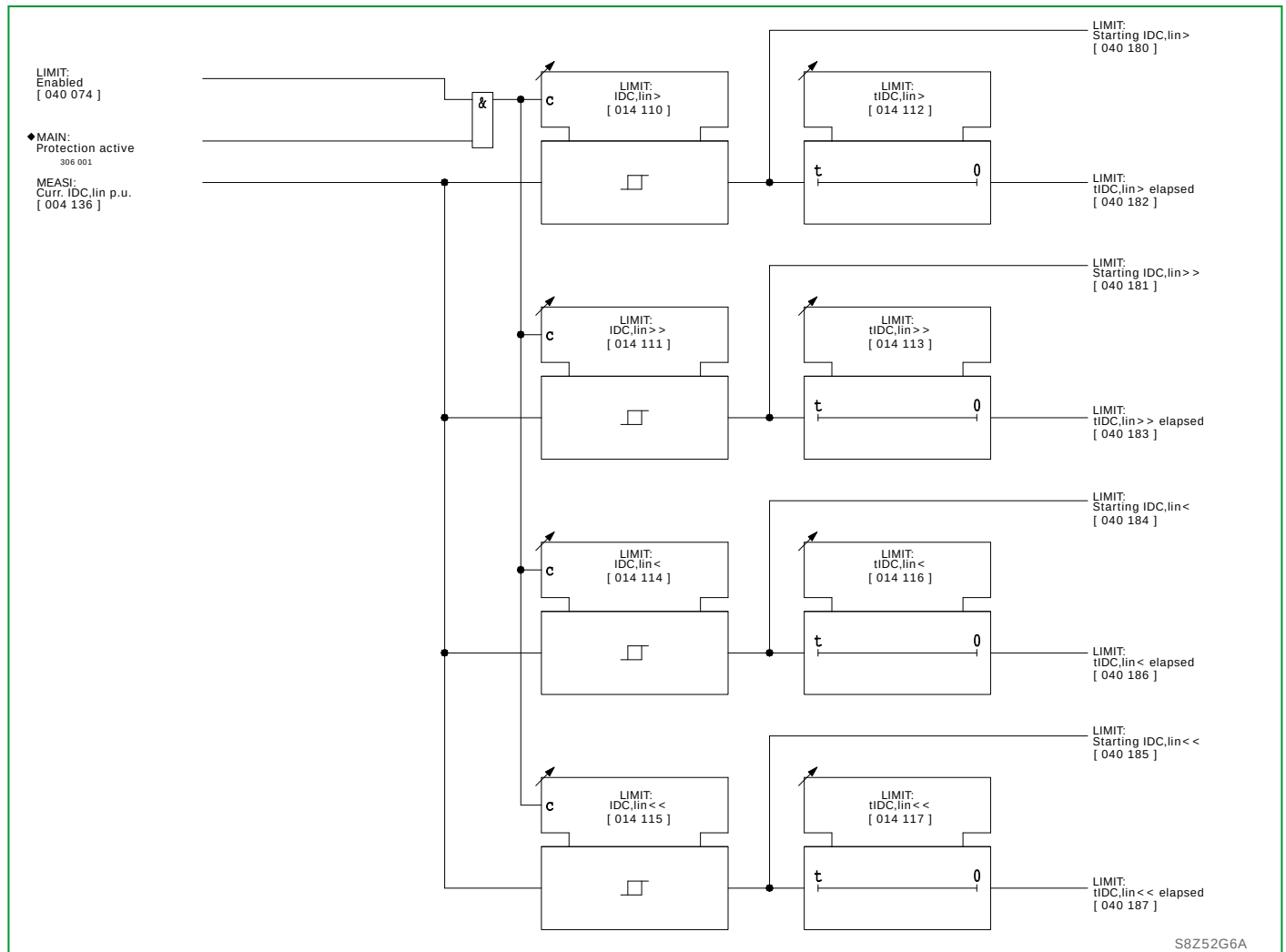


Fig. 3-400: Monitoring the linearized measured DC values.

The direct current, linearized by the analog measured data input, is monitored by two stages to determine if it exceeds or falls below set thresholds. If any of the measured values exceed or fall below the corresponding upper or lower limit values then a signal is issued after the associated time period has elapsed.

3.51.5 Monitoring the Reference Voltage

The reference voltage V_{ref} (when synchrocheck VT is fitted) is monitored by two stages to determine whether it exceeds or falls below the corresponding upper or lower limit values. If the measured value exceeds or falls below the corresponding upper or lower limit values then a signal is issued after the associated time period has elapsed.

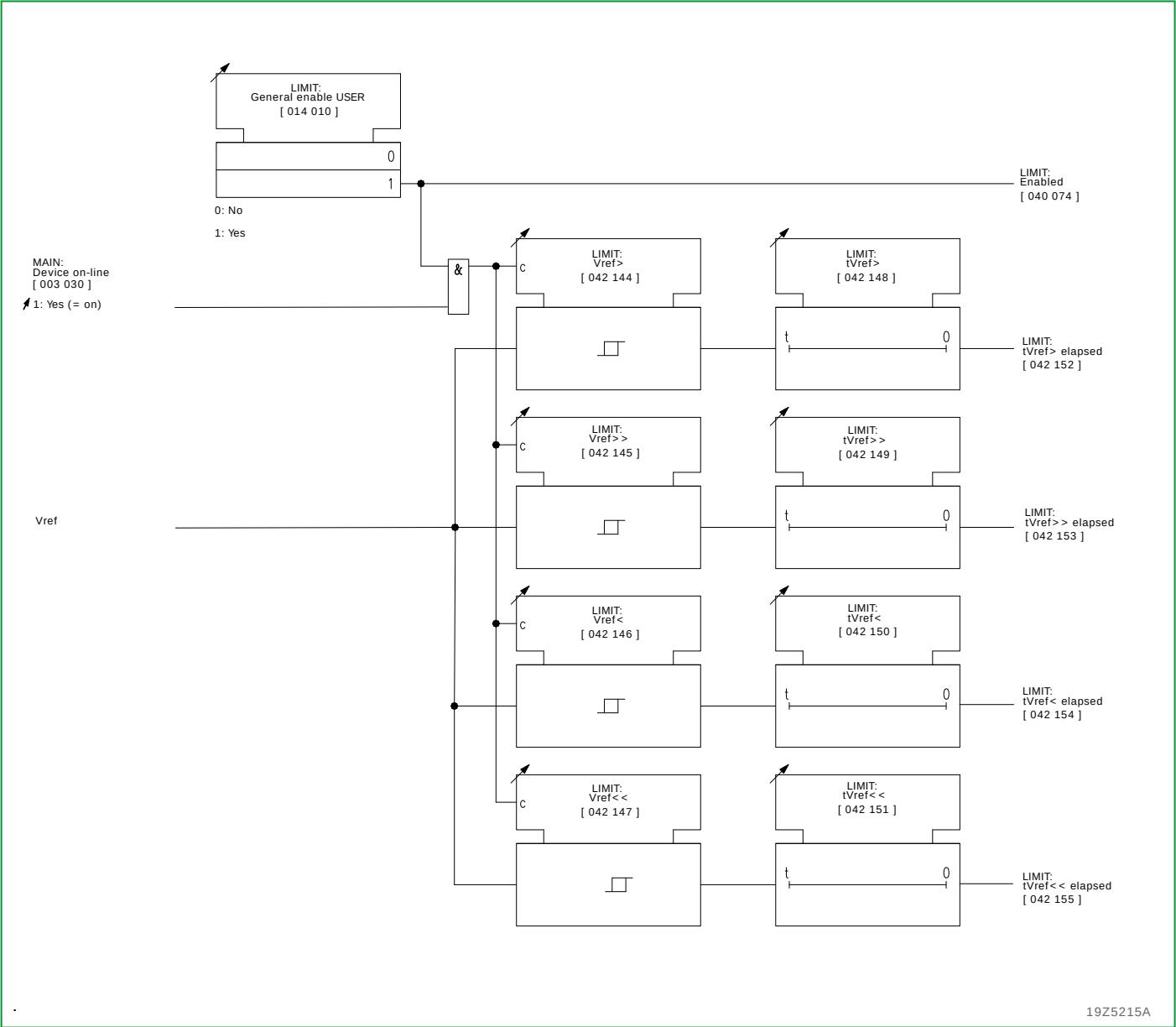


Fig. 3-401: Monitoring the reference voltage.

3.51.6 Monitoring the Measured “PT 100” Temperature Value

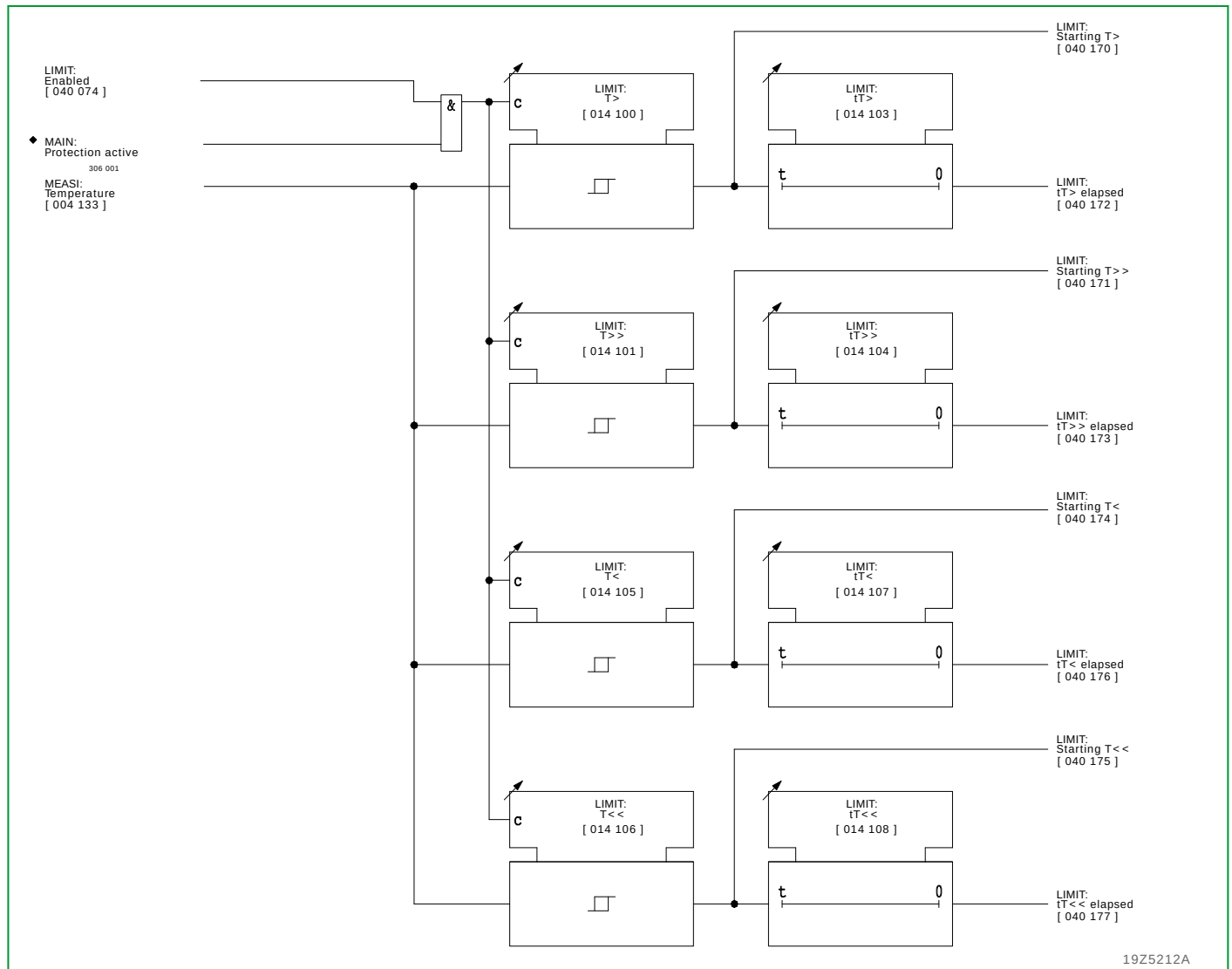


Fig. 3-402: Monitoring the measured “PT 100” temperature value.

The temperature value that is measured by the P433 with a resistance thermometer (PT 100) connected to the analog (I/O) module Y, is monitored by two stages to determine whether it exceeds or falls below the corresponding upper or lower limit values. If any of the measured values exceed or fall below the corresponding upper or lower limit values then a signal is issued after the associated time period has elapsed.

3.52 Transformer Monitoring (Function Group TRMON)

Big transformers are usually fitted with one or more Buchholz relays.

A Buchholz relay detects gases that arise due to normal ageing processes of the transformer insulation. After a sufficient amount of gas has accumulated, the alarm contact is activated. This measurement principle has the effect that the alarm is also activated if the filling level of the insulating oil sinks below the mounting place of the Buchholz relay due to a leakage. Since in such a case the filling level sinks quite rapidly, it is common to have a separate detection hardware for this, which then issues an insulation alarm.

Additionally, a Buchholz relay monitors the rate of oil flow. In case of an inner short-circuit fault gas arises from the fault location, and the gas pushes some part of the insulating oil into the equalizing tank. The Buchholz relay reacts to this by closing its release contact.

The number of such relays mounted at the transformer is dependent on the size and construction details (e. g. 3-phase or three single-phase transformers, with or without tap changers, etc.)

The P433 features dedicated input signals for determining the alarm and tripping signals of up to 3 Buchholz- / insulation monitoring relays. The P433 records these input signals, issues them via the communication interfaces or converts them to user-defined signals and / or trip commands.

It is recommended with respect to a safe transformer protection that a Buchholz trip always directly opens the circuit breaker. This means that routing the Buchholz trip to the P433 is advisable only for reporting purposes, or for triggering a second, independent tripping system.

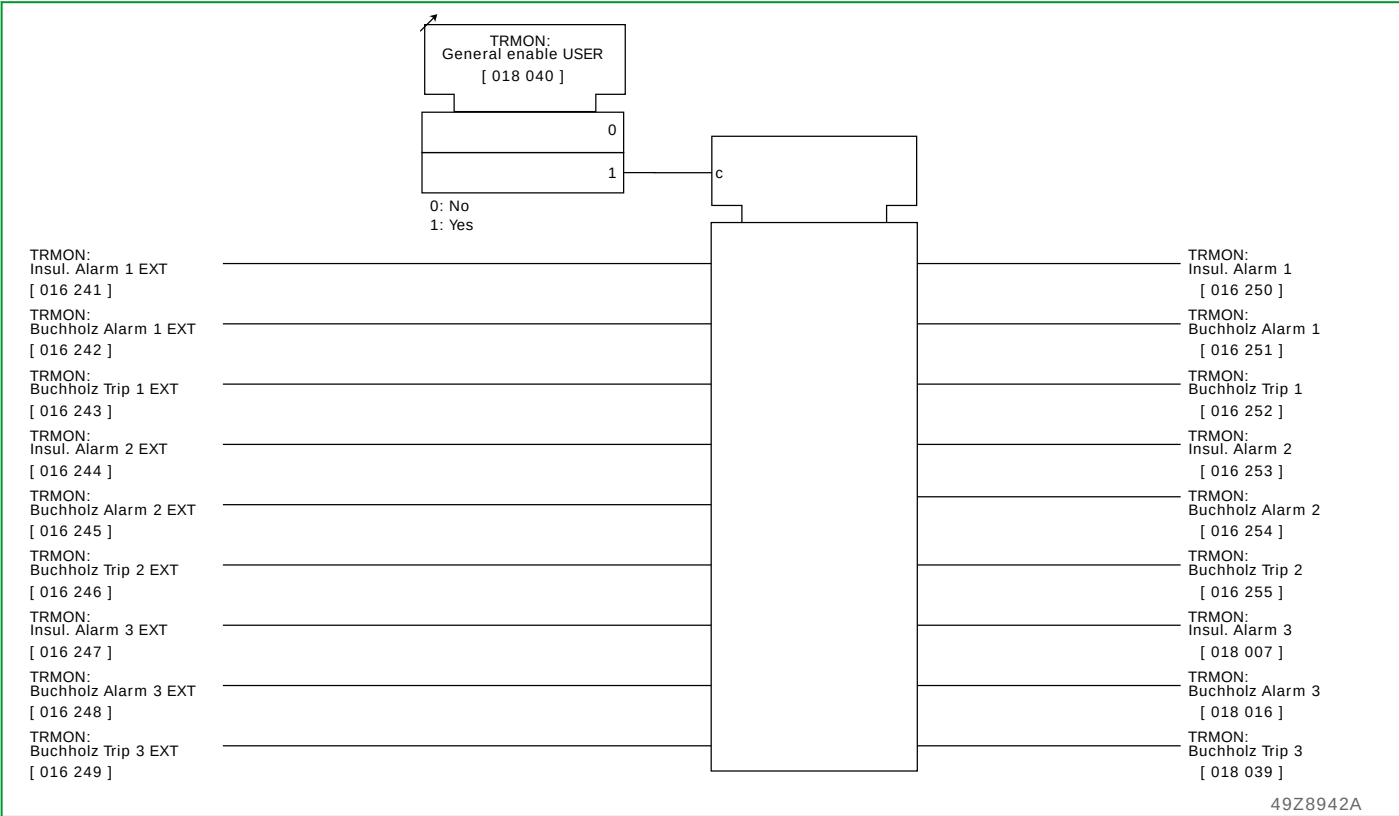


Fig. 3-403: TRMON transformer monitoring: Enabling, disabling and signals.

3.53 Programmable Logic (Function Groups LOGIC and LOG_2)

Programmable (or user-configurable) logic enables the user to link binary signals within a framework of Boolean equations.

Two function groups for programmable logic are available, that can be used independently of each other. There are only two differences between these two function groups:

- LOGIC offers 128 logical equations.
LOG_2 offers only 4 logical equations.
- On the other hand, LOG_2 features long-term timers.

For example for output 1:

- LOGIC: Time t1 output 1 and LOGIC: Time t2 output 1: settable from 0 to 600 s.
- LOG_2: Time t1 output 1 and LOG_2: Time t2 output 1: settable from 0 to 60,000 s.

The following description concentrates on the function group LOGIC. Where applicable, any differences to LOG_2 are mentioned.

Binary signals in the P433 may be linked by logical “OR” or “AND” operations with the option of additional NOT operations by setting LOGIC: Fct.assignm. outp. 1 (or LOGIC: Fct.assignm. outp. 2 to LOGIC: Fct.assignm. outp. 128, or LOG_2: Fct.assignm. outp. 1 to LOG_2: Fct.assignm. outp. 4). The Boolean equations need to be defined without the use of brackets. The following rule applies to the operators: “NOT” before “AND” before “OR”.

A maximum of 32 elements can be processed in one Boolean equation. In addition to the signals generated by the P433, initial conditions for governing the equations can be set using setting parameters, through binary signal inputs, or through the serial interfaces.

Logical operations of the function group LOGIC can be controlled through the binary signal inputs in different ways.

The binary input signals LOGIC: Input 01 EXT (or LOGIC: Input 02 EXT, ..., LOGIC: Input 40 EXT) have an updating function, whereas the input signals LOGIC: Set 1 EXT (or LOGIC: Set 2 EXT, ..., LOGIC: Set 8 EXT) are latched. The logic can only be controlled from the binary signal inputs configured for LOGIC: Set 1 EXT if the corresponding reset input LOGIC: Reset 1 EXT) has been configured for a binary signal input. If only one or neither of the two functions is configured, then this is interpreted as “Logic externally set”. If the input signals of the two binary signal inputs are implausible (such as when they both have a logic value of “1”), then the last plausible state remains stored in memory. (For LOG_2, there are no such parameters for assigning binary input signals.)

! WARNING

HAZARD OF UNINTENDED EQUIPMENT OPERATION

- When using the programmable logic, it is necessary to carry out a functional type test to conform with the requirements of the relevant protection/control application. In particular, it is necessary to verify that the requirements for the implementation of logic linking (by setting) as well as the time performance during startup of the P433, during operation and when there is a fault (blocking of the P433) are fulfilled.

Failure to follow these instructions can result in unintended equipment operation.

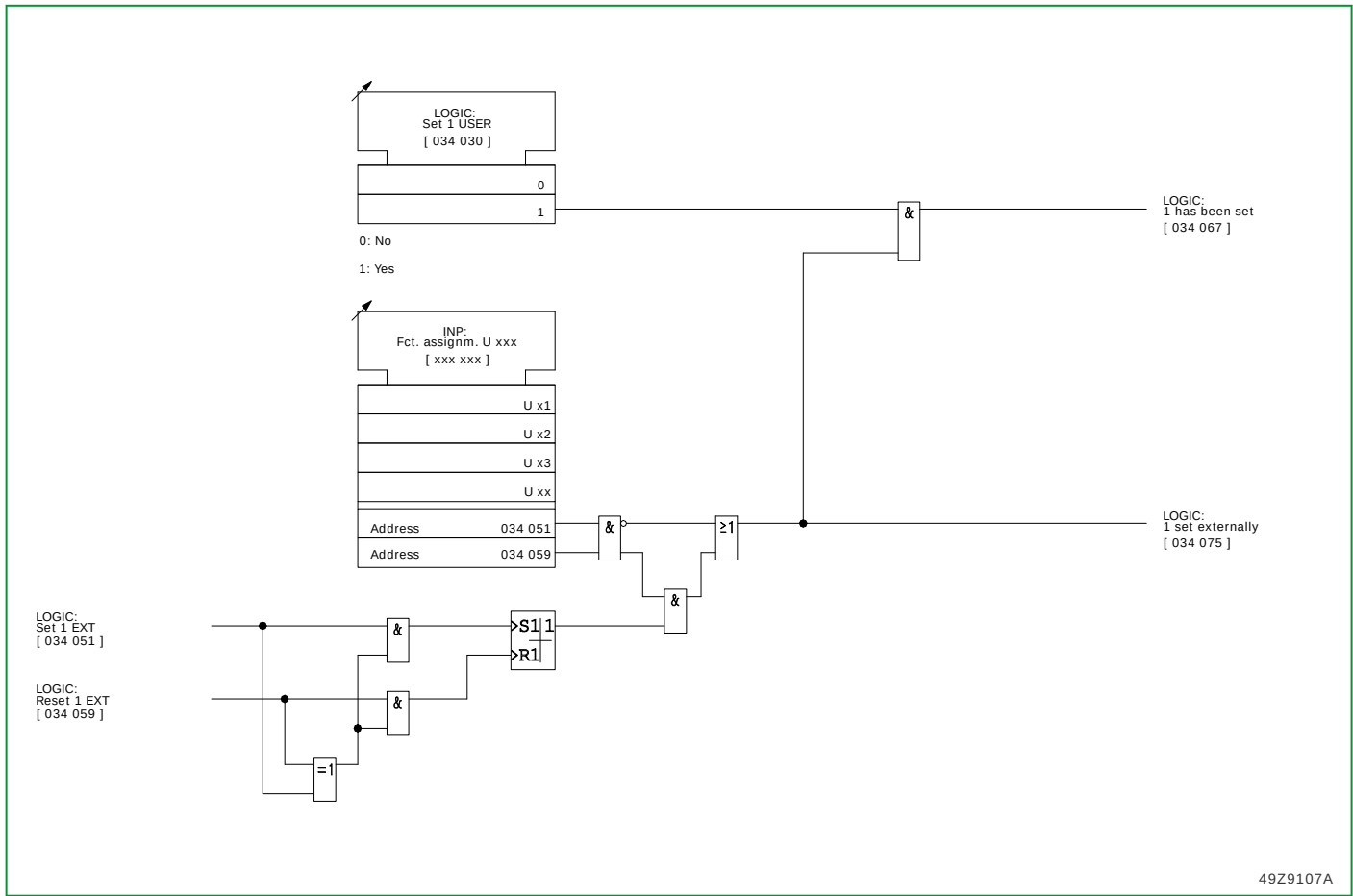
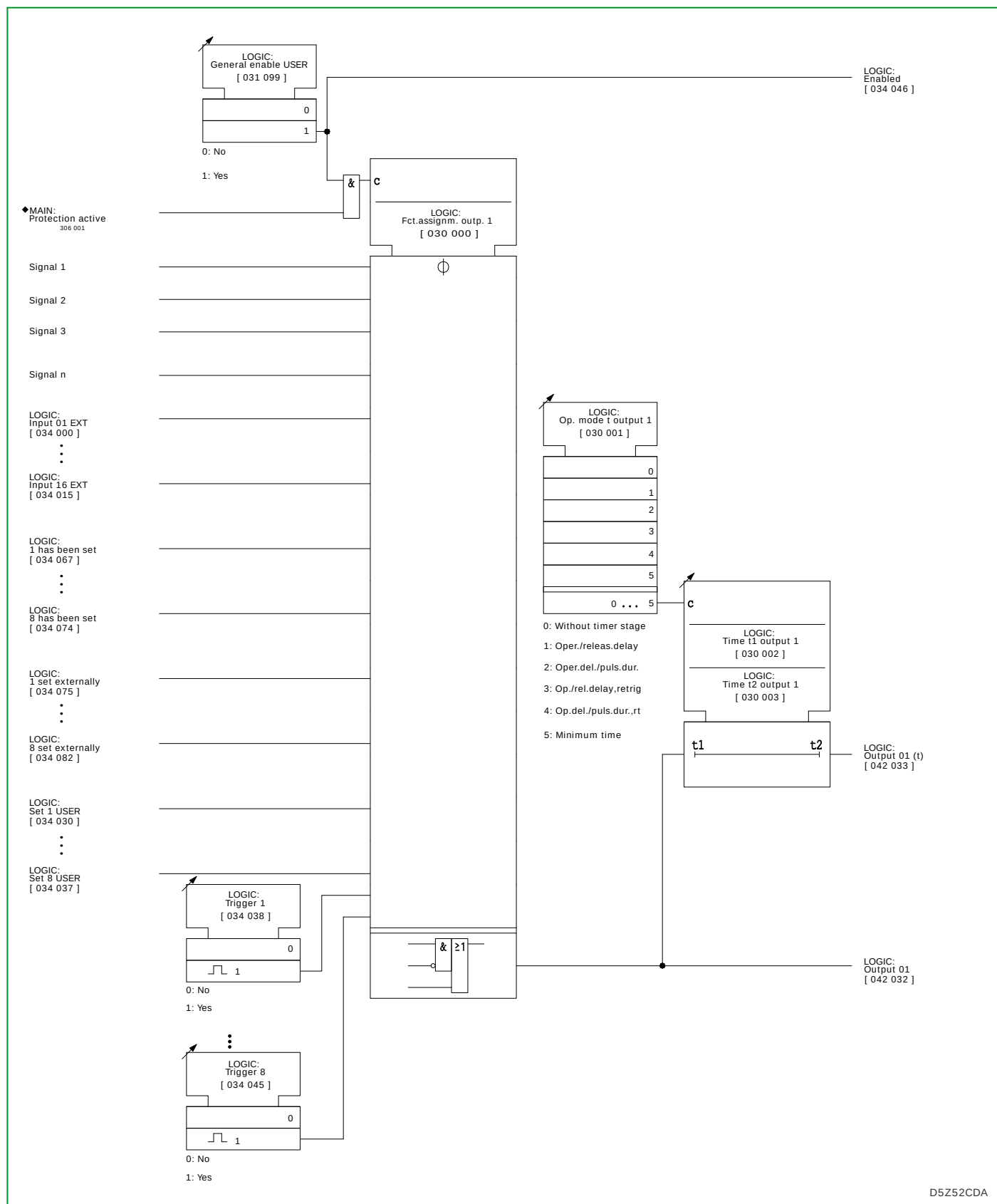


Fig. 3-404: Control of logic operations via setting parameters or stored input signals. (The logic does not apply to LOG_2.)

The LOGIC: Trigger 1 signal is a “triggering function” that causes a 100 ms pulse to be issued.



D5Z52CDA

Fig. 3-405: Setting options for programmable logic, function group LOGIC (shown here for output 1).

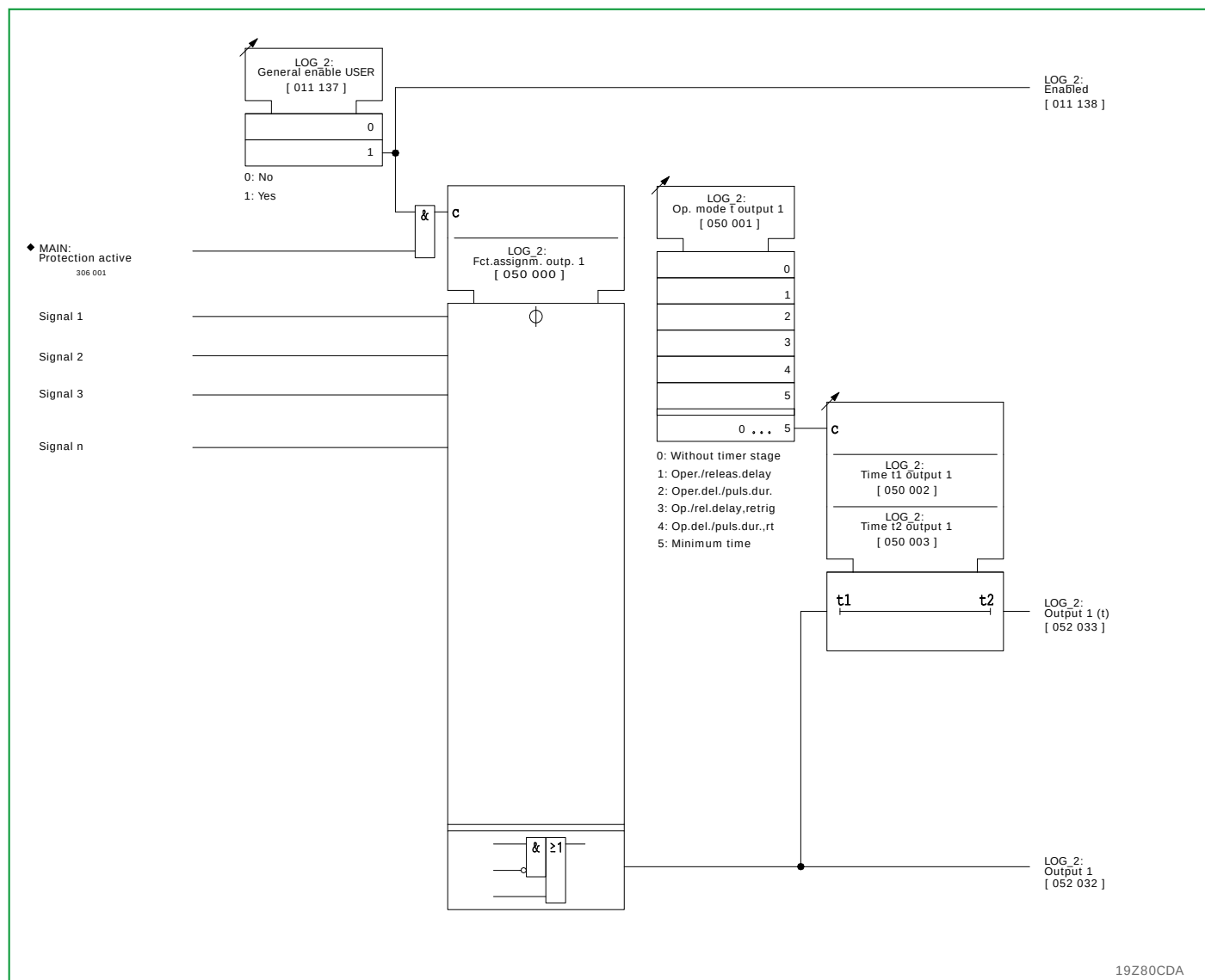


Fig. 3-406: Setting options for programmable logic, function group LOG_2 (shown here for output 1).

The output signal of an equation can be fed into a further, higher order, equation as an input signal thus creating a sequence of interlinked Boolean equations. The equations are processed in the sequence defined by the order of each equation. It should be noted that in the case of overlapping equations, the result is provided by the equation with the highest order.

The output signal of each equation is fed to a separate timer stage with two timer elements and a choice of operating modes. This offers the possibility of assigning a freely configurable time characteristic to the output signal of each Boolean equation. In the *Minimum time* operating mode, the setting of timer stage t2 has no effect. The following diagrams (Fig. 3-407, (p. 3-485) to Fig. 3-411, (p. 3-487)) show the time characteristics for the various timer stage operating modes.

If the P433 is switched to offline the equations are not processed and all outputs are set to the "0" logic level.

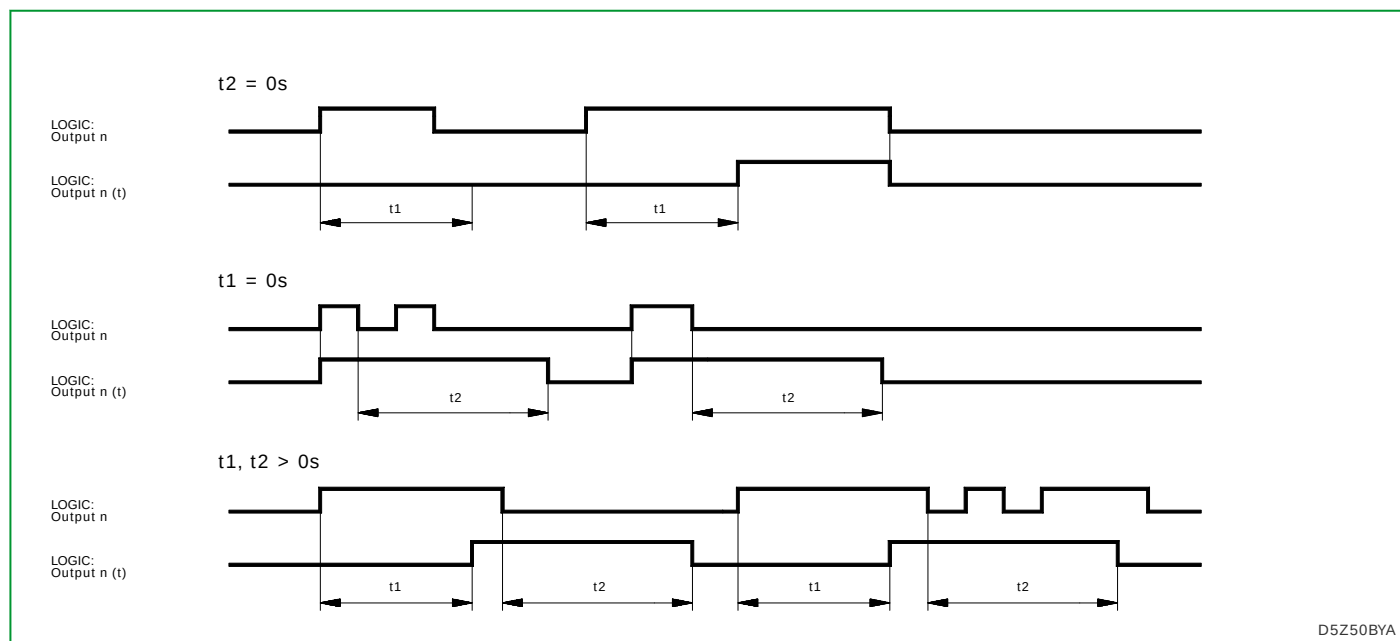


Fig. 3-407: Operating mode 1: Pickup/reset delay (Oper./releas.delay). (This diagram is also valid for LOG_2, if the signal parameters are replaced by the corresponding ones from LOG_2.)

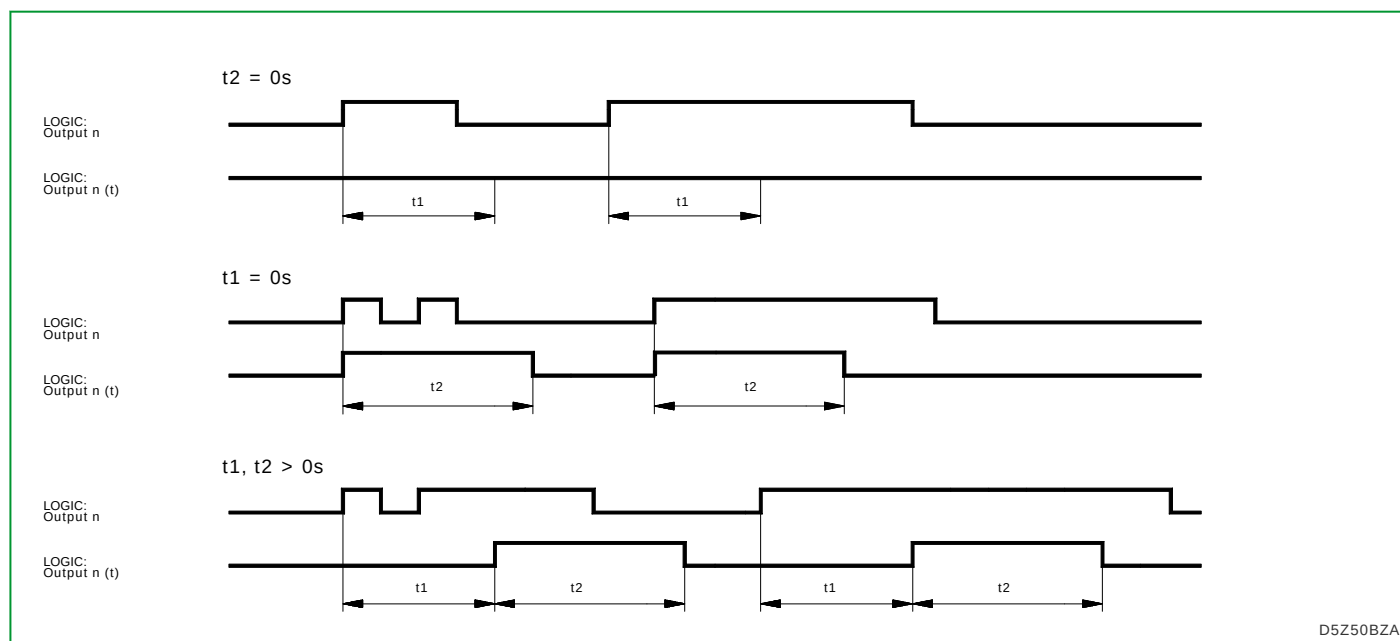


Fig. 3-408: Operating mode 2: Pulse, delayed pickup (Oper.del./puls.dur.). (This diagram is also valid for LOG_2, if the signal parameters are replaced by the corresponding ones from LOG_2.)

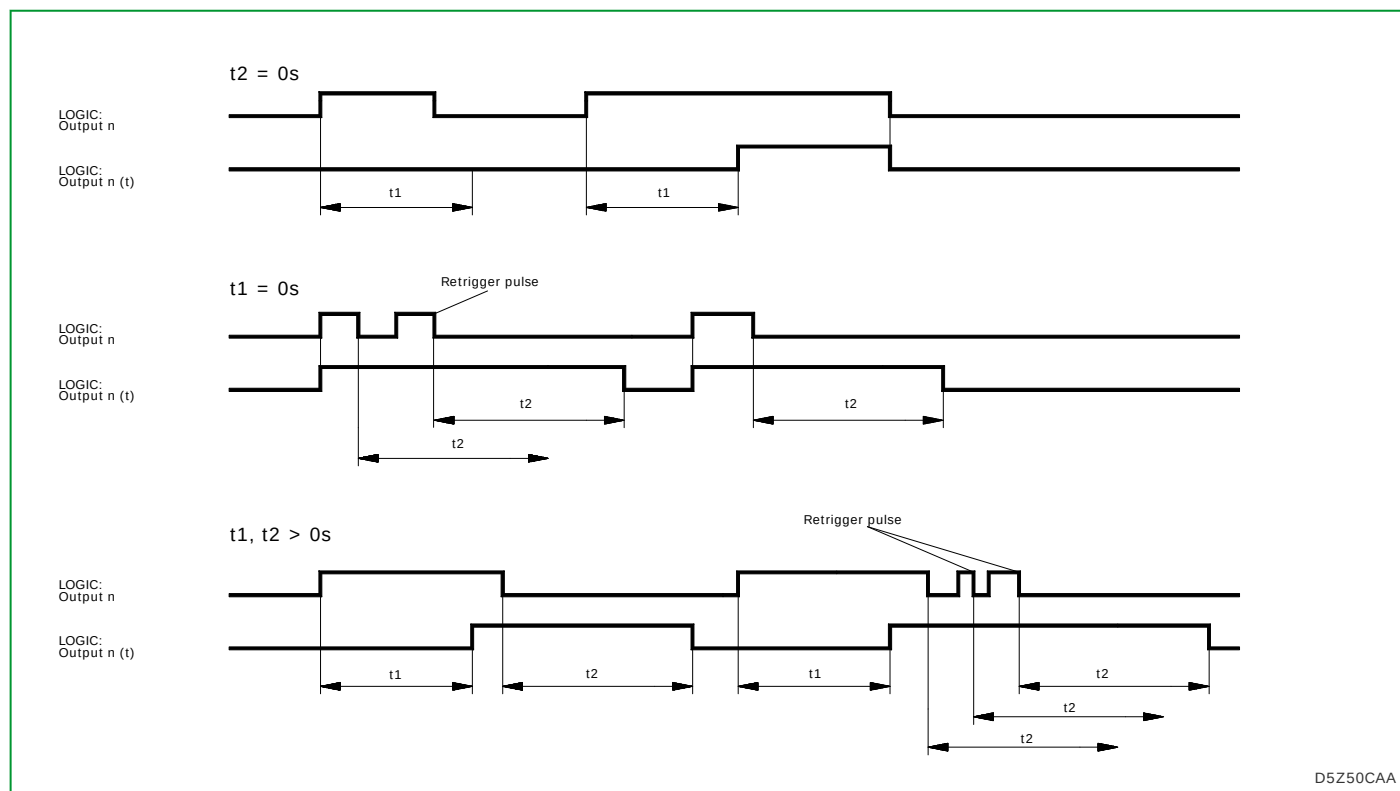


Fig. 3-409: Operating mode 3: Pickup/reset delay, retriggerable (Op./rel.delay, retrigger). (This diagram is also valid for LOG_2, if the signal parameters are replaced by the corresponding ones from LOG_2.)

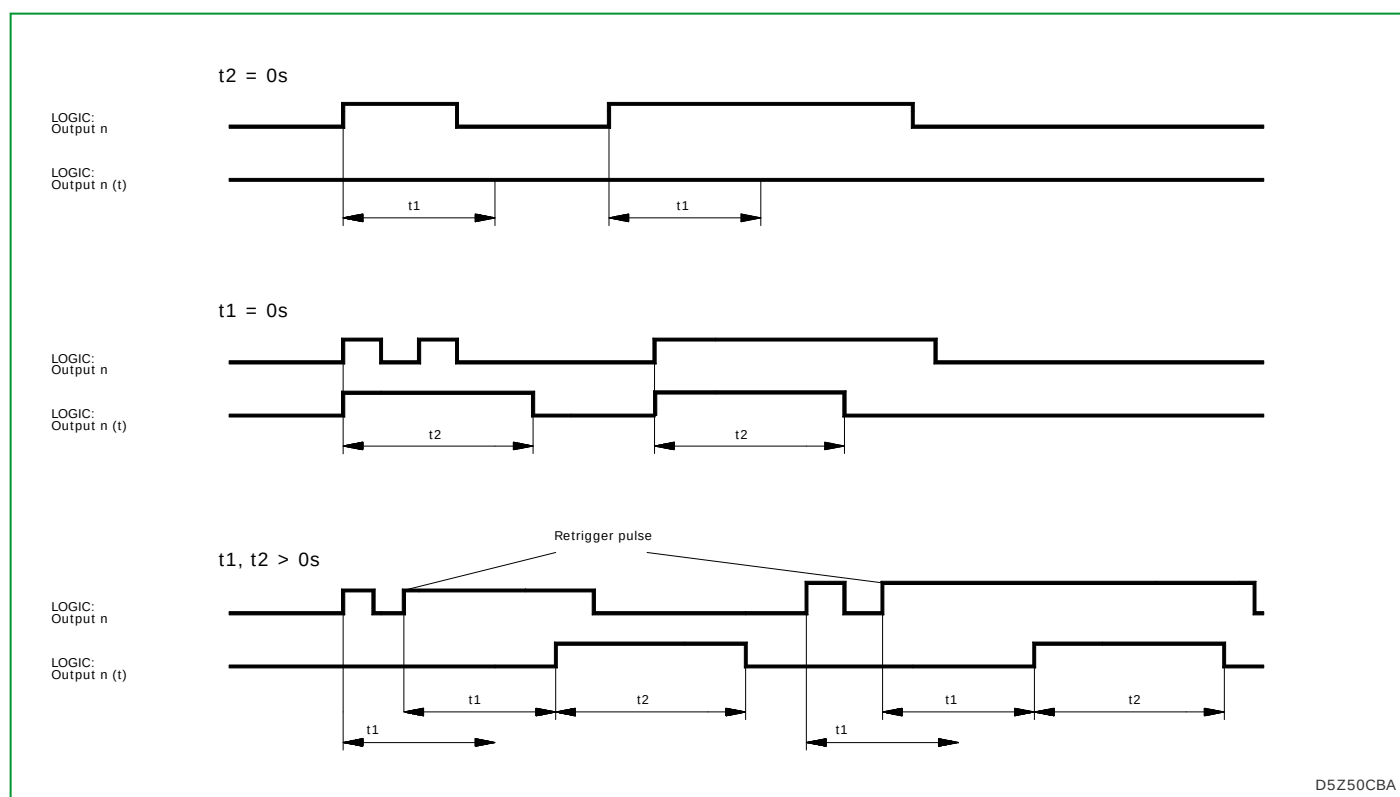


Fig. 3-410: Operating mode 4: Pulse, delayed pickup, retriggerable (Op.del./puls.dur., rt). (This diagram is also valid for LOG_2, if the signal parameters are replaced by the corresponding ones from LOG_2.)

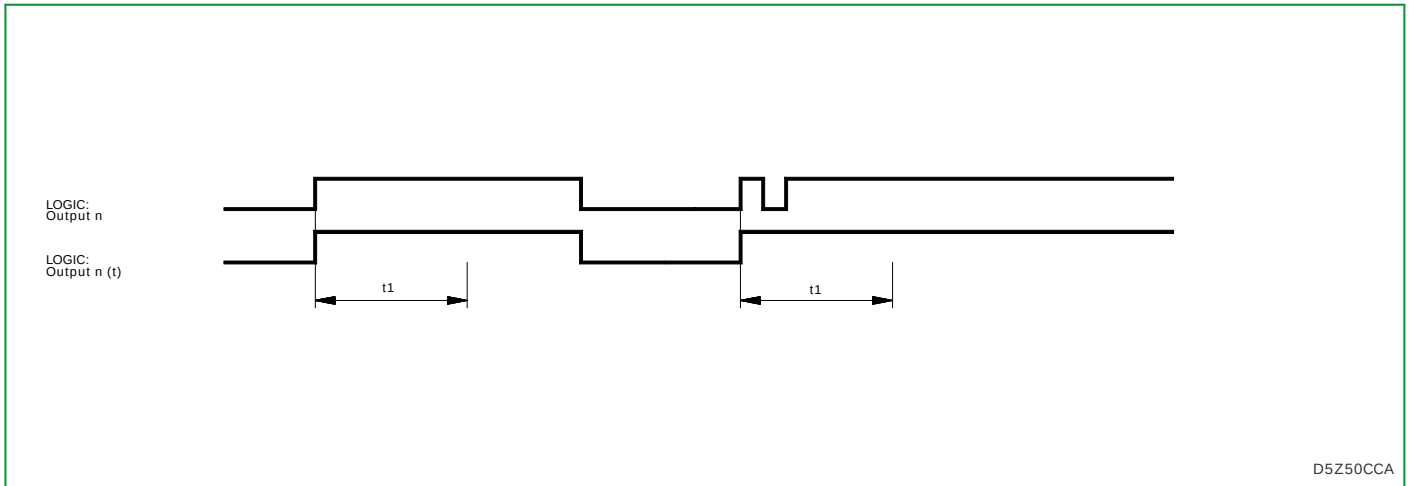
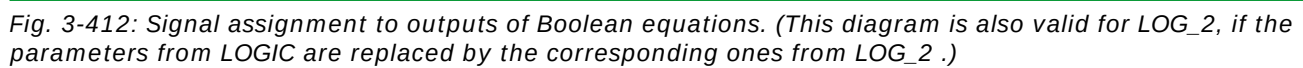


Fig. 3-411: Operating mode 5: Minimum time (Minimum time). (This diagram is also valid for LOG_2, if the signal parameters are replaced by the corresponding ones from LOG_2.)

Through appropriate configuration, it is possible to assign the function of a binary input signal to each output of a logic operation. The output of the logic operation then has the same effect as if the binary signal input to which this function has been assigned were triggered.



3.54 Control and Monitoring of Switchgear Units (Function Groups DEV01 to DEV03)

The P433 is designed to control up to 3 switchgear units. The two-pole forcibly guided termination contacts on the binary module X(6I 6O) are available for these.

The P433 provides a bay panel concept to simplify the configuration of the switchgear control functions. The bay panel type defines the layout of a bay with its switchgear units on the HMI, an automated I/O assignment and the system/bay interlocking equations for all required switchgear units. [Vol. 2, Chapter A5, \(p. A5-1\)](#) provides a description of all bay types which are pre-defined (generally for all Easergy MiCOM 30 devices) and therefore immediately available. The selection of a bay type can be done with the parameter (220 000) MAIN: Type of bay. (See [Section 3.54.1, \(p. 3-489\)](#) for some more information.)

3.54.1 Bay Type Selection

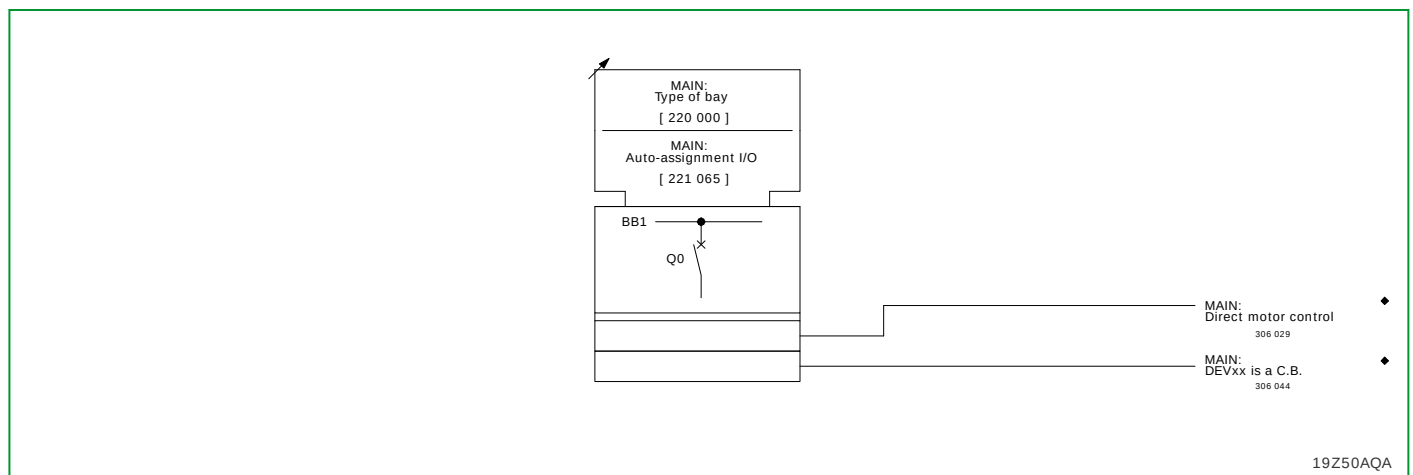


Fig. 3-413: Bay type selection.

The bay type defines the layout of a bay with its switchgear units, an automated I/O assignment and the system/bay interlocking equations for all required switchgear units. [Vol. 2, Chapter A5, \(p. A5-1\)](#) provides a description of all bay types, which are pre-defined (generally for all Easergy MiCOM 30 devices) and therefore immediately available.

The selection of a bay type can be done with the parameter (220 000) MAIN: Type of bay. If the user tries to select a non-existing ID, then the selection will be rejected and an error message “Signal from device: Bay type not assigned (0x8073)” will be reported in the “kommprot.txt” log file.

Once the user has selected a bay type, the P433 can automatically configure the binary inputs and output relays with function assignments for the control of switchgear units. This automatic assignment is defined via the parameter MAIN: Auto-assignment I/O.

The assignment of inputs and outputs for an automatic configuration is shown in the List of Bay Types ([Vol. 2, Chapter A5, \(p. A5-1\)](#)).

In general, the selection of a bay type (via MAIN: Type of bay) is accepted by the P433 only if all of the following requirements are fulfilled:

- The selected ID number is known by the P433, i. e. is available as a pre-defined standard bay type.
- Binary I/O module X(6I 6O) has been fitted to slot 6 (40 TE case) or 12 (84 TE case).
- The hardware (in particular the set of all binary I/O modules and power supply) has got a sufficient number of inputs and outputs as required by the selected bay type.
- Bay types with more than 3 switchgear devices are not supported by the P433.
- Bay types are generally not supported by the P433 in 24 TE case.
- None of the inputs/outputs required by the selected bay type has been previously assigned to a non-control function.

In case of the setting MAIN: Auto-assignment I/O = Yes, the following two constraints must be noted:

- The activation of a new bay type overwrites all DEVxx / SIG_1 / CMD_1 assignments to I/O elements that have been previously made (for the previous bay type definition).
- If the automatic I/O assignment fails because some required inputs and outputs have been assigned to a non-control function, or because the number of I/O elements available is not sufficient, then the previously selected bay type remains active and an error message "Signal from device: Hardware module not fitted (0x8063)" is reported in the "kommprot.txt" log file.

3.54.2 Enable for Switch Commands Issued by the Control Functions

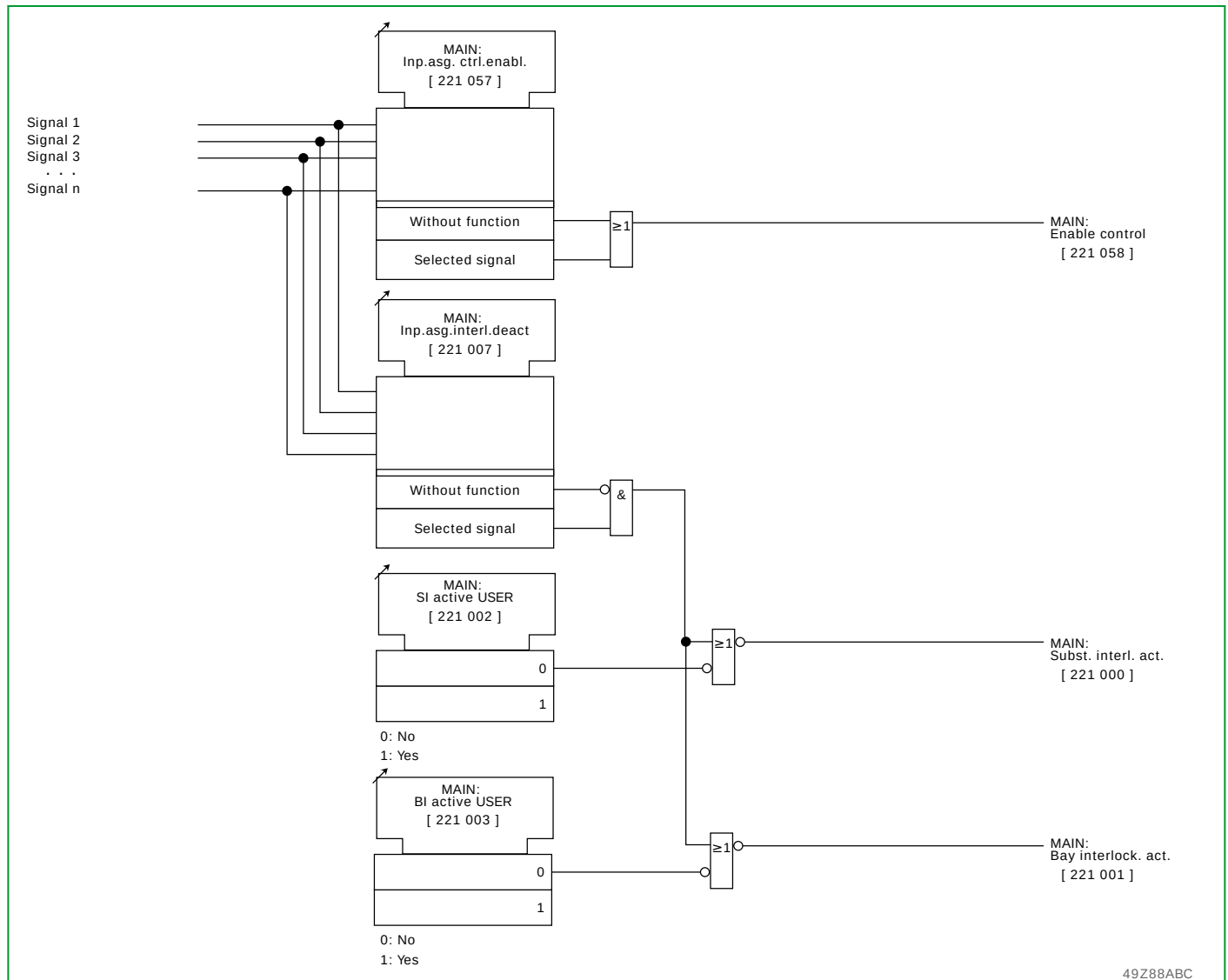


Fig. 3-414: General enable for switch commands issued by the control functions; activating or canceling the interlocks.

Before a switching unit within the bay is closed or opened by the control functions of the P433, the P433 first checks whether the switch command may be executed. A switch command will be executed if the optional control enable has been issued and the interlock conditions are met. The interlock conditions are defined in the interlocking logic for each switching unit within the bay that is subject to control actions and for each control direction (Open/Close). Different conditions are defined for the bay interlock equations to operate with or without station interlock. The check of bay or station interlock equations can be cancelled for all electrically controllable switchgear units within a bay. If the station interlock is active, it may be cancelled selectively for each switching unit and each control direction.

The bay and station interlocks may be cancelled through an appropriately configured binary signal input. This cancellation is effective for all of the operating modes “Local”, “Remote” and “Remote & Local” (setting LOC: Fct. assign. L/R key = R & L <-> L). In other words, the functionality of the binary input for cancelling the bay and station interlocks is independent of the operating mode of the control point for switching between local and remote control.

All station interlock functionality (e.g. the parameter MAIN: SI active USER) is active and available only if a communication module (i. e. a module of type "A") with 2 serial interfaces is fitted and either the IEC 60870-5-101 or -103 communication protocol is configured.

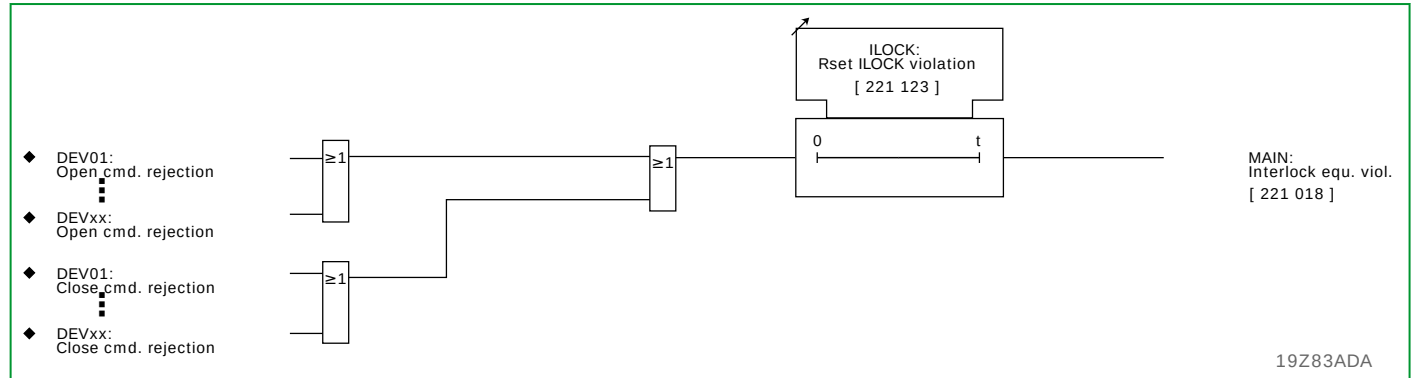


Fig. 3-415: Rejection of the switching commands.

During a switch command is being executed, any further switch command is rejected ("Double Command Lockout"). This includes interlocking of parallel switching operations and further switch commands to the currently selected switching unit.

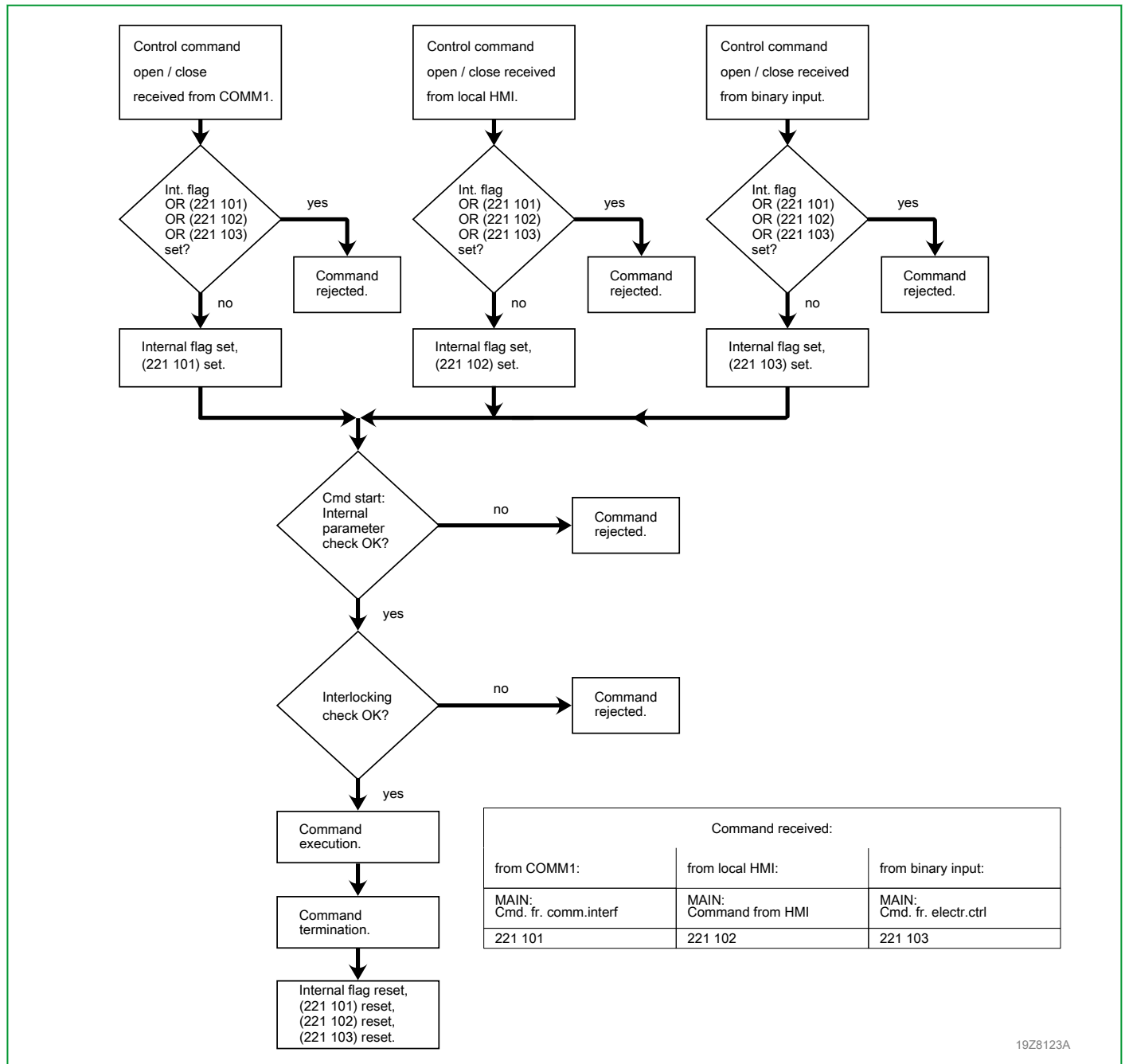


Fig. 3-416: "Double Command Lockout".

3.54.3

Designation of External Devices

Each external device represented in the Bay Panel is identified by an external device designation. The user can either select this designation from a list of over 70 pre-defined names (via the parameter DEV01: Designat. ext. dev. in case of DEV01, for example), or this parameter is set to *Device Name User*. With this selection, a user-defined text for the name of the external device will be used as the designation. This user-defined text has to be entered at DEV01: DEV-Name User (in case of DEV01, for example).

(The maximum length is 4 characters, as with the fixed identifiers. Longer text entries are truncated to 4 characters internally.)

3.54.4

Defining a Bay Panel Type

With the selection of a Bay Panel type, the following definitions are made:

- Manually operated switchgear units with status signals to be processed.
- Switchgear units to be controlled and signaled by the P433.
- The bay interlock conditions for the “Open” / “Close” command control of the switchgear units, for operation with or without the station interlock function.
- Binary inputs required for switchgear units with direct motor control.
- Binary outputs required for switchgear units with direct motor control.

When a Bay Panel type is selected, the binary inputs for switchgear status signals and the output relays for control commands are configured automatically if MAIN: Auto-assignment I/O is set to Yes. If set to No, the user will need to carry out this configuration. The list of Bay Panel types in the Appendix shows which binary inputs and output relays have been assigned signals or commands for control of switchgear units in the case of automatic configuration.

Setting options for the P433 and the different possibilities to integrate a switchgear unit into the functional sequence of the P433 (processing of status signals only or controlling and signaling) will be explained below, using one switchgear unit as an example. Function group DEV01 will be used throughout in this example. If a signal is identified in the function diagrams by function group “COMM1:” with a blank address [--- ---], it will indicate that it is a signal to or from the communication interface and that it has not been assigned an address.

3.54.5 Processing Status Signals from Manually Operated Switchgear Units

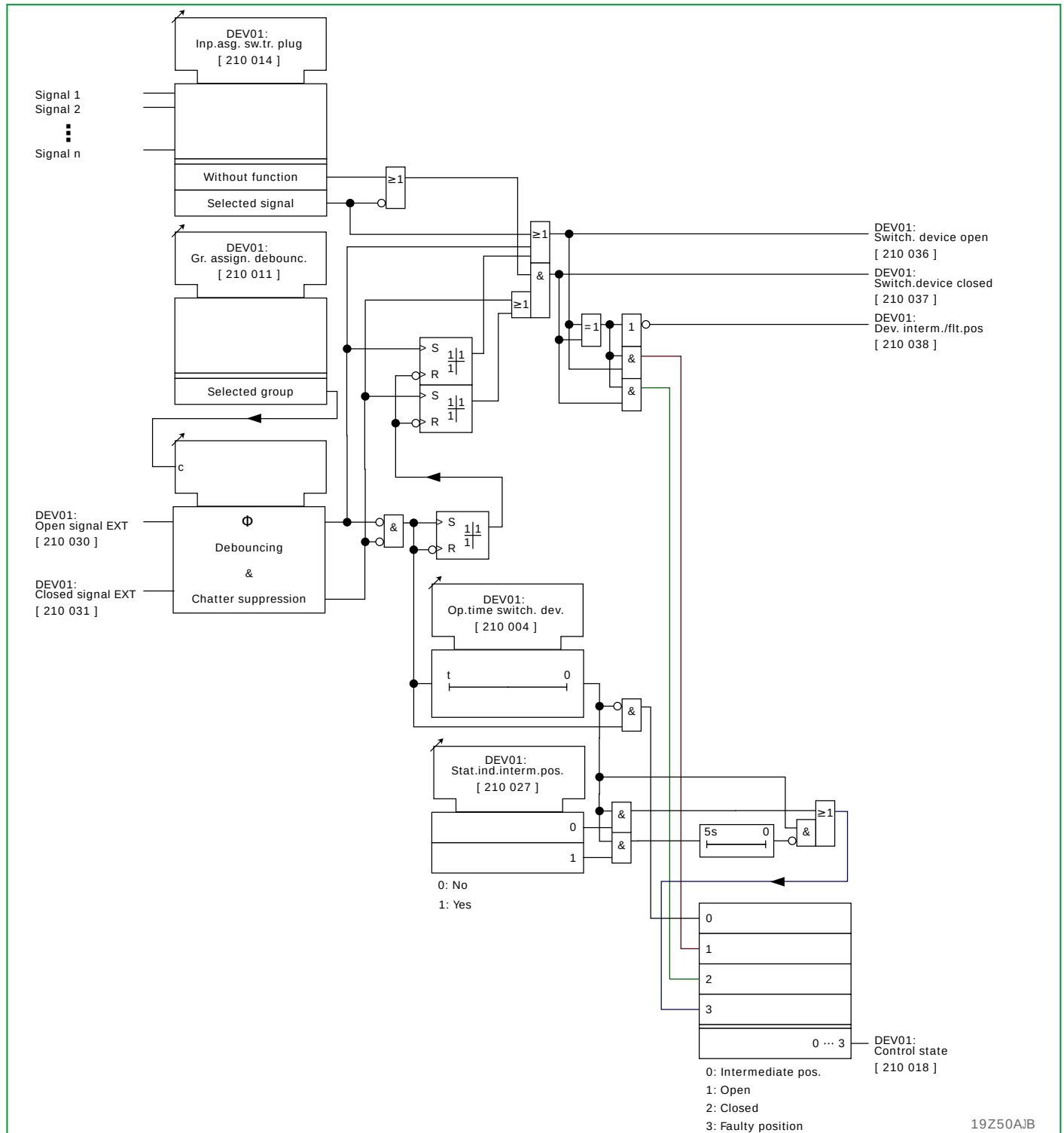


Fig. 3-417: Processing Status Signals from Manually Operated Switchgear Units.

3.54.5.1 Status Signals

The status signals "Open" and "Closed" are assigned to binary signal inputs. The signals conditioned by debouncing and chatter suppression (see [Section 3.57.1.1, \(p. 3-521\)](#)) are used for further processing. If no logic value of "1" is present at any of the two binary signal inputs, the running time monitoring function is started. For the duration of the set time period for running time

monitoring or until the contacts on the switchgear unit are back to a defined position – either “Open” or “Closed” – the signal “Intermediate position” is issued.

If DEV01: Interm. pos. suppr. is set to Yes, the previous switchgear unit status will continue to be signaled to the communication interfaces while the switchgear unit is operating. Once the contacts on the switchgear unit have reached their new position, the updated status is signaled accordingly to the communication interfaces. This parameter has no impact to internal signals, such as DEV01: Switch. device open, DEV01: Switch.device closed or DEV01: Dev. interm./flt.pos.

The signal “Faulty position” is issued if the contacts on the switchgear unit have not reached either their “Open” or “Closed” position after the set time period for running time monitoring and the delay time set in MAIN: Delay Man.Op.Superv. have elapsed. If DEV01: Stat.ind.interm.pos. is set to Yes, a delay time of 5 s is started. Once this time period has elapsed and there is no status signal for the position, the state actually present at the binary inputs will be signaled.

3.54.5.2 Switch Truck

For switchgear units mounted on switch trucks with switch truck plugs, it is possible to configure a single-pole status signal from the switch truck plug. If such a configuration has been assigned, the status signal for the position of the associated switchgear unit is set to “Open” while the input has a logic value of “1”.

3.54.6 Functional Sequence for Controllable Switchgear Units

3.54.6.1 Local or Remote Control of External Devices

Switchgear units can be controlled from a remote location or locally. The selection of the control point is described in [Section 3.4.6, \(p. 3-16\)](#). Usually, remote control is carried out via the communication interface, local control via the keys on the local control panel. Moreover, switchgear units can be controlled via binary inputs configured appropriately (configuration via DEV01: Inp.asg.el.ctrl.open or DEV01: Inp.asg.el.ctrl.close). The setting MAIN: Electrical control determines whether the inputs function as remote or local control points.

Dependent on the respective position of control the P433 will issue the following logic state signals:

- MAIN: Cmd. fr. comm.interf, or
- MAIN: Command from HMI, or
- MAIN: Cmd. fr. electr.ctrl

Additionally the following state signals are issued and entered into the operating data memory:

- DEV01: Open cmd. received
- DEV01: Close cmd. received

The operating mode of the control point is signaled as follows:

	<i>“Remote”</i>	<i>“Local”</i>	<i>“Remote & Local”</i>
LOC: Rem.acc.block.active	No	Yes	No
LOC: Loc.acc.block.active	Yes	No	No

3.54.6.2

Selection of the Switchgear Unit to be Controlled and Generating a Switching Request

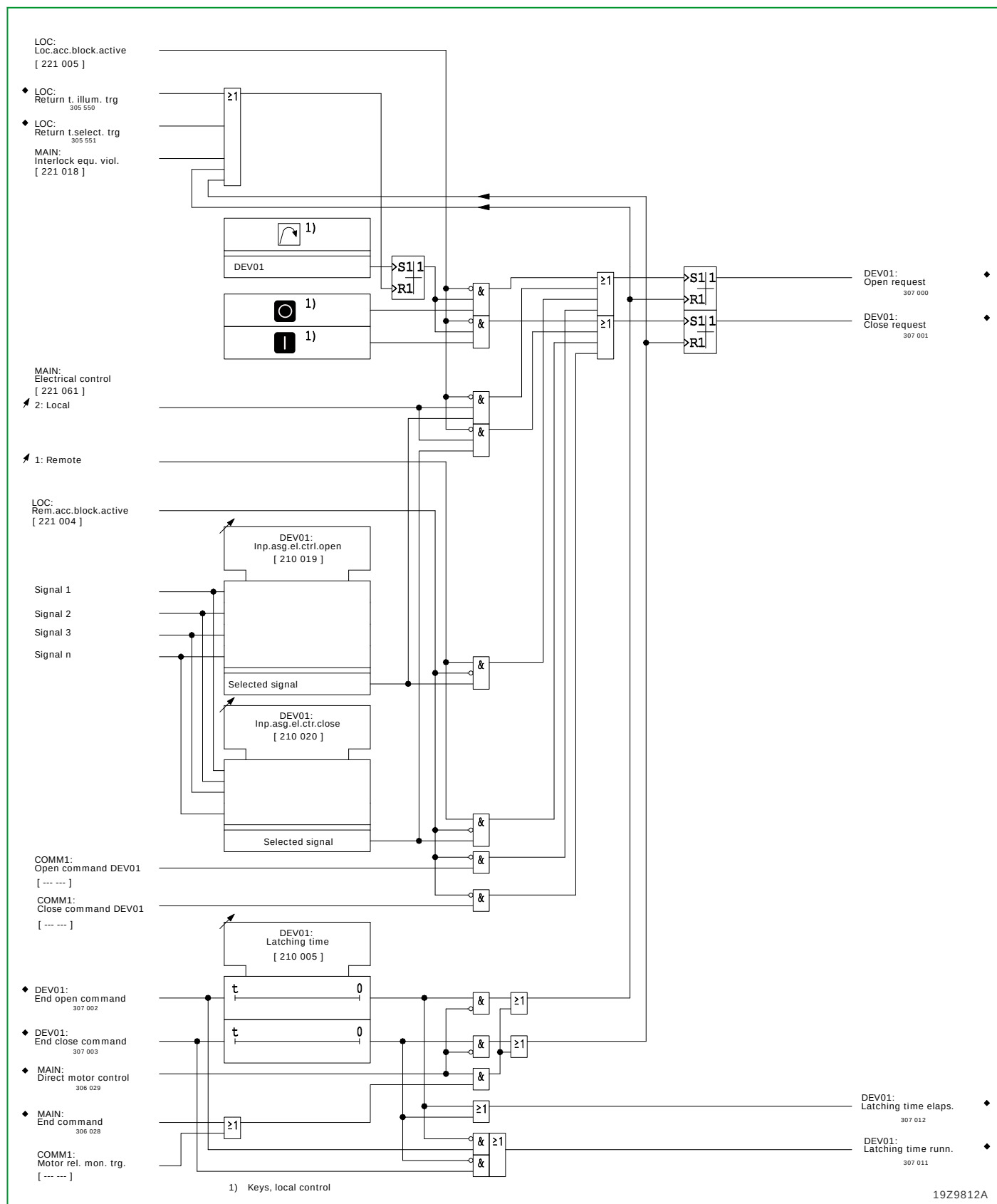


Fig. 3-418: Generating a switching request.

The switchgear unit to be controlled is selected and the switching command is sent to this selected switchgear unit. This can be carried out via the local control panel using the selection key and pressing the “Open” or “Close” key to generate the switching request. For control via binary inputs, the appropriate control inputs need to be configured for switchgear units selected to be controlled. For control via the communication interface, the control commands “Open” or “Close” will also address the switchgear unit to be controlled.

3.54.6.3 Enabling Switching Commands

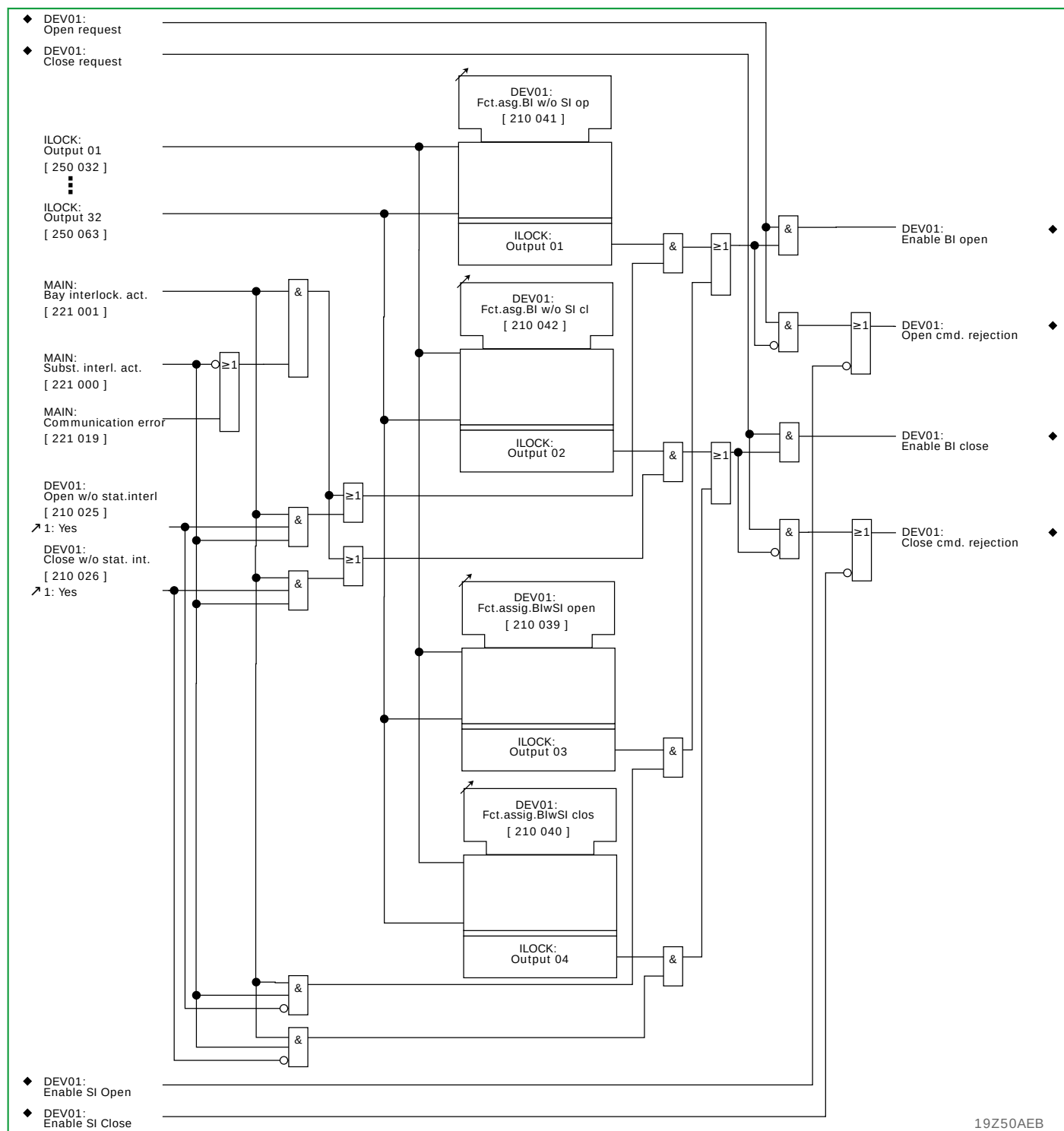


Fig. 3-419: Assignment of the equations of the interlocking logic to the switching commands; enabling of switching commands by the bay interlock function.

Before a switching command is executed, the P433 checks the interlocking conditions defined in the interlocking logic to determine whether a switching command is permitted or not. Bay interlock conditions for operation with or without the station interlock function can be defined. The assignment of an output relay from the interlocking logic to a switching command determines the interlocking conditions that define, for example, the conditions for the “Open” command for operation without the station interlock function.

3.54.6.4

Bay Interlock for Operation with the Station Interlock Function

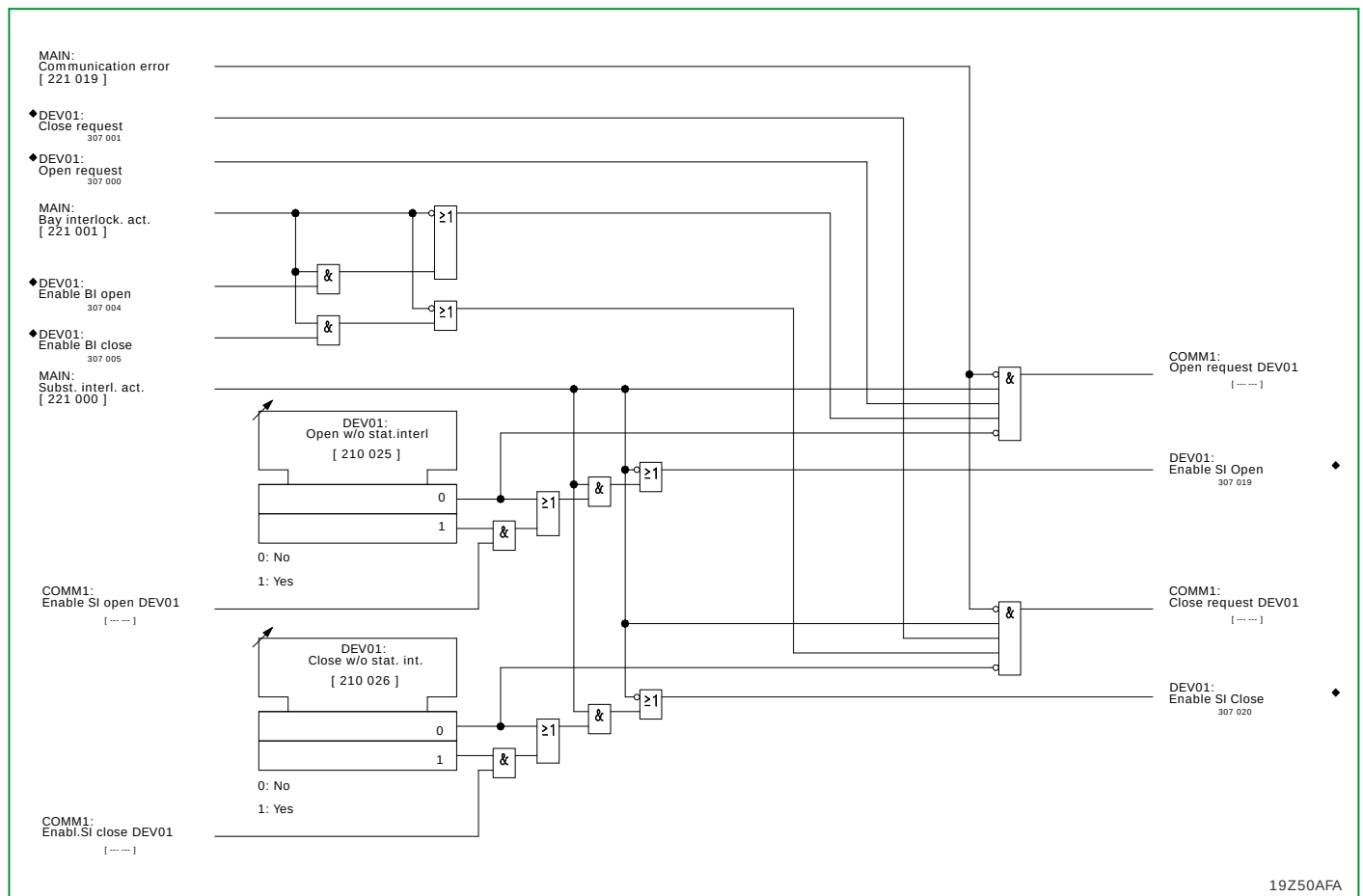


Fig. 3-420: Enabling of the switching commands by the station interlock.

For the station interlock function conditions to be interrogated, there needs to be a communication link with the substation control level. If the P433 detects a communication error or if there is no communication interface available, there will be an automatic switch to bay interlock without the station interlock function. If there is to be a check on the bay interlock and the station interlock function, the bay interlock will be checked first. If bay interlocking issues a switching enable, a switching request will be sent to the substation control level. At substation control level, there will then be a check – taking into account the station interlock functions – as to whether switching is permitted or not. If the substation control level also issues an enabling command, the switching operation is carried out provided that the enable from the bay interlock is still present. Optionally, the “Open” or “Close” switching operation can be carried out without checking the station interlock function conditions. In this case, the bay interlock conditions defined for operation without station interlock functions will be considered.

3.54.6.5

Linking Protection Commands to Switching Commands

For circuit breakers, the “Open” command can be linked to the protection trip signals. The “Close” command can also be linked to the close command of the protection functions. The Bay Panel type defines which of the switchgear units are circuit breakers. The trip (open) or close commands of the protection functions are executed directly without a check of the interlocking conditions.

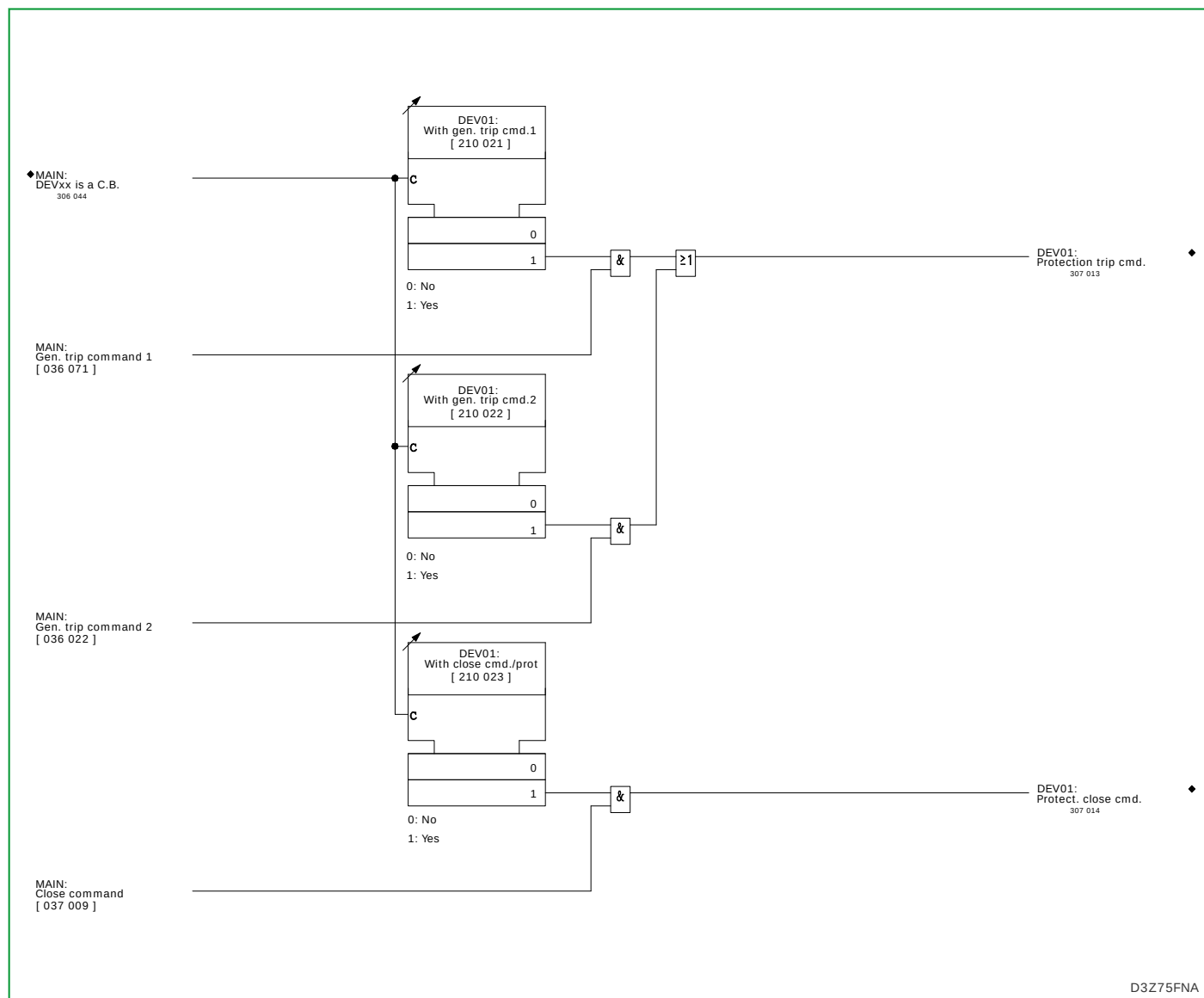


Fig. 3-421: Linking to the protection commands.

3.54.6.6 Issue of Switching Commands

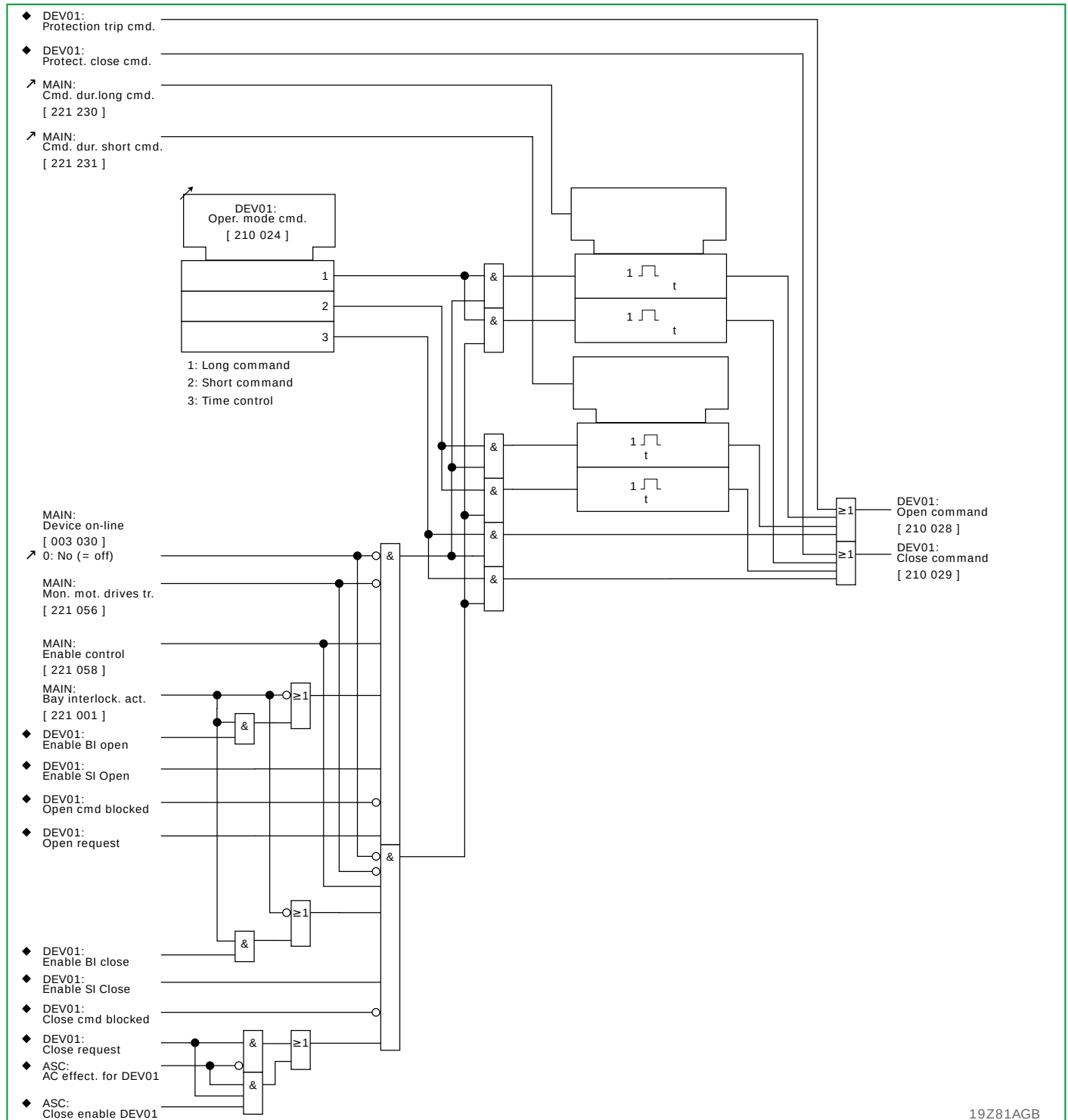


Fig. 3-422: Issue of switching commands.

Dependent on the operating mode (set at DEV01: Oper. mode cmd.) set for commands, switching commands are issued for the set timer durations or according to time control.

When the automatic synchronism check (ASC) is active and the parameter ASC: System integrat. PSx is set to *Autom.synchr.control* a "Close" request will automatically issue a "Close" command for the circuit breaker after a *close enable* was issued by the ASC.

However if ASC: System integrat. PSx is set to *Autom.synchron.check* ASC will not interfere with any switching commands. Data generated and continuously updated by the ASC function is transmitted – when configurations have been set accordingly – to the central control station, where operators may make decisions as to which external device is to be given a switching command.

3.54.6.6.1 Blocking of Switchgear Device Operation

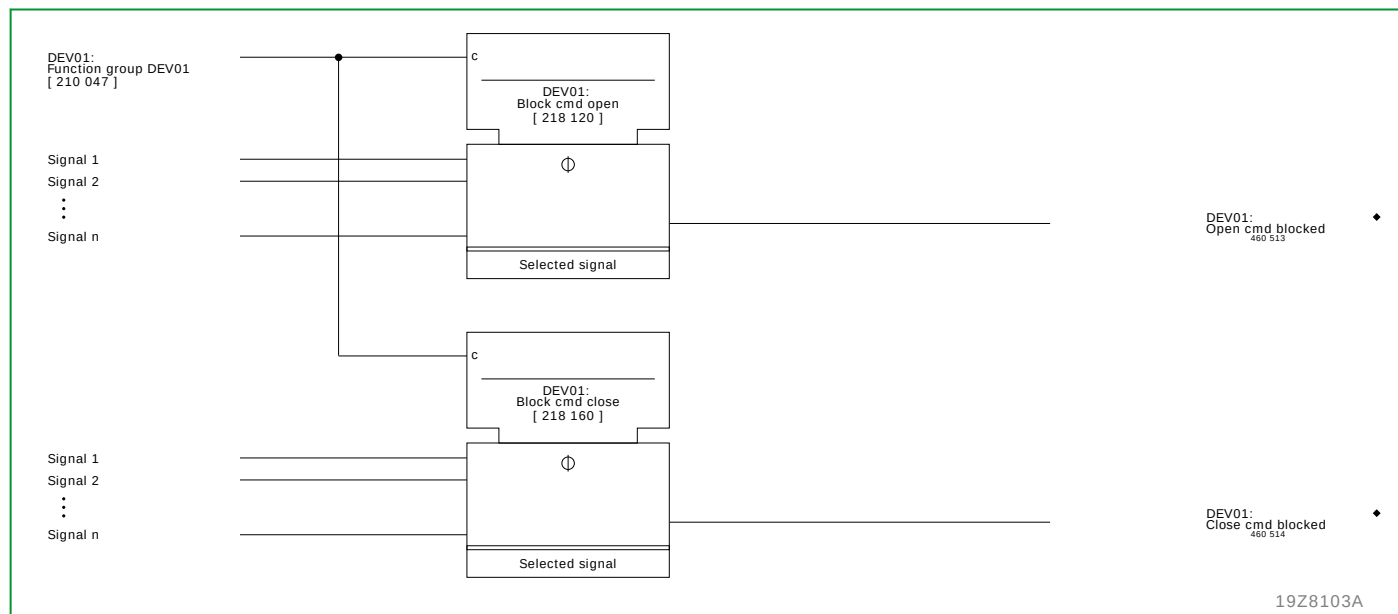


Fig. 3-423: Blocking of switchgear device operation.

It is possible to generally block open and / or close commands to a switchgear device. Setting parameters DEV01: Block cmd open and DEV01: Block cmd close (and correspondent parameters for the other DEVxx) are available for this purpose. Due to safety reasons the blocking inputs are effective only if no command is active. During a switching operation the blocking is disabled to secure that the switch will move always into a safe position.

To each of these setting parameters can be signals assigned; each of these signals then activate the blocking of the switching command appropriate to this setting parameter. In this case the signal MAIN: Interlock equ. viol. is issued, just like with a breach of the interlocking conditions.

3.54.6.6.2 External Termination Control

If the operating mode *Time control* was selected it is possible to intervene in the control process of external switchgear units by using external termination contacts. It will then be necessary to set the P433 at MAIN: W. ext. cmd. termin. to Yes and binary signal inputs must be configured so they can be connected to the external termination contacts. The input configuration has to be done for each device separately. Be aware that an external command termination does not make sense for a fast switch as a circuit breaker, as its operation is edge-controlled and involves no motor being directly time-controlled (contrast to a disconnecter drive).

3.54.6.7

Switch Truck

For switchgear units mounted on switch trucks with switch truck plugs, it is possible to configure a single-pole status signal from the switch truck plug. If such a configuration has been assigned, the status signal for the position of the associated switchgear unit is set to 'Open' while the input has a logic value of "1".

3.54.6.8

Time Control of Switching Commands

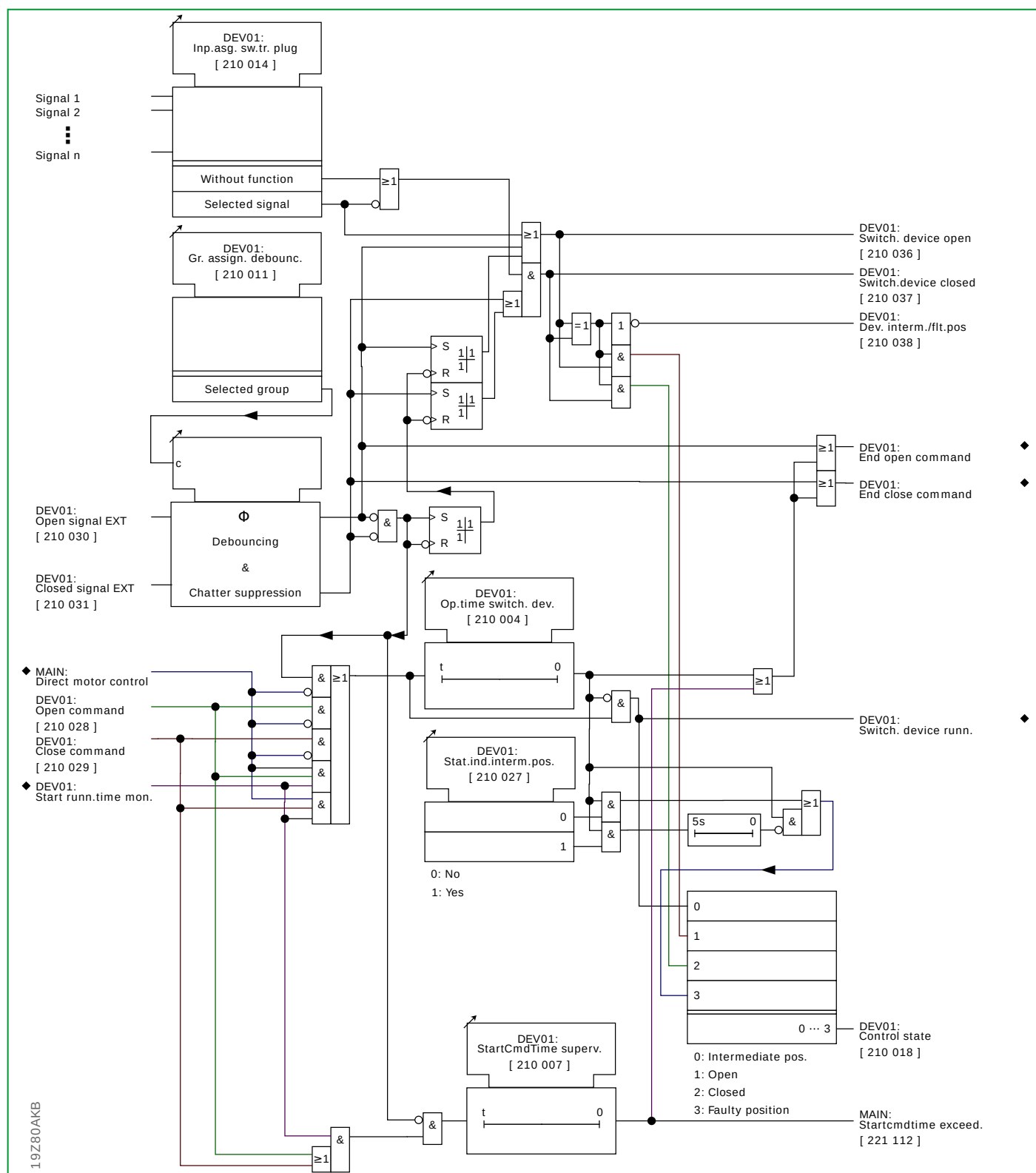


Fig. 3-424: Monitoring of switching commands.

After sending an Open / Close command, running time monitoring for the switchgear unit is started.

The P433 expects that the switchgear unit has reached its intermediate position within a period of time that can be configured via DEV01: StartCmdTime superv. (for DEV01, respective setting parameters exist for the other DEVxx). If

the switchgear unit has not reached its intermediate position after this time has elapsed then the command is deactivated and an exceeded timer is flagged by the signal `MAIN: Startcmdtime exceed..` In case of a switchgear unit for which it is (almost) impossible to detect the intermediate position (for example a Circuit Breaker) it is recommended to switch off this monitoring by setting the parameter to `Blocked`.

Moreover, the P433 expects a status signal – “Open” or “Closed” to be issued by the switchgear unit within the duration of running time monitoring. The status signal for the position of the contacts on the switchgear unit is present at appropriately configured binary inputs on the P433, which can be set to debouncing and chatter suppression mode (see [Section 3.57.1.1, \(p. 3-521\)](#)). For the duration of running time monitoring or until the contacts on the switchgear unit are back to a defined position – either “Open” or “Closed” – the signal “Intermediate position” is issued.

If `DEV01: Interm. pos. suppr.` is set to `Yes`, the previous switchgear unit status will continue to be signaled to the communication interfaces while the switchgear unit is operating. Once the contacts on the switchgear unit have reached their new position, the updated status is signaled accordingly to the communication interfaces. This parameter has no impact to internal signals, such as `DEV01: Switch. device open`, `DEV01: Switch.device closed` or `DEV01: Dev. interm./flt.pos.`

If the contacts on the switchgear unit have not reached either their “Open” or “Closed” position after the set time period for running time monitoring has elapsed the signal *Faulty position* is issued. If `DEV01: Stat.ind.interm.pos.` is set to `Yes`, a delay time of 5 s is started. Once this time period has elapsed and there is no status signal for the position, the state actually present at the binary inputs will be signaled.

If the operating mode without external termination contacts was selected (`MAIN: W. ext. cmd. termin..` is set to `No`) the switching command is terminated after the set latching time has elapsed, when either the ‘Open’ or ‘Closed’ position status signal is received or the set time period for running time monitoring has elapsed (see [Fig. 3-418, \(p. 3-497\)](#)).

If the operating mode with external termination contacts was selected (`MAIN: W. ext. cmd. termin..` is set to `Yes`) the switching command is terminated, after the set latching time has elapsed, when a termination command is issued while the set time period for running time monitoring is active.

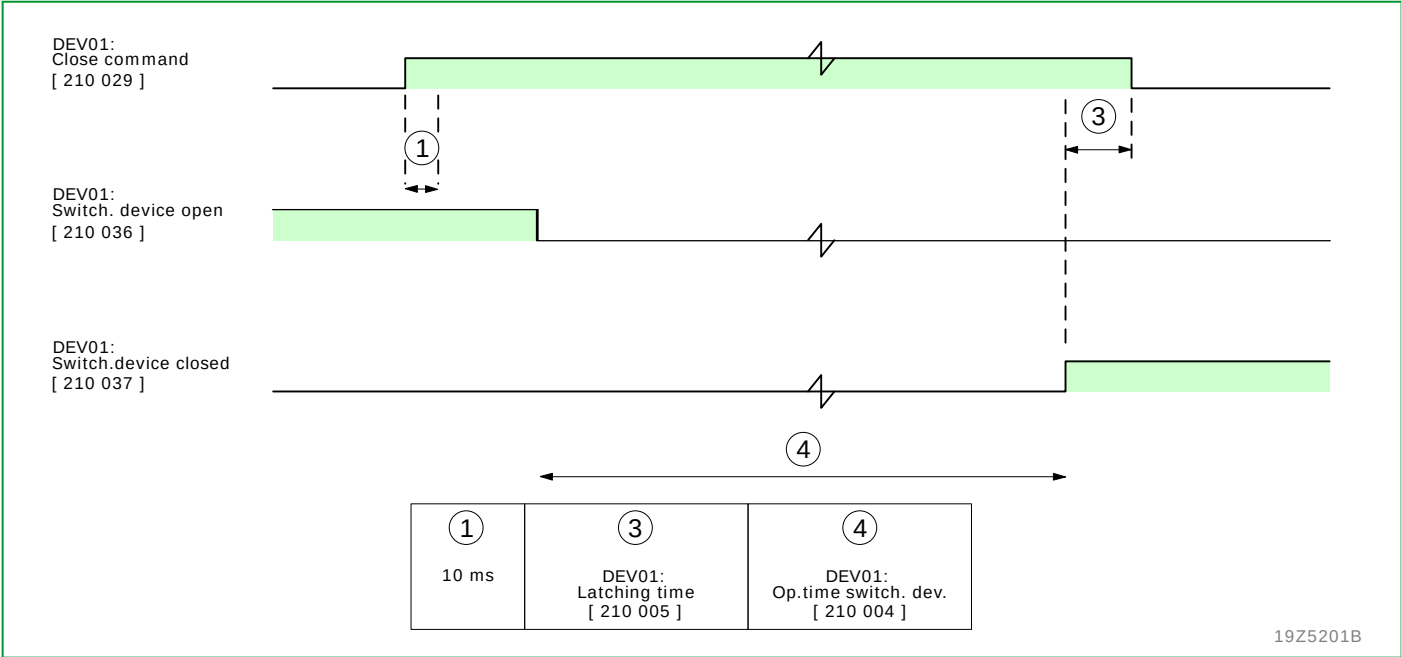


Fig. 3-425: Sequence for time control of switching commands without external termination control, example for switching operation “close”.

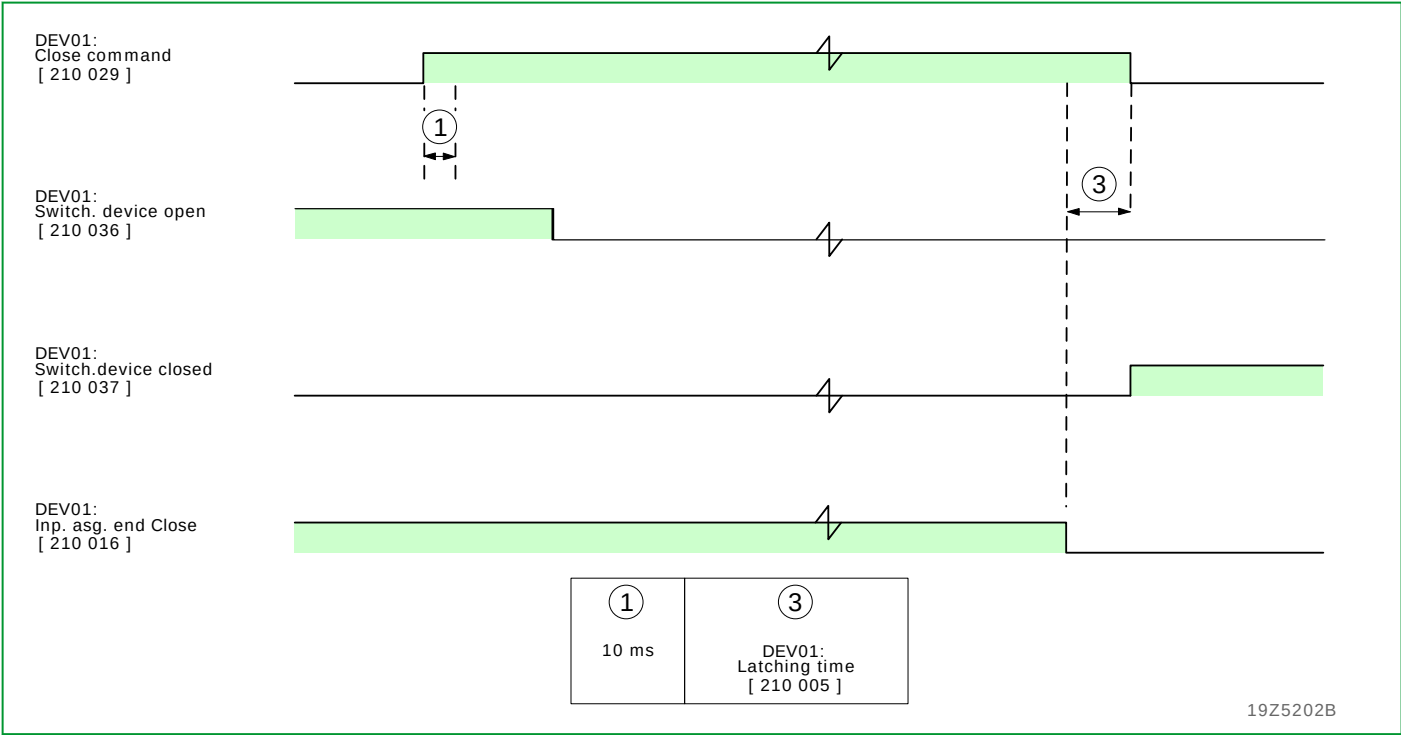


Fig. 3-426: Sequence for time control of switching commands with external termination control, example for switching operation “close”.

3.54.6.9 Monitoring the Number of CB Operations Permitted

The maximum number of CB operations within an ARC cycle (or within a specific time period) may be set with parameter MAIN: CB1 max. oper. cap. Associated with this parameter is the counter at MAIN: CB1 act. oper. cap. to which the maximum number of CB operations permitted is assigned as soon as the positive edge of an event is present that has been selected by a "1 out of n" parameter at MAIN: CB1 ready fct.assign.

The number of CB operations permitted, set with the counter at MAIN: CB1 act. oper. cap. are then decremented by 1 with each CB operation. Operation of the CB is recognized from the contact position signals DEV01: Switch.device open and DEV01: Switch.device closed.

The counter at MAIN: CB1 act. oper. cap. may only be decremented to a value of 1. Reaching a value of 1 will in no way effect the protection or control functionality, in particular there will be no blocking of CB operation! When a CB fault has occurred (i.e. MAIN: CB1 faulty EXT is set to Yes) the counter MAIN: CB1 act. oper. cap. is immediately set to 1.

3.54.7 Direct Motor Control

3.54.7.1 Monitoring the Motor Drives in Case of Direct Motor Control

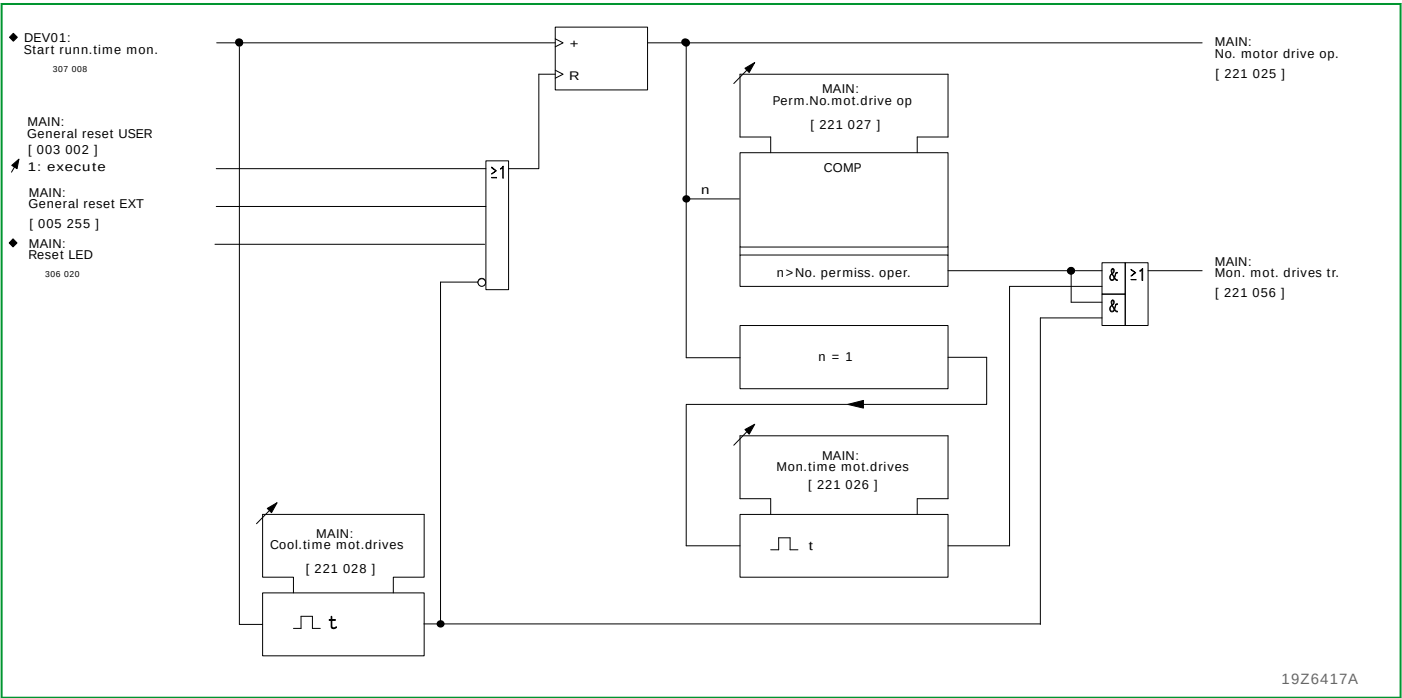


Fig. 3-427: Monitoring the Motor Drives in Case of Direct Motor Control.

For bays with direct motor drive control of load disconnecting switches, isolating links or grounding switches, a monitoring function is provided to protect motors from overheating.

The number of switching operations within a set monitoring period is counted. If the number of switching operations within the monitoring period exceeds the set limit, the signal MAIN: Mon. mot. drives tr. is issued. For the duration of the set cooling time, no control commands to motor-driven switchgear units will be executed. Once the set cooling time has elapsed, the control commands are enabled again.

3.54.7.2 Counter for the Open / Close Commands

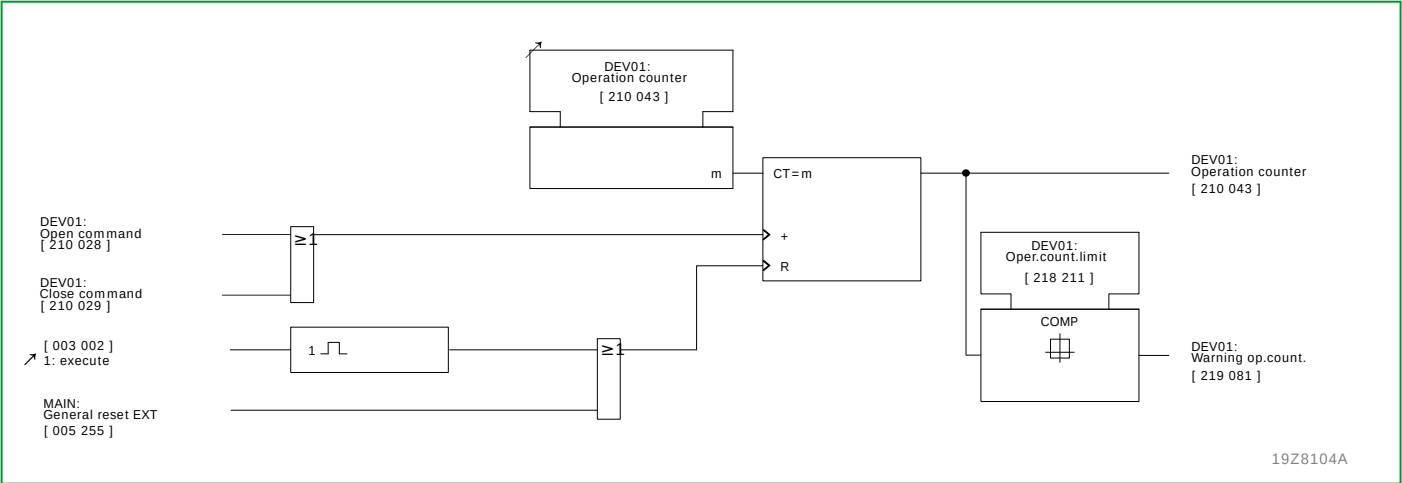


Fig. 3-428: Counter for the Open / Close Commands.

The diagram above shows the example of function group DEV01. The logic, however, is valid for all DEVxx with the appropriate parameters.

All Open and Close commands to the switchgear unit are counted. One counter per DEVxx function group is available for this purpose.

Moreover, a limit value can optionally be set for the counter value. If the counter value reaches the set limit a warning signal is issued. Due to safety reasons the switchgear control will not be blocked when the set limit has been reached.

3.54.7.3

Time Control for Direct Motor Control

The control sequence described above applies to all switchgear units operated via an "Open" contact or a "Close" contact. For bays with direct motor control of load disconnecting switches, isolating links or grounding switches, the following modified control sequence described below applies to motor-operated switchgear units. The list of Bay Panel types shows which bay types are defined for direct motor control. An example for the connection of a bay with direct motor control is illustrated in Chapter "Installation and Connection".

If a Bay Panel type with direct motor control is selected, a binary input for the status signal of the motor relay and one output relay each to trigger the motor relay and the shunt windings will have to be configured. In the example illustrated in [Fig. 3-429, \(p. 3-511\)](#), the single-pole command CMD_1: Command C012 is defined for control of the motor relay, the single-pole command CMD_1: Command C011 is defined for control of the shunt windings and the single-pole signal SIG_1: Signal S012 EXT (debounced and conditioned by chatter suppression) is defined for the status signal to the motor relay.

After triggering the motor relay, a set monitoring time period is started during which the status signal must be issued by the motor relay. If the status signal is not received during this time period a signal is transferred to the substation control level. In addition, the "Close" command issued to the output relays, configured to *Motor relay Cmd* or *Shunt winding*, is terminated if MAIN: Cmd.end f. DC fail. is set to its default value Yes. This results in interrupting the motor control command circuit and thereby preventing an undefined switch position. However, this would involve the danger of contact burn.

A different type of monitoring is active if MAIN: Cmd.end f. DC fail. is set to No: In this case the direction control contacts will remain closed. (Note: This feature bears the danger of an undefined switch position!) Moreover, the P433 issues the following signals (depending on the type of fault) when the monitoring time delay has expired:

- (221 108) MAIN: DC fail. cmd. End – This signal is issued if the K200 contacts have not opened after the set monitoring time-delay has elapsed.
- (221 109) MAIN: DC fail. cmd.start – This signal is issued if the K200 contacts have not closed after the set monitoring time-delay has elapsed.
- (221 110) MAIN: DEV op.time exceeded – This fault signal is issued (as a group signal) when no positive position signal (status signal) has been received from the external device after a command has been issued and the set running time-delay has elapsed.

For further processing each of these fault signals may be configured to selection parameters from the function groups LED (assignment to LED indicators), OUTP (assignment to output relays), LOGIC (processing by the programmable logic function), COMMx / IEC / GOOSE (signaling via the control system) or they may be mapped to the signal panel as an alarm signal. Acknowledging from the local control panel HMI is done by pressing the CLEAR (C) key.

If the status signal from the motor relay is issued during the monitoring time period, the running time monitoring of the motor relay is started simultaneously with this status signal. Monitoring of the switching command is then the same as with electromechanically operated switchgear units.

If the operating mode without external termination contacts was selected the "Close" command to the motor relay is terminated after the set latching time has elapsed, when either the "Open" or "Closed" position status signal is received or the set time period for running time monitoring has elapsed (see [Fig. 3-418](#), [\(p. 3-497\)](#)). The monitoring time period is again started with the termination of the "Close" command to the motor relay and after it has elapsed the control commands "Open" or "Close" are also terminated. The same is valid for the shunt windings.

If the operating mode with external termination contacts was selected (MAIN: W. ext. cmd. termin. is set to Yes) the switching command to the motor relay is terminated after the set latching time has elapsed, when a termination command is issued while the set time period for running time monitoring is active. With the setting MAIN: Ext.cmd.term. w/o PI = No, the switching command is also terminated when either the "Open" or "Closed" position status signal is received. The switching command to the motor relay is always terminated after the set latching time has elapsed. The monitoring time period is again started with the termination of the "Close" command to the motor relay and after it has elapsed the control commands "Open" or "Close" are also terminated.

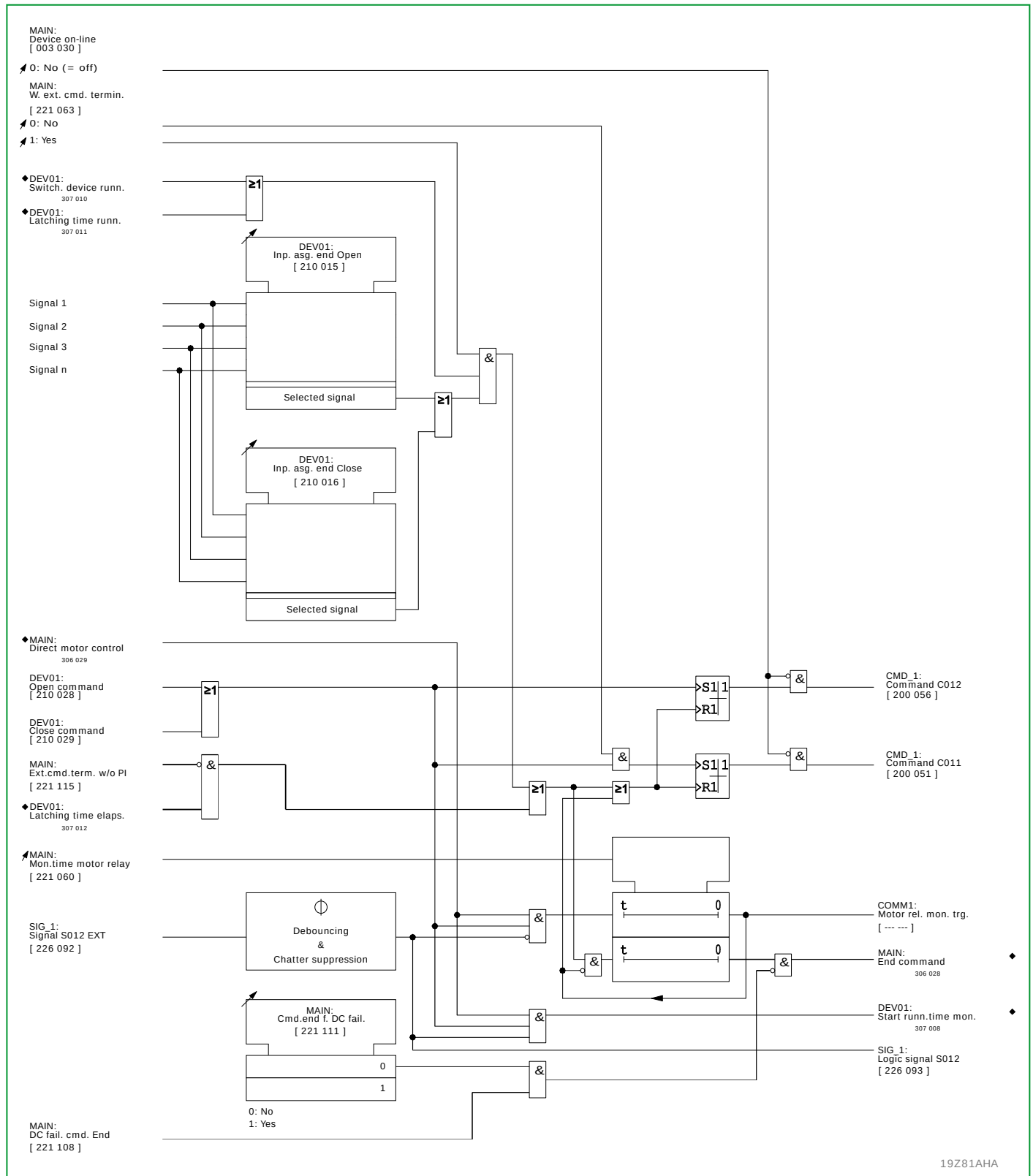


Fig. 3-429: Control and monitoring of the motor relay.

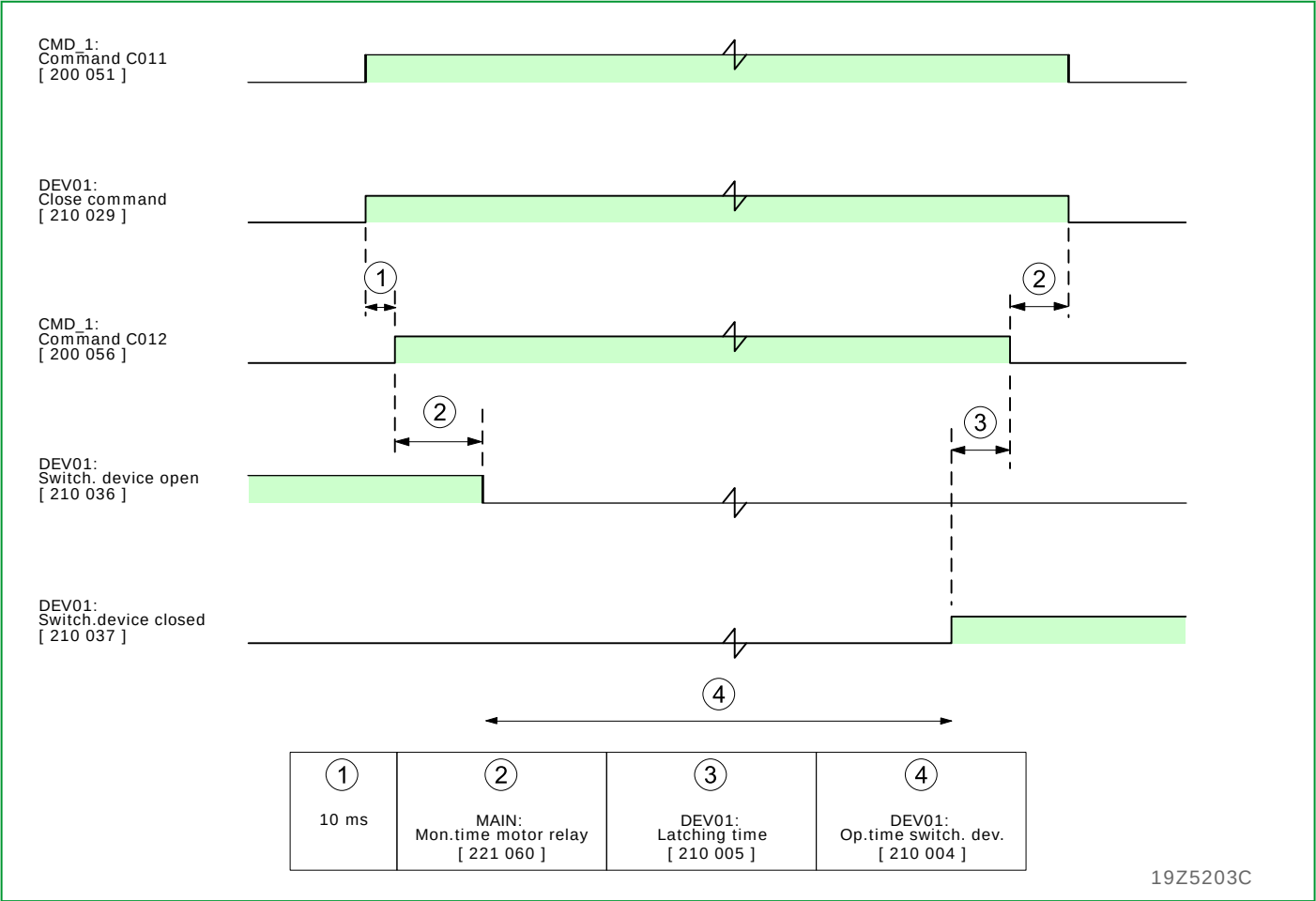


Fig. 3-430: Sequence of time monitoring for direct motor control without external termination, example for switching operation “close”.

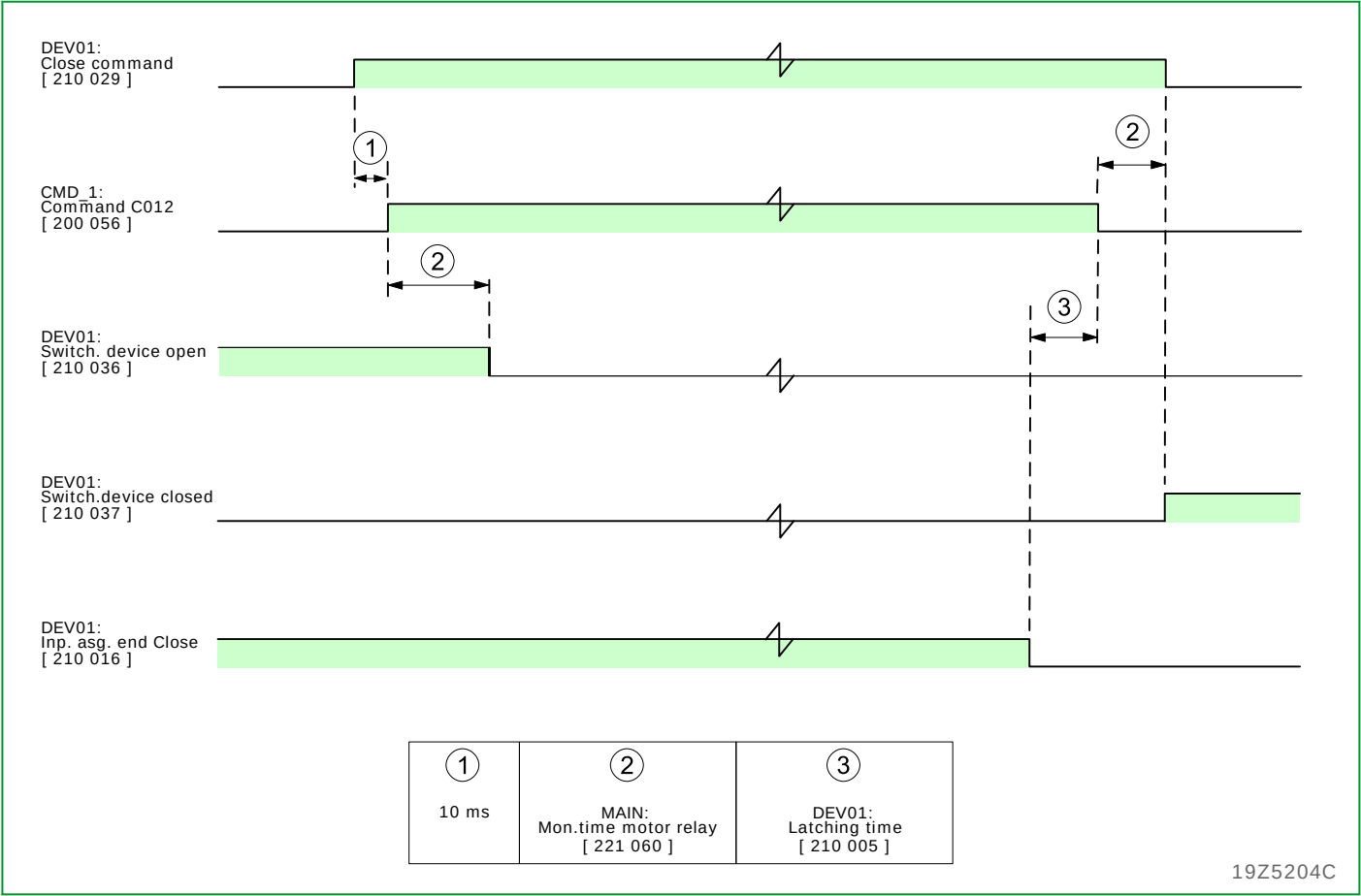


Fig. 3-431: Sequence of time monitoring for direct motor control with external termination, example for switching operation "close".

3.55 Interlocking Logic (Function Group ILOCK)

The switching commands to the controllable switchgear units in the bay are enabled only after interlock conditions have been checked. The interlock conditions are defined in the form of Boolean equations in the interlocking logic function.

The choice of the bay type automatically defines the bay interlock conditions (or equations) for the 'Open' and 'Close' operations of the individual switchgear units in the bay. The bay interlock equations for operation with station interlock differ from the bay interlock equations for operation without station interlock (see [Vol. 2, Chapter A5, \(p. A5-1\)](#)). These automatically defined interlock conditions – determined by the choice of bay type – can be modified by the user at any time to fit particular station requirements. The following signals acquired by the P433 are linked by logic operations for the bay interlock:

- Function blocks 1 and 2
- Programmable logic outputs
- Switchgear position signals, after debouncing and chatter suppression
- Single-pole signals, after debouncing and chatter suppression

A maximum of 32 equations with 32 equation elements each are available to define interlock conditions. The Boolean equations need to be defined without the use of brackets. The following rule applies to the operators: "NOT" before "AND" before "OR". The output signal of one equation can be fed into a higher-order equation as an input thus creating a sequence of interlinked Boolean equations.

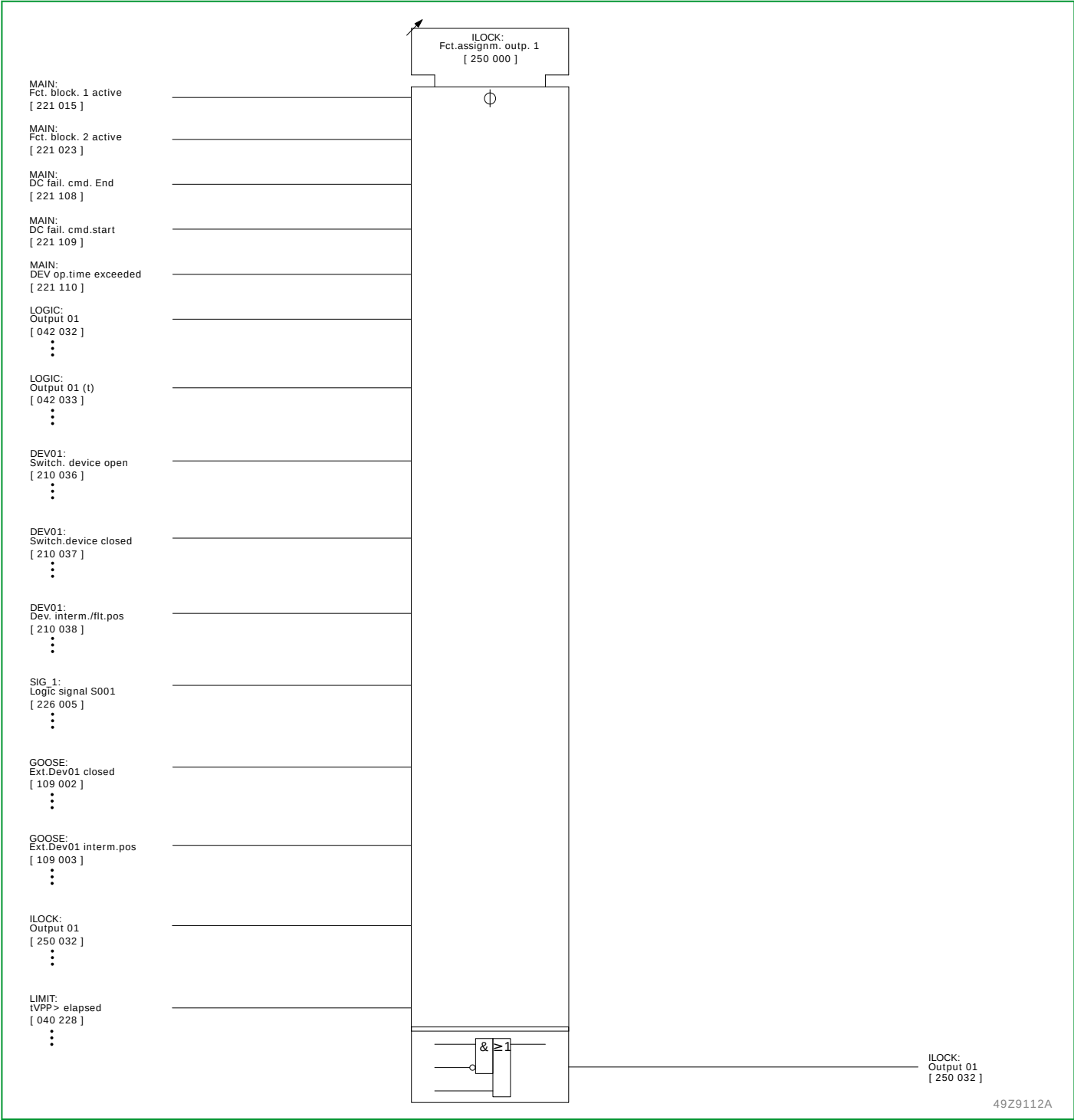


Fig. 3-432: Interlocking logic as illustrated for equation 1.

3.55.1 IEC 61850 Reporting

As the interlock conditions are also transmitted together with reporting in the IEC 61850 communication protocol it is a requirement that these interlock conditions are cyclically checked and not only with the request for a switching operation.

Therefore the parameter (221 104) ILOCK: Cycle t interl.check allows for setting the cycle time (range from 100 ms to 10 s), after which a check of the interlock conditions is carried out. If this parameter is set to *blocked* (default value), the ILOCK signals over IEC 61850 will be updated only if a control command gets executed. If the DEV state changes without a control command

these signals remain unchanged. As additional processor capacity must be provided for each of these checks it must be ensured that a favorable compromise is found for the cycle time setting value. On the one hand it is desirable to select a cycle time value which is as short as possible so that changes in the interlock conditions are updated without any notable delays, but on the other hand this cycle time value should not be so short that the P433 system will be under too much strain. As the P433 CPU load is dependent on the total number of function groups having been configured it is not possible to suggest a generally acceptable cycle time value.

3.56

Single-Pole Commands (Function Group CMD_1)

Commands may be transmitted to the P433 via the communications interface. When the P433 receives such a command, and if the remote control mode is enabled, an appropriately configured output relay will be triggered and a signal issued.

The user can select the operating mode for each 1-pole command. The following settings are possible:

- *Long command*
- *Short command*
- *Persistent command*

If the operating mode *Long command* or *Short command* has been selected the output relay will be triggered for the time period set at MAIN: Cmd. dur.long cmd. or MAIN: Cmd. dur. short cmd..

The setting options and the functional sequence are shown in the example for Command C001. This will apply accordingly to all other single-pole commands.

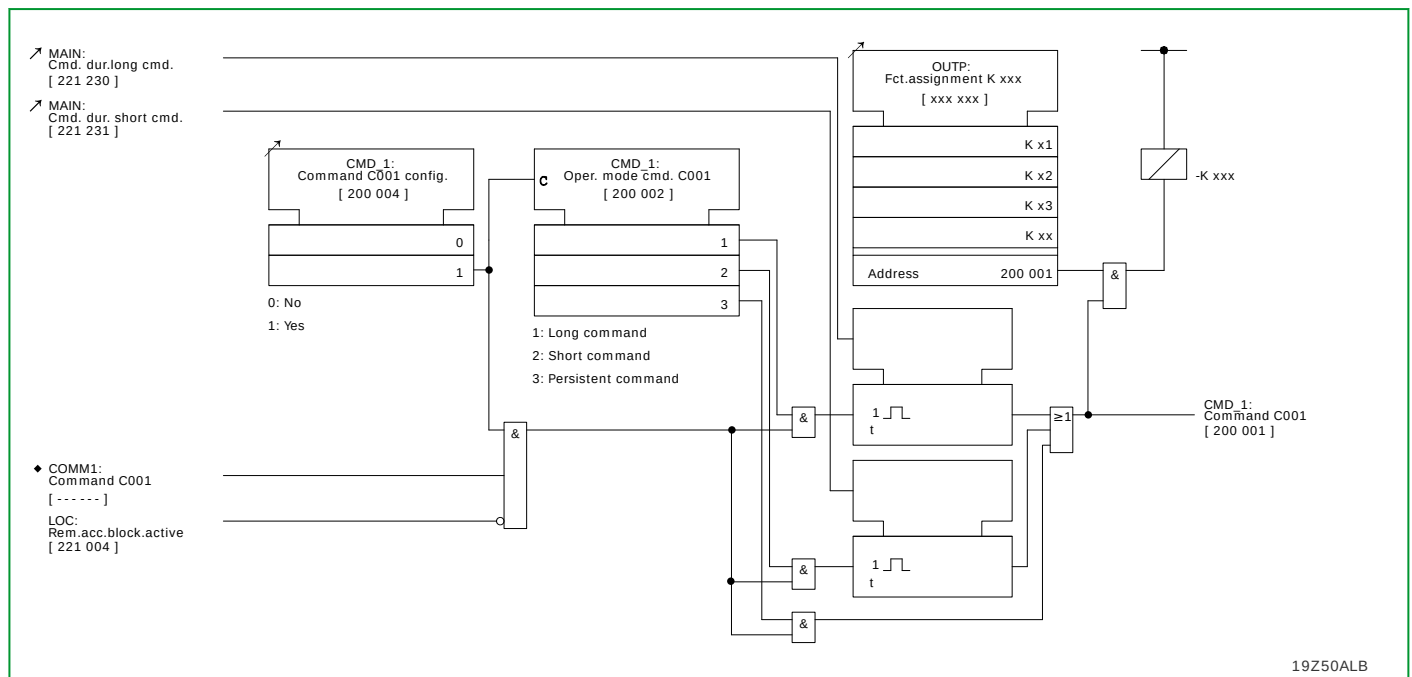


Fig. 3-433: Functional sequence for single-pole commands, as illustrated for Command C001.

3.57 Single-Pole Signals (Function Group SIG_1)

Binary, single-pole signals issued by the system may be transmitted by the P433 via its appropriately configured binary signal inputs to the control station.

Such single-pole input signals are conditioned by debouncing and chatter suppression (see [Section 3.57.1.1, \(p. 3-521\)](#)). This conditioned signal is then presented as SIG_1: Logic signal S001 (to SIG_1: Logic signal S012).

Signaling behavior via the communications interface is determined by selecting the operating mode. The following settings are possible:

- *Without function*
- *Start/end signal*
- *Transient signal*

If setting *Without function* has been selected then no message is transmitted when the signal state at the binary signal input changes. If setting *Start/end signal* has been selected then a message is transmitted every time the signal state at the binary signal input changes. A requirement for transmission of the “*Start signal*” message is that the logic “1” signal is present for the set minimum time period. If setting *Transient signal* has been selected then a message is transmitted every time the signal state at the binary signal input changes from logic “0” to logic “1”.

The following figure displays setting modes and the functional sequence with the example for logic signal S001. This will apply accordingly to all other single-pole signals.

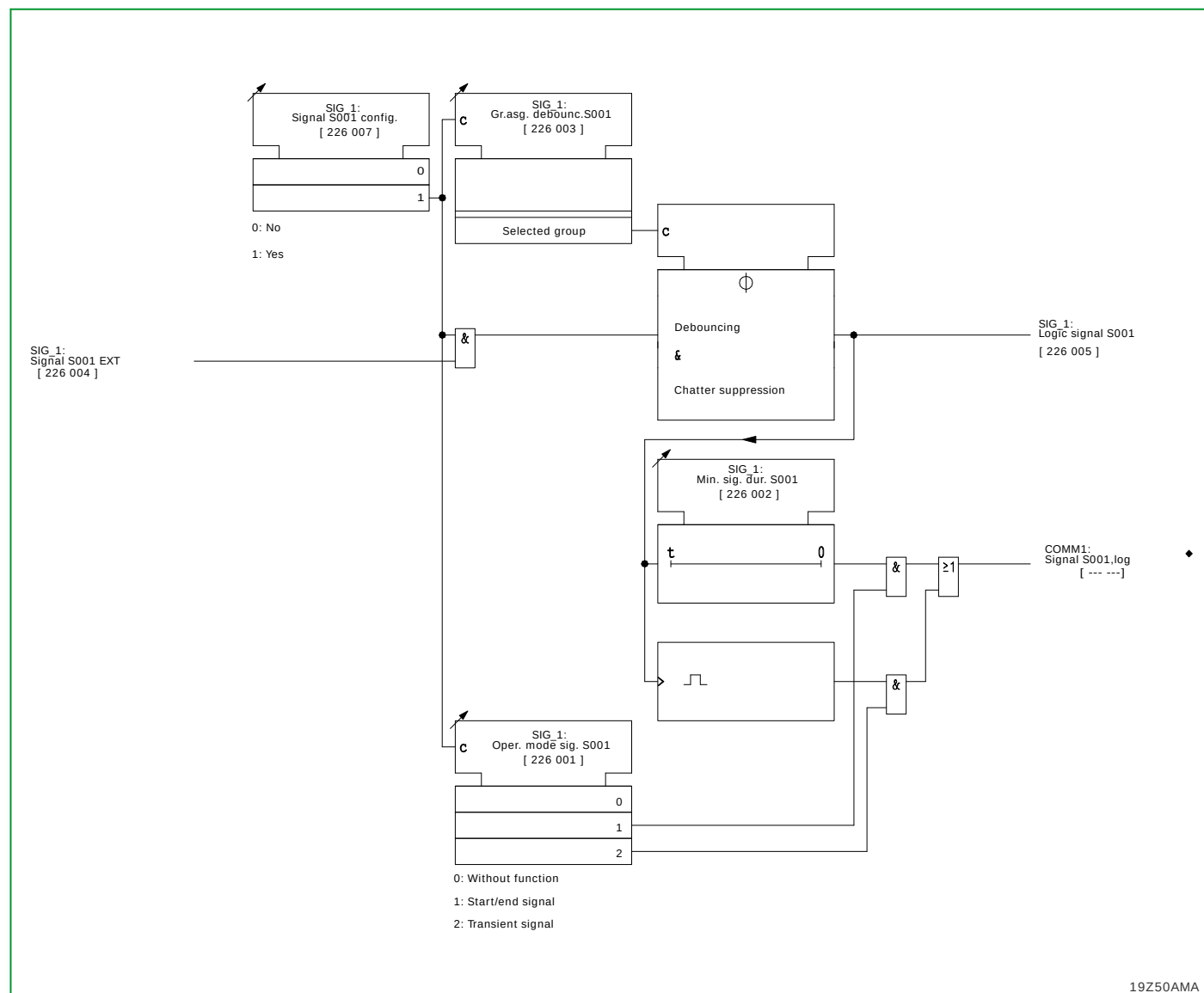


Fig. 3-434: Functional sequence for single-pole signals with the example for logic signal S001.

3.57.1 Acquisition of Binary Signals for Control

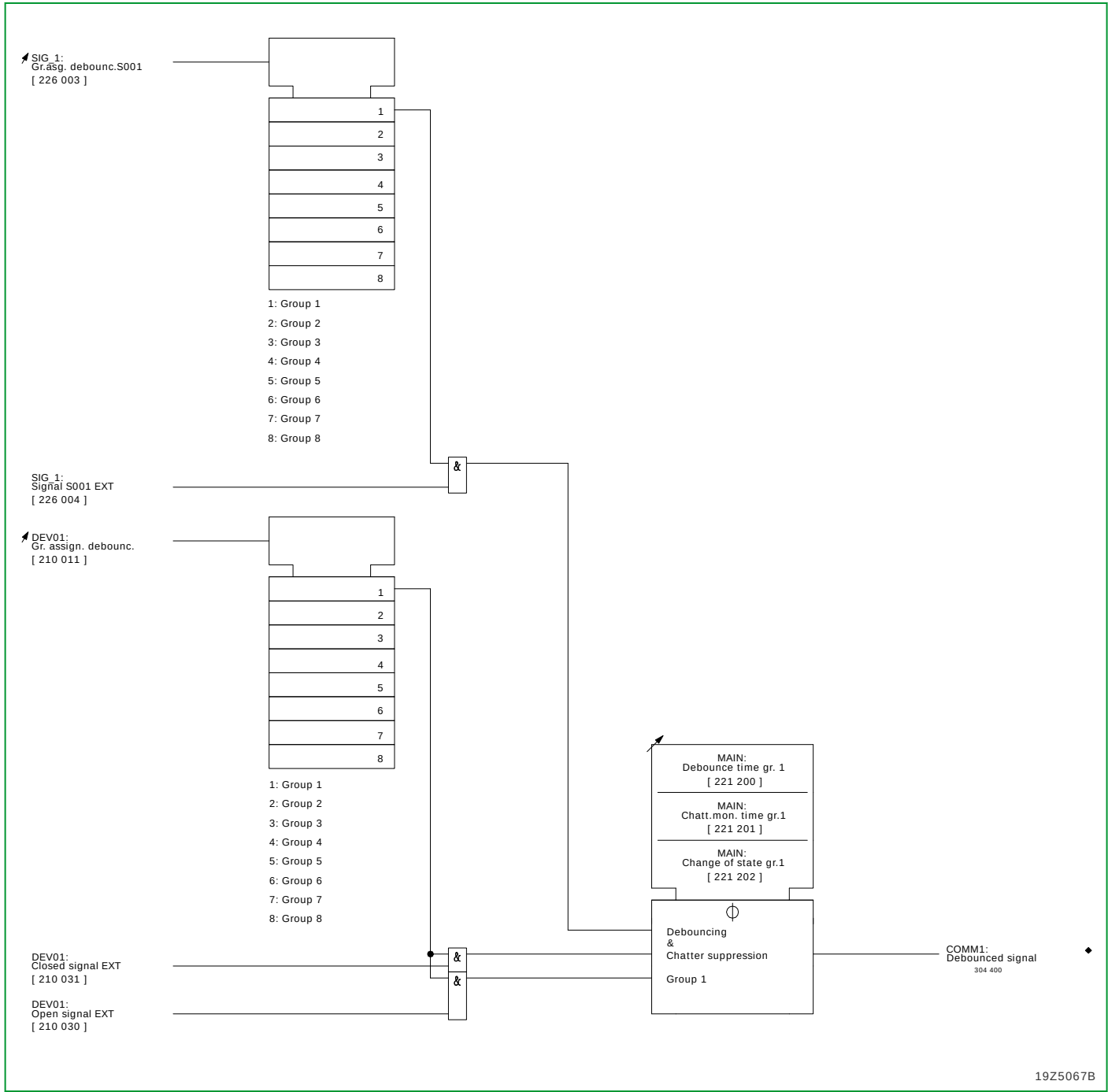


Fig. 3-435: Group assignment and setting of debouncing and chatter suppression, illustrated for group 1.

In the acquisition of signals for control purposes, the functions real time acquisition (time tagging), debouncing and chatter suppression are included as standard. Each of these signals can be assigned to one of eight groups and for each of these groups the debouncing time and chatter suppression can be set. Matching of these two parameters achieves the suppression of multiple spurious pickups.

3.57.1.1 Debouncing and Chatter Suppression

3.57.1.1.1 Debouncing

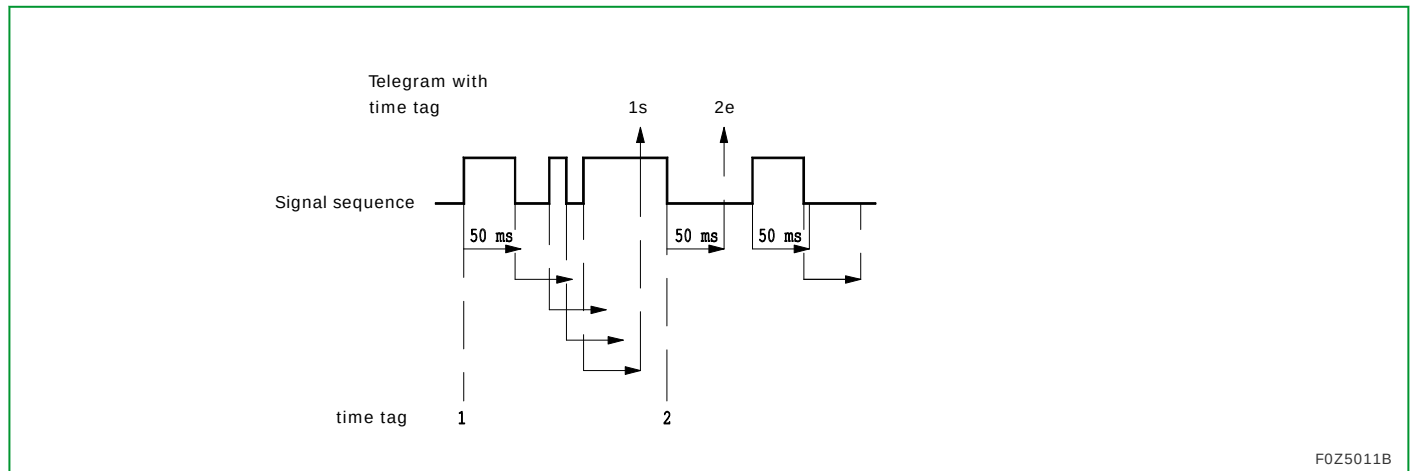


Fig. 3-436: Signal flow with debouncing when time tagging occurs with the 1st pulse edge (e.g. parameter MAIN: Time tag set to the value *1stEdge,OpMem unsort* or *1stEdge,OpMem sorted*.) Example: Set debouncing time: 50 ms, s: start, e: end.

The first pulse edge of a signal starts a timer stage running for the duration of the set debouncing time. Each pulse edge during the debouncing time re-triggers the timer stage.

If the signal is stable until the set debouncing time elapses, a telegram containing the time tag of the first pulse edge is generated. As an alternative the time tag may be generated after debouncing by setting parameter MAIN: Time tag to the value *After debounce time*.

After the set debouncing time has elapsed, the state of the signal is checked. If it is the same as prior to the occurrence of the first pulse edge, no telegram is generated.

Time-tagged entries of the first pulse edge are only generated after debounce time has elapsed. If these entries are saved without delay (setting of MAIN: Time tag to the value *1stEdge,OpMem unsort*) they are not necessarily saved in chronological order in the operating data memory. If above parameter has been set to the value *1stEdge,OpMem sorted* then all entries are always saved in chronological order in the operating data memory.

Time Tag

The following overview illustrates how the (221 098) MAIN: Time tag setting is operating.

Acquisition of binary signals for control	0 $T_1^{1)}$ $T_2^{1)}$
Voltage present at input terminals: Filter function to suppress transient interferences (required number of steps with active signal) (226 004) SIG_1: Signal S001 EXT (no time tag, internal signal to start debouncing) ²⁾	
<i>1stEdge,OpMem sorted:</i> (226 005) SIG_1: Logic signal S001 - on COMM1/IEC (Signaling at T_2 with time tag T_1) - internal on operating memory (Entry in operating memory at T_2 with time tag T_2)	
<i>1stEdge,OpMem unsort:</i> (226 005) SIG_1: Logic signal S001 - on COMM1/IEC (Signaling at T_2 with time tag T_1) - internal on operating memory (Entry in operating memory at T_2 with time tag T_1)	
<i>After debounce time:</i> (226 005) SIG_1: Logic signal S001 - on COMM1/IEC (Signaling at T_2 with time tag T_2) - internal on operating memory (Entry in operating memory at T_2 with time tag T_2)	
¹⁾ $T_2 = T_1$ (cycle time) + debounce time ²⁾ SIG_1: Signal S001 EXT is not foreseen for any further transmission via communication interface, neither for assigning to functions nor LOGIC. ³⁾ Filter (e. g. 3 sampling steps)	T = Time tag L = Log of state

3.57.1.1.2 Chatter Suppression

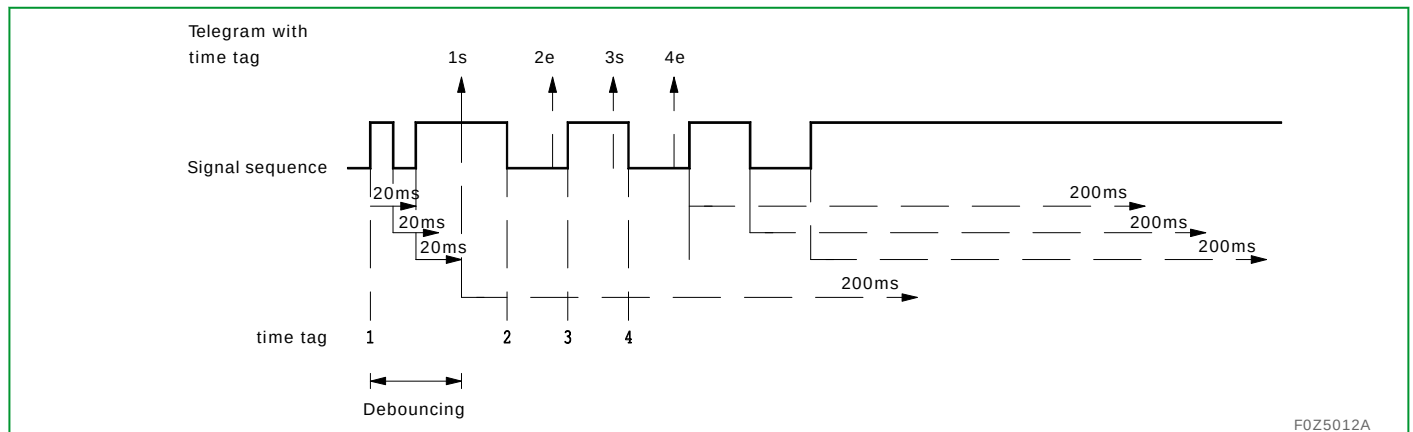


Fig. 3-437: Signal flow for debouncing and chatter suppression. Set debouncing time: 20 ms, set chatter monitoring time: 200 ms, number of admissible signal changes: 4, s: start, e: end.

Sending of the first telegram starts a timer stage running for the duration of the set monitoring time. While the timer stage is elapsing, telegrams are generated for the admissible signal changes. The number of admissible signal changes can be set. After the first “inadmissible” signal change, no further telegrams are generated and the timer stage is re-triggered. While the timer stage is elapsing, it is re-triggered by each new signal change. Once the timer stage has elapsed, each signal change triggers a telegram.

3.58 Binary Counts (Function Group COUNT)

The P433 features four binary counters. Each of these can count the positive pulse edges of a binary signal present at an appropriately configured binary signal input. Such a binary signal can be provided with debouncing.

3.58.1 Enable/Disable the Counting Function

The counting function (COUNT) can be disabled or enabled via setting parameters.

3.58.2 Debouncing

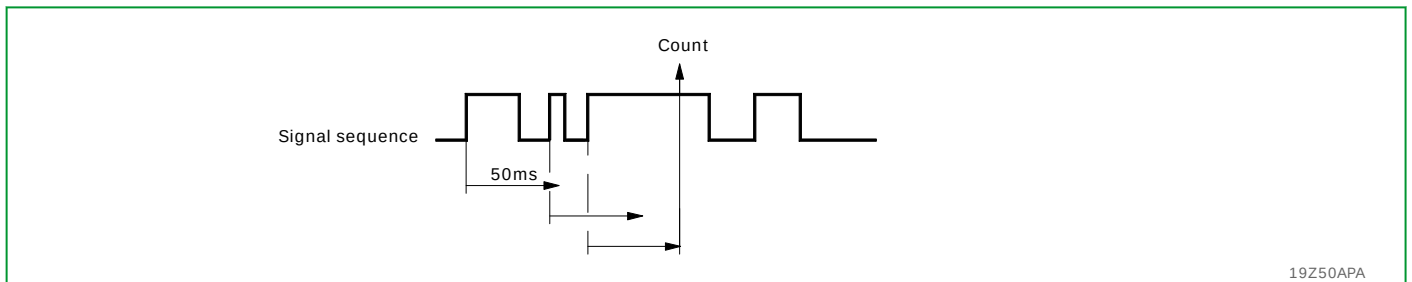


Fig. 3-438: Debouncing signal flow. Set debouncing time: 50 ms.

The first positive pulse edge of the binary input signal to be counted will trigger a timer stage which will continue to run for the set debouncing time period. Each positive pulse edge during the debouncing time re-triggers the timer stage. The binary input signal will be counted if it is stable during the set debouncing time period.

The debouncing time can be set separately for each of the four counters.

After the set debouncing time has elapsed, the state of the signal is checked. If it is the same as prior to the occurrence of the first pulse edge, it will not be counted.

3.58.3 Counting Function

The debounced binary signal is counted by a 16 bit counter. The counters may be set to a specific count value (preload function) by setting a parameter or via the serial interfaces. The values of the counters can be shown on the LC-display and read out via the PC interface or the communications interface.

For each of the four counters, there is a limit value that can be optionally set:

- COUNT: Limit counter 1 (and the same way for counters 2 to 4),
- settable from 1 to 65000,
- setting "Blocked" disables the limit check. (This setting is the default value.)

A warning signal (COUNT: Warning count 1 and the same way for counters 2 to 4) is issued if the associated counter value exceeds the set limit.

3.58.4 Transmitting the Counter Values via Communications Interface

The counter values are transmitted via the communications interface when a signal is presented to an appropriately configured binary signal input, a trigger signal is issued by a setting parameter or at cyclic intervals as set at the cycle time stage COUNT: Cycle t.count transm. When the counter value is transmitted at cyclic intervals, then transmission is time synchronized if the ratio

60/(set cycle time) comes to an integer. In all other cases the counter values are transmitted at time intervals determined by a free running internal clock.

3.58.5 Counter Values Reset

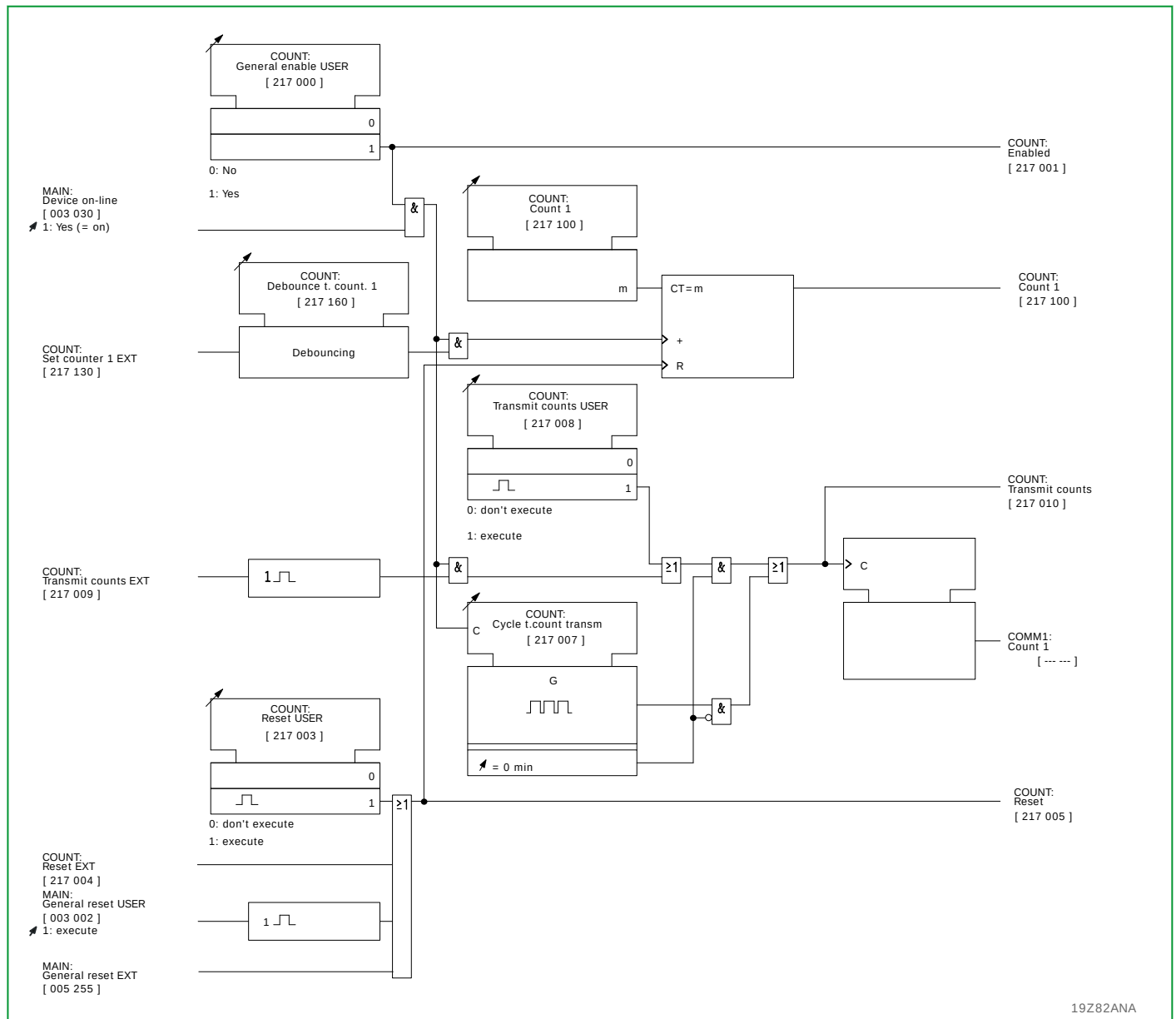


Fig. 3-439: Binary Count. (This diagram shows counter 1 as an example. The displayed logic is also valid for counters 2 to 4, where COUNT: Set counter 1 EXT and COUNT: Count 1 have to be replaced by the respective parameters.

The counter values may be reset – all at once – by setting parameter COUNT: Reset USER or via an appropriately configured binary signal input as well as by the general reset action.

3.59 **TIMER (Function Group TIMER)**

Four groups of timer are available in the P433. The timer can set time for starting and ending automatically with start time (TIMER: Start hour 1, TIMER: Start minute 1) and end time (TIMER: End hour 1, TIMER: End minute 1). Each of the timer can set one or more repeat days in a week TIMER: Calendar 1 (from Monday to Sunday).

For example, it is able to set time for automatic's activation (e.g. keeping the output relay closed) between 12 PM and 18 PM from Monday to Friday for timer stage1 and between 16 PM and 19 PM on Saturday and Sunday for timer stage 2. From version -655 the timer settings allow more flexibility.

If the end time is before (smaller than) start time, the "active" window will end on the next day. For example, timer stage 1 is set for Saturday with start time 18 p.m. and end time 12 p.m., then it will be active from Saturday 18 p.m. until Sunday 12 p.m.

If start and end timers are set to the same value, the timer stage gets active for 24h. For example, timer stage 1 is set for Saturday with start time 12 p.m. and end time 12 p.m., then it will be active from Saturday 12 p.m. until Sunday 12 p.m.

The internal clock is the source of the Timer function. It is also possible to use the time synchronised clock signal (GPS, DCF77, SNTP).

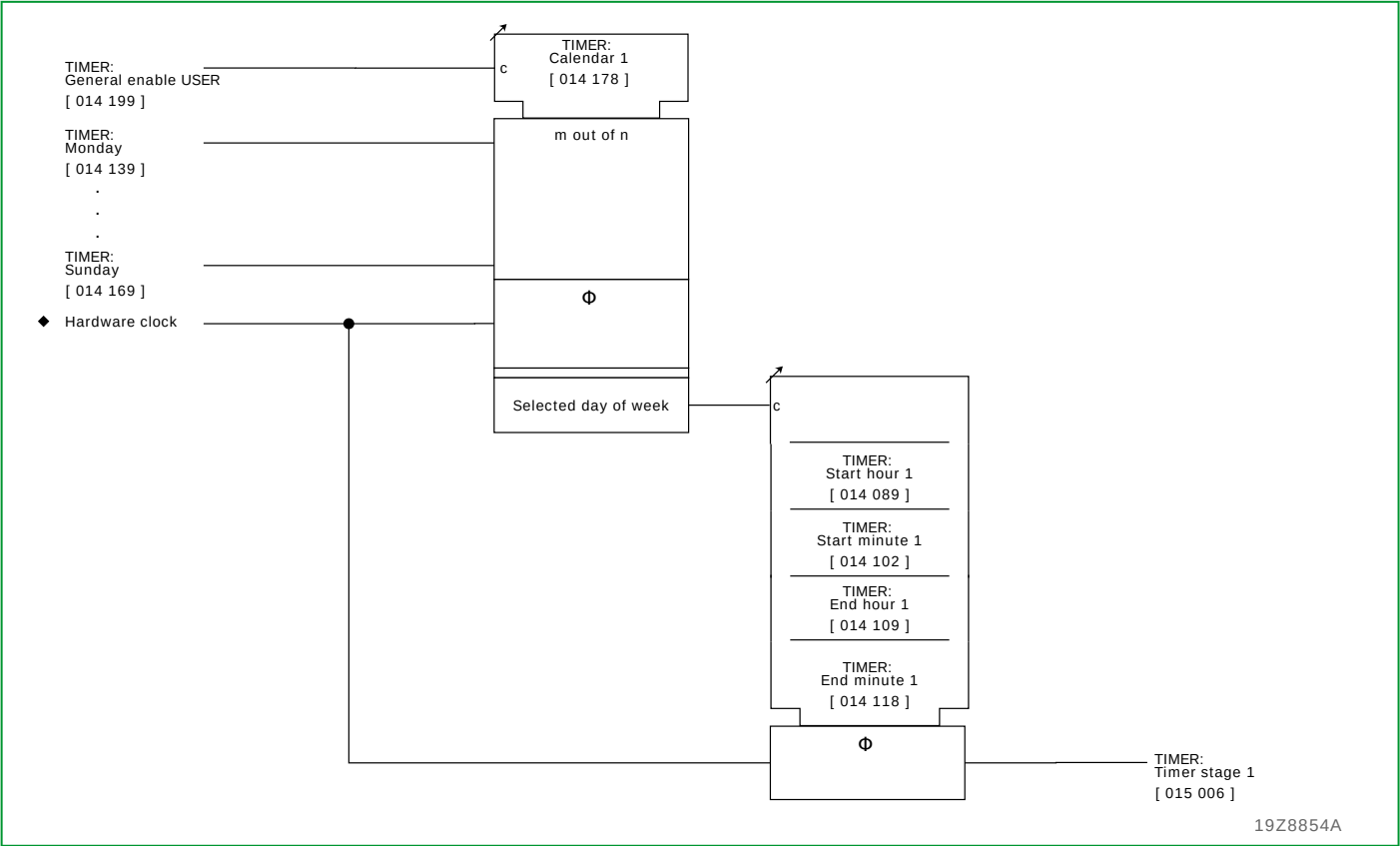


Fig. 3-440: *TIMER logic (Calendar 1 shown as an example for 4 calendar timers).*

4 Design

The P433 is available in different types of cases and with different combinations of modules.

Irrespective of the type a P433 is equipped with a detachable HMI or a fixed local control panel. The local control panel is fitted with seals to ensure that the specified degree of IP protection will be maintained.

In addition to the essential control and display elements, a parallel display consisting of multi-colored LED indicators is also incorporated (see [Section 6.2, \(p. 6-2\)](#)). The meaning of the various LED indications is shown in plain text on a label strip.

For enhanced local control panel, the PC interface (USB Type B socket) is located under the hinged cover at the lower left side of the local control panel.

For 24 TE case, the PC interface (9-pin D-Sub female connector) is located under the hinged cover at the bottom of the local control panel.

<i>NOTICE</i>
The hinged cover should remain closed to ensure IP protection of the connector is maintained.

4.1 Designs

The P433 is available in a surface-mounted and a flush-mounted case. Depending on the connection type – pin-terminal or ring-terminal connection – the case sizes differ. The location diagrams (Section 5.7, (p. 5-32)) show the available combinations of case widths and connection types.

Electrical connections are made via plug-in threaded terminal blocks. The threaded terminal blocks in the surface-mounted case are accessible from the front of the device after unscrewing the torx head steal screws on the sides (see Fig. 4-1, (p. 4-3), ①) and removing the local control panel. The local control panel can then be secured by inserting the tabs in the slots in the left side wall (see Fig. 4-1, (p. 4-3), ②). The flush-mounted case is connected at the back of the case.

WARNING

HAZARD OF EQUIPMENT DAMAGE

- The local control panel (or front element) is connected to processor module P by a plug-in connecting cable. Make sure the connector position is correct. Do not bend the connecting cable!

Failure to follow these instructions can result in equipment damage or unintended equipment operation.

DANGER

HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH

- Do not open the secondary circuit of live system current transformers! If the secondary circuit of a live CT is opened, there is the danger that the resulting voltages will endanger personnel and damage the insulation.
- For pin-terminal connection devices, the terminal block for system current transformer connection is not a shorting block! Therefore always short-circuit the system current transformers before loosening the threaded terminals.

Failure to follow these instructions will result in death or serious injury.

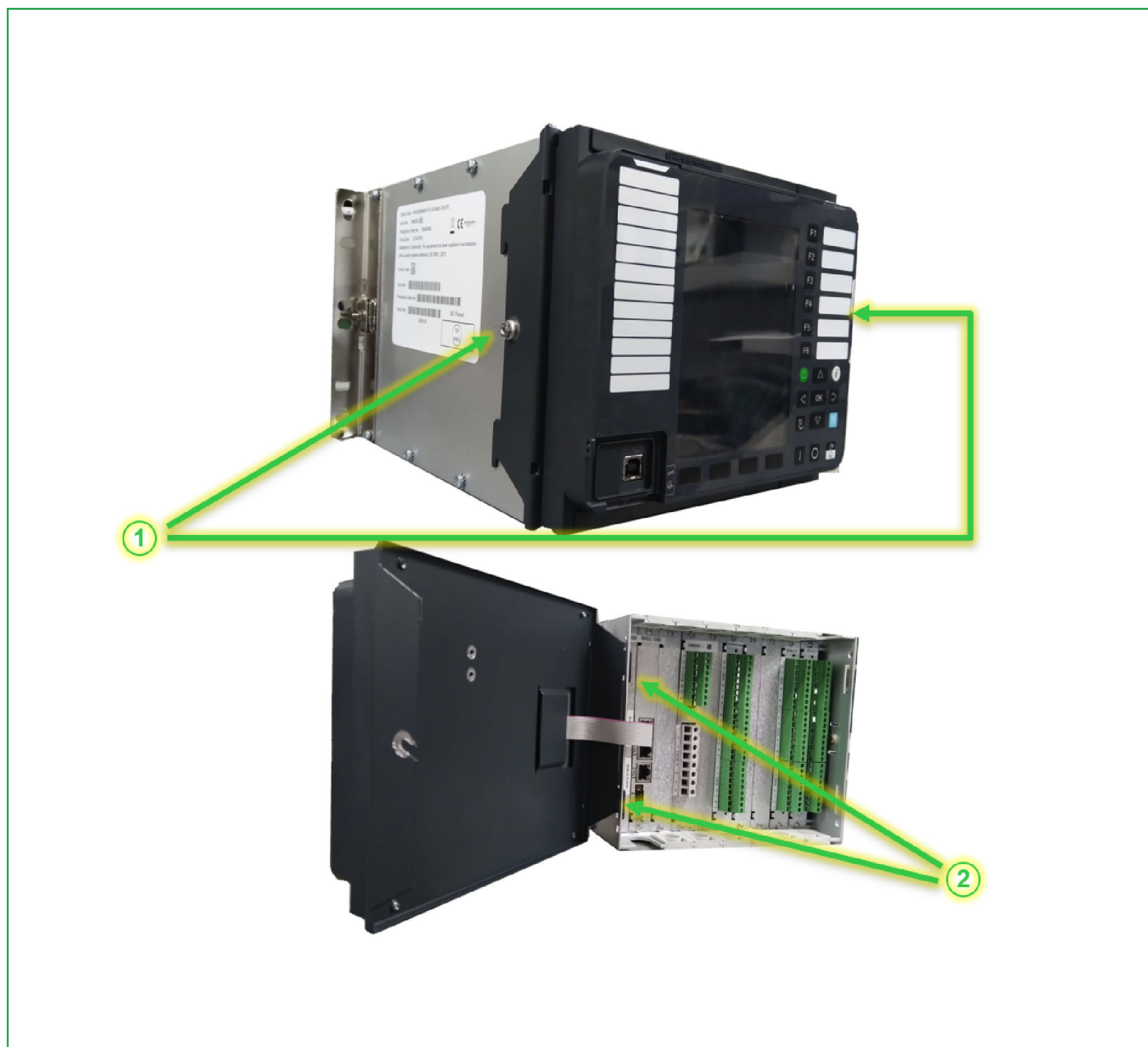


Fig. 4-1: Surface-mounted case, removal of enhanced local control panel (or – in case of a detachable HMI – the case front panel). The illustration shows the 40TE case with (fixed) local control panel as an example.

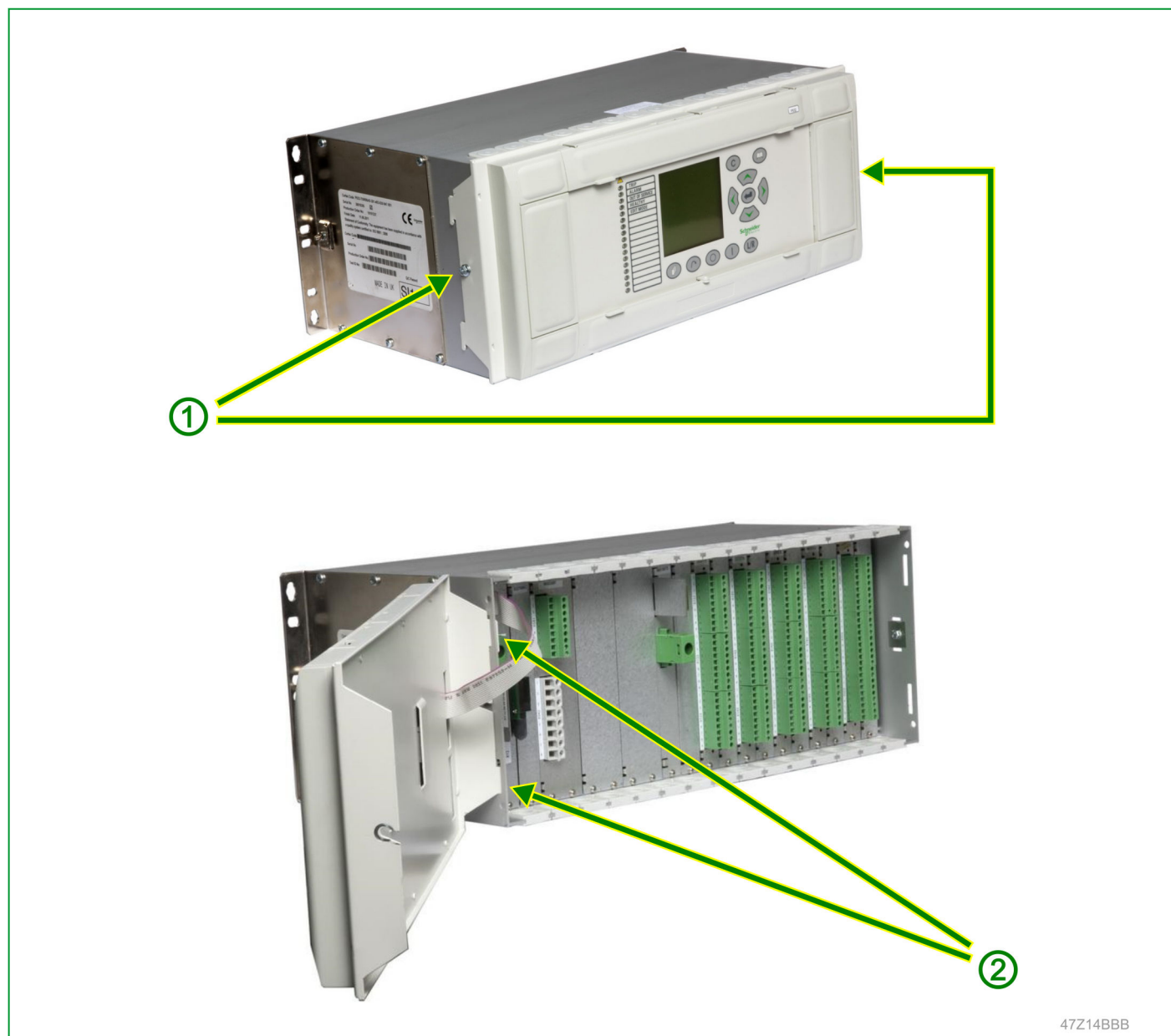


Fig. 4-2: Surface-mounted case, removal of local control panel (24 TE case only). The illustration shows the 84TE case with (fixed) local control panel as an example.

4.2 Dimensional Drawings

4.2.1 Dimensional Drawings for the 40 TE Case

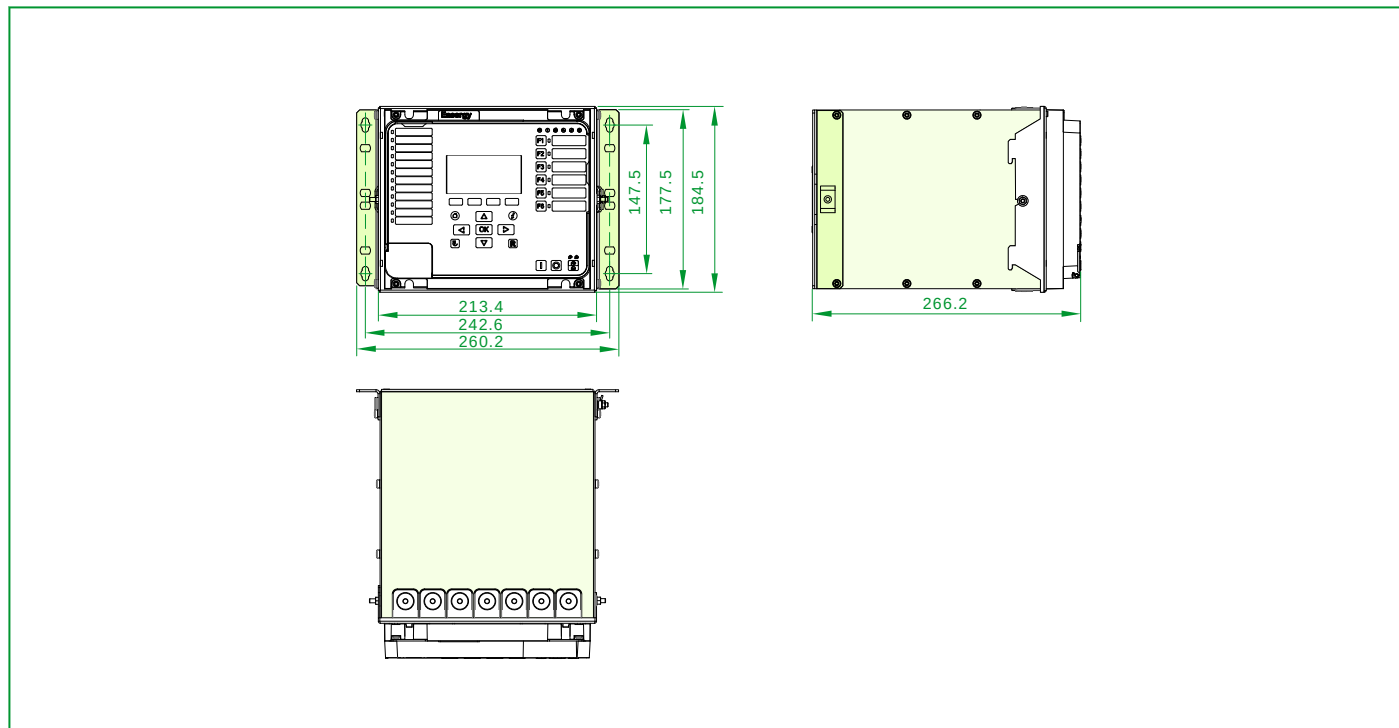


Fig. 4-3: Surface-mounted 40 TE case. (Dimensions in mm.)

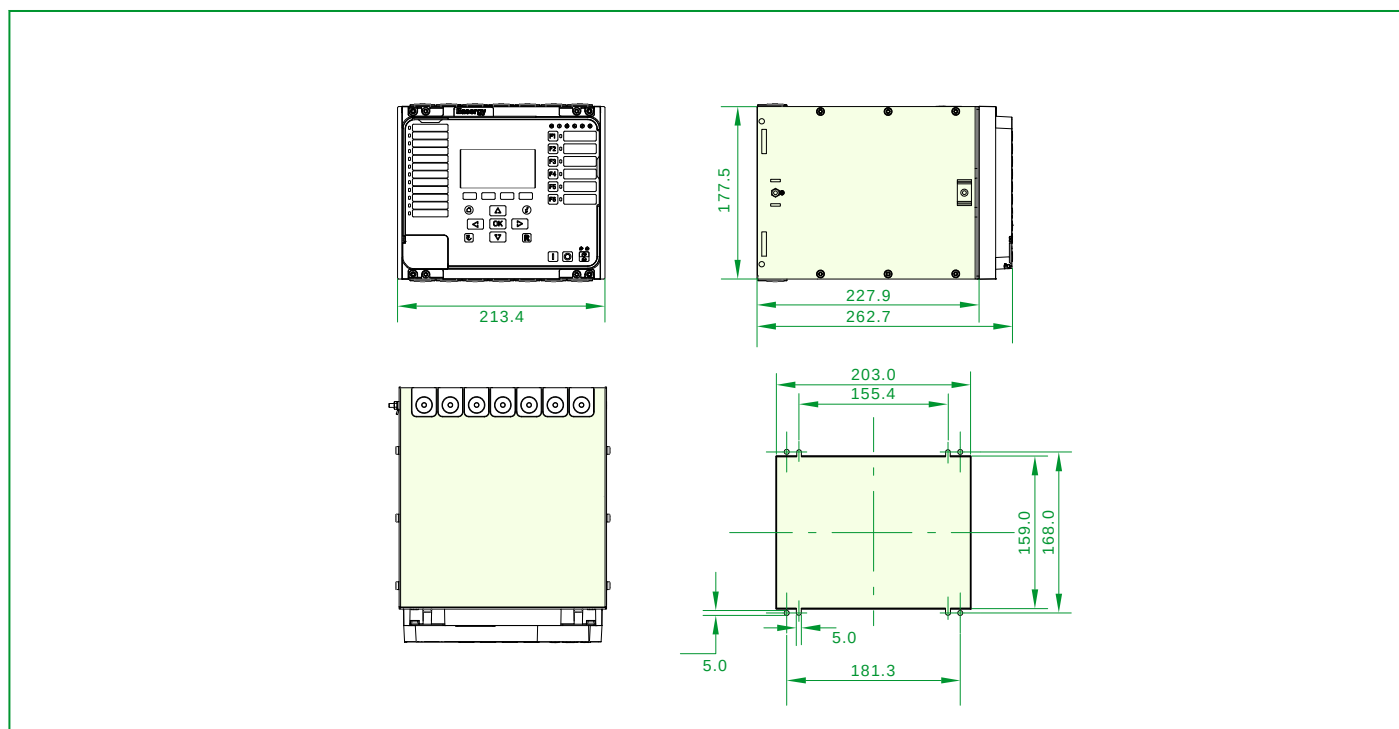


Fig. 4-4: Flush-mounted case 40 TE with panel opening, flush-mount method 1 (without angle brackets). (Dimensions in mm.)

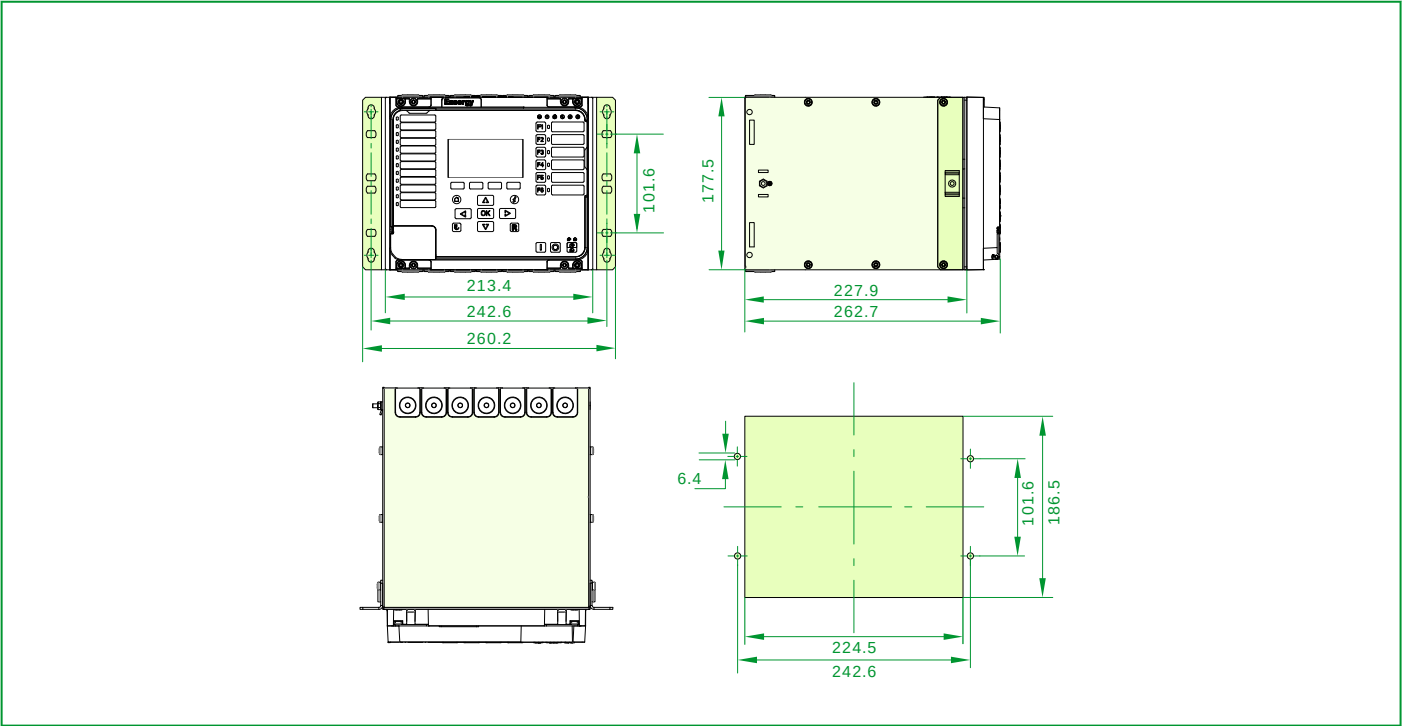


Fig. 4-5: Flush-mounted case 40 TE with panel opening, flush-mount method 2 (with angle brackets and frame). (Dimensions in mm.)

The device has increased mechanical robustness if flush-mount method 2 (with angle brackets and frame) is used for the flush-mounted case.

4.2.2 Dimensional Drawings for the 84 TE Case

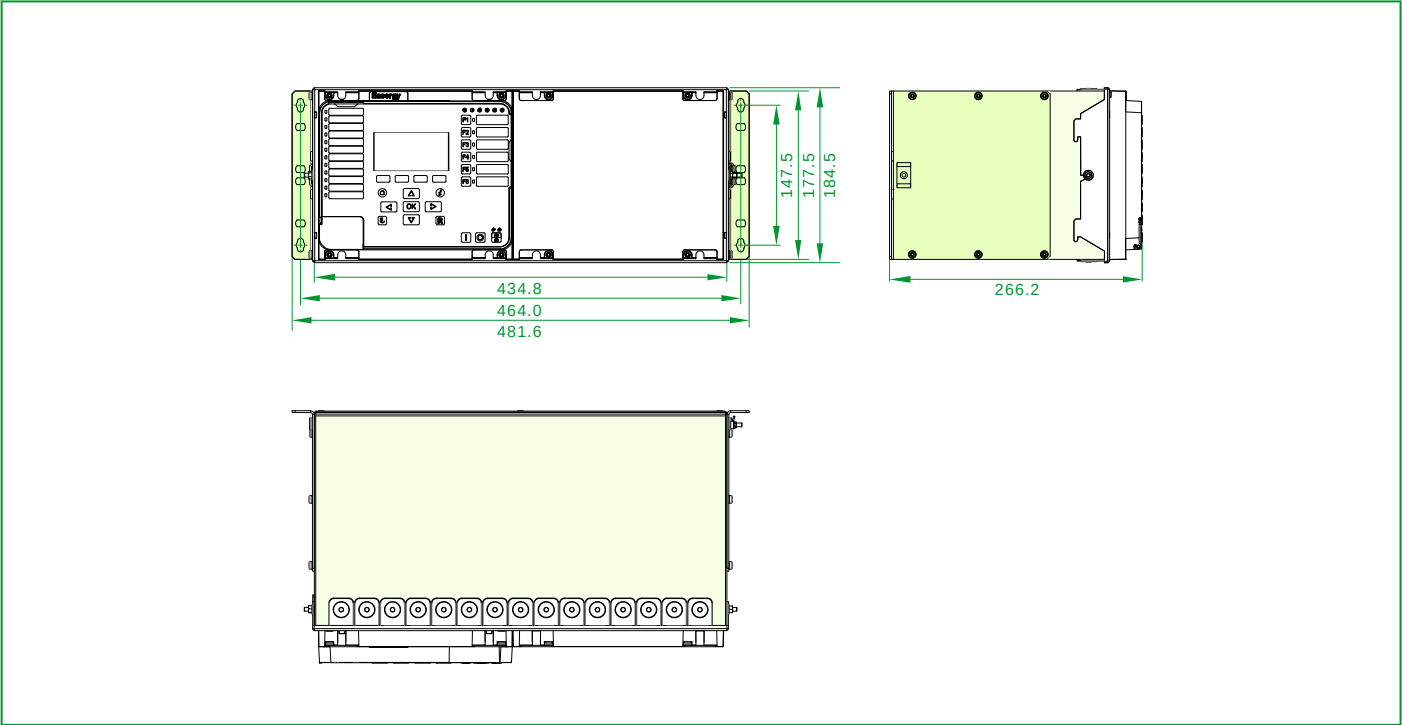


Fig. 4-6: Surface-mounted 84 TE case. (Dimensions in mm.)

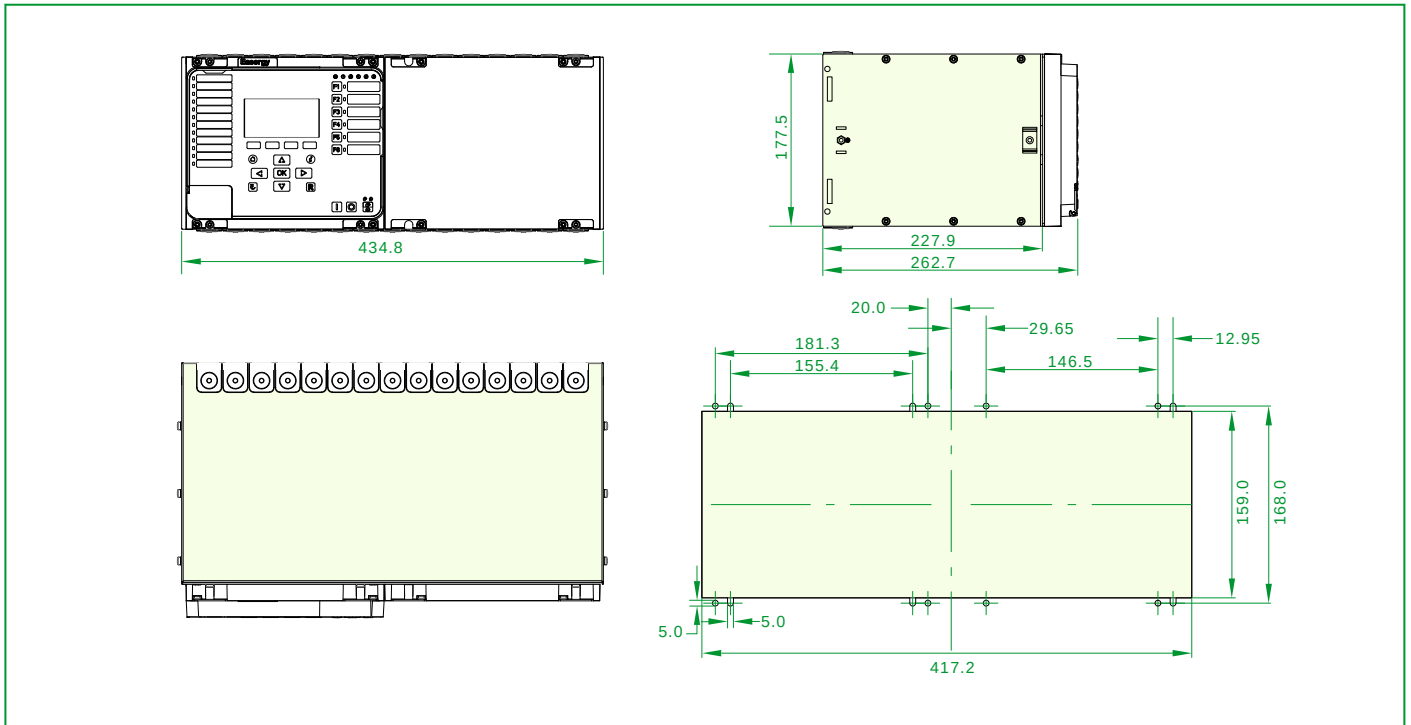


Fig. 4-7: Flush-mounted case 84 TE with panel opening, flush-mount method 1 (without angle brackets). (Dimensions in mm.)

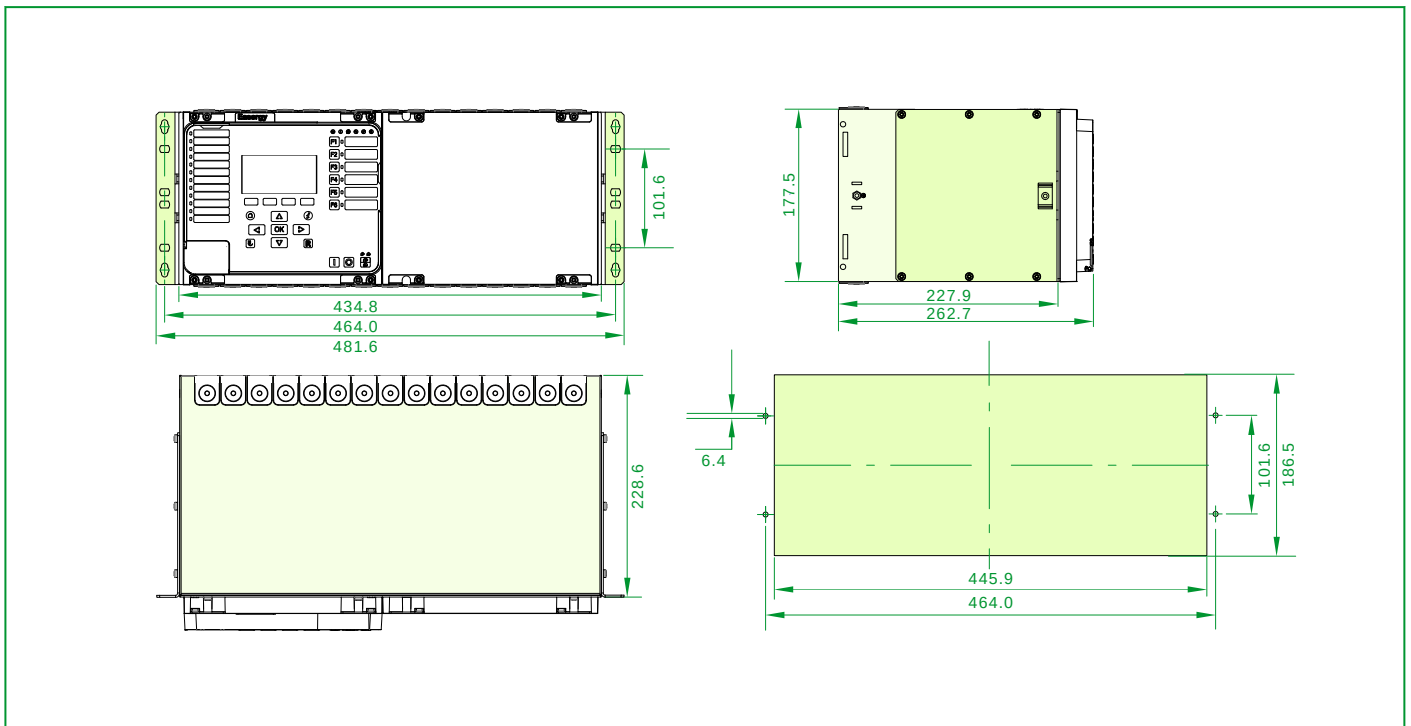


Fig. 4-8: Flush-mounted case 84 TE with panel opening, flush-mount method 2 (with angle brackets and frame). (Dimensions in mm.)

The device has increased mechanical robustness if flush-mount method 2 (with angle brackets and frame) is used for the flush-mounted case.

4.2.3 Dimensional Drawings for the 24 TE Case

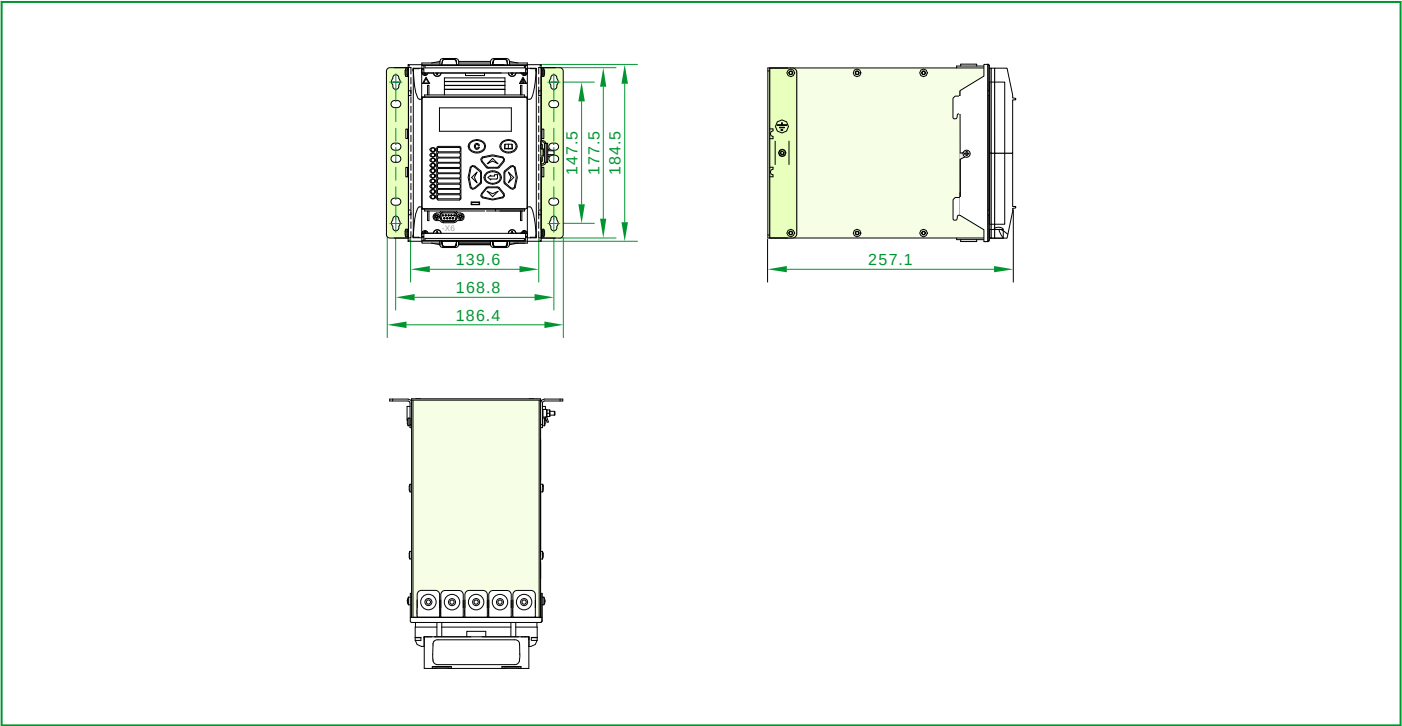


Fig. 4-9: Surface-mounted 24 TE case. (Dimensions in mm.)

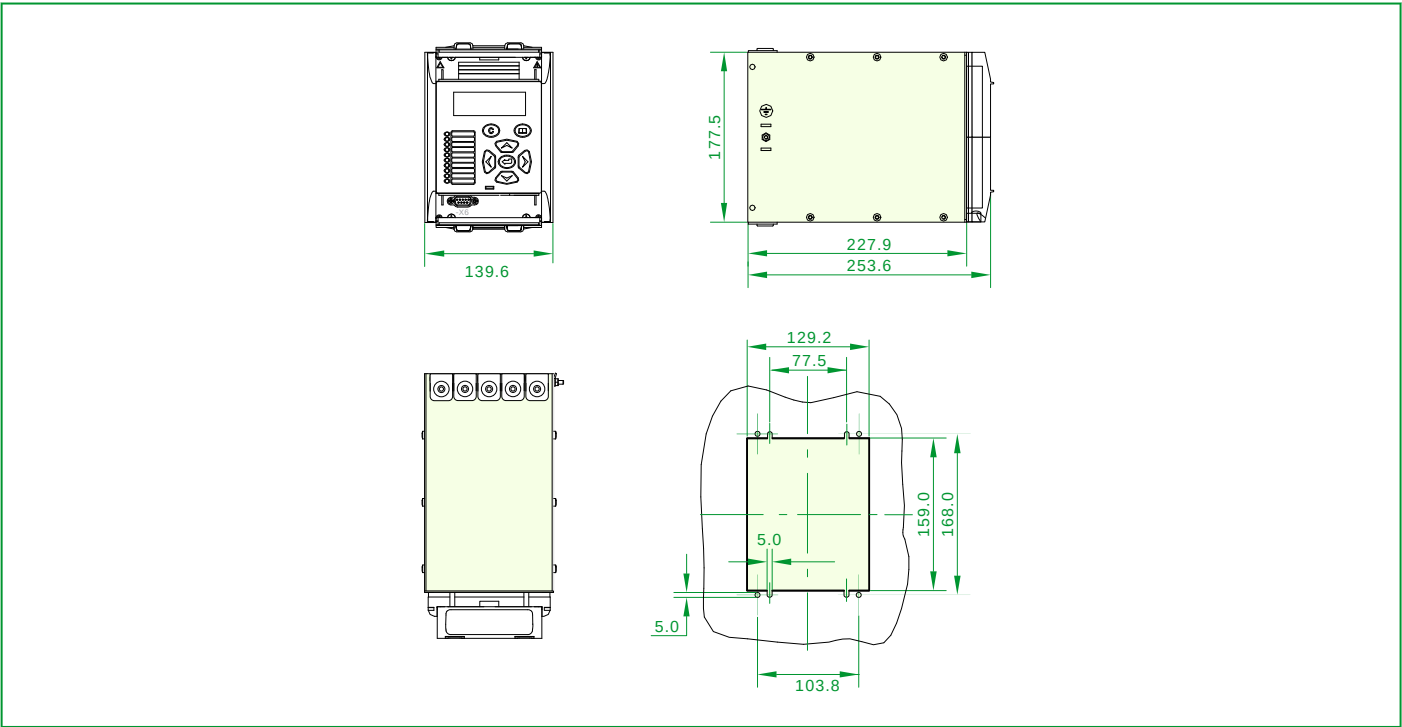


Fig. 4-10: Flush-mounted case 24 TE with panel opening, flush-mount method 1 (without angle brackets). (Dimensions in mm.)

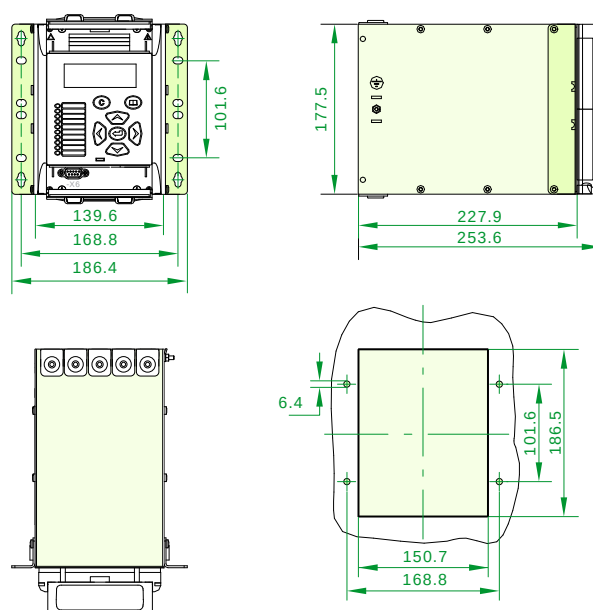


Fig. 4-11: Flush-mounted case 24 TE with panel opening, flush-mount method 2 (with angle brackets and frame). (Dimensions in mm.)

The device has increased mechanical robustness if flush-mount method 2 (with angle brackets and frame) is used for the flush-mounted case.

4.2.4 Detachable HMI

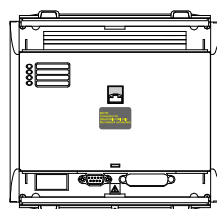


Fig. 4-12: View of case 40 TE for connection of detachable HMI.

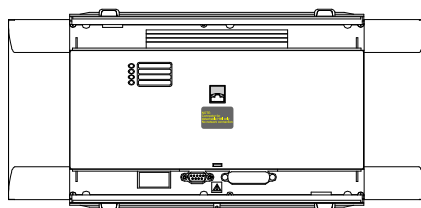


Fig. 4-13: View of case 84 TE for connection of detachable HMI.

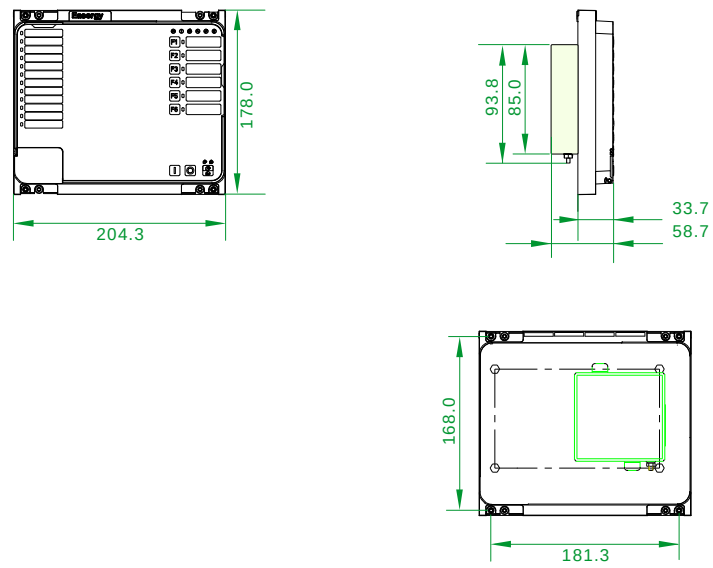


Fig. 4-14: Detachable HMI with panel opening.

4.3 Hardware Modules

The P433 is constructed from standard hardware modules. The following table gives an overview of the modules relevant for the P433.

Key:

- ●: standard equipment,
- ○: optional,
- □: depending on order,
- *: Module is not depicted in the terminal connection diagrams ([Section 5.7, \(p. 5-32\)](#)).
- →xx: Module has to be fitted into slot number xx.
- 1st→xx, 2nd→yy [etc.]:
 - If several modules of the same type may be ordered, these must be fitted into the appropriate slots in a particular order: If only one has been ordered it must be fitted into slot xx (i. e. slot yy is not permitted). If two modules have been ordered these must be fitted into slots xx and yy, etc.
 - For parallel communication options (serial communication module and additional Ethernet module variant [Chapter 15, \(p. 15-1\)](#)):
If serial communication module is on slot xx, the preferred slot for Ethernet module is slot yy and alternative one is slot zz.

Item Number	Description	Type	Width	P433 -430	P433 -431	P433 -432	P433 -433	P433 -434
9650356	Serial communication module (for RS 485 wire connection)	A (CH1 CH2)	4TE	○ →02	○ →02	○ →02	○ →02	○ →02
9650355	Serial communication module (for plastic fiber)							
9650354	Serial communication module (for glass fiber, ST connector)							
9652162	Single Ethernet module (100 Mbit/s, glass fiber LC connector, 2nd wire RJ45)	A (SEB LC)	4TE	○ →02	○ →02	○ 1 st →02 2 nd →03 3 rd →08	○ 1 st →02 2 nd →03 3 rd →08	○ 1 st →02 2 nd →03 3 rd →08
9652161	Single Ethernet module (100 Mbit/s, wire RJ45)	A (SEB RJ45)						
9652160	Redundant Ethernet module (100 Mbit/s, glass fiber LC connector, PRP/HSR/RSTP switchable, 2nd wire RJ45)	A (REB LC)						
9652159	Redundant Ethernet module (100 Mbit/s, wire RJ45, PRP/HSR/RSTP switchable, 2nd wire RJ45)	A (REB RJ45)						
9651567	InterMiCOM Module COMM3 (RS 485)	A(CH3)	4TE			○ →03	○ →03	○ →03
9651569	InterMiCOM Module COMM3 (for glass fiber)							
9651566	InterMiCOM Module COMM3 (RS 232)							
0336186	Bus module (digital, for 24 TE device)	B		●	●			
0336187	Bus module (digital, for 40 TE device)	B				●	●	
0336188	Bus module (digital, for 84 TE device)	B						●
0336421	Bus module (analog)	B		●	●	●	●	●
9651491	Local control module (text HMI, 24 TE, European font)	L		□	□			
9652214	Local control module Monochrome new (D)HMI	L				□	□	□

Item Number	Description	Type	Width	P433 -430	P433 -431	P433 -432	P433 -433	P433 -434
9650561	DHMI Adapter Board	L				☐	☐	☐
9650563	Processor Unit Adapter Board	L				☐	☐	☐
9651571	Processor Unit	P	4TE	● →01	● →01	● →01	● →01	● →01
9650307	Transformer module 4 × I, 4 × V (pin connection)	T(4I 4V)	8TE	☐ →03		☐ →04		
9650321	Transformer module 4 × I, 4 × V (ring connection)	T(4I 4V)	8TE		☐ →03		☐ →04	☐ →04
9650308	Transformer module 4 × I, 5 × V (pin connection)	T(4I 5V)	8TE	☐ →03		☐ →04		
9650322	Transformer module 4 × I, 5 × V (ring connection)	T(4I 5V)	8TE		☐ →03		☐ →04	☐ →04
0337086	Transient ground fault evaluation module	N	4TE			☐ →03	☐ →03	☐ →03
9651534	Power supply module 24 – 60 V DC, standard variant (switching threshold 18 V)	V(4I 80)	4TE	☐ →05	☐ →05	☐ →09	☐ →09	☐ →20
9651536	Power supply module 24 – 60 V DC, switching threshold 73 V							
9651537	Power supply module 24 – 60 V DC, switching threshold 90 V							
9651539	Power supply module 24 – 60 V DC, switching threshold 155 V							
9651538	Power supply module 24 – 60 V DC, switching threshold 146 V							
9651544	Power supply module 60 – 250 V DC / 100 – 230 V AC, Standard variant with switching threshold at 65% of 24 VDC (VA,min)	V(4I 80)	4TE	☐ →05	☐ →05	☐ →09	☐ →09	☐ →20
9651546	Power supply module 60 – 250 V DC / 100 – 230 V AC, Special variant with switching threshold at 65% of 110 VDC (VA,nom)							

Item Number	Description	Type	Width	P433 -430	P433 -431	P433 -432	P433 -433	P433 -434
9651547	Power supply module 60 – 250 V DC / 100 – 230 V AC, Special variant with switching threshold at 65% of 127 VDC (VA,nom)							
9651549	Power supply module 60 – 250 V DC / 100 – 230 V AC, Special variant with switching threshold at 65% of 220 VDC (VA,nom)							
9651548	Power supply module 60 – 250 V DC / 100 – 230 V AC, Special variant with switching threshold at 65% of 250 VDC (VA,nom)							
0337612	Binary I/O module (24 binary inputs), Standard variant with switching threshold at 65% of 24 VDC (VA,min)	X(24I)	4TE			○ 1 st →08 2 nd →03	○ 1 st →08 2 nd →03	○ 1 st →16 2 nd →03
9651304	Binary I/O module (24 binary inputs), Special variant with switching threshold at 65% of 110 VDC (VA,nom)							
9651332	Binary I/O module (24 binary inputs), Special variant with switching threshold at 65% of 127 VDC (VA,nom)							
9651443	Binary I/O module (24 binary inputs), Special variant with switching threshold at 65% of 220 VDC (VA,nom)							
9651360	Binary I/O module (24 binary inputs), Special variant with switching threshold at 65% of 250 VDC (VA,nom)							
9651493	Binary module (4 high-break contacts)	X(4H)	4TE	○→0 6	○→06	○→06	○→10	○→18
9651512	Binary I/O module (6 binary inputs, 3 output relays), Standard variant with switching threshold at 65% of 24 VDC (VA,min)	X(6I 3O)	4TE	○→0 6	○→06	○→10	○→10	○→18

Item Number	Description	Type	Width	P433 -430	P433 -431	P433 -432	P433 -433	P433 -434
9651513	Binary I/O module (6 binary inputs, 3 output relays), Special variant with switching threshold at 65% of 110 VDC (VA,nom)							
9651514	Binary I/O module (6 binary inputs, 3 output relays), Special variant with switching threshold at 65% of 127 VDC (VA,nom)							
9651516	Binary I/O module (6 binary inputs, 3 output relays), Special variant with switching threshold at 65% of 220 VDC (VA,nom)							
9651515	Binary I/O module (6 binary inputs, 3 output relays), Special variant with switching threshold at 65% of 250 VDC (VA,nom)							
0337377	Binary I/O module (6 binary inputs, 6 output relays), Standard variant with switching threshold at 65% of 24 VDC (VA,min)	X(6I 6O)	4TE			○ 1 st →06 2 nd →07	○ 1 st →06 2 nd →07	○ 1 st →12 2 nd →14
9651305	Binary I/O module (6 binary inputs, 6 output relays), Special variant with switching threshold at 65% of 110 VDC (VA,nom)							
9651333	Binary I/O module (6 binary inputs, 6 output relays), Special variant with switching threshold at 65% of 127 VDC (VA,nom)							
9651444	Binary I/O module (6 binary inputs, 6 output relays), Special variant with switching threshold at 65% of 220 VDC (VA,nom)							
9651361	Binary I/O module (6 binary inputs, 6 output relays), Special variant with switching threshold at 65% of 250 VDC (VA,nom)							
0336971	Binary I/O module (6 binary inputs, 8 output relays), Standard variant with switching threshold at 65% of 24 VDC (VA,min)	X(6I 8O)	4TE			○ 1 st →06 2 nd →07	○ 1 st →06 2 nd →07	○ 1 st →10 2 nd →12

Item Number	Description	Type	Width	P433 -430	P433 -431	P433 -432	P433 -433	P433 -434
9651306	Binary I/O module (6 binary inputs, 8 output relays), Special variant with switching threshold at 65% of 110 VDC (VA,nom)							
9651334	Binary I/O module (6 binary inputs, 8 output relays), Special variant with switching threshold at 65% of 127 VDC (VA,nom)							
9651445	Binary I/O module (6 binary inputs, 8 output relays), Special variant with switching threshold at 65% of 220 VDC (VA,nom)							
9651362	Binary I/O module (6 binary inputs, 8 output relays), Special variant with switching threshold at 65% of 250 VDC (VA,nom)							
0336973	Binary module (6 output relays)	X(6O)	4TE			○ →10	○ →10	○ →18
0337406	Analog I/O module, standard variant (switching threshold 18 V)	Y(4I)	4TE			○→08 alt. →03	○→08 alt. →03	○→08
9651307	Analog I/O module, switching threshold 73 V					dep. on ord.	dep. on ord.	
9651335	Analog I/O module, switching threshold 90 V							
9651446	Analog I/O module, switching threshold 146 V							
9651363	Analog I/O module, switching threshold 155 V							

The space available for the modules measures 4 HE in height by 40 TE or 84 TE in width (HE = 44.45 mm, TE = 5.08 mm).

The location of the individual modules and the position of the threaded terminal blocks in the P433 are shown in the location figures and terminal connection diagrams ([Section 5.7, \(p. 5-32\)](#)).

5

Installation and Connection

 DANGER**HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH**

- When electrical equipment is in operation, dangerous voltage will be present in certain parts of the equipment.
- Proper and safe operation of this device depends on appropriate shipping and handling, proper storage, installation and commissioning, and on careful operation, maintenance and servicing. For this reason only qualified personnel shall work on or operate this device.

Failure to follow these instructions will result in death or serious injury.

 DANGER**HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH**

- Switch off the auxiliary power supply before any work in the terminal strip area.
- Switch off all the power supplies in connection to the equipment before any work in the terminal strip area to isolate the device.
- Do not touch the terminal strip area when equipment is in operation.
- Do not remove or add wires in the terminal strip area when equipment is in operation.
- Short-circuit the system current transformers before disconnecting wires to the transformer board (valid only for pin terminals, not required for ring terminals which have a shortening block).
- A protective conductor (ground/earth) of at least 1.5 mm² must be connected to the protective conductor terminal on the power supply board and on the main relay case.
- Do never remove the protective conductor connection to the device casing as long as other wires are connected to it.
- Where stranded conductors are used, insulated crimped wire end ferrules must be employed.

Failure to follow these instructions will result in death or serious injury.

Note: Regarding the appropriate wiring connections of the equipment refer to the document Px3x_Grounding_Application_Guide_EN_h.pdf.

WARNING

HAZARD OF UNSAFE OPERATION

- The user should be familiar with the warnings in the Safety Guide (SFTY/5LM/L11 or later version) before working on the equipment.
- The user should be familiar with the safety messages in Chapter 5, Chapter 10, Chapter 11 and Chapter 12 and with the content of Chapter 13 of this technical manual, before working on the equipment.
- Proper and safe operation of this device depends on appropriate shipping and handling, proper storage, installation and commissioning, and on careful operation, maintenance and servicing. For this reason only qualified personnel shall work on or operate this device.
- Any modifications to this device must be in accordance with the manual. If any other modification is made without the express permission of Schneider Electric, it will invalidate the warranty, and may render the product unsafe.

Failure to follow these instructions can result in unintended equipment operation.

The signals MAIN: Blocked/faulty and SFMON: Warning (LED) are permanently assigned to the LEDs labeled OUT OF SERVICE and ALARM and can be assigned to output relays to indicate the health of the device.

It is recommended that the signals MAIN: Blocked/faulty and SFMON: Warning (LED) are communicated to the substation automation system for alarm purposes, using hardwiring via output relays or the communication interface.

DANGER

HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH

In case of usage of the equipment with DHMI:

- A protective conductor (ground/earth) of at least 1.5 mm² (US: AWG14 or thicker) must be connected to the DHMI protective conductor terminal to link the DHMI and the main relay case; these must be located within the same substation.
- The DHMI communication cable must not be in contact with hazardous live parts.
- The DHMI communication cable must not be routed or placed alongside high-voltage cables or connections. Currents can be induced in the cable which may result in electromagnetic interference.
- We recommend to use only cables of category CAT6 (or better), which has been tested up to a length of 10 m.

Failure to follow these instructions will result in death or serious injury.

 WARNING**HAZARD OF EQUIPMENT DAMAGE OR LIFETIME REDUCTION**

- The instructions given in the Section 5.5, (p. 5-14) (“Protective and Operational Grounding”) should be noted. In particular, check that the protective ground connection is secured with a tooth lock washer, as per the diagram “Installing the protective grounding conductor terminal” (Fig. 5-8. (p. 5-15)).
- If a cable screen is added to this connection or removed from it, then the protective grounding should be checked again.

Failure to follow these instructions can result in death, serious injury or equipment damage.

 WARNING**HAZARD OF EQUIPMENT DAMAGE OR LIFETIME REDUCTION**

- Do not sustain exposure to high humidity during storage, the value shall not exceed 75 % relative humidity.
- Once the device has been unpacked, it is recommended to energize it within the three following months.
- The device has to be energized at least once in 4 years, if it is not in permanent operation.
- Where electrical equipment is being installed, sufficient time should be allowed for acclimatization to the ambient temperature of the environment before energization.

Failure to follow these instructions can result in equipment damage, unintended equipment operation or reduction of equipment lifetime.

5.1 Unpacking and Packing

All P433 devices are packaged separately into dedicated cartons and shipped with outer packaging. Our products leave our factory in closed, sealed original packaging. If at receipt of the delivery the transport packaging is open or the seal is broken, the confidentiality and authenticity of the information contained in the products cannot be ensured.

Use special care when opening cartons and unpacking devices, and do not use force. In addition, make sure to remove supporting documents and the type identification label supplied with each individual device from the inside carton. The design revision level of each module included in the device when shipped can be determined from the list of components (assembly list). This list of components should be filed carefully.

After unpacking, each device should be inspected visually to confirm it is in proper mechanical condition.

If the P433 needs to be shipped, both inner and outer packaging must be used. If the original packaging is no longer available, make sure that packaging conforms to DIN ISO 2248 specifications for a drop height ≤ 0.8 m.

5.2

Checking Nominal Data and Design Type

The nominal data and design type of the P433 can be determined by checking the type identification label (see below). One type identification label is located on the top of the local control panel and a second label can be found under the hinged cover at the lower left side of the device. Another copy of the type identification label is fixed to the outside of the P433 packaging.



Fig. 5-1: Example of the type identification label of a device from the Easergy MiCOM 30 family.

The P433 design version can be determined from the order number. A breakdown of the order number is given in Chapter “Order Information” (Chapter 15, (p. 15-1)).

5.3 Location Requirements

The P433 has been designed to conform to EN 60255-6. Therefore it is important when choosing the installation location to make certain that it provides the operating conditions as specified in above DIN norm sections 3.2 to 3.4. Several of these important operating conditions are listed below.

5.3.1 Environmental Conditions

Ambient temperature: -5 °C to +55 °C [+23 °F to +131 °F]

Air pressure: 800 to 1100 hPa

Relative humidity: The relative humidity must not result in the formation of either condensed water or ice in the P433.

Ambient air: The ambient air must not be significantly polluted by dust, smoke, gases or vapors, or salt.

Solar Radiation: Direct solar radiation on the front of the device must be avoided to ensure that the LC-Display remains readable.

5.3.2 Mechanical Conditions

Vibration stress: 10 to 60 Hz, 0.035 mm and 60 to 150 Hz, 0.5 g

Earth quake resistance: 5 ... 8 Hz, 3.5 mm / 1.5 mm, 8 ... 35 Hz, 5 m/s²,
3 x 1 cycle

5.3.3 Electrical Conditions for Auxiliary Voltage of the Power Supply

Operating range: 0.8 to 1.1 $V_{A,nom}$ with a residual ripple of up to 12 % $V_{A,nom}$

5.3.4 Electromagnetic Conditions

Substation secondary system design must follow the best of modern practices, especially with respect to grounding and EMC.

5.4 Installation

The dimensions and mounting dimensions for surface-mounted cases are given in [Section 4.2, \(p. 4-5\)](#). When the P433 is surface-mounted on a panel, the wiring to the P433 is normally run along the front side of the mounting plane. If the wiring is to be at the back, an opening can be provided above or below the surface-mounted case. [Fig. 5-2, \(p. 5-7\)](#) shows such an opening.

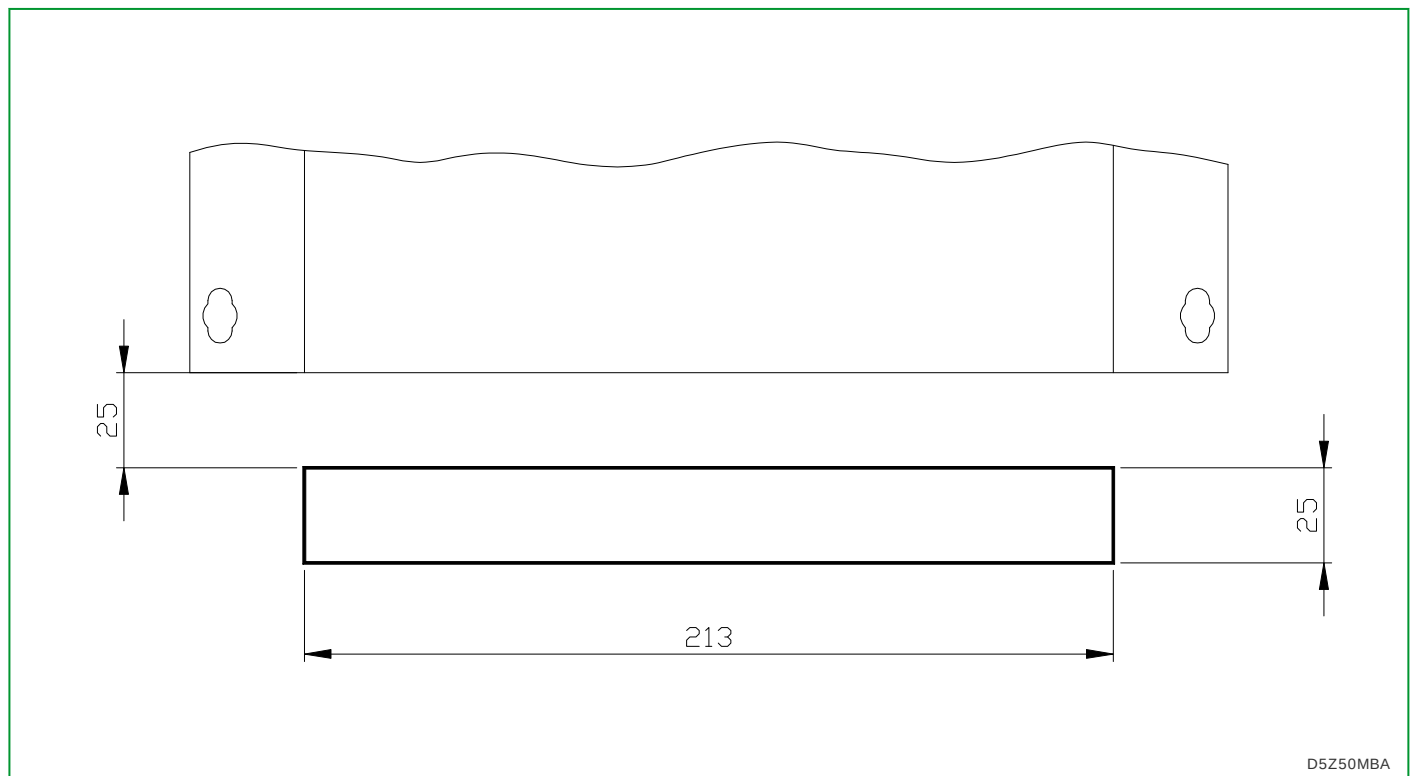


Fig. 5-2: Opening (cutout) for running the connecting leads to an 40 TE surface-mounted case.

The opening width for the 40 TE surface-mounted case: 213 mm (shown in this figure), for the 84 TE surface-mounted case: 435 mm. The other dimensions are the same for all cases.

Flush-mounted cases are designed for control panels. The dimensions and mounting dimensions are given in Chapter “Design”. When the P433 is mounted on a cabinet door, special sealing measures are necessary to provide the degree of protection required for the cabinet (IP 51).

Connection of protective grounding conductor: See “Protective and Operational Grounding” ([Section 5.5, \(p. 5-14\)](#))

Instructions for selecting the flush-mount method:

The P433 has increased mechanical robustness if either the surface-mounted case or – for the flush-mounted case – flush-mount method 2 (with angle brackets and frame) is used. In this case, test severity class 2 of the vibration test, test severity class 2 of the shock response test on operability as well as test severity class 1 of the shock response test on permanent shock are applied additionally.

Dimensions of the panel cutouts:

Dimensional drawings of the panel cutouts for all cases and for the detachable HMI can be found in [Section 4.2, \(p. 4-5\)](#).

For flush-mount method 1 (without angle brackets and frame), the procedure is as follows:

Before the P433 can be installed into a control panel, the local control panel (or the front element of the case for devices with detachable display) must be taken down. The local control panel is removed as described below:

1. Remove the mounting point cover.
2. Remove the M3.5 screws (see [Fig. 5-3, \(p. 5-9\)](#)).
3. Then remove the local control panel.



WARNING

HAZARD OF EQUIPMENT DAMAGE

- The local control panel (or front element) is connected to processor module P by a plug-in connecting cable. Make sure the connector position is correct. Do not bend the connecting cable!

Failure to follow these instructions can result in equipment damage or unintended equipment operation.

Then remove the lower M4 screws and only loosen the upper M4 screws (see [Fig. 5-3, \(p. 5-9\)](#)). Now insert the P433 into the panel opening from the rear so that the upper M4 screws fit into the corresponding holes. Then tighten all the M4 screws. After this, replace the local control panel.

NOTICE

HAZARD OF EQUIPMENT DAMAGE

- When replacing the local control panel, take care not to tighten the screws with too much strength! (Fastening torque 1.5 to 1.8 Newton meters).
- If the control panel thickness is ≥ 2 mm, the longer screws as enclosed within the device packing must be used.

Failure to follow these instructions can result in equipment damage.

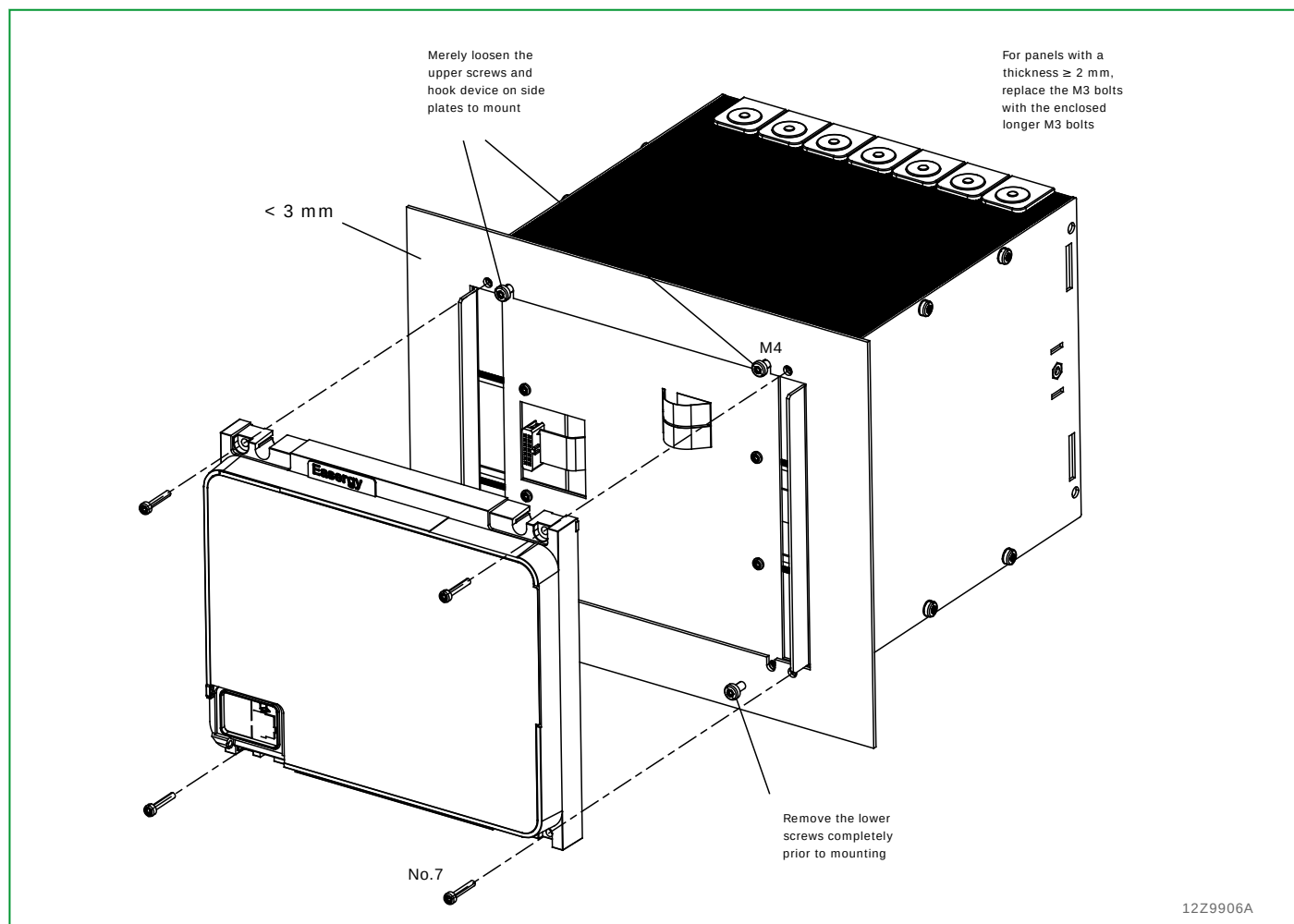


Fig. 5-3: Installation of a case into a control panel. Flush-mount method 1 (without the angle brackets and frame). Example for a device with a 40 TE case.

NOTICE

HAZARD OF EQUIPMENT DAMAGE

- The equipment provides increased mechanical robustness if either the surface-mounted case or for the flush-mounted case flush-mount method 2 (with angle brackets and frame, see Fig. 5-5, (p. 5-10)) is used.

Failure to follow these instructions can result in equipment damage.

DANGER

HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH

- Secure connection of protective grounding conductor: See Section 5.5, (p. 5-14).

Failure to follow these instructions will result in death or serious injury.

For flush-mount method 2 (using the angle brackets and frame), the procedure is as follows:

1. Remove the screws as shown in Fig. 5-4, (p. 5-10), ① and mount the enclosed angle brackets using these same screws.
2. Then push the device into the control panel cutout from the front.
3. Secure the device to the control panel by using the enclosed M6 screws (see Fig. 5-5, (p. 5-10)).
4. Assemble the cover frame and snap-fasten onto the fixing screws.

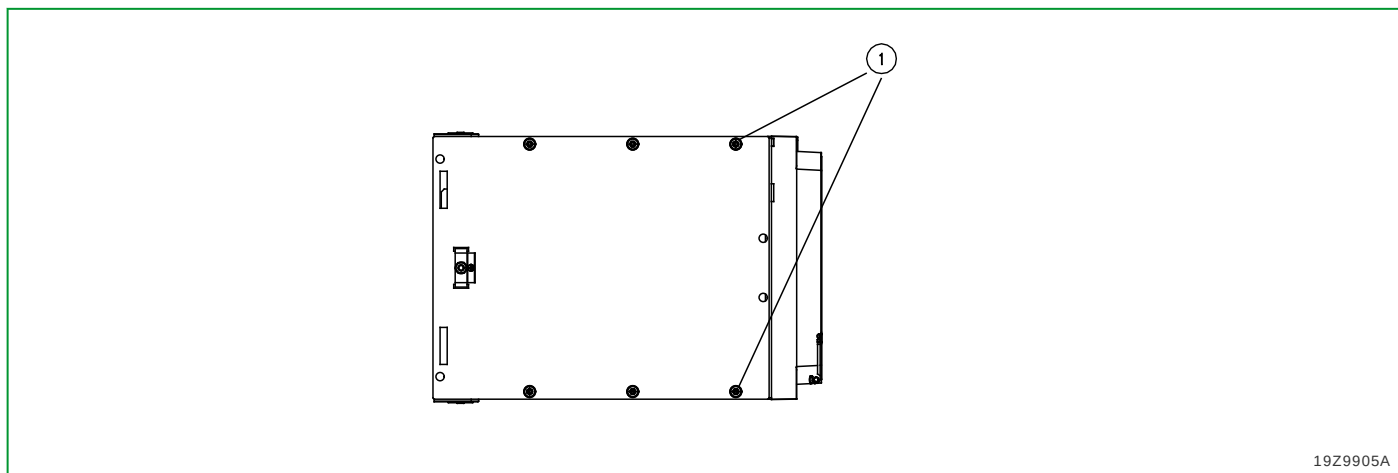


Fig. 5-4: Mounting the angle brackets.

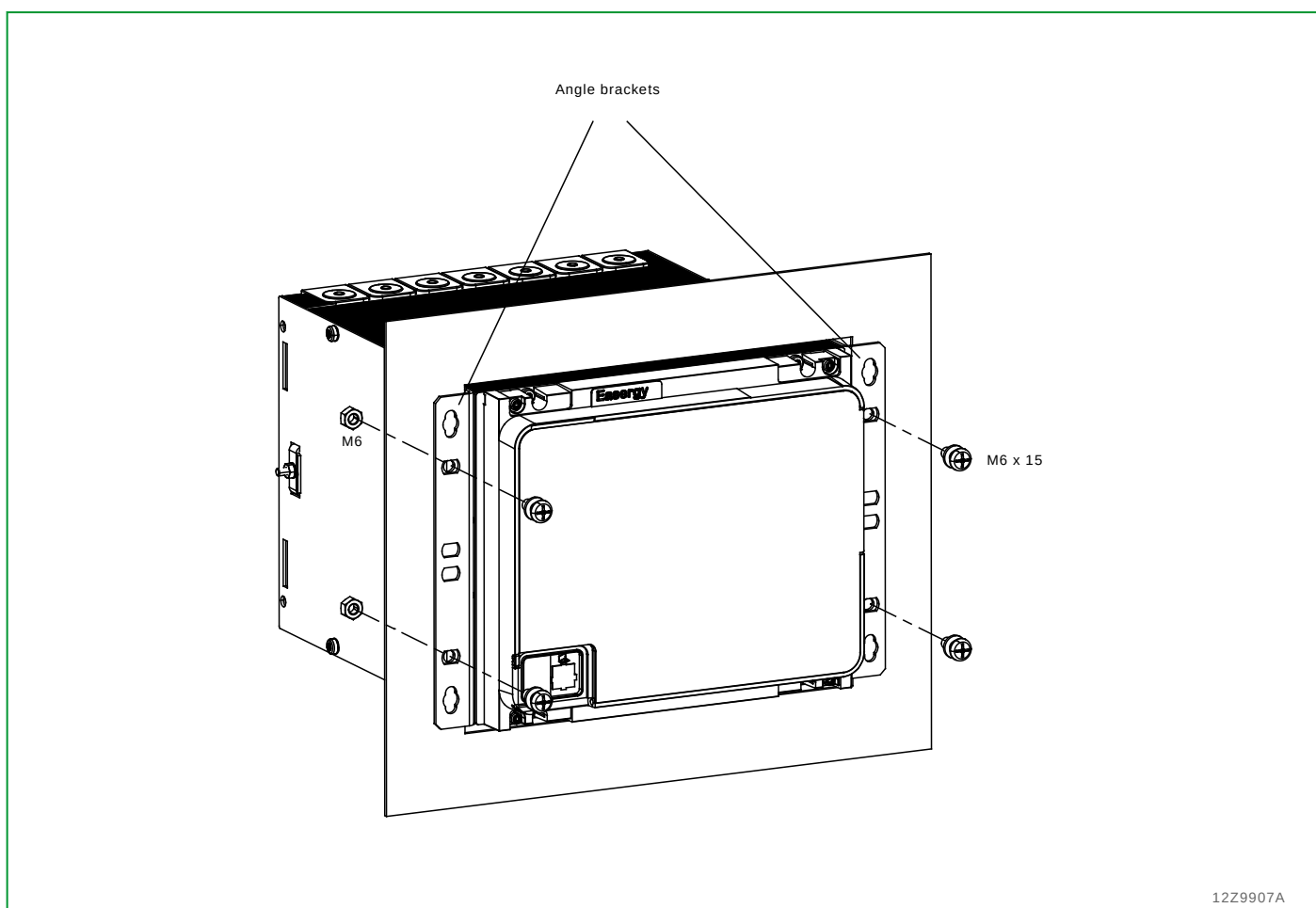


Fig. 5-5: Installation of a case into a control panel, flush-mount method 2 (with angle brackets). Example for a device in a 40 TE case.

In order to cover the angle brackets used with flush-mount method 2, an accessory set containing the frame fairing pack is optional available. Please refer to the following instruction figure for frame fairing assembly.

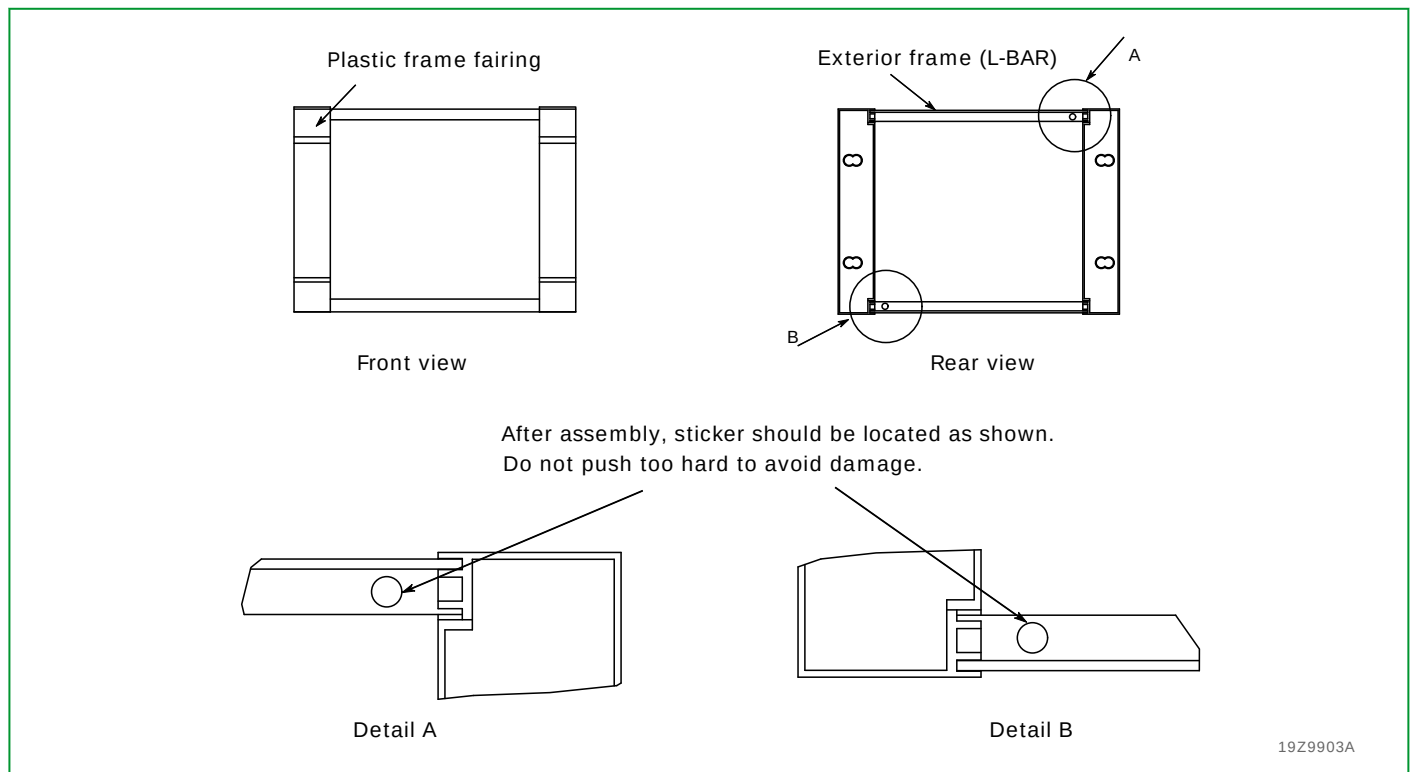


Fig. 5-6: Frame fairing pack assembly instruction. Example for a device in a 40 TE case (optional accessory).

NOTICE

HAZARD OF EQUIPMENT DAMAGE

- Make sure the position of the stickers on the exterior frame is correct when assembling.
- Do not push the exterior frame with too much strength avoiding to damage the plastic frame fairing.

Failure to follow these instructions can result in equipment damage.

Accessories for mounting method 2 are available separately for ordering, refer to Chapter 14, (p. 14-1).

The cover frame width of the 40 TE surface-mounted case is: 280 mm, of the 84 TE case is: 486 mm. The cover frame height is for all cases: 204 mm.

NOTICE

HAZARD OF EQUIPMENT DAMAGE

- The equipment provides increased mechanical robustness if either the surface-mounted case or for the flush-mounted case flush-mount method 2 (with angle brackets and frame, see Fig. 5-5, (p. 5-10)) is used.

Failure to follow these instructions can result in equipment damage.

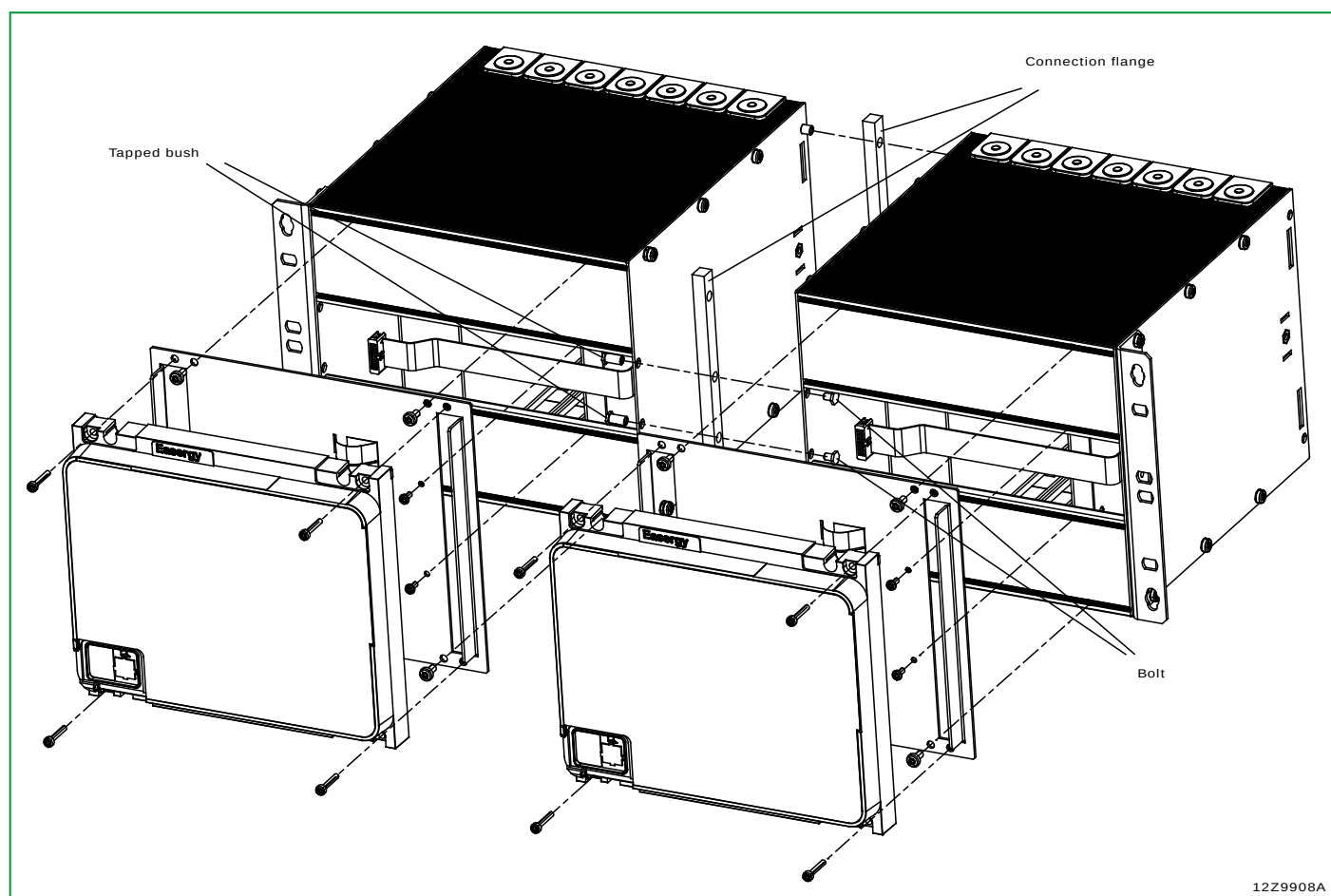
⚡ ⚠ DANGER

HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH

- Secure connection of protective grounding conductor: See Section 5.5, (p. 5-14).

Failure to follow these instructions will result in death or serious injury.

A rack mounting kit can be used to combine a flush-mounted 40 TE case with a second sub-rack to form a 19" mounting rack (see Fig. 5-7, (p. 5-12)). The second sub-rack can be another device, for example, or an empty sub-rack with a blank front panel. Fit the 19" mounting rack to a cabinet as shown in Fig. 5-8, (p. 5-13).



12Z9908A

Fig. 5-7: Combining 40 TE flush-mounted cases to form a 19" mounting rack.

⚡ ⚠ DANGER**HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH**

- Secure connection of protective grounding conductor: See Section 5.5, (p. 5-14).

Failure to follow these instructions will result in death or serious injury.

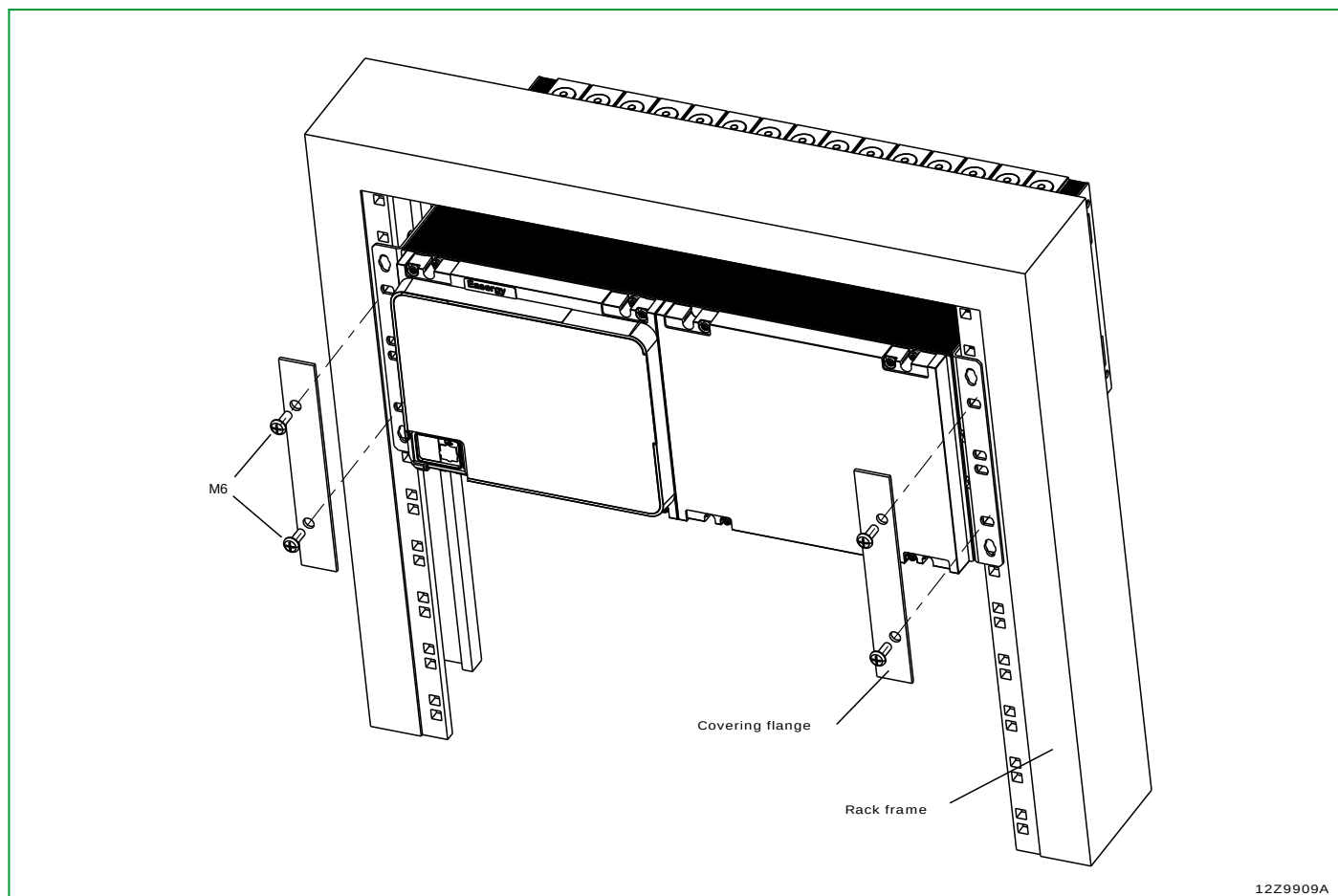


Fig. 5-8: Installing the P433 in a cabinet with a 19" mounting rack.

⚡ ⚠ DANGER**HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH**

- Secure connection of protective grounding conductor: See Section 5.5, (p. 5-14).

Failure to follow these instructions will result in death or serious injury.

5.5 Protective and Operational Grounding



HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH

- The device must be reliably grounded to meet protective equipment grounding requirements.
- The surface-mounted case is grounded using the bolt and nut, appropriately marked, as the ground connection. The flush-mounted case must be grounded in the area of the rear sidepieces at the location provided. The bracket is marked with the protective ground symbol: ⚡. The cross-section of the ground conductor must conform to applicable national standards. A minimum cross section of 2.5 mm² ($\leq$ AWG12) is required.
- In addition, a protective ground connection at the terminal contact on the power supply module (identified by the letters "PE" on the terminal connection diagram) is also required for proper operation of the device. The cross-section of this ground conductor must also conform to applicable national standards. A minimum cross section of 1.5 mm² (US: AWG14 or thicker) is required.
- If a detachable HMI is installed, a further protective conductor (ground/earth) of at least 1.5 mm² (US: AWG14 or thicker) must be connected to the DHMI protective conductor terminal to link the DHMI and the main relay case; these must be located within the same substation.
- All grounding connections must be low-inductance, i.e. it must be kept as short as possible.
- The protective conductor (earth) must always be connected to the protective grounding conductor terminal in order to guarantee the safety given by this setup.

Failure to follow these instructions will result in death or serious injury.

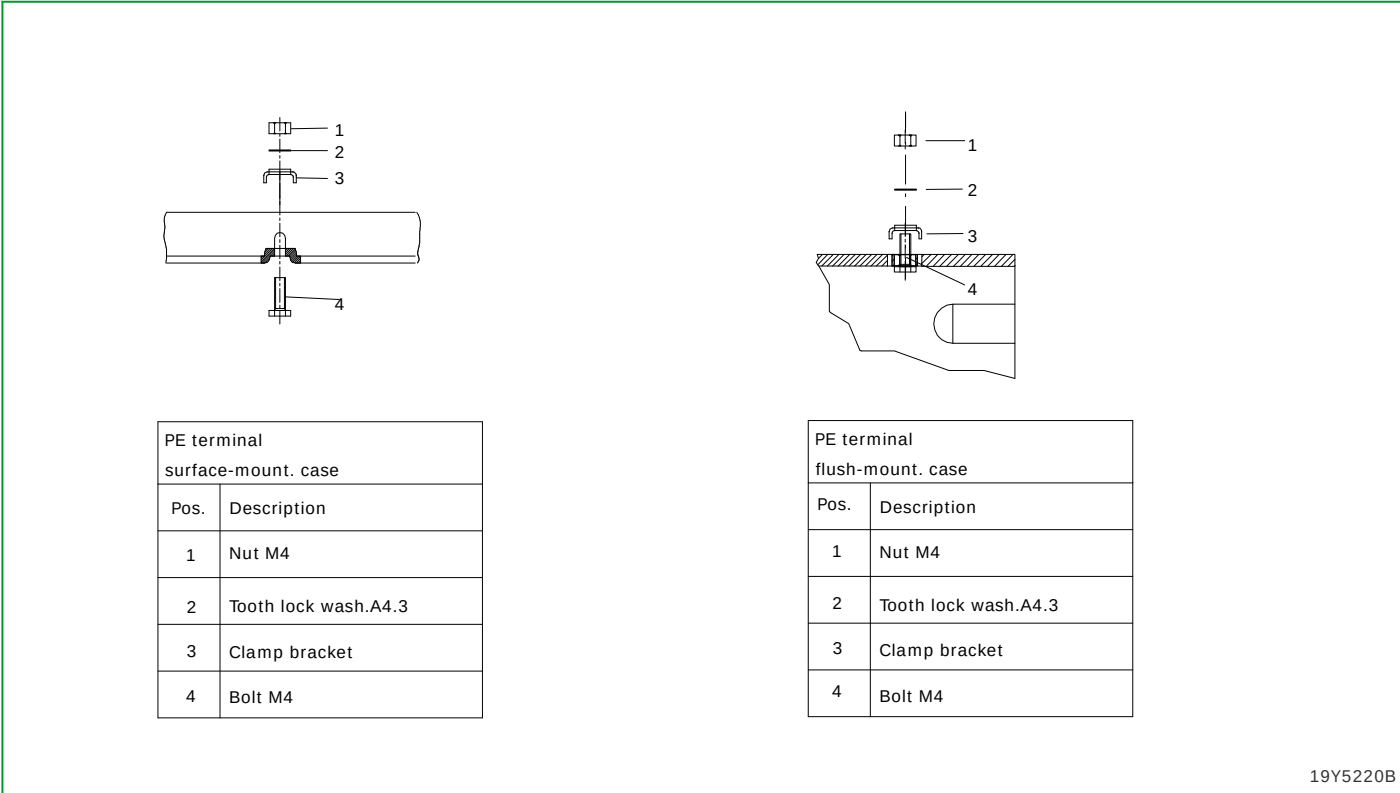


Fig. 5-9: Installing the protective grounding conductor terminal.

5.6 Connection

The P433 Distance Protection and Control Unit must be connected in accordance with the terminal connection diagram as indicated on the type identification label. The relevant terminal connection diagrams that apply to the P433 are to be found either in the supporting documents supplied with the device, or in [Section 5.7, \(p. 5-32\)](#).

In general copper conductors with a cross section of 2.5 mm² (US: AWG12) are sufficient to connect a system current transformer to a current input on the P433. To reduce CT knee-point voltage requirements, it may be necessary to install shorter copper conductors with a greater cross section between the system current transformers and the current inputs on the P433. Copper conductors having a cross section of 1.5 mm² (US: AWG14) are adequate to connect binary signal inputs, the output relays and the power supply input.

All connections run into the system must always have a defined potential. Connections that are pre-wired but not used should preferably be grounded when binary inputs and output relays are isolated. When binary inputs and output relays are connected to common potential, the pre-wired but unused connections should be connected to the common potential of the grouped connections.

 **DANGER**

HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH

- When increased-safety machinery is located in a hazardous area the device must always be installed outside of this hazardous area to protect this equipment.

Failure to follow these instructions will result in death or serious injury.

5.6.1 Connecting Measuring and Auxiliary Circuits

5.6.1.1 Power Supply

Before connecting the auxiliary voltage V_A for the P433 power supply, it must be ensured that the nominal value of the auxiliary device voltage corresponds with the nominal value of the auxiliary system voltage.

 **DANGER**

HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH

- The power supply must be turned off for at least 5 s before power supply module V is removed. Otherwise there is the danger of an electric shock.

Failure to follow these instructions will result in death or serious injury.

5.6.1.2 Current-Measuring Inputs

When connecting the system transformers, it must be ensured that the secondary nominal currents of the system and the device correspond.

 DANGER**HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH**

- Do not open the secondary circuit of live system current transformers! If the secondary circuit of a live CT is opened, there is the danger that the resulting voltages will endanger personnel and damage the insulation.
- For pin-terminal connection devices, the terminal block for system current transformer connection is not a shorting block! Therefore always short-circuit the system current transformers before loosening the threaded terminals.

Failure to follow these instructions will result in death or serious injury.

5.6.1.3

Connecting the Measuring Circuits

The system transformers must be connected in accordance with the standard schematic diagram shown in [Fig. 5-10, \(p. 5-18\)](#).

It is essential that the grounding configuration shown in the diagram be followed. If the CT or VT connection is reversed, this can be taken into account when making settings (see Chapter “Settings”).

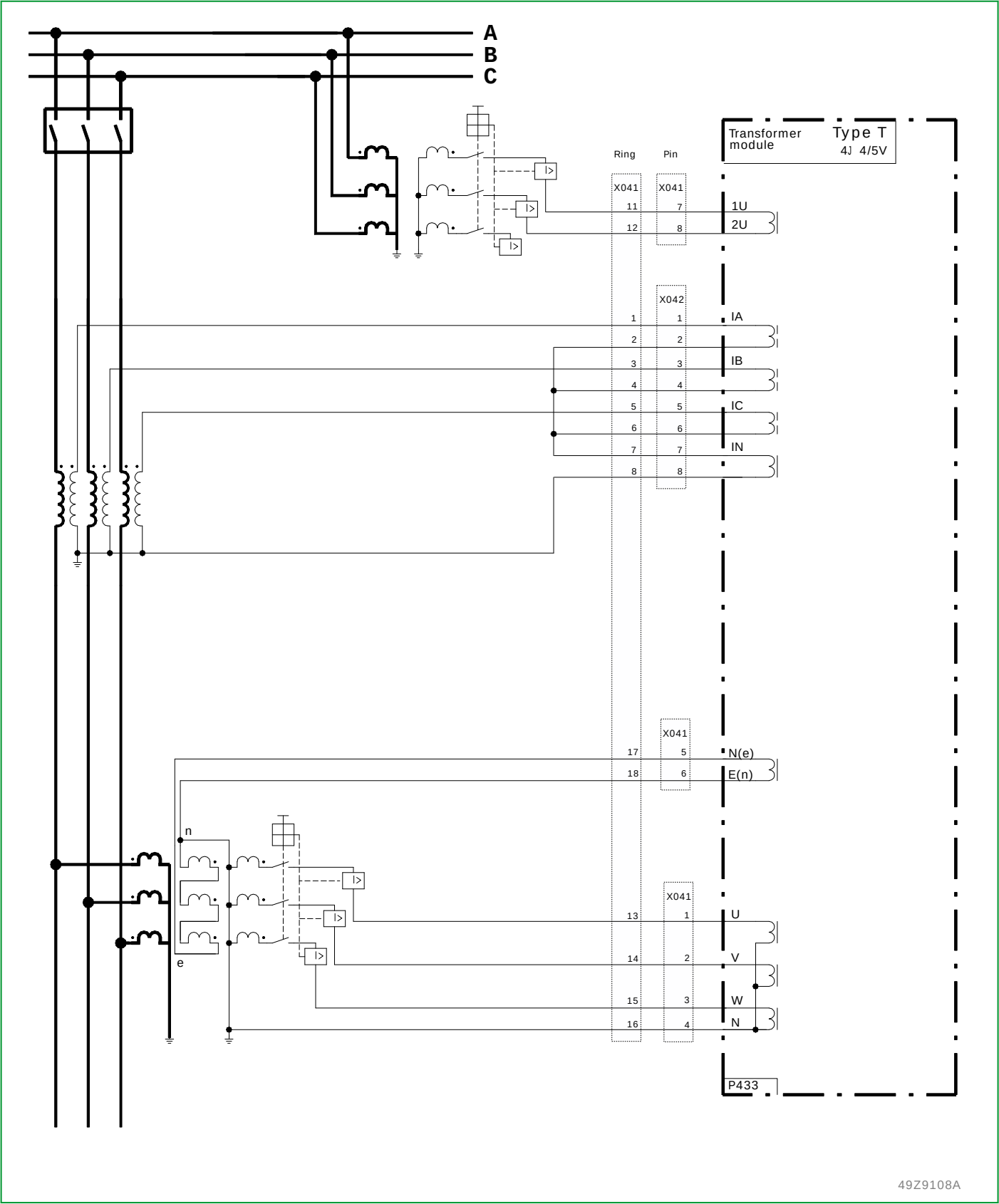


Fig. 5-10: Standard schematic diagram.

5.6.1.4 Connecting the Measuring Circuits for Ground Fault Direction Determination

If the P433 is to function using ground fault direction determination by steady-state values (the GFDSS function), then the T 4 current transformer must be connected to a core balance current transformer or a current transformer in Holmgreen configuration. If the metal shield of the cable is routed through the core balance transformer, the ground wire must be fed through the core again before it is connected to ground. The cable sealing end must be attached so that it is isolated from ground. This ensures that any currents flowing through the shield will not affect measurement.

The steady-state ground fault direction determination requires either the three phase-to-ground voltages or, alternatively, the neutral-point displacement voltage from the open delta winding of a voltage transformer assembly as the measured voltage. The phase voltages are drawn from the same transformers like the measured variables for the time voltage protection. An additional voltage transformer (T 90) is available in the P433 to connect an open delta winding. When setting the protection function, the selected voltage needs to be taken into account.

Fig. 5-11, (p. 5-20) shows the standard connection for ground fault direction determination by steady-state values where the voltage measuring circuit is connected to an open delta winding. With this connection configuration, “forward/LS” is displayed if a ground fault occurs on the line side. A reversed connection is possible for the system current or voltage transformer if the appropriate setting is configured.

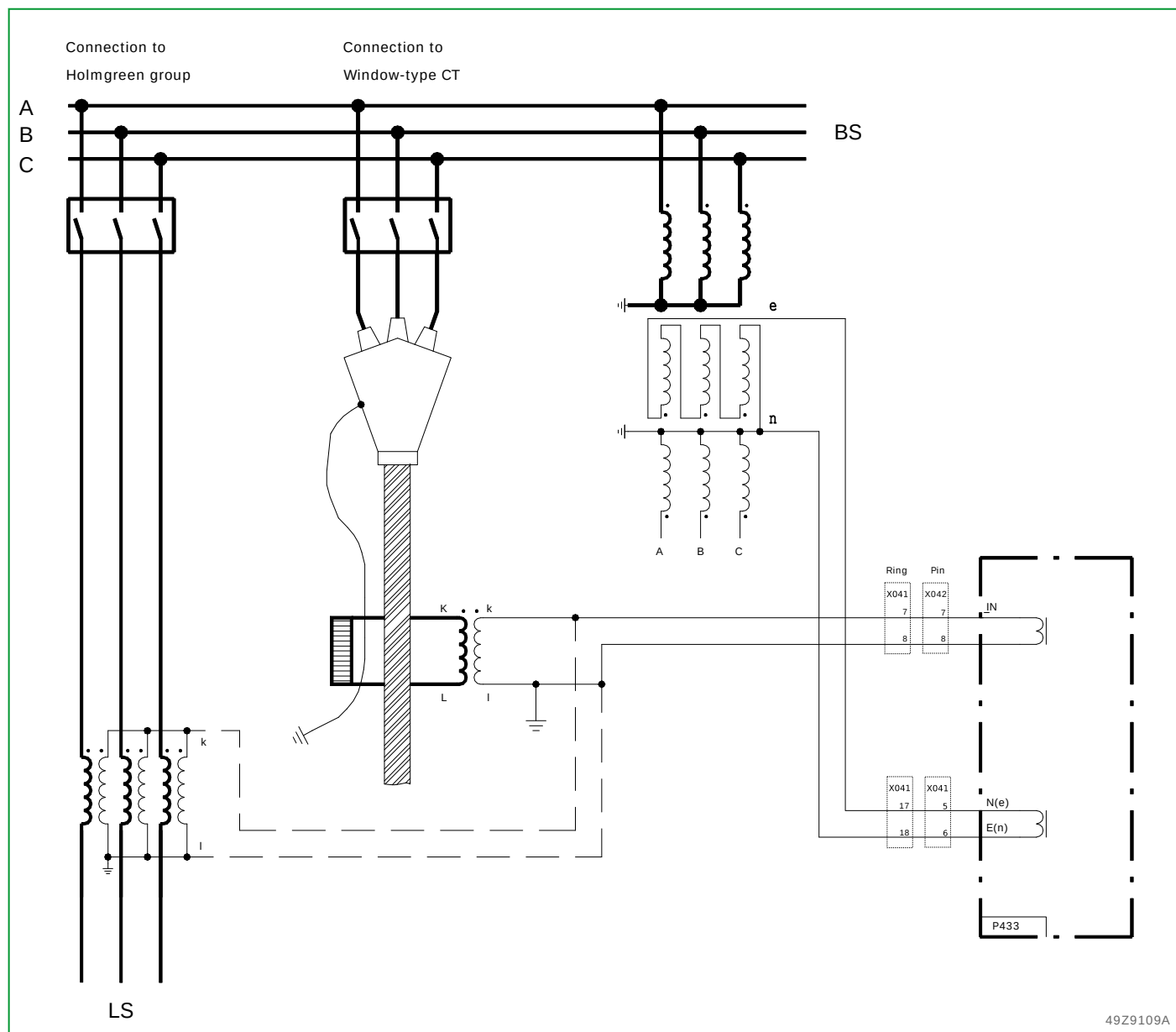
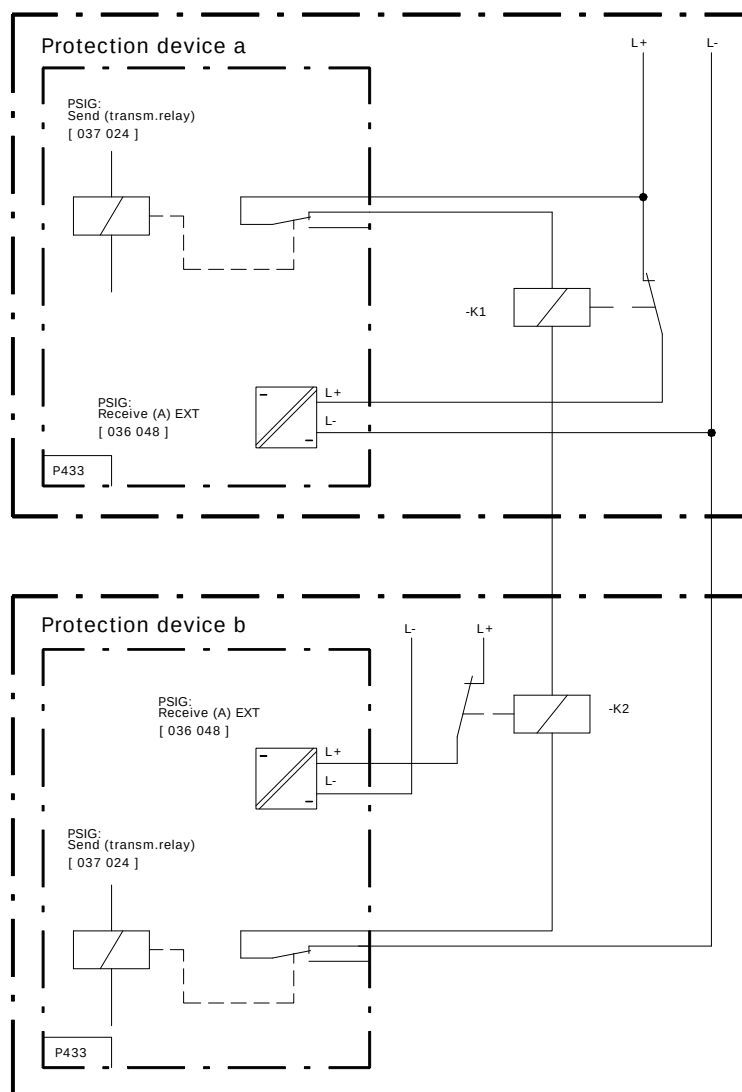


Fig. 5-11: Connecting the steady-state ground fault direction determination function to Holmgreen-configuration and core balance transformers.

5.6.1.5 Connecting Protective Signaling

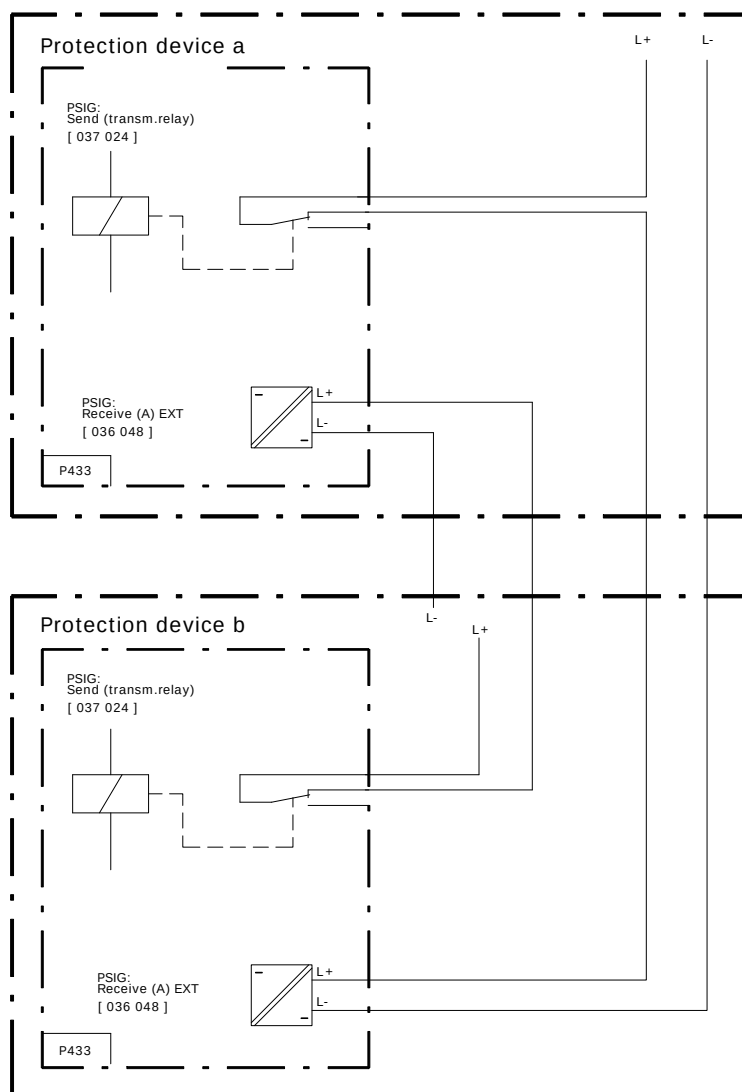
Either a transmission device or pilot wires are required for signal transmission, depending on the operating mode selected. Twisted pair cores should be used as pilot wires. Two or four cores are required. If only two cores are available, there must be an all-or-nothing relay in each station for coupling received and transmitted signals. The coils of the all-or-nothing relays must be designed for half the loop voltage. Fig. 5-12, (p. 5-21) shows the connection with two cores and Fig. 5-13, (p. 5-22) the connection with four cores.

The protective signaling transmitting relay can be set to either *Transm. rel. break con.* or *Transm. rel. make con.* In the first case the break contact of the transmitting relay must be wired, and in the second case the make contact must be wired. The figures show the connection for the setting *Transm. rel. break con.*



D5Z50DBA

Fig. 5-12: Connection of protective signaling with two cores.

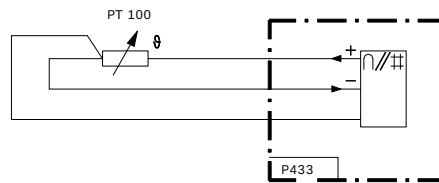


D5Z50DCA

Fig. 5-13: Connection of protective signaling with four cores.

5.6.1.6 Connecting a Resistance Thermometer

A resistance thermometer can be connected if the device is fitted with analog module Y. This analog I/O module input is designed to connect a PT 100 resistance thermometer. The PT 100 should be connected using the 3-wire method (see Fig. 5-14, (p. 5-23)). No supply conductor compensation is required in this case.



S8Z52H9A

Fig. 5-14: Connecting a PT 100 using the 3-wire method.

5.6.1.7 Connecting Binary Inputs and Output Relays

The binary inputs and output relays are freely configurable. When configuring these components it is important to note that the contact rating of the binary I/O modules (X) varies (see Section 2.5.7, (p. 2-13)).

Once the user has selected a bay type, the P433 can automatically configure the binary inputs and output relays with function assignments for the control of switchgear units. The standard configuration of binary inputs and output relays for each bay type is given in the list of bay types to be found in the Appendix (see Vol. 2, Chapter A5, (p. A5-1)).

The polarity for connected binary signal inputs is to be found in the terminal connection diagrams (see supporting documents supplied with the device or in Section 5.7, (p. 5-32)). This is to be understood as a recommendation only. Connection to binary inputs can be made as desired.

5.6.1.8 Connecting Trip and Close Command Relays

Standard outputs of Px30 aren't supposed to open DC current flowing through inductive CB coil. This task has to be addressed by properly applied CB auxiliary contacts (52a/b).

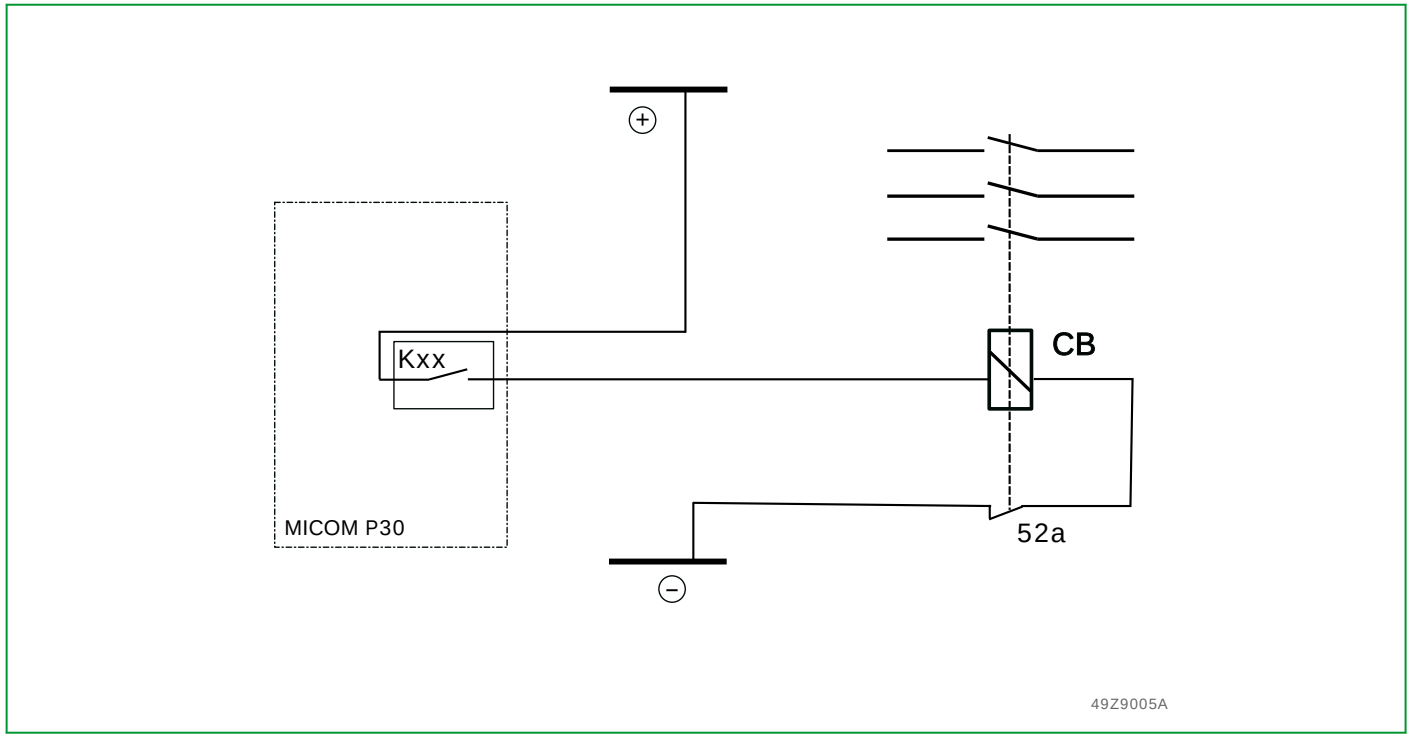


Fig. 5-15: Example of trip circuit wiring.

In order to ascertain that the inductive coil current is switched off from the CB auxiliary contacts, the setting of minimum pulse duration for trip commands (MAIN: Min.dur. trip cmd. 1 etc.) and close command need to consider the operating times of the circuit breaker and its auxiliary contacts. Sufficient margin has to be applied for pulse duration. A common setting is to double operating time of the circuit breaker, e.g. for a CB trip operation time t_{op} of 100 ms, the minimum trip pulse time should be 0.2 s (see the following figure).

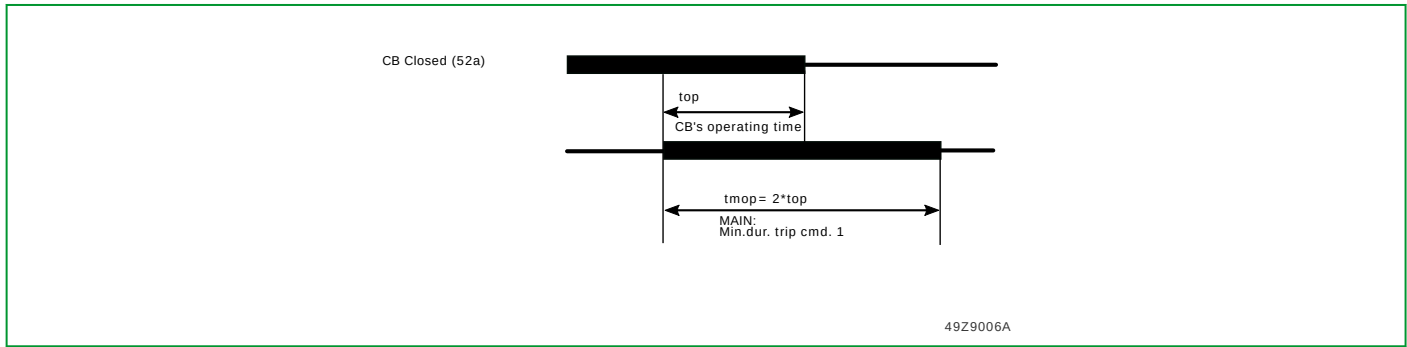


Fig. 5-16: Example of trip pulse timing.

This of course also applies to device open/close command outputs operated with fix (short or long) command duration (e.g. DEVxx Oper. mode cmd. = Short command).

If the Px30 output contact triggers an auxiliary relay which opens or closes the CB consecutively, then it should be verified, that the make/continuous/break coil currents of this auxiliary relay are within the limit values given in [Section 2.5.7, \(p. 2-13\)](#).

Note: Upon testing such command outputs, the CB (or equivalent auxiliary components) must not be mechanically locked, so that the auxiliary 52a/b contact could operate and break the DC current. If the CB has to stay locked, tripping or closing circuit has to be opened by terminal disconnection or test switch.

5.6.1.9

Connection of Switchgear Units Having Direct Motor Control

In the case of bay types having direct motor control, one binary input is configured for the status signal and one output relay is configured for triggering and resetting the motor relay. Configuration of appropriate output relays to trigger the armature and shunt windings of motors on load disconnect switches, isolating links or grounding switches is in accordance with the “List of Bay Types” (see Appendix). A connection example for a direct motor control is shown in the following diagram.

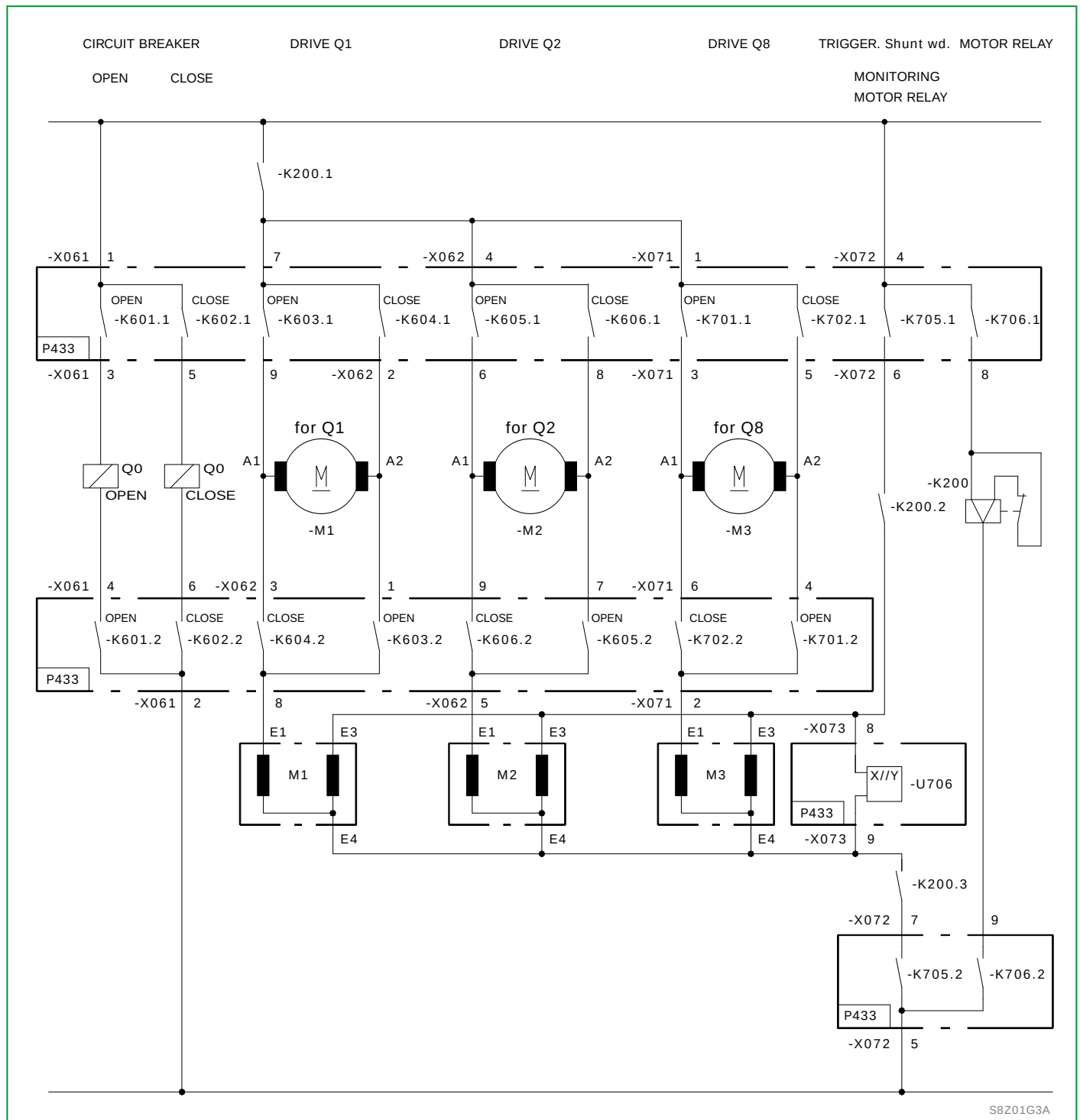


Fig. 5-17: Connection example, motor with shunt winding for a direct motor control, bay type No. 89 (A23.105.M04), feeder bay with circuit breaker, double busbar.

5.6.2 Connecting the IRIG-B Interface

An IRIG-B interface for time synchronization is available with the Ethernet module. It is connected by a BNC connector. Demodulated and modulated signals can be used.

5.6.3 Connecting the Communication Interfaces

5.6.3.1 PC Interface

The PC interface is provided so that personnel can operate the device from a personal computer (PC).

DANGER

HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH

- The PC interface is not designed as a permanent connection. Consequently, the female connector does not have the extra insulation from circuits connected to the system that is required per IEC/EN 60255-27. Therefore DO NOT leave any permanent cable connection on the PC interface connector at the HMI front panel.

Failure to follow these instructions will result in death or serious injury.

WARNING

UNEXPECTED EQUIPMENT OPERATION

- Do not use a PC with active termination on any connection pin of the RS232 interface. Wrong termination can drive the device to delay operating actions from the HMI as long as this wrong termination is active on the PC interface.

Failure to follow these instructions can result in unintended equipment operation.

5.6.3.2 Serial Communication Interfaces

The serial communication interfaces are provided as a permanent connection of the device to a control system for substations or to a central substation unit. Depending on the type, communication interface 1 on the device is connected either by a special fiber-optic connector or an RS 485 interface with twisted pair copper wires. Communication interface 2 is only available as an RS 485 interface. The selection and assembly of a properly cut fiber-optic connecting cable requires special knowledge and expertise and is therefore not covered in this operating manual.

 DANGER**HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH**

- Do not connect or disconnect the RS 485 or fiber-optic interface when the supply voltage for the device is under power and in operation.

Failure to follow these instructions will result in death or serious injury.

An RS 485 data transmission link between a master and several slave devices can be established by using the optional communication interface. The communication master could be, for instance, a central control station. Devices linked to the communication master, e.g. P433, are set-up as slave devices.

The RS 485 interface available on the P433 was designed so that data transfer in a full duplex transmission mode is possible using a 4-wire data link between devices. Data transfer between devices using the RS 485 interface is set up only for a half duplex transmission mode. To connect the RS 485 communication interface the following must be observed:

- Only twisted pair shielded cables must be used, that are common in telecommunication installations.
- At least one symmetrical twisted pair of wires is necessary.
- Conductor insulation and shielding must only be removed from the core in the immediate vicinity of the terminal strips and connected according to national standards.
- All shielding must be connected to an effective protective ground surface at both ends.
- Unused conductors must all be grounded at one end.

A 4-wire data link as an alternative to a 2-wire communications link is also possible. A cable with two symmetrical twisted pair wires is required for a 4-wire data link. A 2-wire data link is shown in [Fig. 5-18, \(p. 5-28\)](#), and a 4-wire data link is shown in [Fig. 5-19, \(p. 5-29\)](#) as an example for channel 2 on the communication module. The same is valid if channel 1 on the communication module is available as a RS 485 interface.

2-wire data link:

The transmitter must be bridged with the receiver on all devices equipped electrically with a full duplex communication interface, e.g. the P433. The two devices situated at either far end must have a 200 to 220 Ω resistor installed to terminate the data transmission conductor. In devices from the *Easergy MiCOM 30* family, and also in the P433, a 220 Ω resistor is integrated into the RS 485 interface hardware and can be connected with a wire jumper. An external resistor is therefore not necessary.

4-wire data link:

Transmitter and receiver must be bridged in the device situated on one far end of the data transmission conductor. The receivers of slave devices, that have an electrically full-duplex communication interface as part of their electrical system, e.g. the P433, are connected to the transmitter of the communication master device, and the transmitters of slave devices are connected to the receiver of the master device. Devices equipped electrically with only a half duplex RS 485 communication interface are connected to the transmitter of the communication master device. The last device in line (master or slave device) on the data transmission conductor must have the transmitter and receiver terminated with a 200 to 220 Ω resistor each. In devices from the *Easergy MiCOM 30* family, and also in the P433, a 220 Ω resistor is integrated into the RS 485 interface

hardware and can be connected with a wire jumper. An external resistor is therefore not necessary. The second resistor must be connected externally to the device (resistor order number see Chapter “Accessories and Spare Parts”).

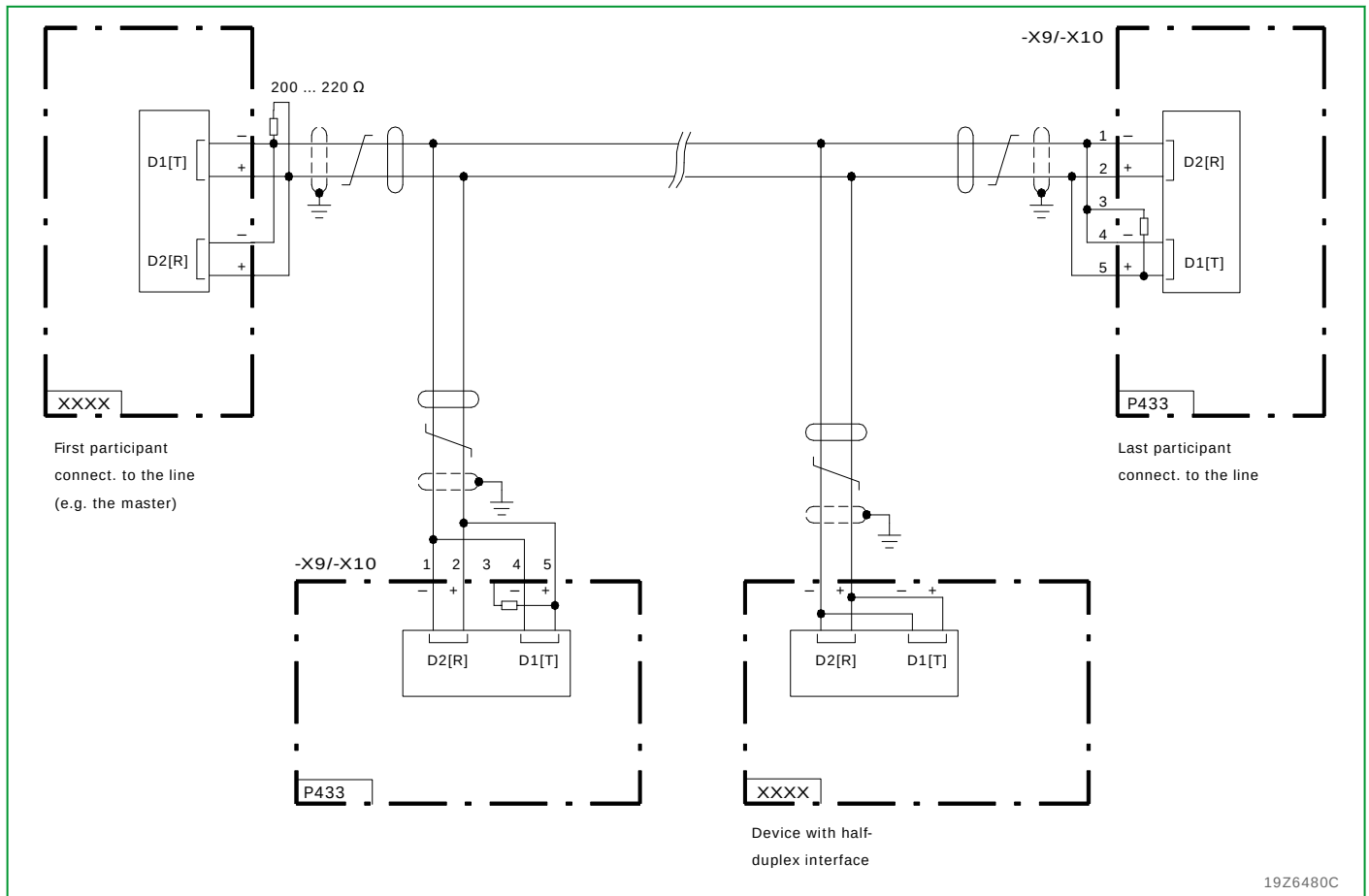


Fig. 5-18: 2-wire data link. (Note: the setting *MAIN: Chann.assign.COMM1/2* decides about whether -X9 (=channel 1) or -X10 (=channel 2) is used.)

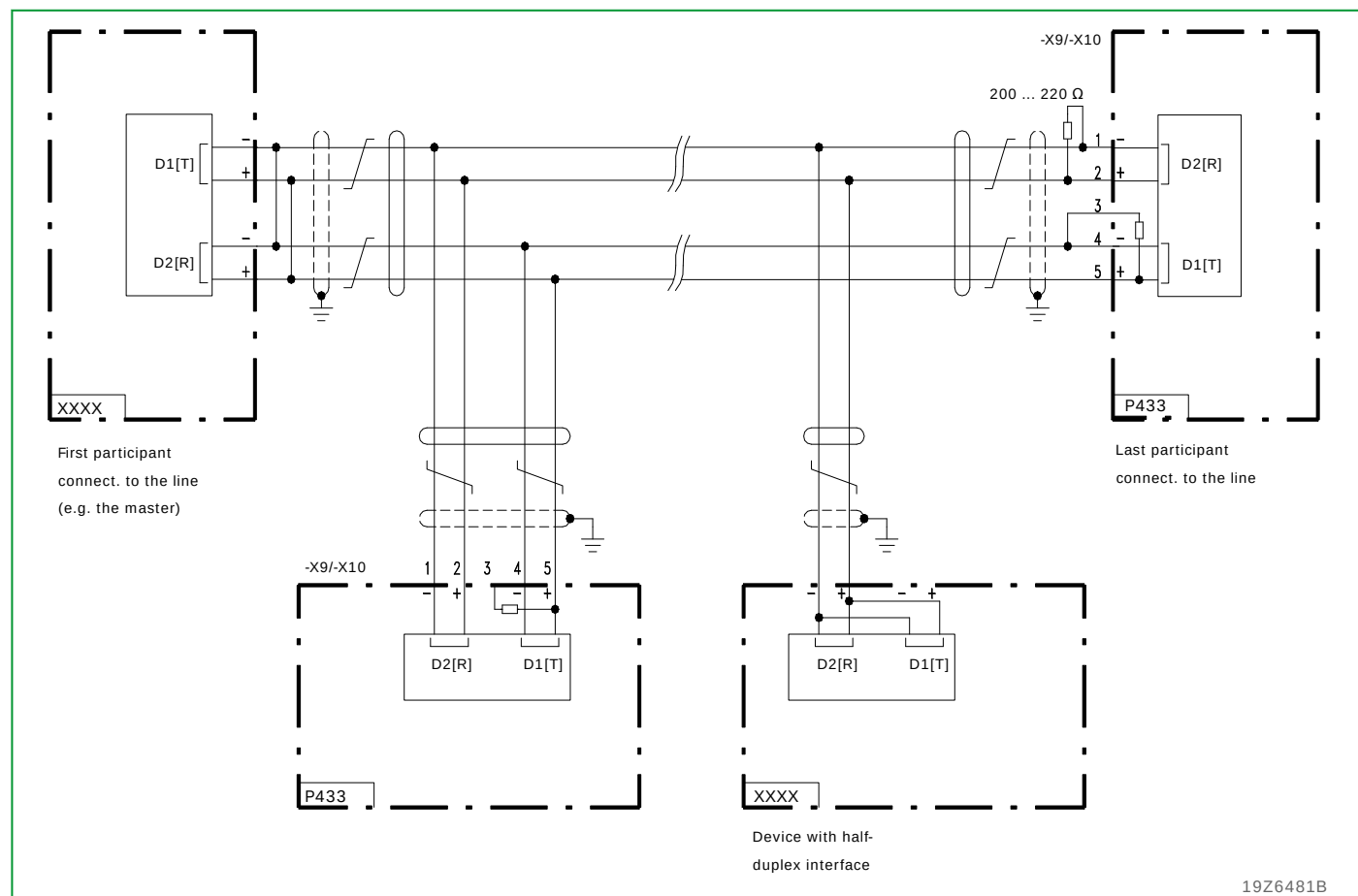
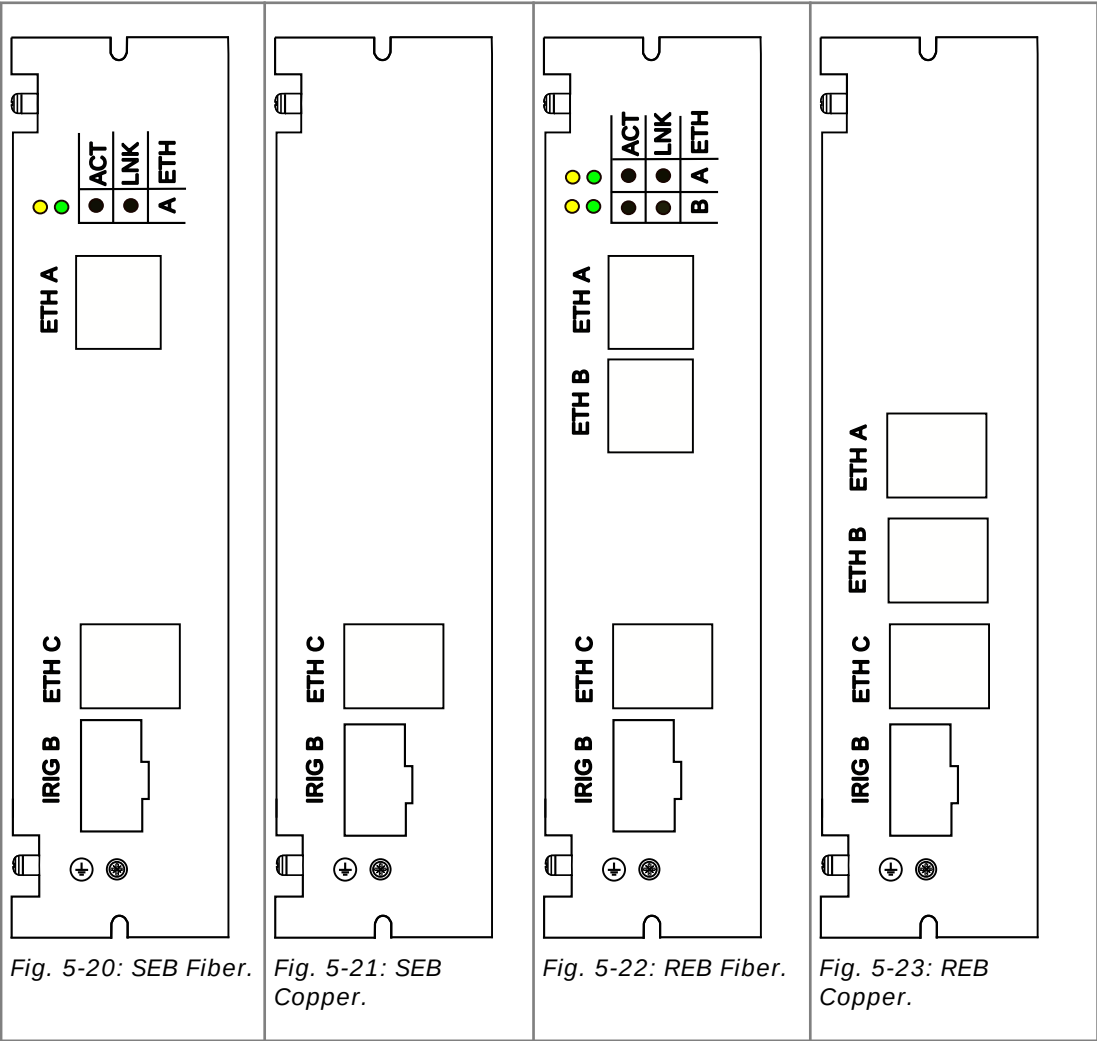


Fig. 5-19: 4-wire data link. (Note: the setting MAIN: Chann.assign.COMM1/2 decides about whether -X9 (=channel 1) or -X10 (=channel 2) is used.)

For CH1/CH2 connection diagram, please refer to [Section 5.7, \(p. 5-32\)](#)

5.6.3.3 Ethernet Module Connection

The diagram and the related tables below show the Interface arrangement of Ethernet module, as they are the fiber/copper connectors and IRIG-B connector.



Connector	Connections
ETH A	Fiber/Copper
ETH B	Fiber/Copper
ETH C	Copper
IRIG-B	Demodulated (DC IRIG-B)/ Modulated (AC IRIG-B)

Tab. 5-1: Connector functionality.

LED	Function	On	Off	Flashing
Green	Link	Link o.k.	Link broken	
Yellow	Activity			Packets received/ emitted

Tab. 5-2: LED functionality.

5.6.3.4 Parallel Serial and Ethernet Modules Connection

The parallel serial and Ethernet modules should be fitted into the appropriate slots in a particular order. The serial communication module must be fitted into slot 2. The preferred and alternative slots for Ethernet module are shown in the location diagrams [Section 5.7, \(p. 5-32\)](#).

Regarding the appropriate wiring connections of parallel serial and Ethernet modules refer to [Section 5.6.3.2, \(p. 5-26\)](#) and [Section 5.6.3.3, \(p. 5-30\)](#).

5.7 Location and Connection Diagrams

5.7.1 Location Diagrams P433-430/431/432/433/434

Location diagram for P433 in 24 TE case

- Pin-terminal connection (P433 -430)
- Transformer module: Ring-terminal connection, other modules pin-terminal connection (P433 -431)

01	02	03	04	05	06
P	A CH1 CH2	T 4J 4V		V 4I 80	X 4H
	A SEB LC/ RJ45	T 4J 5V			X 6I 30
	A REB LC/ RJ45				X 6O
01	02	03	04	05	06

Location diagram for P433 in 40 TE case

- Pin-terminal connection (P433 -432)
- Transformer module: Ring-terminal connection, other modules pin-terminal connection (P433 -433)

01	02	03	04	05	06	07	08	09	10
P	A CH1 CH2	A CH3	T 4J 4V		X 6I 60	X 6I 60	X 24I Y 4I	V 4I 80	X 4H
		X 24I	T 4J 5V		X 6I 80	X 6I 80	X 6I 80		X 6I 30
	A SEB LC/ RJ45	A SEB LC/ RJ45					A SEB LC/ RJ45		X 6O
	A REB LC/ RJ45	A REB LC/ RJ45					A REB LC/ RJ45		
01	02	03	04	05	06	07	08	09	10

Location diagram for P433 in 84 TE case

- Ring-terminal connection (P433 -434)

01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	
P	A CH1 CH2	A CH3 N X 24I A SEB LC/ RJ45 A REB LC/ RJ45	T 4J 4V T 4J 5V				Y 4J A SEB LC/ RJ45 A REB LC/ RJ45				X 6I 6O X 6I 8O	X 6I 6O X 6I 8O	X 24I X 6I 8O	X 4H X 6I 3O X 6O						V 4I 8O	
01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	

Each of the numbered slots can be fitted with max. 1 module.

If a location diagram shows several modules for a particular slot, then these are alternatives, depending on the ordering options.

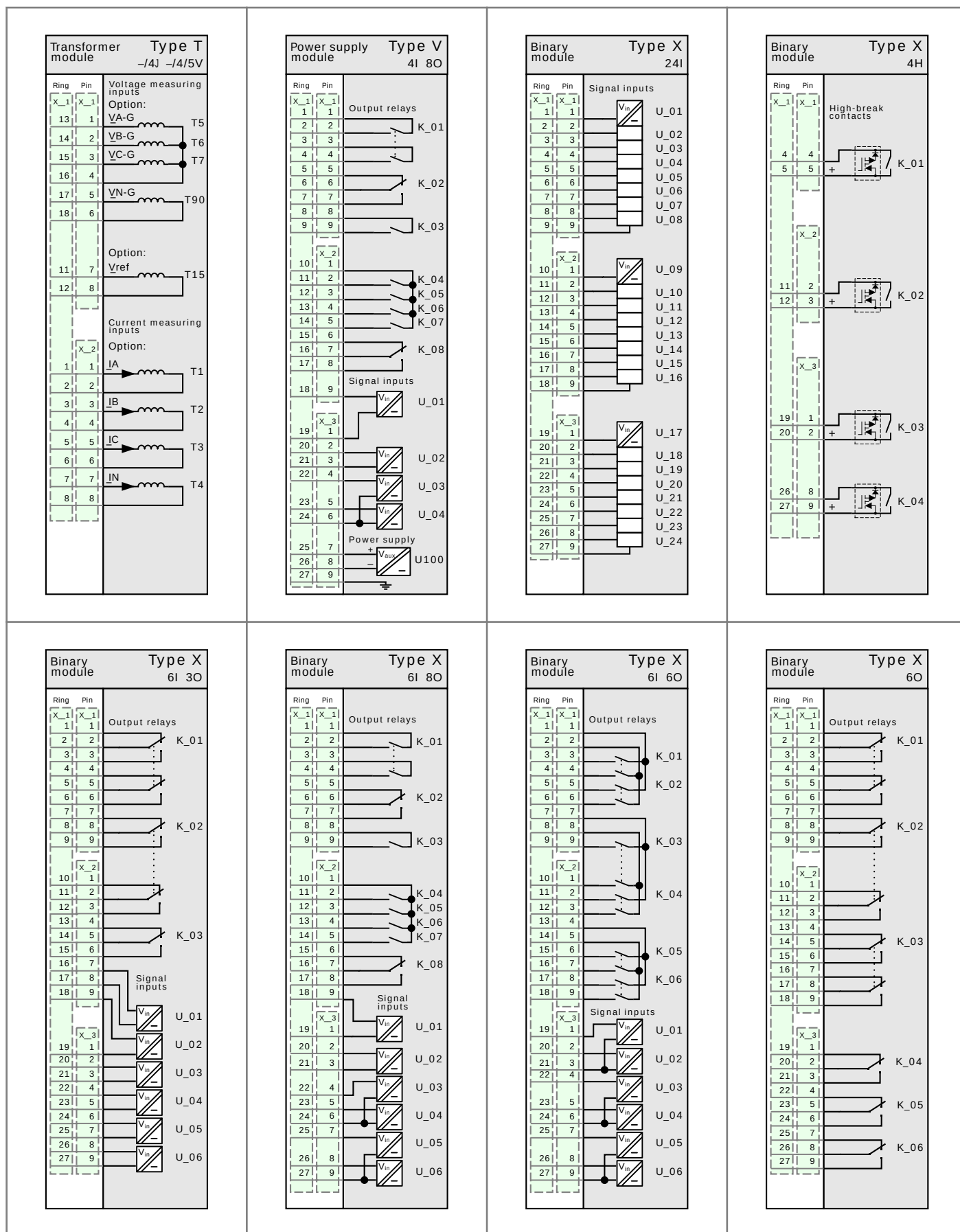
If serial communication module is on slot 2, the preferred slot for Ethernet communication module is slot 3 and alternatively slot 8.

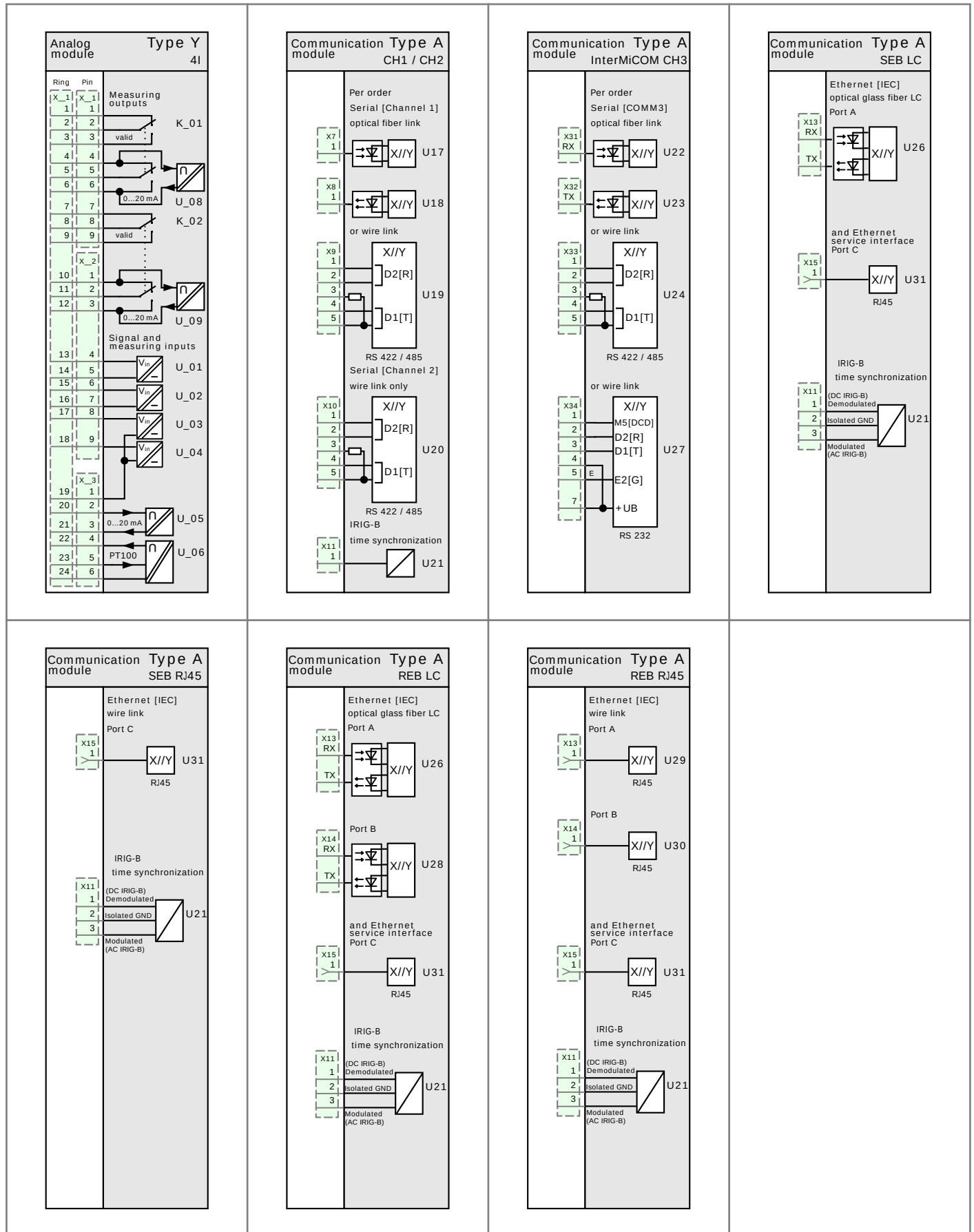
5.7.2

Terminal Connection Diagrams P433-430/431/432/433/434

“_” is a placeholder for the slot.

See also [Section 5.5, \(p. 5-14\)](#), “Protection Conductor Terminal (PCT) / Case Grounding / Protective Earth”





6 Local Control (HMI)

6.1 Local Control Panel (HMI)

Switchgear installed in the bay can be controlled from the local control panel (HMI). All the data required for operation of the protection device is entered from the local control panel, and the data important for system management is read out there as well. The following tasks can be handled from the local control panel:

- Controlling switchgear units
- Readout and modification of settings
- Readout of cyclically updated measured operating data and logic status signals
- Readout of operating data logs and of monitoring signal logs
- Readout of event logs after overload situations, ground faults, or short circuits in the power system
- Device resetting and triggering of additional control functions used in testing and commissioning

Control is also possible through the PC interface. This requires a suitable PC and a specific operating program.

6.2 Display and Keypad

6.2.1 Text Display

The local control panel is a 3.5 Inches LC display with a resolution of 192 × 96 pixels portrait orientation QVGA, containing 12 × 32 alphanumeric characters. There are six freely configurable function keys, nine keys for navigation and three keys for control functions. Moreover, there are four context sensitive hotkeys/softkeys situated below the LCD. Furthermore the local control panel is provided with 25 LED indicators. 5 of these are system LEDs on the top right side of the device. 2 status LEDs are above local/remote keys. 12 of user configurable multi-color LEDs are on the left hand side of the LCD. The other 6 multi-color LED indicators are situated to the right of the six freely configurable function keys. (The configuration of the LED indicators is described in [Section 3.12.2, \(p. 3-86\).](#))

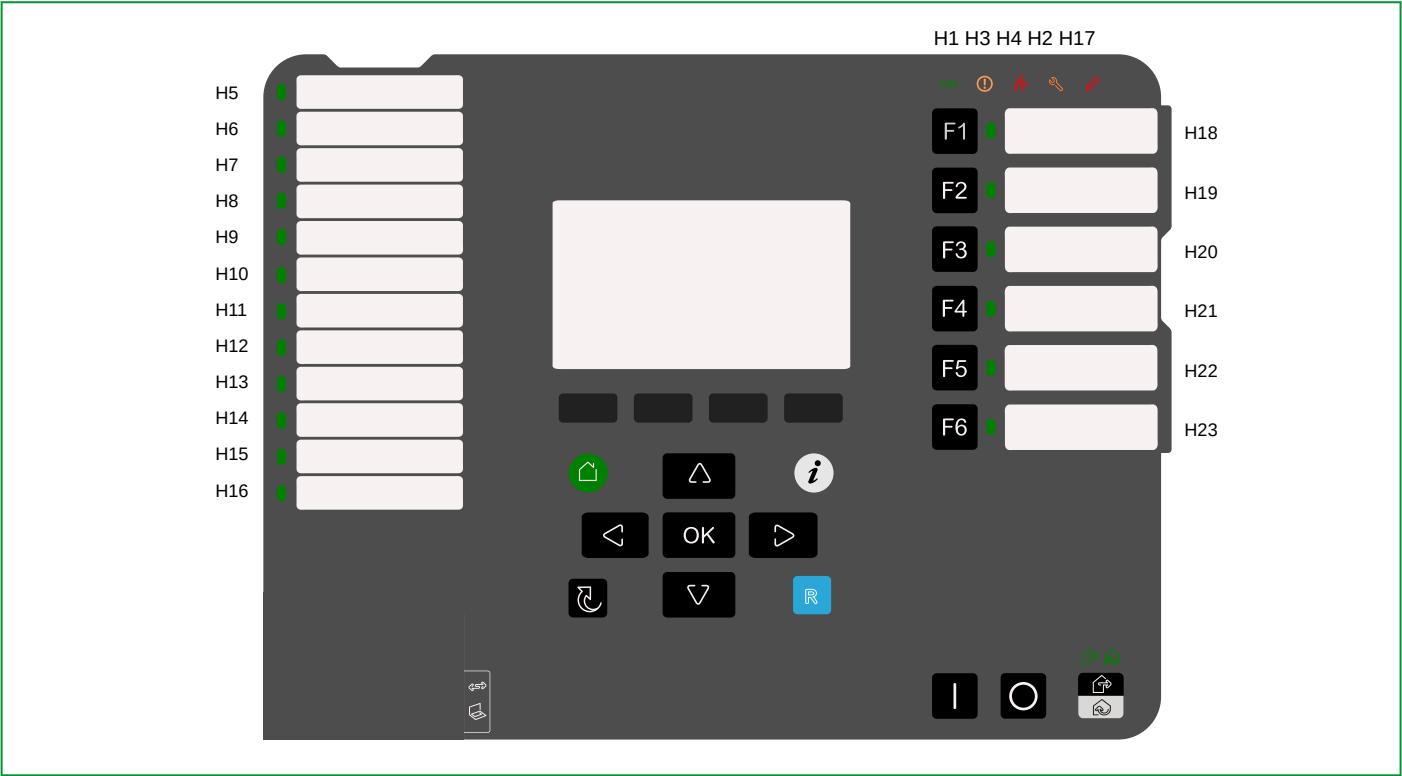


Fig. 6-1: View of the local control panel and layout of the LED indicators for the text display.

6.2.2 Text Display (24 TE Case)

The local control panel as a text display includes an LC display containing 4 × 20 alphanumeric characters.

- There are seven keys with permanently assigned functions and 10 LED indicators situated below the LCD.

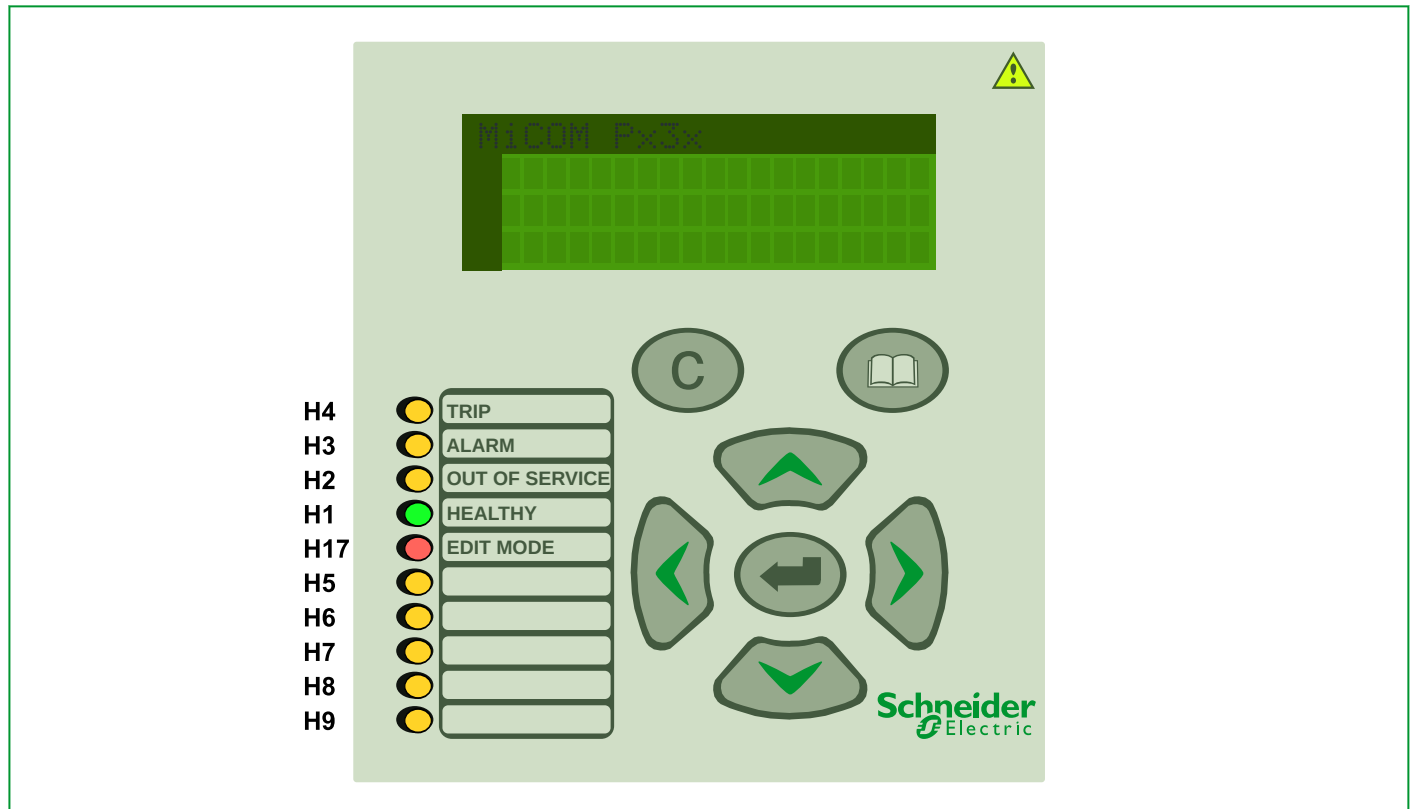


Fig. 6-2: View of the local control panel and layout of the LED indicators for the 24 TE sized case.

6.2.3 Display Illumination

If none of the keys are pressed, the display illumination will switch off once the set “return time illumination” (setting in menu tree: “Par/Conf/LOC”) has elapsed. Pressing any of the keys will turn the display illumination on again. In this case the action that is normally triggered by that key will not be executed. Reactivation of the display illumination is also possible by using a binary input. If continuous display illumination is required, the function “return time illumination” (LOC: Return time illumin.) is set to *blocked*.

The life time of the LCD will be impacted if LOC: Return time illumin. is set to a long return time or 'Blocked'.

6.2.4 Contrast of the Display (24 TE Case)

The contrast of the LC display can be adjusted by pressing 3 keys on the local control panel at the same time, as follows:

Keep the Enter key (⏎) and the Clear key (⊗) pressed simultaneously, then you can press “Up” or “Down” (⏶, ⏷) to raise or lower the contrast, respectively.

6.2.5 Short Description of Keys

6.2.5.1 “Up” and “Down” Keys



Panel Level: The “up”/“down” keys switch between the pages of the Measured Value Panel.

Menu Tree Level: Press the “up” and “down” keys to navigate up and down through the menu tree in a vertical direction. If the unit is in input mode, the “up” and “down” keys have a different function.

Input mode: Settings can only be changed in the input mode, which is signaled by the LED indicator labeled EDIT MODE. Press the “up” and “down” keys in this mode to change the setting value.

- “Up” key: the next higher value is selected.
- “Down” key: the next lower value is selected.

With list settings, press the “up” and “down” key to change the logic operator of the value element.

6.2.5.2 “Left” and “Right” Keys



Menu Tree Level: Press the “left” and “right” keys to navigate through the menu tree in a horizontal direction. If the unit is in input mode, the “left” and “right” keys have a different function.

Input mode: Settings can only be changed in the input mode, which is signaled by the LED indicator labeled EDIT MODE. When the “left” and “right” keys are pressed, the cursor positioned below one of the digits in the change-enabled value moves one digit to the right or left.

- “Left” key: the cursor moves to the next digit on the left.
- “Right” key: the cursor moves to the next digit on the right.

In the case of a list setting, press the “left” and “right” keys to navigate through the list of items available for selection.

6.2.5.3 ENTER Key



Panel Level: Press the ENTER key at the Panel level to go to the menu tree.

Menu Tree Level: Press the ENTER key to enter the input mode. Press the ENTER key a second time to accept the changes as entered and exit the input mode. The LED indicator labeled EDIT MODE signals that the input mode is active.

6.2.5.4 RESET Key



Press the RESET key to reset the functions assigned to the Reset key via LOC: Assignment reset key.

Press the RESET key to reset the LED indicators and clear all measured event data. The records in the recording memories are not affected by this action.

Panel level: Press the RESET key to cancel selection of switchgear unit (when Bay Panel mode is selected).

Input mode: When the RESET key is pressed all changes entered are rejected and the input mode is exited.

When changing the password, press Reset key to cancel the change of password.

6.2.5.5 READ Key



Press the READ key to access a selected event recording from either the Panel level or from any other point in the menu tree.

6.2.5.6 HOME Key



Pressing the HOME key returns to the default display from anywhere in the menu.

If setting mode is enabled, the setting change should be confirmed/cancelled when pressing the HOME key. The edited setting parameter value is returned to its original value if the setting change is cancelled.

6.2.5.7 Configurable Function Keys



By pressing a function key (F1 ... F6) the assigned function is triggered.

More details on assigning functions to function keys can be found in [Section 3.7, \(p. 3-60\)](#).

More details on handling function keys can be found in [Section 6.9, \(p. 6-15\)](#).

6.2.5.8 “Local/Remote” Key



The local/remote key is effective in the Bay Panel except where a binary signal input has been configured for this function.

The local/remote key is the transfer switch between remote and local control (setting $R \leftrightarrow L$), or between remote&local and local control (setting $R \& L \leftrightarrow L$). If the "Local/Remote" key is set to switch from *Remote* control to *Local* control, then this can only occur if the password has first been entered first. Switching from *Local* to *Remote* control will occur without checking the password.

The local, remote or local&remote states can be identified by the two LEDs located above the key. Left LED with amber color is for the remote status, right LED with red color for local status and both LEDs for the local&remote status.

6.2.5.9

Selection Key



Bay Panel: The Selection key is effective only in the Bay Panel and only if local control is activated.

If local control has been selected, pressing the selection key selects the switchgear unit to be controlled. The selected external device will be marked by an asterisk (*) – as long as no external device names are displayed. Otherwise the external device name will flash and will be displayed in the status line.

Signal Panel: The Selection key is used to select a flashing signal (not yet acknowledged) and will also automatically switch to pages that might be available. When the last flashing signal has been reached pressing the Selection key again will start with the first flashing signal.

6.2.5.10

OPEN Key



The OPEN key is effective in the Bay Panel only.

Pressing the OPEN key controls the selected switchgear unit – taking into account the interlock equation – to assume the "open" status.

6.2.5.11

CLOSE Key



The CLOSE key is effective in the Bay Panel only.

Pressing the CLOSE key controls the selected switchgear unit – taking into account the interlock equation – to assume the "closed" status.

6.2.5.12

SOFTKEY

Four softkeys are situated below the LCD and the function labels are displayed on the lower line of the LCD display using smaller Font.

The function of Softkey 1 and 2 is fixed and is not user configurable. The function of Softkey 3 and 4 is not assigned.

Panel Level: Softkey 1 is to provide the Page select function to switch between the different panels available.

Softkey 2 is to provide a Logout function (HMI, Easergy Studio logout and USB connection).

Menu Tree Level: Softkey 1 is to go to the top of menu tree within the current selected Folder.

Softkey 2 is to provide Logout function (HMI, Easergy Studio logout and USB connection).

6.2.6

Short Description of Keys (24 TE Case)

The keys used in 24 TE case are similar to the keys in enhanced local control panel.

	"Up" and "Down" Keys
	"Left" and "Right" Keys
	ENTER Key
	CLEAR Key (RESET Key in enhanced control panel)
	READ Key

6.3 Display Levels

All data relevant for operation and all device settings are displayed on two levels. At the Panel level, data such as measurements are displayed in Panels that provide a quick overview of the current state of the bay. The “*menu tree*” level below the panel level allows the user to select all data points (settings, signals, measured variables, etc.) and to change them, if appropriate. To access a selected event recording from either the panel level or from any other point in the menu tree, press the “READ” key.

6.4 Availability of the Bay Panel

Note: Not available for 24 TE case.

The Bay Panel is only available under these conditions:

1. On the hardware side the protection unit must be fitted with the binary module X(6I 6O) to a slot supporting this module.
2. By selecting and sending a bay type (with parameter MAIN: Type of bay) a bay type has been generated.

To access a selected event recording from either the panel level or from any other point in the menu tree, press the "READ" key.

From the control and display panels (e.g. measured value panels or the bay panel) the user can access the menu tree level by pressing the "ENTER" key.

To return to the previously selected control and display panel from the menu tree level the user must simultaneously press the keys "UP" and "RESET". (If previously no panel was selected, i.e. after a system restart, then the bay panel, if available, is accessed.)

After the set LOC: Autom. return time has elapsed the protection unit will also return automatically from the menu tree level to the control and display panel last selected.

The user can move from a bay panel to a measured value panel by pressing the softkey 1 "Page".

6.5 Display Panels

The text display of the P433 can display Measured Value Panels which are called up according to system conditions.

Selected measured values are displayed on the Measured Value Panels. The system condition determines which Panel is called up (examples are the Operation Panel and the Fault Panel). Only the Measured Value Panels relevant for the particular design version of the given device and its associated range of functions are actually available.

The Operation Panel is always provided.

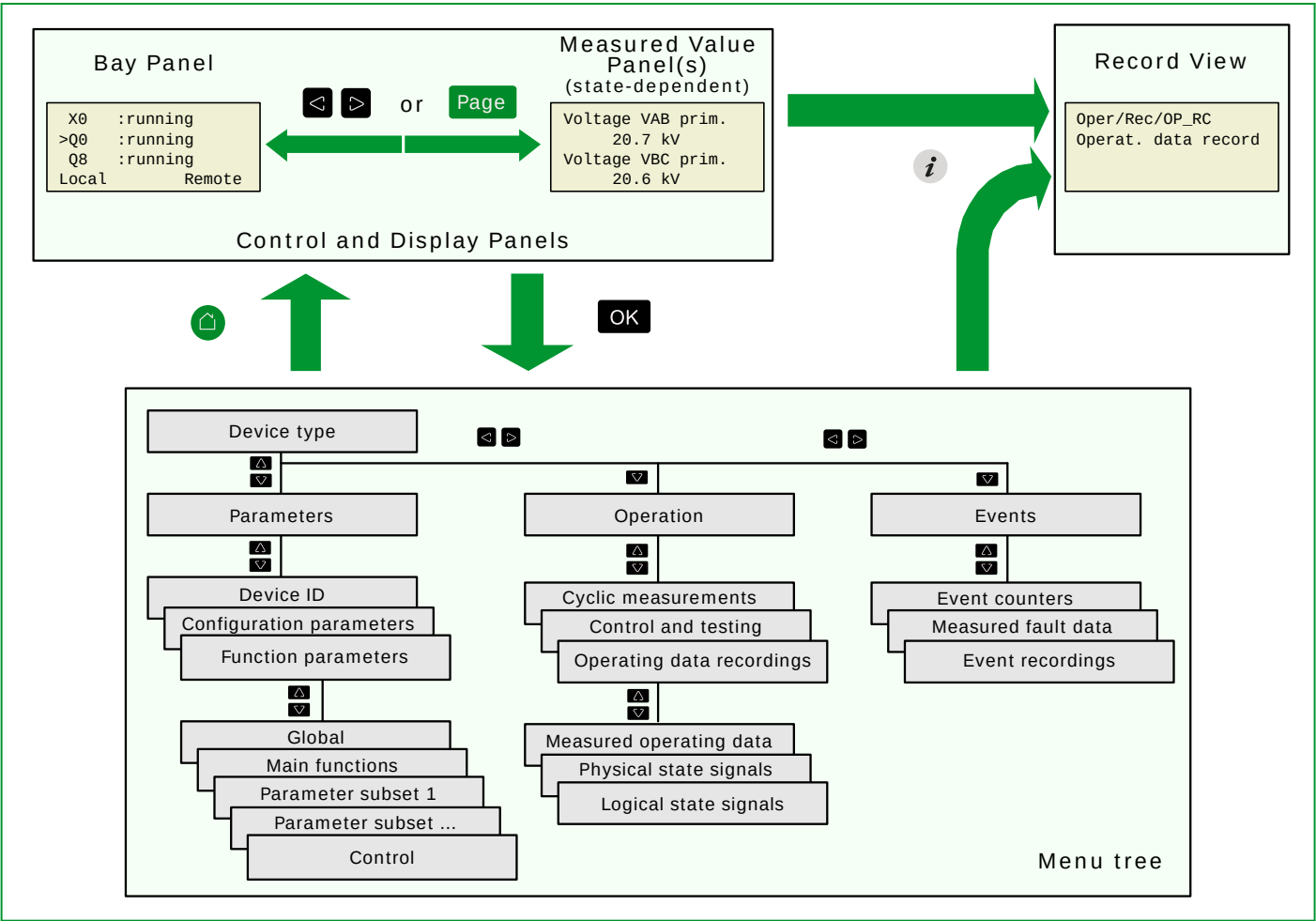


Fig. 6-3: Display panels and menu tree.

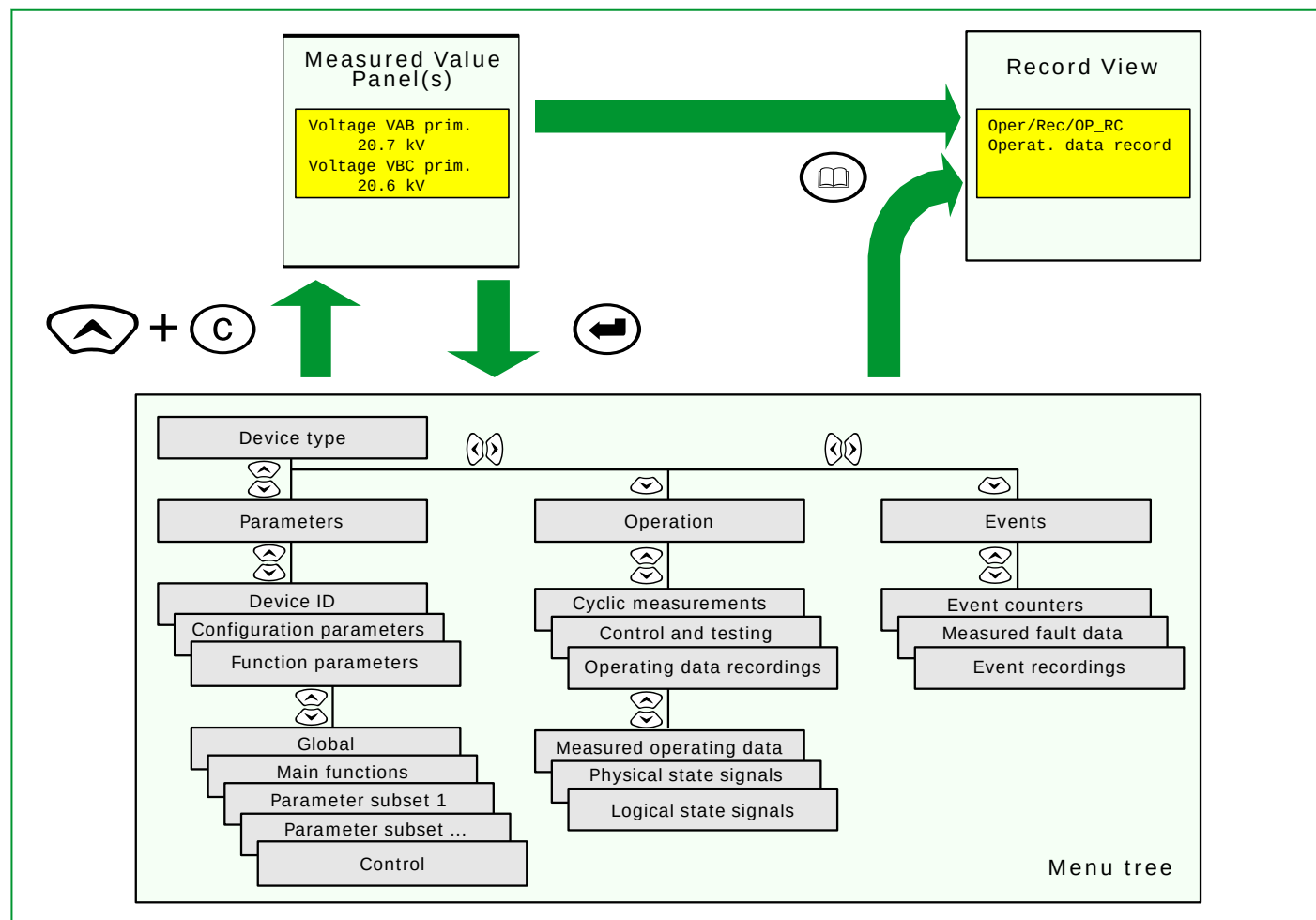


Fig. 6-4: Display panels and menu tree 24 TE.

6.6 Menu Tree and Data Points

All *data points* (setting values, signals, measured values, etc.) are selected using a *menu tree*. When navigating through the *menu tree*, the first two lines of the LC-Display always show the branch of the *menu tree* that is active, as selected by the user. The *data points* are found at the lowest level of a *menu tree* branch and they are displayed either with their plain text description or in numerically encoded form, as selected by the user. The value associated with the selected *data point*, its meaning, and its unit of measurement are displayed in the line below.

6.7 List Data Points

List data points are a special category. In contrast to other data points, *list data points* generally have more than one associated value element. This category includes tripping matrices, programmable logic functions, and event logs. When a *list data point* is selected, the symbol '↓' is displayed in the bottom line of the LCD, indicating that a sub-level is situated below this displayed level. The individual value elements of a *list data point* are found at this sub-level. In the case of a list *parameter*, the individual value elements are linked by operators such as "OR".

6.8

Note Concerning the Step-by-Step Descriptions

The following presentation of the individual control steps shows which displays can be changed in each case by pressing keys. A small black square to the right of the enter key indicates that the LED indicator labeled Edit Mode is illuminated. The examples used here are not necessarily valid for the device type described in this manual; they merely serve to illustrate the control principles involved.

6.9 Configurable Function Keys

Note: Function key is not available for 24 TE case.

6.9.1 Configuration of the Function Keys F1 to Fx

Function keys [F1] to [Fx], by default, no password is required to use the function key.

6.10 Changing Between Display Levels

Jumping from Menu Tree Level to Panel Level

After start-up of the device, the menu tree level is displayed.

	Control Step / Description	Control Action	Display
Step 0	From the Menu Tree Level, the user can jump to the Panel Level from any position within the menu tree.		Par/Func/Glob/MAIN Device on-line No (=off)
Step 1	First press the “up” key and hold it down while pressing the Reset key. Note: It is important to press the “up” key first and release it last in order to avoid unintentional resetting of stored data.	 + 	Voltage A-B prim. 20.7 kV Voltage B-C prim. 20.6 kV

Jumping from Panel Level to Menu Tree Level

	Control Step / Description	Control Action	Display
Step 0	Example of a Measured Value Panel.		Voltage A-B prim. 20.7 kV Voltage B-C prim. 20.6 kV
Step 1	Press the Enter key to go from the Panel Level to the Menu Tree Level.		P433

After the set return time has elapsed (setting in menu tree: “Par/Conf/LOC”), the display will automatically switch to the Panel level if a Measured Value Panel has been configured.

6.11 Changing Between Display Levels (24 TE Case)

Jumping from Menu Tree Level to Panel Level

After start-up of the device, the menu tree level is displayed.

	Control Step / Description	Control Action	Display
Step 0	From the Menu Tree Level, the user can jump to the Panel Level from any position within the menu tree.		Par/Func/Glob/MAIN Device on-line No (=off)
Step 1	First press the “up” key and hold it down while pressing the CLEAR key. Note: It is important to press the “up” key first and release it last in order to avoid unintentional resetting of stored data.	 + 	Voltage A-B prim. 20.7 kV Voltage B-C prim. 20.6 kV

Jumping from Panel Level to Menu Tree Level

	Control Step / Description	Control Action	Display
Step 0	Example of a Measured Value Panel.		Voltage A-B prim. 20.7 kV Voltage B-C prim. 20.6 kV
Step 1	Press the Enter key to go from the Panel Level to the Menu Tree Level.		P433

After the set return time has elapsed (setting in menu tree: “Par/Conf/LOC”), the display will automatically switch to the Panel level if a Measured Value Panel has been configured.

6.12 How to use Cyber Security Features

These sections shows the most common tasks associated with Cyber Security features.

For many of these tasks, the steps you take are the same as you have performed previously and with the main changes being in the steps you use to login and/or logout.

Schneider Electric points out that changing default users and default passwords constitutes an important security measure for the product. Therefore Schneider Electric recommends to change the default passwords after the first usage of the device. Not changing the default passwords can lead to the risk of undesirable changes by third parties.

6.12.1 Usage

6.12.1.1 How to Login

6.12.1.1.1 Local Default Access

If the Local Default Access is enabled, the user can login via the front panel without password with associated roles.

6.12.1.1.2 Login with Prompt User List

This login process will happen if authorization is required for the current operation.

In this case, the IED will prompt the user list, and the user needs to select proper user name and enter the password to login.

	Login Step / Description	Control Action	Display
Step 0	When operation needs authorization, the device security insufficient rights message is displayed for 2 seconds		Device Security insuff. rights
Step 1	The user list is shown Select proper user by pressing the 'up' or 'down'	 Or 	Select a user >DefaultViewer DefaultOperator DefaultEngineer
Step 2	Confirm the selection by 'Enter' key		
Step 3	Password message is shown for user to enter		User Password? *****
Step 4	If password is correct		Device Security login successful
Step 5	If password is incorrect, password message shows again (as in step 3)		Device Security login failed
Step 6	If decided not to login (by pressing the 'Reset' key), the message is displayed for 2 seconds.		User not selected Aborted with R key

6.12.1.1.3

Login with Prompt User List (24 TE Case)

This login process will happen if authorization is required for the current operation.

In this case, the IED will prompt the user list, and the user needs to select proper user name and enter the password to login.

	Login Step / Description	Control Action	Display
Step 0	When operation needs authorization, the CS insufficient rights message is displayed for 2 seconds		Cyber Security insuff. rights
Step 1	The user list is shown Select proper user by pressing the 'up' or 'down'	 Or 	Select a user DefaultOperator DefaultEngineer DefaultViewer
Step 2	Confirm the selection by 'Enter' key		
Step 3	Password message is shown for user to enter		User Password? *****
Step 4	If password is correct		Cyber Security login successful
Step 5	If password is incorrect, password message shows again (as in step 3)		Cyber Security login failed
Step 6	If decided not to login (by pressing the 'CLEAR' key), the message is displayed for 2 seconds.		User not selected Aborted with C key

6.12.1.2 How to Logout

6.12.1.2.1 How to Logout at the IED

For security consideration, it would be better to logout the IED once the configuration is done.

The user can be logged out with 'HMI Logout' in the menu tree: 'Par/Conf/CS' or using the softkey 'LOGOUT'.

6.12.1.2.2 How to Logout at Easergy Studio

- Right-click on the device name and select Log Off.
- In the Log Off confirmation dialog click Yes.

6.12.1.3 How to Disable a Physical Port

It is possible to disable unused physical ports for security reason.

The physical ports can be disabled by using Easergy Studio or the front panel. This can't be done by the CAE. An Engineer-role is needed to perform this action. COMM1 section:

- Allows to disable commands.

It can be disabled with 'Command blocking' in the menu tree: 'Par/Func/Glob/COMM1'.

COMM2 section:

- Allows to disable commands and measurements. If both are disabled, the complete interface is disabled.

It can be disabled with 'Command blocking' or 'Sig./meas.val.block' in the menu tree: 'Par/Func/Glob/COMM2'.

IEC section:

- Allows to disable the physical interface A/B or A (if available).
- Allows to disable the physical interface C.

The physical ports can be disabled with 'Block Port A/B' or 'Block Port C' in the menu tree: 'Par/Conf/IEC'.

PC section (IEC 103):

- Allows to disable commands and measurements. If both are disabled, the complete interface is disabled.

It can be disabled with 'Command blocking' or 'Sig./meas.val.block' in the menu tree: 'Par/Func/Glob/PC'.

6.12.1.4**How to Secure Function key**

For device security reasons, this function has been linked to the front panel authorization.

- When the function key pressed, if there is no user login in the front panel or the logged- in user is not authorized, a prompt message will be raised in the front panel to ask the user login.

Once the user logged-in, function key password is needed if function key has a password. If the user already logged in with authorization and the function key has no password, the command will be executed immediately.

- By default, the OPERATOR or ENGINEER Roles are able to operate the function keys.
- If unauthorized users press Function Key during the setting change, they need to commit the changes first then login with authorized user to operate the function key.

6.13 Control at Panel Level

The measured values that will be displayed on the Measured Value Panels can first be selected in the menu tree under *Par/Conf/LOC*. The user can select different sets of measured values for the Operation Panel (LOC: Fct. Operation Panel), the Overload Panel (LOC: Fct. Overload Panel), the Ground Fault Panel (LOC: Fct. Grd.Fault Panel), and the Fault Panel (LOC: Fct. Fault Panel).

Only the Measured Value Panels relevant for the particular design version of the given device and its associated range of functions are actually available. The selected set of values for the Operation Panel is always available. Please see [Section 6.14.6.1, \(p. 6-37\)](#) for instructions regarding selection. If “MAIN: Without function” has been selected for a given panel, then that panel is disabled.

The Measured Value Panels are called up according to system conditions. If, for example, the device detects an overload or a ground fault, then the corresponding Measured Value Panel will be displayed as long as the overload or ground fault situation exists. Should the device detect a fault, then the Fault Panel is displayed and remains active until the measured fault values are reset, by pressing the RESET key (CLEAR key in 24 TE), for example.

	Control Step / Description	Control Action	Display
Step 0	Two measured values can be displayed simultaneously on the Panel.		Voltage A-B prim. 20.7 kV Voltage B-C prim. 20.6 kV
Step 1	If more than two measured values have been selected, they can be viewed one page at a time by pressing the “up” or “down” keys. The device will also show the next page of the Measured Value Panel after the set Hold-Time for Panels (LOC: Hold-time for Panels, located at “Par/Conf” in the menu tree) has elapsed.	 or 	Voltage C-A prim. 20.8 kV Current A prim. 415 A

	Control Step / Description (24 TE Case)	Control Action	Display
Step 0	Two measured values can be displayed simultaneously on the Panel.		Voltage A-B prim. 20.7 kV Voltage B-C prim. 20.6 kV
Step 1	If more than two measured values have been selected, they can be viewed one page at a time by pressing the “up” or “down” keys. The device will also show the next page of the Measured Value Panel after the set Hold-Time for Panels (LOC: Hold-time for Panels, located at “Par/Conf” in the menu tree) has elapsed.	 or 	Voltage C-A prim. 20.8 kV Current A prim. 415 A

6.13.1 Bay Panel

6.13.1.1 Information Displayed on the Bay Panel

If available the Bay Panel will display switching state signals from external devices (closed, open, intermediate position) and the active control site (local or remote). The text display HMI will show up to 3 external devices, one per line, where the external device selected is marked with the flashing symbol ">" in front of the external devices' designation text.

Note: Not available for 24 TE case.



Fig. 6-5: Example of a bay panel.

The sequence for external devices is downwards in columns according to their numbering (DEV01, DEV02, DEV03). To designate these external devices there are up to four characters available, and next to these, separated by a colon, their current state is displayed ("Interm. pos.", "Open", "Closed" or "Faulty pos."). The active control unit ("Remote" or "Local") is displayed in the fourth line, as well as its state: "Locked" or "Unlocked".

6.13.1.2 Controlling Switchgear Units

Switchgear units can be controlled from the local control panel, provided that the unit has been set for "local control". If the local/remote key is set to switch between remote and local control (R↔L), then the switch from "remote" to "local" operation requires a proper user operation.

Note: Not available for 24 TE case.

	Control Step / Description	Control Action	Display
Step 0	Select the Bay Panel.		X0 :Closed Q0 :Closed Q8 :Closed Remote Locked
Step 1	Press the “local/remote” key (L/R) to switch the device to local operation. The Bay Panel is no longer displayed. Insufficient rights message is displayed for 2 seconds.		Device Security insuff. rights
Step 2	Select proper user by pressing 'up' and 'down'. Press the ENTER key. Eight asterisks (*) appear in the display. Enter the configured password of the selected user. Please refer to Section 3.3.2, (p. 3-6) for detailed information about the compatibility with or without Cyber Security. Bay Panel will re-appear. The fourth line will display “Local”.	 or  	Select a user >DefaultViewer DefaultOperate DefaultEngineer User Password? ***** Device Security login successful
Step 3a	Press the Selection key to select a switchgear unit. Only switchgear units that are electrically controllable can be selected. The external device designation for the selected switchgear unit –“Q0”, for example – is marked by a flashing “>” character.		X0 :Closed >Q0 :Closed Q8 :Closed Local Locked
Step 3b	To cancel the selection of a switchgear unit, press the Reset key. Press the Selection key to select a new switchgear unit.		X0 :Closed Q0 :Closed Q8 :Closed Local Locked
Step 4	After selecting a switchgear unit, press the keys “Open” or “Close” to control the switchgear unit. Before this switching action is executed, compliance with bay interlock conditions – if applicable – is checked.	 or 	
Step 4a	If the check of bay interlock conditions determines that an operation can be carried out, then the switch command is executed. The status “Interm[ediate] pos[ition]” is displayed while the switchgear unit is operating.		X0 :Closed Q0 :Interm. pos Q8 :Closed Local Locked

	Control Step / Description	Control Action	Display
Step 4b	Once the operating time of the switchgear unit has elapsed, the resulting switching status is displayed.		X0 :Closed Q0 :Open Q8 :Closed Local Locked
	If the check of interlock conditions determines that switching is not allowed, then the selected switchgear unit is no longer marked. If the LED indicators have been configured accordingly, the LED indicator for the signal MAIN: Interlock equ. viol. will be illuminated.		X0 :Closed Q0 :Closed Q8 :Closed Local Locked
Step 5	If no control action takes place within a set time period after selection of a switchgear unit or if the return time for illumination (LOC: Return time illumin.) or the return time for selection (LOC: Return time select.) has elapsed, then the selection is canceled.		
Step 6	Press the local/remote key (L/R) to switch to remote control.		X0 :Closed Q0 :Open Q8 :Closed Remote Locked

6.14 Control at the Menu Tree Level

6.14.1 Navigation in the Menu Tree

Folders and Function Groups

All data points are organized in different folders based on practical control requirements.

At the root of the menu tree is the unit type; the tree branches into the three main folders “Settings”, “Measurements & Tests” and “Fault & Event Records”, which form the first folder level. Up to two further folder levels follow so that the entire folder structure consists of three main branches and a maximum of three folder levels.

At the end of each branch of folders are the various function groups in which the individual data points (settings) are combined.

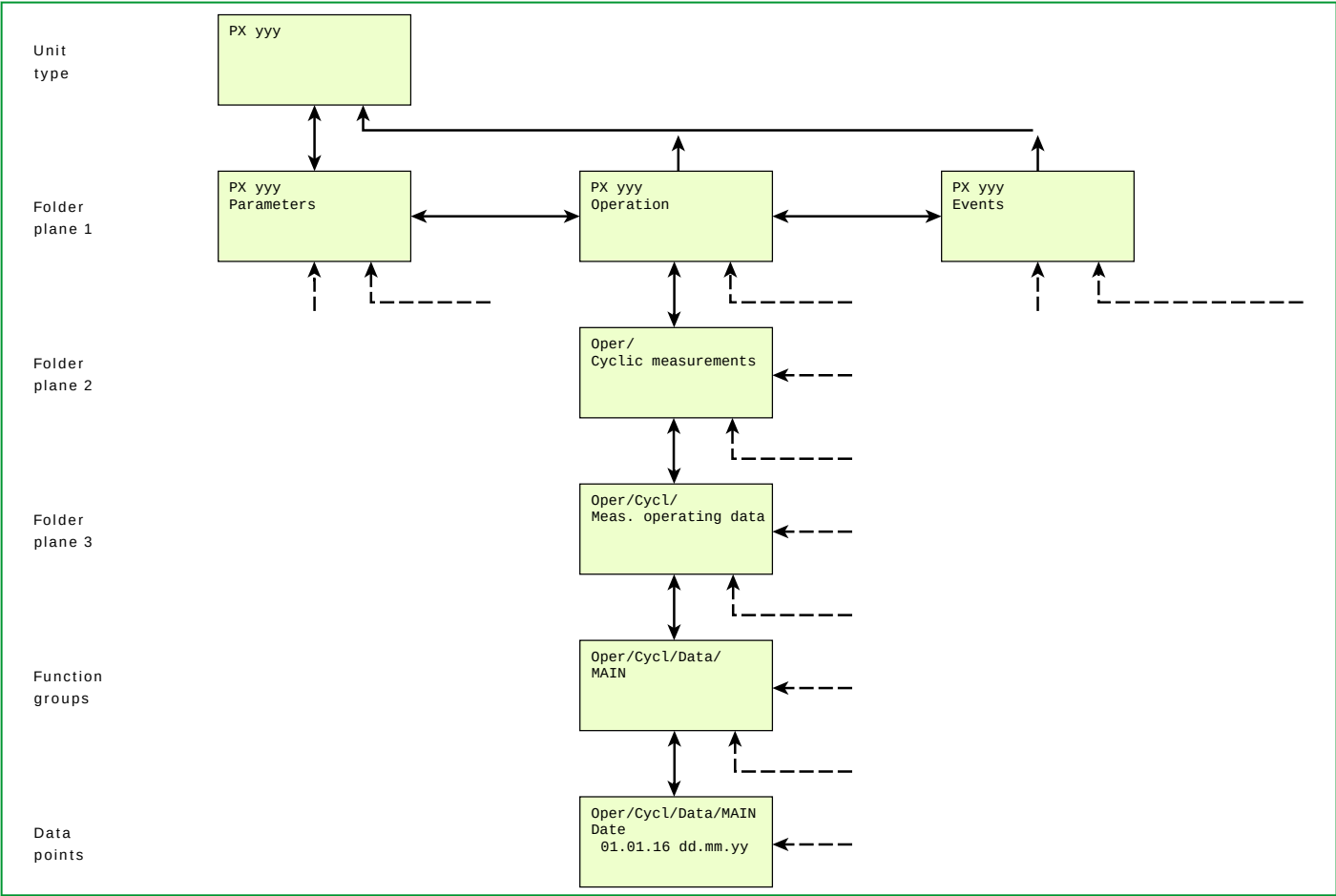


Fig. 6-6: Basic menu tree structure.

6.14.2 Switching Between Address Mode and Plain Text Mode

The display on the menu tree can be switched between address mode and plain text mode. In the address mode the display shows settings, signals, and measured values in numerically coded form, that is, as addresses. In plain text mode the settings, signals, and measured values are displayed in the form of plain text descriptions. In either case, control is guided by the menu tree. The active branch of the menu tree is displayed in plain text in both modes. In the following examples, the display is shown in plain text mode only.

The following description can be accessed and executed after device security LogIn.

	Control Step / Description	Control Action	Display
Step 0	In this example, the user switches from plain text mode to address mode.		Par/Func/Glob/MAIN Device on-line No (= off)
Step 1	To switch from address mode to plain text mode or vice versa, press the RESET key and either the “left” key or the “right” key simultaneously. This can be done at any point in the menu tree.	 +  or 	Par/Func/Glob/MAIN 003.030 0

	Control Step / Description (24 TE Case)	Control Action	Display
Step 0	In this example, the user switches from plain text mode to address mode.		Par/Func/Glob/MAIN Device on-line No (= off)
Step 1	To switch from address mode to plain text mode or vice versa, press the CLEAR key and either the “left” key or the “right” key simultaneously. This can be done at any point in the menu tree.	 +  or 	Par/Func/Glob/MAIN 003.030 0

6.14.3 Change-Enabling Function

Although it is possible to select any data point in the menu tree and read the associated value by pressing the keys, it is not possible to switch directly to the input mode. This safeguard prevents unintended changes in the settings.

There are two ways to enter the input mode.

- Global change-enabling function: To activate the global change-enabling function, set the LOC: Param. change enabl. parameter to Yes (menu tree: Oper/CtrlTest/LOC).

The change can only be made after the password has been entered.

Thereafter, all further changes – with the exception of specially protected control actions (see [Section 6.14.9, \(p. 6-51\)](#)) – are enabled without entering the password.

- Selective change-enabling function: Password input prior to any setting change.

This setup is designed to prevent accidental output and applies even when the global change-enabling function has been activated.

	Control Step / Description	Control Action	Display
Step 0	In the menu tree Oper/CtrlTest/LOC, select the LOC: Param. change enabl. parameter.		Oper/CtrlTest/LOC Param. change enabl. No
Step 1	Login procedure Press the ENTER key. Insufficient rights message is displayed for 2 seconds. Select proper user by pressing 'up' and 'down'. Press the ENTER key. Eight asterisks (*) appear in the display. Enter the configured password of the selected user. Please refer to Section 3.3.2, (p. 3-6) for detailed information about the compatibility with or without Cyber Security.	  or  	Device Security insuff. rights Select a user >DefaultViewer DefaultOperate DefaultEngineer User Password? ***** Device Security login successful
Step 2	The LED indicator labeled EDIT MODE will light up. This indicates that the setting can now be changed by pressing the “up” or “down” keys.		Oper/CtrlTest/LOC Param. change enabl. No
Step 3	Change the setting to Yes.	 	Oper/CtrlTest/LOC Param. change enabl. Yes
Step 4	Press the ENTER key again. The LED indicator will go out. The unit is enabled for further setting changes.		Oper/CtrlTest/LOC Param. change enabl. Yes

	Control Step / Description (24 TE Case)	Control Action	Display
Step 0	In the menu tree Oper/CtrlTest/LOC, select the LOC: Param. change enabl. parameter.		Oper/CtrlTest/LOC Param. change enabl. No
Step 1	Login procedure Press the ENTER key. Insufficient rights message is displayed for 2 seconds. Select proper user by pressing 'up' and 'down'. Press the ENTER key. Eight asterisks (*) appear in the display. Enter the configured password of the selected user. Please refer to Section 3.3.2, (p. 3-6) for detailed information about the compatibility with or without Cyber Security.	  or  	Device Security insuff. rights Select a user >DefaultViewer DefaultOperate DefaultEngineer User Password? ***** Device Security login successful
Step 2	The LED indicator labeled EDIT MODE will light up. This indicates that the setting can now be changed by pressing the “up” or “down” keys.		Oper/CtrlTest/LOC Param. change enabl. No
Step 3	Change the setting to Yes.	 	Oper/CtrlTest/LOC Param. change enabl. Yes
Step 4	Press the ENTER key again. The LED indicator will go out. The unit is enabled for further setting changes.		Oper/CtrlTest/LOC Param. change enabl. Yes

The same procedure applies to any setting change unless the global change-enabling function has been activated. This method is recommended for a single setting change only. If several settings are to be changed, then the global change-enabling function is preferable. In the following examples, the global change-enabling function has been activated.

6.14.3.1

Automatic Return

The automatic return function prevents the change-enabling function from remaining activated after a change of settings has been completed. Once the set return time (LOC: Autom. return time, menu tree “Par/Conf/LOC”) has elapsed, the change-enabling function is automatically deactivated, and the display switches to a Measured Value Panel corresponding to the current system condition. The return time is restarted when any of the control keys is pressed.

6.14.3.2

Forced Return

The return described above can be forced from the local control panel by first pressing the “up” key and then holding it down while pressing the RESET key.

It is important to press the “up” key first and release it last in order to avoid unintentional deletion of stored data.

Even when the change-enabling function is activated, not all settings can be changed. For some settings it is also necessary to disable the protective function (MAIN: Device on-line, menu tree: Par/Func/Glob/MAIN). Such settings include the configuration settings, by means of which the device interfaces can be adapted to the system. The following entries in the “Change” column of the “Telegram Documentation” (part of the separately available “DataModelExplorer”) indicate whether values can be changed or not:

- “on”: The value can be changed even when the protective function is enabled.
- “off”: The value can only be changed when the protective function is disabled.
- “–”: The value can be read out but cannot be changed.

The device is factory-set so that the protective function is disabled.

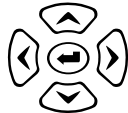
6.14.4 Changing Parameters

If all the conditions for a value change are satisfied, the desired setting can be entered.

	Control Step / Description	Control Action	Display
Step 0	Example of a display. In this example, the change-enabling function is activated and the protective function is disabled, if necessary.		Oper/CtrlTest/LOC Param. change enabl. Yes
Step 1	Select the desired setting by pressing the keys.	   	Par/Conf/LOC Autom. return time 50000 s
Step 2	Login procedure Press the ENTER key. Insufficient rights message is displayed for 2 seconds. Select proper user by pressing 'up' and 'down'. Press the ENTER key. Eight asterisks (*) appear in the display. Enter the configured password of the selected user. Please refer to Section 3.3.2, (p. 3-6) for detailed information about the compatibility with or without Cyber Security.	   	Device Security insuff. rights Select a user >DefaultViewer DefaultOperate DefaultEngineer User Password? ***** Device Security login successful
Step 3	The LED indicator labeled EDIT MODE will light up. The last digit of the value is highlighted by a cursor (underlined).		Par/Conf/LOC Autom. return time 50000 s
Step 4	Press the “left” or “right” keys to move the cursor to the left or right.	 	Par/Conf/LOC Autom. return time 5000_0 s
Step 5	Change the value highlighted by the cursor by pressing the “up” and “down” keys. In the meantime the device will continue to operate with the old value.	 	Par/Conf/LOC Autom. return time 5001_0 s

	Control Step / Description	Control Action	Display
Step 6	Press the ENTER key. The LED indicator labeled EDIT MODE will go out and the device will now operate with the new value. Press the keys to select another setting for a value change.		Par/Conf/LOC Autom. return time 50010 s
Step 7	If you wish to reject the new setting while you are still entering it (LED indicator labeled EDIT MODE is on), press the RESET key. The LED indicator will go out and the device will continue to operate with the old value. A further setting can be selected for a value change by pressing the keys.		Par/Conf/LOC Autom. return time 50000 s

6.14.5 Changing Parameters (24 TE Case)

	Control Step / Description	Control Action	Display
Step 0	Example of a display. In this example, the change-enabling function is activated and the protective function is disabled, if necessary.		Oper/CtrlTest/LOC Param. change enabl. Yes
Step 1	Select the desired setting by pressing the keys.		Par/Conf/LOC Autom. return time 50000 s
Step 2	Login procedure Press the ENTER key. Insufficient rights message is displayed for 2 seconds. Select proper user by pressing 'up' and 'down'. Press the ENTER key. Eight asterisks (*) appear in the display. Enter the configured password of the selected user. Please refer to Section 3.3.2, (p. 3-6) for detailed information about the compatibility with or without Cyber Security.	   	Cyber Security insuff. rights Select a user DefaultOperate DefaultEngineer DefaultViewer User Password? ***** Cyber Security login successful
Step 3	The LED indicator labeled EDIT MODE will light up. The last digit of the value is highlighted by a cursor (underlined).		Par/Conf/LOC Autom. return time 50000_ s
Step 4	Press the “left” or “right” keys to move the cursor to the left or right.	 	Par/Conf/LOC Autom. return time 5000_0 s
Step 5	Change the value highlighted by the cursor by pressing the “up” and “down” keys. In the meantime the device will continue to operate with the old value.	 	Par/Conf/LOC Autom. return time 5001_0 s

	Control Step / Description	Control Action	Display
Step 6	Press the ENTER key. The LED indicator labeled EDIT MODE will go out and the device will now operate with the new value. Press the keys to select another setting for a value change.		Par/Conf/LOC Autom. return time 50010 s
Step 7	If you wish to reject the new setting while you are still entering it (LED indicator labeled EDIT MODE is on), press the CLEAR key. The LED indicator will go out and the device will continue to operate with the old value. A further setting can be selected for a value change by pressing the keys.		Par/Conf/LOC Autom. return time 50000 s

6.14.6 List Parameters

6.14.6.1 Setting a List Parameter

Using list settings, the user is able to select several elements from a list in order to perform tasks such as defining a trip command or defining the measurements that will be displayed on Measured Value Panels. As a rule, the selected elements are linked by an “OR” operator. Other operators (NOT, OR, AND, NOT OR and NOT AND) are available in the LOGIC function group for linking the selected list items. In this way binary signals and binary input signals can be processed in a Boolean equation tailored to meet user requirements. For the DNP 3.0 communication protocol, the user defines the class of a setting instead of assigning operators. The definition of a trip command shall be used here as an illustration.

	Control Step / Description	Control Action	Display
Step 0	Select a list setting (in this example, the parameter MAIN: Fct.assign.trip cmd.1 at "Par/Func/Glob/MAIN" in the menu tree). The down arrow (↓) indicates that a list setting has been selected.		Par/Func/Glob/MAIN Fct.assign.trip cmd. ↓
Step 1	Press the "down" key. The first function and the first selected signal will appear in the third and fourth lines, respectively. The symbol "#01" in the display indicates the first item of the selection. If MAIN: Without function appears for the first item, then this means that no function assignment has yet been made.		Par/Func/Glob/MAIN Fct.assign.trip cmd. #01 DIST Trip zone 1
Step 2	Scroll through the list of assigned functions by pressing the "right" and "left" keys. Once the end of the list is reached, the display shown on the right will appear.	 	Par/Func/Glob/MAIN Fct.assign.trip cmd. OR #02 DIST Trip zone 2 Par/Func/Glob/MAIN Fct.assign.trip cmd. #05 MAIN ?????
Step 3	Login procedure Press the ENTER key at any position in the list. Insufficient rights message is displayed for 2 seconds. Select proper user by pressing 'up' and 'down'. Press the ENTER key. Eight asterisks (*) appear in the display. Enter the configured password of the selected user. Please refer to Section 3.3.2, (p. 3-6) for detailed information about the compatibility with or without Cyber Security.	  or  	Device Security insuff. rights Select a user >DefaultViewer DefaultOperate DefaultEngineer User Password? ***** Device Security login successful
Step 4	The LED indicator labeled EDIT MODE will light up.		Par/Func/Glob/MAIN Fct.assign.trip cmd. #02 DIST Trip zone 2
Step 5	Scroll through the assignable functions by pressing the "right" and "left" keys in the input mode.	 	Par/Func/Glob/MAIN Fct.assign.trip cmd. #02 DIST Trip zone 4

	Control Step / Description	Control Action	Display
Step 6	Select the operator or the class using the “up” and “down” keys. In this particular case, only the “OR” operator can be selected. There is no limitation on the selection of classes.	 	Par/Func/Glob/MAIN Fct.assign.trip cmd. OR #02 DIST Trip zone 4
Step 7	Press the ENTER key. The LED indicator will go out. The assignment has been made. The unit will now operate with the new settings. If no operator has been selected, the “OR” operator is always assigned automatically when the ENTER key is pressed. There is no automatic assignment of classes.		Par/Func/Glob/MAIN Fct.assign.trip cmd. OR #02 DIST Trip zone 4
Step 8	Press the “up” key to exit the list at any point in the list.		Par/Func/Glob/MAIN Fct.assign.trip cmd. ↓
Step 9	If you wish to reject the new setting while you are still entering it (LED indicator labeled EDIT MODE is on), press the RESET key. The LED indicator labeled EDIT MODE will be extinguished.		Par/Func/Glob/MAIN Fct.assign.trip cmd. OR #02 DIST Trip zone 2

	Control Step / Description (24 TE Case)	Control Action	Display
Step 0	Select a list setting (in this example, the parameter MAIN: Fct.assign.trip cmd.1 at "Par/Func/Glob/MAIN" in the menu tree). The down arrow (↓) indicates that a list setting has been selected.		Par/Func/Glob/MAIN Fct.assign.trip cmd. ↓
Step 1	Press the "down" key. The first function and the first selected signal will appear in the third and fourth lines, respectively. The symbol "#01" in the display indicates the first item of the selection. If MAIN: Without function appears for the first item, then this means that no function assignment has yet been made.		Par/Func/Glob/MAIN Fct.assign.trip cmd. #01 DIST Trip zone 1
Step 2	Scroll through the list of assigned functions by pressing the "right" and "left" keys. Once the end of the list is reached, the display shown on the right will appear.	 	Par/Func/Glob/MAIN Fct.assign.trip cmd. OR #02 DIST Trip zone 2 Par/Func/Glob/MAIN Fct.assign.trip cmd. #05 MAIN ?????
Step 3	Login procedure Press the ENTER key at any position in the list. Insufficient rights message is displayed for 2 seconds. Select proper user by pressing 'up' and 'down'. Press the ENTER key. Eight asterisks (*) appear in the display. Enter the configured password of the selected user. Please refer to Section 3.3.2, (p. 3-6) for detailed information about the compatibility with or without Cyber Security.	  or  	Device Security insuff. rights Select a user >DefaultViewer DefaultOperate DefaultEngineer User Password? ***** Device Security login successful
Step 4	The LED indicator labeled EDIT MODE will light up.		Par/Func/Glob/MAIN Fct.assign.trip cmd. #02 DIST Trip zone 2
Step 5	Scroll through the assignable functions by pressing the "right" and "left" keys in the input mode.	 	Par/Func/Glob/MAIN Fct.assign.trip cmd. #02 DIST Trip zone 4

	Control Step / Description (24 TE Case)	Control Action	Display
Step 6	Select the operator or the class using the “up” and “down” keys. In this particular case, only the “OR” operator can be selected. There is no limitation on the selection of classes.	 	Par/Func/Glob/MAIN Fct.assign.trip cmd. OR #02 DIST Trip zone 4
Step 7	Press the ENTER key. The LED indicator will go out. The assignment has been made. The unit will now operate with the new settings. If no operator has been selected, the “OR” operator is always assigned automatically when the ENTER key is pressed. There is no automatic assignment of classes.		Par/Func/Glob/MAIN Fct.assign.trip cmd. OR #02 DIST Trip zone 4
Step 8	Press the “up” key to exit the list at any point in the list.		Par/Func/Glob/MAIN Fct.assign.trip cmd. ↓
Step 9	If you wish to reject the new setting while you are still entering it (LED indicator labeled EDIT MODE is on), press the CLEAR key. The LED indicator labeled EDIT MODE will be extinguished.		Par/Func/Glob/MAIN Fct.assign.trip cmd. OR #02 DIST Trip zone 2

6.14.6.2 Deleting a List Parameter

If MAIN: Without function is assigned to a given item, then all the following items are deleted. If this occurs for item #01, everything is deleted.

6.14.7 Memory Readout

Memories can be read out after going to the corresponding entry point. This does not necessitate activating the change-enabling function or even disabling the protective functions. Inadvertent clearing of a memory at the entry point is not possible.

The following memories are available:

- In the menu tree “Oper/Rec/OP_RC”: Operating data memory
- In the menu tree “Oper/Rec/MT_RC”: Monitoring signal memory
- Event memories
 - In the menu tree “Events/Rec/FT_RC”: Fault memories 1 to 8
 - In the menu tree “Events/Rec/OL_RC”: Overload memories 1 to 8
 - In the menu tree “Events/Rec/GF_RC”: Ground fault memories 1 to 8

Not all of these event memories are present in each unit.

6.14.7.1 Readout of the Operating Data Memory

The operating data memory contains stored signals of actions that occur during operation, such as the enabling or disabling of a device function. A maximum of 100 entries is possible, after which the oldest entry is overwritten.

	Control Step / Description	Control Action	Display
Step 0	Select the entry point for the operating data memory.		Oper/Rec/OP RC Operat. data record. ↓
Step 1	Press the “down” key to enter the operating data memory. The latest entry is displayed.		Oper/Rec/OP RC 01.01.13 11:33 ARC Enabled USER No
Step 2	Press the “left” key repeatedly to display the entries one after the other in chronological order. Once the end of the operating data memory has been reached, pressing the “left” key again will have no effect.		Oper/Rec/OP RC 01.01.13 11:33 PSIG Enabled USER Yes
Step 3	Press the “right” key to display the previous entry.		Oper/Rec/OP RC 01.01.13 11:33 ARC Enabled USER No
Step 4	Press the “up” key at any point within the operating data memory to return to the entry point.		Oper/Rec/OP RC Operat. data record. ↓

	Control Step / Description (24 TE Case)	Control Action	Display
Step 0	Select the entry point for the operating data memory.		Oper/Rec/OP RC Operat. data record. ↓
Step 1	Press the “down” key to enter the operating data memory. The latest entry is displayed.		Oper/Rec/OP RC 01.01.13 11:33 ARC Enabled USER No
Step 2	Press the “left” key repeatedly to display the entries one after the other in chronological order. Once the end of the operating data memory has been reached, pressing the “left” key again will have no effect.		Oper/Rec/OP RC 01.01.13 11:33 PSIG Enabled USER Yes
Step 3	Press the “right” key to display the previous entry.		Oper/Rec/OP RC 01.01.13 11:33 ARC Enabled USER No
Step 4	Press the “up” key at any point within the operating data memory to return to the entry point.		Oper/Rec/OP RC Operat. data record. ↓

6.14.7.2 Readout of the Monitoring Signal Memory

If the unit detects an internal fault in the course of internal self-monitoring routines or if it detects power system conditions that prevent flawless functioning of the unit, then an entry is made in the monitoring signal memory. A maximum of 30 entries is possible. After that an “overflow” signal is issued.

	Control Step / Description	Control Action	Display
Step 0	Select the entry point for the monitoring signal memory.		Oper/Rec/MT RC Mon. signal record. ↓
Step 1	Press the “down” key to enter the monitoring signal memory. The oldest entry is displayed.		Mon. signal record. 01.01.13 13:33 SFMON Checksum error param
Step 2	Press the “right” key repeatedly to display the entries one after the other in chronological order. If more than 30 monitoring signals have been entered since the last reset, the “overflow” signal is displayed as the last entry.		Mon. signal record. 01.01.13 10:01 SFMON Exception oper. syst.
Step 3	Press the “left” key to display the previous entry.		Mon. signal record. 01.01.13 13:33 SFMON Checksum error param
Step 4	If the “down” key is held down while a monitoring signal is being displayed, the following additional information will be displayed: ● First Time when the signal first occurred ● Updated The fault is still being detected (Yes) or is no longer detected (No) by the self-monitoring function. ● Acknowledged The fault was no longer detected by the self-monitoring function and has been reset (Yes). ● Number The signal occurred x times.		Mon. signal record. 01.01.13 13:33 SFMON Checksum error param
			First 13:33:59.744 Updated Yes Acknowledged No Number 5
Step 5	Press the “up” key at any point within the monitoring signal memory to return to the entry point.		Oper/Rec/MT RC Mon. signal record. ↓

	Control Step / Description (24 TE Case)	Control Action	Display
Step 0	Select the entry point for the monitoring signal memory.		Oper/Rec/MT RC Mon. signal record. ↓
Step 1	Press the “down” key to enter the monitoring signal memory. The oldest entry is displayed.		Mon. signal record. 01.01.13 13:33 SFMON Checksum error param
Step 2	Press the “right” key repeatedly to display the entries one after the other in chronological order. If more than 30 monitoring signals have been entered since the last reset, the “overflow” signal is displayed as the last entry.		Mon. signal record. 01.01.13 10:01 SFMON Exception oper. syst.
Step 3	Press the “left” key to display the previous entry.		Mon. signal record. 01.01.13 13:33 SFMON Checksum error param
Step 4	If the “down” key is held down while a monitoring signal is being displayed, the following additional information will be displayed: ● First Time when the signal first occurred ● Updated The fault is still being detected (Yes) or is no longer detected (No) by the self-monitoring function. ● Acknowledged The fault was no longer detected by the self-monitoring function and has been reset (Yes). ● Number The signal occurred x times.		Mon. signal record. 01.01.13 13:33 SFMON Checksum error param
			First 13:33:59.744 Updated Yes Acknowledged No Number 5
Step 5	Press the “up” key at any point within the monitoring signal memory to return to the entry point.		Oper/Rec/MT RC Mon. signal record. ↓

6.14.7.3 Readout of the Event Memories (Records)

There are eight event memories for each type of event. The latest event is stored in event memory 1, the previous one in event memory 2, and so forth.

Readout of event memories is illustrated using the fault memory as an example.

	Control Step / Description	Control Action	Display
Step 0	Select the entry point for the first fault memory, for example. If the memory contains entries, the third line of the display will show the date and time the fault began. If the third line is blank, then there are no entries in the fault memory.		Events/Rec/FT RC Fault recording 1 01.01.13 10:00:33 ↓
Step 1	Press the “down” key to enter the fault memory. First, the fault number is shown. In this example it is the 22nd fault since the last reset.		Fault recording 1 FT RC Event 22
Step 2	Press the “right” key repeatedly to see first the measured fault data and then the binary signals in chronological order. The time shown in the second line is the time, measured from the onset of the fault, at which the value was measured or the binary signal started or ended. Once the end of the fault has been reached (after the “right” key has been pressed repeatedly), pressing the “right” key again will have no effect.		Fault recording 1 200 ms FT DA Running time 0.17 s
			Fault recording 1 0 ms FT RC Record. in progress Start
			Fault recording 1 241 ms FT RC Record. in progress End
Step 3	Press the “left” key to see the previous measured value or the previous signal.		Fault recording 1 0 ms FT RC Record. in progress Start
Step 4	Press the “up” key at any point within the fault memory to return to the entry point.		Events/Rec/FT RC Fault recording 1 01.01.13 10:00:33 ↓

	Control Step / Description (24 TE Case)	Control Action	Display
Step 0	Select the entry point for the monitoring signal memory.		Oper/Rec/MT RC Mon. signal record. ↓
Step 1	Press the “down” key to enter the monitoring signal memory. The oldest entry is displayed.		Mon. signal record. 01.01.13 13:33 SFMON Checksum error param
Step 2	Press the “right” key repeatedly to display the entries one after the other in chronological order. If more than 30 monitoring signals have been entered since the last reset, the “overflow” signal is displayed as the last entry.		Mon. signal record. 01.01.13 10:01 SFMON Exception oper. syst.
Step 3	Press the “left” key to display the previous entry.		Mon. signal record. 01.01.13 13:33 SFMON Checksum error param
Step 4	If the “down” key is held down while a monitoring signal is being displayed, the following additional information will be displayed: ● First Time when the signal first occurred ● Updated The fault is still being detected (Yes) or is no longer detected (No) by the self-monitoring function. ● Acknowledged The fault was no longer detected by the self-monitoring function and has been reset (Yes). ● Number The signal occurred x times.		Mon. signal record. 01.01.13 13:33 SFMON Checksum error param
			First 13:33:59.744 Updated Yes Acknowledged No Number 5
Step 5	Press the “up” key at any point within the monitoring signal memory to return to the entry point.		Oper/Rec/MT RC Mon. signal record. ↓

6.14.8

Resetting

All information memories – including the event memories and the monitoring signal memory – as well as the LED indicators can be reset manually. In addition, the LED indicators are automatically cleared and initialized at the onset of a new fault – provided that the appropriate operating mode has been selected – so that they always indicate the latest fault.

The LED indicators can also be reset manually by pressing the RESET key (CLEAR key in 24 TE), which is always possible in the standard control mode. This action also triggers an LED indicator test and an LCD display test. The event memories are not affected by this action, so that inadvertent deletion of the records associated with the reset signal pattern is reliably prevented.

Because of the ring structure of the event memories, the data for eight consecutive events are updated automatically so that manual resetting should not be necessary, in principle.

Deleting the event memories completely (e.g. after a function test), can be accomplished by various resetting actions including the configuration of a group resetting for several memories. An overview of all resetting actions can be found in section “Resetting Actions” in Chapter “Operation”.

Resetting a single memory from the local control panel is described in the following with the example of a fault memory. In this example the global change-enabling function has already been activated.

	Control Step / Description	Control Action	Display
Step 0	Select the reset setting. Line 3 of the display shows the number of faults since the last reset, 10 in this example.		Oper/CtrlTest/FT RC Reset record. user 10
Step 1	Login procedure Press the ENTER key. Insufficient rights message is displayed for 2 seconds. Select proper user by pressing 'up' and 'down'. Press the ENTER key. Eight asterisks (*) appear in the display. Enter the configured password of the selected user. Please refer to Section 3.3.2, (p. 3-6) for detailed information about the compatibility with or without Cyber Security.	   	Device Security insuff. rights Select a user >DefaultViewer DefaultOperate DefaultEngineer User Password? ***** Device Security login successful
Step 2	The LED indicator labeled EDIT MODE will light up.		Oper/CtrlTest/FT RC Reset recording 10 don't execute
Step 3	Press the “Up” or “Down” keys to change the setting to <i>execute</i> .	 	Oper/CtrlTest/FT RC Reset record. user 10 execute
Step 4	Press the ENTER key. The LED indicator labeled EDIT MODE will be extinguished. The value in line 3 is reset to 0.		Oper/CtrlTest/FT RC Reset record. user 0
Step 5	To cancel the intended clearing of the fault recordings after leaving the standard control mode (the LED indicator labeled EDIT MODE is on), press the RESET key. The LED indicator will be extinguished, and the fault recordings remain stored unchanged in the protection unit's memory. Any setting can be selected again for a value change by pressing the keys.		Oper/CtrlTest/FT RC Reset record. user 10

	Control Step / Description (24 TE Case)	Control Action	Display
Step 0	Select the reset setting. Line 3 of the display shows the number of faults since the last reset, 10 in this example.		Oper/CtrlTest/FT RC Reset record. user 10
Step 1	Login procedure Press the ENTER key. Insufficient rights message is displayed for 2 seconds. Select proper user by pressing 'up' and 'down'. Press the ENTER key. Eight asterisks (*) appear in the display. Enter the configured password of the selected user. Please refer to Section 3.3.2, (p. 3-6) for detailed information about the compatibility with or without Cyber Security.	   	Device Security insuff. rights Select a user >DefaultViewer DefaultOperate DefaultEngineer User Password? ***** Device Security login successful
Step 2	The LED indicator labeled EDIT MODE will light up.		Oper/CtrlTest/FT RC Reset recording 10 don't execute
Step 3	Press the "Up" or "Down" keys to change the setting to <i>execute</i> .	 	Oper/CtrlTest/FT RC Reset record. user 10 execute
Step 4	Press the ENTER key. The LED indicator labeled EDIT MODE will be extinguished. The value in line 3 is reset to 0.		Oper/CtrlTest/FT RC Reset record. user 0
Step 5	To cancel the intended clearing of the fault recordings after leaving the standard control mode (the LED indicator labeled EDIT MODE is on), press the CLEAR key. The LED indicator will be extinguished, and the fault recordings remain stored unchanged in the protection unit's memory. Any setting can be selected again for a value change by pressing the keys.		Oper/CtrlTest/FT RC Reset record. user 10

6.14.9 Password-Protected Control Actions

Certain actions from the local control panel such as a manual trip command for testing purposes can only be carried out by entering a password so as to prevent unwanted output even though the global change-enabling function has been activated (see [Section 6.14.3, \(p. 6-28\)](#)).

This setup is designed to prevent accidental output and applies even when the global change-enabling function has been activated. The password consists of a pre-defined sequential key combination entered within a specific time interval.

	Control Step / Description	Control Action	Display
Step 0	In the menu tree "Oper/CtrlTest/MAIN", select the parameter MAIN: Man. trip cmd. USER.		Oper/CtrlTest/MAIN Man. trip cmd. USER don't execute
Step 1	Login procedure Press the ENTER key. Insufficient rights message is displayed for 2 seconds. Select proper user by pressing 'up' and 'down'. Press the ENTER key. Eight asterisks (*) appear in the display. Enter the configured password of the selected user. Please refer to Section 3.3.2, (p. 3-6) for detailed information about the compatibility with or without Cyber Security.	  or  	Device Security insuff. rights Select a user >DefaultViewer DefaultOperate DefaultEngineer User Password? ***** Device Security login successful
Step 2	The LED indicator labeled EDIT MODE will light up. This indicates that the setting can now be changed by pressing the "up" or "down" keys.		Oper/CtrlTest/MAIN Man. trip cmd. USER don't execute
Step 3	Change the setting to <i>execute</i> .	 	Oper/CtrlTest/MAIN Man. M-trip cmd USER execute
Step 4	Press the enter key again. The LED indicator labeled EDIT MODE will go out. The unit will execute the command.		Oper/CtrlTest/MAIN Man. trip cmd. USER don't execute
Step 5	As long as the LED indicator labeled EDIT MODE is on, the control action can be terminated by pressing the RESET key. The LED indicator labeled EDIT MODE will be extinguished.		Oper/CtrlTest/MAIN Man. trip cmd. USER don't execute

	Control Step / Description (24 TE Case)	Control Action	Display
Step 0	In the menu tree “Oper/CtrlTest/MAIN”, select the parameter MAIN: Man. trip cmd. USER.		Oper/CtrlTest/MAIN Man. trip cmd. USER don't execute
Step 1	Login procedure Press the ENTER key. Insufficient rights message is displayed for 2 seconds. Select proper user by pressing 'up' and 'down'. Press the ENTER key. Eight asterisks (*) appear in the display. Enter the configured password of the selected user. Please refer to Section 3.3.2, (p. 3-6) for detailed information about the compatibility with or without Cyber Security.	  or  	Device Security insuff. rights Select a user >DefaultViewer DefaultOperate DefaultEngineer User Password? ***** Device Security login successful
Step 2	The LED indicator labeled EDIT MODE will light up. This indicates that the setting can now be changed by pressing the “up” or “down” keys.		Oper/CtrlTest/MAIN Man. trip cmd. USER don't execute
Step 3	Change the setting to <i>execute</i> .	 	Oper/CtrlTest/MAIN Man. M-trip cmd USER execute
Step 4	Press the enter key again. The LED indicator labeled EDIT MODE will go out. The unit will execute the command.		Oper/CtrlTest/MAIN Man. trip cmd. USER don't execute
Step 5	As long as the LED indicator labeled EDIT MODE is on, the control action can be terminated by pressing the CLEAR key. The LED indicator labeled EDIT MODE will be extinguished.		Oper/CtrlTest/MAIN Man. trip cmd. USER don't execute

7 Settings

7.1 Parameters

The P433 must be adjusted to the system and to the protected equipment by appropriate settings. This chapter gives instructions for determining the settings, which are located in the folder titled “Parameters” in the menu tree. The sequence in which the settings are listed and described in this chapter corresponds to their sequence in the menu tree.

The P433 devices are supplied with a factory-set standard configuration of settings that, in most cases, correspond to the default settings or become apparent after a “cold restart”. The P433 is blocked in that case. All settings must be re-entered after a cold restart.

Note

Detailed information about all parameters, including complete selection tables and IEC 60870-5-103 protocol properties, are separately available as a set of interlinked PDF files for user-friendly navigation, packed in one ZIP archive named DataModelExplorer_P433_en_P01.zip.

In contrast to P433 versions before P433-630, the implementation of the IEC 61850 protocol now features parameters that cannot be modified from the local control panel (HMI) or with the operating program. Instead, these parameters are set with a special IEC 61850 operating software, named “IED Configurator”. Therefore these settings are not listed in this chapter or the following chapter. These parameters are described in Chapter “IEC 61850 Settings via IED Configurator”.

Cancelling a Protection or Control Function

The user can adapt the device to the requirements of a particular high-voltage system by including the relevant protection or control functions in the device configuration and cancelling all others (removing them from the device configuration).

The following conditions must be met before cancelling a protection or control function:

- The protection or control function in question must be disabled.
- None of the functions of the protection or control function to be cancelled may be assigned to a binary input.
- None of the signals of the protection or control function may be assigned to a binary output or an LED indicator.
- No functions of the device function being cancelled can be selected in a list setting.
- None of the signals of the protection or control function may be linked to other signals by way of an “m out of n” parameter.

The protection or control function to which a parameter, a signal, or a measured value belongs is defined by the function group designation (example: “LIMIT:”).

General Notes on the Configuration of Function Group “Binary Input” (INP)

The P433 has optical coupler inputs for processing binary signals from the system. The number and connection schemes for the available binary inputs are shown in the terminal connection diagrams. The “DataModelExplorer” (available

as a separate ZIP archive file) gives information about the configuration options for all binary inputs.

The P433 identifies the installed modules during startup. If a given binary I/O module is not installed or has fewer binary signal inputs than the maximum number possible at this slot, then the configuration addresses for the missing binary signal inputs are automatically hidden in the menu tree.

When configuring binary inputs, one should keep in mind that the same function can be assigned to several signal inputs. Thus one function can be activated from several control points having different signal voltages.

The configuration in slots A and B and the configuration for the binary inputs U C01 to U C08 will be changed with the selection of a new bay type. (Whether automatic configuration occurs, is defined in the setting MAIN: Auto-assignment I/O.) Depending on the connection type chosen for the P433 – pin-type or ring-type cable socket terminals – the symbolic slots A, B and C refer to the following slots:

Symbolic slot	Pin-type cable socket terminals	Ring-type cable socket terminals
A	06	12
B	07	14
C	08	16

The configuration of binary inputs for each bay type – in the case of auto-assignment – is given in the List of Bay Types in the Appendix.

In the case of auto-assignment, the following notes apply:

Before selecting a new bay type, make sure that the binary inputs at slots A and B as well as the binary inputs U C01 to U C08 are configured for functions from the DEVxx function groups only. Otherwise there will be an error message, and the new bay type will not be activated.

Before selecting a new bay type, make sure that all binary inputs specified in the List of Bay types for the selected bay type are actually available in the device. Otherwise there will be an error message, and the new bay type will not be activated.

In order to ensure that the device will recognize the input signals, the triggering signals must persist for at least 30 ms. The operating mode for each binary signal input can be defined.

The user can specify whether the presence (*active ‘high’* mode) or absence (*active ‘low’* mode) of a voltage shall be interpreted as the logic “1” signal.

General Notes on the Configuration of Function Group “Binary Output” (OUTP)

The P433 has output relays for the output of binary signals. The number and connection schemes for the available binary output relays are shown in the terminal connection diagrams. The “DataModelExplorer” (available as a separate ZIP archive file) gives information about the configuration options for all binary outputs.

The P433 identifies the installed modules during startup. If a given binary I/O module is not installed or has fewer output relays than the maximum number possible at this slot, then the configuration addresses for the missing output relays are automatically hidden in the menu tree.

The contact data for the all-or-nothing relays permits them to be used either as command relays or as signal relays. It is important to note that the contact rating of the binary I/O modules (X) varies (see Chapter “Technical Data”). One signal can also be assigned simultaneously to several output relays for the purpose of contact multiplication.

Selecting a new bay type can change the configuration for slots A and B. (Whether automatic configuration occurs, is defined in the setting MAIN: Auto-assignment I/O.) Depending on the connection type chosen for the P433 – pin-type or ring-type cable socket terminals – the symbolic slots A and B correspond to the following slots:

Symbolic slot	Pin-type cable socket terminals	Ring-type cable socket terminals
A	06	12
B	07	14

The configuration of output relays for each bay type – in the case of auto-assignment – is given in the List of Bay Types in the Appendix.

In the case of auto-assignment, the following notes apply:

Before selecting a new bay type, make sure that the output relays at slots A and B are configured for functions from the DEVxx function groups only. Otherwise there will be an error message, and the new bay type will not be activated.

Before selecting a new bay type, make sure that all output relays specified in the List of Bay types for the selected bay type are actually available in the device. Otherwise there will be an error message, and the new bay type will not be activated.

An operating mode can be defined for each output relay. Depending on the selected operating mode, the output relay will operate in either an energize-on-signal (ES) mode or a normally-energized (NE) mode and in either a latching or non-latching mode. For output relays operating in latching mode, the operating mode setting also determines when latching will be cancelled.

General Notes on the Configuration of the LED Indicators

The P433 has LED indicators for parallel display of binary signals. LED indicator H 1 is not configurable. It is labeled “HEALTHY” and signals the operational readiness of the protection unit (supply voltage present). LED indicators H 2 and H 3 are not configurable either. H 2 is labeled “OUT OF SERVICE” and signals a blocking or malfunction; H 3 is labeled “ALARM” and signals a warning alarm. LED indicator H 17 indicates that the user is in the “EDIT MODE”. Section “Configuration and Operating Mode of the LED Indicators (Function Group LED)” in Chapter “Operation” describes the layout of the LED indicators and the factory setting for LED indicator H 4.

An operating mode can be defined for each LED indicator. Depending on the set operating mode, the LED indicator will operate in either energize-on-signal (ES) mode (“open-circuit principle”) or normally-energized (NE) mode (“closed-circuit principle”) and in either latching or non-latching mode. For LED indicators operating in latching mode, the operating mode setting also determines when latching will be cancelled.

With the multi-color LED indicators the colors red and green can be independently assigned with functions. The third color amber results as a

mixture of red and green, i.e. when both functions assigned to the LED indicator are simultaneously present.

7.1.1 Device Identification

The device identification settings are used to record the ordering information and the design version of the P433. They have no effect on the device functions. These settings should only be changed if the design version of the P433 is modified.

Device

Parameter	Address			
Default	Min	Max	Unit	Logic Diagram
DVICE: Device type				000 000
433	0	1000		
The device type is displayed. This display cannot be altered.				
DVICE: Software version 1XX				024 219
Not measured	0	65535		
The setting defines the software version of the device. This display cannot be altered.				
DVICE: SW date				002 122
1997-01-01	1997-01-01	2098-11-08	dd.mm.yy	
Date the software was created. This display cannot be altered. Note: The centuries are not displayed. The supported dates range from January 1st, 1997, until November 7th, 2098.				
DVICE: SW version COMM1/2				002 103
Not measured	0.00	655.35		
Software version for the device's communication software. This display cannot be altered.				
DVICE: SW vers. Ethernet				025 185
Not measured	0.00	655.35		
Software version for the device's Ethernet software. This display cannot be altered. Note: "Not measured" means either no communication board available or the firmware IEC 61850 is not started or an failure during startup.				
DVICE: DM IEC 61850 version				002 059
Not measured	0	65535		
Software version of the communication software based on the device's protocol per IEC 61850. This display cannot be altered.				
DVICE: Language version				002 123
0.0	0.0	899.9		
Identification of the change level of the texts of the data model. This display cannot be altered.				
DVICE: Text vers.data model				002 121
0	0	255		
Using the 'text replacement tool' provided by the operating program, the user can change the parameter descriptors (plain text designations) and load them into the device. These customized data models contain an identifier defined by the user while preparing the data model. This identifier is displayed at this point in the menu tree. Standard data models have the identifier '0' (factory-set default).				

Parameter					Address			
Default	Min	Max	Unit		Logic Diagram			
DVICE: F number								002 124
0	0	9999						
The F number is the serial number of the device. The display cannot be altered.								
DVICE: AFS Order No.								001 000
0:								
DVICE: PCS Order No.								001 200
0:								
Order numbers for the device. The user cannot alter this number.								
DVICE: Order ext. No. 1								000 003
0	0	999						
DVICE: Order ext. No. 2								000 004
0	0	999						
DVICE: Order ext. No. 3								000 005
0	0	999						
DVICE: Order ext. No. 4								000 006
0	0	999						
DVICE: Order ext. No. 5								000 007
0	0	999						
DVICE: Order ext. No. 6								000 008
0	0	999						
DVICE: Order ext. No. 7								000 009
0	0	999						
DVICE: Order ext. No. 8								000 010
0	0	999						
DVICE: Order ext. No. 9								000 011
0	0	999						
DVICE: Order ext. No. 10								000 012
0	0	999						
DVICE: Order ext. No. 11								000 013
0	0	999						
DVICE: Order ext. No. 12								000 014
0	0	999						
DVICE: Order ext. No. 13								000 015
0	0	999						
DVICE: Order ext. No. 14								000 016
0	0	999						

Parameter				Address
Default	Min	Max	Unit	Logic Diagram
DVICE: Order ext. No. 15				000 017
0	0	999		
DVICE: Order ext. No. 16				000 018
0	0	999		
DVICE: Order ext. No. 17				000 019
0	0	999		
DVICE: Order ext. No. 18				000 020
0	0	999		
DVICE: Order ext. No. 19				000 021
0	0	999		
DVICE: Order ext. No. 20				000 022
0	0	999		
DVICE: Order ext. No. 21				000 023
0	0	999		
DVICE: Order ext. No. 22				000 024
0	0	999		
DVICE: Order ext. No. 23				000 025
0	0	999		
DVICE: Order ext. No. 24				000 026
0	0	999		
DVICE: Order ext. No. 25				000 027
0	0	999		
DVICE: Order ext. No. 26				000 028
0	0	999		
DVICE: Order ext. No. 27				000 029
0	0	999		
Order extension numbers for the device.				
DVICE: Module var. slot 1				086 050
1: Module P: 0336411				
DVICE: Module var. slot 2				086 051
65535: Not fitted				
DVICE: Module var. slot 3				086 052
65535: Not fitted				
DVICE: Module var. slot 4				086 053
65535: Not fitted				
DVICE: Module var. slot 5				086 054
65535: Not fitted				

Parameter				Address
Default	Min	Max	Unit	Logic Diagram
DVICE: Module var. slot 6				086 055
65535: Not fitted				
DVICE: Module var. slot 7				086 056
65535: Not fitted				
DVICE: Module var. slot 8				086 057
65535: Not fitted				
DVICE: Module var. slot 9				086 058
65535: Not fitted				
DVICE: Module var. slot 10				086 059
65535: Not fitted				
DVICE: Module var. slot 12				086 061
65535: Not fitted				
DVICE: Module var. slot 13				086 062
65535: Not fitted				
DVICE: Module var. slot 14				086 063
65535: Not fitted				
DVICE: Module var. slot 15				086 064
65535: Not fitted				
DVICE: Module var. slot 16				086 065
65535: Not fitted				
DVICE: Module var. slot 17				086 066
65535: Not fitted				
DVICE: Module var. slot 18				086 067
65535: Not fitted				
DVICE: Module var. slot 19				086 068
65535: Not fitted				
DVICE: Module var. slot 20				086 069
65535: Not fitted				
Item number of the module inserted in the respective slot 1 to 21. The display always shows the actual component configuration at any given time.				
DVICE: Module vers. slot 1				086 193
27: Not fitted				
DVICE: Module vers. slot 2				086 194
27: Not fitted				
DVICE: Module vers. slot 3				086 195
27: Not fitted				
DVICE: Module vers. slot 4				086 196
27: Not fitted				

Parameter				Address
Default	Min	Max	Unit	Logic Diagram
DVICE: Module vers. slot 5				086 197
27: Not fitted				
DVICE: Module vers. slot 6				086 198
27: Not fitted				
DVICE: Module vers. slot 7				086 199
27: Not fitted				
DVICE: Module vers. slot 8				086 200
27: Not fitted				
DVICE: Module vers. slot 9				086 201
27: Not fitted				
DVICE: Module vers. slot 10				086 202
27: Not fitted				
DVICE: Module vers. slot 12				086 204
27: Not fitted				
DVICE: Module vers. slot 13				086 205
27: Not fitted				
DVICE: Module vers. slot 14				086 206
27: Not fitted				
DVICE: Module vers. slot 15				086 207
27: Not fitted				
DVICE: Module vers. slot 16				086 208
27: Not fitted				
DVICE: Module vers. slot 17				086 209
27: Not fitted				
DVICE: Module vers. slot 18				086 210
27: Not fitted				
DVICE: Module vers. slot 20				086 212
27: Not fitted				
Index letter specifying the version of the module fitted in the respective slot.				
DVICE: Variant of module A				086 047
65535: Not fitted				
Item number of module A in this design version.				
DVICE: Version of module A				086 190
27: Not fitted				
Index letter specifying the version of module A.				

Parameter	Address			
Default	Min	Max	Unit	Logic Diagram
DVICE: Variant of module L				086 048
65535: Not fitted				
Item number of module L in this design version.				
DVICE: Version of module L				086 191
27: Not fitted				
Index letter specifying the version of module L.				
DVICE: Variant of module B				086 049
65535: Not fitted				
Item number of module B in this design version.				
DVICE: Version of module B				086 192
27: Not fitted				
Index letter specifying the version of the digital bus module B.				
DVICE: Variant module B (a)				086 046
65535: Not fitted				
Item number of the analog bus module B in this design version.				
DVICE: Version module B (a)				086 189
27: Not fitted				
Index letter specifying the version of the digital bus module B.				
DVICE: Customer ID data 1				000 040
0.00	0.00	99.99		
DVICE: Customer ID data 2				000 041
0.00	0.00	99.99		
DVICE: Customer ID data 3				000 042
0.00	0.00	99.99		
DVICE: Customer ID data 4				000 043
0.00	0.00	99.99		
DVICE: Customer ID data 5				000 044
0.00	0.00	99.99		
DVICE: Customer ID data 6				000 045
0.00	0.00	99.99		
DVICE: Customer ID data 7				000 046
0.00	0.00	99.99		
DVICE: Customer ID data 8				000 047
0.00	0.00	99.99		
Set your numerically coded user data here for your records.				

Parameter				Address
Default	Min	Max	Unit	Logic Diagram
DVICE: Location				001 201
0:				
Reference input for the device's location as selected by user.				
DVICE: Device ID				000 035
0	0	9999		
ID code for use by the PC programs for operating and setting. Further instructions on this setting are given in the description of the respective operating program.				
DVICE: Substation ID				000 036
0	0	9999		
ID code for use by the PC programs for operating and setting. Further instructions on this setting are given in the description of the respective operating program.				
DVICE: Feeder ID				000 037
0	0	9999		
ID code for use by the PC programs for operating and setting. Further instructions on this setting are given in the description of the respective operating program.				
DVICE: Device password 1				000 048
0	0	9999		
DVICE: Device password 2				000 049
0	0	9999		
ID code used by the operating program for identification purposes. See description of the respective operating program for more detailed setting instructions.				
DVICE: SW version DHMI				002 131
Not measured	0.00	655.35		
DVICE: SW version DHMI DM				002 132
1.10	0.00	655.35		
Internal software version numbers.				

Local control panel

Parameter				Address
Default	Min	Max	Unit	Logic Diagram
LOC: Local HMI exists				221 099
1: Yes				
When set to Yes it is apparent that the device is fitted with the local control panel (HMI).				

7.1.2 Configuration Parameters

	Parameter				Address	
	Default	Min	Max	Unit	Logic Diagram	
Cyber Security	CS: CyberSecurity Vers.					180 031
	2	0	65535			
	Version of Cyber Security implementation within the device. Easergy MiCOM 30 is starting with value 2 to be compatible with other Schneider Electric devices.					
	CS: Number of users					180 002
	0	0	9999			
	Actual number of users in RBAC configuration.					
	CS: Comms logout					180 032
	0: don't execute					
	If executed, the current logged in user at PC port or via Tunneling interface is logged out (can be only executed by Comms).					
	CS: HMI logout					180 033
	0: don't execute					
	If executed, the current logged in user at HMI interface is logged out (can be only executed by HMI).					
	CS: Comms username					180 043
	0:					
	Display of the name of the user which is logged in either at PC-port or via Tunneling.					
	CS: HMI username					180 034
	0:					
	Display of the name of the user which is logged in at HMI.					
	CS: User access role					180 013
	0:					
	Role(s) of user which is actually logged in. It will be set by the device after successful login and will be cleared when user is logged off. Of the first 5 roles of a user, the first 3 chars of the roles names will be displayed separated with one blank between each.					
	CS: Max login attempts					180 011
	0	0	9999			
	Number of possible login attempts or blocked (blocked means no limitation of attempts).					
	CS: Login attempts left					180 010
	0	0	9999			
Remaining login attempts.						

Parameter				Address	
Default	Min	Max	Unit	Logic Diagram	
CS: Blocking time					180 015
0	0	1800	s		
Time how long login shall be blocked after erroneous login attempts or blocked (blocked means it will not getting active).					
CS: Block time left					180 012
0	0	1800	s		
Remaining blocking login time after erroneous login attempts.					
CS: Result EPW setting					180 041
0	-5	0			
Display of a value to informe on the result of the password setting. (EPW = Encrypted Password)					
CS: Change pincode					180 003
0	0	0			
Change the PIN code using the navigation keys of the HMI. It is not necessary at communication interface.					
CS: Config disabled					180 044
1: Yes					
Configure disabled or not.					
CS: Recovery Password					180 014
0:					
Display of the Token and allow entry for reset to factory password.					
CS: Reset RBAC					180 045
12	1	12			
Only on HMI. Starting reset timer and display code.					

Configurable function keys

Parameter					Address		
Default	Min	Max	Unit		Logic Diagram		
F_KEY: Fct. assignm. F1							080 112
061 000: MAIN: Without function							
F_KEY: Fct. assignm. F2							080 113
061 000: MAIN: Without function							
F_KEY: Fct. assignm. F3							080 114
061 000: MAIN: Without function							
F_KEY: Fct. assignm. F4							080 115
061 000: MAIN: Without function							
F_KEY: Fct. assignm. F5							080 116
061 000: MAIN: Without function							
F_KEY: Fct. assignm. F6							080 117
061 000: MAIN: Without function							
Assignment of functions to the function keys. Either a single function or a menu jump list may be selected. There are two menu jump lists, which are assembled at LOC: Fct. menu jmp list 1 or LOC: Fct. menu jmp list 2, respectively.							
F_KEY: Operating mode F1							080 132
1: Key							
F_KEY: Operating mode F2							080 133
1: Key							
F_KEY: Operating mode F3							080 134
1: Key							
F_KEY: Operating mode F4							080 135
1: Key							
F_KEY: Operating mode F5							080 136
1: Key							
F_KEY: Operating mode F6							080 137
1: Key							
Choice between operation of the function key as a key or switch.							

Local control panel

Parameter	Address			
Default	Min	Max	Unit	Logic Diagram
LOC: Language				003 020
2: Reference language				
Language in which texts will be displayed on the user interface (HMI).				
LOC: Decimal delimiter				003 021
1: Dot				
Character to be used as decimal delimiter on the local control panel.				
LOC: Display L/R				221 070
1: With Fig. 3-4, (p. 3-11)				
This setting defines whether the control site – “Local” or “Remote” – shall be displayed on the bay panel.				
LOC: Displ. interl. stat.				221 071
1: With Fig. 3-4, (p. 3-11)				
This setting defines whether the “Locked” or “Unlocked” status shall be displayed on the bay panel.				
LOC: Assignment reset key				005 251
060 000: MAIN: Without function Fig. 3-93, (p. 3-135)				
Selection of counters and memories that are reset by pressing the RESET key on the local control panel. (Resetting LED indicators and measured event values is permanently assigned internally, so that they are always reset when the RESET key is pressed.)				
LOC: Assignment read key				080 110
060 000: MAIN: Without function				
Selection of up to 16 functions to be triggered when pressing the read key. Event counters and event recordings are offered for selection. If several functions have been selected then they will be sequentially triggered by repeated pressing of the read key.				
LOC: Fct. assign. L/R key				225 208
1: R <-> L Fig. 3-9, (p. 3-16)				
This setting defines whether the (electric) key-operated switch switches between remote / local control (L↔R) or between remote+local control / local control (R&L↔L).				
LOC: Fct. menu jmp list 1				030 238
060 000: MAIN: Without function				
LOC: Fct. menu jmp list 2				030 239
060 000: MAIN: Without function				
Selection of specified functions which will be sequentially displayed by repeated reading of the menu jump list 1 (or 2).				

Parameter					Address
Default	Min	Max	Unit		Logic Diagram
LOC: Fct. Operation Panel					053 007
060 000: MAIN: Without function					Fig. 3-5, (p. 3-12)
Definition of the values to be displayed on the Measured Value Panel also referred to as the Operation Panel.					
LOC: Fct. Overload Panel					053 005
060 000: MAIN: Without function					Fig. 3-8, (p. 3-15)
Definition of the values to be displayed on the Overload Panel.					
LOC: Fct. Grd.Fault Panel					053 004
060 000: MAIN: Without function					Fig. 3-7, (p. 3-14)
Definition of the values to be displayed on the Ground Fault Panel.					
LOC: Fct. Fault Panel					053 003
060 000: MAIN: Without function					Fig. 3-6, (p. 3-13)
Definition of the values to be displayed on the Fault Panel.					
LOC: Hold-time for Panels					031 075
10	1	10	s		Fig. 3-5, (p. 3-12)
Setting for the time period during which a panel is displayed, before switching to the next panel. This setting is only relevant if more values are selected than can be shown on the LC-Display.					
LOC: Autom. return time					003 014
60	60	60000	s		Fig. 3-5, (p. 3-12)
If the user does not press a key on the local control panel during this set time period, the change-enabling function is deactivated.					
LOC: Return time select.					221 030
60	60	60000	s		Fig. 3-4, (p. 3-11)
If the user does not press a key on the local control panel during this set time period, then the selection of a switchgear unit is cancelled.					
LOC: Return time illumin.					003 023
60	60	60000	s		Fig. 3-4, (p. 3-11)
If the user does not press a key on the local control panel during this set time period, then the backlighting of the LCD display is switched off, and any switchgear selection that might have been made is cancelled.					

PC link

Parameter					Address	
Default	Min	Max	Unit	Logic Diagram		
PC: Bay address					003 068	
1	0	254	Fig. 3-10, (p. 3-18)			
PC: Device address					003 069	
1	0	255	Fig. 3-10, (p. 3-18)			
Bay and device addresses are used to address the device in communication via the PC interface. An identical setting must be selected for both addresses.						
PC: Baud rate					003 081	
115.2: 115.2 kBaud			Baud	Fig. 3-10, (p. 3-18)		
Baud rate of the PC interface.						
PC: Parity bit					003 181	
1: Even			Fig. 3-10, (p. 3-18)			
Set the same parity that is set at the interface of the PC connected to the P433.						
PC: Spontan. sig. enable					003 187	
0: None			Fig. 3-10, (p. 3-18)			
Enable for the transmission of spontaneous signals via the PC interface.						
PC: Select. spontan.sig.					003 189	
060 000: MAIN: Without function			Fig. 3-10, (p. 3-18)			
Selection of spontaneous signals for transmission via the PC interface.						
PC: Transm.enab.cycl.dat					003 084	
0: Without			Fig. 3-10, (p. 3-18)			
Enable for the cyclic transmission of measured values via the PC interface.						
PC: Cycl. data ILS tel.					003 185	
060 000: MAIN: Without function			Fig. 3-10, (p. 3-18)			
Selection of the measured values that are transmitted in a user-defined telegram via the PC interface.						
PC: Delta V					003 055	
3.0	0.0	15.0	%Vnom	Fig. 3-10, (p. 3-18)		
A measured voltage value is transmitted via the PC interface if it differs by the set delta quantity from the last measured value transmitted.						
PC: Delta I					003 056	
3.0	0.0	15.0	%Inom	Fig. 3-10, (p. 3-18)		
A measured current value is transmitted via the PC interface if it differs by the set delta quantity from the last measured value transmitted.						

Parameter	Address			
Default	Min	Max	Unit	Logic Diagram
PC: Delta P				003 059
15.0	0.0	15.0	%Snom	Fig. 3-10, (p. 3-18)
The active power value is transmitted via the PC interface if it differs by the set delta quantity from the last measured value transmitted.				
PC: Delta f				003 057
2.0	0.0	2.0	%fnom	Fig. 3-10, (p. 3-18)
The measured frequency value is transmitted via the PC interface if it differs by the set delta from the last measured value transmitted.				
PC: Delta meas.v.ILS tel				003 155
3.0	0.0	15.0		Fig. 3-10, (p. 3-18)
The telegram is transmitted if a measured value differs by the set delta quantity from the last measured value transmitted.				
PC: Delta t				003 058
1	0	15	min	Fig. 3-10, (p. 3-18)
All measured values are transmitted again via the PC interface after this time period has elapsed – provided that transmission has not been triggered by the other delta conditions.				
PC: Time-out				003 188
1	1	60	min	Fig. 3-10, (p. 3-18)
Setting for the time to elapse after the last telegram exchange via the PC interface before activating the second communication channel of communication module A.				

“Logical”
communication
interface 1

Parameter				Address
Default	Min	Max	Unit	Logic Diagram
COMM1: Function group COMM1				056 026
0: Without				
Cancelling function group COMM1 or including it in the configuration. If the function group is cancelled from the configuration, then all associated settings and signals are hidden, with the exception of this setting.				
COMM1: General enable USER				003 170
0: No				
Disabling or enabling communication interface 1.				
COMM1: Basic IEC870-5 enable				003 215
0: No Fig. 3-11, (p. 3-20)				
Common settings for enabling all protocols based on IEC 870-5-xxx.				
COMM1: Addit. -101 enable				003 216
0: No Fig. 3-11, (p. 3-20)				
Enabling additional settings that are relevant for the protocol based on IEC 870-5-101.				
COMM1: Addit. ILS enable				003 217
0: No Fig. 3-11, (p. 3-20)				
Enabling additional settings that are relevant for the ILS protocol.				
COMM1: MODBUS enable				003 220
0: No Fig. 3-11, (p. 3-20)				
Enabling settings relevant for the MODBUS protocol.				
COMM1: DNP3 enable				003 231
0: No Fig. 3-11, (p. 3-20)				
Enabling settings relevant for the DNP 3.0 protocol.				
COMM1: COURIER enable				103 040
0: No Fig. 3-11, (p. 3-20)				
Enabling settings relevant for the COURIER protocol.				
COMM1: Communicat. protocol				003 167
060 000: MAIN: Without function Fig. 3-11, (p. 3-20)				
Select the communication protocol that shall be used for the communication interface.				

Parameter				Address
Default	Min	Max	Unit	Logic Diagram
COMM1: -103 prot. variant				003 178
1: Private			Fig. 3-12, (p. 3-21)	
The user may select between two variants of the 103 protocol.				
Note: This setting is hidden unless the IEC 870-5-xxx protocol is enabled.				
COMM1: MODBUS prot. variant				003 214
1: Compatible			Fig. 3-15, (p. 3-24)	
The user may select between two variants of the MODBUS protocol.				
Note: This setting is hidden unless the MODBUS protocol is enabled.				
COMM1: Line idle state				003 165
1: Light on / high			Fig. 3-12, (p. 3-21) Fig. 3-13, (p. 3-22) Fig. 3-14, (p. 3-23) Fig. 3-15, (p. 3-24) Fig. 3-16, (p. 3-25) Fig. 3-17, (p. 3-26)	
Setting for the line idle state indication.				
COMM1: Baud rate				003 071
19.2: 19.2 kBaud			Baud	Fig. 3-12, (p. 3-21) Fig. 3-13, (p. 3-22) Fig. 3-14, (p. 3-23) Fig. 3-15, (p. 3-24) Fig. 3-16, (p. 3-25) Fig. 3-17, (p. 3-26)
Baud rate of the communication interface.				
COMM1: Parity bit				003 171
2: Even			Fig. 3-12, (p. 3-21) Fig. 3-13, (p. 3-22) Fig. 3-14, (p. 3-23) Fig. 3-15, (p. 3-24) Fig. 3-16, (p. 3-25) Fig. 3-17, (p. 3-26)	
Set the same parity that is set at the interface of the control system connected to the P433.				

Parameter				Address
Default	Min	Max	Unit	Logic Diagram
COMM1: Dead time monitoring				003 176
1: Yes				Fig. 3-12, (p. 3-21) Fig. 3-13, (p. 3-22) Fig. 3-14, (p. 3-23) Fig. 3-15, (p. 3-24) Fig. 3-16, (p. 3-25) Fig. 3-17, (p. 3-26)
The P433 monitors telegram transmission to make sure that no excessive pause occurs within a telegram. This monitoring function can be disabled if it is not required. Note: This setting is only necessary for modem transmission.				
COMM1: Mon. time polling				003 202
25	3	254	s	Fig. 3-12, (p. 3-21) Fig. 3-13, (p. 3-22) Fig. 3-14, (p. 3-23) Fig. 3-15, (p. 3-24) Fig. 3-16, (p. 3-25) Fig. 3-17, (p. 3-26)
The time between two polling calls from the communication master must be less than the time set here.				
COMM1: Octet comm. address				003 072
1	0	254		Fig. 3-12, (p. 3-21) Fig. 3-13, (p. 3-22) Fig. 3-14, (p. 3-23) Fig. 3-15, (p. 3-24) Fig. 3-16, (p. 3-25) Fig. 3-17, (p. 3-26)
The communication address and the ASDU address are used to identify the device in communication via the interface. An identical setting must be selected for both addresses. “ASDU”: Application Service Data Unit				
COMM1: Oct.2 comm.addr.DNP3				003 240
0	0	255		Fig. 3-16, (p. 3-25)
In the DNP 3.0 protocol, a 16-bit address is used to identify devices. The address that can be set here is the higher-order octet, whereas the address set at COMM1: Octet comm. address is the lower-order octet of the DNP address. Note: This setting is hidden unless the DNP 3.0 protocol is enabled.				

Parameter	Address			
Default	Min	Max	Unit	Logic Diagram
COMM1: Pos. acknowledgement				103 060
1: Single character E5				
The following transmission frame formats are available (according to the standard): ● <i>Short message FT 1.2</i>: short message with a fixed block length of 5 characters ● <i>Single character E5</i>: single control character				
COMM1: Test monitor on				003 166
0: No				
Fig. 3-12, (p. 3-21) Fig. 3-13, (p. 3-22) Fig. 3-14, (p. 3-23) Fig. 3-15, (p. 3-24) Fig. 3-16, (p. 3-25) Fig. 3-17, (p. 3-26)				
Setting specifying whether data shall be recorded for service activities.				
COMM1: Name of manufacturer				003 161
1: SE				
Fig. 3-12, (p. 3-21) Fig. 3-13, (p. 3-22) Fig. 3-14, (p. 3-23)				
Setting for the name of the manufacturer.				
Note:				
● This setting can be changed to ensure compatibility. ● This setting is hidden unless an IEC 870-5 protocol is enabled.				
COMM1: Octet address ASDU				003 073
1	0	255		Fig. 3-12, (p. 3-21) Fig. 3-13, (p. 3-22) Fig. 3-14, (p. 3-23)
The communication address and the ASDU address are used to identify the device in communication via the interface. An identical setting must be selected for both addresses. Note: This setting is hidden unless an IEC 870-5 protocol is enabled. “ASDU”: Application Service Data Unit				
COMM1: Spontan. sig. enable				003 177
65535: All				
Fig. 3-12, (p. 3-21) Fig. 3-13, (p. 3-22) Fig. 3-14, (p. 3-23)				
Enable for the transmission of spontaneous signals via the communication interface. Note: This setting is hidden unless an IEC 870-5 protocol is enabled.				

Parameter				Address
Default	Min	Max	Unit	Logic Diagram
COMM1: Select. spontan.sig.				003 179
060 000: MAIN: Without function				Fig. 3-12, (p. 3-21) Fig. 3-13, (p. 3-22) Fig. 3-14, (p. 3-23)
Selection of spontaneous signals for transmission via “logical” communication interface 1.				
COMM1: Transm.enab.cycl.dat				003 074
0: Without				Fig. 3-12, (p. 3-21) Fig. 3-13, (p. 3-22) Fig. 3-14, (p. 3-23)
Enabling of cyclic transmission of measured values via the communication interface.				
Note: This setting is hidden unless an IEC 870-5 protocol is enabled.				
COMM1: Cycl. data ILS tel.				003 175
060 000: MAIN: Without function				Fig. 3-12, (p. 3-21) Fig. 3-13, (p. 3-22) Fig. 3-14, (p. 3-23)
Selection of the measured values that are transmitted in a user-defined telegram via the communication interface.				
Note: This setting is hidden unless an IEC 870-5 protocol is enabled.				
COMM1: Delta V				003 050
3.0	0.0	15.0	%Vnom	Fig. 3-12, (p. 3-21) Fig. 3-13, (p. 3-22) Fig. 3-14, (p. 3-23)
A measured voltage value is transmitted via the communication interface if it differs by the set delta quantity from the last measured value transmitted.				
Note: This setting is hidden unless an IEC 870-5 protocol is enabled.				
COMM1: Delta I				003 051
3.0	0.0	15.0	%Inom	Fig. 3-12, (p. 3-21) Fig. 3-13, (p. 3-22) Fig. 3-14, (p. 3-23)
A measured current value is transmitted via the communication interface if it differs by the set delta quantity from the last measured value transmitted.				
Note: This setting is hidden unless an IEC 870-5 protocol is enabled.				
COMM1: Delta P				003 054
15.0	0.0	15.0	%Snom	Fig. 3-12, (p. 3-21) Fig. 3-13, (p. 3-22) Fig. 3-14, (p. 3-23)
The active power value is transmitted via the communication interface if it differs by the set delta quantity from the last measured value transmitted.				
Note: This setting is hidden unless an IEC 870-5 protocol is enabled.				

Parameter					Address		
Default	Min	Max	Unit	Logic Diagram			
COMM1: Delta f						003 052	
2.0	0.0	2.0	%fnom	Fig. 3-12, (p. 3-21) Fig. 3-13, (p. 3-22) Fig. 3-14, (p. 3-23)			
The measured frequency value is transmitted via the communication interface if it differs by the set delta quantity from the last measured value transmitted.							
Note: This setting is hidden unless an IEC 870-5 protocol is enabled.							
COMM1: Delta meas.v.ILS tel						003 150	
3.0	0.0	15.0		Fig. 3-12, (p. 3-21) Fig. 3-13, (p. 3-22) Fig. 3-14, (p. 3-23)			
The telegram is transmitted if a measured value differs by the set delta quantity from the last measured value transmitted.							
Note: This setting is hidden unless an IEC 870-5 protocol is enabled.							
COMM1: Delta t						003 053	
1	0	15	min	Fig. 3-12, (p. 3-21) Fig. 3-13, (p. 3-22) Fig. 3-14, (p. 3-23)			
All measured values are transmitted again via the communication interface after this time period has elapsed – provided that transmission has not been triggered by the other delta conditions.							
Note: This setting is hidden unless an IEC 870-5 protocol is enabled.							
COMM1: Delta t (energy)						003 151	
Blocked	0	15	min	Fig. 3-12, (p. 3-21) Fig. 3-13, (p. 3-22) Fig. 3-14, (p. 3-23)			
The measured values for active energy and reactive energy are transmitted via the communication interface after this time has elapsed.							
Note: This setting is hidden unless an IEC 870-5 protocol is enabled.							
COMM1: Contin. general scan						003 077	
Blocked	10	9000	s	Fig. 3-12, (p. 3-21) Fig. 3-13, (p. 3-22) Fig. 3-14, (p. 3-23)			
A continuous or background general scan means that the P433 transmits all settings, signals, and monitoring signals through the communication interface during slow periods when there is not much activity. This ensures that there will be data consistency with a connected control system. The time to be set defines the minimum time difference between two telegrams.							
Note: This setting is hidden unless an IEC 870-5 protocol is enabled.							

Parameter				Address
Default	Min	Max	Unit	Logic Diagram
COMM1: Comm. address length				003 201
1	1	2	Byte	Fig. 3-13, (p. 3-22)
Setting for the communication address length. Note: This setting is hidden unless the IEC 870-5-101 protocol is set.				
COMM1: Octet 2 comm. addr.				003 200
0	0	255		Fig. 3-13, (p. 3-22)
Setting for the length of the higher-order communication address. Note: This setting is hidden unless the IEC 870-5-101 protocol is set.				
COMM1: Cause transm. length				003 192
1: W/o source address				Fig. 3-13, (p. 3-22)
Setting for the length of the cause of transmission. Note: This setting is hidden unless the IEC 870-5-101 protocol is set.				
COMM1: Address length ASDU				003 193
1	1	2	Byte	Fig. 3-13, (p. 3-22)
Setting for the length of the common address for identification of telegram structures. Note: This setting is hidden unless the IEC 870-5-101 protocol is set. "ASDU": Application Service Data Unit				
COMM1: Octet 2 addr. ASDU				003 194
0	0	255		Fig. 3-13, (p. 3-22)
Setting for the length of the common higher-order address for identification of telegram structures. Note: This setting is hidden unless the IEC 870-5-101 protocol is set. "ASDU": Application Service Data Unit				
COMM1: Addr.length inf.obj.				003 196
2	2	3	Byte	Fig. 3-13, (p. 3-22)
Setting for the length of the address for information objects. Note: This setting is hidden unless the IEC 870-5-101 protocol is set.				
COMM1: Oct.3 addr. inf.obj.				003 197
0	0	255		Fig. 3-13, (p. 3-22)
Setting for the length of the higher-order address for information objects. Note: This setting is hidden unless the IEC 870-5-101 protocol is set.				
COMM1: Inf.No.<->funct.type				003 195
0: No				Fig. 3-13, (p. 3-22)
Setting specifying whether information numbers and function type shall be reversed in the object address. Note: This setting is hidden unless the IEC 870-5-101 protocol is set.				

Parameter					Address	
Default	Min	Max	Unit		Logic Diagram	
COMM1: Time tag length						003 198
3	3	7	Byte	Fig. 3-13, (p. 3-22)		
Setting for the time tag length.						
Note: This setting is hidden unless the IEC 870-5-101 protocol is set.						
COMM1: ASDU1 / ASDU20 conv.						003 190
1: Single signal					Fig. 3-13, (p. 3-22)	
Setting specifying whether telegram structure 1 or 20 shall be converted as a single signal or double signal.						
Note: This setting is hidden unless the IEC 870-5-101 protocol is set.						
"ASDU": Application Service Data Unit						
COMM1: ASDU2 conversion						003 191
1: Single signal					Fig. 3-13, (p. 3-22)	
Setting specifying whether telegram structure 2 shall be converted as a single signal or double signal.						
Note: This setting is hidden unless the IEC 870-5-101 protocol is set.						
"ASDU": Application Service Data Unit						
COMM1: Initializ. signal						003 199
1: Yes					Fig. 3-13, (p. 3-22)	
Setting specifying whether an initialization signal shall be issued.						
Note: This setting is hidden unless the IEC 870-5-101 protocol is set.						
COMM1: Balanced operation						003 226
0: No					Fig. 3-13, (p. 3-22)	
Setting that determines whether communication takes place on a balanced basis (full duplex operation).						
Note: This setting is hidden unless the IEC 870-5-101 protocol is set.						
COMM1: Direction bit						003 227
0	0	1		Fig. 3-13, (p. 3-22)		
Setting for the transmission direction. Normally this value will be set to '1' at the control center and to '0' at the substation.						
Note: This setting is hidden unless the IEC 870-5-101 protocol is enabled.						
COMM1: Time-out interval						003 228
0.40	0.10	2.55	s	Fig. 3-13, (p. 3-22)		
Setting for the maximum time that will elapse until the status signal for the acknowledgment command is issued.						
Note: This setting is hidden unless the IEC 870-5-101 protocol is set.						

Parameter	Address			
Default	Min	Max	Unit	Logic Diagram
COMM1: Reg.asg. selec. cmds				003 210
060 000: MAIN: Without function Fig. 3-15, (p. 3-24)				
MODBUS registers in the range 00301 to 00400 are assigned to the selected commands. Assignment is made in the order of selection. This means that the first command is given the register no. 00301, the second the register no. 00302, etc. Note: This setting is hidden unless the MODBUS protocol is enabled.				
COMM1: Reg.asg. selec. sig.				003 211
060 000: MAIN: Without function Fig. 3-15, (p. 3-24)				
MODBUS registers in the range 10301 to 10400 are assigned to the selected signals. Assignment is made in the order of selection. This means that the first signal is given the register no. 10301, the second the register no. 10302, etc. Note: This setting is hidden unless the MODBUS protocol is enabled.				
COMM1: Reg.asg. sel. m.val.				003 212
060 000: MAIN: Without function Fig. 3-15, (p. 3-24)				
MODBUS registers in the range 30301 to 30400 are assigned to the selected measured values. Assignment is made in the order of selection. This means that the first measured value is given the register no. 30301, the second the register no. 30302, etc. Note: This setting is hidden unless the MODBUS protocol is enabled.				
COMM1: Reg.asg. sel. param.				003 213
060 000: MAIN: Without function Fig. 3-15, (p. 3-24)				
MODBUS registers in the range 40301 to 40400 are assigned to the selected parameters. Assignment is made in the order of selection. This means that the first parameter is given the register no. 40301, the second the register no. 40302, etc. Note: This setting is hidden unless the MODBUS protocol is enabled.				
COMM1: Delta t (MODBUS)				003 152
5	1	120	s	Fig. 3-15, (p. 3-24)
All MODBUS registers are transmitted again through the communication interface after this time has elapsed. Note: This setting is hidden unless the MODBUS protocol is enabled.				
COMM1: Autom.event confirm.				003 249
0: Without Fig. 3-15, (p. 3-24)				
Setting specifying whether an event must be confirmed by the master in order for an event to be deleted from the 'event queue'. Note: This setting is hidden unless the MODBUS protocol is enabled.				

Parameter	Address			
Default	Min	Max	Unit	Logic Diagram
COMM1: Phys. Charact. Delay				003 241
0	0	254	Bit	Fig. 3-16, (p. 3-25)
Number of bits that must pass between the receipt of the 'request' and the start of sending the 'response'.				
Note: This setting is hidden unless the DNP 3.0 protocol is enabled.				
COMM1: Phys. Char. Timeout				003 242
40	0	254	Bit	Fig. 3-16, (p. 3-25)
Number of bits that may be missing from the telegram before receipt is terminated.				
Note: This setting is hidden unless the DNP 3.0 protocol is enabled.				
COMM1: Link Confirm. Mode				003 243
1: Multi-frame fragment				Fig. 3-16, (p. 3-25)
Setting for the acknowledgment mode of the link layer.				
Note: This setting is hidden unless the DNP 3.0 protocol is enabled.				
COMM1: Link Confirm.Timeout				003 244
0.10	0.05	2.54	s	Fig. 3-16, (p. 3-25)
Setting for the time period within which the master must acknowledge at the link layer.				
Note: This setting is hidden unless the DNP 3.0 protocol is enabled.				
COMM1: Link Max. Retries				003 245
2	1	10		Fig. 3-16, (p. 3-25)
Number of repetitions that are carried out on the link layer if errors have occurred during transmission (such as failure to acknowledge).				
Note: This setting is hidden unless the DNP 3.0 protocol is enabled.				
COMM1: Appl.Confirm.Timeout				003 246
5.0	0.5	25.4	s	Fig. 3-16, (p. 3-25)
Setting for the time period within which the master must acknowledge at the application layer.				
Note: This setting is hidden unless the DNP 3.0 protocol is enabled.				
COMM1: Appl. Need Time Del.				003 247
60	5	254	s	Fig. 3-16, (p. 3-25)
Time interval within which the slave requests time synchronization cyclically from the master.				
Note: This setting is hidden unless the DNP 3.0 protocol is enabled.				

Parameter	Address			
Default	Min	Max	Unit	Logic Diagram
COMM1: Ind./cl. bin. inputs				003 232
060 000: MAIN: Without function Fig. 3-16, (p. 3-25)				
Selection of data points and data classes for object 1 – binary inputs. Assignment of indices is made in the order of selection, beginning with 0. Note: This setting is hidden unless the DNP 3.0 protocol is enabled.				
COMM1: Ind./cl. bin.outputs				003 233
060 000: MAIN: Without function Fig. 3-16, (p. 3-25)				
Selection of data points and data classes for object 10 – binary outputs. Assignment of indices is made in the order of selection, beginning with 0. Note: This setting is hidden unless the DNP 3.0 protocol is enabled.				
COMM1: Ind./cl. bin. count.				003 234
060 000: MAIN: Without function Fig. 3-16, (p. 3-25)				
Selection of data points and data classes for object 20 – binary counters. Assignment of indexes is made in the order of selection, beginning with 0. Note: This setting is hidden unless the DNP 3.0 protocol is enabled.				
COMM1: Ind./cl. analog inp.				003 235
060 000: MAIN: Without function Fig. 3-16, (p. 3-25)				
Selection of data points and data classes for object 30 – analog inputs. Assignment of indices is made in the order of selection, beginning with 0. Note: This setting is hidden unless the DNP 3.0 protocol is enabled.				
COMM1: Ind./cl. analog outp				003 236
060 000: MAIN: Without function Fig. 3-16, (p. 3-25)				
Selection of data points and data classes for object 40 – analog outputs. Assignment of indices is made in the order of selection, beginning with 0. Note: This setting is hidden unless the DNP 3.0 protocol is enabled.				
COMM1: Delta meas.v. (DNP3)				003 250
16	0	255		Fig. 3-16, (p. 3-25)
Initialization value of threshold values for transmission of measured values in object 30. The threshold values can be changed separately by the master for each measured value by writing to object 34, 'analog input reporting deadband'. Note: This setting is hidden unless the DNP 3.0 protocol is enabled.				
COMM1: Delta t (DNP3)				003 248
5	1	120	s	Fig. 3-16, (p. 3-25)
Cycle time for updating DNP object 30 (analog inputs). Note: This setting is hidden unless the DNP 3.0 protocol is enabled.				

Parameter				Address
Default	Min	Max	Unit	Logic Diagram
COMM1: Command selection				103 042
060 000: MAIN: Without function			Fig. 3-17, (p. 3-26)	
Selection of commands to be issued via the COURIER protocol.				
Note: This setting is hidden unless the COURIER protocol is enabled.				
COMM1: Signal selection				103 043
060 000: MAIN: Without function			Fig. 3-17, (p. 3-26)	
Selection of signals to be transmitted via the COURIER protocol.				
Note: This setting is hidden unless the COURIER protocol is enabled.				
COMM1: Meas. val. selection				103 044
060 000: MAIN: Without function			Fig. 3-17, (p. 3-26)	
Selection of measured values to be transmitted via the Courier protocol.				
Note: This setting is hidden unless the Courier protocol is enabled.				
COMM1: Parameter selection				103 045
060 000: MAIN: Without function			Fig. 3-17, (p. 3-26)	
Selection of settings to be altered via the Courier protocol.				
Note: This setting is hidden unless the Courier protocol is enabled.				
COMM1: Delta t (COURIER)				103 046
5	1	120	s	Fig. 3-17, (p. 3-26)
Cycle time at the conclusion of which the selected measured values are again transmitted.				
Note: This setting is hidden unless the COURIER protocol is enabled.				

“Logical”
communication
interface 2

Parameter				Address
Default	Min	Max	Unit	Logic Diagram
COMM2: Function group COMM2				056 057
0: Without				
Cancelling function group COMM2 or including it in the configuration. If the function group is cancelled from the configuration, then all associated settings and signals are hidden, with the exception of this setting.				
COMM2: General enable USER				103 170
0: No Fig. 3-19, (p. 3-29)				
Disabling or enabling communication interface 2.				
COMM2: Line idle state				103 165
1: Light on / high Fig. 3-19, (p. 3-29)				
Setting for the line idle state indication.				
COMM2: Baud rate				103 071
19.2: 19.2 kBaud				Baud Fig. 3-19, (p. 3-29)
Baud rate of the communication interface.				
COMM2: Parity bit				103 171
2: Even Fig. 3-19, (p. 3-29)				
Set the same parity that is set at the interface of the control system connected to the P433.				
COMM2: Dead time monitoring				103 176
1: Yes Fig. 3-19, (p. 3-29)				
The P433 monitors telegram transmission to make sure that no excessive pause occurs within a telegram. This monitoring function can be disabled if it is not required.				
Note: This setting is only necessary for modem transmission.				
COMM2: Mon. time polling				103 202
25	3	254	s	Fig. 3-19, (p. 3-29)
The time between two polling calls from the communication master must be less than the time set here.				
COMM2: Positive ackn. fault				103 203
0: No				
It is possible to set whether or not faults can be acknowledged positively after transmission (and consequently deleted from the fault overview at the COMM2/PC interface).				

Parameter					Address
Default	Min	Max	Unit		Logic Diagram
COMM2: Octet comm. address					103 072
1	0	254		Fig. 3-19, (p. 3-29)	
The communication address and the ASDU address are used to identify the device in communication via the interface. An identical setting must be selected for both addresses. "ASDU": Application Service Data Unit					
COMM2: Name of manufacturer					103 161
1: SE					Fig. 3-19, (p. 3-29)
Setting for the name of the manufacturer. Note: This setting can be changed to ensure compatibility.					
COMM2: Octet address ASDU					103 073
1	0	255		Fig. 3-19, (p. 3-29)	
The communication address and the ASDU address are used to identify the device in communication via the interface. An identical setting must be selected for both addresses. "ASDU": Application Service Data Unit					
COMM2: Spontan. sig. enable					103 177
0: None					Fig. 3-19, (p. 3-29)
Enable for the transmission of spontaneous signals via the communication interface.					
COMM2: Select. spontan.sig.					103 179
060 000: MAIN: Without function					Fig. 3-19, (p. 3-29)
Selection of spontaneous signals for transmission via communication interface 2.					
COMM2: Transm.enab.cycl.dat					103 074
0: Without					Fig. 3-19, (p. 3-29)
Enable for the cyclic transmission of measured values via the communication interface.					
COMM2: Cycl. data ILS tel.					103 175
060 000: MAIN: Without function					Fig. 3-19, (p. 3-29)
Selection of the measured values transmitted in a user-defined telegram via the communication interface.					
COMM2: Delta V					103 050
3.0	0.0	15.0	%Vnom	Fig. 3-19, (p. 3-29)	
A measured voltage value is transmitted via the communication interface if it differs by the set delta quantity from the last measured value transmitted.					

Parameter				Address			
Default	Min	Max	Unit	Logic Diagram			
COMM2: Delta I							103 051
3.0	0.0	15.0	%Inom	Fig. 3-19, (p. 3-29)			
A measured current value is transmitted via the communication interface if it differs by the set delta quantity from the last measured value transmitted.							
COMM2: Delta P							103 054
15.0	0.0	15.0	%Snom	Fig. 3-19, (p. 3-29)			
The active power value is transmitted via the communication interface if it differs by the set delta quantity from the last measured value transmitted.							
COMM2: Delta f							103 052
2.0	0.0	2.0	%fnom	Fig. 3-19, (p. 3-29)			
The measured frequency value is transmitted via the communication interface if it differs by the set delta quantity from the last measured value transmitted.							
COMM2: Delta meas.v.ILS tel							103 150
3.0	0.0	15.0		Fig. 3-19, (p. 3-29)			
The telegram is transmitted if a measured value differs by the set delta quantity from the last measured value transmitted.							
COMM2: Delta t							103 053
1	0	15	min	Fig. 3-19, (p. 3-29)			
All measured values are transmitted again via the communication interface after this time period has elapsed – provided that transmission has not been triggered by the other delta conditions.							

InterMiCOM
interface

Parameter	Address			
Default	Min	Max	Unit	Logic Diagram
COMM3: Function group COMM3				056 058
0: Without				
Cancelling function group COMM3 or including it in the configuration. This setting parameter is only visible if the relevant optional communication module is fitted. If the function group is cancelled from the configuration, then all associated settings and signals are hidden, with the exception of this setting.				
COMM3: General enable USER				120 030
0: No				
Disabling or enabling communication interface 3.				
COMM3: Baud rate				120 038
9600: 9600 baud			Baud	
Adjustment of the baud rate for telegram transmission via the guidance interface (InterMiCOM interface) so as to meet the requirements of the transmission carrier.				
COMM3: Source address				120 031
1: 1				
Address for send signals.				
COMM3: Receiving address				120 032
2: 2				
Address for receive signals.				
COMM3: Fct. assignm. send 1				121 001
060 000: MAIN: Without function				
COMM3: Fct. assignm. send 2				121 003
060 000: MAIN: Without function				
COMM3: Fct. assignm. send 3				121 005
060 000: MAIN: Without function				
COMM3: Fct. assignm. send 4				121 007
060 000: MAIN: Without function				
COMM3: Fct. assignm. send 5				121 009
060 000: MAIN: Without function				
COMM3: Fct. assignm. send 6				121 011
060 000: MAIN: Without function				
COMM3: Fct. assignm. send 7				121 013
060 000: MAIN: Without function				

Parameter				Address
Default	Min	Max	Unit	Logic Diagram
COMM3: Fct. assignm. send 8				121 015
060 000: MAIN: Without function				
Assignment of functions for the 8 send signals.				
COMM3: Fct. assignm. rec. 1				120 001
061 000: MAIN: Without function				
COMM3: Fct. assignm. rec. 2				120 004
061 000: MAIN: Without function				
COMM3: Fct. assignm. rec. 3				120 007
061 000: MAIN: Without function				
COMM3: Fct. assignm. rec. 4				120 010
061 000: MAIN: Without function				
COMM3: Fct. assignm. rec. 5				120 013
061 000: MAIN: Without function				
COMM3: Fct. assignm. rec. 6				120 016
061 000: MAIN: Without function				
COMM3: Fct. assignm. rec. 7				120 019
061 000: MAIN: Without function				
COMM3: Fct. assignm. rec. 8				120 022
061 000: MAIN: Without function				
Configuration (assignment of functions) for the 8 receive signals				
COMM3: Oper. mode receive 1				120 002
1: Direct intertrip				
COMM3: Oper. mode receive 2				120 005
1: Direct intertrip				
COMM3: Oper. mode receive 3				120 008
1: Direct intertrip				
COMM3: Oper. mode receive 4				120 011
1: Direct intertrip				
Selection of <i>Blocking</i> or <i>Direct intertrip</i> for the operating mode of receive signals 1 to 4 (single-pole transmission).				
COMM3: Oper. mode receive 5				120 014
1: Direct intertrip				
COMM3: Oper. mode receive 6				120 017
1: Direct intertrip				
COMM3: Oper. mode receive 7				120 020
1: Direct intertrip				

Parameter	Address			
Default	Min	Max	Unit	Logic Diagram
COMM3: Oper. mode receive 8				120 023
1: Direct intertrip				
Selection of <i>Permissive</i> or <i>Direct intertrip</i> for the operating mode of receive signals 5 to 8 (two-pole transmission).				
COMM3: Default value rec. 1				120 060
0: 0				
COMM3: Default value rec. 2				120 061
0: 0				
COMM3: Default value rec. 3				120 062
0: 0				
COMM3: Default value rec. 4				120 063
0: 0				
COMM3: Default value rec. 5				120 064
0: 0				
COMM3: Default value rec. 6				120 065
0: 0				
COMM3: Default value rec. 7				120 066
0: 0				
COMM3: Default value rec. 8				120 067
0: 0				
Definition of the default value for the 8 receive signals.				
COMM3: Time-out comm.fault				120 033
50	10	60000	ms	
This timer triggers the alarm signals COMM3: Communications fault and SFMON: Communic.fault COMM3 the received signals to their user-defined default values. Time-out occurs when the set time has elapsed since the most recent 100% valid telegram was received.				
COMM3: Sig.asg. comm.fault				120 034
0: None Fig. 3-261, (p. 3-330)				
Using this setting, the alarm signal can be configured (assigned) to the corresponding PSIG input signal.				
COMM3: Time-out link fail.				120 035
5	0	600	s	
Time indicating a persistent failure of the transmission channel. After this timer stage has elapsed, alarm signals COMM3: Comm. link failure and SFMON: Comm.link fail.COMM3 are raised. These can be mapped to give the operator a warning LED or contact to indicate that maintenance attention is required.				

Parameter				Address
Default	Min	Max	Unit	Logic Diagram
COMM3: Limit telegr. errors				120 036
Blocked	1	100	%	
Percentage of corrupted messages compared to total messages transmitted before an alarm is raised (COMM3: Lim.exceed., tel.err. and SFMON: Lim.exc.tel.er.COMM3). When this threshold is exceeded, the receive signals are set to their user-defined default values.				

IRIG-B interface

Parameter				Address
Default	Min	Max	Unit	Logic Diagram
IRIGB: Function group IRIGB				056 072
0: Without				
Cancelling function group IRIGB or including it in the configuration. If the function group is cancelled from the configuration, then all associated settings and signals are hidden.				
IRIGB: General enable USER				023 200
0: No				Fig. 3-31, (p. 3-59)
Disabling or enabling the IRIG-B interface.				

IEC 61850
Communication

Parameter	Address			
Default	Min	Max	Unit	Logic Diagram
IEC: Function group IEC				056 059
0: Without				
Cancelling function group IEC or including it in the configuration. If the function group is cancelled from the configuration, then all associated settings and signals are hidden.				
Important notice: Some of the parameters in function group IEC are set with the IEC 61850 configuration tool "IED Configurator", they cannot be modified from the local control panel (HMI) or with the operating program, and therefore these parameters are listed separately.				
IEC: General enable USER				104 000
0: No Fig. 3-25, (p. 3-51)				
Enabling and disabling function group IEC.				
IEC: IEC 61850 enable				104 077
0: No Fig. 3-25, (p. 3-51)				
Disabling or enabling IEC 61850.				
IEC: IEC60870-5-104 enable				104 078
0: No Fig. 3-25, (p. 3-51)				
Disabling or enabling IEC 60870-5-104.				
IEC: RSTP enable				105 182
0: No				
Enabling relevant settings for the RSTP protocol.				
IEC: ETH COMM Mode				104 080
1: PRP Fig. 3-25, (p. 3-51)				
Selection of the redundant Ethernet protocol between <i>PRP</i> , <i>HSR</i> and <i>RSTP</i> .				
IEC: IEC prot. variant				104 084
060 000: MAIN: Without function Fig. 3-25, (p. 3-51)				
Selection of the enabled Ethernet protocol.				
IEC: Block Port A/B				104 073
0: No Fig. 3-25, (p. 3-51)				
When Port A/B blocked is activated, Port A for SEB or Port A&B for REB will be disabled.				
IEC: Block Port C				104 074
0: No Fig. 3-25, (p. 3-51)				
When Port C blocked is activated, Port C will be disabled.				

Parameter				Address
Default	Min	Max	Unit	Logic Diagram
IEC: Switch Config. Bank				104 043
0: don't execute				Fig. 3-25, (p. 3-51)
This parameter can only be sent individually. Accepting the previously set communication parameters as the active communication settings.				
IEC: Active Config. Name				104 045
2:				
Name of the configuration bank currently valid. Setting is carried out with the IED Configurator.				
IEC: Active Config. Vers.				104 046
2:				
Version number of the configuration bank currently valid. Setting is carried out with the IED Configurator.				
IEC: Inact. Config. Name				104 047
2:				
Name of the inactive configuration bank. Setting is carried out with the IED Configurator.				
IEC: Inact. Config. Vers.				104 048
2:				
Version number of the inactive configuration bank. Setting is carried out with the IED Configurator.				
IEC: IED name				104 057
2:				
Explicitly assigned unit name for the function in the system (IED); is part of the Logical Device Name. Setting is carried out with the IED Configurator. Important note: According to the IEC standard the name must consist of only letters (A..Z, a..z), digits (0..9) and underscore characters (_), and neither a digit nor the underscore character must be the first character. Note that a non-standard name causes problems with the IEC 61850 communication.				
IEC: IP address				104 001
2:				
Assigned IP address of the device for the server function in the system. Note: This is an information parameter ('read only') and its value is set from the "IED Configurator" with <i>Communications: IP Address</i> .				

Parameter				Address	
Default	Min	Max	Unit	Logic Diagram	
IEC: Subnet mask				104 005	
2:					
The subnet mask defines which part of the IP address is addressed by the sub-network and which part by the device that is logged-on to the network. Note: This is an information parameter ('read only') and its value is set from the "IED Configurator" with <i>Communications: SubNet Mask</i>.					
IEC: Gateway address				104 011	
2:					
This parameter shows the IPv4 address of the network gateway for communication links to clients outside of the local network. Note: This is an information parameter ('read only') and its value is set from the "IED Configurator" with <i>Communications: Gateway Address</i>.					
IEC: IP address 2				104 070	
2:					
Assigned IP address 2 of the device for the server function in the system. Note: This is an information parameter ('read only') and its value is set from the "IED Configurator" with <i>Communications: IP Address Interface 2 (If fitted)</i>.					
IEC: Subnet mask 2				104 071	
2:					
The subnet mask 2 defines which part of the IP address 2 is addressed by the sub-network and which part by the device that is logged-on to the network. Note: This is an information parameter ('read only') and its value is set from the "IED Configurator" with <i>Communications: SubNet Mask Interface 2 (If fitted)</i>.					
IEC: Gateway address 2				104 072	
2:					
This parameter shows the IPv4 address of the network gateway 2 for communication links to clients outside of the local network. Note: This is an information parameter ('read only') and its value is set from the "IED Configurator" with <i>Communications: Gateway Address Interface 2 (If fitted)</i>.					
IEC: IP address VLAN 1				104 091	
2:					
IEC: IP address VLAN 2				104 095	
2:					
Assigned IP address of VLAN in the system. Note: This is an information parameter ('read only') and its value is set from the "IED Configurator" with <i>Communications: IP Address</i>.					
IEC: Identifier VLAN 1				104 092	
0	0	65535			

Parameter				Address	
Default	Min	Max	Unit	Logic Diagram	
IEC: Identifier VLAN 2					104 096
0	0	65535			
Assigned VLAN ID in the system. Note: This is an information parameter ('read only') and its value is set from the "IED Configurator" with Communications: Vlan ID.					
IEC: Subnet mask VLAN 1					104 093
2:					
IEC: Subnet mask VLAN 2					104 097
2:					
The subnet mask of VLAN defines which part of the IP address is addressed by the sub-network and which part by the device that is logged-on to the network. Note: This is an information parameter ('read only') and its value is set from the "IED Configurator" with Communications: VLAN Subnet Mask.					
IEC: Gateway address VL 1					104 094
2:					
IEC: Gateway address VL 2					104 098
2:					
This parameter shows the network gateway of the VLAN for communication links to clients outside of the local network. Note: This is an information parameter ('read only') and its value is set from the "IED Configurator" with Communications: Gateway Address.					
IEC: SNTP server 1 IP					104 202
2:					
IP address of the preferred server used for clock synchronization. Note: This is an information parameter ('read only') and its value is set from the "IED Configurator".					
IEC: SNTP server 2 IP					104 210
2:					
IP address of the backup server used for clock synchronization. Note: This is an information parameter ('read only') and its value is set from the "IED Configurator".					
IEC: MAC address 1					104 061
2:					
MAC address for the network hardware of the Ethernet module. This address is introduced during manufacture and can only be read.					

Parameter				Address	
Default	Min	Max	Unit	Logic Diagram	
IEC: MAC address 2					104 217
2:					
Mac address for Interface 2.					
Note: This is an information parameter ('read only').					
IEC: MAC address 3					104 218
2:					
Mac address for NIOS (HSR / PRP only).					
Note: This is an information parameter ('read only').					
IEC: SGCB ResvTms					104 199
30	0	600			
The configuration attribute ResvTms defines the time interval in seconds for which the reservation of a SGCB is granted by a client. A reservation of a SGCB starts after a successful selection of a Setting Group using the service SelectEditSG. The client is granted to edit one or multiple parameters of this SGCB if this time has not elapsed.					
IEC: SigGGIO1 selection					104 064
060 000: MAIN: Without function			Fig. 3-25, (p. 3-51)		
Optional signal assignment for a transmission per communication protocol IEC 61850 based on the selection table of the binary inputs (opto coupler inputs).					
IEC: RSTP priority					105 183
32768: 32768					
Setting for port priority in the spanning tree.					
IEC: RSTP max age					105 184
20	6	40	s		
Setting for maximum age of the information transmitted by the Bridge when it is the Root Bridge.					
IEC: RSTP forward delay					105 185
15	4	30	s		
Setting for time delay used by Bridges to transition Root and Designated Ports to Forwarding.					
IEC: RSTP hello time					105 186
2	1	2	s		
Setting for time interval between periodic transmissions of BPDU message.					
IEC: RSTP configuration					105 187
0: don't execute					
Send the RSTP configuration parameters to the communication module. The communication module reboots after setting the values.					

Parameter	Address			
Default	Min	Max	Unit	Logic Diagram
IEC: Diff. local time				104 206
0	-1440	1440	min	Fig. 3-25, (p. 3-51)
Time difference between UTC and local time at the devices' substation (IED).				
IEC: Diff. dayl.sav. time				104 207
60	-1440	1440	min	Fig. 3-25, (p. 3-51)
Time difference of the daylight saving time to standard time.				
IEC: Switch.dayl.sav.time				104 219
1: Yes				Fig. 3-25, (p. 3-51)
This setting defines whether an automatic switching to daylight saving time is wanted. If it is wanted, the time switching is executed upon receiving a related SNTP frame.				
IEC: Dayl.sav.time start				104 220
5: Last				Fig. 3-25, (p. 3-51)
IEC: Dayl.sav.time st. d				104 221
7: Sunday				Fig. 3-25, (p. 3-51)
IEC: Dayl.sav.time st. m				104 222
3: March				Fig. 3-25, (p. 3-51)
These three parameters define the date (e.g. at what day of the year) for switching from standard time over to daylight saving time. Available for IEC: Dayl.sav.time start are the values <i>First</i> , <i>Second</i> , <i>Third</i> , <i>Fourth</i> , and <i>Last</i> . For IEC: Dayl.sav.time st. d the seven weekdays are available so that for example a setting like "on the last Sunday in March" may be used.				
IEC: Dayl.sav.t.st.0:00 +				104 223
120	0	1440	min	Fig. 3-25, (p. 3-51)
Time period in minutes after midnight when daylight saving time is switched to standard time. If for example the clock is advanced one hour from 2:00 AM to 3:00 AM the parameter IEC: Dayl.sav.t.st.0:00 + is set to 120 (minutes).				
IEC: Dayl.sav.time end				104 225
5: Last				Fig. 3-25, (p. 3-51)
IEC: Dayl.sav.time end d				104 226
7: Sunday				Fig. 3-25, (p. 3-51)
IEC: Dayl.sav.time end m				104 227
10: October				Fig. 3-25, (p. 3-51)
IEC: Dayl.sav.t.end 0:00+				104 228
180	0	1440	min	Fig. 3-25, (p. 3-51)
This parameter defines the date and time of day for the clock changeover from daylight saving time to standard time. The setting is similar to that for the clock changeover to daylight saving time.				

Generic Object
Orientated
Substation Events

Parameter				Address
Default	Min	Max	Unit	Logic Diagram
GOOSE: Function group GOOSE				056 068
0: Without				
Cancelling function group GOOSE or including it in the configuration. If the function group is cancelled from the configuration, then all associated settings and signals are hidden. Parameters included in this function group are only effective when function group IEC is configured and enabled and when the parameters in this function group have been activated by setting the parameter IEC: Switch Config. Bank.				
GOOSE: General enable USER				106 001
0: No				
Enabling and disabling function group GOOSE.				
GOOSE: Output 1 fct.assig.				106 011
060 000: MAIN: Without function				
GOOSE: Output 2 fct.assig.				106 013
060 000: MAIN: Without function				
GOOSE: Output 3 fct.assig.				106 015
060 000: MAIN: Without function				
GOOSE: Output 4 fct.assig.				106 017
060 000: MAIN: Without function				
GOOSE: Output 5 fct.assig.				106 019
060 000: MAIN: Without function				
GOOSE: Output 6 fct.assig.				106 021
060 000: MAIN: Without function				
GOOSE: Output 7 fct.assig.				106 023
060 000: MAIN: Without function				
GOOSE: Output 8 fct.assig.				106 025
060 000: MAIN: Without function				
GOOSE: Output 9 fct.assig.				106 027
060 000: MAIN: Without function				
GOOSE: Output 10 fct.assig.				106 029
060 000: MAIN: Without function				
GOOSE: Output 11 fct.assig.				106 031
060 000: MAIN: Without function				
GOOSE: Output 12 fct.assig.				106 033
060 000: MAIN: Without function				

Parameter				Address
Default	Min	Max	Unit	Logic Diagram
GOOSE: Output 13 fct.assig.				106 035
060 000: MAIN: Without function				
GOOSE: Output 14 fct.assig.				106 037
060 000: MAIN: Without function				
GOOSE: Output 15 fct.assig.				106 039
060 000: MAIN: Without function				
GOOSE: Output 16 fct.assig.				106 041
060 000: MAIN: Without function				
GOOSE: Output 17 fct.assig.				106 043
060 000: MAIN: Without function				
GOOSE: Output 18 fct.assig.				106 045
060 000: MAIN: Without function				
GOOSE: Output 19 fct.assig.				106 047
060 000: MAIN: Without function				
GOOSE: Output 20 fct.assig.				106 049
060 000: MAIN: Without function				
GOOSE: Output 21 fct.assig.				106 051
060 000: MAIN: Without function				
GOOSE: Output 22 fct.assig.				106 053
060 000: MAIN: Without function				
GOOSE: Output 23 fct.assig.				106 055
060 000: MAIN: Without function				
GOOSE: Output 24 fct.assig.				106 057
060 000: MAIN: Without function				
GOOSE: Output 25 fct.assig.				106 059
060 000: MAIN: Without function				
GOOSE: Output 26 fct.assig.				106 061
060 000: MAIN: Without function				
GOOSE: Output 27 fct.assig.				106 063
060 000: MAIN: Without function				
GOOSE: Output 28 fct.assig.				106 065
060 000: MAIN: Without function				
GOOSE: Output 29 fct.assig.				106 067
060 000: MAIN: Without function				
GOOSE: Output 30 fct.assig.				106 069
060 000: MAIN: Without function				
GOOSE: Output 31 fct.assig.				106 071
060 000: MAIN: Without function				

Parameter				Address
Default	Min	Max	Unit	Logic Diagram
GOOSE: Output 32 fct.assig.				106 073
060 000: MAIN: Without function				
Function assignment of a binary logical state signal to the virtual GOOSE outputs. Signals configured here can be included as GosGGIO2.ST.ind1, GosGGIO2.ST.ind2, ... in the datasets.				
GOOSE: Input 1 fct.assig.				107 006
061 000: MAIN: Without function				
GOOSE: Input 2 fct.assig.				107 016
061 000: MAIN: Without function				
GOOSE: Input 3 fct.assig.				107 026
061 000: MAIN: Without function				
GOOSE: Input 4 fct.assig.				107 036
061 000: MAIN: Without function				
GOOSE: Input 5 fct.assig.				107 046
061 000: MAIN: Without function				
GOOSE: Input 6 fct.assig.				107 056
061 000: MAIN: Without function				
GOOSE: Input 7 fct.assig.				107 066
061 000: MAIN: Without function				
GOOSE: Input 8 fct.assig.				107 076
061 000: MAIN: Without function				
GOOSE: Input 9 fct.assig.				107 086
061 000: MAIN: Without function				
GOOSE: Input 10 fct.assig.				107 096
061 000: MAIN: Without function				
GOOSE: Input 11 fct.assig.				107 106
061 000: MAIN: Without function				
GOOSE: Input 12 fct.assig.				107 116
061 000: MAIN: Without function				
GOOSE: Input 13 fct.assig.				107 126
061 000: MAIN: Without function				
GOOSE: Input 14 fct.assig.				107 136
061 000: MAIN: Without function				
GOOSE: Input 15 fct.assig.				107 146
061 000: MAIN: Without function				
GOOSE: Input 16 fct.assig.				107 156
061 000: MAIN: Without function				

Parameter				Address
Default	Min	Max	Unit	Logic Diagram
GOOSE: Input 17 fct.assig.				107 157
061 000: MAIN: Without function				
GOOSE: Input 18 fct.assig.				107 158
061 000: MAIN: Without function				
GOOSE: Input 19 fct.assig.				107 159
061 000: MAIN: Without function				
GOOSE: Input 20 fct.assig.				107 160
061 000: MAIN: Without function				
GOOSE: Input 21 fct.assig.				107 161
061 000: MAIN: Without function				
GOOSE: Input 22 fct.assig.				107 162
061 000: MAIN: Without function				
GOOSE: Input 23 fct.assig.				107 163
061 000: MAIN: Without function				
GOOSE: Input 24 fct.assig.				107 164
061 000: MAIN: Without function				
GOOSE: Input 25 fct.assig.				107 165
061 000: MAIN: Without function				
GOOSE: Input 26 fct.assig.				107 166
061 000: MAIN: Without function				
GOOSE: Input 27 fct.assig.				107 167
061 000: MAIN: Without function				
GOOSE: Input 28 fct.assig.				107 168
061 000: MAIN: Without function				
GOOSE: Input 29 fct.assig.				107 169
061 000: MAIN: Without function				
GOOSE: Input 30 fct.assig.				107 170
061 000: MAIN: Without function				
GOOSE: Input 31 fct.assig.				107 171
061 000: MAIN: Without function				
GOOSE: Input 32 fct.assig.				107 172
061 000: MAIN: Without function				
GOOSE: Input 33 fct.assig.				112 000
061 000: MAIN: Without function				
GOOSE: Input 34 fct.assig.				112 001
061 000: MAIN: Without function				
GOOSE: Input 35 fct.assig.				112 002
061 000: MAIN: Without function				

Parameter				Address
Default	Min	Max	Unit	Logic Diagram
GOOSE: Input 36 fct.assig.				112 003
061 000: MAIN: Without function				
GOOSE: Input 37 fct.assig.				112 004
061 000: MAIN: Without function				
GOOSE: Input 38 fct.assig.				112 005
061 000: MAIN: Without function				
GOOSE: Input 39 fct.assig.				112 006
061 000: MAIN: Without function				
GOOSE: Input 40 fct.assig.				112 007
061 000: MAIN: Without function				
GOOSE: Input 41 fct.assig.				112 008
061 000: MAIN: Without function				
GOOSE: Input 42 fct.assig.				112 009
061 000: MAIN: Without function				
GOOSE: Input 43 fct.assig.				112 010
061 000: MAIN: Without function				
GOOSE: Input 44 fct.assig.				112 011
061 000: MAIN: Without function				
GOOSE: Input 45 fct.assig.				112 012
061 000: MAIN: Without function				
GOOSE: Input 46 fct.assig.				112 013
061 000: MAIN: Without function				
GOOSE: Input 47 fct.assig.				112 014
061 000: MAIN: Without function				
GOOSE: Input 48 fct.assig.				112 015
061 000: MAIN: Without function				
GOOSE: Input 49 fct.assig.				112 016
061 000: MAIN: Without function				
GOOSE: Input 50 fct.assig.				112 017
061 000: MAIN: Without function				
GOOSE: Input 51 fct.assig.				112 018
061 000: MAIN: Without function				
GOOSE: Input 52 fct.assig.				112 019
061 000: MAIN: Without function				
GOOSE: Input 53 fct.assig.				112 020
061 000: MAIN: Without function				
GOOSE: Input 54 fct.assig.				112 021
061 000: MAIN: Without function				

Parameter				Address
Default	Min	Max	Unit	Logic Diagram
GOOSE: Input 55 fct.assig.				112 022
061 000: MAIN: Without function				
GOOSE: Input 56 fct.assig.				112 023
061 000: MAIN: Without function				
GOOSE: Input 57 fct.assig.				112 024
061 000: MAIN: Without function				
GOOSE: Input 58 fct.assig.				112 025
061 000: MAIN: Without function				
GOOSE: Input 59 fct.assig.				112 026
061 000: MAIN: Without function				
GOOSE: Input 60 fct.assig.				112 027
061 000: MAIN: Without function				
GOOSE: Input 61 fct.assig.				112 028
061 000: MAIN: Without function				
GOOSE: Input 62 fct.assig.				112 029
061 000: MAIN: Without function				
GOOSE: Input 63 fct.assig.				112 030
061 000: MAIN: Without function				
GOOSE: Input 64 fct.assig.				112 031
061 000: MAIN: Without function				
GOOSE: Input 65 fct.assig.				112 032
061 000: MAIN: Without function				
GOOSE: Input 66 fct.assig.				112 033
061 000: MAIN: Without function				
GOOSE: Input 67 fct.assig.				112 034
061 000: MAIN: Without function				
GOOSE: Input 68 fct.assig.				112 035
061 000: MAIN: Without function				
GOOSE: Input 69 fct.assig.				112 036
061 000: MAIN: Without function				
GOOSE: Input 70 fct.assig.				112 037
061 000: MAIN: Without function				
GOOSE: Input 71 fct.assig.				112 038
061 000: MAIN: Without function				
GOOSE: Input 72 fct.assig.				112 039
061 000: MAIN: Without function				
GOOSE: Input 73 fct.assig.				112 040
061 000: MAIN: Without function				

Parameter					Address
Default	Min	Max	Unit		Logic Diagram
GOOSE: Input 74 fct.assig.					112 041
061 000: MAIN: Without function					
GOOSE: Input 75 fct.assig.					112 042
061 000: MAIN: Without function					
GOOSE: Input 76 fct.assig.					112 043
061 000: MAIN: Without function					
GOOSE: Input 77 fct.assig.					112 044
061 000: MAIN: Without function					
GOOSE: Input 78 fct.assig.					112 045
061 000: MAIN: Without function					
GOOSE: Input 79 fct.assig.					112 046
061 000: MAIN: Without function					
GOOSE: Input 80 fct.assig.					112 047
061 000: MAIN: Without function					
GOOSE: Input 81 fct.assig.					112 048
061 000: MAIN: Without function					
GOOSE: Input 82 fct.assig.					112 049
061 000: MAIN: Without function					
GOOSE: Input 83 fct.assig.					112 050
061 000: MAIN: Without function					
GOOSE: Input 84 fct.assig.					112 051
061 000: MAIN: Without function					
GOOSE: Input 85 fct.assig.					112 052
061 000: MAIN: Without function					
GOOSE: Input 86 fct.assig.					112 053
061 000: MAIN: Without function					
GOOSE: Input 87 fct.assig.					112 054
061 000: MAIN: Without function					
GOOSE: Input 88 fct.assig.					112 055
061 000: MAIN: Without function					
GOOSE: Input 89 fct.assig.					112 056
061 000: MAIN: Without function					
GOOSE: Input 90 fct.assig.					112 057
061 000: MAIN: Without function					
GOOSE: Input 91 fct.assig.					112 058
061 000: MAIN: Without function					
GOOSE: Input 92 fct.assig.					112 059
061 000: MAIN: Without function					

Parameter				Address
Default	Min	Max	Unit	Logic Diagram
GOOSE: Input 93 fct.assig.				112 060
061 000: MAIN: Without function				
GOOSE: Input 94 fct.assig.				112 061
061 000: MAIN: Without function				
GOOSE: Input 95 fct.assig.				112 062
061 000: MAIN: Without function				
GOOSE: Input 96 fct.assig.				112 063
061 000: MAIN: Without function				
GOOSE: Input 97 fct.assig.				112 064
061 000: MAIN: Without function				
GOOSE: Input 98 fct.assig.				112 065
061 000: MAIN: Without function				
GOOSE: Input 99 fct.assig.				112 066
061 000: MAIN: Without function				
GOOSE: Input 100 fct.assig.				112 067
061 000: MAIN: Without function				
GOOSE: Input 101 fct.assig.				112 068
061 000: MAIN: Without function				
GOOSE: Input 102 fct.assig.				112 069
061 000: MAIN: Without function				
GOOSE: Input 103 fct.assig.				112 070
061 000: MAIN: Without function				
GOOSE: Input 104 fct.assig.				112 071
061 000: MAIN: Without function				
GOOSE: Input 105 fct.assig.				112 072
061 000: MAIN: Without function				
GOOSE: Input 106 fct.assig.				112 073
061 000: MAIN: Without function				
GOOSE: Input 107 fct.assig.				112 074
061 000: MAIN: Without function				
GOOSE: Input 108 fct.assig.				112 075
061 000: MAIN: Without function				
GOOSE: Input 109 fct.assig.				112 076
061 000: MAIN: Without function				
GOOSE: Input 110 fct.assig.				112 077
061 000: MAIN: Without function				
GOOSE: Input 111 fct.assig.				112 078
061 000: MAIN: Without function				

Parameter				Address
Default	Min	Max	Unit	Logic Diagram
GOOSE: Input 112 fct.assig.				112 079
061 000: MAIN: Without function				
GOOSE: Input 113 fct.assig.				112 080
061 000: MAIN: Without function				
GOOSE: Input 114 fct.assig.				112 081
061 000: MAIN: Without function				
GOOSE: Input 115 fct.assig.				112 082
061 000: MAIN: Without function				
GOOSE: Input 116 fct.assig.				112 083
061 000: MAIN: Without function				
GOOSE: Input 117 fct.assig.				112 084
061 000: MAIN: Without function				
GOOSE: Input 118 fct.assig.				112 085
061 000: MAIN: Without function				
GOOSE: Input 119 fct.assig.				112 086
061 000: MAIN: Without function				
GOOSE: Input 120 fct.assig.				112 087
061 000: MAIN: Without function				
GOOSE: Input 121 fct.assig.				112 088
061 000: MAIN: Without function				
GOOSE: Input 122 fct.assig.				112 089
061 000: MAIN: Without function				
GOOSE: Input 123 fct.assig.				112 090
061 000: MAIN: Without function				
GOOSE: Input 124 fct.assig.				112 091
061 000: MAIN: Without function				
GOOSE: Input 125 fct.assig.				112 092
061 000: MAIN: Without function				
GOOSE: Input 126 fct.assig.				112 093
061 000: MAIN: Without function				
GOOSE: Input 127 fct.assig.				112 094
061 000: MAIN: Without function				
GOOSE: Input 128 fct.assig.				112 095
061 000: MAIN: Without function				
Function assignment of the virtual binary GOOSE inputs (GosGGIO1/Pos1.stVal, GosGGIO1/Pos2.stVal, ...) to a binary logical state signal on the device so that they can be processed further by the protection, control or logic functions. Signals configured here contain the received and pre-processed state of data attributes configured for GOOSE receipt.				

Virtual Inputs

Parameter	Address			
Default	Min	Max	Unit	Logic Diagram
VINP: Function group VINP				056 098
0: Without				
Cancelling function group VINP or including it in the configuration. If the function group is cancelled from the configuration, then all associated settings and signals are hidden.				
VINP: General enable USER				115 000
0: No				
Disabling or enabling VINP function.				
VINP: Input 1 fct.assig.				115 150
061 000: MAIN: Without function				
VINP: Input 2 fct.assig.				115 151
061 000: MAIN: Without function				
VINP: Input 3 fct.assig.				115 152
061 000: MAIN: Without function				
VINP: Input 4 fct.assig.				115 153
061 000: MAIN: Without function				
VINP: Input 5 fct.assig.				115 154
061 000: MAIN: Without function				
VINP: Input 6 fct.assig.				115 155
061 000: MAIN: Without function				
VINP: Input 7 fct.assig.				115 156
061 000: MAIN: Without function				
VINP: Input 8 fct.assig.				115 157
061 000: MAIN: Without function				
VINP: Input 9 fct.assig.				115 158
061 000: MAIN: Without function				
VINP: Input 10 fct.assig.				115 159
061 000: MAIN: Without function				
VINP: Input 11 fct.assig.				115 160
061 000: MAIN: Without function				
VINP: Input 12 fct.assig.				115 161
061 000: MAIN: Without function				
VINP: Input 13 fct.assig.				115 162
061 000: MAIN: Without function				
VINP: Input 14 fct.assig.				115 163
061 000: MAIN: Without function				

Parameter					Address		
Default	Min	Max	Unit		Logic Diagram		
VINP: Input 15 fct.assig.							115 164
061 000: MAIN: Without function							
VINP: Input 16 fct.assig.							115 165
061 000: MAIN: Without function							
VINP: Input 17 fct.assig.							115 166
061 000: MAIN: Without function							
VINP: Input 18 fct.assig.							115 167
061 000: MAIN: Without function							
VINP: Input 19 fct.assig.							115 168
061 000: MAIN: Without function							
VINP: Input 20 fct.assig.							115 169
061 000: MAIN: Without function							
VINP: Input 21 fct.assig.							115 170
061 000: MAIN: Without function							
VINP: Input 22 fct.assig.							115 171
061 000: MAIN: Without function							
VINP: Input 23 fct.assig.							115 172
061 000: MAIN: Without function							
VINP: Input 24 fct.assig.							115 173
061 000: MAIN: Without function							
VINP: Input 25 fct.assig.							115 174
061 000: MAIN: Without function							
VINP: Input 26 fct.assig.							115 175
061 000: MAIN: Without function							
VINP: Input 27 fct.assig.							115 176
061 000: MAIN: Without function							
VINP: Input 28 fct.assig.							115 177
061 000: MAIN: Without function							
VINP: Input 29 fct.assig.							115 178
061 000: MAIN: Without function							
VINP: Input 30 fct.assig.							115 179
061 000: MAIN: Without function							
VINP: Input 31 fct.assig.							115 180
061 000: MAIN: Without function							
VINP: Input 32 fct.assig.							115 181
061 000: MAIN: Without function							
VINP: Input 33 fct.assig.							115 182
061 000: MAIN: Without function							

Parameter				Address
Default	Min	Max	Unit	Logic Diagram
VINP: Input 34 fct.assig.				115 183
061 000: MAIN: Without function				
VINP: Input 35 fct.assig.				115 184
061 000: MAIN: Without function				
VINP: Input 36 fct.assig.				115 185
061 000: MAIN: Without function				
VINP: Input 37 fct.assig.				115 186
061 000: MAIN: Without function				
VINP: Input 38 fct.assig.				115 187
061 000: MAIN: Without function				
VINP: Input 39 fct.assig.				115 188
061 000: MAIN: Without function				
VINP: Input 40 fct.assig.				115 189
061 000: MAIN: Without function				
VINP: Input 41 fct.assig.				115 190
061 000: MAIN: Without function				
VINP: Input 42 fct.assig.				115 191
061 000: MAIN: Without function				
VINP: Input 43 fct.assig.				115 192
061 000: MAIN: Without function				
VINP: Input 44 fct.assig.				115 193
061 000: MAIN: Without function				
VINP: Input 45 fct.assig.				115 194
061 000: MAIN: Without function				
VINP: Input 46 fct.assig.				115 195
061 000: MAIN: Without function				
VINP: Input 47 fct.assig.				115 196
061 000: MAIN: Without function				
VINP: Input 48 fct.assig.				115 197
061 000: MAIN: Without function				
VINP: Input 49 fct.assig.				115 198
061 000: MAIN: Without function				
VINP: Input 50 fct.assig.				115 199
061 000: MAIN: Without function				
VINP: Input 51 fct.assig.				115 200
061 000: MAIN: Without function				
VINP: Input 52 fct.assig.				115 201
061 000: MAIN: Without function				

Parameter					Address	
Default	Min	Max	Unit		Logic Diagram	
VINP: Input 53 fct.assig.					115 202	
061 000: MAIN: Without function						
VINP: Input 54 fct.assig.					115 203	
061 000: MAIN: Without function						
VINP: Input 55 fct.assig.					115 204	
061 000: MAIN: Without function						
VINP: Input 56 fct.assig.					115 205	
061 000: MAIN: Without function						
VINP: Input 57 fct.assig.					115 206	
061 000: MAIN: Without function						
VINP: Input 58 fct.assig.					115 207	
061 000: MAIN: Without function						
VINP: Input 59 fct.assig.					115 208	
061 000: MAIN: Without function						
VINP: Input 60 fct.assig.					115 209	
061 000: MAIN: Without function						
VINP: Input 61 fct.assig.					115 210	
061 000: MAIN: Without function						
VINP: Input 62 fct.assig.					115 211	
061 000: MAIN: Without function						
VINP: Input 63 fct.assig.					115 212	
061 000: MAIN: Without function						
VINP: Input 64 fct.assig.					115 213	
061 000: MAIN: Without function						
Function assignment of the virtual binary inputs VINP to a binary logical state signal on the device so that they can be processed further by the protection, control or logic functions.						

Binary input

Parameter					Address
Default	Min	Max	Unit		Logic Diagram
INP: Filter					010 220
6	0	20		Fig. 3-33, (p. 3-63)	
Input filter which is activated when either the mode <i>Active "high", filt.</i> or <i>Active "low", filt.</i> has been selected for INP: Oper. mode U xxx. In order to suppress transient interference peaks at the logic signal inputs it is suggested to set this parameter to 6 [steps].					
INP: Fct. assignm. U 301					152 217
061 000: MAIN: Without function					
INP: Fct. assignm. U 302					152 220
061 000: MAIN: Without function					
INP: Fct. assignm. U 303					152 223
061 000: MAIN: Without function					
INP: Fct. assignm. U 304					152 226
061 000: MAIN: Without function					
INP: Fct. assignm. U 305					186 118
061 000: MAIN: Without function					
INP: Fct. assignm. U 306					186 122
061 000: MAIN: Without function					
INP: Fct. assignm. U 307					186 126
061 000: MAIN: Without function					
INP: Fct. assignm. U 308					186 130
061 000: MAIN: Without function					
INP: Fct. assignm. U 309					186 134
061 000: MAIN: Without function					
INP: Fct. assignm. U 310					186 138
061 000: MAIN: Without function					
INP: Fct. assignm. U 311					186 142
061 000: MAIN: Without function					
INP: Fct. assignm. U 312					186 146
061 000: MAIN: Without function					
INP: Fct. assignm. U 313					186 150
061 000: MAIN: Without function					
INP: Fct. assignm. U 314					186 154
061 000: MAIN: Without function					
INP: Fct. assignm. U 315					186 158
061 000: MAIN: Without function					
INP: Fct. assignm. U 316					186 162
061 000: MAIN: Without function					

Parameter					Address		
Default	Min	Max	Unit		Logic Diagram		
INP: Fct. assignm. U 317							186 166
061 000: MAIN: Without function							
INP: Fct. assignm. U 318							186 170
061 000: MAIN: Without function							
INP: Fct. assignm. U 319							186 174
061 000: MAIN: Without function							
INP: Fct. assignm. U 320							186 178
061 000: MAIN: Without function							
INP: Fct. assignm. U 321							186 182
061 000: MAIN: Without function							
INP: Fct. assignm. U 322							186 186
061 000: MAIN: Without function							
INP: Fct. assignm. U 323							186 190
061 000: MAIN: Without function							
INP: Fct. assignm. U 324							186 194
061 000: MAIN: Without function							
INP: Fct. assignm. U 501							152 073
061 000: MAIN: Without function							
INP: Fct. assignm. U 502							152 076
061 000: MAIN: Without function							
INP: Fct. assignm. U 503							152 079
061 000: MAIN: Without function							
INP: Fct. assignm. U 504							152 082
061 000: MAIN: Without function							
INP: Fct. assignm. U 601							152 091
061 000: MAIN: Without function							
INP: Fct. assignm. U 602							152 094
061 000: MAIN: Without function							
INP: Fct. assignm. U 603							152 097
061 000: MAIN: Without function							
INP: Fct. assignm. U 604							152 100
061 000: MAIN: Without function							
INP: Fct. assignm. U 605							152 103
061 000: MAIN: Without function							
INP: Fct. assignm. U 606							152 106
061 000: MAIN: Without function							
INP: Fct. assignm. U 701							152 109
061 000: MAIN: Without function							

Parameter				Address
Default	Min	Max	Unit	Logic Diagram
INP: Fct. assignm. U 702				152 112
061 000: MAIN: Without function				
INP: Fct. assignm. U 703				152 115
061 000: MAIN: Without function				
INP: Fct. assignm. U 704				152 118
061 000: MAIN: Without function				
INP: Fct. assignm. U 705				152 121
061 000: MAIN: Without function				
INP: Fct. assignm. U 706				152 124
061 000: MAIN: Without function				
INP: Fct. assignm. U 801				184 002
061 000: MAIN: Without function				
INP: Fct. assignm. U 802				184 006
061 000: MAIN: Without function				
INP: Fct. assignm. U 803				184 010
061 000: MAIN: Without function				
INP: Fct. assignm. U 804				184 014
061 000: MAIN: Without function				
INP: Fct. assignm. U 805				184 018
061 000: MAIN: Without function				
INP: Fct. assignm. U 806				184 022
061 000: MAIN: Without function				
INP: Fct. assignm. U 807				184 026
061 000: MAIN: Without function				
INP: Fct. assignm. U 808				184 030
061 000: MAIN: Without function				
INP: Fct. assignm. U 809				184 034
061 000: MAIN: Without function				
INP: Fct. assignm. U 810				184 038
061 000: MAIN: Without function				
INP: Fct. assignm. U 811				184 042
061 000: MAIN: Without function				
INP: Fct. assignm. U 812				184 046
061 000: MAIN: Without function				
INP: Fct. assignm. U 813				184 050
061 000: MAIN: Without function				
INP: Fct. assignm. U 814				184 054
061 000: MAIN: Without function				

Parameter					Address		
Default	Min	Max	Unit		Logic Diagram		
INP: Fct. assignm. U 815							184 058
061 000: MAIN: Without function							
INP: Fct. assignm. U 816							184 062
061 000: MAIN: Without function							
INP: Fct. assignm. U 817							184 066
061 000: MAIN: Without function							
INP: Fct. assignm. U 818							184 070
061 000: MAIN: Without function							
INP: Fct. assignm. U 819							184 074
061 000: MAIN: Without function							
INP: Fct. assignm. U 820							184 078
061 000: MAIN: Without function							
INP: Fct. assignm. U 821							184 082
061 000: MAIN: Without function							
INP: Fct. assignm. U 822							184 086
061 000: MAIN: Without function							
INP: Fct. assignm. U 823							184 090
061 000: MAIN: Without function							
INP: Fct. assignm. U 824							184 094
061 000: MAIN: Without function							
INP: Fct. assignm. U 901							152 145
061 000: MAIN: Without function							
INP: Fct. assignm. U 902							152 148
061 000: MAIN: Without function							
INP: Fct. assignm. U 903							152 151
061 000: MAIN: Without function							
INP: Fct. assignm. U 904							152 154
061 000: MAIN: Without function							
INP: Fct. assignm. U 1001							152 163
061 000: MAIN: Without function							
INP: Fct. assignm. U 1002							152 166
061 000: MAIN: Without function							
INP: Fct. assignm. U 1003							152 169
061 000: MAIN: Without function							
INP: Fct. assignm. U 1004							152 172
061 000: MAIN: Without function							
INP: Fct. assignm. U 1005							152 175
061 000: MAIN: Without function							

Parameter				Address
Default	Min	Max	Unit	Logic Diagram
INP: Fct. assignm. U 1006				152 178
061 000: MAIN: Without function				
INP: Fct. assignm. U 1201				152 199
061 000: MAIN: Without function				
INP: Fct. assignm. U 1202				152 202
061 000: MAIN: Without function				
INP: Fct. assignm. U 1203				152 205
061 000: MAIN: Without function				
INP: Fct. assignm. U 1204				152 208
061 000: MAIN: Without function				
INP: Fct. assignm. U 1205				152 211
061 000: MAIN: Without function				
INP: Fct. assignm. U 1206				152 214
061 000: MAIN: Without function				
INP: Fct. assignm. U 1401				190 002
061 000: MAIN: Without function				
INP: Fct. assignm. U 1402				190 006
061 000: MAIN: Without function				
INP: Fct. assignm. U 1403				190 010
061 000: MAIN: Without function				
INP: Fct. assignm. U 1404				190 014
061 000: MAIN: Without function				
INP: Fct. assignm. U 1405				190 018
061 000: MAIN: Without function				
INP: Fct. assignm. U 1406				190 022
061 000: MAIN: Without function				
INP: Fct. assignm. U 1601				192 002
061 000: MAIN: Without function				
INP: Fct. assignm. U 1602				192 006
061 000: MAIN: Without function				
INP: Fct. assignm. U 1603				192 010
061 000: MAIN: Without function				
INP: Fct. assignm. U 1604				192 014
061 000: MAIN: Without function				
INP: Fct. assignm. U 1605				192 018
061 000: MAIN: Without function				
INP: Fct. assignm. U 1606				192 022
061 000: MAIN: Without function				

Parameter					Address		
Default	Min	Max	Unit		Logic Diagram		
INP: Fct. assignm. U 1607							192 026
061 000: MAIN: Without function							
INP: Fct. assignm. U 1608							192 030
061 000: MAIN: Without function							
INP: Fct. assignm. U 1609							192 034
061 000: MAIN: Without function							
INP: Fct. assignm. U 1610							192 038
061 000: MAIN: Without function							
INP: Fct. assignm. U 1611							192 042
061 000: MAIN: Without function							
INP: Fct. assignm. U 1612							192 046
061 000: MAIN: Without function							
INP: Fct. assignm. U 1613							192 050
061 000: MAIN: Without function							
INP: Fct. assignm. U 1614							192 054
061 000: MAIN: Without function							
INP: Fct. assignm. U 1615							192 058
061 000: MAIN: Without function							
INP: Fct. assignm. U 1616							192 062
061 000: MAIN: Without function							
INP: Fct. assignm. U 1617							192 066
061 000: MAIN: Without function							
INP: Fct. assignm. U 1618							192 070
061 000: MAIN: Without function							
INP: Fct. assignm. U 1619							192 074
061 000: MAIN: Without function							
INP: Fct. assignm. U 1620							192 078
061 000: MAIN: Without function							
INP: Fct. assignm. U 1621							192 082
061 000: MAIN: Without function							
INP: Fct. assignm. U 1622							192 086
061 000: MAIN: Without function							
INP: Fct. assignm. U 1623							192 090
061 000: MAIN: Without function							
INP: Fct. assignm. U 1624							192 094
061 000: MAIN: Without function							
INP: Fct. assignm. U 1801							194 002
061 000: MAIN: Without function							

Parameter				Address
Default	Min	Max	Unit	Logic Diagram
INP: Fct. assignm. U 1802				194 006
061 000: MAIN: Without function				
INP: Fct. assignm. U 1803				194 010
061 000: MAIN: Without function				
INP: Fct. assignm. U 1804				194 014
061 000: MAIN: Without function				
INP: Fct. assignm. U 1805				194 018
061 000: MAIN: Without function				
INP: Fct. assignm. U 1806				194 022
061 000: MAIN: Without function				
INP: Fct. assignm. U 2001				153 087
061 000: MAIN: Without function				
INP: Fct. assignm. U 2002				153 090
061 000: MAIN: Without function				
INP: Fct. assignm. U 2003				153 093
061 000: MAIN: Without function				
INP: Fct. assignm. U 2004				153 096
061 000: MAIN: Without function				
Assignment of functions to binary signal inputs.				
INP: Oper. mode U 301				152 218
1: Active "high"				
INP: Oper. mode U 302				152 221
1: Active "high"				
INP: Oper. mode U 303				152 224
1: Active "high"				
INP: Oper. mode U 304				152 227
1: Active "high"				
INP: Oper. mode U 305				186 119
1: Active "high"				
INP: Oper. mode U 306				186 123
1: Active "high"				
INP: Oper. mode U 307				186 127
1: Active "high"				
INP: Oper. mode U 308				186 131
1: Active "high"				
INP: Oper. mode U 309				186 135
1: Active "high"				

Parameter					Address		
Default	Min	Max	Unit		Logic Diagram		
INP: Oper. mode U 310							186 139
1: Active "high"							
INP: Oper. mode U 311							186 143
1: Active "high"							
INP: Oper. mode U 312							186 147
1: Active "high"							
INP: Oper. mode U 313							186 151
1: Active "high"							
INP: Oper. mode U 314							186 155
1: Active "high"							
INP: Oper. mode U 315							186 159
1: Active "high"							
INP: Oper. mode U 316							186 163
1: Active "high"							
INP: Oper. mode U 317							186 167
1: Active "high"							
INP: Oper. mode U 318							186 171
1: Active "high"							
INP: Oper. mode U 319							186 175
1: Active "high"							
INP: Oper. mode U 320							186 179
1: Active "high"							
INP: Oper. mode U 321							186 183
1: Active "high"							
INP: Oper. mode U 322							186 187
1: Active "high"							
INP: Oper. mode U 323							186 191
1: Active "high"							
INP: Oper. mode U 324							186 195
1: Active "high"							
INP: Oper. mode U 501							152 074
1: Active "high"							
INP: Oper. mode U 502							152 077
1: Active "high"							
INP: Oper. mode U 503							152 080
1: Active "high"							
INP: Oper. mode U 504							152 083
1: Active "high"							

Parameter				Address			
Default	Min	Max	Unit	Logic Diagram			
INP: Oper. mode U 601							152 092
1: Active "high"							
INP: Oper. mode U 602							152 095
1: Active "high"							
INP: Oper. mode U 603							152 098
1: Active "high"							
INP: Oper. mode U 604							152 101
1: Active "high"							
INP: Oper. mode U 605							152 104
1: Active "high"							
INP: Oper. mode U 606							152 107
1: Active "high"							
INP: Oper. mode U 701							152 110
1: Active "high"							
INP: Oper. mode U 702							152 113
1: Active "high"							
INP: Oper. mode U 703							152 116
1: Active "high"							
INP: Oper. mode U 704							152 119
1: Active "high"							
INP: Oper. mode U 705							152 122
1: Active "high"							
INP: Oper. mode U 706							152 125
1: Active "high"							
INP: Oper. mode U 801							184 003
1: Active "high"							
INP: Oper. mode U 802							184 007
1: Active "high"							
INP: Oper. mode U 803							184 011
1: Active "high"							
INP: Oper. mode U 804							184 015
1: Active "high"							
INP: Oper. mode U 805							184 019
1: Active "high"							
INP: Oper. mode U 806							184 023
1: Active "high"							
INP: Oper. mode U 807							184 027
1: Active "high"							

Parameter					Address		
Default	Min	Max	Unit		Logic Diagram		
INP: Oper. mode U 808							184 031
1: Active "high"							
INP: Oper. mode U 809							184 035
1: Active "high"							
INP: Oper. mode U 810							184 039
1: Active "high"							
INP: Oper. mode U 811							184 043
1: Active "high"							
INP: Oper. mode U 812							184 047
1: Active "high"							
INP: Oper. mode U 813							184 051
1: Active "high"							
INP: Oper. mode U 814							184 055
1: Active "high"							
INP: Oper. mode U 815							184 059
1: Active "high"							
INP: Oper. mode U 816							184 063
1: Active "high"							
INP: Oper. mode U 817							184 067
1: Active "high"							
INP: Oper. mode U 818							184 071
1: Active "high"							
INP: Oper. mode U 819							184 075
1: Active "high"							
INP: Oper. mode U 820							184 079
1: Active "high"							
INP: Oper. mode U 821							184 083
1: Active "high"							
INP: Oper. mode U 822							184 087
1: Active "high"							
INP: Oper. mode U 823							184 091
1: Active "high"							
INP: Oper. mode U 824							184 095
1: Active "high"							
INP: Oper. mode U 901							152 146
1: Active "high"							
INP: Oper. mode U 902							152 149
1: Active "high"							

Parameter				Address
Default	Min	Max	Unit	Logic Diagram
INP: Oper. mode U 903				152 152
1: Active "high"				
INP: Oper. mode U 904				152 155
1: Active "high"				
INP: Oper. mode U 1001				152 164
1: Active "high"				
INP: Oper. mode U 1002				152 167
1: Active "high"				
INP: Oper. mode U 1003				152 170
1: Active "high"				
INP: Oper. mode U 1004				152 173
1: Active "high"				
INP: Oper. mode U 1005				152 176
1: Active "high"				
INP: Oper. mode U 1006				152 179
1: Active "high"				
INP: Oper. mode U 1201				152 200
1: Active "high"				
INP: Oper. mode U 1202				152 203
1: Active "high"				
INP: Oper. mode U 1203				152 206
1: Active "high"				
INP: Oper. mode U 1204				152 209
1: Active "high"				
INP: Oper. mode U 1205				152 212
1: Active "high"				
INP: Oper. mode U 1206				152 215
1: Active "high"				
INP: Oper. mode U 1401				190 003
1: Active "high"				
INP: Oper. mode U 1402				190 007
1: Active "high"				
INP: Oper. mode U 1403				190 011
1: Active "high"				
INP: Oper. mode U 1404				190 015
1: Active "high"				
INP: Oper. mode U 1405				190 019
1: Active "high"				

Parameter					Address		
Default	Min	Max	Unit		Logic Diagram		
INP: Oper. mode U 1406							190 023
1: Active "high"							
INP: Oper. mode U 1601							192 003
1: Active "high"							
INP: Oper. mode U 1602							192 007
1: Active "high"							
INP: Oper. mode U 1603							192 011
1: Active "high"							
INP: Oper. mode U 1604							192 015
1: Active "high"							
INP: Oper. mode U 1605							192 019
1: Active "high"							
INP: Oper. mode U 1606							192 023
1: Active "high"							
INP: Oper. mode U 1607							192 027
1: Active "high"							
INP: Oper. mode U 1608							192 031
1: Active "high"							
INP: Oper. mode U 1609							192 035
1: Active "high"							
INP: Oper. mode U 1610							192 039
1: Active "high"							
INP: Oper. mode U 1611							192 043
1: Active "high"							
INP: Oper. mode U 1612							192 047
1: Active "high"							
INP: Oper. mode U 1613							192 051
1: Active "high"							
INP: Oper. mode U 1614							192 055
1: Active "high"							
INP: Oper. mode U 1615							192 059
1: Active "high"							
INP: Oper. mode U 1616							192 063
1: Active "high"							
INP: Oper. mode U 1617							192 067
1: Active "high"							
INP: Oper. mode U 1618							192 071
1: Active "high"							

Parameter					Address
Default	Min	Max	Unit		Logic Diagram
INP: Oper. mode U 1619					192 075
1: Active "high"					
INP: Oper. mode U 1620					192 079
1: Active "high"					
INP: Oper. mode U 1621					192 083
1: Active "high"					
INP: Oper. mode U 1622					192 087
1: Active "high"					
INP: Oper. mode U 1623					192 091
1: Active "high"					
INP: Oper. mode U 1624					192 095
1: Active "high"					
INP: Oper. mode U 1801					194 003
1: Active "high"					
INP: Oper. mode U 1802					194 007
1: Active "high"					
INP: Oper. mode U 1803					194 011
1: Active "high"					
INP: Oper. mode U 1804					194 015
1: Active "high"					
INP: Oper. mode U 1805					194 019
1: Active "high"					
INP: Oper. mode U 1806					194 023
1: Active "high"					
INP: Oper. mode U 2001					153 088
1: Active "high"					
INP: Oper. mode U 2002					153 091
1: Active "high"					
INP: Oper. mode U 2003					153 094
1: Active "high"					
INP: Oper. mode U 2004					153 097
1: Active "high"					
Selection of operating mode for binary signal inputs.					

Measured data input

Parameter	Address			
Default	Min	Max	Unit	Logic Diagram
MEASI: Function group MEASI				056 030
0: Without				
Cancelling function group MEASI or including it in the configuration. If the function group is cancelled from the configuration, then all associated settings and signals are hidden.				
MEASI: General enable USER				011 100
0: No				
Disabling or enabling analog measured data input.				
MEASI: Enable IDC p.u.				037 190
0.000	0.000	0.200	IDC,nom	Fig. 3-37, (p. 3-67)
Setting for the minimum current that must flow in order for the P433 to display a measured value > 0 (zero suppression).				
MEASI: IDC < open circuit				037 191
3.0	0.0	10.0	mA	Fig. 3-37, (p. 3-67)
If the input current falls below the set threshold, the P433 will issue an "open circuit" signal.				
MEASI: IDC 1				037 150
0.000	0.000	1.200	IDC,nom	Fig. 3-37, (p. 3-67)
MEASI: IDC 2				037 152
Blocked	0.000	1.200	IDC,nom	Fig. 3-37, (p. 3-67)
MEASI: IDC 3				037 154
Blocked	0.000	1.200	IDC,nom	Fig. 3-37, (p. 3-67)
MEASI: IDC 4				037 156
Blocked	0.000	1.200	IDC,nom	Fig. 3-37, (p. 3-67)
MEASI: IDC 5				037 158
Blocked	0.000	1.200	IDC,nom	Fig. 3-37, (p. 3-67)
MEASI: IDC 6				037 160
Blocked	0.000	1.200	IDC,nom	Fig. 3-37, (p. 3-67)
MEASI: IDC 7				037 162
Blocked	0.000	1.200	IDC,nom	Fig. 3-37, (p. 3-67)
MEASI: IDC 8				037 164
Blocked	0.000	1.200	IDC,nom	Fig. 3-37, (p. 3-67)
MEASI: IDC 9				037 166
Blocked	0.000	1.200	IDC,nom	Fig. 3-37, (p. 3-67)
MEASI: IDC 10				037 168
Blocked	0.000	1.200	IDC,nom	Fig. 3-37, (p. 3-67)

Parameter				Address			
Default	Min	Max	Unit	Logic Diagram			
MEASI: IDC 11							037 170
Blocked	0.000	1.200	IDC,nom	Fig. 3-37, (p. 3-67)			
MEASI: IDC 12							037 172
Blocked	0.000	1.200	IDC,nom	Fig. 3-37, (p. 3-67)			
MEASI: IDC 13							037 174
Blocked	0.000	1.200	IDC,nom	Fig. 3-37, (p. 3-67)			
MEASI: IDC 14							037 176
Blocked	0.000	1.200	IDC,nom	Fig. 3-37, (p. 3-67)			
MEASI: IDC 15							037 178
Blocked	0.000	1.200	IDC,nom	Fig. 3-37, (p. 3-67)			
MEASI: IDC 16							037 180
Blocked	0.000	1.200	IDC,nom	Fig. 3-37, (p. 3-67)			
MEASI: IDC 17							037 182
Blocked	0.000	1.200	IDC,nom	Fig. 3-37, (p. 3-67)			
MEASI: IDC 18							037 184
Blocked	0.000	1.200	IDC,nom	Fig. 3-37, (p. 3-67)			
MEASI: IDC 19							037 186
Blocked	0.000	1.200	IDC,nom	Fig. 3-37, (p. 3-67)			
MEASI: IDC 20							037 188
1.200	0.000	1.200	IDC,nom	Fig. 3-37, (p. 3-67)			
Setting for the input current that will correspond to a linearized value that has been set accordingly.							
MEASI: IDC,lin 1							037 151
0.000	0.000	1.200	IDC,nom	Fig. 3-37, (p. 3-67)			
MEASI: IDC,lin 2							037 153
Blocked	0.000	1.200	IDC,nom	Fig. 3-37, (p. 3-67)			
MEASI: IDC,lin 3							037 155
Blocked	0.000	1.200	IDC,nom	Fig. 3-37, (p. 3-67)			
MEASI: IDC,lin 4							037 157
Blocked	0.000	1.200	IDC,nom	Fig. 3-37, (p. 3-67)			
MEASI: IDC,lin 5							037 159
Blocked	0.000	1.200	IDC,nom	Fig. 3-37, (p. 3-67)			
MEASI: IDC,lin 6							037 161
Blocked	0.000	1.200	IDC,nom	Fig. 3-37, (p. 3-67)			
MEASI: IDC,lin 7							037 163
Blocked	0.000	1.200	IDC,nom	Fig. 3-37, (p. 3-67)			
MEASI: IDC,lin 8							037 165
Blocked	0.000	1.200	IDC,nom	Fig. 3-37, (p. 3-67)			

Parameter					Address		
Default	Min	Max	Unit	Logic Diagram			
MEASI: IDC,lin 9							037 167
Blocked	0.000	1.200	IDC,nom	Fig. 3-37, (p. 3-67)			
MEASI: IDC,lin 10							037 169
Blocked	0.000	1.200	IDC,nom	Fig. 3-37, (p. 3-67)			
MEASI: IDC,lin 11							037 171
Blocked	0.000	1.200	IDC,nom	Fig. 3-37, (p. 3-67)			
MEASI: IDC,lin 12							037 173
Blocked	0.000	1.200	IDC,nom	Fig. 3-37, (p. 3-67)			
MEASI: IDC,lin 13							037 175
Blocked	0.000	1.200	IDC,nom	Fig. 3-37, (p. 3-67)			
MEASI: IDC,lin 14							037 177
Blocked	0.000	1.200	IDC,nom	Fig. 3-37, (p. 3-67)			
MEASI: IDC,lin 15							037 179
Blocked	0.000	1.200	IDC,nom	Fig. 3-37, (p. 3-67)			
MEASI: IDC,lin 16							037 181
Blocked	0.000	1.200	IDC,nom	Fig. 3-37, (p. 3-67)			
MEASI: IDC,lin 17							037 183
Blocked	0.000	1.200	IDC,nom	Fig. 3-37, (p. 3-67)			
MEASI: IDC,lin 18							037 185
Blocked	0.000	1.200	IDC,nom	Fig. 3-37, (p. 3-67)			
MEASI: IDC,lin 19							037 187
Blocked	0.000	1.200	IDC,nom	Fig. 3-37, (p. 3-67)			
MEASI: IDC,lin 20							037 189
1.200	0.000	1.200	IDC,nom	Fig. 3-37, (p. 3-67)			
Setting for the linearized current that will correspond to an input current that has been set accordingly.							
MEASI: Scaled val. IDC,lin1							037 192
0	-32768	32767		Fig. 3-38, (p. 3-68)			
Setting for the scaled value of IDC,lin1.							
MEASI: Scaled val.IDC,lin20							037 193
1200	-32768	32767		Fig. 3-38, (p. 3-68)			
Setting for the scaled value of IDC,lin20.							

Binary and analog
output

Parameter					Address
Default	Min	Max	Unit		Logic Diagram
OUTP: Fct. assignm. K 301					151 045
060 000: MAIN: Without function					
OUTP: Fct. assignm. K 302					151 048
060 000: MAIN: Without function					
OUTP: Fct. assignm. K 501					150 097
060 000: MAIN: Without function					
OUTP: Fct. assignm. K 502					150 100
060 000: MAIN: Without function					
OUTP: Fct. assignm. K 503					150 103
060 000: MAIN: Without function					
OUTP: Fct. assignm. K 504					150 106
060 000: MAIN: Without function					
OUTP: Fct. assignm. K 505					150 109
060 000: MAIN: Without function					
OUTP: Fct. assignm. K 506					150 112
060 000: MAIN: Without function					
OUTP: Fct. assignm. K 507					150 115
060 000: MAIN: Without function					
OUTP: Fct. assignm. K 508					150 118
060 000: MAIN: Without function					
OUTP: Fct. assignm. K 601					150 121
060 000: MAIN: Without function					
OUTP: Fct. assignm. K 602					150 124
060 000: MAIN: Without function					
OUTP: Fct. assignm. K 603					150 127
060 000: MAIN: Without function					
OUTP: Fct. assignm. K 604					150 130
060 000: MAIN: Without function					
OUTP: Fct. assignm. K 605					150 133
060 000: MAIN: Without function					
OUTP: Fct. assignm. K 606					150 136
060 000: MAIN: Without function					
OUTP: Fct. assignm. K 607					150 139
060 000: MAIN: Without function					
OUTP: Fct. assignm. K 608					150 142
060 000: MAIN: Without function					

Parameter					Address		
Default	Min	Max	Unit		Logic Diagram		
OUTP: Fct. assignm. K 701							150 145
060 000: MAIN: Without function							
OUTP: Fct. assignm. K 702							150 148
060 000: MAIN: Without function							
OUTP: Fct. assignm. K 703							150 151
060 000: MAIN: Without function							
OUTP: Fct. assignm. K 704							150 154
060 000: MAIN: Without function							
OUTP: Fct. assignm. K 705							150 157
060 000: MAIN: Without function							
OUTP: Fct. assignm. K 706							150 160
060 000: MAIN: Without function							
OUTP: Fct. assignm. K 707							150 163
060 000: MAIN: Without function							
OUTP: Fct. assignm. K 708							150 166
060 000: MAIN: Without function							
OUTP: Fct. assignm. K 801							150 169
060 000: MAIN: Without function							
OUTP: Fct. assignm. K 802							150 172
060 000: MAIN: Without function							
OUTP: Fct. assignm. K 803							150 175
060 000: MAIN: Without function							
OUTP: Fct. assignm. K 804							150 178
060 000: MAIN: Without function							
OUTP: Fct. assignm. K 805							150 181
060 000: MAIN: Without function							
OUTP: Fct. assignm. K 806							150 184
060 000: MAIN: Without function							
OUTP: Fct. assignm. K 807							150 187
060 000: MAIN: Without function							
OUTP: Fct. assignm. K 808							150 190
060 000: MAIN: Without function							
OUTP: Fct. assignm. K 901							150 193
060 000: MAIN: Without function							
OUTP: Fct. assignm. K 902							150 196
060 000: MAIN: Without function							
OUTP: Fct. assignm. K 903							150 199
060 000: MAIN: Without function							

Parameter				Address			
Default	Min	Max	Unit	Logic Diagram			
OUTP: Fct. assignm. K 904							150 202
060 000: MAIN: Without function							
OUTP: Fct. assignm. K 905							150 205
060 000: MAIN: Without function							
OUTP: Fct. assignm. K 906							150 208
060 000: MAIN: Without function							
OUTP: Fct. assignm. K 907							150 211
060 000: MAIN: Without function							
OUTP: Fct. assignm. K 908							150 214
060 000: MAIN: Without function							
OUTP: Fct. assignm. K 1001							150 217
060 000: MAIN: Without function							
OUTP: Fct. assignm. K 1002							150 220
060 000: MAIN: Without function							
OUTP: Fct. assignm. K 1003							150 223
060 000: MAIN: Without function							
OUTP: Fct. assignm. K 1004							150 226
060 000: MAIN: Without function							
OUTP: Fct. assignm. K 1005							150 229
060 000: MAIN: Without function							
OUTP: Fct. assignm. K 1006							150 232
060 000: MAIN: Without function							
OUTP: Fct. assignm. K 1007							150 235
060 000: MAIN: Without function							
OUTP: Fct. assignm. K 1008							150 238
060 000: MAIN: Without function							
OUTP: Fct. assignm. K 1201							151 009
060 000: MAIN: Without function							
OUTP: Fct. assignm. K 1202							151 012
060 000: MAIN: Without function							
OUTP: Fct. assignm. K 1203							151 015
060 000: MAIN: Without function							
OUTP: Fct. assignm. K 1204							151 018
060 000: MAIN: Without function							
OUTP: Fct. assignm. K 1205							151 021
060 000: MAIN: Without function							
OUTP: Fct. assignm. K 1206							151 024
060 000: MAIN: Without function							

Parameter					Address		
Default	Min	Max	Unit		Logic Diagram		
OUTP: Fct. assignm. K 1207							151 027
060 000: MAIN: Without function							
OUTP: Fct. assignm. K 1208							151 030
060 000: MAIN: Without function							
OUTP: Fct. assignm. K 1401							169 002
060 000: MAIN: Without function							
OUTP: Fct. assignm. K 1402							169 006
060 000: MAIN: Without function							
OUTP: Fct. assignm. K 1403							169 010
060 000: MAIN: Without function							
OUTP: Fct. assignm. K 1404							169 014
060 000: MAIN: Without function							
OUTP: Fct. assignm. K 1405							169 018
060 000: MAIN: Without function							
OUTP: Fct. assignm. K 1406							169 022
060 000: MAIN: Without function							
OUTP: Fct. assignm. K 1407							169 026
060 000: MAIN: Without function							
OUTP: Fct. assignm. K 1408							169 030
060 000: MAIN: Without function							
OUTP: Fct. assignm. K 1601							171 002
060 000: MAIN: Without function							
OUTP: Fct. assignm. K 1602							171 006
060 000: MAIN: Without function							
OUTP: Fct. assignm. K 1603							171 010
060 000: MAIN: Without function							
OUTP: Fct. assignm. K 1604							171 014
060 000: MAIN: Without function							
OUTP: Fct. assignm. K 1605							171 018
060 000: MAIN: Without function							
OUTP: Fct. assignm. K 1606							171 022
060 000: MAIN: Without function							
OUTP: Fct. assignm. K 1607							171 026
060 000: MAIN: Without function							
OUTP: Fct. assignm. K 1608							171 030
060 000: MAIN: Without function							
OUTP: Fct. assignm. K 1801							173 002
060 000: MAIN: Without function							

Parameter				Address
Default	Min	Max	Unit	Logic Diagram
OUTP: Fct. assignm. K 1802				173 006
060 000: MAIN: Without function				
OUTP: Fct. assignm. K 1803				173 010
060 000: MAIN: Without function				
OUTP: Fct. assignm. K 1804				173 014
060 000: MAIN: Without function				
OUTP: Fct. assignm. K 1805				173 018
060 000: MAIN: Without function				
OUTP: Fct. assignm. K 1806				173 022
060 000: MAIN: Without function				
OUTP: Fct. assignm. K 2001				151 201
060 000: MAIN: Without function				
OUTP: Fct. assignm. K 2002				151 204
060 000: MAIN: Without function				
OUTP: Fct. assignm. K 2003				151 207
060 000: MAIN: Without function				
OUTP: Fct. assignm. K 2004				151 210
060 000: MAIN: Without function				
OUTP: Fct. assignm. K 2005				151 213
060 000: MAIN: Without function				
OUTP: Fct. assignm. K 2006				151 216
060 000: MAIN: Without function				
OUTP: Fct. assignm. K 2007				151 219
060 000: MAIN: Without function				
OUTP: Fct. assignm. K 2008				151 222
060 000: MAIN: Without function				
Assignment of functions to output relays.				
OUTP: Oper. mode K 301				151 046
1: ES updating				
OUTP: Oper. mode K 302				151 049
1: ES updating				
OUTP: Oper. mode K 501				150 098
1: ES updating				
OUTP: Oper. mode K 502				150 101
1: ES updating				
OUTP: Oper. mode K 503				150 104
1: ES updating				

Parameter					Address		
Default	Min	Max	Unit		Logic Diagram		
OUTP: Oper. mode K 504							150 107
1: ES updating							
OUTP: Oper. mode K 505							150 110
1: ES updating							
OUTP: Oper. mode K 506							150 113
1: ES updating							
OUTP: Oper. mode K 507							150 116
1: ES updating							
OUTP: Oper. mode K 508							150 119
1: ES updating							
OUTP: Oper. mode K 601							150 122
1: ES updating							
OUTP: Oper. mode K 602							150 125
1: ES updating							
OUTP: Oper. mode K 603							150 128
1: ES updating							
OUTP: Oper. mode K 604							150 131
1: ES updating							
OUTP: Oper. mode K 605							150 134
1: ES updating							
OUTP: Oper. mode K 606							150 137
1: ES updating							
OUTP: Oper. mode K 607							150 140
1: ES updating							
OUTP: Oper. mode K 608							150 143
1: ES updating							
OUTP: Oper. mode K 701							150 146
1: ES updating							
OUTP: Oper. mode K 702							150 149
1: ES updating							
OUTP: Oper. mode K 703							150 152
1: ES updating							
OUTP: Oper. mode K 704							150 155
1: ES updating							
OUTP: Oper. mode K 705							150 158
1: ES updating							
OUTP: Oper. mode K 706							150 161
1: ES updating							

Parameter				Address
Default	Min	Max	Unit	Logic Diagram
OUTP: Oper. mode K 707				150 164
1: ES updating				
OUTP: Oper. mode K 708				150 167
1: ES updating				
OUTP: Oper. mode K 801				150 170
1: ES updating				
OUTP: Oper. mode K 802				150 173
1: ES updating				
OUTP: Oper. mode K 803				150 176
1: ES updating				
OUTP: Oper. mode K 804				150 179
1: ES updating				
OUTP: Oper. mode K 805				150 182
1: ES updating				
OUTP: Oper. mode K 806				150 185
1: ES updating				
OUTP: Oper. mode K 807				150 188
1: ES updating				
OUTP: Oper. mode K 808				150 191
1: ES updating				
OUTP: Oper. mode K 901				150 194
1: ES updating				
OUTP: Oper. mode K 902				150 197
1: ES updating				
OUTP: Oper. mode K 903				150 200
1: ES updating				
OUTP: Oper. mode K 904				150 203
1: ES updating				
OUTP: Oper. mode K 905				150 206
1: ES updating				
OUTP: Oper. mode K 906				150 209
1: ES updating				
OUTP: Oper. mode K 907				150 212
1: ES updating				
OUTP: Oper. mode K 908				150 215
1: ES updating				
OUTP: Oper. mode K 1001				150 218
1: ES updating				

Parameter					Address	
Default	Min	Max	Unit		Logic Diagram	
OUTP: Oper. mode K 1002					150 221	
1: ES updating						
OUTP: Oper. mode K 1003					150 224	
1: ES updating						
OUTP: Oper. mode K 1004					150 227	
1: ES updating						
OUTP: Oper. mode K 1005					150 230	
1: ES updating						
OUTP: Oper. mode K 1006					150 233	
1: ES updating						
OUTP: Oper. mode K 1007					150 236	
1: ES updating						
OUTP: Oper. mode K 1008					150 239	
1: ES updating						
OUTP: Oper. mode K 1201					151 010	
1: ES updating						
OUTP: Oper. mode K 1202					151 013	
1: ES updating						
OUTP: Oper. mode K 1203					151 016	
1: ES updating						
OUTP: Oper. mode K 1204					151 019	
1: ES updating						
OUTP: Oper. mode K 1205					151 022	
1: ES updating						
OUTP: Oper. mode K 1206					151 025	
1: ES updating						
OUTP: Oper. mode K 1207					151 028	
1: ES updating						
OUTP: Oper. mode K 1208					151 031	
1: ES updating						
OUTP: Oper. mode K 1401					169 003	
1: ES updating						
OUTP: Oper. mode K 1402					169 007	
1: ES updating						
OUTP: Oper. mode K 1403					169 011	
1: ES updating						
OUTP: Oper. mode K 1404					169 015	
1: ES updating						

Parameter				Address
Default	Min	Max	Unit	Logic Diagram
OUTP: Oper. mode K 1405				169 019
1: ES updating				
OUTP: Oper. mode K 1406				169 023
1: ES updating				
OUTP: Oper. mode K 1407				169 027
1: ES updating				
OUTP: Oper. mode K 1408				169 031
1: ES updating				
OUTP: Oper. mode K 1601				171 003
1: ES updating				
OUTP: Oper. mode K 1602				171 007
1: ES updating				
OUTP: Oper. mode K 1603				171 011
1: ES updating				
OUTP: Oper. mode K 1604				171 015
1: ES updating				
OUTP: Oper. mode K 1605				171 019
1: ES updating				
OUTP: Oper. mode K 1606				171 023
1: ES updating				
OUTP: Oper. mode K 1607				171 027
1: ES updating				
OUTP: Oper. mode K 1608				171 031
1: ES updating				
OUTP: Oper. mode K 1801				173 003
1: ES updating				
OUTP: Oper. mode K 1802				173 007
1: ES updating				
OUTP: Oper. mode K 1803				173 011
1: ES updating				
OUTP: Oper. mode K 1804				173 015
1: ES updating				
OUTP: Oper. mode K 1805				173 019
1: ES updating				
OUTP: Oper. mode K 1806				173 023
1: ES updating				
OUTP: Oper. mode K 2001				151 202
1: ES updating				

Parameter					Address
Default	Min	Max	Unit		Logic Diagram
OUTP: Oper. mode K 2002					151 205
1: ES updating					
OUTP: Oper. mode K 2003					151 208
1: ES updating					
OUTP: Oper. mode K 2004					151 211
1: ES updating					
OUTP: Oper. mode K 2005					151 214
1: ES updating					
OUTP: Oper. mode K 2006					151 217
1: ES updating					
OUTP: Oper. mode K 2007					151 220
1: ES updating					
OUTP: Oper. mode K 2008					151 223
1: ES updating					
Selection of operating mode for output relays.					

Measured data output

Parameter	Address			
Default	Min	Max	Unit	Logic Diagram
MEASO: Function group MEASO				056 020
0: Without				
Cancelling function group MEASI or including it in the configuration. If the function group is cancelled from the configuration, then all associated settings and signals are hidden. If the function group is cancelled from the configuration, then all associated settings and signals are hidden.				
MEASO: General enable USER				031 074
0: No				
Disabling or enabling the measured data output function.				
MEASO: Fct. assignm. BCD				053 002
060 000: MAIN: Without function Fig. 3-46, (p. 3-78)				
Selection of the measured value to be transmitted in BCD form.				
MEASO: Hold time output BCD				010 010
0.10	0.10	10.00	s	Fig. 3-46, (p. 3-78)
Setting for the transmission time of the selected measured value in BCD form.				
MEASO: Scaled min. val. BCD				037 140
0.000	0.000	1.000		
MEASO: Scaled max. val. BCD				037 141
1.000	0.000	1.000		
MEASO: BCD-Out min. value				037 142
0	0	399		

Parameter	Address			
Default	Min	Max	Unit	Logic Diagram
MEASO: BCD-Out max. value				037 143
399	0	399		
The variable Mx is to be issued in BCD form. For measured values in the range “measured values to be issued” the output value should change linearly with the measured value. ● Range of measured values for the variable Mx: Mx,RL1 ... Mx,RL2 ● Range of associated scaled measured values: 0 ... 1 ● Range of measured values to be issued: Mx,min ... Mx,max ● Range of scaled measured values to be issued: Mx,scal,min ... Mx,scal,max ● Designation of the set values in the data model: “Scaled min. val. BCD” ... “Scaled max. val. BCD” with: $Mx,scal,min = (Mx,min - Mx,RL1)/(Mx,RL2 - Mx,RL1)$ $Mx,scal,max = (Mx,max - Mx,RL1)/(Mx,RL2 - Mx,RL1)$ BCD display values for measured values in the range “measured values to be issued”; range: “BCD-Out min. value” ... “BCD-Out max. value” BBCD display values for measured values $\leq$ Mx,min; range: “BCD-Out min. value” BCD display values for measured values $\geq$ Mx,max; range: “BCD-Out max. value”				
MEASO: Fct. assignm. A-1				053 000
060 000: MAIN: Without function				Fig. 3-48, (p. 3-84)
MEASO: Fct. assignm. A-2				053 001
060 000: MAIN: Without function				
Selection of the measured value to be transmitted in analog form.				
MEASO: Hold time output A-1				010 114
0.10	0.10	10.00	s	Fig. 3-48, (p. 3-84)
MEASO: Hold time output A-2				010 115
0.10	0.10	10.00	s	
Setting for the time delay for output of the selected measured value.				
MEASO: Scaled min. val. A-1				037 104
0.000	0.000	1.000		Fig. 3-48, (p. 3-84)
MEASO: Scaled knee val. A-1				037 105
Blocked	0.000	1.000		Fig. 3-48, (p. 3-84)
MEASO: Scaled max. val. A-1				037 106
1.000	0.000	1.000		Fig. 3-48, (p. 3-84)
MEASO: Scaled min. val. A-2				037 110
0.000	0.000	1.000		

Parameter				Address
Default	Min	Max	Unit	Logic Diagram
MEASO: Scaled knee val. A-2				037 111
Blocked	0.000	1.000		
MEASO: Scaled max. val. A-2				037 112
1.000	0.000	1.000		
After conversion via a characteristic the selected measured value Ax (x = 1, 2) is to be issued as an output current. For this purpose a range "measured values to be issued" is defined. In this range the characteristic has two linear sections, which are separated by a knee point. ● Range of measured values for the variable Mx: Mx,RL1 ... Mx,RL2 ● Range of associated scaled measured values: 0 ... 1 ● Range of measured values to be issued: Mx,min ... Mx,max ● Range of scaled measured values to be output: Mx,scal,min ... Mx,scal,max ● Designation of the set values in the data model: „Scaled min. val. Ax“ ... „Scaled max. val. Ax“ with: $Mx,scal,min = (Mx,min - Mx,RL1)/(Mx,RL2 - Mx,RL1)$ $Mx,scal,max = (Mx,max - Mx,RL1)/(Mx,RL2 - Mx,RL1)$ ● Designation of value for knee point: Mx,knee ● Designation of scaled knee point value: Mx,scaled,knee ● Designation of this set value in the data model: „Scaled knee val. Ax“ with: $Mx,scaled,knee = (Mx,knee - Mx,RL1)/(Mx,RL2 - Mx,RL1)$				
MEASO: AnOut min. val. A-1				037 107
0.00	0.00	20.00	mA	Fig. 3-48, (p. 3-84)
MEASO: AnOut knee point A-1				037 108
Blocked	0.00	20.00	mA	Fig. 3-48, (p. 3-84)
MEASO: AnOut max. val. A-1				037 109
20.00	0.00	20.00	mA	Fig. 3-48, (p. 3-84)
MEASO: AnOut min. val. A-2				037 113
0.00	0.00	20.00	mA	
MEASO: AnOut knee point A-2				037 114
Blocked	0.00	20.00	mA	

Parameter				Address			
Default	Min	Max	Unit	Logic Diagram			
MEASO: AnOut max. val. A-2							037 115
20.00	0.00	20.00	mA				
Output current range for measured values in the range “measured values to be issued”; designation in the data model: “An-Out min. val. Ax” ... “An-Out max. val. Ax” Output current to be set for measured values $\leq$ Mx,min; designation in the data model: “An-Out min. val. Ax” Output current to be set for measured values $\geq$ Mx,max; designation in the data model: “An-Out max. val. Ax” Output current to be set for measured values = Mx,knee; designation in the data model: “AnOut knee point Ax” with: Mx,min ... Mx,max: measured values to be issued							
MEASO: Output value 1							037 120
0.00	0.00	100.00	%				
MEASO: Output value 2							037 121
0.00	0.00	100.00	%				
MEASO: Output value 3							037 122
0.00	0.00	100.00	%				
Measured values of external devices, which must be scaled to 0 to 100%, can be issued.							

LED indicators

Parameter	Address			
Default	Min	Max	Unit	Logic Diagram
LED: Fct.assig. H 1 green				085 184
060 001: MAIN: Healthy				
Display of the operational readiness of the protection device. The function MAIN: Healthy is permanently assigned.				
LED: Fct.assig. H 2 yell.				085 001
004 065: MAIN: Blocked/faulty				
Display of the function assigned to LED indicator H 2. The function MAIN: Blocked/faulty is permanently assigned.				
LED: Fct.assig. H 3 yell.				085 004
036 070: SFMON: Warning (LED)				
Display of the function assigned to LED indicator H 3. The function SFMON: Warning (LED) is permanently assigned.				
LED: Fct.assig. H 4 red				085 007
036 251: MAIN: Gen. trip signal				
LED: Fct.assig. H 4 green				085 057
060 000: MAIN: Without function				
LED: Fct.assig. H 5 red				085 010
060 000: MAIN: Without function				
LED: Fct.assig. H 5 green				085 060
060 000: MAIN: Without function				
LED: Fct.assig. H 6 red				085 013
060 000: MAIN: Without function				
LED: Fct.assig. H 6 green				085 063
060 000: MAIN: Without function				
LED: Fct.assig. H 7 red				085 016
060 000: MAIN: Without function				
LED: Fct.assig. H 7 green				085 066
060 000: MAIN: Without function				
LED: Fct.assig. H 8 red				085 019
060 000: MAIN: Without function				
LED: Fct.assig. H 8 green				085 069
060 000: MAIN: Without function				
LED: Fct.assig. H 9 red				085 022
060 000: MAIN: Without function				
LED: Fct.assig. H 9 green				085 072
060 000: MAIN: Without function				

Parameter					Address		
Default	Min	Max	Unit		Logic Diagram		
LED: Fct.assig. H10 red							085 025
060 000: MAIN: Without function							
LED: Fct.assig. H10 green							085 075
060 000: MAIN: Without function							
LED: Fct.assig. H11 red							085 028
060 000: MAIN: Without function							
LED: Fct.assig. H11 green							085 078
060 000: MAIN: Without function							
LED: Fct.assig. H12 red							085 031
060 000: MAIN: Without function							
LED: Fct.assig. H12 green							085 081
060 000: MAIN: Without function							
LED: Fct.assig. H13 red							085 034
060 000: MAIN: Without function							
LED: Fct.assig. H13 green							085 084
060 000: MAIN: Without function							
LED: Fct.assig. H14 red							085 037
060 000: MAIN: Without function							
LED: Fct.assig. H14 green							085 087
060 000: MAIN: Without function							
LED: Fct.assig. H15 red							085 040
060 000: MAIN: Without function							
LED: Fct.assig. H15 green							085 090
060 000: MAIN: Without function							
LED: Fct.assig. H16 red							085 043
060 000: MAIN: Without function							
LED: Fct.assig. H16 green							085 093
060 000: MAIN: Without function							
LED: Fct.assig. H18 red							085 131
060 000: MAIN: Without function							
LED: Fct.assig. H18 green							085 161
060 000: MAIN: Without function							
LED: Fct.assig. H19 red							085 134
060 000: MAIN: Without function							
LED: Fct.assig. H19 green							085 164
060 000: MAIN: Without function							
LED: Fct.assig. H20 red							085 137
060 000: MAIN: Without function							

Parameter				Address
Default	Min	Max	Unit	Logic Diagram
LED: Fct.assig. H20 green				085 167
060 000: MAIN: Without function				
LED: Fct.assig. H21 red				085 140
060 000: MAIN: Without function				
LED: Fct.assig. H21 green				085 170
060 000: MAIN: Without function				
LED: Fct.assig. H22 red				085 143
060 000: MAIN: Without function				
LED: Fct.assig. H22 green				085 173
060 000: MAIN: Without function				
LED: Fct.assig. H23 red				085 146
060 000: MAIN: Without function				
LED: Fct.assig. H23 green				085 177
060 000: MAIN: Without function				
Assignment of functions to LED indicators.				
LED: Fct.assig. H17 red				085 185
080 111: LOC: Edit mode				
Display of the function assigned to LED indicator H 17. The function LOC: Edit mode is permanently assigned.				
LED: Operating mode H 1				085 182
1: ES updating				
The operating mode <i>ES updating</i> is permanently assigned.				
LED: Operating mode H 2				085 002
1: ES updating				
The operating mode <i>ES updating</i> is permanently assigned.				
LED: Operating mode H 3				085 005
1: ES updating				
The <i>ES updating</i> operating mode is permanently assigned.				
LED: Operating mode H 4				085 008
3: ES reset (fault)				
LED: Operating mode H 5				085 011
1: ES updating				
LED: Operating mode H 6				085 014
1: ES updating				
LED: Operating mode H 7				085 017
1: ES updating				

Parameter					Address
Default	Min	Max	Unit		Logic Diagram
LED: Operating mode H 8					085 020
1: ES updating					
LED: Operating mode H 9					085 023
1: ES updating					
LED: Operating mode H 10					085 026
1: ES updating					
LED: Operating mode H 11					085 029
1: ES updating					
LED: Operating mode H 12					085 032
1: ES updating					
LED: Operating mode H 13					085 035
1: ES updating					
LED: Operating mode H 14					085 038
1: ES updating					
LED: Operating mode H 15					085 041
1: ES updating					
LED: Operating mode H 16					085 044
1: ES updating					
LED: Operating mode H 18					085 132
1: ES updating					
LED: Operating mode H 19					085 135
1: ES updating					
LED: Operating mode H 20					085 138
1: ES updating					
LED: Operating mode H 21					085 141
1: ES updating					
LED: Operating mode H 22					085 144
1: ES updating					
LED: Operating mode H 23					085 147
1: ES updating					
Selection of operating mode for LED indicators.					
LED: Operating mode H 17					085 183
1: ES updating					
The operating mode <i>ES updating</i> is permanently assigned.					

Main function

Parameter	Address			
Default	Min	Max	Unit	Logic Diagram
MAIN: Fct.assignm. control				104 242
0: COMM1				
Selection of the communication interfaces for control.				
MAIN: Chann.assign.COMM1/2				003 169
1: COMM1->chann.1,(2-2)				Fig. 3-94, (p. 3-136)
Assignment of communication interfaces to physical communication channels.				
MAIN: Auto-assignment I/O				221 065
1: Yes				Fig. 3-413, (p. 3-489)
Disabling or enabling of automatic assignment of binary inputs and outputs to the set bay type.				
MAIN: Type of bay				220 000
1	1	9999		Fig. 3-413, (p. 3-489)
Configuration of a bay type.				
MAIN: Prim.Source TimeSync				103 210
0: IEC				
Selection of the primary source for date and time synchronization. Available are <i>IEC</i> , <i>COMM1</i> , <i>COMM2/PC</i> or a binary input for minute signal pulses.				
MAIN: BackupSourceTimeSync				103 211
1: COMM1				
Selection of the backup source for date and time synchronization. Available are <i>IEC</i> , <i>COMM1</i> , <i>COMM2/PC</i> or a binary input for minute signal pulses. The backup source is used when there is no synchronization generated by the primary source after MAIN: Time sync. time-out has elapsed.				
MAIN: Time sync. time-out				103 212
Blocked	1	60	min	
Time-out setting for the time synchronization generated by the primary source.				

Operating data recording

Parameter	Address			
Default	Min	Max	Unit	Logic Diagram
OP_RC: Op.mode recording				100 004
0: Operating signals				
Selection for the operating mode of the operating data recording.				

Fault recording

Parameter	Address			
Default	Min	Max	Unit	Logic Diagram
FT_RC: Rec. analog chann. 1				035 160
1: Current IA				
FT_RC: Rec. analog chann. 2				035 161
2: Current IB				
FT_RC: Rec. analog chann. 3				035 162
3: Current IC				
FT_RC: Rec. analog chann. 4				035 163
5: Voltage A-G				
FT_RC: Rec. analog chann. 5				035 164
6: Voltage B-G				
FT_RC: Rec. analog chann. 6				035 165
7: Voltage C-G				
FT_RC: Rec. analog chann. 7				035 166
4: Current IN				
FT_RC: Rec. analog chann. 8				035 167
8: Voltage VNG				
FT_RC: Rec. analog chann. 9				035 168
210: Voltage Vref				
The user specifies the channel on which each physical variable is recorded.				
FT_RC: Rec. analog chann.10				035 169
0: Without				
<i>fmeas</i> can be recorded on this channel. Note: The setting options might offer physical variables that the P433 is not able to measure. This is due to the fact that the setting options are shared between different MiCOM Px3x devices. For the P433, however, only the settings <i>Without</i> and <i>fmeas</i> are functional.				

Distance protection

Parameter	Address			
Default	Min	Max	Unit	Logic Diagram
DIST: Function group DIST				056 014
1: With				
Canceling function group DIST or including it in the configuration. If the function group is cancelled from the configuration, then all associated settings and signals are hidden.				

Power swing
blocking

Parameter	Address			
Default	Min	Max	Unit	Logic Diagram
PSB: Function group PSB				056 001
0: Without				
Cancelling function group PSB or including it in the configuration. If any function group is cancelled from the configuration, then all associated settings and signals are hidden.				

Measuring-circuit
monitoring

Parameter	Address			
Default	Min	Max	Unit	Logic Diagram
MCMON: Function group MCMON				056 015
0: Without				
Cancelling function group MCMON or including it in the configuration. If the function group is cancelled from the configuration, then all associated settings and signals are hidden.				

Backup overcurrent-
time protection

Parameter	Address			
Default	Min	Max	Unit	Logic Diagram
BUOC: Function group BUOC				056 002
0: Without				
Cancelling function group BUOC or including it in the configuration. If the function group is cancelled from the configuration, then all associated settings and signals are hidden.				

Switch on to fault
protection

Parameter	Address			
Default	Min	Max	Unit	Logic Diagram
SOTF: Function group SOTF				056 003
0: Without				
Cancelling function group SOTF or including it in the configuration. If the function group is cancelled from the configuration, then all associated settings and signals are hidden.				

Protective signaling

Parameter	Address			
Default	Min	Max	Unit	Logic Diagram
PSIG: Function group PSIG				056 004
0: Without				
Cancelling function group PSIG or including it in the configuration. If the function group is cancelled from the configuration, then all associated settings and signals are hidden.				

Auto-reclosing control

Parameter	Address			
Default	Min	Max	Unit	Logic Diagram
ARC: Function group ARC				056 005
0: Without				
Cancelling function group ARC or including it in the configuration. If the function group is cancelled from the configuration, then all associated settings and signals are hidden.				

Automatic synchronism check

Parameter	Address			
Default	Min	Max	Unit	Logic Diagram
ASC: Function group ASC				056 006
0: Without				
Cancelling function group ASC or including it in the configuration. If any function group is cancelled from the configuration, then all associated settings and signals are hidden.				

Ground fault (short-circuit) protection

Parameter	Address			
Default	Min	Max	Unit	Logic Diagram
GFSC: Function group GFSC				056 011
0: Without				
Cancelling function group GFSC or including it in the configuration. If any function group is cancelled from the configuration, then all associated settings and signals are hidden.				

Ground fault (short-circuit) protection signaling

Parameter				Address
Default	Min	Max	Unit	Logic Diagram
GSCSG: Function group GSCSG				056 028
0: Without				
Cancelling function group GSCSG or including it in the configuration. If any function group is cancelled from the configuration, then all associated settings and signals are hidden.				

Definite-time over-current protection

Parameter				Address
Default	Min	Max	Unit	Logic Diagram
DTOC: Function group DTOC				056 008
0: Without				
Cancelling function group DTOC or including it in the configuration. If the function group is cancelled from the configuration, then all associated settings and signals are hidden.				

Inverse-time overcurrent protection

Parameter				Address
Default	Min	Max	Unit	Logic Diagram
IDMT: Function group IDMT				056 009
0: Without				
Canceling function group IDMT or including it in the configuration. If the function group is cancelled from the configuration, then all associated settings and signals are hidden.				

Short-circuit direction determination

Parameter				Address
Default	Min	Max	Unit	Logic Diagram
SCDD: Function group SCDD				056 021
1: With				
Canceling function group SCDD or including it in the configuration. If the function group is cancelled from the configuration, then all associated settings and signals are hidden.				

Ground fault direction determination using steady-state values

Parameter					Address
Default	Min	Max	Unit		Logic Diagram
GFDSS: Function group GFDSS					056 012
0: Without					
Cancelling function group GFDSS or including it in the configuration. If the function group is cancelled from the configuration, then all associated settings and signals are hidden.					

Pulse detection

Parameter					Address
Default	Min	Max	Unit		Logic Diagram
PULSE: Function group PULSE					056 099
0: Without					
Cancelling function group PULSE or including it in the configuration. If the function group is cancelled from the configuration, then all associated settings and signals are hidden.					

Ground fault tripping

Parameter					Address
Default	Min	Max	Unit		Logic Diagram
GFTRP: Function group GFTRP					056 016
0: Without					
Cancelling function group GFTRP or including it in the configuration. If the function group is cancelled from the configuration, then all associated settings and signals are hidden.					

Ground fault protection signaling

Parameter					Address
Default	Min	Max	Unit		Logic Diagram
GFSIG: Function group GFSIG					056 018
0: Without					
Cancelling function group GFSIG or including it in the configuration. If the function group is cancelled from the configuration, then all associated settings and signals are hidden.					

Transient ground
fault direction deter-
mination

Parameter					Address
Default	Min	Max	Unit		Logic Diagram
TGFD: Function group TGFD					056 019
0: Without					
Cancelling function group TGFD or including it in the configuration. If any function group is cancelled from the configuration, then all associated settings and signals are hidden.					

Thermal overload
protection

Parameter					Address
Default	Min	Max	Unit		Logic Diagram
THERM: Function group THERM					056 023
0: Without					
Cancelling function group THERM or including it in the configuration. If the function group is cancelled from the configuration, then all associated settings and signals are hidden, with the exception of this setting.					

Time-voltage protec-
tion

Parameter					Address
Default	Min	Max	Unit		Logic Diagram
V<>: Function group V<>					056 010
0: Without					
Cancelling function group V<> or including it in the configuration. If the function group is cancelled from the configuration, then all associated settings and signals are hidden, with the exception of this setting.					

Over-/
underfrequency pro-
tection

Parameter					Address
Default	Min	Max	Unit		Logic Diagram
f<>: Function group f<>					056 033
0: Without					
Canceling function group f<> or including it in the configuration. If the function group is cancelled from the configuration, then all associated settings and signals are hidden, with the exception of this setting.					

Underfrequency load shedding

Parameter	Address			
Default	Min	Max	Unit	Logic Diagram
Pf<: Function group Pf<				056 094
0: Without				
Cancelling function group Pf< or including it in the configuration. If the function group is cancelled from the configuration, then all associated settings and signals are hidden.				

Power directional protection

Parameter	Address			
Default	Min	Max	Unit	Logic Diagram
P<>: Function group P<>				056 045
0: Without				
Cancelling function group P<> or including it in the configuration. If the function group is cancelled from the configuration, then all associated settings and signals are hidden.				

Voltage controlled directional reactive power protection

Parameter	Address			
Default	Min	Max	Unit	Logic Diagram
QV: Function group QV				056 092
0: Without				
Cancelling function group QV or including it in the configuration. If the function group is cancelled from the configuration, then all associated settings and signals are hidden.				

High Impedance protection

Parameter	Address			
Default	Min	Max	Unit	Logic Diagram
DELTA: Function group DELTA				056 078
0: Without				
Cancelling function group DELTA or including it in the configuration. If the function group is cancelled from the configuration, then all associated settings and signals are hidden, with the exception of this setting.				

Circuit breaker
failure protection

Parameter					Address
Default	Min	Max	Unit		Logic Diagram
CBF: Function group CBF					056 007
0: Without					
Cancelling function group CBF or including it in the configuration. If the function group is cancelled from the configuration, then all associated settings and signals are hidden, with the exception of this setting.					

Circuit breaker
condition monitoring

Parameter					Address
Default	Min	Max	Unit		Logic Diagram
CBM: Function group CBM					056 062
0: Without					
Cancelling function group CBM or including it in the configuration. If the function group is cancelled from the configuration, then all associated settings and signals are hidden.					

Limit value
monitoring

Parameter					Address
Default	Min	Max	Unit		Logic Diagram
LIMIT: Function group LIMIT					056 025
0: Without					
Cancelling function group LIMIT or including it in the configuration. If the function group is cancelled from the configuration, then all associated settings and signals are hidden, with the exception of this setting.					

Transformer
monitoring

Parameter					Address
Default	Min	Max	Unit		Logic Diagram
TRMON: Function group TRMON					056 095
0: Without					
Cancelling function group TRMON or including it in the configuration. If the function group is cancelled from the configuration, then all associated settings and signals are hidden.					

Programmable Logic

Parameter					Address
Default	Min	Max	Unit		Logic Diagram
LOGIC: Function group LOGIC					056 017
0: Without					
Cancelling function group LOGIC or including it in the configuration. If the function group is cancelled from the configuration, then all associated settings and signals are hidden.					

Programmable Logic

Parameter					Address
Default	Min	Max	Unit		Logic Diagram
LOG_2: Function group LOG_2					056 089
0: Without					
Cancelling function group LOG_2 ("Logic 2") or including it in the configuration. If the function group is cancelled from the configuration, then all associated settings and signals are hidden.					

Real Timer

Parameter					Address
Default	Min	Max	Unit		Logic Diagram
TIMER: Function group TIMER					056 093
0: Without					
Cancelling function group TIMER or including it in the configuration. If the function group is cancelled from the configuration, then all associated settings and signals are hidden.					

External device

Parameter	Address			
Default	Min	Max	Unit	Logic Diagram
DEV01: Function group DEV01				210 047
0: Without				
DEV02: Function group DEV02				210 097
0: Without				
DEV03: Function group DEV03				210 147
0: Without				
Cancelling function groups DEV01 to DEV03 or including them in the configuration. If any function group is cancelled from the configuration, then all associated settings and signals are hidden.				
DEV01: Funct. type, signal				210 034
242	1	254		
DEV02: Funct. type, signal				210 084
242	1	254		
DEV03: Funct. type, signal				210 134
242	1	254		
Setting the function type of the signal. Note: If the IEC 870-5-101 communication protocol has been set, then the 'low address' of the information object will be defined by this setting. If the ILS-C protocol has been set, then this setting will correspond to DN2.				
DEV01: Inform. No., signal				210 035
1	0	254		
DEV02: Inform. No., signal				210 085
3	0	254		
DEV03: Inform. No., signal				210 135
5	0	254		
Setting the information number of the signal. Note: If the IEC 870-5-101 communication protocol has been set, then the 'high address' of the information object will be defined by this setting. If the ILS-C protocol has been set, then this setting will correspond to DN3.				
DEV01: Funct. type, command				210 032
242	1	254		
DEV02: Funct. type, command				210 082
242	1	254		
DEV03: Funct. type, command				210 132
242	1	254		
Setting for the function type of the command. Note: If the IEC 870-5-101 communication protocol has been set, then the "low address" of the information object will be defined by this setting. If the ILS-C protocol has been set, then this setting will correspond to DN2.				

Parameter					Address
Default	Min	Max	Unit		Logic Diagram
DEV01: Inform. No., command					210 033
65	0	254			
DEV02: Inform. No., command					210 083
67	0	254			
DEV03: Inform. No., command					210 133
69	0	254			
Setting the information number of the command.					
Note: If the IEC 870-5-101 communication protocol has been set, then the 'high address' of the information object will be defined by this setting. If the ILS-C protocol has been set, then this setting will correspond to DN3.					

Interlocking logic

Parameter					Address
Default	Min	Max	Unit		Logic Diagram
ILOCK: Function group ILOCK					250 102
1: With					
Cancelling function group ILOCK or including it in the configuration. If the function group is cancelled from the configuration, then all associated settings and signals are hidden, with the exception of this setting.					

Single-pole
commands

Parameter				Address	
Default	Min	Max	Unit	Logic Diagram	
CMD_1: Function group CMD_1					249 252
1: With					
Cancelling function group CMD_1 or including it in the configuration. If the function group is cancelled from the configuration, then all associated settings and signals are hidden, with the exception of this setting.					
CMD_1: Command C001 config.					200 004
0: No Fig. 3-433, (p. 3-517)					
CMD_1: Command C002 config.					200 009
0: No					
CMD_1: Command C003 config.					200 014
0: No					
CMD_1: Command C004 config.					200 019
0: No					
CMD_1: Command C005 config.					200 024
0: No					
CMD_1: Command C006 config.					200 029
0: No					
CMD_1: Command C007 config.					200 034
0: No					
CMD_1: Command C008 config.					200 039
0: No					
CMD_1: Command C009 config.					200 044
0: No					
CMD_1: Command C010 config.					200 049
0: No					
CMD_1: Command C011 config.					200 054
0: No					
CMD_1: Command C012 config.					200 059
0: No					
Cancelling the command or including it in the configuration. If the command is cancelled, then all associated settings and signals are hidden, with the exception of this setting.					

Parameter				Address	
Default	Min	Max	Unit	Logic Diagram	
CMD_1: CMD_DC3 config.					202 014
0: No					
Cancelling command CMD_DC3 or including it in the configuration. This command is used for direct motor control, the operation is delayed by the set value MAIN: DC op. delay t1, and it is terminated with the signal SIG_1: Logic SIG_DC3 or – if MAIN: Ext.cmd.term. w/o PI = No – with positive indication of the final switchgear position; in any case this reset is delayed by the set value MAIN: DC2/3 release delay. If the command is cancelled, then all associated settings and signals are hidden, with the exception of this setting.					

Single-pole signals

Parameter					Address
Default	Min	Max	Unit		Logic Diagram
SIG_1: Function group SIG_1					249 250
1: With					
Cancelling function group SIG_1 or including it in the configuration. If the function group is cancelled from the configuration, then all associated settings and signals are hidden, with the exception of this setting.					
SIG_1: Signal S001 config.					226 007
0: No Fig. 3-434, (p. 3-519)					
SIG_1: Signal S002 config.					226 015
0: No					
SIG_1: Signal S003 config.					226 023
0: No					
SIG_1: Signal S004 config.					226 031
0: No					
SIG_1: Signal S005 config.					226 039
0: No					
SIG_1: Signal S006 config.					226 047
0: No					
SIG_1: Signal S007 config.					226 055
0: No					
SIG_1: Signal S008 config.					226 063
0: No					
SIG_1: Signal S009 config.					226 071
0: No					
SIG_1: Signal S010 config.					226 079
0: No					
SIG_1: Signal S011 config.					226 087
0: No					
SIG_1: Signal S012 config.					226 095
0: No					
Cancelling the signal or including it in the configuration. If a signal is cancelled, then all associated settings and signals are hidden.					
SIG_1: SIG_DC3 config.					233 007
0: No					
Cancelling the signal SIG_DC3 or including it in the configuration. This signal is used to terminate a direct motor control command in combination with the single-pole command CMD_1: CMD_DC3. If this signal is cancelled, then all associated settings are hidden.					

Binary counts

Parameter				Address
Default	Min	Max	Unit	Logic Diagram
COUNT: Function group COUNT				217 047
0: Without				
Cancelling function group COUNT or including it in the configuration. If the function group is cancelled from the configuration, then all associated settings and signals are hidden, with the exception of this setting.				

7.1.3

Function Parameters

7.1.3.1

Global

PC link

Parameter				Address
Default	Min	Max	Unit	Logic Diagram
PC: Command blocking				003 182
0: No Fig. 3-10, (p. 3-18)				
When command blocking is activated, commands are rejected at the PC interface.				
PC: Sig./meas.val.block.				003 086
0: No Fig. 3-10, (p. 3-18)				
When signal and measured value blocking is activated, no signals or measured data are transmitted through the PC interface.				

“Logical”
communication
interface 1

Parameter				Address
Default	Min	Max	Unit	Logic Diagram
COMM1: Command block. USER				003 172
1: Yes Fig. 3-11, (p. 3-20)				
When command blocking is activated, commands are rejected at communication interface 1.				
COMM1: Sig./meas.block.USER				003 076
0: No Fig. 3-12, (p. 3-21) Fig. 3-13, (p. 3-22) Fig. 3-14, (p. 3-23)				
When signal and measured value blocking user is activated, no signals or measured data are transmitted through communication interface COMM1.				

“Logical”
communication
interface 2

Parameter					Address
Default	Min	Max	Unit		Logic Diagram
COMM2: Command block. USER					103 172
0: No					Fig. 3-19, (p. 3-29)
When command blocking is activated, commands are rejected at communication interface 2.					
COMM2: Sig./meas.block.USER					103 076
0: No					Fig. 3-19, (p. 3-29)
When signal and measured value blocking user is activated, no signals or measured data are transmitted through communication interface COMM2.					

IEC 61850
Communication

Parameter					Address
Default	Min	Max	Unit		Logic Diagram
IEC: Command block. USER					104 085
1: Yes					
When command blocking is activated, commands are rejected at IEC communication interface.					
IEC: Ctrl blocked user					221 125
0: No					Fig. 3-25, (p. 3-51)
When control blocking is activated, controls are rejected at IEC communication, i.e no output data (digital by relays) will be issued to the process.					
IEC: Sig./meas.block.USER					104 088
0: No					
When signal and measured value blocking user is activated, no signals or measured data are transmitted through IEC communication interface.					

Binary and analog
output

Parameter					Address
Default	Min	Max	Unit		Logic Diagram
OUTP: Outp.rel.block USER					021 014
0: No					Fig. 3-40, (p. 3-71)
When this blocking is activated, all output relays are blocked.					

Main function

Parameter					Address
Default	Min	Max	Unit	Logic Diagram	
MAIN: Device on-line					003 030
0: No (= off)			Fig. 3-67, (p. 3-110)		
Switching the device off-line or on-line. Some parameters can only be changed when protection is disabled.					
MAIN: Test mode USER					003 012
0: No			Fig. 3-95, (p. 3-137)		
When the test mode user is activated, signals or measured data for PC and communication interfaces are labeled 'test mode'.					
MAIN: Nominal frequ. f _{nom}					010 030
50: 50 Hz			Hz		
Setting for the nominal frequency of the protected system.					
MAIN: Phase sequence					010 049
1: A - B - C			Fig. 3-57, (p. 3-99) Fig. 3-287, (p. 3-360)		
Setting the phase sequence A-B-C or A-C-B. (Alternative terminology: Setting for the rotary field's direction, either clockwise or anticlockwise.)					
MAIN: Time tag					221 098
1: 1stEdge,OpMem sorted					
For bay control function signals detected via binary signal inputs and conditioned with debouncing it is now possible to select whether the time tag for the signal is to be issued after debouncing or when the first pulse edge is detected. Furthermore it is defined whether entries in the operating data memory are made in chronological order or not.					
MAIN: I _{nom} C.T. prim.					010 001
1000	1	10000	A	Fig. 3-53, (p. 3-95) Fig. 3-54, (p. 3-96) Fig. 3-393, (p. 3-469)	
Setting for the primary nominal current of the main current transformers for measurement of phase currents.					
MAIN: I _{N,nom} C.T. prim.					010 018
1000	1	10000	A	Fig. 3-55, (p. 3-97)	
Setting for the primary nominal current of the main current transformer for measurement of residual current.					
MAIN: V _{nom} V.T. prim.					010 002
100.0	0.1	1000.0	kV	Fig. 3-58, (p. 3-100)	
Setting for the primary nominal voltage of the system transformer for measurement of phase-to-ground and phase-to-phase voltages.					

Parameter					Address
Default	Min	Max	Unit		Logic Diagram
MAIN: VNG,nom V.T. prim.					010 027
100.0	0.1	1000.0	kV	Fig. 3-59, (p. 3-101)	
Setting for the primary nominal voltage of the system transformer for measurement of neutral-point displacement voltage.					
MAIN: Vref,nom V.T. prim.					010 100
100.0	0.1	1000.0	kV	Fig. 3-60, (p. 3-101)	
Setting for the primary nominal voltage of the system transformer for measurement of reference voltage for automatic synchronism check.					
MAIN: Inom device					010 003
1.0: 1.0 A			A	Fig. 3-52, (p. 3-92)	
Setting for the secondary nominal current of the system transformer for measurement of phase currents. This also corresponds to the nominal device current.					
MAIN: IN,nom device					010 026
1.0: 1.0 A			A	Fig. 3-52, (p. 3-92)	
Setting for the secondary nominal current of the system transformer for measurement of residual current. This also corresponds to the nominal device current.					
MAIN: Vnom V.T. sec.					010 009
100	50	130	V	Fig. 3-52, (p. 3-92)	
Setting for the secondary nominal voltage of the system transformer for measurement of phase-to-ground and phase-to-phase voltages.					
MAIN: VNG,nom V.T. sec.					010 028
100	50	130	V	Fig. 3-52, (p. 3-92)	
Setting for the secondary nominal voltage of the system transformer for measurement of neutral-point displacement voltage.					
MAIN: Vref,nom V.T. sec.					031 052
100	50	130	V	Fig. 3-52, (p. 3-92)	
Setting for the secondary nominal voltage of the system transformer for measurement of reference voltage for automatic synchronism check.					
MAIN: Conn. meas. circ. IP					010 004
1: Standard				Fig. 3-52, (p. 3-92)	
Short-circuit direction determination depends on the connection of the measuring circuits. If the connection is as shown in Chapter "Installation and Connection", then the setting must be <i>Standard</i> , if the P433's 'forward' decision is to be in the direction of the outgoing feeder. If the connection direction is reversed or – given a connection scheme according to Chapter "Installation and Connection" – if the 'forward' decision is to be in the busbar direction, then the setting must be <i>Opposite</i> .					

Parameter					Address
Default	Min	Max	Unit	Logic Diagram	
MAIN: Conn. meas. circ. IN					010 019
1: Standard			Fig. 3-52, (p. 3-92)		
Direction determination of the ground fault measuring systems depends on the connection of the measuring circuits. If the connection is as shown in Chapter "Installation and Connection", then the setting must be <i>Standard</i> , if the P433's 'forward' decision is to be in the direction of the outgoing feeder. If the connection direction is reversed or – given a connection scheme according to Chapter "Installation and Connection" – if the 'forward' decision is to be in the busbar direction, then the setting must be <i>Opposite</i> .					
MAIN: Meas. direction P,Q					006 096
1: Standard			Fig. 3-61, (p. 3-102)		
This parameter allows inverting the sign for the following measured operating values: ● MAIN: Active power P prim. ● MAIN: Reac. power Q prim. ● MAIN: Active power P p.u. ● MAIN: Reac. power Q p.u.					
MAIN: Meas. value rel. IP					011 030
0.000	0.000	0.200	Inom	Fig. 3-53, (p. 3-95)	
Setting for the minimum current that must be exceeded so that measured operating values of the phase currents and, if applicable, derived currents are displayed.					
MAIN: Meas. value rel. IN					011 031
0.000	0.000	0.200	IN,nom	Fig. 3-55, (p. 3-97)	
Setting for the minimum current that must be exceeded so that the measured operating value of the residual current is displayed.					
MAIN: Meas. value rel. V					011 032
0.000	0.000	0.200	Vnom	Fig. 3-58, (p. 3-100)	
Setting for the minimum voltage that must be exceeded so that measured operating values of the phase-to-ground voltages, phase-to-phase voltages, and, if applicable, derived voltages are displayed.					
MAIN: Meas. val. rel. VNG					011 033
0.000	0.000	0.200	VNG,nom	Fig. 3-59, (p. 3-101)	
Setting for the minimum voltage that must be exceeded so that the measured operating value of the neutral-point displacement voltage is displayed.					
MAIN: Meas. val. rel. Vref					011 034
0.000	0.000	0.200	Vref,nom	Fig. 3-60, (p. 3-101)	
Setting for the minimum voltage that must be exceeded so that the measured operating value of the reference voltage for the automatic synchronism check is displayed.					

Parameter				Address
Default	Min	Max	Unit	Logic Diagram
MAIN: Op. mode energy cnt.				010 138
1: Procedure 1				Fig. 3-65, (p. 3-106)
Selection of the procedure to determine the active and reactive energy output. 1 st procedure: Data acquisition every 2s (approximately). 2 nd procedure: Data acquisition every 100ms (approximately)				
MAIN: Settl. t. $I_{P,max,del}$				010 113
15.0	0.1	60.0	min	Fig. 3-54, (p. 3-96)
Setting for the time after which the delayed maximum current display shall reach 95% of the maximum current $I_{P,max}$.				
MAIN: Fct.assign. reset 1				005 248
060 000: MAIN: Without function				Fig. 3-93, (p. 3-135)
Assigning specific memories and counters which are to be reset jointly if MAIN: Group reset 1 USER is enabled.				
MAIN: Fct.assign. reset 2				005 249
060 000: MAIN: Without function				Fig. 3-93, (p. 3-135)
Assigning specific memories and counters which are to be reset jointly if MAIN: Group reset 2 USER is enabled.				
MAIN: Fct.assign. block. 1				021 021
060 000: MAIN: Without function				Fig. 3-73, (p. 3-115)
Assignment of functions that will be blocked simultaneously when blocking input 1 (MAIN: Blocking 1 EXT) is activated.				
MAIN: Fct.assign. block. 2				021 022
060 000: MAIN: Without function				Fig. 3-73, (p. 3-115)
Assignment of functions that will be blocked simultaneously when blocking input 2 (MAIN: Blocking 2 EXT) is activated.				
MAIN: Trip cmd.block. USER				021 012
0: No				Fig. 3-85, (p. 3-127)
Blocking the trip commands from the local control panel.				
MAIN: Fct.assign.trip cmd.1				021 001
060 000: MAIN: Without function				Fig. 3-84, (p. 3-126) Fig. 3-224, (p. 3-287)
Assignment of signals that trigger trip command 1.				
MAIN: Fct.assign.trip cmd.2				021 002
060 000: MAIN: Without function				Fig. 3-84, (p. 3-126)
Assignment of the signals that trigger trip command 2.				

Parameter					Address
Default	Min	Max	Unit		Logic Diagram
MAIN: Fct.assig.trip cmd.3					021 046
060 000: MAIN: Without function					Fig. 3-84, (p. 3-126)
Assignment of signals that trigger trip command 3.					
MAIN: Fct.assig.trip cmd.4					021 047
060 000: MAIN: Without function					Fig. 3-84, (p. 3-126)
Assignment of signals that trigger trip command 4.					
MAIN: Min.dur. trip cmd. 1					021 003
0.10	0.10	10.00	s		Fig. 3-84, (p. 3-126) Fig. 5-16, (p. 5-24)
Setting for the minimum duration of trip command 1.					
MAIN: Min.dur. trip cmd. 2					021 004
0.10	0.10	10.00	s		Fig. 3-84, (p. 3-126)
Setting for the minimum duration of trip command 2.					
MAIN: Min.dur. trip cmd. 3					021 032
0.10	0.10	10.00	s		Fig. 3-84, (p. 3-126)
Setting for the minimum duration of trip command 3.					
MAIN: Min.dur. trip cmd. 4					021 033
0.10	0.10	10.00	s		Fig. 3-84, (p. 3-126)
Setting for the minimum duration of trip command 4.					
MAIN: Latching trip cmd. 1					021 023
0: No					
Specification as to whether trip command 1 should latch.					
MAIN: Latching trip cmd. 2					021 024
0: No					
Specification as to whether trip command 2 should latch.					
MAIN: Latching trip cmd. 3					021 025
0: No					
Specification as to whether trip command 3 should latch.					
MAIN: Latching trip cmd. 4					021 026
0: No					
Specification as to whether trip command 4 should latch.					
MAIN: Close cmd.pulse time					015 067
0.100	0.100	10.000	s		Fig. 3-77, (p. 3-119)
Setting for the duration of the close command.					

Parameter				Address			
Default	Min	Max	Unit	Logic Diagram			
MAIN: tCB,close							000 032
0.060	0.000	1.000	s				
This setting determines the CB close time. In slightly asynchronous power systems, the CB close time is taken into account by the automatic synchronism check (ASC) to issue of a close command. This is only possible if setting ASC: AR with tCB PSx = Yes or ASC: MC with tCB PSx = Yes.							
MAIN: RC inhib.by CB close							015 042
0: No				Fig. 3-77, (p. 3-119)			
This setting determines whether the reclose command will be inhibited as soon as the “Circuit breaker closed” signal starts.							
MAIN: Rel.t. enab. man.cmd							003 088
60	1	3600	s	Fig. 3-77, (p. 3-119)			
Setting for the release time of the enable for the manual close command.							
MAIN: Fct. assign. fault							021 031
060 000: MAIN: Without function				Fig. 3-74, (p. 3-115)			
Selection of the signals to be signaled as Blocked/Faulty in addition to the messages that always result in the message Blocked/Faulty.							
MAIN: Sig. asg. CB open							021 017
061 000: MAIN: Without function				Fig. 3-391, (p. 3-467)			
Definition of the binary signal used by the P433 to evaluate the “CB open” position signal.							
MAIN: Sig.assign. CB close							021 020
061 000: MAIN: Without function				Fig. 3-75, (p. 3-116)			
Definition of the binary signal used by the P433 to evaluate the “CB closed” position signal.							
MAIN: Debounce time gr. 1							221 200
0.02	0.00	2.54	s	Fig. 3-435, (p. 3-520)			
MAIN: Debounce time gr. 2							221 203
0.02	0.00	2.54	s				
MAIN: Debounce time gr. 3							221 206
0.02	0.00	2.54	s				
Setting for the debouncing time.							
MAIN: Chatt.mon. time gr.1							221 201
0.0	0.0	25.4	s	Fig. 3-435, (p. 3-520)			
MAIN: Chatt.mon. time gr.2							221 204
0.0	0.0	25.4	s				

Parameter	Address			
Default	Min	Max	Unit	Logic Diagram
MAIN: Chatt.mon. time gr.3				221 207
0.0	0.0	25.4	s	
Setting for the chatter monitoring time.				
MAIN: Change of state gr.1				221 202
0	0	254		Fig. 3-435, (p. 3-520)
MAIN: Change of state gr.2				221 205
0	0	254		
MAIN: Change of state gr.3				221 208
0	0	254		
Setting the number of signal changes allowed during the chatter monitoring time before chatter suppression operates.				
MAIN: Cmd. dur.long cmd.				221 230
20	1	254	s	
Setting for the command duration for a long command.				
MAIN: Cmd. dur. short cmd.				221 231
1	1	254	s	
Setting for the command duration for a short command.				
MAIN: Inp.asg. ctrl.enabl.				221 057
060 000: MAIN: Without function				Fig. 3-414, (p. 3-491)
Definition of the binary signal used to issue a general command output enable.				
MAIN: Inp.asg.interl.deact				221 007
060 000: MAIN: Without function				Fig. 3-414, (p. 3-491)
Definition of the binary signal used to disable interlocking of control commands for switchgear.				
MAIN: Inp.asg. L/R key sw.				221 008
060 000: MAIN: Without function				
Definition of the binary signal used to switch from remote control to local control.				
MAIN: Electrical control				221 061
1: Remote				
This setting determines whether the binary inputs, that are configured to control switchgear, will be active with remote control or local control.				

Parameter				Address
Default	Min	Max	Unit	Logic Diagram
MAIN: Delay Man.Op.Superv.				221 079
3	0	255	s	
After the delay time period, to be set in this window, has elapsed (with the signal "Sw. dev. interm. pos." already present and the status signal continuously absent), the actual switchgear status signal, as obtained from the respective binary inputs, will be issued. (See also "Processing status signals from manually operated switchgear".)				
MAIN: Oper. mode CB Trip				221 080
1: ALSTOM D				Fig. 3-89, (p. 3-131)
Definition of the operating mode of the CB trip.				
MAIN: W. ext. cmd. termin.				221 063
0: No				
This setting determines if bay types, defined for direct motor control, can be used together with external termination contacts to directly influence the control process of motor driven switchgear.				
MAIN: Inp.assign. tripping				221 010
060 000: MAIN: Without function				Fig. 3-89, (p. 3-131)
Definition of the binary signal used to signal the tripping of an external protection device. This signal is used to form the CB trip signal.				
MAIN: Prot.trip>CB tripped				221 012
0: Without function				Fig. 3-89, (p. 3-131)
Selection of the protection function trip command that will be used to form the CB trip signal.				
MAIN: Inp. asg. CB trip				221 013
060 000: MAIN: Without function				Fig. 3-89, (p. 3-131)
Definition of the binary signal used by the P433 to signal the "CB open" position signal.				
MAIN: Inp.asg.CB tr.en.ext				221 050
060 000: MAIN: Without function				Fig. 3-89, (p. 3-131)
Definition of the binary signal used to enable the CB trip signal of an external device.				
MAIN: Inp.asg. CB trip ext				221 024
060 000: MAIN: Without function				Fig. 3-89, (p. 3-131)
Definition of the binary signal used to carry the CB trip signal of an external device.				
MAIN: Inp.asg. mult.sig. 1				221 051
060 000: MAIN: Without function				Fig. 3-78, (p. 3-120)

Parameter				Address
Default	Min	Max	Unit	Logic Diagram
MAIN: Inp.asg. mult.sig. 2				221 052
060 000: MAIN: Without function				Fig. 3-78, (p. 3-120)
Definition of the function that will be interpreted as a multiple signal (group signal).				
MAIN: Fct.asg. grp.sig. 01				019 184
060 000: MAIN: Without function				
MAIN: Fct.asg. grp.sig. 02				019 185
060 000: MAIN: Without function				
MAIN: Fct.asg. grp.sig. 03				019 186
060 000: MAIN: Without function				
MAIN: Fct.asg. grp.sig. 04				019 187
060 000: MAIN: Without function				
MAIN: Fct.asg. grp.sig. 05				019 188
060 000: MAIN: Without function				
MAIN: Fct.asg. grp.sig. 06				019 189
060 000: MAIN: Without function				
MAIN: Fct.asg. grp.sig. 07				019 190
060 000: MAIN: Without function				
MAIN: Fct.asg. grp.sig. 08				019 191
060 000: MAIN: Without function				
Selection up to 32 internal signals to be grouped using Boolean operators NOT, AND, OR.				

Parameter subset selection

Parameter	Address			
Default	Min	Max	Unit	Logic Diagram
PSS: Control via USER				003 100
0: No Fig. 3-96, (p. 3-139)				
If parameter subset selection is to be handled from the integrated local control panel rather than via binary signal inputs, choose the setting Yes.				
PSS: Param.subs.sel. USER				003 060
1: Parameter subset 1 Fig. 3-96, (p. 3-139)				
Selection of the parameter subset from the local control panel.				
PSS: Keep time				003 063
Blocked	0.000	65.000	s	Fig. 3-96, (p. 3-139)
The setting of this timer stage is relevant only if parameter subset selection is carried out via the binary signal inputs. Any voltage-free pause that may occur during selection is bridged. If, after this time period has elapsed, no binary signal input has yet been set, then the parameter subset selected from the local control panel shall apply.				

Self-monitoring

Parameter	Address			
Default	Min	Max	Unit	Logic Diagram
SFMON: Fct. assign. warning				021 030
060 000: MAIN: Without function Fig. 3-97, (p. 3-140)				
Selection of the signals whose appearance shall result in the signals “Warning (LED)” and “Warning (relay)” and in the activation of the LED indicator labeled “ALARM”. Signals caused by faulty hardware and leading to blocking of the device are not configurable. They always result in the above signals and indication.				
SFMON: Mon.sig. retention				021 018
Blocked	0	240	h	
This setting defines the duration (in hours) for which a device-internal fault is stored, so that a decision may be taken between an automatic warm restart and an automatic device blocking. (Setting to <i>Blocked</i> may be considered the same as unlimited storage.)				

Fault recording

Parameter	Address			
Default	Min	Max	Unit	Logic Diagram
FT_RC: Fct. assign. trigger				003 085
060 000: MAIN: Without function Fig. 3-118, (p. 3-166)				
This setting defines the signals that will trigger fault recording.				
FT_RC: I>				017 065
Blocked	0.01	40.00	Inom	
This setting defines the threshold value of the phase currents that will trigger fault recording and fault data acquisition.				
FT_RC: Pre-fault time				003 078
5	1	50	Periods	Fig. 3-120, (p. 3-169)
Setting for the time during which data will be recorded before the onset of a fault (pre-fault recording time).				
FT_RC: Post-fault time				003 079
5	1	750	Periods	Fig. 3-120, (p. 3-169)
Setting for the time during which data will be recorded after the end of a fault (post-fault recording time).				
FT_RC: Max. recording time				003 075
50	5	1500	Periods	Fig. 3-120, (p. 3-169)
Setting for the maximum recording time per fault. This includes pre-fault and post-fault recording times.				

7.1.3.2

General Functions

Main function

Parameter	Address			
Default	Min	Max	Unit	Logic Diagram
MAIN: Selection meas. volt				018 202
4: Voltage A-B Fig. 3-71, (p. 3-113)				
Setting for the voltage that shall be used for frequency measurement.				
MAIN: Evaluation time				018 201
5	3	6	Periods	Fig. 3-71, (p. 3-113)
Setting for the evaluation time. The operate conditions must be met for the duration of the set evaluation time in order for a signal to be issued.				
MAIN: Undervolt. block. V<				018 200
0.65	0.20	1.00	Vnom/(√3)	Fig. 3-71, (p. 3-113)
Setting for the threshold of undervoltage blocking. If the voltage falls below this threshold, the over-/underfrequency protection function and underfrequency load shedding function will be blocked.				

Distance protection

Parameter				Address	
Default	Min	Max	Unit	Logic Diagram	
DIST: General enable USER					031 073
1: Yes			Fig. 3-121, (p. 3-170)		
Enable/disable the distance protection function.					
DIST: CVT stabilization					010 031
0: No			Fig. 3-133, (p. 3-186)		
This setting defines whether distance protection will operate with or without stabilization against transient transformation errors of capacitive voltage transformers.					

Power swing blocking

Parameter				Address
Default	Min	Max	Unit	Logic Diagram
PSB: General enable USER				014 050
0: No			Fig. 3-164, (p. 3-220)	
Disabling or enabling power swing blocking.				
PSB: R				014 060
50 10 (For MAIN: Inom device=1.0A 5.0A)	0.1 0.02	200 40	Ω	Fig. 3-165, (p. 3-221)
PSB: posX				014 061
50 10 (For MAIN: Inom device=1.0A 5.0A)	0.1 0.02	200 40	Ω	Fig. 3-165, (p. 3-221)
PSB: negX				006 185
50 10 (For MAIN: Inom device=1.0A 5.0A)	0.1 0.02	200 40	Ω	Fig. 3-165, (p. 3-221)
PSB: α				014 062
75	40	90	°	Fig. 3-165, (p. 3-221)
Setting for the power swing polygon.				
PSB: Oper. value Delta T				014 090
20	5	60	ms	
Setting of the timer stage for operating mode PSB: Operating mode = Delta Z.				
PSB: Activation cond. dZ				008 235
1: Power Swing polygon				
Setting of the Activation condition for the power swing detection based on impedance variation.				
PSB: Fct. assign. block.				012 017
060 000: MAIN: Without function				
Selection of the zones to be blocked if the blocking criterion is present.				
PSB: Max. PS cycle dur.				014 055
30.00	0.00	60.00	s	
Time limit of the blocking effect.				
PSB: Hold time				011 142
30.00	0.00	60.00	s	
Setting of the timer stage by which the signal for power swing blocking condition is extended.				
PSB: Blocking time int.				011 143
0.00	0.00	60.00	s	
Duration of the signal PSB: Blocked.				

Parameter				Address
Default	Min	Max	Unit	Logic Diagram
PSB: Max. blocking time				010 179
Blocked	0.00	60.00	s	
Setting of the timer stage by which the signal PSB: Blocked is delayed.				
PSB: IP >				014 058
3.00	1.00	20.00	Inom	
If the phase current exceeds this threshold, the blocking is cancelled without time delay.				
PSB: Ineg >				014 057
0.30	0.10	1.00	IP,max	
If the negative-sequence current exceeds this threshold, the blocking is cancelled without time delay.				
PSB: IN >				014 056
0.40	0.10	1.00	IP,max	
If the residual current exceeds this threshold, the blocking is cancelled without time delay.				
PSB: Abort delay				008 234
0.00	0.00	1.00	s	
Setting of the extension of the blocking effect, which will become active after a current trigger has started or after the maximum blocking time period has elapsed.				
PSB: R (OOS)				006 184
50 10 (For MAIN: Inom device=1.0A 5.0A)	0.1 0.02	200 40	Ω	
PSB: posX (OOS)				006 186
50 10 (For MAIN: Inom device=1.0A 5.0A)	0.1 0.02	200 40	Ω	
PSB: negX (OOS)				006 187
50 10 (For MAIN: Inom device=1.0A 5.0A)	0.1 0.02	200 40	Ω	
Settings for the power swing polygon that is used for the enhanced counting-based tripping.				
PSB: Perm. No. OOS (a)				006 028
Blocked	1	10		
Tripping threshold value of the instable power swing counter, that counts power swings crossing the inner zone (a).				
PSB: Perm. No. OOS (b)				006 189
Blocked	1	10		
Tripping threshold value of the instable power swing counter, that counts power swings crossing the outer zone (b).				

Parameter				Address			
Default	Min	Max	Unit	Logic Diagram			
PSB: Perm. No. stab. PS							006 027
Blocked	1	10					
Tripping threshold value of the stable power swing counter.							

Measuring-circuit monitoring

Parameter	Address			
Default	Min	Max	Unit	Logic Diagram
MCMON: General enable USER				014 001
0: No Fig. 3-176, (p. 3-235)				
Enabling or disabling the measuring-circuit monitoring function.				
MCMON: Current monitoring				014 006
1: Yes Fig. 3-176, (p. 3-235)				
This setting defines whether the current-measuring circuits shall be monitored.				
MCMON: I _{min} curr. monitor.				010 183
0.250	0.050	2.000	I _{nom}	Fig. 3-176, (p. 3-235)
The current-measuring circuit monitoring function is enabled when the current exceeds this setting in at least one phase.				
MCMON: I _{neg} >				014 002
0.20	0.10	1.00	I _{max}	Fig. 3-176, (p. 3-235)
Setting for the operate value I _{neg} > (permissible unbalance threshold in the current-measuring circuit).				
MCMON: Op. mode volt. mon.				014 007
1: V _{neg} Fig. 3-177, (p. 3-236)				
Selection of the monitoring mode in the voltage-measuring circuit.				
MCMON: I _{min} V _{neg} monitoring				010 184
0.050	0.050	2.000	I _{nom}	Fig. 3-177, (p. 3-236)
The negative-sequence voltage monitoring function is enabled when the current exceeds this setting in at least one phase.				
MCMON: Operate delay				017 011
1.00	0.00	10.00	s	Fig. 3-175, (p. 3-234) Fig. 3-177, (p. 3-236)
Setting for the operate delay after which the 'Meas. circ. (V/I) faulty' signals will be issued.				
MCMON: FF, V enabled USER				014 009
0: No				
Enabling or disabling the “Fuse Failure” monitoring function.				
MCMON: FF, V _{ref} enabled USER				014 013
0: No Fig. 3-179, (p. 3-241)				
Enabling or disabling the “Fuse Failure” monitoring function of the reference voltage V _{ref} .				

Parameter				Address
Default	Min	Max	Unit	Logic Diagram
MCMON: Oper. delay FF, Vref				014 012
0.00	0.00	10.00	s	Fig. 3-179, (p. 3-241)
Setting for the time delay for “Fuse Failure” monitoring of the reference voltage Vref.				

Backup overcurrent-time protection

Parameter				Address
Default	Min	Max	Unit	Logic Diagram
BUOC: General enable USER				014 011
0: No				Fig. 3-180, (p. 3-243)
Enabling or disabling BUOC protection				
BUOC: Operating mode				014 000
1: Without ARC				Fig. 3-180, (p. 3-243)
Setting for the BUOC protection operating mode.				

Switch on to fault protection

Parameter				Address
Default	Min	Max	Unit	Logic Diagram
SOTF: General enable USER				011 068
0: No				Fig. 3-183, (p. 3-247)
Enabling or disabling the switch on to fault (short circuit) protection.				

Protective signaling

Parameter				Address
Default	Min	Max	Unit	Logic Diagram
PSIG: General enable USER				015 004
0: No				Fig. 3-184, (p. 3-249)
Disabling or enabling protective signaling.				

Auto-reclosing control

Parameter					Address
Default	Min	Max	Unit	Logic Diagram	
ARC: General enable USER					015 060
0: No					Fig. 3-211, (p. 3-274)
Disabling or enabling auto-reclosing control.					
ARC: Fct.assgn. tLOGIC					015 033
060 000: MAIN: Without function					Fig. 3-224, (p. 3-287)
Function assignment to tLOGIC.					

Automatic synchronism check

Parameter					Address	
Default	Min	Max	Unit	Logic Diagram		
ASC: General enable USER						018 000
0: No				Fig. 3-227, (p. 3-292)		
Enabling or disabling the automatic synchronism check.						
ASC: Transm.cycle, meas.v.						101 212
3	0	10	s	Fig. 3-240, (p. 3-307)		
Cycle period for transmission of ASC measured values.						

Ground fault (short-circuit) protection

Parameter				Address
Default	Min	Max	Unit	Logic Diagram
GFSC: General enable USER				018 060
0: No			Fig. 3-242, (p. 3-310)	
Disabling or enabling ground fault (short-circuit) protection.				
GFSC: Fct.assign. blocking				006 020
060 000: MAIN: Without function			Fig. 3-243, (p. 3-311)	
Select those binary signals that will – if present – block the GFSC protection.				
GFSC: Evaluation VNG				002 136
1: Calculated			Fig. 3-243, (p. 3-311) Fig. 3-244, (p. 3-312)	
Setting how the GFSC protection will determine the neutral-point displacement voltage: It will either be internally calculated from the three measured phase-to-ground voltages, or measured from the open-delta VT.				
GFSC: Virtual current pol.				006 009
0: No				
Set to Yes if you want the device to apply “virtual current polarization”, i.e. calculate the polarizing voltage as sum of the 2 healthy phase voltages. The default is No to provide backwards compatibility.				
GFSC: Comp. reactance X0				002 135
0 0 (For MAIN: Inom device=1.0A 5.0A)			0 0	200 40 Ω
Setting of “cross-polarization” parameter X ₀ (see section GFSC, “Improved directional measurement for series compensated line applications”).				
GFSC: IN >				018 063
0.050			0.002	0.500 Inom Fig. 3-245, (p. 3-313)
Setting for the operate value of the residual current.				
GFSC: VNG >				018 062
0.030			0.005	0.500 Vnom/(√3) Fig. 3-245, (p. 3-313)
Setting for the operate value of the neutral-point displacement voltage.				
GFSC: Angle phi N				018 061
0			-90	0 ° Fig. 3-257, (p. 3-326)
Setting for the position of the straight line separating forward and backward (reverse) directions.				
GFSC: Start. oper. delay				018 064
1.00			0.00	10.00 s Fig. 3-245, (p. 3-313)
Setting for the operate delay of starting.				

Parameter					Address		
Default	Min	Max	Unit	Logic Diagram			
GFSC: Start. releas. delay						018 065	
0.00	0.00	10.00	s	Fig. 3-245, (p. 3-313)			
Setting for the release delay of the starting.							
GFSC: t1 (forward)						018 066	
Blocked	0.00	60.00	s	Fig. 3-257, (p. 3-326)			
Setting for the operate delay of the trip signal in the event of a “forward” decision.							
GFSC: t2 (backward)						018 067	
Blocked	0.00	60.00	s	Fig. 3-257, (p. 3-326)			
Setting for the operate delay of the trip signal in the event of a “backward” (reverse) decision.							
GFSC: t3 (non-directional)						018 068	
Blocked	0.00	60.00	s	Fig. 3-257, (p. 3-326)			
Setting for the operate delay of the non-directional trip signal.							
GFSC: Criteria tS active						018 071	
1: forward				Fig. 3-257, (p. 3-326)			
This setting defines the direction of time-voltage protection tripping.							
GFSC: Operating mode tS						018 080	
1: VNG-dependent				Fig. 3-251, (p. 3-320)			
This setting specifies whether the voltage-dependent or current-dependent tripping time characteristic shall apply.							
GFSC: Iref,N						018 076	
Blocked	0.01	0.80	Inom	Fig. 3-256, (p. 3-325)			
Setting for the reference current.							
GFSC: Characteristic N						018 078	
0: Definite Time				Fig. 3-256, (p. 3-325)			
Setting for the tripping characteristic.							
GFSC: Factor kt,N						018 077	
1.00	0.05	10.00		Fig. 3-256, (p. 3-325)			
Setting for the starting characteristic factor kP.							

Ground fault (short-circuit) protection signaling

Parameter					Address
Default	Min	Max	Unit	Logic Diagram	
GSCSG: General enable USER				023 069	
0: No				Fig. 3-260, (p. 3-329)	
Disabling or enabling ground fault (short-circuit) protection signaling.					
GSCSG: Fct.assign. blocking				002 180	
060 000: MAIN: Without function				Fig. 3-261, (p. 3-330)	
Select those binary signals that will – if present – block the GFSC protection.					
GSCSG: Channel mode				023 078	
1: Independent channel				Fig. 3-261, (p. 3-330) Fig. 3-263, (p. 3-332) Fig. 3-265, (p. 3-334) Fig. 3-266, (p. 3-335) Fig. 3-267, (p. 3-336) Fig. 3-269, (p. 3-338)	
This setting specifies whether GSCSG and PSIG operate with independent communication channels or with a common communication channel. Note: Operation with a common communication channel is only possible, if the same operating mode is set for both PSIG and GSCSG. The correct assignment of signals to the functions must be done by setting the time delays appropriately.					
GSCSG: Operating mode				023 079	
1: Signal comp. release				Fig. 3-265, (p. 3-334) Fig. 3-266, (p. 3-335)	
Setting for the operating mode of ground fault (short-circuit) protection signaling.					
GSCSG: Trip mode				023 088	
1: 1/3-pole trip w.HSR				Fig. 3-268, (p. 3-337)	
This setting specifies whether there shall be a single-pole or three-pole trip and whether an HSR shall be triggered.					
GSCSG: Tripping time				023 075	
1.00	0.00	10.00	s	Fig. 3-262, (p. 3-332)	
Setting for the delay of the send signal (of the signal comparison release scheme) and the trip signal. This delay shall be used for coordinating GSCSG with the other protection functions.					
GSCSG: Release time send				023 076	
0.25	0.00	10.00	s	Fig. 3-265, (p. 3-334) Fig. 3-266, (p. 3-335) Fig. 3-270, (p. 3-339)	
This setting specifies extension of the send signal after starting of ground fault (short-circuit) protection has dropped out.					

Parameter				Address			
Default	Min	Max	Unit	Logic Diagram			
GSCSG: tBlock							023 077
1.00	0.00	10.00	s	Fig. 3-264, (p. 3-333)			
Setting for the transient blocking time of ground fault (short-circuit) protection signaling in the event of a change in fault direction.							
GSCSG: Echo on receive							023 080
0: No			s	Fig. 3-269, (p. 3-338)			
This setting determines whether ground fault (short-circuit) protection signaling operates with or without echo. Note: Use of the echo only makes sense if the signal comparison release scheme has been selected as the operating mode.							
GSCSG: Operate delay echo							023 081
0.20	0.00	10.00	s	Fig. 3-269, (p. 3-338)			
Setting for the operate delay of the echo pulse.							
GSCSG: Pulse duration echo							023 082
0.05	0.00	10.00	s	Fig. 3-269, (p. 3-338)			
Setting for echo pulse duration.							
GSCSG: tBlock echo							023 083
0.05	0.00	10.00	s	Fig. 3-269, (p. 3-338)			
Setting for the transient blocking time of the echo signal in the event of a change in fault direction.							
GSCSG: Weak infeed trip							023 084
0: No				Fig. 3-267, (p. 3-336)			
This setting determines whether a trip signal will be issued when the weak-infeed logic is triggered. Note: Use of the weak-infeed logic only makes sense if the signal comparison release scheme has been selected as the operating mode.							
GSCSG: Op.delay weak infeed							023 087
0.20	0.00	10.00	s	Fig. 3-267, (p. 3-336)			
Setting for the operate delay of weak-infeed logic.							
GSCSG: Block. sig. nondir.							023 089
0: No			s	Fig. 3-266, (p. 3-335)			
This setting specifies whether the blocking signal will be transmitted only in the event of a backward (reverse) decision by ground fault (short-circuit) protection or whether it will be transmitted as long as there is no forward decision.							
GSCSG: Frequency monitoring							023 085
0: No			s	Fig. 3-263, (p. 3-332)			
This setting defines whether failure of frequency transmission will be monitored.							

Definite-time over-current protection

Parameter	Address			
Default	Min	Max	Unit	Logic Diagram
DTOC: General enable USER				031 068
0: No Fig. 3-271, (p. 3-340)				
Enable/disable the definite-time overcurrent protection function.				

Inverse-time overcurrent protection

Parameter	Address			
Default	Min	Max	Unit	Logic Diagram
IDMT: General enable USER				017 096
0: No Fig. 3-280, (p. 3-350)				
Enabling or disabling the inverse-time overcurrent protection function.				

Short-circuit direction determination

Parameter	Address			
Default	Min	Max	Unit	Logic Diagram
SCDD: General enable USER				017 070
1: Yes Fig. 3-291, (p. 3-364)				
Enable/disable the short-circuit direction determination.				

Ground fault direction determination using steady-state values

Parameter	Address			
Default	Min	Max	Unit	Logic Diagram
GFDSS: General enable USER				016 060
0: No Fig. 3-303, (p. 3-377)				
Enabling or disabling ground fault direction determination by steady-state values.				
GFDSS: Operating mode				016 090
1: Steady-state power Fig. 3-303, (p. 3-377)				
This setting specifies whether steady-state power evaluation or steady-state current evaluation will be performed.				

Pulse detection

Parameter				Address	
Default	Min	Max	Unit	Logic Diagram	
PULSE: General enable USER					027 031
0: No			Fig. 3-317, (p. 3-390)		
Enabling or disabling the pulse detection function.					

Ground fault tripping

Parameter				Address	
Default	Min	Max	Unit	Logic Diagram	
GFTRP: General enable USER					014 005
0: No				Fig. 3-320, (p. 3-394)	
Disabling and enabling ground fault protection signaling.					

Ground fault protection signaling

Parameter				Address	
Default	Min	Max	Unit	Logic Diagram	
GFSIG: General enable USER					016 078
0: No			Fig. 3-321, (p. 3-396)		
Disabling or enabling ground fault protection signaling.					
GFSIG: Operate delay					016 076
0.10	0.00	10.00	s	Fig. 3-321, (p. 3-396)	
Setting for the operate delay of the trip signal.					
GFSIG: Send reset time					016 074
0.00	0.00	10.00	s	Fig. 3-321, (p. 3-396)	
Setting for the reset time of the send signal.					
GFSIG: DC loop op. mode					016 077
1: Transm.relay break c			Fig. 3-321, (p. 3-396)		
Setting for the send relay operating mode.					

Transient ground fault direction determination

Parameter				Address	
Default	Min	Max	Unit	Logic Diagram	
TGFD: General enable USER					016 040
0: No			Fig. 3-322, (p. 3-398)		
Enabling or disabling the transient ground fault direction determination.					

Thermal overload protection

Parameter	Address			
Default	Min	Max	Unit	Logic Diagram
THERM: General enable USER				022 050
0: No Fig. 3-329, (p. 3-403)				
Disabling or enabling thermal overload protection.				
THERM: Relative replica				022 064
1: Yes Fig. 3-332, (p. 3-409)				
Disabling or enabling the <i>Relative replica</i> mode of operation.				
Note that it is not permitted to enable both <i>Absolute replica</i> and <i>Relative replica</i> modes.				
THERM: Absolute replica				022 065
0: No Fig. 3-332, (p. 3-409)				
Enabling or disabling the <i>Absolute replica</i> mode of operation.				
Note that it is not permitted to enable both <i>Absolute replica</i> and <i>Relative replica</i> modes.				

Time-voltage protection

Parameter				Address	
Default	Min	Max	Unit	Logic Diagram	
V<>: General enable USER					023 030
0: No			Fig. 3-334, (p. 3-411)		
Disabling or enabling time-voltage protection.					

Over-/underfrequency protection

Parameter				Address			
Default	Min	Max	Unit	Logic Diagram			
f<>: General enable USER							023 031
0: No				Fig. 3-350, (p. 3-427)			
Disabling or enabling over-/underfrequency protection.							

Underfrequency load shedding

Parameter				Address	
Default	Min	Max	Unit	Logic Diagram	
Pf<: General enable USER					015 202
0: No			Fig. 3-353, (p. 3-432)		
Disabling or enabling underfrequency load shedding protection.					

Power directional protection

Parameter	Address			
Default	Min	Max	Unit	Logic Diagram
P<>: General enable USER				014 220
0: No Fig. 3-357, (p. 3-436)				
Disabling or enabling the power directional protection function.				

Voltage controlled directional reactive power protection

Parameter	Address			
Default	Min	Max	Unit	Logic Diagram
QV: General enable USER				013 147
0: No Fig. 3-371, (p. 3-449)				
Disabling or enabling QV protection.				

High Impedance protection

Parameter	Address			
Default	Min	Max	Unit	Logic Diagram
DELTA: General enable USER				022 179
0: No Fig. 3-376, (p. 3-453)				
Enabling/disabling DELTA protection.				

Circuit breaker
failure protection

Parameter					Address
Default	Min	Max	Unit		Logic Diagram
CBF: General enable USER					022 080
0: No					Fig. 3-378, (p. 3-455)
Disabling or enabling circuit breaker failure protection.					
CBF: Start with man. trip					022 154
0: No					Fig. 3-382, (p. 3-459)
Setting that permit a manual trip signal to also be used as a start criterion.					
CBF: Fct.assignm. CBAux.					022 159
060 000: MAIN: Without function					Fig. 3-382, (p. 3-459)
Selection of trip signals – assigned to Gen. trip command 1 – for which, in addition to current flow monitoring, status signals from CB auxiliary contacts are evaluated.					
CBF: I <					022 160
1.00	0.05	20.00	Inom		Fig. 3-380, (p. 3-457) Fig. 3-386, (p. 3-462) Fig. 3-387, (p. 3-462)
Setting for the threshold to detect a break in current flow.					
CBF: Evaluation IN					022 184
0: Without					Fig. 3-380, (p. 3-457)
Select whether the measured or the calculated residual current shall be used for residual current monitoring function. This choice is only possible when a measuring input for the residual current is available, otherwise the internally derived value of the residual current is always used, regardless of the setting.					
CBF: IN <					022 180
1.00	0.05	20.00	Inom		
Setting of the comparator threshold for residual current monitoring function.					
CBF: t1 3p					022 165
0.15	0.00	100.00	s		Fig. 3-383, (p. 3-460)
Setting the 1st CBF timer stage to 3-pole operating mode.					
CBF: t2					022 166
0.25	0.00	100.00	s		Fig. 3-383, (p. 3-460)
Setting for the 2nd CBF timer stage.					
CBF: Min.dur. trip cmd.t1					022 167
0.25	0.10	10.00	s		Fig. 3-384, (p. 3-461)
Setting the 1st timer stage for minimum duration of trip command.					

Parameter					Address
Default	Min	Max	Unit	Logic Diagram	
CBF: Min.dur. trip cmd.t2					022 168
0.25	0.10	10.00	s	Fig. 3-384, (p. 3-461)	
Setting the 2nd timer stage for minimum duration of trip command.					
CBF: Latching trip cmd.t1					022 169
0: No					Fig. 3-384, (p. 3-461)
The 1st timer stage trip command, set to latch mode, will remain active until reset by operating parameters or through an appropriately configured binary signal input.					
CBF: Latching trip cmd.t2					022 170
0: No					Fig. 3-384, (p. 3-461)
The 2nd timer stage trip command, set to latch mode, will remain active until reset by operating parameters or through an appropriately configured binary signal input.					
CBF: Delay/starting trig.					022 155
0.00	0.00	100.00	s	Fig. 3-385, (p. 3-461)	
The signal CBF: Trip signal is issued when this timer stage's time duration has elapsed.					
CBF: Delay/fault beh. CB					022 171
0.12	0.00	100.00	s	Fig. 3-386, (p. 3-462)	
If during this delay time period the circuit breaker does not provide a signal from its auxiliary contacts that it is closed, then faults behind the CB are recognized through the current criterion (see section "Fault behind CB protection").					
CBF: Delay/CB sync.superv					022 172
Blocked	0.00	100.00	s	Fig. 3-387, (p. 3-462)	
Setting for the time delay to bridge circuit breaker operate times during CB synchronization supervision.					

Circuit breaker
condition monitoring

Parameter					Address
Default	Min	Max	Unit		Logic Diagram
CBM: General enable USER					022 010
0: No					Fig. 3-388, (p. 3-464)
Enabling or disabling circuit breaker monitoring.					
CBM: Sig. asg. trip cmd.					022 152
060 000: MAIN: Without function					Fig. 3-390, (p. 3-467)
Using the setting for external devices the trip command issued by the control function may be linked to the trip command 1 issued by the protection by assigning the trip command issued by the control function by this parameter.					
CBM: Operating mode					022 007
3: CB sig. EXT or trip					Fig. 3-393, (p. 3-469)
This setting defines starting criteria for circuit breaker monitoring. To evaluate all trip commands issued by the protection device <i>With trip cmd. only</i> must be selected. For further evaluation of operational trip commands the additional CB auxiliary contact <i>CB sig. EXT or trip</i> is used.					
CBM: Inom,CB					022 012
2000	1	65000	A		Fig. 3-393, (p. 3-469)
Setting for the CB nominal current.					
CBM: Perm. CB op. Inom,CB					022 013
30000	1	65000			Fig. 3-393, (p. 3-469)
Setting for the maximum number of CB operations at nominal current.					
CBM: Med. curr. Itrip,CB					022 014
Blocked	1	65000	A		Fig. 3-393, (p. 3-469)
Setting for the average CB disconnection current. Note: In general valid only for pneumatically operated CBs.					
CBM: Perm. CB op. Imed,CB					022 015
Blocked	1	65000			Fig. 3-393, (p. 3-469)
Setting for the maximum number of CB operations at average disconnection (ruptured) current. Note: In general valid only for pneumatically operated CBs.					
CBM: Max. curr. Itrip,CB					022 016
63000	1	65000	A		Fig. 3-393, (p. 3-469)
Setting for the maximum CB disconnection (ruptured) current.					
CBM: Perm. CB op. Imax,CB					022 017
20	1	65000			Fig. 3-393, (p. 3-469)
Setting for the maximum number of CB operations permitted at maximum CB disconnection (ruptured) current.					

Parameter					Address
Default	Min	Max	Unit	Logic Diagram	
CBM: No. CB operations >					022 019
10000	1	65000		Fig. 3-395, (p. 3-471)	
Setting for the maximum number of mechanical CB switching operations.					
CBM: Remain No. CB op. <					022 020
1000	1	65000		Fig. 3-394, (p. 3-471)	
Setting for the warning stage with the number of remaining CB operations at CB nominal current.					
CBM: ΣI_{trip} >					022 022
1000	1	65000	Inom,CB		
Setting for the warning stage with the accumulated CB disconnection (ruptured) current values.					
CBM: ΣI_{trip}^{**2} >					022 081
1000	1	65000	Inom,CB** 2		
Setting for the warning stage with the accumulated CB disconnection (ruptured) current values to the second power.					
CBM: $\Sigma I \cdot t$ >					022 096
1000.0	1.0	4000.0	kAs		
Setting for the warning stage with the sum of the current-time integrals of the CB disconnection (ruptured) current values					
CBM: Corr. acqu.time trip					007 249
0.000	0.000	0.200	s	Fig. 3-393, (p. 3-469)	
Correction of the time tolerances permissible for leading or lagging CB auxiliary contacts in case of a triggering by the open command.					
CBM: Corr. acquis. time					022 018
0.000	-0.200	0.200	s	Fig. 3-393, (p. 3-469)	
Correction of the time tolerances permissible for leading or lagging CB auxiliary contacts in case of a triggering by the position signal issued by the CB auxiliary contacts.					

Limit value monitoring

Parameter					Address
Default	Min	Max	Unit	Logic Diagram	
LIMIT: General enable USER				014 010	
0: No				Fig. 3-401, (p. 3-478)	
Disabling or enabling limit value monitoring.					
LIMIT: I >				014 004	
1.10	0.10	2.40	Inom	Fig. 3-397, (p. 3-474)	
Setting for the operate value of the first overcurrent stage for limit value monitoring.					
LIMIT: I > >				014 020	
1.20	0.10	2.40	Inom	Fig. 3-397, (p. 3-474)	
Setting for the operate value of the second overcurrent stage for limit value monitoring.					
LIMIT: tI >				014 031	
1	1	1000	s	Fig. 3-397, (p. 3-474)	
Setting for the operate delay of the first overcurrent stage of limit value monitoring.					
LIMIT: tI > >				014 032	
1	1	1000	s	Fig. 3-397, (p. 3-474)	
Setting for the operate delay of the second overcurrent stage of limit value monitoring.					
LIMIT: I <				014 021	
0.90	0.10	2.40	Inom	Fig. 3-397, (p. 3-474)	
Setting for the operate value of the first undercurrent stage of limit value monitoring.					
LIMIT: I < <				014 022	
0.80	0.10	2.40	Inom	Fig. 3-397, (p. 3-474)	
Setting for the operate value of the second undercurrent stage of limit value monitoring.					
LIMIT: tI <				014 033	
1	1	1000	s	Fig. 3-397, (p. 3-474)	
Setting for the operate delay of the first undercurrent stage of limit value monitoring.					
LIMIT: tI < <				014 034	
1	1	1000	s	Fig. 3-397, (p. 3-474)	
Setting for the operate delay of the second undercurrent stage of limit value monitoring.					

Parameter	Address			
Default	Min	Max	Unit	Logic Diagram
LIMIT: VPG>				014 023
1.10	0.10	2.50	Vnom/ $\sqrt{3}$	Fig. 3-398, (p. 3-475)
Setting for the operate value of overvoltage stage VPG> of limit value monitoring.				
LIMIT: VPG>>				014 024
1.20	0.10	2.50	Vnom/ $\sqrt{3}$	Fig. 3-398, (p. 3-475)
Setting for the operate value of overvoltage stage VPG>> of limit value monitoring.				
LIMIT: tVPG>				014 035
1	1	1000	s	Fig. 3-398, (p. 3-475)
Setting for the operate delay of overvoltage stage VPG> of limit value monitoring.				
LIMIT: tVPG>>				014 036
1	1	1000	s	Fig. 3-398, (p. 3-475)
Setting for the operate delay of overvoltage stage VPG>> of limit value monitoring.				
LIMIT: VPG<				014 025
0.90	0.10	2.50	Vnom/ $\sqrt{3}$	Fig. 3-398, (p. 3-475)
Setting for the operate value of undervoltage stage VPG< of limit value monitoring.				
LIMIT: VPG<<				014 026
0.80	0.10	2.50	Vnom/ $\sqrt{3}$	Fig. 3-398, (p. 3-475)
Setting for the operate value of undervoltage stage VPG<< of limit value monitoring.				
LIMIT: tVPG<				014 037
1	1	1000	s	Fig. 3-398, (p. 3-475)
Setting for the operate delay of undervoltage stage VPG< of limit value monitoring.				
LIMIT: tVPG<<				014 038
1	1	1000	s	Fig. 3-398, (p. 3-475)
Setting for the operate delay of undervoltage stage VPG<< of limit value monitoring.				
LIMIT: VPP>				014 027
1.10	0.10	1.50	Vnom	Fig. 3-398, (p. 3-475)
Setting for the operate value of overvoltage stage VPP> of limit value monitoring.				

Parameter	Address			
Default	Min	Max	Unit	Logic Diagram
LIMIT: VPP>>				014 028
1.20	0.10	1.50	Vnom	Fig. 3-398, (p. 3-475)
Setting for the operate value of overvoltage stage VPP>> of limit value monitoring.				
LIMIT: tVPP>				014 039
1	1	1000	s	Fig. 3-398, (p. 3-475)
Setting for the operate delay of overvoltage stage VPP> of limit value monitoring.				
LIMIT: tVPP>>				014 040
1	1	1000	s	Fig. 3-398, (p. 3-475)
Setting for the operate delay of overvoltage stage VPP>> of limit value monitoring.				
LIMIT: VPP<				014 029
0.90	0.10	1.50	Vnom	Fig. 3-398, (p. 3-475)
Setting for the operate value of undervoltage stage VPP< of limit value monitoring.				
LIMIT: VPP<<				014 030
0.80	0.10	1.50	Vnom	Fig. 3-398, (p. 3-475)
Setting for the operate value of undervoltage stage VPP<< of limit value monitoring.				
LIMIT: tVPP<				014 041
1	1	1000	s	Fig. 3-398, (p. 3-475)
Setting for the operate delay of undervoltage stage VPP< of limit value monitoring.				
LIMIT: tVPP<<				014 042
1	1	1000	s	Fig. 3-398, (p. 3-475)
Setting for the operate delay of undervoltage stage VPP<< of limit value monitoring.				
LIMIT: VNG>				014 043
0.050	0.010	1.000	Vnom/v3	Fig. 3-399, (p. 3-476)
Setting for the operate value of overvoltage stage VNG> of limit value monitoring.				
LIMIT: VNG>>				014 044
0.100	0.010	1.000	Vnom/v3	Fig. 3-399, (p. 3-476)
Setting for the operate value of overvoltage stage VNG>> of limit value monitoring.				

Parameter	Address			
Default	Min	Max	Unit	Logic Diagram
LIMIT: tVNG>				014 045
1	1	1000	s	Fig. 3-399, (p. 3-476)
Setting for the operate delay of overvoltage stage VNG> of limit value monitoring.				
LIMIT: tVNG>>				014 046
1	1	1000	s	Fig. 3-399, (p. 3-476)
Setting for the operate delay of overvoltage stage VNG>> of limit value monitoring.				
LIMIT: Vref>				042 144
1.10	0.10	2.50	Vnom	Fig. 3-401, (p. 3-478)
Setting for the operate value of overvoltage stage Vref> for limit value monitoring.				
LIMIT: Vref>>				042 145
1.20	0.10	2.50	Vnom	Fig. 3-401, (p. 3-478)
Setting for the operate value of overvoltage stage Vref>> for limit value monitoring.				
LIMIT: tVref>				042 148
1	1	1000	s	Fig. 3-401, (p. 3-478)
Setting for the operate delay of overvoltage stage Vref> for limit value monitoring.				
LIMIT: tVref>>				042 149
1	1	1000	s	Fig. 3-401, (p. 3-478)
Setting for the operate delay of overvoltage stage Vref>> for limit value monitoring.				
LIMIT: Vref<				042 146
0.90	0.10	2.50	Vnom	Fig. 3-401, (p. 3-478)
Setting for the operate value of undervoltage stage Vref< for limit value monitoring.				
LIMIT: Vref<<				042 147
0.80	0.10	2.50	Vnom	Fig. 3-401, (p. 3-478)
Setting for the operate value of undervoltage stage Vref<< for limit value monitoring.				
LIMIT: tVref<				042 150
1	1	1000	s	Fig. 3-401, (p. 3-478)
Setting for the operate delay of undervoltage stage Vref< for limit value monitoring.				

Parameter	Address			
Default	Min	Max	Unit	Logic Diagram
LIMIT: tVref<<				042 151
1	1	1000	s	Fig. 3-401, (p. 3-478)
Setting for the operate delay of undervoltage stage Vref<< for limit value monitoring.				
LIMIT: IDC,lin>				014 110
Blocked	0.100	1.100	IDC,nom	Fig. 3-400, (p. 3-477)
Setting for the operate value IDC,lin> for monitoring the linearized direct current.				
LIMIT: IDC,lin>>				014 111
Blocked	0.100	1.100	IDC,nom	Fig. 3-400, (p. 3-477)
Setting for the operate value IDC,lin>> for monitoring the linearized direct current.				
LIMIT: tIDC,lin>				014 112
Blocked	0.00	20.00	s	Fig. 3-400, (p. 3-477)
Setting for the operate delay of overcurrent stage IDC,lin>.				
LIMIT: tIDC,lin>>				014 113
Blocked	0.00	20.00	s	Fig. 3-400, (p. 3-477)
Setting for the operate delay of overcurrent stage IDC,lin>>.				
LIMIT: IDC,lin<				014 114
Blocked	0.100	1.100	IDC,nom	Fig. 3-400, (p. 3-477)
Setting for the operate value IDC,lin< for monitoring the linearized direct current.				
LIMIT: IDC,lin<<				014 115
Blocked	0.100	1.100	IDC,nom	Fig. 3-400, (p. 3-477)
Setting for the operate value IDC,lin<< for monitoring the linearized direct current.				
LIMIT: tIDC,lin<				014 116
Blocked	0.00	20.00	s	Fig. 3-400, (p. 3-477)
Setting for the operate delay of undercurrent stage IDC,lin<.				
LIMIT: tIDC,lin<<				014 117
Blocked	0.00	20.00	s	Fig. 3-400, (p. 3-477)
Setting for the operate delay of undercurrent stage IDC,lin<<.				
LIMIT: T>				014 100
200	-20	200	°C	Fig. 3-402, (p. 3-479)
Setting for the operate value of temperature monitoring T>.				

Parameter				Address			
Default	Min	Max	Unit	Logic Diagram			
LIMIT: T>>							014 101
200	-20	200	°C	Fig. 3-402, (p. 3-479)			
Setting for the operate value of temperature monitoring T>>.							
LIMIT: tT>							014 103
Blocked	0	1000	s	Fig. 3-402, (p. 3-479)			
Setting for the operate delay of temperature monitoring T>.							
LIMIT: tT>>							014 104
Blocked	0	1000	s	Fig. 3-402, (p. 3-479)			
Setting for the operate delay of temperature monitoring T>>.							
LIMIT: T<							014 105
-20	-20	200	°C	Fig. 3-402, (p. 3-479)			
Setting for the operate value of temperature monitoring T<.							
LIMIT: T<<							014 106
-20	-20	200	°C	Fig. 3-402, (p. 3-479)			
Setting for the operate value of temperature monitoring T<<.							
LIMIT: tT<							014 107
Blocked	0	1000	s	Fig. 3-402, (p. 3-479)			
Setting for the operate delay of temperature monitoring T<.							
LIMIT: tT<<							014 108
Blocked	0	1000	s	Fig. 3-402, (p. 3-479)			
Setting for the operate delay of temperature monitoring T<<.							

Transformer
monitoring

Parameter				Address			
Default	Min	Max	Unit	Logic Diagram			
TRMON: General enable USER							018 040
0: No				Fig. 3-403, (p. 3-480)			
Disabling or enabling the transformer monitoring.							

Programmable Logic

Parameter				Address
Default	Min	Max	Unit	Logic Diagram
LOGIC: General enable USER				031 099
0: No				
Fig. 3-405, (p. 3-483)				
Enable/disable the logic function.				
LOGIC: Set 1 USER				034 030
0: No				
Fig. 3-404, (p. 3-482)				
LOGIC: Set 2 USER				034 031
0: No				
LOGIC: Set 3 USER				034 032
0: No				
LOGIC: Set 4 USER				034 033
0: No				
LOGIC: Set 5 USER				034 034
0: No				
LOGIC: Set 6 USER				034 035
0: No				
LOGIC: Set 7 USER				034 036
0: No				
LOGIC: Set 8 USER				034 037
0: No				
These settings define the static input conditions for the logic function.				
LOGIC: Fct.assignm. outp. 1				030 000
060 000: MAIN: Without function				
Fig. 3-224, (p. 3-287)				
Fig. 3-405, (p. 3-483)				
LOGIC: Fct.assignm. outp. 2				030 004
060 000: MAIN: Without function				
s				
LOGIC: Fct.assignm. outp. 3				030 008
060 000: MAIN: Without function				
LOGIC: Fct.assignm. outp. 4				030 012
060 000: MAIN: Without function				
LOGIC: Fct.assignm. outp. 5				030 016
060 000: MAIN: Without function				
LOGIC: Fct.assignm. outp. 6				030 020
060 000: MAIN: Without function				
LOGIC: Fct.assignm. outp. 7				030 024
060 000: MAIN: Without function				
LOGIC: Fct.assignm. outp. 8				030 028
060 000: MAIN: Without function				

Parameter				Address
Default	Min	Max	Unit	Logic Diagram
LOGIC: Fct.assignm. outp. 9				030 032
060 000: MAIN: Without function				
LOGIC: Fct.assignm. outp.10				030 036
060 000: MAIN: Without function				
LOGIC: Fct.assignm. outp.11				030 040
060 000: MAIN: Without function				
LOGIC: Fct.assignm. outp.12				030 044
060 000: MAIN: Without function				
LOGIC: Fct.assignm. outp.13				030 048
060 000: MAIN: Without function				
LOGIC: Fct.assignm. outp.14				030 052
060 000: MAIN: Without function				
LOGIC: Fct.assignm. outp.15				030 056
060 000: MAIN: Without function				
LOGIC: Fct.assignm. outp.16				030 060
060 000: MAIN: Without function				
LOGIC: Fct.assignm. outp.17				030 064
060 000: MAIN: Without function				
LOGIC: Fct.assignm. outp.18				030 068
060 000: MAIN: Without function				
LOGIC: Fct.assignm. outp.19				030 072
060 000: MAIN: Without function				
LOGIC: Fct.assignm. outp.20				030 076
060 000: MAIN: Without function				
LOGIC: Fct.assignm. outp.21				030 080
060 000: MAIN: Without function				
LOGIC: Fct.assignm. outp.22				030 084
060 000: MAIN: Without function				
LOGIC: Fct.assignm. outp.23				030 088
060 000: MAIN: Without function				
LOGIC: Fct.assignm. outp.24				030 092
060 000: MAIN: Without function				
LOGIC: Fct.assignm. outp.25				030 096
060 000: MAIN: Without function				
LOGIC: Fct.assignm. outp.26				031 000
060 000: MAIN: Without function				
LOGIC: Fct.assignm. outp.27				031 004
060 000: MAIN: Without function				

Parameter					Address		
Default	Min	Max	Unit		Logic Diagram		
LOGIC: Fct.assignm. outp.28							031 008
060 000: MAIN: Without function							
LOGIC: Fct.assignm. outp.29							031 012
060 000: MAIN: Without function							
LOGIC: Fct.assignm. outp.30							031 016
060 000: MAIN: Without function							
LOGIC: Fct.assignm. outp.31							031 020
060 000: MAIN: Without function							
LOGIC: Fct.assignm. outp.32							031 024
060 000: MAIN: Without function							
LOGIC: Fct.assignm. outp.33							030 100
060 000: MAIN: Without function							
LOGIC: Fct.assignm. outp.34							030 104
060 000: MAIN: Without function							
LOGIC: Fct.assignm. outp.35							030 108
060 000: MAIN: Without function							
LOGIC: Fct.assignm. outp.36							030 112
060 000: MAIN: Without function							
LOGIC: Fct.assignm. outp.37							030 116
060 000: MAIN: Without function							
LOGIC: Fct.assignm. outp.38							030 120
060 000: MAIN: Without function							
LOGIC: Fct.assignm. outp.39							030 124
060 000: MAIN: Without function							
LOGIC: Fct.assignm. outp.40							030 128
060 000: MAIN: Without function							
LOGIC: Fct.assignm. outp.41							030 132
060 000: MAIN: Without function							
LOGIC: Fct.assignm. outp.42							030 136
060 000: MAIN: Without function							
LOGIC: Fct.assignm. outp.43							030 140
060 000: MAIN: Without function							
LOGIC: Fct.assignm. outp.44							030 144
060 000: MAIN: Without function							
LOGIC: Fct.assignm. outp.45							030 148
060 000: MAIN: Without function							
LOGIC: Fct.assignm. outp.46							030 152
060 000: MAIN: Without function							

Parameter				Address
Default	Min	Max	Unit	Logic Diagram
LOGIC: Fct.assignm. outp.47				030 156
060 000: MAIN: Without function				
LOGIC: Fct.assignm. outp.48				030 160
060 000: MAIN: Without function				
LOGIC: Fct.assignm. outp.49				030 164
060 000: MAIN: Without function				
LOGIC: Fct.assignm. outp.50				030 168
060 000: MAIN: Without function				
LOGIC: Fct.assignm. outp.51				030 172
060 000: MAIN: Without function				
LOGIC: Fct.assignm. outp.52				030 176
060 000: MAIN: Without function				
LOGIC: Fct.assignm. outp.53				030 180
060 000: MAIN: Without function				
LOGIC: Fct.assignm. outp.54				030 184
060 000: MAIN: Without function				
LOGIC: Fct.assignm. outp.55				030 188
060 000: MAIN: Without function				
LOGIC: Fct.assignm. outp.56				030 192
060 000: MAIN: Without function				
LOGIC: Fct.assignm. outp.57				030 196
060 000: MAIN: Without function				
LOGIC: Fct.assignm. outp.58				030 200
060 000: MAIN: Without function				
LOGIC: Fct.assignm. outp.59				030 204
060 000: MAIN: Without function				
LOGIC: Fct.assignm. outp.60				030 208
060 000: MAIN: Without function				
LOGIC: Fct.assignm. outp.61				030 212
060 000: MAIN: Without function				
LOGIC: Fct.assignm. outp.62				030 216
060 000: MAIN: Without function				
LOGIC: Fct.assignm. outp.63				030 220
060 000: MAIN: Without function				
LOGIC: Fct.assignm. outp.64				030 224
060 000: MAIN: Without function				
LOGIC: Fct.assignm. outp.65				046 000
060 000: MAIN: Without function				

Parameter					Address		
Default	Min	Max	Unit		Logic Diagram		
LOGIC: Fct.assignm. outp.66							045 004
060 000: MAIN: Without function							
LOGIC: Fct.assignm. outp.67							045 008
060 000: MAIN: Without function							
LOGIC: Fct.assignm. outp.68							045 012
060 000: MAIN: Without function							
LOGIC: Fct.assignm. outp.69							045 016
060 000: MAIN: Without function							
LOGIC: Fct.assignm. outp.70							045 020
060 000: MAIN: Without function							
LOGIC: Fct.assignm. outp.71							045 024
060 000: MAIN: Without function							
LOGIC: Fct.assignm. outp.72							045 028
060 000: MAIN: Without function							
LOGIC: Fct.assignm. outp.73							045 032
060 000: MAIN: Without function							
LOGIC: Fct.assignm. outp.74							045 036
060 000: MAIN: Without function							
LOGIC: Fct.assignm. outp.75							045 040
060 000: MAIN: Without function							
LOGIC: Fct.assignm. outp.76							045 044
060 000: MAIN: Without function							
LOGIC: Fct.assignm. outp.77							045 048
060 000: MAIN: Without function							
LOGIC: Fct.assignm. outp.78							045 052
060 000: MAIN: Without function							
LOGIC: Fct.assignm. outp.79							045 056
060 000: MAIN: Without function							
LOGIC: Fct.assignm. outp.80							045 060
060 000: MAIN: Without function							
LOGIC: Fct.assignm. outp.81							045 064
060 000: MAIN: Without function							
LOGIC: Fct.assignm. outp.82							045 068
060 000: MAIN: Without function							
LOGIC: Fct.assignm. outp.83							045 072
060 000: MAIN: Without function							
LOGIC: Fct.assignm. outp.84							045 076
060 000: MAIN: Without function							

Parameter				Address
Default	Min	Max	Unit	Logic Diagram
LOGIC: Fct.assignm. outp.85				045 080
060 000: MAIN: Without function				
LOGIC: Fct.assignm. outp.86				045 084
060 000: MAIN: Without function				
LOGIC: Fct.assignm. outp.87				045 088
060 000: MAIN: Without function				
LOGIC: Fct.assignm. outp.88				045 092
060 000: MAIN: Without function				
LOGIC: Fct.assignm. outp.89				045 096
060 000: MAIN: Without function				
LOGIC: Fct.assignm. outp.90				045 100
060 000: MAIN: Without function				
LOGIC: Fct.assignm. outp.91				045 104
060 000: MAIN: Without function				
LOGIC: Fct.assignm. outp.92				045 108
060 000: MAIN: Without function				
LOGIC: Fct.assignm. outp.93				045 112
060 000: MAIN: Without function				
LOGIC: Fct.assignm. outp.94				045 116
060 000: MAIN: Without function				
LOGIC: Fct.assignm. outp.95				045 120
060 000: MAIN: Without function				
LOGIC: Fct.assignm. outp.96				045 124
060 000: MAIN: Without function				
LOGIC: Fct.assignm. outp.97				045 128
060 000: MAIN: Without function				
LOGIC: Fct.assignm. outp.98				045 132
060 000: MAIN: Without function				
LOGIC: Fct.assignm. outp.99				045 136
060 000: MAIN: Without function				
LOGIC: Fct.assignm.outp.100				045 140
060 000: MAIN: Without function				
LOGIC: Fct.assignm.outp.101				045 144
060 000: MAIN: Without function				
LOGIC: Fct.assignm.outp.102				045 148
060 000: MAIN: Without function				
LOGIC: Fct.assignm.outp.103				045 152
060 000: MAIN: Without function				

Parameter					Address
Default	Min	Max	Unit		Logic Diagram
LOGIC: Fct.assignm.outp.104					045 156
060 000: MAIN: Without function					
LOGIC: Fct.assignm.outp.105					045 160
060 000: MAIN: Without function					
LOGIC: Fct.assignm.outp.106					045 164
060 000: MAIN: Without function					
LOGIC: Fct.assignm.outp.107					045 168
060 000: MAIN: Without function					
LOGIC: Fct.assignm.outp.108					045 172
060 000: MAIN: Without function					
LOGIC: Fct.assignm.outp.109					045 176
060 000: MAIN: Without function					
LOGIC: Fct.assignm.outp.110					045 180
060 000: MAIN: Without function					
LOGIC: Fct.assignm.outp.111					045 184
060 000: MAIN: Without function					
LOGIC: Fct.assignm.outp.112					045 188
060 000: MAIN: Without function					
LOGIC: Fct.assignm.outp.113					045 192
060 000: MAIN: Without function					
LOGIC: Fct.assignm.outp.114					045 196
060 000: MAIN: Without function					
LOGIC: Fct.assignm.outp.115					045 200
060 000: MAIN: Without function					
LOGIC: Fct.assignm.outp.116					045 204
060 000: MAIN: Without function					
LOGIC: Fct.assignm.outp.117					045 208
060 000: MAIN: Without function					
LOGIC: Fct.assignm.outp.118					045 212
060 000: MAIN: Without function					
LOGIC: Fct.assignm.outp.119					045 216
060 000: MAIN: Without function					
LOGIC: Fct.assignm.outp.120					045 220
060 000: MAIN: Without function					
LOGIC: Fct.assignm.outp.121					045 224
060 000: MAIN: Without function					
LOGIC: Fct.assignm.outp.122					045 228
060 000: MAIN: Without function					

Parameter				Address
Default	Min	Max	Unit	Logic Diagram
LOGIC: Fct.assignm.output.123				045 232
060 000: MAIN: Without function				
LOGIC: Fct.assignm.output.124				045 236
060 000: MAIN: Without function				
LOGIC: Fct.assignm.output.125				045 240
060 000: MAIN: Without function				
LOGIC: Fct.assignm.output.126				045 244
060 000: MAIN: Without function				
LOGIC: Fct.assignm.output.127				045 248
060 000: MAIN: Without function				
LOGIC: Fct.assignm.output.128				045 252
060 000: MAIN: Without function				
These settings assign functions to the outputs.				
LOGIC: Op. mode t output 1				030 001
0: Without timer stage				Fig. 3-224, (p. 3-287) Fig. 3-405, (p. 3-483)
LOGIC: Op. mode t output 2				030 005
0: Without timer stage				
LOGIC: Op. mode t output 3				030 009
0: Without timer stage				
LOGIC: Op. mode t output 4				030 013
0: Without timer stage				
LOGIC: Op. mode t output 5				030 017
0: Without timer stage				
LOGIC: Op. mode t output 6				030 021
0: Without timer stage				
LOGIC: Op. mode t output 7				030 025
0: Without timer stage				
LOGIC: Op. mode t output 8				030 029
0: Without timer stage				
LOGIC: Op. mode t output 9				030 033
0: Without timer stage				
LOGIC: Op. mode t output 10				030 037
0: Without timer stage				
LOGIC: Op. mode t output 11				030 041
0: Without timer stage				
LOGIC: Op. mode t output 12				030 045
0: Without timer stage				

Parameter					Address		
Default	Min	Max	Unit		Logic Diagram		
LOGIC: Op. mode t output 13							030 049
0: Without timer stage							
LOGIC: Op. mode t output 14							030 053
0: Without timer stage							
LOGIC: Op. mode t output 15							030 057
0: Without timer stage							
LOGIC: Op. mode t output 16							030 061
0: Without timer stage							
LOGIC: Op. mode t output 17							030 065
0: Without timer stage							
LOGIC: Op. mode t output 18							030 069
0: Without timer stage							
LOGIC: Op. mode t output 19							030 073
0: Without timer stage							
LOGIC: Op. mode t output 20							030 077
0: Without timer stage							
LOGIC: Op. mode t output 21							030 081
0: Without timer stage							
LOGIC: Op. mode t output 22							030 085
0: Without timer stage							
LOGIC: Op. mode t output 23							030 089
0: Without timer stage							
LOGIC: Op. mode t output 24							030 093
0: Without timer stage							
LOGIC: Op. mode t output 25							030 097
0: Without timer stage							
LOGIC: Op. mode t output 26							031 001
0: Without timer stage							
LOGIC: Op. mode t output 27							031 005
0: Without timer stage							
LOGIC: Op. mode t output 28							031 009
0: Without timer stage							
LOGIC: Op. mode t output 29							031 013
0: Without timer stage							
LOGIC: Op. mode t output 30							031 017
0: Without timer stage							
LOGIC: Op. mode t output 31							031 021
0: Without timer stage							

Parameter				Address
Default	Min	Max	Unit	Logic Diagram
LOGIC: Op. mode t output 32				031 025
0: Without timer stage				
LOGIC: Op. mode t output 33				030 101
0: Without timer stage				
LOGIC: Op. mode t output 34				030 105
0: Without timer stage				
LOGIC: Op. mode t output 35				030 109
0: Without timer stage				
LOGIC: Op. mode t output 36				030 113
0: Without timer stage				
LOGIC: Op. mode t output 37				030 117
0: Without timer stage				
LOGIC: Op. mode t output 38				030 121
0: Without timer stage				
LOGIC: Op. mode t output 39				030 125
0: Without timer stage				
LOGIC: Op. mode t output 40				030 129
0: Without timer stage				
LOGIC: Op. mode t output 41				030 133
0: Without timer stage				
LOGIC: Op. mode t output 42				030 137
0: Without timer stage				
LOGIC: Op. mode t output 43				030 141
0: Without timer stage				
LOGIC: Op. mode t output 44				030 145
0: Without timer stage				
LOGIC: Op. mode t output 45				030 149
0: Without timer stage				
LOGIC: Op. mode t output 46				030 153
0: Without timer stage				
LOGIC: Op. mode t output 47				030 157
0: Without timer stage				
LOGIC: Op. mode t output 48				030 161
0: Without timer stage				
LOGIC: Op. mode t output 49				030 165
0: Without timer stage				
LOGIC: Op. mode t output 50				030 169
0: Without timer stage				

Parameter					Address		
Default	Min	Max	Unit		Logic Diagram		
LOGIC: Op. mode t output 51							030 173
0: Without timer stage							
LOGIC: Op. mode t output 52							030 177
0: Without timer stage							
LOGIC: Op. mode t output 53							030 181
0: Without timer stage							
LOGIC: Op. mode t output 54							030 185
0: Without timer stage							
LOGIC: Op. mode t output 55							030 189
0: Without timer stage							
LOGIC: Op. mode t output 56							030 193
0: Without timer stage							
LOGIC: Op. mode t output 57							030 197
0: Without timer stage							
LOGIC: Op. mode t output 58							030 201
0: Without timer stage							
LOGIC: Op. mode t output 59							030 205
0: Without timer stage							
LOGIC: Op. mode t output 60							030 209
0: Without timer stage							
LOGIC: Op. mode t output 61							030 213
0: Without timer stage							
LOGIC: Op. mode t output 62							030 217
0: Without timer stage							
LOGIC: Op. mode t output 63							030 221
0: Without timer stage							
LOGIC: Op. mode t output 64							030 225
0: Without timer stage							
LOGIC: Op. mode t output 65							046 001
0: Without timer stage							
LOGIC: Op. mode t output 66							045 005
0: Without timer stage							
LOGIC: Op. mode t output 67							045 009
0: Without timer stage							
LOGIC: Op. mode t output 68							045 013
0: Without timer stage							
LOGIC: Op. mode t output 69							045 017
0: Without timer stage							

Parameter				Address
Default	Min	Max	Unit	Logic Diagram
LOGIC: Op. mode t output 70				045 021
0: Without timer stage				
LOGIC: Op. mode t output 71				045 025
0: Without timer stage				
LOGIC: Op. mode t output 72				045 029
0: Without timer stage				
LOGIC: Op. mode t output 73				045 033
0: Without timer stage				
LOGIC: Op. mode t output 74				045 037
0: Without timer stage				
LOGIC: Op. mode t output 75				045 041
0: Without timer stage				
LOGIC: Op. mode t output 76				045 045
0: Without timer stage				
LOGIC: Op. mode t output 77				045 049
0: Without timer stage				
LOGIC: Op. mode t output 78				045 053
0: Without timer stage				
LOGIC: Op. mode t output 79				045 057
0: Without timer stage				
LOGIC: Op. mode t output 80				045 061
0: Without timer stage				
LOGIC: Op. mode t output 81				045 065
0: Without timer stage				
LOGIC: Op. mode t output 82				045 069
0: Without timer stage				
LOGIC: Op. mode t output 83				045 073
0: Without timer stage				
LOGIC: Op. mode t output 84				045 077
0: Without timer stage				
LOGIC: Op. mode t output 85				045 081
0: Without timer stage				
LOGIC: Op. mode t output 86				045 085
0: Without timer stage				
LOGIC: Op. mode t output 87				045 089
0: Without timer stage				
LOGIC: Op. mode t output 88				045 093
0: Without timer stage				

Parameter					Address		
Default	Min	Max	Unit		Logic Diagram		
LOGIC: Op. mode t output 89							045 097
0: Without timer stage							
LOGIC: Op. mode t output 90							045 101
0: Without timer stage							
LOGIC: Op. mode t output 91							045 105
0: Without timer stage							
LOGIC: Op. mode t output 92							045 109
0: Without timer stage							
LOGIC: Op. mode t output 93							045 113
0: Without timer stage							
LOGIC: Op. mode t output 94							045 117
0: Without timer stage							
LOGIC: Op. mode t output 95							045 121
0: Without timer stage							
LOGIC: Op. mode t output 96							045 125
0: Without timer stage							
LOGIC: Op. mode t output 97							045 129
0: Without timer stage							
LOGIC: Op. mode t output 98							045 133
0: Without timer stage							
LOGIC: Op. mode t output 99							045 137
0: Without timer stage							
LOGIC: Op. mode t output100							045 141
0: Without timer stage							
LOGIC: Op. mode t output101							045 145
0: Without timer stage							
LOGIC: Op. mode t output102							045 149
0: Without timer stage							
LOGIC: Op. mode t output103							045 153
0: Without timer stage							
LOGIC: Op. mode t output104							045 157
0: Without timer stage							
LOGIC: Op. mode t output105							045 161
0: Without timer stage							
LOGIC: Op. mode t output106							045 165
0: Without timer stage							
LOGIC: Op. mode t output107							045 169
0: Without timer stage							

Parameter				Address
Default	Min	Max	Unit	Logic Diagram
LOGIC: Op. mode t output108				045 173
0: Without timer stage				
LOGIC: Op. mode t output109				045 177
0: Without timer stage				
LOGIC: Op. mode t output110				045 181
0: Without timer stage				
LOGIC: Op. mode t output111				045 185
0: Without timer stage				
LOGIC: Op. mode t output112				045 189
0: Without timer stage				
LOGIC: Op. mode t output113				045 193
0: Without timer stage				
LOGIC: Op. mode t output114				045 197
0: Without timer stage				
LOGIC: Op. mode t output115				045 201
0: Without timer stage				
LOGIC: Op. mode t output116				045 205
0: Without timer stage				
LOGIC: Op. mode t output117				045 209
0: Without timer stage				
LOGIC: Op. mode t output118				045 213
0: Without timer stage				
LOGIC: Op. mode t output119				045 217
0: Without timer stage				
LOGIC: Op. mode t output120				045 221
0: Without timer stage				
LOGIC: Op. mode t output121				045 225
0: Without timer stage				
LOGIC: Op. mode t output122				045 229
0: Without timer stage				
LOGIC: Op. mode t output123				045 233
0: Without timer stage				
LOGIC: Op. mode t output124				045 237
0: Without timer stage				
LOGIC: Op. mode t output125				045 241
0: Without timer stage				
LOGIC: Op. mode t output126				045 245
0: Without timer stage				

Parameter				Address
Default	Min	Max	Unit	Logic Diagram
LOGIC: Op. mode t output127				045 249
0: Without timer stage				
LOGIC: Op. mode t output128				045 253
0: Without timer stage				
These settings define the operating modes for the output timer stages.				
LOGIC: Time t1 output 1				030 002
0.00	0.00	600.00	s	Fig. 3-405, (p. 3-483)
LOGIC: Time t1 output 2				030 006
0.00	0.00	600.00	s	
LOGIC: Time t1 output 3				030 010
0.00	0.00	600.00	s	
LOGIC: Time t1 output 4				030 014
0.00	0.00	600.00	s	
LOGIC: Time t1 output 5				030 018
0.00	0.00	600.00	s	
LOGIC: Time t1 output 6				030 022
0.00	0.00	600.00	s	
LOGIC: Time t1 output 7				030 026
0.00	0.00	600.00	s	
LOGIC: Time t1 output 8				030 030
0.00	0.00	600.00	s	
LOGIC: Time t1 output 9				030 034
0.00	0.00	600.00	s	
LOGIC: Time t1 output 10				030 038
0.00	0.00	600.00	s	
LOGIC: Time t1 output 11				030 042
0.00	0.00	600.00	s	
LOGIC: Time t1 output 12				030 046
0.00	0.00	600.00	s	
LOGIC: Time t1 output 13				030 050
0.00	0.00	600.00	s	
LOGIC: Time t1 output 14				030 054
0.00	0.00	600.00	s	
LOGIC: Time t1 output 15				030 058
0.00	0.00	600.00	s	
LOGIC: Time t1 output 16				030 062
0.00	0.00	600.00	s	

Parameter					Address			
Default	Min	Max	Unit		Logic Diagram			
LOGIC: Time t1 output 17								030 066
0.00	0.00	600.00	s					
LOGIC: Time t1 output 18								030 070
0.00	0.00	600.00	s					
LOGIC: Time t1 output 19								030 074
0.00	0.00	600.00	s					
LOGIC: Time t1 output 20								030 078
0.00	0.00	600.00	s					
LOGIC: Time t1 output 21								030 082
0.00	0.00	600.00	s					
LOGIC: Time t1 output 22								030 086
0.00	0.00	600.00	s					
LOGIC: Time t1 output 23								030 090
0.00	0.00	600.00	s					
LOGIC: Time t1 output 24								030 094
0.00	0.00	600.00	s					
LOGIC: Time t1 output 25								030 098
0.00	0.00	600.00	s					
LOGIC: Time t1 output 26								031 002
0.00	0.00	600.00	s					
LOGIC: Time t1 output 27								031 006
0.00	0.00	600.00	s					
LOGIC: Time t1 output 28								031 010
0.00	0.00	600.00	s					
LOGIC: Time t1 output 29								031 014
0.00	0.00	600.00	s					
LOGIC: Time t1 output 30								031 018
0.00	0.00	600.00	s					
LOGIC: Time t1 output 31								031 022
0.00	0.00	600.00	s					
LOGIC: Time t1 output 32								031 026
0.00	0.00	600.00	s					
LOGIC: Time t1 output 33								030 102
0.00	0.00	600.00	s					
LOGIC: Time t1 output 34								030 106
0.00	0.00	600.00	s					
LOGIC: Time t1 output 35								030 110
0.00	0.00	600.00	s					

Parameter				Address			
Default	Min	Max	Unit	Logic Diagram			
LOGIC: Time t1 output 36							030 114
0.00	0.00	600.00	s				
LOGIC: Time t1 output 37							030 118
0.00	0.00	600.00	s				
LOGIC: Time t1 output 38							030 122
0.00	0.00	600.00	s				
LOGIC: Time t1 output 39							030 126
0.00	0.00	600.00	s				
LOGIC: Time t1 output 40							030 130
0.00	0.00	600.00	s				
LOGIC: Time t1 output 41							030 134
0.00	0.00	600.00	s				
LOGIC: Time t1 output 42							030 138
0.00	0.00	600.00	s				
LOGIC: Time t1 output 43							030 142
0.00	0.00	600.00	s				
LOGIC: Time t1 output 44							030 146
0.00	0.00	600.00	s				
LOGIC: Time t1 output 45							030 150
0.00	0.00	600.00	s				
LOGIC: Time t1 output 46							030 154
0.00	0.00	600.00	s				
LOGIC: Time t1 output 47							030 158
0.00	0.00	600.00	s				
LOGIC: Time t1 output 48							030 162
0.00	0.00	600.00	s				
LOGIC: Time t1 output 49							030 166
0.00	0.00	600.00	s				
LOGIC: Time t1 output 50							030 170
0.00	0.00	600.00	s				
LOGIC: Time t1 output 51							030 174
0.00	0.00	600.00	s				
LOGIC: Time t1 output 52							030 178
0.00	0.00	600.00	s				
LOGIC: Time t1 output 53							030 182
0.00	0.00	600.00	s				
LOGIC: Time t1 output 54							030 186
0.00	0.00	600.00	s				

Parameter					Address			
Default	Min	Max	Unit		Logic Diagram			
LOGIC: Time t1 output 55								030 190
0.00	0.00	600.00	s					
LOGIC: Time t1 output 56								030 194
0.00	0.00	600.00	s					
LOGIC: Time t1 output 57								030 198
0.00	0.00	600.00	s					
LOGIC: Time t1 output 58								030 202
0.00	0.00	600.00	s					
LOGIC: Time t1 output 59								030 206
0.00	0.00	600.00	s					
LOGIC: Time t1 output 60								030 210
0.00	0.00	600.00	s					
LOGIC: Time t1 output 61								030 214
0.00	0.00	600.00	s					
LOGIC: Time t1 output 62								030 218
0.00	0.00	600.00	s					
LOGIC: Time t1 output 63								030 222
0.00	0.00	600.00	s					
LOGIC: Time t1 output 64								030 226
0.00	0.00	600.00	s					
LOGIC: Time t1 output 65								046 002
0.00	0.00	600.00	s					
LOGIC: Time t1 output 66								045 006
0.00	0.00	600.00	s					
LOGIC: Time t1 output 67								045 010
0.00	0.00	600.00	s					
LOGIC: Time t1 output 68								045 014
0.00	0.00	600.00	s					
LOGIC: Time t1 output 69								045 018
0.00	0.00	600.00	s					
LOGIC: Time t1 output 70								045 022
0.00	0.00	600.00	s					
LOGIC: Time t1 output 71								045 026
0.00	0.00	600.00	s					
LOGIC: Time t1 output 72								045 030
0.00	0.00	600.00	s					
LOGIC: Time t1 output 73								045 034
0.00	0.00	600.00	s					

Parameter				Address			
Default	Min	Max	Unit	Logic Diagram			
LOGIC: Time t1 output 74							045 038
0.00	0.00	600.00	s				
LOGIC: Time t1 output 75							045 042
0.00	0.00	600.00	s				
LOGIC: Time t1 output 76							045 046
0.00	0.00	600.00	s				
LOGIC: Time t1 output 77							045 050
0.00	0.00	600.00	s				
LOGIC: Time t1 output 78							045 054
0.00	0.00	600.00	s				
LOGIC: Time t1 output 79							045 058
0.00	0.00	600.00	s				
LOGIC: Time t1 output 80							045 062
0.00	0.00	600.00	s				
LOGIC: Time t1 output 81							045 066
0.00	0.00	600.00	s				
LOGIC: Time t1 output 82							045 070
0.00	0.00	600.00	s				
LOGIC: Time t1 output 83							045 074
0.00	0.00	600.00	s				
LOGIC: Time t1 output 84							045 078
0.00	0.00	600.00	s				
LOGIC: Time t1 output 85							045 082
0.00	0.00	600.00	s				
LOGIC: Time t1 output 86							045 086
0.00	0.00	600.00	s				
LOGIC: Time t1 output 87							045 090
0.00	0.00	600.00	s				
LOGIC: Time t1 output 88							045 094
0.00	0.00	600.00	s				
LOGIC: Time t1 output 89							045 098
0.00	0.00	600.00	s				
LOGIC: Time t1 output 90							045 102
0.00	0.00	600.00	s				
LOGIC: Time t1 output 91							045 106
0.00	0.00	600.00	s				
LOGIC: Time t1 output 92							045 110
0.00	0.00	600.00	s				

Parameter				Address			
Default	Min	Max	Unit	Logic Diagram			
LOGIC: Time t1 output 93							045 114
0.00	0.00	600.00	s				
LOGIC: Time t1 output 94							045 118
0.00	0.00	600.00	s				
LOGIC: Time t1 output 95							045 122
0.00	0.00	600.00	s				
LOGIC: Time t1 output 96							045 126
0.00	0.00	600.00	s				
LOGIC: Time t1 output 97							045 130
0.00	0.00	600.00	s				
LOGIC: Time t1 output 98							045 134
0.00	0.00	600.00	s				
LOGIC: Time t1 output 99							045 138
0.00	0.00	600.00	s				
LOGIC: Time t1 output100							045 142
0.00	0.00	600.00	s				
LOGIC: Time t1 output101							045 146
0.00	0.00	600.00	s				
LOGIC: Time t1 output102							045 150
0.00	0.00	600.00	s				
LOGIC: Time t1 output103							045 154
0.00	0.00	600.00	s				
LOGIC: Time t1 output104							045 158
0.00	0.00	600.00	s				
LOGIC: Time t1 output105							045 162
0.00	0.00	600.00	s				
LOGIC: Time t1 output106							045 166
0.00	0.00	600.00	s				
LOGIC: Time t1 output107							045 170
0.00	0.00	600.00	s				
LOGIC: Time t1 output108							045 174
0.00	0.00	600.00	s				
LOGIC: Time t1 output109							045 178
0.00	0.00	600.00	s				
LOGIC: Time t1 output110							045 182
0.00	0.00	600.00	s				
LOGIC: Time t1 output111							045 186
0.00	0.00	600.00	s				

Parameter				Address			
Default	Min	Max	Unit	Logic Diagram			
LOGIC: Time t1 output112							045 190
0.00	0.00	600.00	s				
LOGIC: Time t1 output113							045 194
0.00	0.00	600.00	s				
LOGIC: Time t1 output114							045 198
0.00	0.00	600.00	s				
LOGIC: Time t1 output115							045 202
0.00	0.00	600.00	s				
LOGIC: Time t1 output116							045 206
0.00	0.00	600.00	s				
LOGIC: Time t1 output117							045 210
0.00	0.00	600.00	s				
LOGIC: Time t1 output118							045 214
0.00	0.00	600.00	s				
LOGIC: Time t1 output119							045 218
0.00	0.00	600.00	s				
LOGIC: Time t1 output120							045 222
0.00	0.00	600.00	s				
LOGIC: Time t1 output121							045 226
0.00	0.00	600.00	s				
LOGIC: Time t1 output122							045 230
0.00	0.00	600.00	s				
LOGIC: Time t1 output123							045 234
0.00	0.00	600.00	s				
LOGIC: Time t1 output124							045 238
0.00	0.00	600.00	s				
LOGIC: Time t1 output125							045 242
0.00	0.00	600.00	s				
LOGIC: Time t1 output126							045 246
0.00	0.00	600.00	s				
LOGIC: Time t1 output127							045 250
0.00	0.00	600.00	s				
LOGIC: Time t1 output128							045 254
0.00	0.00	600.00	s				
Settings of timer stage t1 for the respective outputs.							
LOGIC: Time t2 output 1							030 003
0.00	0.00	600.00	s	Fig. 3-405, (p. 3-483)			

Parameter					Address			
Default	Min	Max	Unit		Logic Diagram			
LOGIC: Time t2 output 2								030 007
0.00	0.00	600.00	s					
LOGIC: Time t2 output 3								030 011
0.00	0.00	600.00	s					
LOGIC: Time t2 output 4								030 015
0.00	0.00	600.00	s					
LOGIC: Time t2 output 5								030 019
0.00	0.00	600.00	s					
LOGIC: Time t2 output 6								030 023
0.00	0.00	600.00	s					
LOGIC: Time t2 output 7								030 027
0.00	0.00	600.00	s					
LOGIC: Time t2 output 8								030 031
0.00	0.00	600.00	s					
LOGIC: Time t2 output 9								030 035
0.00	0.00	600.00	s					
LOGIC: Time t2 output 10								030 039
0.00	0.00	600.00	s					
LOGIC: Time t2 output 11								030 043
0.00	0.00	600.00	s					
LOGIC: Time t2 output 12								030 047
0.00	0.00	600.00	s					
LOGIC: Time t2 output 13								030 051
0.00	0.00	600.00	s					
LOGIC: Time t2 output 14								030 055
0.00	0.00	600.00	s					
LOGIC: Time t2 output 15								030 059
0.00	0.00	600.00	s					
LOGIC: Time t2 output 16								030 063
0.00	0.00	600.00	s					
LOGIC: Time t2 output 17								030 067
0.00	0.00	600.00	s					
LOGIC: Time t2 output 18								030 071
0.00	0.00	600.00	s					
LOGIC: Time t2 output 19								030 075
0.00	0.00	600.00	s					
LOGIC: Time t2 output 20								030 079
0.00	0.00	600.00	s					

Parameter				Address			
Default	Min	Max	Unit	Logic Diagram			
LOGIC: Time t2 output 21							030 083
0.00	0.00	600.00	s				
LOGIC: Time t2 output 22							030 087
0.00	0.00	600.00	s				
LOGIC: Time t2 output 23							030 091
0.00	0.00	600.00	s				
LOGIC: Time t2 output 24							030 095
0.00	0.00	600.00	s				
LOGIC: Time t2 output 25							030 099
0.00	0.00	600.00	s				
LOGIC: Time t2 output 26							031 003
0.00	0.00	600.00	s				
LOGIC: Time t2 output 27							031 007
0.00	0.00	600.00	s				
LOGIC: Time t2 output 28							031 011
0.00	0.00	600.00	s				
LOGIC: Time t2 output 29							031 015
0.00	0.00	600.00	s				
LOGIC: Time t2 output 30							031 019
0.00	0.00	600.00	s				
LOGIC: Time t2 output 31							031 023
0.00	0.00	600.00	s				
LOGIC: Time t2 output 32							031 027
0.00	0.00	600.00	s				
LOGIC: Time t2 output 33							030 103
0.00	0.00	600.00	s				
LOGIC: Time t2 output 34							030 107
0.00	0.00	600.00	s				
LOGIC: Time t2 output 35							030 111
0.00	0.00	600.00	s				
LOGIC: Time t2 output 36							030 115
0.00	0.00	600.00	s				
LOGIC: Time t2 output 37							030 119
0.00	0.00	600.00	s				
LOGIC: Time t2 output 38							030 123
0.00	0.00	600.00	s				
LOGIC: Time t2 output 39							030 127
0.00	0.00	600.00	s				

Parameter					Address			
Default	Min	Max	Unit		Logic Diagram			
LOGIC: Time t2 output 40								030 131
0.00	0.00	600.00	s					
LOGIC: Time t2 output 41								030 135
0.00	0.00	600.00	s					
LOGIC: Time t2 output 42								030 139
0.00	0.00	600.00	s					
LOGIC: Time t2 output 43								030 143
0.00	0.00	600.00	s					
LOGIC: Time t2 output 44								030 147
0.00	0.00	600.00	s					
LOGIC: Time t2 output 45								030 151
0.00	0.00	600.00	s					
LOGIC: Time t2 output 46								030 155
0.00	0.00	600.00	s					
LOGIC: Time t2 output 47								030 159
0.00	0.00	600.00	s					
LOGIC: Time t2 output 48								030 163
0.00	0.00	600.00	s					
LOGIC: Time t2 output 49								030 167
0.00	0.00	600.00	s					
LOGIC: Time t2 output 50								030 171
0.00	0.00	600.00	s					
LOGIC: Time t2 output 51								030 175
0.00	0.00	600.00	s					
LOGIC: Time t2 output 52								030 179
0.00	0.00	600.00	s					
LOGIC: Time t2 output 53								030 183
0.00	0.00	600.00	s					
LOGIC: Time t2 output 54								030 187
0.00	0.00	600.00	s					
LOGIC: Time t2 output 55								030 191
0.00	0.00	600.00	s					
LOGIC: Time t2 output 56								030 195
0.00	0.00	600.00	s					
LOGIC: Time t2 output 57								030 199
0.00	0.00	600.00	s					
LOGIC: Time t2 output 58								030 203
0.00	0.00	600.00	s					

Parameter				Address			
Default	Min	Max	Unit	Logic Diagram			
LOGIC: Time t2 output 59							030 207
0.00	0.00	600.00	s				
LOGIC: Time t2 output 60							030 211
0.00	0.00	600.00	s				
LOGIC: Time t2 output 61							030 215
0.00	0.00	600.00	s				
LOGIC: Time t2 output 62							030 219
0.00	0.00	600.00	s				
LOGIC: Time t2 output 63							030 223
0.00	0.00	600.00	s				
LOGIC: Time t2 output 64							030 227
0.00	0.00	600.00	s				
LOGIC: Time t2 output 65							046 003
0.00	0.00	600.00	s				
LOGIC: Time t2 output 66							045 007
0.00	0.00	600.00	s				
LOGIC: Time t2 output 67							045 011
0.00	0.00	600.00	s				
LOGIC: Time t2 output 68							045 015
0.00	0.00	600.00	s				
LOGIC: Time t2 output 69							045 019
0.00	0.00	600.00	s				
LOGIC: Time t2 output 70							045 023
0.00	0.00	600.00	s				
LOGIC: Time t2 output 71							045 027
0.00	0.00	600.00	s				
LOGIC: Time t2 output 72							045 031
0.00	0.00	600.00	s				
LOGIC: Time t2 output 73							045 035
0.00	0.00	600.00	s				
LOGIC: Time t2 output 74							045 039
0.00	0.00	600.00	s				
LOGIC: Time t2 output 75							045 043
0.00	0.00	600.00	s				
LOGIC: Time t2 output 76							045 047
0.00	0.00	600.00	s				
LOGIC: Time t2 output 77							045 051
0.00	0.00	600.00	s				

Parameter					Address			
Default	Min	Max	Unit		Logic Diagram			
LOGIC: Time t2 output 78								045 055
0.00	0.00	600.00	s					
LOGIC: Time t2 output 79								045 059
0.00	0.00	600.00	s					
LOGIC: Time t2 output 80								045 063
0.00	0.00	600.00	s					
LOGIC: Time t2 output 81								045 067
0.00	0.00	600.00	s					
LOGIC: Time t2 output 82								045 071
0.00	0.00	600.00	s					
LOGIC: Time t2 output 83								045 075
0.00	0.00	600.00	s					
LOGIC: Time t2 output 84								045 079
0.00	0.00	600.00	s					
LOGIC: Time t2 output 85								045 083
0.00	0.00	600.00	s					
LOGIC: Time t2 output 86								045 087
0.00	0.00	600.00	s					
LOGIC: Time t2 output 87								045 091
0.00	0.00	600.00	s					
LOGIC: Time t2 output 88								045 095
0.00	0.00	600.00	s					
LOGIC: Time t2 output 89								045 099
0.00	0.00	600.00	s					
LOGIC: Time t2 output 90								045 103
0.00	0.00	600.00	s					
LOGIC: Time t2 output 91								045 107
0.00	0.00	600.00	s					
LOGIC: Time t2 output 92								045 111
0.00	0.00	600.00	s					
LOGIC: Time t2 output 93								045 115
0.00	0.00	600.00	s					
LOGIC: Time t2 output 94								045 119
0.00	0.00	600.00	s					
LOGIC: Time t2 output 95								045 123
0.00	0.00	600.00	s					
LOGIC: Time t2 output 96								045 127
0.00	0.00	600.00	s					

Parameter				Address			
Default	Min	Max	Unit	Logic Diagram			
LOGIC: Time t2 output 97							045 131
0.00	0.00	600.00	s				
LOGIC: Time t2 output 98							045 135
0.00	0.00	600.00	s				
LOGIC: Time t2 output 99							045 139
0.00	0.00	600.00	s				
LOGIC: Time t2 output100							045 143
0.00	0.00	600.00	s				
LOGIC: Time t2 output101							045 147
0.00	0.00	600.00	s				
LOGIC: Time t2 output102							045 151
0.00	0.00	600.00	s				
LOGIC: Time t2 output103							045 155
0.00	0.00	600.00	s				
LOGIC: Time t2 output104							045 159
0.00	0.00	600.00	s				
LOGIC: Time t2 output105							045 163
0.00	0.00	600.00	s				
LOGIC: Time t2 output106							045 167
0.00	0.00	600.00	s				
LOGIC: Time t2 output107							045 171
0.00	0.00	600.00	s				
LOGIC: Time t2 output108							045 175
0.00	0.00	600.00	s				
LOGIC: Time t2 output109							045 179
0.00	0.00	600.00	s				
LOGIC: Time t2 output110							045 183
0.00	0.00	600.00	s				
LOGIC: Time t2 output111							045 187
0.00	0.00	600.00	s				
LOGIC: Time t2 output112							045 191
0.00	0.00	600.00	s				
LOGIC: Time t2 output113							045 195
0.00	0.00	600.00	s				
LOGIC: Time t2 output114							045 199
0.00	0.00	600.00	s				
LOGIC: Time t2 output115							045 203
0.00	0.00	600.00	s				

Parameter					Address			
Default	Min	Max	Unit		Logic Diagram			
LOGIC: Time t2 output116								045 207
0.00	0.00	600.00	s					
LOGIC: Time t2 output117								045 211
0.00	0.00	600.00	s					
LOGIC: Time t2 output118								045 215
0.00	0.00	600.00	s					
LOGIC: Time t2 output119								045 219
0.00	0.00	600.00	s					
LOGIC: Time t2 output120								045 223
0.00	0.00	600.00	s					
LOGIC: Time t2 output121								045 227
0.00	0.00	600.00	s					
LOGIC: Time t2 output122								045 231
0.00	0.00	600.00	s					
LOGIC: Time t2 output123								045 235
0.00	0.00	600.00	s					
LOGIC: Time t2 output124								045 239
0.00	0.00	600.00	s					
LOGIC: Time t2 output125								045 243
0.00	0.00	600.00	s					
LOGIC: Time t2 output126								045 247
0.00	0.00	600.00	s					
LOGIC: Time t2 output127								045 251
0.00	0.00	600.00	s					
LOGIC: Time t2 output128								045 255
0.00	0.00	600.00	s					
Settings for timer stage t2 for the respective outputs.								
Note: This setting has no effect in the “minimum time” operating mode.								
LOGIC: Sig. assign. outp. 1								044 000
061 000: MAIN: Without function					Fig. 3-412, (p. 3-488)			
LOGIC: Sig. assign. outp. 2								044 002
061 000: MAIN: Without function								
LOGIC: Sig. assign. outp. 3								044 004
061 000: MAIN: Without function								
LOGIC: Sig. assign. outp. 4								044 006
061 000: MAIN: Without function								
LOGIC: Sig. assign. outp. 5								044 008
061 000: MAIN: Without function								

Parameter				Address
Default	Min	Max	Unit	Logic Diagram
LOGIC: Sig.assig. outp. 6				044 010
061 000: MAIN: Without function				
LOGIC: Sig.assig. outp. 7				044 012
061 000: MAIN: Without function				
LOGIC: Sig.assig. outp. 8				044 014
061 000: MAIN: Without function				
LOGIC: Sig.assig. outp. 9				044 016
061 000: MAIN: Without function				
LOGIC: Sig.assig. outp. 10				044 018
061 000: MAIN: Without function				
LOGIC: Sig.assig. outp. 11				044 020
061 000: MAIN: Without function				
LOGIC: Sig.assig. outp. 12				044 022
061 000: MAIN: Without function				
LOGIC: Sig.assig. outp. 13				044 024
061 000: MAIN: Without function				
LOGIC: Sig.assig. outp. 14				044 026
061 000: MAIN: Without function				
LOGIC: Sig.assig. outp. 15				044 028
061 000: MAIN: Without function				
LOGIC: Sig.assig. outp. 16				044 030
061 000: MAIN: Without function				
LOGIC: Sig.assig. outp. 17				044 032
061 000: MAIN: Without function				
LOGIC: Sig.assig. outp. 18				044 034
061 000: MAIN: Without function				
LOGIC: Sig.assig. outp. 19				044 036
061 000: MAIN: Without function				
LOGIC: Sig.assig. outp. 20				044 038
061 000: MAIN: Without function				
LOGIC: Sig.assig. outp. 21				044 040
061 000: MAIN: Without function				
LOGIC: Sig.assig. outp. 22				044 042
061 000: MAIN: Without function				
LOGIC: Sig.assig. outp. 23				044 044
061 000: MAIN: Without function				
LOGIC: Sig.assig. outp. 24				044 046
061 000: MAIN: Without function				

Parameter				Address
Default	Min	Max	Unit	Logic Diagram
LOGIC: Sig.assig. outp. 25				044 048
061 000: MAIN: Without function				
LOGIC: Sig.assig. outp. 26				044 050
061 000: MAIN: Without function				
LOGIC: Sig.assig. outp. 27				044 052
061 000: MAIN: Without function				
LOGIC: Sig.assig. outp. 28				044 054
061 000: MAIN: Without function				
LOGIC: Sig.assig. outp. 29				044 056
061 000: MAIN: Without function				
LOGIC: Sig.assig. outp. 30				044 058
061 000: MAIN: Without function				
LOGIC: Sig.assig. outp. 31				044 060
061 000: MAIN: Without function				
LOGIC: Sig.assig. outp. 32				044 062
061 000: MAIN: Without function				
LOGIC: Sig.assig. outp. 33				044 064
061 000: MAIN: Without function				
LOGIC: Sig.assig. outp. 34				044 066
061 000: MAIN: Without function				
LOGIC: Sig.assig. outp. 35				044 068
061 000: MAIN: Without function				
LOGIC: Sig.assig. outp. 36				044 070
061 000: MAIN: Without function				
LOGIC: Sig.assig. outp. 37				044 072
061 000: MAIN: Without function				
LOGIC: Sig.assig. outp. 38				044 074
061 000: MAIN: Without function				
LOGIC: Sig.assig. outp. 39				044 076
061 000: MAIN: Without function				
LOGIC: Sig.assig. outp. 40				044 078
061 000: MAIN: Without function				
LOGIC: Sig.assig. outp. 41				044 080
061 000: MAIN: Without function				
LOGIC: Sig.assig. outp. 42				044 082
061 000: MAIN: Without function				
LOGIC: Sig.assig. outp. 43				044 084
061 000: MAIN: Without function				

Parameter					Address
Default	Min	Max	Unit		Logic Diagram
LOGIC: Sig.assig. outp. 44					044 086
061 000: MAIN: Without function					
LOGIC: Sig.assig. outp. 45					044 088
061 000: MAIN: Without function					
LOGIC: Sig.assig. outp. 46					044 090
061 000: MAIN: Without function					
LOGIC: Sig.assig. outp. 47					044 092
061 000: MAIN: Without function					
LOGIC: Sig.assig. outp. 48					044 094
061 000: MAIN: Without function					
LOGIC: Sig.assig. outp. 49					044 096
061 000: MAIN: Without function					
LOGIC: Sig.assig. outp. 50					044 098
061 000: MAIN: Without function					
LOGIC: Sig.assig. outp. 51					044 100
061 000: MAIN: Without function					
LOGIC: Sig.assig. outp. 52					044 102
061 000: MAIN: Without function					
LOGIC: Sig.assig. outp. 53					044 104
061 000: MAIN: Without function					
LOGIC: Sig.assig. outp. 54					044 106
061 000: MAIN: Without function					
LOGIC: Sig.assig. outp. 55					044 108
061 000: MAIN: Without function					
LOGIC: Sig.assig. outp. 56					044 110
061 000: MAIN: Without function					
LOGIC: Sig.assig. outp. 57					044 112
061 000: MAIN: Without function					
LOGIC: Sig.assig. outp. 58					044 114
061 000: MAIN: Without function					
LOGIC: Sig.assig. outp. 59					044 116
061 000: MAIN: Without function					
LOGIC: Sig.assig. outp. 60					044 118
061 000: MAIN: Without function					
LOGIC: Sig.assig. outp. 61					044 120
061 000: MAIN: Without function					
LOGIC: Sig.assig. outp. 62					044 122
061 000: MAIN: Without function					

Parameter				Address
Default	Min	Max	Unit	Logic Diagram
LOGIC: Sig.assig. outp. 63				044 124
061 000: MAIN: Without function				
LOGIC: Sig.assig. outp. 64				044 126
061 000: MAIN: Without function				
LOGIC: Sig.assig. outp. 65				048 128
061 000: MAIN: Without function				
LOGIC: Sig.assig. outp. 66				048 002
061 000: MAIN: Without function				
LOGIC: Sig.assig. outp. 67				048 004
061 000: MAIN: Without function				
LOGIC: Sig.assig. outp. 68				048 006
061 000: MAIN: Without function				
LOGIC: Sig.assig. outp. 69				048 008
061 000: MAIN: Without function				
LOGIC: Sig.assig. outp. 70				048 010
061 000: MAIN: Without function				
LOGIC: Sig.assig. outp. 71				048 012
061 000: MAIN: Without function				
LOGIC: Sig.assig. outp. 72				048 014
061 000: MAIN: Without function				
LOGIC: Sig.assig. outp. 73				048 016
061 000: MAIN: Without function				
LOGIC: Sig.assig. outp. 74				048 018
061 000: MAIN: Without function				
LOGIC: Sig.assig. outp. 75				048 020
061 000: MAIN: Without function				
LOGIC: Sig.assig. outp. 76				048 022
061 000: MAIN: Without function				
LOGIC: Sig.assig. outp. 77				048 024
061 000: MAIN: Without function				
LOGIC: Sig.assig. outp. 78				048 026
061 000: MAIN: Without function				
LOGIC: Sig.assig. outp. 79				048 028
061 000: MAIN: Without function				
LOGIC: Sig.assig. outp. 80				048 030
061 000: MAIN: Without function				
LOGIC: Sig.assig. outp. 81				048 032
061 000: MAIN: Without function				

Parameter					Address
Default	Min	Max	Unit		Logic Diagram
LOGIC: Sig.assig. outp. 82					048 034
061 000: MAIN: Without function					
LOGIC: Sig.assig. outp. 83					048 036
061 000: MAIN: Without function					
LOGIC: Sig.assig. outp. 84					048 038
061 000: MAIN: Without function					
LOGIC: Sig.assig. outp. 85					048 040
061 000: MAIN: Without function					
LOGIC: Sig.assig. outp. 86					048 042
061 000: MAIN: Without function					
LOGIC: Sig.assig. outp. 87					048 044
061 000: MAIN: Without function					
LOGIC: Sig.assig. outp. 88					048 046
061 000: MAIN: Without function					
LOGIC: Sig.assig. outp. 89					048 048
061 000: MAIN: Without function					
LOGIC: Sig.assig. outp. 90					048 050
061 000: MAIN: Without function					
LOGIC: Sig.assig. outp. 91					048 052
061 000: MAIN: Without function					
LOGIC: Sig.assig. outp. 92					048 054
061 000: MAIN: Without function					
LOGIC: Sig.assig. outp. 93					048 056
061 000: MAIN: Without function					
LOGIC: Sig.assig. outp. 94					048 058
061 000: MAIN: Without function					
LOGIC: Sig.assig. outp. 95					048 060
061 000: MAIN: Without function					
LOGIC: Sig.assig. outp. 96					048 062
061 000: MAIN: Without function					
LOGIC: Sig.assig. outp. 97					048 064
061 000: MAIN: Without function					
LOGIC: Sig.assig. outp. 98					048 066
061 000: MAIN: Without function					
LOGIC: Sig.assig. outp. 99					048 068
061 000: MAIN: Without function					
LOGIC: Sig.assig. outp.100					048 070
061 000: MAIN: Without function					

Parameter				Address
Default	Min	Max	Unit	Logic Diagram
LOGIC: Sig.assig. outp.101				048 072
061 000: MAIN: Without function				
LOGIC: Sig.assig. outp.102				048 074
061 000: MAIN: Without function				
LOGIC: Sig.assig. outp.103				048 076
061 000: MAIN: Without function				
LOGIC: Sig.assig. outp.104				048 078
061 000: MAIN: Without function				
LOGIC: Sig.assig. outp.105				048 080
061 000: MAIN: Without function				
LOGIC: Sig.assig. outp.106				048 082
061 000: MAIN: Without function				
LOGIC: Sig.assig. outp.107				048 084
061 000: MAIN: Without function				
LOGIC: Sig.assig. outp.108				048 086
061 000: MAIN: Without function				
LOGIC: Sig.assig. outp.109				048 088
061 000: MAIN: Without function				
LOGIC: Sig.assig. outp.110				048 090
061 000: MAIN: Without function				
LOGIC: Sig.assig. outp.111				048 092
061 000: MAIN: Without function				
LOGIC: Sig.assig. outp.112				048 094
061 000: MAIN: Without function				
LOGIC: Sig.assig. outp.113				048 096
061 000: MAIN: Without function				
LOGIC: Sig.assig. outp.114				048 098
061 000: MAIN: Without function				
LOGIC: Sig.assig. outp.115				048 100
061 000: MAIN: Without function				
LOGIC: Sig.assig. outp.116				048 102
061 000: MAIN: Without function				
LOGIC: Sig.assig. outp.117				048 104
061 000: MAIN: Without function				
LOGIC: Sig.assig. outp.118				048 106
061 000: MAIN: Without function				
LOGIC: Sig.assig. outp.119				048 108
061 000: MAIN: Without function				

Parameter					Address	
Default	Min	Max	Unit		Logic Diagram	
LOGIC: Sig.assig. outp.120					048 110	
061 000: MAIN: Without function						
LOGIC: Sig.assig. outp.121					048 112	
061 000: MAIN: Without function						
LOGIC: Sig.assig. outp.122					048 114	
061 000: MAIN: Without function						
LOGIC: Sig.assig. outp.123					048 116	
061 000: MAIN: Without function						
LOGIC: Sig.assig. outp.124					048 118	
061 000: MAIN: Without function						
LOGIC: Sig.assig. outp.125					048 120	
061 000: MAIN: Without function						
LOGIC: Sig.assig. outp.126					048 122	
061 000: MAIN: Without function						
LOGIC: Sig.assig. outp.127					048 124	
061 000: MAIN: Without function						
LOGIC: Sig.assig. outp.128					048 126	
061 000: MAIN: Without function						
These settings assign the function of a binary input signal to the output of the logic equation.						
LOGIC: Sig.assig.outp. 1(t)					044 001	
061 000: MAIN: Without function					Fig. 3-412, (p. 3-488)	
LOGIC: Sig.assig.outp. 2(t)					044 003	
061 000: MAIN: Without function						
LOGIC: Sig.assig.outp. 3(t)					044 005	
061 000: MAIN: Without function						
LOGIC: Sig.assig.outp. 4(t)					044 007	
061 000: MAIN: Without function						
LOGIC: Sig.assig.outp. 5(t)					044 009	
061 000: MAIN: Without function						
LOGIC: Sig.assig.outp. 6(t)					044 011	
061 000: MAIN: Without function						
LOGIC: Sig.assig.outp. 7(t)					044 013	
061 000: MAIN: Without function						
LOGIC: Sig.assig.outp. 8(t)					044 015	
061 000: MAIN: Without function						
LOGIC: Sig.assig.outp. 9(t)					044 017	
061 000: MAIN: Without function						

Parameter				Address
Default	Min	Max	Unit	Logic Diagram
LOGIC: Sig.assig.outp.10(t)				044 019
061 000: MAIN: Without function				
LOGIC: Sig.assig.outp.11(t)				044 021
061 000: MAIN: Without function				
LOGIC: Sig.assig.outp.12(t)				044 023
061 000: MAIN: Without function				
LOGIC: Sig.assig.outp.13(t)				044 025
061 000: MAIN: Without function				
LOGIC: Sig.assig.outp.14(t)				044 027
061 000: MAIN: Without function				
LOGIC: Sig.assig.outp.15(t)				044 029
061 000: MAIN: Without function				
LOGIC: Sig.assig.outp.16(t)				044 031
061 000: MAIN: Without function				
LOGIC: Sig.assig.outp.17(t)				044 033
061 000: MAIN: Without function				
LOGIC: Sig.assig.outp.18(t)				044 035
061 000: MAIN: Without function				
LOGIC: Sig.assig.outp.19(t)				044 037
061 000: MAIN: Without function				
LOGIC: Sig.assig.outp.20(t)				044 039
061 000: MAIN: Without function				
LOGIC: Sig.assig.outp.21(t)				044 041
061 000: MAIN: Without function				
LOGIC: Sig.assig.outp.22(t)				044 043
061 000: MAIN: Without function				
LOGIC: Sig.assig.outp.23(t)				044 045
061 000: MAIN: Without function				
LOGIC: Sig.assig.outp.24(t)				044 047
061 000: MAIN: Without function				
LOGIC: Sig.assig.outp.25(t)				044 049
061 000: MAIN: Without function				
LOGIC: Sig.assig.outp.26(t)				044 051
061 000: MAIN: Without function				
LOGIC: Sig.assig.outp.27(t)				044 053
061 000: MAIN: Without function				
LOGIC: Sig.assig.outp.28(t)				044 055
061 000: MAIN: Without function				

Parameter				Address
Default	Min	Max	Unit	Logic Diagram
LOGIC: Sig.assig.outp.29(t)				044 057
061 000: MAIN: Without function				
LOGIC: Sig.assig.outp.30(t)				044 059
061 000: MAIN: Without function				
LOGIC: Sig.assig.outp.31(t)				044 061
061 000: MAIN: Without function				
LOGIC: Sig.assig.outp.32(t)				044 063
061 000: MAIN: Without function				
LOGIC: Sig.assig.outp.33(t)				044 065
061 000: MAIN: Without function				
LOGIC: Sig.assig.outp.34(t)				044 067
061 000: MAIN: Without function				
LOGIC: Sig.assig.outp.35(t)				044 069
061 000: MAIN: Without function				
LOGIC: Sig.assig.outp.36(t)				044 071
061 000: MAIN: Without function				
LOGIC: Sig.assig.outp.37(t)				044 073
061 000: MAIN: Without function				
LOGIC: Sig.assig.outp.38(t)				044 075
061 000: MAIN: Without function				
LOGIC: Sig.assig.outp.39(t)				044 077
061 000: MAIN: Without function				
LOGIC: Sig.assig.outp.40(t)				044 079
061 000: MAIN: Without function				
LOGIC: Sig.assig.outp.41(t)				044 081
061 000: MAIN: Without function				
LOGIC: Sig.assig.outp.42(t)				044 083
061 000: MAIN: Without function				
LOGIC: Sig.assig.outp.43(t)				044 085
061 000: MAIN: Without function				
LOGIC: Sig.assig.outp.44(t)				044 087
061 000: MAIN: Without function				
LOGIC: Sig.assig.outp.45(t)				044 089
061 000: MAIN: Without function				
LOGIC: Sig.assig.outp.46(t)				044 091
061 000: MAIN: Without function				
LOGIC: Sig.assig.outp.47(t)				044 093
061 000: MAIN: Without function				

Parameter				Address
Default	Min	Max	Unit	Logic Diagram
LOGIC: Sig.assig.outp.48(t)				044 095
061 000: MAIN: Without function				
LOGIC: Sig.assig.outp.49(t)				044 097
061 000: MAIN: Without function				
LOGIC: Sig.assig.outp.50(t)				044 099
061 000: MAIN: Without function				
LOGIC: Sig.assig.outp.51(t)				044 101
061 000: MAIN: Without function				
LOGIC: Sig.assig.outp.52(t)				044 103
061 000: MAIN: Without function				
LOGIC: Sig.assig.outp.53(t)				044 105
061 000: MAIN: Without function				
LOGIC: Sig.assig.outp.54(t)				044 107
061 000: MAIN: Without function				
LOGIC: Sig.assig.outp.55(t)				044 109
061 000: MAIN: Without function				
LOGIC: Sig.assig.outp.56(t)				044 111
061 000: MAIN: Without function				
LOGIC: Sig.assig.outp.57(t)				044 113
061 000: MAIN: Without function				
LOGIC: Sig.assig.outp.58(t)				044 115
061 000: MAIN: Without function				
LOGIC: Sig.assig.outp.59(t)				044 117
061 000: MAIN: Without function				
LOGIC: Sig.assig.outp.60(t)				044 119
061 000: MAIN: Without function				
LOGIC: Sig.assig.outp.61(t)				044 121
061 000: MAIN: Without function				
LOGIC: Sig.assig.outp.62(t)				044 123
061 000: MAIN: Without function				
LOGIC: Sig.assig.outp.63(t)				044 125
061 000: MAIN: Without function				
LOGIC: Sig.assig.outp.64(t)				044 127
061 000: MAIN: Without function				
LOGIC: Sig.assig.outp.65(t)				048 129
061 000: MAIN: Without function				
LOGIC: Sig.assig.outp.66(t)				048 003
061 000: MAIN: Without function				

Parameter					Address
Default	Min	Max	Unit		Logic Diagram
LOGIC: Sig.assig.outp.67(t)					048 005
061 000: MAIN: Without function					
LOGIC: Sig.assig.outp.68(t)					048 007
061 000: MAIN: Without function					
LOGIC: Sig.assig.outp.69(t)					048 009
061 000: MAIN: Without function					
LOGIC: Sig.assig.outp.70(t)					048 011
061 000: MAIN: Without function					
LOGIC: Sig.assig.outp.71(t)					048 013
061 000: MAIN: Without function					
LOGIC: Sig.assig.outp.72(t)					048 015
061 000: MAIN: Without function					
LOGIC: Sig.assig.outp.73(t)					048 017
061 000: MAIN: Without function					
LOGIC: Sig.assig.outp.74(t)					048 019
061 000: MAIN: Without function					
LOGIC: Sig.assig.outp.75(t)					048 021
061 000: MAIN: Without function					
LOGIC: Sig.assig.outp.76(t)					048 023
061 000: MAIN: Without function					
LOGIC: Sig.assig.outp.77(t)					048 025
061 000: MAIN: Without function					
LOGIC: Sig.assig.outp.78(t)					048 027
061 000: MAIN: Without function					
LOGIC: Sig.assig.outp.79(t)					048 029
061 000: MAIN: Without function					
LOGIC: Sig.assig.outp.80(t)					048 031
061 000: MAIN: Without function					
LOGIC: Sig.assig.outp.81(t)					048 033
061 000: MAIN: Without function					
LOGIC: Sig.assig.outp.82(t)					048 035
061 000: MAIN: Without function					
LOGIC: Sig.assig.outp.83(t)					048 037
061 000: MAIN: Without function					
LOGIC: Sig.assig.outp.84(t)					048 039
061 000: MAIN: Without function					
LOGIC: Sig.assig.outp.85(t)					048 041
061 000: MAIN: Without function					

Parameter				Address
Default	Min	Max	Unit	Logic Diagram
LOGIC: Sig.assig.outp.86(t)				048 043
061 000: MAIN: Without function				
LOGIC: Sig.assig.outp.87(t)				048 045
061 000: MAIN: Without function				
LOGIC: Sig.assig.outp.88(t)				048 047
061 000: MAIN: Without function				
LOGIC: Sig.assig.outp.89(t)				048 049
061 000: MAIN: Without function				
LOGIC: Sig.assig.outp.90(t)				048 051
061 000: MAIN: Without function				
LOGIC: Sig.assig.outp.91(t)				048 053
061 000: MAIN: Without function				
LOGIC: Sig.assig.outp.92(t)				048 055
061 000: MAIN: Without function				
LOGIC: Sig.assig.outp.93(t)				048 057
061 000: MAIN: Without function				
LOGIC: Sig.assig.outp.94(t)				048 059
061 000: MAIN: Without function				
LOGIC: Sig.assig.outp.95(t)				048 061
061 000: MAIN: Without function				
LOGIC: Sig.assig.outp.96(t)				048 063
061 000: MAIN: Without function				
LOGIC: Sig.assig.outp.97(t)				048 065
061 000: MAIN: Without function				
LOGIC: Sig.assig.outp.98(t)				048 067
061 000: MAIN: Without function				
LOGIC: Sig.assig.outp.99(t)				048 069
061 000: MAIN: Without function				
LOGIC: Sig.assig.outp100(t)				048 071
061 000: MAIN: Without function				
LOGIC: Sig.assig.outp101(t)				048 073
061 000: MAIN: Without function				
LOGIC: Sig.assig.outp102(t)				048 075
061 000: MAIN: Without function				
LOGIC: Sig.assig.outp103(t)				048 077
061 000: MAIN: Without function				
LOGIC: Sig.assig.outp104(t)				048 079
061 000: MAIN: Without function				

Parameter				Address
Default	Min	Max	Unit	Logic Diagram
LOGIC: Sig.assig.outp105(t)				048 081
061 000: MAIN: Without function				
LOGIC: Sig.assig.outp106(t)				048 083
061 000: MAIN: Without function				
LOGIC: Sig.assig.outp107(t)				048 085
061 000: MAIN: Without function				
LOGIC: Sig.assig.outp108(t)				048 087
061 000: MAIN: Without function				
LOGIC: Sig.assig.outp109(t)				048 089
061 000: MAIN: Without function				
LOGIC: Sig.assig.outp110(t)				048 091
061 000: MAIN: Without function				
LOGIC: Sig.assig.outp111(t)				048 093
061 000: MAIN: Without function				
LOGIC: Sig.assig.outp112(t)				048 095
061 000: MAIN: Without function				
LOGIC: Sig.assig.outp112(t)				048 097
061 000: MAIN: Without function				
LOGIC: Sig.assig.outp114(t)				048 099
061 000: MAIN: Without function				
LOGIC: Sig.assig.outp115(t)				048 101
061 000: MAIN: Without function				
LOGIC: Sig.assig.outp116(t)				048 103
061 000: MAIN: Without function				
LOGIC: Sig.assig.outp117(t)				048 105
061 000: MAIN: Without function				
LOGIC: Sig.assig.outp118(t)				048 107
061 000: MAIN: Without function				
LOGIC: Sig.assig.outp119(t)				048 109
061 000: MAIN: Without function				
LOGIC: Sig.assig.outp120(t)				048 111
061 000: MAIN: Without function				
LOGIC: Sig.assig.outp121(t)				048 113
061 000: MAIN: Without function				
LOGIC: Sig.assig.outp122(t)				048 115
061 000: MAIN: Without function				
LOGIC: Sig.assig.outp123(t)				048 117
061 000: MAIN: Without function				

Parameter				Address
Default	Min	Max	Unit	Logic Diagram
LOGIC: Sig.assig.outp124(t)				048 119
061 000: MAIN: Without function				
LOGIC: Sig.assig.outp125(t)				048 121
061 000: MAIN: Without function				
LOGIC: Sig.assig.outp126(t)				048 123
061 000: MAIN: Without function				
LOGIC: Sig.assig.outp127(t)				048 125
061 000: MAIN: Without function				
LOGIC: Sig.assig.outp128(t)				048 127
061 000: MAIN: Without function				
These settings assign the function of a binary input signal to the output of the logic equation.				

Programmable Logic

Parameter				Address
Default	Min	Max	Unit	Logic Diagram
LOG_2: General enable USER				011 137
0: No Fig. 3-406, (p. 3-484)				
Enable/disable the function group LOG_2 (Programmable Logic 2).				
LOG_2: Fct.assignm. outp. 1				050 000
060 000: MAIN: Without function Fig. 3-406, (p. 3-484)				
LOG_2: Fct.assignm. outp. 2				050 004
060 000: MAIN: Without function s				
LOG_2: Fct.assignm. outp. 3				050 008
060 000: MAIN: Without function				
LOG_2: Fct.assignm. outp. 4				050 012
060 000: MAIN: Without function				
These settings assign functions to the outputs.				
LOG_2: Op. mode t output 1				050 001
0: Without timer stage Fig. 3-406, (p. 3-484)				
LOG_2: Op. mode t output 2				050 005
0: Without timer stage				
LOG_2: Op. mode t output 3				050 009
0: Without timer stage				
LOG_2: Op. mode t output 4				050 013
0: Without timer stage				
These settings define the operating modes for the output timer stages.				
LOG_2: Time t1 output 1				050 002
0	0	60000	s	Fig. 3-406, (p. 3-484)
LOG_2: Time t1 output 2				050 006
0	0	60000	s	
LOG_2: Time t1 output 3				050 010
0	0	60000	s	
LOG_2: Time t1 output 4				050 014
0	0	60000	s	
Settings of timer stage t1 for the respective outputs.				
LOG_2: Time t2 output 1				050 003
0	0	60000	s	Fig. 3-406, (p. 3-484)
LOG_2: Time t2 output 2				050 007
0	0	60000	s	
LOG_2: Time t2 output 3				050 011
0	0	60000	s	

Parameter				Address	
Default	Min	Max	Unit	Logic Diagram	
LOG_2: Time t2 output 4					050 015
0	0	60000	s		
Settings for timer stage t2 for the respective outputs.					
Note: This setting has no effect in the “minimum time” operating mode.					
LOG_2: Sig. assign. outp. 1					064 000
061 000: MAIN: Without function					
LOG_2: Sig. assign. outp. 2					064 002
061 000: MAIN: Without function					
LOG_2: Sig. assign. outp. 3					064 004
061 000: MAIN: Without function					
LOG_2: Sig. assign. outp. 4					064 006
061 000: MAIN: Without function					
These settings assign the function of a binary input signal to the output of the logic equation.					
LOG_2: Sig. assign.outp. 1(t)					064 001
061 000: MAIN: Without function					
LOG_2: Sig. assign.outp. 2(t)					064 003
061 000: MAIN: Without function					
LOG_2: Sig. assign.outp. 3(t)					064 005
061 000: MAIN: Without function					
LOG_2: Sig. assign.outp. 4(t)					064 007
061 000: MAIN: Without function					
These settings assign the function of a binary input signal to the output of the logic equation.					

Real Timer

Parameter	Address			
Default	Min	Max	Unit	Logic Diagram
TIMER: General enable USER				014 199
0: No				Fig. 3-440, (p. 3-526)
Disabling or enabling TIMER protection.				
TIMER: Calendar 1				014 178
060 000: MAIN: Without function				Fig. 3-440, (p. 3-526)
TIMER: Calendar 2				014 179
060 000: MAIN: Without function				
TIMER: Calendar 3				014 189
060 000: MAIN: Without function				
TIMER: Calendar 4				015 005
060 000: MAIN: Without function				
The setting defines the calendar day of week for the TIMER. One or more of the seven weekdays can be selected.				
TIMER: Start hour 1				014 089
0	0	23	h	Fig. 3-440, (p. 3-526)
TIMER: Start hour 2				014 119
0	0	23	h	
TIMER: Start hour 3				015 030
0	0	23	h	
TIMER: Start hour 4				015 063
0	0	23	h	
The parameter defines the start hour of the TIMER.				
TIMER: Start minute 1				014 102
0	0	59	min	Fig. 3-440, (p. 3-526)
TIMER: Start minute 2				014 128
0	0	59	min	
TIMER: Start minute 3				015 052
0	0	59	min	
TIMER: Start minute 4				015 089
0	0	59	min	
The parameter defines the start minute of the TIMER.				
TIMER: End hour 1				014 109
0	0	23	h	Fig. 3-440, (p. 3-526)
TIMER: End hour 2				014 129
0	0	23	h	
TIMER: End hour 3				015 061
0	0	23	h	

Parameter				Address			
Default	Min	Max	Unit	Logic Diagram			
TIMER: End hour 4							015 200
0	0	23	h				
The parameter defines the end hour of the TIMER.							
TIMER: End minute 1							014 118
0	0	59	min	Fig. 3-440, (p. 3-526)			
TIMER: End minute 2							014 138
0	0	59	min				
TIMER: End minute 3							015 062
0	0	59	min				
TIMER: End minute 4							015 201
0	0	59	min				
The parameter defines the end minute of the TIMER.							

Single-pole
commands

Parameter					Address
Default	Min	Max	Unit		Logic Diagram
CMD_1: Design. command C001					200 000
1: C001					
CMD_1: Design. command C002					200 005
2: C002					
CMD_1: Design. command C003					200 010
3: C003					
CMD_1: Design. command C004					200 015
4: C004					
CMD_1: Design. command C005					200 020
5: C005					
CMD_1: Design. command C006					200 025
6: C006					
CMD_1: Design. command C007					200 030
7: C007					
CMD_1: Design. command C008					200 035
8: C008					
CMD_1: Design. command C009					200 040
9: C009					
CMD_1: Design. command C010					200 045
10: C010					
CMD_1: Design. command C011					200 050
11: C011					
CMD_1: Design. command C012					200 055
12: C012					
CMD_1: Design. CMD_DC3					202 010
234: CMD_DC3					
Selection of the command designation.					
CMD_1: Oper. mode cmd. C001					200 002
3: Persistent command					Fig. 3-433, (p. 3-517)
CMD_1: Oper. mode cmd. C002					200 007
3: Persistent command					
CMD_1: Oper. mode cmd. C003					200 012
3: Persistent command					
CMD_1: Oper. mode cmd. C004					200 017
3: Persistent command					
CMD_1: Oper. mode cmd. C005					200 022
3: Persistent command					

Parameter				Address
Default	Min	Max	Unit	Logic Diagram
CMD_1: Oper. mode cmd. C006				200 027
3: Persistent command				
CMD_1: Oper. mode cmd. C007				200 032
3: Persistent command				
CMD_1: Oper. mode cmd. C008				200 037
3: Persistent command				
CMD_1: Oper. mode cmd. C009				200 042
3: Persistent command				
CMD_1: Oper. mode cmd. C010				200 047
3: Persistent command				
CMD_1: Oper. mode cmd. C011				200 052
3: Persistent command				
CMD_1: Oper. mode cmd. C012				200 057
3: Persistent command				
Selection of the command operating mode.				

Single-pole signals

Parameter					Address
Default	Min	Max	Unit		Logic Diagram
SIG_1: Designat. sig. S001					226 000
1: S001					
SIG_1: Designat. sig. S002					226 008
2: S002					
SIG_1: Designat. sig. S003					226 016
3: S003					
SIG_1: Designat. sig. S004					226 024
4: S004					
SIG_1: Designat. sig. S005					226 032
5: S005					
SIG_1: Designat. sig. S006					226 040
6: S006					
SIG_1: Designat. sig. S007					226 048
7: S007					
SIG_1: Designat. sig. S008					226 056
8: S008					
SIG_1: Designat. sig. S009					226 064
9: S009					
SIG_1: Designat. sig. S010					226 072
10: S010					
SIG_1: Designat. sig. S011					226 080
11: S011					
SIG_1: Designat. sig. S012					226 088
12: S012					
SIG_1: Designat. sig. S041					227 064
41: S041					
SIG_1: Designat. SIG_DC3					233 000
234: SIGNAL DC3					
Selection of the signal designation.					
SIG_1: Oper. mode sig. S001					226 001
1: Start/end signal					Fig. 3-434, (p. 3-519)
SIG_1: Oper. mode sig. S002					226 009
1: Start/end signal					
SIG_1: Oper. mode sig. S003					226 017
1: Start/end signal					
SIG_1: Oper. mode sig. S004					226 025
1: Start/end signal					

Parameter				Address
Default	Min	Max	Unit	Logic Diagram
SIG_1: Oper. mode sig. S005				226 033
1: Start/end signal				
SIG_1: Oper. mode sig. S006				226 041
1: Start/end signal				
SIG_1: Oper. mode sig. S007				226 049
1: Start/end signal				
SIG_1: Oper. mode sig. S008				226 057
1: Start/end signal				
SIG_1: Oper. mode sig. S009				226 065
1: Start/end signal				
SIG_1: Oper. mode sig. S010				226 073
1: Start/end signal				
SIG_1: Oper. mode sig. S011				226 081
1: Start/end signal				
SIG_1: Oper. mode sig. S012				226 089
1: Start/end signal				
Selection of the signal operating mode.				
SIG_1: Gr.asg. debounc.S001				226 003
1: Group 1				Fig. 3-434, (p. 3-519)
SIG_1: Gr.asg. debounc.S002				226 011
1: Group 1				
SIG_1: Gr.asg. debounc.S003				226 019
1: Group 1				
SIG_1: Gr.asg. debounc.S004				226 027
1: Group 1				
SIG_1: Gr.asg. debounc.S005				226 035
1: Group 1				
SIG_1: Gr.asg. debounc.S006				226 043
1: Group 1				
SIG_1: Gr.asg. debounc.S007				226 051
1: Group 1				
SIG_1: Gr.asg. debounc.S008				226 059
1: Group 1				
SIG_1: Gr.asg. debounc.S009				226 067
1: Group 1				
SIG_1: Gr.asg. debounc.S010				226 075
1: Group 1				

Parameter				Address
Default	Min	Max	Unit	Logic Diagram
SIG_1: Gr.asg. debounc.S011				226 083
1: Group 1				
SIG_1: Gr.asg. debounc.S012				226 091
1: Group 1				
Group assignment for the debouncing time and the chatter suppression.				
SIG_1: Min. sig. dur. S001				226 002
0	0	254	s	Fig. 3-434, (p. 3-519)
SIG_1: Min. sig. dur. S002				226 010
0	0	254	s	
SIG_1: Min. sig. dur. S003				226 018
0	0	254	s	
SIG_1: Min. sig. dur. S004				226 026
0	0	254	s	
SIG_1: Min. sig. dur. S005				226 034
0	0	254	s	
SIG_1: Min. sig. dur. S006				226 042
0	0	254	s	
SIG_1: Min. sig. dur. S007				226 050
0	0	254	s	
SIG_1: Min. sig. dur. S008				226 058
0	0	254	s	
SIG_1: Min. sig. dur. S009				226 066
0	0	254	s	
SIG_1: Min. sig. dur. S010				226 074
0	0	254	s	
SIG_1: Min. sig. dur. S011				226 082
0	0	254	s	
SIG_1: Min. sig. dur. S012				226 090
0	0	254	s	
The logic "1" signal must be available for this minimum time setting so that a telegram can be sent in the <i>Start/end signal</i> mode.				

Binary counts

Parameter				Address
Default	Min	Max	Unit	Logic Diagram
COUNT: General enable USER				217 000
0: No				Fig. 3-439, (p. 3-525)
Disabling or enabling binary counts.				
COUNT: Debounce t. count. 1				217 160
3	0	1000	ms	Fig. 3-439, (p. 3-525)
COUNT: Debounce t. count. 2				217 161
3	0	1000	ms	
COUNT: Debounce t. count. 3				217 162
3	0	1000	ms	
COUNT: Debounce t. count. 4				217 163
3	0	1000	ms	
Setting for the debounce time of the binary signal to be counted.				
COUNT: Limit counter 1				217 221
Blocked	1	65000		
COUNT: Limit counter 2				217 222
Blocked	1	65000		
COUNT: Limit counter 3				217 223
Blocked	1	65000		
COUNT: Limit counter 4				217 224
Blocked	1	65000		
Setting a limit for the counter value. A warning signal is issued if the counter value exceeds the set limit. Setting this parameter to <i>Blocked</i> disables the limit check.				
COUNT: Cycle t.count transm				217 007
0: No transmission				Fig. 3-439, (p. 3-525)
Setting the cycle time for the periodic transmission of the counts.				
COUNT: IEC61850 pulsQty				221 096
1	0	1000		
Setting the scaling factor to transmit the counter value via IEC 61850. According to the standard the resulting value is calculated as: Value transmitted = actual value · pulsQty (see IEC 61850: Value = actVal · pulsQty).				

7.1.3.3

Parameter Subsets

Main function

Parameter	Address			
Default	Min	Max	Unit	Logic Diagram
MAIN: Neutr.pt. treat. PSx	010 048	001 076	001 077	001 078
1: Low-imped. grounding				
The neutral-point treatment of the system must be set here.				
MAIN: Ground starting PSx	001 249	001 250	001 251	002 001
1: IN> OR VNG> Fig. 3-124, (p. 3-174)				
Setting whether a ground fault is determined by an 'OR'-linked or an 'AND'-linked condition of the IN> and VNG> thresholds.				
MAIN: Phase prio. 2pG PSx	010 041	001 082	001 083	001 084
1: Phase-to-phase loop Fig. 3-133, (p. 3-186)				
The selection of measured variables in the event of two-phase grounded faults is a function of the set phase priority.				
MAIN: Transfer for 1p PSx	010 040	001 079	001 080	001 081
1: Ground				
For single-phase overcurrent starting without ground starting, either ground starting or another phase starting needs to be triggered. The user may choose to always activate the ground starting or – as a function of current magnitude ratios – to trigger ground or phase starting.				
MAIN: Op. mode rush r. PSx	017 097	001 088	001 089	001 090
0: Without Fig. 3-69, (p. 3-111)				
Setting for the operating mode of the inrush stabilization function.				
MAIN: Funct.Rush restr.PSx	017 093	017 064	017 082	017 083
060 000: MAIN: Without function Fig. 3-70, (p. 3-112)				
Select the protection elements that shall be blocked when the inrush stabilization is triggered.				
MAIN: Rush I(2fn)/I(fn)PSx	017 098	001 091	001 092	001 093
20	10	35	%	Fig. 3-69, (p. 3-111)
Setting for the operate value of inrush stabilization.				
MAIN: I> lift rush r. PSx	017 095	001 085	001 086	001 087
10.0	1.0	20.0	Inom	Fig. 3-69, (p. 3-111)
Setting for the current threshold for disabling the inrush stabilization.				
MAIN: t lift rush rstr.PSx	019 001	019 002	019 003	019 004
Blocked	0.01	10.00	s	Fig. 3-69, (p. 3-111)
Setting for the maximum duration of inrush stabilization.				

Parameter				Address
Default	Min	Max	Unit	Logic Diagram
MAIN: Gen. start w. OC PSx				013 072 013 088 013 090 013 091
0: No				Fig. 3-82, (p. 3-124)
General starting with DTOC/IDMT starting conditions. This setting parameter defines whether DTOC/IDMT starting signals contribute to general starting.				
MAIN: Gen. start. mode PSx				017 027 001 219 001 220 001 221
1: With start. IN, Ineg				Fig. 3-276, (p. 3-345)
This setting defines whether the triggering of the residual current stages $I_{N>}$, $I_{ref,N>}$, $I_{N>>}$ or $I_{N>>>}$ as well as the negative-sequence current stage $I_{ref,neg>}$ should result in the formation of the general starting signal. If the setting is <i>W/o start. IN, Ineg</i> then the associated time delays $t_{IN>}$, $t_{Iref,N>}$, $t_{IN>>}$, $t_{IN>>>}$, $t_{Iref,neg>}$ are automatically excluded from the formation of the trip command.				

Fault data acquisition

Parameter				Address
Default	Min	Max	Unit	Logic Diagram
FT_DA: Line length PSx				010 005 010 006 010 007 010 008
10.00	0.01	500.00	km	Fig. 3-116, (p. 3-163)
This setting defines the distance in km that the fault locator interprets as 100 % when calculating the fault distance.				
FT_DA: Line reactance PSx				010 012 010 013 010 014 010 015
10 2 (For MAIN: Inom device=1.0A 5.0A)	0.1 0.02	200 40	Ω	Fig. 3-116, (p. 3-163)
This setting defines the reactance X that the fault locator interprets as 100 % when calculating the fault distance.				
FT_DA: Flt.loc. determ. PSx				008 007 008 008 008 009 008 027
0: with GS				Fig. 3-114, (p. 3-160)
Select whether the fault location shall be determined only for short-circuits with a general starting (<i>with GS</i>) or also in case of a sole neutral starting, e. g. during a short-duration grounding (<i>with GS or N</i>).				
FT_DA: Start data acqu. PSx				010 011 010 042 010 043 010 044
1: End of fault				Fig. 3-114, (p. 3-160)
This setting determines at what point during a fault the acquisition of fault data should take place.				
FT_DA: Outp. flt.locat. PSx				010 032 010 033 010 034 010 035
1: Always				Fig. 3-114, (p. 3-160)
Setting for the conditions under which a fault location is output.				

Distance protection

Parameter				Address		
Default	Min	Max	Unit	Logic Diagram		
DIST: Enable PSx			019 009	019 015	019 030	019 039
1: Yes			Fig. 3-121, (p. 3-170)			
This setting defines the parameter subset in which distance protection is enabled.						
DIST: I>> PSx			010 054	010 074	010 094	011 014
1.00	0.10	20.00	Inom	Fig. 3-122, (p. 3-172)		
Setting for the operate value of overcurrent starting.						
DIST: I> (Ibl) PSx			010 068	010 088	011 008	011 028
0.20	0.05	1.00	Inom	Fig. 3-125, (p. 3-175)		
Base current setting above which undervoltage and underimpedance starting is enabled.						
DIST: Operat. mode V< PSx			010 067	010 087	011 007	011 027
2: With V< start.PG,PP			Fig. 3-126, (p. 3-177)			
Operating mode setting for undervoltage starting.						
DIST: V< PSx			010 069	010 089	011 009	011 029
0.70	0.10	0.90	Vnom/(√3)	Fig. 3-126, (p. 3-177)		
Setting for the operate value of undervoltage starting.						
DIST: Operat. mode Z< PSx			010 066	010 086	011 006	011 026
2: With Z< start.PG,PP			Fig. 3-127, (p. 3-178)			
Operating mode setting for underimpedance starting.						
DIST: Xfw PSx			010 050	010 070	010 090	011 010
10 2 (For MAIN: Inom device=1.0A 5.0A)	0.1 0.02	400 80	Ω	Fig. 3-130, (p. 3-181)		
Setting for the reactance limit of underimpedance starting.						
DIST: Rfw,PG PSx			010 051	010 071	010 091	011 011
10 2 (For MAIN: Inom device=1.0A 5.0A)	0.1 0.02	400 80	Ω	Fig. 3-130, (p. 3-181)		
Setting for the resistance limit of underimpedance starting for phase-to-ground loops.						
DIST: Rfw,PP PSx			010 052	010 072	010 092	011 012
10 2 (For MAIN: Inom device=1.0A 5.0A)	0.1 0.02	400 80	Ω	Fig. 3-130, (p. 3-181)		
Setting for the resistance limit of underimpedance starting for phase-to-phase loops.						
DIST: β PSx			010 063	010 083	011 003	011 023
30	15	65	°	Fig. 3-130, (p. 3-181)		
Angle setting for load blinder of underimpedance starting characteristic.						

Parameter				Address			
Default	Min	Max	Unit	Logic Diagram			
DIST: Zfw,PG PSx				010 101	010 102	010 103	010 104
0 0 (For MAIN: Inom device=1.0A 5.0A)				0 0	400 80	Ω	Fig. 3-130, (p. 3-181)
Setting for the circular reach (load-angle-independent limit) of underimpedance starting characteristic for phase-to-ground loops.							
DIST: Zfw,PP PSx				010 105	010 106	010 107	010 108
0 0 (For MAIN: Inom device=1.0A 5.0A)				0 0	400 80	Ω	Fig. 3-130, (p. 3-181)
Setting for the circular reach (load-angle-independent limit) of underimpedance starting characteristic for phase-to-phase loops.							
DIST: Zbw/Zfw PSx				010 053	010 073	010 093	011 013
0.50				0.00	4.00		Fig. 3-130, (p. 3-181)
Setting for the limit of underimpedance starting in the backward (reverse) direction.							
DIST: Z evaluation PSx				025 093	024 013	024 073	025 033
1: ZPG=VPG/(IP + kG*IN)				Fig. 3-130, (p. 3-181)			
This setting determines how the P433 will carry out the impedance calculation of the phase-to-ground loops for evaluating underimpedance starting condition:							
● Setting $ZPG=VPG/(IP + kG*IN)$: The calculation will be carried out using the residual current compensated phase current using the set (complex) ground factor. ● Setting $ZPG=VPG/2*IP$: The calculation will be carried out using twice the phase current. ● Setting $ZPG=VPG/IP*(1 + kG)$: The calculation will be carried out using the phase current corrected by the real value of the ground factor.							
Note: Calculation with twice or (1+kG) times the phase current may be necessary in lowimpedance-grounded networks in order to avoid inadvertent starting in healthy lines as the result of the high ground fault current.							
Phase-Ground impedance is calculated by the distance measuring system using solely the residual current compensated phase current using the set (complex) ground factor.							
DIST: IN > PSx				010 055	010 075	010 095	011 015
0.20				0.05	2.00	Inom	Fig. 3-123, (p. 3-173)
Operate value setting for the residual current stage of ground starting.							

Parameter				Address			
Default	Min	Max	Unit	Logic Diagram			
DIST: $t_{IN>}$ PSx				010 057	010 077	010 097	011 017
0.100	0.000	0.500	s	Fig. 3-123, (p. 3-173) Fig. 3-131, (p. 3-183)			
In isolated-neutral or resonant-grounded systems, the operate delay $t_{IN>}$ should be set so as to avoid erroneous transient ground starting resulting from residual current flow due to switching phenomena related to phase-to-ground capacitances.							
Note: For single-phase faults, neutral starting does not proceed before $t_{IN>}$ has elapsed. $t_{IN>}$ should be set to at least 20 ms so that starting transfer does not occur.							
DIST: $V_{NG>}$ PSx				010 056	010 076	010 096	011 016
0.10	0.01	1.00	Vnom/v3	Fig. 3-123, (p. 3-173)			
Operate value setting for the voltage trigger $V_{NG>}$ of ground starting.							
DIST: $V_{NG>>}$ PSx				010 062	010 082	011 002	011 022
0.50	0.20	1.00	Vnom/v3	Fig. 3-123, (p. 3-173)			
Operate value setting for the voltage trigger $V_{NG>>}$ of ground starting.							
DIST: $t_{VNG>>}$ PSx				010 061	010 081	011 001	011 021
1.000	0.000	60.000	s	Fig. 3-123, (p. 3-173)			
Setting for the operate delay of the $V_{NG>>}$ trigger.							
DIST: Characteristic PSx				012 040	073 097	074 097	075 097
2: Polygon				Fig. 3-138, (p. 3-192)			
Selection of the characteristic used in distance measurement.							
DIST: Op. mode zone 4 PSx				012 000	012 050	013 000	013 050
1: Normal				Fig. 3-148, (p. 3-203)			
Zone 4 can be used as a special zone. This setting defines the use of zone 4.							
DIST: X1,PG (polygon) PSx				012 001	012 051	013 001	013 051
10 2 (For MAIN: Inom device=1.0A 5.0A)	0.05 0.01	400 80	Ω	Fig. 3-146, (p. 3-201)			
DIST: X2,PG (polygon) PSx				012 002	012 052	013 002	013 052
20 4 (For MAIN: Inom device=1.0A 5.0A)	0.05 0.01	400 80	Ω	Fig. 3-145, (p. 3-199)			
DIST: X3,PG (polygon) PSx				012 003	012 053	013 003	013 053
30 6 (For MAIN: Inom device=1.0A 5.0A)	0.05 0.01	400 80	Ω				
DIST: X4,PG (polygon) PSx				012 004	012 054	013 004	013 054
40 8 (For MAIN: Inom device=1.0A 5.0A)	0.05 0.01	400 80	Ω				

Parameter				Address			
Default	Min	Max	Unit	Logic Diagram			
DIST: X5,PG (polygon) PSx				012 100	012 101	012 102	012 103
50 10 (For MAIN: Inom device=1.0A 5.0A)	0.05 0.01	400 80	Ω				
DIST: X6,PG (polygon) PSx				012 104	012 105	012 106	012 107
60 12 (For MAIN: Inom device=1.0A 5.0A)	0.05 0.01	400 80	Ω				
DIST: X7,PG (polygon) PSx				021 122	021 123	021 124	021 125
70 14 (For MAIN: Inom device=1.0A 5.0A)	0.05 0.01	400 80	Ω				
DIST: X8,PG (polygon) PSx				021 126	021 127	021 128	021 129
80 16 (For MAIN: Inom device=1.0A 5.0A)	0.05 0.01	400 80	Ω				
Setting for the reactance limit in impedance zones 1 to n of the polygon characteristic for the phase-to-ground loops (in secondary values).							
DIST: X1,PP (polygon) PSx				002 076	002 077	002 078	002 079
10 2 (For MAIN: Inom device=1.0A 5.0A)	0.05 0.01	400 80	Ω				
DIST: X2,PP (polygon) PSx				002 080	002 081	002 082	002 083
20 4 (For MAIN: Inom device=1.0A 5.0A)	0.05 0.01	400 80	Ω				
							Fig. 3-145, (p. 3-199) Fig. 3-146, (p. 3-201)
DIST: X3,PP (polygon) PSx				002 084	002 085	002 086	002 087
30 6 (For MAIN: Inom device=1.0A 5.0A)	0.05 0.01	400 80	Ω				
DIST: X4,PP (polygon) PSx				002 089	002 090	002 091	002 092
40 8 (For MAIN: Inom device=1.0A 5.0A)	0.05 0.01	400 80	Ω				
DIST: X5,PP (polygon) PSx				002 093	002 094	002 095	002 096
50 10 (For MAIN: Inom device=1.0A 5.0A)	0.05 0.01	400 80	Ω				
DIST: X6,PP (polygon) PSx				002 097	002 098	002 099	002 126
60 12 (For MAIN: Inom device=1.0A 5.0A)	0.05 0.01	400 80	Ω				
DIST: X7,PP (polygon) PSx				021 088	021 089	021 090	021 091
70 14 (For MAIN: Inom device=1.0A 5.0A)	0.05 0.01	400 80	Ω				
DIST: X8,PP (polygon) PSx				021 092	021 093	021 094	021 095
80 16 (For MAIN: Inom device=1.0A 5.0A)	0.05 0.01	400 80	Ω				
Setting for the reactance limit in impedance zones 1 to n of the polygon characteristic for the phase-to-phase loops (in secondary values).							
DIST: R1,PG (polygon) PSx				012 005	012 055	013 005	013 055
10 2 (For MAIN: Inom device=1.0A 5.0A)	0.1 0.02	400 80	Ω				Fig. 3-146, (p. 3-201)

Parameter				Address
Default	Min	Max	Unit	Logic Diagram
DIST: R2,PG (polygon) PSx				012 007 012 057 013 007 013 057
20 4 (For MAIN: Inom device=1.0A 5.0A)	0.1 0.02	400 80	Ω	Fig. 3-145, (p. 3-199)
DIST: R3,PG (polygon) PSx				012 009 012 059 013 009 013 059
30 6 (For MAIN: Inom device=1.0A 5.0A)	0.1 0.02	400 80	Ω	
DIST: R4,PG (polygon) PSx				012 011 012 061 013 011 013 061
40 8 (For MAIN: Inom device=1.0A 5.0A)	0.1 0.02	400 80	Ω	
DIST: R5,PG (polygon) PSx				012 108 012 109 012 110 012 111
50 10 (For MAIN: Inom device=1.0A 5.0A)	0.1 0.02	400 80	Ω	
DIST: R6,PG (polygon) PSx				012 116 012 117 012 118 012 119
50 10 (For MAIN: Inom device=1.0A 5.0A)	0.1 0.02	400 80	Ω	
DIST: R7,PG (polygon) PSx				021 096 021 097 021 098 021 099
70 14 (For MAIN: Inom device=1.0A 5.0A)	0.1 0.02	400 80	Ω	
DIST: R8,PG (polygon) PSx				021 100 021 101 021 102 021 103
80 16 (For MAIN: Inom device=1.0A 5.0A)	0.1 0.02	400 80	Ω	
Setting for the resistance limit in impedance zones 1 to n of the polygon characteristic for the phase-to-ground loops (in secondary values). Note: The specified precision of measurement can only be reached if the ratio R / X is less than 8, i.e.: $R_{n,PG} / X_n < 8$ If the ratio is greater than this (i.e. the polygon becomes extremely “flat”), the measurement conditions for high fault resistances become quite bad, because in this case, the angle of the fault impedance gets small, which results in quite big measurement deviations for the reactance.				
DIST: R1,PP (polygon) PSx				012 006 012 056 013 006 013 056
10 2 (For MAIN: Inom device=1.0A 5.0A)	0.1 0.02	400 80	Ω	Fig. 3-146, (p. 3-201)
DIST: R2,PP (polygon) PSx				012 008 012 058 013 008 013 058
20 4 (For MAIN: Inom device=1.0A 5.0A)	0.1 0.02	400 80	Ω	Fig. 3-145, (p. 3-199)
DIST: R3,PP (polygon) PSx				012 010 012 060 013 010 013 060
30 6 (For MAIN: Inom device=1.0A 5.0A)	0.1 0.02	400 80	Ω	
DIST: R4,PP (polygon) PSx				012 012 012 062 013 012 013 062
40 8 (For MAIN: Inom device=1.0A 5.0A)	0.1 0.02	400 80	Ω	

Parameter				Address
Default	Min	Max	Unit	Logic Diagram
DIST: R5,PP (polygon) PSx				012 112 012 113 012 114 012 115
50 10 (For MAIN: Inom device=1.0A 5.0A)	0.1 0.02	400 80	Ω	
DIST: R6,PP (polygon) PSx				012 120 012 121 012 122 012 123
50 10 (For MAIN: Inom device=1.0A 5.0A)	0.1 0.02	400 80	Ω	
DIST: R7,PP (polygon) PSx				021 104 021 115 021 116 021 117
70 14 (For MAIN: Inom device=1.0A 5.0A)	0.1 0.02	400 80	Ω	
DIST: R8,PP (polygon) PSx				021 118 021 119 021 120 021 121
80 16 (For MAIN: Inom device=1.0A 5.0A)	0.1 0.02	400 80	Ω	
Setting for the resistance limit in impedance zones 1 to n of the polygon characteristic for the phase-to-phase loops (in secondary values). Note: The specified precision of measurement can only be reached if the ratio R / X is less than 8, i.e.: $R_{n,PP} / X_n < 8$ If the ratio is greater than this (i.e. the polygon becomes extremely “flat”), the measurement conditions for high fault resistances become quite bad, because in this case, the angle of the fault impedance gets small, which results in quite big measurement deviations for the reactance.				
DIST: α1 (polygon) PSx				012 013 012 063 013 013 013 063
75	15	90	°	Fig. 3-146, (p. 3-201)
DIST: α2 (polygon) PSx				012 014 012 064 013 014 013 064
75	15	90	°	Fig. 3-145, (p. 3-199)
DIST: α3 (polygon) PSx				012 015 012 065 013 015 013 065
75	15	90	°	
DIST: α4 (polygon) PSx				012 016 012 066 013 016 013 066
75	15	90	°	
DIST: α5 (polygon) PSx				012 124 012 125 012 126 012 127
75	15	90	°	
DIST: α6 (polygon) PSx				012 128 012 129 012 130 012 131
75	15	90	°	
DIST: α7 (polygon) PSx				021 155 021 156 021 157 021 158
75	15	90	°	
DIST: α8 (polygon) PSx				021 159 021 160 021 161 021 162
75	15	90	°	
Setting for the slope angle of the tripping polygon of impedance zones 1 to n in R-direction (resistance line).				
DIST: σ1 (polygon) PSx				072 086 073 086 074 086 075 086
0	-20	20	°	Fig. 3-146, (p. 3-201)

Parameter				Address			
Default	Min	Max	Unit	Logic Diagram			
DIST: σ2 (polygon) PSx				072 087	073 087	074 087	075 087
0	-20	20	°	Fig. 3-145, (p. 3-199)			
DIST: σ3 (polygon) PSx				072 088	073 088	074 088	075 088
0	-20	20	°				
DIST: σ4 (polygon) PSx				072 089	073 089	074 089	075 089
0	-20	20	°				
DIST: σ5 (polygon) PSx				012 156	012 157	012 158	012 159
0	-20	20	°				
DIST: σ6 (polygon) PSx				012 160	012 161	012 162	012 163
0	-20	20	°				
DIST: σ7 (polygon) PSx				021 163	021 164	021 165	021 166
0	-20	20	°				
DIST: σ8 (polygon) PSx				021 168	021 169	021 170	021 171
0	-20	20	°				
Setting for the slope angle of the tripping polygon of impedance zones 1 to n in X-direction (reactance line).							
DIST: Z1 (circle) PSx				012 042	073 091	074 091	075 091
10 2 (For MAIN: Inom device=1.0A 5.0A)	0.05 0.01	400 80	Ω	Fig. 3-142, (p. 3-196)			
DIST: Z2 (circle) PSx				012 043	073 092	074 092	075 092
20 4 (For MAIN: Inom device=1.0A 5.0A)	0.05 0.01	400 80	Ω	Fig. 3-141, (p. 3-195)			
DIST: Z3 (circle) PSx				012 044	073 093	074 093	075 093
30 6 (For MAIN: Inom device=1.0A 5.0A)	0.05 0.01	400 80	Ω				
DIST: Z4 (circle) PSx				012 045	073 094	074 094	075 094
40 8 (For MAIN: Inom device=1.0A 5.0A)	0.05 0.01	400 80	Ω				
DIST: Z5 (circle) PSx				012 148	012 149	012 150	012 151
50 10 (For MAIN: Inom device=1.0A 5.0A)	0.05 0.01	400 80	Ω				
DIST: Z6 (circle) PSx				012 152	012 153	012 154	012 155
60 12 (For MAIN: Inom device=1.0A 5.0A)	0.05 0.01	400 80	Ω				
DIST: Z7 (circle) PSx				021 172	021 173	021 174	021 175
70 14 (For MAIN: Inom device=1.0A 5.0A)	0.05 0.01	400 80	Ω				

Parameter				Address			
Default	Min	Max	Unit	Logic Diagram			
DIST: Z8 (circle) PSx				021 183	021 184	021 185	021 186
80 16 (For MAIN: Inom device=1.0A 5.0A)	0.05 0.01	400 80	Ω				
Setting for the impedance limit in impedance zones 1 to 8 of the circular characteristic (in secondary values).							
DIST: α1 (circle) PSx				072 090	073 090	074 090	075 090
75	10	90	°	Fig. 3-142, (p. 3-196)			
DIST: α2 (circle) PSx				072 095	073 095	074 095	075 095
75	10	90	°	Fig. 3-141, (p. 3-195)			
DIST: α3 (circle) PSx				072 096	073 096	074 096	075 096
75	10	90	°				
DIST: α4 (circle) PSx				072 099	073 099	074 099	075 099
75	10	90	°				
DIST: α5 (circle) PSx				012 164	012 165	012 166	012 167
75	10	90	°				
DIST: α6 (circle) PSx				012 168	012 169	012 170	012 171
75	10	90	°				
DIST: α7 (circle) PSx				021 176	021 180	021 181	021 182
75	10	90	°				
DIST: α8 (circle) PSx				021 187	021 188	021 189	021 190
75	10	90	°				
This setting is only important if the setting <i>With arc compensation</i> is active (DIST: Arc comp. circle PSx=Yes). In this case, the setting at this address determines the angle where arc compensation becomes active in zones 1 to n.							
DIST: Arc comp. circle PSx				012 038	012 090	012 091	012 092
0: No				Fig. 3-139, (p. 3-193)			
Disabling or enabling arc compensation when the circular characteristic is selected.							
DIST: Direction N1 PSx				012 023	012 073	013 023	013 073
1: Forward directional				Fig. 3-149, (p. 3-204)			
DIST: Direction N2 PSx				012 024	012 074	013 024	013 074
1: Forward directional				Fig. 3-149, (p. 3-204)			
DIST: Direction N3 PSx				012 025	012 075	013 025	013 075
1: Forward directional				Fig. 3-149, (p. 3-204)			
DIST: Direction N4 PSx				012 026	012 076	013 026	013 076
1: Forward directional				Fig. 3-149, (p. 3-204)			
DIST: Direction N5 PSx				012 027	012 077	013 027	013 077
1: Forward directional							

Parameter				Address
Default	Min	Max	Unit	Logic Diagram
DIST: Direction N6 PSx				012 132 012 133 012 134 012 135
1: Forward directional				Fig. 3-149, (p. 3-204)
DIST: Direction N7 PSx				021 147 021 148 021 149 021 150
1: Forward directional				Fig. 3-149, (p. 3-204)
DIST: Direction N8 PSx				021 151 021 152 021 153 021 154
1: Forward directional				Fig. 3-149, (p. 3-204)
DIST: Direction N9 PSx				012 136 012 137 012 138 012 139
1: Forward directional				Fig. 3-149, (p. 3-204)
This directional setting defines the direction in which impedance stages 1 to n or final timer stage n+1 measure – relative to the basic measuring direction determined by the connection of the measuring circuits and the setting at MAIN: Conn. meas. circ. IP.				
DIST: Oper.val.Vmemory PSx				010 109 010 116 010 117 010 118
0.15	0.01	2.00	Vnom	Fig. 3-136, (p. 3-189)
Setting for the voltage threshold that must be exceeded so that the measured fault angle is used for the direction determination and the impedance calculation.				
DIST: t1 PSx				012 028 012 078 013 028 013 078
0.00	0.00	60.00	s	Fig. 3-147, (p. 3-202)
DIST: t2 PSx				012 029 012 079 013 029 013 079
1.00	0.00	60.00	s	Fig. 3-148, (p. 3-203)
DIST: t3 PSx				012 030 012 080 013 030 013 080
2.00	0.00	60.00	s	Fig. 3-148, (p. 3-203)
DIST: t4 PSx				012 031 012 081 013 031 013 081
3.00	0.00	60.00	s	Fig. 3-148, (p. 3-203)
DIST: t5 PSx				012 032 012 082 013 032 013 082
4.00	0.00	60.00	s	Fig. 3-148, (p. 3-203)
DIST: t6 PSx				012 033 012 083 013 033 013 083
5.00	0.00	60.00	s	Fig. 3-148, (p. 3-203)
DIST: t7 PSx				021 139 021 140 021 141 021 142
Blocked	0.00	60.00	s	Fig. 3-148, (p. 3-203)
DIST: t8 PSx				021 143 021 144 021 145 021 146
Blocked	0.00	60.00	s	Fig. 3-148, (p. 3-203)
DIST: t9 PSx				012 140 012 141 012 142 012 143
6.00	0.00	60.00	s	Fig. 3-148, (p. 3-203)
DIST: t10 PSx				012 144 012 145 012 146 012 147
7.00	0.00	60.00	s	Fig. 3-148, (p. 3-203)
Setting for the timer stages of impedance zones 1 to n and of directional and non-directional backup timer stages n+1 and n+2.				

Parameter				Address			
Default	Min	Max	Unit	Logic Diagram			
DIST: kze,PG HSR PSx				012 034	012 084	013 034	013 084
1.50	1.00	450.00		Fig. 3-142, (p. 3-196) Fig. 3-146, (p. 3-201)			
DIST: kze,PP HSR PSx				012 035	012 085	013 035	013 085
1.50	1.00	450.00		Fig. 3-142, (p. 3-196) Fig. 3-146, (p. 3-201)			
Setting for the HSR zone extension factor for phase-to-ground loops or phase-to-phase loops, respectively. The setting for the zone extension factor modifies the zone 1 reactance and resistance limits of the polygon characteristic. The following applies to the measurement: $X_{1,ze}HSR = (k_{ze}HSR) \cdot X_1$ $R_{1,ze}HSR = (k_{ze}HSR) \cdot R_1$, if DIST: kze (polygon) PSx = R and X $R_{1,ze}HSR = R_1$ (i.e. without extension), if DIST: kze (polygon) PSx = Only X $X_{1,ze}HSR$: reactance modified by the zone extension factor $R_{1,ze}HSR$: resistance modified by the zone extension factor The following applies to measurement using the circle characteristic: $Z_{1,ze}HSR = (k_{ze}HSR) \cdot Z_1$ $Z_{1,ze}HSR$: impedance modified by the zone extension factor The zone extension HSR is controlled by ● Protective signaling, ● Auto-reclosing control (ARC) before an HSR when protective signaling is not ready, ● a reclose command, whether or not protective signaling is ready, ● Switch on to fault protection, ● an appropriately configured binary signal input.							
DIST: kze,PG TDR PSx				012 046	012 096	013 046	013 096
1.50	1.00	450.00		Fig. 3-142, (p. 3-196) Fig. 3-146, (p. 3-201)			

Parameter				Address			
Default	Min	Max	Unit	Logic Diagram			
DIST: kze,PP TDR PSx				012 047	012 097	013 047	013 097
1.50	1.00	450.00		Fig. 3-142, (p. 3-196) Fig. 3-146, (p. 3-201)			
Setting for the TDR zone extension factor for phase-to-ground loops or phase-to-phase loops, respectively. The setting for the zone extension factor modifies the zone 1 reactance and resistance limits of the polygon characteristic. The following applies to the measurement: $X_{1,ze}TDR = (k_{ze}TDR) \cdot X_1$ $R_{1,ze}TDR = (k_{ze}TDR) \cdot R_1$, if DIST: kze (polygon) PSx = <i>R and X</i> $R_{1,ze}TDR = R_1$ (i.e. without extension), if DIST: kze (polygon) PSx = <i>Only X</i> $X_{1,ze}TDR$: reactance modified by the zone extension factor $R_{1,ze}TDR$: resistance modified by the zone extension factor The following applies to measurement using the circle characteristic: $Z_{1,ze}TDR = (k_{ze}TDR) \cdot Z_1$ $Z_{1,ze}TDR$: impedance modified by the zone extension factor Zone extension takes place before a TDR (time-delay reclosure), as long as a further TDR is permitted.							
DIST: kze (polygon) PSx				010 186	010 195	010 196	010 197
2: R and X				Fig. 3-146, (p. 3-201)			
Select whether the impedance zone 1 of the polygon characteristic shall be extended only in reactance direction (<i>Only X</i>) or for both reactance and resistance (<i>R and X</i>).							
DIST: t1,ze PSx				026 025	027 025	028 025	029 025
Blocked	0.00	10.00	s	Fig. 3-147, (p. 3-202)			
Setting for the timer stage of impedance zone 1 with extended reach. Note: This timer is only used if zone extension is activated from binary input. When controlled from internal function, extended zone trip time is set from that function (e.g. PSIG trip time).							
DIST: Abs. value kG PSx				012 037	012 087	013 037	013 087
1.00	0.00	8.00		Fig. 3-129, (p. 3-180)			

Parameter				Address			
Default	Min	Max	Unit	Logic Diagram			
DIST: Angle kG PSx				012 036	012 086	013 036	013 086
0	-180	180	°	Fig. 3-129, (p. 3-180)			

Setting for the absolute value and angle of the complex ground factor $\underline{k}_G$.

$$\underline{k}_G = \frac{\underline{Z}_0 - \underline{Z}_{pos}}{3 \cdot \underline{Z}_{pos}}$$

$\underline{Z}_0$: zero-sequence impedance
 $\underline{Z}_{pos}$: positive-sequence impedance

$$\text{Angle}(\underline{k}_G) = \arctan \frac{X_0 - X_{pos}}{R_0 - R_{pos}} - \arctan \frac{X_{pos}}{R_{pos}}$$
$$|\underline{k}_G| = \frac{\sqrt{(X_0 - X_{pos})^2 + (R_0 - R_{pos})^2}}{3 \cdot \sqrt{X_{pos}^2 + R_{pos}^2}}$$

R_0 : resistance component of zero-sequence impedance
 R_{pos} : resistance component of positive-sequence impedance
 X_0 : reactance component of zero-sequence impedance
 X_{pos} : reactance component of positive-sequence impedance

If the calculated value cannot be set exactly, then a next smaller value should be set.

Power swing
blocking

Parameter				Address			
Default	Min	Max	Unit	Logic Diagram			
PSB: Enable PSx				015 090	015 091	015 092	015 093
0: No				Fig. 3-164, (p. 3-220)			
This setting defines the setting group in which the power swing blocking function is enabled.							

Backup overcurrent-time protection

Parameter	Address			
Default	Min	Max	Unit	Logic Diagram
BUOC: Enable PSx				072 118 073 118 074 118 075 118
1: Yes				
This setting defines the setting group in which backup overcurrent-time protection is enabled.				
BUOC: I> PSx				010 058 010 078 010 098 011 018
1.00	0.10	20.00	Inom	Fig. 3-180, (p. 3-243)
Setting for operate threshold $I_{>}$ of the phase current of the backup overcurrent-time protection.				
BUOC: tI> PSx				010 059 010 079 010 099 011 019
1.00	0.00	10.00	s	Fig. 3-180, (p. 3-243)
Setting for the operate delay of stage I> of the backup overcurrent-time protection.				
BUOC: IN> PSx				010 064 010 084 011 004 011 024
0.20	0.10	20.00	Inom	Fig. 3-180, (p. 3-243)
Operate value setting for the residual current of the backup overcurrent-time protection function.				
Note: For isolated / compensated networks it is possible to use the residual stage as a backup; in this case the operate threshold has to be set greater than the maximum ground-fault current (earth-fault current).				
BUOC: tIN> PSx				010 065 010 085 011 005 011 025
1.00	0.00	10.00	s	Fig. 3-180, (p. 3-243)
Operate delay for the backup overcurrent-time protection.				

Switch on to fault protection

Parameter				Address			
Default	Min	Max	Unit	Logic Diagram			
SOTF: Enable PSx				001 203	001 204	001 205	001 206
0: No				Fig. 3-183, (p. 3-247)			
This setting defines the parameter subset in which function group SOTF is enabled.							
SOTF: Operating mode PSx				011 061	001 184	001 185	001 186
4: Trip with starting				Fig. 3-183, (p. 3-247)			
The setting of the operating mode defines whether, while the timer is running, a general starting will lead to a trip command (<i>Trip with starting</i>) or if the measuring range of the impedance zone 1 is extended by the set zone extension factor DIST: kze,PG HSR PSx (<i>Trip with overreach</i>).							
SOTF: Activation mode PSx				006 142	006 143	006 144	006 145
1: Trigger				Fig. 3-183, (p. 3-247)			
Select the SOTF activation mode (either <i>Trigger</i> or <i>Line Dead State</i>).							
SOTF: Man. close timer PSx				011 060	001 181	001 182	001 183
1.00	0.00	10.00	s	Fig. 3-183, (p. 3-247)			
Setting for the timer stage that will be started by a manual close.							
SOTF: With V< enable PSx				006 005	006 006	006 007	006 008
0: No				Fig. 3-181, (p. 3-245)			
SOTF: Operate delay PSx				006 138	006 139	006 140	006 141
110.00	0.00	600.00	s	Fig. 3-181, (p. 3-245)			
SOTF: Release delay PSx				002 128	002 129	002 133	002 134
1.00	0.00	10.00	s	Fig. 3-181, (p. 3-245)			
If SOTF: With V< enable PSx is set to Yes, then a “Line dead” condition is determined if all 3 measured voltages are below a fixed threshold, conditioned by settable operate and release timer stages.							
If the “Line dead” condition is fulfilled either triggering of SOTF through binary input is enabled or SOTF is permanently activated, depending on the SOTF activation mode.							
SOTF: Tripping time PSx				010 218	010 219	010 221	010 222
0.00	0.00	10.00	s	Fig. 3-183, (p. 3-247)			
Setting for the time delay of SOTF tripping.							
SOTF: I> PSx				006 130	006 131	006 132	006 133
Blocked	0.10	20.00	Inom	Fig. 3-182, (p. 3-246)			
Setting for the phase current operate value I _{>} .							
SOTF: tI> PSx				006 134	006 135	006 136	006 137
0.00	0.00	10.00	s	Fig. 3-182, (p. 3-246)			
Setting for the operate delay of stage I _{>} .							

Parameter				Address			
Default	Min	Max	Unit	Logic Diagram			
SOTF: Evaluation IN PSx				001 191	001 192	001 193	001 194
1: Calculated				Fig. 3-182, (p. 3-246)			
This setting defines which residual current will be monitored: the residual current calculated from the three phase currents or the residual current measured at the T 4 transformer.							
SOTF: IN > (meas.) PSx				001 189	001 195	001 196	001 197
Blocked	0.01	4.00	Inom	Fig. 3-182, (p. 3-246)			
SOTF: IN > (calc.) PSx				001 190	001 198	001 199	001 202
Blocked	0.10	4.00	Inom	Fig. 3-182, (p. 3-246)			
Settings for operate values of neutral current IN > (meas.) and IN > (calc.).							
SOTF: tIN > PSx				001 177	001 178	001 179	001 180
0.00	0.00	10.00	s	Fig. 3-182, (p. 3-246)			
Setting for the operate delay of stages IN > (meas.) or IN > (calc.).							

	Parameter				Address			
	Default	Min	Max	Unit	Logic Diagram			
Protective signaling	PSIG: Enable PSx				015 014	015 015	015 016	015 017
	0: No				Fig. 3-184, (p. 3-249)			
	This setting defines the parameter subset in which protective signaling is enabled.							
	PSIG: Blk.f.telcom.flr PSx				012 246	012 247	012 248	012 249
	1: Ch. (A)OR(B) faulty				Fig. 3-187, (p. 3-251)			
	Depending on this setting the Protective Signaling gets blocked if the communication is faulty on either channel (setting value <i>Ch. (A)OR(B) faulty</i>), or on both channels (setting value <i>Ch. (A)AND(B) faulty</i>).							
	PSIG: Operating mode PSx				015 000	024 000	024 060	025 020
	2: PUTT				Fig. 3-191, (p. 3-254)			
	Setting for the operating mode of protective signaling.							
	PSIG: Oper. mode send PSx				015 036	015 037	015 040	015 041
1: Direct.-dependent				Fig. 3-198, (p. 3-261) Fig. 3-200, (p. 3-263)				
This setting defines whether protective signaling generates the send signal as a function of direction or distance.								
PSIG: Oper. mode trip PSx				015 107	015 108	015 113	015 114	
2: Dist.-dependent				Fig. 3-196, (p. 3-259) Fig. 3-198, (p. 3-261) Fig. 3-200, (p. 3-263)				
This setting defines whether a trip triggered by protective signaling will be a function of direction or distance.								
PSIG: Tripping time PSx				015 011	024 003	024 063	025 023	
0.08				0.00	10.00	s	Fig. 3-185, (p. 3-250)	
The tripping time replaces timer stage t1,ze of distance protection when protective signaling is ready.								
With blocking schemes this time must be set to the channel transmission delay +30 ms.								
PSIG: Release t. send PSx				015 002	024 001	024 061	025 021	
0.25				0.00	10.00	s	Fig. 3-193, (p. 3-256) Fig. 3-194, (p. 3-257) Fig. 3-196, (p. 3-259) Fig. 3-198, (p. 3-261) Fig. 3-200, (p. 3-263) Fig. 3-202, (p. 3-265) Fig. 3-205, (p. 3-268) Fig. 3-209, (p. 3-272)	
This setting determines the duration of the send signal.								

Parameter				Address		
Default	Min	Max	Unit	Logic Diagram		
PSIG: DC loop op. mode PSx			015 012	024 051	025 011	025 071
1: Transm.relay break c			Fig. 3-190, (p. 3-253)			
This setting defines whether the transmitting relay will be operated in energize-on-signal mode (“open-circuit principle”) or normally-energized mode (“closed-circuit principle”), i.e., <i>Transm.relay make co</i> or <i>Transm.relay break c</i> , respectively.						
PSIG: Echo on receive PSx			015 003	024 002	024 062	025 022
0: Without			Fig. 3-208, (p. 3-271)			
This setting determines whether protective signaling operates with or without echo.						
PSIG: Op. delay echo PSx			015 022	024 008	024 068	025 028
0.00			0.00	10.00	s	Fig. 3-208, (p. 3-271)
Setting for the operate delay of the echo pulse.						
PSIG: Pulse dur. echo PSx			015 023	024 009	024 069	025 029
0.10			0.00	10.00	s	Fig. 3-208, (p. 3-271)
Setting for echo pulse duration.						
PSIG: Trip signal V< PSx			015 021	024 007	024 067	025 027
0: No			Fig. 3-206, (p. 3-269)			
This setting determines whether a trip signal will be issued when the weak-infeed logic is triggered.						
PSIG: V< weak infeed PSx			015 020	024 006	024 066	025 026
0.60			0.10	0.90	Vnom/(√3)	Fig. 3-206, (p. 3-269)
Setting for the threshold of the weak infeed logic.						
PSIG: tV< PSx			015 019	024 005	024 065	025 025
0.20			0.00	10.00	s	Fig. 3-206, (p. 3-269)
Setting for the operate delay of weak-infeed logic.						
PSIG: tBlock PSx			015 024	024 010	024 070	025 030
0.05			0.00	10.00	s	Fig. 3-189, (p. 3-252)
Setting for the transient blocking time of protective signaling.						
PSIG: 3 ended line prot PSx			006 039	006 046	006 047	006 048
0: No			Fig. 3-186, (p. 3-251)			
Select whether the PSIG: Receive (A) EXT or PSIG: Receive (B) EXT signals shall be used in an OR combination (setting: No) or in an AND combination (setting: Yes).						
PSIG: Frequency monit. PSx			015 025	024 011	024 071	025 031
0: No			Fig. 3-188, (p. 3-252)			
This setting defines whether failure of frequency transmission will be monitored.						

Auto-reclosing control

Parameter				Address			
Default	Min	Max	Unit	Logic Diagram			
ARC: Enable PSx				015 046	015 047	015 048	015 049
0: No				Fig. 3-211, (p. 3-274)			
This setting defines the parameter subset in which ARC is enabled.							
ARC: CB clos.pos.sig. PSx				015 050	024 024	024 084	025 044
0: Without				Fig. 3-212, (p. 3-275)			
This setting defines whether the CB closed position will be taken into account or not. If the setting is <i>With</i> , a binary signal input must be configured accordingly. Then the ARC function is ready only if the CB is closed.							
ARC: Operating mode PSx				015 100	015 101	015 102	015 103
1: HSR/TDR permitted				Fig. 3-210, (p. 3-273)			
This setting defines whether the ARC will carry out HSR and TDR, only TDR, or only a test HSR.							
ARC: Operative time 1 PSx				015 066	024 035	024 095	025 055
0.30	0.00	10.00	s				
Setting for operative time 1.							
If the fault is cleared within this time, the fixed dead time 3p (depending on the trip condition and HSR operating mode) is started.							
ARC: Operative time 2 PSx				015 083	024 042	025 002	025 062
0.30	0.00	10.00	s				
Setting for operative time 2.							
If the fault is cleared within this time, the maximum dead time is started.							
ARC: Trip time HSR PSx				015 072	024 040	025 000	025 060
0.00	0.00	10.00	s	Fig. 3-214, (p. 3-277)			
The HSR tripping time replaces timer stage t1,ze of distance protection or the operate delay of backup overcurrent-time protection – provided that the BUOC operating mode is set accordingly – if a HSR is permitted and protective signaling is not ready.							
ARC: Dead time 3p PSx				015 056	024 030	024 090	025 050
1.00	0.10	600.00	s				
Dead time setting for a three-pole HSR.							
ARC: Dead time max PSx				015 084	024 043	025 003	025 063
1.00	0.10	600.00	s				
Setting for the maximum dead time.							

Parameter				Address			
Default	Min	Max	Unit	Logic Diagram			
ARC: Zone ext. f. HSR PSx				015 059	024 033	024 093	025 053
0: No				Fig. 3-220, (p. 3-284)			
This setting determines whether the measuring range shall be extended by the zone extension factor kze HSR during normal system operation and while the operative times are elapsing.							
Note: This setting is only active if protective signaling is not ready.							
ARC: No. permit. TDR PSx				015 068	024 037	024 097	025 057
0				0	9		
Setting for the number of time-delayed reclosures permitted. With the 0 setting, only one HSR is carried out.							
ARC: Trip time TDR PSx				015 073	024 041	025 001	025 061
0.00				0.00	10.00	s	Fig. 3-214, (p. 3-277)
The TDR tripping time replaces timer stage t1,ze of distance protection or the operate delay of backup overcurrent-time protection – provided that the BUOC operating mode is set accordingly – if a TDR is permitted and protective signaling is not ready.							
ARC: TDR dead time PSx				015 057	024 031	024 091	025 051
1.00				0.10	600.00	s	
Setting for the TDR dead time.							
ARC: Zone ext. f. TDR PSx				015 071	024 039	024 099	025 059
0: No				Fig. 3-220, (p. 3-284)			
This setting determines whether the measuring range shall be extended prior to a TDR.							
ARC: Sec. arc eval. PSx				020 144	020 145	020 146	020 147
0: Without							
Setting to enable adaptive 1p auto-reclosing.							
Furthermore it can be set whether adaptive 1p auto-reclosing shall become active only after an initial secondary arc is detected (THD> present) or in any case.							
ARC: Enable RRC PSx				015 085	024 044	025 004	025 064
0: No				Fig. 3-218, (p. 3-282)			
Enabling the rapid reclosure (RRC) function.							
ARC: tRRC PSx				015 086	024 045	025 005	025 065
0.20				0.10	2.00	s	
Setting for the timer stage of rapid reclosure (RRC).							

Parameter				Address			
Default	Min	Max	Unit	Logic Diagram			
ARC: V > RRC PSx				015 087	024 046	025 006	025 066
0.75	0.40	0.90	Vnom(/√3)	Fig. 3-218, (p. 3-282)			
Setting for the voltage threshold that must be exceeded in order for an RRC to be carried out.							
ARC: Zone ext.dur. RC PSx				015 088	024 047	025 007	025 067
0: Without				Fig. 3-220, (p. 3-284)			
This setting defines whether the following takes place:							
● A zone extension will be carried out during a close command by a HSR that is not synchronism-checked. ● Zone extension will occur with each reclose command.							
ARC: Reclaim time PSx				015 054	024 028	024 088	025 048
1.00	1.00	600.00	s				
Setting for the reclaim time.							
ARC: Block. time int. PSx				015 043	024 021	024 081	025 041
5	1	600	s	Fig. 3-213, (p. 3-276)			
Setting for the time that will elapse before the ARC will be ready again after cancellation of the blocks set by internal functions, such as SOTF.							
ARC: Block. time ext. PSx				015 058	024 032	024 092	025 052
5	0	600	s	Fig. 3-213, (p. 3-276)			
Setting for the time that will elapse before the ARC will be ready again after blocking by a binary signal input.							
ARC: Mon. PSIG recv. PSx				015 082	024 050	025 010	025 070
0: No				Fig. 3-221, (p. 3-285)			
This setting determines whether the number of PSIG receive signals is monitored during the dead time.							
ARC: Parallel trip PSx				015 053	024 027	024 087	025 047
0: Without function							
This setting defines whether and how the trip command(s) of a protection device operating in parallel to the P433 will affect operation of the ARC function.							

Automatic
synchronism check

Parameter				Address			
Default	Min	Max	Unit	Logic Diagram			
ASC: Enable PSx				018 020	018 021	018 022	018 023
0: No				Fig. 3-227, (p. 3-292)			
This setting defines the parameter subset in which automatic synchronism check (ASC) is enabled.							
ASC: CB assignment PSx				037 131	037 132	037 133	037 134
0: Not assigned				Fig. 3-239, (p. 3-306)			
This setting defines the function group DEVxx that will control the circuit breaker.							
ASC: System integrat. PSx				037 135	037 136	037 137	037 138
1: Autom.synchron.check				Fig. 3-239, (p. 3-306)			
This setting defines whether ASC will operate in “Autom. synchron. check” or “Autom. synchr. control” mode.							
ASC: Active for HSR PSx				018 001	077 030	078 030	079 030
0: No				Fig. 3-228, (p. 3-293)			
This setting defines whether reclosing after a three-pole HSR will occur only after being enabled by ASC.							
ASC: Active for TDR PSx				018 002	077 031	078 031	079 031
0: No				Fig. 3-228, (p. 3-293)			
This setting defines whether reclosing after a three-pole TDR will occur only after being enabled by ASC.							
ASC: Active for RRC PSx				018 006	077 033	078 033	079 033
0: No							
This setting specifies whether enabling by the ASC function is required before reclosing after a rapid reclosure can occur.							
ASC: Clos.rej.w.block PSx				018 003	077 032	078 032	079 032
0: No				Fig. 3-228, (p. 3-293)			
This setting defines whether reclosing is rejected after being blocked by ASC.							
ASC: Meas.V(T90) USER PSx				016 222	016 223	016 224	016 225
0: No							
This setting decides which voltage(s) the ASC function shall use for the operating modes “voltage-checked close enable” and “voltage/synchronism-checked close enable”:							
● If set to No then the three phase-to-ground voltages are checked. ● If set to Yes then the (single-phase) voltage measured at transformer T90 is checked. (Note that it is left to system engineering that the proper voltage – matching the setting ASC: Measurement loop PSx – is connected to the T90 input.)							

Parameter				Address
Default	Min	Max	Unit	Logic Diagram
ASC: Operative time PSx				018 010 077 034 078 034 079 034
100.0	0.0	6000.0	s	Fig. 3-232, (p. 3-296)
Setting for the operative time for ASC.				
ASC: Measurement loop PSx				031 060 077 044 078 044 079 044
4: Loop A-B				Fig. 3-226, (p. 3-291)
The voltage measurement loop, corresponding to the reference voltage, must be selected so that determination of differential values is correct. Example: Connect transformer T 15 to measure the reference voltage to phases A & B. The measurement loop should be set to <i>Loop A-B</i> .				
ASC: Phi offset PSx				018 034 077 042 078 042 079 042
0	-180	180	°	Fig. 3-236, (p. 3-302) Fig. 3-237, (p. 3-304)
Setting for a Phi offset that may be necessary so that determination of the differential angle is correct.				
ASC: AR op. mode PSx				018 025 018 026 018 027 018 028
1: Voltage-checked				
Auto-reclosing control: Criteria for a close enable are defined by setting for the operating mode.				
ASC: AR with tCB PSx				000 038 000 039 000 050 000 051
0: No				
Function ASC provides a choice as to whether the CB operating time (tCB), as configured at MAIN: tCB,close is to be taken into account for the precisely synchronized reclosure (AR) or not.				
ASC: AR Op.mode v-chk.PSx				018 029 018 030 018 031 018 032
1: Vref but not V				Fig. 3-234, (p. 3-299)
Auto-reclosing control: This setting defines the logic linking of trigger decisions for a voltage controlled close enable.				
ASC: AR V > volt.check PSx				026 017 077 043 078 043 079 043
0.80	0.10	1.20	Vnom/(√3)	Fig. 3-234, (p. 3-299)
Auto-reclosing control: Setting the voltage threshold that the phase-to-ground voltages and the reference voltage must exceed so that they are recognized as "Voltage present". Note: The logic linking of trigger decisions is defined by setting ASC: AR Op.mode v-chk.PSx.				

Parameter				Address			
Default	Min	Max	Unit	Logic Diagram			
ASC: AR V< volt.check PSx				018 017	077 040	078 040	079 040
0.20	0.10	1.20	Vnom/(√3)	Fig. 3-234, (p. 3-299)			
Auto-reclosing control: Setting the voltage threshold that the phase-to-ground voltages and the reference voltage must fall below so that they are recognized as “No voltage”.							
Note: The logic linking of trigger decisions is defined by setting ASC: AR Op.mode v-chk.PSx.							
ASC: AR tmin v-check PSx				018 018	077 041	078 041	079 041
0.10	0.00	10.00	s	Fig. 3-234, (p. 3-299)			
Auto-reclosing control: Setting for the operate delay value to define the minimum time period during which voltage conditions must be met so that the close enable of the ASC is effected.							
ASC: AR V> sync.check PSx				018 011	077 035	078 035	079 035
0.80	0.40	1.20	Vnom/(√3)	Fig. 3-236, (p. 3-302)			
Auto-reclosing control: Setting for the threshold of the minimum voltage to obtain a synchronism checked close enable.							
ASC: AR delta Vmax PSx				018 012	077 036	078 036	079 036
0.10	0.02	0.40	Vnom	Fig. 3-236, (p. 3-302)			
Auto-reclosing control: Setting the maximum differential voltage between measured and reference voltages to obtain a synchronism checked close enable.							
ASC: AR delta f max PSx				018 014	077 038	078 038	079 038
0.20	0.01	2.00	Hz	Fig. 3-236, (p. 3-302)			
Auto-reclosing control: Setting the maximum differential frequency between measured and reference voltages to obtain a synchronism checked close enable.							
ASC: AR delta phi max PSx				018 013	077 037	078 037	079 037
15	5	100	°	Fig. 3-236, (p. 3-302)			
Auto-reclosing control: Setting the maximum differential angle between measured and reference voltages to obtain a synchronism checked close enable.							
ASC: AR tmin sync.chk PSx				018 015	077 039	078 039	079 039
0.10	0.00	10.00	s	Fig. 3-236, (p. 3-302)			
Auto-reclosing control: Setting for the operate delay value to define the minimum time period during which synchronism conditions must be met so that the close enable of the ASC is effected.							
ASC: MC op. mode PSx				000 056	000 057	000 058	000 059
1: Voltage-checked							
Manual close command: Criteria for a close enable are defined by setting for the operating mode.							

Parameter				Address			
Default	Min	Max	Unit	Logic Diagram			
ASC: MC with tCB PSx				000 102	000 103	000 104	000 105
0: No							
Manual close command: In slightly asynchronous power systems, setting this parameter to Yes ensures that the circuit breaker closing time is taken into account by the automatic synchronism check (ASC) to issue of a close command.							
ASC: MC op.mode v-chk.PSx				000 060	000 061	000 062	000 063
1: Vref but not V				Fig. 3-235, (p. 3-301)			
Manual close command: This setting defines the logic linking of trigger decisions for a voltage controlled close enable.							
ASC: MC V> volt.check PSx				000 064	000 065	000 066	000 067
0.80	0.10	1.20	Vnom(/√3)	Fig. 3-235, (p. 3-301)			
Manual close command: Setting the voltage threshold that the phase-to-ground voltages and the reference voltage must exceed so that they are recognized as “Voltage present”.							
Note: The logic linking of trigger decisions is defined by setting ASC: MC op.mode v-chk.PSx.							
ASC: MC V< volt.check PSx				000 068	000 069	000 070	000 071
0.20	0.10	1.20	Vnom(/√3)	Fig. 3-235, (p. 3-301)			
Manual close command: Setting the voltage threshold that the phase-to-ground voltages and the reference voltage must fall below so that they are recognized as “No voltage”.							
Note: The logic linking of trigger decisions is defined by setting ASC: MC op.mode v-chk.PSx.							
ASC: MC tmin v-check PSx				000 072	000 073	000 074	000 075
0.10	0.00	10.00	s	Fig. 3-235, (p. 3-301)			
Manual close command: Setting for the operate delay value to define the minimum time period during which voltage conditions must be met so that the close enable of the ASC is effected.							
ASC: MC V> sync.check PSx				000 052	000 053	000 054	000 055
0.80	0.40	1.20	Vnom(/√3)	Fig. 3-237, (p. 3-304)			
Manual close command: Setting for the threshold of the minimum voltage to obtain a synchronism checked close enable.							
ASC: MC delta Vmax PSx				000 080	000 081	000 082	000 083
0.10	0.02	0.40	Vnom	Fig. 3-237, (p. 3-304)			
Manual close command: Setting the maximum differential voltage between measured and reference voltages to obtain a synchronism checked close enable.							

Parameter				Address			
Default	Min	Max	Unit	Logic Diagram			
ASC: MC delta f max PSx				000 084	000 086	000 087	000 088
0.20	0.01	2.00	Hz	Fig. 3-237, (p. 3-304)			
Manual close command: Setting the maximum differential frequency between measured and reference voltages to obtain a synchronism checked close enable.							
ASC: MC delta phi max PSx				000 089	000 091	000 092	000 093
15	5	100	°	Fig. 3-237, (p. 3-304)			
Manual close command: Setting the maximum differential angle between measured and reference voltages to obtain a synchronism checked close enable.							
ASC: MC tmin sync.chk PSx				000 098	000 099	000 100	000 101
0.10	0.00	10.00	s	Fig. 3-237, (p. 3-304)			
Manual close command: Setting for the operate delay value to define the minimum time period during which synchronism conditions must be met so that the close enable of the ASC is effected.							

Ground fault (short-circuit) protection

Parameter				Address			
Default	Min	Max	Unit	Logic Diagram			
GFSC: Enable PSx				018 072	018 073	018 074	018 075
0: No				Fig. 3-242, (p. 3-310)			
This setting defines the parameter subset in which ground fault (short-circuit) protection is enabled.							

Ground fault (short-circuit) protection signaling

Parameter				Address			
Default	Min	Max	Unit	Logic Diagram			
GSCSG: Enable PSx				023 071	023 072	023 073	023 074
0: No				Fig. 3-260, (p. 3-329)			
This setting defines the parameter subset in which ground fault (short-circuit) protection signaling is enabled.							

Definite-time over-current protection

Parameter				Address			
Default	Min	Max	Unit	Logic Diagram			
DTC: Enable PSx				072 098	073 098	074 098	075 098
0: No				Fig. 3-271, (p. 3-340)			
This setting defines the parameter subset in which definite-time overcurrent protection is enabled.							
DTC: Funct. start ARC PSx				013 127	013 128	013 129	013 130
060 000: MAIN: Without function							
Using this setting parameter, any of the DTC elements can trigger an autoreclosing cycle: DTC: Funct. start ARC PSx is set to DTC: Starting I> or DTC: Starting Ineg>>, or ... (up to 8 DTC elements can be set simultaneously).							
DTC: Mode timer start PSx				002 138	002 139	002 142	002 143
1: With starting				Fig. 3-272, (p. 3-341) Fig. 3-275, (p. 3-344)			
This parameter permits the selection whether the timer stages for phase or residual current stages are triggered with the start (<i>With starting</i>) or are direction-dependent (<i>With direction</i>).							
DTC: Meas.value I/IN> PSx				060 002	060 003	060 004	060 005
0: Fundamental				Fig. 3-272, (p. 3-341) Fig. 3-275, (p. 3-344)			
DTC: Meas.val. I/IN>> PSx				060 006	060 007	060 008	060 009
0: Fundamental							
DTC: Meas.val.I/IN>>> PSx				060 010	060 011	060 012	060 013
0: Fundamental							
DTC: Meas.v. I/IN>>>> PSx				060 014	060 015	060 016	060 017
0: Fundamental							
These settings allow to select for the respective overcurrent stage whether the starting decision shall be based on the fundamental or on the r.m.s. value. Remark: For the negative-sequence stages, the starting decision is always based on the fundamental.							
DTC: I> PSx				072 007	073 007	074 007	075 007
1.00	0.05	25.00	Inom	Fig. 3-272, (p. 3-341)			
DTC: I>> PSx				072 008	073 008	074 008	075 008
1.00	0.05	25.00	Inom				
DTC: I>>> PSx				072 009	073 009	074 009	075 009
1.00	0.05	25.00	Inom				
DTC: I>>>> PSx				072 010	073 010	074 010	075 010
1.00	0.05	25.00	Inom				
Setting for operate value of the overcurrent stage.							

Parameter				Address			
Default	Min	Max	Unit	Logic Diagram			
DTC: tI> PSx				072 019	073 019	074 019	075 019
1.00	0.00	30.00	s	Fig. 3-272, (p. 3-341)			
DTC: tI>> PSx				072 020	073 020	074 020	075 020
1.00	0.00	30.00	s				
DTC: tI>>> PSx				072 021	073 021	074 021	075 021
1.00	0.00	30.00	s				
DTC: tI>>>> PSx				072 022	073 022	074 022	075 022
1.00	0.00	30.00	s				
Setting for the operate delay of the overcurrent stage.							
DTC: Direction tI> PSx				017 071	077 237	078 237	079 237
3: Non-directional				Fig. 3-272, (p. 3-341) Fig. 3-295, (p. 3-368)			
DTC: Direction tI>> PSx				017 072	077 238	078 238	079 238
3: Non-directional				Fig. 3-295, (p. 3-368)			
DTC: Direction tI>>> PSx				007 230	007 231	007 232	007 233
3: Non-directional				Fig. 3-295, (p. 3-368)			
DTC: Direction tI>>>> PSx				013 115	013 116	013 117	013 118
3: Non-directional				Fig. 3-295, (p. 3-368)			
This setting for the measuring direction determines whether a trip signal in the DTC phase current stage will be issued for forward, backward or non-directional fault decisions. If the ARC is enabled and has been set accordingly then a starting will trigger the associated ARC tripping time.							
DTC: Ineg> PSx				072 011	073 011	074 011	075 011
1.00	0.10	20.00	Inom	Fig. 3-273, (p. 3-343)			
DTC: Ineg>> PSx				072 012	073 012	074 012	075 012
1.00	0.10	20.00	Inom				
DTC: Ineg>>> PSx				072 013	073 013	074 013	075 013
1.00	0.10	20.00	Inom				
DTC: Ineg>>>> PSx				072 014	073 014	074 014	075 014
1.00	0.10	20.00	Inom				
Setting for the operate value of the overcurrent stage of the negative-sequence system.							
DTC: tIneg> PSx				072 023	073 023	074 023	075 023
1.00	0.00	30.00	s	Fig. 3-273, (p. 3-343)			
DTC: tIneg>> PSx				072 024	073 024	074 024	075 024
1.00	0.00	30.00	s				
DTC: tIneg>>> PSx				072 025	073 025	074 025	075 025
1.00	0.00	30.00	s				

Parameter				Address			
Default	Min	Max	Unit	Logic Diagram			
DTC: tIneg>>> PSx				072 026	073 026	074 026	075 026
1.00	0.00	30.00	s				
Setting for the operate delay of the overcurrent stage of the negative-sequence system.							
DTC: Evaluation IN PSx				073 189	073 190	073 202	073 219
2: Measured				Fig. 3-274, (p. 3-343)			
This setting defines which residual current will be monitored by the residual current stages: the residual current calculated from the three phase currents or the residual current measured at the T 4 transformer.							
DTC: IN> PSx				072 015	073 015	074 015	075 015
1.00	0.10	20.00	Inom				
Setting for operate value IN> (I _N = residual current).							
DTC: IN>> PSx				072 016	073 016	074 016	075 016
1.00	0.10	20.00	Inom				
Setting for operate value IN>> (I _N = residual current).							
DTC: IN>>> PSx				072 017	073 017	074 017	075 017
1.00	0.10	20.00	Inom				
Setting for operate value IN>>> (I _N = residual current).							
DTC: IN>>>> PSx				072 018	073 018	074 018	075 018
1.00	0.10	20.00	Inom				
Setting the operate value of the fourth overcurrent stage (residual current stage).							
Caution! The range of setting values includes operate values that are not permitted as continuous current values (see Chapter “Technical Data”).							
DTC: tIN> PSx				072 027	073 027	074 027	075 027
1.00	0.00	30.00	s	Fig. 3-275, (p. 3-344)			
Setting for the operate delay of overcurrent stage IN>.							
DTC: tIN>> PSx				072 028	073 028	074 028	075 028
1.00	0.00	30.00	s				
Setting for the operate delay of overcurrent stage IN>>.							
DTC: tIN>>> PSx				072 029	073 029	074 029	075 029
1.00	0.00	30.00	s				
Setting for the operate delay of overcurrent stage IN>>>.							
DTC: tIN>>>> PSx				072 030	073 030	074 030	075 030
1.00	0.00	30.00	s				
Setting for the operate delay of overcurrent stage IN>>>>.							

Parameter				Address
Default	Min	Max	Unit	Logic Diagram
DTC: Direction tIN> PSx				072 032 072 042 072 082 072 091
3: Non-directional				Fig. 3-275, (p. 3-344) Fig. 3-301, (p. 3-374)
DTC: Direction tIN>> PSx				072 033 072 043 072 083 072 092
3: Non-directional				Fig. 3-301, (p. 3-374)
DTC: Direction tIN>>> PSx				072 034 072 044 072 084 072 093
3: Non-directional				Fig. 3-301, (p. 3-374)
DTC: Direction tIN>>>> PSx				072 035 072 045 072 085 072 094
3: Non-directional				Fig. 3-301, (p. 3-374)
The setting for the measurement direction determines the measurement direction of the residual current stages.				
DTC: Puls.prol.IN>,intPSx				017 055 073 042 074 042 075 042
0.08	0.00	10.00	s	Fig. 3-277, (p. 3-347)
Setting for the pulse prolongation time of the hold-time logic for intermittent ground faults.				
DTC: tIN>,interm. PSx				017 056 073 038 074 038 075 038
Blocked	0.00	100.00	s	Fig. 3-277, (p. 3-347)
Setting for the tripping time of the hold-time logic for intermittent ground faults.				
DTC: Hold-t. tIN>,intmPSx				017 057 073 039 074 039 075 039
0.0	0.0	600.0	s	Fig. 3-277, (p. 3-347)
Setting for the hold-time for intermittent ground faults.				

Inverse-time overcurrent protection

Parameter				Address			
Default	Min	Max	Unit	Logic Diagram			
IDMT: Enable PSx				072 070	073 070	074 070	075 070
0: No				Fig. 3-280, (p. 3-350)			
This setting defines the parameter subset in which IDMT protection is enabled.							
IDMT: Mode timer start PSx				007 226	007 227	007 228	007 229
1: With starting							
This parameter permits the selection whether the timer stages for phase or residual current stages are triggered with the start (<i>With starting</i>) or are direction-dependent (<i>With direction</i>).							
IDMT: Meas.value I/IN PSx				060 018	060 019	060 020	060 021
0: Fundamental				Fig. 3-286, (p. 3-357) Fig. 3-289, (p. 3-362)			
These settings allow to select for the respective overcurrent stage whether the starting decision shall be based on the fundamental or on the r.m.s. value. Remark: For the negative-sequence stage of each IDMTx, the starting decision is always based on the fundamental.							
IDMT: Time Correction PSx				013 143	013 144	013 145	013 146
0.000	-0.100	0.100	s	Fig. 3-286, (p. 3-357) Fig. 3-287, (p. 3-360) Fig. 3-289, (p. 3-362)			
Parameter to compensate the IDMT starting time. Negative values reduce the IDMT starting time by the set value. Positive values extend the IDMT starting time by the set value.							
IDMT: Iref,P PSx				072 050	073 050	074 050	075 050
1.00	0.10	4.00	Inom	Fig. 3-286, (p. 3-357)			
Setting for the reference current (phase current system).							
IDMT: Factor KI,P PSx				007 250	007 251	007 252	007 253
1.00	1.00	10.00		Fig. 3-286, (p. 3-357)			
Enable threshold for the IDMT protection starting for all types of characteristics. This factor KI will result in a linear shifting of the enable threshold along the X axis of the respective characteristic. The factor will not result in a shifting of the characteristic itself.							
IDMT: Characteristic P PSx				072 056	073 056	074 056	075 056
0: Definite Time				Fig. 3-286, (p. 3-357)			
Setting for the tripping characteristic (phase current system).							
IDMT: Factor kt,P PSx				072 053	073 053	074 053	075 053
1.00	0.01	10.00		Fig. 3-286, (p. 3-357)			
Setting for the factor kt,P of the starting characteristic (phase current system).							

Parameter				Address			
Default	Min	Max	Unit	Logic Diagram			
IDMT: Min. trip time P PSx				072 077	073 077	074 077	075 077
1.00	0.00	10.00	s	Fig. 3-286, (p. 3-357)			
Setting for the minimum trip time (phase current system). As a rule, this value should be set as for the first DTOC stage (I>).							
IDMT: Hold time P PSx				072 071	073 071	074 071	075 071
0.00	0.00	600.00	s	Fig. 3-286, (p. 3-357)			
Setting for the holding time for intermittent short circuits (phase current system).							
IDMT: Release P PSx				072 059	073 059	074 059	075 059
1: Without delay				Fig. 3-286, (p. 3-357)			
Setting for the release or reset characteristic (phase current system).							
IDMT: Direct. tlref,P> PSx				017 066	077 239	078 239	079 239
1: Forward directional				Fig. 3-295, (p. 3-368)			
This setting for the measuring direction determines whether a tlref,P> trip signal in the IDMT1 phase current stage will be issued for forward, backward or non-directional fault decisions. If the ARC is enabled and has been set accordingly then a starting will trigger the associated ARC tripping time.							
IDMT: Iref,neg PSx				072 051	073 051	074 051	075 051
1.00	0.01	4.00	Inom	Fig. 3-287, (p. 3-360)			
Setting for the reference current (negative-sequence current system).							
IDMT: Factor KI,neg PSx				007 254	007 255	008 002	008 005
1.00	1.00	10.00		Fig. 3-287, (p. 3-360)			
Enable threshold for the IDMT protection starting for all Ineg types of characteristics. This factor KI will result in a linear shifting of the enable threshold along the X axis of the respective characteristic. The factor will not result in a shifting of the characteristic itself.							
IDMT: Character. neg. PSx				072 057	073 057	074 057	075 057
0: Definite Time				Fig. 3-287, (p. 3-360)			
Setting for the tripping characteristic (negative-sequence current system).							
IDMT: Factor kt,neg PSx				072 054	073 054	074 054	075 054
1.00	0.01	10.00		Fig. 3-287, (p. 3-360)			
Setting for the factor kt,neg of the starting characteristic (negative-sequence current system).							
IDMT: Min.trip time negPSx				072 078	073 078	074 078	075 078
1.00	0.00	10.00	s	Fig. 3-287, (p. 3-360)			
Setting for the minimum trip time (negative-sequence current system). As a rule, this value should be set as for the first DTOC stage (I>).							

Parameter				Address			
Default	Min	Max	Unit	Logic Diagram			
IDMT: Hold time neg PSx				072 072	073 072	074 072	075 072
0.00	0.00	600.00	s	Fig. 3-287, (p. 3-360)			
Setting the holding time for intermittent short circuits (negative-sequence current system).							
IDMT: Release neg. PSx				072 060	073 060	074 060	075 060
1: Without delay				Fig. 3-287, (p. 3-360)			
Setting for the release or reset characteristic (negative-sequence current system).							
IDMT: Evaluation IN PSx				072 075	073 075	074 075	075 075
2: Measured				Fig. 3-288, (p. 3-361)			
This setting determines which current will be monitored: The calculated current ΣI_P or the residual current I_N measured at the T 4 current transformer.							
IDMT: Iref,N PSx				072 052	073 052	074 052	075 052
1.00	0.01	4.00	Inom	Fig. 3-289, (p. 3-362)			
Setting for the reference current (residual current system). Depending on the setting of IDMT: Evaluation IN PSx, either the calculated or the measured reference current is used.							
IDMT: Factor KI,N PSx				001 173	001 174	001 175	001 176
1.00	1.00	10.00		Fig. 3-289, (p. 3-362)			
The set factor IDMT: Factor KI,N PSx is multiplied by the reference quantity Iref,N in order to constitute the minimum operate value for the current in the residual current measuring system.							
IDMT: Characteristic N PSx				072 058	073 058	074 058	075 058
0: Definite Time				Fig. 3-289, (p. 3-362)			
Setting for the tripping characteristic (residual current system).							
IDMT: Factor kt,N PSx				072 055	073 055	074 055	075 055
1.00	0.01	10.00		Fig. 3-289, (p. 3-362)			
Setting for the factor kt,N of the starting characteristic (residual current system).							
IDMT: Min. trip time N PSx				072 079	073 079	074 079	075 079
1.00	0.00	10.00	s	Fig. 3-289, (p. 3-362)			
Setting for the minimum trip time for the residual current measuring system. This timer stage is started as soon as the minimum operate value is exceeded. After the timer has elapsed, the trip signal is issued, regardless of the value of the current.							
IDMT: Hold time N PSx				072 073	073 073	074 073	075 073
0.00	0.00	600.00	s	Fig. 3-289, (p. 3-362)			
Setting for the holding time for intermittent short circuits (residual current system).							

Parameter				Address			
Default	Min	Max	Unit	Logic Diagram			
IDMT: Release N PSx				072 061	073 061	074 061	075 061
1: Without delay				Fig. 3-289, (p. 3-362)			
Setting for for the reset characteristic (residual current system).							
IDMT: Direct. tlref,N> PSx				017 067	077 242	078 242	079 242
1: Forward directional				Fig. 3-301, (p. 3-374)			
This setting for the measuring direction determines whether a tlref,N> trip signal in the IDMT1 residual current stage will be issued for forward, backward or non-directional fault decisions. If the ARC is enabled and has been set accordingly then a starting will trigger the associated ARC tripping time.							

Short-circuit
direction
determination

Parameter	Address			
Default	Min	Max	Unit	Logic Diagram
SCDD: Enable PSx	076 235	077 235	078 235	079 235
1: Yes Fig. 3-291, (p. 3-364)				
This setting defines the parameter subset in which short-circuit direction determination is enabled.				
SCDD: Evaluation IN PSx	008 105	008 106	008 107	008 108
1: Calculated Fig. 3-298, (p. 3-371)				
This parameter is used to select whether the measured or the calculated residual current value is to be used for the SCDD residual current stages.				
SCDD: Trip bias PSx	017 074	077 236	078 236	079 236
1: Yes Fig. 3-295, (p. 3-368)				
This setting determines whether an overcurrent direction determination in forward direction shall be formed when the direction determination of the phase current and residual current stage is blocked.				
SCDD: Evaluation VNG PSx	071 056	071 057	071 058	071 059
1: Calculated Fig. 3-297, (p. 3-371)				
User may select between <i>Measured</i> and <i>Calculated</i> (standard default).				
SCDD: VNG> PSx	010 045	010 060	010 080	010 139
0.030	0.010	0.500	Vnom(/√3)	Fig. 3-299, (p. 3-372)
Setting the operate value VNG>. This setting value is an enabling criterion of the base point release of short-circuit direction determination.				
In choosing this setting, the set nominal voltage MAIN: VNG,nom V.T. sec. should be taken into account.				
SCDD: Angle phi N PSx	004 092	004 247	004 248	004 249
0	-90	90	°	Fig. 3-300, (p. 3-373)
Setting for the characteristic angle of the residual current stage in correspondence to the measuring relation. Using this setting, a wide range of conditions can be accommodated, depending on the system's neutral grounding impedance.				
Examples:				
● System neutral with relatively high resistance $\alpha_G = 0^\circ$ ● System neutral with relatively low resistance $\alpha_G = -45^\circ$ ● System neutral effectively grounded $\alpha_G = -75^\circ$ ● System neutral reactance-grounded $\alpha_G = -90^\circ$ ● System with isolated neutral $\alpha_G = +90^\circ$				

Ground fault
direction
determination using
steady-state values

Parameter				Address			
Default	Min	Max	Unit	Logic Diagram			
GFDSS: Enable PSx				001 050	001 051	001 052	001 053
0: No				Fig. 3-303, (p. 3-377)			
This setting defines the parameter subset in which the GFDSS function is enabled.							
GFDSS: Op.m.GF pow./adm PSx				016 063	000 236	000 237	000 238
1: cos phi circuit				Fig. 3-305, (p. 3-379) Fig. 3-311, (p. 3-385)			
Setting for the operating mode of the ground fault direction determination by steady-state values. The following settings are possible:							
● “cos ϕ circuit” for resonant-grounded systems, ● “sin ϕ circuit” for isolated neutral-point systems.							
GFDSS: Evaluation VNG PSx				016 083	001 011	001 012	001 013
1: Calculated				Fig. 3-304, (p. 3-378)			
This setting specifies which neutral-point displacement voltage will be used for direction determination: The displacement voltage calculated from the phase-to-ground voltages or the displacement voltage measured at the T 90 transformer of the P433.							
GFDSS: Meas. direction PSx				016 070	001 002	001 003	001 004
1: Standard				Fig. 3-305, (p. 3-379) Fig. 3-311, (p. 3-385)			
This setting defines the measuring direction for the “forward” or “backward” decision.							
GFDSS: VNG > PSx				016 062	000 233	000 234	000 235
0.25	0.02	1.00	Vnom($\sqrt{3}$)	Fig. 3-305, (p. 3-379) Fig. 3-311, (p. 3-385)			
Setting for the operate value of the neutral-point displacement voltage.							
GFDSS: tVNG > PSx				016 061	000 230	000 231	000 232
1.00	0.02	10.00	s	Fig. 3-305, (p. 3-379) Fig. 3-311, (p. 3-385)			
Setting for the operate delay of the VNG > trigger.							
GFDSS: f/fnom (P.meas.) PSx				016 091	001 044	001 045	001 046
1: 1				Fig. 3-305, (p. 3-379) Fig. 3-311, (p. 3-385)			
Setting for the frequency of the measured variables evaluated in steady-state power evaluation.							

Parameter				Address
Default	Min	Max	Unit	Logic Diagram
GFDSS: f/fnom (I.meas.) PSx				016 092 001 047 001 048 001 049
1: 1				Fig. 3-309, (p. 3-383)
Setting for the frequency of the measured variables evaluated in steady-state current evaluation.				
GFDSS: IN,act>/reac> LS PSx				016 064 000 239 000 240 000 241
0.050 0.003 1.000 IN,nom				Fig. 3-308, (p. 3-382)
Setting for the threshold of the active or reactive power component of residual current that must be exceeded so that the "LS" (line side) directional decision is enabled.				
GFDSS: Sector angle LS PSx				016 065 000 242 000 243 000 244
86 80 89 °				Fig. 3-308, (p. 3-382)
Setting for the sector angle for measurement in the line side direction. Note: This setting is only effective in the "cos φ circuit" operating mode.				
GFDSS: Operate delay LS PSx				016 066 000 245 000 246 000 247
0.10 0.00 100.00 s				Fig. 3-308, (p. 3-382) Fig. 3-314, (p. 3-388)
Setting for the operate delay of the direction decision in the forward direction.				
GFDSS: Release delay LS PSx				016 072 001 005 001 006 001 007
0.00 0.00 10.00 s				Fig. 3-308, (p. 3-382) Fig. 3-314, (p. 3-388)
Setting for the release delay (reset time) of the direction decision in the forward direction.				
GFDSS: IN,act>/reac> BS PSx				016 067 000 251 000 252 000 253
0.050 0.003 1.000 IN,nom				Fig. 3-308, (p. 3-382)
Setting for the threshold of the active or reactive power component of residual current that must be exceeded so that the "BS" (busbar side) directional decision is enabled.				
GFDSS: Sector angle BS PSx				016 068 000 248 000 249 000 250
86 80 89 °				Fig. 3-308, (p. 3-382)
Setting for the sector angle for measurement in the direction of the busbar side. Note: This setting is only effective in the "cos φ circuit" operating mode.				
GFDSS: Operate delay BS PSx				016 069 000 254 000 255 001 001
0.10 0.00 100.00 s				Fig. 3-308, (p. 3-382) Fig. 3-314, (p. 3-388)
Setting for the operate delay of the direction decision in the backward (reverse) direction.				

Parameter				Address			
Default	Min	Max	Unit	Logic Diagram			
GFDSS: Release delay BS PSx				016 073	001 008	001 009	001 010
0.00	0.00	10.00	s	Fig. 3-308, (p. 3-382) Fig. 3-314, (p. 3-388)			
Setting for the release delay (reset time) of the direction decision in the backward direction.							
GFDSS: IN > PSx				016 093	001 017	001 018	001 019
0.050	0.003	1.000	IN,nom	Fig. 3-309, (p. 3-383)			
Setting for the operate value of steady-state current evaluation.							
GFDSS: Operate delay IN PSx				016 094	001 020	001 021	001 022
0.10	0.00	100.00	s	Fig. 3-309, (p. 3-383)			
Setting for the operate delay of steady-state current evaluation.							
GFDSS: Release delay IN PSx				016 095	001 023	001 024	001 025
0.00	0.00	10.00	s	Fig. 3-309, (p. 3-383)			
Setting for the release delay (reset time) of steady-state current evaluation.							
GFDSS: G(N) > / B(N) > LS PSx				016 111	001 029	001 030	001 031
0.05	0.01	1.00	YN,nom	Fig. 3-314, (p. 3-388)			
Setting for the threshold of the active or reactive susceptance component of residual current that must be exceeded so that the “LS” (line side) directional decision is enabled.							
GFDSS: G(N) > / B(N) > BS PSx				016 112	001 032	001 033	001 034
0.05	0.01	1.00	YN,nom	Fig. 3-314, (p. 3-388)			
Setting for the threshold of the active or reactive susceptance component of residual current that must be exceeded so that the “BS” (busbar side) directional decision is enabled.							
GFDSS: Y(N) > PSx				016 113	001 035	001 036	001 037
0.50	0.01	2.00	YN,nom	Fig. 3-315, (p. 3-389)			
Setting for the operate value of the admittance for non-directional ground fault determination (in operating mode “ <i>admittance evaluation</i> ”).							
GFDSS: Correction angle PSx				016 110	001 026	001 027	001 028
0	-30	30	°				
This setting is provided to compensate for phase-angle errors of the system transformers (in operating mode “ <i>admittance evaluation</i> ”).							
GFDSS: Oper.delay Y(N) > PSx				016 114	001 038	001 039	001 040
0.10	0.00	100.00	s	Fig. 3-315, (p. 3-389)			
Setting for the operate delay value of the admittance for non-directional ground fault determination (in operating mode “ <i>admittance evaluation</i> ”).							

Parameter				Address			
Default	Min	Max	Unit	Logic Diagram			
GFDSS: Rel. delay Y(N)> PSx				016 115	001 041	001 042	001 043
0.00	0.00	10.00	s	Fig. 3-315, (p. 3-389)			
Setting for the release delay (reset time) of the admittance for non-directional ground fault determination (in operating mode “ <i>admittance evaluation</i> ”).							

Pulse detection

Parameter				Address			
Default	Min	Max	Unit	Logic Diagram			
PULSE: Enabled PSx				027 036	027 037	027 038	027 039
0: No				Fig. 3-317, (p. 3-390)			
This setting defines the parameter subset in which pulse detection function is enabled.							
PULSE: Evaluation VNG PSx				027 041	027 046	027 047	027 048
1: Calculated				Fig. 3-318, (p. 3-391)			
This setting specifies which neutral displacement voltage will be monitored: The displacement voltage calculated from the phase to ground voltages or the displacement voltage measured at the T 90 transformer.							
PULSE: VNG > PSx				027 040	027 043	027 044	027 045
0.25	0.02	1.00	Vnom(/√3)	Fig. 3-318, (p. 3-391)			
Setting for the operate value of the neutral displacement voltage.							
PULSE: IN > PSx				027 042	027 049	027 050	027 051
0.050	0.003	1.000	IN,nom	Fig. 3-318, (p. 3-391)			
Setting for the operate value of the measured neutral current.							
PULSE: Delta IN > PSx				027 064	027 065	027 066	027 067
10.0	5.0	50.0	%				
Setting the minimum relative change of the neutral current caused by the pulsing.							
PULSE: Close Time PSx				027 052	027 053	027 054	027 055
1.0	0.2	10.0	s				
Setting for timer stage of the capacitor on duration.							
PULSE: Open Time PSx				027 056	027 057	027 058	027 059
1.5	0.2	10.0	s				
Setting for timer stage of the capacitor off duration.							
PULSE: Zeittoleranz PSx				027 061	027 060	027 062	027 063
0.15	0.02	2.00	s				
Setting for permissible time tolerance.							
Note: This setting should not exceed 10% of the total impulse duration. If the time tolerance setting exceeds 10%, a warning signal (098 089)							
SFMON: Setting error PULSE is raised and the pulse function gets blocked.							
PULSE: Number of pulses PSx				027 068	027 069	027 070	027 071
3	2	10					
Setting the number of pulses during the monitoring time before pulse detection operates.							

Parameter				Address			
Default	Min	Max	Unit	Logic Diagram			
PULSE: Mon.time(pulses) PSx				027 072	027 073	027 074	027 075
5	2	10					
Setting for the pulse monitoring time which is set as multiple of the total impulse duration.							

Ground fault tripping

Parameter				Address			
Default	Min	Max	Unit	Logic Diagram			
GFTRP: Enable PSx				001 135	001 148	001 149	001 150
0: No							
This setting defines the parameter subset in which the GFTRP function is enabled.							

Ground fault protection signaling

Parameter				Address			
Default	Min	Max	Unit	Logic Diagram			
GFSIG: Enable PSx				001 134	001 136	001 137	001 138
0: No				Fig. 3-321, (p. 3-396)			
This setting defines the parameter subset in which the GFSIG function is enabled.							

Transient ground
fault direction deter-
mination

Parameter				Address			
Default	Min	Max	Unit	Logic Diagram			
TGFD: Enable PSx				001 054	001 055	001 056	001 057
0: No				Fig. 3-322, (p. 3-398)			
This setting defines the parameter subset in which the TGFD function is enabled.							
TGFD: Evaluation VNG PSx				016 048	001 058	001 059	001 060
1: Calculated				Fig. 3-323, (p. 3-399)			
This setting specifies which neutral-point displacement voltage will be used for evaluation: The displacement voltage from the open delta winding of a voltage transformer assembly or the displacement voltage calculated from the three phase-to-ground voltages.							
TGFD: Measurem. direc. PSx				016 045	001 073	001 074	001 075
1: Standard				Fig. 3-324, (p. 3-400)			
The direction measurement of the transient ground fault direction determination function depends on the connection of the measuring circuits. If the connection is as shown in Chapter “Installation and Connection”, then the setting must be <i>Standard</i> , if the P433's “ <i>forward</i> ” decision is to be in the direction of the outgoing feeder. If the connection direction is reversed or – given a connection scheme according to Chapter “Installation and Connection” – if the “ <i>forward</i> ” decision is to be in the busbar direction, then the setting must be <i>Opposite</i> .							
Note: The global setting MAIN: Conn. meas. circ. IN does not affect the direction determination feature of the transient ground fault direction determination function.							
TGFD: VNG > PSx				016 041	001 061	001 062	001 063
0.30	0.15	0.50	Vnom(/√3)	Fig. 3-324, (p. 3-400)			
Setting for the neutral-point displacement voltage threshold.							
TGFD: IN, p > PSx				016 042	001 064	001 065	001 066
0.15	0.03	0.50	Inom	Fig. 3-324, (p. 3-400)			
Setting for the residual current threshold. A peak value is evaluated.							
TGFD: Operate delay PSx				016 044	001 067	001 068	001 069
0.05	0.05	1.60	s	Fig. 3-324, (p. 3-400)			
Setting for the operate delay.							
TGFD: Buffer time PSx				016 043	001 070	001 071	001 072
1	0	1200	s	Fig. 3-325, (p. 3-401)			
Setting for the signal buffer time for transient ground fault direction determination.							
Buffer time = 0 keeps the directional decision stored as long as VNG(50Hz) exceeds the threshold VNG >.							
Buffer time = blocked keeps the directional decision stored until (manual) reset through TGFD: Reset signals USER or TGFD: Reset signals EXT.							

Thermal overload protection

Parameter				Address
Default	Min	Max	Unit	Logic Diagram
THERM: Select current PSx				013 139013 140013 141013 142
0: Max. phase current				Fig., (p. 3-404)
Depending on this setting the thermal replica is calculated based on either the maximum phase current, or based on the calculated residual current derived from the sum of the phase currents (setting <i>IN calculated</i>), or based on the residual current measured at the fourth transformer (setting <i>IN measured</i>).				
THERM: Enable PSx				072 175073 175074 175075 175
0: No				Fig. 3-329, (p. 3-403)
This setting defines the parameter subset in which thermal overload protection is enabled.				
THERM: Iref PSx				072 179073 179074 179075 179
1.00	0.05	4.00	Inom	Fig. 3-332, (p. 3-409)
Setting for the reference current.				
THERM: Start.fact.OL_RC PSx				072 180073 180074 180075 180
1.15	1.05	1.50		Fig. 3-332, (p. 3-409)
Setting for the starting factor to trigger overload recording.				
THERM: Tim.const.1,>Ibl PSx				072 187073 187074 187075 187
30.0	1.0	1000.0	min	Fig. 3-332, (p. 3-409)
Setting for the thermal time constants of the protected object with current flow (Ibl: base line current).				
THERM: Tim.const.2,<Ibl PSx				072 188073 188074 188075 188
30.0	1.0	1000.0	min	Fig. 3-332, (p. 3-409)
Setting for the thermal time constants of the protected object without current flow (cooling time constant).				
Note: This setting option is only relevant when machines are running. In all other cases, time constant 2 must be set equal to time constant 1.				
THERM: Max.object temp. PSx				072 182073 182074 182075 182
120	0	300	°C	Fig. 3-332, (p. 3-409)
Setting for the maximum permissible temperature of the protected object.				
THERM: O/T f.Iref pers. PSx				072 167073 167074 167075 167
80	0	300	K	Fig. 3-332, (p. 3-409)
Setting for overtemperature resulting from a persistent limit current ($\Theta_{\max}$ - $\Theta_{a,\max}$).				

Parameter				Address			
Default	Min	Max	Unit	Logic Diagram			
THERM: Warning temp. PSx				072 153	073 153	074 153	075 153
95	0	300	°C	Fig. 3-332, (p. 3-409)			
Setting for the temperature (in °C) to trigger a warning alarm.							
Note: This setting is only enabled in the <i>Absolute replica</i> mode of operation.							
THERM: Max. cool. temp. PSx				072 185	073 185	074 185	075 185
40	0	70	°C	Fig. 3-332, (p. 3-409)			
Setting for the maximum permissible coolant temperature.							
Note: This setting is active only if the coolant temperature is measured via the PT 100 or the 20 mA input.							
THERM: Select meas.inputPSx				072 177	073 177	074 177	075 177
0: Default temp. value				Fig. 3-330, (p. 3-406)			
This setting defines whether coolant temperature (ambient) shall be measured and, if so, whether data acquisition shall take place via the PT 100 or the 20 mA input.							
THERM: Coolant temp. PSx				072 186	073 186	074 186	075 186
40	-40	70	°C	Fig. 3-332, (p. 3-409)			
Setting for the coolant temperature to be used for calculation of the trip time if coolant temperature is not measured.							
THERM: Minimum temperat.PSx				076 178	077 178	078 178	079 178
-40	-40	100	°C				
Setting for the minimum coolant temperature to be used for trip time calculation if a cable runs in an underground tunnel system.							
THERM: Funct.f.CTA fail.PSx				076 177	077 177	078 177	079 177
3: Blocking				Fig. 3-330, (p. 3-406)			
The setting defines how the thermal overload protection function will continue to operate in the event of faulty coolant temperature acquisition. User can select between <i>Default temp. value</i> , <i>Last meas.temperat.</i> and <i>Blocking</i> .							
THERM: 🚩 warning PSx				072 184	073 184	074 184	075 184
95	50	200	%	Fig. 3-332, (p. 3-409)			
Setting for the operate value of the warning stage.							
THERM: 🚩 trip PSx				072 181	073 181	074 181	075 181
100	50	200	%	Fig. 3-332, (p. 3-409)			
Setting for the operate value of the trip stage.							
Note: If the operating mode has been set to <i>Absolute replica</i> , the setting here will be automatically set to 100% and this parameter will be hidden as far as the local control panel is concerned.							

Parameter				Address
Default	Min	Max	Unit	Logic Diagram
THERM: Hysteres. Θ , trip PSx				072 183 073 183 074 183 075 183
2	2	30	%	Fig. 3-332, (p. 3-409)
Setting for the hysteresis of the trip stage.				
THERM: Warning pre-trip PSx				072 191 073 191 074 191 075 191
30.0	0.0	1000.0	min	Fig. 3-332, (p. 3-409)
A warning will be given in advance of the trip. The time difference between the warning time and the trip time is set here.				
THERM: Retain replica PSx				009 019 009 030 009 032 009 039
0: No				
With this parameter it can be configured whether the thermal replica is retained in the non-volatile section of the device's memory so that it will still be available after an interruption of the supply voltage.				

Time-voltage protection

Parameter	Address			
Default	Min	Max	Unit	Logic Diagram
V<>: Enable PSx				076 000 077 000 078 000 079 000
0: No				
This setting defines the setting group in which V<> protection is enabled.				
V<>: Operating mode PSx				076 001 077 001 078 001 079 001
1: Delta Fig. 3-335, (p. 3-412) Fig. 3-336, (p. 3-413)				
This setting specifies whether the phase-to-ground voltages ('Star' operating mode) or the phase-to-phase voltages ('Delta' operating mode) will be monitored.				
Note: In the settings for the operate values of the time-voltage protection function, the reference quantity is V_{nom} in the <i>Delta</i> operating mode, but $V_{nom}/\sqrt{3}$ in the <i>Star</i> operating mode.				
To work out the settings for the over/undervoltage stages, consider the following example for $V_{nom} = 100\text{ V}$:				
Setting in the <i>Delta</i> operating mode for an operate value of 80 V (phase-to-phase):				
Setting value = $\frac{\text{operate value}}{V_{nom}} = \frac{80\text{V}}{100\text{V}} = 0.80$				
Setting in the <i>Star</i> operating mode for an operate value of 46.2 V (phase-to-phase):				
Setting value = $\frac{\text{operate value}}{\frac{V_{nom}}{\sqrt{3}}} = \frac{46.2\text{V}}{\frac{100\text{V}}{\sqrt{3}}} = \frac{46.2\text{V} \cdot \sqrt{3}}{100\text{V}} = 0.80$				
V<>: V> PSx				076 003 077 003 078 003 079 003
1.10	0.10	1.50	$V_{nom}/(\sqrt{3})$	Fig. 3-337, (p. 3-414)
Setting for operate value V>.				
V<>: V>> PSx				076 004 077 004 078 004 079 004
1.10	0.10	1.50	$V_{nom}/(\sqrt{3})$	Fig. 3-337, (p. 3-414)
Setting for operate value V>>.				
V<>: V>>> PSx				011 075 011 076 011 077 011 078
1.10	0.10	1.50	$V_{nom}/(\sqrt{3})$	Fig. 3-338, (p. 3-415)
Setting for operate value V>>>.				
V<>: tV> PSx				076 005 077 005 078 005 079 005
1.00	0.00	200.00	s	Fig. 3-337, (p. 3-414)
Setting for the operate delay of overvoltage stage V>.				

Parameter				Address			
Default	Min	Max	Unit	Logic Diagram			
V<>: tV>> PSx				076 006	077 006	078 006	079 006
1.00	0.00	200.00	s	Fig. 3-337, (p. 3-414)			
Setting for the operate delay of overvoltage stage V>>.							
V<>: tV>>> PSx				011 079	011 080	011 081	011 082
1.00	0.00	200.00	s	Fig. 3-338, (p. 3-415)			
Setting for the operate delay of overvoltage stage V>>>.							
V<>: tV> 3-pole PSx				076 027	077 027	078 027	079 027
1.00	0.00	200.00	s	Fig. 3-337, (p. 3-414)			
Setting for the operate delay of overvoltage stage V> when all three trigger stages are activated.							
V<>: tV>> 3-pole PSx				011 092	011 094	011 095	011 096
1.00	0.00	200.00	s	Fig. 3-337, (p. 3-414)			
Setting for the operate delay of overvoltage stage V>> when all three trigger stages are activated.							
V<>: tV>>> 3-pole PSx				011 099	011 105	011 117	011 118
1.00	0.00	200.00	s	Fig. 3-338, (p. 3-415)			
Setting for the operate delay of overvoltage stage V>>> when all three trigger stages are activated.							
V<>: V< PSx				076 007	077 007	078 007	079 007
0.80	0.10	1.50	Vnom/(√3)	Fig. 3-339, (p. 3-416)			
Setting for operate value V<.							
V<>: V<< PSx				076 008	077 008	078 008	079 008
0.80	0.10	1.50	Vnom/(√3)	Fig. 3-340, (p. 3-417)			
Setting for operate value V<<.							
V<>: V<<< PSx				011 083	011 084	011 085	011 086
0.80	0.10	1.50	Vnom/(√3)	Fig. 3-341, (p. 3-418)			
Setting for operate value V<<<.							
V<>: tV< PSx				076 009	077 009	078 009	079 009
1.00	0.00	200.00	s	Fig. 3-339, (p. 3-416)			
Setting for the operate delay of undervoltage stage V<.							
V<>: tV<< PSx				076 010	077 010	078 010	079 010
1.00	0.00	200.00	s	Fig. 3-340, (p. 3-417)			
Setting for the operate delay of undervoltage stage V<<.							

Parameter				Address			
Default	Min	Max	Unit	Logic Diagram			
V<>: tV<<< PSx				011 088	011 089	011 090	011 091
1.00	0.00	200.00	s	Fig. 3-341, (p. 3-418)			
Setting for the operate delay of undervoltage stage V<<<.							
V<>: tV< 3-pole PSx				076 028	077 028	078 028	079 028
1.00	0.00	200.00	s	Fig. 3-339, (p. 3-416)			
Setting for the operate delay of undervoltage stage V< when all three trigger stages are activated.							
V<>: tV<< 3-pole PSx				011 119	011 124	011 125	011 126
1.00	0.00	200.00	s	Fig. 3-340, (p. 3-417)			
Setting for the operate delay of undervoltage stage V<< when all three trigger stages are activated.							
V<>: tV<<< 3-pole PSx				011 127	011 128	011 129	011 130
1.00	0.00	200.00	s	Fig. 3-341, (p. 3-418)			
Setting for the operate delay of undervoltage stage V<<< when all three trigger stages are activated.							
V<>: Vpos> PSx				076 015	077 015	078 015	079 015
1.10	0.02	1.50	Vnom/√3	Fig. 3-344, (p. 3-422)			
Setting for operate value Vpos>.							
V<>: Vpos>> PSx				076 016	077 016	078 016	079 016
1.10	0.02	1.50	Vnom/√3	Fig. 3-344, (p. 3-422)			
Setting for operate value Vpos>>.							
V<>: tVpos> PSx				076 017	077 017	078 017	079 017
1.00	0.00	200.00	s	Fig. 3-344, (p. 3-422)			
Setting for the operate delay of overvoltage stage Vpos>.							
V<>: tVpos>> PSx				076 018	077 018	078 018	079 018
1.00	0.00	200.00	s	Fig. 3-344, (p. 3-422)			
Setting for the operate delay of overvoltage stage Vpos>>.							
V<>: Vpos< PSx				076 019	077 019	078 019	079 019
0.80	0.10	1.50	Vnom/√3	Fig. 3-344, (p. 3-422)			
Setting for operate value Vpos<.							
V<>: Vpos<< PSx				076 020	077 020	078 020	079 020
0.80	0.10	1.50	Vnom/√3	Fig. 3-344, (p. 3-422)			
Setting for operate value Vpos<<.							

Parameter				Address			
Default	Min	Max	Unit	Logic Diagram			
V<>: tVpos< PSx				076 021	077 021	078 021	079 021
1.00	0.00	200.00	s	Fig. 3-344, (p. 3-422)			
Setting for the operate delay of undervoltage stage Vpos<.							
V<>: tVpos<< PSx				076 022	077 022	078 022	079 022
1.00	0.00	200.00	s	Fig. 3-344, (p. 3-422)			
Setting for the operate delay of undervoltage stage Vpos<<.							
V<>: Vneg> PSx				076 023	077 023	078 023	079 023
Blocked	0.02	1.50	Vnom/√3	Fig. 3-345, (p. 3-423)			
Setting for operate value Vneg>.							
V<>: Vneg>> PSx				076 024	077 024	078 024	079 024
Blocked	0.02	1.50	Vnom/√3	Fig. 3-345, (p. 3-423)			
Setting for operate value Vneg>>.							
V<>: tVneg> PSx				076 025	077 025	078 025	079 025
1.00	0.00	200.00	s	Fig. 3-345, (p. 3-423)			
Setting for the operate delay of overvoltage stage Vneg>.							
V<>: tVneg>> PSx				076 026	077 026	078 026	079 026
1.00	0.00	200.00	s	Fig. 3-345, (p. 3-423)			
Setting for the operate delay of overvoltage stage Vneg>>.							
V<>: Evaluation VNG PSx				076 002	077 002	078 002	079 002
1: Calculated				Fig. 3-346, (p. 3-423)			
This setting determines which neutral-point displacement voltage will be monitored: The displacement voltage calculated by the P433 or the displacement voltage measured at the T 90 voltage transformer.							
V<>: Meas. Value VNG> PSx				018 219	018 250	018 251	018 252
0: Fundamental				Fig. 3-347, (p. 3-424)			
V<>: Meas. Value VNG>>PSx				018 253	018 254	018 255	019 005
0: Fundamental				Fig. 3-347, (p. 3-424)			
V<>: Meas.Value VNG>>>PSx				025 206	025 207	025 208	025 209
0: Fundamental				Fig. 3-347, (p. 3-424)			
These settings allow to select for the respective overcurrent stage whether the starting decision shall be based on the fundamental or on the r.m.s. value.							
V<>: VNG> PSx				076 011	077 011	078 011	079 011
Blocked	0.02	1.00	Vnom/(√3)	Fig. 3-347, (p. 3-424)			
Setting for operate value VNG>.							

Parameter				Address			
Default	Min	Max	Unit	Logic Diagram			
V<>: VNG>> PSx				076 012	077 012	078 012	079 012
Blocked	0.02	1.00	Vnom(/√3)	Fig. 3-347, (p. 3-424)			
Setting for operate value VNG>>.							
V<>: VNG>>> PSx				025 210	025 211	025 212	025 213
Blocked	0.02	1.00	Vnom(/√3)	Fig. 3-347, (p. 3-424)			
Setting for operate value VNG>>>.							
V<>: tVNG> PSx				076 013	077 013	078 013	079 013
1.00	0.00	200.00	s	Fig. 3-347, (p. 3-424)			
Setting for the operate delay of overvoltage stage VNG>.							
V<>: tVNG>> PSx				076 014	077 014	078 014	079 014
1.00	0.00	200.00	s	Fig. 3-347, (p. 3-424)			
Setting for the operate delay of overvoltage stage VNG>>.							
V<>: tVNG>>> PSx				025 214	025 215	025 216	025 217
1.00	0.00	200.00	s	Fig. 3-347, (p. 3-424)			
Setting for the operate delay of overvoltage stage VNG>>>.							
V<>: Vref> PSx				007 064	007 071	007 075	007 079
1.10	0.10	1.50	Vref,nom	Fig. 3-348, (p. 3-425)			
Setting for operate value Vref>.							
V<>: Vref>> PSx				007 065	007 068	007 072	007 076
1.10	0.10	1.50	Vref,nom	Fig. 3-348, (p. 3-425)			
Setting for operate value Vref>>.							
V<>: Vref>>> PSx				010 250	010 251	010 252	010 253
1.10	0.10	1.50	Vref,nom	Fig. 3-348, (p. 3-425)			
Setting for operate value Vref>>>.							
V<>: tVref> PSx				007 066	007 069	007 073	007 077
1.00	0.00	200.00	s	Fig. 3-348, (p. 3-425)			
Setting for the operate delay of overvoltage stage Vref>.							
V<>: tVref>> PSx				007 067	007 070	007 074	007 078
1.00	0.00	200.00	s	Fig. 3-348, (p. 3-425)			
Setting for the operate delay of overvoltage stage Vref>>.							
V<>: tVref>>> PSx				010 254	010 255	011 020	011 035
1.00	0.00	200.00	s	Fig. 3-348, (p. 3-425)			
Setting for the operate delay of overvoltage stage Vref>>>.							

Parameter				Address			
Default	Min	Max	Unit	Logic Diagram			
V<>: Vref< PSx				007 086	007 097	007 101	007 105
0.80	0.20	1.50	Vref,nom	Fig. 3-349, (p. 3-426)			
Setting for operate value Vref<.							
V<>: Vref<< PSx				007 087	007 098	007 102	007 106
0.80	0.20	1.50	Vref,nom	Fig. 3-349, (p. 3-426)			
Setting for operate value Vref<<.							
V<>: Vref<<< PSx				011 059	011 062	011 069	011 070
0.80	0.20	1.50	Vref,nom	Fig. 3-349, (p. 3-426)			
Setting for operate value Vref<<<.							
V<>: tVref< PSx				007 088	007 099	007 103	007 107
1.00	0.00	200.00	s	Fig. 3-349, (p. 3-426)			
Setting for the operate delay of undervoltage stage Vref<.							
V<>: tVref<< PSx				007 096	007 100	007 104	007 108
1.00	0.00	200.00	s	Fig. 3-349, (p. 3-426)			
Setting for the operate delay of undervoltage stage Vref<<.							
V<>: tVref<<< PSx				011 071	011 072	011 073	011 074
1.00	0.00	200.00	s	Fig. 3-349, (p. 3-426)			
Setting for the operate delay of overvoltage stage Vref<<<.							
V<>: Op. mode V< mon. PSx				001 162	001 163	001 164	001 165
0: Without				Fig. 3-335, (p. 3-412)			
Activation of the minimum current monitoring mode for undervoltage stage V<.							
V<>: I enable V< PSx				001 155	001 159	001 160	001 161
0.10	0.04	1.00	Inom	Fig. 3-335, (p. 3-412)			
This setting defines the threshold value of the minimum current monitoring for undervoltage stage V<.							
V<>: tTransient pulse PSx				076 029	077 029	078 029	079 029
1.00	0.00	100.00	s	Fig. 3-342, (p. 3-419)			
Setting for the time limit of the signals generated by the undervoltage stages.							
V<>: Hyst. V<> meas. PSx				076 048	077 048	078 048	079 048
3	1	10	%	Fig. 3-337, (p. 3-414) Fig. 3-338, (p. 3-415)			
Setting for the hysteresis of the trigger stages for monitoring measured voltages.							

Parameter					Address			
Default	Min	Max	Unit	Logic Diagram				
V<>: Hyst. V<> deduc. PSx				076 049	077 049	078 049	079 049	
3	1	10	%	Fig. 3-344, (p. 3-422)				
Setting for the hysteresis of the trigger stages for monitoring deduced voltages such as Vneg and VNG.								

Over-/
underfrequency pro-
tection

Parameter				Address			
Default	Min	Max	Unit	Logic Diagram			
f<>: Enable PSx				018 196	018 197	018 198	018 199
0: No							
Fig. 3-350, (p. 3-427)							
This setting defines the parameter subset in which over-/underfrequency protection is enabled.							
f<>: Oper. mode f1 PSx				018 120	018 121	018 122	018 123
1: f							
Fig. 3-352, (p. 3-430)							
f<>: Oper. mode f2 PSx				018 144	018 145	018 146	018 147
1: f							
f<>: Oper. mode f3 PSx				018 168	018 169	018 170	018 171
1: f							
f<>: Oper. mode f4 PSx				018 192	018 193	018 194	018 195
1: f							
f<>: Oper. mode f5 PSx				019 171	019 172	019 173	019 174
1: f							
Setting for the operating mode of the timer stages of over-/underfrequency protection.							
f<>: f1 PSx				018 100	018 101	018 102	018 103
49.80	40.00	70.00	Hz	Fig. 3-352, (p. 3-430)			
f<>: f2 PSx				018 124	018 125	018 126	018 127
49.80	40.00	70.00	Hz				
f<>: f3 PSx				018 148	018 149	018 150	018 151
49.80	40.00	70.00	Hz				
f<>: f4 PSx				018 172	018 173	018 174	018 175
49.80	40.00	70.00	Hz				
f<>: f5 PSx				019 151	019 152	019 153	019 154
49.80	40.00	70.00	Hz				
Setting for the frequency threshold. The over-/underfrequency protection function will operate if one of the following two conditions applies: The threshold is higher than the set nominal frequency and the frequency exceeds this threshold. The threshold is lower than the set nominal frequency and the frequency falls below this threshold. Depending on the chosen operating mode, either a signal is issued without further monitoring, or further monitoring mechanisms are started.							
f<>: tf1 PSx				018 104	018 105	018 106	018 107
0.00	0.00	10.00	s	Fig. 3-352, (p. 3-430)			
f<>: tf2 PSx				018 128	018 129	018 130	018 131
0.00	0.00	10.00	s				

Parameter				Address			
Default	Min	Max	Unit	Logic Diagram			
f<>: tf3 PSx				018 152	018 153	018 154	018 155
0.00	0.00	10.00	s				
f<>: tf4 PSx				018 176	018 177	018 178	018 179
0.00	0.00	10.00	s				
f<>: tf5 PSx				019 155	019 156	019 157	019 158
0.00	0.00	10.00	s				
Setting for the operate delay of over-/underfrequency protection.							
f<>: df1/dt PSx				018 108	018 109	018 110	018 111
2.0	0.1	10.0	Hz/s	Fig. 3-352, (p. 3-430)			
f<>: df2/dt PSx				018 132	018 133	018 134	018 135
2.0	0.1	10.0	Hz/s				
f<>: df3/dt PSx				018 156	018 157	018 158	018 159
2.0	0.1	10.0	Hz/s				
f<>: df4/dt PSx				018 180	018 181	018 182	018 183
2.0	0.1	10.0	Hz/s				
f<>: df5/dt PSx				019 159	013 092	013 093	013 094
2.0	0.1	10.0	Hz/s				
Setting for the frequency gradient to be monitored. Note: This setting is ineffective unless operating mode <i>f with df/dt</i> has been selected.							
f<>: Delta f1 PSx				018 112	018 113	018 114	018 115
0.30	0.01	5.00	Hz	Fig. 3-352, (p. 3-430)			
f<>: Delta f2 PSx				018 136	018 137	018 138	018 139
0.30	0.01	5.00	Hz				
f<>: Delta f3 PSx				018 160	018 161	018 162	018 163
0.30	0.01	5.00	Hz				
f<>: Delta f4 PSx				018 184	018 185	018 186	018 187
0.30	0.01	5.00	Hz				
f<>: Delta f5 PSx				019 163	019 164	019 165	019 166
0.30	0.01	5.00	Hz				
Setting for Delta f. Note: This setting is ineffective unless operating mode <i>f w. Delta f/Delta t</i> has been selected.							
f<>: Delta t1 PSx				018 116	018 117	018 118	018 119
0.30	0.04	3.00	s	Fig. 3-352, (p. 3-430)			
f<>: Delta t2 PSx				018 140	018 141	018 142	018 143
0.30	0.04	3.00	s				

Parameter				Address			
Default	Min	Max	Unit	Logic Diagram			
f<>: Delta t3 PSx				018 164	018 165	018 166	018 167
0.30	0.04	3.00	s				
f<>: Delta t4 PSx				018 188	018 189	018 190	018 191
0.30	0.04	3.00	s				
f<>: Delta t5 PSx				019 167	019 168	019 169	019 170
0.30	0.04	3.00	s				
Setting for Delta t.							
Note: This setting is ineffective unless operating mode <i>f w. Delta f/Delta t</i> has been selected.							

Underfrequency load shedding

Parameter				Address
Default	Min	Max	Unit	Logic Diagram
Pf<: Enable PSx				015 206015 207015 208015 209
0: No				Fig. 3-353, (p. 3-432)
This setting defines the parameter subset in which underfrequency load shedding protection is enabled.				
Pf<: f1 PSx				015 211015 212015 221015 222
49.20	40.00	60.00	Hz	
Pf<: f2 PSx				015 223015 224015 225015 226
49.00	40.00	60.00	Hz	
Pf<: f3 PSx				015 227015 228015 229015 230
48.80	40.00	60.00	Hz	
Pf<: f4 PSx				015 231015 232015 233015 234
48.60	40.00	60.00	Hz	
Pf<: f5 PSx				015 235015 236015 237015 238
48.40	40.00	60.00	Hz	
Pf<: f6 PSx				015 239015 240015 241015 242
48.20	40.00	60.00	Hz	
Pf<: f7 PSx				015 243015 244015 245015 246
48.00	40.00	60.00	Hz	
Pf<: f8 PSx				015 247015 248015 249015 250
48.00	40.00	60.00	Hz	
Pf<: f9 PSx				015 251015 252015 253015 254
48.00	40.00	60.00	Hz	
Pf<: f10 PSx				015 255016 001016 002016 003
48.00	40.00	60.00	Hz	
Setting for the frequency threshold.				
Pf<: tPF< PSx				016 004016 005016 006016 007
0.00	0.00	10.00	s	Fig. 3-356, (p. 3-435)
Setting for the operate delay of underfrequency load shedding protection.				
Pf<: Direction Pmin PSx				016 008016 009016 010016 011
0: Forward directional				
This setting defines the active power direction.				
Pf<: Pmin PSx				016 012016 016016 020016 021
0.050	0.000	0.100	Snom	Fig. 3-356, (p. 3-435)
The setting defines the threshold of maximum active power for allowing tripping in case of underfrequency threshold is reached.				

Parameter				Address			
Default	Min	Max	Unit	Logic Diagram			
Pf<: hysteresis Pmin PSx				016 217	016 218	016 219	016 220
0.010	0.001	0.010	Snom				
Setting for the hysteresis of the active power threshold.							
Pf<: Imin PSx				016 022	016 023	016 024	016 025
0.050	0.010	0.500	Inom	Fig. 3-356, (p. 3-435)			
The setting defines the minimum current to release active power measurement.							
Pf<: Sector angle PSx				016 026	016 027	016 028	016 029
5.0	0.0	10.0	°	Fig. 3-356, (p. 3-435)			
The setting defines the angle to provide stability under high active power condition.							

Power directional protection

Parameter				Address
Default	Min	Max	Unit	Logic Diagram
P < > : Enabled PSx				014 252 014 253 014 254 014 255
0: No				Fig. 3-357, (p. 3-436)
This setting defines the parameter subset in which power directional protection is enabled.				
P < > : Start w. Direct. PSx				021 074 021 075 021 076 021 077
0: No				Fig. 3-359, (p. 3-438) Fig. 3-361, (p. 3-440) Fig. 3-363, (p. 3-442) Fig. 3-366, (p. 3-445)
Setting for determination of the starting condition for all power stages:				
● With setting Yes, starting takes place only, if the power start threshold operates AND the measured direction is equal to the set direction of the stage. ● With setting No, starting takes place, if the power start threshold operates.				
P < > : P > PSx				017 120 017 200 017 201 017 202
0.500	0.010	1.500	Snom	Fig. 3-359, (p. 3-438)
Setting for the operate value P > for the active power.				
P < > : Operate delay P > PSx				017 128 017 129 017 130 017 131
0.10	0.00	100.00	s	Fig. 3-359, (p. 3-438)
Setting for the operate delay of stage P >.				
P < > : Release delay P > PSx				017 132 017 133 017 134 017 135
0.00	0.00	100.00	s	Fig. 3-359, (p. 3-438)
Setting for the release delay of stage P >.				
P < > : Direction P > PSx				017 136 017 137 017 138 017 139
1: Forward directional				Fig. 3-359, (p. 3-438) Fig. 3-360, (p. 3-439)
This setting of the measuring direction determines whether a P > > trip signal will be issued for forward, backward (reverse) or non-directional fault decisions.				
P < > : Diseng. ratio P > PSx				017 124 017 125 017 126 017 127
0.95	0.05	0.95		Fig. 3-359, (p. 3-438)
Setting for the disengaging ratio of operate value P > of active power.				
P < > : P > > PSx				017 140 017 141 017 142 017 143
0.500	0.010	1.500	Snom	Fig. 3-359, (p. 3-438)
Setting for the operate value P > > for the active power.				

Parameter				Address			
Default	Min	Max	Unit	Logic Diagram			
P<>: Operate delay P>>PSx				017 148	017 149	017 150	017 151
Blocked	0.00	100.00	s	Fig. 3-359, (p. 3-438)			
Setting for the operate delay of stage P>>.							
P<>: Release delay P>>PSx				017 152	017 153	017 154	017 155
0.00	0.00	100.00	s	Fig. 3-359, (p. 3-438)			
Setting for the release delay of stage P>>.							
P<>: Direction P>> PSx				017 156	017 157	017 158	017 159
1: Forward directional				Fig. 3-359, (p. 3-438) Fig. 3-360, (p. 3-439)			
This setting of the measuring direction determines whether a P>> trip signal will be issued for forward, backward (reverse) or non-directional fault decisions.							
P<>: Diseng. ratio P>>PSx				017 144	017 145	017 146	017 147
0.95	0.05	0.95		Fig. 3-359, (p. 3-438)			
Setting for the disengaging ratio of operate value P>> of active power.							
P<>: Q> PSx				017 160	017 161	017 162	017 163
0.500	0.010	1.500	Snom	Fig. 3-361, (p. 3-440)			
Setting for the operate value Q> of the reactive power.							
P<>: Operate delay Q> PSx				017 168	017 169	017 170	017 171
Blocked	0.00	100.00	s	Fig. 3-361, (p. 3-440)			
Setting for the operate delay of stage Q>.							
P<>: Release delay Q> PSx				017 172	017 173	017 174	017 175
0.00	0.00	10.00	s	Fig. 3-361, (p. 3-440)			
Setting for the release delay of stage Q>.							
P<>: Direction Q> PSx				017 176	017 177	017 178	017 179
1: Forward directional				Fig. 3-361, (p. 3-440) Fig. 3-362, (p. 3-441)			
This setting of the measuring direction determines whether a Q> trip signal will be issued for forward, backward (reverse) or non-directional fault decisions.							
P<>: Diseng. ratio Q> PSx				017 164	017 165	017 166	017 167
0.95	0.05	0.95		Fig. 3-361, (p. 3-440)			
Setting for the disengaging ratio of operate value Q> of reactive power.							
P<>: Q>> PSx				017 180	017 181	017 182	017 183
0.500	0.010	1.500	Snom	Fig. 3-361, (p. 3-440)			
Setting for the operate value Q>> of the reactive power.							

Parameter	Address			
Default	Min	Max	Unit	Logic Diagram
P<>: Operate delay Q>>PSx				017 188 017 189 017 190 017 191
Blocked	0.00	100.00	s	Fig. 3-361, (p. 3-440)
Setting for the operate delay of stage Q>>.				
P<>: Release delay Q>>PSx				017 192 017 193 017 194 017 195
0.00	0.00	100.00	s	Fig. 3-361, (p. 3-440)
Setting for the release delay of stage Q>>.				
P<>: Direction Q>> PSx				017 196 017 197 017 198 017 199
1: Forward directional				Fig. 3-361, (p. 3-440) Fig. 3-362, (p. 3-441)
This setting of the measuring direction determines whether a Q>> trip signal will be issued for forward, backward or non-directional fault decisions.				
P<>: Diseng. ratio Q>>PSx				017 184 017 185 017 186 017 187
0.95	0.05	0.95		Fig. 3-361, (p. 3-440)
Setting for the disengaging ratio of operate value Q>> of reactive power.				
P<>: P< PSx				017 030 017 031 017 032 017 033
0.500	0.010	1.500	Snom	Fig. 3-363, (p. 3-442)
Setting the operate value P< for the active power.				
P<>: Operate delay P< PSx				017 060 017 061 017 062 017 063
0.10	0.00	100.00	s	Fig. 3-363, (p. 3-442)
Setting for the operate delay of stage P<.				
P<>: Release delay P< PSx				017 226 017 227 017 228 017 229
0.00	0.00	100.00	s	Fig. 3-363, (p. 3-442)
Setting for the release delay (reset time) of stage P<.				
P<>: Direction P< PSx				017 230 017 231 017 232 017 233
1: Forward directional				Fig. 3-363, (p. 3-442) Fig. 3-364, (p. 3-443)
This setting of the measuring direction determines whether a P< trip signal will be issued for forward, backward (reverse) or non-directional fault decisions.				
P<>: Diseng. ratio P< PSx				017 034 017 035 017 036 017 037
1.05	1.05	20.00		Fig. 3-363, (p. 3-442)
Setting for the disengaging ratio of operate value P< of active power.				
P<>: P<< PSx				017 234 017 235 017 236 017 237
0.500	0.010	1.500	Snom	Fig. 3-363, (p. 3-442)
Setting for operate value P<< of active power.				

Parameter				Address			
Default	Min	Max	Unit	Logic Diagram			
P<>: Operate delay P<<PSx				017 242	017 243	017 244	017 245
Blocked	0.00	100.00	s	Fig. 3-363, (p. 3-442)			
Setting for the operate delay of stage P<<.							
P<>: Release delay P<<PSx				017 246	017 247	017 248	017 249
0.00	0.00	100.00	s	Fig. 3-363, (p. 3-442)			
Setting for the release delay (reset time) of stage P<<.							
P<>: Direction P<< PSx				017 250	017 251	017 252	017 253
1: Forward directional				Fig. 3-363, (p. 3-442) Fig. 3-364, (p. 3-443)			
This setting of the measuring direction determines whether a P<< trip signal will be issued for forward, backward (reverse) or non-directional fault decisions.							
P<>: Diseng.ratio P<< PSx				017 238	017 239	017 240	017 241
1.05	1.05	20.00		Fig. 3-363, (p. 3-442)			
Setting for the disengaging ratio of operate value P<< of active power.							
P<>: Q< PSx				018 035	018 036	018 037	018 038
0.500	0.010	0.500	Snom	Fig. 3-366, (p. 3-445)			
Setting for operate value Q< of reactive power.							
P<>: Operate delay Q< PSx				018 052	018 053	018 054	018 055
Blocked	0.00	100.00	s	Fig. 3-366, (p. 3-445)			
Setting for the operate delay of stage Q<.							
P<>: Release delay Q< PSx				018 056	018 057	018 058	018 059
0.00	0.00	100.00	s	Fig. 3-366, (p. 3-445)			
Setting for the release delay (reset time) of stage Q<.							
P<>: Direction Q< PSx				018 081	018 082	018 083	018 084
1: Forward directional				Fig. 3-366, (p. 3-445) Fig. 3-367, (p. 3-446)			
This setting of the measuring direction determines whether a Q< trip signal will be issued for forward, backward (reverse) or non-directional fault decisions.							
P<>: Diseng. ratio Q< PSx				018 044	018 045	018 046	018 047
1.05	1.05	20.00		Fig. 3-366, (p. 3-445)			
Setting for the disengaging ratio of operate value Q< of reactive power.							
P<>: Q<< PSx				018 085	018 086	018 087	018 088
0.500	0.010	0.500	Snom	Fig. 3-366, (p. 3-445)			
Setting for operate value Q<< of reactive power.							

Parameter	Address			
Default	Min	Max	Unit	Logic Diagram
P<>: Operate delay Q<<PSx				018 213 018 214 018 215 018 216
Blocked	0.00	100.00	s	Fig. 3-366, (p. 3-445)
Setting for the operate delay of stage Q<<.				
P<>: Release delay Q<<PSx				018 236 018 237 018 238 018 239
0.00	0.00	100.00	s	Fig. 3-366, (p. 3-445)
Setting for the release delay (reset time) of stage Q<<.				
P<>: Direction Q<< PSx				018 242 018 243 018 244 018 245
1: Forward directional				Fig. 3-366, (p. 3-445) Fig. 3-367, (p. 3-446)
This setting of the measuring direction determines whether a Q<< trip signal will be issued for forward, backward (reverse) or non-directional fault decisions.				
P<>: Diseng.ratio Q<< PSx				018 095 018 096 018 097 018 098
1.05	1.05	20.00		Fig. 3-366, (p. 3-445)
Setting for the disengaging ratio of operate value Q<< of reactive power.				
P<>: tTransient pulse PSx				018 246 018 247 018 248 018 249
1.00	0.00	100.00	s	Fig. 3-363, (p. 3-442) Fig. 3-366, (p. 3-445)
Setting for the time limit of the signals generated by stages P<, P<<, Q< and Q<< after the respective operate delays have elapsed.				

Voltage controlled
directional reactive
power protection

Parameter	Address			
Default	Min	Max	Unit	Logic Diagram
QV: Enabled PSx	013 223	013 224	013 225	013 226
0: No				
Fig. 3-371, (p. 3-449) Fig. 3-372, (p. 3-449)				
This setting defines the parameter subset in which QV protection is enabled.				
QV: V < PSx	013 231	013 232	013 233	013 234
0.85	0.20	1.50	Vnom	
The setting defines the phase-phase undervoltage threshold. The function operates when all three phase-phase voltages drop below the set threshold (AND combination).				
QV: hysteresis V < PSx	014 079	014 080	014 081	014 082
2	1	10	%	
Setting for the hysteresis of the undervoltage threshold of QV function.				
QV: Direction Q PSx	013 227	013 228	013 229	013 230
0: Forward directional				
This setting defines the reactive power direction.				
QV: Qmin PSx	014 084	014 085	014 086	014 087
0.050	0.000	0.100	Snom	
The setting defines the threshold of maximum reactive power for allowing tripping in case of undervoltage threshold is reached.				
QV: hysteresis Qmin PSx	016 213	016 214	016 215	016 216
0.010	0.001	0.010	Snom	
Setting for the hysteresis of the reactive power threshold.				
QV: Sector angle PSx	013 235	013 236	013 237	013 238
3.0	0.0	6.0	°	
The setting defines the angle to provide stability under high active power condition.				
QV: Imin PSx	013 243	013 244	013 245	013 246
0.100	0.020	0.200	Inom	
The setting defines the minimum current to release reactive power measurement.				
QV: t1 PSx	013 247	013 248	013 249	013 250
0.50	0.10	10.00	s	Fig. 3-374, (p. 3-451)
QV: t2 PSx	013 251	013 252	013 253	013 254
1.50	0.10	10.00	s	Fig. 3-374, (p. 3-451)
Setting for the first or second operate time, respectively.				

Parameter				Address			
Default	Min	Max	Unit	Logic Diagram			
QV: Min.dur.tr.cmd.1 PSx				014 065	014 066	014 067	014 068
0.50	0.10	10.00	s	Fig. 3-374, (p. 3-451)			
Setting for the minimum pulse time of the first trip command.							
QV: Min.dur.tr.cmd.2 PSx				014 069	014 070	014 071	014 072
1.50	0.10	10.00	s	Fig. 3-374, (p. 3-451)			
Setting for the minimum pulse time of the second trip command.							

High Impedance protection

Parameter				Address			
Default	Min	Max	Unit	Logic Diagram			
DELTA: Enable PSx				062 030	063 030	064 030	065 030
0: No				Fig. 3-376, (p. 3-453)			
This setting defines the setting group in which DELTA protection is enabled.							
DELTA: dI > PSx				062 037	063 037	064 037	065 037
1.00				0.10	10.00	Inom	Fig. 3-377, (p. 3-453)
Setting for the operate threshold to detect a sudden current change.							
DELTA: Operative time PSx				021 006	021 084	021 085	021 086
5.00				0.10	100.00	s	Fig. 3-377, (p. 3-453)
Setting for the operative time for DELTA protection.							
DELTA: Trip time PSx				062 038	063 038	064 038	065 038
0.50				0.00	10.00	s	Fig. 3-377, (p. 3-453)
Setting for the trip time of DELTA protection. Its trip signal is issued when the time delay has elapsed.							

7.1.3.4

Control

Main function

Parameter	Address			
Default	Min	Max	Unit	Logic Diagram
MAIN: BI active USER				221 003
1: Yes				Fig. 3-414, (p. 3-491)
Enabling the bay interlocking function from the local control panel.				
MAIN: SI active USER				221 002
0: No				Fig. 3-414, (p. 3-491)
Enabling the station interlocking function from the local control panel.				
MAIN: Inp.asg. fct.block.1				221 014
060 000: MAIN: Without function				Fig. 3-72, (p. 3-114)
MAIN: Inp.asg. fct.block.2				221 022
060 000: MAIN: Without function				Fig. 3-72, (p. 3-114)
Definition of the binary signals assigned to function block 1 and 2.				
MAIN: Op. delay fct. block				221 029
0	0	60	s	Fig. 3-72, (p. 3-114)
Setting for the operate delay of the function blocks.				
MAIN: Perm.No.mot.drive op				221 027
15	1	20		Fig. 3-427, (p. 3-508)
Setting for the permissible motor drive operations within the time interval defined at MAIN: Mon.time mot.drives.				
MAIN: Mon.time mot.drives				221 026
15	1	20	min	Fig. 3-427, (p. 3-508)
Setting for the monitoring time to monitor the number of motor drives.				
MAIN: Cool.time mot.drives				221 028
3	0	10	min	Fig. 3-427, (p. 3-508)
Setting for the cooling time for motors in motor-operated switchgear.				
MAIN: Mon.time motor relay				221 060
0.10	0.01	2.00	s	Fig. 3-430, (p. 3-512) Fig. 3-431, (p. 3-513)
Setting for the monitoring time for the motor relay.				
MAIN: CB1 max. oper. cap.				221 084
1	1	99		
Setting for the maximum number of CB operations for an ARC cycle (or for a limited time period).				

Parameter				Address
Default	Min	Max	Unit	Logic Diagram
MAIN: CB1 ready fct.assign				221 085
060 000: MAIN: Without function				
Selecting the event which, when present, will initialize the counter at MAIN: CB1 act. oper. cap. with the value at MAIN: CB1 max. oper. cap..				
MAIN: DC op. delay t1				221 240
0.10	0.00	2.00	s	
Setting the delay of the commands CMD_DC1, CMD_DC2 and CMD_DC3.				
MAIN: DC2/3 release delay				221 242
0.10	0.01	2.00	s	
Setting the delay of the termination of the commands CMD_DC2 and CMD_DC3.				
MAIN: Cmd.end f. DC fail.				221 111
1: Yes Fig. 3-429, (p. 3-511)				
In the case of direct motor control by motor relay K200, this parameter can be set to <i>Yes</i> or <i>No</i> . If the K200 contacts should not have opened until the end of the command to the motor when the set monitoring time-delay had expired (monitoring via binary signal input –U 706, signal SIG_1: Signal S012 EXT as the standard setting) then the direction control contacts are opened if this parameter is set to <i>Yes</i> .				
If this parameter is set to <i>No</i> then respective fault signals (MAIN: DC fail. cmd. End, MAIN: DC fail. cmd.start, MAIN: DEV op.time exceeded) are issued when the monitoring time-delay has expired and the direction control contacts will remain closed. (Note: This behavior still bears the danger of an undefined switch position!)				
MAIN: Ext.cmd.term. w/o PI				221 115
1: Yes				
Select whether the command CMD_DC3 shall be terminated only by the signal SIG_DC3, or with positive indication of the final switchgear position as well. (Note that in either case, the termination of CMD_DC3 is delayed by the setting MAIN: DC2/3 release delay.)				

External device

Parameter					Address
Default	Min	Max	Unit		Logic Diagram
DEV01: Designat. ext. dev.					210 000
0: Not assigned					
DEV02: Designat. ext. dev.					210 050
0: Not assigned					
DEV03: Designat. ext. dev.					210 100
0: Not assigned					
Setting for the designation of the respective external device. Either one of the pre-defined designations or the term <i>Device Name User</i> may be selected. In the latter case any text (max 4 characters) may be entered at DEV01: DEV-Name User that will be used as the devices' designation. (The same holds for DEV02 etc.)					
DEV01: DEV-Name User					218 101
0:					
DEV02: DEV-Name User					218 102
0:					
DEV03: DEV-Name User					218 103
0:					
Any text (max. 4 characters) may be entered as the devices' name which will then be used as the designation, if the associated parameter DEV01: Designat. ext. dev. has been set to <i>Device Name User</i> . When instead one of the pre-defined designations is selected at DEV01: Designat. ext. dev. it will be used and DEV01: DEV-Name User is ignored. A designation with more than 4 characters is internally truncated. (The same holds for DEV02 etc.)					
DEV01: Oper. mode cmd.					210 024
3: Time control					Fig. 3-422, (p. 3-501)
DEV02: Oper. mode cmd.					210 074
3: Time control					
DEV03: Oper. mode cmd.					210 124
3: Time control					
Selecting the operating mode of the command from long command, short command or time control.					
DEV01: Latching time					210 005
0.00	0.00	5.00	s	Fig. 3-418, (p. 3-497) Fig. 3-425, (p. 3-506) Fig. 3-426, (p. 3-506) Fig. 3-430, (p. 3-512) Fig. 3-431, (p. 3-513)	
DEV02: Latching time					210 055
0.00	0.00	5.00	s		

Parameter	Address			
Default	Min	Max	Unit	Logic Diagram
DEV03: Latching time				210 105
0.00	0.00	5.00	s	
Setting for the time that a control command is sustained after a switchgear position signal – “Open” or “Closed” – has been received.				
DEV01: Op.time switch. dev.				210 004
20	0	254	s	Fig. 3-417, (p. 3-495) Fig. 3-424, (p. 3-504) Fig. 3-425, (p. 3-506) Fig. 3-430, (p. 3-512)
DEV02: Op.time switch. dev.				210 054
20	0	254	s	
DEV03: Op.time switch. dev.				210 104
20	0	254	s	
Setting the operating time for switchgear (switching device).				
DEV01: Gr. assign. debounc.				210 011
1: Group 1				Fig. 3-417, (p. 3-495) Fig. 3-424, (p. 3-504)
DEV02: Gr. assign. debounc.				210 061
1: Group 1				
DEV03: Gr. assign. debounc.				210 111
1: Group 1				
Assigning the external device to one of eight groups for debouncing and chatter suppression.				
DEV01: StartCmdTime superv.				210 007
Blocked	0.1	10.0	s	Fig. 3-424, (p. 3-504)
DEV02: StartCmdTime superv.				210 057
Blocked	0.1	10.0	s	
DEV03: StartCmdTime superv.				210 107
Blocked	0.1	10.0	s	
This parameter allows for defining a monitoring timer for the begin of a switch command.				
After sending an Open / Close command, the corresponding timer starts. If the switchgear unit has not reached its intermediate position after this time has elapsed then the command is deactivated and MAIN: Startcmdtime exceed. is signaled.				
In the default setting <i>blocked</i> this monitoring is switched off. This is recommended for switchgear units for which it is impossible to detect the intermediate position.				
DEV01: Interm. pos. suppr.				210 012
0: No				

Parameter				Address
Default	Min	Max	Unit	Logic Diagram
DEV02: Interm. pos. suppr.				210 062
0: No				
DEV03: Interm. pos. suppr.				210 112
0: No				
This setting determines whether the “intermediate position” signal will be suppressed or not, while the switchgear is operating.				
DEV01: Stat.ind.interm.pos.				210 027
0: No				Fig. 3-417, (p. 3-495) Fig. 3-424, (p. 3-504)
DEV02: Stat.ind.interm.pos.				210 077
0: No				
DEV03: Stat.ind.interm.pos.				210 127
0: No				
This setting determines whether the actual status will be signaled with a 5 s delay after the “Faulty position” signal is issued.				
DEV01: Inp.asg. sw.tr. plug				210 014
060 000: MAIN: Without function				Fig. 3-417, (p. 3-495) Fig. 3-424, (p. 3-504)
DEV02: Inp.asg. sw.tr. plug				210 064
060 000: MAIN: Without function				
DEV03: Inp.asg. sw.tr. plug				210 114
060 000: MAIN: Without function				
Definition of the binary signal that is used to signal the position (“plugged-in” / “unplugged”) of the switch truck plug.				
DEV01: With gen. trip cmd.1				210 021
0: No				Fig. 3-421, (p. 3-500)
DEV02: With gen. trip cmd.1				210 071
0: No				
DEV03: With gen. trip cmd.1				210 121
0: No				
This setting specifies whether the circuit breaker will be opened by “general trip command 1” of the protection function.				
Note: This setting is only visible (active) for external devices that are defined as “circuit breakers”. This definition is included in the bay type definitions.				
DEV01: With gen. trip cmd.2				210 022
0: No				Fig. 3-421, (p. 3-500)
DEV02: With gen. trip cmd.2				210 072
0: No				

Parameter	Address			
Default	Min	Max	Unit	Logic Diagram
DEV03: With gen. trip cmd.2				210 122
0: No				
This setting specifies whether the circuit breaker will be opened by “general trip command 2” of the protection function. Note: This setting is only visible (active) for external devices that are defined as “circuit breakers”. This definition is included in the bay type definitions.				
DEV01: With close cmd./prot				210 023
0: No				Fig. 3-421, (p. 3-500)
DEV02: With close cmd./prot				210 073
0: No				
DEV03: With close cmd./prot				210 123
0: No				
This setting specifies whether the circuit breaker will be closed by the “close command” of the protection function. Note: This setting is only visible (active) for external devices that are defined as “circuit breakers”. This definition is included in the bay type definitions.				
DEV01: Inp.asg.el.ctrl.open				210 019
060 000: MAIN: Without function				Fig. 3-418, (p. 3-497)
DEV02: Inp.asg.el.ctrl.open				210 069
060 000: MAIN: Without function				
DEV03: Inp.asg.el.ctrl.open				210 119
060 000: MAIN: Without function				
This setting defines the binary signal that will be used as the control signal to move the switchgear unit to the open position. Note: Only signals that are defined in the DEVxx function groups can be selected.				
DEV01: Inp.asg.el.ctr.close				210 020
060 000: MAIN: Without function				Fig. 3-418, (p. 3-497)
DEV02: Inp.asg.el.ctr.close				210 070
060 000: MAIN: Without function				
DEV03: Inp.asg.el.ctr.close				210 120
060 000: MAIN: Without function				
This setting defines the binary signal that will be used as the control signal to move the switchgear unit to the “Closed” position. Note: Only signals that are defined in the DEVxx function groups can be selected.				
DEV01: Block cmd open				218 120
060 000: MAIN: Without function				Fig. 3-423, (p. 3-502)

Parameter				Address
Default	Min	Max	Unit	Logic Diagram
DEV02: Block cmd open				218 121
060 000: MAIN: Without function				
DEV03: Block cmd open				218 122
060 000: MAIN: Without function				
Select whether open commands for the switchgear unit shall be blocked.				
DEV01: Block cmd close				218 160
060 000: MAIN: Without function				Fig. 3-423, (p. 3-502)
DEV02: Block cmd close				218 161
060 000: MAIN: Without function				
DEV03: Block cmd close				218 162
060 000: MAIN: Without function				
Select whether close commands for the switchgear unit shall be blocked.				
DEV01: Oper.count.limit				218 211
Blocked	1	65000		Fig. 3-428, (p. 3-508)
DEV02: Oper.count.limit				218 212
Blocked	1	65000		
DEV03: Oper.count.limit				218 213
Blocked	1	65000		
Setting a limit value for the number of switching commands for the respective switchgear unit.				
DEV01: Inp. asg. end Open				210 015
060 000: MAIN: Without function				Fig. 3-429, (p. 3-511)
DEV02: Inp. asg. end Open				210 065
060 000: MAIN: Without function				
DEV03: Inp. asg. end Open				210 115
060 000: MAIN: Without function				
This setting defines the binary signal that will be used to terminate the "Open" command.				
DEV01: Inp. asg. end Close				210 016
060 000: MAIN: Without function				Fig. 3-429, (p. 3-511)
DEV02: Inp. asg. end Close				210 066
060 000: MAIN: Without function				
DEV03: Inp. asg. end Close				210 116
060 000: MAIN: Without function				
This setting defines the binary signal that will be used to terminate the "Close" command.				

Parameter				Address
Default	Min	Max	Unit	Logic Diagram
DEV01: Open w/o stat.interl				210 025
0: No				Fig. 3-420, (p. 3-499)
DEV02: Open w/o stat.interl				210 075
0: No				
DEV03: Open w/o stat.interl				210 125
0: No				
This setting specifies whether switching to “Open” position is permitted without a check by the station interlock function.				
DEV01: Close w/o stat. int.				210 026
0: No				Fig. 3-420, (p. 3-499)
DEV02: Close w/o stat. int.				210 076
0: No				
DEV03: Close w/o stat. int.				210 126
0: No				
This setting specifies whether switching to “Closed” position is permitted without a check by the station interlock function.				
DEV01: Fct.assig.BlwSI open				210 039
060 000: MAIN: Without function				Fig. 3-419, (p. 3-498)
DEV02: Fct.assig.BlwSI open				210 089
060 000: MAIN: Without function				
DEV03: Fct.assig.BlwSI open				210 139
060 000: MAIN: Without function				
This setting defines which output will issue the “Open” enable to the interlocking logic when there is “bay interlock with substation interlock”.				
Note: The interlock conditions for bay interlock with station interlock are included in the bay type definitions (see “List of Bay Types” in the Appendix). If the interlock condition is to be modified, this is possible by modifying the corresponding Boolean equation in the interlocking logic or by defining a new interlocking logic equation. Only in the latter case is it necessary to change the function assignment.				
DEV01: Fct.assig.BlwSI clos				210 040
060 000: MAIN: Without function				Fig. 3-419, (p. 3-498)
DEV02: Fct.assig.BlwSI clos				210 090
060 000: MAIN: Without function				

Parameter				Address
Default	Min	Max	Unit	Logic Diagram
DEV03: Fct.assig.BIwSI clos				210 140
060 000: MAIN: Without function				
This setting defines which output will issue the “Close” enable to the interlocking logic when there is “bay interlock with substation interlock”. Note: The interlock conditions for bay interlock with station interlock are included in the bay type definitions (see “List of Bay Types” in the Appendix). If the interlock condition is to be modified, this is possible by modifying the corresponding Boolean equation in the interlocking logic or by defining a new interlocking logic equation. Only in the latter case is it necessary to change the function assignment.				
DEV01: Fct.asg.BI w/o SI op				210 041
060 000: MAIN: Without function				Fig. 3-419, (p. 3-498)
DEV02: Fct.asg.BI w/o SI op				210 091
060 000: MAIN: Without function				
DEV03: Fct.asg.BI w/o SI op				210 141
060 000: MAIN: Without function				
This setting defines which output will issue the “Open” enable to the interlocking logic when there is “bay interlock without substation interlock”. Note: The interlock conditions for bay interlock without station interlock are included in the bay type definitions (see “List of Bay Types” in the Appendix). If the interlock condition is to be modified, this is possible by modifying the corresponding Boolean equation in the interlocking logic or by defining a new interlocking logic equation. Only in the latter case is it necessary to change the function assignment.				
DEV01: Fct.asg.BI w/o SI cl				210 042
060 000: MAIN: Without function				Fig. 3-419, (p. 3-498)
DEV02: Fct.asg.BI w/o SI cl				210 092
060 000: MAIN: Without function				
DEV03: Fct.asg.BI w/o SI cl				210 142
060 000: MAIN: Without function				
This setting defines which output will issue the “Close” enable to the interlocking logic when there is “bay interlock without substation interlock”. Note: The interlock conditions for bay interlock without station interlock are included in the bay type definitions (see “List of Bay Types” in the Appendix). If the interlock condition is to be modified, this is possible by modifying the corresponding Boolean equation in the interlocking logic or by defining a new interlocking logic equation. Only in the latter case is it necessary to change the function assignment.				

Interlocking logic

Parameter	Address			
Default	Min	Max	Unit	Logic Diagram
ILOCK: Rset ILOCK violation				221 123
Blocked	1	10	s	Fig. 3-415, (p. 3-492)
The interlock violation signal (221 018) MAIN: Interlock equ. viol. will be automatically reset after the time period set here. (The default value <i>Blocked</i> disables the automatic reset.)				
ILOCK: Cycle t interl.check				221 104
Blocked	0.1	10.0	s	
The interlock conditions are also transmitted together with reporting in the “phase 2” of the IEC 61850 communication protocol. Therefore it is a requirement that these interlock conditions are cyclically checked and not, as with software versions that still implement “phase 1”, only with the request for a switching operation.				
This parameter sets the cycle time, after which a check of the interlock conditions is carried out.				
As additional processor capacity must be provided for each of these checks it must be ensured that a favorable compromise is found for the cycle time setting value. On the one hand it is desirable to select a cycle time value which is as short as possible so that changes in the interlock conditions are updated without any notable delays, but on the other hand this cycle time value should not be so short that the P433 will be under too much strain. As the CPU load of the P433 is dependent on the total number of function groups having been configured it is not possible to suggest a generally acceptable cycle time value.				
ILOCK: Fct.assignm. outp. 1				250 000
060 000: MAIN: Without function				Fig. 3-432, (p. 3-515)
ILOCK: Fct.assignm. outp. 2				250 001
060 000: MAIN: Without function				
ILOCK: Fct.assignm. outp. 3				250 002
060 000: MAIN: Without function				
ILOCK: Fct.assignm. outp. 4				250 003
060 000: MAIN: Without function				
ILOCK: Fct.assignm. outp. 5				250 004
060 000: MAIN: Without function				
ILOCK: Fct.assignm. outp. 6				250 005
060 000: MAIN: Without function				
ILOCK: Fct.assignm. outp. 7				250 006
060 000: MAIN: Without function				
ILOCK: Fct.assignm. outp. 8				250 007
060 000: MAIN: Without function				
ILOCK: Fct.assignm. outp. 9				250 008
060 000: MAIN: Without function				

Parameter				Address
Default	Min	Max	Unit	Logic Diagram
ILOCK: Fct.assignm. outp.10				250 009
060 000: MAIN: Without function				
ILOCK: Fct.assignm. outp.11				250 010
060 000: MAIN: Without function				
ILOCK: Fct.assignm. outp.12				250 011
060 000: MAIN: Without function				
ILOCK: Fct.assignm. outp.13				250 012
060 000: MAIN: Without function				
ILOCK: Fct.assignm. outp.14				250 013
060 000: MAIN: Without function				
ILOCK: Fct.assignm. outp.15				250 014
060 000: MAIN: Without function				
ILOCK: Fct.assignm. outp.16				250 015
060 000: MAIN: Without function				
ILOCK: Fct.assignm. outp.17				250 016
060 000: MAIN: Without function				
ILOCK: Fct.assignm. outp.18				250 017
060 000: MAIN: Without function				
ILOCK: Fct.assignm. outp.19				250 018
060 000: MAIN: Without function				
ILOCK: Fct.assignm. outp.20				250 019
060 000: MAIN: Without function				
ILOCK: Fct.assignm. outp.21				250 020
060 000: MAIN: Without function				
ILOCK: Fct.assignm. outp.22				250 021
060 000: MAIN: Without function				
ILOCK: Fct.assignm. outp.23				250 022
060 000: MAIN: Without function				
ILOCK: Fct.assignm. outp.24				250 023
060 000: MAIN: Without function				
ILOCK: Fct.assignm. outp.25				250 024
060 000: MAIN: Without function				
ILOCK: Fct.assignm. outp.26				250 025
060 000: MAIN: Without function				
ILOCK: Fct.assignm. outp.27				250 026
060 000: MAIN: Without function				
ILOCK: Fct.assignm. outp.28				250 027
060 000: MAIN: Without function				

Parameter				Address			
Default	Min	Max	Unit	Logic Diagram			
ILOCK: Fct.assignm. outp.29							250 028
060 000: MAIN: Without function							
ILOCK: Fct.assignm. outp.30							250 029
060 000: MAIN: Without function							
ILOCK: Fct.assignm. outp.31							250 030
060 000: MAIN: Without function							
ILOCK: Fct.assignm. outp.32							250 031
060 000: MAIN: Without function							
Definition of the interlock conditions.							

8 Information and Control Functions

8.1 Operation

The P433 generates a large number of signals, processes binary input signals, and acquires measured data during fault-free operation of the protected object as well as fault-related data. A number of counters are available for statistical purposes. This information can be read out from the integrated local control panel or via the operating program.

All this information can be found in the “Operation” and “Events” folders in the menu tree.

Note

Detailed information about all parameters, including complete selection tables and IEC 60870-5-103 protocol properties, are separately available as a set of interlinked PDF files for user-friendly navigation, packed in one ZIP archive named DataModelExplorer_P433_en_P01.zip.

A list of the Logical Nodes that have been implemented for the IEC 61850 protocol can be found in a separate document.

8.1.1 Cyclic Values

8.1.1.1 Measured Operating Data

InterMiCOM interface	Parameter				Address			
	Default	Min	Max	Unit	Logic Diagram			
	COMM3: No. tel. errors p.u.							120 040
	0.0	0.0	100.0	%				
	Display of the updated measured operating value for the number of corrupted messages within the last 1000 received messages.							
	COMM3: No.t.err.,max,stored							120 041
	0.0	0.0	100.0	%				
	Display of the updated measured operating value for the proportion of corrupted messages within the last 1000 received messages.							
	COMM3: Loop back result							120 057
	: Not measured							
COMM3: Loop back receive							120 056	
Not measured				0	255			
While the hold time is running, the loop back test results can be checked by reading out these values.								

Measured data input

Parameter	Address			
Default	Min	Max	Unit	Logic Diagram
MEASI: Current IDC				004 134
Not measured	0.00	24.00	mA	Fig. 3-37, (p. 3-67)
Display of the input current.				
MEASI: Current IDC p.u.				004 135
Not measured	0.00	1.20	IDC,nom	Fig. 3-37, (p. 3-67)
Display of the input current referred to $I_{DC,nom}$.				
MEASI: Curr. IDC,lin p.u.				004 136
Not measured	0.00	1.20	IDC,nom	Fig. 3-37, (p. 3-67)
Display of the linearized input current referred to $I_{DC,nom}$.				
MEASI: Scaled value IDC,lin				004 180
Not measured	-32000	32000		Fig. 3-38, (p. 3-68)
Display of the scaled linearized value.				
MEASI: Temperature				004 133
Not measured	-40.0	215.0	°C	Fig. 3-39, (p. 3-69)
Display of the temperature measured at the "PT 100" temperature input on the analog p/c board.				
MEASI: Temperature p.u.				004 221
Not measured	-0.40	2.15	100°C	Fig. 3-39, (p. 3-69)
Display of the temperature measured at the "PT 100" temperature input on the analog p/c board referred to 100°C.				
MEASI: Temperature Tmax				004 233
Not measured	-40.0	215.0	°C	Fig. 3-39, (p. 3-69)
Display of the maximum temperature measured at the "PT 100" temperature input on the analog p/c board.				

Measured data output

Parameter	Address			
Default	Min	Max	Unit	Logic Diagram
MEASO: Current A-1				005 100
0.00	0.00	20.00	mA	Fig. 3-48, (p. 3-84)
MEASO: Current A-2				005 099
0.00	0.00	20.00	mA	
Display of the current on the analog measured data output (A1: channel 1; A2: channel 2).				

Main function

Parameter	Address			
Default	Min	Max	Unit	Logic Diagram
MAIN: Date				003 090
1997-01-01	1997-01-01	2098-11-08	dd.mm.yy	Fig. 3-91, (p. 3-132)
Date display. The date can also be set here. The centuries are not displayed. The supported dates range from January 1st, 1997, until November 7th, 2098.				
MAIN: Time of day				003 091
00:00:00	00:00:00	24:00:00	hh:mm:ss	Fig. 3-91, (p. 3-132)
Display of the time of day. The time can also be set here.				
MAIN: Time switching				003 095
0: Standard time				Fig. 3-91, (p. 3-132)
Setting for standard time or daylight saving time. This setting is necessary in order to avoid misinterpretation of the times assigned to signals and event data that can be read out through the PC or communication interfaces.				
MAIN: Frequency f				004 040
Not measured	40.00	70.00	Hz	Fig. 3-63, (p. 3-104)
Display of system frequency.				
MAIN: IA prim,demand				006 226
Not measured	0	25000	A	Fig. 3-54, (p. 3-96)
MAIN: IB prim,demand				006 227
Not measured	0	25000	A	Fig. 3-54, (p. 3-96)
MAIN: IC prim,demand				006 228
Not measured	0	25000	A	Fig. 3-54, (p. 3-96)
Display the three delayed phase currents (demand values) as primary quantities.				
MAIN: IA prim,demand stor.				006 223
Not measured	0	25000	A	Fig. 3-54, (p. 3-96)
MAIN: IB prim,demand stor.				006 224
Not measured	0	25000	A	Fig. 3-54, (p. 3-96)
MAIN: IC prim,demand stor.				006 225
Not measured	0	25000	A	Fig. 3-54, (p. 3-96)
Display the three stored phase currents (demand values) as primary quantities.				
MAIN: Curr. IP,max prim.				005 050
Not measured	0	25000	A	Fig. 3-53, (p. 3-95)
Display of the maximum phase current as a primary quantity.				

Parameter				Address			
Default	Min	Max	Unit	Logic Diagram			
MAIN: IP,max prim.,delay							005 036
Not measured	0	25000	A	Fig. 3-54, (p. 3-96)			
Display of the delayed maximum phase current as a primary quantity.							
MAIN: IP,max prim.,stored							005 034
Not measured	0	25000	A	Fig. 3-54, (p. 3-96)			
Display of the delayed stored maximum phase current as a primary quantity.							
MAIN: Curr. IP,min prim.							005 055
Not measured	0	25000	A	Fig. 3-53, (p. 3-95)			
Display of the minimum phase current as a primary quantity.							
MAIN: Current A prim.							005 040
Not measured	0	25000	A	Fig. 3-53, (p. 3-95)			
Display of phase current A as a primary quantity.							
MAIN: Current B prim.							006 040
Not measured	0	25000	A	Fig. 3-53, (p. 3-95)			
Display of phase current B as a primary quantity.							
MAIN: Current C prim.							007 040
Not measured	0	25000	A	Fig. 3-53, (p. 3-95)			
Display of phase current C as a primary quantity.							
MAIN: Current Σ (IP) prim.							005 010
Not measured	0	25000	A	Fig. 3-53, (p. 3-95)			
Display of the calculated resultant current as a primary quantity.							
MAIN: Current IN prim.							004 043
Not measured	0	25000	A	Fig. 3-55, (p. 3-97)			
Display of the updated value for the residual current as a primary quantity. The measured residual current is displayed.							
MAIN: Volt. VPG,max prim.							008 042
Not measured	0.0	2500.0	kV	Fig. 3-58, (p. 3-100)			
Display of the maximum phase-to-ground voltage as a primary quantity.							
MAIN: Volt. VPG,min prim.							009 042
Not measured	0.0	2500.0	kV	Fig. 3-58, (p. 3-100)			
Display of the minimum phase-to-ground voltage as a primary quantity.							
MAIN: Voltage A-G prim.							005 042
Not measured	0.0	2500.0	kV	Fig. 3-58, (p. 3-100)			
Display of the updated value for phase-to-ground voltage A-G as a primary quantity.							

Parameter				Address			
Default	Min	Max	Unit	Logic Diagram			
MAIN: Voltage B-G prim.							006 042
Not measured	0.0	2500.0	kV	Fig. 3-58, (p. 3-100)			
Display of the updated value for phase-to-ground voltage B-G as a primary quantity.							
MAIN: Voltage C-G prim.							007 042
Not measured	0.0	2500.0	kV	Fig. 3-58, (p. 3-100)			
Display of the updated value for phase-to-ground voltage C-G as a primary quantity.							
MAIN: Volt. $\Sigma(VPG)/3$ prim.							005 012
Not measured	0.0	2500.0	kV	Fig. 3-58, (p. 3-100)			
Display of the calculated neutral-displacement voltage as a primary quantity.							
MAIN: Voltage VNG prim.							004 041
Not measured	0.0	2500.0	kV	Fig. 3-59, (p. 3-101)			
Display of the neutral-point displacement voltage measured at transformer T 90 as a primary quantity.							
MAIN: Voltage Vref prim.							005 046
Not measured	0.0	3000.0	kV	Fig. 3-60, (p. 3-101)			
Display of the reference voltage measured at transformer T 15 as a primary quantity.							
MAIN: Volt. VPP,max prim.							008 044
Not measured	0.0	2500.0	kV	Fig. 3-58, (p. 3-100)			
Display of the maximum phase-to-phase voltage as a primary quantity.							
MAIN: Volt. VPP,min prim.							009 044
Not measured	0.0	2500.0	kV	Fig. 3-58, (p. 3-100)			
Display of the minimum phase-to-phase voltage as a primary quantity.							
MAIN: Voltage A-B prim.							005 044
Not measured	0.0	2500.0	kV	Fig. 3-58, (p. 3-100)			
Display of the updated value for phase-to-phase voltage A-B as a primary quantity.							
MAIN: Voltage B-C prim.							006 044
Not measured	0.0	2500.0	kV	Fig. 3-58, (p. 3-100)			
Display of the updated value for phase-to-phase voltage B-C as a primary quantity.							
MAIN: Voltage C-A prim.							007 044
Not measured	0.0	2500.0	kV	Fig. 3-58, (p. 3-100)			
Display of the updated value for phase-to-phase voltage C-A as a primary quantity.							

Parameter				Address
Default	Min	Max	Unit	Logic Diagram
MAIN: Appar. power S prim.				005 025
Not measured	-1399.9	1400.0	MVA	Fig. 3-61, (p. 3-102)
Display of the updated apparent power value as a primary quantity.				
MAIN: Active power P prim.				004 050
Not measured	-3200.0	3200.0	MW	Fig. 3-61, (p. 3-102)
Display of the updated active power value as a primary quantity.				
MAIN: Reac. power Q prim.				004 052
Not measured	-3200.0	3200.0	Mvar	Fig. 3-61, (p. 3-102)
Display of the updated reactive power value as a primary quantity.				
MAIN: Active power factor				004 054
Not measured	-1.000	1.000		Fig. 3-61, (p. 3-102)
Display of the updated active power factor.				
MAIN: Act.energy outp.prim				008 065
2:			MWh	
MAIN: Act.energy inp. prim				008 066
2:			MWh	
MAIN: React.en. outp. prim				008 067
2:			Mvarh	
MAIN: React. en. inp. prim				008 068
2:			Mvarh	
Display of the updated active energy output (or active energy input, reactive energy output, reactive energy input, respectively) as a primary quantity. At run-time, the value is displayed with 32 bit precision. (But note that for technical reasons, this value is internally stored as a text value.) Value ranges:				
● MAIN: Act.energy outp.prim – 0 ... 6,553,500.00 MWh ● MAIN: Act.energy inp. prim – 0 ... 6,553,500.00 MWh ● MAIN: React.en. outp. prim – 0 ... 6,553,500.00 Mvar h ● MAIN: React. en. inp. prim – 0 ... 6,553,500.00 Mvar h				
Note: As an alternative, the same values also exist as numbers with 16 bit precision:				
● (005 061) MAIN: Act.energy outp.prim ● (005 062) MAIN: Act.energy inp. prim ● (005 063) MAIN: React.en. outp. prim ● (005 064) MAIN: React. en. inp. prim				
MAIN: Act.energy outp.prim				005 061
0.00	0.00	655.35	MWh	Fig. 3-65, (p. 3-106)

Parameter					Address
Default	Min	Max	Unit	Logic Diagram	
MAIN: Act.energy inp. prim					005 062
0.00	0.00	655.35	MWh	Fig. 3-65, (p. 3-106)	
MAIN: React.en. outp. prim					005 063
0.00	0.00	655.35	Mvarh	Fig. 3-65, (p. 3-106)	
MAIN: React. en. inp. prim					005 064
0.00	0.00	655.35	Mvarh	Fig. 3-65, (p. 3-106)	
Display of the updated active energy output (or active energy input, reactive energy output, reactive energy input, respectively) as a primary quantity. The value is displayed as a number with 16 bit precision. The setting at MAIN: Op. mode energy cnt. decides which procedure shall be used to determine the active and reactive energy: ● If procedure 1 is selected, active and reactive energy are determined every 2 s (approximately). ● If procedure 2 is selected, active and reactive energy are determined every 100 ms (approximately). Procedure 2 obviously gives more precise results but puts more strain on the system. Whenever the maximum value of 655.35 MWh or 655.35 MVar h is exceeded, the determination of the energy output is restarted, and the value that exceeded the range is transferred to the new cycle. Moreover, a counter is incremented: ● (009 090) MAIN: No.overfl.act.en.out: Counter for value overflow of MAIN: Act.energy outp.prim ● (009 091) MAIN: No.overfl.act.en.inp: Counter for value overflow of MAIN: Act.energy inp. prim ● (009 092) MAIN: No.ov/fl.reac.en.out: Counter for value overflow of MAIN: React.en. outp. prim ● (009 093) MAIN: No.ov/fl.reac.en.inp: Counter for value overflow of MAIN: React. en. inp. prim Note that the maximum value of these counters is 10000. As an alternative to these 16 bit numbers, there are also 32 bit precision values available: ● (008 065) MAIN: Act.energy outp.prim ● (008 066) MAIN: Act.energy inp. prim ● (008 067) MAIN: React.en. outp. prim ● (008 068) MAIN: React. en. inp. prim					
MAIN: Angle ZAB					021 191
Not measured	-180.0	180.0	°	Fig. 3-64, (p. 3-105)	
MAIN: Angle ZBC					021 192
Not measured	-180.0	180.0	°	Fig. 3-64, (p. 3-105)	

Parameter				Address
Default	Min	Max	Unit	Logic Diagram
MAIN: Angle ZCA				021 193
Not measured	-180.0	180.0	°	Fig. 3-64, (p. 3-105)
Display of the angle of phase-to-phase impedance.				
MAIN: Abs.value ZAB prim.				021 204
Not measured	0.0	6000.0	Ω	Fig. 3-64, (p. 3-105)
MAIN: Abs.value ZBC prim.				021 205
Not measured	0.0	6000.0	Ω	Fig. 3-64, (p. 3-105)
MAIN: Abs.value ZCA prim.				021 206
Not measured	0.0	6000.0	Ω	Fig. 3-64, (p. 3-105)
Display of the absolute value of phase-to-phase impedance as a primary quantity.				
MAIN: Load angle phi A				004 055
Not measured	-180.0	180.0	°	Fig. 3-61, (p. 3-102)
Display of the updated load angle value in phase A.				
MAIN: Load angle phi B				004 056
Not measured	-180.0	180.0	°	Fig. 3-61, (p. 3-102)
Display of the updated load angle value in phase B.				
MAIN: Load angle phi C				004 057
Not measured	-180.0	180.0	°	Fig. 3-61, (p. 3-102)
Display of the updated load angle value in phase C.				
MAIN: Angle phi N				004 072
Not measured	-180.0	180.0	°	Fig. 3-61, (p. 3-102)
Display of the angle between the measured residual current system quantities I_N and V_{NG} .				
MAIN: Angle ΣVPG vs. I_N				005 009
Not measured	-180	180	°	Fig. 3-61, (p. 3-102)
Display of the angle between the calculated neutral-point displacement voltage and the measured residual current system quantities I_N .				
MAIN: Phase rel. I_N vs ΣIP				004 073
....: Not measured				Fig. 3-62, (p. 3-103)
Display of the phase relation of measured and calculated residual current. (The phase relation is displayed as either "Equal phase" or "Reverse phase".)				
MAIN: Frequency f p.u.				004 070
Not measured	0.200	4.000	f _{nom}	Fig. 3-63, (p. 3-104)
Display of system frequency referred to f _n .				

Parameter				Address			
Default	Min	Max	Unit	Logic Diagram			
MAIN: IA p.u.,demand							006 235
Not measured	0.000	25.000	Inom	Fig. 3-54, (p. 3-96)			
MAIN: IB p.u.,demand							006 236
Not measured	0.000	25.000	Inom	Fig. 3-54, (p. 3-96)			
MAIN: IC p.u.,demand							006 237
Not measured	0.000	25.000	Inom	Fig. 3-54, (p. 3-96)			
Display of the delayed phase currents referred to I_{nom} .							
MAIN: IA p.u.,demand stor.							006 232
Not measured	0.000	25.000	Inom	Fig. 3-54, (p. 3-96)			
MAIN: IB p.u.,demand stor.							006 233
Not measured	0.000	25.000	Inom	Fig. 3-54, (p. 3-96)			
MAIN: IC p.u.,demand stor.							006 234
Not measured	0.000	25.000	Inom	Fig. 3-54, (p. 3-96)			
Display of the delayed stored phase currents referred to I_{nom} .							
MAIN: Current IP,max p.u.							005 051
Not measured	0.000	25.000	Inom	Fig. 3-53, (p. 3-95)			
Display of the maximum phase current referred to I_{nom} .							
MAIN: IP,max p.u.,delay							005 037
Not measured	0.000	25.000	Inom	Fig. 3-54, (p. 3-96)			
Display of the delayed maximum phase current referred to I_{nom} .							
MAIN: IP,max p.u.,stored							005 035
Not measured	0.000	25.000	Inom	Fig. 3-54, (p. 3-96)			
Display of the delayed stored maximum phase current referred to I_{nom} .							
MAIN: Current IP,min p.u.							005 056
Not measured	0.000	25.000	Inom	Fig. 3-53, (p. 3-95)			
Display of the minimum phase current referred to I_{nom} .							
MAIN: Current A p.u.							005 041
Not measured	0.000	25.000	Inom	Fig. 3-53, (p. 3-95)			
Display of phase current A referred to I_{nom} .							
MAIN: Current B p.u.							006 041
Not measured	0.000	25.000	Inom	Fig. 3-53, (p. 3-95)			
Display of phase current B referred to I_{nom} .							

Parameter				Address			
Default	Min	Max	Unit	Logic Diagram			
MAIN: Current C p.u.							007 041
Not measured	0.000	25.000	Inom	Fig. 3-53, (p. 3-95)			
Display of phase current C referred to I_{nom} .							
MAIN: Current Ipos p.u.							009 011
Not measured	0.000	25.000	Inom				
Display of the positive sequence current referred to I_{nom} .							
MAIN: Current Ineg p.u.							009 015
Not measured	0.000	25.000	Inom				
Display of the negative-sequence current referred to I_{nom} .							
MAIN: Current $\Sigma(IP)$ p.u.							005 011
Not measured	0.000	25.000	Inom	Fig. 3-53, (p. 3-95)			
Display of the calculated residual current referred to I_{nom} .							
MAIN: Current IN p.u.							004 044
Not measured	0.000	25.000	IN,nom	Fig. 3-55, (p. 3-97)			
Display of the updated residual current value referred to I_{nom} . The measured residual current is displayed.							
MAIN: Voltage VPG,max p.u.							008 043
Not measured	0.000	25.000	Vnom	Fig. 3-58, (p. 3-100)			
Display of the maximum phase-to-ground voltage referred to V_{nom} .							
MAIN: Voltage VPG,min p.u.							009 043
Not measured	0.000	25.000	Vnom	Fig. 3-58, (p. 3-100)			
Display of the minimum phase-to-ground voltage referred to V_{nom} .							
MAIN: Angle $\Sigma VPG/IN$ p.u.							005 072
Not measured	-1.80	1.80	phi,ref	Fig. 3-61, (p. 3-102)			
Display of the angle between the calculated neutral-point displacement voltage and the measured residual current system quantities I_N referred to 100° .							
MAIN: Voltage A-G p.u.							005 043
Not measured	0.000	25.000	Vnom	Fig. 3-58, (p. 3-100)			
Display of the updated value for phase-to-ground voltage A-G referred to V_{nom} .							
MAIN: Voltage B-G p.u.							006 043
Not measured	0.000	25.000	Vnom	Fig. 3-58, (p. 3-100)			
Display of the updated value for phase-to-ground voltage B-G referred to V_{nom} .							

Parameter					Address		
Default	Min	Max	Unit		Logic Diagram		
MAIN: Voltage C-G p.u.							007 043
Not measured	0.000	25.000	Vnom	Fig. 3-58, (p. 3-100)			
Display of the updated value for phase-to-ground voltage C-G referred to V_{nom} .							
MAIN: Voltage Vpos p.u.							009 018
Not measured	0.000	25.000	Vnom	Fig. 3-58, (p. 3-100)			
Display of the positive-sequence voltage referred to V_{nom} .							
MAIN: Voltage Vneg p.u.							009 017
Not measured	0.000	25.000	Vnom	Fig. 3-58, (p. 3-100)			
Display of the negative-sequence voltage referred to V_{nom} .							
MAIN: Volt. $\Sigma(VPG)/\sqrt{3}$ p.u.							005 013
Not measured	0.000	12.000	Vnom	Fig. 3-58, (p. 3-100)			
Display of the calculated neutral-point displacement voltage referred to V_{nom} .							
MAIN: Voltage VNG p.u.							004 042
Not measured	0.000	25.000	VNG,nom	Fig. 3-59, (p. 3-101)			
Display of the neutral-point displacement voltage measured at transformer T 90 referred to V_{nom} .							
MAIN: Voltage Vref p.u.							005 047
Not measured	0.000	3.000	Vnom	Fig. 3-60, (p. 3-101)			
Display of the reference voltage measured at transformer T 15 referred to V_{nom} .							
MAIN: Voltage VPP,max p.u.							008 045
Not measured	0.000	25.000	Vnom	Fig. 3-58, (p. 3-100)			
Display of the maximum phase-to-phase voltage referred to V_{nom} .							
MAIN: Voltage VPP,min p.u.							009 045
Not measured	0.000	25.000	Vnom	Fig. 3-58, (p. 3-100)			
Display of the minimum phase-to-phase voltage referred to V_{nom} .							
MAIN: Voltage A-B p.u.							005 045
Not measured	0.000	25.000	Vnom	Fig. 3-58, (p. 3-100)			
Display of the updated value for phase-to-phase voltage A-B referred to V_{nom} .							
MAIN: Voltage B-C p.u.							006 045
Not measured	0.000	25.000	Vnom	Fig. 3-58, (p. 3-100)			
Display of the updated value for phase-to-phase voltage B-C referred to V_{nom} .							
MAIN: Voltage C-A p.u.							007 045
Not measured	0.000	25.000	Vnom	Fig. 3-58, (p. 3-100)			
Display of the updated value for phase-to-phase voltage C-A referred to V_{nom} .							

Parameter					Address		
Default	Min	Max	Unit	Logic Diagram			
MAIN: Appar. power S p.u.						005 026	
Not measured	-10.700	10.700	Snom	Fig. 3-61, (p. 3-102)			
Display of the updated apparent power value referred to nominal apparent power S_{nom} .							
MAIN: Active power P p.u.						004 051	
Not measured	-7.500	7.500	Snom	Fig. 3-61, (p. 3-102)			
Display of the updated active power value referred to nominal apparent power S_{nom} .							
MAIN: Reac. power Q p.u.						004 053	
Not measured	-7.500	7.500	Snom	Fig. 3-61, (p. 3-102)			
Display of the updated value for reactive power referred to nominal apparent power S_{nom} .							
MAIN: Load angle phi A p.u						005 073	
Not measured	-1.80	1.80	phi,ref	Fig. 3-61, (p. 3-102)			
Display of the updated load angle value in phase A referred to 100°C.							
MAIN: Load angle phi B p.u						005 074	
Not measured	-1.80	1.80	phi,ref	Fig. 3-61, (p. 3-102)			
Display of the updated load angle value in phase B referred to 100°C.							
MAIN: Load angle phi C p.u						005 075	
Not measured	-1.80	1.80	phi,ref	Fig. 3-61, (p. 3-102)			
Display of the updated load angle value in phase C referred to 100°C.							
MAIN: Angle phi N p.u.						005 076	
Not measured	-1.80	1.80	phi,ref	Fig. 3-61, (p. 3-102)			
Display of the angle between the measured residual current system quantities I_N and V_{NG} referred to 100°.							
MAIN: Abs.value ZAB sec.						021 194	
Not measured	0.0	2000.0	Ω	Fig. 3-64, (p. 3-105)			
MAIN: Abs.value ZBC sec.						021 195	
Not measured	0.0	2000.0	Ω	Fig. 3-64, (p. 3-105)			
MAIN: Abs.value ZCA sec.						021 200	
Not measured	0.0	2000.0	Ω	Fig. 3-64, (p. 3-105)			
Display of the absolute value of phase-to-phase impedance as a secondary quantity.							
MAIN: Current ΣI unfilt.						004 074	
Not measured	0.000	25.000	Inom				
Display of calculated unfiltered resultant current.							

Parameter				Address			
Default	Min	Max	Unit	Logic Diagram			
MAIN: Dummy entry							000 031
Not measured	0.000	25.000					

Ground fault
direction
determination using
steady-state values

Parameter	Address			
Default	Min	Max	Unit	Logic Diagram
GFDSS: Current $I_{N,act}$ p.u.				004 045
Not measured	0.000	30.000	$I_{N,nom}$	Fig. 3-308, (p. 3-382)
Display of the updated value for the active component of residual current referred to $I_{N,nom}$.				
GFDSS: Curr. $I_{N,react}$ p.u.				004 046
Not measured	0.000	30.000	$I_{N,nom}$	Fig. 3-308, (p. 3-382)
Display of the updated value for the reactive component of residual current referred to $I_{N,nom}$.				
GFDSS: Curr. $I_{N,filt}$ p.u.				004 047
Not measured	0.000	30.000	$I_{N,nom}$	Fig. 3-309, (p. 3-383)
Display of the updated value for the harmonic content of residual current referred to $I_{N,nom}$. This display is only active when the steady-state current evaluation mode of the ground fault direction determination function (GFDSS) is enabled.				
GFDSS: Admitt. $Y(N)$ p.u.				004 191
Not measured	0.000	5.000	$Y_{N,nom}$	Fig. 3-314, (p. 3-388)
Display of the updated admittance value referred to $Y_{N,nom}$.				
Note: With setting: GFDSS: Evaluation VNG PSx set to <i>Measured</i> :				
$Y_{N,nom} = I_{N,nom} / V_{NG,nom}$				
With setting: GFDSS: Evaluation VNG PSx = <i>Calculated</i> :				
$Y_{N,nom} = I_{N,nom} / V_{nom}$				
GFDSS: Conduct. $G(N)$ p.u.				004 192
Not measured	-5.000	5.000	$Y_{N,nom}$	Fig. 3-314, (p. 3-388)
Display of the updated conductance value referred to $Y_{N,nom}$.				
Note: With setting: GFDSS: Evaluation VNG PSx set to <i>Measured</i> :				
$Y_{N,nom} = I_{N,nom} / V_{NG,nom}$				
With setting: GFDSS: Evaluation VNG PSx = <i>Calculated</i> :				
$Y_{N,nom} = I_{N,nom} / V_{nom}$				
GFDSS: Suscept. $B(N)$ p.u.				004 193
Not measured	-5.000	5.000	$Y_{N,nom}$	Fig. 3-314, (p. 3-388)
Display of the updated susceptance value referred to $Y_{N,nom}$.				
Note: With setting: GFDSS: Evaluation VNG PSx set to <i>Measured</i> :				
$Y_{N,nom} = I_{N,nom} / V_{NG,nom}$				
With setting: GFDSS: Evaluation VNG PSx = <i>Calculated</i> :				
$Y_{N,nom} = I_{N,nom} / V_{nom}$				

Thermal overload protection

Parameter	Address			
Default	Min	Max	Unit	Logic Diagram
THERM: Status THERM replica				004 016
Not measured	-250	250	%	Fig. 3-332, (p. 3-409)
Display of the buffer content of the thermal overload protection function.				
THERM: Current I _{therm prim}				007 220
Not measured	0	25000	A	Fig. 3-332, (p. 3-409)
THERM: Current I _{therm p.u.}				007 221
Not measured	0.000	2.400	I _{ref}	Fig. 3-332, (p. 3-409)
Display of the “thermal current” (as a primary quantity, or as a per unit quantity, respectively).				
These measured operating values are calculated as follows:				
$I_{\text{therm,prim}} = \sqrt{\frac{\text{Status}_{\text{therm. repl.}}}{100}} I_{\text{ref}} I_{\text{nom,CT,prim}}$				
$I_{\text{therm,p.u.}} = \frac{I_{\text{therm,prim}}}{I_{\text{ref}} I_{\text{nom,CT,prim}}}$				
With:				
● I_{therm,prim} = THERM: Current I_{therm prim} ● I_{therm,p.u.} = THERM: Current I_{therm p.u.} ● Status_{therm. repl.} = THERM: Status THERM replica ● I_{ref} = THERM: I_{ref PSx} ● I_{nom,CT,prim} = MAIN: I_{nom C.T. prim.}				
In a measured values message the thermal current is processed as a per-unit variable referred to I _{ref} .				
THERM: Object temperature				004 137
Not measured	-40	300	°C	Fig. 3-332, (p. 3-409)
Display of the temperature of the protected object.				
THERM: Coolant temperature				004 149
Not measured	-40	200	°C	Fig. 3-332, (p. 3-409)
Display of coolant temperature, dependent on the setting for THERM: Select meas.inputPSx.				
When set to <i>Default temp. value</i> the set temperature value will be displayed.				
When set to <i>From PT100</i> the temperature measured by the resistance thermometer will be displayed. When set to <i>From 20 mA input</i> the temperature measured via an external 20 mA transducer will be displayed.				
THERM: Pre-trip time left				004 139
Not measured	0.0	1000.0	min	Fig. 3-332, (p. 3-409)
Display of the time remaining before the thermal overload protection function will reach the tripping threshold (“time-to-trip”).				

Parameter				Address
Default	Min	Max	Unit	Logic Diagram
THERM: Therm. replica p.u.				004 017
Not measured	-2.500	2.500		Fig. 3-332, (p. 3-409)
Display of the buffer content of the thermal overload protection function referred to a buffer content of 100%.				
THERM: Object temp. p.u.				004 179
Not measured	-0.40	3.00	100°C	Fig. 3-332, (p. 3-409)
Display of the temperature of the protected object referred to 100°C.				
THERM: Coolant temp. p.u.				004 178
Not measured	-0.40	2.00	100°C	Fig. 3-332, (p. 3-409)
Display of the coolant temperature referred to 100°C.				
THERM: Temp. offset replica				004 109
Not measured	-25000	25000	%	Fig. 3-332, (p. 3-409)
Display of the additional reserve if coolant temperature is taken into account and if the measured coolant temperature is lower than the set maximum permissible coolant temperature. (In this case, the thermal model has been shifted downwards.)				
If there is no coolant temperature acquisition and if the coolant temperature and the maximum permissible coolant temperature have been set to the same value, then the coolant temperature is not taken into account and the characteristic is a function of the current only. The additional reserve amounts to 0 in this case.				

Binary counts

Parameter				Address
Default	Min	Max	Unit	Logic Diagram
COUNT: Count 1				217 100
0	0	65535		Fig. 3-439, (p. 3-525)
COUNT: Count 2				217 080
0	0	65535		
COUNT: Count 3				217 081
0	0	65535		
COUNT: Count 4				217 082
0	0	65535		
Display of the updated count.				
Note: The count value can be set here (Preload-Function).				

8.1.1.2

Physical State Signals

Configurable func-
tion keys

Parameter				Address	
Default	Min	Max	Unit	Logic Diagram	
F_KEY: State F1					080 122
0: "Off"					
F_KEY: State F2					080 123
0: "Off"					
F_KEY: State F3					080 124
0: "Off"					
F_KEY: State F4					080 125
0: "Off"					
F_KEY: State F5					080 126
0: "Off"					
F_KEY: State F6					080 127
0: "Off"					
The state of the function keys is displayed as follows: ● <i>Without function</i>: No functions are assigned to the function key. ● <i>"Off"</i>: The function key is in the "Off" position. ● <i>"On"</i>: The function key is in the "On" position.					

InterMiCOM
interface

Parameter					Address		
Default	Min	Max	Unit		Logic Diagram		
COMM3: State receive 1							120 000
0: 0							
COMM3: State receive 2							120 003
0: 0							
COMM3: State receive 3							120 006
0: 0							
COMM3: State receive 4							120 009
0: 0							
COMM3: State receive 5							120 012
0: 0							
COMM3: State receive 6							120 015
0: 0							
COMM3: State receive 7							120 018
0: 0							
COMM3: State receive 8							120 021
0: 0							
Display of the relevant receive signal.							
COMM3: State send 1							121 000
0: 0							
COMM3: State send 2							121 002
0: 0							
COMM3: State send 3							121 004
0: 0							
COMM3: State send 4							121 006
0: 0							
COMM3: State send 5							121 008
0: 0							
COMM3: State send 6							121 010
0: 0							
COMM3: State send 7							121 012
0: 0							
COMM3: State send 8							121 014
0: 0							
Display of the updated value for the relevant send signal.							

Generic Object
Orientated
Substation Events

Parameter					Address
Default	Min	Max	Unit		Logic Diagram
GOOSE: Output 1 state					106 010
0: 0					
GOOSE: Output 2 state					106 012
0: 0					
GOOSE: Output 3 state					106 014
0: 0					
GOOSE: Output 4 state					106 016
0: 0					
GOOSE: Output 5 state					106 018
0: 0					
GOOSE: Output 6 state					106 020
0: 0					
GOOSE: Output 7 state					106 022
0: 0					
GOOSE: Output 8 state					106 024
0: 0					
GOOSE: Output 9 state					106 026
0: 0					
GOOSE: Output 10 state					106 028
0: 0					
GOOSE: Output 11 state					106 030
0: 0					
GOOSE: Output 12 state					106 032
0: 0					
GOOSE: Output 13 state					106 034
0: 0					
GOOSE: Output 14 state					106 036
0: 0					
GOOSE: Output 15 state					106 038
0: 0					
GOOSE: Output 16 state					106 040
0: 0					
GOOSE: Output 17 state					106 042
0: 0					
GOOSE: Output 18 state					106 044
0: 0					

Parameter					Address	
Default	Min	Max	Unit		Logic Diagram	
GOOSE: Output 19 state					106 046	
0: 0						
GOOSE: Output 20 state					106 048	
0: 0						
GOOSE: Output 21 state					106 050	
0: 0						
GOOSE: Output 22 state					106 052	
0: 0						
GOOSE: Output 23 state					106 054	
0: 0						
GOOSE: Output 24 state					106 056	
0: 0						
GOOSE: Output 25 state					106 058	
0: 0						
GOOSE: Output 26 state					106 060	
0: 0						
GOOSE: Output 27 state					106 062	
0: 0						
GOOSE: Output 28 state					106 064	
0: 0						
GOOSE: Output 29 state					106 066	
0: 0						
GOOSE: Output 30 state					106 068	
0: 0						
GOOSE: Output 31 state					106 070	
0: 0						
GOOSE: Output 32 state					106 072	
0: 0						
Display of the virtual binary GOOSE output state.						

Virtual Inputs

Parameter					Address
Default	Min	Max	Unit		Logic Diagram
VINP: Input 1 state					115 010
0: 0					
VINP: Input 2 state					115 011
0: 0					
VINP: Input 3 state					115 012
0: 0					
VINP: Input 4 state					115 013
0: 0					
VINP: Input 5 state					115 014
0: 0					
VINP: Input 6 state					115 015
0: 0					
VINP: Input 7 state					115 016
0: 0					
VINP: Input 8 state					115 017
0: 0					
VINP: Input 9 state					115 018
0: 0					
VINP: Input 10 state					115 019
0: 0					
VINP: Input 11 state					115 020
0: 0					
VINP: Input 12 state					115 021
0: 0					
VINP: Input 13 state					115 022
0: 0					
VINP: Input 14 state					115 023
0: 0					
VINP: Input 15 state					115 024
0: 0					
VINP: Input 16 state					115 025
0: 0					
VINP: Input 17 state					115 026
0: 0					
VINP: Input 18 state					115 027
0: 0					
VINP: Input 19 state					115 028
0: 0					

Parameter					Address		
Default	Min	Max	Unit		Logic Diagram		
VINP: Input 20 state							115 029
0: 0							
VINP: Input 21 state							115 030
0: 0							
VINP: Input 22 state							115 031
0: 0							
VINP: Input 23 state							115 032
0: 0							
VINP: Input 24 state							115 033
0: 0							
VINP: Input 25 state							115 034
0: 0							
VINP: Input 26 state							115 035
0: 0							
VINP: Input 27 state							115 036
0: 0							
VINP: Input 28 state							115 037
0: 0							
VINP: Input 29 state							115 038
0: 0							
VINP: Input 30 state							115 039
0: 0							
VINP: Input 31 state							115 040
0: 0							
VINP: Input 32 state							115 041
0: 0							
VINP: Input 33 state							115 042
0: 0							
VINP: Input 34 state							115 043
0: 0							
VINP: Input 35 state							115 044
0: 0							
VINP: Input 36 state							115 045
0: 0							
VINP: Input 37 state							115 046
0: 0							
VINP: Input 38 state							115 047
0: 0							

Parameter				Address
Default	Min	Max	Unit	Logic Diagram
VINP: Input 39 state				115 048
0: 0				
VINP: Input 40 state				115 049
0: 0				
VINP: Input 41 state				115 050
0: 0				
VINP: Input 42 state				115 051
0: 0				
VINP: Input 43 state				115 052
0: 0				
VINP: Input 44 state				115 053
0: 0				
VINP: Input 45 state				115 054
0: 0				
VINP: Input 46 state				115 055
0: 0				
VINP: Input 47 state				115 056
0: 0				
VINP: Input 48 state				115 057
0: 0				
VINP: Input 49 state				115 058
0: 0				
VINP: Input 50 state				115 059
0: 0				
VINP: Input 51 state				115 060
0: 0				
VINP: Input 52 state				115 061
0: 0				
VINP: Input 53 state				115 062
0: 0				
VINP: Input 54 state				115 063
0: 0				
VINP: Input 55 state				115 064
0: 0				
VINP: Input 56 state				115 065
0: 0				
VINP: Input 57 state				115 066
0: 0				

Parameter					Address		
Default	Min	Max	Unit		Logic Diagram		
VINP: Input 58 state							115 067
0: 0							
VINP: Input 59 state							115 068
0: 0							
VINP: Input 60 state							115 069
0: 0							
VINP: Input 61 state							115 070
0: 0							
VINP: Input 62 state							115 071
0: 0							
VINP: Input 63 state							115 072
0: 0							
VINP: Input 64 state							115 073
0: 0							

Binary input

Parameter					Address
Default	Min	Max	Unit		Logic Diagram
INP: State U 301					152 216
0: "Low"					
INP: State U 302					152 219
0: "Low"					
INP: State U 303					152 222
0: "Low"					
INP: State U 304					152 225
0: "Low"					
INP: State U 305					186 117
0: "Low"					
INP: State U 306					186 121
0: "Low"					
INP: State U 307					186 125
0: "Low"					
INP: State U 308					186 129
0: "Low"					
INP: State U 309					186 133
0: "Low"					
INP: State U 310					186 137
0: "Low"					
INP: State U 311					186 141
0: "Low"					
INP: State U 312					186 145
0: "Low"					
INP: State U 313					186 149
0: "Low"					
INP: State U 314					186 153
0: "Low"					
INP: State U 315					186 157
0: "Low"					
INP: State U 316					186 161
0: "Low"					
INP: State U 317					186 165
0: "Low"					
INP: State U 318					186 169
0: "Low"					
INP: State U 319					186 173
0: "Low"					

Parameter					Address		
Default	Min	Max	Unit		Logic Diagram		
INP: State U 320							186 177
0: "Low"							
INP: State U 321							186 181
0: "Low"							
INP: State U 322							186 185
0: "Low"							
INP: State U 323							186 189
0: "Low"							
INP: State U 324							186 193
0: "Low"							
INP: State U 501							152 072
0: "Low"							
INP: State U 502							152 075
0: "Low"							
INP: State U 503							152 078
0: "Low"							
INP: State U 504							152 081
0: "Low"							
INP: State U 601							152 090
0: "Low"							
INP: State U 602							152 093
0: "Low"							
INP: State U 603							152 096
0: "Low"							
INP: State U 604							152 099
0: "Low"							
INP: State U 605							152 102
0: "Low"							
INP: State U 606							152 105
0: "Low"							
INP: State U 701							152 108
0: "Low"							
INP: State U 702							152 111
0: "Low"							
INP: State U 703							152 114
0: "Low"							
INP: State U 704							152 117
0: "Low"							

Parameter				Address
Default	Min	Max	Unit	Logic Diagram
INP: State U 705				152 120
0: "Low"				
INP: State U 706				152 123
0: "Low"				
INP: State U 801				184 001
0: "Low"				
INP: State U 802				184 005
0: "Low"				
INP: State U 803				184 009
0: "Low"				
INP: State U 804				184 013
0: "Low"				
INP: State U 805				184 017
0: "Low"				
INP: State U 806				184 021
0: "Low"				
INP: State U 807				184 025
0: "Low"				
INP: State U 808				184 029
0: "Low"				
INP: State U 809				184 033
0: "Low"				
INP: State U 810				184 037
0: "Low"				
INP: State U 811				184 041
0: "Low"				
INP: State U 812				184 045
0: "Low"				
INP: State U 813				184 049
0: "Low"				
INP: State U 814				184 053
0: "Low"				
INP: State U 815				184 057
0: "Low"				
INP: State U 816				184 061
0: "Low"				
INP: State U 817				184 065
0: "Low"				

Parameter					Address		
Default	Min	Max	Unit		Logic Diagram		
INP: State U 818							184 069
0: "Low"							
INP: State U 819							184 073
0: "Low"							
INP: State U 820							184 077
0: "Low"							
INP: State U 821							184 081
0: "Low"							
INP: State U 822							184 085
0: "Low"							
INP: State U 823							184 089
0: "Low"							
INP: State U 824							184 093
0: "Low"							
INP: State U 901							152 144
0: "Low"							
INP: State U 902							152 147
0: "Low"							
INP: State U 903							152 150
0: "Low"							
INP: State U 904							152 153
0: "Low"							
INP: State U 1001							152 162
0: "Low"							
INP: State U 1002							152 165
0: "Low"							
INP: State U 1003							152 168
0: "Low"							
INP: State U 1004							152 171
0: "Low"							
INP: State U 1005							152 174
0: "Low"							
INP: State U 1006							152 177
0: "Low"							
INP: State U 1201							152 198
0: "Low"							
INP: State U 1202							152 201
0: "Low"							

Parameter				Address
Default	Min	Max	Unit	Logic Diagram
INP: State U 1203				152 204
0: "Low"				
INP: State U 1204				152 207
0: "Low"				
INP: State U 1205				152 210
0: "Low"				
INP: State U 1206				152 213
0: "Low"				
INP: State U 1401				190 001
0: "Low"				
INP: State U 1402				190 005
0: "Low"				
INP: State U 1403				190 009
0: "Low"				
INP: State U 1404				190 013
0: "Low"				
INP: State U 1405				190 017
0: "Low"				
INP: State U 1406				190 021
0: "Low"				
INP: State U 1601				192 001
0: "Low"				
INP: State U 1602				192 005
0: "Low"				
INP: State U 1603				192 009
0: "Low"				
INP: State U 1604				192 013
0: "Low"				
INP: State U 1605				192 017
0: "Low"				
INP: State U 1606				192 021
0: "Low"				
INP: State U 1607				192 025
0: "Low"				
INP: State U 1608				192 029
0: "Low"				
INP: State U 1609				192 033
0: "Low"				

Parameter					Address		
Default	Min	Max	Unit		Logic Diagram		
INP: State U 1610							192 037
0: "Low"							
INP: State U 1611							192 041
0: "Low"							
INP: State U 1612							192 045
0: "Low"							
INP: State U 1613							192 049
0: "Low"							
INP: State U 1614							192 053
0: "Low"							
INP: State U 1615							192 057
0: "Low"							
INP: State U 1616							192 061
0: "Low"							
INP: State U 1617							192 065
0: "Low"							
INP: State U 1618							192 069
0: "Low"							
INP: State U 1619							192 073
0: "Low"							
INP: State U 1620							192 077
0: "Low"							
INP: State U 1621							192 081
0: "Low"							
INP: State U 1622							192 085
0: "Low"							
INP: State U 1623							192 089
0: "Low"							
INP: State U 1624							192 093
0: "Low"							
INP: State U 1801							194 001
0: "Low"							
INP: State U 1802							194 005
0: "Low"							
INP: State U 1803							194 009
0: "Low"							
INP: State U 1804							194 013
0: "Low"							

Parameter				Address
Default	Min	Max	Unit	Logic Diagram
INP: State U 1805				194 017
0: "Low"				
INP: State U 1806				194 021
0: "Low"				
INP: State U 2001				153 086
0: "Low"				
INP: State U 2002				153 089
0: "Low"				
INP: State U 2003				153 092
0: "Low"				
INP: State U 2004				153 095
0: "Low"				
The state of the binary signal inputs is displayed as follows: ● <i>Without function</i>: No functions are assigned to the binary signal input. ● <i>"Low"</i>: Not energized. ● <i>"High"</i>: Energized. This display appears regardless of the setting for the binary signal input mode.				

Binary and analog
output

Parameter					Address			
Default	Min	Max	Unit		Logic Diagram			
OUTP: State K 301								151 044
0: Inactive					Fig. 3-40, (p. 3-71)			
OUTP: State K 302								151 047
0: Inactive								
OUTP: State K 501								150 096
0: Inactive								
OUTP: State K 502								150 099
0: Inactive								
OUTP: State K 503								150 102
0: Inactive								
OUTP: State K 504								150 105
0: Inactive								
OUTP: State K 505								150 108
0: Inactive								
OUTP: State K 506								150 111
0: Inactive								
OUTP: State K 507								150 114
0: Inactive								
OUTP: State K 508								150 117
0: Inactive								
OUTP: State K 601								150 120
0: Inactive								
OUTP: State K 602								150 123
0: Inactive								
OUTP: State K 603								150 126
0: Inactive								
OUTP: State K 604								150 129
0: Inactive								
OUTP: State K 605								150 132
0: Inactive								
OUTP: State K 606								150 135
0: Inactive								
OUTP: State K 607								150 138
0: Inactive								
OUTP: State K 608								150 141
0: Inactive								

Parameter				Address
Default	Min	Max	Unit	Logic Diagram
OUTP: State K 701				150 144
0: Inactive				
OUTP: State K 702				150 147
0: Inactive				
OUTP: State K 703				150 150
0: Inactive				
OUTP: State K 704				150 153
0: Inactive				
OUTP: State K 705				150 156
0: Inactive				
OUTP: State K 706				150 159
0: Inactive				
OUTP: State K 707				150 162
0: Inactive				
OUTP: State K 708				150 165
0: Inactive				
OUTP: State K 801				150 168
0: Inactive				
OUTP: State K 802				150 171
0: Inactive				
OUTP: State K 803				150 174
0: Inactive				
OUTP: State K 804				150 177
0: Inactive				
OUTP: State K 805				150 180
0: Inactive				
OUTP: State K 806				150 183
0: Inactive				
OUTP: State K 807				150 186
0: Inactive				
OUTP: State K 808				150 189
0: Inactive				
OUTP: State K 901				150 192
0: Inactive				
OUTP: State K 902				150 195
0: Inactive				
OUTP: State K 903				150 198
0: Inactive				

Parameter					Address		
Default	Min	Max	Unit		Logic Diagram		
OUTP: State K 904							150 201
0: Inactive							
OUTP: State K 905							150 204
0: Inactive							
OUTP: State K 906							150 207
0: Inactive							
OUTP: State K 907							150 210
0: Inactive							
OUTP: State K 908							150 213
0: Inactive							
OUTP: State K 1001							150 216
0: Inactive							
OUTP: State K 1002							150 219
0: Inactive							
OUTP: State K 1003							150 222
0: Inactive							
OUTP: State K 1004							150 225
0: Inactive							
OUTP: State K 1005							150 228
0: Inactive							
OUTP: State K 1006							150 231
0: Inactive							
OUTP: State K 1007							150 234
0: Inactive							
OUTP: State K 1008							150 237
0: Inactive							
OUTP: State K 1201							151 008
0: Inactive							
OUTP: State K 1202							151 011
0: Inactive							
OUTP: State K 1203							151 014
0: Inactive							
OUTP: State K 1204							151 017
0: Inactive							
OUTP: State K 1205							151 020
0: Inactive							
OUTP: State K 1206							151 023
0: Inactive							

Parameter				Address
Default	Min	Max	Unit	Logic Diagram
OUTP: State K 1207				151 026
0: Inactive				
OUTP: State K 1208				151 029
0: Inactive				
OUTP: State K 1401				169 001
0: Inactive				
OUTP: State K 1402				169 005
0: Inactive				
OUTP: State K 1403				169 009
0: Inactive				
OUTP: State K 1404				169 013
0: Inactive				
OUTP: State K 1405				169 017
0: Inactive				
OUTP: State K 1406				169 021
0: Inactive				
OUTP: State K 1407				169 025
0: Inactive				
OUTP: State K 1408				169 029
0: Inactive				
OUTP: State K 1601				171 001
0: Inactive				
OUTP: State K 1602				171 005
0: Inactive				
OUTP: State K 1603				171 009
0: Inactive				
OUTP: State K 1604				171 013
0: Inactive				
OUTP: State K 1605				171 017
0: Inactive				
OUTP: State K 1606				171 021
0: Inactive				
OUTP: State K 1607				171 025
0: Inactive				
OUTP: State K 1608				171 029
0: Inactive				
OUTP: State K 1801				173 001
0: Inactive				

Parameter					Address		
Default	Min	Max	Unit		Logic Diagram		
OUTP: State K 1802							173 005
0: Inactive							
OUTP: State K 1803							173 009
0: Inactive							
OUTP: State K 1804							173 013
0: Inactive							
OUTP: State K 1805							173 017
0: Inactive							
OUTP: State K 1806							173 021
0: Inactive							
OUTP: State K 2001							151 200
0: Inactive							
OUTP: State K 2002							151 203
0: Inactive							
OUTP: State K 2003							151 206
0: Inactive							
OUTP: State K 2004							151 209
0: Inactive							
OUTP: State K 2005							151 212
0: Inactive							
OUTP: State K 2006							151 215
0: Inactive							
OUTP: State K 2007							151 218
0: Inactive							
OUTP: State K 2008							151 221
0: Inactive							
The state of the output relays is displayed as follows: ● <i>Without function</i>: No functions are assigned to the output relay. ● <i>Inactive</i>: The output relay is not energized. ● <i>Active</i>: The output relay is energized. This display appears regardless of the operating mode set for the output relay.							

LED indicators

Parameter					Address
Default	Min	Max	Unit		Logic Diagram
LED: State H 1 green					085 180
1: Active					
LED: State H 3 yell.					085 003
0: Inactive					
LED: State H 4 red					085 006
0: Inactive					
LED: State H 5 red					085 009
0: Inactive					
LED: State H 6 red					085 012
0: Inactive					
LED: State H 7 red					085 015
0: Inactive					
LED: State H 8 red					085 018
0: Inactive					
LED: State H 9 red					085 021
0: Inactive					
LED: State H10 red					085 024
0: Inactive					
LED: State H11 red					085 027
0: Inactive					
LED: State H12 red					085 030
0: Inactive					
LED: State H13 red					085 033
0: Inactive					
LED: State H14 red					085 036
0: Inactive					
LED: State H15 red					085 039
0: Inactive					
LED: State H16 red					085 042
0: Inactive					
LED: State H17 red.					085 181
0: Inactive					
LED: State H18 red					085 130
0: Inactive					
LED: State H19 red					085 133
0: Inactive					
LED: State H20 red					085 136
0: Inactive					

Parameter					Address		
Default	Min	Max	Unit		Logic Diagram		
LED: State H21 red							085 139
0: Inactive							
LED: State H22 red							085 142
0: Inactive							
LED: State H23 red							085 145
0: Inactive							
LED: State H 4 green							085 056
0: Inactive							
LED: State H 5 green							085 059
0: Inactive							
LED: State H 6 green							085 062
0: Inactive							
LED: State H 7 green							085 065
0: Inactive							
LED: State H 8 green							085 068
0: Inactive							
LED: State H 9 green							085 071
0: Inactive							
LED: State H10 green							085 074
0: Inactive							
LED: State H11 green							085 077
0: Inactive							
LED: State H12 green							085 080
0: Inactive							
LED: State H13 green							085 083
0: Inactive							
LED: State H14 green							085 086
0: Inactive							
LED: State H15 green							085 089
0: Inactive							
LED: State H16 green							085 092
0: Inactive							
LED: State H18 green							085 160
0: Inactive							
LED: State H19 green							085 163
0: Inactive							
LED: State H20 green							085 166
0: Inactive							

Parameter				Address	
Default	Min	Max	Unit	Logic Diagram	
LED: State H21 green					085 169
0: Inactive					
LED: State H22 green					085 172
0: Inactive					
LED: State H23 green					085 176
0: Inactive					
The state of the LED indicators is displayed as follows:					
● <i>Inactive</i>: The LED indicator is not energized. ● <i>Active</i>: The LED indicator is energized.					

8.1.1.3

Logic State Signals

Cyber Security

Parameter	Address			
Default	Min	Max	Unit	Logic Diagram
CS: HMI pincode changed				180 100
0: No				
The signal shows the PIN code of HMI is changed.				
CS: COMM passw. change				180 101
0: No				
The signal shows the password of communication interface is changed.				
CS: HMI pincode invalid				180 102
0: No				
The signal shows the PIN code via HMI is invalid.				
CS: COMM passw. invalid				180 103
0: No				
The signal shows the password via communication interface is invalid.				
CS: reset token generate				180 104
0: No				
The signal shows the reset token is generated.				
CS: RBAC reset success				180 105
0: No				
Display when the RBAC reset is successful.				
CS: RBAC reset failed				180 106
0: No				
Display when the RBAC reset is failed.				
CS: User01 blocked				180 107
0: No				
CS: User02 blocked				180 108
0: No				
CS: User03 blocked				180 109
0: No				
CS: User04 blocked				180 110
0: No				
CS: User05 blocked				180 111
0: No				
CS: User06 blocked				180 112
0: No				

Parameter				Address			
Default	Min	Max	Unit	Logic Diagram			
CS: User07 blocked							180 113
0: No							
CS: User08 blocked							180 114
0: No							
CS: User09 blocked							180 115
0: No							
CS: User10 blocked							180 116
0: No							
CS: User11 blocked							180 117
0: No							
CS: User12 blocked							180 118
0: No							
CS: User13 blocked							180 119
0: No							
CS: User14 blocked							180 120
0: No							
CS: User15 blocked							180 121
0: No							
The signal shows the user is blocked.							
CS: HMI logged in							180 122
0: No							
The signal shows the user is logged in via HMI.							
CS: COMMS logged in							180 123
0: No							
The signal shows the user is logged in via communication interface.							
CS: IEC CS brick faulty							180 124
1: Yes							

Local control panel

Parameter					Address	
Default	Min	Max	Unit		Logic Diagram	
LOC: Edit mode						080 111
0: No						
Signal that the protection unit is in edit mode. As a standard this signal is linked to LED: Fct.assig. H17 red.						
LOC: Trig. menu jmp 1 EXT						030 230
0: No						
Signal that menu jump list 1 is being triggered. (See the corresponding setting at LOC: Fct. menu jmp list 1.)						
LOC: Trig. menu jmp 2 EXT						030 231
0: No						
Signal that menu jump list 2 is being triggered. (See the corresponding setting at LOC: Fct. menu jmp list 2.)						
LOC: Illumination on EXT						037 101
0: No						
This signal shows that the backlighting for the front panel LCD is switched on.						
LOC: Loc.acc.block.active						221 005
0: No					Fig. 3-9, (p. 3-16)	
LOC: Rem.acc.block.active						221 004
0: No					Fig. 3-9, (p. 3-16)	

“Logical”
communication
interface 1

Parameter				Address
Default	Min	Max	Unit	Logic Diagram
COMM1: Command block. EXT				003 173
0: No				
COMM1: Sig./meas. block EXT				037 074
0: No				
COMM1: Command blocking				003 174
0: No				Fig. 3-11, (p. 3-20)
COMM1: Sig./meas.val.block.				037 075
0: No				Fig. 3-12, (p. 3-21) Fig. 3-13, (p. 3-22) Fig. 3-14, (p. 3-23)
COMM1: IEC 870-5-103				003 219
0: No				
COMM1: IEC 870-5-101				003 218
0: No				
COMM1: IEC 870-5, ILS				003 221
0: No				
COMM1: MODBUS				003 223
0: No				
COMM1: DNP3				003 230
0: No				
COMM1: COURIER				103 041
0: No				

InterMiCOM
interface

Parameter				Address
Default	Min	Max	Unit	Logic Diagram
COMM3: Reset No.tlg.err.EXT				006 054
0: No				
COMM3: Communications fault				120 043
0: No				
COMM3: Comm. link failure				120 044
0: No				
COMM3: Lim.exceed.,tel.err.				120 045
0: No				

IRIG-B interface

Parameter					Address			
Default	Min	Max	Unit		Logic Diagram			
IRIGB: Enabled								023 201
0: No					Fig. 3-31, (p. 3-59)			
IRIGB: Synchron. ready								023 202
0: No					Fig. 3-31, (p. 3-59)			
IRIGB: EBR Synchron. ready								023 203
0: No					Fig. 3-31, (p. 3-59)			

IEC 61850
Communication

Parameter	Address			
Default	Min	Max	Unit	Logic Diagram
IEC: Command block. EXT				104 086
0: No				
IEC: Sig./meas. block EXT				104 089
0: No				
IEC: Multiple ctrl level				221 124
0: No				
Display when control from multiple levels is allowed, i.e. (225 208) LOC: Fct. assign. L/R key is set to R & L<->L, and relay is in 'R&L' mode.				
IEC: Command blocking				104 087
0: No				
IEC: Sig./meas.val.block.				104 090
0: No				
IEC: Port A/B blocked				104 075
0: No				
Display when Port A for SEB or Port A&B for REB is blocked.				
IEC: Port C blocked				104 076
0: No				
Display when Port C is blocked.				
IEC: Port A faulty				104 197
0: No				
IEC: Port B faulty				104 198
0: No				
IEC: IEC 61850 ED2				104 081
0: No				
IEC: IEC 61850 ED1				104 082
0: No				
IEC: IEC 60870-5-104				104 083
0: No				
IEC: VLAN enabled				104 196
0: No				
IEC: Comm. link faulty				105 180
0: No				
Display when an Ethernet module is not operational, i.e. if the MAC address is missing or there is a non-plausible parameter setting.				

Fig. 3-25, (p. 3-51)

Parameter				Address	
Default	Min	Max	Unit	Logic Diagram	
IEC: Control reservation					221 082
0: No					
Display when a client has made a reservation to control an external device ("select" for control by control mode "select before operate").					
IEC: Control blocked					221 126
0: No					
Display when control via communication is blocked, i.e. (221 125) IEC: Ctrl blocked user is set to Yes.					

Fig. 3-25, (p. 3-51)

Generic Object
Orientated
Substation Events

Parameter				Address
Default	Min	Max	Unit	Logic Diagram
GOOSE: IED link faulty				107 250
0: No				
Display which appears as soon as receipt of at least one of the configured GOOSEs is faulty or not available. To each GOOSE the GOOSE sending device will attach a validity stamp, up to which a repetition of GOOSE will be carried out independent of a change of state. Thus the unit monitors the time period at which the next state signal must be received.				
GOOSE: IED01-16 linked				107 251
2:				
GOOSE: IED17-32 linked				107 252
2:				
GOOSE: IED33-48 linked				112 200
2:				
GOOSE: IED49-64 linked				112 201
2:				
GOOSE: IED65-80 linked				112 202
2:				
GOOSE: IED81-96 linked				112 203
2:				
GOOSE: IED97-112 linked				112 204
2:				
GOOSE: IED113-128 linked				112 205
2:				
GOOSE: OrdRun01-16 linked				107 248
2:				
GOOSE: OrdRun17-32 linked				107 249
2:				
GOOSE: Uniqueness 1-16				007 217
Not measured	0	65535		
GOOSE: Uniqueness 17-32				007 218
Not measured	0	65535		
GOOSE: Ext.Dev01 position				109 000
0: Interm. pos.				
GOOSE: Ext.Dev02 position				109 005
0: Interm. pos.				
GOOSE: Ext.Dev03 position				109 010
0: Interm. pos.				

Parameter					Address
Default	Min	Max	Unit		Logic Diagram
GOOSE: Ext.Dev04 position					109 015
0: Interm. pos.					
GOOSE: Ext.Dev05 position					109 020
0: Interm. pos.					
GOOSE: Ext.Dev06 position					109 025
0: Interm. pos.					
GOOSE: Ext.Dev07 position					109 030
0: Interm. pos.					
GOOSE: Ext.Dev08 position					109 035
0: Interm. pos.					
GOOSE: Ext.Dev09 position					109 040
0: Interm. pos.					
GOOSE: Ext.Dev10 position					109 045
0: Interm. pos.					
GOOSE: Ext.Dev11 position					109 050
0: Interm. pos.					
GOOSE: Ext.Dev12 position					109 055
0: Interm. pos.					
GOOSE: Ext.Dev13 position					109 060
0: Interm. pos.					
GOOSE: Ext.Dev14 position					109 065
0: Interm. pos.					
GOOSE: Ext.Dev15 position					109 070
0: Interm. pos.					
GOOSE: Ext.Dev16 position					109 075
0: Interm. pos.					
GOOSE: Ext.Dev17 position					109 100
0: Interm. pos.					
GOOSE: Ext.Dev18 position					109 105
0: Interm. pos.					
GOOSE: Ext.Dev19 position					109 110
0: Interm. pos.					
GOOSE: Ext.Dev20 position					109 115
0: Interm. pos.					
GOOSE: Ext.Dev21 position					109 120
0: Interm. pos.					
GOOSE: Ext.Dev22 position					109 125
0: Interm. pos.					

Parameter				Address
Default	Min	Max	Unit	Logic Diagram
GOOSE: Ext.Dev23 position				109 130
0: Interm. pos.				
GOOSE: Ext.Dev24 position				109 135
0: Interm. pos.				
GOOSE: Ext.Dev25 position				109 140
0: Interm. pos.				
GOOSE: Ext.Dev26 position				109 145
0: Interm. pos.				
GOOSE: Ext.Dev27 position				109 150
0: Interm. pos.				
GOOSE: Ext.Dev28 position				109 155
0: Interm. pos.				
GOOSE: Ext.Dev29 position				109 160
0: Interm. pos.				
GOOSE: Ext.Dev30 position				109 165
0: Interm. pos.				
GOOSE: Ext.Dev31 position				109 170
0: Interm. pos.				
GOOSE: Ext.Dev32 position				109 175
0: Interm. pos.				
GOOSE: Ext.Dev33 position				113 000
0: Interm. pos.				
GOOSE: Ext.Dev34 position				113 004
0: Interm. pos.				
GOOSE: Ext.Dev35 position				113 008
0: Interm. pos.				
GOOSE: Ext.Dev36 position				113 012
0: Interm. pos.				
GOOSE: Ext.Dev37 position				113 016
0: Interm. pos.				
GOOSE: Ext.Dev38 position				113 020
0: Interm. pos.				
GOOSE: Ext.Dev39 position				113 024
0: Interm. pos.				
GOOSE: Ext.Dev40 position				113 028
0: Interm. pos.				
GOOSE: Ext.Dev41 position				113 032
0: Interm. pos.				

Parameter					Address
Default	Min	Max	Unit		Logic Diagram
GOOSE: Ext.Dev42 position					113 036
0: Interm. pos.					
GOOSE: Ext.Dev43 position					113 040
0: Interm. pos.					
GOOSE: Ext.Dev44 position					113 044
0: Interm. pos.					
GOOSE: Ext.Dev45 position					113 048
0: Interm. pos.					
GOOSE: Ext.Dev46 position					113 052
0: Interm. pos.					
GOOSE: Ext.Dev47 position					113 056
0: Interm. pos.					
GOOSE: Ext.Dev48 position					113 060
0: Interm. pos.					
GOOSE: Ext.Dev49 position					113 064
0: Interm. pos.					
GOOSE: Ext.Dev50 position					113 068
0: Interm. pos.					
GOOSE: Ext.Dev51 position					113 072
0: Interm. pos.					
GOOSE: Ext.Dev52 position					113 076
0: Interm. pos.					
GOOSE: Ext.Dev53 position					113 080
0: Interm. pos.					
GOOSE: Ext.Dev54 position					113 084
0: Interm. pos.					
GOOSE: Ext.Dev55 position					113 088
0: Interm. pos.					
GOOSE: Ext.Dev56 position					113 092
0: Interm. pos.					
GOOSE: Ext.Dev57 position					113 096
0: Interm. pos.					
GOOSE: Ext.Dev58 position					113 100
0: Interm. pos.					
GOOSE: Ext.Dev59 position					113 104
0: Interm. pos.					
GOOSE: Ext.Dev60 position					113 108
0: Interm. pos.					

Parameter				Address
Default	Min	Max	Unit	Logic Diagram
GOOSE: Ext.Dev61 position				113 112
0: Interm. pos.				
GOOSE: Ext.Dev62 position				113 116
0: Interm. pos.				
GOOSE: Ext.Dev63 position				113 120
0: Interm. pos.				
GOOSE: Ext.Dev64 position				113 124
0: Interm. pos.				
GOOSE: Ext.Dev65 position				113 128
0: Interm. pos.				
GOOSE: Ext.Dev66 position				113 132
0: Interm. pos.				
GOOSE: Ext.Dev67 position				113 136
0: Interm. pos.				
GOOSE: Ext.Dev68 position				113 140
0: Interm. pos.				
GOOSE: Ext.Dev69 position				113 144
0: Interm. pos.				
GOOSE: Ext.Dev70 position				113 148
0: Interm. pos.				
GOOSE: Ext.Dev71 position				113 152
0: Interm. pos.				
GOOSE: Ext.Dev72 position				113 156
0: Interm. pos.				
GOOSE: Ext.Dev73 position				113 160
0: Interm. pos.				
GOOSE: Ext.Dev74 position				113 164
0: Interm. pos.				
GOOSE: Ext.Dev75 position				113 168
0: Interm. pos.				
GOOSE: Ext.Dev76 position				113 172
0: Interm. pos.				
GOOSE: Ext.Dev77 position				113 176
0: Interm. pos.				
GOOSE: Ext.Dev78 position				113 180
0: Interm. pos.				
GOOSE: Ext.Dev79 position				113 184
0: Interm. pos.				

Parameter					Address
Default	Min	Max	Unit		Logic Diagram
GOOSE: Ext.Dev80 position					113 188
0: Interm. pos.					
GOOSE: Ext.Dev81 position					113 192
0: Interm. pos.					
GOOSE: Ext.Dev82 position					113 196
0: Interm. pos.					
GOOSE: Ext.Dev83 position					113 200
0: Interm. pos.					
GOOSE: Ext.Dev84 position					113 204
0: Interm. pos.					
GOOSE: Ext.Dev85 position					113 208
0: Interm. pos.					
GOOSE: Ext.Dev86 position					113 212
0: Interm. pos.					
GOOSE: Ext.Dev87 position					113 216
0: Interm. pos.					
GOOSE: Ext.Dev88 position					113 220
0: Interm. pos.					
GOOSE: Ext.Dev89 position					113 224
0: Interm. pos.					
GOOSE: Ext.Dev90 position					113 228
0: Interm. pos.					
GOOSE: Ext.Dev91 position					113 232
0: Interm. pos.					
GOOSE: Ext.Dev92 position					113 236
0: Interm. pos.					
GOOSE: Ext.Dev93 position					113 240
0: Interm. pos.					
GOOSE: Ext.Dev94 position					113 244
0: Interm. pos.					
GOOSE: Ext.Dev95 position					113 248
0: Interm. pos.					
GOOSE: Ext.Dev96 position					113 252
0: Interm. pos.					
GOOSE: Ext.Dev97 position					114 000
0: Interm. pos.					
GOOSE: Ext.Dev98 position					114 004
0: Interm. pos.					

Parameter				Address
Default	Min	Max	Unit	Logic Diagram
GOOSE: Ext.Dev99 position				114 008
0: Interm. pos.				
GOOSE: Ext.Dev100 position				114 012
0: Interm. pos.				
GOOSE: Ext.Dev101 position				114 016
0: Interm. pos.				
GOOSE: Ext.Dev102 position				114 020
0: Interm. pos.				
GOOSE: Ext.Dev103 position				114 024
0: Interm. pos.				
GOOSE: Ext.Dev104 position				114 028
0: Interm. pos.				
GOOSE: Ext.Dev105 position				114 032
0: Interm. pos.				
GOOSE: Ext.Dev106 position				114 036
0: Interm. pos.				
GOOSE: Ext.Dev107 position				114 040
0: Interm. pos.				
GOOSE: Ext.Dev108 position				114 044
0: Interm. pos.				
GOOSE: Ext.Dev109 position				114 048
0: Interm. pos.				
GOOSE: Ext.Dev110 position				114 052
0: Interm. pos.				
GOOSE: Ext.Dev111 position				114 056
0: Interm. pos.				
GOOSE: Ext.Dev112 position				114 060
0: Interm. pos.				
GOOSE: Ext.Dev113 position				114 064
0: Interm. pos.				
GOOSE: Ext.Dev114 position				114 068
0: Interm. pos.				
GOOSE: Ext.Dev115 position				114 072
0: Interm. pos.				
GOOSE: Ext.Dev116 position				114 076
0: Interm. pos.				
GOOSE: Ext.Dev117 position				114 080
0: Interm. pos.				

Parameter					Address	
Default	Min	Max	Unit		Logic Diagram	
GOOSE: Ext.Dev118 position					114 084	
0: Interm. pos.						
GOOSE: Ext.Dev119 position					114 088	
0: Interm. pos.						
GOOSE: Ext.Dev120 position					114 092	
0: Interm. pos.						
GOOSE: Ext.Dev121 position					114 096	
0: Interm. pos.						
GOOSE: Ext.Dev122 position					114 100	
0: Interm. pos.						
GOOSE: Ext.Dev123 position					114 104	
0: Interm. pos.						
GOOSE: Ext.Dev124 position					114 108	
0: Interm. pos.						
GOOSE: Ext.Dev125 position					114 112	
0: Interm. pos.						
GOOSE: Ext.Dev126 position					114 116	
0: Interm. pos.						
GOOSE: Ext.Dev127 position					114 120	
0: Interm. pos.						
GOOSE: Ext.Dev128 position					114 124	
0: Interm. pos.						
State of the virtual two-pole GOOSE input, representing the state of an external device.						
GOOSE: Ext.Dev01 open					109 001	
0: No						
GOOSE: Ext.Dev02 open					109 006	
0: No						
GOOSE: Ext.Dev03 open					109 011	
0: No						
GOOSE: Ext.Dev04 open					109 016	
0: No						
GOOSE: Ext.Dev05 open					109 021	
0: No						
GOOSE: Ext.Dev06 open					109 026	
0: No						
GOOSE: Ext.Dev07 open					109 031	
0: No						

Parameter					Address		
Default	Min	Max	Unit		Logic Diagram		
GOOSE: Ext.Dev08 open							109 036
0: No							
GOOSE: Ext.Dev09 open							109 041
0: No							
GOOSE: Ext.Dev10 open							109 046
0: No							
GOOSE: Ext.Dev11 open							109 051
0: No							
GOOSE: Ext.Dev12 open							109 056
0: No							
GOOSE: Ext.Dev13 open							109 061
0: No							
GOOSE: Ext.Dev14 open							109 066
0: No							
GOOSE: Ext.Dev15 open							109 071
0: No							
GOOSE: Ext.Dev16 open							109 076
0: No							
GOOSE: Ext.Dev17 open							109 101
0: No							
GOOSE: Ext.Dev18 open							109 106
0: No							
GOOSE: Ext.Dev19 open							109 111
0: No							
GOOSE: Ext.Dev20 open							109 116
0: No							
GOOSE: Ext.Dev21 open							109 121
0: No							
GOOSE: Ext.Dev22 open							109 126
0: No							
GOOSE: Ext.Dev23 open							109 131
0: No							
GOOSE: Ext.Dev24 open							109 136
0: No							
GOOSE: Ext.Dev25 open							109 141
0: No							
GOOSE: Ext.Dev26 open							109 146
0: No							

Parameter					Address		
Default	Min	Max	Unit		Logic Diagram		
GOOSE: Ext.Dev27 open							109 151
0: No							
GOOSE: Ext.Dev28 open							109 156
0: No							
GOOSE: Ext.Dev29 open							109 161
0: No							
GOOSE: Ext.Dev30 open							109 166
0: No							
GOOSE: Ext.Dev31 open							109 171
0: No							
GOOSE: Ext.Dev32 open							109 176
0: No							
GOOSE: Ext.Dev33 open							113 001
0: No							
GOOSE: Ext.Dev34 open							113 005
0: No							
GOOSE: Ext.Dev35 open							113 009
0: No							
GOOSE: Ext.Dev36 open							113 013
0: No							
GOOSE: Ext.Dev37 open							113 017
0: No							
GOOSE: Ext.Dev38 open							113 021
0: No							
GOOSE: Ext.Dev39 open							113 025
0: No							
GOOSE: Ext.Dev40 open							113 029
0: No							
GOOSE: Ext.Dev41 open							113 033
0: No							
GOOSE: Ext.Dev42 open							113 037
0: No							
GOOSE: Ext.Dev43 open							113 041
0: No							
GOOSE: Ext.Dev44 open							113 045
0: No							
GOOSE: Ext.Dev45 open							113 049
0: No							

Parameter					Address		
Default	Min	Max	Unit		Logic Diagram		
GOOSE: Ext.Dev46 open							113 053
0: No							
GOOSE: Ext.Dev47 open							113 057
0: No							
GOOSE: Ext.Dev48 open							113 061
0: No							
GOOSE: Ext.Dev49 open							113 065
0: No							
GOOSE: Ext.Dev50 open							113 069
0: No							
GOOSE: Ext.Dev51 open							113 073
0: No							
GOOSE: Ext.Dev52 open							113 077
0: No							
GOOSE: Ext.Dev53 open							113 081
0: No							
GOOSE: Ext.Dev54 open							113 085
0: No							
GOOSE: Ext.Dev55 open							113 089
0: No							
GOOSE: Ext.Dev56 open							113 093
0: No							
GOOSE: Ext.Dev57 open							113 097
0: No							
GOOSE: Ext.Dev58 open							113 101
0: No							
GOOSE: Ext.Dev59 open							113 105
0: No							
GOOSE: Ext.Dev60 open							113 109
0: No							
GOOSE: Ext.Dev61 open							113 113
0: No							
GOOSE: Ext.Dev62 open							113 117
0: No							
GOOSE: Ext.Dev63 open							113 121
0: No							
GOOSE: Ext.Dev64 open							113 125
0: No							

Parameter					Address		
Default	Min	Max	Unit		Logic Diagram		
GOOSE: Ext.Dev65 open							113 129
0: No							
GOOSE: Ext.Dev66 open							113 133
0: No							
GOOSE: Ext.Dev67 open							113 137
0: No							
GOOSE: Ext.Dev68 open							113 141
0: No							
GOOSE: Ext.Dev69 open							113 145
0: No							
GOOSE: Ext.Dev70 open							113 149
0: No							
GOOSE: Ext.Dev71 open							113 153
0: No							
GOOSE: Ext.Dev72 open							113 157
0: No							
GOOSE: Ext.Dev73 open							113 161
0: No							
GOOSE: Ext.Dev74 open							113 165
0: No							
GOOSE: Ext.Dev75 open							113 169
0: No							
GOOSE: Ext.Dev76 open							113 173
0: No							
GOOSE: Ext.Dev77 open							113 177
0: No							
GOOSE: Ext.Dev78 open							113 181
0: No							
GOOSE: Ext.Dev79 open							113 185
0: No							
GOOSE: Ext.Dev80 open							113 189
0: No							
GOOSE: Ext.Dev81 open							113 193
0: No							
GOOSE: Ext.Dev82 open							113 197
0: No							
GOOSE: Ext.Dev83 open							113 201
0: No							

Parameter					Address		
Default	Min	Max	Unit		Logic Diagram		
GOOSE: Ext.Dev84 open							113 205
0: No							
GOOSE: Ext.Dev85 open							113 209
0: No							
GOOSE: Ext.Dev86 open							113 213
0: No							
GOOSE: Ext.Dev87 open							113 217
0: No							
GOOSE: Ext.Dev88 open							113 221
0: No							
GOOSE: Ext.Dev89 open							113 225
0: No							
GOOSE: Ext.Dev90 open							113 229
0: No							
GOOSE: Ext.Dev91 open							113 233
0: No							
GOOSE: Ext.Dev92 open							113 237
0: No							
GOOSE: Ext.Dev93 open							113 241
0: No							
GOOSE: Ext.Dev94 open							113 245
0: No							
GOOSE: Ext.Dev95 open							113 249
0: No							
GOOSE: Ext.Dev96 open							113 253
0: No							
GOOSE: Ext.Dev97 open							114 001
0: No							
GOOSE: Ext.Dev98 open							114 005
0: No							
GOOSE: Ext.Dev99 open							114 009
0: No							
GOOSE: Ext.Dev100 open							114 013
0: No							
GOOSE: Ext.Dev101 open							114 017
0: No							
GOOSE: Ext.Dev102 open							114 021
0: No							

Parameter					Address		
Default	Min	Max	Unit		Logic Diagram		
GOOSE: Ext.Dev103 open							114 025
0: No							
GOOSE: Ext.Dev104 open							114 029
0: No							
GOOSE: Ext.Dev105 open							114 033
0: No							
GOOSE: Ext.Dev106 open							114 037
0: No							
GOOSE: Ext.Dev107 open							114 041
0: No							
GOOSE: Ext.Dev108 open							114 045
0: No							
GOOSE: Ext.Dev109 open							114 049
0: No							
GOOSE: Ext.Dev110 open							114 053
0: No							
GOOSE: Ext.Dev111 open							114 057
0: No							
GOOSE: Ext.Dev112 open							114 061
0: No							
GOOSE: Ext.Dev113 open							114 065
0: No							
GOOSE: Ext.Dev114 open							114 069
0: No							
GOOSE: Ext.Dev115 open							114 073
0: No							
GOOSE: Ext.Dev116 open							114 077
0: No							
GOOSE: Ext.Dev117 open							114 081
0: No							
GOOSE: Ext.Dev118 open							114 085
0: No							
GOOSE: Ext.Dev119 open							114 089
0: No							
GOOSE: Ext.Dev120 open							114 093
0: No							
GOOSE: Ext.Dev121 open							114 097
0: No							

Parameter				Address
Default	Min	Max	Unit	Logic Diagram
GOOSE: Ext.Dev122 open				114 101
0: No				
GOOSE: Ext.Dev123 open				114 105
0: No				
GOOSE: Ext.Dev124 open				114 109
0: No				
GOOSE: Ext.Dev125 open				114 113
0: No				
GOOSE: Ext.Dev126 open				114 117
0: No				
GOOSE: Ext.Dev127 open				114 121
0: No				
GOOSE: Ext.Dev128 open				114 125
0: No				
Binary open state of the virtual two-pole GOOSE input, representing the state of an external device.				
GOOSE: Ext.Dev01 closed				109 002
0: No				
GOOSE: Ext.Dev02 closed				109 007
0: No				
GOOSE: Ext.Dev03 closed				109 012
0: No				
GOOSE: Ext.Dev04 closed				109 017
0: No				
GOOSE: Ext.Dev05 closed				109 022
0: No				
GOOSE: Ext.Dev06 closed				109 027
0: No				
GOOSE: Ext.Dev07 closed				109 032
0: No				
GOOSE: Ext.Dev08 closed				109 037
0: No				
GOOSE: Ext.Dev09 closed				109 042
0: No				
GOOSE: Ext.Dev10 closed				109 047
0: No				
GOOSE: Ext.Dev11 closed				109 052
0: No				

Parameter					Address		
Default	Min	Max	Unit		Logic Diagram		
GOOSE: Ext.Dev12 closed							109 057
0: No							
GOOSE: Ext.Dev13 closed							109 062
0: No							
GOOSE: Ext.Dev14 closed							109 067
0: No							
GOOSE: Ext.Dev15 closed							109 072
0: No							
GOOSE: Ext.Dev16 closed							109 077
0: No							
GOOSE: Ext.Dev17 closed							109 102
0: No							
GOOSE: Ext.Dev18 closed							109 107
0: No							
GOOSE: Ext.Dev19 closed							109 112
0: No							
GOOSE: Ext.Dev20 closed							109 117
0: No							
GOOSE: Ext.Dev21 closed							109 122
0: No							
GOOSE: Ext.Dev22 closed							109 127
0: No							
GOOSE: Ext.Dev23 closed							109 132
0: No							
GOOSE: Ext.Dev24 closed							109 137
0: No							
GOOSE: Ext.Dev25 closed							109 142
0: No							
GOOSE: Ext.Dev26 closed							109 147
0: No							
GOOSE: Ext.Dev27 closed							109 152
0: No							
GOOSE: Ext.Dev28 closed							109 157
0: No							
GOOSE: Ext.Dev29 closed							109 162
0: No							
GOOSE: Ext.Dev30 closed							109 167
0: No							

Parameter					Address
Default	Min	Max	Unit		Logic Diagram
GOOSE: Ext.Dev31 closed					109 172
0: No					
GOOSE: Ext.Dev32 closed					109 177
0: No					
GOOSE: Ext.Dev33 closed					113 002
0: No					
GOOSE: Ext.Dev34 closed					113 006
0: No					
GOOSE: Ext.Dev35 closed					113 010
0: No					
GOOSE: Ext.Dev36 closed					113 014
0: No					
GOOSE: Ext.Dev37 closed					113 018
0: No					
GOOSE: Ext.Dev38 closed					113 022
0: No					
GOOSE: Ext.Dev39 closed					113 026
0: No					
GOOSE: Ext.Dev40 closed					113 030
0: No					
GOOSE: Ext.Dev41 closed					113 034
0: No					
GOOSE: Ext.Dev42 closed					113 038
0: No					
GOOSE: Ext.Dev43 closed					113 042
0: No					
GOOSE: Ext.Dev44 closed					113 046
0: No					
GOOSE: Ext.Dev45 closed					113 050
0: No					
GOOSE: Ext.Dev46 closed					113 054
0: No					
GOOSE: Ext.Dev47 closed					113 058
0: No					
GOOSE: Ext.Dev48 closed					113 062
0: No					
GOOSE: Ext.Dev49 closed					113 066
0: No					

Parameter					Address
Default	Min	Max	Unit		Logic Diagram
GOOSE: Ext.Dev50 closed					113 070
0: No					
GOOSE: Ext.Dev51 closed					113 074
0: No					
GOOSE: Ext.Dev52 closed					113 078
0: No					
GOOSE: Ext.Dev53 closed					113 082
0: No					
GOOSE: Ext.Dev54 closed					113 086
0: No					
GOOSE: Ext.Dev55 closed					113 090
0: No					
GOOSE: Ext.Dev56 closed					113 094
0: No					
GOOSE: Ext.Dev57 closed					113 098
0: No					
GOOSE: Ext.Dev58 closed					113 102
0: No					
GOOSE: Ext.Dev59 closed					113 106
0: No					
GOOSE: Ext.Dev60 closed					113 110
0: No					
GOOSE: Ext.Dev61 closed					113 114
0: No					
GOOSE: Ext.Dev62 closed					113 118
0: No					
GOOSE: Ext.Dev63 closed					113 122
0: No					
GOOSE: Ext.Dev64 closed					113 126
0: No					
GOOSE: Ext.Dev65 closed					113 130
0: No					
GOOSE: Ext.Dev66 closed					113 134
0: No					
GOOSE: Ext.Dev67 closed					113 138
0: No					
GOOSE: Ext.Dev68 closed					113 142
0: No					

Parameter					Address
Default	Min	Max	Unit		Logic Diagram
GOOSE: Ext.Dev69 closed					113 146
0: No					
GOOSE: Ext.Dev70 closed					113 150
0: No					
GOOSE: Ext.Dev71 closed					113 154
0: No					
GOOSE: Ext.Dev72 closed					113 158
0: No					
GOOSE: Ext.Dev73 closed					113 162
0: No					
GOOSE: Ext.Dev74 closed					113 166
0: No					
GOOSE: Ext.Dev75 closed					113 170
0: No					
GOOSE: Ext.Dev76 closed					113 174
0: No					
GOOSE: Ext.Dev77 closed					113 178
0: No					
GOOSE: Ext.Dev78 closed					113 182
0: No					
GOOSE: Ext.Dev79 closed					113 186
0: No					
GOOSE: Ext.Dev80 closed					113 190
0: No					
GOOSE: Ext.Dev81 closed					113 194
0: No					
GOOSE: Ext.Dev82 closed					113 198
0: No					
GOOSE: Ext.Dev83 closed					113 202
0: No					
GOOSE: Ext.Dev84 closed					113 206
0: No					
GOOSE: Ext.Dev85 closed					113 210
0: No					
GOOSE: Ext.Dev86 closed					113 214
0: No					
GOOSE: Ext.Dev87 closed					113 218
0: No					

Parameter					Address		
Default	Min	Max	Unit		Logic Diagram		
GOOSE: Ext.Dev88 closed							113 222
0: No							
GOOSE: Ext.Dev89 closed							113 226
0: No							
GOOSE: Ext.Dev90 closed							113 230
0: No							
GOOSE: Ext.Dev91 closed							113 234
0: No							
GOOSE: Ext.Dev92 closed							113 238
0: No							
GOOSE: Ext.Dev93 closed							113 242
0: No							
GOOSE: Ext.Dev94 closed							113 246
0: No							
GOOSE: Ext.Dev95 closed							113 250
0: No							
GOOSE: Ext.Dev96 closed							113 254
0: No							
GOOSE: Ext.Dev97 closed							114 002
0: No							
GOOSE: Ext.Dev98 closed							114 006
0: No							
GOOSE: Ext.Dev99 closed							114 010
0: No							
GOOSE: Ext.Dev100 closed							114 014
0: No							
GOOSE: Ext.Dev101 closed							114 018
0: No							
GOOSE: Ext.Dev102 closed							114 022
0: No							
GOOSE: Ext.Dev103 closed							114 026
0: No							
GOOSE: Ext.Dev104 closed							114 030
0: No							
GOOSE: Ext.Dev105 closed							114 034
0: No							
GOOSE: Ext.Dev106 closed							114 038
0: No							

Parameter				Address
Default	Min	Max	Unit	Logic Diagram
GOOSE: Ext.Dev107 closed				114 042
0: No				
GOOSE: Ext.Dev108 closed				114 046
0: No				
GOOSE: Ext.Dev109 closed				114 050
0: No				
GOOSE: Ext.Dev110 closed				114 054
0: No				
GOOSE: Ext.Dev111 closed				114 058
0: No				
GOOSE: Ext.Dev112 closed				114 062
0: No				
GOOSE: Ext.Dev113 closed				114 066
0: No				
GOOSE: Ext.Dev114 closed				114 070
0: No				
GOOSE: Ext.Dev115 closed				114 074
0: No				
GOOSE: Ext.Dev116 closed				114 078
0: No				
GOOSE: Ext.Dev117 closed				114 082
0: No				
GOOSE: Ext.Dev118 closed				114 086
0: No				
GOOSE: Ext.Dev119 closed				114 090
0: No				
GOOSE: Ext.Dev120 closed				114 094
0: No				
GOOSE: Ext.Dev121 closed				114 098
0: No				
GOOSE: Ext.Dev122 closed				114 102
0: No				
GOOSE: Ext.Dev123 closed				114 106
0: No				
GOOSE: Ext.Dev124 closed				114 110
0: No				
GOOSE: Ext.Dev125 closed				114 114
0: No				

Parameter				Address
Default	Min	Max	Unit	Logic Diagram
GOOSE: Ext.Dev126 closed				114 118
0: No				
GOOSE: Ext.Dev127 closed				114 122
0: No				
GOOSE: Ext.Dev128 closed				114 126
0: No				
Binary closed state of the virtual two-pole GOOSE input, representing the state of an external device.				
GOOSE: Ext.Dev01 interm.pos				109 003
0: No				
GOOSE: Ext.Dev02 interm.pos				109 008
0: No				
GOOSE: Ext.Dev03 interm.pos				109 013
0: No				
GOOSE: Ext.Dev04 interm.pos				109 018
0: No				
GOOSE: Ext.Dev05 interm.pos				109 023
0: No				
GOOSE: Ext.Dev06 interm.pos				109 028
0: No				
GOOSE: Ext.Dev07 interm.pos				109 033
0: No				
GOOSE: Ext.Dev08 interm.pos				109 038
0: No				
GOOSE: Ext.Dev09 interm.pos				109 043
0: No				
GOOSE: Ext.Dev10 interm.pos				109 048
0: No				
GOOSE: Ext.Dev11 interm.pos				109 053
0: No				
GOOSE: Ext.Dev12 interm.pos				109 058
0: No				
GOOSE: Ext.Dev13 interm.pos				109 063
0: No				
GOOSE: Ext.Dev14 interm.pos				109 068
0: No				
GOOSE: Ext.Dev15 interm.pos				109 073
0: No				

Parameter				Address
Default	Min	Max	Unit	Logic Diagram
GOOSE: Ext.Dev16 interm.pos				109 078
0: No				
GOOSE: Ext.Dev17 interm.pos				109 103
0: No				
GOOSE: Ext.Dev18 interm.pos				109 108
0: No				
GOOSE: Ext.Dev19 interm.pos				109 113
0: No				
GOOSE: Ext.Dev20 interm.pos				109 118
0: No				
GOOSE: Ext.Dev21 interm.pos				109 123
0: No				
GOOSE: Ext.Dev22 interm.pos				109 128
0: No				
GOOSE: Ext.Dev23 interm.pos				109 133
0: No				
GOOSE: Ext.Dev24 interm.pos				109 138
0: No				
GOOSE: Ext.Dev25 interm.pos				109 143
0: No				
GOOSE: Ext.Dev26 interm.pos				109 148
0: No				
GOOSE: Ext.Dev27 interm.pos				109 153
0: No				
GOOSE: Ext.Dev28 interm.pos				109 158
0: No				
GOOSE: Ext.Dev29 interm.pos				109 163
0: No				
GOOSE: Ext.Dev30 interm.pos				109 168
0: No				
GOOSE: Ext.Dev31 interm.pos				109 173
0: No				
GOOSE: Ext.Dev32 interm.pos				109 178
0: No				
GOOSE: Ext.Dev33 interm.pos				113 003
0: No				
GOOSE: Ext.Dev34 interm.pos				113 007
0: No				

Parameter					Address	
Default	Min	Max	Unit		Logic Diagram	
GOOSE: Ext.Dev35 interm.pos					113 011	
0: No						
GOOSE: Ext.Dev36 interm.pos					113 015	
0: No						
GOOSE: Ext.Dev37 interm.pos					113 019	
0: No						
GOOSE: Ext.Dev38 interm.pos					113 023	
0: No						
GOOSE: Ext.Dev39 interm.pos					113 027	
0: No						
GOOSE: Ext.Dev40 interm.pos					113 031	
0: No						
GOOSE: Ext.Dev41 interm.pos					113 035	
0: No						
GOOSE: Ext.Dev42 interm.pos					113 039	
0: No						
GOOSE: Ext.Dev43 interm.pos					113 043	
0: No						
GOOSE: Ext.Dev44 interm.pos					113 047	
0: No						
GOOSE: Ext.Dev45 interm.pos					113 051	
0: No						
GOOSE: Ext.Dev46 interm.pos					113 055	
0: No						
GOOSE: Ext.Dev47 interm.pos					113 059	
0: No						
GOOSE: Ext.Dev48 interm.pos					113 063	
0: No						
GOOSE: Ext.Dev49 interm.pos					113 067	
0: No						
GOOSE: Ext.Dev50 interm.pos					113 071	
0: No						
GOOSE: Ext.Dev51 interm.pos					113 075	
0: No						
GOOSE: Ext.Dev52 interm.pos					113 079	
0: No						
GOOSE: Ext.Dev53 interm.pos					113 083	
0: No						

Parameter				Address
Default	Min	Max	Unit	Logic Diagram
GOOSE: Ext.Dev54 interm.pos				113 087
0: No				
GOOSE: Ext.Dev55 interm.pos				113 091
0: No				
GOOSE: Ext.Dev56 interm.pos				113 095
0: No				
GOOSE: Ext.Dev57 interm.pos				113 099
0: No				
GOOSE: Ext.Dev58 interm.pos				113 103
0: No				
GOOSE: Ext.Dev59 interm.pos				113 107
0: No				
GOOSE: Ext.Dev60 interm.pos				113 111
0: No				
GOOSE: Ext.Dev61 interm.pos				113 115
0: No				
GOOSE: Ext.Dev62 interm.pos				113 119
0: No				
GOOSE: Ext.Dev63 interm.pos				113 123
0: No				
GOOSE: Ext.Dev64 interm.pos				113 127
0: No				
GOOSE: Ext.Dev65 interm.pos				113 131
0: No				
GOOSE: Ext.Dev66 interm.pos				113 135
0: No				
GOOSE: Ext.Dev67 interm.pos				113 139
0: No				
GOOSE: Ext.Dev68 interm.pos				113 143
0: No				
GOOSE: Ext.Dev69 interm.pos				113 147
0: No				
GOOSE: Ext.Dev70 interm.pos				113 151
0: No				
GOOSE: Ext.Dev71 interm.pos				113 155
0: No				
GOOSE: Ext.Dev72 interm.pos				113 159
0: No				

Parameter					Address	
Default	Min	Max	Unit		Logic Diagram	
GOOSE: Ext.Dev73 interm.pos					113	163
0: No						
GOOSE: Ext.Dev74 interm.pos					113	167
0: No						
GOOSE: Ext.Dev75 interm.pos					113	171
0: No						
GOOSE: Ext.Dev76 interm.pos					113	175
0: No						
GOOSE: Ext.Dev77 interm.pos					113	179
0: No						
GOOSE: Ext.Dev78 interm.pos					113	183
0: No						
GOOSE: Ext.Dev79 interm.pos					113	187
0: No						
GOOSE: Ext.Dev80 interm.pos					113	191
0: No						
GOOSE: Ext.Dev81 interm.pos					113	195
0: No						
GOOSE: Ext.Dev82 interm.pos					113	199
0: No						
GOOSE: Ext.Dev83 interm.pos					113	203
0: No						
GOOSE: Ext.Dev84 interm.pos					113	207
0: No						
GOOSE: Ext.Dev85 interm.pos					113	211
0: No						
GOOSE: Ext.Dev86 interm.pos					113	215
0: No						
GOOSE: Ext.Dev87 interm.pos					113	219
0: No						
GOOSE: Ext.Dev88 interm.pos					113	223
0: No						
GOOSE: Ext.Dev89 interm.pos					113	227
0: No						
GOOSE: Ext.Dev90 interm.pos					113	231
0: No						
GOOSE: Ext.Dev91 interm.pos					113	235
0: No						

Parameter				Address
Default	Min	Max	Unit	Logic Diagram
GOOSE: Ext.Dev92 interm.pos				113 239
0: No				
GOOSE: Ext.Dev93 interm.pos				113 243
0: No				
GOOSE: Ext.Dev94 interm.pos				113 247
0: No				
GOOSE: Ext.Dev95 interm.pos				113 251
0: No				
GOOSE: Ext.Dev96 interm.pos				113 255
0: No				
GOOSE: Ext.Dev97 interm.pos				114 003
0: No				
GOOSE: Ext.Dev98 interm.pos				114 007
0: No				
GOOSE: Ext.Dev99 interm.pos				114 011
0: No				
GOOSE: Ext.Dev100 interm.po				114 015
0: No				
GOOSE: Ext.Dev101 interm.po				114 019
0: No				
GOOSE: Ext.Dev102 interm.po				114 023
0: No				
GOOSE: Ext.Dev103 interm.po				114 027
0: No				
GOOSE: Ext.Dev104 interm.po				114 031
0: No				
GOOSE: Ext.Dev105 interm.po				114 035
0: No				
GOOSE: Ext.Dev106 interm.po				114 039
0: No				
GOOSE: Ext.Dev107 interm.po				114 043
0: No				
GOOSE: Ext.Dev108 interm.po				114 047
0: No				
GOOSE: Ext.Dev109 interm.po				114 051
0: No				
GOOSE: Ext.Dev110 interm.po				114 055
0: No				

Parameter					Address	
Default	Min	Max	Unit		Logic Diagram	
GOOSE: Ext.Dev111 interm.po					114 059	
0: No						
GOOSE: Ext.Dev112 interm.po					114 063	
0: No						
GOOSE: Ext.Dev113 interm.po					114 067	
0: No						
GOOSE: Ext.Dev114 interm.po					114 071	
0: No						
GOOSE: Ext.Dev115 interm.po					114 075	
0: No						
GOOSE: Ext.Dev116 interm.po					114 079	
0: No						
GOOSE: Ext.Dev117 interm.po					114 083	
0: No						
GOOSE: Ext.Dev118 interm.po					114 087	
0: No						
GOOSE: Ext.Dev119 interm.po					114 091	
0: No						
GOOSE: Ext.Dev120 interm.po					114 095	
0: No						
GOOSE: Ext.Dev121 interm.po					114 099	
0: No						
GOOSE: Ext.Dev122 interm.po					114 103	
0: No						
GOOSE: Ext.Dev123 interm.po					114 107	
0: No						
GOOSE: Ext.Dev124 interm.po					114 111	
0: No						
GOOSE: Ext.Dev125 interm.po					114 115	
0: No						
GOOSE: Ext.Dev126 interm.po					114 119	
0: No						
GOOSE: Ext.Dev127 interm.po					114 123	
0: No						
GOOSE: Ext.Dev128 interm.po					114 127	
0: No						
Binary intermediate position state of the virtual two-pole GOOSE input, representing the state of an external device.						

Parameter				Address
Default	Min	Max	Unit	Logic Diagram
GOOSE: Input 01 faulty				111 100
0: No				
GOOSE: Input 02 faulty				111 101
0: No				
GOOSE: Input 03 faulty				111 102
0: No				
GOOSE: Input 04 faulty				111 103
0: No				
GOOSE: Input 05 faulty				111 104
0: No				
GOOSE: Input 06 faulty				111 105
0: No				
GOOSE: Input 07 faulty				111 106
0: No				
GOOSE: Input 08 faulty				111 107
0: No				
GOOSE: Input 09 faulty				111 108
0: No				
GOOSE: Input 10 faulty				111 109
0: No				
GOOSE: Input 11 faulty				111 110
0: No				
GOOSE: Input 12 faulty				111 111
0: No				
GOOSE: Input 13 faulty				111 112
0: No				
GOOSE: Input 14 faulty				111 113
0: No				
GOOSE: Input 15 faulty				111 114
0: No				
GOOSE: Input 16 faulty				111 115
0: No				
GOOSE: Input 17 faulty				111 116
0: No				
GOOSE: Input 18 faulty				111 117
0: No				
GOOSE: Input 19 faulty				111 118
0: No				

Parameter					Address		
Default	Min	Max	Unit		Logic Diagram		
GOOSE: Input 20 faulty							111 119
0: No							
GOOSE: Input 21 faulty							111 120
0: No							
GOOSE: Input 22 faulty							111 121
0: No							
GOOSE: Input 23 faulty							111 122
0: No							
GOOSE: Input 24 faulty							111 123
0: No							
GOOSE: Input 25 faulty							111 124
0: No							
GOOSE: Input 26 faulty							111 125
0: No							
GOOSE: Input 27 faulty							111 126
0: No							
GOOSE: Input 28 faulty							111 127
0: No							
GOOSE: Input 29 faulty							111 128
0: No							
GOOSE: Input 30 faulty							111 129
0: No							
GOOSE: Input 31 faulty							111 130
0: No							
GOOSE: Input 32 faulty							111 131
0: No							
GOOSE: Input 33 faulty							111 132
0: No							
GOOSE: Input 34 faulty							111 133
0: No							
GOOSE: Input 35 faulty							111 134
0: No							
GOOSE: Input 36 faulty							111 135
0: No							
GOOSE: Input 37 faulty							111 136
0: No							
GOOSE: Input 38 faulty							111 137
0: No							

Parameter				Address
Default	Min	Max	Unit	Logic Diagram
GOOSE: Input 39 faulty				111 138
0: No				
GOOSE: Input 40 faulty				111 139
0: No				
GOOSE: Input 41 faulty				111 140
0: No				
GOOSE: Input 42 faulty				111 141
0: No				
GOOSE: Input 43 faulty				111 142
0: No				
GOOSE: Input 44 faulty				111 143
0: No				
GOOSE: Input 45 faulty				111 144
0: No				
GOOSE: Input 46 faulty				111 145
0: No				
GOOSE: Input 47 faulty				111 146
0: No				
GOOSE: Input 48 faulty				111 147
0: No				
GOOSE: Input 49 faulty				111 148
0: No				
GOOSE: Input 50 faulty				111 149
0: No				
GOOSE: Input 51 faulty				111 150
0: No				
GOOSE: Input 52 faulty				111 151
0: No				
GOOSE: Input 53 faulty				111 152
0: No				
GOOSE: Input 54 faulty				111 153
0: No				
GOOSE: Input 55 faulty				111 154
0: No				
GOOSE: Input 56 faulty				111 155
0: No				
GOOSE: Input 57 faulty				111 156
0: No				

Parameter					Address		
Default	Min	Max	Unit		Logic Diagram		
GOOSE: Input 58 faulty							111 157
0: No							
GOOSE: Input 59 faulty							111 158
0: No							
GOOSE: Input 60 faulty							111 159
0: No							
GOOSE: Input 61 faulty							111 160
0: No							
GOOSE: Input 62 faulty							111 161
0: No							
GOOSE: Input 63 faulty							111 162
0: No							
GOOSE: Input 64 faulty							111 163
0: No							
GOOSE: Input 65 faulty							111 164
0: No							
GOOSE: Input 66 faulty							111 165
0: No							
GOOSE: Input 67 faulty							111 166
0: No							
GOOSE: Input 68 faulty							111 167
0: No							
GOOSE: Input 69 faulty							111 168
0: No							
GOOSE: Input 70 faulty							111 169
0: No							
GOOSE: Input 71 faulty							111 170
0: No							
GOOSE: Input 72 faulty							111 171
0: No							
GOOSE: Input 73 faulty							111 172
0: No							
GOOSE: Input 74 faulty							111 173
0: No							
GOOSE: Input 75 faulty							111 174
0: No							
GOOSE: Input 76 faulty							111 175
0: No							

Parameter				Address
Default	Min	Max	Unit	Logic Diagram
GOOSE: Input 77 faulty				111 176
0: No				
GOOSE: Input 78 faulty				111 177
0: No				
GOOSE: Input 79 faulty				111 178
0: No				
GOOSE: Input 80 faulty				111 179
0: No				
GOOSE: Input 81 faulty				111 180
0: No				
GOOSE: Input 82 faulty				111 181
0: No				
GOOSE: Input 83 faulty				111 182
0: No				
GOOSE: Input 84 faulty				111 183
0: No				
GOOSE: Input 85 faulty				111 184
0: No				
GOOSE: Input 86 faulty				111 185
0: No				
GOOSE: Input 87 faulty				111 186
0: No				
GOOSE: Input 88 faulty				111 187
0: No				
GOOSE: Input 89 faulty				111 188
0: No				
GOOSE: Input 90 faulty				111 189
0: No				
GOOSE: Input 91 faulty				111 190
0: No				
GOOSE: Input 92 faulty				111 191
0: No				
GOOSE: Input 93 faulty				111 192
0: No				
GOOSE: Input 94 faulty				111 193
0: No				
GOOSE: Input 95 faulty				111 194
0: No				

Parameter					Address		
Default	Min	Max	Unit		Logic Diagram		
GOOSE: Input 96 faulty							111 195
0: No							
GOOSE: Input 97 faulty							111 196
0: No							
GOOSE: Input 98 faulty							111 197
0: No							
GOOSE: Input 99 faulty							111 198
0: No							
GOOSE: Input 100 faulty							111 199
0: No							
GOOSE: Input 101 faulty							111 200
0: No							
GOOSE: Input 102 faulty							111 201
0: No							
GOOSE: Input 103 faulty							111 202
0: No							
GOOSE: Input 104 faulty							111 203
0: No							
GOOSE: Input 105 faulty							111 204
0: No							
GOOSE: Input 106 faulty							111 205
0: No							
GOOSE: Input 107 faulty							111 206
0: No							
GOOSE: Input 108 faulty							111 207
0: No							
GOOSE: Input 109 faulty							111 208
0: No							
GOOSE: Input 110 faulty							111 209
0: No							
GOOSE: Input 111 faulty							111 210
0: No							
GOOSE: Input 112 faulty							111 211
0: No							
GOOSE: Input 113 faulty							111 212
0: No							
GOOSE: Input 114 faulty							111 213
0: No							

Parameter				Address
Default	Min	Max	Unit	Logic Diagram
GOOSE: Input 115 faulty				111 214
0: No				
GOOSE: Input 116 faulty				111 215
0: No				
GOOSE: Input 117 faulty				111 216
0: No				
GOOSE: Input 118 faulty				111 217
0: No				
GOOSE: Input 119 faulty				111 218
0: No				
GOOSE: Input 120 faulty				111 219
0: No				
GOOSE: Input 121 faulty				111 220
0: No				
GOOSE: Input 122 faulty				111 221
0: No				
GOOSE: Input 123 faulty				111 222
0: No				
GOOSE: Input 124 faulty				111 223
0: No				
GOOSE: Input 125 faulty				111 224
0: No				
GOOSE: Input 126 faulty				111 225
0: No				
GOOSE: Input 127 faulty				111 226
0: No				
GOOSE: Input 128 faulty				111 227
0: No				
GOOSE: Input 01 state				106 200
0: 0				
GOOSE: Input 02 state				106 201
0: 0				
GOOSE: Input 03 state				106 202
0: 0				
GOOSE: Input 04 state				106 203
0: 0				
GOOSE: Input 05 state				106 204
0: 0				

Parameter					Address		
Default	Min	Max	Unit		Logic Diagram		
GOOSE: Input 06 state							106 205
0: 0							
GOOSE: Input 07 state							106 206
0: 0							
GOOSE: Input 08 state							106 207
0: 0							
GOOSE: Input 09 state							106 208
0: 0							
GOOSE: Input 10 state							106 209
0: 0							
GOOSE: Input 11 state							106 210
0: 0							
GOOSE: Input 12 state							106 211
0: 0							
GOOSE: Input 13 state							106 212
0: 0							
GOOSE: Input 14 state							106 213
0: 0							
GOOSE: Input 15 state							106 214
0: 0							
GOOSE: Input 16 state							106 215
0: 0							
GOOSE: Input 17 state							106 216
0: 0							
GOOSE: Input 18 state							106 217
0: 0							
GOOSE: Input 19 state							106 218
0: 0							
GOOSE: Input 20 state							106 219
0: 0							
GOOSE: Input 21 state							106 220
0: 0							
GOOSE: Input 22 state							106 221
0: 0							
GOOSE: Input 23 state							106 222
0: 0							
GOOSE: Input 24 state							106 223
0: 0							

Parameter				Address
Default	Min	Max	Unit	Logic Diagram
GOOSE: Input 25 state				106 224
0: 0				
GOOSE: Input 26 state				106 225
0: 0				
GOOSE: Input 27 state				106 226
0: 0				
GOOSE: Input 28 state				106 227
0: 0				
GOOSE: Input 29 state				106 228
0: 0				
GOOSE: Input 30 state				106 229
0: 0				
GOOSE: Input 31 state				106 230
0: 0				
GOOSE: Input 32 state				106 231
0: 0				
GOOSE: Input 33 state				112 100
0: 0				
GOOSE: Input 34 state				112 101
0: 0				
GOOSE: Input 35 state				112 102
0: 0				
GOOSE: Input 36 state				112 103
0: 0				
GOOSE: Input 37 state				112 104
0: 0				
GOOSE: Input 38 state				112 105
0: 0				
GOOSE: Input 39 state				112 106
0: 0				
GOOSE: Input 40 state				112 107
0: 0				
GOOSE: Input 41 state				112 108
0: 0				
GOOSE: Input 42 state				112 109
0: 0				
GOOSE: Input 43 state				112 110
0: 0				

Parameter					Address		
Default	Min	Max	Unit		Logic Diagram		
GOOSE: Input 44 state					112	111	
0: 0							
GOOSE: Input 45 state					112	112	
0: 0							
GOOSE: Input 46 state					112	113	
0: 0							
GOOSE: Input 47 state					112	114	
0: 0							
GOOSE: Input 48 state					112	115	
0: 0							
GOOSE: Input 49 state					112	116	
0: 0							
GOOSE: Input 50 state					112	117	
0: 0							
GOOSE: Input 51 state					112	118	
0: 0							
GOOSE: Input 52 state					112	119	
0: 0							
GOOSE: Input 53 state					112	120	
0: 0							
GOOSE: Input 54 state					112	121	
0: 0							
GOOSE: Input 55 state					112	122	
0: 0							
GOOSE: Input 56 state					112	123	
0: 0							
GOOSE: Input 57 state					112	124	
0: 0							
GOOSE: Input 58 state					112	125	
0: 0							
GOOSE: Input 59 state					112	126	
0: 0							
GOOSE: Input 60 state					112	127	
0: 0							
GOOSE: Input 61 state					112	128	
0: 0							
GOOSE: Input 62 state					112	129	
0: 0							

Parameter				Address
Default	Min	Max	Unit	Logic Diagram
GOOSE: Input 63 state				112 130
0: 0				
GOOSE: Input 64 state				112 131
0: 0				
GOOSE: Input 65 state				112 132
0: 0				
GOOSE: Input 66 state				112 133
0: 0				
GOOSE: Input 67 state				112 134
0: 0				
GOOSE: Input 68 state				112 135
0: 0				
GOOSE: Input 69 state				112 136
0: 0				
GOOSE: Input 70 state				112 137
0: 0				
GOOSE: Input 71 state				112 138
0: 0				
GOOSE: Input 72 state				112 139
0: 0				
GOOSE: Input 73 state				112 140
0: 0				
GOOSE: Input 74 state				112 141
0: 0				
GOOSE: Input 75 state				112 142
0: 0				
GOOSE: Input 76 state				112 143
0: 0				
GOOSE: Input 77 state				112 144
0: 0				
GOOSE: Input 78 state				112 145
0: 0				
GOOSE: Input 79 state				112 146
0: 0				
GOOSE: Input 80 state				112 147
0: 0				
GOOSE: Input 81 state				112 148
0: 0				

Parameter					Address		
Default	Min	Max	Unit		Logic Diagram		
GOOSE: Input 82 state							112 149
0: 0							
GOOSE: Input 83 state							112 150
0: 0							
GOOSE: Input 84 state							112 151
0: 0							
GOOSE: Input 85 state							112 152
0: 0							
GOOSE: Input 86 state							112 153
0: 0							
GOOSE: Input 87 state							112 154
0: 0							
GOOSE: Input 88 state							112 155
0: 0							
GOOSE: Input 89 state							112 156
0: 0							
GOOSE: Input 90 state							112 157
0: 0							
GOOSE: Input 91 state							112 158
0: 0							
GOOSE: Input 92 state							112 159
0: 0							
GOOSE: Input 93 state							112 160
0: 0							
GOOSE: Input 94 state							112 161
0: 0							
GOOSE: Input 95 state							112 162
0: 0							
GOOSE: Input 96 state							112 163
0: 0							
GOOSE: Input 97 state							112 164
0: 0							
GOOSE: Input 98 state							112 165
0: 0							
GOOSE: Input 99 state							112 166
0: 0							
GOOSE: Input 100 state							112 167
0: 0							

Parameter				Address
Default	Min	Max	Unit	Logic Diagram
GOOSE: Input 101 state				112 168
0: 0				
GOOSE: Input 102 state				112 169
0: 0				
GOOSE: Input 103 state				112 170
0: 0				
GOOSE: Input 104 state				112 171
0: 0				
GOOSE: Input 105 state				112 172
0: 0				
GOOSE: Input 106 state				112 173
0: 0				
GOOSE: Input 107 state				112 174
0: 0				
GOOSE: Input 108 state				112 175
0: 0				
GOOSE: Input 109 state				112 176
0: 0				
GOOSE: Input 110 state				112 177
0: 0				
GOOSE: Input 111 state				112 178
0: 0				
GOOSE: Input 112 state				112 179
0: 0				
GOOSE: Input 113 state				112 180
0: 0				
GOOSE: Input 114 state				112 181
0: 0				
GOOSE: Input 115 state				112 182
0: 0				
GOOSE: Input 116 state				112 183
0: 0				
GOOSE: Input 117 state				112 184
0: 0				
GOOSE: Input 118 state				112 185
0: 0				
GOOSE: Input 119 state				112 186
0: 0				

Parameter					Address		
Default	Min	Max	Unit		Logic Diagram		
GOOSE: Input 120 state							112 187
0: 0							
GOOSE: Input 121 state							112 188
0: 0							
GOOSE: Input 122 state							112 189
0: 0							
GOOSE: Input 123 state							112 190
0: 0							
GOOSE: Input 124 state							112 191
0: 0							
GOOSE: Input 125 state							112 192
0: 0							
GOOSE: Input 126 state							112 193
0: 0							
GOOSE: Input 127 state							112 194
0: 0							
GOOSE: Input 128 state							112 195
0: 0							
Display of the virtual binary GOOSE input state.							

Virtual Inputs

Parameter					Address
Default	Min	Max	Unit		Logic Diagram
VINP: Input 1 faulty					115 080
0: No					
VINP: Input 2 faulty					115 081
0: No					
VINP: Input 3 faulty					115 082
0: No					
VINP: Input 4 faulty					115 083
0: No					
VINP: Input 5 faulty					115 084
0: No					
VINP: Input 6 faulty					115 085
0: No					
VINP: Input 7 faulty					115 086
0: No					
VINP: Input 8 faulty					115 087
0: No					
VINP: Input 9 faulty					115 088
0: No					
VINP: Input 10 faulty					115 089
0: No					
VINP: Input 11 faulty					115 090
0: No					
VINP: Input 12 faulty					115 091
0: No					
VINP: Input 13 faulty					115 092
0: No					
VINP: Input 14 faulty					115 093
0: No					
VINP: Input 15 faulty					115 094
0: No					
VINP: Input 16 faulty					115 095
0: No					
VINP: Input 17 faulty					115 096
0: No					
VINP: Input 18 faulty					115 097
0: No					
VINP: Input 19 faulty					115 098
0: No					

Parameter					Address		
Default	Min	Max	Unit		Logic Diagram		
VINP: Input 20 faulty							115 099
0: No							
VINP: Input 21 faulty							115 100
0: No							
VINP: Input 22 faulty							115 101
0: No							
VINP: Input 23 faulty							115 102
0: No							
VINP: Input 24 faulty							115 103
0: No							
VINP: Input 25 faulty							115 104
0: No							
VINP: Input 26 faulty							115 105
0: No							
VINP: Input 27 faulty							115 106
0: No							
VINP: Input 28 faulty							115 107
0: No							
VINP: Input 29 faulty							115 108
0: No							
VINP: Input 30 faulty							115 109
0: No							
VINP: Input 31 faulty							115 110
0: No							
VINP: Input 32 faulty							115 111
0: No							
VINP: Input 33 faulty							115 112
0: No							
VINP: Input 34 faulty							115 113
0: No							
VINP: Input 35 faulty							115 114
0: No							
VINP: Input 36 faulty							115 115
0: No							
VINP: Input 37 faulty							115 116
0: No							
VINP: Input 38 faulty							115 117
0: No							

Parameter				Address
Default	Min	Max	Unit	Logic Diagram
VINP: Input 39 faulty				115 118
0: No				
VINP: Input 40 faulty				115 119
0: No				
VINP: Input 41 faulty				115 120
0: No				
VINP: Input 42 faulty				115 121
0: No				
VINP: Input 43 faulty				115 122
0: No				
VINP: Input 44 faulty				115 123
0: No				
VINP: Input 45 faulty				115 124
0: No				
VINP: Input 46 faulty				115 125
0: No				
VINP: Input 47 faulty				115 126
0: No				
VINP: Input 48 faulty				115 127
0: No				
VINP: Input 49 faulty				115 128
0: No				
VINP: Input 50 faulty				115 129
0: No				
VINP: Input 51 faulty				115 130
0: No				
VINP: Input 52 faulty				115 131
0: No				
VINP: Input 53 faulty				115 132
0: No				
VINP: Input 54 faulty				115 133
0: No				
VINP: Input 55 faulty				115 134
0: No				
VINP: Input 56 faulty				115 135
0: No				
VINP: Input 57 faulty				115 136
0: No				

Parameter					Address		
Default	Min	Max	Unit		Logic Diagram		
VINP: Input 58 faulty							115 137
0: No							
VINP: Input 59 faulty							115 138
0: No							
VINP: Input 60 faulty							115 139
0: No							
VINP: Input 61 faulty							115 140
0: No							
VINP: Input 62 faulty							115 141
0: No							
VINP: Input 63 faulty							115 142
0: No							
VINP: Input 64 faulty							115 143
0: No							

Measured data input

Parameter					Address		
Default	Min	Max	Unit		Logic Diagram		
MEASI: Rst. temp. Tmax EXT							006 076
0: No							
MEASI: Enabled							035 008
0: No					Fig. 3-34, (p. 3-64) Fig. 3-42, (p. 3-73)		
MEASI: PT100 faulty							040 190
0: No					Fig. 3-39, (p. 3-69)		
MEASI: Overload 20mA input							040 191
0: No					Fig. 3-37, (p. 3-67)		
MEASI: Open circ. 20mA inp.							040 192
0: No					Fig. 3-37, (p. 3-67)		

Binary and analog
output

Parameter					Address
Default	Min	Max	Unit		Logic Diagram
OUTP: Block outp.rel. EXT					040 014
0: No					
OUTP: Reset latch. EXT					040 015
0: No					
OUTP: Outp. relays blocked					021 015
1: Yes				Fig. 3-40, (p. 3-71)	
OUTP: Latching reset					040 088
0: No				Fig. 3-40, (p. 3-71)	

Measured data
output

Parameter					Address	
Default	Min	Max	Unit		Logic Diagram	
MEASO: Outp. enabled EXT					036 085	
1: Yes						
MEASO: Reset output EXT					036 087	
0: No						
MEASO: Enabled					037 102	
0: No						
MEASO: Output reset					037 117	
0: No					Fig. 3-44, (p. 3-74)	
MEASO: Valid BCD value					037 050	
0: No					Fig. 3-46, (p. 3-78)	
MEASO: 1-digit bit 0 (BCD)					037 051	
0: No					Fig. 3-46, (p. 3-78)	
MEASO: 1-digit bit 1 (BCD)					037 052	
0: No					Fig. 3-46, (p. 3-78)	
MEASO: 1-digit bit 2 (BCD)					037 053	
0: No					Fig. 3-46, (p. 3-78)	
MEASO: 1-digit bit 3 (BCD)					037 054	
0: No					Fig. 3-46, (p. 3-78)	
MEASO: 10-digit bit 0 (BCD)					037 055	
0: No					Fig. 3-46, (p. 3-78)	
MEASO: 10-digit bit 1 (BCD)					037 056	
0: No					Fig. 3-46, (p. 3-78)	
MEASO: 10-digit bit 2 (BCD)					037 057	
0: No					Fig. 3-46, (p. 3-78)	
MEASO: 10-digit bit 3 (BCD)					037 058	
0: No					Fig. 3-46, (p. 3-78)	
MEASO: 100-dig. bit 0 (BCD)					037 059	
0: No					Fig. 3-46, (p. 3-78)	
MEASO: 100-dig. bit 1 (BCD)					037 060	
0: No					Fig. 3-46, (p. 3-78)	
MEASO: Value A-1 valid					069 014	
0: No					Fig. 3-48, (p. 3-84)	
MEASO: Value A-1 output					037 118	
0: No					Fig. 3-48, (p. 3-84)	
MEASO: Value A-2 valid					069 015	
0: No						

Parameter				Address			
Default	Min	Max	Unit	Logic Diagram			
MEASO: Value A-2 output							037 119
0: No							

Main function

Parameter	Address			
Default	Min	Max	Unit	Logic Diagram
MAIN: Enable protect. EXT				003 027
2: Not configured				
MAIN: Disable protect. EXT				003 026
2: Not configured				
MAIN: General reset EXT				005 255
0: No				
MAIN: Group reset 1 EXT				005 209
0: No				
MAIN: Group reset 2 EXT				005 252
0: No				
MAIN: Reset indicat. EXT				065 001
0: No				
MAIN: Reset latch.trip EXT				040 138
0: No				
MAIN: Reset.c.cl./tr.c EXT				005 210
0: No				
MAIN: Rst IP,max,stor. EXT				005 211
0: No				
MAIN: Rst meas.v.ener. EXT				005 212
0: No				
MAIN: CB open 3p EXT				031 028
0: No				
MAIN: CB closed 3p EXT				036 051
0: No				Fig. 3-75, (p. 3-116)
MAIN: CB closed A EXT				031 029
0: No				
MAIN: CB closed B EXT				031 030
0: No				Fig. 3-75, (p. 3-116)
MAIN: CB closed C EXT				031 031
0: No				
MAIN: CB1 faulty EXT				221 086
0: No				
MAIN: Blocking 1 EXT				040 060
0: No				
MAIN: Blocking 2 EXT				040 061
0: No				
MAIN: M.c.b. trip V EXT				004 061
0: No				

Parameter				Address
Default	Min	Max	Unit	Logic Diagram
MAIN: M.c.b. trip VNG EXT				002 183
0: No				
MAIN: M.c.b. trip Vref EXT				036 086
0: No				
MAIN: Trip cmd. block. EXT				036 045
0: No				
MAIN: Man. trip cmd. EXT				037 018
0: No				
MAIN: Man def. trip A EXT				038 030
0: No				
MAIN: Man def. trip B EXT				038 031
0: No				
MAIN: Man def. trip C EXT				038 032
0: No				
MAIN: Parallel trip EXT				037 019
0: No				
MAIN: Transfer trip. EXT				120 046
0: No				
MAIN: Man.cl.cmd.enabl.EXT				041 023
0: No				
MAIN: Man. close cmd. EXT				041 022
0: No				Fig. 3-77, (p. 3-119)
MAIN: Manual close EXT				036 047
0: No				
MAIN: Test mode EXT				037 070
0: No				
MAIN: Time switching EXT				003 096
0: Standard time				
MAIN: Min-pulse clock EXT				060 060
0: No				
MAIN: Healthy				060 001
1: Yes				
Signal that the protection unit is operational. By default this signal is linked to LED: Fct.assig. H 1 green.				
MAIN: Time synchronized				009 109
0: No				
MAIN: Blocked/faulty				004 065
1: Yes				Fig. 3-74, (p. 3-115)

Parameter				Address
Default	Min	Max	Unit	Logic Diagram
MAIN: Device not ready				004 060
1: Yes				Fig. 3-74, (p. 3-115)
MAIN: Test mode				037 071
0: No				Fig. 3-95, (p. 3-137)
MAIN: Prot. ext. enabled				003 028
0: No				Fig. 3-67, (p. 3-110)
MAIN: Prot. ext. disabled				038 046
1: Yes				Fig. 3-67, (p. 3-110)
MAIN: Current flow A				010 223
0: No				Fig. 3-68, (p. 3-110)
MAIN: Current flow B				010 224
0: No				Fig. 3-68, (p. 3-110)
MAIN: Current flow C				010 225
0: No				Fig. 3-68, (p. 3-110)
MAIN: CB open 3p				031 040
0: No				Fig. 3-76, (p. 3-117)
MAIN: CB open A				031 032
0: No				Fig. 3-76, (p. 3-117)
MAIN: CB open B				031 033
0: No				Fig. 3-76, (p. 3-117)
MAIN: CB open C				031 034
0: No				Fig. 3-76, (p. 3-117)
MAIN: CB closed 3p				031 042
0: No				Fig. 3-76, (p. 3-117)
MAIN: CB closed A				031 035
0: No				Fig. 3-76, (p. 3-117)
MAIN: CB closed B				031 036
0: No				Fig. 3-76, (p. 3-117)
MAIN: CB closed C				031 037
0: No				Fig. 3-76, (p. 3-117)
MAIN: CB pos.sig. implaus.				031 041
0: No				
MAIN: Trip cmd. blocked				021 013
1: Yes				Fig. 3-85, (p. 3-127)
MAIN: Latch. trip c. reset				040 139
0: No				Fig. 3-384, (p. 3-461)
MAIN: Gen. trip command				035 071
0: No				Fig. 3-84, (p. 3-126)

Parameter				Address
Default	Min	Max	Unit	Logic Diagram
MAIN: Gen. trip command 1				036 071
0: No				Fig. 3-84, (p. 3-126)
MAIN: Gen. trip command 2				036 022
0: No				Fig. 3-84, (p. 3-126)
MAIN: Gen. trip command 3				036 113
0: No				Fig. 3-84, (p. 3-126)
MAIN: Gen. trip command 4				036 114
0: No				Fig. 3-84, (p. 3-126)
MAIN: Gen. trip signal				036 251
0: No				Fig. 3-84, (p. 3-126)
MAIN: Gen. trip signal 1				036 005
0: No				Fig. 3-84, (p. 3-126)
MAIN: Trip signal 1, 3p				037 253
0: No				
MAIN: Gen. trip signal 2				036 023
0: No				Fig. 3-84, (p. 3-126)
MAIN: Gen. trip signal 3				036 108
0: No				Fig. 3-84, (p. 3-126)
MAIN: Gen. trip signal 4				036 109
0: No				Fig. 3-84, (p. 3-126)
MAIN: Final trip				038 103
0: No				Fig. 3-86, (p. 3-128)
MAIN: Send transfer trip				001 207
0: No				
MAIN: Manual trip signal				034 017
0: No				Fig. 3-88, (p. 3-129)
MAIN: Man. cl. cmd.enabl.				039 113
0: No				Fig. 3-77, (p. 3-119)
MAIN: Man. close command				037 068
0: No				Fig. 3-77, (p. 3-119)
MAIN: Close command				037 009
0: No				Fig. 3-77, (p. 3-119)
MAIN: Close aft.man.cl.rqu				037 012
0: No				
MAIN: Inrush blk. trigg.				019 213
0: No				
MAIN: Rush restr. A trig.				041 027
0: No				

Parameter				Address
Default	Min	Max	Unit	Logic Diagram
MAIN: Rush restr. B trig.				041 028
0: No				
MAIN: Rush restr. C trig.				041 029
0: No				
MAIN: General starting				036 000
0: No				Fig. 3-82, (p. 3-124) Fig. 3-350, (p. 3-427)
MAIN: Starting A				036 001
0: No				Fig. 3-82, (p. 3-124)
MAIN: Starting B				036 002
0: No				Fig. 3-82, (p. 3-124)
MAIN: Starting C				036 003
0: No				Fig. 3-82, (p. 3-124)
MAIN: Starting GF				036 004
0: No				Fig. 3-82, (p. 3-124)
MAIN: OC General starting				040 000
0: No				Fig. 3-276, (p. 3-345)
MAIN: OC Starting A				040 005
0: No				Fig. 3-272, (p. 3-341)
MAIN: OC Starting B				040 006
0: No				Fig. 3-272, (p. 3-341)
MAIN: OC Starting C				040 007
0: No				Fig. 3-272, (p. 3-341)
MAIN: OC Starting GF				040 008
0: No				Fig. 3-276, (p. 3-345)
MAIN: OC Starting Ineg				040 105
0: No				Fig. 3-276, (p. 3-345)
MAIN: Short circuit AG				006 011
0: No				
MAIN: Short circuit BG				006 012
0: No				
MAIN: Short circuit CG				006 013
0: No				
MAIN: Ground fault				041 087
0: No				Fig. 3-81, (p. 3-123)
MAIN: Ground fault A				041 054
0: No				Fig. 3-80, (p. 3-122)

Parameter				Address
Default	Min	Max	Unit	Logic Diagram
MAIN: Ground fault B				041 055
0: No	Fig. 3-80, (p. 3-122)			
MAIN: Ground fault C				041 056
0: No	Fig. 3-80, (p. 3-122)			
MAIN: Gnd. fault forw./LS				041 088
0: No	Fig. 3-81, (p. 3-123)			
MAIN: Gnd. fault backw./BS				041 089
0: No	Fig. 3-81, (p. 3-123)			
MAIN: Enable control				221 058
1: Yes	Fig. 3-414, (p. 3-491)			
MAIN: Bay interlock. act.				221 001
0: No	Fig. 3-414, (p. 3-491)			
MAIN: Interlock equ. viol.				221 018
0: No	Fig. 3-415, (p. 3-492)			
MAIN: Subst. interl. act.				221 000
0: No	Fig. 3-414, (p. 3-491)			
MAIN: Fct. block. 1 active				221 015
0: No	Fig. 3-72, (p. 3-114)			
MAIN: Fct. block. 2 active				221 023
0: No	Fig. 3-72, (p. 3-114)			
MAIN: Mon. mot. drives tr.				221 056
0: No	Fig. 3-427, (p. 3-508)			
MAIN: CB trip internal				221 006
0: No	Fig. 3-89, (p. 3-131)			
MAIN: CB tripped				221 016
0: No	Fig. 3-89, (p. 3-131)			
MAIN: DEV op.time exceeded				221 110
0: No				
In the case of direct motor control by motor relay K200 this fault signal is issued (as a group signal) when no positive position signal (status signal) has been received from the external device after it has been issued a close command and the set running time-delay has elapsed.				
MAIN: Chatt.suppr. started				221 121
0: No				
Signal that the chatter suppression has started.				

Parameter				Address
Default	Min	Max	Unit	Logic Diagram
MAIN: DC fail. cmd. End				221 108
0: No				
In the case of direct motor control by motor relay K200 this signal is issued if the K200 contacts have not reopened after the set monitoring time-delay has elapsed.				
MAIN: DC fail. cmd.start				221 109
0: No				
In the case of direct motor control by motor relay K200 this signal is issued if the K200 contacts have not closed after the set monitoring time-delay has elapsed.				
MAIN: Startcmdtime exceed.				221 112
0: No Fig. 3-424, (p. 3-504)				
If the monitoring, set by DEV01: StartCmdTime superv. (or DEV02: StartCmdTime superv. etc.), is active then an exceeded timer is flagged by this logic state signal.				
MAIN: Mult. sig. 1 active				221 017
0: No Fig. 3-78, (p. 3-120)				
MAIN: Mult. sig. 1 stored				221 054
0: No Fig. 3-78, (p. 3-120)				
MAIN: Mult. sig. 2 active				221 053
0: No Fig. 3-78, (p. 3-120)				
MAIN: Mult. sig. 2 stored				221 055
0: No Fig. 3-78, (p. 3-120)				
MAIN: Group signal 01				019 192
0: No				
MAIN: Group signal 02				019 193
0: No				
MAIN: Group signal 03				019 194
0: No				
MAIN: Group signal 04				019 195
0: No				
MAIN: Group signal 05				019 196
0: No				
MAIN: Group signal 06				019 197
0: No				
MAIN: Group signal 07				019 198
0: No				
MAIN: Group signal 08				019 199
0: No				

Parameter				Address
Default	Min	Max	Unit	Logic Diagram
MAIN: Communication error				221 019
1: Yes	Fig. 3-90, (p. 3-132)			
MAIN: SI commu. disturbed				221 031
1: Yes				
MAIN: Cmd. fr. comm.interf				221 101
0: No				
MAIN: Cmd. fr. electr.ctrl				221 103
0: No				
MAIN: Command from HMI				221 102
0: No				
MAIN: Device selection key				006 001
0: No				
MAIN: Device OPEN key				006 002
0: No				
MAIN: Device CLOSE key				006 003
0: No				
MAIN: Local/Remote key				006 004
0: No				
MAIN: Dummy entry				004 129
0: No				
MAIN: Without function				060 000
0: No				
MAIN: Without function				061 000
0: No				

Parameter subset
selection

Parameter					Address	
Default	Min	Max	Unit		Logic Diagram	
PSS: Control via user EXT					036 101	
0: No						
PSS: Activate PS 1 EXT					065 002	
2: Not configured						
PSS: Activate PS 2 EXT					065 003	
2: Not configured						
PSS: Activate PS 3 EXT					065 004	
2: Not configured						
PSS: Activate PS 4 EXT					065 005	
2: Not configured						
PSS: Control via user					036 102	
0: No					Fig. 3-96, (p. 3-139)	
PSS: Ext.sel.param.subset					003 061	
0: No param. subset sel					Fig. 3-96, (p. 3-139)	
PSS: PS 1 activated ext.					036 094	
0: No					Fig. 3-96, (p. 3-139)	
PSS: PS 2 activated ext.					036 095	
0: No					Fig. 3-96, (p. 3-139)	
PSS: PS 3 activated ext.					036 096	
0: No					Fig. 3-96, (p. 3-139)	
PSS: PS 4 activated ext.					036 097	
0: No					Fig. 3-96, (p. 3-139)	
PSS: Actual param. subset					003 062	
1: Parameter subset 1					Fig. 3-96, (p. 3-139)	
PSS: PS 1 active					036 090	
1: Yes					Fig. 3-96, (p. 3-139)	
PSS: PS 2 active					036 091	
0: No					Fig. 3-96, (p. 3-139)	
PSS: PS 3 active					036 092	
0: No					Fig. 3-96, (p. 3-139)	
PSS: PS 4 active					036 093	
0: No					Fig. 3-96, (p. 3-139)	

Self-monitoring

Parameter					Address
Default	Min	Max	Unit		Logic Diagram
SFMON: CB faulty EXT					098 072
0: No					
SFMON: Warning (LED)					036 070
0: No					Fig. 3-97, (p. 3-140)
SFMON: Warning (relay)					036 100
0: No					Fig. 3-97, (p. 3-140)
SFMON: Warm restart exec.					041 202
0: No					
SFMON: Cold restart exec.					041 201
0: No					
SFMON: Cold rest. checksum					093 024
0: No					
SFMON: Cold rest. SW update					093 025
0: No					
SFMON: Blocking HW failure					090 019
0: No					
SFMON: Relay Kxx faulty					041 200
0: No					
SFMON: Hardware clock fail.					093 040
0: No					
SFMON: Battery failure					090 010
0: No					
SFMON: Interm.volt.fail.RAM					093 026
0: No					
SFMON: +15V supply faulty					093 081
0: No					
SFMON: +24V supply faulty					093 082
0: No					
SFMON: -15V supply faulty					093 080
0: No					
SFMON: Wrong module slot 1					096 100
0: No					
SFMON: Wrong module slot 2					096 101
0: No					
SFMON: Wrong module slot 3					096 102
0: No					
SFMON: Wrong module slot 4					096 103
0: No					

Parameter				Address
Default	Min	Max	Unit	Logic Diagram
SFMON: Wrong module slot 5				096 104
0: No				
SFMON: Wrong module slot 6				096 105
0: No				
SFMON: Wrong module slot 7				096 106
0: No				
SFMON: Wrong module slot 8				096 107
0: No				
SFMON: Wrong module slot 9				096 108
0: No				
SFMON: Wrong module slot 10				096 109
0: No				
SFMON: Wrong module slot 11				096 110
0: No				
SFMON: Wrong module slot 12				096 111
0: No				
SFMON: Wrong module slot 13				096 112
0: No				
SFMON: Wrong module slot 14				096 113
0: No				
SFMON: Wrong module slot 15				096 114
0: No				
SFMON: Wrong module slot 16				096 115
0: No				
SFMON: Wrong module slot 17				096 116
0: No				
SFMON: Wrong module slot 18				096 117
0: No				
SFMON: Wrong module slot 19				096 118
0: No				
SFMON: Wrong module slot 20				096 119
0: No				
SFMON: Wrong module slot 21				096 120
0: No				
SFMON: Wrong module Dig.Bus				096 123
0: No				
SFMON: Wrong module HMI				096 124
0: No				

Parameter				Address
Default	Min	Max	Unit	Logic Diagram
SFMON: Wrong module Comm				096 125
0: No				
SFMON: Wrong module Ana.Bus				096 126
0: No				
SFMON: Defect.module slot 1				097 000
0: No				
SFMON: Defect.module slot 2				097 001
0: No				
SFMON: Defect.module slot 3				097 002
0: No				
SFMON: Defect.module slot 4				097 003
0: No				
SFMON: Defect.module slot 5				097 004
0: No				
SFMON: Defect.module slot 6				097 005
0: No				
SFMON: Defect.module slot 7				097 006
0: No				
SFMON: Defect.module slot 8				097 007
0: No				
SFMON: Defect.module slot 9				097 008
0: No				
SFMON: Defect.module slot10				097 009
0: No				
SFMON: Defect.module slot11				097 010
0: No				
SFMON: Defect.module slot12				097 011
0: No				
SFMON: Defect.module slot13				097 012
0: No				
SFMON: Defect.module slot14				097 013
0: No				
SFMON: Defect.module slot15				097 014
0: No				
SFMON: Defect.module slot16				097 015
0: No				
SFMON: Defect.module slot17				097 016
0: No				

Parameter				Address
Default	Min	Max	Unit	Logic Diagram
SFMON: Defect.module slot18				097 017
0: No				
SFMON: Defect.module slot19				097 018
0: No				
SFMON: Defect.module slot20				097 019
0: No				
SFMON: Defect.module slot21				097 020
0: No				
SFMON: Module N +15V faulty				093 096
0: No				
SFMON: Module N -15V faulty				093 097
0: No				
SFMON: Module N DAC faulty				093 095
0: No				
SFMON: Module N DPR faulty				093 090
0: No				
SFMON: Module N RAM faulty				093 091
0: No				
SFMON: Module Y DPR faulty				093 110
0: No				
SFMON: Module Y RAM faulty				093 111
0: No				
SFMON: Error K 301				097 021
0: No				
SFMON: Error K 302				097 022
0: No				
SFMON: Error K 601				097 070
0: No				
SFMON: Error K 602				097 071
0: No				
SFMON: Error K 603				097 072
0: No				
SFMON: Error K 604				097 073
0: No				
SFMON: Error K 605				097 074
0: No				
SFMON: Error K 606				097 075
0: No				

Parameter				Address
Default	Min	Max	Unit	Logic Diagram
SFMON: Error K 607				097 076
0: No				
SFMON: Error K 608				097 077
0: No				
SFMON: Error K 701				097 078
0: No				
SFMON: Error K 702				097 079
0: No				
SFMON: Error K 703				097 080
0: No				
SFMON: Error K 704				097 081
0: No				
SFMON: Error K 705				097 082
0: No				
SFMON: Error K 706				097 083
0: No				
SFMON: Error K 707				097 084
0: No				
SFMON: Error K 708				097 085
0: No				
SFMON: Error K 801				097 086
0: No				
SFMON: Error K 802				097 087
0: No				
SFMON: Error K 803				097 088
0: No				
SFMON: Error K 804				097 089
0: No				
SFMON: Error K 805				097 090
0: No				
SFMON: Error K 806				097 091
0: No				
SFMON: Error K 807				097 092
0: No				
SFMON: Error K 808				097 093
0: No				
SFMON: Error K 901				097 094
0: No				

Parameter					Address		
Default	Min	Max	Unit		Logic Diagram		
SFMON: Error K 902							097 095
0: No							
SFMON: Error K 903							097 096
0: No							
SFMON: Error K 904							097 097
0: No							
SFMON: Error K 905							097 098
0: No							
SFMON: Error K 906							097 099
0: No							
SFMON: Error K 907							097 100
0: No							
SFMON: Error K 908							097 101
0: No							
SFMON: Error K 1001							097 102
0: No							
SFMON: Error K 1002							097 103
0: No							
SFMON: Error K 1003							097 104
0: No							
SFMON: Error K 1004							097 105
0: No							
SFMON: Error K 1005							097 106
0: No							
SFMON: Error K 1006							097 107
0: No							
SFMON: Error K 1007							097 108
0: No							
SFMON: Error K 1008							097 109
0: No							
SFMON: Error K 1201							097 118
0: No							
SFMON: Error K 1202							097 119
0: No							
SFMON: Error K 1203							097 120
0: No							
SFMON: Error K 1204							097 121
0: No							

Parameter				Address
Default	Min	Max	Unit	Logic Diagram
SFMON: Error K 1205				097 122
0: No				
SFMON: Error K 1206				097 123
0: No				
SFMON: Error K 1207				097 124
0: No				
SFMON: Error K 1208				097 125
0: No				
SFMON: Error K 1401				097 134
0: No				
SFMON: Error K 1402				097 135
0: No				
SFMON: Error K 1403				097 136
0: No				
SFMON: Error K 1404				097 137
0: No				
SFMON: Error K 1405				097 138
0: No				
SFMON: Error K 1406				097 139
0: No				
SFMON: Error K 1407				097 140
0: No				
SFMON: Error K 1408				097 141
0: No				
SFMON: Error K 1601				097 150
0: No				
SFMON: Error K 1602				097 151
0: No				
SFMON: Error K 1603				097 152
0: No				
SFMON: Error K 1604				097 153
0: No				
SFMON: Error K 1605				097 154
0: No				
SFMON: Error K 1606				097 155
0: No				
SFMON: Error K 1607				097 156
0: No				

Parameter					Address		
Default	Min	Max	Unit		Logic Diagram		
SFMON: Error K 1608							097 157
0: No							
SFMON: Error K 1801							097 166
0: No							
SFMON: Error K 1802							097 167
0: No							
SFMON: Error K 1803							097 168
0: No							
SFMON: Error K 1804							097 169
0: No							
SFMON: Error K 1805							097 170
0: No							
SFMON: Error K 1806							097 171
0: No							
SFMON: Error K 2001							097 182
0: No							
SFMON: Error K 2002							097 183
0: No							
SFMON: Error K 2003							097 184
0: No							
SFMON: Error K 2004							097 185
0: No							
SFMON: Error K 2005							097 186
0: No							
SFMON: Error K 2006							097 187
0: No							
SFMON: Error K 2007							097 188
0: No							
SFMON: Error K 2008							097 189
0: No							
SFMON: Undef. operat. code							093 010
0: No							
SFMON: Abnormal termination							093 030
0: No							
SFMON: Bad arg. system call							093 031
0: No							
SFMON: Mutex deadlock							093 032
0: No							

Parameter				Address
Default	Min	Max	Unit	Logic Diagram
SFMON: Invalid memory ref.				093 033
0: No				
SFMON: Unexpected exception				093 034
0: No				
SFMON: Invalid arithm. op.				093 011
0: No				
SFMON: Undefined interrupt				093 012
0: No				
SFMON: Exception oper.syst.				093 013
0: No				
SFMON: Protection failure				090 021
0: No				
SFMON: Checksum error param				090 003
0: No				
SFMON: Clock sync. error				093 041
0: No				
SFMON: Overflow MT_RC				090 012
0: No				Fig. 3-99, (p. 3-144)
SFMON: Semaph. MT_RC block.				093 015
0: No				
SFMON: Time-out module N				093 092
0: No				
SFMON: Time-out module Y				093 112
0: No				
SFMON: Invalid SW d.loaded				096 121
0: No				
SFMON: Invalid type of bay				096 122
0: No				
SFMON: Invalid SW vers DHMI				093 145
0: No				
SFMON: Inval. SW vers.COMM1				093 075
0: No				
SFMON: Inval. Config. IEC				093 079
0: No				
SFMON: Invalid SW vers. N				093 093
0: No				
SFMON: Invalid SW vers. Y				093 113
0: No				

Parameter				Address
Default	Min	Max	Unit	Logic Diagram
SFMON: Inom not adjustable				093 118
0: No				
SFMON: Fcts.not perm.f.60Hz				093 098
0: No				Fig. 3-322, (p. 3-398)
SFMON: Invalid scaling BCD				093 124
0: No				
SFMON: Invalid scaling A-1				093 114
0: No				Fig. 3-48, (p. 3-84)
SFMON: Invalid scaling A-2				093 115
0: No				
SFMON: Invalid scaling IDC				093 116
0: No				Fig. 3-37, (p. 3-67)
SFMON: Setting error THERM				098 035
0: No				Fig. 3-332, (p. 3-409)
SFMON: Setting error f<>				098 028
0: No				Fig. 3-352, (p. 3-430)
SFMON: Setting error CBM				098 020
0: No				
SFMON: Peripheral fault				098 018
0: No				Fig. 3-175, (p. 3-234)
SFMON: M.c.b. trip V				098 000
0: No				Fig. 3-175, (p. 3-234)
SFMON: M.c.b. trip VNG				098 132
0: No				Fig. 3-243, (p. 3-311)
SFMON: M.c.b. trip Vref				098 011
0: No				Fig. 3-175, (p. 3-234)
SFMON: Insul. Alarm 1				098 091
0: No				
SFMON: Insul. Alarm 2				098 092
0: No				
SFMON: Insul. Alarm 3				098 093
0: No				
SFMON: Buchholz Alarm 1				098 094
0: No				
SFMON: Buchholz Alarm 2				098 095
0: No				
SFMON: Buchholz Alarm 3				098 096
0: No				

Parameter				Address
Default	Min	Max	Unit	Logic Diagram
SFMON: DC Faulty 1				098 097
0: No				
SFMON: DC Faulty 2				098 098
0: No				
SFMON: DC Faulty 3				098 099
0: No				
SFMON: Phase sequ. V faulty				098 001
0: No				Fig. 3-177, (p. 3-236)
SFMON: Vneg > triggered				098 014
0: No				Fig. 3-177, (p. 3-236)
SFMON: Undervoltage				098 009
0: No				Fig. 3-177, (p. 3-236)
SFMON: FF, V triggered				098 021
0: No				Fig. 3-178, (p. 3-240)
SFMON: FF, Vref triggered				098 022
0: No				Fig. 3-179, (p. 3-241)
SFMON: M.circ. V,Vref flty.				098 023
0: No				Fig. 3-175, (p. 3-234)
SFMON: Meas. circ. V faulty				098 017
0: No				Fig. 3-175, (p. 3-234)
SFMON: Meas.circ.VNG faulty				098 254
0: No				
SFMON: M.circ. Vref faulty				098 255
0: No				
SFMON: BUOC not active				098 002
0: No				Fig. 3-180, (p. 3-243)
SFMON: BUOC active w/o ARC				098 003
0: No				Fig. 3-180, (p. 3-243)
SFMON: BUOC active with ARC				098 004
0: No				Fig. 3-180, (p. 3-243)
SFMON: Meas. circ. I faulty				098 005
0: No				Fig. 3-176, (p. 3-235)
SFMON: Meas.circ.V,I faulty				098 016
0: No				Fig. 3-175, (p. 3-234)
SFMON: Zero-sequ. starting				098 015
0: No				Fig. 3-175, (p. 3-234)
SFMON: Meas. circuits GFSC				098 013
0: No				

Parameter				Address
Default	Min	Max	Unit	Logic Diagram
SFMON: Communic.fault COMM3				093 140
0: No				
SFMON: Hardware error COMM3				093 143
0: No				
SFMON: Comm.link fail.COMM3				093 142
0: No				
SFMON: Lim.exc.tel.er.COMM3				093 141
0: No				
SFMON: Telecom. faulty/PSIG				098 006
0: No				Fig. 3-187, (p. 3-251)
SFMON: Op.mode PSIG inval.				098 019
0: No				Fig. 3-192, (p. 3-255)
SFMON: Telecom.faulty/GFSIG				098 012
0: No				Fig. 3-321, (p. 3-396)
SFMON: Setting error PULSE				098 089
0: No				
SFMON: CB pos.sig. implaus.				098 124
0: No				
SFMON: TGFD mon. triggered				093 094
0: No				Fig. 3-327, (p. 3-402)
SFMON: CB No. CB op. >				098 066
0: No				
SFMON: CB rem. No. CB op. <				098 067
0: No				
SFMON: CB Σ Itrip >				098 068
0: No				
SFMON: CB Σ Itrip**2 >				098 069
0: No				
SFMON: CB tmax> A				098 070
0: No				
SFMON: CB tmax> B				098 071
0: No				
SFMON: CB tmax> C				098 077
0: No				
SFMON: Setting error fn				098 133
0: No				
SFMON: Inv.inp.f.clock sync				093 120
0: No				

Parameter				Address
Default	Min	Max	Unit	Logic Diagram
SFMON: Output 30				098 053
0: No				
SFMON: Output 30 (t)				098 054
0: No				
SFMON: Output 31				098 055
0: No				
SFMON: Output 31 (t)				098 056
0: No				
SFMON: Output 32				098 057
0: No				
SFMON: Output 32 (t)				098 058
0: No				
SFMON: PT100 open circuit				098 024
0: No				Fig. 3-39, (p. 3-69)
SFMON: Overload 20 mA input				098 025
0: No				Fig. 3-37, (p. 3-67)
SFMON: Open circ. 20mA inp.				098 026
0: No				Fig. 3-37, (p. 3-67)
SFMON: CTA error				098 034
0: No				Fig. 3-330, (p. 3-406)

Operating data recording

Parameter				Address
Default	Min	Max	Unit	Logic Diagram
OP_RC: Reset record. EXT				005 213
0: No				Fig. 3-93, (p. 3-135)

Monitoring signal recording

Parameter				Address
Default	Min	Max	Unit	Logic Diagram
MT_RC: Reset record. EXT				005 240
0: No				

Overload recording

Parameter					Address
Default	Min	Max	Unit		Logic Diagram
OL_RC: Reset record. EXT					005 241
0: No					
OL_RC: Record. in progress					035 003
0: No Fig. 3-102, (p. 3-147)					
OL_RC: Overl. mem. overflow					035 007
0: No Fig. 3-103, (p. 3-148)					

Ground fault recording

Parameter					Address
Default	Min	Max	Unit		Logic Diagram
GF_RC: Reset record. EXT					005 242
0: No					
GF_RC: Record. in progress					035 005
0: No Fig. 3-111, (p. 3-155)					
GF_RC: GF memory overflow					035 006
0: No Fig. 3-112, (p. 3-156)					

Fault data acquisition

Parameter					Address
Default	Min	Max	Unit		Logic Diagram
FT_DA: Trigger EXT					036 088
0: No					

Fault recording

Parameter					Address
Default	Min	Max	Unit	Logic Diagram	
FT_RC: Reset record. EXT					005 243
0: No					
FT_RC: Trigger EXT					036 089
0: No					
FT_RC: Trigger					037 076
0: No				Fig. 3-118, (p. 3-166)	
FT_RC: I> triggered					040 063
0: No					
FT_RC: Record. trig active					002 002
0: No				Fig. 3-118, (p. 3-166)	
FT_RC: Record. in progress					035 000
0: No				Fig. 3-118, (p. 3-166)	
FT_RC: System disturb. runn					035 004
0: No				Fig. 3-118, (p. 3-166)	
FT_RC: Fault mem. overflow					035 001
0: No				Fig. 3-119, (p. 3-167)	
FT_RC: Faulty time tag					035 002
0: No					

Distance protection

Parameter					Address	
Default	Min	Max	Unit		Logic Diagram	
DIST: Blocking Z1 EXT					036 034	
0: No						
DIST: Blocking Z1,ze EXT					036 036	
0: No						
DIST: Blocking Z2 EXT					036 037	
0: No						
DIST: Blocking Z3 EXT					036 039	
0: No						
DIST: Blocking Z4 EXT					036 041	
0: No						
DIST: Blocking Z5 EXT					036 044	
0: No						
DIST: Blocking Z7 EXT					021 133	
0: No						
DIST: Blocking Z8 EXT					021 134	
0: No						
DIST: Blocking Z6 EXT					036 061	
0: No						
DIST: Blocking Z9 EXT					036 067	
0: No						
DIST: Blocking Z10 EXT					036 068	
0: No						
DIST: Enabled					036 104	
0: No						Fig. 3-121, (p. 3-170)
DIST: General starting					036 240	
0: No						Fig. 3-131, (p. 3-183)
DIST: Starting I>					019 107	
0: No						
DIST: Starting I>>					011 139	
0: No						Fig. 3-132, (p. 3-184)
DIST: Starting I>> A					040 064	
0: No						Fig. 3-132, (p. 3-184)
DIST: Starting I>> B					040 065	
0: No						Fig. 3-132, (p. 3-184)
DIST: Starting I>> C					040 097	
0: No						Fig. 3-132, (p. 3-184)
DIST: Starting V<					019 098	
0: No						

Parameter				Address
Default	Min	Max	Unit	Logic Diagram
DIST: Starting V < A				040 067
0: No	Fig. 3-132, (p. 3-184)			
DIST: Starting V < B				040 075
0: No	Fig. 3-132, (p. 3-184)			
DIST: Starting V < C				040 096
0: No	Fig. 3-132, (p. 3-184)			
DIST: Starting Z <				036 241
0: No	Fig. 3-132, (p. 3-184)			
DIST: Starting Z < A				040 070
0: No	Fig. 3-132, (p. 3-184)			
DIST: Starting Z < B				040 071
0: No	Fig. 3-132, (p. 3-184)			
DIST: Starting Z < C				040 072
0: No	Fig. 3-132, (p. 3-184)			
DIST: Start. switch. to PG				040 052
0: No	Fig. 3-124, (p. 3-174)			
DIST: VNG>> triggered				036 015
0: No	Fig. 3-123, (p. 3-173)			
DIST: Zero-sequ. starting				036 021
0: No	Fig. 3-131, (p. 3-183)			
DIST: tIN> running				036 105
0: No	Fig. 3-123, (p. 3-173)			
DIST: tVNG>> elapsed				036 016
0: No	Fig. 3-123, (p. 3-173)			
DIST: Fault forward / LS				036 018
0: No	Fig. 3-136, (p. 3-189)			
DIST: Fault backward / BS				036 019
0: No	Fig. 3-136, (p. 3-189)			
DIST: Direct. using Vmeas				038 045
0: No	Fig. 3-136, (p. 3-189)			
DIST: Direct. using memory				038 047
0: No	Fig. 3-136, (p. 3-189)			
DIST: Forw. w/o measurem.				038 044
0: No	Fig. 3-136, (p. 3-189)			
DIST: tVmemory running				040 034
0: No	Fig. 3-134, (p. 3-187)			

Parameter				Address
Default	Min	Max	Unit	Logic Diagram
DIST: Zone extension				036 065
0: No				Fig. 3-142, (p. 3-196) Fig. 3-146, (p. 3-201)
DIST: Zone extension EXT				036 046
0: No				
DIST: Zone extension HSR				036 103
0: No				Fig. 3-142, (p. 3-196) Fig. 3-146, (p. 3-201)
DIST: Zone extension TDR				038 022
0: No				Fig. 3-142, (p. 3-196) Fig. 3-146, (p. 3-201)
DIST: t1 elapsed				036 026
0: No				Fig. 3-147, (p. 3-202)
DIST: t1,ze elapsed				035 079
0: No				Fig. 3-147, (p. 3-202)
DIST: t2 elapsed				036 027
0: No				Fig. 3-148, (p. 3-203)
DIST: t3 elapsed				036 028
0: No				Fig. 3-148, (p. 3-203)
DIST: t4 elapsed				036 029
0: No				Fig. 3-148, (p. 3-203)
DIST: t5 elapsed				036 030
0: No				Fig. 3-148, (p. 3-203)
DIST: t6 elapsed				036 031
0: No				Fig. 3-148, (p. 3-203)
DIST: t7 elapsed				021 135
0: No				Fig. 3-148, (p. 3-203)
DIST: t8 elapsed				021 136
0: No				Fig. 3-148, (p. 3-203)
DIST: t9 elapsed				037 127
0: No				Fig. 3-148, (p. 3-203)
DIST: t10 elapsed				037 128
0: No				Fig. 3-148, (p. 3-203)
DIST: Trip signal				036 009
0: No				Fig. 3-162, (p. 3-218)
DIST: Trip signal zone 1				035 072
0: No				Fig. 3-162, (p. 3-218)
DIST: Trip signal Z1,ze				035 074
0: No				Fig. 3-162, (p. 3-218)

Parameter				Address
Default	Min	Max	Unit	Logic Diagram
DIST: Trip sig. zone 2-10				035 073
0: No				Fig. 3-162, (p. 3-218)
DIST: Trip signal zone 2				041 084
0: No				Fig. 3-162, (p. 3-218)
DIST: Trip signal zone 3				040 056
0: No				
DIST: Trip signal zone 4				040 057
0: No				
DIST: Trip signal zone 5				040 058
0: No				
DIST: Trip signal zone 6				040 059
0: No				
DIST: Trip signal zone 7				021 137
0: No				
DIST: Trip signal zone 8				021 138
0: No				
DIST: Trip signal zone 9				037 129
0: No				Fig. 3-162, (p. 3-218)
DIST: Trip signal zone 10				037 130
0: No				Fig. 3-162, (p. 3-218)
DIST: Impedance in zone 6				037 200
0: No				Fig. 3-163, (p. 3-219)

Power swing
blocking

Parameter					Address		
Default	Min	Max	Unit		Logic Diagram		
PSB: Blocking EXT							008 248
0: No							
PSB: Blocked							011 144
0: No							
PSB: Blocking init. EXT							036 069
0: No							
PSB: Enabled							040 095
0: No Fig. 3-164, (p. 3-220)							
PSB: Z within polygon							036 024
0: No Fig. 3-165, (p. 3-221)							
PSB: Blocking initiated							036 032
0: No							
PSB: Trip signal							036 025
0: No							
PSB: Trip signal OOS (a)							006 035
0: No							
PSB: Trip signal OOS (b)							006 192
0: No							
PSB: Trip signal stab. PS							006 030
0: No							
PSB: IP> triggered							036 012
0: No							
PSB: Ineg> triggered							036 011
0: No							
PSB: IN> triggered							036 010
0: No							

Measuring-circuit
monitoring

Parameter	Address			
Default	Min	Max	Unit	Logic Diagram
MCMON: Blocking FF, V EXT				002 182
0: No				
MCMON: Enabled				040 094
0: No				Fig. 3-176, (p. 3-235)
MCMON: Meas. circ. I faulty				040 087
0: No				Fig. 3-176, (p. 3-235)
MCMON: Undervoltage				038 038
0: No				Fig. 3-177, (p. 3-236)
MCMON: Phase sequ. V faulty				038 049
0: No				Fig. 3-177, (p. 3-236)
MCMON: Vneg > triggered				041 079
0: No				Fig. 3-177, (p. 3-236)
MCMON: FF, V triggered				035 081
0: No				Fig. 3-178, (p. 3-240)
MCMON: FF, Vref triggered				038 100
0: No				Fig. 3-179, (p. 3-241)
MCMON: Meas. circ. V faulty				038 023
0: No				Fig. 3-175, (p. 3-234)
MCMON: M.circ. Vref faulty				007 213
0: No				Fig. 3-175, (p. 3-234)
MCMON: M.circ. VNG faulty				007 214
0: No				Fig. 3-175, (p. 3-234)
MCMON: M.circ. V, Vref flty.				040 078
0: No				Fig. 3-175, (p. 3-234)
MCMON: Meas.circ.V, I faulty				037 020
0: No				Fig. 3-175, (p. 3-234)
MCMON: Zero-sequ. starting				041 080
0: No				Fig. 3-175, (p. 3-234)
MCMON: Peripheral fault				038 024
0: No				Fig. 3-175, (p. 3-234)
MCMON: Blocking FF, Vref EXT				018 099
0: No				Fig. 3-179, (p. 3-241)
This parameter allows to block the “Fuse Failure” monitoring of the reference voltage via binary input (e. g. from circuit breaker auxiliary contacts) or programmable logic.				
MCMON: Meas. voltage o.k.				038 048
0: No				Fig. 3-177, (p. 3-236)

Backup overcurrent-
time protection

Parameter					Address			
Default	Min	Max	Unit		Logic Diagram			
BUOC: Blocking I > EXT								018 217
0: No					Fig. 3-180, (p. 3-243)			
BUOC: Blocking IN > EXT								018 218
0: No					Fig. 3-180, (p. 3-243)			
BUOC: Enabled								040 093
0: No					Fig. 3-180, (p. 3-243)			
BUOC: Active								037 021
0: No					Fig. 3-180, (p. 3-243)			
BUOC: Starting								036 013
0: No					Fig. 3-180, (p. 3-243)			
BUOC: Trip signal								036 014
0: No					Fig. 3-180, (p. 3-243)			
BUOC: Zero-sequ. starting								010 185
0: No					Fig. 3-180, (p. 3-243)			

Switch on to fault protection

Parameter					Address
Default	Min	Max	Unit		Logic Diagram
SOTF: Trigger EXT					002 127
0: No					
SOTF: Par. ARC running EXT					039 063
0: No					
SOTF: Enabled					040 069
0: No					Fig. 3-183, (p. 3-247)
SOTF: Line dead					006 147
0: No					
SOTF: Active					006 146
0: No					Fig. 3-183, (p. 3-247)
SOTF: tManual-close runn.					036 063
0: No					Fig. 3-183, (p. 3-247)
SOTF: Z1 extended					035 076
0: No					Fig. 3-183, (p. 3-247)
SOTF: Starting I>					006 128
0: No					Fig. 3-182, (p. 3-246)
SOTF: Starting IN>					001 187
0: No					Fig. 3-182, (p. 3-246)
SOTF: tI> elapsed					006 129
0: No					Fig. 3-182, (p. 3-246)
SOTF: tIN> elapsed					001 188
0: No					Fig. 3-182, (p. 3-246)
SOTF: Trip signal					036 064
0: No					Fig. 3-183, (p. 3-247)

Protective signaling

Parameter	Address			
Default	Min	Max	Unit	Logic Diagram
PSIG: Enable EXT				037 025
2: Not configured				
PSIG: Disable EXT				037 026
2: Not configured				
PSIG: Blocking EXT				036 049
0: No				
PSIG: Test telecom. EXT				036 038
0: No				
PSIG: Telec.faulty (A) EXT				004 064
0: No				Fig. 3-187, (p. 3-251)
PSIG: Telec.faulty (B) EXT				008 094
0: No				Fig. 3-187, (p. 3-251)
PSIG: Block. weak inf. EXT				036 255
0: No				
PSIG: Weak inf. trigg. EXT				043 062
0: No				
PSIG: Freq. mon. trig. EXT				038 080
0: No				
PSIG: Receive (A) EXT				036 048
0: No				
PSIG: Receive (B) EXT				006 037
0: No				
PSIG: Ext./user enabled				037 023
1: Yes				Fig. 3-184, (p. 3-249)
PSIG: Enabled				015 008
0: No				Fig. 3-184, (p. 3-249)
PSIG: Ready				037 027
0: No				Fig. 3-184, (p. 3-249)
PSIG: Not ready				037 028
1: Yes				Fig. 3-184, (p. 3-249)
PSIG: Telecom. faulty				036 060
0: No				Fig. 3-187, (p. 3-251)
PSIG: Telecom. faulty (A)				012 244
0: No				Fig. 3-187, (p. 3-251)
PSIG: Telecom. faulty (B)				012 245
0: No				Fig. 3-187, (p. 3-251)

Parameter				Address
Default	Min	Max	Unit	Logic Diagram
PSIG: Transient blocking				037 255
0: No				Fig. 3-189, (p. 3-252) Fig. 3-204, (p. 3-267)
PSIG: Test telecom. chann.				034 016
0: No				Fig. 3-209, (p. 3-272)
PSIG: Send				012 243
0: No				Fig. 3-193, (p. 3-256) Fig. 3-194, (p. 3-257) Fig. 3-196, (p. 3-259) Fig. 3-198, (p. 3-261) Fig. 3-200, (p. 3-263) Fig. 3-202, (p. 3-265) Fig. 3-205, (p. 3-268) Fig. 3-208, (p. 3-271) Fig. 3-209, (p. 3-272)
PSIG: Send (signal)				036 035
0: No				Fig. 3-193, (p. 3-256) Fig. 3-194, (p. 3-257) Fig. 3-196, (p. 3-259) Fig. 3-198, (p. 3-261) Fig. 3-200, (p. 3-263) Fig. 3-202, (p. 3-265) Fig. 3-205, (p. 3-268) Fig. 3-208, (p. 3-271) Fig. 3-209, (p. 3-272)
PSIG: Send (transm.relay)				037 024
0: No				Fig. 3-190, (p. 3-253)
PSIG: Receive				006 036
0: No				Fig. 3-186, (p. 3-251)
PSIG: Receive (signal)				037 029
0: No				Fig. 3-193, (p. 3-256) Fig. 3-194, (p. 3-257) Fig. 3-196, (p. 3-259) Fig. 3-198, (p. 3-261) Fig. 3-200, (p. 3-263) Fig. 3-202, (p. 3-265) Fig. 3-204, (p. 3-267) Fig. 3-205, (p. 3-268)
PSIG: Z1 extended				035 075
0: No				Fig. 3-196, (p. 3-259) Fig. 3-198, (p. 3-261) Fig. 3-200, (p. 3-263) Fig. 3-202, (p. 3-265) Fig. 3-204, (p. 3-267)

Parameter				Address
Default	Min	Max	Unit	Logic Diagram
PSIG: t1 revers.interlock				036 020
0: No				Fig. 3-204, (p. 3-267)
PSIG: Weak infeed start.				043 064
0: No				Fig. 3-206, (p. 3-269)
PSIG: Trip signal				038 007
0: No				Fig. 3-193, (p. 3-256) Fig. 3-194, (p. 3-257) Fig. 3-196, (p. 3-259) Fig. 3-198, (p. 3-261) Fig. 3-200, (p. 3-263) Fig. 3-202, (p. 3-265) Fig. 3-204, (p. 3-267) Fig. 3-205, (p. 3-268)

Auto-reclosing
control

Parameter					Address
Default	Min	Max	Unit		Logic Diagram
ARC: Reset counters EXT					005 244
0: No					
ARC: Enable EXT					037 010
2: Not configured					
ARC: Disable EXT					037 011
2: Not configured					
ARC: Test HSR A-B-C EXT					037 017
0: No					
ARC: General starting EXT					037 096
0: No					
ARC: Blocking EXT					036 050
0: No					
ARC: CB drive ready EXT					004 066
0: No					
ARC: 3p transfer trip EXT					038 043
0: No					
ARC: Ext./user enabled					037 013
1: Yes					Fig. 3-211, (p. 3-274)
ARC: Enabled					015 064
0: No					Fig. 3-211, (p. 3-274)
ARC: Test HSR A-B-C					034 023
0: No					Fig. 3-216, (p. 3-280)
ARC: Blocked					004 069
0: No					Fig. 3-213, (p. 3-276)
ARC: Start by LOGIC					037 078
0: No					Fig. 3-224, (p. 3-287)
ARC: Ready					004 068
0: No					Fig. 3-212, (p. 3-275)
ARC: Not ready					037 008
1: Yes					Fig. 3-212, (p. 3-275)
ARC: Reject test HSR					036 055
0: No					Fig. 3-216, (p. 3-280)
ARC: Block. time running					037 004
0: No					Fig. 3-213, (p. 3-276)
ARC: Cycle running					037 000
0: No					

Parameter					Address
Default	Min	Max	Unit		Logic Diagram
ARC: Oper. time 1 running					037 005
0: No					
ARC: Oper. time 2 running					037 065
0: No					
ARC: Dead time running					037 002
0: No					
ARC: Dead time 3p running					037 067
0: No					
ARC: Max. dead time runn.					037 069
0: No					
ARC: Dead time TDR runn.					037 003
0: No					
ARC: Reclaim time running					036 042
0: No					
ARC: (Re)close request					037 077
0: No					
ARC: (Re)close signal HSR					037 007
0: No					
ARC: (Re)close signal TDR					037 006
0: No					
ARC: Reclosure successful					036 062
0: No					
ARC: Sig.interr. CB trip					036 040
0: No					
ARC: 3p final trip					036 043
0: No					

Automatic
synchronism check

Parameter	Address			
Default	Min	Max	Unit	Logic Diagram
ASC: Meas.V(T90) EXT				016 221
0: No				
This parameter allows to select the ASC input source via binary input, communication protocol signal or programmable logic. (See setting (016 222) ASC: Meas.V(T90) USER PSx for details.)				
ASC: Meas.V(T90) active				016 240
0: No Fig. 3-226, (p. 3-291)				
Signal that reports which voltage(s) the ASC function is currently using for the operating modes “voltage-checked close enable” and “voltage/synchronism-checked close enable”.				
● The value No means that the three phase-to-ground voltages are checked. ● The value Yes means that the (single-phase) voltage measured at transformer T90 is checked.				
(See also parameters (016 222) ASC: Meas.V(T90) USER PSx, (016 221) ASC: Meas.V(T90) EXT.)				
ASC: Reset counters EXT				006 074
0: No				
ASC: Enable EXT				037 049
2: Not configured				
ASC: Disable EXT				037 061
2: Not configured				
ASC: Blocking EXT				037 048
0: No				
ASC: Test AR close r. EXT				000 106
0: No				
Close request via external signal for a test triggering of the ASC in operating mode automatic reclosure.				
ASC: Test MC close r. EXT				037 064
0: No				
Close request via external signal for a test triggering of the ASC in operating mode manual reclosure.				
ASC: Enabl.close requ.EXT				037 063
1: Yes				
ASC: MC Close request EXT				037 062
0: No				
Close request via external signal for a triggering of the ASC in operating mode manual reclosure.				

Parameter				Address
Default	Min	Max	Unit	Logic Diagram
ASC: AR close request EXT				008 236
0: No				
Close request via external signal for a triggering of the ASC in operating mode automatic reclosure.				
ASC: Ext./user enabled				037 092
1: Yes	Fig. 3-227, (p. 3-292)			
ASC: Enabled				018 024
0: No	Fig. 3-227, (p. 3-292)			
ASC: Blocked				038 018
0: No	Fig. 3-228, (p. 3-293)			
ASC: Ready				037 079
0: No	Fig. 3-228, (p. 3-293)			
ASC: Not ready				037 082
1: Yes	Fig. 3-228, (p. 3-293)			
ASC: Test AR close requ.				008 240
0: No	Fig. 3-229, (p. 3-294)			
Signaling of a close request for a test triggering of the ASC in operating mode automatic reclosure.				
ASC: Test MC close requ.				034 019
0: No	Fig. 3-230, (p. 3-295)			
Signaling of a close request for a test triggering of the ASC in operating mode manual reclosure.				
ASC: AR close request				008 239
0: No	Fig. 3-229, (p. 3-294)			
Signaling of a close request for a triggering of the ASC in operating mode automatic reclosure.				
ASC: MC Close request				034 018
0: No	Fig. 3-230, (p. 3-295)			
Signaling of a close request for a triggering of the ASC in operating mode manual reclosure.				
ASC: Cycle running				038 019
0: No	Fig. 3-232, (p. 3-296) Fig. 3-240, (p. 3-307)			
ASC: Operat.time running				037 093
0: No	Fig. 3-232, (p. 3-296)			
ASC: Close enable				037 083
0: No	Fig. 3-234, (p. 3-299) Fig. 3-235, (p. 3-301)			

Parameter				Address
Default	Min	Max	Unit	Logic Diagram
ASC: Close enable,volt.ch				037 085
0: No				Fig. 3-234, (p. 3-299) Fig. 3-235, (p. 3-301)
ASC: Close enable,sync.ch				037 084
0: No				Fig. 3-236, (p. 3-302) Fig. 3-237, (p. 3-304)
ASC: Close rejection				037 086
0: No				Fig. 3-232, (p. 3-296)

Ground fault (short-circuit) protection

Parameter					Address	
Default	Min	Max	Unit		Logic Diagram	
GFSC: Enable EXT					039 095	
2: Not configured						
GFSC: Disable EXT					039 096	
2: Not configured						
GFSC: Blocking EXT					043 068	
0: No						
GFSC: Ext. enabled					039 097	
1: Yes					Fig. 3-242, (p. 3-310)	
GFSC: Enabled					038 094	
0: No					Fig. 3-242, (p. 3-310)	
GFSC: Ready					039 093	
0: No					Fig. 3-242, (p. 3-310)	
GFSC: Not ready					039 094	
1: Yes					Fig. 3-242, (p. 3-310)	
GFSC: Monitor. triggered					038 095	
0: No					Fig. 3-259, (p. 3-327)	
GFSC: IN> triggered					039 088	
0: No					Fig. 3-245, (p. 3-313)	
GFSC: Direct.determ.enabl.					043 061	
0: No					Fig. 3-245, (p. 3-313)	
GFSC: VNG> triggered					039 089	
0: No					Fig. 3-245, (p. 3-313)	
GFSC: Starting					038 096	
0: No					Fig. 3-245, (p. 3-313)	
GFSC: Fault forward / LS					039 090	
0: No					Fig. 3-257, (p. 3-326)	
GFSC: Fault backward / BS					039 091	
0: No					Fig. 3-257, (p. 3-326)	
GFSC: t1 elapsed					038 097	
0: No					Fig. 3-257, (p. 3-326)	
GFSC: t2 elapsed					038 098	
0: No					Fig. 3-257, (p. 3-326)	
GFSC: t3 elapsed					038 099	
0: No					Fig. 3-257, (p. 3-326)	
GFSC: Trip signal					039 092	
0: No					Fig. 3-257, (p. 3-326)	

Ground fault (short-circuit) protection signaling

Parameter				Address			
Default	Min	Max	Unit	Logic Diagram			
GSCSG: Enable EXT							043 050
2: Not configured							
GSCSG: Disable EXT							043 051
2: Not configured							
GSCSG: Blocking EXT							043 052
0: No							
GSCSG: Telecom. faulty EXT							043 053
0: No							
GSCSG: Frequ.mon.trigd. EXT							043 054
0: No							
GSCSG: Receive EXT							043 055
0: No							
GSCSG: Test telecom. EXT							043 056
0: No							
GSCSG: Enabled							023 070
0: No				Fig. 3-260, (p. 3-329)			
GSCSG: Ext. enabled							043 066
1: Yes				Fig. 3-260, (p. 3-329)			
GSCSG: Ready							043 057
0: No				Fig. 3-261, (p. 3-330)			
GSCSG: Not ready							043 058
1: Yes				Fig. 3-261, (p. 3-330)			
GSCSG: Test telecom. chann.							034 029
0: No				Fig. 3-270, (p. 3-339)			
GSCSG: Telecom. faulty							046 060
0: No				Fig. 3-261, (p. 3-330)			
GSCSG: Send signal							043 059
0: No				Fig. 3-265, (p. 3-334) Fig. 3-266, (p. 3-335) Fig. 3-269, (p. 3-338) Fig. 3-270, (p. 3-339)			
GSCSG: Trip signal							043 060
0: No				Fig. 3-265, (p. 3-334) Fig. 3-266, (p. 3-335) Fig. 3-267, (p. 3-336)			
GSCSG: Tripping time elaps.							043 063
0: No				Fig. 3-262, (p. 3-332)			

Parameter				Address	
Default	Min	Max	Unit	Logic Diagram	
GSCSG: Transient blocking					037 254
0: No					

Definite-time over-current protection

Parameter					Address
Default	Min	Max	Unit		Logic Diagram
DTOC: Blocking tI> EXT					041 060
0: No					
DTOC: Blocking tI>> EXT					041 061
0: No					
DTOC: Blocking tI>>> EXT					041 062
0: No					
DTOC: Blocking tI>>>> EXT					041 100
0: No					
DTOC: Block. dir. tI> EXT					013 119
0: No					
DTOC: Block. dir. tN>> EXT					013 120
0: No					
DTOC: Block.dir. tI>>> EXT					013 121
0: No					
DTOC: Block.dir.tI>>>> EXT					013 122
0: No					
DTOC: Blocking tIneg> EXT					041 102
0: No					
DTOC: Blocking tIneg>> EXT					041 103
0: No					
DTOC: Block. tIneg>>> EXT					041 104
0: No					
DTOC: Block. tIneg>>>> EXT					041 105
0: No					
DTOC: Blocking tIN> EXT					041 063
0: No					
DTOC: Blocking tIN>> EXT					041 064
0: No					
DTOC: Blocking tIN>>> EXT					041 065
0: No					
DTOC: Blocking tIN>>>> EXT					041 101
0: No					
DTOC: Block. dir. tIN> EXT					002 176
0: No					
DTOC: Blck. dir. tIN>> EXT					002 177
0: No					

Parameter				Address
Default	Min	Max	Unit	Logic Diagram
DTOC: Blk. dir. tIN>>> EXT				002 178
0: No				
DTOC: Bl. dir. tIN>>>> EXT				002 179
0: No				
DTOC: Enabled				040 120
0: No				Fig. 3-271, (p. 3-340)
DTOC: Starting I>				035 020
0: No				Fig. 3-272, (p. 3-341)
DTOC: Starting I>>				035 021
0: No				
DTOC: Starting I>>>				035 022
0: No				
DTOC: Starting I>>>>				035 023
0: No				
DTOC: tI> elapsed				040 010
0: No				Fig. 3-272, (p. 3-341)
DTOC: tI>> elapsed				040 011
0: No				
DTOC: tI>>> elapsed				040 012
0: No				
DTOC: tI>>>> elapsed				035 032
0: No				
DTOC: Trip signal tI>				013 123
0: No				Fig. 3-272, (p. 3-341)
DTOC: Trip signal tI>>				013 124
0: No				
DTOC: Trip signal tI>>>				013 125
0: No				
DTOC: Trip signal tI>>>>				013 126
0: No				
DTOC: Starting Ineg>				035 024
0: No				Fig. 3-273, (p. 3-343)
DTOC: Starting Ineg>>				035 025
0: No				
DTOC: Starting Ineg>>>				035 026
0: No				
DTOC: Starting Ineg>>>>				035 027
0: No				

Parameter				Address
Default	Min	Max	Unit	Logic Diagram
DTOC: tIneg> elapsed				035 033
0: No	Fig. 3-273, (p. 3-343)			
DTOC: tIneg>> elapsed				035 034
0: No				
DTOC: tIneg>>> elapsed				035 035
0: No				
DTOC: tIneg>>>> elapsed				035 036
0: No				
DTOC: Starting IN>				035 028
0: No	Fig. 3-275, (p. 3-344)			
DTOC: Starting IN>>				035 029
0: No				
DTOC: Starting IN>>>				035 030
0: No				
DTOC: Starting IN>>>>				035 031
0: No				
DTOC: tIN> elapsed				035 037
0: No	Fig. 3-275, (p. 3-344)			
DTOC: tIN>> elapsed				035 038
0: No				
DTOC: tIN>>> elapsed				035 039
0: No				
DTOC: tIN>>>> elapsed				035 040
0: No				
DTOC: Trip signal tIN>				035 043
0: No	Fig. 3-275, (p. 3-344)			
DTOC: Trip signal tIN>>				035 044
0: No				
DTOC: Trip signal tIN>>>				035 045
0: No				
DTOC: Trip sign. tIN>>>>				035 046
0: No				
DTOC: H.-time tIN>,i. runn				040 086
0: No	Fig. 3-277, (p. 3-347)			
DTOC: tIN>,interm. elapsed				040 099
0: No	Fig. 3-277, (p. 3-347)			
DTOC: Trip sig. tIN>,intm.				039 073
0: No	Fig. 3-277, (p. 3-347)			

Inverse-time overcurrent protection

Parameter					Address	
Default	Min	Max	Unit		Logic Diagram	
IDMT: Block. tlref,P> EXT					040 101	
0: No						Fig. 3-286, (p. 3-357)
IDMT: Block. tlref,neg>EXT					040 102	
0: No						Fig. 3-287, (p. 3-360)
IDMT: Block. tlref,N> EXT					040 103	
0: No						Fig. 3-289, (p. 3-362)
IDMT: Enabled					040 100	
0: No						Fig. 3-280, (p. 3-350) Fig. 3-286, (p. 3-357) Fig. 3-287, (p. 3-360) Fig. 3-289, (p. 3-362)
IDMT: Starting Iref,P>					040 080	
0: No						Fig. 3-286, (p. 3-357)
IDMT: tlref,P> elapsed					040 082	
0: No						Fig. 3-286, (p. 3-357)
IDMT: Trip signal tlref,P>					040 084	
0: No						
IDMT: Hold time P running					040 053	
0: No						Fig. 3-286, (p. 3-357)
IDMT: Memory P clear					040 110	
1: Yes						Fig. 3-286, (p. 3-357)
IDMT: Starting Iref,neg>					040 107	
0: No						Fig. 3-287, (p. 3-360)
IDMT: tlref,neg> elapsed					040 109	
0: No						Fig. 3-287, (p. 3-360)
IDMT: Trip sig.tlref,neg>					040 108	
0: No						Fig. 3-287, (p. 3-360)
IDMT: Hold time neg runn.					040 113	
0: No						Fig. 3-287, (p. 3-360)
IDMT: Memory neg clear					040 111	
1: Yes						Fig. 3-287, (p. 3-360)
IDMT: Starting Iref,N>					040 081	
0: No						Fig. 3-289, (p. 3-362)
IDMT: tlref,N> elapsed					040 083	
0: No						Fig. 3-289, (p. 3-362)
IDMT: Trip signal tlref,N>					040 085	
0: No						Fig. 3-289, (p. 3-362)

Parameter				Address
Default	Min	Max	Unit	Logic Diagram
IDMT: Hold time N running				040 054
0: No	Fig. 3-289, (p. 3-362)			
IDMT: Memory N clear				040 112
1: Yes	Fig. 3-289, (p. 3-362)			

Short-circuit
direction
determination

Parameter				Address
Default	Min	Max	Unit	Logic Diagram
SCDD: Blocked P				040 062
0: No	Fig. 3-293, (p. 3-366)			
SCDD: Fault P forward				013 110
0: No	Fig. 3-294, (p. 3-367)			
SCDD: Fault P backward				013 111
0: No	Fig. 3-294, (p. 3-367)			
SCDD: Fault N forward				035 047
0: No	Fig. 3-300, (p. 3-373)			
SCDD: Fault N backward				035 048
0: No	Fig. 3-300, (p. 3-373)			
SCDD: Fault P or G forwd.				040 039
0: No	Fig. 3-302, (p. 3-375)			
SCDD: Forw. w/o measurem.				013 112
0: No				
SCDD: Fault P or G backw.				040 040
0: No	Fig. 3-302, (p. 3-375)			
SCDD: Direct. using Vmeas				013 113
0: No				
SCDD: Direct. using memory				013 114
0: No				

Ground fault
direction
determination using
steady-state values

Parameter					Address		
Default	Min	Max	Unit		Logic Diagram		
GFDSS: Reset counters EXT							005 245
0: No							
GFDSS: GF (curr.) eval. EXT							038 020
0: No							
GFDSS: Enabled							042 096
0: No					Fig. 3-303, (p. 3-377)		
GFDSS: GF (pow.) ready							038 026
1: Yes					Fig. 3-303, (p. 3-377)		
GFDSS: GF (pow.) not ready							038 027
1: Yes					Fig. 3-303, (p. 3-377)		
GFDSS: GF (curr.) evaluat.							039 071
0: No					Fig. 3-303, (p. 3-377)		
GFDSS: GF (curr.) ready							038 028
1: Yes					Fig. 3-303, (p. 3-377)		
GFDSS: GF (curr.) not ready							038 029
1: Yes					Fig. 3-303, (p. 3-377)		
GFDSS: Admittance ready							038 167
1: Yes					Fig. 3-303, (p. 3-377)		
GFDSS: Admittance not ready							038 168
1: Yes					Fig. 3-303, (p. 3-377)		
GFDSS: Grd. fault pow./adm.							009 037
0: No					Fig. 3-305, (p. 3-379) Fig. 3-311, (p. 3-385)		
GFDSS: Direct. forward/LS							009 035
0: No					Fig. 3-308, (p. 3-382) Fig. 3-314, (p. 3-388)		
GFDSS: Direct. backward/BS							009 036
0: No					Fig. 3-308, (p. 3-382) Fig. 3-314, (p. 3-388)		
GFDSS: Starting forward/LS							009 040
0: No					Fig. 3-308, (p. 3-382) Fig. 3-314, (p. 3-388)		
GFDSS: Starting backward/BS							009 041
0: No					Fig. 3-308, (p. 3-382) Fig. 3-314, (p. 3-388)		

Parameter				Address
Default	Min	Max	Unit	Logic Diagram
GFDSS: Trip signal forw./LS				009 031
0: No				Fig. 3-308, (p. 3-382) Fig. 3-314, (p. 3-388)
GFDSS: Ground fault (curr.)				009 038
0: No				Fig. 3-309, (p. 3-383)
GFDSS: Starting Y(N)>				009 074
0: No				Fig. 3-315, (p. 3-389)
GFDSS: Trip Y(N)>				009 075
0: No				Fig. 3-315, (p. 3-389)
GFDSS: Trip signal Y(N)>				009 072
0: No				Fig. 3-315, (p. 3-389)

Pulse detection

Parameter				Address
Default	Min	Max	Unit	Logic Diagram
PULSE: Blocking EXT				027 032
0: No				
PULSE: Enabled				027 033
0: No				Fig. 3-317, (p. 3-390)
PULSE: Ready				027 035
0: No				Fig. 3-317, (p. 3-390)
PULSE: Blocked				027 034
0: No				Fig. 3-317, (p. 3-390)
PULSE: VNG> triggered				027 077
0: No				Fig. 3-318, (p. 3-391)
PULSE: IN> triggered				027 078
0: No				Fig. 3-318, (p. 3-391)
PULSE: Active				027 079
0: No				Fig. 3-318, (p. 3-391)
PULSE: Starting				027 080
0: No				
PULSE: G/F forward				027 081
0: No				

Ground fault tripping

Parameter	Address			
Default	Min	Max	Unit	Logic Diagram
GFTRP: Blocking EXT				037 046
0: No				
GFTRP: VNG> triggered EXT				037 047
0: No				
GFTRP: Enabled				040 092
0: No				Fig. 3-320, (p. 3-394)
GFTRP: Trip signal				037 091
0: No				Fig. 3-320, (p. 3-394)

Ground fault protection signaling

Parameter	Address			
Default	Min	Max	Unit	Logic Diagram
GFSIG: Test telecom. EXT				037 045
0: No				
GFSIG: Receive EXT				037 044
0: No				
GFSIG: Enabled				040 091
0: No				Fig. 3-321, (p. 3-396)
GFSIG: Test telecom.				034 025
0: No				Fig. 3-321, (p. 3-396)
GFSIG: Telecom. faulty				038 017
0: No				Fig. 3-321, (p. 3-396)
GFSIG: Send (signal)				037 088
0: No				Fig. 3-321, (p. 3-396)
GFSIG: Send (transm.relay)				037 089
0: No				Fig. 3-321, (p. 3-396)
GFSIG: Trip signal				037 087
0: No				Fig. 3-321, (p. 3-396)

Transient ground
fault direction deter-
mination

Parameter					Address		
Default	Min	Max	Unit		Logic Diagram		
TGFD: Blocking EXT							004 034
0: No							
TGFD: Reset counters EXT							005 246
0: No							
TGFD: Reset mon. sig. EXT							025 168
0: No							
TGFD: Reset signals EXT							004 140
0: No							
TGFD: Enabled							037 100
0: No					Fig. 3-322, (p. 3-398)		
TGFD: Ready							037 080
0: No					Fig. 3-322, (p. 3-398)		
TGFD: Not ready							037 081
1: Yes					Fig. 3-322, (p. 3-398)		
TGFD: Ground fault							004 033
0: No					Fig. 3-324, (p. 3-400)		
TGFD: Direct. determined							004 030
0: No					Fig. 3-325, (p. 3-401)		
TGFD: Forward / LS							004 031
0: No					Fig. 3-325, (p. 3-401)		
TGFD: Backward / BS							004 032
0: No					Fig. 3-325, (p. 3-401)		
TGFD: Signal reset							004 141
0: No					Fig. 3-326, (p. 3-401)		
TGFD: Reset mon. sig.							025 169
0: No					Fig. 3-327, (p. 3-402)		

Thermal overload protection

Parameter					Address		
Default	Min	Max	Unit		Logic Diagram		
THERM: Block replica EXT							041 074
0: No							
THERM: Reset replica EXT							038 061
0: No							
THERM: CTA error EXT							038 062
0: No							
THERM: Enabled							040 068
0: No					Fig. 3-329, (p. 3-403)		
THERM: Not ready							040 035
1: Yes							
THERM: Reset replica							039 061
0: No					Fig. 3-333, (p. 3-410)		
THERM: Starting k*Iref>							041 108
0: No					Fig. 3-332, (p. 3-409)		
THERM: Warning							039 025
0: No					Fig. 3-332, (p. 3-409)		
THERM: Within pre-trip time							041 109
1: Yes					Fig. 3-332, (p. 3-409)		
THERM: Trip signal							039 020
0: No					Fig. 3-332, (p. 3-409)		
THERM: Reclosure blocked							039 024
0: No							
THERM: Buffer empty							039 112
1: Yes					Fig. 3-332, (p. 3-409)		
THERM: CTA error							039 111
0: No					Fig. 3-330, (p. 3-406)		
THERM: Setting error, block.							039 110
0: No					Fig. 3-332, (p. 3-409)		

Time-voltage protection

Parameter					Address		
Default	Min	Max	Unit		Logic Diagram		
V<>: Blocking tV> EXT							041 068
0: No							
V<>: Blocking tV>> EXT							041 069
0: No							
V<>: Blocking tV>>> EXT							010 246
0: No							
V<>: Blocking tV< EXT							041 070
0: No							
V<>: Blocking tV<< EXT							041 071
0: No							
V<>: Blocking tV<<< EXT							010 247
0: No							
V<>: Blocking tVpos> EXT							041 090
0: No							
V<>: Blocking tVpos>> EXT							041 091
0: No							
V<>: Blocking tVpos< EXT							041 092
0: No							
V<>: Blocking tVpos<< EXT							041 093
0: No							
V<>: Blocking tVneg> EXT							041 094
0: No							
V<>: Blocking tVneg>> EXT							041 095
0: No							
V<>: Blocking tVNG> EXT							041 072
0: No							
V<>: Blocking tVNG>>> EXT							025 218
0: No							
V<>: Blocking tVNG>> EXT							041 073
0: No							
V<>: Blocking tVref> EXT							007 036
0: No							
V<>: Blocking tVref>> EXT							007 037
0: No							
V<>: Block. tVref>>> EXT							010 248
0: No							

Parameter				Address
Default	Min	Max	Unit	Logic Diagram
V<>: Blocking tVref< EXT				007 039
0: No				
V<>: Blocking tVref<< EXT				007 046
0: No				
V<>: Block. tVref<<< EXT				010 249
0: No				
V<>: Enabled				040 066
0: No				Fig. 3-334, (p. 3-411)
V<>: Ready				042 003
0: No				Fig. 3-334, (p. 3-411)
V<>: Not ready				042 004
1: Yes				Fig. 3-334, (p. 3-411)
V<>: Starting V>/>> A(-B)				041 031
0: No				Fig. 3-337, (p. 3-414)
V<>: Starting V>/>> B(-C)				041 032
0: No				Fig. 3-337, (p. 3-414)
V<>: Starting V>/>> C(-A)				041 033
0: No				Fig. 3-337, (p. 3-414)
V<>: Starting V>				041 030
0: No				Fig. 3-337, (p. 3-414)
V<>: Starting V>>				041 096
0: No				Fig. 3-337, (p. 3-414)
V<>: Starting V>>>				010 231
0: No				Fig. 3-337, (p. 3-414) Fig. 3-338, (p. 3-415)
V<>: Starting V> 3-pole				041 097
0: No				Fig. 3-337, (p. 3-414)
V<>: Starting V>> 3-pole				010 226
0: No				
V<>: Starting V>>> 3-pole				010 232
0: No				Fig. 3-338, (p. 3-415)
V<>: tV> elapsed				041 034
0: No				Fig. 3-337, (p. 3-414)
V<>: tV>> elapsed				041 035
0: No				Fig. 3-337, (p. 3-414)
V<>: tV>>> elapsed				010 233
0: No				Fig. 3-338, (p. 3-415)

Parameter				Address
Default	Min	Max	Unit	Logic Diagram
V<>: tV> 3-pole elapsed				041 098
0: No				Fig. 3-337, (p. 3-414)
V<>: tV>> 3-pole elapsed				010 227
0: No				Fig. 3-337, (p. 3-414) Fig. 3-340, (p. 3-417)
V<>: tV>>> 3-pole elapsed				010 234
0: No				Fig. 3-338, (p. 3-415)
V<>: Starting V</<< A(-B)				041 038
0: No				Fig. 3-340, (p. 3-417)
V<>: Starting V</<< B(-C)				041 039
0: No				Fig. 3-340, (p. 3-417)
V<>: Starting V</<< C(-A)				041 040
0: No				Fig. 3-340, (p. 3-417)
V<>: Starting V<				041 037
0: No				Fig. 3-339, (p. 3-416)
V<>: Starting V<<				041 099
0: No				Fig. 3-340, (p. 3-417)
V<>: Starting V<<<				010 235
0: No				Fig. 3-341, (p. 3-418)
V<>: Starting V< 1-pole				019 006
0: No				Fig. 3-339, (p. 3-416)
V<>: Starting V< 3-pole				042 005
0: No				Fig. 3-339, (p. 3-416)
V<>: Starting V<< 3-pole				010 228
0: No				Fig. 3-340, (p. 3-417)
V<>: Starting V<< 1-pole				019 007
0: No				Fig. 3-340, (p. 3-417)
V<>: Starting V<<< 3-pole				010 236
0: No				Fig. 3-341, (p. 3-418)
V<>: Starting V<<< 1-pole				019 008
0: No				Fig. 3-341, (p. 3-418)
V<>: tV< elapsed				041 041
0: No				Fig. 3-339, (p. 3-416)
V<>: tV<< elapsed				041 042
0: No				Fig. 3-340, (p. 3-417)
V<>: tV<<< elapsed				010 237
0: No				Fig. 3-341, (p. 3-418)

Parameter				Address
Default	Min	Max	Unit	Logic Diagram
V<>: tV< elaps. transient				042 023
0: No				Fig. 3-339, (p. 3-416) Fig. 3-342, (p. 3-419)
V<>: tV<< elapsed trans.				042 025
0: No				Fig. 3-340, (p. 3-417) Fig. 3-342, (p. 3-419)
V<>: tV<<< elaps.transien				010 238
0: No				Fig. 3-341, (p. 3-418) Fig. 3-342, (p. 3-419)
V<>: tV</<</<<< el.trans				042 007
0: No				Fig. 3-342, (p. 3-419)
V<>: tV< 3-pole elapsed				042 006
0: No				Fig. 3-339, (p. 3-416)
V<>: tV<< 3-pole elapsed				010 229
0: No				
V<>: tV<<< 3-pole elapsed				010 239
0: No				Fig. 3-341, (p. 3-418)
V<>: tV< 3p elaps. trans.				042 024
0: No				Fig. 3-339, (p. 3-416) Fig. 3-342, (p. 3-419)
V<>: tV<< 3p elaps. trans				010 230
0: No				Fig. 3-340, (p. 3-417) Fig. 3-342, (p. 3-419)
V<>: tV<<< 3p elaps.trans				010 240
0: No				Fig. 3-341, (p. 3-418) Fig. 3-342, (p. 3-419)
V<>: Fault V<				041 110
0: No				Fig. 3-339, (p. 3-416)
V<>: Fault V<<				041 112
0: No				Fig. 3-340, (p. 3-417)
V<>: Fault V<<<				011 134
0: No				Fig. 3-341, (p. 3-418)
V<>: Fault V< 3-pole				041 111
0: No				Fig. 3-339, (p. 3-416)
V<>: Fault V<< 3-pole				011 132
0: No				Fig. 3-340, (p. 3-417)
V<>: Fault V<<< 3-pole				011 133
0: No				Fig. 3-341, (p. 3-418)

Parameter				Address
Default	Min	Max	Unit	Logic Diagram
V<>: Starting Vpos>				042 010
0: No	Fig. 3-344, (p. 3-422)			
V<>: Starting Vpos>>				042 011
0: No	Fig. 3-344, (p. 3-422)			
V<>: tVpos> elapsed				042 012
0: No	Fig. 3-344, (p. 3-422)			
V<>: tVpos>> elapsed				042 013
0: No	Fig. 3-344, (p. 3-422)			
V<>: Starting Vpos<				042 014
0: No	Fig. 3-344, (p. 3-422)			
V<>: Starting Vpos<<				042 015
0: No	Fig. 3-344, (p. 3-422)			
V<>: tVpos< elapsed				042 016
0: No	Fig. 3-344, (p. 3-422)			
V<>: tVpos< elaps. trans.				042 026
0: No	Fig. 3-344, (p. 3-422)			
V<>: tVpos<< elapsed				042 017
0: No	Fig. 3-344, (p. 3-422)			
V<>: tVpos<< elaps.trans.				042 027
0: No	Fig. 3-344, (p. 3-422)			
V<>: tVpos</<< elap.trans				042 018
0: No	Fig. 3-344, (p. 3-422)			
V<>: Fault Vpos<				041 113
0: No	Fig. 3-344, (p. 3-422)			
V<>: Fault Vpos<<				041 114
0: No	Fig. 3-344, (p. 3-422)			
V<>: Starting Vneg>				042 019
0: No	Fig. 3-345, (p. 3-423)			
V<>: Starting Vneg>>				042 020
0: No	Fig. 3-345, (p. 3-423)			
V<>: tVneg> elapsed				042 021
0: No	Fig. 3-345, (p. 3-423)			
V<>: tVneg>> elapsed				042 022
0: No	Fig. 3-345, (p. 3-423)			
V<>: Starting VNG>				041 044
0: No	Fig. 3-347, (p. 3-424)			
V<>: Starting VNG>>				042 008
0: No	Fig. 3-347, (p. 3-424)			

Parameter				Address
Default	Min	Max	Unit	Logic Diagram
V<>: Starting VNG>>>				025 219
0: No				Fig. 3-347, (p. 3-424)
V<>: tVNG> elapsed				041 045
0: No				Fig. 3-347, (p. 3-424)
V<>: tVNG>> elapsed				041 046
0: No				Fig. 3-347, (p. 3-424)
V<>: tVNG>>> elapsed				025 220
0: No				Fig. 3-347, (p. 3-424)
V<>: Starting Vref>				007 051
0: No				Fig. 3-348, (p. 3-425)
V<>: Starting Vref>>				007 052
0: No				Fig. 3-348, (p. 3-425)
V<>: Starting Vref>>>				010 241
0: No				Fig. 3-348, (p. 3-425)
V<>: tVref> elapsed				007 047
0: No				Fig. 3-348, (p. 3-425)
V<>: tVref>> elapsed				007 048
0: No				Fig. 3-348, (p. 3-425)
V<>: tVref>>> elapsed				010 242
0: No				Fig. 3-348, (p. 3-425)
V<>: Starting Vref<				007 055
0: No				Fig. 3-349, (p. 3-426)
V<>: Starting Vref<<				007 056
0: No				Fig. 3-349, (p. 3-426)
V<>: Starting Vref<<<				010 243
0: No				Fig. 3-349, (p. 3-426)
V<>: tVref< elapsed				007 053
0: No				Fig. 3-349, (p. 3-426)
V<>: tVref<< elapsed				007 054
0: No				Fig. 3-349, (p. 3-426)
V<>: tVref<<< elapsed				010 244
0: No				
V<>: tVref< elaps. trans.				007 057
0: No				Fig. 3-349, (p. 3-426)
V<>: tVref<< elaps.trans.				007 060
0: No				Fig. 3-349, (p. 3-426)
V<>: tVref<<< elaps.trans				010 245
0: No				Fig. 3-349, (p. 3-426)

Parameter				Address
Default	Min	Max	Unit	Logic Diagram
V<>: tVref</<</<<< el.tr.				007 063
0: No	Fig. 3-349, (p. 3-426)			
V<>: Fault Vref<				007 061
0: No	Fig. 3-349, (p. 3-426)			
V<>: Fault Vref<<				007 062
0: No	Fig. 3-349, (p. 3-426)			
V<>: Fault Vref<<<				011 135
0: No	Fig. 3-349, (p. 3-426)			

Over/
underfrequency pro-
tection

Parameter					Address		
Default	Min	Max	Unit		Logic Diagram		
f<>: Reset meas. vals EXT							006 075
0: No							
f<>: Blocking f1 EXT							042 103
0: No							
f<>: Blocking f2 EXT							042 104
0: No							
f<>: Blocking f3 EXT							042 105
0: No							
f<>: Blocking f4 EXT							042 106
0: No							
f<>: Blocking f5 EXT							013 095
0: No							
f<>: Enabled							042 100
0: No					Fig. 3-350, (p. 3-427)		
f<>: Ready							042 101
0: No					Fig. 3-350, (p. 3-427)		
f<>: Not ready							042 140
0: No					Fig. 3-350, (p. 3-427)		
f<>: Blocked by V<							042 102
0: No					Fig. 3-71, (p. 3-113) Fig. 3-350, (p. 3-427)		
f<>: Starting f1							042 107
0: No					Fig. 3-352, (p. 3-430)		
f<>: Starting f1/df1							042 108
0: No					Fig. 3-352, (p. 3-430)		
f<>: Delta f1 triggered							042 109
0: No					Fig. 3-352, (p. 3-430)		
f<>: Delta t1 elapsed							042 110
0: No					Fig. 3-352, (p. 3-430)		
f<>: Trip signal f1							042 111
0: No					Fig. 3-352, (p. 3-430)		
f<>: Starting f2							042 115
0: No							
f<>: Starting f2/df2							042 116
0: No							

Parameter				Address
Default	Min	Max	Unit	Logic Diagram
f<>: Delta f2 triggered				042 117
0: No				
f<>: Delta t2 elapsed				042 118
0: No				
f<>: Trip signal f2				042 119
0: No				
f<>: Starting f3				042 123
0: No				
f<>: Starting f3/df3				042 124
0: No				
f<>: Delta f3 triggered				042 125
0: No				
f<>: Delta t3 elapsed				042 126
0: No				
f<>: Trip signal f3				042 127
0: No				
f<>: Starting f4				042 131
0: No				
f<>: Starting f4/df4				042 132
0: No				
f<>: Delta f4 triggered				042 133
0: No				
f<>: Delta t4 elapsed				042 134
0: No				
f<>: Trip signal f4				042 135
0: No				
f<>: Starting f5				013 100
0: No				
f<>: Starting f5/df5				013 101
0: No				
f<>: Delta f5 triggered				013 103
0: No				
f<>: Delta t5 elapsed				013 104
0: No				
f<>: Trip signal f5				013 105
0: No				

Underfrequency load shedding

Parameter	Address			
Default	Min	Max	Unit	Logic Diagram
Pf<: Delta U detected				015 205
0: No				
Pf<: Enabled				016 052
0: No				Fig. 3-353, (p. 3-432)
Pf<: Ready				016 053
0: No				Fig. 3-354, (p. 3-433)
Pf<: Blocked				016 055
0: No				Fig. 3-354, (p. 3-433)
Pf<: Blocked by V<				016 056
0: No				Fig. 3-71, (p. 3-113)
Pf<: Blocked by Pmin				016 057
0: No				Fig. 3-356, (p. 3-435)
Pf<: Starting Pf<				016 058
0: No				Fig. 3-356, (p. 3-435)
Pf<: Trip signal Pf<				016 059
0: No				Fig. 3-356, (p. 3-435)
Pf<: f1 active				016 071
0: No				
Pf<: f2 active				016 075
0: No				
Pf<: f3 active				016 080
0: No				
Pf<: f4 active				016 081
0: No				
Pf<: f5 active				016 084
0: No				
Pf<: f6 active				016 085
0: No				
Pf<: f7 active				016 086
0: No				
Pf<: f8 active				016 087
0: No				
Pf<: f9 active				016 088
0: No				
Pf<: f10 active				016 089
0: No				

Parameter				Address
Default	Min	Max	Unit	Logic Diagram
Pf<: Blocking tPF< EXT				016 030
0: No				
Pf<: Activate f1 EXT				016 031
0: No				
Pf<: Activate f2 EXT				016 032
0: No				
Pf<: Activate f3 EXT				016 033
0: No				
Pf<: Activate f4 EXT				016 034
0: No				
Pf<: Activate f5 EXT				016 035
0: No				
Pf<: Activate f6 EXT				016 036
0: No				
Pf<: Activate f7 EXT				016 037
0: No				
Pf<: Activate f8 EXT				016 038
0: No				
Pf<: Activate f9 EXT				016 039
0: No				
Pf<: Activate f10 EXT				016 046
0: No				
Pf<: Deactivate fn EXT				016 051
0: No				

Power directional protection

Parameter	Address			
Default	Min	Max	Unit	Logic Diagram
P<>: Blocking tP> EXT				035 082
0: No				
P<>: Blocking tP>> EXT				035 083
0: No				
P<>: Blocking tQ> EXT				035 084
0: No				
P<>: Blocking tQ>> EXT				035 085
0: No				
P<>: Blocking tP< EXT				035 050
0: No				
P<>: Blocking tP<< EXT				035 051
0: No				
P<>: Blocking tQ< EXT				035 052
0: No				
P<>: Blocking tQ<< EXT				035 053
0: No				
P<>: Enabled				036 250
0: No				Fig. 3-357, (p. 3-436)
P<>: Starting P>				035 086
0: No				Fig. 3-359, (p. 3-438)
P<>: Starting P>>				035 089
0: No				Fig. 3-359, (p. 3-438)
P<>: Signal P> delayed				035 087
0: No				Fig. 3-359, (p. 3-438)
P<>: Signal P>> delayed				035 090
0: No				Fig. 3-359, (p. 3-438)
P<>: Trip signal P>				035 088
0: No				Fig. 3-360, (p. 3-439)
P<>: Trip signal P>>				035 091
0: No				Fig. 3-360, (p. 3-439)
P<>: Starting Q>				035 092
0: No				Fig. 3-361, (p. 3-440)
P<>: Starting Q>>				035 095
0: No				Fig. 3-361, (p. 3-440)
P<>: Signal Q> delayed				035 093
0: No				Fig. 3-361, (p. 3-440)

Parameter				Address
Default	Min	Max	Unit	Logic Diagram
P<>: Signal Q>> delayed				035 096
0: No				Fig. 3-361, (p. 3-440)
P<>: Trip signal Q>				035 094
0: No				Fig. 3-362, (p. 3-441)
P<>: Trip signal Q>>				035 097
0: No				Fig. 3-362, (p. 3-441)
P<>: Starting P<				035 054
0: No				Fig. 3-363, (p. 3-442)
P<>: Starting P<<				035 060
0: No				Fig. 3-363, (p. 3-442)
P<>: Signal P< delayed				035 055
0: No				Fig. 3-363, (p. 3-442)
P<>: Signal P<< delayed				035 061
0: No				Fig. 3-363, (p. 3-442)
P<>: tP< elapsed trans.				035 056
0: No				Fig. 3-363, (p. 3-442)
P<>: tP<< elapsed trans.				035 062
0: No				Fig. 3-363, (p. 3-442)
P<>: tP</tP<< elaps.trans				035 178
0: No				Fig. 3-363, (p. 3-442)
P<>: Fault P<				035 057
0: No				Fig. 3-363, (p. 3-442)
P<>: Fault P<<				035 063
0: No				Fig. 3-363, (p. 3-442)
P<>: Trip signal P<				035 058
0: No				Fig. 3-364, (p. 3-443)
P<>: Trip signal P<<				035 064
0: No				Fig. 3-364, (p. 3-443)
P<>: Trip signal P< trans				035 059
0: No				Fig. 3-364, (p. 3-443)
P<>: Trip sig. P<< trans.				035 065
0: No				Fig. 3-364, (p. 3-443)
P<>: Starting Q<				035 066
0: No				Fig. 3-366, (p. 3-445)
P<>: Starting Q<<				035 010
0: No				Fig. 3-366, (p. 3-445)
P<>: Signal Q< delayed				035 067
0: No				Fig. 3-366, (p. 3-445)

Parameter				Address
Default	Min	Max	Unit	Logic Diagram
P<>: Signal Q<< delayed				035 011
0: No				Fig. 3-366, (p. 3-445)
P<>: tQ< elapsed trans.				035 068
0: No				Fig. 3-366, (p. 3-445)
P<>: tQ<< elapsed trans.				035 016
0: No				Fig. 3-366, (p. 3-445)
P<>: tQ</tQ<< elaps.trans				035 179
0: No				Fig. 3-366, (p. 3-445)
P<>: Fault Q<				035 069
0: No				Fig. 3-366, (p. 3-445)
P<>: Fault Q<<				035 049
0: No				Fig. 3-366, (p. 3-445)
P<>: Trip signal Q<				035 155
0: No				Fig. 3-367, (p. 3-446)
P<>: Trip signal Q<<				035 176
0: No				Fig. 3-367, (p. 3-446)
P<>: Trip sig. Q< trans.				035 156
0: No				Fig. 3-367, (p. 3-446)
P<>: Trip sig. Q<< trans.				035 177
0: No				Fig. 3-367, (p. 3-446)
P<>: Direction P forw.				035 181
0: No				Fig. 3-369, (p. 3-447)
P<>: Direction P backw.				035 191
0: No				Fig. 3-369, (p. 3-447)
P<>: Direction Q forw.				035 193
0: No				Fig. 3-370, (p. 3-448)
P<>: Direction Q backw.				035 194
0: No				Fig. 3-370, (p. 3-448)

Voltage controlled
directional reactive
power protection

Parameter					Address			
Default	Min	Max	Unit		Logic Diagram			
QV: Blocking EXT								013 149
0: No								
QV: Enabled								013 181
0: No					Fig. 3-371, (p. 3-449)			
QV: Blocked								013 182
0: No					Fig. 3-372, (p. 3-449)			
QV: Ready								013 183
0: No					Fig. 3-372, (p. 3-449)			
QV: Not ready								013 255
0: No								
QV: Starting $V < 3p$								014 073
0: No								
QV: Starting Imin								014 083
0: No								
QV: Starting Q direction								014 074
0: No								
QV: Starting QV								014 088
0: No								
QV: Trip signal t1								014 075
0: No					Fig. 3-374, (p. 3-451)			
QV: Trip signal t2								014 076
0: No					Fig. 3-374, (p. 3-451)			
QV: Trip command t1								014 077
0: No					Fig. 3-374, (p. 3-451)			
QV: Trip command t2								014 078
0: No					Fig. 3-374, (p. 3-451)			

High Impedance protection

Parameter					Address		
Default	Min	Max	Unit		Logic Diagram		
DELTA: Start EXT							021 082
0: No							
DELTA: Blocking EXT							038 053
0: No							
External blocking signal of DELTA protection.							
DELTA: Enabled							038 054
0: No Fig. 3-376, (p. 3-453)							
Indicates that DELTA protection is enabled.							
DELTA: Starting							021 078
0: No Fig. 3-377, (p. 3-453)							
DELTA: Starting A							021 079
0: No Fig. 3-377, (p. 3-453)							
DELTA: Starting B							021 080
0: No Fig. 3-377, (p. 3-453)							
DELTA: Starting C							021 081
0: No Fig. 3-377, (p. 3-453)							
DELTA: Operative time runn.							021 083
0: No Fig. 3-377, (p. 3-453)							
DELTA: Trip signal							038 056
0: No Fig. 3-377, (p. 3-453)							
Trip signal by the DELTA protection function.							

Circuit breaker
failure protection

Parameter				Address
Default	Min	Max	Unit	Logic Diagram
CBF: Enable EXT				038 041
2: Not configured				
CBF: Disable EXT				038 042
2: Not configured				
CBF: Blocking EXT				038 058
0: No				
CBF: Start enable EXT				038 209
1: Yes				
CBF: Start 3p EXT				038 205
0: No				
CBF: Starting trig. EXT				038 016
0: No				
CBF: CB faulty EXT				038 234
0: No				
CBF: Ext./user enabled				038 040
1: Yes	Fig. 3-378, (p. 3-455)			
CBF: Enabled				040 055
0: No Fig. 3-378, (p. 3-455)				
CBF: Ready				038 009
0: No				
CBF: Not ready				040 025
1: Yes Fig. 3-379, (p. 3-456)				
CBF: CB pos. implausible				038 210
0: No Fig. 3-76, (p. 3-117) Fig. 3-381, (p. 3-458)				
CBF: Current flow A				038 230
0: No Fig. 3-380, (p. 3-457)				
CBF: Current flow B				038 231
0: No Fig. 3-380, (p. 3-457)				
CBF: Current flow C				038 232
0: No Fig. 3-380, (p. 3-457)				
CBF: Current flow Phx				038 233
0: No Fig. 3-380, (p. 3-457)				
CBF: Current flow N				038 235
0: No Fig. 3-380, (p. 3-457)				
Signal that the residual current is greater than the set value CBF: IN < .				

Parameter				Address
Default	Min	Max	Unit	Logic Diagram
CBF: Startup 3p				038 211
0: No				Fig. 3-382, (p. 3-459)
CBF: Trip signal t1				038 215
0: No				Fig. 3-383, (p. 3-460)
CBF: Trip signal t2				038 219
0: No				Fig. 3-383, (p. 3-460)
CBF: Trip command t1				038 220
0: No				Fig. 3-384, (p. 3-461)
CBF: Trip command t2				038 224
0: No				Fig. 3-384, (p. 3-461)
CBF: CB failure				036 017
0: No				Fig. 3-383, (p. 3-460)
CBF: Starting				038 021
0: No				Fig. 3-385, (p. 3-461)
CBF: Trip signal				040 026
0: No				Fig. 3-385, (p. 3-461)
CBF: Fault behind CB				038 225
0: No				Fig. 3-386, (p. 3-462)
CBF: TripSig Cbsync.super				038 226
0: No				Fig. 3-387, (p. 3-462)
CBF: Cbsync.superv A open				038 227
0: No				Fig. 3-387, (p. 3-462)
CBF: Cbsync.superv B open				038 228
0: No				Fig. 3-387, (p. 3-462)
CBF: Cbsync.superv C open				038 229
0: No				Fig. 3-387, (p. 3-462)

Circuit breaker
condition monitoring

Parameter					Address
Default	Min	Max	Unit	Logic Diagram	
CBM: Reset meas.val. EXT					005 247
0: No					
CBM: Blocking EXT					044 128
0: No					
CBM: Enabled					044 130
0: No				Fig. 3-388, (p. 3-464)	
CBM: Blocked					044 199
0: No				Fig. 3-396, (p. 3-472)	
CBM: Sig. No. CB op. >					044 135
0: No				Fig. 3-395, (p. 3-471)	
CBM: Sig. Rem. No.CB op.<					044 136
0: No				Fig. 3-394, (p. 3-471)	
CBM: Signal ΣI_{trip} >					044 137
0: No					
CBM: Signal ΣI_{trip}^{**2} >					044 138
0: No					
CBM: Signal ΣI^{*t} >					044 139
0: No					
CBM: Cycle running A					044 205
0: No					
CBM: Cycle running B					044 206
0: No					
CBM: Cycle running C					044 207
0: No					
CBM: tmax> A					044 177
0: No					
CBM: tmax> B					044 178
0: No					
CBM: tmax> C					044 179
0: No					
CBM: Curr. flow ended A					044 201
0: No					
CBM: Curr. flow ended B					044 202
0: No					
CBM: Curr. flow ended C					044 203
0: No					

Parameter				Address			
Default	Min	Max	Unit	Logic Diagram			
CBM: Setting error CBM							044 204
0: No							

Limit value monitoring

Parameter					Address
Default	Min	Max	Unit		Logic Diagram
LIMIT: Enabled					040 074
0: No					Fig. 3-397, (p. 3-474) Fig. 3-401, (p. 3-478)
LIMIT: tI> elapsed					040 220
0: No					Fig. 3-397, (p. 3-474)
LIMIT: tI>> elapsed					040 221
0: No					Fig. 3-397, (p. 3-474)
LIMIT: tI< elapsed					040 222
0: No					Fig. 3-397, (p. 3-474)
LIMIT: tI<< elapsed					040 223
0: No					Fig. 3-397, (p. 3-474)
LIMIT: tVPG> elapsed					040 224
0: No					Fig. 3-398, (p. 3-475)
LIMIT: tVPG>> elapsed					040 225
0: No					Fig. 3-398, (p. 3-475)
LIMIT: tVPG< elapsed					040 226
0: No					Fig. 3-398, (p. 3-475)
LIMIT: tVPG<< elapsed					040 227
0: No					Fig. 3-398, (p. 3-475)
LIMIT: tVPP> elapsed					040 228
0: No					Fig. 3-398, (p. 3-475)
LIMIT: tVPP>> elapsed					040 229
0: No					Fig. 3-398, (p. 3-475)
LIMIT: tVPP< elapsed					040 230
0: No					Fig. 3-398, (p. 3-475)
LIMIT: tVPP<< elapsed					040 231
0: No					Fig. 3-398, (p. 3-475)
LIMIT: tVNG> elapsed					040 168
0: No					Fig. 3-399, (p. 3-476)
LIMIT: tVNG>> elapsed					040 169
0: No					Fig. 3-399, (p. 3-476)
LIMIT: tVref> elapsed					042 152
0: No					Fig. 3-401, (p. 3-478)
LIMIT: tVref>> elapsed					042 153
0: No					Fig. 3-401, (p. 3-478)
LIMIT: tVref< elapsed					042 154
0: No					Fig. 3-401, (p. 3-478)

Parameter				Address
Default	Min	Max	Unit	Logic Diagram
LIMIT: tVref<< elapsed				042 155
0: No				Fig. 3-401, (p. 3-478)
LIMIT: Starting IDC,lin>				040 180
0: No				Fig. 3-400, (p. 3-477)
LIMIT: Starting IDC,lin>>				040 181
0: No				Fig. 3-400, (p. 3-477)
LIMIT: tIDC,lin> elapsed				040 182
0: No				Fig. 3-400, (p. 3-477)
LIMIT: tIDC,lin>> elapsed				040 183
0: No				Fig. 3-400, (p. 3-477)
LIMIT: Starting IDC,lin<				040 184
0: No				Fig. 3-400, (p. 3-477)
LIMIT: Starting IDC,lin<<				040 185
0: No				Fig. 3-400, (p. 3-477)
LIMIT: tIDC,lin< elapsed				040 186
0: No				Fig. 3-400, (p. 3-477)
LIMIT: tIDC,lin<< elapsed				040 187
0: No				Fig. 3-400, (p. 3-477)
LIMIT: Starting T>				040 170
0: No				Fig. 3-402, (p. 3-479)
LIMIT: Starting T>>				040 171
0: No				Fig. 3-402, (p. 3-479)
LIMIT: tT> elapsed				040 172
0: No				Fig. 3-402, (p. 3-479)
LIMIT: tT>> elapsed				040 173
0: No				Fig. 3-402, (p. 3-479)
LIMIT: Starting T<				040 174
0: No				Fig. 3-402, (p. 3-479)
LIMIT: Starting T<<				040 175
0: No				Fig. 3-402, (p. 3-479)
LIMIT: tT< elapsed				040 176
0: No				Fig. 3-402, (p. 3-479)
LIMIT: tT<< elapsed				040 177
0: No				Fig. 3-402, (p. 3-479)
LIMIT: tIPxx triggered				221 232
0: Not triggered				
LIMIT: tVPGxx triggered				221 233
0: Not triggered				

Parameter					Address		
Default	Min	Max	Unit		Logic Diagram		
LIMIT: tVPPxx triggered							221 234
0: Not triggered							
LIMIT: tVNGxx triggered							221 235
0: Not triggered							
LIMIT: tVrefxx triggered							221 237
0: Not triggered							

Transformer
monitoring

Parameter					Address		
Default	Min	Max	Unit		Logic Diagram		
TRMON: DC Faulty 1 EXT							024 014
0: No							
TRMON: Insul. Alarm 1 EXT							016 241
0: No							
TRMON: Buchholz Alarm 3 EXT							016 248
0: No							
TRMON: Buchholz Alarm 1 EXT							016 242
0: No							
TRMON: Buchholz Trip 1 EXT							016 243
0: No							
TRMON: DC Faulty 2 EXT							024 019
0: No							
TRMON: Insul. Alarm 2 EXT							016 244
0: No							
TRMON: Buchholz Alarm 2 EXT							016 245
0: No							
TRMON: Buchholz Trip 2 EXT							016 246
0: No							
TRMON: DC Faulty 3 EXT							024 026
0: No							
TRMON: Insul. Alarm 3 EXT							016 247
0: No							
TRMON: Buchholz Trip 3 EXT							016 249
0: No							
TRMON: DC Faulty 1							024 018
0: No							
TRMON: Insul. Alarm 1							016 250
0: No						Fig. 3-403, (p. 3-480)	
TRMON: Buchholz Alarm 1							016 251
0: No						Fig. 3-403, (p. 3-480)	
TRMON: Buchholz Trip 1							016 252
0: No						Fig. 3-403, (p. 3-480)	
TRMON: DC Faulty 2							024 020
0: No							
TRMON: Insul. Alarm 2							016 253
0: No						Fig. 3-403, (p. 3-480)	

Parameter				Address
Default	Min	Max	Unit	Logic Diagram
TRMON: Buchholz Alarm 2				016 254
0: No	Fig. 3-403, (p. 3-480)			
TRMON: Buchholz Trip 2				016 255
0: No	Fig. 3-403, (p. 3-480)			
TRMON: DC Faulty 3				024 036
0: No				
TRMON: Insul. Alarm 3				018 007
0: No	Fig. 3-403, (p. 3-480)			
TRMON: Buchholz Alarm 3				018 016
0: No	Fig. 3-403, (p. 3-480)			
TRMON: Buchholz Trip 3				018 039
0: No	Fig. 3-403, (p. 3-480)			

Programmable Logic

Parameter					Address		
Default	Min	Max	Unit		Logic Diagram		
LOGIC: Input 01 EXT							034 000
0: No							
LOGIC: Input 02 EXT							034 001
0: No							
LOGIC: Input 03 EXT							034 002
0: No							
LOGIC: Input 04 EXT							034 003
0: No							
LOGIC: Input 05 EXT							034 004
0: No							
LOGIC: Input 06 EXT							034 005
0: No							
LOGIC: Input 07 EXT							034 006
0: No							
LOGIC: Input 08 EXT							034 007
0: No							
LOGIC: Input 09 EXT							034 008
0: No							
LOGIC: Input 10 EXT							034 009
0: No							
LOGIC: Input 11 EXT							034 010
0: No							
LOGIC: Input 12 EXT							034 011
0: No							
LOGIC: Input 13 EXT							034 012
0: No							
LOGIC: Input 14 EXT							034 013
0: No							
LOGIC: Input 15 EXT							034 014
0: No							
LOGIC: Input 16 EXT							034 015
0: No							
LOGIC: Input 17 EXT							034 086
0: No							
LOGIC: Input 18 EXT							034 087
0: No							
LOGIC: Input 19 EXT							034 088
0: No							

Parameter				Address
Default	Min	Max	Unit	Logic Diagram
LOGIC: Input 20 EXT				034 089
0: No				
LOGIC: Input 21 EXT				034 090
0: No				
LOGIC: Input 22 EXT				034 091
0: No				
LOGIC: Input 23 EXT				034 092
0: No				
LOGIC: Input 24 EXT				034 093
0: No				
LOGIC: Input 25 EXT				034 094
0: No				
LOGIC: Input 26 EXT				034 095
0: No				
LOGIC: Input 27 EXT				034 096
0: No				
LOGIC: Input 28 EXT				034 097
0: No				
LOGIC: Input 29 EXT				034 098
0: No				
LOGIC: Input 30 EXT				034 099
0: No				
LOGIC: Input 31 EXT				034 100
0: No				
LOGIC: Input 32 EXT				034 101
0: No				
LOGIC: Input 33 EXT				034 102
0: No				
LOGIC: Input 34 EXT				034 103
0: No				
LOGIC: Input 35 EXT				034 104
0: No				
LOGIC: Input 36 EXT				034 105
0: No				
LOGIC: Input 37 EXT				034 106
0: No				
LOGIC: Input 38 EXT				034 107
0: No				

Parameter					Address		
Default	Min	Max	Unit		Logic Diagram		
LOGIC: Input 39 EXT							034 108
0: No							
LOGIC: Input 40 EXT							034 109
0: No							
LOGIC: Set 1 EXT							034 051
2: Not configured							
LOGIC: Set 2 EXT							034 052
2: Not configured							
LOGIC: Set 3 EXT							034 053
2: Not configured							
LOGIC: Set 4 EXT							034 054
2: Not configured							
LOGIC: Set 5 EXT							034 055
2: Not configured							
LOGIC: Set 6 EXT							034 056
2: Not configured							
LOGIC: Set 7 EXT							034 057
2: Not configured							
LOGIC: Set 8 EXT							034 058
2: Not configured							
LOGIC: Reset 1 EXT							034 059
2: Not configured							
LOGIC: Reset 2 EXT							034 060
2: Not configured							
LOGIC: Reset 3 EXT							034 061
2: Not configured							
LOGIC: Reset 4 EXT							034 062
2: Not configured							
LOGIC: Reset 5 EXT							034 063
2: Not configured							
LOGIC: Reset 6 EXT							034 064
2: Not configured							
LOGIC: Reset 7 EXT							034 065
2: Not configured							
LOGIC: Reset 8 EXT							034 066
2: Not configured							
LOGIC: 1 has been set							034 067
0: No							

Fig. 3-404, (p. 3-482)

Parameter				Address
Default	Min	Max	Unit	Logic Diagram
LOGIC: 2 has been set				034 068
0: No				
LOGIC: 3 has been set				034 069
0: No				
LOGIC: 4 has been set				034 070
0: No				
LOGIC: 5 has been set				034 071
0: No				
LOGIC: 6 has been set				034 072
0: No				
LOGIC: 7 has been set				034 073
0: No				
LOGIC: 8 has been set				034 074
0: No				
LOGIC: 1 set externally				034 075
0: No				Fig. 3-404, (p. 3-482)
LOGIC: 2 set externally				034 076
0: No				
LOGIC: 3 set externally				034 077
0: No				
LOGIC: 4 set externally				034 078
0: No				
LOGIC: 5 set externally				034 079
0: No				
LOGIC: 6 set externally				034 080
0: No				
LOGIC: 7 set externally				034 081
0: No				
LOGIC: 8 set externally				034 082
0: No				
LOGIC: Enabled				034 046
0: No				Fig. 3-405, (p. 3-483)
LOGIC: Output 01				042 032
0: No				Fig. 3-405, (p. 3-483)
LOGIC: Output 01 (t)				042 033
0: No				Fig. 3-405, (p. 3-483)
LOGIC: Output 02				042 034
0: No				

Parameter					Address		
Default	Min	Max	Unit		Logic Diagram		
LOGIC: Output 02 (t)							042 035
0: No							
LOGIC: Output 03							042 036
0: No							
LOGIC: Output 03 (t)							042 037
0: No							
LOGIC: Output 04							042 038
0: No							
LOGIC: Output 04 (t)							042 039
0: No							
LOGIC: Output 05							042 040
0: No							
LOGIC: Output 05 (t)							042 041
0: No							
LOGIC: Output 06							042 042
0: No							
LOGIC: Output 06 (t)							042 043
0: No							
LOGIC: Output 07							042 044
0: No							
LOGIC: Output 07 (t)							042 045
0: No							
LOGIC: Output 08							042 046
0: No							
LOGIC: Output 08 (t)							042 047
0: No							
LOGIC: Output 09							042 048
0: No							
LOGIC: Output 09 (t)							042 049
0: No							
LOGIC: Output 10							042 050
0: No							
LOGIC: Output 10 (t)							042 051
0: No							
LOGIC: Output 11							042 052
0: No							
LOGIC: Output 11 (t)							042 053
0: No							

Parameter				Address
Default	Min	Max	Unit	Logic Diagram
LOGIC: Output 12				042 054
0: No				
LOGIC: Output 12 (t)				042 055
0: No				
LOGIC: Output 13				042 056
0: No				
LOGIC: Output 13 (t)				042 057
0: No				
LOGIC: Output 14				042 058
0: No				
LOGIC: Output 14 (t)				042 059
0: No				
LOGIC: Output 15				042 060
0: No				
LOGIC: Output 15 (t)				042 061
0: No				
LOGIC: Output 16				042 062
0: No				
LOGIC: Output 16 (t)				042 063
0: No				
LOGIC: Output 17				042 064
0: No				
LOGIC: Output 17 (t)				042 065
0: No				
LOGIC: Output 18				042 066
0: No				
LOGIC: Output 18 (t)				042 067
0: No				
LOGIC: Output 19				042 068
0: No				
LOGIC: Output 19 (t)				042 069
0: No				
LOGIC: Output 20				042 070
0: No				
LOGIC: Output 20 (t)				042 071
0: No				
LOGIC: Output 21				042 072
0: No				

Parameter					Address		
Default	Min	Max	Unit		Logic Diagram		
LOGIC: Output 21 (t)							042 073
0: No							
LOGIC: Output 22							042 074
0: No							
LOGIC: Output 22 (t)							042 075
0: No							
LOGIC: Output 23							042 076
0: No							
LOGIC: Output 23 (t)							042 077
0: No							
LOGIC: Output 24							042 078
0: No							
LOGIC: Output 24 (t)							042 079
0: No							
LOGIC: Output 25							042 080
0: No							
LOGIC: Output 25 (t)							042 081
0: No							
LOGIC: Output 26							042 082
0: No							
LOGIC: Output 26 (t)							042 083
0: No							
LOGIC: Output 27							042 084
0: No							
LOGIC: Output 27 (t)							042 085
0: No							
LOGIC: Output 28							042 086
0: No							
LOGIC: Output 28 (t)							042 087
0: No							
LOGIC: Output 29							042 088
0: No							
LOGIC: Output 29 (t)							042 089
0: No							
LOGIC: Output 30							042 090
0: No							
LOGIC: Output 30 (t)							042 091
0: No							

Parameter				Address
Default	Min	Max	Unit	Logic Diagram
LOGIC: Output 31				042 092
0: No				
LOGIC: Output 31 (t)				042 093
0: No				
LOGIC: Output 32				042 094
0: No				
LOGIC: Output 32 (t)				042 095
0: No				
LOGIC: Output 33				042 180
0: No				
LOGIC: Output 33 (t)				042 181
0: No				
LOGIC: Output 34				042 182
0: No				
LOGIC: Output 34 (t)				042 183
0: No				
LOGIC: Output 35				042 184
0: No				
LOGIC: Output 35 (t)				042 185
0: No				
LOGIC: Output 36				042 186
0: No				
LOGIC: Output 36 (t)				042 187
0: No				
LOGIC: Output 37				042 188
0: No				
LOGIC: Output 37 (t)				042 189
0: No				
LOGIC: Output 38				042 190
0: No				
LOGIC: Output 38 (t)				042 191
0: No				
LOGIC: Output 39				042 192
0: No				
LOGIC: Output 39 (t)				042 193
0: No				
LOGIC: Output 40				042 194
0: No				

Parameter					Address
Default	Min	Max	Unit		Logic Diagram
LOGIC: Output 40 (t)					042 195
0: No					
LOGIC: Output 41					042 196
0: No					
LOGIC: Output 41 (t)					042 197
0: No					
LOGIC: Output 42					042 198
0: No					
LOGIC: Output 42 (t)					042 199
0: No					
LOGIC: Output 43					042 200
0: No					
LOGIC: Output 43 (t)					042 201
0: No					
LOGIC: Output 44					042 202
0: No					
LOGIC: Output 44 (t)					042 203
0: No					
LOGIC: Output 45					042 204
0: No					
LOGIC: Output 45 (t)					042 205
0: No					
LOGIC: Output 46					042 206
0: No					
LOGIC: Output 46 (t)					042 207
0: No					
LOGIC: Output 47					042 208
0: No					
LOGIC: Output 47 (t)					042 209
0: No					
LOGIC: Output 48					042 210
0: No					
LOGIC: Output 48 (t)					042 211
0: No					
LOGIC: Output 49					042 212
0: No					
LOGIC: Output 49 (t)					042 213
0: No					

Parameter				Address
Default	Min	Max	Unit	Logic Diagram
LOGIC: Output 50				042 214
0: No				
LOGIC: Output 50 (t)				042 215
0: No				
LOGIC: Output 51				042 216
0: No				
LOGIC: Output 51 (t)				042 217
0: No				
LOGIC: Output 52				042 218
0: No				
LOGIC: Output 52 (t)				042 219
0: No				
LOGIC: Output 53				042 220
0: No				
LOGIC: Output 53 (t)				042 221
0: No				
LOGIC: Output 54				042 222
0: No				
LOGIC: Output 54 (t)				042 223
0: No				
LOGIC: Output 55				042 224
0: No				
LOGIC: Output 55 (t)				042 225
0: No				
LOGIC: Output 56				042 226
0: No				
LOGIC: Output 56 (t)				042 227
0: No				
LOGIC: Output 57				042 228
0: No				
LOGIC: Output 57 (t)				042 229
0: No				
LOGIC: Output 58				042 230
0: No				
LOGIC: Output 58 (t)				042 231
0: No				
LOGIC: Output 59				042 232
0: No				

Parameter					Address		
Default	Min	Max	Unit		Logic Diagram		
LOGIC: Output 59 (t)							042 233
0: No							
LOGIC: Output 60							042 234
0: No							
LOGIC: Output 60 (t)							042 235
0: No							
LOGIC: Output 61							042 236
0: No							
LOGIC: Output 61 (t)							042 237
0: No							
LOGIC: Output 62							042 238
0: No							
LOGIC: Output 62 (t)							042 239
0: No							
LOGIC: Output 63							042 240
0: No							
LOGIC: Output 63 (t)							042 241
0: No							
LOGIC: Output 64							042 242
0: No							
LOGIC: Output 64 (t)							042 243
0: No							
LOGIC: Output 65							047 128
0: No							
LOGIC: Output 65 (t)							047 129
0: No							
LOGIC: Output 66							047 002
0: No							
LOGIC: Output 66 (t)							047 003
0: No							
LOGIC: Output 67							047 004
0: No							
LOGIC: Output 67 (t)							047 005
0: No							
LOGIC: Output 68							047 006
0: No							
LOGIC: Output 68 (t)							047 007
0: No							

Parameter				Address
Default	Min	Max	Unit	Logic Diagram
LOGIC: Output 69				047 008
0: No				
LOGIC: Output 69 (t)				047 009
0: No				
LOGIC: Output 70				047 010
0: No				
LOGIC: Output 70 (t)				047 011
0: No				
LOGIC: Output 71				047 012
0: No				
LOGIC: Output 71 (t)				047 013
0: No				
LOGIC: Output 72				047 014
0: No				
LOGIC: Output 72 (t)				047 015
0: No				
LOGIC: Output 73				047 016
0: No				
LOGIC: Output 73 (t)				047 017
0: No				
LOGIC: Output 74				047 018
0: No				
LOGIC: Output 74 (t)				047 019
0: No				
LOGIC: Output 75				047 020
0: No				
LOGIC: Output 75 (t)				047 021
0: No				
LOGIC: Output 76				047 022
0: No				
LOGIC: Output 76 (t)				047 023
0: No				
LOGIC: Output 77				047 024
0: No				
LOGIC: Output 77 (t)				047 025
0: No				
LOGIC: Output 78				047 026
0: No				

Parameter					Address		
Default	Min	Max	Unit		Logic Diagram		
LOGIC: Output 78 (t)							047 027
0: No							
LOGIC: Output 79							047 028
0: No							
LOGIC: Output 79 (t)							047 029
0: No							
LOGIC: Output 80							047 030
0: No							
LOGIC: Output 80 (t)							047 031
0: No							
LOGIC: Output 81							047 032
0: No							
LOGIC: Output 81 (t)							047 033
0: No							
LOGIC: Output 82							047 034
0: No							
LOGIC: Output 82 (t)							047 035
0: No							
LOGIC: Output 83							047 036
0: No							
LOGIC: Output 83 (t)							047 037
0: No							
LOGIC: Output 84							047 038
0: No							
LOGIC: Output 84 (t)							047 039
0: No							
LOGIC: Output 85							047 040
0: No							
LOGIC: Output 85 (t)							047 041
0: No							
LOGIC: Output 86							047 042
0: No							
LOGIC: Output 86 (t)							047 043
0: No							
LOGIC: Output 87							047 044
0: No							
LOGIC: Output 87 (t)							047 045
0: No							

Parameter				Address
Default	Min	Max	Unit	Logic Diagram
LOGIC: Output 88				047 046
0: No				
LOGIC: Output 88 (t)				047 047
0: No				
LOGIC: Output 89				047 048
0: No				
LOGIC: Output 89 (t)				047 049
0: No				
LOGIC: Output 90				047 050
0: No				
LOGIC: Output 90 (t)				047 051
0: No				
LOGIC: Output 91				047 052
0: No				
LOGIC: Output 91 (t)				047 053
0: No				
LOGIC: Output 92				047 054
0: No				
LOGIC: Output 92 (t)				047 055
0: No				
LOGIC: Output 93				047 056
0: No				
LOGIC: Output 93 (t)				047 057
0: No				
LOGIC: Output 94				047 058
0: No				
LOGIC: Output 94 (t)				047 059
0: No				
LOGIC: Output 95				047 060
0: No				
LOGIC: Output 95 (t)				047 061
0: No				
LOGIC: Output 96				047 062
0: No				
LOGIC: Output 96 (t)				047 063
0: No				
LOGIC: Output 97				047 064
0: No				

Parameter				Address
Default	Min	Max	Unit	Logic Diagram
LOGIC: Output 97 (t)				047 065
0: No				
LOGIC: Output 98				047 066
0: No				
LOGIC: Output 98 (t)				047 067
0: No				
LOGIC: Output 99				047 068
0: No				
LOGIC: Output 99 (t)				047 069
0: No				
LOGIC: Output100				047 070
0: No				
LOGIC: Output100 (t)				047 071
0: No				
LOGIC: Output101				047 072
0: No				
LOGIC: Output101 (t)				047 073
0: No				
LOGIC: Output102				047 074
0: No				
LOGIC: Output102 (t)				047 075
0: No				
LOGIC: Output103				047 076
0: No				
LOGIC: Output103 (t)				047 077
0: No				
LOGIC: Output104				047 078
0: No				
LOGIC: Output104 (t)				047 079
0: No				
LOGIC: Output105				047 080
0: No				
LOGIC: Output105 (t)				047 081
0: No				
LOGIC: Output106				047 082
0: No				
LOGIC: Output106 (t)				047 083
0: No				

Parameter				Address
Default	Min	Max	Unit	Logic Diagram
LOGIC: Output107				047 084
0: No				
LOGIC: Output107 (t)				047 085
0: No				
LOGIC: Output108				047 086
0: No				
LOGIC: Output108 (t)				047 087
0: No				
LOGIC: Output109				047 088
0: No				
LOGIC: Output109 (t)				047 089
0: No				
LOGIC: Output110				047 090
0: No				
LOGIC: Output110 (t)				047 091
0: No				
LOGIC: Output111				047 092
0: No				
LOGIC: Output111 (t)				047 093
0: No				
LOGIC: Output112				047 094
0: No				
LOGIC: Output112 (t)				047 095
0: No				
LOGIC: Output113				047 096
0: No				
LOGIC: Output113 (t)				047 097
0: No				
LOGIC: Output114				047 098
0: No				
LOGIC: Output114 (t)				047 099
0: No				
LOGIC: Output115				047 100
0: No				
LOGIC: Output115 (t)				047 101
0: No				
LOGIC: Output116				047 102
0: No				

Parameter				Address
Default	Min	Max	Unit	Logic Diagram
LOGIC: Output116 (t)				047 103
0: No				
LOGIC: Output117				047 104
0: No				
LOGIC: Output117 (t)				047 105
0: No				
LOGIC: Output118				047 106
0: No				
LOGIC: Output118 (t)				047 107
0: No				
LOGIC: Output119				047 108
0: No				
LOGIC: Output119 (t)				047 109
0: No				
LOGIC: Output120				047 110
0: No				
LOGIC: Output120 (t)				047 111
0: No				
LOGIC: Output121				047 112
0: No				
LOGIC: Output121 (t)				047 113
0: No				
LOGIC: Output122				047 114
0: No				
LOGIC: Output122 (t)				047 115
0: No				
LOGIC: Output123				047 116
0: No				
LOGIC: Output123 (t)				047 117
0: No				
LOGIC: Output124				047 118
0: No				
LOGIC: Output124 (t)				047 119
0: No				
LOGIC: Output125				047 120
0: No				
LOGIC: Output125 (t)				047 121
0: No				

Parameter					Address
Default	Min	Max	Unit		Logic Diagram
LOGIC: Output126					047 122
0: No					
LOGIC: Output126 (t)					047 123
0: No					
LOGIC: Output127					047 124
0: No					
LOGIC: Output127 (t)					047 125
0: No					
LOGIC: Output128					047 126
0: No					
LOGIC: Output128 (t)					047 127
0: No					

Programmable Logic

Parameter					Address
Default	Min	Max	Unit		Logic Diagram
LOG_2: Enabled					011 138
0: No					Fig. 3-406, (p. 3-484)
LOG_2: Output 1					052 032
0: No					Fig. 3-406, (p. 3-484)
LOG_2: Output 1 (t)					052 033
0: No					Fig. 3-406, (p. 3-484)
LOG_2: Output 2					052 034
0: No					
LOG_2: Output 2 (t)					052 035
0: No					
LOG_2: Output 3					052 036
0: No					
LOG_2: Output 3 (t)					052 037
0: No					
LOG_2: Output 4					052 038
0: No					
LOG_2: Output 4 (t)					052 039
0: No					

Real Timer

Parameter				Address			
Default	Min	Max	Unit	Logic Diagram			
TIMER: Monday							014 139
0: No	Fig. 3-440, (p. 3-526)						
TIMER: Tuesday							014 148
0: No							
TIMER: Wednesday							014 149
0: No							
TIMER: Thursday							014 158
0: No							
TIMER: Friday							014 159
0: No							
TIMER: Saturday							014 168
0: No							
TIMER: Sunday							014 169
0: No	Fig. 3-440, (p. 3-526)						
TIMER: Timer stage 1							015 006
0: No	Fig. 3-440, (p. 3-526)						
TIMER: Timer stage 2							015 007
0: No							
TIMER: Timer stage 4							015 013
0: No							
TIMER: Timer stage 3							015 010
0: No							

External device

Parameter					Address
Default	Min	Max	Unit		Logic Diagram
DEV01: Open signal EXT					210 030
0: No					
DEV01: Closed signal EXT					210 031
0: No					
DEV01: Control state					210 018
0: Intermediate pos.					Fig. 3-417, (p. 3-495) Fig. 3-424, (p. 3-504)
DEV01: Switch. device open					210 036
0: No					Fig. 3-417, (p. 3-495) Fig. 3-424, (p. 3-504)
DEV01: Switch. device closed					210 037
0: No					Fig. 3-417, (p. 3-495) Fig. 3-424, (p. 3-504)
DEV01: Dev. interm./flt.pos					210 038
0: No					Fig. 3-417, (p. 3-495) Fig. 3-424, (p. 3-504)
DEV01: Open command					210 028
0: No					Fig. 3-422, (p. 3-501)
DEV01: Close command					210 029
0: No					Fig. 3-422, (p. 3-501)
DEV01: Open cmd. received					218 000
0: No					
DEV01: Close cmd. received					218 001
0: No					
DEV01: Warning op.count.					219 081
0: No					Fig. 3-428, (p. 3-508)
DEV02: Warning op.count.					219 082
0: No					
DEV03: Warning op.count.					219 083
0: No					
Warning that the number of switching commands has exceeded the set limit value.					

External device

Parameter					Address		
Default	Min	Max	Unit		Logic Diagram		
DEV02: Open signal EXT							210 080
0: No							
DEV02: Closed signal EXT							210 081
0: No							
DEV02: Control state							210 068
0: Intermediate pos.							
DEV02: Switch. device open							210 086
0: No							
DEV02: Switch. device closed							210 087
0: No							
DEV02: Dev. interm./flt.pos							210 088
0: No							
DEV02: Open command							210 078
0: No							
DEV02: Close command							210 079
0: No							
DEV02: Open cmd. received							218 002
0: No							
DEV02: Close cmd. received							218 003
0: No							

External device

Parameter					Address
Default	Min	Max	Unit		Logic Diagram
DEV03: Open signal EXT					210 130
0: No					
DEV03: Closed signal EXT					210 131
0: No					
DEV03: Control state					210 118
0: Intermediate pos.					
DEV03: Switch. device open					210 136
0: No					
DEV03: Switch. device closed					210 137
0: No					
DEV03: Dev. interm./flt.pos					210 138
0: No					
DEV03: Open command					210 128
0: No					
DEV03: Close command					210 129
0: No					
DEV03: Open cmd. received					218 004
0: No					
DEV03: Close cmd. received					218 005
0: No					

Interlocking logic

Parameter					Address		
Default	Min	Max	Unit		Logic Diagram		
ILOCK: Output 01							250 032
0: No					Fig. 3-432, (p. 3-515)		
ILOCK: Output 02							250 033
0: No							
ILOCK: Output 03							250 034
0: No							
ILOCK: Output 04							250 035
0: No							
ILOCK: Output 05							250 036
0: No							
ILOCK: Output 06							250 037
0: No							
ILOCK: Output 07							250 038
0: No							
ILOCK: Output 08							250 039
0: No							
ILOCK: Output 09							250 040
0: No							
ILOCK: Output 10							250 041
0: No							
ILOCK: Output 11							250 042
0: No							
ILOCK: Output 12							250 043
0: No							
ILOCK: Output 13							250 044
0: No							
ILOCK: Output 14							250 045
0: No							
ILOCK: Output 15							250 046
0: No							
ILOCK: Output 16							250 047
0: No							
ILOCK: Output 17							250 048
0: No							
ILOCK: Output 18							250 049
0: No							
ILOCK: Output 19							250 050
0: No							

Parameter				Address
Default	Min	Max	Unit	Logic Diagram
ILOCK: Output 20				250 051
0: No				
ILOCK: Output 21				250 052
0: No				
ILOCK: Output 22				250 053
0: No				
ILOCK: Output 23				250 054
0: No				
ILOCK: Output 24				250 055
0: No				
ILOCK: Output 25				250 056
0: No				
ILOCK: Output 26				250 057
0: No				
ILOCK: Output 27				250 058
0: No				
ILOCK: Output 28				250 059
0: No				
ILOCK: Output 29				250 060
0: No				
ILOCK: Output 30				250 061
0: No				
ILOCK: Output 31				250 062
0: No				
ILOCK: Output 32				250 063
0: No				
Output of the respective equation of the interlocking logic. These logic state signals are transmitted with the request for a switching operation, and cyclically (according to the setting ILOCK: Cycle t interl.check).				

Single-pole
commands

Parameter					Address		
Default	Min	Max	Unit		Logic Diagram		
CMD_1: Command C001							200 001
0: No					Fig. 3-433, (p. 3-517)		
CMD_1: Command C002							200 006
0: No							
CMD_1: Command C003							200 011
0: No							
CMD_1: Command C004							200 016
0: No							
CMD_1: Command C005							200 021
0: No							
CMD_1: Command C006							200 026
0: No							
CMD_1: Command C007							200 031
0: No							
CMD_1: Command C008							200 036
0: No							
CMD_1: Command C009							200 041
0: No							
CMD_1: Command C010							200 046
0: No							
CMD_1: Command C011							200 051
0: No					Fig. 3-429, (p. 3-511)		
CMD_1: Command C012							200 056
0: No					Fig. 3-429, (p. 3-511)		
CMD_1: CMD_DC3							202 011
0: No							

Single-pole signals

Parameter					Address
Default	Min	Max	Unit		Logic Diagram
SIG_1: Signal S001 EXT					226 004
0: No					
SIG_1: Logic signal S001					226 005
0: No					Fig. 3-434, (p. 3-519)
SIG_1: Signal S002 EXT					226 012
0: No					
SIG_1: Logic signal S002					226 013
0: No					
SIG_1: Signal S003 EXT					226 020
0: No					
SIG_1: Logic signal S003					226 021
0: No					
SIG_1: Signal S004 EXT					226 028
0: No					
SIG_1: Logic signal S004					226 029
0: No					
SIG_1: Signal S005 EXT					226 036
0: No					
SIG_1: Logic signal S005					226 037
0: No					
SIG_1: Signal S006 EXT					226 044
0: No					
SIG_1: Logic signal S006					226 045
0: No					
SIG_1: Signal S007 EXT					226 052
0: No					
SIG_1: Logic signal S007					226 053
0: No					
SIG_1: Signal S008 EXT					226 060
0: No					
SIG_1: Logic signal S008					226 061
0: No					
SIG_1: Signal S009 EXT					226 068
0: No					
SIG_1: Logic signal S009					226 069
0: No					
SIG_1: Signal S010 EXT					226 076
0: No					

Parameter					Address	
Default	Min	Max	Unit		Logic Diagram	
SIG_1: Logic signal S010					226 077	
0: No						
SIG_1: Signal S011 EXT					226 084	
0: No						
SIG_1: Logic signal S011					226 085	
0: No						
SIG_1: Signal S012 EXT					226 092	
0: No						
SIG_1: Logic signal S012					226 093	
0: No Fig. 3-429, (p. 3-511)						
SIG_1: SIG_DC3 EXT					233 004	
0: No						
SIG_1: Logic SIG_DC3					233 005	
0: No						

Binary counts

Parameter					Address
Default	Min	Max	Unit		Logic Diagram
COUNT: Set counter 1 EXT					217 130
0: No					
COUNT: Set counter 2 EXT					217 085
0: No					
COUNT: Set counter 3 EXT					217 086
0: No					
COUNT: Set counter 4 EXT					217 087
0: No					
COUNT: Transmit counts EXT					217 009
0: No					
COUNT: Reset EXT					217 004
0: No					
COUNT: Enabled					217 001
0: No					Fig. 3-439, (p. 3-525)
COUNT: Transmit counts					217 010
0: No					Fig. 3-439, (p. 3-525)
COUNT: Reset					217 005
0: No					Fig. 3-439, (p. 3-525)
COUNT: Warning count 1					217 191
0: No					
COUNT: Warning count 2					217 192
0: No					
COUNT: Warning count 3					217 193
0: No					
COUNT: Warning count 4					217 194
0: No					
Warning that the counter value has exceeded the set limit value.					

8.1.2

Control and Testing

Device

Parameter					Address
Default	Min	Max	Unit		Logic Diagram
DVICE: Service info 031 080					031 080
0: No					

Local control panel

Parameter	Address			
Default	Min	Max	Unit	Logic Diagram
LOC: Param. change enabl.				003 010
0: No				
Setting the enable for changing values from the local control panel.				

“Logical”
communication
interface 1

Parameter	Address			
Default	Min	Max	Unit	Logic Diagram
COMM1: Sel.spontan.sig.test				003 180
060 000: MAIN: Without function Fig. 3-18, (p. 3-27)				
Signal selection for testing purposes.				
COMM1: Test spont.sig.start				003 184
0: don't execute Fig. 3-18, (p. 3-27)				
Triggering of transmission of a selected signal as “starting”.				
COMM1: Test spont.sig. end				003 186
0: don't execute Fig. 3-18, (p. 3-27)				
Triggering of transmission of a selected signal as “ending”.				
COMM1: Sel. pos. dev.test				221 105
0: Not assigned				
Select a device DEVxx for testing the transmission of switchgear device position in monitoring direction.				
COMM1: Test position dev.				221 106
0: don't execute				
Carry out a test to check the transmission of switchgear device position in monitoring direction for the device selected at COMM1: Sel. pos. dev.test.				

“Logical”
communication
interface 2

Parameter				Address
Default	Min	Max	Unit	Logic Diagram
COMM2: Sel.spontan.sig.test				103 180
060 000: MAIN: Without function				Fig. 3-20, (p. 3-30)
Signal selection for testing purposes.				
COMM2: Test spont.sig.start				103 184
0: don't execute				Fig. 3-20, (p. 3-30)
Triggering of transmission of a selected signal as "starting".				
COMM2: Test spont.sig. end				103 186
0: don't execute				Fig. 3-20, (p. 3-30)
Triggering of transmission of a selected signal as "ending".				

InterMiCOM
interface

Parameter				Address
Default	Min	Max	Unit	Logic Diagram
COMM3: Rset No.tlg.err.USER				120 037
0: don't execute				
Resetting counter for number of telegram errors.				
COMM3: Send signal for test				120 050
0: None				
COMM3: Log. state for test				120 051
1: 1				
COMM3: Send signal, test				120 053
0: don't execute				
COMM3: Loop back send				120 055
170	0	255		
Setting a bit pattern consisting of 3 bits.				
COMM3: Loop back test				120 054
0: don't execute				
Carrying out a loop back test with the PCOMM interface.				
COMM3: Hold time for test				120 052
10	1	600	s	
Selecting the hold time (in seconds) for the functional testing.				

IEC 61850
Communication

Parameter	Address			
Default	Min	Max	Unit	Logic Diagram
IEC: Sel.spontan.sig.test				104 245
060 000: MAIN: Without function	Fig. 3-28, (p. 3-54)			
IEC: Test spont.sig.start				104 246
0: don't execute	Fig. 3-28, (p. 3-54)			
IEC: Test spont.sig. end				104 247
0: don't execute	Fig. 3-28, (p. 3-54)			
IEC: Sel. pos. dev.test				104 248
0: Not assigned				
IEC: Test position DEV				104 249
0: don't execute				

Measured data input

Parameter				Address	
Default	Min	Max	Unit	Logic Diagram	
MEASI: Rst. temp. Tmax USER					003 045
0: don't execute					
Resetting measured maximum temperatures Tmax and Tmax Tx (x=1...9) to updated measured values.					

Binary and analog
output

Parameter				Address
Default	Min	Max	Unit	Logic Diagram
OUTP: Reset latch. USER				021 009
0: don't execute				Fig. 3-40, (p. 3-71)
Reset of latched output relays from the user interface.				
OUTP: Relay assign. f.test				003 042
060 000: MAIN: Without function				Fig. 3-41, (p. 3-72)
Selection of the relay to be tested.				
OUTP: Relay test				003 043
0: don't execute				Fig. 3-41, (p. 3-72)
The relay selected for testing is triggered for the duration set at OUTP: Hold-time for test.				
OUTP: Hold-time for test				003 044
1	1	10	s	Fig. 3-41, (p. 3-72)
Setting for the time period for which the selected output relay is triggered for functional testing.				

Measured data
output

Parameter				Address		
Default	Min	Max	Unit	Logic Diagram		
MEASO: Reset output USER						037 116
0: don't execute				Fig. 3-44, (p. 3-74)		
Resetting the measured data output function.						

Main function

Parameter	Address			
Default	Min	Max	Unit	Logic Diagram
MAIN: General reset USER				003 002
0: don't execute Fig. 3-92, (p. 3-135)				
Reset of the following memories:				
● All counters ● LED indicators ● Operating data memory ● All event memories ● Event counters ● Fault data ● Measured overload data ● Recorded fault values				
MAIN: Reset indicat. USER				021 010
0: No Fig. 3-92, (p. 3-135)				
Reset of the following displays:				
● LED indicators ● Fault data				
MAIN: Rset.latch.trip USER				021 005
0: don't execute Fig. 3-384, (p. 3-461)				
Reset of latched trip commands from the local control panel.				
MAIN: Reset c. cl/tr.cUSER				003 007
0: don't execute Fig. 3-77, (p. 3-119) Fig. 3-86, (p. 3-128)				
The counters for counting the close and trip commands are reset.				
MAIN: Reset IP,max,st.USER				003 033
0: don't execute Fig. 3-54, (p. 3-96)				
The display of the stored maximum phase current is reset.				
MAIN: Reset meas.v.en.USER				003 032
0: don't execute Fig. 3-65, (p. 3-106)				
The display of active and reactive energy output and input is reset.				
MAIN: Group reset 1 USER				005 253
0: don't execute Fig. 3-93, (p. 3-135)				
MAIN: Group reset 2 USER				005 254
0: don't execute Fig. 3-93, (p. 3-135)				
Group of resetting commands.				

Parameter				Address
Default	Min	Max	Unit	Logic Diagram
MAIN: Man. trip cmd. USER				003 040
0: don't execute				Fig. 3-88, (p. 3-129)
A 100 ms trip command is issued from the local control panel. Note: The command is only executed if the manual trip command has been configured as trip command 1 or 2.				
MAIN: En. man. clos. cmd. USER				003 105
0: No				Fig. 3-77, (p. 3-119)
Setting the enable for the issue of a close command from the local control panel (enables manual breaker close operations).				
MAIN: Man. trip cmd. A USER				003 017
0: don't execute				
MAIN: Man. trip cmd. B USER				003 018
0: don't execute				
MAIN: Man. trip cmd. C USER				003 019
0: don't execute				
A phase-selective trip command is issued from the local control panel for 100 ms.				
MAIN: Man. close cmd. USER				018 033
0: don't execute				Fig. 3-77, (p. 3-119)
A close command is issued from the local control panel for the set reclose command time.				
MAIN: Soft Warm restart				003 039
0: don't execute				
A warm restart of the software is carried out. The device functions as it does when the power supply is turned on, except that no hardware tests are carried out.				
MAIN: Warm restart				010 166
0: don't execute				
A warm restart is carried out. The device functions as it does when the power supply is turned on.				
MAIN: Soft Cold restart				000 085
0: don't execute				
A cold restart of the software is carried out. This means that all settings and recordings are cleared, but no tests of the hardware are carried out during the restart. Parameter values used by the P433 after a cold restart have been selected in such a manner that the P433 is blocked after a cold restart.				

Parameter	Address			
Default	Min	Max	Unit	Logic Diagram
MAIN: Cold restart				009 254
0: don't execute				
A cold restart is carried out. A cold restart means that all settings and recordings are cleared. Parameter values used by the P433 after a cold restart have been selected in such a manner that the P433 is blocked after a cold restart.				

Operating data recording

Parameter	Address			
Default	Min	Max	Unit	Logic Diagram
OP_RC: Reset record. USER				100 001
0: don't execute Fig. 3-98, (p. 3-143)				
The operating data memory and the counter for operation signals are reset.				

Monitoring signal recording

Parameter	Address			
Default	Min	Max	Unit	Logic Diagram
MT_RC: Reset record. USER				003 008
0: don't execute Fig. 3-99, (p. 3-144)				
Reset of the monitoring signal memory.				

Overload recording

Parameter	Address			
Default	Min	Max	Unit	Logic Diagram
OL_RC: Reset record. USER				100 003
0: don't execute Fig. 3-103, (p. 3-148)				
Reset of the overload memory.				

Ground fault recording

Parameter	Address			
Default	Min	Max	Unit	Logic Diagram
GF_RC: Reset record. USER				100 000
0: don't execute Fig. 3-112, (p. 3-156)				
Reset of the ground fault memory.				

Fault recording

Parameter	Address			
Default	Min	Max	Unit	Logic Diagram
FT_RC: Trigger USER				003 041
0: don't execute Fig. 3-118, (p. 3-166)				
Fault recording is enabled from the local control panel for 500 ms.				
FT_RC: Reset record. USER				003 006
0: don't execute Fig. 3-119, (p. 3-167)				
Reset of the following memories:				
● LED indicators ● Fault memory ● Fault counter ● Fault data ● Recorded fault values				

Power swing blocking

Parameter	Address			
Default	Min	Max	Unit	Logic Diagram
PSB: Reset counters				006 029
0: don't execute				
Reset of the counters that are used for the enhanced counting-based tripping.				

Protective signaling

Parameter	Address			
Default	Min	Max	Unit	Logic Diagram
PSIG: Enable USER				003 132
0: don't execute Fig. 3-184, (p. 3-249)				
Protective signaling is enabled from the local control panel.				
PSIG: Disable USER				003 131
0: don't execute Fig. 3-184, (p. 3-249)				
Protective signaling is disabled from the local control panel.				
PSIG: Test telecom. USER				015 009
0: don't execute Fig. 3-209, (p. 3-272)				
A send signal is issued for 500 ms.				

Auto-reclosing control

Parameter	Address			
Default	Min	Max	Unit	Logic Diagram
ARC: Enable USER				003 134
0: don't execute Fig. 3-211, (p. 3-274)				
The auto-reclosing control function is enabled from the local control panel.				
ARC: Disable USER				003 133
0: don't execute Fig. 3-211, (p. 3-274)				
The auto-reclosing control function is disabled from the local control panel.				
ARC: Test HSR A-B-C USER				011 066
0: don't execute Fig. 3-216, (p. 3-280)				
A three-pole test HSR is triggered.				
ARC: Reset counters USER				003 005
0: don't execute Fig. 3-223, (p. 3-287)				
The ARC counters are reset.				

Automatic
synchronism check

Parameter					Address
Default	Min	Max	Unit	Logic Diagram	
ASC: Enable USER					003 136
0: don't execute					Fig. 3-227, (p. 3-292)
Automatic synchronism check is enabled from the local control panel.					
ASC: Disable USER					003 135
0: don't execute					Fig. 3-227, (p. 3-292)
Automatic synchronism check is disabled from the local control panel.					
ASC: AR close requ. USER					008 238
0: don't execute					Fig. 3-229, (p. 3-294)
A close request is issued with Automatic Reclose parameters. This will trigger the ASC functional operation. A close command is transmitted to the CB if the check of the ASC is positive.					
ASC: MC close requ. USER					018 004
0: don't execute					Fig. 3-230, (p. 3-295)
A close request is issued from the integrated local control panel. This will trigger the ASC functional operation. A close command is transmitted to the CB if the check of the ASC is positive.					
ASC: Test AR close r.USER					008 237
0: don't execute					Fig. 3-229, (p. 3-294)
A close request is issued with Automatic Reclose parameters. This will trigger the ASC functional operation. No close command is transmitted to the CB if the check of the ASC is positive. Only a signal is issued.					
ASC: Test MC close r USER					018 005
0: don't execute					Fig. 3-230, (p. 3-295)
A close request is issued from the integrated local control panel. This will trigger the ASC functional operation. No close command is transmitted to the CB if the check of the ASC is positive. Only a signal is issued.					
ASC: Reset counters USER					003 089
0: don't execute					Fig. 3-241, (p. 3-307)
The ASC counters are reset.					

Ground fault (short-circuit) protection

Parameter	Address			
Default	Min	Max	Unit	Logic Diagram
GFSC: Enable USER				003 138
0: don't execute Fig. 3-242, (p. 3-310)				
Ground fault (short-circuit) protection is enabled from the local control panel.				
GFSC: Disable USER				003 137
0: don't execute Fig. 3-242, (p. 3-310)				
Ground fault (short-circuit) protection is disabled from the local control panel.				

Ground fault (short-circuit) protection signaling

Parameter	Address			
Default	Min	Max	Unit	Logic Diagram
GSCSG: Enable USER				003 140
0: don't execute Fig. 3-260, (p. 3-329)				
Ground fault (short-circuit) protection signaling is enabled from the local control panel.				
GSCSG: Disable USER				003 139
0: don't execute Fig. 3-260, (p. 3-329)				
Ground fault (short-circuit) protection signaling is disabled from the local control panel.				
GSCSG: Test telecom. USER				023 086
0: don't execute Fig. 3-270, (p. 3-339)				
A send signal is issued for 500 ms.				

Ground fault direction determination using steady-state values

Parameter	Address			
Default	Min	Max	Unit	Logic Diagram
GFDSS: Reset counters USER				003 004
0: don't execute Fig. 3-310, (p. 3-383) Fig. 3-316, (p. 3-389)				
The counters for the ground fault direction determination function using steady-state values are reset.				

Ground fault protection signaling

Parameter	Address			
Default	Min	Max	Unit	Logic Diagram
GFSIG: Test telecom. USER				016 079
0: don't execute Fig. 3-321, (p. 3-396)				
A send signal is issued for 500 ms.				

Transient ground fault direction determination

Parameter	Address			
Default	Min	Max	Unit	Logic Diagram
TGFD: Reset signals USER				003 009
0: don't execute Fig. 3-326, (p. 3-401)				
The direction decisions can be reset while the buffer time is elapsing.				
TGFD: Reset counters USER				003 022
0: don't execute Fig. 3-328, (p. 3-402)				
The counters for the transient ground fault direction determination function are reset.				
TGFD: Reset mon. sig. USER				025 170
0: don't execute Fig. 3-327, (p. 3-402)				

Thermal overload protection

Parameter	Address			
Default	Min	Max	Unit	Logic Diagram
THERM: Reset replica USER				022 061
0: don't execute Fig. 3-333, (p. 3-410)				
Resetting the thermal replica of the thermal overload protection function.				

Over-/underfrequency protection

Parameter	Address			
Default	Min	Max	Unit	Logic Diagram
f<>: Reset meas.val. USER				003 080
0: don't execute				
Resetting the measured event values f<>: Max. frequ. for f> and f<>: Min. frequ. for f<.				

Underfrequency load shedding

Parameter					Address
Default	Min	Max	Unit		Logic Diagram
Pf<: Trigger Deactivate					016 200
0: don't execute					
Pf<: Trigger f1					016 201
0: don't execute					
Pf<: Trigger f2					016 202
0: don't execute					
Pf<: Trigger f3					016 203
0: don't execute					
Pf<: Trigger f4					016 204
0: don't execute					
Pf<: Trigger f5					016 205
0: don't execute					
Pf<: Trigger f6					016 206
0: don't execute					
Pf<: Trigger f7					016 207
0: don't execute					
Pf<: Trigger f8					016 208
0: don't execute					
Pf<: Trigger f9					016 209
0: don't execute					
Pf<: Trigger f10					016 210
0: don't execute					

Circuit breaker failure protection

Parameter					Address
Default	Min	Max	Unit		Logic Diagram
CBF: Enable USER					003 016
0: don't execute Fig. 3-378, (p. 3-455)					
Circuit breaker failure protection is enabled from the local control panel.					
CBF: Disable USER					003 015
0: don't execute Fig. 3-378, (p. 3-455)					
Circuit breaker failure protection is disabled from the local control panel.					

Circuit breaker
condition monitoring

Parameter	Address			
Default	Min	Max	Unit	Logic Diagram
CBM: Initialize values				003 011
0: don't execute				
Values are initialized to trigger circuit breaker condition monitoring.				
CBM: Blocking USER				022 150
0: No Fig. 3-396, (p. 3-472)				
Setting for temporary blocking of circuit breaker monitoring during protection injection testing.				
CBM: Reset meas.val. USER				003 013
0: don't execute				
Resetting circuit breaker condition monitoring				
CBM: Set No. CB oper. A				022 131
Blocked	0	65000		Fig. 3-393, (p. 3-469)
CBM: Set No. CB oper. B				022 132
Blocked	0	65000		
CBM: Set No. CB oper. C				022 133
Blocked	0	65000		
Set the number of CB operations.				
CBM: Set remain. CB op. A				022 134
Blocked	0	65000		Fig. 3-393, (p. 3-469)
CBM: Set remain. CB op. B				022 135
Blocked	0	65000		
CBM: Set remain. CB op. C				022 136
Blocked	0	65000		
Set the remaining CB operations.				
CBM: Set Σ Itrip A				022 137
Blocked	0	65000	Inom,CB	Fig. 3-393, (p. 3-469)
CBM: Set Σ Itrip B				022 138
Blocked	0	65000	Inom,CB	
CBM: Set Σ Itrip C				022 139
Blocked	0	65000	Inom,CB	
CBM: Set Σ Itrip**2 A				022 140
Blocked	0	65000	Inom,CB** 2	Fig. 3-393, (p. 3-469)
CBM: Set Σ Itrip**2 B				022 141
Blocked	0	65000	Inom,CB** 2	

Parameter				Address
Default	Min	Max	Unit	Logic Diagram
CBM: Set $\Sigma I_{trip}^{**2} C$				022 142
Blocked	0	65000	Inom,CB** 2	
CBM: Set $\Sigma I^{*t} A$				022 143
Blocked	0.0	4000.0	kAs	Fig. 3-393, (p. 3-469)
CBM: Set $\Sigma I^{*t} B$				022 144
Blocked	0.0	4000.0	kAs	
CBM: Set $\Sigma I^{*t} C$				022 145
Blocked	0.0	4000.0	kAs	
Set the limit values for the ruptured currents and their squares. (An alarm is displayed if these limit values are exceeded.)				

Programmable Logic

Parameter				Address
Default	Min	Max	Unit	Logic Diagram
LOGIC: Trigger 1				034 038
0: No				Fig. 3-405, (p. 3-483)
LOGIC: Trigger 2				034 039
0: No				
LOGIC: Trigger 3				034 040
0: No				
LOGIC: Trigger 4				034 041
0: No				
LOGIC: Trigger 5				034 042
0: No				
LOGIC: Trigger 6				034 043
0: No				
LOGIC: Trigger 7				034 044
0: No				
LOGIC: Trigger 8				034 045
0: No				Fig. 3-405, (p. 3-483)
Intervention in the logic at the appropriate point by a 100 ms pulse.				

Binary counts

Parameter	Address			
Default	Min	Max	Unit	Logic Diagram
COUNT: Transmit counts USER				217 008
0: don't execute Fig. 3-439, (p. 3-525)				
Count transmission.				
COUNT: Reset USER				217 003
0: don't execute Fig. 3-439, (p. 3-525)				
Count reset.				

8.1.3

Operating Data Recording

Operating data recording

Parameter	Address			
Default	Min	Max	Unit	Logic Diagram
OP_RC: Operat. data record.				003 024
0	0	3000		Fig. 3-98, (p. 3-143)
Point of entry into the operating data log.				

Monitoring signal recording

Parameter	Address			
Default	Min	Max	Unit	Logic Diagram
MT_RC: Mon. signal record.				003 001
0	0	30		Fig. 3-99, (p. 3-144)
Point of entry into the monitoring signal log.				

8.2 Events

8.2.1 Event Counters

InterMiCOM
interface

Parameter				Address	
Default	Min	Max	Unit	Logic Diagram	
COMM3: No. telegram errors					120 042
0	0	65535			
Number of corrupted telegrams.					

	Parameter				Address
	Default	Min	Max	Unit	Logic Diagram
Main function	MAIN: No. general start.				004 000
	0: don't execute				Fig. 3-82, (p. 3-124)
	Number of general starting signals.				
	MAIN: CB1 act. oper. cap.				221 087
	1	1	99		
	Setting for the maximum number of CB operations for an ARC cycle (or for a limited time period).				
	MAIN: No. gen.trip cmds. 1				004 006
	0: don't execute				Fig. 3-86, (p. 3-128)
	Number of general trip commands 1.				
	MAIN: No. gen.trip cmds. 2				009 050
	0: don't execute				Fig. 3-86, (p. 3-128)
	Number of general trip commands 2.				
	MAIN: No. gen.trip cmds. 3				009 056
	0: don't execute				Fig. 3-86, (p. 3-128)
	Number of general trip commands 3.				
	MAIN: No. gen.trip cmds. 4				009 057
	0: don't execute				Fig. 3-86, (p. 3-128)
	Number of general trip commands 4.				
	MAIN: No. final trip cmds.				004 005
	0: don't execute				Fig. 3-86, (p. 3-128)
	Number of final trip commands.				
	MAIN: No. close commands				009 055
	0: don't execute				Fig. 3-77, (p. 3-119)
	Number of close commands.				
	MAIN: No. motor drive op.				221 025
	0: don't execute				Fig. 3-427, (p. 3-508)
	Number of times external devices with direct motor control are activated during the monitoring time.				
	MAIN: No.overfl.act.en.out				009 090
	0: don't execute				Fig. 3-65, (p. 3-106)
	Counter for the number of times the measuring range of the active energy output was exceeded.				
	Note: The maximum value of this counter is 10000.				

Parameter	Address			
Default	Min	Max	Unit	Logic Diagram
MAIN: No.overfl.act.en.inp				009 091
0: don't execute Fig. 3-65, (p. 3-106)				
Counter for the number of times the measuring range of the active energy input was exceeded. Note: The maximum value of this counter is 10000.				
MAIN: No.ov/fl.reac.en.out				009 092
0: don't execute Fig. 3-65, (p. 3-106)				
Counter for the number of times the measuring range of the reactive energy output was exceeded. Note: The maximum value of this counter is 10000.				
MAIN: No.ov/fl.reac.en.inp				009 093
0: don't execute Fig. 3-65, (p. 3-106)				
Counter for the number of times the measuring range of the reactive energy input was exceeded. Note: The maximum value of this counter is 10000.				

Operating data recording

Parameter	Address			
Default	Min	Max	Unit	Logic Diagram
OP_RC: No. oper. data sig.				100 002
0	0	3000		Fig. 3-98, (p. 3-143)
Number of signals stored in the operating data memory.				

Monitoring signal recording

Parameter	Address			
Default	Min	Max	Unit	Logic Diagram
MT_RC: No. monit. signals				004 019
0	0	30		Fig. 3-99, (p. 3-144)
Number of signals stored in the monitoring signal memory.				

Overload recording

Parameter	Address			
Default	Min	Max	Unit	Logic Diagram
OL_RC: No. overload				004 101
0	0	9999		Fig. 3-102, (p. 3-147)
Number of overload events.				

Ground fault recording

Parameter				Address	
Default	Min	Max	Unit	Logic Diagram	
GF_RC: No. ground faults					004 100
0	0	9999	Fig. 3-111, (p. 3-155)		
Number of ground faults.					

Fault recording

Parameter				Address	
Default	Min	Max	Unit	Logic Diagram	
FT_RC: No. of faults					004 020
0	0	9999	Fig. 3-118, (p. 3-166)		
Number of faults.					
FT_RC: No. system disturb.					004 010
0	0	9999	Fig. 3-118, (p. 3-166)		
Number of system disturbances.					

Power swing blocking

Parameter	Address			
Default	Min	Max	Unit	Logic Diagram
PSB: No. stab. PSwing				006 025
0: don't execute				
Number of stable power swing trajectories.				
PSB: No. OOS-Swing				006 026
0: don't execute				
Number of unstable power swings.				

Auto-reclosing control

Parameter	Address			
Default	Min	Max	Unit	Logic Diagram
ARC: No. of HSR A-B-C				004 004
0: don't execute				
Number of three-pole high-speed reclosures.				
ARC: Number TDR				004 008
0: don't execute				
Number of time-delay reclosures.				

Automatic
synchronism check

Parameter				Address	
Default	Min	Max	Unit	Logic Diagram	
ASC: No. RC aft. man.clos					004 009
0: don't execute				Fig. 3-241, (p. 3-307)	
Number of reclosures after a manual close request.					
ASC: No. close requests					009 033
0: don't execute				Fig. 3-241, (p. 3-307)	
Number of close requests.					
ASC: No. close rejections					009 034
0: don't execute				Fig. 3-241, (p. 3-307)	
Number of close rejections.					

Ground fault (short-
circuit) protection

Parameter				Address	
Default	Min	Max	Unit	Logic Diagram	
GFSC: No. of trip signals					009 054
0: don't execute				Fig. 3-258, (p. 3-327)	
Number of trip signals.					

Ground fault
direction
determination using
steady-state values

Parameter	Address			
Default	Min	Max	Unit	Logic Diagram
GFDSS: No. GF power/admitt.				009 002
0: don't execute Fig. 3-316, (p. 3-389)				
Number of ground faults detected by steady-state power evaluation.				
GFDSS: No. GF (curr. meas)				009 003
0: don't execute Fig. 3-310, (p. 3-383)				
Number of ground faults detected by steady-state current evaluation.				
GFDSS: No. GF admitt. Y(N)				009 060
0: don't execute Fig. 3-316, (p. 3-389)				
Number of ground faults (non-directional) detected by the admittance evaluation method.				
GFDSS: No. GF forward/LS				009 000
0: don't execute Fig. 3-316, (p. 3-389)				
Number of ground faults in the forward direction.				
GFDSS: No. GF backward/BS				009 001
0: don't execute Fig. 3-316, (p. 3-389)				
Number of ground faults in the backward direction.				

Transient ground
fault direction deter-
mination

Parameter	Address			
Default	Min	Max	Unit	Logic Diagram
TGFD: No. GF				004 015
0: don't execute Fig. 3-328, (p. 3-402)				
Number of transient ground faults.				
TGFD: No. GF forward/LS				004 013
0: don't execute Fig. 3-328, (p. 3-402)				
Number of transient ground faults in the forward direction.				
TGFD: No. GF backward/BS				004 014
0: don't execute Fig. 3-328, (p. 3-402)				
Number of ground faults in the backward direction.				

Circuit breaker
condition monitoring

Parameter					Address
Default	Min	Max	Unit		Logic Diagram
CBM: No. of CB oper. A					008 011
0	0	65000			Fig. 3-393, (p. 3-469)
CBM: No. of CB oper. B					008 012
0	0	65000			
CBM: No. of CB oper. C					008 013
0	0	65000			
Number of mechanical switching operations made.					
CBM: Remain. No. CB op. A					008 014
30000	0	65000			Fig. 3-393, (p. 3-469)
CBM: Remain. No. CB op. B					008 015
30000	0	65000			
CBM: Remain. No. CB op. C					008 016
30000	0	65000			
Number of remaining switching operations (as shown by evaluating wear with reference to the CB wear characteristic).					

External device

Parameter					Address
Default	Min	Max	Unit		Logic Diagram
DEV01: Operation counter					210 043
0	0	65535			Fig. 3-428, (p. 3-508)
DEV02: Operation counter					210 093
0	0	65535			
DEV03: Operation counter					210 143
0	0	65535			
Number of switching operations made. It is also possible to manually set this counter to any value from 0 to 65535.					
DEV01: Dev. op. capability					210 003
1	1	99			
DEV02: Dev. op. capability					210 053
1	1	99			
DEV03: Dev. op. capability					210 103
1	1	99			
Number of remaining switching operations. It is also possible to manually set this counter to any value from 1 to 99.					

8.2.2 Measured Event Data

Overload data acquisition

Parameter	Address			
Default	Min	Max	Unit	Logic Diagram
OL_DA: Overload duration				004 102
Not measured	0.0	6500.0	s	Fig. 3-100, (p. 3-145)
Duration of the overload event.				
OL_DA: Status THERM replica				004 147
Not measured	0	250	%	Fig. 3-101, (p. 3-146)
Display of the buffer content of the thermal overload protection function.				
OL_DA: Load current THERM				004 058
Not measured	0.00	3.00	Inom	Fig. 3-101, (p. 3-146)
Display of the load current used by the thermal overload protection function to calculate the tripping time.				
OL_DA: Object temp. THERM				004 035
Not measured	-40	300	°C	Fig. 3-101, (p. 3-146)
Display of the temperature of the protected object.				
OL_DA: Coolant temp. THERM				004 036
Not measured	-40	215	°C	Fig. 3-101, (p. 3-146)
Display of coolant temperature, dependent on the setting for THERM: Select meas.inputPSx.				
When set to <i>Default temp. value</i> the set temperature value will be displayed. When set to <i>From PT100</i> the temperature measured by the resistance thermometer will be displayed. When set to <i>From 20 mA input</i> the temperature measured via an external 20 mA transducer will be displayed.				
OL_DA: Pre-trip t.leftTHERM				004 148
Not measured	0.0	1000.0	min	Fig. 3-101, (p. 3-146)
Display of the time remaining before the thermal overload protection function will reach the tripping threshold ("time-to-trip").				
OL_DA: Offset THERM replica				004 154
Not measured	-25000	25000	%	Fig. 3-101, (p. 3-146)
Display of the additional reserve if coolant temperature is taken into account and if the measured coolant temperature is lower than the set maximum permissible coolant temperature. (In this case, the thermal model has been shifted downwards.)				
If there is no coolant temperature acquisition and if the coolant temperature and the maximum permissible coolant temperature have been set to the same value, then the coolant temperature is not taken into account and the characteristic is a function of the current only. The additional reserve amounts to 0 in this case.				

Ground fault data acquisition

Parameter	Address			
Default	Min	Max	Unit	Logic Diagram
GF_DA: GF recording time				009 100
Not measured	0.0	6500.0	min	Fig. 3-104, (p. 3-149)
Display of the ground fault duration of the most recent ground fault.				
GF_DA: GF duration pow.meas				009 024
Not measured	0.0	6500.0	min	Fig. 3-105, (p. 3-150)
Display of the ground fault duration of the most recent ground fault as determined by the steady-state power evaluation feature of the ground fault direction determination function.				
GF_DA: Voltage VNG p.u.				009 020
Not measured	0.000	3.000	VNG,nom	Fig. 3-106, (p. 3-151) Fig. 3-110, (p. 3-154)
Display of the neutral-displacement voltage of the most recent ground fault referred to V_{nom} .				
Note: This display is only active if the steady-state power evaluation mode of the ground fault direction determination function is enabled.				
GF_DA: Current IN p.u.				009 021
Not measured	0.000	30.000	IN,nom	Fig. 3-106, (p. 3-151) Fig. 3-108, (p. 3-152) Fig. 3-110, (p. 3-154)
Display of the residual current of the most recent ground fault referred to I_{nom} .				
Note: This display is only active when the ground fault direction determination function using steady state values (GFDSS) is enabled.				
GF_DA: Curr. IN,act p.u.				009 022
Not measured	0.000	30.000	IN,nom	Fig. 3-106, (p. 3-151)
Display of the active component of the residual current of the most recent ground fault referred to I_{nom} .				
Note: This display is only active if the steady-state power evaluation mode of the ground fault direction determination function is enabled.				
GF_DA: Curr.IN,react p.u.				009 023
Not measured	0.000	30.000	IN,nom	Fig. 3-106, (p. 3-151)
Display of the reactive component of the residual current of the most recent ground fault referred to I_{nom} .				
Note: This display is only active if the steady-state power evaluation mode of the ground fault direction determination function is enabled.				
GF_DA: GF durat. curr.meas.				009 026
Not measured	0.0	6500.0	min	Fig. 3-107, (p. 3-152)
Display of the ground fault duration of the most recent ground fault as determined by the steady-state current evaluation feature of the ground fault direction determination function.				

Parameter				Address			
Default	Min	Max	Unit	Logic Diagram			
GF_DA: Curr. IN filt. p.u.							009 025
Not measured	0.000	30.000	IN,nom	Fig. 3-108, (p. 3-152)			
Display of the residual current component having the set filter frequency for the most recent ground fault (referred to I_{nom}).							
GF_DA: GF duration admitt.							009 068
Not measured	0.0	6500.0	min	Fig. 3-109, (p. 3-153)			
Display of the ground fault duration of the most recent ground fault as determined by the admittance evaluation mode of the ground fault direction determination function.							
GF_DA: Admittance Y(N) p.u.							009 065
Not measured	0.000	5.000	YN,nom	Fig. 3-110, (p. 3-154)			
Display of the admittance value referred to $Y_{N,nom}$.							
Note:							
If GFDSS: Evaluation VNG PSx is set to <i>Measured</i> :							
$Y_{N,nom} = I_{N,nom} / V_{NG,nom}$							
If GFDSS: Evaluation VNG PSx is set to <i>Calculated</i> :							
$Y_{N,nom} = I_{N,nom} / V_{nom}$							
GF_DA: Conduct. G(N) p.u.							009 066
Not measured	-5.000	5.000	YN,nom	Fig. 3-110, (p. 3-154)			
Display of the conductance value referred to $Y_{N,nom}$.							
Note:							
If GFDSS: Evaluation VNG PSx is set to <i>Measured</i> :							
$Y_{N,nom} = I_{N,nom} / V_{NG,nom}$							
If GFDSS: Evaluation VNG PSx is set to <i>Calculated</i> :							
$Y_{N,nom} = I_{N,nom} / V_{nom}$							
GF_DA: Suscept. B(N) p.u.							009 067
Not measured	-5.000	5.000	YN,nom	Fig. 3-110, (p. 3-154)			
Display of the susceptance value referred to $Y_{N,nom}$.							
Note:							
If GFDSS: Evaluation VNG PSx is set to <i>Measured</i> :							
$Y_{N,nom} = I_{N,nom} / V_{NG,nom}$							
If GFDSS: Evaluation VNG PSx is set to <i>Calculated</i> :							
$Y_{N,nom} = I_{N,nom} / V_{nom}$							

Fault data acquisition

Parameter	Address			
Default	Min	Max	Unit	Logic Diagram
FT_DA: Fault duration				008 010
Not measured	0.0	6500.0	s	Fig. 3-113, (p. 3-158)
Display of the fault duration.				
FT_DA: Running time				004 021
Not measured	0.00	65.00	s	Fig. 3-113, (p. 3-158)
Display of the running time.				
FT_DA: Fault current A p.u.				024 207
Not measured	0.00	100.00	Inom	
FT_DA: Fault current B p.u.				024 208
Not measured	0.00	100.00	Inom	
FT_DA: Fault current C p.u.				024 209
Not measured	0.00	100.00	Inom	
Display of the phase fault current referred to I_{nom} .				
FT_DA: Current IN meas p.u.				024 217
Not measured	0.00	16.00	Inom	
Display of the measured ground fault current referred to $I_{N,nom}$.				
FT_DA: Fault type				010 198
....: Not measured				
Display of the fault type. This value is determined from the starting signals of the function group MAIN.				
FT_DA: Fault voltage A p.u.				025 171
Not measured	0.000	3.000	Vnom	
FT_DA: Fault voltage B p.u.				025 172
Not measured	0.000	3.000	Vnom	
FT_DA: Fault voltage C p.u.				025 173
Not measured	0.000	3.000	Vnom	
FT_DA: Fault voltage AB p.u				025 174
Not measured	0.000	3.000	Vnom	
FT_DA: Fault voltage BC p.u				025 175
Not measured	0.000	3.000	Vnom	
FT_DA: Fault voltage CA p.u				025 176
Not measured	0.000	3.000	Vnom	
Display of the fault voltage as a secondary quantity.				
FT_DA: Fault current A prim				024 225
Not measured	0	25000	A	

Parameter				Address
Default	Min	Max	Unit	Logic Diagram
FT_DA: Fault current B prim				024 226
Not measured	0	25000	A	
FT_DA: Fault current C prim				024 227
Not measured	0	25000	A	
Display of the phase fault current as a primary quantity.				
FT_DA: Meas. loop selected				004 079
....: Not measured				Fig. 3-115, (p. 3-162)
Display of the measuring loop selected for determination of fault data.				
FT_DA: Current IN meas prim				024 218
Not measured	0	16000	A	
Display of the measured ground fault current as a primary quantity.				
FT_DA: Fault voltage A prim				025 177
Not measured	0.000	3.000	Vnom	
FT_DA: Fault voltage B prim				025 178
Not measured	0.000	3.000	Vnom	
FT_DA: Fault voltage C prim				025 179
Not measured	0.000	3.000	Vnom	
FT_DA: Faultvoltage AB prim				025 180
Not measured	0.000	3.000	Vnom	
FT_DA: Faultvoltage BC prim				025 181
Not measured	0.000	3.000	Vnom	
FT_DA: Faultvoltage CA prim				025 182
Not measured	0.000	3.000	Vnom	
Display of the fault voltage as a primary quantity.				
FT_DA: FaultFrequency				025 183
Not measured	10	70	Hz	
Display of the fault frequency.				
FT_DA: Flt.volt. PG/PP p.u.				004 026
Not measured	0.000	3.000	Vnom	Fig. 3-115, (p. 3-162)
Display of the fault voltage referred to V_{nom} .				
FT_DA: Fault current P p.u.				004 025
Not measured	0.00	100.00	Inom	Fig. 3-115, (p. 3-162)
Display of the fault current referred to I_{nom} .				

Parameter				Address
Default	Min	Max	Unit	Logic Diagram
FT_DA: Fault loop angle P				004 024
Not measured	-180	180	°	Fig. 3-115, (p. 3-162)
Display of the fault angle.				
FT_DA: Fault curr. N p.u.				004 049
Not measured	0.00	100.00	Inom	Fig. 3-115, (p. 3-162)
Display of the ground fault current referred to $I_{N,nom}$.				
FT_DA: Fault loop angle N				004 048
Not measured	-180	180	°	Fig. 3-115, (p. 3-162)
Display of the ground fault angle.				
FT_DA: Fault reactance, sec.				004 028
Not measured	-320.00	320.00	Ω	Fig. 3-115, (p. 3-162)
Display of the fault reactance as a secondary quantity.				
FT_DA: Fault impedance, sec				004 023
Not measured	0.00	320.00	Ω	Fig. 3-115, (p. 3-162)
Display of the fault impedance as a secondary quantity.				
FT_DA: Fault locat. percent				004 027
Not measured	-320.00	320.00	%	Fig. 3-116, (p. 3-163)
Display of the fault location of the last fault (in %) referred to the setting at FT_DA: Line reactance PSx.				
FT_DA: Fault location				004 022
Not measured	-500.0	500.0	km	Fig. 3-116, (p. 3-163)
Display of the fault location of the last fault in km.				
FT_DA: Flt.volt. PG/PP prim				010 217
Not measured	0.0	2500.0	kV	
Display of the fault voltage as a primary quantity.				
FT_DA: Fault current P prim				010 199
Not measured	0	25000	A	
Display of the fault current as a primary quantity.				
FT_DA: Fault curr. N prim.				010 216
Not measured	0	25000	A	
Display of the ground fault current as a primary quantity.				
FT_DA: Fault react., prim.				004 029
Not measured	-320.00	320.00	Ω	Fig. 3-115, (p. 3-162)
Display of the fault reactance as a primary quantity.				

Parameter				Address
Default	Min	Max	Unit	Logic Diagram
FT_DA: Fault impedance, prim				024 004
Not measured	-320.00	320.00	Ω	
Display of the fault impedance as a primary quantity.				
FT_DA: Start current P prim				024 130
Not measured	0	25000	A	
FT_DA: Xv prim.				024 098
Not measured	0.0	2000.0	Ω	
FT_DA: Rfw,PP prim.				024 125
Not measured	0.0	2000.0	Ω	
FT_DA: Rfw,PG prim.				024 123
Not measured	0.0	2000.0	Ω	
FT_DA: Zfw,PP prim.				024 127
Not measured	0.0	2000.0	Ω	
FT_DA: Zfw,PG prim.				024 126
Not measured	0.0	2000.0	Ω	
FT_DA: β				024 128
Not measured	15	65	°	
FT_DA: Zbw/Zfw				024 129
0.00	0.00	4.00		

Automatic
synchronism check

Parameter	Address			
Default	Min	Max	Unit	Logic Diagram
ASC: Voltage Vref				004 087
Not measured	0.000	3.000	Vnom	Fig. 3-240, (p. 3-307)
ASC: Volt. sel. meas.loop				004 088
Not measured	0.000	3.000	Vnom	Fig. 3-240, (p. 3-307)
ASC: Volt. magn. diff.				004 091
Not measured	-3.000	3.000	Vnom	Fig. 3-236, (p. 3-302) Fig. 3-237, (p. 3-304) Fig. 3-240, (p. 3-307)
Display of the difference between amplitudes of the measurement loop voltage and the reference voltage during a close request, referred to V_{nom} . The display only appears if ASC is operating.				
ASC: Angle difference				004 089
Not measured	-180.0	180.0	°	Fig. 3-236, (p. 3-302) Fig. 3-237, (p. 3-304) Fig. 3-240, (p. 3-307)
Display of the angle difference between measured voltage and reference voltage at the time of the close request (in degrees). This display only appears when the automatic synchronism check function is active.				
ASC: Frequ. difference				004 090
Not measured	-5.00	5.00	Hz	Fig. 3-236, (p. 3-302) Fig. 3-237, (p. 3-304) Fig. 3-240, (p. 3-307)
Display of the frequency difference between measured voltage and reference voltage at the time of the close request (in Hz). This display only appears when the automatic synchronism check function is active.				

Ground fault (short-
circuit) protection

Parameter	Address			
Default	Min	Max	Unit	Logic Diagram
GFSC: Angle VNG/IN				009 098
Not measured	0	360	°	Fig. 3-257, (p. 3-326)
Angle between residual current and neutral-displacement voltage when triggers IN> and VNG> are both operating. This display only appears when the ground fault (short-circuit) protection function is active.				

Short-circuit
direction
determination

Parameter				Address			
Default	Min	Max	Unit	Logic Diagram			
SCDD: Angle VNG/IN							009 004
Not measured	0	360	°				
Angle between the residual current and the neutral-point displacement voltage.							

Over-/
underfrequency pro-
tection

Parameter				Address			
Default	Min	Max	Unit	Logic Diagram			
f<>: Max. frequ. for f>							005 002
Not measured	12.00	70.00	Hz				
Maximum frequency during an overfrequency condition.							
f<>: Min. frequ. for f<							005 001
Not measured	12.00	70.00	Hz				
Minimum frequency during an underfrequency condition.							

Circuit breaker
condition monitoring

Parameter				Address
Default	Min	Max	Unit	Logic Diagram
CBM: Itrip,prim A				009 212
Not measured	0	65000	A	Fig. 3-393, (p. 3-469)
CBM: Itrip,prim B				009 213
Not measured	0	65000	A	
CBM: Itrip,prim C				009 214
Not measured	0	65000	A	
CBM: Itrip A				009 047
Not measured	0.00	100.00	Inom,CB	Fig. 3-393, (p. 3-469)
CBM: Itrip B				009 048
Not measured	0.00	100.00	Inom,CB	
CBM: Itrip C				009 049
Not measured	0.00	100.00	Inom,CB	
CBM: Itrip**2 A				009 051
Not measured	0.0	6000.0	Inom,CB** 2	Fig. 3-393, (p. 3-469)
CBM: Itrip**2 B				009 052
Not measured	0.0	6000.0	Inom,CB** 2	
CBM: Itrip**2 C				009 053
Not measured	0.0	6000.0	Inom,CB** 2	
Ruptured currents and their squared values.				
CBM: Σ Itrip A				009 071
0	0	65000	Inom,CB	Fig. 3-393, (p. 3-469)
CBM: Σ Itrip B				009 073
0	0	65000	Inom,CB	
CBM: Σ Itrip C				009 076
0	0	65000	Inom,CB	
Sum of the per-unit ruptured currents for each circuit breaker contact.				
CBM: Σ Itrip**2 A				009 077
0	0	65000	Inom,CB** 2	Fig. 3-393, (p. 3-469)
CBM: Σ Itrip**2 B				009 078
0	0	65000	Inom,CB** 2	

Parameter				Address			
Default	Min	Max	Unit	Logic Diagram			
CBM: $\Sigma I_{trip}^{**2} C$							009 079
0	0	65000	$I_{nom,CB}^{**2}$				
Sum of the squared per-unit ruptured currents for each circuit breaker contact.							
CBM: $I * t A$							009 061
Not measured	0	60000	As	Fig. 3-393, (p. 3-469)			
CBM: $I * t B$							009 062
Not measured	0	60000	As				
CBM: $I * t C$							009 063
Not measured	0	60000	As				
Current-time integral of the per-unit ruptured current for each circuit breaker contact.							
CBM: $\Sigma I * t A$							009 087
0.0	0.0	4000.0	kAs	Fig. 3-393, (p. 3-469)			
CBM: $\Sigma I * t B$							009 088
0.0	0.0	4000.0	kAs				
CBM: $\Sigma I * t C$							009 089
0.0	0.0	4000.0	kAs				
Sum of the current-time integrals of the per-unit ruptured currents for each circuit breaker contact.							

8.2.3 Event Recording

	Parameter				Address			
	Default	Min	Max	Unit	Logic Diagram			
Overload recording	OL_RC: Overload recording 1							033 020
	0	0	9999	Fig. 3-103, (p. 3-148)				
	OL_RC: Overload recording 2							033 021
	0	0	9999					
	OL_RC: Overload recording 3							033 022
	0	0	9999					
	OL_RC: Overload recording 4							033 023
	0	0	9999					
	OL_RC: Overload recording 5							033 024
	0	0	9999					
	OL_RC: Overload recording 6							033 025
	0	0	9999					
	OL_RC: Overload recording 7							033 026
	0	0	9999					
	OL_RC: Overload recording 8							033 027
	0	0	9999					
	Point of entry into the overload log.							

Ground fault
recording

Parameter				Address
Default	Min	Max	Unit	Logic Diagram
GF_RC: Ground flt.record. 1				033 010
0	0	9999		
GF_RC: Ground flt.record. 2				033 011
0	0	9999		
GF_RC: Ground flt.record. 3				033 012
0	0	9999		
GF_RC: Ground flt.record. 4				033 013
0	0	9999		
GF_RC: Ground flt.record. 5				033 014
0	0	9999		
GF_RC: Ground flt.record. 6				033 015
0	0	9999		
GF_RC: Ground flt.record. 7				033 016
0	0	9999		
GF_RC: Ground flt.record. 8				033 017
0	0	9999		
Point of entry into the ground fault log.				

Fault recording

Parameter					Address		
Default	Min	Max	Unit		Logic Diagram		
FT_RC: Fault recording 1							003 000
0	0	9999					
FT_RC: Fault recording 2							003 001
0	0	9999					
FT_RC: Fault recording 3							003 002
0	0	9999					
FT_RC: Fault recording 4							003 003
0	0	9999					
FT_RC: Fault recording 5							003 004
0	0	9999					
FT_RC: Fault recording 6							003 005
0	0	9999					
FT_RC: Fault recording 7							003 006
0	0	9999					
FT_RC: Fault recording 8							003 007
0	0	9999					
Point of entry into the fault log.							

9

IEC 61850 Settings via IED Configurator

This chapter lists all IEC 61850-specific settings, that are carried out with the configuration tool “IED Configurator”.

The sequence in which the settings are listed and described in this chapter corresponds to their sequence in the menu tree of the “IED Configurator”.

However, only those setting parameters are described that are mandatory for establishing the IEC 61850 communication.

Further setting parameters are listed in the “Settings” chapter under the function groups IEC and GOOSE. A list of all available *Logical Nodes* can be found in a separate document.

9.1 Manage IED

The menu item “Manage IED” allows for establishing a connection between the “IED Configurator” and the device.

The P433 features two memory “banks” one of which includes the active setting parameters. The other memory bank is used with the configuration procedure for parameters via “IED Configurator” or operating program.

Toggling between active and inactive memory bank is carried out either by executing the parameter IEC: Switch Config. Bank or via “IED Configurator” (after the connection has been established) by pressing the “Switch Banks” button.

Active Bank

Parameter	
SCL File ID	
Name of the configuration bank currently valid. Setting is carried out with the <i>IED Configurator</i> , after a connection with the device has been established (via menu item “Manage IED”).	
SCL File Version	
Version number of the configuration bank currently valid. Setting is carried out with the <i>IED Configurator</i> , after a connection with the device has been established (via menu item “Manage IED”).	

Inactive Bank

Parameter	
SCL File ID	
Name of the inactive configuration bank. Setting is carried out with the <i>IED Configurator</i> , after a connection with the device has been established (via menu item “Manage IED”).	
SCL File Version	
Version number of the inactive configuration bank. Setting is carried out with the <i>IED Configurator</i> , after a connection with the device has been established (via menu item “Manage IED”).	

9.2

IED Details

The category “IED Details” contains several settings that characterize the device as well as the SCL file, which identifies the IEC 61850 configuration.

SCL Details	Parameter		Default Value	
	SCL File ID		PX 433	
	Identification of the .MCL configuration file. If required, this preset value may be modified by, for example, entering a bay name.			
	SCL File Version		251.2.01	
Specific value to identify the IEC 61850 data model and configuration. If required, this preset value may be modified by, for example, identifying the revision states during engineering.				
IED Details	Parameter			Address
	Name			104 057
	Explicitly assigned device name for the function in the system (IED); is part of the Logical Device Name.			
	Important note: According to the IEC standard the name must consist of only letters (A..Z, a..z), digits (0..9) and underscore characters (_), and the name must start with a letter. Note that a non-standard name causes problems with the IEC 61850 communication.			
Template Details	Parameter			
	ICD Template			
	SCL Schema Version			
	Description			
	Type			
	Configuration Revision			
	Supported Models			
The values listed in the column “Template Details” only provide information. They are preset and cannot be modified.				

9.3 Communications

The category “Communications” contains the general network-related settings.

Connected Sub-Network

Parameter		Default Value	
Interface 1 Connected Sub-Network		NONE	
Interface 2 Connected Sub-Network		NONE2	
Optional name available to identify the Ethernet network.			
Access Point		AP1	
Part of the communications control; preset, cannot be modified.			

Address Configuration

Parameter		Default Value	Address
Enable VLANs		false	
Checkbox to enable/disable VLANs. When the checkbox is checked, all configurations for physical Interfaces that have defined any VLANs will be replaced by the configuration of these VLANs (grouped by physical interfaces).			
Enable Port Assignment		false	
Checkbox to enable/disable Port Assignment. When the checkbox is checked, Port Assignments configuration will appear for all physical interfaces supported by the device.			

Parameter		Default Value	Address
Interface 1			
IP Address		0.0.0.0	104 001
Assigned IP address of the Interface1 of P433 for the server function in the system.			
SubNet Mask		0.0.0.0	104 005
The subnet mask defines which part of the IP address is addressed by the sub-network and which part by the device that is logged-on to the network.			
Gateway Address		0.0.0.0	104 011
This parameter shows the IPv4 address of the network gateway for communication links to clients outside of the local network.			

Parameter	Default Value	Address
Interface 2 (if fitted)		
IP Address	0.0.0.0	104 070
Assigned IP address of the Interface2 of P433 for the server function in the system.		
SubNet Mask	0.0.0.0	104 071
The subnet mask defines which part of the IP address is addressed by the sub-network and which part by the device that is logged-on to the network.		
Gateway Address	0.0.0.0	104 072
This parameter shows the IPv4 address of the network gateway for communication links to clients outside of the local network.		

Parameter	Default Value	Address
Interface 1 VLAN1/VLAN2		
VLAN Id (hex)	1	104 092
	2	104 096
Assigned VLAN ID of Interface 1. (These parameters appear when checkbox of Enable VLANs is switched on.)		
IP Address	192.168.10.4	104 091
	192.168.11.4	104 094
Assigned IP address of VLAN in the system.		
SubNet Mask	255.255.255.0	104 093
	255.255.255.0	104 097
The subnet mask of VLAN defines which part of the IP address is addressed by the sub-network and which part by the device that is logged-on to the network.		
Gateway Address	0.0.0.0	104 094
	0.0.0.0	104 098
This parameter shows the IPv4 address of the network gateway of the VLAN for communication links to clients outside of the local network.		

Parameter	Default Value	Address
IEC 61850 (MMS)		
Checkbox to enable/disable MMS services including report. (These parameters can be configured for Interface1, Interface2, VLAN1 and VLAN2 separately when checkbox of Enable Port Assignment is switched on.)		
Network Time Protocol (NTP)		
Checkbox to enable/disable NTP service.		
IED Configuration (TLS)		
Checkbox to enable/disable services via TLS to configure the device from Easergy Studio.		
Basic Administration (SSH/SFTP)		
Checkbox to enable/disable loader service e.g. Update firmware, Read/Write MAC addresses.		
User management (RBAC) (Webservice)		
Checkbox to enable/disable web services for the SAT tool to configure security and the RBAC.		

General Configuration

Parameter	Default Value	
TCP Keepalive	5 seconds	
Communication monitoring at TCP level.		
Database Lock Timeout	2 minutes	
Return time period for setting procedures that have commenced. (The default value above is in seconds. The <i>IED Configurator</i> , however, displays converts this to minutes.)		

9.4 SNTP

The category “SNTP” contains the clock synchronization settings.

9.4.1 General Config

Client Operation	Parameter	Default Value	
	Poll Rate (seconds)	64	
	Polling interval for clock synchronization.		
	Accepted Stratum Level	All levels (0 - 15)	
	Quality criterion to accept an SNTP server for clock synchronization; preset, cannot be modified.		

9.4.2 External Server 1

Settings for the primary clock synchronization server.

Note that all values except IP Address and the “Use Anycast” button are usually disabled and may be accepted only when imported from an XML configuration file.

External Server Parameters	Parameter	Default Value	Address
	IP Address	0.0.0.0	104 202
	IP address of the preferred server used for clock synchronization. Clicking the “Use Anycast” button in the <i>IED Configurator</i> changes the value such that any server in the local network is appointed to provide clock synchronization.		

9.4.3 External Server 2

Settings for the backup clock synchronization server.

Note that all values except IP Address and the “Use Anycast” button are usually disabled and may be accepted only when imported from an XML configuration file.

External Server Parameters	Parameter	Default Value	Address
	IP Address	0.0.0.0	104 210
	IP address of the backup server used for clock synchronization. Clicking the “Use Anycast” button in the <i>IED Configurator</i> changes the value such that any server in the local network is appointed to provide clock synchronization.		

9.5 Dataset Definitions

Dataset Definitions	Parameter
	Name
	Explicitly (and uniquely) assigned name for the dataset.
	Location
	Saving datasets at System/LLN0 is compulsory.
	Contents
Content (data objects, data attributes) of a dataset. The “GOOSE Capacity” display allows for checking the length of a dataset for less than 1500 bytes to permit transmission in GOOSE messages. Note: It is not possible to read the IEC configuration back from the P433 if the “Dataset” sizes exceed the GOOSE size limit significantly. Too large a dataset can spoil IEC 61850 communication. Hence, the dataset size limit of 100% of the GOOSE capacity should not be exceeded, neither for GOOSE nor for reports.	

9.6 GOOSE Publishing

9.6.1 System/LLN0

Network Parameters	Parameter	Default Value	
	Multicast MAC Address	01-0C-CD-01-00-00	
	Virtual MAC address that the sending device provides as the destination; preset.		
	Application ID (hex)	0000	
	Explicitly (and uniquely) assigned ID-number of the GOOSE.		
	VLAN Identifier (hex)	0	
	ID-number of the virtual LAN with which the GOOSE is sent; preset.		
	VLAN Priority	4	
	Priority with which the GOOSE is sent in the virtual LAN; preset.		

Repeat Message Transmission Parameters	Parameter	Default Value	
	Minimum Cycle Time	10 ms	
	First send repetition of the GOOSE occurring after the set time period; preset.		
	Maximum Cycle Time	1 s	
	Continuous send repetition of the GOOSE occurring after the set time period; preset.		
	Increment	900	
	Specification factor for the transition of time intervals for GOOSE send repetitions from the first to the continuous repetition.		

Message Data
Parameters

Parameter		Default Value	
GOOSE Identifier		TEMPLATESystem/ LLN0\$GO\$gcb01	
GOOSE ID consisting of the Device Name and the GOOSE Control Block.			
Dataset Reference			
Name of the dataset assigned to the GOOSE.			
Configuration Revision		1	
Revision status of the configuration.			

9.7

GOOSE Subscribing

9.7.1

Mapped Inputs

Source Network
Parameters

Parameter		Default Value	
Multicast MAC Address		01-0C-CD-01-00-00	
Virtual MAC address used as a receive filter; preset.			
Application ID (hex)		0	
ID-number of the GOOSE.			

GOOSE Source
Parameters

Parameter	Default Value	
Source Path		
Information data attribute in the transmitting device.		
GOOSE Identifier		
ID of the GOOSE in the transmitting device.		
Dataset Reference		
Name of the dataset assigned to the GOOSE in the transmitting device.		
Configuration Revision	0	
Configuration revision status of the transmitting device.		
Data Obj Index	1	
Position index of the data object within the GOOSE.		
Data Obj Type	Unknown	
Structure of the data object; possible settings: ● <i>Unknown</i> ● <i>Boolean</i> (logical value) ● <i>Int8</i> (Integer, with 8 digits) ● <i>Int16</i> (Integer, with 16 digits) ● <i>Int32</i> (Integer, with 32 digits) ● <i>UInt8</i> (Positive integer, with 8 digits) ● <i>UInt16</i> (Positive integer, with 16 digits) ● <i>UInt32</i> (Positive integer, with 32 digits) ● <i>Float</i> (Floating-point number) ● <i>BStr2</i> (Binary state, with 2 digits) ● <i>SPS</i> (Single-pole signal) ● <i>DPS</i> (Two-pole signal)		
Quality Obj Index	1	
Distance of the quality descriptor to the data object if not preset. The quality of the received information is to be tested if such has been configured.		

Destination
Parameters

Parameter	Default Value
Evaluation Expression	Equal to
Criteria to check the received information content by comparing it with a set integer value; the parameter is not supported in the device. ● <i>Equal to</i> (Compared to: equal) ● <i>Not equal to</i> (Compared to: unequal) ● <i>Greater than</i> (Compared to: greater) ● <i>Less than</i> (Compared to: less) ● <i>Pass through</i> (Do not compare)	
Default Input Value	False
Default value for the information in case GOOSE receipt has failed. ● <i>False</i> – not set ● <i>True</i> – set ● <i>Last Known Value</i> – retain last value received (not supported, equivalent to 'False' setting) ● <i>Double Point: intermediate (00)</i> – switching device in intermediate position ● <i>Double Point: Off (01)</i> – switching device open ● <i>Double Point: On (10)</i> – switching device closed ● <i>Double Point: Bad state (11)</i> – switching device in intermediate position	
Invalidity Quality bits	
Quality criterion, which is to be tested. ● <i>Invalid / Questionable</i>: Invalid / questionable ● <i>Source</i>: Information source is faulty ● <i>Relay test</i>: Sending device is set to test mode ● <i>OperatorBlocked</i>: Blocked by operator and ● <i>Overflow</i>: Measured value has exceeded its capacity ● <i>OutOfRange</i>: Measured value has exceeded its range ● <i>BadReference</i>: Referenced value is faulty ● <i>Oscillatory</i>: Value is volatile ● <i>Failure</i>: Faulty ● <i>OldData</i>: Information is out-of-date ● <i>Inconsistent</i>: Information is unreliable ● <i>Inaccurate</i>: Information is inaccurate	

9.8 Report Control Blocks

9.8.1 System/LLN0

Report Parameters

Parameter		Default Value
Report Type		
Report type: ● <i>Unbuffered</i> (updating) ● <i>Buffered</i> (saving)		
Report ID	TEMPLATESystem/ LLN0\$RP \$urcbA, ..., TEMPLATESystem/ LLN0\$RP \$urcbP, ..., TEMPLATESystem/ LLN0\$BR \$brcbA, ..., TEMPLATESystem/ LLN0\$BR\$brcbH	
Report ID consisting of the Device Name and the Report Control Block.		
Dataset Reference		
Name of the dataset assigned to the report.		
Configuration Revision	1	
Revision status of the configuration.		

9.9 Controls

9.9.1 Control Objects

Control Object Parameters

Parameter
ctlModel
To control external devices the following operating modes can be set: ● <i>Status only</i> (manually operated switching device) ● <i>Direct control with enhanced security</i> (direct command issue with extended monitoring of command effecting) ● <i>SBO (Select before operate) with enhanced security</i> (switching device selection procedure with extended monitoring of command effecting)
sboTimeout
Return time period after selection without issuing a command.

9.9.2 Uniqueness of Control

Source Network Parameters

Parameter	Default Value
Multicast MAC Address	01-0C-CD-01-00-00
Virtual MAC address used as a receive filter; preset.	
Application ID (hex)	0
ID-number of the GOOSE.	

GOOSE Source Parameters

Parameter	Default Value	
Source Path		
Information data attribute in the transmitting device.		
GOOSE Identifier		
ID of the GOOSE in the transmitting device.		
Dataset Reference		
Name of the dataset assigned to the GOOSE in the transmitting device.		
Configuration Revision	0	
Configuration revision status of the transmitting device.		
Data Obj Index	1	
Position index of the data object within the GOOSE.		
Default Input Value	True	
Default value for the information in case GOOSE receipt has failed:		
● <i>False</i> – not set ● <i>True</i> – set ● <i>Last Known Value</i> – retain last value received ● <i>Double Point: intermediate (00)</i> – switching device in intermediate position ● <i>Double Point: Off (01)</i> – switching device open ● <i>Double Point: On (10)</i> – switching device closed ● <i>Double Point: Bad state (11)</i> – switching device in intermediate position		

9.10

Measurements

Scaling	Parameter		
	Unit Multiplier		
	Multiplication factor; not supported.		
Range configuration	Parameter		
	Scaled Measurement Range: Min		
	Scaled Measurement Range: Max		
	Lower / Upper measuring range limit value; not supported.		
Deadband Configuration	Parameter		Default Value
	Deadband		10000
	Multiplier for the smallest display value of the measured value. In order to have the current measured value sent when it has changed from the value last sent the result of the set dead band value multiplied by the smallest display value must exceed the smallest display value.		

9.11 Configurable Data Attributes

9.11.1 System/LLN0

Mod.measCyc

Parameter

Value

Transmission of measured values: Time interval in seconds between two dead band evaluations.

Mod.enCyc

Parameter

Value

Cyclic transmission of measured values without dead band check: Time interval in seconds between transmissions of two energy count values.

Mod.comtrade

Parameter

Value

Transmission of COMTRADE fault files formatted either as ASCII or binary files.

Mod.distExtr

Parameter

Value

Cancelling fault transmission or including it in the configuration.

10

Commissioning

10.1

Safety Instructions

 DANGER**HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH**

- Only qualified personnel, trained, authorized and familiar with the device and all the safety instructions in the general Safety Guide (SFTY/5LM/L11 or later version) and appropriate Chapter 5, Chapter 10, Chapter 11, Chapter 12 and Chapter 13 of this manual, shall work on installation, connection, commissioning, maintenance or servicing of this device.
- When installing and connecting the device the warning notices at the beginning of Chapter "Installation and Connection" (Chapter 5) must be observed.

Failure to follow these instructions will result in death or serious injury.

 DANGER**HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH**

- Switch off the auxiliary power supply before any work in the terminal strip area.
- Switch off all the power supplies in connection to the equipment before any work in the terminal strip area to isolate the device.
- Do not touch the terminal strip area when equipment is in operation.
- Do not remove or add wires in the terminal strip area when equipment is in operation.
- Short-circuit the system current transformers before disconnecting wires to the transformer board (valid only for pin terminals, not required for ring terminals which have a shortening block).
- A protective conductor (ground/earth) of at least 1.5 mm² must be connected to the protective conductor terminal on the power supply board and on the main relay case.
- Do never remove the protective conductor connection to the device casing as long as other wires are connected to it.
- Where stranded conductors are used, insulated crimped wire end ferrules must be employed.

Failure to follow these instructions will result in death or serious injury.

Note: Regarding the appropriate wiring connections of the equipment refer to the document Px3x_Grounding_Application_Guide_EN_h.pdf.

 DANGER
HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH

- The device must be reliably grounded to meet protective equipment grounding requirements.
- The surface-mounted case is grounded using the bolt and nut, appropriately marked, as the ground connection. The flush-mounted case must be grounded in the area of the rear sidepieces at the location provided. The bracket is marked with the protective ground symbol: ⊕. The cross-section of the ground conductor must conform to applicable national standards. A minimum cross section of 2.5 mm² (≤ AWG12) is required.
- In addition, a protective ground connection at the terminal contact on the power supply module (identified by the letters “PE” on the terminal connection diagram) is also required for proper operation of the device. The cross-section of this ground conductor must also conform to applicable national standards. A minimum cross section of 1.5 mm² (US: AWG14 or thicker) is required.
- If a detachable HMI is installed, a further protective conductor (ground/earth) of at least 1.5 mm² (US: AWG14 or thicker) must be connected to the DHMI protective conductor terminal to link the DHMI and the main relay case; these must be located within the same substation.
- All grounding connections must be low-inductance, i.e. it must be kept as short as possible.
- The protective conductor (earth) must always be connected to the protective grounding conductor terminal in order to guarantee the safety given by this setup.

Failure to follow these instructions will result in death or serious injury.

 DANGER
HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH

- Application of analog signals to the measuring inputs must be in compliance with the maximum permissible rating of the measuring inputs (see “Technical Data”, Chapter 2).
- Do not open the secondary circuit of live system current transformers! If the secondary circuit of a live CT is opened, there is the danger that the resulting voltages will endanger personnel and damage the insulation.
- For pin-terminal connection devices, the terminal block for system current transformer connection is not a shorting block! Therefore always short-circuit the system current transformers before loosening the threaded terminals.

Failure to follow these instructions will result in death or serious injury.

 DANGER**HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH**

- The power supply must be turned off for at least 5 s before power supply module V is removed. Otherwise there is the danger of an electric shock.

Failure to follow these instructions will result in death or serious injury.

 DANGER**HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH**

- When increased-safety machinery is located in a hazardous area the device must always be installed outside of this hazardous area to protect this equipment.

Failure to follow these instructions will result in death or serious injury.

 DANGER**HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH**

- The PC interface is not designed as a permanent connection. Consequently, the female connector does not have the extra insulation from circuits connected to the system that is required per IEC/EN 60255-27. Therefore DO NOT leave any permanent cable connection on the PC interface connector at the HMI front panel.

Failure to follow these instructions will result in death or serious injury.

 DANGER**HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH**

- Do not connect or disconnect the RS 485 or fiber-optic interface when the supply voltage for the device is under power and in operation.

Failure to follow these instructions will result in death or serious injury.

 WARNING**HAZARD OF UNINTENDED EQUIPMENT OPERATION**

- When using the programmable logic (function group LOGIC), the user must carry out a functional type test to conform to the requirements of the relevant protection/control application.
- In particular, it is necessary to verify that the requirements for the implementation of logic linking (by setting) as well as the time performance during device startup, during operation and when there is a fault (device blocking) are fulfilled.

Failure to follow these instructions can result in unintended equipment operation.

10.2 Commissioning Tests

10.2.1 Preparation

After the P433 has been installed and connected as described in [Chapter 5, \(p. 5-1\)](#), the commissioning procedure can begin.

Before turning on the power supply voltage, the following items must be checked again:

- Is the device connected to the protective ground at the specified location?
- Does the nominal voltage of the battery agree with the nominal auxiliary voltage of the device?
- Are the current and voltage transformer connections, grounding, and phase sequences correct?

After the wiring work is completed, check the system to make sure it is properly isolated. The conditions given in IEC/EN 60255-27 must be satisfied.

Once all checks have been made, the power supply voltage may be turned on. After voltage has been applied, the device starts up. During startup, various startup tests are carried out (see [Section 3.15, \(p. 3-140\)](#)). The LED indicators for HEALTHY (H1) and OUT OF SERVICE (H2) will light up. After approximately 15 s, the P433 is ready for operation. By default (factory setting) or after a cold restart, the device type "P433" and the time are displayed on the first line of the LCD after the device has started up. If a bay type has already been selected this bay will then be shown as a single-pole display.

Once the change enabling command has been issued (see [Section 6.14.3, \(p. 6-28\)](#)), all settings can be entered. The procedure for entering settings from the integrated local control panel is described in [Section 6.14.4, \(p. 6-32\)](#).

First the type of bay wanted is to be set at MAIN: Type of bay, Par/Conf menu branch. When the automatic assignment has been enabled at MAIN: Auto-assignment I/O then selecting the type of bay will automatically configure binary signal inputs and output relays according to the definitions corresponding to the bay type.

After pressing the ENTER key to confirm the setting parameter MAIN: Type of bay the signal Bay initialization is displayed on the LCD for a time duration of 20 s. The LED indicator labeled EDIT MODE will light up. A control action is not possible during this time period.

If either the PC interface or the communication interface will be used for setting the P433 and reading out event records, then the following settings must first be made from the integrated local control panel.

Par/DvID menu branch:

- DVICE: Device password 1
- DVICE: Device password 2

Par/Conf menu branch:

- PC: Bay address
- PC: Device address
- PC: Baud rate
- PC: Parity bit
- COMM1: Function group COMM1
- COMM1: General enable USER
- COMM1: Name of manufacturer
- COMM1: Line idle state
- COMM1: Baud rate
- COMM1: Parity bit
- COMM1: Communicat. protocol
- COMM1: Octet comm. address
- COMM1: Octet address ASDU
- COMM2: Function group COMM2
- COMM2: General enable USER
- COMM2: Name of manufacturer
- COMM2: Line idle state
- COMM2: Baud rate
- COMM2: Parity bit
- COMM2: Octet comm. address
- COMM2: Octet address ASDU
- COMM3: Function group COMM3
- COMM3: General enable USER
- COMM3: Baud rate

Par/Func/Glob menu branch:

- PC: Command blocking
- PC: Sig./meas.val.block.
- COMM1: Command block. USER
- COMM1: Sig./meas.block.USER
- COMM2: Command block. USER
- COMM2: Sig./meas.block.USER

Instructions on these settings are given in Chapters “Settings” and “Information and Control Functions”.

The settings given above apply to the IEC 60870-5-103 communication protocol. If another protocol is being used for the communication interface, additional settings may be necessary. See Chapter “Settings” for further details.

After the settings have been made, the following checks should be carried out again before the blocking is cancelled:

- Is the correct bay type configured?
- Does the function assignment of the binary signal inputs agree with the terminal connection diagram?
- Has the correct operating mode been selected for the binary signal inputs?
- Does the function assignment of the output relays agree with the terminal connection diagram?
- Has the correct operating mode been selected for the output relays?
- Are the interlocking conditions and the external interlock inputs correctly configured?
- Have all settings been made correctly?

Now blocking can be cleared as follows (*Par/Func/Glob* menu branch):

- MAIN: Device on-line = Yes (= on)

10.2.2

Cyber Security Commission

For device with Cyber Security, access to some parts of the menu is only possible with an user authentication after "Log in" with an user name and password. The user should "Log out" after operation (see [Section 3.3.1, \(p. 3-5\)](#)).

The EcoStruxure™ Cybersecurity Admin Expert (CAE) is used to access to security functions rights with the security administration role (by default). It provides:

- User accounts setting.
- Rights and roles management.
- Rights and roles administration.

User accounts setting button gives access to user informations and authentication tools: you can manage login (user name and password and arrow password), login attempts, inactivity time etc.).

Login	First Name	Last Name	Phone Num	Email
DefaultEngineer	Engineer	Engineer		
DefaultOperator	Operator	Operator		
DefaultViewer	Viewer	Viewer		
NewUser	NewUser	NewUser		
SecurityAdmin	SecurityAdmin	SecurityAdmin		

User Information

First Name * :

Last Name * :

User Authentication

Login * :

Password :

Confirm Password :

Arrow key password :

User Parameters

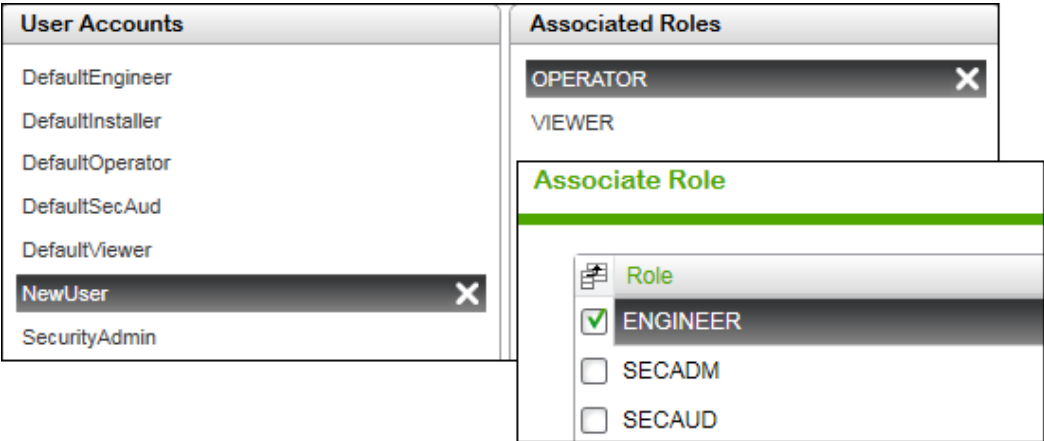
Minimum inactivity period (min) :

Allow user locking : ☒

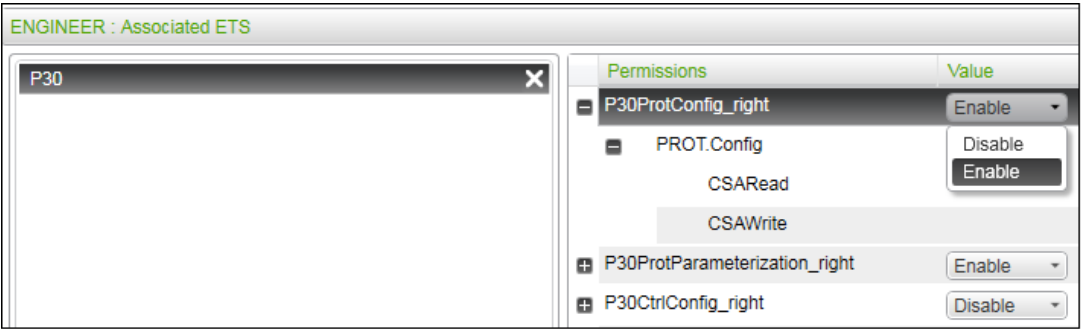
Maximum login attempts :

Password attempts timer (min) :

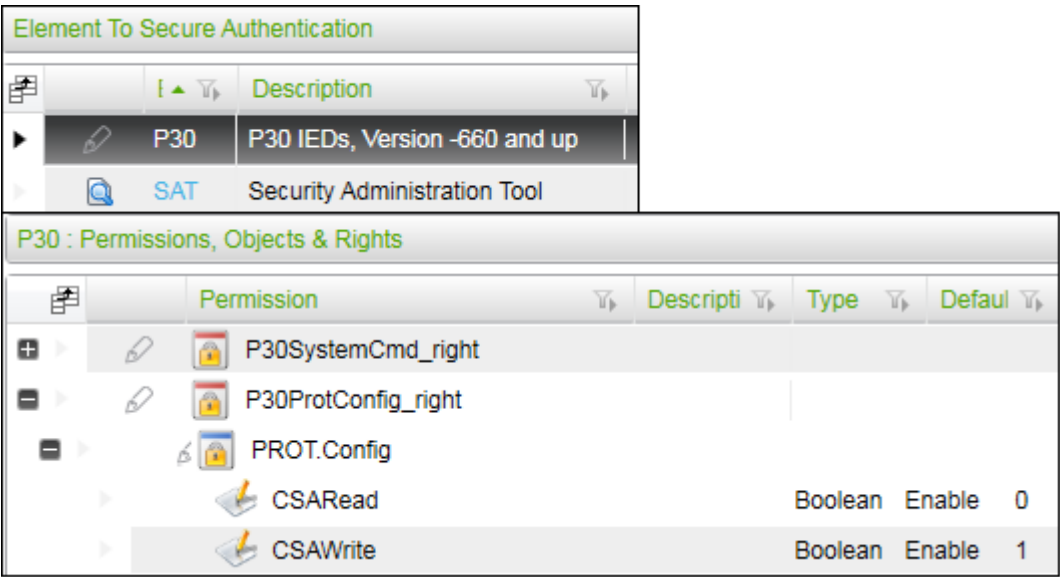
You can associate (add or remove) role(s) to an user account:



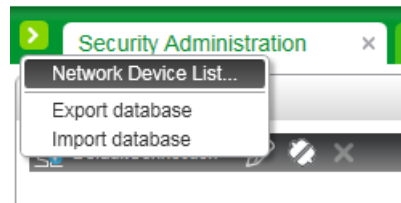
You can edit rights (associated Element To Secure (ETS)) for each role:



You can edit Elements To Secure (ETS) by editing permissions, objects and rights:



Set “Network Device List...” to select file to send to the device.



Please, refer to the “Security Administration Tool ” for complete information about security administration tool.

10.2.3

Testing

When testing trip or close commands configured to standard outputs, the CB must not be mechanically locked, so that its auxiliary 52a/b contact could operate and break the DC current. If the CB has to stay locked, tripping or closing circuit has to be opened by terminal disconnection or test switch. Otherwise there is a high risk of damaging the P433 output contact.

By using the signals and displays generated by the P433, it is possible to determine whether the P433 is correctly set and properly interconnected with the station. Signals are signaled by output relays and LED indicators and entered into the event memory. In addition, the signals can be checked by selecting the appropriate signal in the menu tree.

If the user does not wish the circuit breaker to operate during protection testing, the trip commands can be blocked through MAIN: Trip cmd.block. USER (Par/Func/Glob menu branch) or an appropriately configured binary signal input. If circuit breaker testing is desired, it is possible to issue a trip command for 100 ms through MAIN: Man. trip cmd. USER (Oper/Ctrl/Test menu branch) or an appropriately configured binary signal input. Selection of the trip command from the integrated local control panel is password-protected (see [Section 6.14.9, \(p. 6-51\)](#)).

The manual trip command is not executed unless the manual trip is included in the selection of possible functions to effect a trip (in the configuration of trip commands).

If the P433 is connected at substation control level, the user is advised to activate the test mode via MAIN: Test mode USER (Par/Func/Glob menu branch) or an appropriately configured binary signal input. The telegrams are then identified accordingly (reason for transmission: test mode).

10.2.4

Checking the Binary Signal Inputs

By selecting the corresponding state signal (Oper/Cycl/Phys menu branch), it is possible to determine whether the input signal that is present is recognized correctly by the device. The values displayed have the following meanings:

- “Low”: Not energized.
- “High”: Energized.
- Without function: No functions are assigned to the binary signal input.

This display appears regardless of the binary signal input mode selected.

10.2.5 Checking the Output Relays

It is possible to trigger the output relays for a settable time period for test purposes (time setting at OUP: Hold-time for test in *Oper/Ctrl/Test* menu branch). First select the output relay to be tested (OUP: Relay assign. f.test, *Oper/Ctrl/Test* menu branch).

Test triggering then occurs via OUP: Relay test (*Oper/Ctrl/Test* menu branch). It is password-protected (see [Section 6.14.9, \(p. 6-51\)](#)).

 DANGER HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH Before starting the test, open any triggering circuits for external devices so that no inadvertent switching operations will take place. Failure to follow these instructions will result in death or serious injury.

10.2.6 Checking the Current-Measuring Inputs

By injecting appropriate analog test values at the measuring inputs it is possible to check, by taking a readout from the operating data display (see [Chapter 8, \(p. 8-1\)](#)), whether the Time-Overcurrent Protection and Control Unit will detect such analog signals within the required class accuracy (*Oper/Cycl/Data* menu branch).

- MAIN: Current A p.u.: Display of the updated phase A current in reference to the nominal device current I_{nom} .
- MAIN: Current B p.u.: Display of the updated phase B current in reference to the nominal device current I_{nom} .
- MAIN: Current C p.u.: Display of the updated phase C current in reference to the nominal device current I_{nom} .
- MAIN: Current IN p.u.: Display of the updated residual current I_N in reference to the nominal device current I_{nom} .

 DANGER HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH Application of analog test values to the measuring inputs must be in compliance with the maximum permissible rating of the measuring inputs (see Chapter “Technical Data”, Chapter 2). Failure to follow these instructions will result in death or serious injury.

10.2.7 Checking the Correct Phase Connection of Current and Voltage Transformers with Load Current

The user can check correct connection to the system’s current and voltage transformers by consulting the operating data displays for load angle (MAIN: Load angle phi A, MAIN: Load angle phi C in the *Oper/Cycl/Data* menu branch).

Based on the actual connection scheme of the current transformers (“standard” schematic connection diagram shown in Chapter “Installation and Connection”)

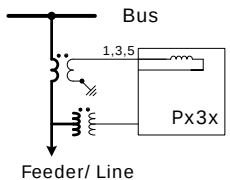
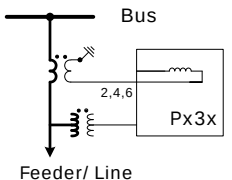
and the device setting at MAIN: Conn. meas. circ. IP = *Standard* or *Opposite* (*Par/Func/Glob* menu branch) the “forward” direction of the protection functions is determined. Therefore the connection and the settings must be known for the direction control. This is of fundamental importance for all directional metering and protection functions of the device, and therefore should be done as one of the first steps in commissioning.

The table of possible combinations below lists the 4 possible combinations of CT connections and direction settings.

It is recommended to carry out the direction control with either primary injected currents and voltages, or under load flow conditions, to make sure that the actual CT and VT connections are implied.

The check itself shall be done by reading the measured load angles. Power measurement operating data can lead to misinterpretation, since the devices additionally provide inverted display of power metering values (setting MAIN: Meas. direction P,Q). The load angles are independent from such post-processing and indicate the actual phase angle between phase current (as reference) and phase-ground voltage. They are displayed for phase currents greater than 5% I_{nom} .

For directional control it is sufficient to check the load angles at active power flow (which is predominantly present in power systems). If active power flow direction is correct, inherently also reactive power flow direction is correct, which is advantageous because only relatively small reactive power flows are in practice available. The expected load angles for active power flow usually is around $\pm 0^\circ$ (typically $-10^\circ \dots 0^\circ$ and $0^\circ \dots +10^\circ$) or $\pm 180^\circ$ (typically $-170^\circ \dots -180^\circ$ and $+170^\circ \dots +180^\circ$). Even for balanced loads small differences between the three load angles may be present (typ. $\pm 2^\circ$). Root cause of bigger differences of load angles should be clarified.

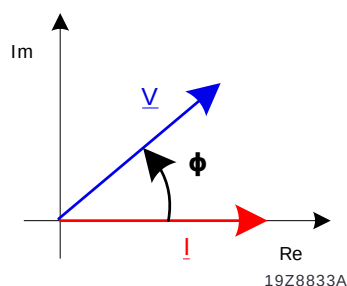
CT connection scheme:	Standard		Opposite	
				
Direction Definition: Forward = by user	Feeder/Line	Bus	Feeder/Line	Bus
required Relay setting: MAIN: Conn. meas. circ. IP =	Standard	Opposite	Opposite	Standard
Direction check: with active power flow from Feeder to Bus: Load angle ϕ^1) =	$\pm 180^\circ$	$\pm 0^\circ$	$\pm 180^\circ$	$\pm 0^\circ$
from Bus to Feeder: Load angle ϕ^1) =	$\pm 0^\circ$	$\pm 180^\circ$	$\pm 0^\circ$	$\pm 180^\circ$

1) Check all three load angles:

MAIN: Load angle ϕ A

MAIN: Load angle ϕ B

MAIN: Load angle ϕ C



Devices from the “Easergy MiCOM 30” family use the current phasor as reference for angle measurement. With positive reactive power the load angle is positive, too.

10.2.8 Checking the Protection Function

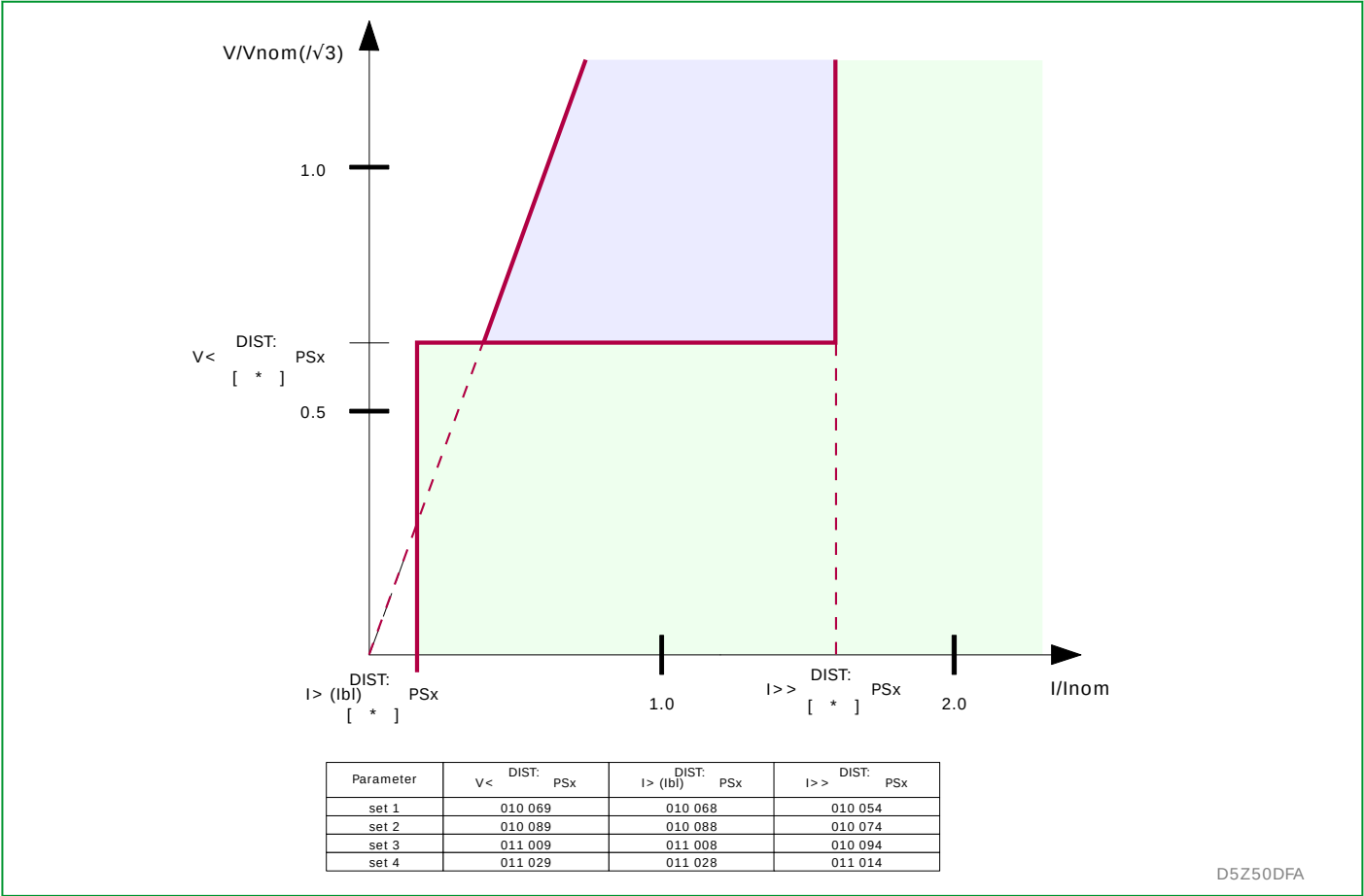
Four parameter subsets are stored in the P433, one of which is activated. Before checking the protective function, the user should determine which parameter subset is activated. The active parameter subset is displayed at PSS: Actual param. subset (*Oper/Cycl/Log* menu branch).

10.2.8.1 Checking Distance Protection

Before checking the distance protection function using a single-phase testing device, disable the measuring circuit monitoring function (MCMON: Enabled, *Oper/Cycl/Log* menu branch) and the fuse failure monitoring function (MCMON: FF, V enabled USER, *Par/Func/Gen* menu branch) since they would otherwise always operate and block distance protection after the set operate delay had elapsed. Furthermore, the signal at the binary signal input configured for MAIN: M.c.b. trip V EXT must have a logic value of “0”.

10.2.8.1.1 Checking Starting

The starting settings can be illustrated in a V-I diagram (see [Fig. 10-1, \(p. 10-13\)](#)). The slope of the impedance line plotted in the V-I diagram is a function of the settings for underimpedance starting and the phase displacement between the measured values (see [Fig. 10-2, \(p. 10-14\)](#)).



D5Z50DFA

Fig. 10-1: Example of the starting settings in a V-I diagram.

Checking $I > (I_{min})$, $V <$ and $I >>$:

The phase displacement between the measured values $\underline{V}$ and $\underline{I}$ should be selected so as to be smaller than the angle set at DIST: β PSx.

Checking $Z <$:

The phase displacement between the measured values V and I should be selected so as to be greater than the angle set at DIST: β PSx.

The measured values should be selected in accordance with the selected operate values such that only one starting measuring system operates. Operation of the checked starting threshold is possible by checking the phase-selective and starting-selective state signals.

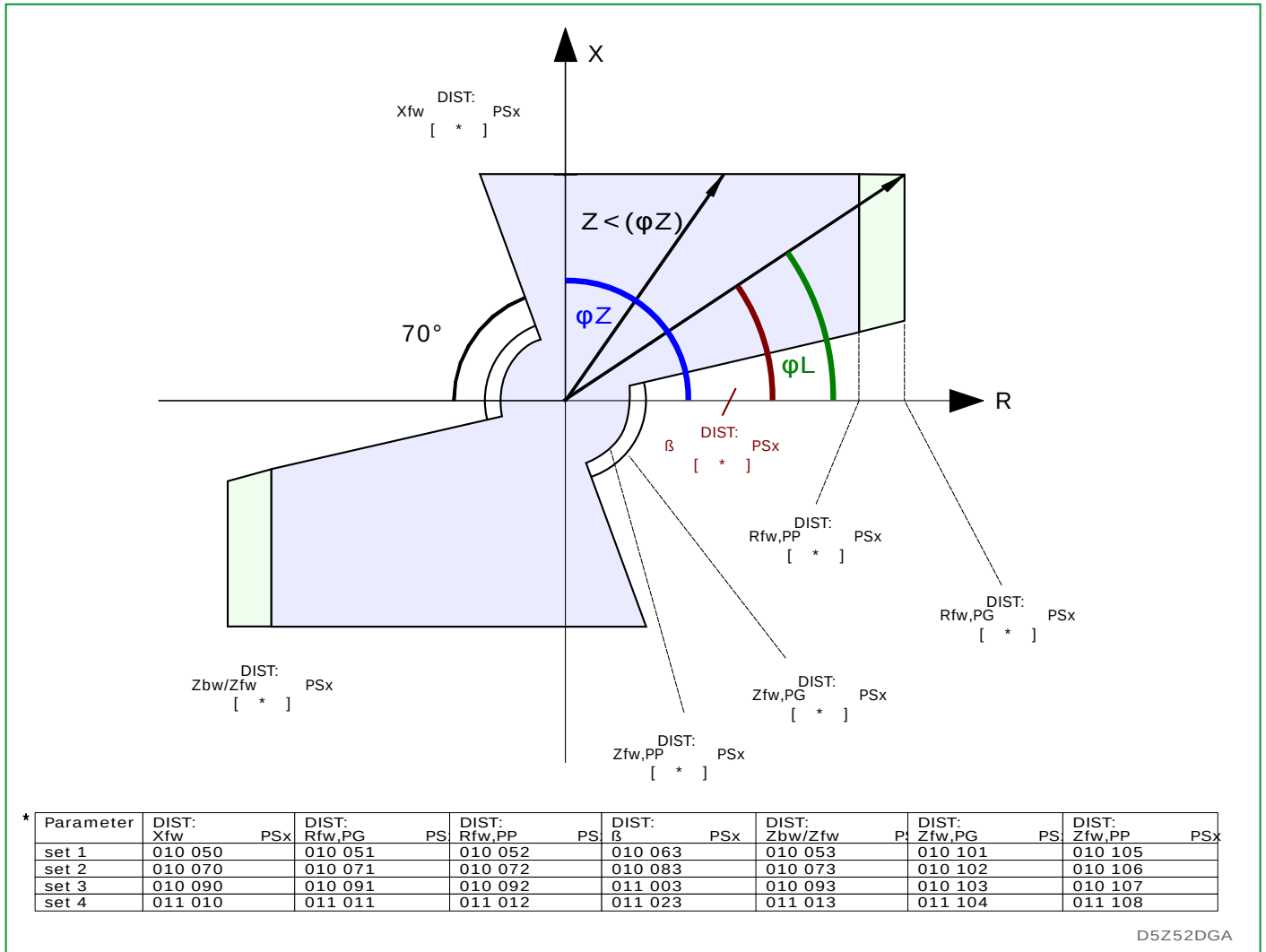


Fig. 10-2: Characteristic of underimpedance starting.

When checking underimpedance starting using single-phase test current, we obtain the following relation for the operate condition for phase-to-phase starting:

$$\frac{V_{\text{test}}}{I_{\text{test}}} = 2 \cdot Z_{<}$$

$$\frac{|V_{\text{test}}| \cdot e^{j \cdot \varphi_{\text{test}}}}{|I_{\text{test}}| \cdot e^{j \cdot 0^\circ}} = 2 \cdot |Z_{<}| \cdot e^{j \cdot \varphi_Z}$$

For absolute value and angle this means:

$$\frac{|V_{\text{test}}|}{|I_{\text{test}}|} = 2 \cdot |Z_{<}|$$

$$\varphi_{\text{test}} = \varphi_Z$$

where:

- $\underline{Z}_{<} =$ Starting Impedance
- $\varphi_Z =$ Impedance Angle
- $\underline{V}_{\text{test}} =$ Test Voltage
- $\underline{I}_{\text{test}} =$ Test Current
- $\varphi_{\text{test}} =$ Phase angle between test voltage and test current

In the range of the reactance limit, that is, for impedance angle φ_Z in the range $\varphi_L < \varphi_Z < 110^\circ$, the starting impedance is calculated as follows:

$$|\underline{Z}_{<}| = \frac{X_{\text{fw}}}{\sin \varphi_Z}$$

$X_{\text{fw}} =$ DIST: Xfw PSx setting

The limit angle φ_L is defined by the point of intersection of reactance and resistance limits and is calculated as follows:

$$\varphi_L = \arctan \frac{X_{\text{fw}}}{R_{\text{fw}}}$$

$R_{\text{fw}} =$ DIST: Rfw,PG PSx or DIST: Rfw,PP PSx setting

If underimpedance starting is to be checked under all angle conditions, then the starting impedances for the individual angle ranges are calculated according to the following equations:

Angle Range	Starting Impedance
$\beta \leq \varphi_Z \leq \varphi_G$	$ \underline{Z}_{<} = \frac{R_{\text{fw}}}{\cos \varphi_Z}$
$(180^\circ + \beta) \leq \varphi_Z \leq (180^\circ + \varphi_G)$	$ \underline{Z}_{<} = \frac{R_{\text{fw}}}{\cos \varphi_Z} \cdot \frac{Z_{\text{bw}}}{Z_{\text{fw}}}$
$(180^\circ + \varphi_G) < \varphi_Z \leq 290^\circ$	$ \underline{Z}_{<} = \frac{X_{\text{fw}}}{\sin \varphi_Z} \cdot \frac{Z_{\text{bw}}}{Z_{\text{fw}}}$

- β : DIST: β PSx setting
- $Z_{\text{bw}} / Z_{\text{fw}}$: DIST: Zbw/Zfw PSx setting

When phase-to-ground starting conditions are checked, the DIST: Z evaluation PSx setting must be taken into account. If $ZPG = VPG/2 \cdot IP$ is set, then the equations given for phase-to-phase starting apply. If, on the other hand, $ZPG = VPG/(IP + kG \cdot IN)$ is set, then the set complex ground factor k_G must be taken into account if the setting for DIST: Abs. value k_G PSx is not equal to one and/or the setting for DIST: Angle k_G PSx is not equal to 0° . When the test is carried out using single-phase test current, the following relation for the operate condition is obtained:

$$\frac{\underline{V}_{\text{test}}}{\underline{I}_{\text{test}}} = (1 + \underline{k}_G) \cdot \underline{Z}_{<}$$

$$\frac{|\underline{V}_{\text{test}}| \cdot e^{j \cdot \varphi_{\text{test}}}}{|\underline{I}_{\text{test}}| \cdot e^{j \cdot 0^\circ}} = (1 + |\underline{k}_G| \cdot e^{j \cdot \varphi_G}) \cdot |\underline{Z}_{<}| \cdot e^{j \cdot \varphi_Z}$$

For absolute value and angle this means:

$$\frac{|\underline{V}_{\text{test}}|}{|\underline{I}_{\text{test}}|} = \sqrt{1 + |\underline{k}_G|^2 + 2 \cdot |\underline{k}_G| \cdot \cos \varphi_G} \cdot |\underline{Z}_{<}|$$

$$\varphi_{\text{test}} = \arctan \frac{\sin \varphi_Z + |k_G| \cdot \sin(\varphi_Z + \varphi_G)}{\cos \varphi_Z + |k_G| \cdot \cos(\varphi_Z + \varphi_G)}$$

or

$$\varphi_Z = \arctan \frac{\sin \varphi_{\text{test}} + |k_G| \cdot \sin(\varphi_{\text{test}} - \varphi_G)}{\cos \varphi_{\text{test}} + |k_G| \cdot \cos(\varphi_{\text{test}} - \varphi_G)}$$

where:

- $Z_{<} =$ Starting Impedance
- $\varphi_Z =$ Impedance Angle
- $|k_G| =$ DIST: Abs. value kG PSx setting
- $\varphi_G =$ DIST: Angle kG PSx setting
- $V_{\text{test}} =$ Test Voltage
- $I_{\text{test}} =$ Test Current
- $\varphi_{\text{test}} =$ Phase angle between test voltage and test current

From the input measured values, the P433 calculates the residual current I_N and the neutral-displacement voltage V_{NG} , which are used for zero-sequence starting. They are calculated according to the following equations:

$$I_N = I_A + I_B + I_C$$

$$|V_{NG}| = \frac{1}{3} \cdot |V_{A-G} + V_{B-G} + V_{C-G}|$$

For a single-phase test where $|V_{B-G}| = |V_{C-G}| = 0$, the result of the calculation formula for V_{NG} given above is that the DIST: VNG> PSx or DIST: VNG>> PSx triggers operate if the test voltage exceeds the following value:

$$|V_{\text{test}}| = 3 \cdot V_{NG>} \cdot \frac{V_{\text{nom}}}{\sqrt{3}}$$

$V_{NG>} =$ setting DIST: VNG> PSx or DIST: VNG>> PSx

For a single-phase test where $|I_B| = |I_C| = 0$, the following applies to currents:

$$|I_{\text{test}}| = I_{N>} \cdot I_{\text{nom}}$$

$I_{N>} =$ DIST: IN> PSx setting

Operation of ground starting is only signaled by the LED indicator if starting also operates in a phase. The operation of ground starting can be observed, independently of the operation of phase starting, at DIST: Zero-sequ. starting (*Oper/Cycl/Log* menu branch).

The values determined by the P433 for the residual current I_N and the neutral-point displacement voltage V_{NG} are displayed by the operating data display (current: MAIN: Current IN p.u. and voltage: MAIN: Voltage VNG p.u. in the *Oper/Cycl/Data* menu branch).

10.2.8.1.2

Checking Distance and Directional Measurement

When checking the impedance zones using single-phase test current we obtain the following relation for the operate condition for a phase-to-phase loop:

$$\frac{V_{\text{test}}}{I_{\text{test}}} = 2 \cdot Z_{<}$$

$$\frac{|V_{\text{test}}| \cdot e^{j \cdot \varphi_{\text{test}}}}{|I_{\text{test}}| \cdot e^{j \cdot 0^\circ}} = 2 \cdot |Z_{<}| \cdot e^{j \cdot \varphi_Z}$$

For absolute value and angle this means:

$$\frac{|V_{\text{test}}|}{|I_{\text{test}}|} = 2 \cdot |Z_{\angle}|$$

$$\varphi_{\text{test}} = \varphi_Z$$

where:

- $Z_{\angle}$: Tripping Impedance
- φ_Z : Impedance Angle
- V_{test} : Test Voltage
- I_{test} : Test Current
- φ_{test} : Phase angle between test voltage and test current

10.2.8.1.3

Characteristics

With the P433, the user may choose between a polygonal and a circular tripping characteristic. This selection of the tripping characteristic will then govern calculation of the tripping impedances.

10.2.8.1.3.1

Circle Characteristic

If the circle characteristic has been selected, the tripping impedance is set in the P433. If the setting *Arc compensation: yes* has also been selected, then the characteristic shown in the following diagram is obtained when measuring with sinusoidal quantities.

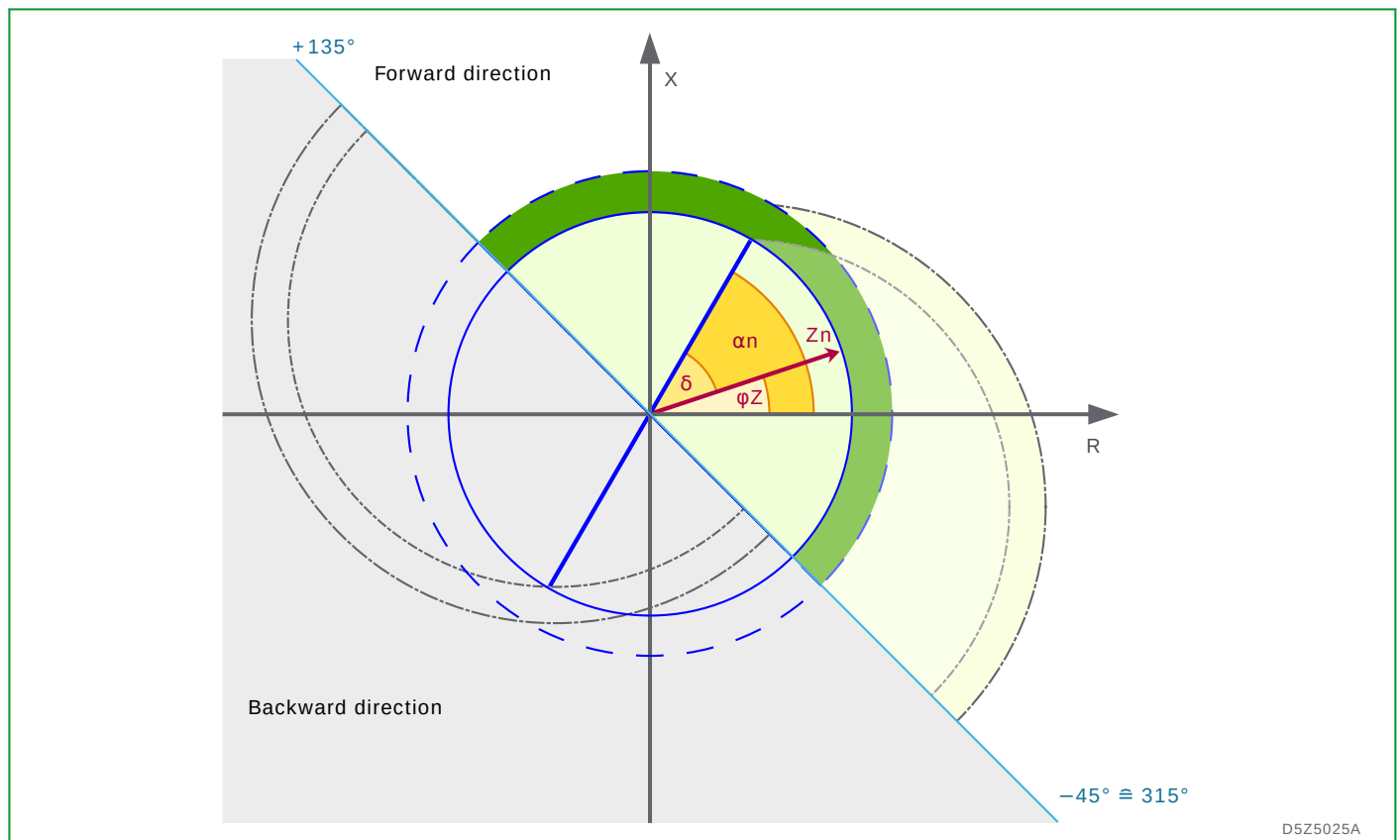


Fig. 10-3: Impedance characteristic for distance and directional determination for the "Circle" setting.

The actual tripping impedance in the ranges $-45^\circ < \varphi_Z < \alpha$ and $135^\circ < \varphi_Z < (\alpha + 180^\circ)$ is then calculated as follows:

$$|Z_{\text{trip}}| = |Z_{\angle}| \cdot (1 + \sin \delta)$$

In the range $-45^\circ < \varphi_Z < \alpha$, the following relation applies: $\delta = \alpha - \varphi_Z$

In the range $135^\circ < \varphi_Z < (\alpha + 180^\circ)$, the following relation applies: $\delta = \alpha - \varphi_Z + 180^\circ$

where:

Z_{trip} : Actual tripping impedance

Z : settings DIST: Z1 (circle) PSx to DIST: Z6 (circle) PSx

φ_Z : Impedance Angle

α : settings DIST: $\alpha 1$ (circle) PSx to DIST: $\alpha 6$ (circle) PSx

When phase-to-ground loops are checked, the set complex ground factor k_G must be taken into account if the setting for DIST: Abs. value k_G PSx is not equal to one and/or the setting for DIST: Angle k_G PSx is not equal to 0° . When the test is carried out using single-phase test current, the following relation for the operate condition is obtained:

$$\frac{V_{\text{test}}}{I_{\text{test}}} = (1 + k_G) \cdot Z_{<}$$

$$\frac{|V_{\text{test}}| \cdot e^{j \cdot \varphi_{\text{test}}}}{|I_{\text{test}}| \cdot e^{j \cdot 0^\circ}} = (1 + |k_G| \cdot e^{j \cdot \varphi_G}) \cdot |Z_{<}| \cdot e^{j \cdot \varphi_Z}$$

For absolute value and angle this means:

$$\frac{|V_{\text{test}}|}{|I_{\text{test}}|} = \sqrt{1 + |k_G|^2 + 2 \cdot |k_G| \cdot \cos \varphi_G} \cdot |Z_{<}|$$

$$\varphi_{\text{test}} = \arctan \frac{\sin \varphi_Z + |k_G| \cdot \sin(\varphi_Z + \varphi_G)}{\cos \varphi_Z + |k_G| \cdot \cos(\varphi_Z + \varphi_G)}$$

or

$$\varphi_Z = \arctan \frac{\sin \varphi_{\text{test}} + |k_G| \cdot \sin(\varphi_{\text{test}} - \varphi_G)}{\cos \varphi_{\text{test}} + |k_G| \cdot \cos(\varphi_{\text{test}} - \varphi_G)}$$

where:

- $Z_{<}$: Tripping Impedance
- φ_Z : Impedance Angle
- $|k_G|$: DIST: Abs. value k_G PSx setting
- φ_G : DIST: Angle k_G PSx setting
- V_{test} : Test Voltage
- I_{test} : Test Current
- φ_{test} : Phase angle between test voltage and test current

In impedance zone 1, the set zone extension factors k_{ze} enter into the tripping impedance in all fault cases.

$$Z_{\text{trip}} = k_{ze} Z_1$$

where:

Z_{trip} : Actual tripping impedance

k_{ze} :

- DIST: $k_{ze,PG}$ HSR PSx or
- DIST: $k_{ze,PP}$ HSR PSx or
- DIST: $k_{ze,PG}$ TDR PSx or
- DIST: $k_{ze,PP}$ TDR PSx setting

Z_1 : DIST: Z1 (circle) PSx setting

Whether the zone extension factors k_{ze} HSR are active or not is controlled by the following protective functions:

- Switch on to fault protection
- An appropriately configured signal input.
- Protective signaling.

If protective signaling is not ready, then control and switching to the zone extension factor k_{zeTDR} , if applicable, is handled by the internal auto-reclosing function. Regardless of the readiness of protective signaling, the zone extension factor k_{zeHSR} may be activated during the reclose command – if set accordingly.

10.2.8.1.3.2

Polygon (Quadrilateral) Characteristic

The tripping impedance is calculated in the range of the reactance limits (for impedance angle φ_Z this means in the range $\varphi_L < \varphi_Z < 90^\circ$) as follows:

$$|Z_{<}| = \frac{X}{\sin \varphi_Z}$$

X: DIST: X1,PG (polygon) PSx to DIST: X6,PG (polygon) PSx setting

The limit angle φ_L is defined by the point of intersection of reactance and resistance limits and is calculated as follows:

$$|\varphi_L| = \arctan \frac{X}{R + \frac{X}{\tan \alpha}}$$

R:

- Settings DIST: R1,PG (polygon) PSx
- to DIST: R6,PG (polygon) PSx
- or DIST: R1,PP (polygon) PSx
- to DIST: R6,PP (polygon) PSx

α : DIST: $\alpha 1$ (polygon) PSx to DIST: $\alpha 6$ (circle) PSx

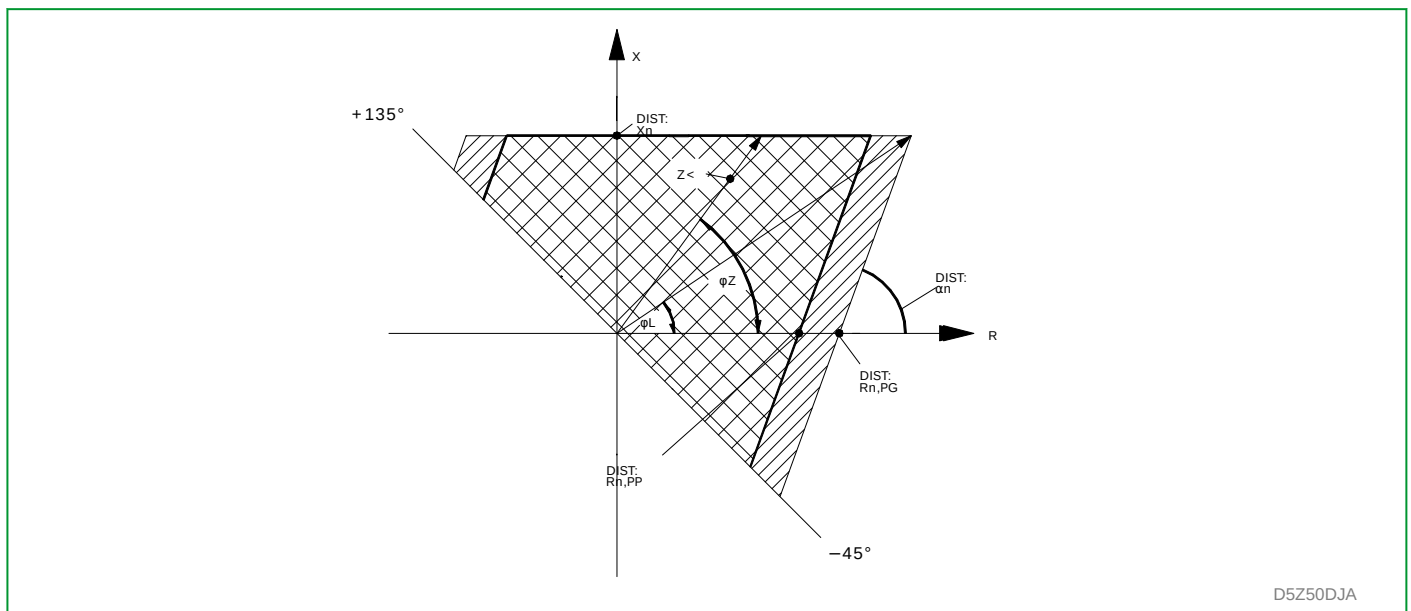


Fig. 10-4: Impedance characteristic for distance and directional determination for the "Polygon" setting.

In the range of the resistance limits (for impedance angles this means in the range of $0^\circ < \varphi_Z \leq \varphi_L$), the tripping impedance is calculated according to the following equation:

$$|Z_{<}| = \frac{R}{\cos\varphi_Z - \frac{\sin\varphi_Z}{\tan\alpha}}$$

When phase-to-ground loops are checked, the set complex ground factor k_G must be taken into account if the setting for DIST: Abs. value k_G PSx is not equal to one and/or the setting for DIST: Angle k_G PSx is not equal to 0° . When the test is carried out using single-phase test current, the following relation for the operate condition is obtained:

$$\frac{V_{\text{test}}}{I_{\text{test}}} = (1 + k_G) \cdot Z_{<}$$

$$\frac{|V_{\text{test}}| \cdot e^{j\varphi_{\text{test}}}}{|I_{\text{test}}| \cdot e^{j\cdot 0^\circ}} = (1 + |k_G| \cdot e^{j\varphi_G}) \cdot |Z_{<}| \cdot e^{j\varphi_Z}$$

For absolute value and angle this means:

$$\frac{|V_{\text{test}}|}{|I_{\text{test}}|} = \sqrt{1 + |k_G|^2 + 2 \cdot |k_G| \cdot \cos\varphi_G} \cdot |Z_{<}|$$

$$\varphi_{\text{test}} = \arctan \frac{\sin\varphi_Z + |k_G| \cdot \sin(\varphi_Z + \varphi_G)}{\cos\varphi_Z + |k_G| \cdot \cos(\varphi_Z + \varphi_G)}$$

or

$$\varphi_Z = \arctan \frac{\sin\varphi_{\text{test}} + |k_G| \cdot \sin(\varphi_{\text{test}} - \varphi_G)}{\cos\varphi_{\text{test}} + |k_G| \cdot \cos(\varphi_{\text{test}} - \varphi_G)}$$

where:

- $Z_{<}$: Tripping Impedance
- φ_Z : Impedance Angle
- $|k_G|$: DIST: Abs. value k_G PSx setting
- φ_G : DIST: Angle k_G PSx setting
- V_{test} : Test Voltage
- I_{test} : Test Current
- φ_{test} : Phase angle between test voltage and test current

In impedance zone 1, the set zone extension factors k_{ze} enter into the tripping impedance in all fault cases.

$$R_{\text{trip}} = k_{ze} R_1$$

$$X_{\text{trip}} = k_{ze} X_1$$

where:

R_{trip} : Actual tripping resistance

X_{trip} : Actual tripping reactance

k_{ze} :

- setting DIST: $k_{ze,PG}$ HSR PSx
- or DIST: $k_{ze,PP}$ HSR PSx
- or DIST: $k_{ze,PG}$ TDR PSx
- or DIST: $k_{ze,PP}$ TDR PSx

R_1 : DIST: R1,PG (polygon) PSx or DIST: R1,PP (polygon) PSx setting

X_1 : DIST: X1,PG (polygon) PSx setting

Whether the k_{ze} HSR zone extension factors are active or not is controlled by the following protective functions:

- Switch on to fault protection
- An appropriately configured binary signal input.
- Protective signaling.

If protective signaling is not ready, then control and switching to zone extension factor k_{zeTDR} , if applicable, is handled by the internal auto-reclosing function. Regardless of the readiness of protective signaling, zone extension factor k_{zeHSR} may be activated during the reclose command – if set accordingly.

10.2.8.1.4

Checking the Voltage Memory

The voltage stored by the voltage memory is used in certain cases for direction determination. The voltage stored by the voltage memory is used in certain cases for direction determination.

If the voltage memory is to be tested using a single-phase test device, checking should only be done for an A-B fault.

- Voltage $|\underline{V}_{A-B}|$ is greater than $0.65 V_{nom}$.
- The frequency is in the range $0.95 \cdot f_{nom} < f < 1.05 \cdot f_{nom}$.

With the starting signal, the voltage memory is decoupled from the synchronizing voltage ($\underline{V}_{A-B}$), and the stored voltage can be used for directional measurement for 2 s maximum.

The P433 determines, on the basis of the magnitude of the fault voltage, whether the direction will be determined using the fault voltage, the stored voltage, or the set angle α (DIST: $\alpha 1$ (polygon) PSx, ..., DIST: $\alpha 6$ (polygon) PSx). The following possibilities exist:

Angle for Direction Determination with:

V memory	$0.002 \cdot V_{nom} < V_{meas} < \text{DIST: Oper.val.V memory PSx}$	$V_{meas} < 0.002 \cdot V_{nom}$
Enabled	φ_X	φ_X
Not enabled	φ_F	α

φ_X : Angle determined using the stored voltage

φ_F : Angle determined using the selected measured values

$\underline{V}_{meas}$: Selected measuring voltage

The method for determining φ_X is described in [Section 3.24, \(p. 3-170\)](#).

The user can check to make sure connection to the system's current and voltage transformers involves the correct phase by consulting the operating data displays for load angle (MAIN: Load angle phi A, MAIN: Load angle phi B, and MAIN: Load angle phi C in the *Oper/Cycl/Data* menu branch). The load angles for all three phases must be approximately equal. The load angles are only determined if at least 5% of the nominal device current is flowing.

10.2.8.2

Checking Measuring-Circuit Monitoring

Both the current- and voltage-measuring circuits are monitored. Operation of the monitoring functions can be observed by selecting logic state signals MCMON: Meas.circ.V,I faulty (*Oper/Cycl/Log* menu branch) or MCMON: M.circ. V,Vref flty. (*Oper/Cycl/Log* menu branch). The monitoring signals can also be entered into the monitoring signal memory and identified by reading out the monitoring signal memory.

10.2.8.2.1

Current-Measuring Circuits

Monitoring of current-measuring circuits functions only if the current value is greater than the setting MCMON: I_{min curr. monitor.} in at least one phase. The P433 determines the absolute value of the negative-sequence component, from the three phase currents; the negative-sequence component is calculated according to the following equation:

Phase sequence A-B-C

- (Alternative terminology: clockwise rotating field)

$$|I_{\text{neg}}| = \frac{1}{3} \cdot |I_A + \underline{a}^2 \cdot I_B + \underline{a} \cdot I_C|$$

Phase sequence A-C-B

- (Alternative terminology: anti-clockwise rotating field)

$$|I_{\text{neg}}| = \frac{1}{3} \cdot |I_A + \underline{a} \cdot I_B + \underline{a}^2 \cdot I_C|$$

- Symbols used:

$$\underline{a} = e^{2\pi j/3} = e^{j \cdot 120^\circ}$$

$$\underline{a}^2 = e^{4\pi j/3} = e^{j \cdot 240^\circ}$$

The operate condition for the current measuring circuits is:

$$|I_{\text{neg}}| \geq (I_{\text{neg}>}) \cdot |I_{\text{P,max}}|$$

With

$I_{\text{neg}>}$: MCMON: I_{neg>} setting

With a single-phase test current we obtain:

$$|I_{\text{neg}}| = \frac{1}{3} \cdot |I_{\text{test}}|$$

$$I_{\text{P,max}} = I_{\text{test}}$$

For the operate condition that means:

$$\frac{1}{3} \cdot |I_{\text{test}}| \geq (I_{\text{neg}>}) \cdot |I_{\text{test}}|$$

$$0.333 \geq (I_{\text{neg}>})$$

Therefore operation of the monitoring function for current-measuring circuits with single-phase test current is only possible if the threshold operate value is set at less than 0.333.

For two-phase test current in phase opposition we obtain:

$$|I_{\text{neg}}| = \frac{1}{3} \cdot |I_{\text{test}} + \underline{a}^2 \cdot (-I_{\text{test}})| = \frac{1}{\sqrt{3}} \cdot |I_{\text{test}}|$$

$$I_{\text{P,max}} = I_{\text{test}}$$

For the operate condition that means:

$$\frac{1}{\sqrt{3}} \cdot |I_{\text{test}}| \geq (I_{\text{neg}>}) \cdot |I_{\text{test}}|$$

$$0.577 \geq (I_{\text{neg}>})$$

Therefore operation of the monitoring function for current-measuring circuits with a two-phase test current in phase opposition is only possible if the threshold operate value is set at less than 0.577.

If the threshold operate value satisfies the respective condition, then the monitoring function for current-measuring circuits operates with a test current greater than the setting MCMON: I_{min curr. monitor.}, after the set operate delay plus 300 ms has elapsed.

10.2.8.2.2

Voltage-Measuring Circuits

Negative-sequence monitoring of the voltage-measuring circuits is enabled if at least one phase-to-ground voltage exceeds the value $0.7 V_{nom}/\sqrt{3}$. Other enabling criteria that can be activated if desired are the following (selection of enabling criteria at MCMON: Op. mode volt. mon. in the 'Par/Func/Main/' menu branch):

- One of the phase currents must exceed the set threshold MCMON: I_{min} V_{neg} monitoring.
- The signal at the binary signal input configured for MAIN: CB closed 3p EXT must have a logic value of "1".

If negative-sequence monitoring has been enabled, the P433 determines the absolute value of negative-sequence voltage according to the following equation:

Phase sequence A-B-C (alternative terminology: clockwise rotating field)

- Negative-sequence voltage

$$|V_{neg}| = \frac{1}{3} \cdot |(V_{A-G} + \underline{a}^2 \cdot V_{B-G} + \underline{a} \cdot V_{C-G})|$$

- Negative-sequence current

$$|I_{neg}| = \frac{1}{3} \cdot |(I_A + \underline{a}^2 \cdot I_B + \underline{a} \cdot I_C)|$$

Phase sequence A-C-B (alternative terminology: anti-clockwise rotating field)

- Negative-sequence voltage

$$|V_{neg}| = \frac{1}{3} \cdot |(V_{A-G} + \underline{a} \cdot V_{B-G} + \underline{a}^2 \cdot V_{C-G})|$$

- Negative-sequence current

$$|I_{neg}| = \frac{1}{3} \cdot |(I_A + \underline{a} \cdot I_B + \underline{a}^2 \cdot I_C)|$$

- Symbols used:

$$\underline{a} = e^{2\pi j/3} = e^{j \cdot 120^\circ}$$

$$\underline{a}^2 = e^{4\pi j/3} = e^{j \cdot 240^\circ}$$

The trigger threshold of V_{neg} is set permanently at $0.2 \cdot V_{nom}/\sqrt{3}$. The result of a single-phase test using $|V_{B-G}| = |V_{C-G}| = 0$ and also of the calculation formula for V_{neg} given above is that the trigger operates when the test voltage exceeds the following value:

$$|V_{test}| \geq 3 \cdot 0.2 \cdot \frac{V_{nom}}{\sqrt{3}}$$

A trip signal is issued once the set operate delay has elapsed.

10.2.8.3

Checking Backup Overcurrent-Time Protection

The switch to backup overcurrent-time protection (BUOC) – provided it has been appropriately set – is brought about by the measuring-circuit monitoring function or the tripping of the voltage transformer miniature circuit breaker on the line side.

If the current exceeds the set operate value (BUOC: I > PSx), then starting occurs in the corresponding phase(s). After the set time delay (BUOC: tI > PSx) has elapsed, the P433 trips. If the calculated residual exceeds the set operate value (BUOC: IN > PSx), then starting (BUOC: Zero-sequ. starting) is signaled and after the set time delay has elapsed (BUOC: tIN > PSx), the P433 trips.

When the inrush stabilization function is triggered, the BUOC function is blocked, if its stage(s) are selected at MAIN: Funct.Rush restr.PSx.

If the BUOC is set to activate the ARC, then timer stages BUOC: $t_I > PSx$ and BUOC: $t_{IN} > PSx$ are blocked when the ARC is ready. The trip signal is then issued instantaneously for phase starting or with an 80 ms delay for zero-sequence starting. Timer stage t_{IN} is also blocked by phase starting or while the ARC hold time is elapsing.

The P433 calculates the residual current I_N according to the following equation:

$$|I_N| = |I_A + I_B + I_C|$$

In the case of a single-phase test (for example, $I_B = I_C = 0$), the following test current is obtained:

$$|I_{test}| = I_N \cdot I_{nom}$$

At this test current the operate value (BUOC: $I_N > PSx$) is reached.

10.2.8.4

Checking Protective Signaling

The protective signaling function can only be tested if protective signaling is ready. This can be determined by checking logic state signal PSIG: Ready (*Oper/Cycl/Log* menu branch).

If protective signaling is not ready, this may be due to the following reasons:

- Protective signaling is not enabled.
(This can be determined by checking PSIG: Enabled in the *Oper/Cycl/Log* menu branch.)
This may be due to the following reasons:
 - PSIG: General enable USER (*Par/Func/Gen* menu branch) is set to *No*
 - PSIG: Enable PSx (in one of the *Par/Func/PSx* menu branches, depending on the parameter subset) is set to *No*.
 - Protective signaling is disabled via an appropriately configured binary signal input or from the integrated local control panel. (This can be determined by checking logic state signal PSIG: Ext./user enabled in the *Oper/Cycl/Log* menu branch.)
- Protective signaling is being blocked by triggering a correspondingly configured binary signal input (PSIG: Blocking EXT).
- A fault has been detected in the communications channel. (This can be determined by checking logic state signal PSIG: Telecom. faulty in the *Oper/Cycl/Log* menu branch.)

If the conditions for testing are satisfied, it is possible to generate a send signal for test purposes using a setting parameter (PSIG: Test telecom. USER in the *Oper/Ctrl/Test* menu branch) or by triggering an appropriately configured binary signal input. This pulse will be present for 500 ms and is extended for the set reset time. If the “with echo” setting has been selected in the protection device at the remote station, then the received signal will be returned.

10.2.8.5

Checking the Auto-Reclosing Function

The auto-reclosing function (ARC) can only be checked if it is ready. This may be determined by checking logic state signal ARC: CB drive ready EXT (*Oper/Cycl/Log*).

If the ARC function is not ready, this may be due to the following reasons:

- The ARC function is not enabled.
(This can be determined by checking logic state signal ARC: Enabled, (*Oper/Cycl/Log* menu branch)). This can have the following causes:
 - ARC: General enable USER (*Par/Func/Gen* menu branch) is set to *No*
 - ARC: Enable PSx (in one of the *Par/Func/PSx* menu branches, depending on the parameter subset) is set to *No*.
 - ARC is disabled via an appropriately configured binary signal input or a setting parameter.
(This can be determined by checking logic state signal ARC: Ext./user enabled, *Oper/Cycl/Log* menu branch)
- The ARC function is blocked by Switch On To Fault protection, backup DTOC protection, Ground Fault protection, Ground Fault (Short-Circuit) Protection Signaling, a manual trip command or via an appropriately configured signal input (ARC: Blocking EXT). (This can be determined by checking logic state signal ARC: Blocked, *Oper/Cycl/Log* menu branch.)
- There is no signal with a logic value of “1” at the binary signal input configured for ARC: CB drive ready EXT.
- There is no signal with a logic value of “1” at the binary signal input configured for MAIN: CB closed 3p EXT. The circuit breaker position signal is only necessary if the setting at ARC: CB clos.pos.sig. PSx is Yes.
- An ARC cycle is in progress. (This can be determined by checking logic state signal ARC: Cycle running in the *Oper/Cycl/Log* menu branch.)
- An ASC cycle is in progress. (This can be determined by checking logic state signal ASC: Cycle running, *Oper/Cycl/Log* menu branch.)

A test HSR can be executed for testing purposes using a setting parameter or by triggering binary signal inputs. The test HSR function first issues a trip command and then issues a reclose command after the set dead time has elapsed.

10.2.8.6

Checking the Automatic Synchronism Check

The automatic synchronism check can only take place if it is ready. This can be determined by checking logic state signal ASC: Ready.

The possible reasons for the ASC function not being ready are as follows:

- The ASC function is not enabled. (This can be determined by checking logic state signal ASC: Enabled, (*Oper/Cycl/Log* menu branch.) This can have the following causes:
 - ASC: General enable USER (*Par/Func/Gen* menu branch) has been set to *No*.
 - ASC: Enable PSx (*Par/Func/PSx* menu branch, depending on the parameter subset) has been set to *No*.
 - ASC is disabled via an appropriately configured binary signal input or a setting parameter.
(This can be determined by checking logic state signal ASC: Ext./user enabled, *Oper/Cycl/Log* menu branch.)
- A logic “1” signal is present at the binary signal inputs configured for MAIN: M.c.b. trip V EXT.
- The ASC function will be blocked by triggering the binary signal input configured for ASC: Blocking EXT.

The setting determines whether a close enable may be carried out in case of blocking.

For test purposes, a close request can be generated for 500 ms using ASC: Test MC close r USER the setting parameter (*Oper/Ctrl/Test* menu branch) or by

triggering an appropriately configured binary signal input (ASC: Test MC close r. EXT). The check can only be carried out if there is no ARC cycle running. The P433 checks whether enabling is permitted or not according to the set conditions. If a positive decision is reached, then there is an ASC: Close enable signal. No (re-)close command takes place! If the check determines that enabling is not permitted, the signal ASC: Close rejection is issued.

10.2.8.7

Checking Ground Fault Short-Circuit Protection

Ground fault short-circuit protection can be checked only if it is ready. It can be interrogated via the logic state signal GFSC: Ready (*Oper/Cycl/Log* menu branch).

If ground fault short-circuit protection is not ready, this may be due to the following reasons:

- Ground fault short-circuit protection is not enabled. (This can be determined by checking logic state signal GFSC: Enabled, *Oper/Cycl/Log* menu branch). This may be due to the following reasons:
 - GFSC: General enable USER (*Par/Func/Gen* menu branch) has been set to *No*.
 - GFSC: Enable PSx (*Par/Func/PSx* menu branch, depending on the parameter subset) has been set to *No*.
 - Ground fault short-circuit protection is disabled via an appropriately configured binary signal input or a setting parameter.
(This can be determined by checking logic state signal GFSC: Ext. enabled, *Oper/Cycl/Log* menu branch).
- On the binary signal input configured to MAIN: M.c.b. trip V EXT a logic "1" signal is present.

The ground fault short-circuit protection function calculates the neutral displacement voltage $\underline{V}_{N-G}$ via the three phase-to-ground voltages according to the following equation:

$$|\underline{V}_{N-G}| = \frac{1}{3} \cdot |\underline{V}_{A-G} + \underline{V}_{B-G} + \underline{V}_{C-G}|$$

In the case of a single-phase test using $|\underline{V}_{B-G}| = |\underline{V}_{C-G}| = 0$, the result of the calculation formula for $\underline{V}_{N-G}$ given above is that trigger GFSC: VNG > operates when the test voltage exceeds the following value:

$$|\underline{V}_{\text{test}}| = 3 \cdot V_{\text{NG} >} \cdot \frac{V_{\text{nom}}}{\sqrt{3}}$$

$V_{N-G >} >$: Setting GFSC: VNG >

The operation of the trigger can be determined by checking logic state signal GFSC: VNG > triggered (*Oper/Cycl/Log* menu branch)

10.2.8.8

Checking Ground Fault (Short-Circuit) Protection Signaling

Ground fault short-circuit protection signaling can be checked using a setting parameter (GSCSG: Test telecom. USER) or by triggering an appropriately configured binary signal input (GSCSG: Test telecom. EXT). The P433 then generates a send signal for 500 ms.

10.2.8.9

Checking the Steady-State-Power Ground Fault Direction Detection

If values for both residual current and neutral-point displacement voltage are available as measuring quantities the P433, when set to operating mode *Steady-state power* or *Steady-state admitt.*, will determine the direction of a ground fault by steady-state power evaluation of the measuring values. Depending on the setting either the value calculated by the P433 or the value measured at the transformer T 90 will be evaluated as the neutral-point displacement voltage. If

current values only can be measured the P433 will decide on “ground fault” (*Steady-state current* evaluation) because of the residual current value level. Switching to *Steady-state current* evaluation is made via the integrated local control panel or by triggering an appropriately configured binary signal input. Should the system permit such operation a ground fault on the busbar side (BS) or on the line side (LS) may be simulated by wiring a short circuit. Then the P433 must issue the respective signal. With the operating mode for ground faults set to *Steady-state power* it is assumed that threshold values for residual current (set at GFDSS: IN,act>/reac> BS PSx and GFDSS: IN,act>/reac> LS PSx) and the neutral-point displacement voltage with *Steady-state current* evaluation (set at GFDSS: VNG> PSx) or GFDSS: IN> PSx are exceeded. With the operating mode set to *Steady-state current* the set threshold values for conductance / susceptance (set at GFDSS: G(N)> / B(N)> LS PSx and GFDSS: G(N)> / B(N)> BS PSx) and the neutral-point displacement voltage (GFDSS: VNG> PSx) or the admittance (GFDSS: Y(N)> PSx) must be exceeded.

A ground fault functional test by wiring a short circuit is, in most cases, not possible as there is the danger of a double ground fault occurring. As an alternative it is possible to wire the system's CTs and VTs such that a functional test is possible without causing a ground fault.

The residual current and the neutral-point displacement voltage measured by the P433 are displayed as measured operating values in primary quantities referred to the nominal quantities of the Protection & Control device (see “Measured Operating Data” in [Section 3.13, \(p. 3-91\)](#)).

10.2.8.10

Ancillary Circuit for Systems with Ground Fault Compensation

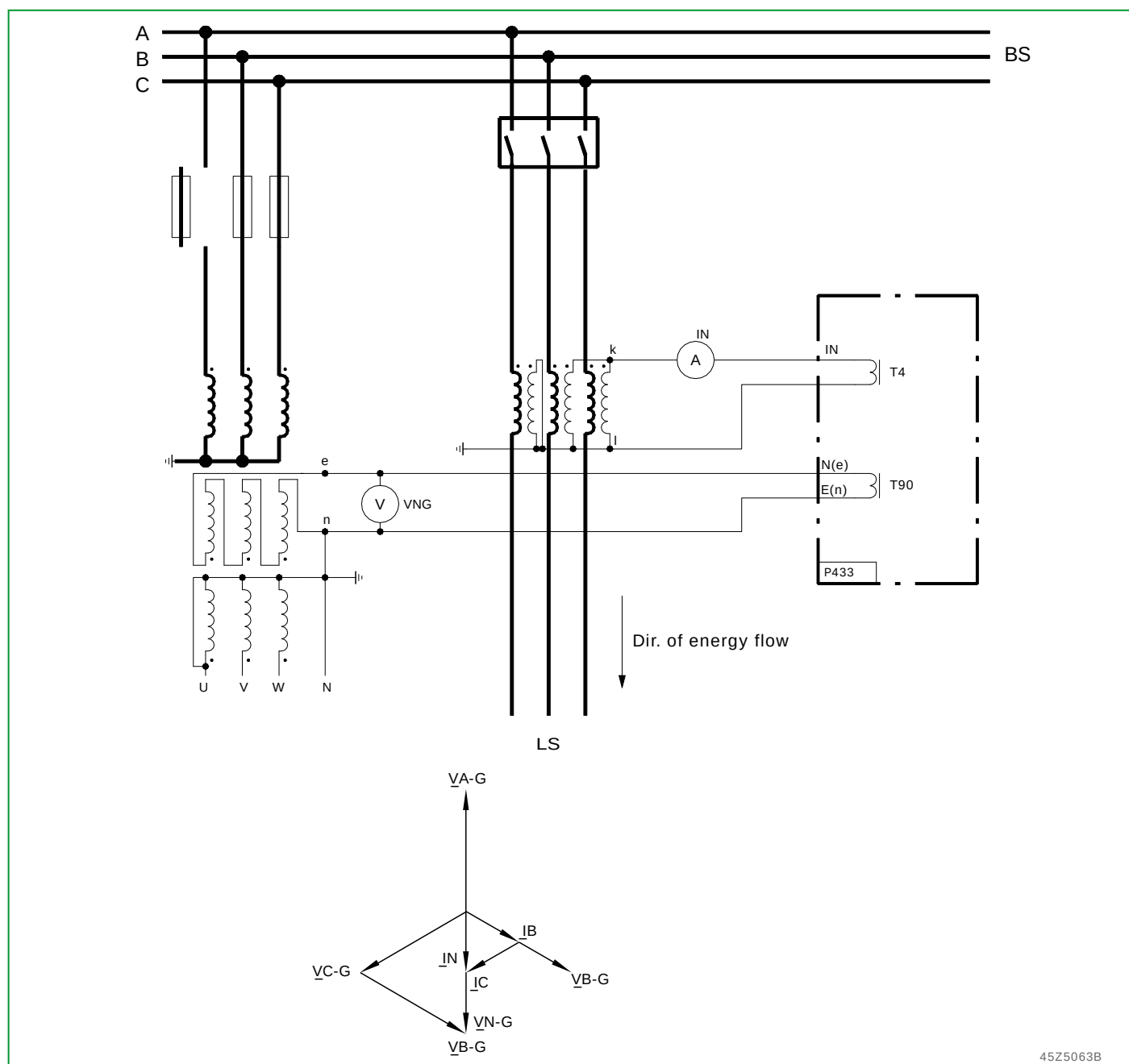


Fig. 10-5: Ancillary circuit for systems with ground fault compensation and Holmgreen group, ground fault towards BS.

First the fuse in the phase A line to the voltage transformer is removed and the associated secondary VT line is short circuited (see Fig. 10-5, (p. 10-28) and Fig. 10-6, (p. 10-29)). This will produce a neutral-point displacement voltage $\underline{V}_{N-G}$ with an amplitude which is smaller by the factor $\sqrt{3}$ than with a saturated ground fault.

If current is measured at a Holmgreen group the secondary side of the phase A line current transformer must be disconnected and shorted (see Fig. 10-5, (p. 10-28)).

A test-wire is inserted through the core balance current transformer to obtain a current flow from the phase B line (see Fig. 10-6, (p. 10-29)). The ancillary

10.2.8.11

Ancillary Circuit for Isolated Neutral-Point Systems

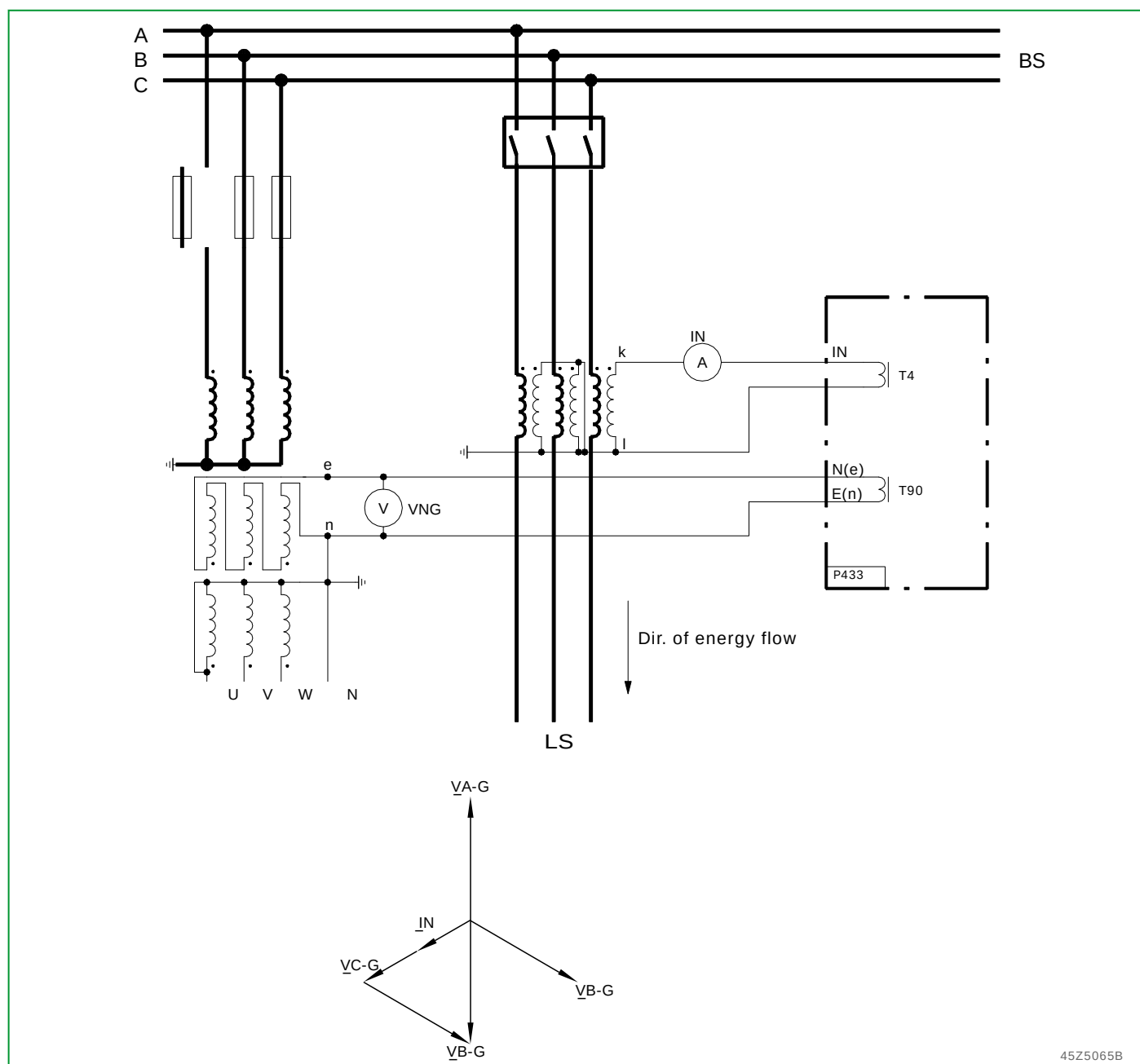


Fig. 10-7: Ancillary circuit for isolated neutral-point systems and Holmgreen group, ground fault towards LS.

First the fuse in the phase A line to the voltage transformer's primary side is removed and the associated secondary VT line is short circuited (see Fig. 10-7, (p. 10-30) and Fig. 10-8, (p. 10-31)). This will produce a neutral-point displacement voltage $\underline{V}_{N-G}$ with an amplitude which is smaller by the factor $\sqrt{3}$ than with a saturated ground fault.

If current is measured at a Holmgreen group the secondary side of the phase A and B line current transformers must be disconnected and shorted (see Fig. 10-7, (p. 10-30)).

A test-wire is inserted through the core balance current transformer to obtain current flow from the phase B and C lines (see Fig. 10-8, (p. 10-31)). The ancillary circuit figures include vector diagrams displaying the position of current and voltage vectors.

A simulated ground fault on the line side is displayed in the example. The current connections or the voltage connections must be exchanged to test a ground fault on the busbar side.

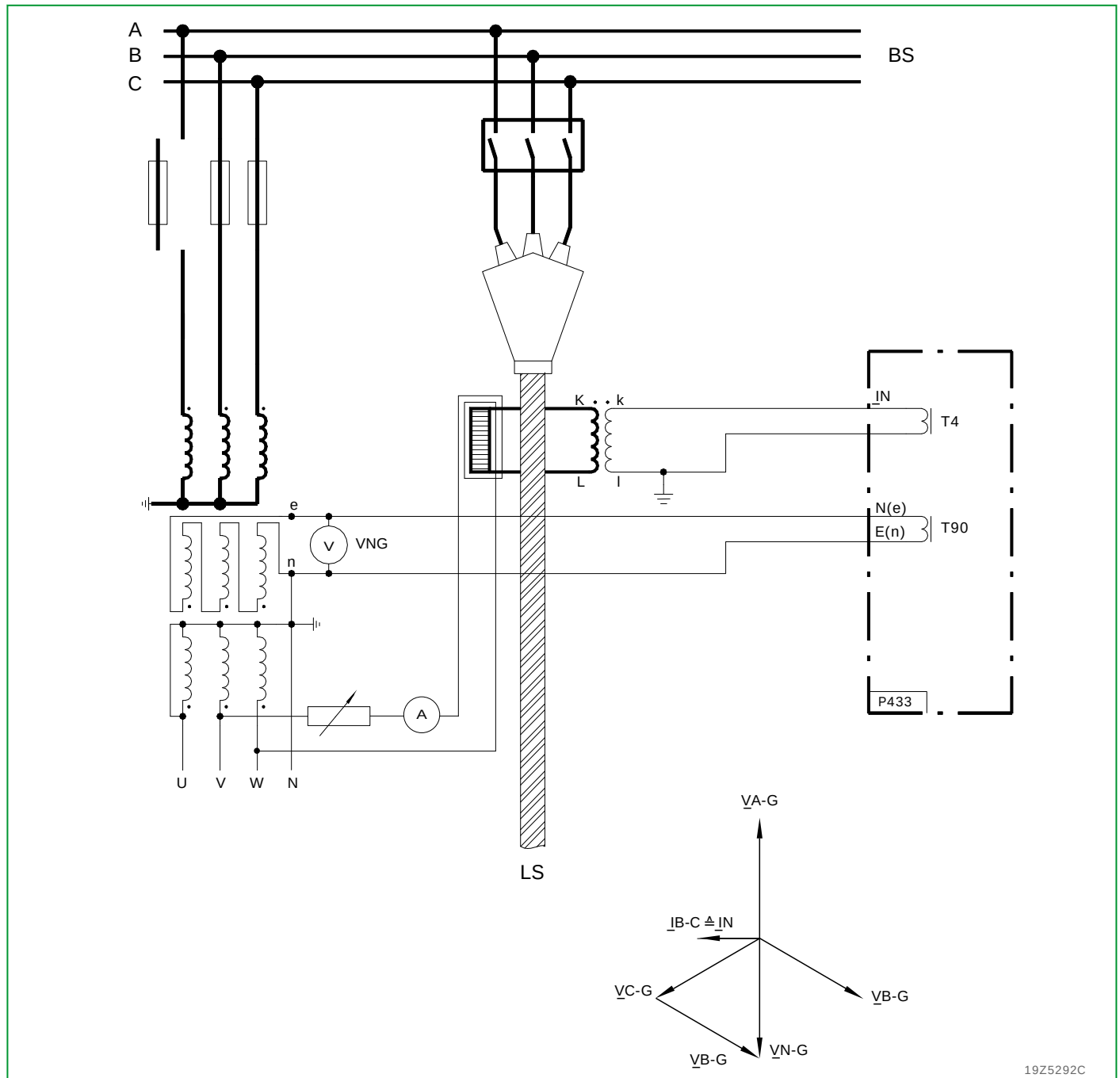


Fig. 10-8: Ancillary circuit for isolated neutral-point systems and core balance current transformers, ground fault towards LS.

10.2.8.12 Checking the Transient Ground Fault Direction Determination

A secondary check of the transient ground fault direction determination is only possible by applying a testing device which is capable of simulating the transient pulse with sufficient accuracy. Otherwise it is possible that the transient ground fault direction determination will not operate as the logic has been designed specifically to detect such transient pulses.

10.2.9 Checking Control Functions

The selected bay type is displayed on the Bay Panel. The selection of the Bay Panel is described in the Chapter 6. The current switching state of the switchgear units is displayed on the Bay Panel if state signals from such switching devices are connected properly to binary signal inputs on the P433. Should the switching state not be displayed correctly then it can be determined by checking the physical state of binary signal inputs whether the state signals are presented correctly to the P433 (check at parameter INP: State U xxx, Oper/Cycl/Phys menu branch).

10.2.9.1 Local/Remote Selection

Controlling switchgear units may be carried out from keys on the local control panel, remotely via the communication interface or through appropriately configured binary signal inputs. The control site – *Local* or *Remote* – is selected by the L/R key on the local control panel or by an appropriately configured binary signal input. The L/R key has no effect when a binary signal input has been configured. Using the L/R key on the local control panel to switch from “*Remote*” to “*Local*” is only possible after the “Password L/R” was entered (see Chapter “Local Control Panel” for further information). The Bay Panel display will show which control site has been selected.

10.2.9.2 Local Control

The switchgear unit to be controlled is selected by pressing the selection key on the local control panel, and pressing the “Open” or “Close” key will generate a switching request. When control is carried out with binary signal inputs the respective binary signal input is to be triggered.

10.2.9.3 Remote Control

Remote control of switchgear units may be carried out via the communication interface or with appropriately configured binary signal inputs.

10.2.9.4 Switchgear Unit Cannot Be Controlled

Should a switchgear unit refuse to be controlled, then this may be due to the following reasons:

- General enable for switch commands has not been set.
(Configuration at MAIN: Inp.asg. ctrl.enabl., *Par/Func/Glob* menu branch)
- Interlocking has operated.
(Check at MAIN: Interlock equ. viol., *Oper/Cycl/Log* menu branch).
- Only with bays for direct motor control:
The motor protection has operated.
(Check at parameter MAIN: Mon. mot. drives tr., *Oper/Cycl/Log* menu branch)

Which interlock(s) is(are) activated may be checked at:

- Bay interlock (BI): MAIN: Bay interlock. act., *Oper/Cycl/Log* menu branch
- Substation interlock (SI): MAIN: Subst. interl. act., *Oper/Cycl/Log* menu branch
- With control set to “Local”:
It is possible to deactivate the interlock through an appropriately configured binary signal input.
(Configuration at MAIN: Inp.asg.interl.deact, *Par/Func/Glob* menu branch)

A substation interlock is only effective when a communication link exists from the communication interface to the substation control level. If the communication link is disrupted then the device switches automatically to bay interlock (BI) without substation interlock (SI). Whether or not a communication error is present can be checked at MAIN: Communication error (Oper/Cycl/Log menu branch).

The substation interlock (SI) can be deactivated selectively for any switchgear unit and in any control direction – “Open” or “Close”. (Check – e.g. for DEV01 – at DEV01: Open w/o stat.interl or DEV01: Close w/o stat. int. (Par/Func/Cont menu branch).

10.2.10

Completing Commissioning

Before the P433 is released for operation, the user should make sure that the following steps have been taken:

- (Reset at MAIN: General reset USER (password-protected) and MT_RC: Reset record. USER, both in *Oper/Ctrl/Test* menu branch.)
- Blocking of output relays has been cancelled.
(OUTP: Outp.rel.block USER, *Par/Func/Glob* menu branch, setting No.)
- Blocking of the trip command has been cancelled.
(MAIN: Trip cmd.block. USER, *Par/Func/Glob* menu branch, setting No.)
- The device is on-line.
(MAIN: Device on-line, *Par/Func/Glob* menu branch, setting Yes (= on).)
- Measuring-circuit monitoring is enabled – if it was previously cancelled for testing purposes.
(MCMON: General enable USER, *Par/Func/Gen* menu branch, setting Yes)
- The correct control point – *Local* or *Remote* – has been activated.
- The required interlock equations have been activated.

After completion of commissioning, only the green LED indicator signaling “HEALTHY” (H1) should be on.

11

Troubleshooting

This chapter describes problems that might be encountered, their causes, and possible methods for eliminating them. It is intended as a general orientation only, and in cases of doubt it is better to return the P433 to the manufacturer. Please follow the packaging instructions in [Section 5.1, \(p. 5-4\)](#) when returning equipment to the manufacturer.

 DANGER
HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH

- Only qualified personnel, trained, authorized and familiar with the device and all the safety instructions in the general Safety Guide (SFTY/5LM/L11 or later version) and appropriate Chapter 5, Chapter 10, Chapter 11, Chapter 12 and Chapter 13 of this manual, shall work on installation, connection, commissioning, maintenance or servicing of this device.
- Before checking further, disconnect the P433 from the power supply.
- Switch off all the power supplies in connection to the equipment to isolate the device.

Failure to follow these instructions will result in death or serious injury.

The following instructions apply to surface-mounted cases:

 WARNING
HAZARD OF EQUIPMENT DAMAGE

- The local control panel (or front element) is connected to processor module P by a plug-in connecting cable. Make sure the connector position is correct. Do not bend the connecting cable!

Failure to follow these instructions can result in equipment damage or unintended equipment operation.

Problem

- Lines of text are not displayed on the local control panel.
 - Check to see whether there is supply voltage at the device connection points.
 - Check to see whether the magnitude of the auxiliary voltage is correct. The P433 is protected against damage resulting from polarity reversal.
- The P433 issues an "Alarm" signal on LED H 3.
 - Identify the specific problem by reading out the monitoring signal memory (see [Section 6.14.7.2, \(p. 6-44\)](#)). The table below lists possible monitoring or warning indication (provided that a configuration setting has been entered at SFMON: Fct. assign. warning), the faulty area, the P433's response, and the mode of the output relay configured for "Warning" and "Blocked/faulty".

Key

- -: No reaction and/or no output relay triggered.
- Yes: The corresponding output relay is triggered.
- Updating: The output relay configured for 'Warning' starts only if the monitoring signal is still present.

Self-monitoring

Parameter				Address
SFMON: Fct. assign. warning				021 030
SFMON: Mon.sig. retention				021 018

Self-monitoring

Parameter	Address			
SFMON: CB faulty EXT				098 072
The external input CBF: CB faulty EXT has become active. Device reaction: – “Warning” output relay: Yes “Blocked/faulty” output relay: –				
SFMON: Warning (LED)				036 070
Warning configured for LED H3.				
SFMON: Warning (relay)				036 100
Warning configured for an output relay.				
SFMON: Warm restart exec.				041 202
A warm restart has been carried out.				
SFMON: Cold restart exec.				041 201
A cold restart has been carried out.				
SFMON: Cold rest. checksum				093 024
A cold restart has been carried out on account of a checksum error in the memory (NOVRAM). 1st device reaction: Warm restart 2nd device reaction: Device blocking “Warning” output relay: Yes “Blocked/faulty” output relay: Yes				
SFMON: Cold rest. SW update				093 025
A cold restart has been carried out following a software update. 1st device reaction: Warm restart 2nd device reaction: Device blocking “Warning” output relay: Yes “Blocked/faulty” output relay: Yes				
SFMON: Blocking HW failure				090 019
Supplementary warning that this device is blocked. “Warning” output relay: Updating “Blocked/faulty” output relay: –				
SFMON: Relay Kxx faulty				041 200
Multiple signal: output relay defective. Device reaction: – ‘Warning’ output relay: Updating ‘Blocked/faulty’ output relay: Yes				

Parameter	Address			
SFMON: Hardware clock fail.				093 040
The hardware clock has failed. Device reaction: – “Warning” output relay: Yes “Blocked/faulty” output relay: –				
SFMON: Battery failure				090 010
Battery voltage too low. Replace battery. Device reaction: – “Warning” output relay: Updating “Blocked/faulty” output relay: –				
SFMON: Interm.volt.fail.RAM				093 026
Faulty test pattern in the RAM. This can occur, for example, if the processor module or the power supply module is removed from the bus module (digital). This fault is only detected during device startup. After the fault is detected, the software initializes the RAM. This means that all records are deleted. 1st device reaction: Warm restart 2nd device reaction: Device blocking “Warning” output relay: Yes “Blocked/faulty” output relay: Yes				
SFMON: +15V supply faulty				093 081
The +15 V internal supply voltage has dropped below a minimum value. 1st device reaction: Warm restart 2nd device reaction: Device blocking “Warning” output relay: Yes “Blocked/faulty” output relay: Yes				
SFMON: +24V supply faulty				093 082
The +24 V internal supply voltage has dropped below a minimum value. 1st device reaction: Warm restart 2nd device reaction: Device blocking “Warning” output relay: Yes “Blocked/faulty” output relay: Yes				
SFMON: -15V supply faulty				093 080
The –15 V internal supply voltage has dropped below a minimum value. 1st device reaction: Warm restart 2nd device reaction: Device blocking “Warning” output relay: Yes “Blocked/faulty” output relay: Yes				
SFMON: Wrong module slot 1				096 100
SFMON: Wrong module slot 2				096 101
SFMON: Wrong module slot 3				096 102

Parameter	Address			
SFMON: Wrong module slot 4				096 103
SFMON: Wrong module slot 5				096 104
SFMON: Wrong module slot 6				096 105
SFMON: Wrong module slot 7				096 106
SFMON: Wrong module slot 8				096 107
SFMON: Wrong module slot 9				096 108
SFMON: Wrong module slot 10				096 109
SFMON: Wrong module slot 11				096 110
SFMON: Wrong module slot 12				096 111
SFMON: Wrong module slot 13				096 112
SFMON: Wrong module slot 14				096 113
SFMON: Wrong module slot 15				096 114
SFMON: Wrong module slot 16				096 115
SFMON: Wrong module slot 17				096 116
SFMON: Wrong module slot 18				096 117
SFMON: Wrong module slot 19				096 118
SFMON: Wrong module slot 20				096 119
SFMON: Wrong module slot 21				096 120
Module in wrong slot. 1st device reaction: Warm restart 2nd device reaction: Device blocking “Warning” output relay: Yes “Blocked/faulty” output relay: Yes				
SFMON: Wrong module Dig.Bus				096 123
The device has been fitted with a wrong digital bus. Since this is checked using the module variant number this signal can also occur after a firmware upgrade to a version that is not compatible with the hardware. 1st device reaction: Warm restart 2nd device reaction: Device blocking “Warning” output relay: Yes “Blocked/faulty” output relay: Yes				
SFMON: Wrong module HMI				096 124
The device has been fitted with a wrong HMI. Since this is checked using the module variant number this signal can also occur after a firmware upgrade to a version that is not compatible with the hardware. 1st device reaction: Warm restart 2nd device reaction: Device blocking “Warning” output relay: Yes “Blocked/faulty” output relay: Yes				

Parameter				Address
SFMON: Wrong module Comm				096 125
The device has been fitted with a wrong communication module. Since this is checked using the module variant number this signal can also occur after a firmware upgrade to a version that is not compatible with the hardware. 1st device reaction: Warm restart 2nd device reaction: Device blocking “Warning” output relay: Yes “Blocked/faulty” output relay: Yes				
SFMON: Wrong module Ana.Bus				096 126
The device has been fitted with a wrong analog bus. Since this is checked using the module variant number this signal can also occur after a firmware upgrade to a version that is not compatible with the hardware. 1st device reaction: Warm restart 2nd device reaction: Device blocking “Warning” output relay: Yes “Blocked/faulty” output relay: Yes				
SFMON: Defect.module slot 1				097 000
SFMON: Defect.module slot 2				097 001
SFMON: Defect.module slot 3				097 002
SFMON: Defect.module slot 4				097 003
SFMON: Defect.module slot 5				097 004
SFMON: Defect.module slot 6				097 005
SFMON: Defect.module slot 7				097 006
SFMON: Defect.module slot 8				097 007
SFMON: Defect.module slot 9				097 008
SFMON: Defect.module slot10				097 009
SFMON: Defect.module slot11				097 010
SFMON: Defect.module slot12				097 011
SFMON: Defect.module slot13				097 012
SFMON: Defect.module slot14				097 013
SFMON: Defect.module slot15				097 014
SFMON: Defect.module slot16				097 015
SFMON: Defect.module slot17				097 016
SFMON: Defect.module slot18				097 017
SFMON: Defect.module slot19				097 018
SFMON: Defect.module slot20				097 019

Parameter	Address			
SFMON: Defect.module slot21				097 020
Defective module in slot x. Device reaction: – “Warning” output relay: Updating “Blocked/faulty” output relay: –				
SFMON: Module N +15V faulty				093 096
The +15 V internal supply voltage of the transient ground fault evaluation module has dropped below a minimum value. Device reaction: – “Warning” output relay: Yes “Blocked/faulty” output relay: –				
SFMON: Module N -15V faulty				093 097
The –15 V internal supply voltage of the transient ground fault evaluation module has dropped below a minimum value. Device reaction: – “Warning” output relay: Yes “Blocked/faulty” output relay: –				
SFMON: Module N DAC faulty				093 095
The digital-to-analog converter of the transient ground fault evaluation module is defective. Device reaction: – “Warning” output relay: Yes “Blocked/faulty” output relay: –				
SFMON: Module N DPR faulty				093 090
The checksum feature of the transient ground fault evaluation module has detected a fault in the data transmission of the Dual-Port-RAM. Device reaction: – “Warning” output relay: Yes “Blocked/faulty” output relay: –				
SFMON: Module N RAM faulty				093 091
Fault in the program or data memory of the transient ground fault evaluation module. Device reaction: – “Warning” output relay: Yes “Blocked/faulty” output relay: –				

Parameter	Address			
SFMON: Module Y DPR faulty				093 110
The checksum feature of analog I/O module Y has detected a fault in the data transmission of the Dual-Port-RAM. Device reaction: – “Warning” output relay: Yes “Blocked/faulty” output relay: –				
SFMON: Module Y RAM faulty				093 111
Fault in the program or data memory of the analog I/O module. Device reaction: – “Warning” output relay: Yes “Blocked/faulty” output relay: –				
SFMON: Error K 301				097 021
SFMON: Error K 302				097 022
SFMON: Error K 601				097 070
SFMON: Error K 602				097 071
SFMON: Error K 603				097 072
SFMON: Error K 604				097 073
SFMON: Error K 605				097 074
SFMON: Error K 606				097 075
SFMON: Error K 607				097 076
SFMON: Error K 608				097 077
SFMON: Error K 701				097 078
SFMON: Error K 702				097 079
SFMON: Error K 703				097 080
SFMON: Error K 704				097 081
SFMON: Error K 705				097 082
SFMON: Error K 706				097 083
SFMON: Error K 707				097 084
SFMON: Error K 708				097 085
SFMON: Error K 801				097 086
SFMON: Error K 802				097 087
SFMON: Error K 803				097 088
SFMON: Error K 804				097 089
SFMON: Error K 805				097 090
SFMON: Error K 806				097 091
SFMON: Error K 807				097 092
SFMON: Error K 808				097 093

Parameter	Address
SFMON: Error K 901	097 094
SFMON: Error K 902	097 095
SFMON: Error K 903	097 096
SFMON: Error K 904	097 097
SFMON: Error K 905	097 098
SFMON: Error K 906	097 099
SFMON: Error K 907	097 100
SFMON: Error K 908	097 101
SFMON: Error K 1001	097 102
SFMON: Error K 1002	097 103
SFMON: Error K 1003	097 104
SFMON: Error K 1004	097 105
SFMON: Error K 1005	097 106
SFMON: Error K 1006	097 107
SFMON: Error K 1007	097 108
SFMON: Error K 1008	097 109
SFMON: Error K 1201	097 118
SFMON: Error K 1202	097 119
SFMON: Error K 1203	097 120
SFMON: Error K 1204	097 121
SFMON: Error K 1205	097 122
SFMON: Error K 1206	097 123
SFMON: Error K 1207	097 124
SFMON: Error K 1208	097 125
SFMON: Error K 1401	097 134
SFMON: Error K 1402	097 135
SFMON: Error K 1403	097 136
SFMON: Error K 1404	097 137
SFMON: Error K 1405	097 138
SFMON: Error K 1406	097 139
SFMON: Error K 1407	097 140
SFMON: Error K 1408	097 141
SFMON: Error K 1601	097 150
SFMON: Error K 1602	097 151
SFMON: Error K 1603	097 152
SFMON: Error K 1604	097 153

Parameter	Address			
SFMON: Error K 1605				097 154
SFMON: Error K 1606				097 155
SFMON: Error K 1607				097 156
SFMON: Error K 1608				097 157
SFMON: Error K 1801				097 166
SFMON: Error K 1802				097 167
SFMON: Error K 1803				097 168
SFMON: Error K 1804				097 169
SFMON: Error K 1805				097 170
SFMON: Error K 1806				097 171
SFMON: Error K 2001				097 182
SFMON: Error K 2002				097 183
SFMON: Error K 2003				097 184
SFMON: Error K 2004				097 185
SFMON: Error K 2005				097 186
SFMON: Error K 2006				097 187
SFMON: Error K 2007				097 188
SFMON: Error K 2008				097 189
Output relay K xxx defective. Device reaction: – “Warning” output relay: Updating “Blocked/faulty” output relay: Yes				
SFMON: Undef. operat. code				093 010
Undefined operation code. 1st device reaction: Warm restart 2nd device reaction: Device blocking “Warning” output relay: Yes “Blocked/faulty” output relay: Yes				
SFMON: Abnormal termination				093 030
The application has been terminated in an unexpected way. If this error occurs during a (re-)start of the device then this message is displayed and the device is blocked. 1st device reaction: Warm restart 2nd device reaction: Device blocking “Warning” output relay: Yes “Blocked/faulty” output relay: Yes				

Parameter	Address			
SFMON: Bad arg. system call				093 031
Invalid parameter when calling a function of the operating system. If this error occurs during a (re-)start of the device then this message is displayed and the device is blocked. 1st device reaction: Warm restart 2nd device reaction: Device blocking "Warning" output relay: Yes "Blocked/faulty" output relay: Yes				
SFMON: Mutex deadlock				093 032
Software threads are locked from each other by mutex. If this error occurs during a (re-)start of the device then this message is displayed and the device is blocked. 1st device reaction: Warm restart 2nd device reaction: Device blocking "Warning" output relay: Yes "Blocked/faulty" output relay: Yes				
SFMON: Invalid memory ref.				093 033
Attempt to access an invalid memory segment. If this error occurs during a (re-)start of the device then this message is displayed and the device is blocked. 1st device reaction: Warm restart 2nd device reaction: Device blocking "Warning" output relay: Yes "Blocked/faulty" output relay: Yes				
SFMON: Unexpected exception				093 034
Miscellaneous error message from the processor or operating system. If this error occurs during a (re-)start of the device then this message is displayed and the device is blocked. 1st device reaction: Warm restart 2nd device reaction: Device blocking "Warning" output relay: Yes "Blocked/faulty" output relay: Yes				
SFMON: Invalid arithm. op.				093 011
Invalid arithmetic operation. 1st device reaction: Warm restart 2nd device reaction: Device blocking "Warning" output relay: Yes "Blocked/faulty" output relay: Yes				

Parameter	Address			
SFMON: Undefined interrupt				093 012
Undefined interrupt. 1st device reaction: Warm restart 2nd device reaction: Device blocking "Warning" output relay: Yes "Blocked/faulty" output relay: Yes				
SFMON: Exception oper.syst.				093 013
Interrupt of the operating system. 1st device reaction: Warm restart 2nd device reaction: Device blocking "Warning" output relay: Yes "Blocked/faulty" output relay: Yes				
SFMON: Protection failure				090 021
Watchdog is monitoring the periodic start of protection routines. It has detected an error. 1st device reaction: Warm restart 2nd device reaction: Device blocking "Warning" output relay: Yes "Blocked/faulty" output relay: Yes				
SFMON: Checksum error param				090 003
A checksum error involving the parameters in the memory (NOVRAM) has been detected. 1st device reaction: Warm restart 2nd device reaction: Device blocking "Warning" output relay: Yes "Blocked/faulty" output relay: Yes				
SFMON: Clock sync. error				093 041
In 10 consecutive clock synchronization telegrams, the difference between the time of day given in the telegram and that of the hardware clock is greater than 10 ms. Device reaction: – "Warning" output relay: Yes "Blocked/faulty" output relay: –				
SFMON: Overflow MT_RC				090 012
Last entry in the monitoring signal memory in the event of overflow. Device reaction: – "Warning" output relay: Yes "Blocked/faulty" output relay: –				

Parameter	Address			
SFMON: Semaph. MT_RC block.				093 015
Software overloaded. Device reaction: – “Warning” output relay: Yes “Blocked/faulty” output relay: –				
SFMON: Time-out module N				093 092
Watchdog is monitoring the periodic status signal of the transient ground fault evaluation module. It has detected an error. Device reaction: – “Warning” output relay: Yes “Blocked/faulty” output relay: –				
SFMON: Time-out module Y				093 112
Watchdog is monitoring the periodic status signal of the analog I/O module Y. It has detected an error. Device reaction: – “Warning” output relay: Yes “Blocked/faulty” output relay: –				
SFMON: Invalid SW d.loaded				096 121
Wrong or invalid software has been downloaded. 1st device reaction: Warm restart 2nd device reaction: Device blocking “Warning” output relay: Yes “Blocked/faulty” output relay: Yes				
SFMON: Invalid type of bay				096 122
If the user has selected a bay type that requires a P433 hardware configuration that is not actually fitted, then this signal is generated. 1st device reaction: Warm restart 2nd device reaction: Device blocking “Warning” output relay: Yes “Blocked/faulty” output relay: Yes				
SFMON: Invalid SW vers DHMI				093 145
Incorrect or invalid software was loaded to operate the detachable display (DHMI). Device reaction: – “Warning” output relay: Yes “Blocked/faulty” output relay: –				

Parameter	Address		
SFMON: Inval. SW vers.COMM1			093 075
Incorrect or invalid communication software has been downloaded. Device reaction: – “Warning” output relay: Yes “Blocked/faulty” output relay: –			
SFMON: Inval. Config. IEC			093 079
Invalid parameters in the IEC configuration. Device reaction: – “Warning” output relay: Yes “Blocked/faulty” output relay: –			
SFMON: Invalid SW vers. N			093 093
Incorrect or invalid software for transient ground fault evaluation module has been downloaded. Device reaction: – “Warning” output relay: Yes “Blocked/faulty” output relay: –			
SFMON: Invalid SW vers. Y			093 113
Incorrect or invalid software for analog I/O module Y has been downloaded. Device reaction: – “Warning” output relay: Yes “Blocked/faulty” output relay: –			
SFMON: Inom not adjustable			093 118
Transformer module T is not suitable for setting I_{nom} . Device reaction: – “Warning” output relay: Yes “Blocked/faulty” output relay: –			
SFMON: Fcts.not perm.f.60Hz			093 098
A protective function has been activated that is not permitted for operation at a system frequency of 60 Hz. Device reaction: – “Warning” output relay: Yes “Blocked/faulty” output relay: –			
SFMON: Invalid scaling BCD			093 124
An invalid characteristic has been set for the BCD output channel of analog I/O module Y. Device reaction: Depends on type of fault detected. “Warning” output relay: Updating “Blocked/faulty” output relay: –			
SFMON: Invalid scaling A-1			093 114

Parameter	Address			
SFMON: Invalid scaling A-2				093 115
An invalid characteristic has been set for one of the analog output channels of analog I/O module Y. Device reaction: Depends on type of fault detected. “Warning” output relay: Updating “Blocked/faulty” output relay: –				
SFMON: Invalid scaling IDC				093 116
An invalid characteristic has been set for the analog input channel of analog I/O module Y. Device reaction: Depends on type of fault detected. “Warning” output relay: Updating “Blocked/faulty” output relay: –				
SFMON: Setting error THERM				098 035
Invalid parameters in the setting for the thermal replica. Device reaction: Blocking of thermal overload protection. “Warning” output relay: Yes “Blocked/faulty” output relay: –				
SFMON: Setting error f < >				098 028
The over-/underfrequency protection function has been set for “overfrequency” monitoring (based on the settings for operate value and nominal frequency). This setting is not valid in the $f w. \Delta f / \Delta t$ operating mode. Device reaction: Blocking of the over-/under frequency protection function “Warning” output relay: Updating “Blocked/faulty” output relay: –				
SFMON: Setting error CBM				098 020
An invalid characteristic has been set for circuit breaker monitoring. Device reaction: Depends on type of fault. “Warning” output relay: Yes “Blocked/faulty” output relay: –				
SFMON: Peripheral fault				098 018
Multiple signal. “Warning” output relay: Yes “Blocked/faulty” output relay: –				
SFMON: M.c.b. trip V				098 000
The line-side voltage transformer m.c.b. has tripped. Device reaction: Blocking of the short-circuit direction determination. “Warning” output relay: Yes “Blocked/faulty” output relay: –				

Parameter	Address			
SFMON: M.c.b. trip VNG				098 132
The m.c.b. monitoring the neutral-displacement voltage has tripped. The Ground fault protection (GFSC and GSCSG) is blocked (if these function groups are operated with measured neutral-displacement voltage) “Warning” output relay: Yes “Blocked/faulty” output relay: –				
SFMON: M.c.b. trip Vref				098 011
The m.c.b. monitoring the reference voltage transformer has tripped. Device reaction: Blocking of automatic synchronism check (ASC). “Warning” output relay: Yes “Blocked/faulty” output relay: –				
SFMON: Insul. Alarm 1				098 091
SFMON: Insul. Alarm 2				098 092
SFMON: Insul. Alarm 3				098 093
SFMON: Buchholz Alarm 1				098 094
SFMON: Buchholz Alarm 2				098 095
SFMON: Buchholz Alarm 3				098 096
The transformer monitoring has received/detected a Buchholz/insulation fault. “Warning” output relay: Yes “Blocked/faulty” output relay: –				
SFMON: DC Faulty 1				098 097
SFMON: DC Faulty 2				098 098
SFMON: DC Faulty 3				098 099
The transformer monitoring has received/detected a DC fault. “Warning” output relay: Yes “Blocked/faulty” output relay: –				
SFMON: Phase sequ. V faulty				098 001
Measuring-circuit monitoring has detected a fault in the phase sequence of the phase-to-ground voltages. “Warning” output relay: Yes “Blocked/faulty” output relay: –				
SFMON: Vneg > triggered				098 014
The negative-sequence monitoring function of measuring-circuit monitoring has been triggered. “Warning” output relay: Yes “Blocked/faulty” output relay: –				

Parameter	Address			
SFMON: Undervoltage				098 009
The measuring-circuit monitoring function has detected an undervoltage. “Warning” output relay: Yes “Blocked/faulty” output relay: –				
SFMON: FF, V triggered				098 021
The fuse failure monitoring function has detected a fault in the voltage-measuring circuit. “Warning” output relay: Yes “Blocked/faulty” output relay: –				
SFMON: FF, Vref triggered				098 022
The fuse failure monitoring function has detected a fault in the reference voltage-measuring circuit. “Warning” output relay: Yes “Blocked/faulty” output relay: –				
SFMON: M.circ. V, Vref flty.				098 023
Multiple signal: Voltage-measuring circuits for phase-to-ground voltages or the reference voltage faulty. Device reaction: Depends on type of fault. “Warning” output relay: Yes “Blocked/faulty” output relay: –				
SFMON: Meas. circ. V faulty				098 017
Multiple signal: Voltage-measuring circuits faulty. Device reaction: Depends on type of fault. “Warning” output relay: Yes “Blocked/faulty” output relay: –				
SFMON: Meas.circ.VNG faulty				098 254
The voltage-measuring circuits for the neutral-point displacement voltage are faulty. Device reaction: Selective blocking of the neutral-point displacement voltage monitor (in function group V<>) if it were set so that it would evaluate the measured value of the neutral-point displacement voltage. “Warning” output relay: Yes “Blocked/faulty” output relay: –				
SFMON: M.circ. Vref faulty				098 255
The voltage-measuring circuits for the reference voltage are faulty. Device reaction: Selective blocking of the neutral-point displacement voltage monitor in function groups V<> and LIMIT as well as blocking of ASC. “Warning” output relay: Yes “Blocked/faulty” output relay: –				

Parameter	Address		
SFMON: BUOC not active			098 002
Due to a fault in the voltage-measuring circuit, distance protection has been blocked, but the unit has not switched to backup overcurrent-time protection. “Warning” output relay: Yes “Blocked/faulty” output relay: –			
SFMON: BUOC active w/o ARC			098 003
Due to a fault in the voltage-measuring circuit, distance protection has been blocked, and the unit has switched to backup overcurrent-time protection. ARC is not activated by the backup overcurrent-time protection function. “Warning” output relay: Yes “Blocked/faulty” output relay: –			
SFMON: BUOC active with ARC			098 004
Due to a fault in the voltage-measuring circuit, distance protection has been blocked, and the unit has switched to backup overcurrent-time protection. ARC is activated by the backup overcurrent-time protection function. “Warning” output relay: Yes “Blocked/faulty” output relay: –			
SFMON: Meas. circ. I faulty			098 005
The measuring-circuit monitoring function has detected a fault in the current-measuring circuits. “Warning” output relay: Yes “Blocked/faulty” output relay: –			
SFMON: Meas.circ.V,I faulty			098 016
Multiple signal: Multiple signaling: Current- or voltage-measuring circuits faulty. Device reaction: Depends on type of fault. “Warning” output relay: Yes “Blocked/faulty” output relay: –			
SFMON: Zero-sequ. starting			098 015
The zero-sequence starting of distance protection has been triggered without phase starting. “Warning” output relay: Yes “Blocked/faulty” output relay: –			
SFMON: Meas. circuits GFSC			098 013
Ground fault (short-circuit) protection monitoring has been triggered. “Warning” output relay: Yes “Blocked/faulty” output relay: –			

Parameter	Address			
SFMON: Communic.fault COMM3				093 140
The set time COMM3: Time-out comm.fault has elapsed since the most recent 100% valid telegram was received. The receive signals are set to their user-defined default values. “Warning” output relay: Yes “Blocked/faulty” output relay: –				
SFMON: Hardware error COMM3				093 143
The device has detected a hardware error in the effective connection InterMiCOM (communication interface 3). “Warning” output relay: Yes “Blocked/faulty” output relay: –				
SFMON: Comm.link fail.COMM3				093 142
Timer stage COMM3: Time-out link fail. has elapsed indicating a persistent failure of the transmission channel. The receive signals are set to their user-defined default values. “Warning” output relay: Yes “Blocked/faulty” output relay: –				
SFMON: Lim.exc.tel.er.COMM3				093 141
The threshold set for timer stage COMM3: Limit telegr. errors was exceeded and the receive signals are set to their user-defined default values. “Warning” output relay: Yes “Blocked/faulty” output relay: –				
SFMON: Telecom. faulty/PSIG				098 006
The transmission channel of protective signaling is faulty. Device reaction: Blocking of protective signaling. “Warning” output relay: Yes “Blocked/faulty” output relay: –				
SFMON: Op.mode PSIG inval.				098 019
The operating mode settings for protective signaling and ground fault (short-circuit) protection signaling are not identical. “Warning” output relay: Yes “Blocked/faulty” output relay: –				
SFMON: Telecom.faulty/GFSIG				098 012
The transmission channel for ground fault protective signaling is faulty. Device reaction: Blocking of ground fault protection signaling. “Warning” output relay: Yes “Blocked/faulty” output relay: –				

Parameter	Address			
SFMON: Setting error PULSE				098 089
An invalid timer tolerance setting has been set for the pulse detection. If the time tolerance setting exceeds 10% of the total impulse duration, the warning signal is raised and the pulse function gets blocked. Device reaction: Blocking of pulse detection function. “Warning” output relay: Yes “Blocked/faulty” output relay: –				
SFMON: CB pos.sig. implaus.				098 124
The plausibility logic was triggered during the acquisition of the circuit breaker's (CB) status signals. “Warning” output relay: Yes “Blocked/faulty” output relay: –				
SFMON: TGFD mon. triggered				093 094
The monitoring function for transient ground fault direction determination has operated. “Warning” output relay: Yes “Blocked/faulty” output relay: –				
SFMON: CB No. CB op. >				098 066
The maximum number of CB operations performed has been exceeded. Device reaction: Depends on type of fault. “Warning” output relay: Yes “Blocked/faulty” output relay: –				
SFMON: CB rem. No. CB op. <				098 067
The minimum number of CB operations performed at nominal current has fallen below the threshold. Device reaction: Depends on type of fault. “Warning” output relay: Yes “Blocked/faulty” output relay: –				
SFMON: CB $\Sigma I_{trip} >$				098 068
The maximum sum of disconnection current values has been exceeded. Device reaction: Depends on type of fault. “Warning” output relay: Yes “Blocked/faulty” output relay: –				
SFMON: CB $\Sigma I_{trip}^{**2} >$				098 069
The maximum sum of the disconnection current values to the second power has been exceeded. Device reaction: Depends on type of fault. “Warning” output relay: Yes “Blocked/faulty” output relay: –				
SFMON: CB $t_{max} > A$				098 070

Parameter	Address			
SFMON: CB t max > B				098 071
SFMON: CB t max > C				098 077
The maximum duration for the opening of a CB pole has been exceeded. Disconnection is not determined for this CB pole. Device reaction: Depends on type of fault. “Warning” output relay: Yes “Blocked/faulty” output relay: –				
SFMON: Setting error fn				098 133
The underfrequency load shedding protection function Pf< has been set for “overfrequency” monitoring (based on Pf< underfrequency threshold settings and nominal frequency). If fnom = 50 Hz and any Pf< threshold setting is greater or equal to 50 Hz, the alarm is raised and the Pf< function is blocked. Ditto fnom = 60 Hz and any Pf< threshold setting is equal to 60 Hz. Whether the threshold with false setting is activated or not does not matter. Device reaction: Blocking of the underfrequency load shedding protection function Pf< “Warning” output relay: Updating “Blocked/faulty” output relay: –				
SFMON: Inv.inp.f.clock sync				093 120
The function was configured to a binary signal input on the analog I/O module Y. Such a configuration is not permitted for this function. Device reaction: – “Warning” output relay: Updating “Blocked/faulty” output relay: –				
SFMON: Output 30				098 053
SFMON: Output 30 (t)				098 054
SFMON: Output 31				098 055
SFMON: Output 31 (t)				098 056
SFMON: Output 32				098 057
SFMON: Output 32 (t)				098 058
The LOGIC outputs 30 ... 32(t) are mirrored into these SFMON outputs, which can be included in the list of warning signals by selection at SFMON: Fct. assign. warning. The warning signals are also recorded in the monitoring signal memory. “Warning” output relay: Yes “Blocked/faulty” output relay: –				

Parameter	Address		
SFMON: PT100 open circuit			098 024
The P433 has detected an open circuit in the connection of the resistance thermometer "PT100" to the analog I/O module Y. Device reaction: Depends on type of fault detected. "Warning" output relay: Updating "Blocked/faulty" output relay: –			
SFMON: Overload 20 mA input			098 025
The 20 mA input of analog I/O module Y is overloaded. Device reaction: Depends on type of fault detected. "Warning" output relay: Updating "Blocked/faulty" output relay: –			
SFMON: Open circ. 20 mA inp.			098 026
The P433 has detected an open circuit in the connection of the 20 mA input. Device reaction: Depends on type of fault detected. "Warning" output relay: Updating "Blocked/faulty" output relay: –			
SFMON: CTA error			098 034
Measurement of the coolant temperature via the analog module is faulty. "Warning" output relay: Yes "Blocked/faulty" output relay: –			

 DANGER**HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH**

- Only qualified personnel, trained, authorized and familiar with the device and all the safety instructions in the general Safety Guide (SFTY/5LM/L11 or later version) and appropriate Chapter 5, Chapter 10, Chapter 11, Chapter 12 and Chapter 13 of this manual, shall work on installation, connection, commissioning, maintenance or servicing of this device.

Failure to follow these instructions will result in death or serious injury.

The P433 is a low-maintenance device. The components used in the units are selected to meet exacting requirements. Recalibration is not necessary.

 WARNING**HAZARD OF EQUIPMENT DAMAGE OR LIFETIME REDUCTION**

- Before cleaning the equipment ensure that all ac and dc supplies, current transformer and voltage transformer connections are isolated to prevent any chance of an electric shock whilst cleaning.
- The equipment may be cleaned using a lint-free cloth moistened with clean water. The use of detergents, solvents or abrasive cleaners is not recommended as they may damage the relay's surface and leave a conductive residue.

Failure to follow these instructions can result in equipment damage, unintended equipment operation or reduction of equipment lifetime.

12.1 Maintenance Procedures in the Power Supply Area

Replacement of the power supply module must be carried out by trained personnel, and the power supply voltage must be turned off while the work is being performed.

 DANGER HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH • Always disconnect the device from the auxiliary power supply, before removing any hardware module. • Switch off all the power supplies in connection to the equipment to isolate the device, before removing any hardware module. Failure to follow these instructions will result in death or serious injury.

 DANGER HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH • The power supply must be turned off for at least 5 s before power supply module V is removed. Otherwise there is the danger of an electric shock. Failure to follow these instructions will result in death or serious injury.

The following instructions apply to surface-mounted cases:

 WARNING HAZARD OF EQUIPMENT DAMAGE • The local control panel (or front element) is connected to processor module P by a plug-in connecting cable. Make sure the connector position is correct. Do not bend the connecting cable! Failure to follow these instructions can result in equipment damage or unintended equipment operation.

In general, the electronic components used for the device family *Easergy MiCOM 30* are designed for a long service life.

For the power supply, however, dimensioning requirements dictate the use of electrolytic capacitors that are subject to increased wear and tear. The useful life of these capacitors depends on their temperature and thus on the components fitted in the device, the load conditions, device location and environmental conditions.

The internal voltage levels are cyclically checked by the P30 self-monitoring functions. In case the voltage levels deviate from their specified values a warning message will be issued or, for persistent problems, the device will be set to a safe condition (blocking).

Moreover, the power supply module of the P433 is equipped with a lithium battery for non-volatile storage of fault data and for keeping the internal clock running in the event of failure of the auxiliary power supply. The useful life of the lithium battery depends on the auxiliary power supply of the device.

- If the P433 is continuously connected to the auxiliary power supply, then there is no discharging of the battery, and the battery will thus not be depleted during its service life.
- Should the P433 be disconnected from the auxiliary power supply for several years, then the battery capacity would decrease.

During normal operation, the battery voltage is monitored. If the voltage falls below a pre-defined threshold, a warning message will be issued and the battery has to be replaced.

After the maintenance procedures described above have been completed, new commissioning tests as described in [Section 10.2, \(p. 10-5\)](#) must be carried out.

12.2 Routine Functional Testing

The P433 is used as a safety device and must therefore be routinely injection tested for proper operation. Functional tests should be carried out according to the Operator instruction and maintenance plan. We recommend to perform the functional tests at intervals of 2 to 4 years. This interval can be extended to 6 years if a functional check is performed at least 3 years after the last functional test.

The P433 incorporates in its system a very extensive self-monitoring function for hardware and software. The internal structure guarantees, for example, that communication within the processor system will be checked on a continuing basis.

Nonetheless, there are a number of subfunctions that cannot be checked by the self-monitoring feature without injection testing from the device terminals. The respective device-specific properties and settings must be observed in such cases.

In particular, none of the control and signaling circuits that are run to the device from the outside are checked by the self-monitoring function.

12.3 Analog Input Circuits

The analog inputs are fed through an analog preprocessing feature (anti-aliasing filtering) to a common analog-to-digital converter. In conjunction with the self-monitoring function, the CT/VT supervision function that is available for the device's general functions can detect deviations in many cases. However, it is still necessary to test from the device terminals in order to make sure that the analog measuring circuits are functioning correctly.

The best way to carry out a static test of the analog input circuits is to check the primary measured operating data using the operating data measurement function or to use a suitable testing instrument. A "small" measured value (such as the nominal current in the current path) and a "large" measured value (such as the nominal voltage in the voltage path) should be used to check the measuring range of the A/D converter. This makes it possible to check the entire dynamic range.

The accuracy of operating data measurement is $<1\%$. An important factor in evaluating device performance is long-term performance based on comparison with previous measurements.

In addition, a dynamic test can be used to check transmission performance and the phase relation of the current transformers and the anti-aliasing filter. This can best be done by measuring the trigger point of the first zone when there is a two-phase ungrounded fault. For this test, the value of the short-circuit current should be such that a loop voltage of approximately 2 V is obtained at the device's terminals with the set impedance. Furthermore, a suitable testing instrument that correctly replicates the two-phase ungrounded fault should be used for this purpose.

Additional analog testing of such factors as the impedance characteristic or the starting characteristic is not necessary, in our opinion, since information processing is completely digital and is based on the measured analog current and voltage values. Proper operation was checked in conjunction with type testing.

12.4 Binary Opto Inputs

The binary inputs are not checked by the self-monitoring function. However, a testing function is integrated into the software so that the trigger state of each input can be read out (*Oper/Cycl/Phys* menu branch). This check should be performed for each input being used and can be done, if necessary, without disconnecting any device wiring.

12.5 Binary Outputs

With respect to binary outputs, the integrated self-monitoring function includes even two-phase triggering of the relay coils of all the relays. There is no monitoring function for the external contact circuit. In this case, the all-or-nothing relays must be triggered by way of device functions or integrated test functions. For these testing purposes, triggering of the output circuits is integrated into the software through a special control function (*Oper/CtrlTest* menu branch).

DANGER

HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH

- Before starting the test, open any triggering circuits for external devices so that no inadvertent switching operations will take place.

Failure to follow these instructions will result in death or serious injury.

12.6 Communication Interfaces

The integrated self-monitoring function for the PC or communication interface also includes the communication module. The complete communication system, including connecting link and fiber-optic module (if applicable), is always totally monitored as long as a link is established through the control program or the communication protocol.

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Storage

Devices must be stored in a dry and clean environment. A temperature range of -25°C to +70°C (-13°F to +158°F) must be maintained during storage (see chapter entitled "Technical Data"). The relative humidity must be controlled so that neither condensation nor ice formation will result.

If the units are stored without being connected to auxiliary voltage, then the electrolytic capacitors in the power supply area need to be recharged every 4 years. Recharge the capacitors by connecting auxiliary voltage to the P433 for approximately 10 minutes.

If the units are stored during a longer time, the battery of the power supply module is used for the continuous buffering of the event data in the working memory of the processor module. Therefore the battery is permanently required and discharges over time. In order to avoid this continuous discharge, it is recommended to remove the power supply module from the mounting rack during long storage periods. The contents of the event memory should be previously read out and stored separately!

 WARNING**HAZARD OF EQUIPMENT DAMAGE OR LIFETIME REDUCTION**

- Do not sustain exposure to high humidity during storage, the value shall not exceed 75% relative humidity.
- Once the device has been unpacked, it is recommended to energize it within the three following months.
- The device has to be energized at least once in 4 years, if it is not in permanent operation.
- Where electrical equipment is being installed, sufficient time should be allowed for acclimatization to the ambient temperature of the environment before energization.

Failure to follow these instructions can result in equipment damage, unintended equipment operation or reduction of equipment lifetime.

14

Accessories and Spare Parts

Description	Order No.
Cable bushings	88512-4-0337414-301
Resistor 200 Ω	255.002.696
Accessory set #1, 40T Rack/Panel/Flush Mounting Set	9652221
Accessory set #2, 84T Rack/Panel/Flush Mounting Set for two 40T devices	9652236
Accessory set #3, 84T Rack/Panel/Flush Mounting Set	9652222
Operating program for Windows	Use Easergy Studio setting tool or can be downloaded from SE website

LED indicators and function keys that are not already configured can be labeled by paper strips. The paper labels can be inserted into slot in front membrane at the appropriate location.

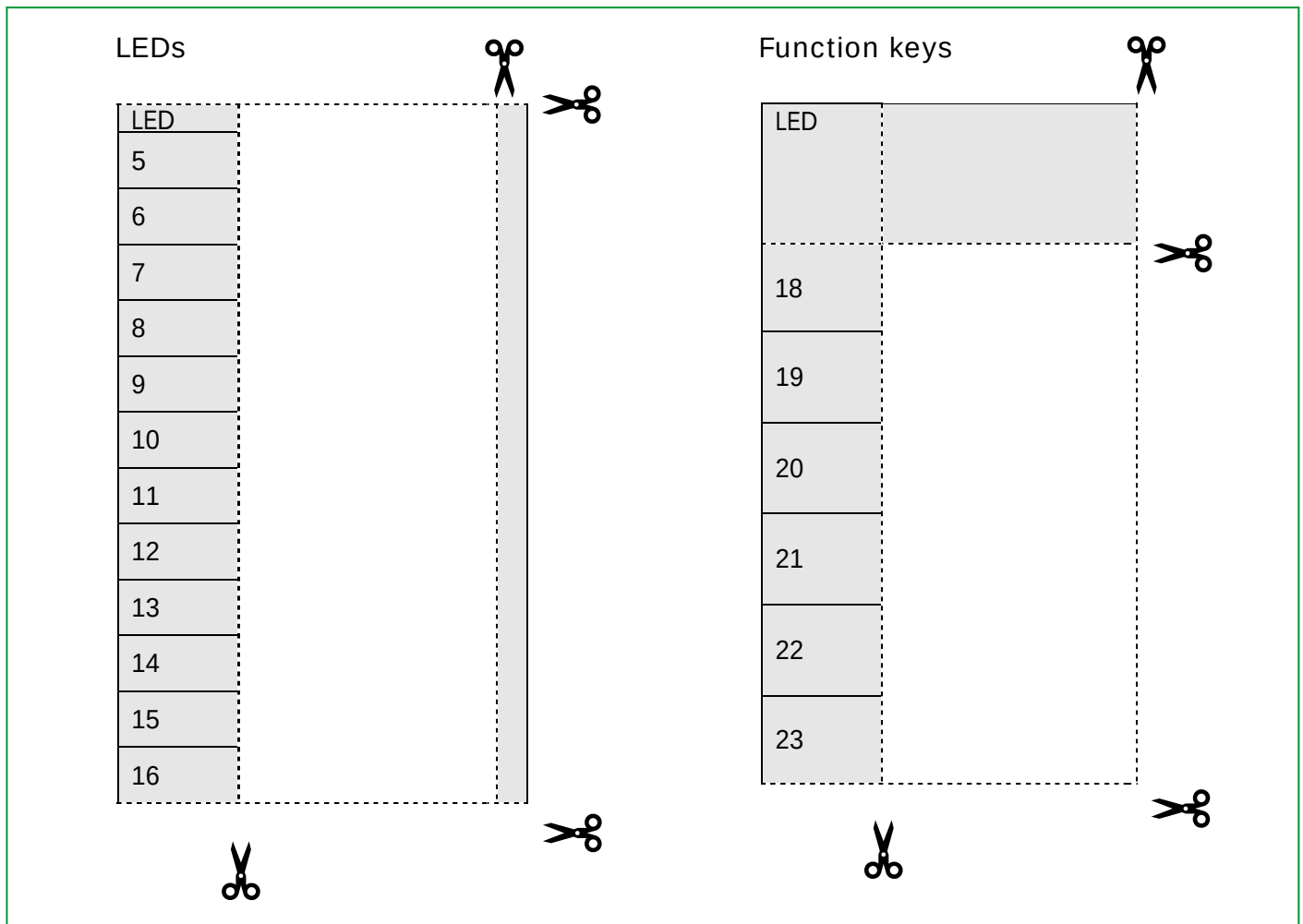


Fig. 14-1: LEDs / Function key LEDs assignment template. (Please cut out the white area between the grey blocks.)

15 Order Information

Basic Configuration Variants

Order information MiCOM P433																												
18 character cortec				1	2	3	4	5	6	7	8	9	10	11	12, 13		14	15	16	17	18							
Distance Protection Device				P	4	3	3	-			9	0					-317	-4xx	-671	-7xx	-	-46x	-9x	x	-9x	x	-8xx	
Basic device: Basic device 24TE, pin-terminal connection, Basic device 24TE, CT/VT ring-, I/O pin-terminal connection, Basic device 40TE, pin-terminal connection, Basic device 40TE, CT/VT ring-, I/O pin-terminal connection, Basic device 84TE, ring-terminal connection, basic complement with 4 binary inputs, 8 output relays and 6 function keys ¹⁶⁾								1					0		0		-430											
								2					0		0		-431											
								3									-432											
								5									-433											
								8									-434											
Mounting option and display: Surface-mounted, local control panel with text display ³³⁾ Flush-mounted, local control panel with text display ³³⁾ Surface-mounted, enhanced local control panel with text display ^{16) 34)} Flush-mounted, enhanced local control panel with text display ^{16) 34)} Surface-mounted, with enhanced detachable HMI ^{16) 34)} Flush-mounted, with enhanced detachable HMI ^{16) 34)}								3																				
								4																				
								A																				
								B																				
								E																				
								F																				
Current transformer: Inom = <u>1A</u> / 5 A (T1...T4) ²⁾										9																		
Voltage transformer: Vnom = 50 ... 130 V (4-pole) Vnom = 50 ... 130 V (5-pole) for Automatic Synchronism Check												4																
											5																	
Additional binary I/O options: ¹⁶⁾ Without With 1 binary module (add. 6 binary inputs and 8 output relays) With 2 binary modules (add. 12 binary inputs and 16 output relays) With 1 binary module (add. 6 binary inputs and 6 output relays (2-pole)) for the control of up to 3 switchgear units With 1 binary module (add. 6 binary inputs and 6 output relays (2-pole)) for the control of up to 3 switchgear units and 1 binary module (add. 6 binary inputs and 6 output relays (2-pole)) With 1 binary module (add. 6 binary inputs and 6 output relays (2-pole)) for the control of up to 3 switchgear units and 1 binary module (add. 6 binary inputs and 8 output relays)													0															
												1																
												2																
												5																
												6																
												8																

Further Options

Order information MiCOM P433																										
18 character cortec				1	2	3	4	5	6	7	8	9	10	11	12, 13		14	15	16	17	18					
Distance Protection Device				P	4	3	3	-		9	0					-317	-4xx	-671	-7xx	-	-46x	-9x x	-9x x	-8xx		
Power supply and additional binary I/O options:																										
VA , nom = 24 ... 60 VDC														E												
VA,nom = 60 ... 250 VDC / 100 ... 230 VAC														F												
VA,nom = 24 ... 60 VDC and 6 output relays														G												
VA,nom = 60 ... 250 VDC / 100 ... 230 VAC and 6 output relays														H												
VA , nom = 24 ... 60 VDC and 6 binary inputs and 3 output relays														J												
VA,nom = 60 ... 250 VDC / 100 ... 230 VAC														K												
and 6 binary inputs and 3 output relays																										
VA , nom = 24 ... 60 VDC and 4 high break contacts														L												
VA,nom = 60 ... 250 VDC / 100 ... 230 VAC and 4 high break contacts														M												
Further add. options: ¹⁶⁾																										
Without														0												
With TGF (transient ground fault direction determination) module ³⁾														1												
With analogue module														2												
With TGF and analogue module ³⁾														3												
With binary module (add. 24 binary inputs)														4												
With TGF and binary module (add. 24 binary inputs) ³⁾														5												
With analog module and binary module (add. 24 binary inputs)															A											
With two binary modules (add. 48 binary inputs) ³⁾															B											
With binary module (add. 6 binary inputs and 8 outputs)															C											
With binary modules (add. 6 binary inputs and 8 outputs)															D											
and 24 binary inputs ³⁾																										
With binary modules (add. 6 binary inputs and 8 outputs)															E											
and analog module ³⁾																										
With binary modules (add. 6 binary inputs and 8 outputs)															G											
and TGF module ³⁾																										
Switching threshold on binary inputs:																										
Standard variant with switching threshold at 65% of 24 VDC (VA,min) ⁸⁾																		Without order extension No.								
Special variant with switching threshold at 65% of 127 VDC (VA,nom) ⁸⁾																										
Special variant with switching threshold at 65% of 250 VDC (VA,nom) ⁸⁾																										
Special variant with switching threshold at 65% of 110 VDC (VA,nom) ⁸⁾																										
Special variant with switching threshold at 65% of 220 VDC (VA,nom) ⁸⁾																										

Order information MiCOM P433																												
18 character cortec				1	2	3	4	5	6	7	8	9	10	11	12, 13		14	15	16	17	18							
Distance Protection Device				P	4	3	3	-				9	0					-317	-4xx	-671	-7xx	-	-46x	-9x	x	-9x	x	-8xx
With communication / information interface: Without Serial communication IEC 60870-5-101/103, Modbus, DNP3, Courier (switchable) all with 2nd RS485 service interface (IEC 60870-5-103) & IRIG-B Variant RS485: for connection to wire Variant FSMA: for connection to plastic fiber Variant ST: for connection to glass fiber																												
IP Ethernet modules IEC 61850 Ed. 1/ Ed. 2/ IEC 60870-5-104 (switchable) ²⁶⁾ <i>all with IRIG-B</i> CSL0: without Cyber Security compatibility CSL1: with Cyber Security compatibility (+ additional SAT licence) ^{27) 31)} Variant SEB RJ45: Single Ethernet, 1 x RJ45 port Variant SEB LC: Single Ethernet, 1 LC port + 1 RJ45 port Variant REB RJ45: Redundant Ethernet RSTP or PRP or HSR, VLAN, 3 RJ45 ports Variant REB LC: Redundant Ethernet RSTP or PRP or HSR, VLAN, 2 LC ports + 1 RJ45 port																												
Serial communication module and additional IP Ethernet module variant ^{16) 32)} Variant ST and Variant SEB RJ45 Variant ST and Variant SEB LC Variant ST and Variant REB RJ45 Variant ST and Variant REB LC																												
With guidance / protection interface: ¹⁶⁾ Without Protocol InterMiCOM For connection to wire, RS485, isolated For connection to glass fibre, ST connector For connection to wire, RS232, isolated																												
Language: English (German) ⁴⁾ Px40 English (German) ⁴⁾ German (English) ⁴⁾ French (English) ⁴⁾ Spanish (English) ⁴⁾ Polish (English) ⁴⁾ Russian (English) ^{4) 7)}																												

- *) Please check availability for basic device 24 TE by Cortec.*
- 2) Switching via parameter, default setting is underlined!*
- 3) This option is excluded if the InterMiCOM interface (-95x) is ordered.*
- 4) Second included language in brackets.*
- 7) Hardware option, supports Cyrillic letters instead of special West European characters.*
- 8) Standard variant recommended if higher pickup threshold not explicitly required by the application.*
- 16) Options for basic device 24 TE not possible.*
- 26) Option IEC 60870-5-104 only for German market and on request.*
- 27) According to BDEW / NERC / IEEE 1686.*
- 31) Cyber Security feature is only available for Ethernet communication.*
- 32) Serial communication module on slot 2; IP Ethernet module variant on slot 3 or slot 8 (if slot 3 is already used).*
- 33) Options for basic device 24 TE only.*
- 34) Rack/Flush Mounting accessory available separately.*

In order to display the Russian data model, the corresponding order extension number (-805) must be added upon ordering so that the hardware option supporting Cyrillic characters is integrated. With this ordering option, reference menu texts (English) will be available for display. However, other Western

European languages containing extra characters will not be fully supported. Consequently, selecting the “Russian / English” ordering option means that it will not be possible to download Western European data models into the device.

Binary Inputs' Switching Threshold

The standard version of binary signal inputs (opto-couplers) is recommended in most applications, as these inputs operate with any voltage from 18 V. Special versions with higher pick-up/drop-off thresholds (see also “Technical Data”, [Chapter 2, \(p. 2-1\)](#)) are provided for applications where a higher switching threshold is expressly required.



Customer Care Centre

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