



TC.GSS Grid-tie Source Sink Bidirectional DC power supply



**With the application
TopControl**

General

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Identification

Device hardware

Information on the device is to be found on the type plate on the rear side of the TopCon TC.GSS power supply.

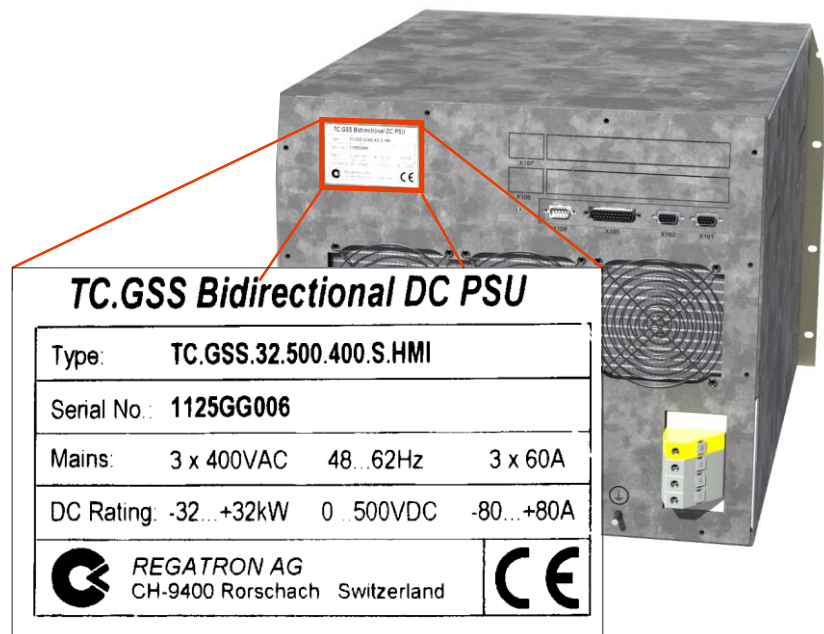


Fig. 1 Example - information on the device type, serial number as well as input and output data on the TopCon TC.GSS power supply.

Manufacturer

Information on the manufacturer	
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Instructions

Version overview	
Operating instructions	Manual - TC.GSS; V00.14; 15.01.2019
For following modules:	
TopCon MainDSP	From version V4.20.XX
HMI	From version V5.08.00

Table 1 Subject to technical change without notice.
xx: valid for all sub-versions.

General information on the manual

Purpose of the manual

This manual provides information on the usage of the TopCon TC.GSS bidirectional DC power supply. It serves as instructions and as a reference work. Familiarise yourself with the contents of these operating instructions to operate the device efficiently.

Availability of the manual

The manual must be available at all times to the personnel who are operating the device.

Actuality of the manual

The TopCon TC.GSS bidirectional DC power supply is a new product on which there may be changes to the operation and scope of operation during the initial phase.

The first printed edition addresses this situation and is published as a preliminary version. You can download the latest version of the manual from the web site www.regatron.com.

Using the manual

In its description the manual first provides an overview and then discusses the details of a function or situation.

If it is necessary, instructions on how to perform actions are given step by step after explanatory text, figures and tables.

This aspect is reflected in the layout, which is broken down as follows:



Voraussetzungen für AAP und benutzerdefinierte Kurven

Um Kurven editieren bzw. erzeugen zu können, müssen bestimmte Voraussetzungen erfüllt sein

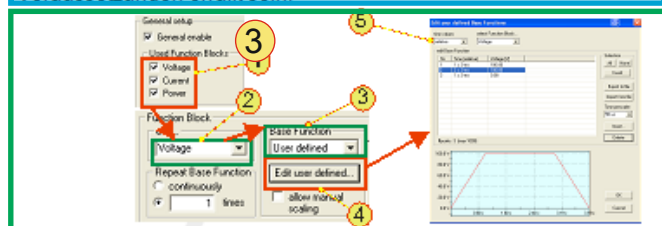


Abb. 107 Voraussetzung um zu den Dialog-Fenstern zum Editieren für benutzerdefinierte und AAP Kurven zu gelangen.

Voraussetzungen für benutzerdefinierte und AAP-Kurven	
1	Used Function Blocks, Rubrik Es muss „General enable“ in Rubrik „General Setup“ aktiviert sein. Mindestens eine Auswahl aus Voltage, Current oder Power muss getroffen werden. Wird keine Auswahl getroffen oder „General enable“ ist deaktiviert stehen keine Bedienelemente der Rubrik „Function Block“ für eine Bearbeitung zur Verfügung.
2	Function Block, Rubrik Entsprechend der aktivierten „Used Function Blocks“ -1- kann unter dem Auswahlmü ein entsprechender Funktions-Block ausgewählt werden. Die hier gemachte Auswahl bestimmt die Führungsgröße der Y-Achse im Editorfenster -5-.
3	Base Function, Rubrik Im Auswahlmü muss eine der folgenden Einträge ausgewählt werden User defined: → Bezeichnungsänderung bei -4- auf „Edit user defined ...“ AAP-Kurve: → Bezeichnungsänderung bei -4- auf „Edit AAP ...“
4	<Edit user defined...>/<Edit AAP>, Druckknopf Der Druckknopf ändert seine Bezeichnung und seine Funktion entsprechend der Auswahl in -3-. Mit dem Druckknopf wird immer ein Dialog-Fenster zum Editieren von Kurven geöffnet.
5	Dialogfenster Entsprechend der Auswahl in -2- und -3- öffnet sich das Dialog-Fenster für benutzerdefinierte oder AAP-Kurven.

Tabelle 91 Voraussetzung für benutzerdefinierte und AAP-Kurven.



Fig. 2 Example page – layout of a page of the document

-1- The header

... contains the title of the instructions, the chapter numbers and chapter headings with the related sub-chapters so that you do not lose the overview even in the midst of explanations that cover several pages.

-2- Informative text

... contains important notes, prerequisites for specific situations and introduces you to specific topics.

-3- Figures

... say more than words to illustrate the majority of the topics. Important details within the figure are referred to using item numbers, boxes and arrows.

-4- Tables

... provide the information in concise form for reference and provide information on the item numbers used in the figure above.

-5- The footer

... contains the publication date, the manual version and the current page number.

A short explanation of specific symbols in the manual:

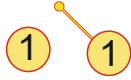
Symbol	Meaning
<Bezeichnung>	Text in angle brackets refers to software and hardware buttons, as well as tabs in the software.
-1-	Item numbers in descriptions, in instructions on how to perform actions or in tables.
●	The dot is used to mark lists and instructions for performing actions.
↳	The result arrow marks the description of a consequence of an action.
⇒	The double arrow marks preventive instructions that occur in information on hazards.
→	The single arrow is used as a result or reference arrow in tables.
	Item numbers with and without reference lines in figures refer to important details.

Table 2 Explanation of symbols in the document.

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1. Product description

1.1. Product usage and restrictions

Feeding and regenerative operation with several TopCon TC.GSS power supplies.

The system is used as a constant current, voltage and power source or current/power sink. To be able to obtain higher power, current or voltage, several TopCon modules can be connected in series or in parallel.

Restriction on usage

TopCon TC.GSS power supplies connected in series are not allowed to exceed a total DC voltage of 1500 V_{DC}.

If you do not observe this specification:

- You will fall outside the scope of the Low voltage directive.
- You will do so at your own risk.

1.2. Features

1.2.1. Description of the model identifier

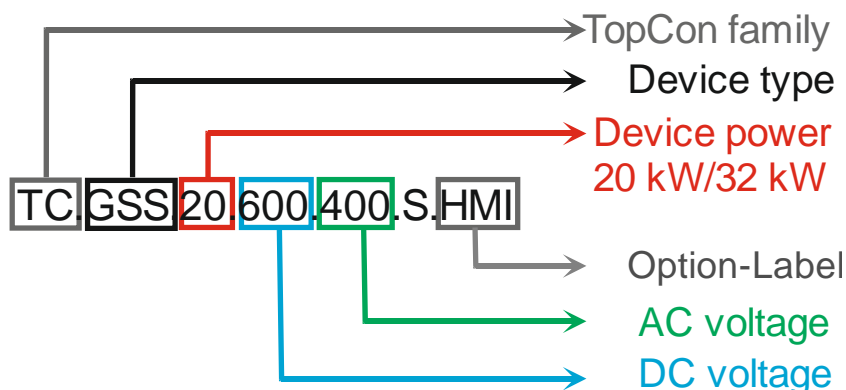


Fig. 3 Structure of the model identifier

1.2.2. Model range



The model range has the following common parameters on the mains side:

For further information: see related data sheets

- Mains voltage standard models
Mains input AC: 3 x 360 V_{AC} ... 3 x 440 V_{AC},
at frequency: 48 - 62 Hz
- Mains voltage wide range models
Mains input AC: 3 x 380 V_{AC} ± 10 % ... 3 x 480 V_{AC} ± 10 %,
at frequency: 48 - 62 Hz
- Depending on your requirements, it is also possible to manufacture other models.

The manual is valid for following devices

Standard-Mo

TC.[c].20.400.400.S[a][b]
 TC.[c].32.400.400.S[a][b]
 TC.[c].20.500.400.S[a][b]
 TC.[c].32.500.400.S[a][b]
 TC.[c].20.600.400.S[a][b]
 TC.[c].32.600.400.S[a][b]

Wide Range -Modelle

TC.[c].20.65.4WR.S[a][b]
 TC.[c].32.65.4WR.S[a][b]
 TC.[c].20.130.4WR.S[a][b]
 TC.[c].32.130.4WR.S[a][b]
 TC.[c].20.400.4WR.S[a][b]
 TC.[c].32.400.4WR.S[a][b]
 TC.[c].20.500.4WR.S[a][b]
 TC.[c].32.500.4WR.S[a][b]
 TC.[c].20.600.4WR.S[a][b]
 TC.[c].32.600.4WR.S[a][b]

Table 3 TC.GSS / TC.GSX/ TC.GXS models .
 [a] = .HMI (option); [b] = .LC (option)
 [c] = GSS: Full Q1/4 range available
 GSX: Only Q1 range available
 GXS: Only Q4 range available

1.3. Mechanical data

1.3.1. Dimensions

Rear view

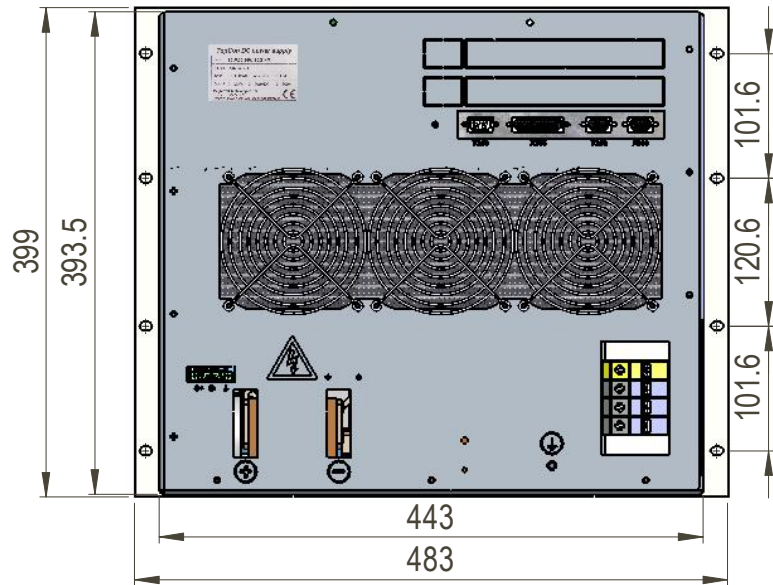


Fig. 4 TopCon TC.GSS rear view

Side view

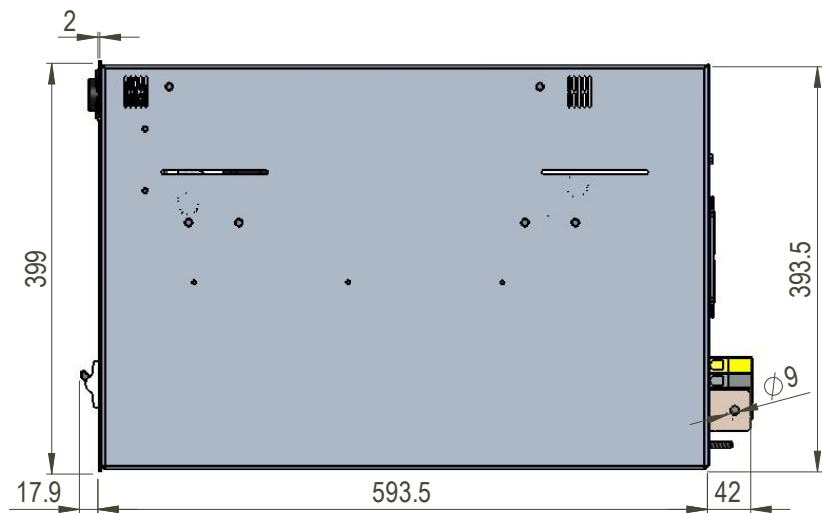


Fig. 5 TopCon TC.GSS side view

1.3.2. Weight

Power class	Device total weight
20 kW	~97 kg
32 kW	~97 kg

Table 4 Information on the device weight.
The weight may vary slightly depending on the hardware option.

1.4. Ambient conditions

Ambient conditions for standard devices ¹	
Maximum ambient temperature	
Storage temperature	-18 – 70 °C
Cooling air temperature in operation	5 – 40 °C
Ventilation type	
Standard	Internal water cooling with a fully integrated liquid-air heat exchanger with 3 regulated fans.
Liquid cooled (LC) (option)	Internal water cooling with a fully integrated liquid-liquid heat exchanger. (see chapter 5.2.1, Seite 70)
Atmospheric humidity	15 – 85 %, non-condensing
Installation altitude	0 – 2000 m above sea level
Ingress protection (IEC 60529)	
Basic version ²	IP 20
Utilisation category	
Protection class	I
Overvoltage category	III
Degree of soiling	2

Table 5 Ambient conditions for the TopCon TC.GSS power supply.
¹ Versions with extended characteristics may vary from this information.
² In accordance with standard IEC 60068-2-6.

1.5. Position of the interfaces

1.5.1. Overview of the front side of the device

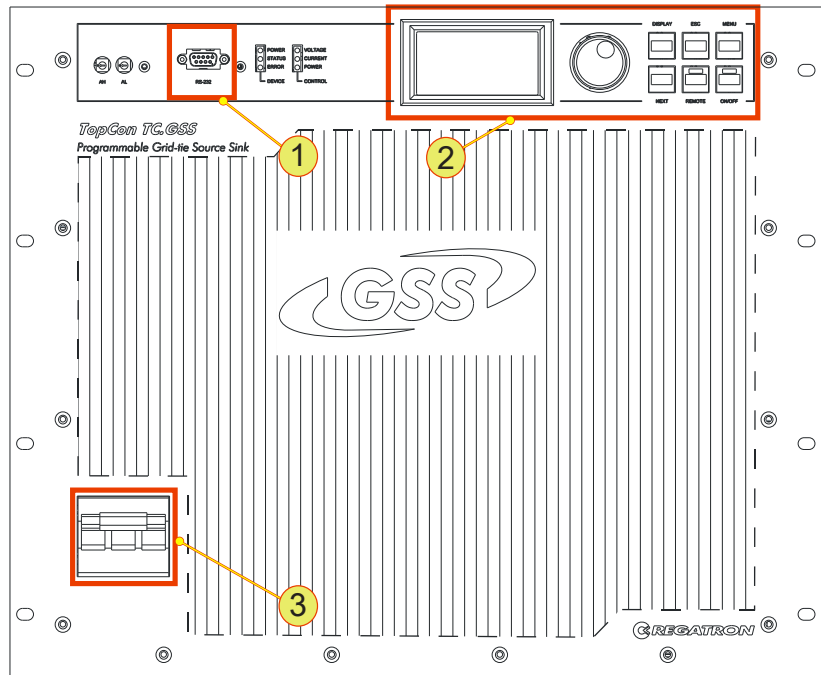


Fig. 6 Opening a new user level in the <Preferences> window.

Interfaces - front side	
1	RS-232 For information on connecting the interface to a PC see chapter, see software manual chapter 7.2.5, page 131.
2	Human Machine Interface (HMI), option For function description see chapter 7.3, page 132
3	Main circuit breaker For technical information see chapter 10.1.1, page 182

1.5.2. Overview of the rear side of the device

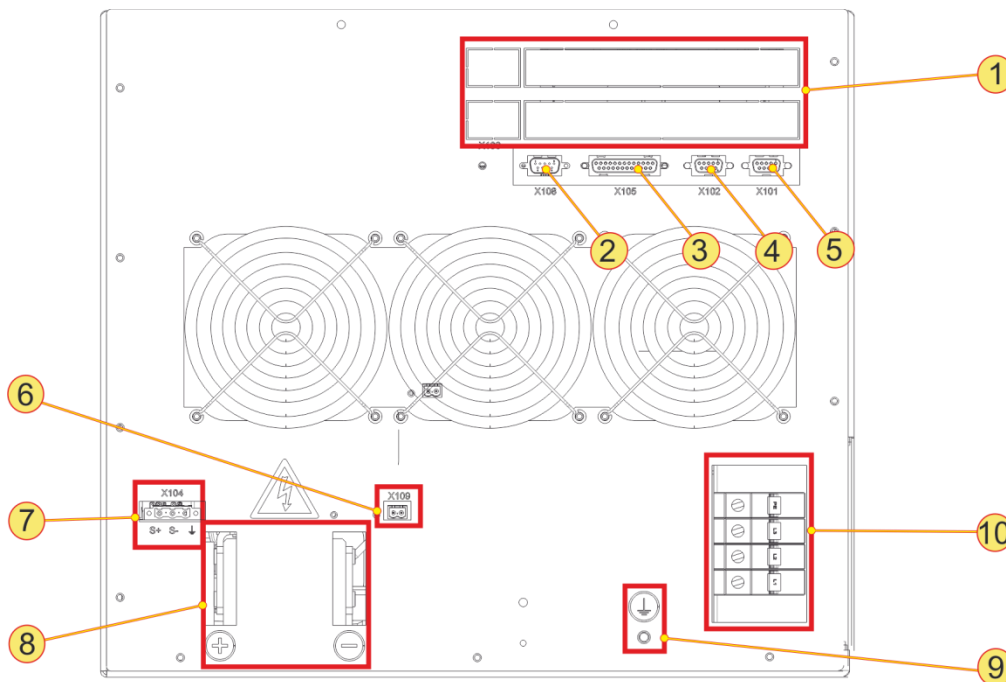
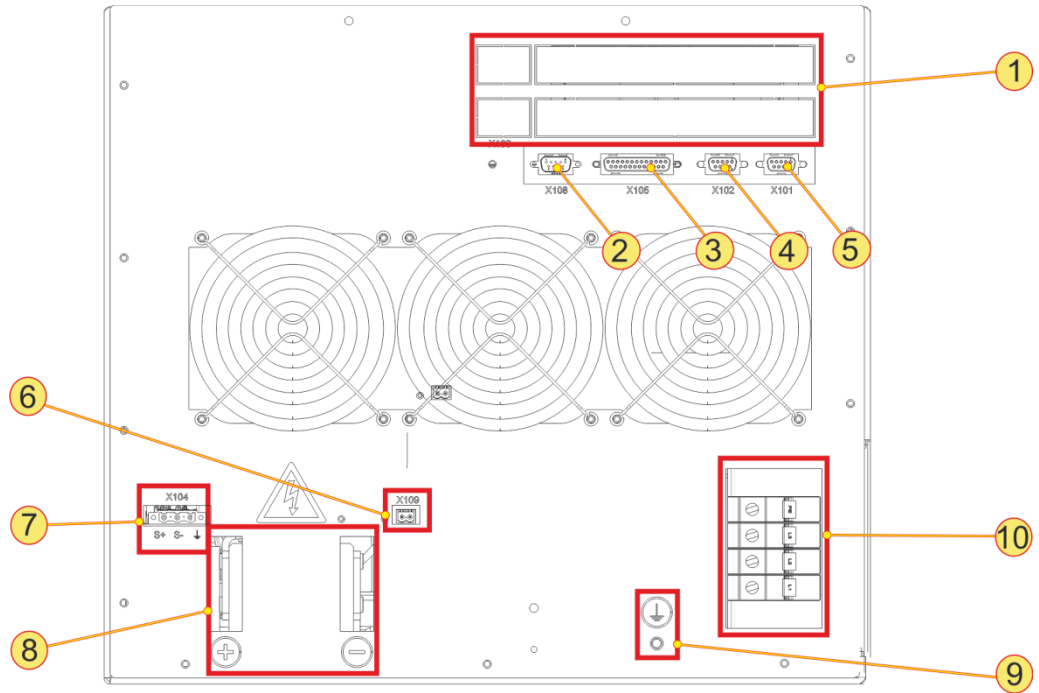


Fig. 7 Position of the interfaces on the rear side of the device.

Interfaces - rear side	
1	Placeholders for optional interfaces For example ISR (option) – X112-2 For function description on device operation see chapter 7.2, page 127.
2	System current sense – X108 For technical data see chapter 10.1.4.8, page 191 Currently this interface is not supported.
3	Analogue-digital interface – X105 For technical data see chapter 10.1.4.6, page 188 For function description on device operation see chapter 7.2, page 127.
4	CAN bus – X102 For technical data see chapter 10.1.4.4, page 186 For function description on single device see chapter 4.3.2, page 42. For function description on multi-unit system see chapter 4.4.3, page 58.
5	CAN bus – X101 For technical data see chapter 10.1.4.4, page 186 For function description on single device see chapter 4.3.2, page 42. For function description on multi-unit system see chapter 4.4.3, page 58

Be continued on the next page



Position of the interfaces on the rear side of the device.

Interfaces - rear side (continued)	
6	Disconnecting discharge resistors – X109 For function description see chapter 4.3.5, page 47.
7	Sense – X104 For technical data see chapter 10.1.4.5, page 187. For function description on single device see chapter 4.3.1, page 37.
8	DC current bars
9	Earthing pin For the connection of an additional earth.
10	Mains connection, AC connection terminals

Table 6 Interfaces on the rear side of the device

2. Safety

2.1. General information on safety and hazards

Scope and applicability

The general information applies to all TopCon low-voltage systems. The user(s) has (have) the obligation to avoid the risks and hazards mentioned by means of the rigorous application of specialist electrical rules.

The system is subject to the Low voltage directive, it is to be operated by adequately trained and instructed personnel.

2.2. Categorisation of the hazard areas

The assessment of the effects of hazards from low-voltage systems with a flow of energy for feed and possibly regeneration is divided into the following areas:

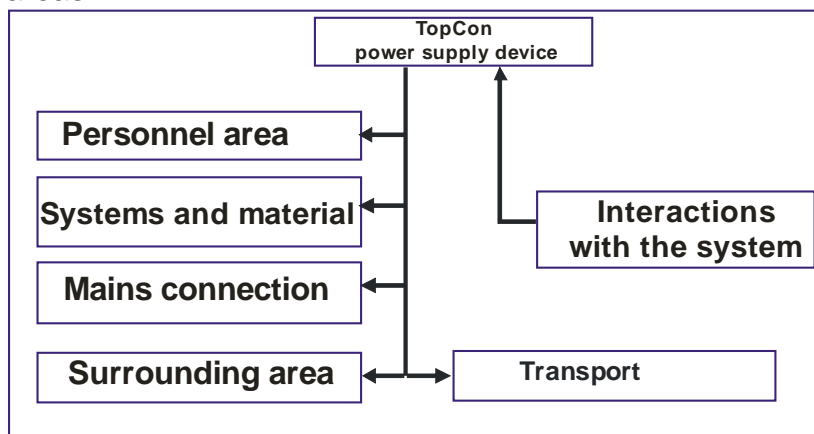


Fig. 8 Categorisation of the hazard areas.

The hazard areas stated are explained in the sub-sections of this chapter that follow.

2.2.1. Personnel area

The utmost attention is to be paid to the hazards for individuals. There are various risks and hazards, of these the most important are mentioned here.

Electric shock

A low-voltage system can produce electrical potentials that can be dangerous or even fatal for individuals. During work on the system the following guidelines are to be observed:

a) **Work in electrically isolated state**

This is the recommended way of working, it should be rigorously applied during all connection and wiring work. Follow the rules:

1. Electrically isolate
2. Secure against switching back on.
3. Short-circuit
4. Connect to earth
5. Report and instruct

After shut down, the short-circuiting of the outputs and earthing are particularly important for safety reasons if reactive loads or loads that store energy (accumulators, capacitors, ULTRACAP etc.) are used.

b) **Work in the vicinity of live parts**

In these circumstances an increased hazard potential is to be expected. Minimise the risks by means of:

1. Guards
2. Covers
3. Insulating encapsulation, cladding
4. Impose separation by means of mechanical features, protective grilles
5. Supervision, reporting

c) Work on live equipment

It is imperative this form of working is avoided. If it cannot be avoided, careful work preparation is essential.

Pay attention to the following:

1. The personnel must be specially trained.
(see NIV Art 26)
2. Work in accordance with recognised specialist methods.
3. Controlled personal protective equipment must be available.
(passive protection)
4. Organisation of the working area.
5. Supervision and preparatory measures. (Active protection)
6. Use appropriate protection against physical contact throughout.
Set up a suitable EMERGENCY STOP chain and test it at regular intervals!
Mark all wires and cables to prevent mistakes.

Electrical heating

TopCon electrical power supply systems operate with significant amounts of energy. High currents can cause heating of cables and wires. In particular, during unmonitored endurance tests insulation fires and short-circuits may be caused.

- At particular risk are connectors, switchgear and cable terminals. Check these parts particularly carefully and at regular intervals.
- Use wiring material suitable and stipulated for your application with the related insulation class!
- Monitor your system actively or passively using appropriate sensors or by monitoring parameters.

Arcing and sparking on opening contacts

In relation to DC systems, note that on opening a circuit through which a current is flowing, arcing with very high energies can be produced depending on the inductance!

In some circumstances this arcing can result in burns, damage to the eyes as well as damage, destruction or fire on parts of the system.

The usage of normal mains contactors as isolating devices in DC circuits is not recommended! Instead use DC contactors. In case of doubt contact the related manufacturer.

Take into consideration that the protective devices on the TopCon low-voltage system cannot detect an arc as a fault condition, as this situation may be a required function.

Risk of mechanical injury

As on all electrical installations, mechanical injuries to the head and hands may be caused on removing and fitting covers, wire and cable connections.

Always use the correct tool. If necessary protect the head and hands against injuries due to cuts and impacts.

2.2.2. Systems and material area

Risk of fire

In case of fire, electrically isolate the system immediately, on the one hand to interrupt the supply of energy and on the other hand to shut down the fans.

Fight the fire from bottom to top in accordance with the rules in your organisation using suitable fire fighting equipment (CO₂ fire extinguisher). If possible use fire extinguishers with asphyxiation action to keep the secondary damage low.

Electromagnetic fields

Like any electrical system, TopCon low-voltage systems produce electrical and magnetic fields. However, these fields comply fully with the usual standards.

Note, however, that particularly the EM fields from your cables and equipment connected could nevertheless produce interference on objects in the immediate area.

Note the following:

- Keep data carriers and PC-based measuring environments an adequate distance from live cables to prevent interference and data loss.
- Protect highly-sensitive sensors and instruments.
- Test effects on communication networks, in particular radio networks.
- Make individuals with electronic implants aware that implants may be affected.

Noise and noise level

The inductive elements as well as the fans on the TopCon low voltage system produce a lower or higher noise level dependent on the operating mode. However, in the immediate vicinity of the cabinet this noise is under the tolerance limit that would make acoustic protection equipment necessary.

The usage of acoustic protection equipment or acoustic insulation measures can, however, be necessary in specific circumstances.

Mechanical damage

Incorrect operation of the systems can result in mechanical damage to the downstream equipment and systems.

In particular, on the supply of power to drives it is to be ensured that excessively high speeds cannot result on load shedding.

The monitoring of the maximum speed with intervention in the safety chain is recommended above all if the system runs unmonitored.

Handling stores containing large amounts of energy

Modern energy storage systems are able to absorb very large amounts of energy. This situation has the following consequences:

- The cabling should not just comply with the maximum charging and discharging currents to be expected, to some extent significantly higher peak currents are to be expected during switching processes.
- Unlike the TopCon low-voltage system, which is fully current-limited, in the case of stores containing large amounts of energy a short-circuit or failure can be very serious. Due to the high currents serious injuries and serious damage can be caused.

The following, incomplete list indicates some this damage:

1. Burning of wires and connectors
2. Sparking
3. Fires, insulation fires
4. Arcing, welding
5. Electric shocks

Note the following points:

1. Never short-circuit energy stores to discharge them!
Always use a suitable discharge resistor of appropriate power rating!
2. Visibly secure a discharged energy store using a short-circuit bridge.
3. Always monitor the maximum storage voltage, also during practical test operation.
4. Use a device that clearly indicates the charge state of the energy store, e.g. by monitoring the low-voltage limit.

2.2.3. Mains connection area

TopCon TC.GSS power supplies are operated with 400V/480V 3~ AC. When they are switched on there may be an uneven load on the 3 phases; this uneven load may cause older residual current circuit breakers to trip.

Here a modern make of residual current circuit breaker is to be used that will tolerate such asymmetries during the switch-on process.

2.2.4. Surrounding area

TopCon TC.GSS power supplies are generally forced air cooled. Despite the very high efficiency, a power loss occurs in the components that must be dissipated in the form of heat to the surroundings. The energy is dissipated with the aid of forced ventilation to the rear of the TopCon TC.GSS power supply.

It is to be ensured that the rooms in which TopCon TC.GSS power supplies operate are cool and therefore the heat produced can actually be removed.

- Active cooling is, however, generally unnecessary.
- The forced ventilation discharges air from the rear side of the TopCon power supply.

It is to be ensured that there are no undesirable effects (e.g. stirring up of dust or sand, deformation due to the action of heat etc.) due to the flow of air and the heat, which at high load may be powerful.

On TopCon models with the water cooling option, a large portion of the power loss produced is dissipated via the cooling circuit.

Here it is to be ensured the cooling liquid feed is not too warm. Further requirements on the cooling liquid are given in the option description from p. 70.

2.2.5. Transport area

TopCon power supplies are always supplied with 2 strong carrying handles (steel sheet). These handles are inserted in the slots in the side of case and make it possible to transport the device easily.



Fig. 9 Attaching the carrying handles to transport a TopCon power supply.

Due to the high weight it is advisable to carry the device between 3-4 people and whenever possible to use a trolley.

Remove the carrying handles after transporting the TopCon power supply and store them in a safe place.

On lifting the system using a crane:

In any circumstance it is recommended to attach blocks of wood to the corners of the cabinet to prevent twisting/distortion of the cabinet structure (see Fig. 10).

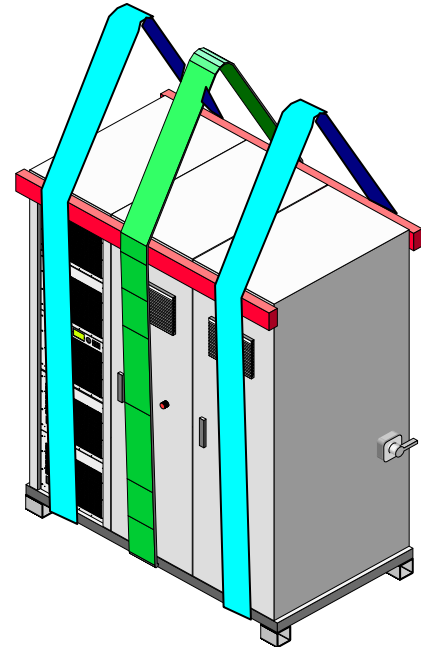


Fig. 10 Usage of blocks of wood as protection against mechanical damage (lifting using 2 (better 3) carrying straps)

- It is imperative you remove all cable connections prior to moving the system!
- Note that between switching off the power supply and disconnecting the power cables on the output side, it is necessary to wait at least 15 min for discharging.
- Keep all doors closed during the transport of cabinets.
- Pay attention to protruding parts such as main switch, controls and fan covers. They must not be damaged by transport aids (straps, blocks of wood, etc.).

2.2.6. Area related to interaction with the system

Compliance with the design data for the specific system is a prerequisite for malfunction-free operation.

Load systems can have significant effects on the power source. The following points are to be noted:

1. The maximum voltage specified is not allowed to be exceeded.
2. Protective measures must be provided against voltage spikes on the load side and their function must be monitored (voltage spikes could damage the filter capacitors and semiconductors in the system).
3. Periodic overcurrents are to be avoided.
4. The DC ripple currents produced on the load side are to be monitored to avoid overloading filter capacitors; in case of doubt ask the manufacturer.

The system is always to be operated within the permissible temperature range. High temperatures will reduce the service life of various modules.

2.3. Safety pictograms used

Important information in these operating instructions is marked with the following symbols:




Hazard and warning information	
Pictogram	Meaning
 DANGER	For an immediate hazard that will result in serious injuries or fatality.
 WARNING	For an immediate hazard that can result in serious injuries or fatality.
 CAUTION	For a possibly hazardous situation that can result in serious injuries or fatality.
CAUTION	For a possibly hazardous situation that could result in damage to the product or another item in its surroundings.

Table 7 Basic hazard and warning information.



Further warning and hazard information	
Pictogram	Meaning
	DANGER, WARNING or CAUTION due to electrical power
	DANGER, WARNING or CAUTION related to suspended load

Table 8 Symbols included in the table can be used for more specific depiction of warning information from Table 7 "Basic hazard and warning information".


Instructions	
Pictogram	Meaning
	Important information

Table 9 Mandatory signs that are important for the operation of the device or the software


General notes	
Pictogram	Meaning
	Tip, for working efficiently with the device.

Table 10 Additional information, so that you can find possibly important information quickly.

3. Layout and function

Overview of the function

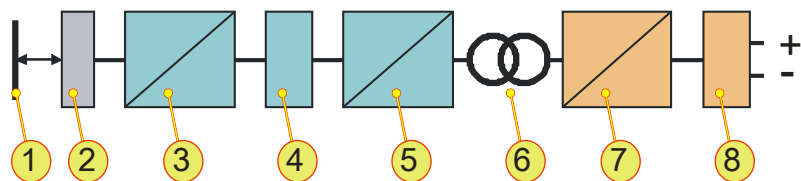
The development, optimisation and testing of modern energy storage systems is increasingly demanding programmable active feed/regeneration systems. More and more, significant amounts of energy are handled such that the dissipative conversion into heat losses does not represent a sensible alternative to power regeneration.

The TopCon TC.GSS series is the first fully digital power supply that controls both energy directions for feeding the load and regeneration from the load.

Examples of possible applications:

- Testing and evaluating battery systems
- Developing and debugging drive trains
- Simulation of on-board power systems for road vehicles and aircraft
- Test systems for electrical propulsion drives, lifts, cranes, light railways
- Evaluation and tests on hybrid concepts
- Electrical processes in process engineering

Topology – inside the device



-1- MAINS; -2- FILTER; -3- PFC/ RECTIFIER/ INVERTER;
 -4- DC INTERMEDIATE CIRCUIT; -5- RECTIFIER/ INVERTER;
 -6- TRANSFORMER; -7- RECTIFIER/ INVERTER;
 -8- OUTPUT FILTER

The new device series is based on the latest concepts and by means of the multiple utilisation of the power stages ensures optimum performance and compactness. The high frequency regeneration inverter/rectifier eliminates the familiar problems with passive 6-pulse rectifiers during feeding operation (PFC functionality). Due to the medium frequency transformer coupling, complete isolation between mains and DC load circuit is achieved.

4. Controls and displays and operating modes

4.1. Controls and displays

4.1.1. Elements of the standard interface



Fig. 11 Standard controls on the front side of the device.

Standard controls (cf. Fig. 11)	
1	<p>Device address selection switch For multi-unit operation Standard: covered by plastic caps AH: Upper address range AL: Lower address range</p>
2	<p>RS-232, interface For operation via a PC using the TopControl application see software manual chapter 7.2.5, page 131.</p>
3	<p>DEVICE, LED indicator Indication of the device status Green: POWER Yellow: STATUS/WARNING Red: ERROR</p>
4	<p>CONTROL, LED indicator Green LED illuminates in front of the related label for the operating state: VOLTAGE: Voltage control CURRENT: Current control POWER: Power control</p>

Table 11 Overview of the standard controls.

4.1.2. Controls on the Human Machine Interface (option HMI)



Fig. 12 Controls for the optional HMI (or the RCU).

HMI controls (cf. Fig. 12)	
1	LC display Indication of the actual device settings and various menus
2	<JogDial> , rotary selector switch For the selection of menu items and scaling of parameters
3	<DISPLAY> , button Return to the last interactive display used
4	<ESC> , button Active on main screen and system screen
5	<MENU> , button Opens the main menu.
6	<ON/OFF> , switch ON: Green LED illuminated. On reaching the operating state the output value set is present on the device output. OFF: Green LED is off, device output is electrically isolated.
7	<REMOTE> , switch Change over as to whether the TC.GSS power supply is to be remotely controlled. Deactivated: Red LED off. HMI is ready for entries. Activated: Red LED illuminated. HMI is remotely controlled, only indicates the device state.
8	<NEXT> , button In case of two-page menus for data entry used to jump to next page.

Table 12 Controls on the HMI or RCU.
For detailed information on the usage of the HMI (or RCU) see chapter 7.3, page 132

4.2. Operating modes

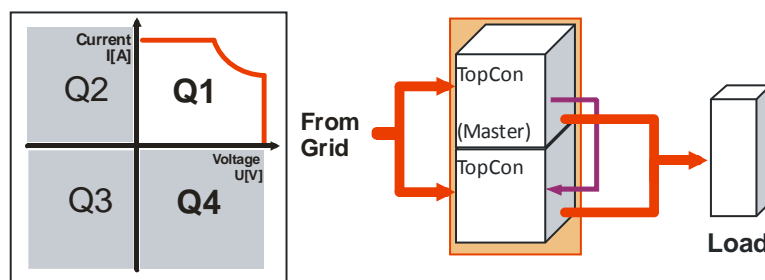
4.2.1. Feeding and regenerative operation

The digitally controlled TC.GSS power supply is a bidirectional electrical power supply that provides two operating modes in the four quadrant field. Feeding and regenerative operation.

Feeding operation (Q1):

Feeding operation is achieved via positive set values for DC current and positive DC voltage.

Q1: Feeding mode

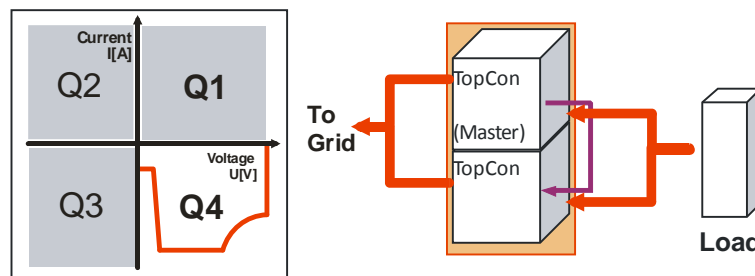


The energy flows from the electrical supply system to the item under test (load).

Regenerative operation (Q4):

Regenerative operation is achieved via a negative set value for the DC current and a positive set value for the DC voltage. Due to the negative current the power is also negative.

Q4: Regenerative mode



The energy flows from the item under test (load) to the electrical supply system.

Multi-unit system operation

If several TC.GSS power supplies are utilised in a multi-unit system, the overall system is controlled by a master device. Multi-unit operation is possible for Q1 and Q4 operation.

Operation

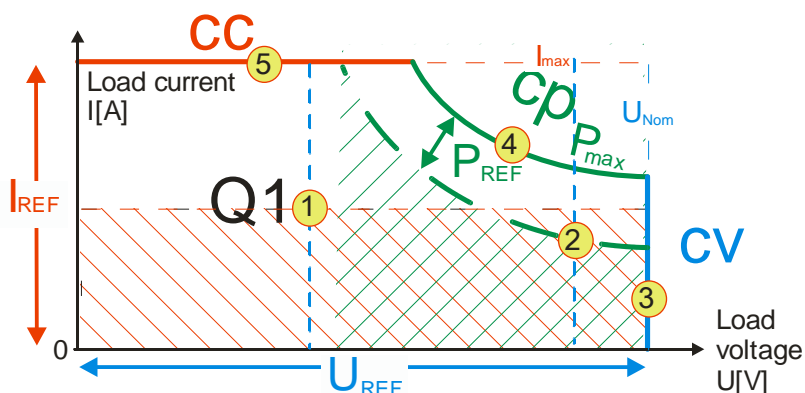
All set values can be specified either via the operating panel HMI (option), from an external PC using the TopControl application or using an analogue interface.

4.2.1.1. Q1 operation – operating states

Positive flow of current: current flows from the power supply to the load (positive current)

Set values for Q1 operation	
Voltage set value U_{REF}	Voltage reference value. Value range: $0 \dots U_{Nom}$; U_{Nom} is the device-specific limit (for continuous load).
Current set value I_{REF}	Current reference value. Value range: $0 \dots I_{Nom}$; I_{Nom} is the device-specific limit (for continuous load).
Power set value P_{REF}	Power reference value. Value range: $0 \dots P_{max}$; P_{max} is given by the power characteristics of the device.

Table 13 Set values for Q1 operation.



Controller behaviour in Q1 operation at different operating points.

The operating points are examples for different areas within the operating characteristic.

- Operating point -1-
Voltage control cv with a U_{Load} limit at U_{REF} or current control cc with an I_{Load} limit at I_{REF} .
- Operating point -2-
Voltage control cv with a U_{Load} limit at U_{REF} or power control cp with a P_{Load} limit at P_{REF} .
- Operating point -3-
Voltage control cv with a U_{Load} limit at $U_{REF}=U_{Nom}$.
- Operating point -4-
Power control cp with a P_{Load} limit at $P_{REF}=P_{max}$.
- Operating point -5-
Current control cc with an I_{Load} limit at I_{max} .

4.2.1.2. Q4 operation operating states

Negative flow of current: current flows from the load to the power supply

Set values for Q4 operation	
Voltage set value U_{REF}	Voltage reference value. Value range: $0 \dots U_{Nom}$; U_{Nom} is the device-specific limit.
Current set value $I_{LimitQ4}$	Current reference value. Value range: $-I_{max} \dots 0$; I_{max} is the device-specific limit.
Power set value $P_{LimitQ4}$	Power reference value. Value range: $-P_{max} \dots 0$; P_{max} is given by the power characteristics of the device.

Table 14 Set values for Q4 operation.

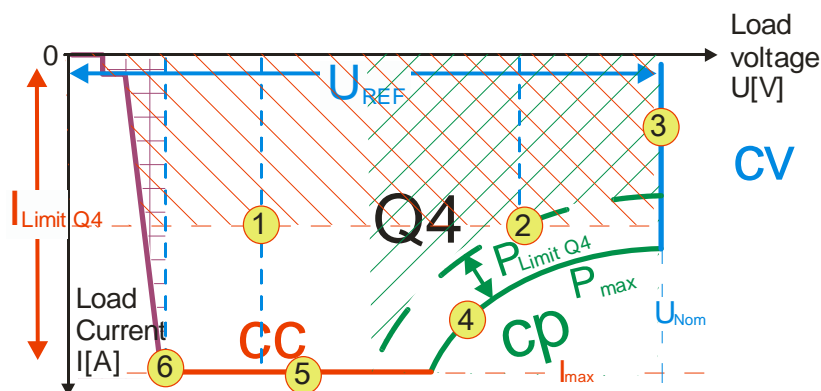


Fig. 13

Controller behaviour in Q4 operation at different operating points.

The operating points are examples for different areas within the operating characteristic.

- Operating point -1-:
Voltage control cv with a U_{Load} limit at U_{REF} or current control cc with an I_{Load} limit at $I_{LimitQ4}$.
- Operating point -2-:
Voltage control cv with a U_{Load} limit at U_{REF} or power control cp, from P_{Load} to $P_{LimitQ4}$.
- Operating point -3-:
Voltage control cv with a U_{Load} limit at $U_{REF}=U_{Nom}$.
- Operating point -4-:
Power control cp, from P_{Load} to $P_{LimitQ4}=P_{max}$.
- Operating point -5-:
Current control cc with an I_{Load} limit at $I_{LimitQ4}=I_{max}$

- Operating point **-6-**:
Current or voltage control.
In the area of operating point -6- the load current is reduced within the device at low load voltages U_{Load} .

Dynamic consideration of the control error at the set value limit

Decision as to which control is used.

There are 3 control types in the power supply:

- Voltage control
- Current control
- Power control

Which control is used is explained in the following sketch of the principle of operation.

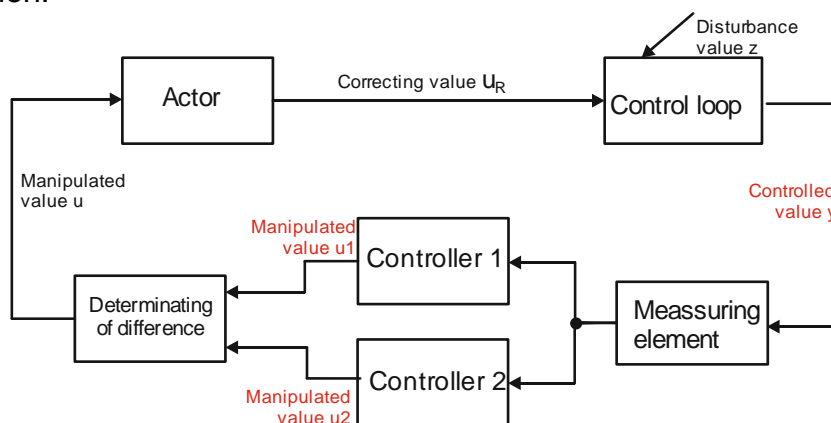


Fig. 14 Control principle – example with 2 controllers and their manipulated value u

The decision in limit cases as to which controller defines the manipulated value u is decided via the magnitude of the manipulated value u.

- If the difference between the manipulated value u and the controlled value y $|u_1 - y| > |u_2 - y|$ □ control is via controller 2.
- If the difference between the manipulated value u and the controlled value y $|u_1 - y| < |u_2 - y|$ □ control is via controller 1.

The following cases are defined by the properties of the load connected and the operating mode:

- **Actual value \leq reference value:**
Depending on which control difference is smaller the following occurs:
Voltage control cv with a U_{Load} limit at U_{REF} or
current control cc with an I_{Load} limit at I_{REF} or
power control cp with a P_{Load} limit at P_{REF}
- **Actual value $>$ reference value:**
The control does not allow the reference value to be exceeded. For example, the voltage control attempts to maintain $U_{Load} = U_{REF}$. During this process the load current I_{Load} can also be negative until the current limit $I_{LimitQ4} = -I_{max}$ or the power limit $P_{LimitQ4} = -P_{max}$ is reached. □ Change from Q1 to Q4 operation.

Q4 operation: example case for load voltage U_L with reactive loads:

At $I_L = I_{LimitQ4}$, the current control starts to limit, during this process U_L increases.

- If $U_L \leq U_{Nom}$ the current control cc remains with $I_{LimitQ4}$ as the limit.
- If $U_L > U_{Nom}$ voltage control cv with the device safety limit $U_{max} = 1.1 * U_{Nom}$.
If U_{max} is reached, the device switches off for safety reasons.

4.2.2. Setting operating states

4.2.2.1. Setting the set values via the TopControl application



For further information on the usage of the software, see software manual chapter 7.2.5, page 131

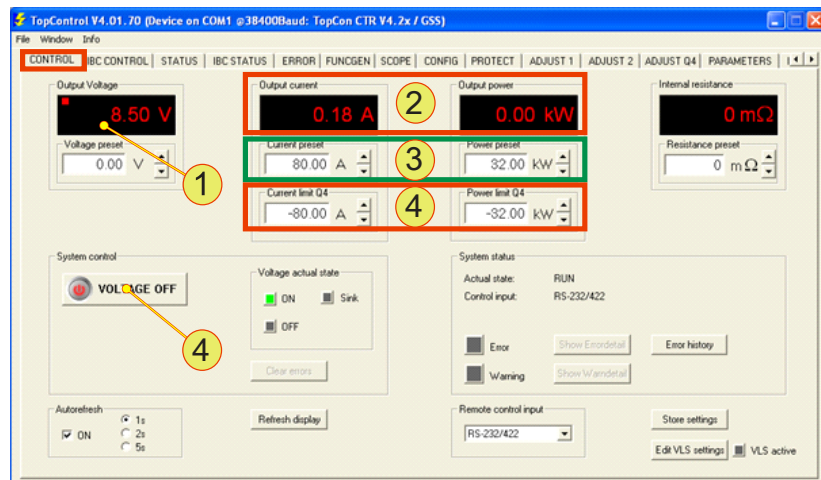


Fig. 15 <CONTROL> tab - TopControl application window

Procedure

- Set the required voltage -1-.
- Set the required set values for current and power -1-.
“+” sign = Q1 operation; “-” sign = Q4 operation
- For Q4 operation set the current set value ILimitQ4 and the power set value PLimitQ4 -4-.
- Start the flow of energy between the AC side and DC side using <VOLTAGE ON>.

4.2.2.2. Setting set values via HMI



For further information on the operation of the HMI see chapter 7.3, page 132.



The specification of the parameters using the HMI is only fully suitable for Q1 operation.

For Q4 operation it is only possible to specify set values for the current, voltage and power, but not for the limit values.



Fig. 16 Output settings display - HMI window

Procedure for Q1/Q4 operation

- Set the required voltage **-1-**.
- Set the required set values for current and power **-2-**.
“+” sign = Q1 operation; “-” sign = Q4 operation
- For Q1 operation set the corresponding limit values for the power **-3-**.
- Start the flow of energy from the AC side to the DC side using the <ON/OFF> switch on the HMI panel.

4.2.2.3. Setting set values via the analogue interface X105



For further information on the operation of the device via the analogue interface X105 see chapter 7.2, page 127.

4.3. Single device operation – special aspects

4.3.1. Sense connection

To compensate for the voltage drop over the load cables, TopCon power supplies have a “Sense” connection feature.

The voltage can be measured directly at the test specimen and controlled more accurately.

If this sense function is not required, the connection is simply left unconnected.



Modifications and restrictions apply for multi-unit systems. First read this section to become familiar with the principle. You will find a further description on the usage of the function in multi-unit systems in the chapter on multi-unit systems.

(See chapter 4.4.2.1, Seite 57).

Characteristics of the sense function

On the usage of the sense function the following characteristics apply to the overall system:

- The controller compensates for losses that result in particular due to high load currents and high cable resistances.
- The load cable may be interrupted in operation.
- The maximum voltage compensation is adjustable.
- The voltage difference between device output and sense sensor can be monitored

TopControl: Voltage sensing - Error level.

The device will shut down with an error message if the limit is exceeded.

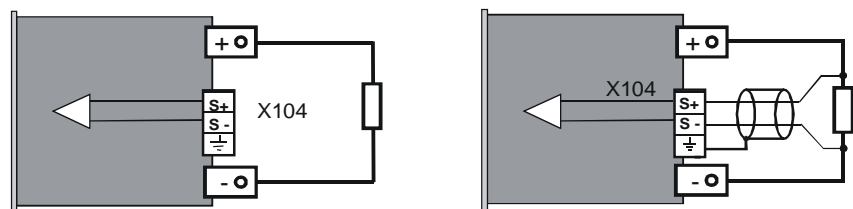


Fig. 17 Connection of load without/with sense functionality.

Connection cables

On selecting a sense cable you must take into account the following:

- **Cable cross-section: 0.5 mm², per cable**
Single cables are mostly adequate.
- **Cable resistance: can be ignored**
Only a low current flows through the sense cable.
(OP-Amp input)
- **Voltage class**
The sense cable must correspond to the voltage class of the device. (In particular from 800 V output voltage, as many cables are not approved for 800 V).
- **EMI shielding/coupling of interference**
Use shielded cables to prevent the coupling of electrical interference onto the sense input.



Increase the interference immunity by means of simple measures:

- Simply twist the sense cables.
- Lay the sense cables physically separate from power cables.

Software requirements

The following conditions must be met for the sense function to be supported and so that it can be activated.

- Main DSP firmware: **from V4.11.33**
- TopControl application: **from V4.01.12**
- User rights for the activation of the sense function in the TopControl application: **“Advanced User”** see software manual chapter 7.2.5, page 131
- Connection must be established between TopCon TC.GSS power supply and TopControl application, see software manual chapter 7.2.5, page 131
- **State: “VOLTAGE_OFF”**
The sense function can only be activated if there is no voltage present on activation.



Sense activation/deactivation in the TopControl application

The sense function can be found on the <CONFIG> -1- tab, and the parameters defined in the “Voltage sensing” -2- group.

The entire function is activated/deactivated via the “Use sense input” -3- check box.



For information on the significance of the parameters see software manual chapter 7.2.5, page 131.

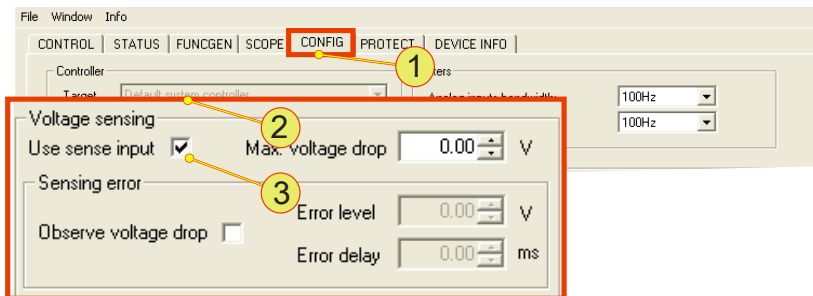


Fig. 18 Configuration of the sense function in TopControl.

Sense actual value indication

On the activation of the sense function, the following indications alternate:

- <CONTROL> tab
The labels “Output Voltage” -1- and “Output Power” -1- change to “Sense Voltage” -2- and “Sense Power” -2-

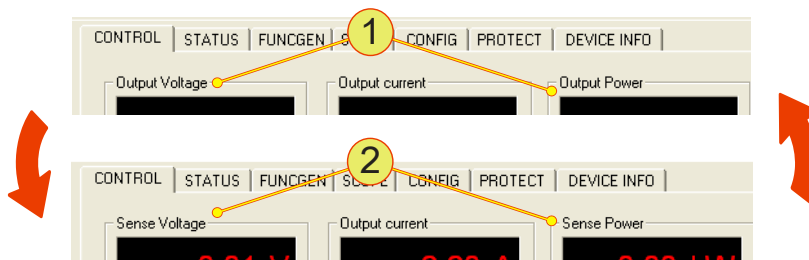


Fig. 19 Indication change between output voltage and sense voltage.

- <STATUS> -3- tab
Along with the indication of the output values -1- the sense actual values -2- are also displayed.

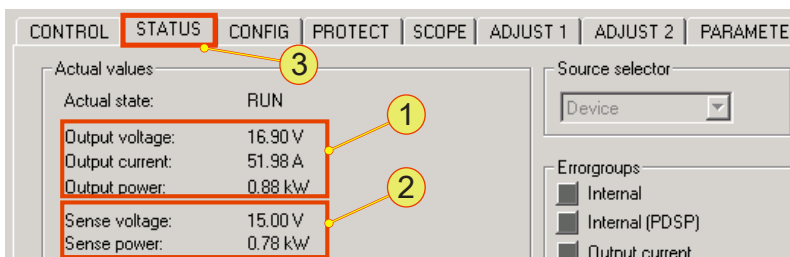


Fig. 20 Indication of the output values.

Sense configuration

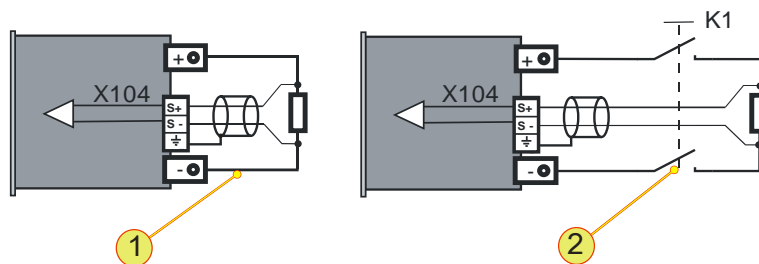


Fig. 21 Connection of load with sense function, not switched -1- or switched -2-.

The sense cables are connected directly across the load. Here it is allowed to install a switch (contactor) -2- in the load circuit. The maximum output voltage U_{out} can be configured via the software. The output voltage can be limited via the value configured.



For further information on the significance of the parameters, see software manual chapter 7.2.5, page 131

Output of the sense voltage via the analogue interface X105

With the sense function activated, the analogue sense voltage actual value can be used for the indication via the analogue interface X105.



For further information on the pin definition of X105 see chapter 10.1.4.6, page 188.

Sense function indication change

- On the <CONTROL> tab**
 If the corresponding sense actual values cannot be achieved, the sense indication (voltage or power) changes from red (normal state) -1- to yellow -2-.



Fig. 22 Indication of the sense actual values. Example voltage value in normal state -1- and actual value is not reached -2-.

- On the front panel**
 The related LED on the front panel of the TopCon TC.GSS power supply starts to flash.



Fig. 23 Flashing LED with the sense function VOLTAGE LED -1- , POWER LED -2-

The following cases will produce an indication change:

- Max voltage drop**
 The value set on the <CONFIG> tab <Max voltage drop> is insufficient to compensate for the voltage drop over the load cable.
- The required sense voltage is not reached**
 The maximum module voltage allowed is insufficient to achieve the required sense voltage.
- The required sense power is not reached**
 The maximum module power allowed is insufficient to achieve the required sense power.

4.3.2. CAN communication (X101/102)

TopCon power supplies that are operated in a multi-unit system require system-internal communication via the related interfaces X101/X102.

The tasks of the individual TopCon power supplies and their peripheral modules, e.g. RCUs and series controllers are controlled via the CAN communication. At the same time the CAN communication is used for communication between the system master and the slaves assigned.

The interfaces X101 and X102 have the following tasks:

- CAN interface, for the communication
- Interlock connection



The related interface must always be “terminated”, i.e. fitted with the related dummy plugs or a bus connection.

4.3.2.1. Assignment of interface and dummy plug

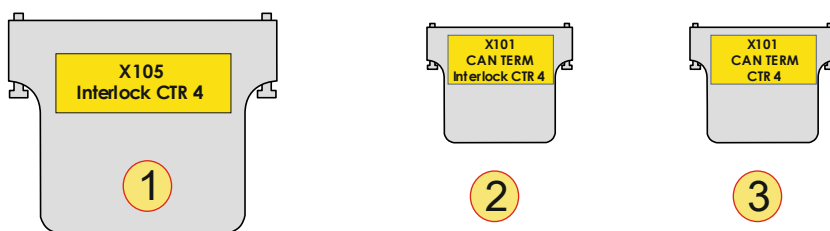


Fig. 24 Schematic illustration of the D-Sub dummy plugs used with their labelling.

Dummy plug	
1	Interlock connector, D-Sub, 25-pin (dummy plug) Label: “X105; Interlock CTR 4” Is connected on the rear side of all devices to interface X105.
2	Interlock or CAN-Term, D-Sub, 9-pin (dummy plug) Label: “X101; CAN TERM; Interlock CTR 4” Is connected to interface X101 on the rear side of the device at the start of the CAN multi-unit system.
3	CAN-Term, D-Sub, 9-pin (dummy plug) Label: “X101; CAN TERM;” Is connected to interface X102 on the rear side of the device at the end of the CAN multi-unit system.

Table 15 Dummy plugs and their labelling.



Only one CAN-Term is allowed to be connected to a single device. Independent of whether X101 or X102 is used.

4.3.2.2. Establishment of communication connection
TopCon with/without HMI and RCU

In the following the configuration of a TopCon power supply and its peripheral devices is considered.

With the possible combinations of HMI and RCU, there are 4 standard configurations for a TopCon power supply.



For further information on multi-unit systems with at least 2 or more TopCon TC.GSS power supplies, see from chapter 4.4.3, page 58.

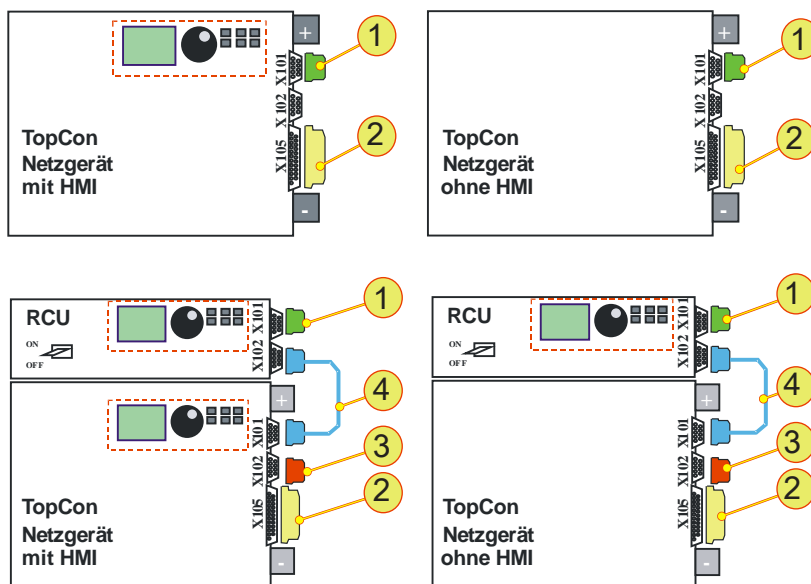


Fig. 25 Circuit diagram for TopCon with HMI (left) and without HMI (right).

No.	Function	Dummy plug used	Device	Interface
1	“Interlock” + “CAN TERM”	Dummy plug X101	TopCon RCU	X101
2	“Interlock”	Dummy plug X105	TopCon	X105
3	“CAN TERM”	Dummy plug X102	TopCon	X102
4	“CAN CABLE”	---	TopCon RCU	X101/ X102

Table 16 Allocation of components to chapter 4.3.2.1, page 42.

4.3.3. Interlock output inhibit

TopCon TC.GSS power supplies have a feature for rapidly inhibiting the output using an interlock signal.

All external EMERGENCY STOP contacts must close the interlock circuit for operation to be possible.

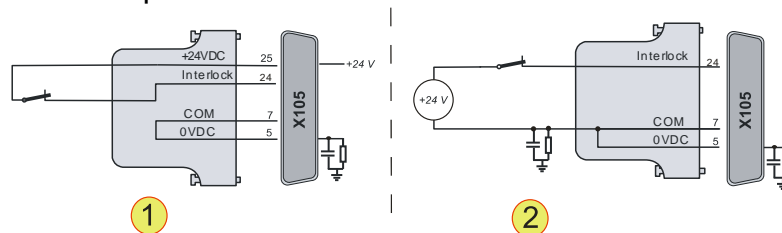


Fig. 26 Example interlock circuit on the interface X105.
 -1- External EMERGENCY STOP button with internal voltage source.
 -2- External EMERGENCY STOP switch with external voltage source.

With interrupted interlock circuit

- The power stage is switched off directly via a hardware link.
- The controller remains switched on.
- The device changes to the state: “Error”.



To work using the TC.GSS power supply (or a system with TopCon modules), check that the interlock circuit is actually closed.



Ensure that the correct dummy plug has been used for the termination of the interface X101.



For further information see chapter 4.3.2.1, page 42.



The description of the interlock circuit for multi-unit systems is different due to the utilisation of the interface X102 for the different devices in the system. For further information see Fig. 31, Seite 59.

4.3.4. Interlock circuit with X101 and X105

Ring structure of the interlock circuit

The interlock circuit makes it possible to setup a safety infrastructure. The basis for the function is an electrical ring structure that must be closed for operation.

Safety elements **-2-** (e.g. EMERGENCY STOP buttons) can interrupt the ring and as a result switch off the TopCon power supply.

For higher safety requirements, e.g. safety class 1, the option: ISR (Integrated Safety Relay) is available.

For further information see chapter 5.2.2, on page 76.

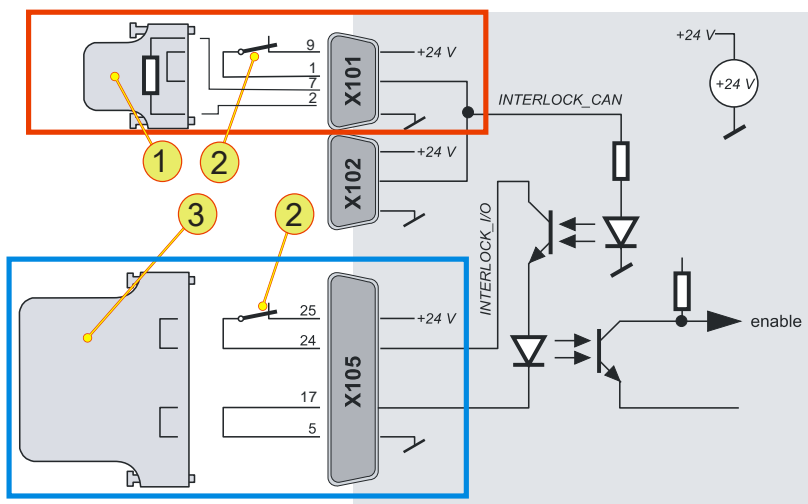


Fig. 27 Explanation of function of interlock circuit for single device.

Connection of the interlock circuit	
1	Dummy plug X101 Safety circuit is closed using a jumper. Terminating resistor for the CAN bus
2	External EMERGENCY STOP button
3	Dummy plug X105 Safety circuit is closed using a jumper.

Table 17 Connection of the interlock circuit

Interfaces used for the interlock circuit

- **X101/X102**

Suitable for external **EMERGENCY STOP button**.

In multi-unit systems the interlock circuit is interrupted immediately on the operation of an EMERGENCY STOP. All devices in the multi-unit system are shut down simultaneously.

- **X105**

Suitable for an external **EMERGENCY STOP button on a single device**. The interlock contact is interrupted on the local single device.

In the multi-unit system the shutdown signal is only passed on via the internal device communication with a delay.

To be able to place a TopCon power supply in operation, these interfaces must be connected appropriately.



Use dummy plugs supplied!

In the simplest configuration corresponding dummy plugs must be fitted to the two interfaces X101 and X105.

4.3.5. Disconnecting discharge resistors - X109

TOPCON power supplies have a multi-level concept to minimize the EMI - effects. One of these measures is the capacitive bleeding of interference frequencies by means of so-called Y-capacitors. The Y-capacitors are connecting the corresponding DC output bars with PE (protective earth).

The Y-capacitors shunt out the interference signals effectively, which produced by the internal switching, while they are isolating the DC voltage. A side effect of this circuit is, that the DC voltage, which is present between the DC bars and PE is maintained for long time when the device is switched off (VOLTAGE OFF).

Although the capacitors are of small capacitance, unintentional contact could cause an unpleasing electrical shock or sensitive measuring devices could be damaged.

With the built-in discharging resistor the Y-capacitors can be discharged, but in some applications such resistor are not permitted.

The new interface X109 allows to discharge the internal Y-capacitors of the DC terminals via an external jumper bridge.

The external jumper is inserted

The Y-capacitors will be discharged against earth via the discharging resistor.

The external jumper is not inserted

Any possible existing charge of the Y-capacitors will not be discharged against earth and will stay on a free floating potential.

Device leakage capacitance

The internal Y-capacitors are located at the secondary side in the DC output filter. They are placed between positive output and earth and between negative output and earth.

The capacity of the internal Y-capacitors are: 13.6 nF.

Internal discharging resistor

The discharging resistor is located at the secondary side in the DC output filter. It is placed at the DC output.

The resistor value is: 10.8 MΩ.

Function description

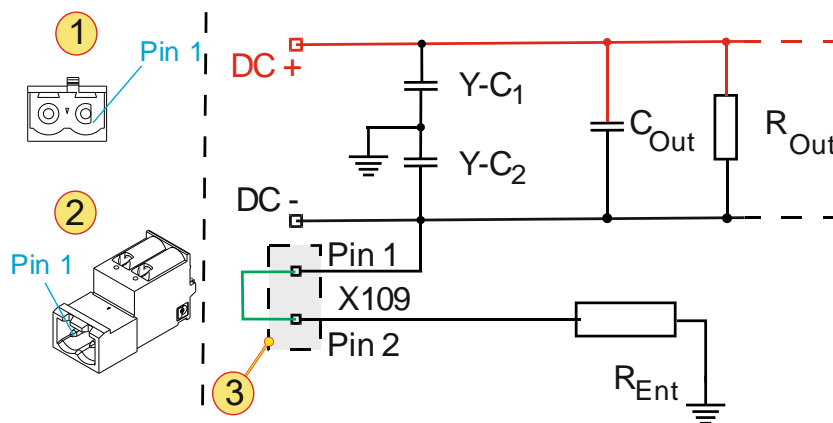


Fig. 1 Schema of a device.
 -1- Interface of the device.
 -2- External plug with the contained bridge.
 -3- Connection of the interface X109 with the inserted bridge (green).

Pay attention in multi-unit mode

A jumper is inserted

In case that is wanted to discharge the Y-capacitors Y-C₁ and Y-C₂ via the device internal discharging resistor, it is necessary to have inserted one jumper at minimum in the multi-unit system.

Several jumpers are inserted in a multi-unit system

It is possible to insert several jumper in a multi-unit system.

Possible multi-unit modes:

- Devices in parallel
- Devices in serial
- Devices in matrix connection



Pay attention that according to the multi-unit mode the values of the total capacity and the value of the total resistance may change.

4.3.6. Internal system status and troubleshooting

This section explains the internal control processes. It will help you to better understand the system messages, in particular warnings and error messages provided by the device in various ways.

4.3.6.1. Monitoring device-internal processes

The internal processes are monitored using a state machine. For the correct starting and during the operation of the device, the state machine works through the following tasks:

- The device self-test is started.
- The charging of the intermediate circuit is monitored.
- It reacts to user commands.
- Warning and error flags are polled and the resulting state changes are made.

Device states

As a consequence there exist different device states:

State	Description
ST_POWERUP	Initialisation phase, CAN login, all modules asynchronous
ST_READY	All modules ready, output electrically isolated, fans off ¹
ST_RUN	Output live, controlled to set values, fans on
ST_WARN	As for ST_RUN, at least one warning flag set
ST_ERROR	Error in at least one module, output electrically isolated, fans off ¹
ST_STOP	Stop state for software update
FATAL_ERROR	Internal communication failed

Table 18 Internal system states.

¹Depending on the temperature, the fans may continue to operate at reduced speed.

The device state is output to the exterior on the following interfaces:

- Device and control/LEDs (light emitting diode on the front panel)
Green: POWER
Yellow: STATUS
Red: ERROR

For information on the control console see chapter 4.1, page 28.

- Digital outputs

The relay contacts are operated in a corresponding manner and permit the connection of external status indications.

For further information see chapter 4.3.6.3, page 52.



4.3.6.2. Indications on DEVICE and CONTROL LEDs

State of the device	DEVICE and CONTROL LEDs on the front of the device			
	“READY”	“STATUS”	“ERROR”	“CV”, “CC” and “CP”
Power UP	OFF	ON	OFF	OFF
STOP	ON	ON	OFF	OFF
READY	ON	FLASHING ³⁾	OFF	OFF
RUN	ON ¹⁾	OFF	OFF	ON ²⁾
warn	ON ¹⁾	FLASHING ³⁾	OFF	ON ²⁾
Error	ON	OFF ⁴⁾	FLASHING ₃₎	OFF
FATAL ERROR ⁵⁾	FLASHING ⁵⁾	FLASHING ⁵⁾	FLASHING ⁵⁾	OFF

Table 19 Indication of the system status via LED indication (front).

¹ Flashing, if a discharge device is active.² One of the three LEDs, as per the actual control mode.³ Flashing code as per the error table or warning table (see chapter on troubleshooting).⁴ Flashing, if a warning is active at the same time.⁵ The three LEDs are flashing together: internal communication failed.**Description of the shutdown process**

Changing the position of the main switch does not shut down the TC.GSS power supply immediately, instead a shutdown process is initiated. In particular, the discharge of the internal capacitors takes a certain amount of time during which the device is still live internally and to some extent the outputs are still live.

As long as the shutdown process is running:

- The three DEVICE LEDs form a running light.
- The HMI display indicates “shutting down...”

For this reason it imperative to wait until this process is complete before undertaking further tasks on the device.

On devices with 10 and 16 kW the shutdown process is so fast that there is no indication and no delays.

4.3.6.3. Indications via digital outputs (relays)

The internal system status of the TC.GSS power supply is output to the exterior via the relay connections. External signalling devices or a superior system controller that monitors several devices can be connected via the relays. The device state can then be evaluated.

State	RELAY 1	RELAY 2	RELAY 3
	“OK/ALARM”	“RUN”	“WARN”
Power UP	OPEN	OPEN	OPEN
STOP	OPEN	OPEN	OPEN
READY	CLOSED	OPEN	OPEN/CLOSED ¹
RUN	CLOSED	CLOSED	OPEN
warn	CLOSED	CLOSED	CLOSED
Error	OPEN	OPEN	OPEN/CLOSED ¹
FATAL ERROR	OPEN	OPEN	CLOSED

Table 20 Indication of the system status using relays (interface X105).

¹ Closed if there is a warning, otherwise open.

4.3.6.4. Monitoring function - current monitoring concept

The current limiting is intended on the one hand to protect the device (above all the semiconductors) against damage, on the other hand certain monitoring functions can also be used to protect the load connected.

Monitoring	Protection in case of	Implementation	Time range
Short-circuit monitoring by IGBT driver	Transformer saturation, hardware faulty	Hardware level fixed	3 μ s – 6 μ s
Monitoring of I_{Primary}	Transformer saturation	Hardware	10 μ s – 50 μ s
Monitoring of $I_{\text{Secondary}}$	High load current peaks (electrical power supply or load protection)	Software	50 μ s – 10 ms
I^2t algorithm $I_{\text{Secondary}}$	Temporary overload (electrical power supply or load protection), “fuse substitute”	Software	10 ms – as req. ¹
Current limiting by the controller	Output current too high (load protection)	Software	1 ms – ∞

Table 21 Properties of the internal monitoring functions in the TopCon.

¹ The maximum value is defined by the specific I^2t value

4.3.6.5. **Causes of errors**

There are various reasons for undesired, possibly erroneous system states:

- Faulty component
- System limits are reached or exceeded.
- Application error by the user
E.g. selected limits exceeded.

4.3.6.6. **Division into group and detail errors (warnings)**

To be able to troubleshoot errors as quickly and accurately as possible, the possible errors and warnings are divided into 16 group errors. Each of these group errors is in turn broken down into 16 detail errors. The list of all errors and possible rectification measures is given in the manual error list.

The **group errors, detail errors and warnings** are output as follows:

- **Direct indication via TopControl or HMI/RCU**
- **LED flashing codes on the front of the device**
Group and detail errors are indicated sequentially as flashing codes on the red “ERROR” light emitting diode on the front of the device.
Warnings are indicated via the yellow “STATUS” light emitting diode on the front panel.
Output in the form of flashing codes is important in multi-unit systems, as in this case as a rule only one TC.GSS power supply has a HMI user interface. However, all TC.GSS power supplies have the LED indicator.
- **Output via digital outputs (relays)**
For further information see chapter 4.3.6.3, Seite 52.



4.3.6.7. **Error and warning indication on the front panel LEDs**

The number of flashes indicates the possible reasons for the malfunction (group error and detail error). The complete flashing code comprises the following: <Flashes for group error><Pause in flashing><Flashes for detail error>

The following illustration shows a period in the indication cycle.

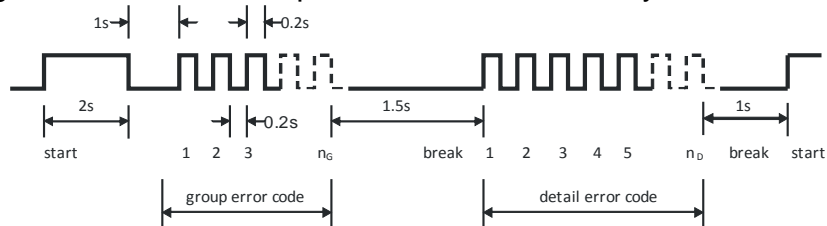


Fig. 28 Structure of the flashing code for error/warning indication via LED.

Flashing code sequence with errors or warnings

5. Error codes and warning codes are identical.
All errors and warnings are output one after the other based on the scheme in Fig. 28, Seite 53.
6. After the output of the last error or warning the flashing sequence starts again with the first error or first warning.

Practical example

After switching on the TopCon Quadro power supply and setting the set values, the device is activated (On/Off). The buzzer comes on and an error code is indicated via the light emitting diodes:

Count the flashes:

- Group error code = 16,
- Detail error code = 3.

Reference to the error code list shows that an interlock error has been detected (F-2).



Note that the error coding is in hexadecimal. $F_{Hex} = 15_{10}$, 3 is the third element in 0, 1, 2, 3....

The indication on the HMI or in TopControl is: 0... 15 or 0 ... F_{Hex} . The flashing code on the "ERROR" LED does not have a zero and therefore assumes the counting order 1...16. 0 signifies a pause in the flashing.

4.3.6.8. Acknowledging an error

After the occurrence of an error, the device remains in the ERROR state until the reason for the error has been rectified (as per error list) and the error has been acknowledged.

It is possible to acknowledge an error via the following interfaces:

- HMI
Using the **<ESC>** button on the front of the device
- TopControl
Using the **<Clear error>** button on the **<CONTROL>** tab
- Analogue interface X105
Positive edge on pin 8 with 10-24 V relative to ground

4.4. Multi-unit system

4.4.1. Introduction

Due to the fully digital control of the TC.GSS power supplies, all control signals are exchanged between the devices within a multi-unit system without losses.

Multi-unit system

A multi-unit system can only be made up of TC.GSS power supplies of the same type (model number).

The devices can be connected together in the following operating modes:

- **Serial**
To increase the output voltage, the outputs of all devices are connected **in series**.
- **Parallel**
To increase the output current, the outputs of all devices are connected **in parallel**.
- **Matrix**
Some of the systems are connected as a serial multi-unit system, at least two of these serial configurations are connected in parallel.
- **Multiple load**
Each device supplies **a load** and is not connected with any other device or only to one connection terminal on another device.

In principle the operating modes act on two areas:

- **Load connections**
The outputs on the TC.GSS power supplies are connected accordingly in the serial, parallel, multiple load or in the matrix multi-unit system.
The related total output value is distributed evenly over all TC.GSS power supplies in the multi-unit system.
- **Internal communication**
All devices in the multi-unit system are taken into account during internal system communication by means of device addressing. Along with the TC.GSS power supplies this aspect also covers the HMI and RCU.

System communication

The system communication in multi-unit systems is ensured by the digital exchange of data (CAN). The wiring is undertaken with individual point-point connections between the devices (modules) as well using the terminating resistors at the two physical ends of the bus structure.



A multi-unit system with max. 7 devices is recommended. Theoretically up to 64 devices can be connected to the bus. From approx. 8 devices the communication is reduced. As a result, the dynamic performance of individual devices cannot be achieved with more than 8 devices.

Here it is recommended to use the **Master Array Controller (MAC)**, for information on the realisation of larger multi-unit systems see dedicated instructions.

Device addressing

The device address comprises an upper address range (AH) and a lower address range (AL).

During the configuration of the related address range, the device type and the master-slave principle play a role, along with the type of configuration.

Master-slave principle

The set values are provided to the master device, e.g. via HMI or the PC using the TopControl application.

The master device passes on the parameters to its slaves via the internal system communication. The individual slave devices in the multi-unit system convert the set values specified into the related output values.

4.4.2. Load connection on devices in multi-unit operation

Multi-unit system supplied from the factory

The load connection is configured on multi-unit systems supplied from the factory. The minus and plus connections on the individual TC.GSS power supplies are combined to form a system load terminal. The load is connected to this load terminal.

Special aspects of the multi-unit system in relation to the interlock circuit and the sense function are taken into account.

4.4.2.1. Sense function in a multi-unit system

Configuration of the sense function



For information on the sense function and the configuration of the single device see chapter 4.3.1, Seite 37.

Serial multi-unit system

In the serial multi-unit system the sense cables are not allowed to be connected! An attempt to activate the sense function will result in an error message on the related device.

Parallel multi-unit system

The sense function can be used in a parallel multi-unit system. All devices in the multi-unit system must be connected to the sense cable connected and the sense function must be configured in the controller.

Example sense configuration in a parallel multi-unit system with two TC.GSS power supplies:

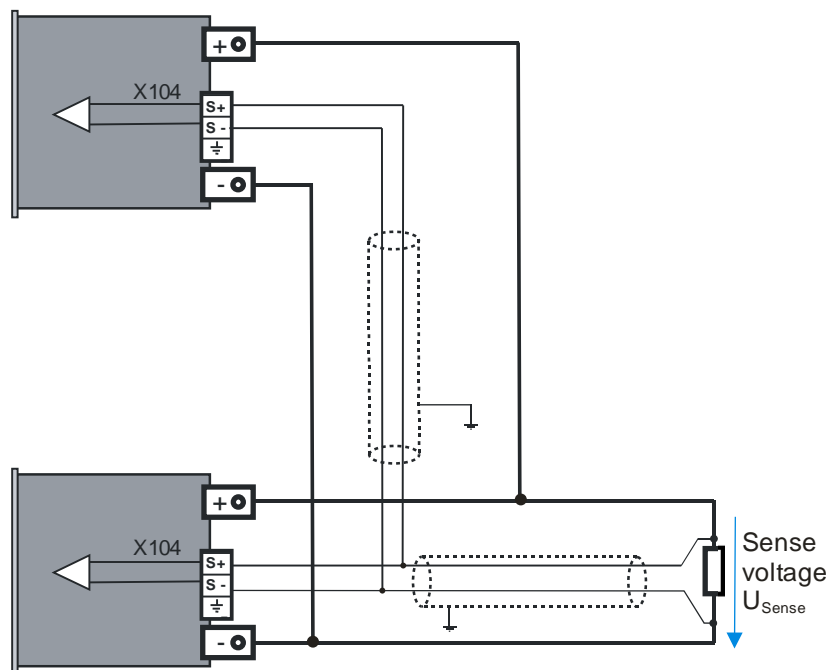


Fig. 29 Circuit diagram for load and sense cables in multi-unit operation

4.4.3. Internal system communication

4.4.3.1. Hardware required for the multi-unit system

Allocation of interface using dummy plug

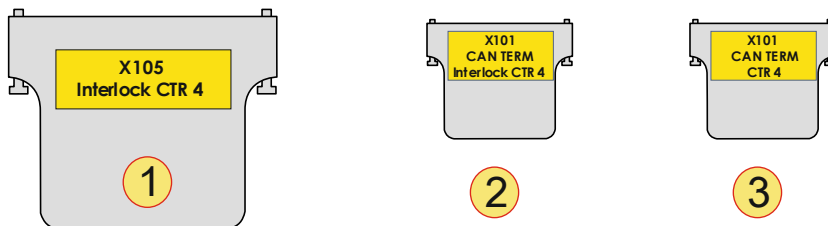


Fig. 30 Schematic illustration of the D-Sub dummy plugs used with their labelling.

Dummy plug	
1	Interlock connector, D-Sub, 25-pin (dummy plug) Label: "X105; Interlock CTR 4" Is connected on the rear side of all devices to interface X105.
2	Interlock or CAN-Term, D-Sub, 9-pin (dummy plug) Label: "X101; CAN TERM; Interlock CTR 4" Is connected to interface X101 on the rear side of the device at the start of the CAN multi-unit system.
3	CAN-Term, D-Sub, 9-pin (dummy plug) Label: "X101; CAN TERM;" Is connected to interface X102 on the rear side of the device at the end of the CAN multi-unit system.

Table 22 Dummy plugs and their labelling.

For a wiring diagram for multiple power supplies see Fig. 31, Seite 59.

4.4.3.2. Interlock circuit in a multi-unit system

If the interlock circuit is used in a multi-unit system, there are changes compared to operation using an individual power supply. The principles of function and usage with a single device are described in the interlock circuit chapter 4.3.4, page 45 and interlock output inhibit chapter 4.3.3, Seite 44.



So that a multi-unit system can also be operated with a single interlock contact, the interlock circuit for all devices in the system must be supplied from a 24 V auxiliary supply (any device).



Note that the dummy plugs for the interfaces X101/X102 have similar cases, however internally the interlock wiring is different and therefore a differentiation must be made!

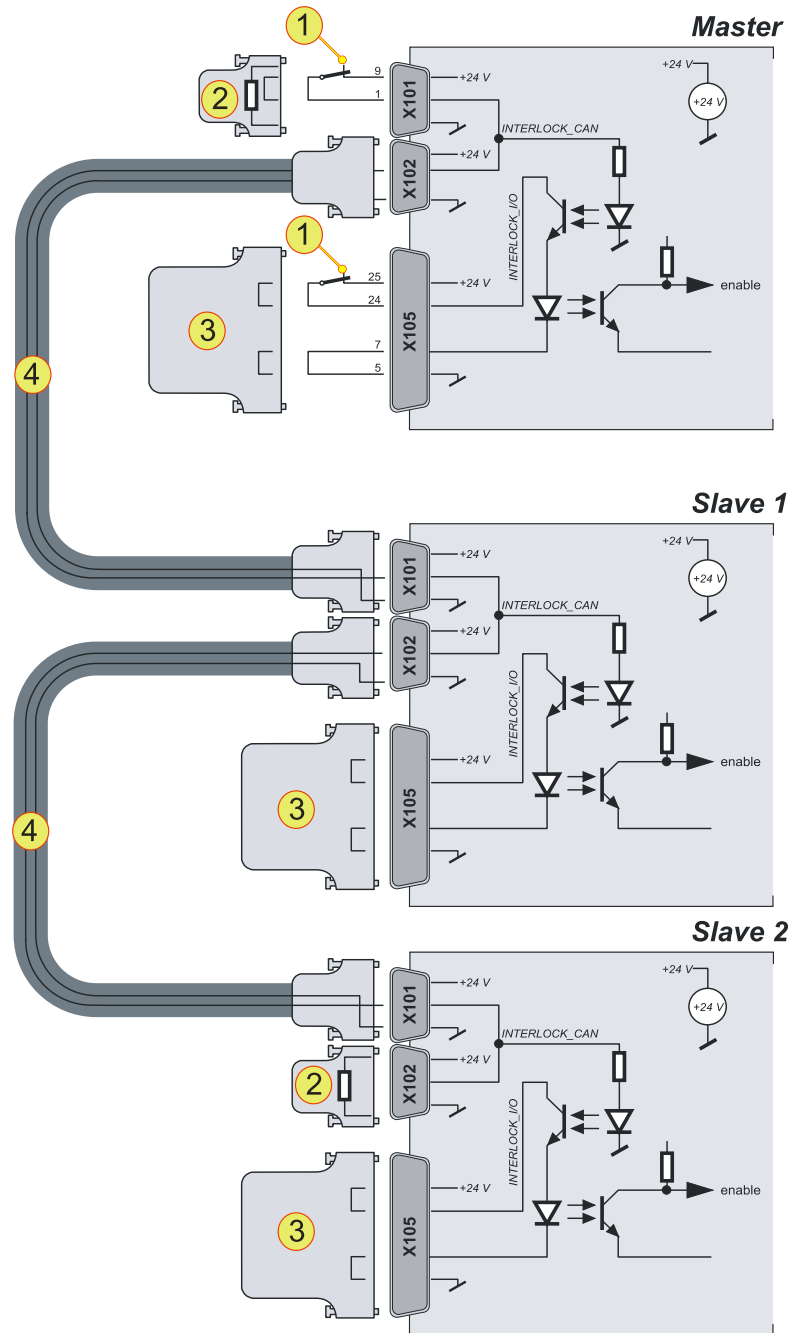


Fig. 31 Interlock connection scheme for TC.GSS power supplies via the CAN cable and the related dummy plugs.

Interlock modules in accordance with Fig. 31	
1	External EMERGENCY STOP button that can interrupt the interlock circuit.
2	Dummy plug "X101; CAN TERM; Interlock CTR 4" Is connected to interface X101 on the rear side so that the interlock circuit is not interrupted. (If there is no circuit -1-). Dummy plug: "X101 CAN TERM" Is connected to interface X102 on the rear side of the last device in the multi-unit system (if there is no circuit).
3	Dummy plug "X105; Interlock CTR 4" Is connected to interface X105 on the rear side so that the interlock circuit is not interrupted.
4	CAN cable connects interface X102 on the first device to the interface X101 on the following device.

Table 23 Connection of dummy plugs to the related interfaces in the multi-unit system.

4.4.3.3. Multi-unit system with TopCon power supplies

Master-slave principle on power supplies in the multi-unit system

The set values are provided to the master device, e.g. via HMI or the PC using the TopControl application.

The master device passes on the parameters to its slaves via the internal system communication. The individual slave devices in the multi-unit system convert the set values specified into the related output values.

Limits of a multi-unit system

- Only one master is allowed per multi-unit system.
- Per multi-unit system at full bandwidth maximum number of devices: 7
(From 8 devices, the bandwidth can be reduced)
Devices such as HMI or RCU also count in a multi-unit system.
- A device address is only allowed to occur once in the multi-unit system.
- Several multi-unit systems can be connected via a Master Array Controller (MAC) to form a large multi-unit system.

Display of the operating parameters for individual devices

The most important operating parameters are sent continuously by the slave devices to the master and can be displayed there, e. g., using the TopControl application.

Errors in the multi-unit system

Control of the state information in the multi-unit system:

- Slave devices follow the state of the master device.
- Each single device (module) can independently enter the “WARN” or “ERROR” state and trigger the entire system to change to this state.
- Acknowledging an error will affect the entire system.

Addressing of master and slave devices

The addresses of multi-unit system devices comprise an upper address range (AH) and lower address range (AL).

The device is defined as a master or slave device depending on the value used for the address.

- **Master device**
AL: 0; AH: 0
- **Slave device**
The value for the address is always > 0 , whether in the AL or AH address range.

Addressing on power supplies in the multi-unit system

Whether the issue is a single device or a multi-unit system of TopCon, the device addresses are used to allocate the TopCon to its logical position in the multi-unit system

The device address comprises an upper address range (AH) and a lower address range (AL).

During the configuration of the related address range, the device type and the master-slave principle play a role, along with the type of configuration.

Configuration of the addresses via the rotary switch

The device address is configured via the rotary switches. Default values are AH: 0; AL: 0



Fig. 32 Rotary switch AH -1- for the upper address range
Rotary switch AL -2- for the lower address range

Addressing for a parallel multi-unit system

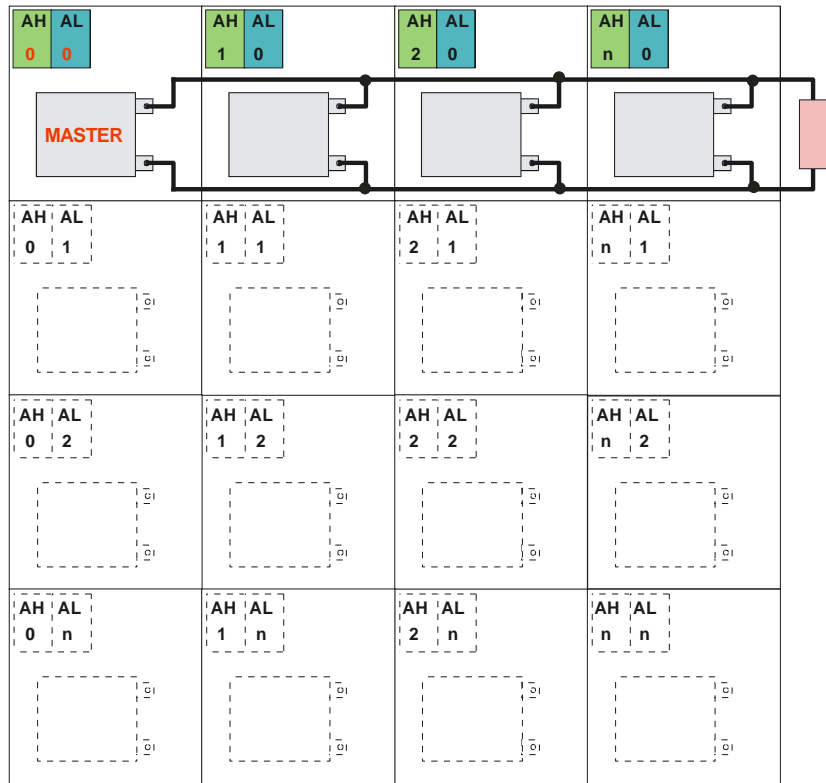


Fig. 33 Example definition for device addresses with 4 TopCon in parallel.

Addressing for a serial multi-unit system

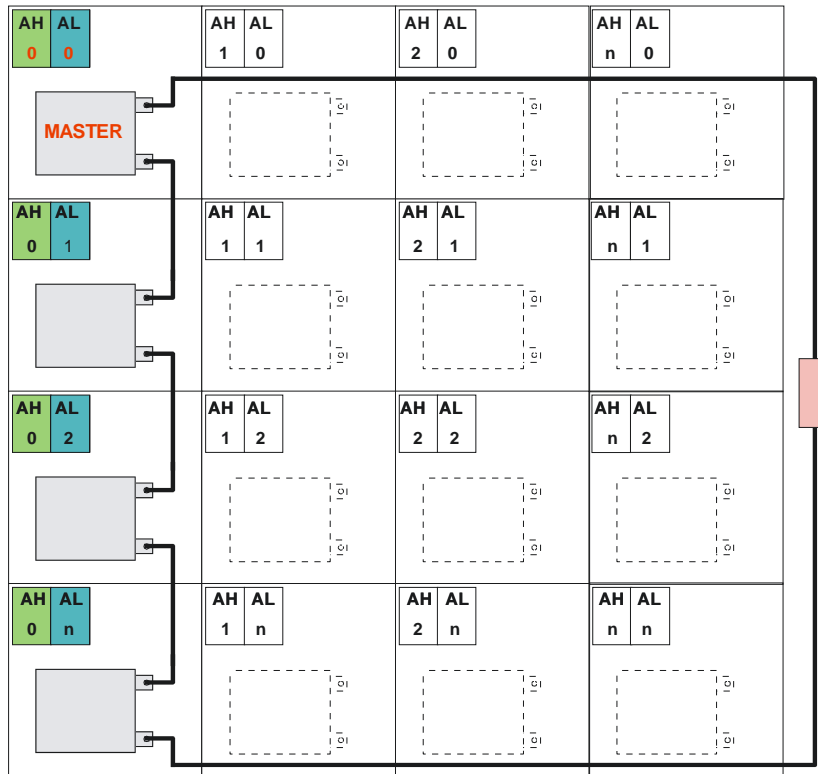


Fig. 34 Example definition for device addresses with 4 TopCon in series.

Addressing for a matrix multi-unit system

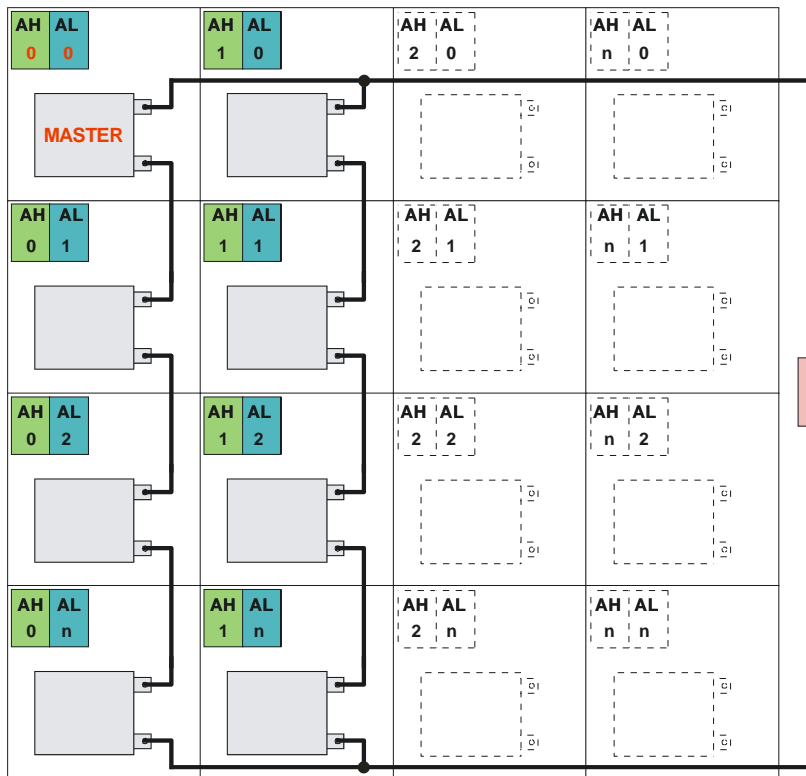


Fig. 35 Example definition for device addresses with 8 TopCon in a matrix. 2 serial strings of 4 devices each are connected in parallel.

4.4.3.4. ID addresses on several HMI/RCU (option) in a multi-unit system

The optional display and data entry devices HMI and RCU have equal priority.



HMI devices directly installed in the power supply are not necessarily responsible for the display and entry of the data for the device. In principle all HMI devices in the multi-unit system only display the overall system parameters.

Master-slave principle for HMI/RCU (option)

Using the master HMI/RCU the parameters for the overall system can be displayed and changed.

Specifications for the multi-unit system

- There can only be one master.
- Each ID number is only allowed to occur once in the multi-unit system.
- In case of a single device combination of HMI/RCU and TC.GSS power supply, HMI/RCU must be defined as the master. This definition corresponds to ID address 1.

Addressing with HMI/RCU (option) in a multi-unit system

Whether the issue is a single device or a multi-unit system of TopCons, the device addresses for HMI/RCU are used to allocate the HMI to its logical position in the multi-unit system

ID addresses

- Master HMI/RCU with ID address: 1
- Slaves with ID address: > 1
Slave 1 = 2; Slave 2 = 3; Slave 3 = 4; etc.

Configuration of ID addresses on the HMI/RCU

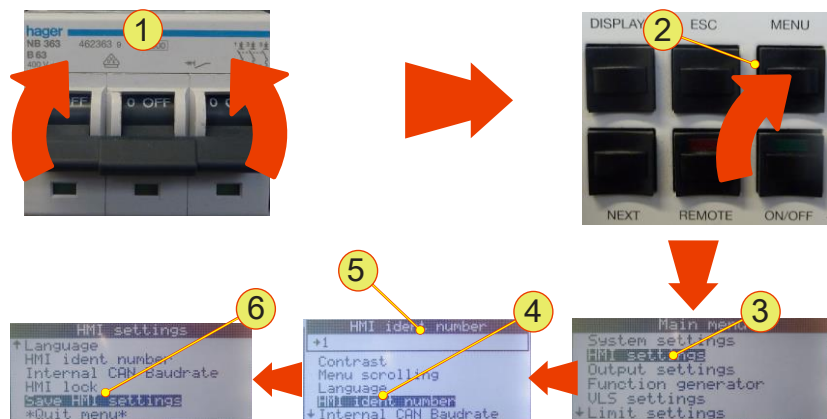


Fig. 36 Configuration of ID addresses on HMI/RCU

Opening the settings menu

- Switch on the device -1-.
- Press the <Menu> button -2-.
- Using the JogDial find the “HMI settings” -3- menu item and accept your selection by pressing the JogDial.
- Select the “HMI ident number” -4- menu item using the JogDial and accept this selection.
- Select the address ID -5-.
(Master: 1, slave: > 1)
- Save the HMI settings -6-.
- Repeat the procedure for all HMI/RCUs in the multi-unit system with sequential addressing.

4.4.3.5. Examples for multi-unit system configurations of the hardware

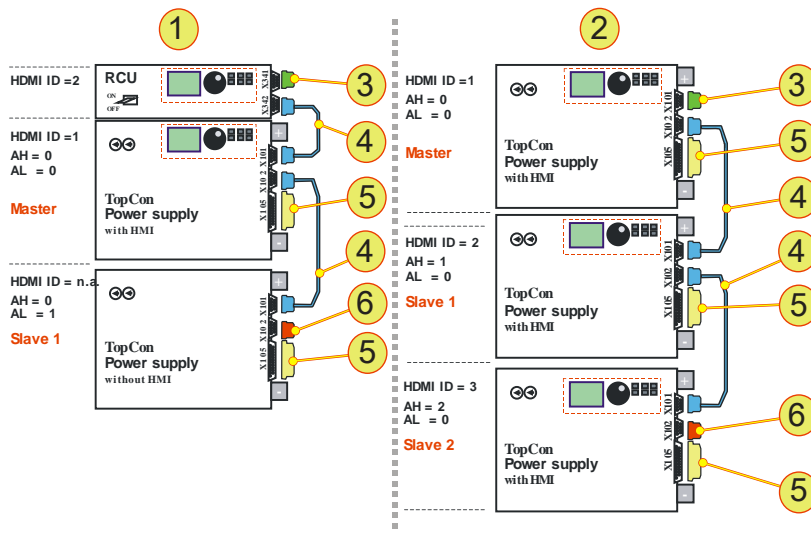


Fig. 37 Examples for systems with corresponding system communication. Master-slave configuration with address specification and hardware configuration

No	Description
1	2 TC.GSS power supplies 1 master device with HMI, 1 slave device without HMI, 1 RCU
2	3 TC.GSS power supplies 1 master device with HMI, 1 slave device 1 with HMI, 1 slave device 2 with HMI
3	Interlock with CAN-Term D-Sub, 9-pin
4	CAN cable D-Sub, 9-pin, 2 plugs
5	Interlock D-Sub, 25-pin
6	CAN-TERM D-Sub, 9-pin

Table 24 Description and position of the hardware for Fig. 37 oben

4.4.3.6. Multi-unit system and TopControl application



Only the master is configured in the multi-unit system using the TopControl application.

Necessary conditions for configuration:

- The master device in the multi-unit system must be connected to a PC on which the TopControl application is running.
- CAN connection to all devices in the multi-unit system see chapter 4.4.3.3, Seite 60.



Procedure for the multi-unit system configuration using TopControl

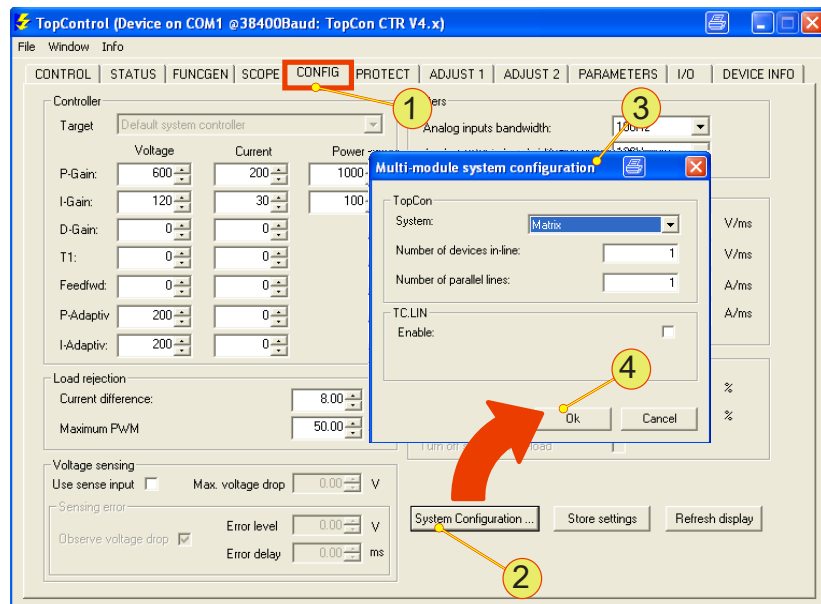


Fig. 38 Setting up multi-unit system using TopControl

- On the <CONFIG> -1- tab press the <System Configuration...> -2- button.
 - ↳ The “Multi module system configuration” -3- window opens.
- Set the parameters for the multi-unit system. For further information on the meaning and entry of the parameters, see software manual chapter 7.2.5, page 131.
- Accept your entries using the <OK> -4- button.
 - ↳ A message appears with the rest of the procedure.
- Set up the addresses of all the devices in the multi-unit system, as per chapter 4.4.3.3, Seite 61.
- Restart all devices to complete the multi-unit system configuration. During this process switch back on all devices within 10 s. The master device last.



5. Options

5.1. Overview

Definition

Regatron considers the term option to cover characteristics that expand the functionality of a TC.GSS power supply and that can be purchased.

In principle the options can be divided into 3 main groups:

- **Hardware options**
Additional hardware that is built into the device, attached to the device, or that can be formed from device combinations (system options).
- **Software options**
Functions that are enabled using an enable key.
- **Interface options**
Additional hardware interfaces mostly with additional software, or protocols.

In this chapter

In this chapter options are described with a varying degree of detail:

- Frequently procured options are given special attention in this chapter.

The following options are described:

Hardware options	Name	Chapter	Page
Liquid cooling	LC	5.2.1	70
Integrated safety relay	ISR	5.2.2	76
Internal resistance simulation	Internal Resistance Extension IRXTS	5.2.3	76

Table 25 Hardware and system options for TopCon TC.GSS.

Software options	Name	Chapter	Page
Function generator	TFE	5.3.1	88
PV simulation Solar array simulator	SAS Control	5.3.2	91
Rechargeable battery management	Akku Control	5.3.3	94

Table 26 Software options for TopControl

Interface options	Name	Chapter	Page
Serial interface, rear side	RS-232 REAR	5.4.3	97
Serial interface, differential	RS-422	5.4.4	98
Universal Serial Bus	USB	5.4.5	99
Controller Area Network	CAN/CANOpen	5.4.6	100
Parallel IEC bus, standard 488	IEEE488 with SCPI command set/ GPIB	5.4.7	101
Ethernet	TC.Ethernet	5.4.8	102

Table 27 Interface options for TopCon TC.GSS.

5.2. Hardware options

5.2.1. Liquid cooling (LC)

Optionally the integrated liquid cooling on the Regatron TopCon TC.GSS can be connected to an external cooling system.

The advantages of liquid cooling:

- **Noise reduction**
The majority of the power loss is removed via the liquid cooling. The noise emissions are reduced.
- **Greater temperature tolerance**
The device can be used in areas with a higher ambient temperature if the cooling liquid is correspondingly pre-cooled or is connected to a larger cooling water system.

5.2.1.1. Mechanical properties

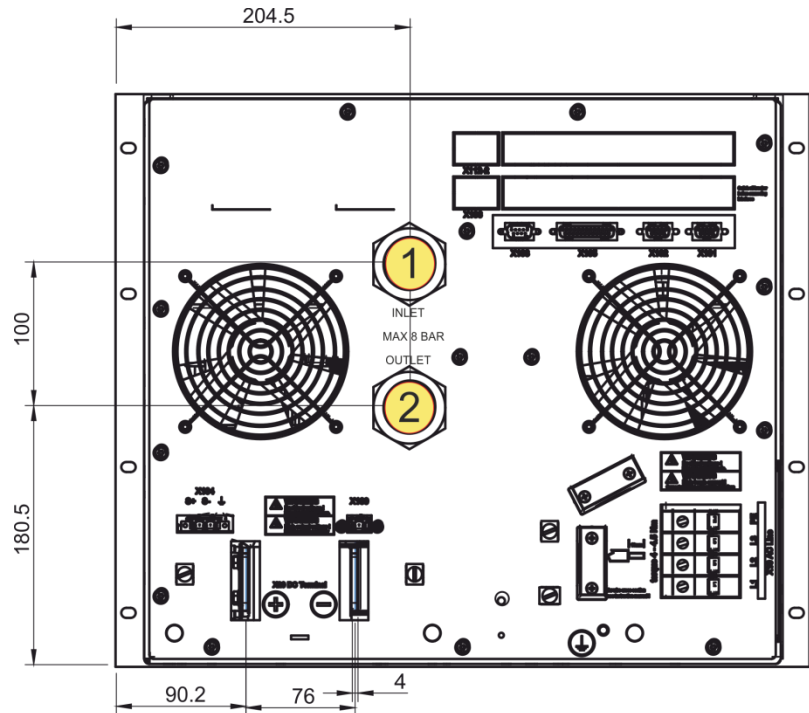


Fig. 39 Position of the internal thread connection

Liquid cooling connections	
1	Input: internal thread connection G ½"
2	Output: internal thread connection G ½"

Table 28 Connections on TC.GSS power supplies.

5.2.1.2. Characteristics of a water cooling circuit

General information on the heat exchanger

Parameter	TC.GSS.20	TC.GSS.32
Connections	On rear side of device, G 1/2"	
Cooling medium (CM) ¹	Purified water, alternatively heat exchanger liquids, non-corrosive	
Heat sink material	Corrosion-resistant steel	
CM ¹ specific heat capacity	4.2 kJ/kgK (water)	
Thermal rating	2,2 kW	3,5 kW
Recommended flow rate CM	4 – 6 l/min	
Minimum CM flow rate for $dT \leq 10$ K, $dT \triangleq$ temp. difference between inlet and outlet temp. of the liquid cooling.	3 l/min	

Table 29 Characteristics of the liquid cooling.

¹If you use liquid cooling with different parameter values contact Regatron support.**CAUTION****Damage due to condensation!**

Damage in the device due to condensed water is excluded from the warranty.

Reason:

- **Due to cooling liquid temperatures < 15 °C.**
(At normal atmospheric conditions:
- ambient temperature 21 °C
- relative atmospheric humidity ≥ 70 %.)

Avoidance:

- ⇒ Keep the feed temperature at a temperature level > 15 °C to avoid condensation inside the device and on the supply cable.
- ⇒ In case of doubt contact Regatron support.



Liquid cooling data

In general the quality of normal purified, soft and largely chlorine-free drinking water is adequate.

The installation of fine filters will keep back fine sludge particles.

Your local water utility will be able to provide detailed information on the water quality. For information on the water quality see Table 30, below.

Information on the cooling medium

The quality of the cooling medium will have a long-term effect on the system performance. Avoid the following processes by using suitable measures:

- The deposition of foreign bodies on the heat exchanger surfaces.
- Electrolytic and/or chemical corrosion.
- The deposition of fine sludge.
- Coating with foreign substances and as a result degradation of the heat transfer.

Recommended characteristics of water as a cooling medium

Parameter	Unit	Limit value with single flow ¹
ph-value	-	6 - 10
Total hardness	[°dH] ²	6 - 15
Substances that can be removed by filtering	[mg/l]	< 30
Free chlorine	[mg/l]	< 0.5
Sulphate	[mg/l]	< 300
Sulphide	[mg/l]	< 5

Table 30 Recommended water quality with liquid cooling.

¹ The flow is in a closed system

² °dH = German hardness figure (= 10 mg CaO/l)

Hardness figures are dependent on the country and may therefore vary.

5.2.1.3. **Pressure drop as a function of the volume flow rate**



The maximum permissible cooling liquid pressure is 8 bar = 8000 hPa.

The pressure drops for feed pipes, manifolds and pressure and flow rate sensors are also to be taken into account.

In particular, on the parallel supply of several power supplies an appropriate safety margin is to be included.

Recommended volume flow rate -1- 4 l/min – 6 l/min.

Graph – pressure drop-volume flow rate

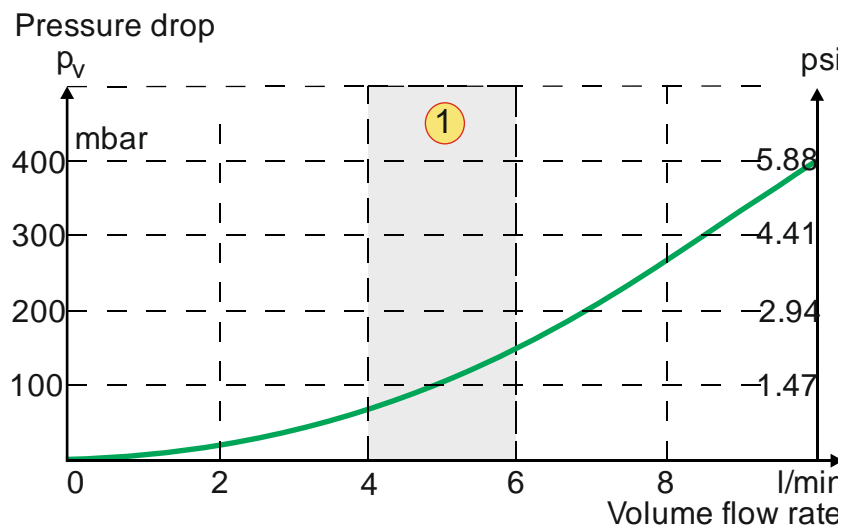


Fig. 40 Pressure drop as a function of the volume flow rate.

5.2.1.4. **Connection variants – examples**

Various connections can be screwed to the power supply to suit the specific needs.

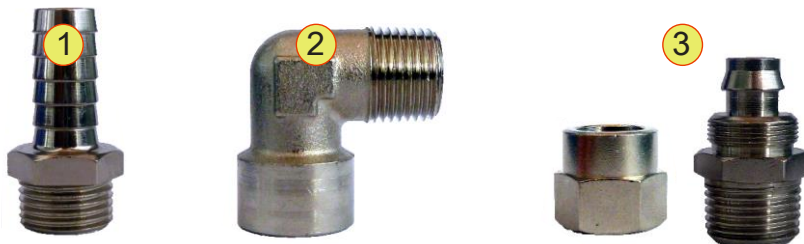


Fig. 41 Connection examples

Connection variants	
1	<p>Hose connection fitting</p> <p>Standard hose connection for hose clip.</p> <p>Male thread: G1/2"</p> <p>Hose diameter: Inside: 13 mm; Outside: 16 mm</p>
2	<p>L-piece</p> <p>L-piece with male thread and female thread</p> <p>Male thread: G1/2"</p> <p>Female thread: G1/2"</p>
3	<p>Hose connection with union nut</p> <p>For a reusable and secure hose connection.</p> <p>Male thread: G1/2"</p> <p>Hose diameter: Inside: 13 mm; Outside: 16 mm</p>

Table 31 Examples for cooling liquid connections.

Installing a cooling liquid connection

- Apply thread sealant to the turns on the thread to seal the connection.
During this process follow the recommendations from the manufacturer of the sealant.
Example: LOCTITE® 542
- Screw the connection into the 1/2" connection on the power supply and tighten.
- Fasten the pipe system.

5.2.2. Integrated Safety Relay (ISR)

Definition of applied standard

Applied standard: EN ISO 13849-1:2006

Explanation of the term 'Performance Level PL'

Safety functions of an electrical system can be done according to several so-called safety classes, starting from simple switch-based solutions up to complex and self-monitoring safety systems. The 'Performance Level 'PL' is an indicator specifying how extensively the safety-related parts of a system are performing the task. The most important factors for the PL are:

- Reliability of the used parts within the safety system (**MTTFd**)
- Ability of the system for self-monitoring (**DC_{ave}**)
- Architecture of the safety system

The reliability of used parts is defined by the parameter MTTFd and refers to the conditional probability of failure of the used parts inside each of the respective safety channels. According to the type and number of parts, a number of years can be calculated.

- For 3 years < MTTFd < 10 **years**, MTTFd is 'low'
- For 10 years < MTTFd < 30 years, MTTFd is 'fair'
- For 30 years < MTTFd < 100 years MTTFd is 'high'

The capability of the safety system to detect malfunctions within the safety system itself is expressed by the parameter DC_{ave}. This number is expressed by the %-ratio of:

- number of identified failures which led to an ordinary shut down
- number of all failures, including these not being identified by the system

- ↳ DC < 60% means DC_{avg} = Null;
(System detects own malfunctions only occasionally)
- ↳ 60% < DC < 90% means DC_{avg} = 'low'
- ↳ 90% < DC < 99% means DC_{avg} = 'fair'
- ↳ DC > 99% means DC_{avg} = 'high'
(system detects own malfunctions completely and safely)

The term is derived from the category of the safety system and relates to the type of electro-mechanical/electronic architecture of the safety system. For more details please refer to the regulations EN ISO 13849-1:2006.

If the above explained three terms are given, the Performance Level PL can be determined from the following Abb 1.

As an example: A safety system uses a circuit defined as **Cat 2**. The **MTTF_d** was calculated as to be 20 years -> **MTTF_d** = 'fair' and **DC** = 75% -> **DC_{avg}** = 'low'.

The small triangle within Graph 1 shows the rating of the system as to be **PL c**.

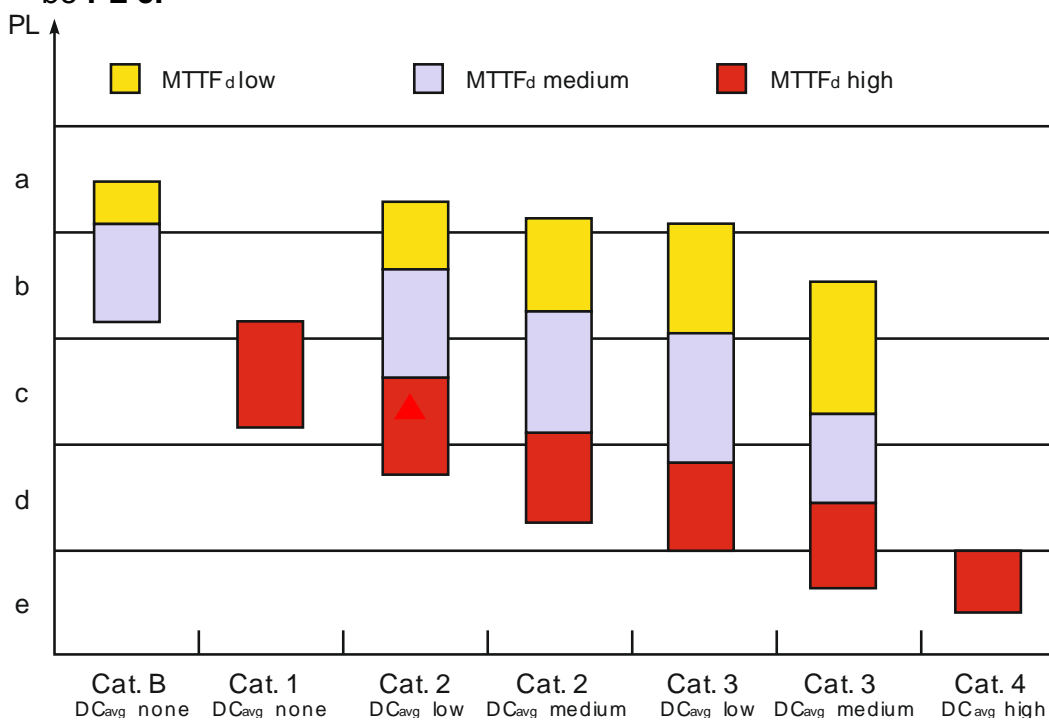


Fig. 42 Relationship between DC_{avg}, MTTFd and Performance Level PL

Legende	
PL	Performance Level
MTTF_d	Mean Time to dangerous failure
DC_{avg}	average Diagnostic Coverage
Cat.	Category

Table 32 Legend

5.2.2.1. General function

TopCon High power supplies TC.P and TC.GSS may be equipped with the Integral Safety Relay option ISR. Fitted with 'restraint driven contacts', ISR is connected to external safety switch elements providing safe concepts for emergency shut down of the power supply or system.

As an important feature, ISR is acting directly on the alimentation of the power conversion stages and blocks therefore any energy flow in an emergency case.

Integration of the ISR option is done at the time point of initial manufacturing. A later integration is possible but needs the unit to be returned to the factory.

Function of ISR in a single power supply

ISR is to be connected to the external 'safety switch loop' via the X112 interface.

If the external loop is opened, the DC-output of the power supply is powered down immediately. In the case of a TC.GSS (bidirectional power supply), the DC output as the AC input stage too are blocked in the same manner. (See also chapters 5.2.2.2)

Please note, that an 'X112 Safety-Shutdown plug' has to be plugged onto the X112 interface if the external safety loop is not connected.

Function of ISR in a multi-unit power supply system

A multi-unit power supply system may also be equipped with an external safety shutdown loop using the individual X112 interfaces. Note that all respective units have to be equipped with the ISR option. Breaking the external loop or any fault condition of an individual power supply will immediately shut down the entire system. (Refer to the application examples in chapter 3)

REGATRON power supplies

The above stated principle of operation is valid for TopCon TC.P. unidirectional power supplies as also for the TC.GSS bidirectional series.

5.2.2.2. Detailed description of ISR in TopCon TC.GSS power supplies

Due to the more complex architecture of TC.GSS bidirectional power supplies, the ISR's have to act on several power blocks simultaneously. ISR's block the primary and the secondary H-bridges in order to disable any energy flow whether sourcing nor sinking the load, at the same time the active mains input/output rectifier/inverter is blocked too in the same way to isolate the unit from the mains. Again, the restraint-driven signal contacts of the ISR's transmit the state of the relays redundantly to the interface X112. Refer to Picture 3 for more details.

Please note that TC.GSS Safety Performance Level is different depending on the operation mode.

In source mode, two ISR's break the energy flow independently and therefore a Performance Level of PL e is obtainable.

Device dependent Performance Level PL:

- **Devices with the interface labelling X112**
In sink mode - due to technical reasons – one ISR breaks the energy flow and therefore a Performance Level of PL c is given. Of course the PL could be increased for example by adding an additional AC circuit breaker.
- **Devices with the interface labelling X112-2**
In sink mode, two ISR's break the energy flow independently and therefore a Performance Level of PL e is obtainable.

Performance level vs. operation mode	
Source mode	PL e
Sink mode	Device dependent Performance Level PL Labelling X112: PL c Labelling X112-2: PL e

Table 33 Performance level vs. Operation mode.

Applicationexamples	
Single safety loop	See on page 83.
Double safety loop	See on page 84.
With ext. Safety building block, double loop	See on page 85.

Table 34 Application variants of safety system

Functional block diagram of TC.GSS devices with the labelling X112

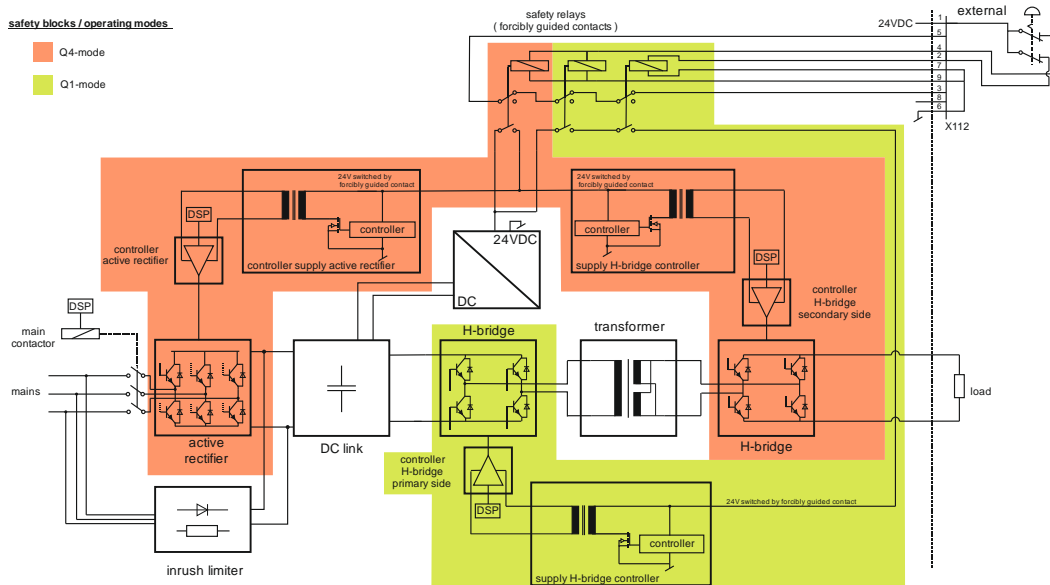


Fig. 43 Functional block diagram of ISR feature in TC.GSS unit with the labelling X112.

Functional block diagram of TC.GSS devices with the labelling X112-2

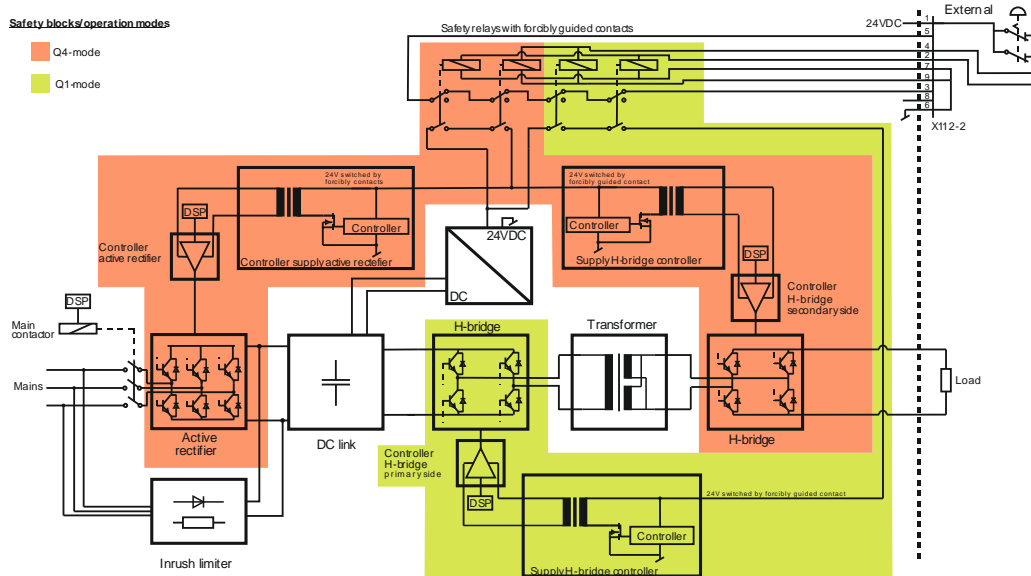


Fig. 44 Functional block diagram of ISR feature in TC.GSS unit with the labelling X112-2.

5.2.2.3. Interface X112/ X112-2

Please note that interface X112 is available only if ISR option is built in.

D-Sub Buchse
9pol (female)

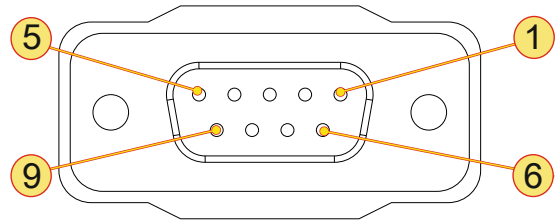


Fig. 45 Pin layout of interface X112/ X112-2, front view

Pin	Signal	I/O	Description
1	+24VDC	O	Low voltage internal supply + 24 V _{DC}
2	RELAY2¹	I	Coil a) of ISR relay#2
3	NC	I/O	Relay contact NC
4	RELAY1¹	I	Coil a) of ISR relay#1
5	COMMON	I/O	Common contact
6	GND	O	Low voltage 0 V _{DC}
7	RELAY2¹	I	Coil b) of ISR#2
8	---	---	---
9	RELAY1¹	I	Coil b) of ISR#1
Cover	Shield	---	Cable screen, tied to earth (PE) internally

Table 35 Interface X112/ X112-2, pin assignment.

¹ Polarity of relay coil pins 2 and 7 resp. 4 and 9 of no importance.

Dummy plug for interface X112/ X112-2

A TopCon power supply equipped with ISR option needs either to be connected to an external safety loop as described above, or alternatively a dummy plug “X112 Safety-shutdown” has to be connected to interface X112/ X112-2. If the interface X112/ X112-2 is left open, the power supply will rest in the ‘Emergency OFF’ state and is inoperative.

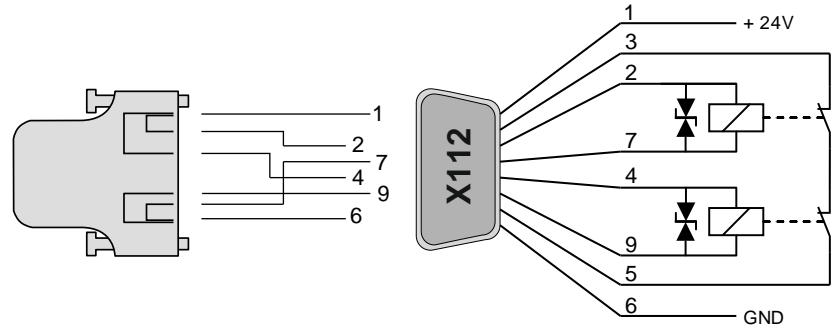


Fig. 46

Adapter for equipment with an X107 interface

Many TopCon power supplies are equipped with the ‘Single channel ISR option X107’. By the aid of a special adapter, X107 ISR equipped units may be operated together with X112/ X112-2 equipped units. Refer to picture 6 for details.

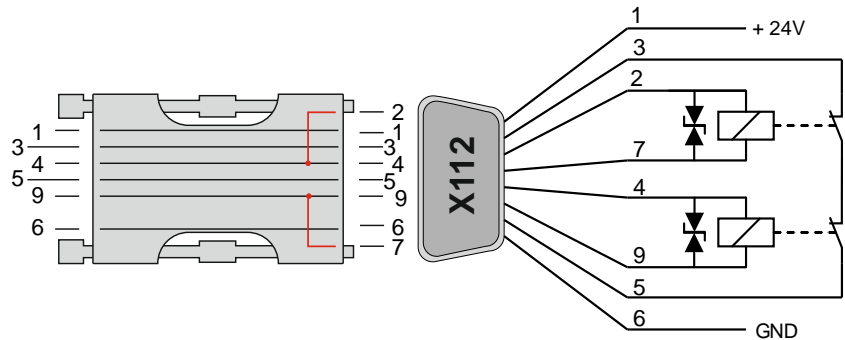


Fig. 47 Adapter for connecting ISR X107 units to ISR X112 units.

5.2.2.4. Application examples

Example 1: Category 1 PL c

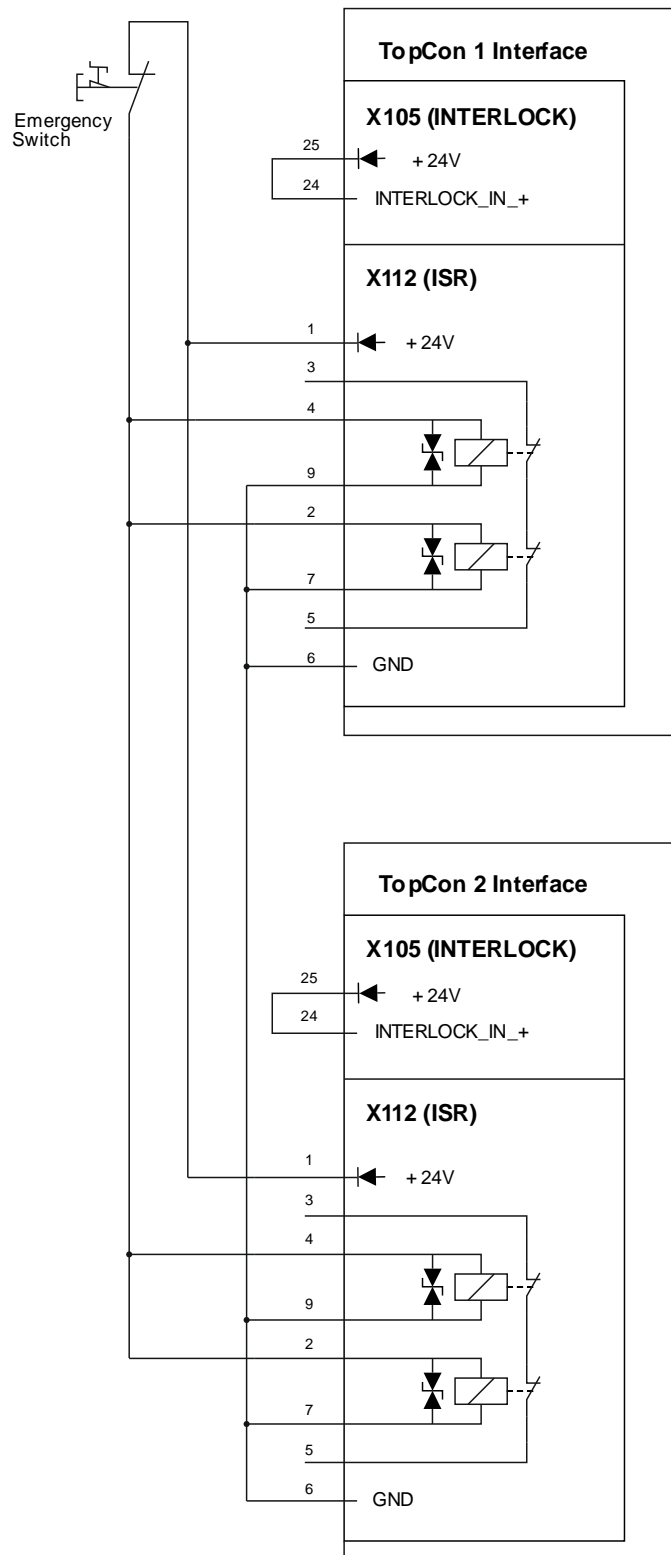


Fig. 48 Wiring diagram using a single pole external safety loop.

Example 2: Category 1 PL c

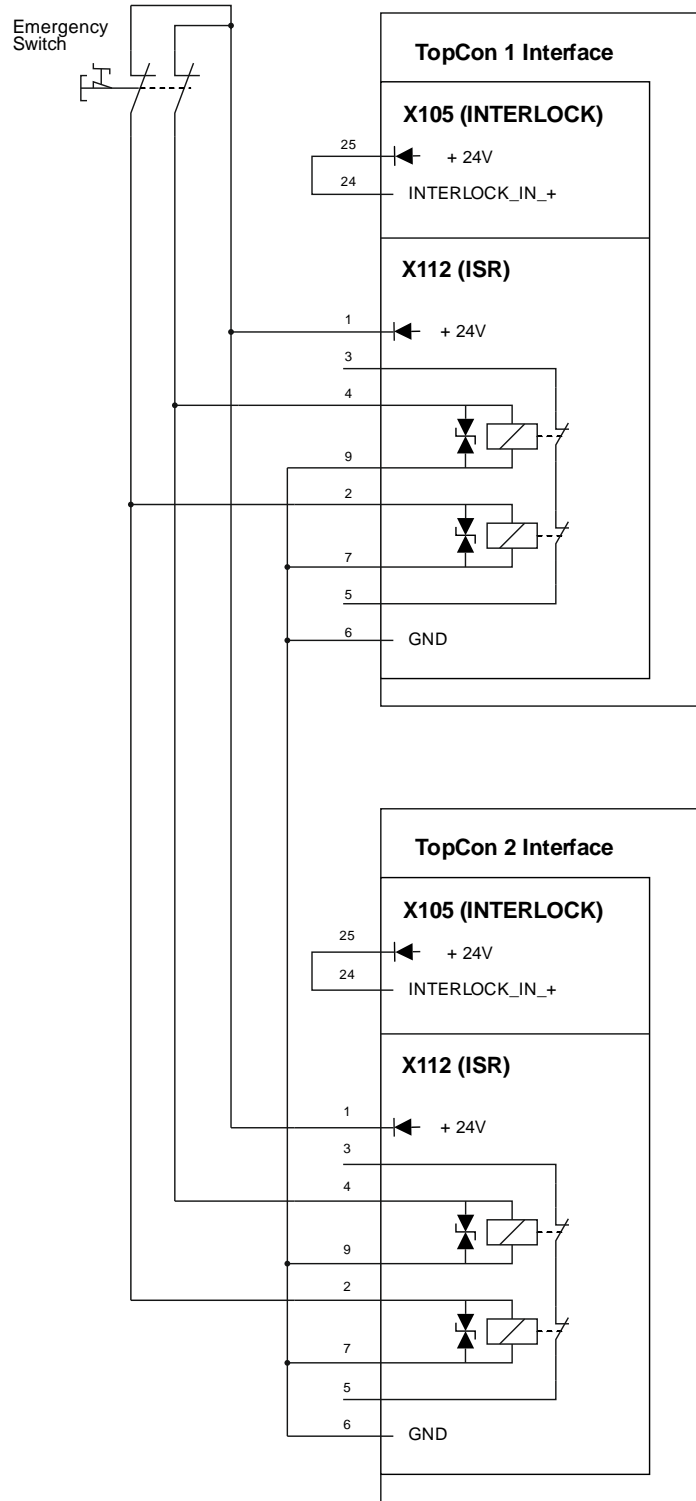


Fig. 49 Wiring diagram using a double pole external safety loop.

Example 3: Category 3 PL e

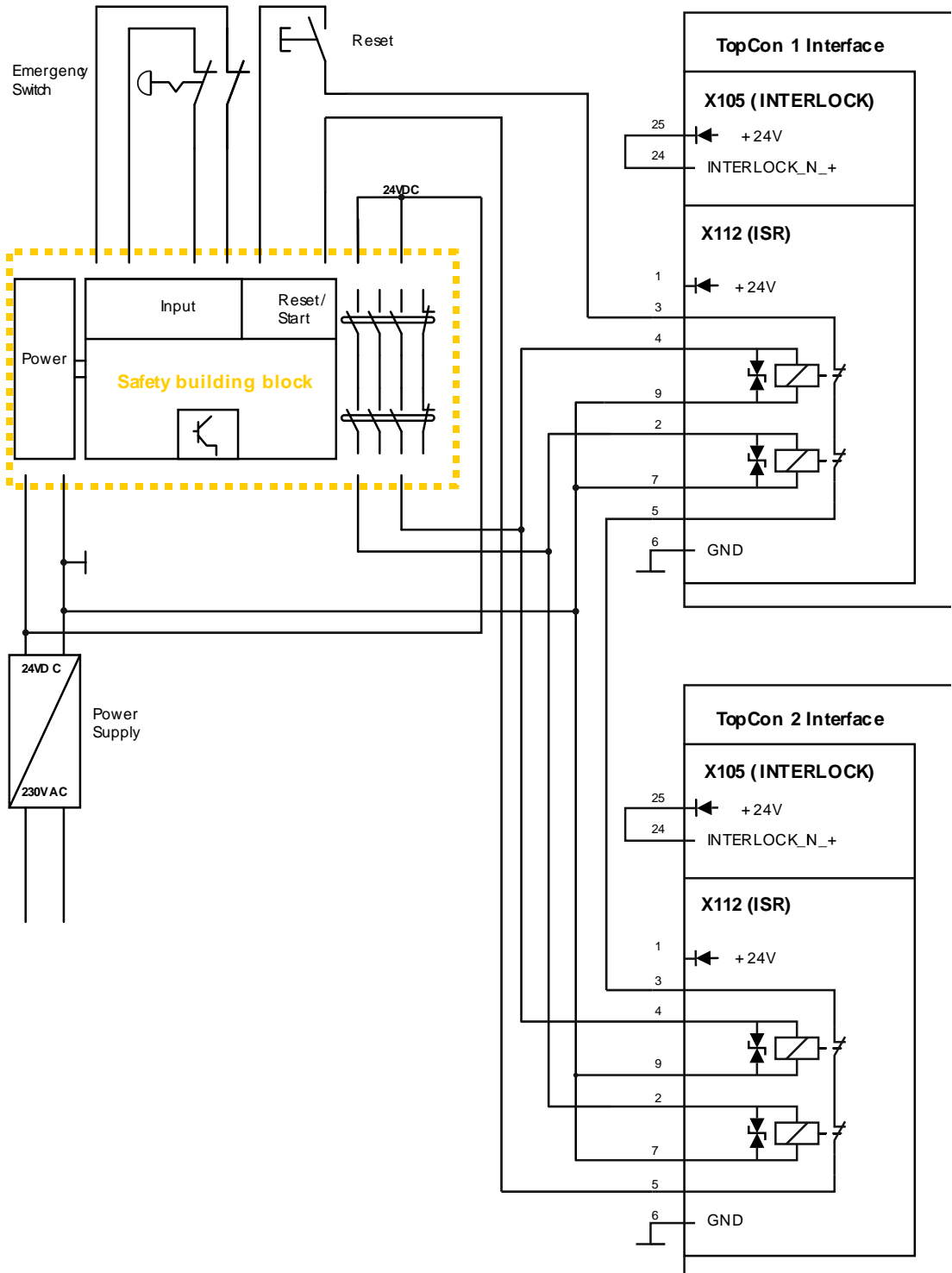


Fig. 50 Wiring diagram using an external safety module, double pole safety loop.

5.2.3. Internal Resistance Extensions (IRXTS)

Function

The TopCon power supply can simulate the static internal resistance of a source.

The basic problem

Due to the digital control, the TC.GSS power supply does not have any apparent internal resistance.

The solution

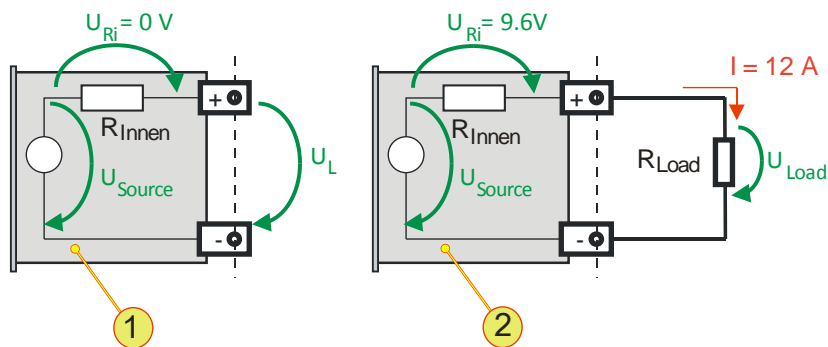


Fig. 51 Internal resistance simulation
 -1- TopCon source with no load and internal resistance
 -2- TopCon source with load and internal resistance

Example calculation

The TC.GSS power supply simulates a rechargeable battery with an internal resistance $R_{\text{Internal}} = 0.8 \Omega$ and a no-load voltage $U_L = 48 \text{ V}$.

A load current $I = 12 \text{ A}$ flows, the voltage at the load U_{Load} is reduced by 20 % from U_L

Differentiation between cases - no-load

No-load voltage $U_L = U_{\text{Source}} - U_{Ri} = 48 \text{ V} - 0 \text{ V} = 48 \text{ V} \quad \square \quad U_L = U_{\text{source}}$
 No-load current $I = 0 \text{ A}$

Differentiation between cases - load

Voltage drop $U_{Ri} = I * R_{\text{Internal}} = 12 \text{ A} * 0.8 \Omega = 9.6 \text{ V}$

Load voltage $U_{\text{Load}} = U_{\text{Source}} - U_{Ri} = 48 \text{ V} - 9.6 \text{ V} = 38.4 \text{ V}$

80 % of U_{source}

Internal resistance extension

Simulation options	Internal resistance [mΩ]
Standard internal resistance	0 to 1000
With option IRXTS	0 to 32000
Customer request ¹	Over 32000

Table 36 Overview of internal resistance simulation options
¹ In consultation with Regatron support

You can obtain further information from your sales partner and Regatron support.

5.3. Software options

5.3.1. Function generator (TFE/TopCon Function Engine)

Introduction

The activated function generator can specify set values for voltage, current and power in the form of pre-defined or user-defined functions for the control of the TC.GSS power supply.

Here individual function blocks are combined into function sequences that can be triggered by events.

The points on the user-defined functions and the AAP characteristic curves to be used can be created and modified using TopControl or by utilising a function library (DLL).

It is possible to use the “function generator (TFE)” in the demo mode. Within the TopControl application, e.g. sequences of functions can be defined. However, the function curves can only be transferred to a TC.GSS power supply and used after the activation of this option.



For a description of the parameter entry for the function generator TFE via the TopControl application see software manual chapter 7.2.5, page 131.

For information on calling defined function sequences for the function generator via the HMI see Table 60, Seite 149.

Function Block (FB)



A function block can be formed from various base functions for voltage, current and/or output power.

The following functions for which the parameters can be set as required are available:

- Time-dependent standard functions: square, triangle, sine
- Arbitrary time-dependent functions (user-defined)
- Arbitrary functions (AAP, e.g. $I = f(U)$)

Function Sequence (FS)

A function sequence comprises at least one function block. As a consequence a sequence has the following properties:

- Each function block contains base functions (e.g. sine wave with symmetry, offset and possibly exponential decay curve elements)
- The function blocks can be repeated 1 to n-times, or can be defined as continuous functions. In addition, the functions can be given further parameters, e.g., a pause between the repetitions.
- In the case of several reference values within a function sequence, several function blocks can be active at the same time.
 - ↳ The shortest function block defines the duration of the function sequence.
 - ↳ The pause time and the number of repetitions apply equally to all function blocks within a function sequence.

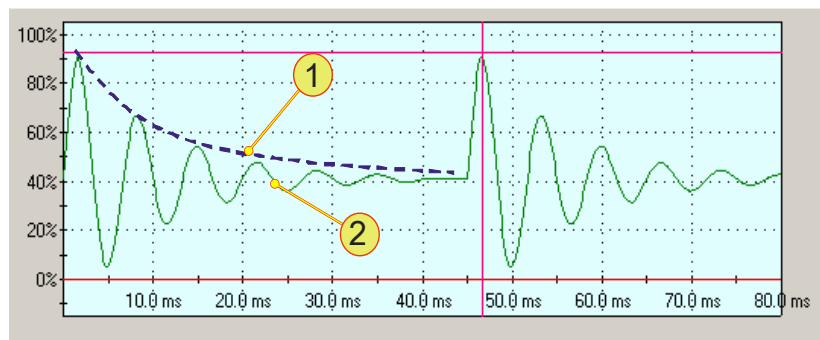


Fig. 52 Example of the capabilities of the function generator.

- 1- Exponential envelope, specified in the TFE
- 2- Result: a sine wave function that decays correspondingly -1-. In the example 2 repetitions have been defined.

The following events (“Trigger mode”) can trigger a function sequence:

- VOLTAGE ON (“Voltage on”)
 - As soon as the output power is activated at the output of the power supply.
- Manual triggering (“Manual”)
 - Manual triggering is possible in the TopControl application or with the aid of the HMI/RCU.
- Analogue interface X105 (“High level on X105/19”)
 - If there is a high level on pin 19 of the interface.

Definition of reference values prior to a trigger event

The nature of the trigger can be specified in the TopControl application and HMI/RCU. Up until the trigger event, the set values specified by the active interface apply, e.g.:

- RS-232 interface
Set values defined via the TopControl application.
- HMI/RCU
Set values defined via HMI/RCU.
- Analogue interface X105
Set values defined via the analogue interface.

Definition of reference values after the completion of a function sequence (“After Function Sequence finished”)

After a function sequence has been completed, a reference value can be defined as follows:

- “VOLTAGE OFF” (“Voltage off”)
The device output is electrically isolated.
- Actual reference values are retained directly from the function block (“Hold level”).
- From the active set value interface.
Set values are defined via this interface.

Maximum number of function sequences in the TopCon power supply:

- Up to 256 **time-dependent standard function sequences**.
- In the case of **arbitrary time-dependent (user-defined) function sequences** the number is dependent on the number of points.
A maximum of 1000 points is possible.
- In the case of **arbitrary function sequences** (user-defined AAP) the number is dependent on number of points.
A maximum of 64 points is possible; these points can be distributed unevenly.

The function sequences saved in the power supply can be called via the following interfaces:

- HMI (RCU).
- RS-232 interface.
TopControl application.
Using custom programs via function libraries.

The parameters summarised

Setting	Value range – TopControl	Value range – HMI
Base function	Sine, square, triangle, user-defined, AAP	
Amplitude	0...100 %, resolution: 12 bits	
Offset	Standard: 0 – 100 % Bipolar: -100 % – +100 %	Resolution: 12 bits Resolution: 12 bits
Symmetry	0...100 % (only with triangle and square)	
Frequency	0.001 Hz – 1 kHz	0.01 Hz – 320 Hz
Exponential envelope (time constant)	0.1 ms – 100000 s	10 ms – 320 s
Rectify negative amplitude	Yes/no	Cannot be changed, Standard: no
Amplitude polarity	Unipolar/bipolar	Cannot be changed, Standard: bipolar
No. of repetitions of the base function	1 – 65535 or continuous	0 – 32000 (0 \triangleq continuous)

Table 37 Possible function generator settings with comparison between TopControl and HMI.

Loading and saving function sequences

All the settings can be saved in the non-volatile memory (flash) and loaded again. It is also possible to set that when the power supply is started (power-up), a previously saved function sequence is loaded automatically. Several function sequences can be saved. 64kB of memory are available for this feature. Without user-defined curve shapes, up to 256 function sequences can be saved. In the case of user-defined curves (4 bytes per point) the number reduces accordingly.

The function sequences are saved in a sequence number (1...1000) that can be selected and can be called again using this number. It is also possible to call the function sequences from the HMI. On saving a function sequence via TopControl it is also possible to give an arbitrarily defined name (up to 31 characters) as well as the date and time.

Restrictions and information

The function generator makes it possible to specify complex set value curves. For the output values on the power supply to also be able to follow these set value curves, the following points are to be noted:

The gradient limiters

(can be adjusted in the TopControl application on the <CONFIG> tab □ Slopes) are also active during function generator operation. If, e.g., steeper edges are defined in the function generator, it may be necessary to increase these slope values.

Small control parameters prevent fast control movements.

(can be adjusted in the TopControl application <CONFIG> tab □ Controller)

The control parameters depend heavily on the load. In the specific case the current or voltage curve should be checked using an oscilloscope or the Scope function integrated in TopControl to optimally adapt the control parameters.

In addition, it is to be noted that a TopCon power supply in the basic version cannot absorb any energy from the load side, i.e. in case of set value steps the control time constant is dependent on the load impedance.



Negative set values can only be processed in combination with an AC-polarity reverse bridge or Q14 system (see options chapter 5.2, Seite 70). A TopCon power supply without AC-polarity reverse bridge interprets negative set values as zero.

5.3.2. Solar Array Simulator (SAS) - SASControl

Function

The function generator for the TopCon power supply is switched to the AAP mode with a function $I = f(U)$ and can behave like a solar panel in accordance with this function.

By overlaying on another AAP characteristic curve, the effect of solar irradiation and temperature on the solar panel can be simulated. During this process it is possible to “softly” overlay linearly from one AAP characteristic curve to another.

The solar array simulator can be used for photovoltaic simulation (PV simulation).

The basic problem

On photovoltaic installations the energy from light is converted into electrical power. The DC produced is fed back to the grid via an inverter.

(Conversion of the DC from the solar panel to 230 V 1~ or 400 V 3~ AC.)

During inverter production and development the TopCon power supply can be used as a solar panel simulator for testing inverters.

The solution

Modules required for this usage

- TopCon Quadro power supply
- SASControl option

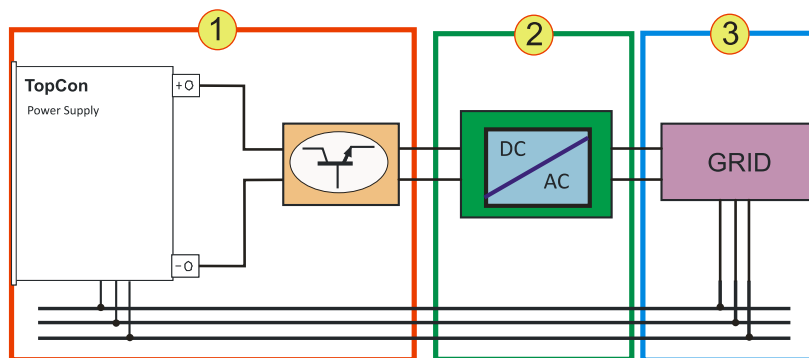


Fig. 53 Usage of the TopCon power supply as a test stand

Test stand - modules	
1	<p>TC.GSS power supply with TC.LIN</p> <p>The TopCon simulates a solar panel with its function generator TFE. The TC.LIN helps to improve the dynamic performance of the system, during the process greater accuracy is required.</p>
2	<p>Test object: inverter</p>
3	<p>Grid</p> <p>The grid can be real or also be a simulation so that the test object can be operated in an environment that closely represents reality.</p>

Table 38

Improvement of dynamic performance using the TC-LIN linear series controller

A further improvement in the dynamic performance of the system is provided by the usage of the downstream TC.LIN linear series controller. The linear series controller communicates with the TopCon power supply. While the TopCon power supply defines the signal “coarsely”, the TC.LIN modifies the output signal with high dynamic performance and accuracy (5 μs cycle time, 14.5-bit resolution). The combination of the TopCon Quadro power supply and the TC.LIN linear series controller can be used very flexibly and at the same time at high powers for the realistic simulation of small to medium solar panels.

This functionality is largely controlled from the TopControl application. Alternatively the functionality can be controlled via the DLL for custom programs.

5.3.3. Akku-Control – rechargeable battery maintenance charging curves

Research and development on environmentally friendly vehicle concepts is closely linked to the ability to store or temporarily store electrical energy. Electrochemical and also capacitive stores have specific applications – however a common feature is the highly dynamic usage of storage during vehicle operation.

To test the resilience of modern storage systems in relation to charging/discharge cycles and microcycles, bidirectional power supply systems are required that can apply to the stores the loads due to the cycles that occur during vehicle operation as well as boundary loads.

In the context of sensible energy management, the regenerative energy that is produced must be fed back to the supply system with high efficiency. This statement applies in general only at higher loads. On small energy stores it is often sensible to discharge using a dissipative load, because energy recovery to the grid is only economical from higher quantities of energy.

The characteristics for the rechargeable battery management in the Regatron software AccuControl are:

- Feature for charging and discharging a rechargeable battery via constant current or constant power.
- Largely arbitrarily programmable charging/discharging cycles e.g. standard curves or specified values for different rechargeable battery types.
- 8-channel long-term data acquisition for current, voltage, power, temperature (up to 4 external temperature channels), etc.
- Adaptive sampling of the measured values, with larger curve changes the measuring frequency is increased automatically (can be configured as required).

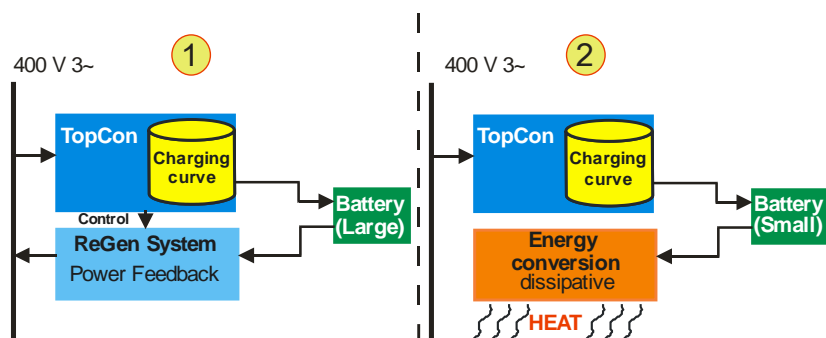


Fig. 54 Overview of "Akku-Management" with large rechargeable batteries -1- and small rechargeable batteries -2-

5.4. Interface options

5.4.1. Functionality as a function of an optional interface

	CAN/CANopen	IEEE488	HMI/RCU	RS-232 REAR, RS-422
Read/write register (low-level function)	X	X	X	X
Read system information	X	X	X	X
Reference values: set/specify	X	X	X	X
Read actual values	X	X	X	X
Read errors/warnings	X	X	X	X
Function generator: standard functions (sine, square, triangle)	X ^{1), 2)}	X ^{1), 2)}	X ²⁾	X ²⁾
Function generator: AAP function □ call	X ^{1), 2)}	X ^{1), 2)}	X ²⁾	X ²⁾
Function generator: AAP function □ define	–	–	–	X ²⁾
SCOPE function	–	–	–	X

Table 39 Overview of dependencies between task category and interface

¹ Increased effort required.

² Only in combination with the option FUNCGEN (TFE)..

5.4.2. Overview of possible interface combinations

	Analogue	HMI	RCU	RS-232 REAR	RS-232	RS-422	USB	Ethernet	IEEE488	CAN/CANOpen	Profibus
Analogue	○ _p	●	●	●	●	●	●	●	●	●	● ²
HMI	●	○ _p	●	●	●	●	●	●	●	●	●
RCU	●	●	●	●	●	●	●	●	●	●	●
RS-232 REAR	●	●	●	○ _p	○ _p	○ ^p	○ ^s	● ³	○ _p	↑	● ¹
RS-232	●	●	●	○ _p	○ _p	○	○ ^s	● ³	○ _p	↑	● ¹
RS-422	●	●	●	○ _p	○ _p	○ ^p	○ ^s	○ _p	○	○	○
USB	●	●	●	○ ^s	○ ^s	○ _s	○ ^p	○ ^s	○	↑	(○)
Ethernet	●	●	●	● ³	● ³	○ ^p	○ ^s	○ _p	○	○	○
IEEE-488	●	●	●	○ _p	○ _p	○ ^p	○ ^s	○	○ _p	○	○
CAN/CANOpen	●	●	●	↑	↑	○	↑	○	○	○ ^p	○
Profibus	● ²	●	●	● ¹	● ¹	○	(○)	○	○	○	○ ^p

Table 40 Possible combinations of various interfaces

- The two interfaces are possible and function together (autonomous).
- The two interfaces are not possible at the same time.
- (○) Not foreseen/possible at the moment.
- ↑ The two interfaces are possible, CAN/CANOpen interface is dominant.
- 1) External Profibus to RS-232 converter.
- 2) External converter (not bidirectional). Functionality must be checked
- 3) External Ethernet to RS-232 converter.
- P) Only one interface is allowed to be physically active
E.g. A connection is made to the interface to be activated, while the inactive interface must be disconnected.
- S) Only one interface can be activated via the software.
The other interface is automatically deactivated.

5.4.3. RS-232 REAR interface – rear side of power supply

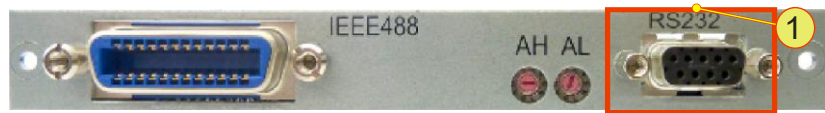


Fig. 55 RS-232 REAR interface -1- in combination with other interfaces on the rear side of the device.

Installation location:

The interface is built into the rear side of the device. It can be retrofitted to a device or be already installed on delivery.

Combination with other interfaces

- The RS-232 REAR interface takes over the tasks of the RS-232 interface on the front side of the device.

Technical characteristics

- Type of bus connection: plug, D-Sub 9-pin
- Interface standard: in accordance with EIA-232



For technical data and information on function, see chapter 10.1.4.3, page 185.

5.4.4. RS-422 interface – diagnostics and control connection

Installation location:

The interface is built into the rear side of the device. It can be retrofitted to a device or be already installed on delivery.

Combination with other interfaces

- A maximum of ten RS-422 receivers are allowed to be connected to a transmitter within one transmission device.

Technical characteristics

- Type: designed as D-Sub socket, 9 pin
- Interface standard: ITU-T V.11

Function

The RS-422 interface is used for high speed data transmission over large distances.

The serial data are transmitted as a voltage difference between two corresponding wires without a reference to ground.

For each signal to be transmitted there is one pair of cores that comprises an inverted signal wire and a non-inverted signal wire that are twisted together.

The receiver only evaluates the difference between the two wires such that common mode interference up to 7 V on the transmission cable will not corrupt the data signal.



You can obtain further information from Regatron support.

5.4.5. USB interface – Universal Serial Bus



Fig. 56 USB interface -1- in combination with RS-232 REAR interface -2-.

Installation of the interfaces

The interface is built into the rear side of the device. It can be retrofitted to a device or be already installed on delivery.

Combination with other interfaces

- The interface is always supplied in combination with the RS-232 REAR interface.
- The RS-232 REAR interface takes over the tasks of the RS-232 interface on the front side of the device.

Technical characteristics

- Type: socket for USB plugs of type B (see Fig. 56 oben)
- Interface standard: USB 1.1

Function

This is a serial interface and corresponds to the functionality of the RS-232 interface. The USB interface is used for the transparent transmission of data and can as a consequence be utilised both using the DLL and directly at the low protocol level.

The USB driver for the PC included must be installed for it to be possible to detect and operate the TC.GSS power supply from the operating system.

5.4.6. CAN/CANOpen® interface



Fig. 57 CAN bus interface -1- in combination with RS-232 REAR interface -2-.

Installation of the interfaces

The interface is built into the rear side of the device. It can be already installed in a device on delivery.

Only Regatron can retrofit this interface.

Combination with other interfaces

- The interface is always supplied in combination with the RS-232 REAR interface.
- The RS-232 REAR interface takes over the tasks of the RS-232 interface on the front side of the device.
- An active CAN/CANOpen® interface has a higher priority than HMI/RCU control units connected and therefore implements its commands instead.

Technical characteristics

- Type of bus connection: plug, D-Sub 9-pin
- CANOpen protocol: CiA standard 301 V 4.02

Function

Unlike the internal CAN bus in the device, which is responsible for the internal flow of information in the device and that is supplied as standard, the optional CAN/CanOpen® interface is used for the connection of devices from other manufacturers.

As a real-time system the CAN bus can be used for controlled systems.

The CAN bus is a serial two-wire bus that combines a high transmission speed with the communication protocol CANOpen®. By means of its collision management a lasting communication blockage on the bus is prevented.

The utilisation of the CAN/CANOpen® interface makes it possible to connect the TopCon power supply to a type of communication network in widespread use in industry.



You will find further information in the instructions supplied with the order.

5.4.7. IEEE488 – GPIB (General Purpose Interface Bus)

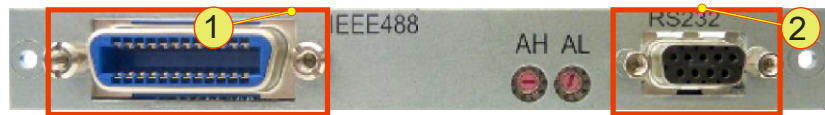


Fig. 58 IEEE488 bus interface -1- in combination with RS-232 REAR interface -2-.

Installation of the interfaces

The interface is built into the rear side of the device. It can be already installed in a device on delivery.

Only Regatron can retrofit this interface.

Combination with other interfaces

- It is not possible to operate an active IEEE488 interface and the RS-232 interface at the same time.
- Combination with other interfaces is not possible.

Technical characteristics

- Type of bus connection: socket, Centronics 24-pin
- SCPI command set: standard IEEE488.2 expanded with TopCon control commands

Function

Using commercially available Centronics connectors and the IEEE488 interface, TopCon power supplies can be operated independently. During this process specific TopCon control commands are interpreted and executed on the interface board.

Using the IEEE488.2 standard SCPI command set, straightforward connection to other network devices, instrumentation and electrical devices with support for the interface is possible.



You will find further information in the instructions supplied with the order.

5.4.8. TC.Ethernet

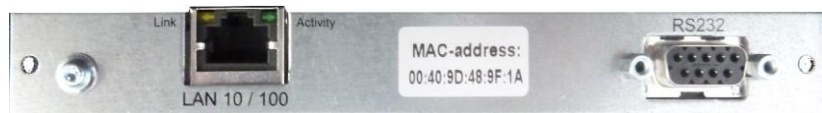


Fig. 59 TC.Ethernet interface -1- in combination with RS-232 REAR interface -2-.

Installation of the interfaces

The interface is built into the rear side of the device. It can be already installed in a device on delivery or retrofitted.

Combination with other interfaces

- It is not possible to operate an active TC.Ethernet interface and the RS-232 interface at the same time.
- Combination with other interfaces is not possible.

Technical characteristics

- Type of bus connection: socket, RJ45

5.4.8.1. Conditions for the Ethernet interface

Standard configuration of the interface card

- DHCP server: the card is configured for the allocation of IP addresses by a DHCP server.
- APIPA: If an address is not allocated by a DHCP server in a specific time window, the card automatically assigns itself an IP address (APIPA).

Crossover cable

The Ethernet interface card cannot switch automatically between a crossover cable and an uncrossed network cable. If the other end does not support Auto-MDI(x), you will need a crossover cable for the installation.

5.4.8.2. Installation of the device driver

Preparation

First integrate all network devices in your company's network before you run the driver setup on the PC with the TopControl application. Make a note of the MAC addresses and the device name along with its location. You will find the MAC address on the panel on the interface card. You can then search for specific devices later.

Procedure for a static IP address or dynamic IP address on the TC.GSS power supply



- For procedure for a static IP address
- For procedure for a dynamic IP address see chapter 5.4.8.2, page 104.

Procedure for assigning a static IP address to the power supplies



You will find further information on the various buttons on the subsequent “TCEthernet interface” submenu in chapter 5.4.8.6, page 110.

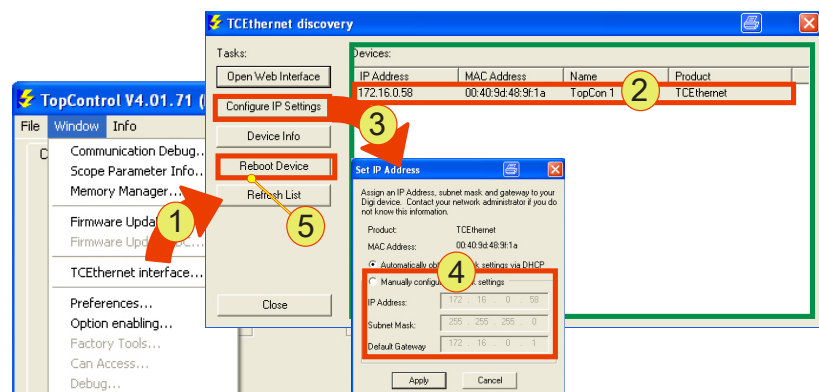


Fig. 60 Sequence in the TopControl application

Procedure

- It is best to contact your system administrator prior to installation.
- First integrate all TC.GSS power supplies in your company's network.
The best method is to assign the IP addresses using a DHCP server.
- Start the TopControl application and in the “Window” menu item select the “TCEthernet interface...” -1- submenu item.
 - ↳ The “TCEthernet discovery” windows opens.
- Mark the required TC.GSS power supply -2- in the list.
- Click the “Configure IP Settings” -3- button.
 - ↳ The “Set IP Address” windows opens.
- Activate “Manual configure network Settings” -4-
 - ↳ The boxes for the static IP address assignment can then be edited.
- Enter your network settings.
- Click the “Reboot” -5- button so that the new settings are applied by the network card.



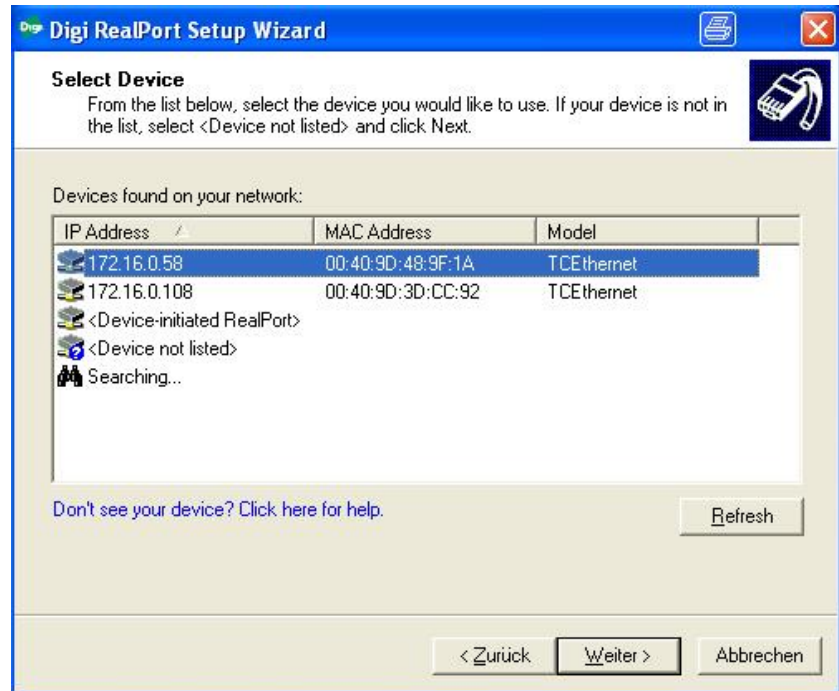
- Repeat this procedure for all TC.GSS power supplies.
- Make a note of the IP and MAC address allocated, after you have refreshed the list.
- Undertake the driver setup for each power supply using the static IP addresses in the network, as per chapter 5.4.8.2, page 104.
- You have completed the setup of the static IP addresses.
- Optionally you can rename the interfaces in the Device Manager or assign a new host name via the web interface.

Driver installation with allocation of IP address and COM port

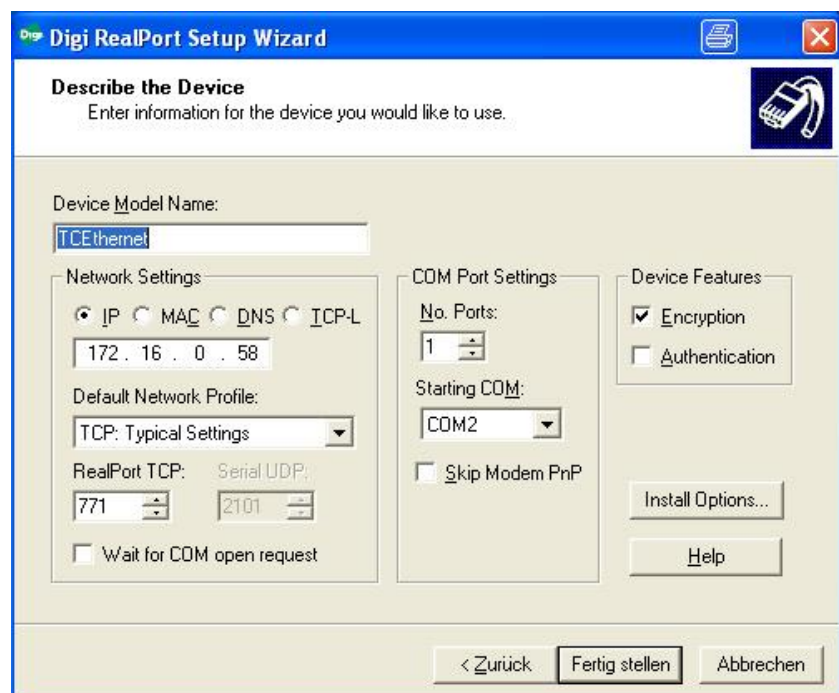
Start the setup program “Setup.exe” on the installation CD supplied.



- Click the <Next> button
- ↳ The “Select Device” window opens



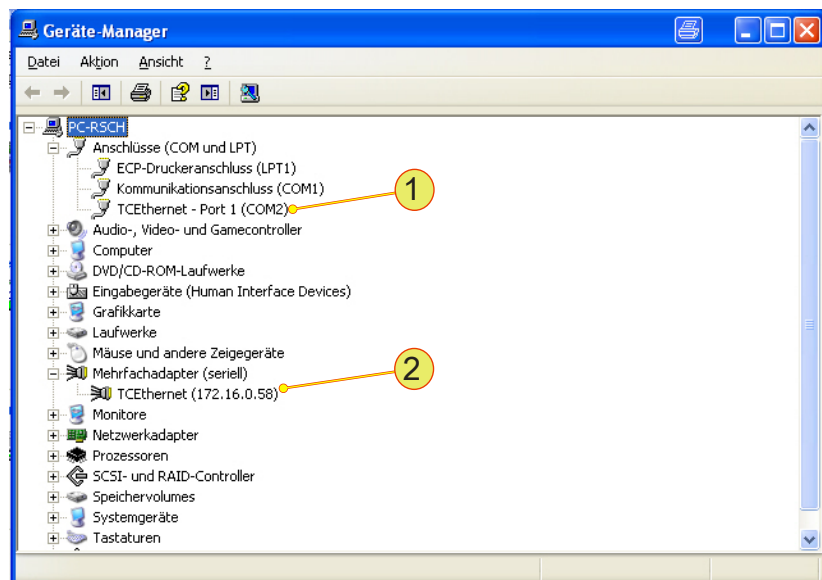
- Click the “Refresh” button so that all devices are displayed
- Select a device (TCEthernet interface) (marked in blue).
 - ↳ All interface parameters for the setup process are automatically applied.
- Click the <NEXT> button
 - ↳ The “Describe the Device” windows opens.



- Click the <Finish> button
Do not change any parameters!
- The installation starts.
The installation process takes some time until it is completed.

5.4.8.3. Indication of the Ethernet card in the Device Manager in the operating system

- Open the Device Manager.
 - 1- Allocation of the Com port via your IP address for the interface
 - 2- Indication of the interface card in “Mehrfachadapter (seriell)”



Changing the name in the Device Manager

If the IP address is changed (e.g. by a DHCP server) the allocation of the device and COM port is lost.

The following entries must be entered again in case of a new IP address.

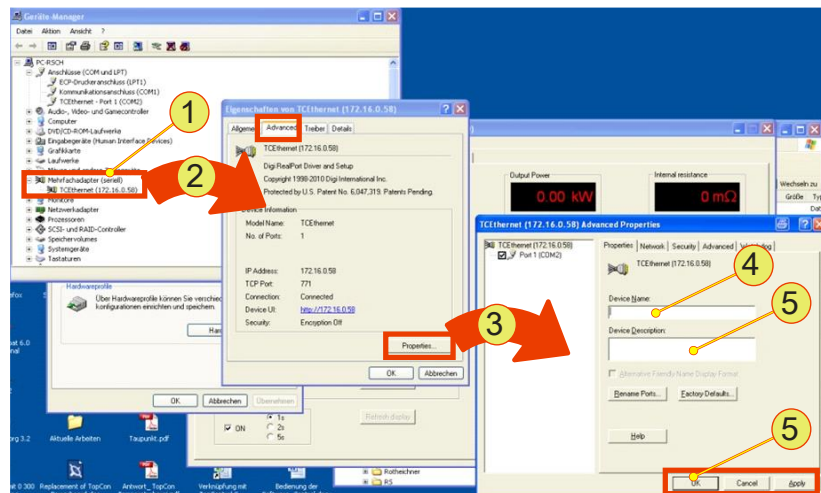


Fig. 61

Procedure

- Open the Device Manager.
- Click the required device under “Multiple adapter (seriell)” -1- using the left mouse button
 - Click with the right mouse button “Properties” on the context menu
- ↳ The “Properties of TCEthernet....” -2- window opens
- Select the <Advanced> tab
- Click the <Properties> -3- button
- Select the <Properties> tab in the “Advanced Properties” window
- Type the name -4- and description -5-
- Accept your changes using “Apply” or “OK” -6-

5.4.8.4. Adding a new COM port driver and removing an old COM port driver

Adding a new device

- Start the driver setup program on the driver CD supplied.
- Select “Add a New Device” -1- in the start window.



- Proceed as in “Installation of a device driver”, see chapter 5.4.8.2, page 104.

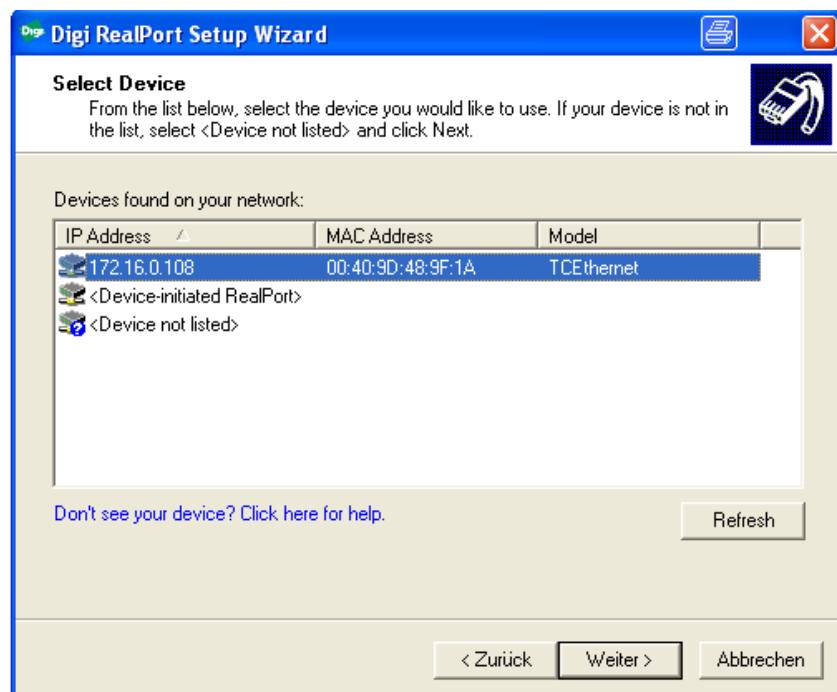
5.4.8.5. Removing a COM port driver

Uninstall the IP addresses and Com ports shown in the Device Manager that have become superfluous in the “Ports” group.

- Start the setup program setup.exe on the installation CD supplied.
- ↳ The setup program detects device drivers already installed
- Select “Remove Existing Device” -2- and accept your selection using “Next”.



↳ A window for selecting from the device drivers installed opens.



- Select the required driver and accept your selection using the “Next” button
- ↳ The selected driver is uninstalled.
- ↳ The entries are removed from the system Device Manager.
- ↳ The entries are no longer available for the automatic establishment of a connection in TopControl.

5.4.8.6. TopControl submenu - TCEthernet Interfaces

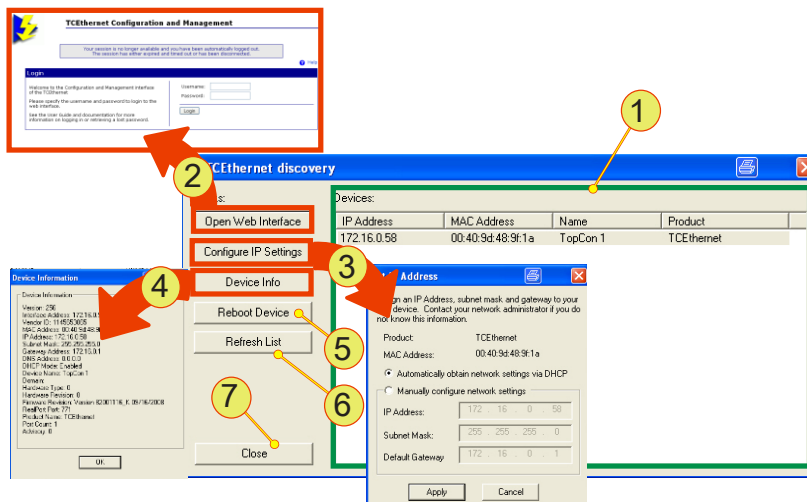
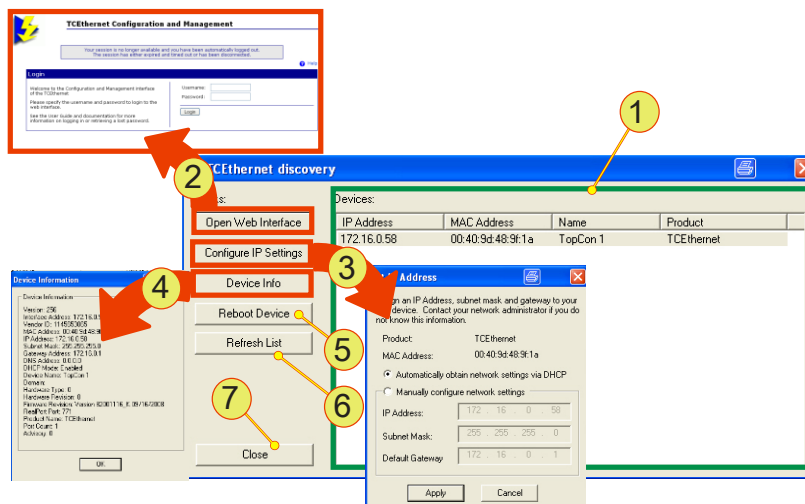


Fig. 62 Setting up the TCEthernet interface

Entries on the TCEthernet Interfaces submenu	
1	<p>List</p> <p>Indication of the IP address, MAC address and the name (if one has been assigned). TCEthernet is the product name for the Ethernet card. Update the list using the button -6-. Selected power supplies (rows) can be edited in -2- and -3-.</p>
2	<p><Open Web interface>, button</p> <p>Opens in your web browser a configuration page from the Ethernet card manufacturer. You can obtain online help in English using the “Help” link. Access data: User: administrator Password: kilowatt</p>
3	<p>“Set IP Address”, dialog box</p> <p>Configuration of the Ethernet card selected in -1-. You can select between the manual and automatic allocation of an IP address. Please contact your system administrator before you make changes. To apply changes you must reboot the Ethernet card using -5-.</p>
4	<p>“Device Information”, window</p> <p>Network and software version information on the Ethernet interface card selected in -1-.</p>

Continued on next page.



Entries on the TC Ethernet Interfaces submenu (continued)	
5	<Reboot Device>, button Reboots the Ethernet interface selected in -1-. The power supply is not rebooted!
6	<Refresh List>, button Refreshes the list -1-
7	<Close>, button for closing the window.

Table 41 Parameters on the TC Ethernet interface submenu

5.4.8.7. Connecting the power supply to TopControl

The TopControl application automatically connects to a power supply via the Ethernet after it is started.

Pay attention to the following points:

- The serial interface RS-232 is not allowed to be connected directly to a power supply.
- The power supply with the lowest COM port is selected automatically.

Connect a power supply to the TopControl application using the following console command:

```
'C:\Program Files\Regatron\TopControl\TopControl.exe /COMStart=5 /COMEnd=5'
```

In this example communication is with the device with COM port 5. "COM-Start" defines the start of the COM port search range and "COMEnd" the end of the COM port search range.

You can create a desktop shortcut for each power supply with the related console command.

In this way you can access different power supplies with a click of the mouse.

6. Installation and commissioning

6.1. Installation

6.1.1. Transport

TopCon power supplies are always supplied with 2 strong carrying handles (steel sheet). These handles are inserted in the slots in the side of case and make it possible to transport the device easily.



Fig. 63 Attaching the carrying handles to transport a TopCon power supply.

Due to the high weight it is advisable to carry the device between 3-4 people and whenever possible to use a trolley or crane.

Remove the carrying handles after transporting the TopCon power supply and store them in a safe place.

6.1.2. Building in the device

These installation instructions apply to standard TopCon TC.GSS power supplies with a complete case and internal liquid cooling with 3 fans on the rear of the device.

CAUTION Possible damage!

- Due to soiling and foreign bodies at the installation location.
- Due to a build-up of heat.

Avoidance:

- ⇒ The installation location must be free of conductive and aggressive substances as well as moisture.
- ⇒ No foreign bodies such as drilling swarf or screws are to be allowed to fall into the system.
- ⇒ It imperative you observe the minimum distances during installation.
- ⇒ The ventilation openings on the front panel and rear wall of the devices must not be covered or sealed under any circumstances.

Case installation/delivery with case

TopCon TC.GSS power supplies are installed in standard cases or switch cabinets either separately or in multi-unit systems.

In the standard design TopCon TC.GSS power supplies are intended to be installed in standard 19" cases and switch cabinets with an external air flow. In this case they are to be placed on rails or shelves and fastened at the points provided on the front panel.

Number of screws:

- For 9 U devices typically: 6 x screws M6.

On installation in cases or switch cabinets, the following points are to be noted:

- Use robust rails or shelves (from the case/cabinet manufacturer): the cases for TopCon TC.GSS power supplies must be in contact over the full installation depth. At the rear a cross-member is to be installed for additional fastening of the power supplies.
- Suitable transport aids must be used for the installation and removal of the power supplies. E. g. fit the carrying handles supplied in the side walls of the power supplies. The power supplies are to be lifted at these handles.

Cooling

In the standard version TopCon TC.GSS are equipped with internal liquid cooling and 3 fans on the heat exchanger on the rear of the device. For this reason the supply of cooling air is to be ensured while complying with the maximum permissible temperature and humidity.

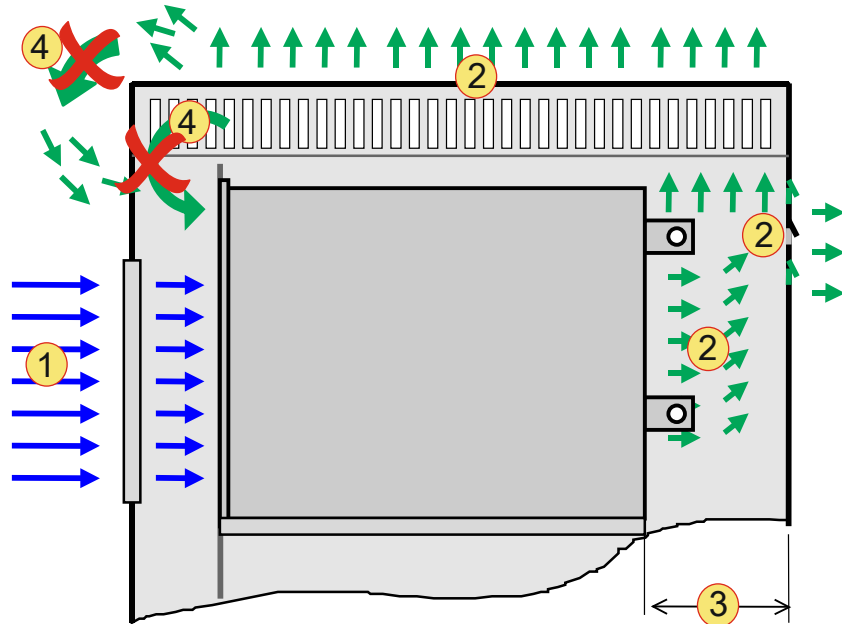


Fig. 64 Scheme of the passage of the air on installation in a cabinet case.

Air cooling	
1	Air supply
2	Air exhaust,
3	Depth to the rear wall, 150 mm
4	Air short-circuit, must be prevented

Table 42 Schematic illustration of the cooling air flow.

For the supply and removal of cooling air, sufficiently large, suitable cases with corresponding inlet and outlet openings for the passage of the cooling air are to be used.

Air supply -1-: The cooling air is drawn in at the front. The air must be supplied unhindered, any air filters necessary are to be installed in the cabinet door or directly on the front of the power supplies. For an adequate supply of air, an inlet opening of at least 300 mm x 300 mm is to be provided per power supply and, if necessary, covered with a correspondingly large air filter.

Air removal -2-: The cooling air discharged from the power supplies at the rear. It is imperative there is adequate clearance for the passage of the air: at least 150 mm deep -3- over the full width of the power supply.

The cooling air can be discharged via the roof and/or rear wall. During this process an "air short-circuit" -4- must be avoided.

(Directly drawing back in discharged cooling air)

Liquid cooling

In the case of TopCon TC.GSS power supplies with water-water heat exchangers that you always provide enough space for the connections for your cooling system within a switch cabinet.



Further information in chapter 5.2.1, Seite 70.

6.2. Commissioning

6.2.1. General

TopCon TC.GSS power supplies are prepared so that they can be installed, wired and interference suppressed in accordance with the applicable regulations with as little effort as possible. Nevertheless, the responsibility for the compliance of systems and machines with built-in TopCon TC.GSS power supplies remains with the manufacturer of the system or machine.



On the usage of the electrical power supply in certain application areas, the related applicable standards and health and safety regulations are to be followed.

6.2.2. Safety information



WARNING

Possible mortal danger due to electric shock!

Avoidance:

- ⇒ Never connect or disconnect electrical connections while they are live.
- ⇒ Do not open the device if it is in operation, as it contains live parts.
- ⇒ Lay cables carrying high currents using an adequate cable cross-section.
- ⇒ Wait min. 15 minutes!
In the devices built-in there can be dangerous voltages after switching off the mains voltage, as well as in case of loads that store energy.
- ⇒ Only use the devices for the intended application and type of load.
In particular, the mains voltage and load must match the information on the type plate, as well as the settings on the device.
- ⇒ Protection against touching the output current bars!
E.g. by fitting a suitable case.

6.2.3. Electrical connections

6.2.3.1. Electrical installation – general

Prior to installation and commissioning, these operating instructions as well as any other information and instructions are to be read carefully.



WARNING

Possible mortal danger due to electric shock!

- Due to tampering with electrical modules

Avoidance:

- ⇒ The electrical installation is to be undertaken by personnel with electrical training.
- ⇒ Never connect or disconnect electrical connections while they are live.

General check

The correlation of the modules and documentation supplied must be checked:

1. Do the type plates match the order and delivery documentation?
2. Are the device nominal data suitable for the intended application?
3. Do the cables/connector supplied match the intended connections?

During the installation work, pay particular attention to the following:

1. Never connect or disconnect electrical connections while they are live!
2. Lay cables carrying high currents using an adequate cable cross-section as per VDE0110!
3. Ensure correct earthing of each power supply to a common PE rail!
4. It is imperative cable shields are connected via the cable clamps and/or connector cases to earth or the case on the power supplies using large area connections!
5. Follow measures for compliance with EMC regulations in the following section on electromagnetic compatibility Seite 118.
6. Provide safety shutdown feature (EMERGENCY STOP/interlock) and test it!

Electromagnetic compatibility

TopCon TC.GSS power supplies have interference protection and suppression filters on all power and signal connections such that, on correct installation, compliance is achieved with the applicable IEC and EN standards in relation to interference.

The following standards are applicable:

- Interference immunity: EN 61000-6-2
- Interference emission: EN 61000-6-4

For the interference protection components to be able to perform their function, the following conditions must apply:

- Large area earthing suitable for EMI.
- Shield mains and load connection.
(Depending on load and installation situation)
- Connect both ends of shields to earth.
(Depending on load and installation situation)

Interference immunity

The system must be fully earthed (encompassing all parts) and earthed suitable for EMI.

Correct earthing and shielding of the cable connections are key elements for interference immunity.

- All cable shields must be connected to earth potential at both ends using large area connections.
- Ideally shielded connectors are used that are earthed directly via the earthed sockets on the electrical power supply.
- Star topology earthing (suitable for EMI) of the device.

Interference suppression

TopCon TC.GSS power supplies have integrated interference suppression. For the interference protection components to be able to perform their function, the following conditions must apply:

- Large area earthing suitable for EMI.
- Shield mains and load connection.
Depending on load and installation situation.
- Connect both ends of shields to earth.
Depending on load and installation situation.

6.2.3.2. Mains connection

The mains connection is made via the terminals L1, L2, L3 and PE. The N conductor is not used and any direction of rotation is acceptable.

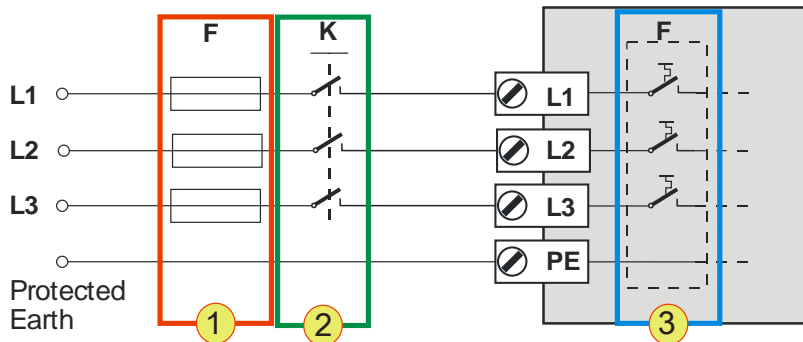


Fig. 65 Circuit diagram – mains connection to the TC.GSS power supplies.

Protection of the TopCon power supply

- **Circuit breaker F -3-**
The internal circuit breaker is designed for the related current and power consumption of the TopCon power supply.
- **External main switch K (option) -2-**
The external main switch is mostly used for devices in a multi-unit system in a switch cabinet.
- **Fuse F -1-**
In case of cable lengths over 3 m, a fuse must be included in the circuit in accordance with VDE636. The rating is to be selected as appropriate, see Table 43, page 119.
- **Cable cross-section**
The external cables must have the necessary cable cross-section, see Table 43, page 119.

Mains connection/ mains voltage				
Fuse				
400 V _{AC}	25 A	35 A	50 A	80 A
Connection cross-section				
400 V _{AC}	10 mm ²	10 mm ²	16 mm ²	25 mm ²

Table 43 Specification of fuse and connection cross-section.

Usage of an earth leakage circuit breaker

If you want to use an earth leakage circuit breaker, please take note of the varying requirements for protection against fire and the protection of individuals.

Regatron recommends the usage of an earth leakage circuit breaker sensitive to AC and DC leakage currents.

6.2.3.3. DC connection/load connection

The output connections are laid to the rear side of the device as current bars.

For the load connection you must pay attention to the following aspects:

- Use a cable cross-section to suit the device power and nominal voltage. (See Table 44, unten.)
- Screw cable to current bars using cable lugs
Hole diameter: 9 mm

Follow the standards applicable to the related application and type of cable laying. The values in the table are only a recommendation.

Nominal voltage on DC side	Cross-section [mm ²] – cable on DC side	
	20 kW device	32 kW device
50 V	95	150
100 V	70	70
200 V	35	50
500 V	16	25
1000 V	6	10
1200 V	6	10

Table 44 Cross-section sizing for the load cable as a function of the output voltage.

For cable lengths of more than 5 m the next size cross-section up should be selected to keep the voltage drop over the load cable in limits.

6.3. Switching on and off a TopCon power supply

6.3.1. Prior to switching on for the first time

Prior to switching on for the first time, the following points are to be checked:

- Does the information on the type plate match the mains connection and load?
- Mains connection correctly wired?
Adequate cable cross-section used?
For further information see chapter 6.2.3.2, page 119.
- Loads connected with correct polarity?
For further information see chapter 6.2.3.3, page 120.
- Control signals connected correctly?
For information on X101/X102 see chapter 4.3.2, page 42.
- For information on X105 see chapter 7.2, page 127.
- Interlock inhibit wired?
For further information see 4.3.3, page 44.



Preparing interlock and communication bus correctly

- Connect the control interface (X105) to the 25-pin dummy plug (device rear side)
 - ↳ The CAN bus for the device communication is connected.
 - ↳ Situation: no RCU (Remote Control Unit) available.
The communication and interlock interface (X101) on the rear side of the TopCon power supply is terminated using the “Interlock and CAN-Term” dummy plug (9-pin) (device rear side).
 - ↳ Situation: RCU (Remote Control Unit) available.
Connect the connection cable to the communication and interlock interface (X101) on the rear side of the TopCon power supply. The other end is connected to the RCU interface (X101). The “Interlock and CAN-Term” dummy plug is connected to connector X102 on the RCU. (Device rear side)

6.3.2. Switching on and off a TopCon power supply

6.3.2.1. Switching on the device

- Switch on main switch.
On the front of the TopCon TC.GSS power supply in the form of a triple switch.
- ↳ The TopCon power supply is booted.
The signal processor is initialised and a device self-test performed.
- ↳ Can be seen on the HMI/RCU during the login process:
Login: HMI login on the system
System information screen:
The system information screen appears for approx. 5 s and changes to the main screen.
- ↳ At the end of the successful start process, the green “Power” LED on the front of the device illuminates.

6.3.2.2. Switching off the device

- Switch off the device via the main switch.
- ↳ The shutdown process is indicated on the front of the TopCon power supply as a running light on the STATUS LED.
The running light continues until the internal energy stores are discharged.

6.3.2.3. Device self-test

The duration of the device self-test is approx. 5 seconds. In multi-unit operation the system is also configured and the communication between the power supplies connected checked for correct function.

Self-test reports status: "OK".

- READY light emitting diode (green) illuminates continuously.
- The device is ready.
- State machine changes to the "READY" state.
For further information see chapter 4.3.6, page 49.

Self-test reports status: "Error".

- Error light emitting diode (red) illuminates or flashes.
Flashing code on the ERROR light emitting diode indicates the reason for the error.
- State machine changes to the "ERROR" state.
For further information see chapter 4.3.6, page 49.
- If the state machine remains in the "ERROR" state after a repeated start attempt, look for the reasons for the error using the "TopControl" application and take the necessary corrective measures.

Parameterisation



If possible do not make any changes to the factory settings, as the factory settings take into account your needs, the operation foreseen and your individual applications in the majority of cases.

If you nevertheless need to make application-specific settings, you can make them using the TopControl application from your PC.



However, prior to changing the settings we recommend undertaking the function test described in the following and only then changing the settings. In particular for monitoring values, ramp functions or controller settings.

6.3.2.4. Function test

Condition for the function test:

- Mains voltage switched on.
- Connected load.

Vary the procedure depending on which interface you use.

- With analogue interface X105

The control signal VOLTAGE_ON can be applied from a possible input device (e.g. PLC, 12 V_{DC} power supply) via the interface X105. Set values can also be defined via this interface.

For further information see chapter 7.4.3, Seite 160.

- With the HMI (option)

Set values can be defined via a rotary switch on the related menu.

Further information from chapter 7.3.4, Seite 135.

- With the RS-232 interface

In combination with a PC and the TopControl application the set values can be defined on the <CONTROL> tab and the device switched on.

For further information see software manual chapter 7.2.5, page 131.

Check the output voltage or current to ensure it matches the set values.

Please note that, depending on the configuration of ramp functions, the set values specified may in some circumstances only be reached after the related ramp functions/time have been completed.



Error-free state

After you have set the set values, the following occurs in the error-free state:

- The output is switched on and regulated to the related set value defined.
- The device is in the state: RUNNING,
One CONTROL LED illuminates depending on the controller that is providing the limiting.
CV for voltage controller
CC for current controller
CP for power controller

Error state

In the error state a flashing error code is output on the front via the CONTROL LED.

If there is no output voltage at the device, check the interlock circuit using the related dummy plugs.

For further information see chapter 4.3.3, Seite 44.

7. Device operation

7.1. Interface hierarchy

In principle, all interfaces have the same priority, i.e. control can be transferred to another interface at any time.

An exception is the interfaces CANOpen, USB and GPIB.

There is an interface hierarchy during the power-up process. Depending on which interface was saved previously in the device as “activated”, control is superimposed via the system state. Settings from an interface lower in the hierarchy can be overwritten by a interface higher up in the hierarchy.

Interface hierarchy during power-up

1. **HMI/RCU (optional)**

All settings from interfaces lower in the hierarchy are overwritten by the HMI /RCU interface provided this interface is in the active state.

In the case of multi-unit systems with several active HMI /RCU interfaces, the interface that was switched on first takes over the control. If several active HMI are switched on at the same time, the selection is random.

The HMI/RCU interface can be set to “passive” such that it does not make any attempt to take control.

2. **Analogue interface X105**

If the HMI is set to “passive” and there is a high level on pin 20, the analogue interface takes over control.

For further information see chapter 7.2, page 127.

3. **RS-232 (TopControl application)**

If the HMI and the analogue interface are not activated, the RS-232 interface takes over control.

The different interfaces can be selected on this interface using a PC with the TopControl application. It is also possible to transfer set values to the TopCon.

4. **CAN/CANOpen (optional) and USB (optional) as well as GPIB (optional)**

If the CAN/CANOpen interface is allocated the function of exclusive control over all interfaces, it is first in the hierarchy.

Exclusive control means that a change in the interface configuration via other interfaces is no longer allowed and the analogue interface is switched off.

HMI/RCU settings are overwritten.

Further information can be found in the CANOpen instructions.



7.2. TopControl application

7.2.1. Software use and restrictions

The user-friendly TopControl operating and service program is included in the delivery of a device of the TopCon series.

It makes communication with the TopCon device possible. The connection is made via the RS-232 serial interface from a PC and its Windows operating system.

The functionality of TopControl includes:

- Switching the energy flow on and off, from and to the load.
- Setting the reference/set values.
- Indication of the actual values.
- Indication of warning and error states. (Including the error history)
- Display of further information on the TopCon device.
- Software oscilloscope: "Scope". Recording and analysis of various variables (set values, actual values, system status etc.).
- Configuration of multi-unit operation.

By means of a user concept it is possible to access advanced functionality in password-protected levels:

- Online access to PID control parameters
Adaptation of the control characteristics of the mains unit to the load-specific situation.
- Linear ramp functions.
Programming of linear ramp functions for voltage activation and set value steps (set value gradient limiter).
- Setting the limit values.
- Adjustment, modification of internal system parameters.
- Reading the version states of the software.
- Firmware update.

7.2.1.1. Control of the following device series

TopControl software and the TopCon device series	
TC.P	Programmable DC power supply
TC.GSS; TC.GSX; TC.GXS	Programmable grid-tie source sink Programmable DC power supply Programmable regenerating DC sink
TC.DSS	Programmable DC power supply
TC.LIN, TC.LIN.SER	Programmable DC power supply Integrated linear post-processor
TC.P.LIN, TC.P.LIN.S3R	Programmable DC power supply Integrated linear post-processor
TC.MAC	Master Array Controller

Table 45 TopCon device series that can be operated with TopControl.

Adapted scope of operation of the software

The scope of operation of the software is determined by the scope of operation of the connected device.

- It is possible that certain tabs will not be displayed.
- It is also possible that certain input and selection menus cannot be operated.

7.2.2. Installation of the software

TopControl is supplied with an installation program. Follow the instructions in the installation program, which will correctly install the application on the Windows system.

An older version of TopControl on the computer will be uninstalled first, and then the new version will be installed.



If older versions of the TopControl software are not uninstalled automatically, the software must be uninstalled manually. For this purpose use the operating system's uninstall wizard.

7.2.3. Connection between the software and a TopCon device

The standard connection between a computer with the TopControl software and a TopCon device is via an RS-232 interface (standard).

CAUTION Possible damage to the RS-232 interface due to:

- Current spikes and static charging.

Avoidance:

- ⇒ Before making the mechanical connection, the devices connected via the RS-232 interface must not be charged with a voltage.

Conditions for a successful connection between the PC and the TopControl software and the TopCon device:

- 1:1 RS-232 interface cable (commercially available)
The interface cable is included in the items supplied with the mains unit.
- The Rx and Tx data wires are not crossed.
- Connection of the PC's COMx serial interface to the mains unit's RS-232 serial interface.
- The mains unit must be connected to the electrical supply system and the circuit breaker switched on.

7.2.4. Start/communication with the TopCon mains unit

Procedure for establishing communication

- Switch on the mains unit.
- Start the TopControl PC software.
- ↳ The software searches for the COM ports from port 1 ... 255. A connection is made automatically to the first TopCon power supply connected via the serial interface.
- If the TopCon mains unit is not detected by the TopControl application, the following message window appears.

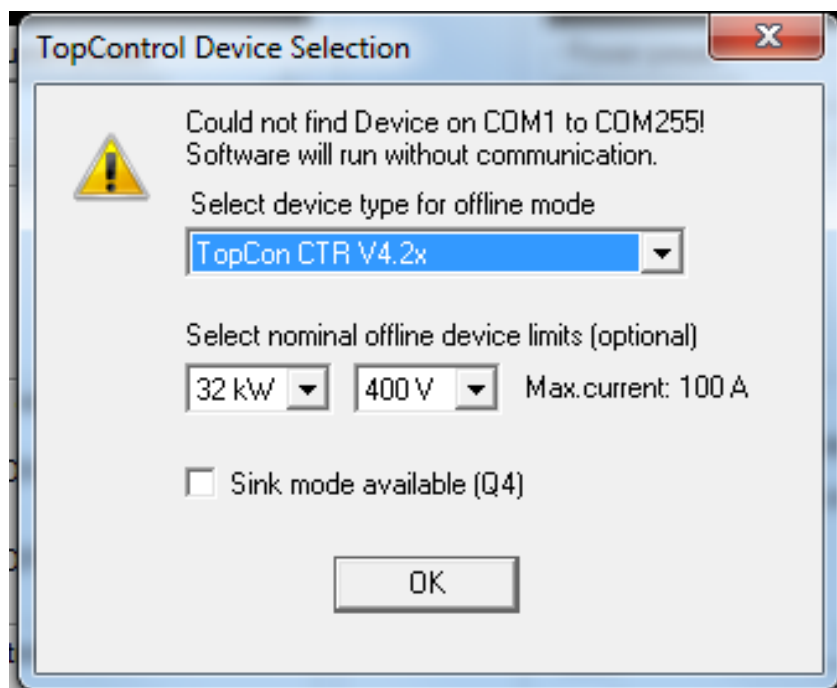


Fig. 66 Message window, when TopControl does not recognise the TopCon device.

- ↳ The software is run in the Offline mode as soon as you accept the message using the <OK> button.
- ↳ Check the RS-232 connections!
- ↳ Is the interface perhaps in use by another program or another instance of TopControl?
- ↳ You can also use a Command Line with appropriate parameters, in the control Panel, to directly connect to the desired power supply.
Example: For a direct connection to a device via Com-Port 5
'C:\Programme\Regatron\TopControl\TopControl.exe
/COMStart=5 /COMEnd=5'
where COMStart = start of search and COMEnd = end of search.
- ↳ If the connection problem persists, please contact Regatron support.



If the communication between the TopControl software and the TopCon mains unit fails, the connection can be re-established manually.

Procedure after communication failure

- On the menu bar select <Connect> on the <File> menu.
Or restart the TopControl application.
- ↳ Communication is re-established.

7.2.5. Find the software manual

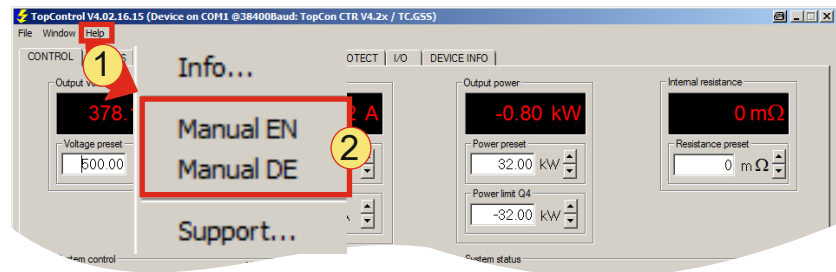


Fig. 67 Menu bar of the Software - Help menu

- Open the Submenu <Help> -1- in the menu bar.
- Select the desired manual item,
to open the manual with file-type: pdf
DE: German language manual
EN: English language manual

7.3. HMI and RCU

7.3.1. Case designs

The HMI and RCU are available in three different forms



Fig. 68 Installation forms for the control unit (HMI/RCU)

Case designs for HMI/RCU	
1	HMI, Human Machine Interface Directly built into the front panel on the single TopCon power supply.
2	RCU front panel, Remote Control Unit Built into a system cabinet, as front panel with 2 U.
3	RCU device, Remote Control Unit Remote Control Unit is built into a dedicated case with 2 U.

Table 46 HMI/RCU - different forms

7.3.2. Short description/terminology

Function of the Human Machine Interface (HMI), option

Clear system control is made possible by the indication on the display via text menus. Along with the entry of system parameters, the system status is also output.



HMI devices directly installed in the power supply are not necessarily responsible for the display and entry of the data for the device. In principle all HMI devices in the multi-unit system only display the overall system parameters.

Function of the Remote Control Unit (RCU), option

RCU devices have the same functionality as HMIs, they are a device variant with a dedicated case.

In addition, the RCUs can also have an interlock switch on the front.

Function

As per the analogue interface, using the HMI reference values such as current, voltage and power can be specified, the voltage switched on/off and warnings and errors acknowledged.

In addition, the HMI provides the following features:

- Plain text indication of errors and warnings.
- Error thresholds for overcurrent and overvoltage.
- Adjustment of the bandwidth of the analogue inputs and outputs (set and actual values).
- Linear internal resistance simulation.
- Selection of the active interface (analogue, HMI or RS232).
- Permanent storage of the selected settings (HMI specific settings as well as system settings).
- Setting the function and characteristics of the Versatile Limit Switch (VLS).

With TFE (function generator) option:

- Loading/activation of a function sequence in the flash.
- Changing function generator settings (Note: a user-defined function can only be changed using the TopControl application)

Multi-unit system

On usage in a multi-unit system, the data are forwarded from the master to the slaves and in this way an entire multi-unit system can be operated from a single HMI unit. Depending on the reference values required, the related data are forwarded via the internal communication interface (CAN bus, X101/X102) to the slaves and automatically implemented there.

In the opposite direction (= from the slaves to the master) various items of information, in particular the error and warning data are forwarded and output there.



HMI devices directly installed in the power supply are not necessarily responsible for the display and entry of the data for the device. In principle all HMI devices in the multi-unit system only display the overall system parameters.

HMI identification

All HMI or RCU must be equipped with a unique identifier (ID). Important for the sequence:

- The identifier sequence must start with 1 (for master).
- The identifier sequence must be contiguous.

7.3.3. Technical data on the HMI

The HMI comprises, as an interface component, inputs and outputs and the support interfaces: communication and electrical power supply.

Technical data on the HMI/RCU	
Communication	Communication bus Internal proprietary based on CAN Version: V2.0 B (communication with electrical power supply, RCU via interface X101)
Electrical power supply	Internal (HMI) or via RCU connection RCU connection cable (communication and supply cable)
Controls	For further information see Table 48, Seite 135.

Table 47 Technical data on the HMI/RCU

7.3.4. Operation of the HMI (option)/RCU (option)

7.3.4.1. Controls on the HMI/RCU



Fig. 69 Controls for the optional HMI (or the RCU).

Standard controls (cf. Fig. 12)	
1	<p>LC display</p> <p>Indication of the actual device settings and various menus 160x80 pixels, font: black, background: blue-grey constant LED background lighting, contrast can be selected Buzzer</p>
2	<p><JogDial>, rotary selector switch</p> <p>Mechanical rotary encoder with detent and integrated button. For the selection of menu items and scaling of parameters.</p>
3	<p><DISPLAY>, button</p> <p>Cycles entire main window.</p>
4	<p><ESC>, button</p> <p>Leaves the actual window and return to the next level up in the hierarchy. Acknowledges error messages and warnings.</p>
5	<p><MENU>, button</p> <p>Opens the main menu.</p>
6	<p><ON/OFF>, switch</p> <p>ON: Green LED illuminated. In the operating state the output value set is present at the device output.</p> <p>OFF: Green LED is off, device output is electrically isolated</p>
7	<p><REMOTE>, switch</p> <p>Change over as to whether the TC.GSS power supply is to be remotely controlled.</p> <p>Deactivated: Red LED off. HMI is ready for entries.</p> <p>Activated: Red LED illuminated. HMI is remotely controlled and indicates the device state.</p>
8	<p><NEXT>, button</p> <p>In case of multiple page menus for data entry used to jump to next page.</p>

Table 48 Controls on the HMI or RCU.

7.3.4.2. HMI/RCU navigation concept

The basic functions of the TopCon power supply can be controlled fully via the HMI or the RCU.

There are 3 different levels in the navigation within the HMI/RCU:

- **DISPLAY level**
 Indication of the most important system data in main windows. On system start the HMI is at the system level. The individual main windows can be opened one after the other using the <DISPLAY> button. Individual menu windows are also displayed at the DISPLAY level depending on the option activated. For an overview of the DISPLAY level, see Fig. 72, Seite 138.
- **MENU level**
 Menu windows have an inverse heading. The main menu window can be opened explicitly using the <MENU> button. Each individual submenu is opened using the JogDial and left again using the <ESC> button. For an overview of the MENU level see Fig. 73, Seite 139.
- **DATA INPUT level**
 You can open the data input level using the JogDial. A text box is selected by clicking the related cursor position. The value can be changed using the JogDial.

Navigation aids within windows

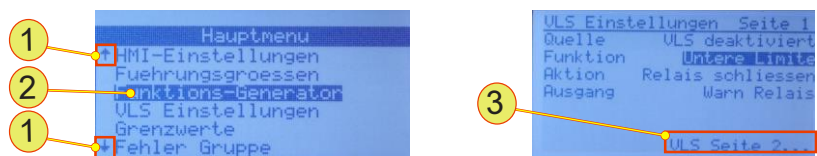


Fig. 70 Window from the DISPLAY level

Navigation aids in windows	
1	<p>Down/up arrow</p> <p>The window content is longer than the DISPLAY. The arrow direction indicates the direction of the hidden information. Using the JogDial you can navigate in the required direction.</p>
2	<p>Cursor</p> <p>Indicates the actual entry position within a window.</p>
3	<p>Links</p> <p>Are mostly in a clearly separate position if there are several pages on a topic or if a window can be left using a navigation item.</p>

Table 49 Navigation within DISPLAY windows

Working with the JogDial (rotary selector wheel)

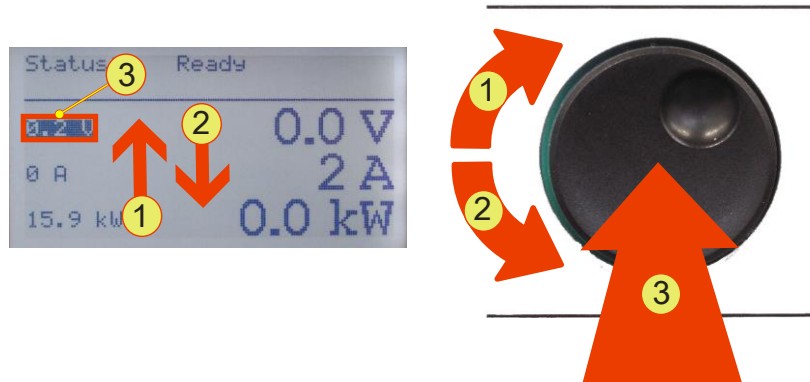


Fig. 71 JogDial for navigating, accepting or setting values

Functions of the JogDial - navigation	
1	<p>Navigate up</p> <p>The cursor on the display jumps from one entry to the next entry down as long as the JogDial is turned. On reaching the entry at the top, the cursor starts to jump from bottom to top again.</p>
2	<p>Navigate down</p> <p>The cursor on the display jumps from one entry to the next entry down as long as the JogDial is turned. On reaching the entry at the bottom, the cursor starts to jump from top to bottom again.</p>
3	<p>Select</p> <p>By pressing the JogDial once the actual selection (cursor position) is selected. Depending on the selection you can define a value or open a submenu.</p>

Table 50 Navigation using the JogDial on the HMI menus

Functions of the JogDial - DATA INPUT level	
1	<p>Increase the value</p> <p>The value is increased as long as the JogDial is turned or until the maximum value is reached.</p>
2	<p>Reduce the value</p> <p>The value is decreased as long as the JogDial is turned or until the minimum value is reached.</p>
3	<p>Accept your entry</p> <p>The value entered is accepted by pressing the JogDial once and the data input mode is left for the navigation mode.</p>

Table 51 Entry of parameters using the JogDial in individual menu windows
Navigation overview – display level

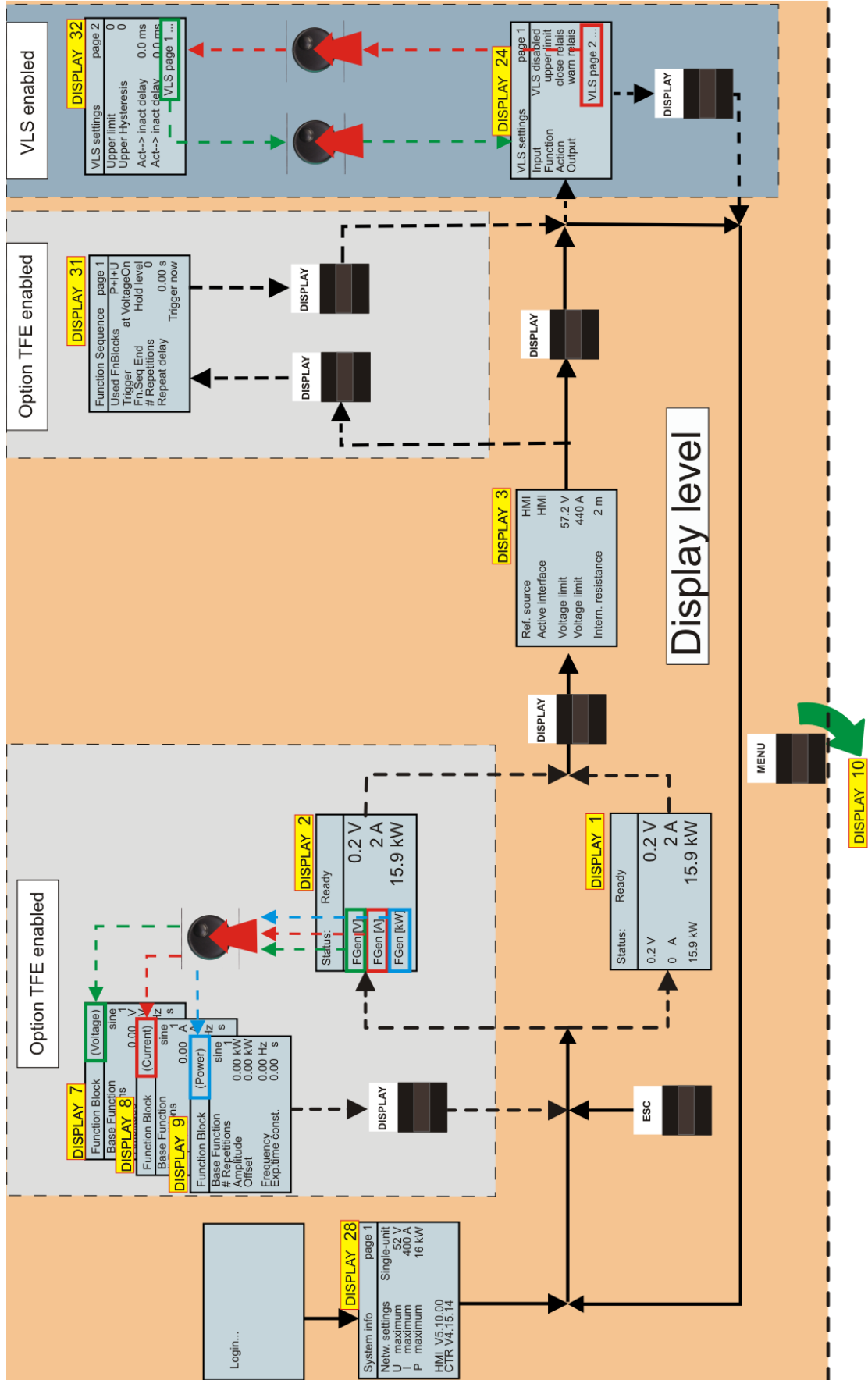


Fig. 72 Overview of HMI operation: DISPLAY level

7.3.4.3. Navigation overview – menu level

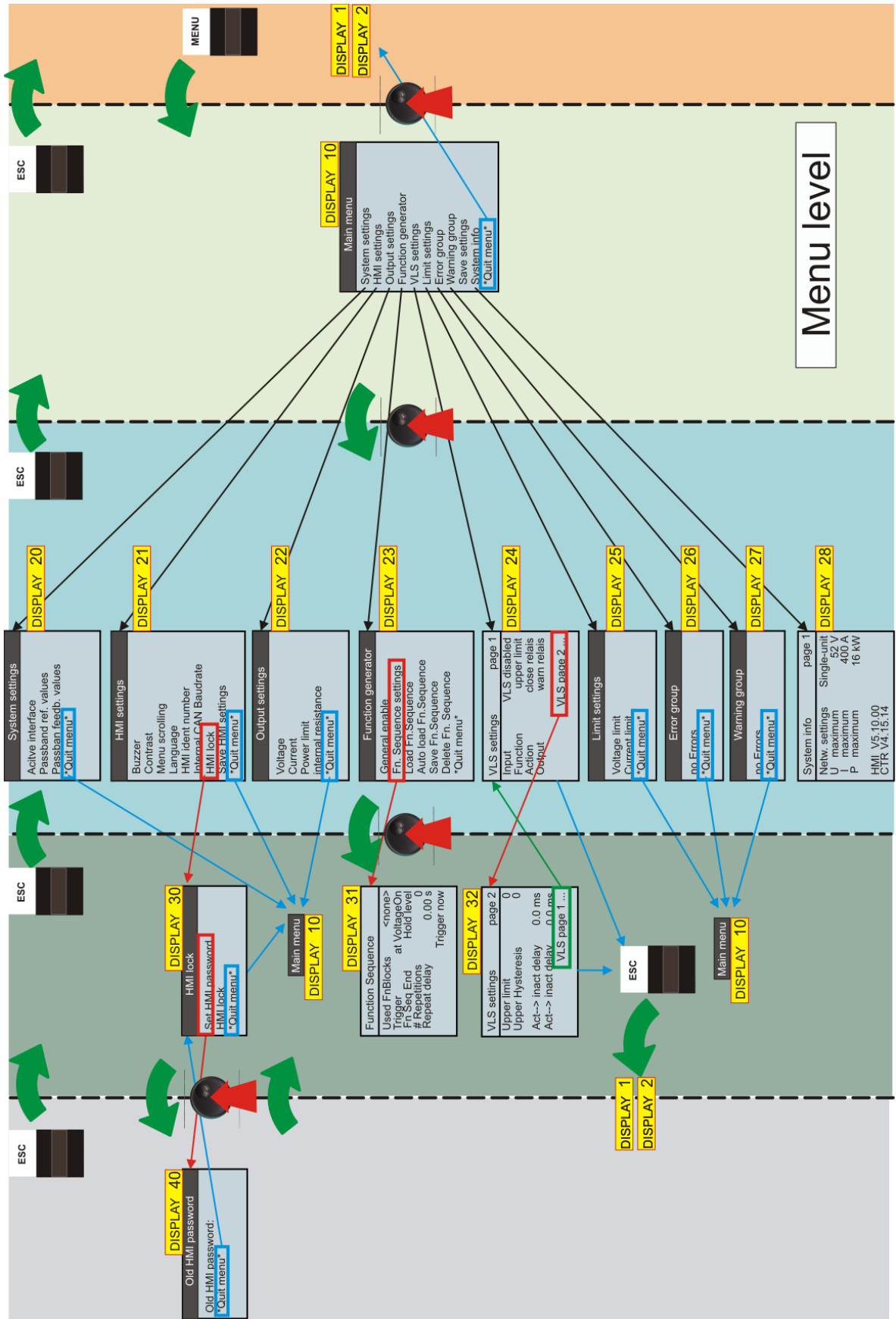


Fig. 73 Overview of HMI operation: MENU level

7.3.4.4. **DISPLAY level – windows and their information**
During the start process

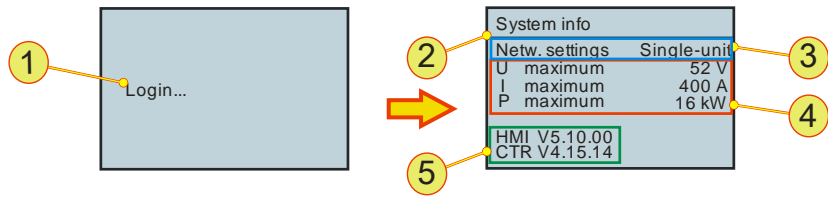


Fig. 74 Login and start information on a single device TP.C.16.52.400.S

Login and system information – DISPLAY 1	
1	Login , read-only indication Duration of indication approx. 5 s, while the TC.GSS power supply is initialised.
2	System info , read-only indication Indicates following key system data -3-, -4-, -5- Duration of indication approx. 5 s.
3	Operating mode , read-only indication Indication of the possible operating modes: Single device Multi-unit system
4	Device parameters , read-only indication Parameters for the maximum values that the device reaches in the hardware. Maximum voltage U_{Max} , maximum current I_{Max} , maximum power P_{Max} .
5	Version information , read-only indication firmware HMI (Human Machine Interface) CTR (TopCon controller board)

Table 52 Login and device status on starting the system

Main screen – DISPLAY 1

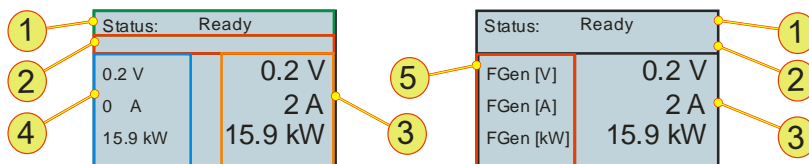


Fig. 75 Main screen without (DISPLAY 1), left, and with enabled and activated TFE option (DISPLAY 2), right

Main screen without/with enabled option TFE – DISPLAY 1, 2	
1	<p>Status line The system state is displayed:</p> <p>Ready: Device is ready for operation, the output is electrically isolated and the power semiconductor is inhibited.</p> <p>Running: Device is in operation, the output is providing power. If a load is connected current flows.</p> <p>Warning: Device is still in operation, warning limit is exceeded, an error may be approaching, e.g. over-temperature. Indication: warning in the message bar -2-.</p> <p>Error: Device is not ready for operation, the output is electrically isolated and the power semiconductor is inhibited. Indication: error in the message bar -2-</p> <p>Stop: Is generated by the TopControl application on an update to the firmware for the TC.GSS power supply. The control electronics are inhibited. The output is electrically isolated and the power semiconductor is inhibited. After the update the device must be switched off briefly via the circuit breaker and then switched back on again.</p>
2	<p>Message bar Short description in case of error messages and warnings. E.g. "Communication" message if the interlock connector is not fitted.</p>
3	<p>Actual values Indication of the actual output values: voltage U, current I and power P.</p>
4	<p>Set values Indication of the reference values: voltage U, current I and power P.</p>
5	<p>TFE display If the function generator option is enabled and activated, set value -4- changes to "FGen". The change in the indication to "FGen" appears as per the function sequence set. See DISPLAY 23, 31 function generator Fig. 82, Seite 148.</p>

Table 53 Parameters on the main screen DISPLAY 1, 2

System screen – DISPLAY 3

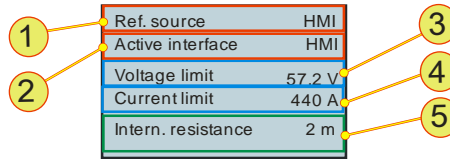


Fig. 76 Parameter entry in DISPLAY 3

System screen – DISPLAY 3	
1	<p>Ref. source</p> <p>Indication of the interface that is specifying the set values for the TC.GSS power supply. (Can e.g. be defined by TopControl.) If a set value source is not defined, the active interface -2- is displayed.</p>
2	<p>Active interface², menu item</p> <p>Selection of the actual interface with which the device is to be operated. The selection has an effect on parameters in the system settings – DISPLAY 20, Table 56, Seite 144.</p> <p>Possible interface selections:</p> <p>Internal: Is not used. RS232³: Interface see paragraph. HMI: Human-Machine-Interface</p> <p>Analog: Interface X105, see paragraph</p>
3	<p>Voltage limit, text box [V]</p> <p>Selection of the voltage U_{limit} from which the device indicates an overvoltage error and the output is electrically isolated.</p> <p>Value range: $0\text{ V} - 1.1 * U_{Max}$; default: $1.1 * U_{Max}$</p>
4	<p>Current limit, text box [A]</p> <p>Selection of the current I_{limit} from which the device indicates an overcurrent error and the output is electrically isolated.</p> <p>Value range: $0\text{ V} - 1.1 * I_{Max}$; default: $1.1 * I_{Max}$</p>
5	<p>Intern. resistance¹, text box [m\square]</p> <p>Default: up to upper value limit 1000 m\square. As an option the value limit can be extended to 32000 m\square.</p>

Table 54 HMI screens and menu (selection)

¹ Can be expanded on customer request.

²Active interface: defines the active control interface: the message “HMI ist passiv” (HMI is passive) means that the HMI is not the active interface or there is more than one HMI in the system and another HMI has the “master role”.

³RS232: the selection of the RS232 menu item activates both the RS232 and also the optional RS422/USB interface. To avoid conflicts it is only allowed to use one interface.

7.3.4.5. MENU level – windows and their information

Main menu – DISPLAY 10

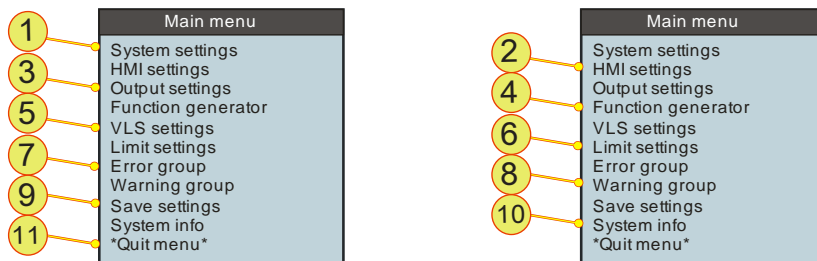


Fig. 77 Main menu DISPLAY10 is used to open windows for entering various options and parameters.

Main menu – DISPLAY 10	
1	System settings , navigation item Opens DISPLAY 20, see Fig. 78, Seite 16.
2	HMI settings , navigation item Opens DISPLAY 21, see Fig. 79, Seite 145.
3	Output settings , navigation item Opens DISPLAY 22, see Fig. 81, Seite 147.
4	Function generator , navigation item Opens DISPLAY 23, see Fig. 82, Seite 148.
5	VLS settings , navigation item Opens DISPLAY 24, see Fig. 84, Seite 152.
6	Limit settings , navigation item Opens DISPLAY 25, see Fig. 86, Seite 154.
7	Error group , navigation item Opens DISPLAY 26, see Fig. 87, Seite 155.
8	Warning group , navigation item Opens DISPLAY 27, see Fig. 87, Seite 155.
9	Save settings , menu item All changes made are saved and are available again on the next system start.
10	System info , navigation item Opens DISPLAY 28, see Fig. 74, Seite 140.
11	*Quit menu* , Return to the DISPLAY level to DISPLAY 1, 2, see Fig. 75 Seite 141.

Table 55 Navigation items on DISPLAY10 for opening other windows.

System settings – DISPLAY 20



Fig. 78 System settings

System settings – DISPLAY 20	
1	<p>Active interface^{1,2}, menu item</p> <p>Selection of the actual interface with which the device is to be operated. Corresponds to parameters of the same name in DISPLAY 3, Table 54, Seite 142.</p>
2	<p>Passband ref. values, menu item</p> <p>Cut-off frequency for the input filter for the reference values is set. Value range: 0.1 Hz – 1.6 kHz, in 15 steps.</p>
3	<p>Passband feedb. values, menu item</p> <p>Cut-off frequency for the output filter for the actual values is set. Value range: 0.1 Hz – 1.6 kHz, in 15 steps.</p>
4	<p>*Quit menu*, Return one level up in the hierarchy.</p>

Table 56 ¹Active interface: defines the active control interface: the message “HMI ist passiv” (HMI is passive) means that the HMI is not the active interface or there is more than one HMI in the system and another HMI has the “master role”.
²RS232: the selection of the RS232 menu item activates both the RS232 and also the optional RS422/USB interface. To avoid conflicts it is only allowed to use one interface.

HMI settings – DISPLAY 21

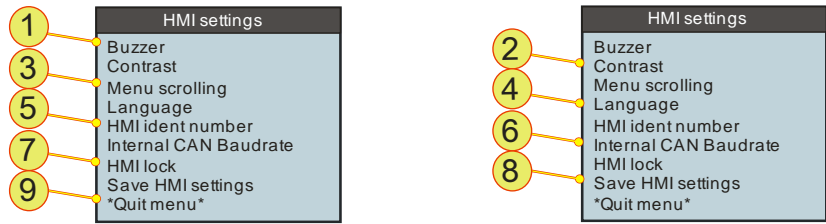


Fig. 79 HMI settings to change the properties of the HMI.

HMI settings – DISPLAY 21	
1	<p>Buzzer, menu item</p> <p>Built-in buzzer outputs a tone in case of an error.</p> <p>Selection: On/Off; On \triangleq Buzzer tone; Off \triangleq No Buzzer tone; default: ON</p>
2	<p>Contrast, menu item</p> <p>Value range: 0 % - 100 %; 0 % \triangleq White; 100 % \triangleq Black; default: 35 %</p>
3	<p>Menu scrolling, menu item</p> <p>Cursor position reacts as per the direction of rotation of the JogDial.</p> <p>Selection: "Clockwise down"/"Clockwise up" default: "Clockwise up"</p>
4	<p>Language, menu item</p> <p>Selection: German/English</p>
5	<p>HMI ident number, menu item</p> <p>Value range: 1 – 16; default: 1 (\triangleq Master)</p>
6	<p>Internal CAN baud rate, menu item</p> <p>The transmission rate on the CAN bus is displayed.</p>
7	<p>HMI lock, navigation item</p> <p>Open the submenu, see Table 58, Seite 146.</p>
8	<p>Save HMI settings, menu item</p> <p>This menu item causes the HMI settings to be saved immediately. Settings are retained also if the device is switched off in the meantime. The display can be left using the <ESC> button or by confirming again using the JogDial.</p>
9	<p>*Quit menu*, Return one level up in the hierarchy.</p>

Table 57 HMI settings

HMI lock and setting password – DISPLAY 30/40

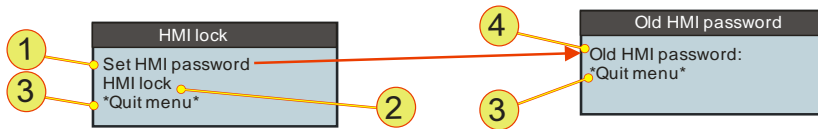


Fig. 80 HMI lock, the HMI can be locked against changes using a password.

HMI lock and setting password – DISPLAY 30, 40	
1	Set HMI password , navigation item If you want to define a new password. Open the “Old HMI password” window – DISPLAY 40
2	HMI lock/HMI unlock , menu item The HMI can be protected against changes. For the locking and unlocking process, the correct password must be entered at the password prompt. Default password: 0
3	*Quit menu* , Return one level up in the hierarchy.
4	Old HMI password/New HMI password First you must confirm the old password before you can enter a new password. Value range: 0 - 32767; default: 0

Table 58 Locking the HMI using a password.
The password comprises a number that can be selected.

CAUTION Do not forget your password!

If you have forgotten your password, it is only possible to reset the password with a hardware reset after contacting support.

Avoidance:

⇒ Make a note of your password and keep it in a safe place!

Output settings – DISPLAY 22



Fig. 81 Entry of the output settings – DISPLAY22

Output settings – DISPLAY22	
1	Voltage , menu item [V] Specification of the set value for the voltage U_{Set} Value range: 0 V – U_{Max} ; default: 0 V
2	Current , menu item [A] Specification of the set value for the current I_{Set} Value range: 0 A – I_{Max} ; default: 0 A
3	Power limit , menu item [kW] Specification of the set value for the power P_{Set} Value range: 0 kW – P_{Max} ; default: P_{Max}
4	Internal resistance , menu item [m \square] Specification of the set value for the internal resistance R_{Set} Value range ¹ : 0 m \square - 1000 m \square ; default: 0 m \square
5	*Quit menu* , Return one level up in the hierarchy.

Table 59 Entry of the output settings – DISPLAY 22
¹The value range can be increased as an option. If required, please contact Regatron support.

Function generator – DISPLAY 23



Fig. 82 Function generator – DISPLAY 23



For information on the properties and a description of the features of the function generator see chapter 5.3.1, Seite 88.

Function generator – DISPLAY23	
1	General enable , menu item Function generator is activated or deactivated.
2	Fn.Sequence settings , menu item Opens the function sequence window.
3	Load Fn. Sequence , menu item The required function sequence number is entered using the JogDial and loaded after acceptance (by pressing JogDial). The process can be cancelled using the ESC button. Value range: 0 - 1000
4	Auto load Fn.Sequence , menu item Automatically loads the function sequence given on each powerup. To save these settings permanently, the *Save settings* menu item must be selected on the HMI main menu.
5	Save Fn.Sequence , menu item The required function sequence number is entered using the JogDial and saved after acceptance (by pressing JogDial). Sequence number does not exist in the memory: There is a confirmation on saving Sequence number has already been saved once: Confirmation prompt as to whether the existing sequence number is to be overwritten. The process can be cancelled using the ESC button Value range: 0 - 1000

The table is continued on the next page.

Function generator – DISPLAY23	
6	<p>Delete Fn.Sequence, The required function sequence number is entered using the JogDial and deleted after acceptance (by pressing JogDial).</p> <p>Sequence number entered exists: Confirmation of the deletion process Confirmation can be closed using <ESC>.</p> <p>Sequence number entered does not exist: Message that the sequence number does not exist Message can be closed using <ESC>.</p> <p>Value range: 0 - 1000</p>
7	<p>*Quit menu*, Return one level up in the hierarchy.</p>

Table 60 Function generator – DISPLAY 23

Function Sequence – DISPLAY 31

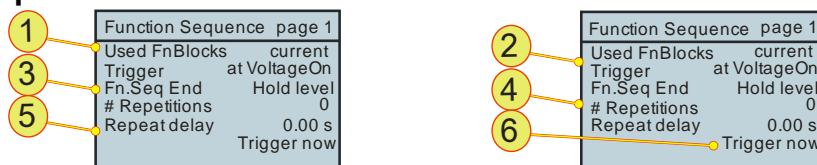


Fig. 83 Settings for the individual function sequences

Function Sequence – DISPLAY 31	
1	<p>Used FnBlocks, menu item Function blocks selected here have a direct effect on the indication in the Display mode. (see especially DISPLAY 2). Possible selections:</p> <p>none: All function blocks are deactivated. Voltage: Voltage function block is active. Current: Current function block is active. Power: Power function block is active. U+I: Voltage and current function blocks are active. U+P: Voltage and power function blocks are active. I+P: Current and power function blocks are active. U+I+P: All function blocks are active.</p>
2	<p>Trigger, menu item Event that triggers the function block selected in -1-:</p> <p>atVoltageOn: As soon as device output is switched live. Manual: Manual triggering via TopControl or HMI/RCU via -6-. Pin on X105: As soon as there is a high level on pin 19 on interface X105.</p>
3	<p>FnSeq End, menu item On continuous repetition -4- FnSeq End has no significance. Selection of the output setting that is present on the output after the end of a function sequence:</p> <p>VoltageOff: The output is electrically isolated. Hold level: Last set values in the function block are present on the output. Std. setvalues: The set values on the active interface are present on the output.</p>
4	<p># Repetitions, menu item Number of times a function block is repeated. Value range: 0 – 65000; 0 ≙ Continuous; default: 0</p>

The table is continued on the next page.

Function Sequence – DISPLAY 31 (continued)	
5	<p>Repeat delay Waiting time between function block repetitions. Value range: 0 - 650 s; step width: 0.01 s ; default: 0 s</p>
6	<p>Trigger now, menu item Manual trigger, starts a function block. (Press the JogDial) Conditions: Trigger -2- is set to "Manual". The device is switched on (voltage on).</p>

Table 61 Function generator – function sequence blocks – DISPLAY 23

VLS settings (page 1) – DISPLAY 24



Fig. 84 VLS settings page 1 – DISPLAY 24

VLS settings page 1 – DISPLAY 24	
1	<p>Input, menu item Selection of the actual values to which the VLS function reacts:</p> <p>VLS disabled: The VLS function is disabled. DISPLAY 5 and DISPLAY 6 cannot be seen on the DISPLAY.</p> <p>Voltage: VLS reacts to the actual value for the output voltage.</p> <p>Current: VLS reacts to the actual value for the output current.</p> <p>Power: VLS reacts to the actual value for the output power.</p>
2	<p>Function, menu item Selection of the thresholds from -1- at which the VLS function reacts:</p> <p>upper limit: VLS reacts to an upper signal threshold.</p> <p>lower limit: VLS reacts to a lower signal threshold.</p> <p>inside window: VLS reacts to signals within threshold window.</p> <p>outside window: VLS reacts to signals that are outside a threshold window.</p>
3	<p>Action, menu item How the switching relay defined in -4- is to react:</p> <p>open relais: The relay is to open when the state set in -2- occurs.</p> <p>close relais: The relay is to close when the state set in -2- occurs.</p>
4	<p>Output, menu item Which relay is to be operated with VLS. warn relais, run relais, OK/alarm relais.</p>
5	<p>VLS page 2 ... , navigation item Continue to page 2 of the VLS settings – DISPLAY32</p>

Table 62 VLS settings page 1 – DISPLAY 24

VLS settings (page 2) – DISPLAY 32



Fig. 85 VLS settings page 2 – DISPLAY 32

VLS settings page 2 – DISPLAY 32	
1	<p>Upper limit or Lower limit, menu item¹ [V], [A], [kW] Whether the upper limit or lower limit can be entered depends on the function selected on VLS page 1 (DISPLAY 24). See Table 62, Seite 152.</p> <p>Input range: Voltage¹: -2*U_{Max} – 2*U_{Max} Current¹: -2*I_{Max} – 2*I_{Max} Power¹: -2*P_{Max} – 2*P_{Max}</p>
2	<p>Upper hysteresis or Lower hysteresis, menu item¹ [V], [A], [kW] Whether the upper hysteresis or lower hysteresis can be entered depends on the function selected on VLS page 1 (DISPLAY 24). See Table 62, Seite 152.</p> <p>Value range: Voltage¹: -2*U_{Max} – 2*U_{Max} Current¹: -2*I_{Max} – 2*I_{Max} Power¹: -2*P_{Max} – 2*P_{Max}</p>
3	<p>Act-> inact delay, menu item [ms] Delay from the active to the inactive state. Value range: 0 ms – 3600 ms; step width: 0.1 ms; default: 0 ms.</p>
4	<p>Inact-> act delay, menu item [ms] Delay from the inactive to the active state. Value range: 0 ms – 3600 ms; step width: 0.1 ms; default: 0 ms.</p>
5	<p>VLS page 1 ..., navigation item Return to page 1 of the VLS settings – DISPLAY24</p>

Table 63 VLS settings page 2 – DISPLAY 24
¹Unit is dependent on the source selected on VLS page 1 Table 62.

Limit settings – DISPLAY 25



Fig. 86 Limit settings – DISPLAY 25

Limit settings – DISPLAY25	
1	Voltage limit¹ , menu item [V] Value range ² : 0 V – 1.1* U _{Max}
2	Current limit¹ , menu item [A] Value range ² : 0 A – 1.1* I _{Max}
3	*Quit menu* , Return one level up in the hierarchy.

Table 64 Limit settings – DISPLAY 25
¹ Value at which the device switches to the error state. (over-voltage/current protection)
² Maximum value is device-dependent

Warning group and Error group – DISPLAY 26/27



Fig. 87 Indication of errors – DISPLAY 26 and warnings DISPLAY 27.

Warning group and Error group – DISPLAY 26, 27	
1	Indication of error status, ready-only indication and navigation item Message with no errors : “no Errors” Not a navigation item, cannot be selected <input type="checkbox"/> Quit message using -3-. Message with error : <Error group><Short description> Navigation item, can be selected <input type="checkbox"/> Message can be clicked using JogDial. A more detailed error description is displayed.
2	Indication of warning status, read-only indication and navigation item Message with no warnings : “no Warnings” Not a navigation item, cannot be selected <input type="checkbox"/> Quit message using -3-. Message with warning : <Error group><Short description> Navigation item, can be selected <input type="checkbox"/> Message can be clicked using JogDial. A more detailed warning description is displayed.
3	*Quit menu* , Return one level up in the hierarchy.

Table 65 Warning and error indications
¹ For a detailed description and information of troubleshooting please see the warning and error list.

7.3.5. Troubleshooting using the HMI

(HMI: Human Maschine Interface)

7.3.5.1. Acknowledging warning and error messages

If error states occur, the electrical power supply changes to the Error operating state.

The electrical power supply is returned to the Ready state by acknowledging the error messages (<Escape> button on the main screen) if the reason for the error has been rectified.

Acknowledging will delete all actual warnings and error messages.

Prior to acknowledging, all messages in the error and warning lists must be analysed. In particular the error and warning sub-groups provide further, more detailed information on the error or the warning.

7.3.5.2. Error during initialisation

Errors that occur during the initialisation are indicated in a separate window. After the error window is acknowledged, the main screen appears. The electrical power supply is in the Error state and the message Login Error is displayed in the message bar on the main screen. After eliminating the reason for the error, a restart (switch off and on at the circuit breaker) is required:

The following initialisation errors are displayed in an error window.

Error	Reason and correction
"No call for login"	<p>The internal CAN connection cable between device and HMI is not correctly connected.</p> <ul style="list-style-type: none"> <input type="checkbox"/> HMI: contact manufacturer. <input type="checkbox"/> RCU: check seating of cable connection between RCU and X101 interface, otherwise contact manufacturer.

Table 66 Error description, HMI initialisation (login error)

7.3.5.3. **Error during operation**

The errors that occur during operation are indicated both in the message bar on the main screen and on the Error group menu – DISPLAY. A differentiation is to be made between descriptions for group errors and detail errors. Detail errors are combined into a group error. Only the group error appears in the message bar, the detail errors can be checked on the menu.



For a complete list of all group and detail errors, as well as the warnings, see the manual error list.

The communication errors listed in the following table are initially displayed in a separate window. After the selection knob or **<Escape>** is pressed, the separate window disappears and the message *Communication Error* appears in the message bar on the main menu. The electrical power supply changes to the *Error* operating state.

Error	Reason and correction
CAN controller error	The CAN controller is in the Bus-Off state.
No data received by HMI	The HMI or RCU is not receiving any data. <ul style="list-style-type: none"> <input type="checkbox"/> Check the connection of the connection cable between power supply and RCU <input type="checkbox"/> CANTERM terminating resistor present on the end of the CAN bus?

Table 67 Error description for HMI errors during operation

In the TopControl application error lists can be further broken down. The error list can also be cleared using the TopControl command “Clear Errors”.

7.3.5.4. **Warnings during operation**

The warnings that occur during operation are indicated both in the message bar on the main screen and on the *Warning group* menu. A differentiation is to be made between descriptions for group warnings and detail warnings. Detail warnings are combined into a group warning. Only the group warning appears in the message bar, the detail warnings can be checked on the menu.



For a complete list of all group and detail errors, as well as the warnings, see the manual error list.

7.4. Analogue interface

Short description of the analogue interface

The operation of the analogue interface is defined by the pin definition for the analogue interface X105.

Set values can be specified by applying a reference voltage to the inputs for U, I, P, R on the analogue interface.



- **Pin definition** of the analogue interface X105
For further information see 10.1.4.6, page 188.



- **Activation** of the analogue interface for remote programming
For further information see chapter 7.4.1, page 158.
- **Utilisation of the Master Array Controller (MAC)**
Operation of the master devices in several multi-unit systems to form a large multi-unit system.

7.4.1. Activation of the analogue interface for remote control

The analogue interface can be activated via all the interfaces in the device, and also via the analogue interface itself.

Activation of the analogue interface without HMI for remote control

The analogue interface is activated via itself.

Activation is via pin 20 on the digital input on the analogue interface by means of the following signals:

- Rising edge from 0 V to 24 V.
- If the ANALOG_REFERENCE_SELECT signal has already reached the high level of 24 V on power-up.

For information on the pin definition see Table 91, page 188.



Pay attention to the interface hierarchy.

Activation of the analogue interface with HMI (option) for remote control

Using the “analogue” selection in the HMI, the control over the system can be transferred to the analogue interface.

If this setting is to be retained on the next system start, to save the settings the RS-232 interface and the TopControl application must be used.

The HMI interface does not have any feature for saving settings.

Activation of the analogue interface via RS-232 using the TopControl application for remote control

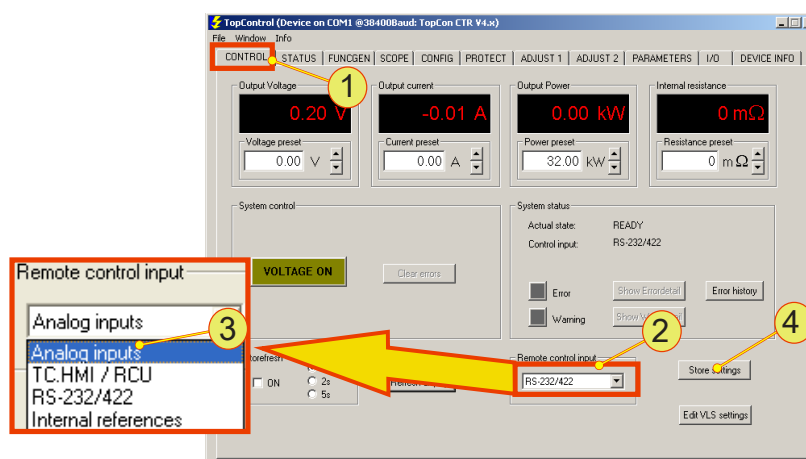


Fig. 88 Activation of the analogue interface via the <Remote control input> list box.

The remote control is transferred to the analogue interface as follows:

- On the <CONTROL> -1- tab, select in the <Remote control input> -2- list box the “Analog inputs” -3- entry.
- If the analogue interface is to be activated the next time the TC.GSS power supply is powered up, you must save the selection using the <Store Settings> -4- button.

7.4.2. Remote programming

Isolation of the signal inputs

All four analogue inputs for current I_{REF} , voltage V_{REF} , internal resistance R_{REF} and power P_{REF} are fully isolated, as a result external isolating amplifiers are not required.

Reference ground

The reference ground is common for all analogue inputs and must be connected to the reference potential of the supplying signal source.

If individual set values are not required, these inputs can be left unconnected or connected to the analogue reference earth.

Digital entry

The set values for current I_{REF} , voltage V_{REF} , power P_{REF} and internal resistance R_{REF} can also be entered digitally via the RS-232 interface instead of using analogue specification.

7.4.3. Remote programming – switching on/off the device

Condition: the interface has been activated.

The control signal `VOLTAGE_ON` controls the power section of the electrical power supply and is coupled directly to the state machine for the device and system control.

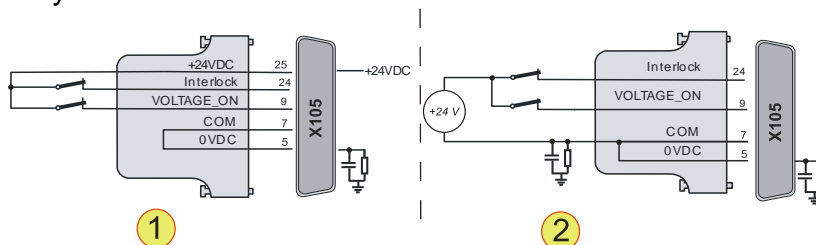


Fig. 89 On/Off control of the TC.GSS power supply.
 -1- External ON/OFF contact with internal voltage source.
 -2- External ON/OFF contact with external voltage source.

Pin	Analogue control	Function
9	VOLTAGE_ON	Device switched on: 24 VDC are present Device switched off: open connection

Table 68 Switching states VOLTAGE_ON



Use dummy plugs supplied!

In the simplest configuration the related dummy plug must be used; this plug is fitted to interface connection X105. For information on dummy plugs see chapter 4.3.2.1, page 42

7.4.4. Remote programming for current and voltage

If this set value setting is not required, these inputs can be left unconnected or connected to the analogue reference earth.

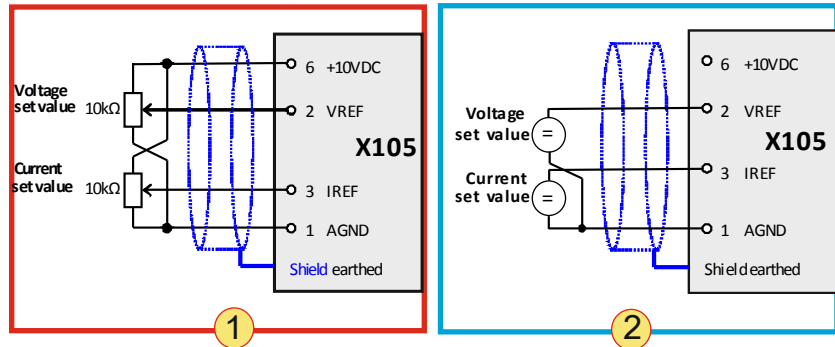


Fig. 90 Analogue set value specification using potentiometers -1-.
Analogue set value specification using external sources -2-.

Pin	Analogue control	Function
2	Voltage V_{REF} 0...10 V or 0...10 k Ω	Voltage $U_{max} = U_{nom} * [0.. 100\%]$ where $V_{REF} \hat{=} [0.. 100\%]$
3	Current I_{REF}¹ -10V ...0...10 V or 0...10 k Ω	Current $I_{max} = I_{max} * [-100\% \dots 0 \dots 100\%]$ where $I_{REF} \hat{=} [-100\% \dots 0 \dots 100\%]$

Table 69 Factory pin definition and value range for the manipulated values V_{REF} and I_{REF} .
¹ Only positive set values can be specified with a resistor (0 ... 10 K Ω).

7.4.5. Power limit and internal resistance simulation

If this set value setting is not required, these inputs can be left unconnected or connected to the analogue reference earth.

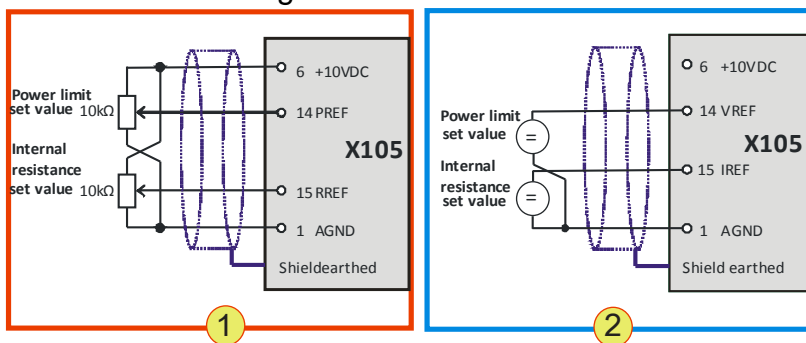


Fig. 91 Analogue specification of power limit and internal resistance. Only positive analogue set values can be specified with potentiometers (0 ... 10 KΩ) -1-. Analogue set value specification using external sources -2-

Standard input values

Pin	Analogue control	Function
14	Power limit P_{REF} 10...0 V or 0 ... 10 KΩ	Output power $P_{max} = P_{nom} * [0... 100\%]$ where $P_{REF} \triangleq [0... 100\%]$
15	Internal res. R_{REF} 0...10 V or 0 ... 10 KΩ	Internal resistance $R_{REF} = 0...1000 \text{ m}\Omega$

Table 70 Factory pin definition and value range for the manipulated values P_{REF} and R_{REF} . Only positive set values can be specified with a resistor (0 ... 10 KΩ).

Internal resistance extension (option)

With an optional internal resistance extension, the same pin definition and specification values apply.



For the power limit the specification is inverted!

In the case the power limit input voltage $P_{REF} = 0 \text{ V}$, there will not be any limiting of the maximum power, i.e. the power limit is set to the (full) nominal power. For this reason the power limit is set correspondingly on operation via pin 14 (P_{REF}).

Changing the power input to bipolar inputs

The output power can be changed to bipolar inputs using a configuration flag.

Power limit P_{REF} : -10 V... 0 ... 10 V ; $P_{REF} \triangleq [-100\% ... 0 ... 100\%]$



If necessary, please contact Regatron support.

Internal resistance input as Q4 parameter input

Using a configuration flag the internal resistance input can be used for nQ4 parameter inputs as follows:

1. See standard resistance input parameters
2. $I_{LimitQ4}$ parameter
 $R_{REF}: 0..10\text{ V} \triangleq 0 \dots -I_{LimitQ4}$;
Where P_{LimitQ} must be specified via TopControl.
3. $P_{LimitQ4}$ parameter
 $R_{REF}: 0..10\text{ V} \triangleq 0 \dots -P_{LimitQ4}$;
Where I_{LimitQ} must be specified via TopControl.



If necessary, please contact Regatron support.

7.4.6. Digital outputs (relay contact)



These relay contacts can be used, e.g., for a Versatile Limit Switch (VLS).

For further information on VLS see chapter 7.4.7, below

As standard the definition of the digital outputs is as follows:

Name	Meaning	X105 Pin no.	Contact type
DIGOUT_1	OK/ALARM	Pin 10, 11	Closed \triangleq OK OK = Device ready for operation
DIGOUT_2	RUN	Pin 12, 13	Closed \triangleq Run RUN = "VOLTAGE_ON"
DIGOUT_3	WARN	Pin 21, 22, 23	Change-over contact WARN \triangleq Warning

Table 71 Standard function of the X105 relay outputs.
Maximum switching current 1 A; maximum switching voltage: 125 V
The rest of the pin definition for X105 is listed in Table 91, page 188.

7.4.7. Versatile Limit Switch (VLS)

7.4.7.1. Description of VLS function

Using the VLS function the following analogue outputs on the X105 interface can be monitored:

- Voltage
- Current
- Power

If programmed limit values are not respected, an output relay is switched.

You can select the type of relay that is operated via the interface X105:

- "Warn" relay (normally open)
- "Run" relay (normally open)
- "OK/Alarm" relay (normally closed/normally open)



For further information see chapter 7.4.6, page 164.

The following VLS functions can be selected:

- Exceeding a threshold
- Dropping below a threshold
- Entering a window
Defined value range is reached
- Leaving window Defined value range is left

Each threshold can also be assigned a hysteresis range above or below a threshold value.

A value of zero will deactivate the hysteresis.

Programmable switching delays help to suppress brief irrelevant transients (settling processes, pulses).

Due to the cyclical digital sampling, rapid changes (duration < 50µs) on the signals monitored may not be detected in some circumstances.

Exceeding or dropping below a threshold

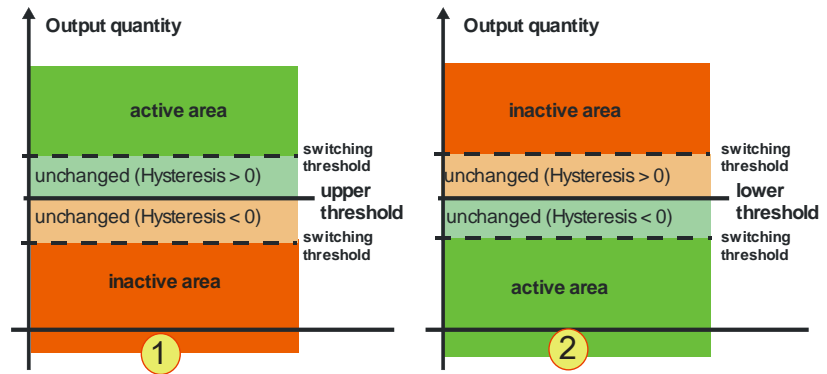


Fig. 92 VLS functions:
Exceeding the threshold -1-
Dropping below the threshold -2-

Entering a window/leaving a window

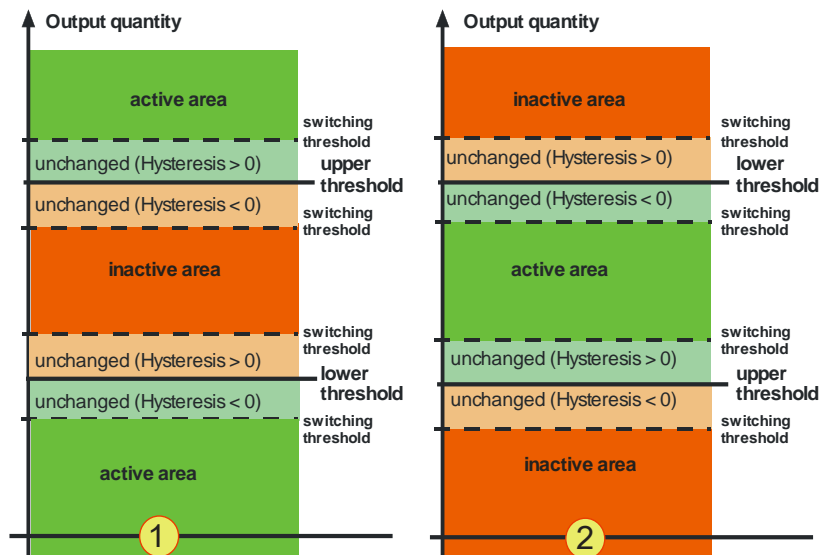


Fig. 93 VLS function:
Leaving a window -1-
Entering a window -2-

Switching behaviour – time dimension

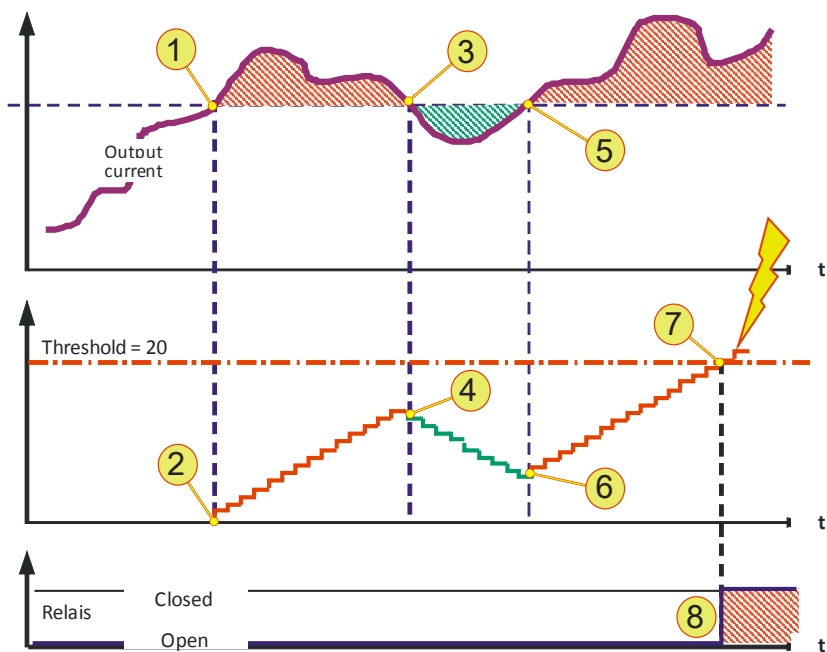


Fig. 94 Explanation of the VLS example (time dimension)

Along with the consideration of the dimension stated above, parameters can be set for the behaviour over time. The switching behaviour for the selected relay is also defined by various (timers) counters that evaluate the VLS state of the TC.GSS power supply.

The following explanatory example from Fig. 94 assumes the active-to-inactive delay = 20 ms the hysteresis set = 0 V.

The current curve exceeds the threshold -1-, as a consequence it is in the active range. The active counter now counts up, as per the limit value set, (“inactive-to-active delay”) -2-.

In this example the current drops back below the (lower) hysteresis threshold -3-. From this point in time the counter counts down -4-. From point -5- the monitored current increases again over the upper hysteresis value and the counter counts up again -6-.

Once the counter has reached the limit value set (as per the delay parameter) -7-, the required relay is closed or opened depending on the configuration -8-.

This process is setup similarly for the opposite direction using the “active-to-inactive delay” counter.

7.4.7.2. Programming VLS in TopControl

VLS can be programmed using the TopControl application supplied (from V4.01.35).

The data are then transferred directly to the TC.GSS power supply. VLS then operates independent of the TopControl application, i.e. continued connection to the PC is not necessary.

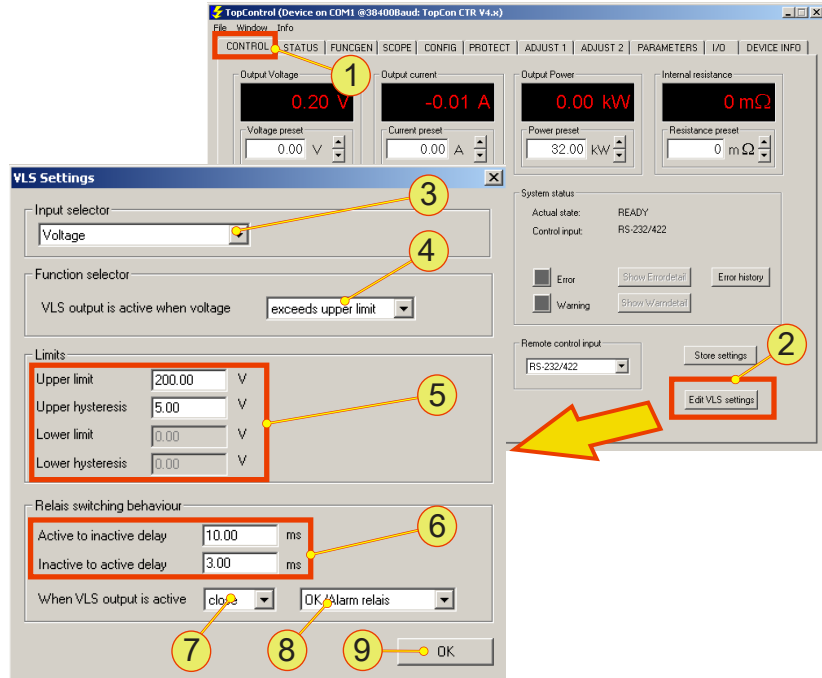


Fig. 95 The “VLS Settings” window is opened via the <CONTROL> -1- tab and the <Edit VLS settings> -2- button.

Window - VLS Settings	
3	<p>Input selector, list box</p> <p>“None VLS deactivated” VLS function is switched off <input type="checkbox"/> All text boxes are grey, no entries can be made</p> <p>“Voltage”, “Current”, “Power” Related text boxes can be edited <input type="checkbox"/> The units change depending on the selection made.</p>
4	<p>Function selector, “VLS output is active when voltage” list box</p> <p>Defines the range in which the relay is activated. The following options are available: exceeds upper limit – Exceeding a threshold falls below lower limit – Dropping below a threshold is inside window – Entering a window is outside window – Leaving a window</p>
5	<p>Limits, text boxes</p> <p>Defines the related thresholds and hysteresis for the selected range. Depending on the selection in -4-, different text boxes are activated.</p>
6	<p>Relais switching behavior, text boxes</p> <p>The adjustable switching delay between the active and the inactive range helps to ignore brief fluctuations in the output value.</p>
7	<p>Relais switching behavior, list box – switching state</p> <p>Selection of whether the relay is to be closed or opened in the active range. The switching state is inverted in the non-active range.</p>
8	<p>Relais switching behavior, list box – relay type</p> <p>The following selection is possible: “OK/Alarm” relay (normally open/normally closed), “Warn” relay (normally open), “Run” relay (normally open).</p>
9	<p><OK>, button</p> <p>Closes the VLS window.</p>

Table 72 Window for the VLS function.

8. Maintenance

8.1. Maintenance tasks

Determination of the operating hours

The operating hours represent the time during which the supply voltage is present at the device independent of the operating state.

The number of operating hours is indicated in the TopControl application on the <DEVICE INFO> tab, see software manual chapter 7.2.5, page 131.



8.1.1. Maintenance of the hardware

In principle the electronics in the TopCon TC.GSS power supply are maintenance-free.

However, the following components require maintenance depending on the number of operating hours:

- Fans
- Electrolytic capacitors.

8.1.1.1. Fans

The TopCon TC.GSS power supplies contain 3 temperature-regulated, ball bearing mounted fans to cool the electrical and electronic components.

Life-expectancy – fans	
Life-expectancy per fan with an average ambient temperature of 40 °C	40,000 operating hours

Table 73 Life expectancy of electrical fans.

Use a torch and check at regular, intervals with the device switched on, whether the fans are rotating.

8.1.1.2. Electrolytic capacitors

TopCon TC.GSS power supplies have electrolytic capacitors in the DC intermediate circuit.

Life expectancy – capacitors	
Life-expectancy of the electrolytic capacitors with an average ambient temperature of 40 °C	100,000 operating hours

Table 74 Life expectancy of electrolytic capacitors.

8.2. Maintenance of the software and firmware

8.2.1. Version of the TopControl application

The TopControl application is subject to a continuous process of further development.

An update to the latest software version makes it possible for you to use new functions and software improvements.



Fig. 96 Indication of the version of the TopControl application.

Using “Info” on the menu bar you can open a window with the actual version of the application -1- and the version of the function library (DLL) -2-.



You will find further information in “Using the software – menu bar” see software manual chapter 7.2.5, page 131.

Updating the TopControl application

TopControl is supplied with an installation program. Follow the instructions in the installation program, which will correctly install the application on the Windows system.

An older version of TopControl on the computer will be uninstalled first and the new version installed.

If older versions of the TopControl application are not uninstalled automatically, the application must be uninstalled manually. For this purpose use the operating system’s uninstall wizard.

8.2.2. TopCon firmware version



You will find further information in “Determination of the system information” chapter 9.2, Seite 173.

Updating the firmware versions

CAUTION Damage can be caused by the following points!

- If the TC.GSS power supply is updated unnecessarily, the device may cease to function, as gridfiles and firmware update must match.
- A firmware update is not fully completed.

Avoidance:

- ⇒ Prior to a firmware update, contact support to clarify if an update is necessary.
- ⇒ Only update the firmware if necessary.
If your application works without problems, an update is not necessary.

9. Support

You will receive assistance from Regatron support:

- In case of questions on hardware and software, interfaces and maintenance.
- On the procedure in the event of a repair.

Prepare for contacting support!

If you contact Regatron support, you can make the process more efficient with the following information:

- Contact data:
About your company, your sales partner
- System information:
Device type, serial number, description of error, software versions

9.1. Contact information

If you compile the following information in an e-mail and send this e-mail to support in advance, support will then have this information available already when you ring.

Contact data	
1	Name of company The name of your company
2	Contact person Your name or the name of the person responsible for the problem in your company with whom further contact will be made.
3	Contact details E-mail address, telephone number (extension)
4	Sales partner or supplier Name of the sales partners or supplier's company and name of the employee in this company.
5	Any support number, S 12345678 If you have already received a support number or enquiry number for your problem from support.

Table 75 Important contact information for support.

System information	
1	Hardware and software information Software version and firmware version, device serial number or device input and output data for single devices or multi-unit systems.
2	Description of error Information that documents the situation and the state of the system using measured results, logs, scope, screenshots and photographs

Table 76 Important system information for support.

9.2. How to contact support

Regatron TopCon support
 Feldmühlestrasse 50
 CH – 9400 Rorschach
 SWITZERLAND

E-mail: tc.support@regatron.ch

Phone: +41 (0)71 846 67 44

Fax: +41 (0)71 846 67 77

Web: www.regatron.com

9.3. Determination of the system information

9.3.1. Software versions



Fig. 97 Indication of the version of the TopControl application.

In the TopControl application, the actual version of the application **-1-** and version of the function library (DLL) **-2-** are indicated in the “About Top Control” window using “Info” on the menu bar.

Provide this information to support as contact information.



“Using the software – menu bar”,
 see software manual chapter 7.2.5, page 131.

9.3.2. Firmware versions and device information

Device hardware

Information on the device is to be found on the type plate on the rear side of the TC.GSS power supply.

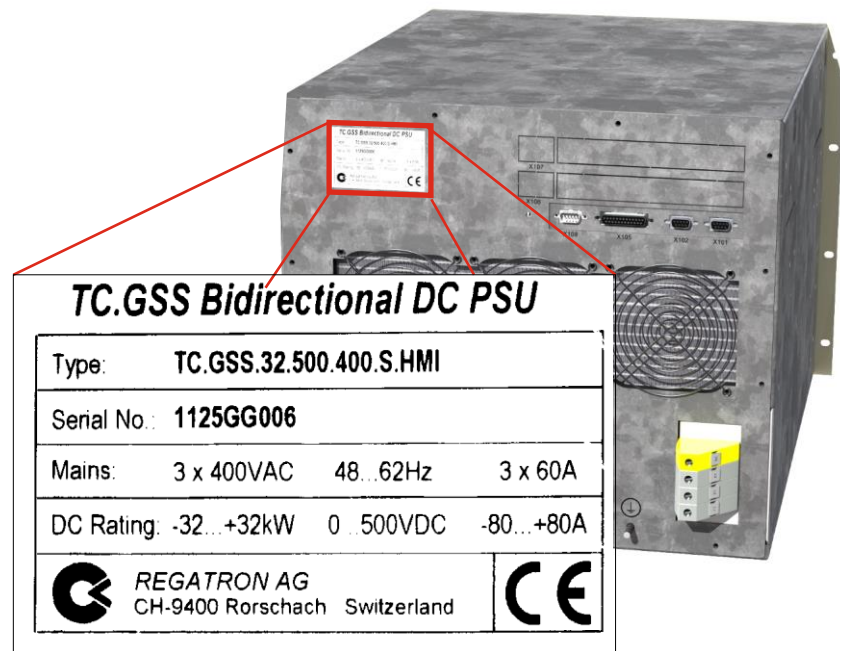


Fig. 98 Example - information on the device type, serial number as well as input and output data on the TC.GSS power supply.

Device hardware and firmware

The <DEVICE INFO> tab contains a large amount of information on individual devices and the multi-unit system, as well as the various firmware versions in the individual device modules.

The best method is to take a screenshot of the <DEVICE INFO> tab and send it to support as part of the contact information.

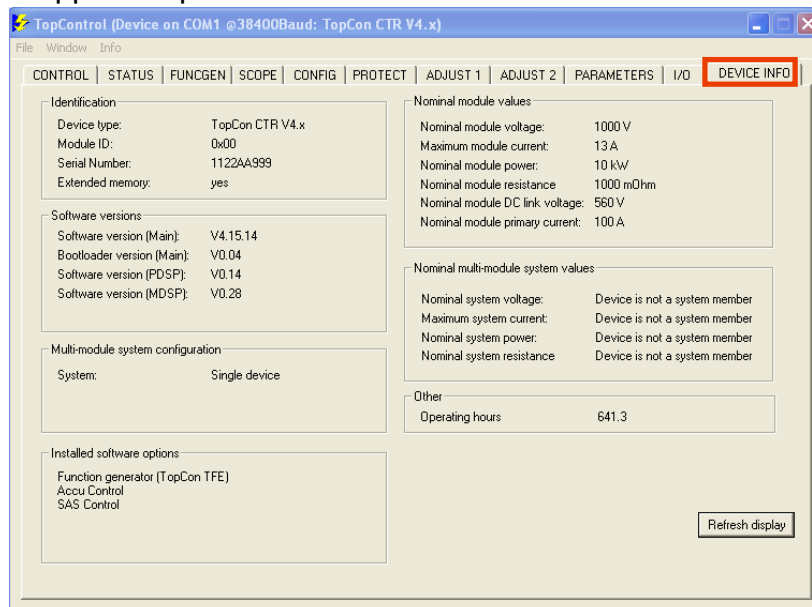


Fig. 99 Example – screenshot of the <DEVICE INFO> tab with all information on device hardware and firmware.



For further information on the <Device INFO> tab, see software manual chapter 7.2.5, page 131.



Alternatively, it is possible to read the software versions for the HMI and controller board as well as the operating mode via the display for the HMI. For further information see chapter 0, Seite 137.

9.4. Enabling software options

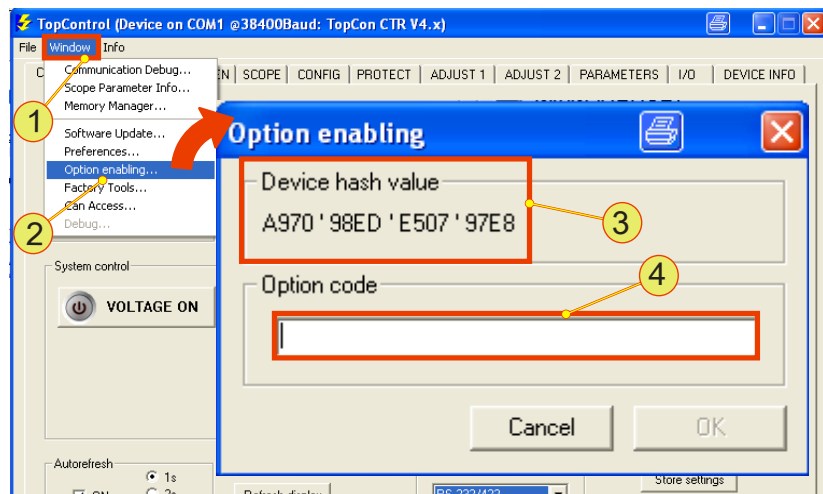


Fig. 100 “Option enabling” window for enabling software options.

Procedure:

- On the menu bar open the “Window” -**1**- menu.
- Click the “Option enabling...” -**2**- submenu item.
↳ The “Option enabling” window opens.
- Send the “Device hash value” -**3**- for the TC.GSS power supply connected to Regatron support.
- You will receive from support an “Option code” that you must enter in the text box -**4**- as soon as possible.
- Accept your entry using the <OK> button.
↳ The software option has been successfully enabled.

9.5. Producing a standard scope

Using the SCOPE function the following signals can be recorded that are useful for diagnostics by support:

- Input and output signals for the actual values and set values Voltage, current, power etc. (digital and analogue)
- Device-internal parameters, such as temperature, controller signals, system state/error signals, intermediate circuit voltage, transformer current, internal 24 V supply, etc.

The procedure is described based on default settings and default signal variables. To be able to make your specific settings, you will find further information in “Scope tab”, see software manual chapter 7.2.5, page 131.

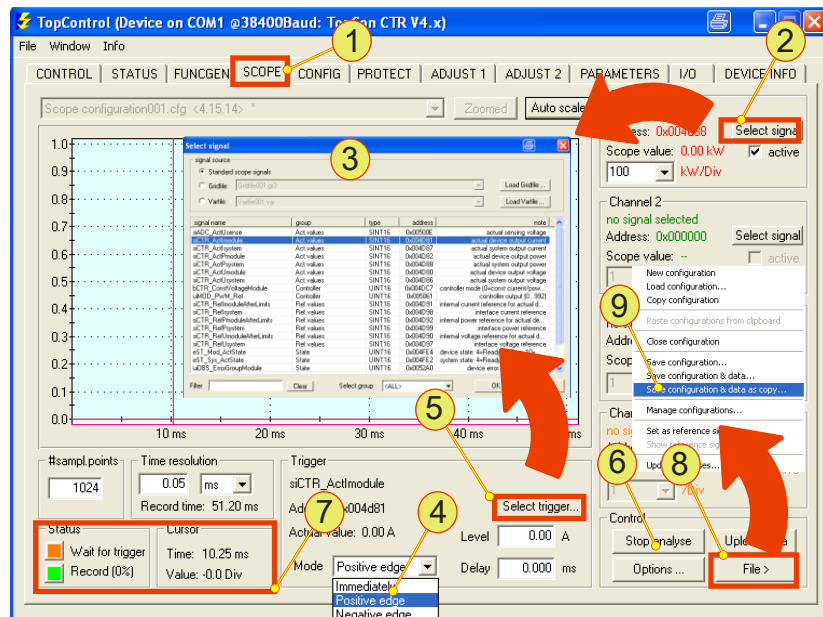


Fig. 101 Overview of the <SCOPE> tab with the controls.

- Open the <SCOPE> -1- tab.
- Using the related <Select signal> -2- button, select the following default signals variables from the “Select signal” -3- window for each channel.

Channel	Variable	Description
1	siCTR_ActUmodule	Output voltage of the single device
2	siCTR_ActImodule	Output current of the single device
3	uiMOD_PWM_Ref	Pulse-width modulation
4	bCTR_ConstVoltageModule	Controller mode

Table 77 Default signal variables for a scope recording.

- In the list box **-4-** select “positive edge”.
- ↳ <Select trigger...> **-5-** button is activated for the entry.
- Using the <Select trigger...> **-5-** button in the “Select signal” **-3-** window, select the trigger signal.
(Here in the example: siCTR_ActUmodule)
- Enter the related trigger level.
- Start the scope recording using the <Start analyse> **-6-** button.
- ↳ The button **-6-** changes function and label to <Stop analyse>.
- ↳ The indication changes in the “Status” **-7-** group.
“Wait for trigger” read-only indication changes to orange.
“Record” read-only indication changes to green.
- ↳ Storage and indication on the scope are automatic.
(Condition: correctly set trigger parameters)
- Save the scope and data using a folder and name of your choice using the <File> **-8-** button and the “Save configuration & data as copy” **-9-** submenu item.
- Send the scope file as part of the contact information to your sales partner or Regatron support using your e-mail client.

9.6. Device return

Use the original packaging to return the device.

If you no longer have the device packaging at hand, you can order new packaging via Regatron support.

9.6.1.1. Packaging sequence – standard packaging

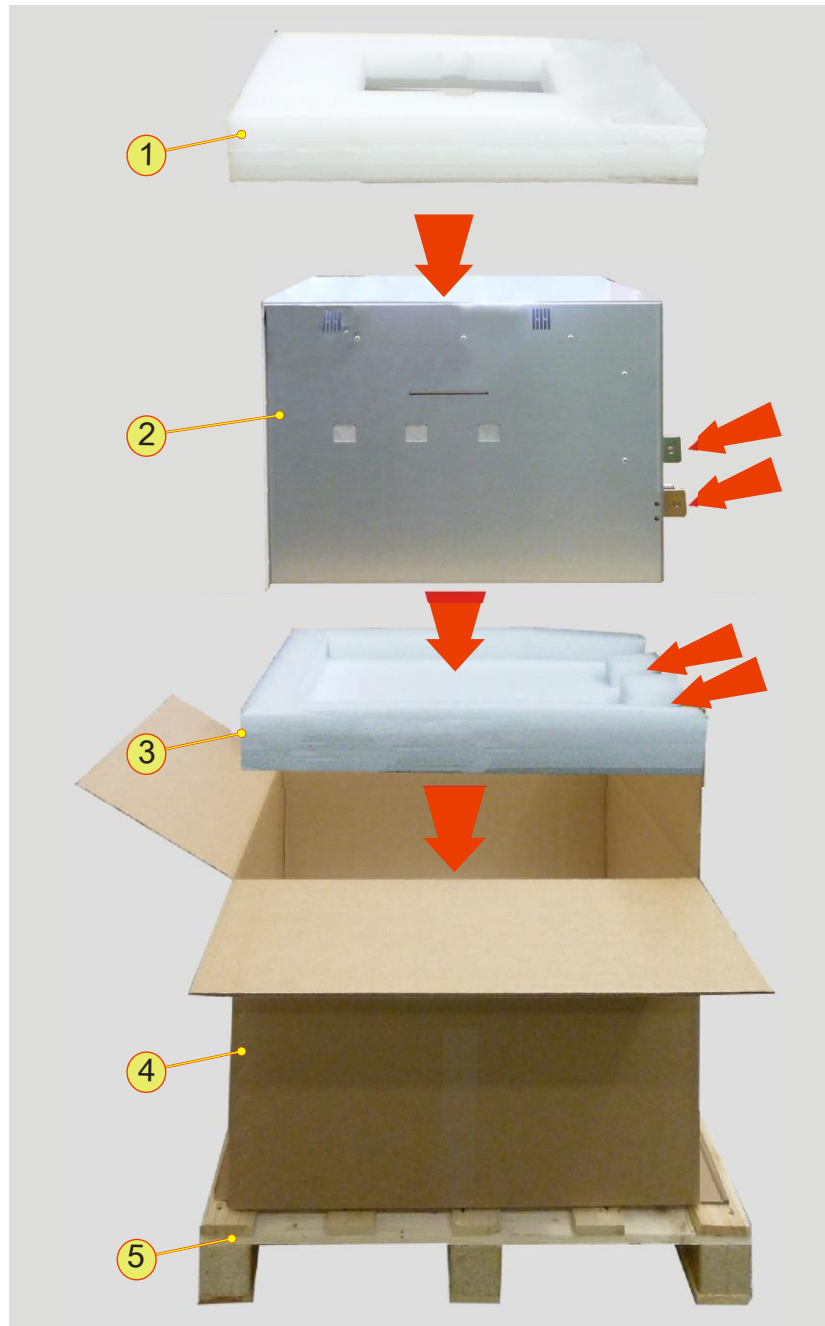


Fig. 102 Arrangement of standard shipping packaging for a TC.GSS power supply with 9 U.

Elements of the original shipping packaging	
1	Cover Upper cover with cut-out for the box of accessories. Varies for 9U and 6 U devices.
2	TopCon power supply with 9U 6 U devices are a little lower.
3	Bottom Lower protective support with space on the rear side for the current bars on the TopCon power supply. Varies for 9 U and 6 U devices.
4	Cardboard box Varies for 9 U and 6 U devices.
5	Transport pallet , disposable pallet 120 x 80 mm The cardboard box is firmly strapped to the disposable pallet.

Table 78 Packaging material for standard packaging.

9.6.1.2. **Optional packaging protection**

For certain transport routes it can be necessary to protect TopCon power supplies against damage with additional transport protection.

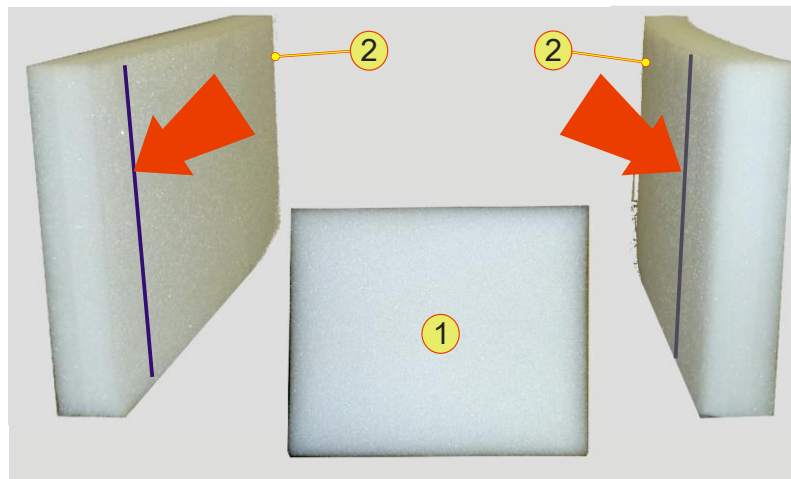


Fig. 103 Additional packaging material.

Optional additional protection	
1	Device front protection Provides additional protection for the front side of the device
2	Side protection The side protection has slits for the protruding front panel on the TC.GSS power supply.

Table 79 Additional packaging material.

9.7. Disposal with due care for the environment



Electrical equipment is too valuable for household waste.

On the disposal of electrical equipment, comply with national laws.

10. Appendix

10.1. Technical data

10.1.1. Mains connection

Device type	TC.P.20	TC.P.32
Permissible mains imbalance	< 3%	
Connection rating	25 kVA	40 kVA
Model 400 VAC (3-phase)	32 A _{eff}	50 A _{eff}
Inrush current ¹	< 15 A	
Nominal current Circuit breaker ²	40 A	63 A
Breaking capacity Circuit breaker ²	10 kA	

Table 80 Electrical parameters for the various TopCon TC.GSS power classes.
For further information please refer to the related data sheet.

¹ At nominal voltage on the mains connection.

² Built-in circuit breaker. For further information on the

10.1.2. Leakage current

The following leakage current events are produced by the correct function of the mains filter.

Leakage current condition	Total leakage current	Frequency range				
		50 Hz	≤ 100 Hz	150 Hz	≤ 1 kHz	> 1 kHz
"Voltage ON" without load	100 mA	1 mA	2 mA	2 mA	3 mA	100 mA
"Voltage ON" with full load	114 mA	5 mA	5 mA	1 mA	6 mA	114 mA

Table 81 Leakage current – Measured result on a TC.GSS power supply with 32 kW XXXX (still needs to be expanded) with no load and with load.



If you want to use an earth leakage trip, use a device with an expanded frequency range.

Please take note of the varying requirements for protection against fire and the protection of individuals.



Regatron recommends the usage of an earth leakage circuit breaker sensitive to AC and DC leakage currents.

10.1.3. Control and regulation parameters

Remote programming	
Analogue operation X105	Input impedance 20 k Ω
Voltage set value	0 – 10 V _{DC} for 0 – 100 % V _{nom}
Current set value	0 – ± 10 V _{DC} for 0 – ± 100 % I _{max}
Power limit ⁴	10 – 0 V _{DC} for 0 – 100 % P _{nom}
Internal resistance simulation ^{4,3}	0 – 10 V _{DC} for 0 – R _{max}
Digital operation (interfaces)	RS-232 ¹ ; HMI ² ; TC.CANOpen ² ; TC.GPIB ² ; TC.USB ²
Isolation in relation to mains voltage	2500 V _{AC}

Table 82 Analogue and digital operation. ¹Standard, ²Option
³Maximum resistance value as standard 1.2 Ω or optional : 3.2 Ω
⁴The values are depended of a configuration flag refer to chapter 7.4.5, page 162.

Accuracy – measurement resolution ¹	
Analogue input and output	0.1 % at 10-bit resolution
Actual voltage	0.025 % at 12-bit resolution
Actual current	0.025 % at 12-bit resolution
Temperature measurement	0.2 C

Table 83 Measuring accuracy of the TC.GSS power supply.
¹Absolute value or referred to nominal values.

Times	
Starting time	
Control electronics ¹	5.0 s
Power section ²	0.1 s
Cycle times	
Power section	25.0 μ s
Voltage and current controllers	50.0 μ s
Power controller	50.0 μ s
Protection and monitoring	50.0 μ s
State machine	1.0 ms
System communication	1.0 ms

Table 84 Starting and cycle times for a TC.GSS power supply.

10.1.4. Interfaces – pin definition

10.1.4.1. General electrical *properties*

All interfaces are insulated from each other and also from earth. The insulation voltage is min. 125 V before a flashover can occur.

Electrical characteristics of internal auxiliary supply:

Internal auxiliary supply 24 V _{DC}	
Voltage (max.)	24 V _{DC}
Current (max.)	0.2 A

10.1.4.2. Pin definition D-Sub plug

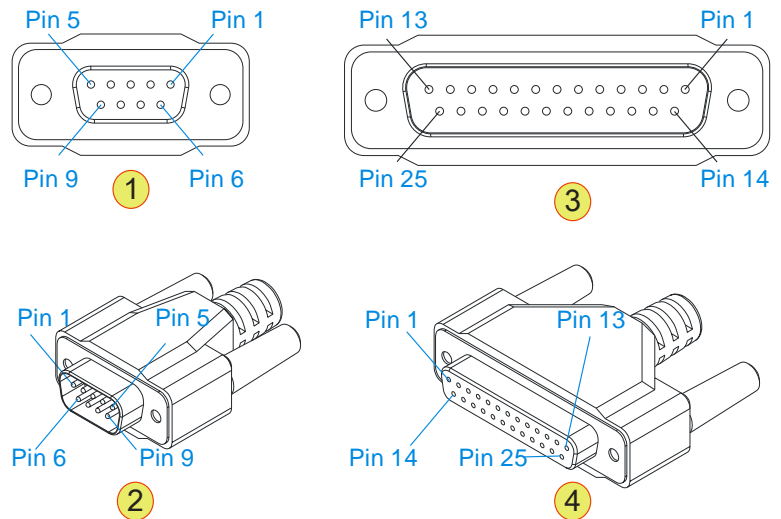


Fig. 104 -1- D-Sub 9 pin socket; . -2- D-Sub 9 pin plug
-3- D-Sub 25 pin socket; -4- D-Sub 25 pin plug

10.1.4.3. RS-232 interface

Calibration or parameterisation and control of the power supply via a PC using:

- TopControl software
- Customer-specific software

Connection: D-Sub socket 9-pin

TopControl end				PC end
Pin	Description	I/O	Signal	Signal
1	not connected (n.c.)	-	-	-
2	Transmit data	O	TXD	RXD
3	Receive data	I	RXD	TXD
4	n.c.	-	-	-
5	Common ground	-	GND	GND
6	n.c.	-	-	-
7	n.c.	-	-	-
8	n.c.	-	-	-
9	n.c.	-	-	-
	Connected to earth	-	Shield	-

Table 85 Pin definition RS-232.
n.c.: not connected.

Pin definition for the interface RS-232

Properties	Description
Electrical level	RS-232/V.24
Baud rate/parity start bits/data bits/stop bits	38400 Baud/none 1/8 /1
Isolation in relation to controller and earth	125 V
Connector	D-Sub, 9-pin, front side

Table 86 Information on the interface X301 (RS-232).

CAUTION Possible damaging of interface RS-232 by:

- Peak current and static electricity

Avoidance:

- ⇒ All devices with a connection via RS-232 should not have voltage at the interface, before the connection is mechanically produced.

10.1.4.4. CAN bus – interfaces X101/X102

Connection: D-Sub socket 9-pin

Pin definition – CAN bus interface			
Pin	Signal	I/O	Description
1	INTERLOCK_CAN	I	Interlock CAN
2	CAN_L	I/O	CAN low
3	GND_CAN	O	CAN common
4	Q4_Enable	I/O	
5	I_Sys	O	
6	AGND	O	CAN common
7	CAN_H	I/O	CAN high
8	0 VDC I/O	O	Auxiliary supply common
9	+24 VDC I/O	O	Auxiliary supply + 24 V _{DC}
	Shield		Connected with PE

Table 87 Pin definition on the interfaces X101/X102.

Recommended cable characteristics for the system communication

Properties	Description
Characteristic impedance	120 ± 20 Ω
Cable cross-section	4 x 2 x 0.14 mm ² with shielding
Twisting	In pairs 1 + 8/2 + 7/3 + 6/4 + 5
Recommended types	Dätwyler Uninet –4P, Dätwyler Uninet –4P flex

Table 88 Cable characteristics.

10.1.4.5. Sense interface X104

Connection: socket, 3-pin

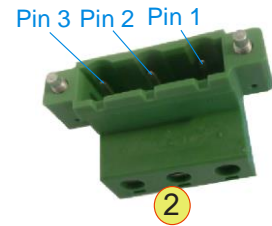
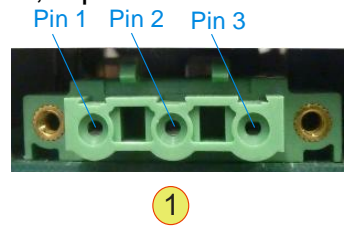


Fig. 105 -1- 3 pin socket; -2- 3 pin plug

Pin definition – sense			
Pin	Signal	I/O	Description
1	S+	I	Sense positive pole
2	S-	I	Sense negative pole
3	GND	I	Ground connected with PE

Table 89 Pin definition on the interfaces X101/X102 as per

General electrical properties – sense	
Pins used	Pin 1, 2, 3
Current consumption (max.)	Approx. 1 mA at U _{NOM}
Voltage (max.)	U _{NOM}
Reference ground	Pin 3

Table 90 Electrical properties of the interface X104

10.1.4.6. Analogue-digital interface – interface X105

Pin definition – analogue/digital interface			
Pin	Signal	I/O	Description
1	AGND	I	Analogue ground for pins 2–4, 14–16
2	VREF	I	Voltage setpoint
3	IREF	I	Current setpoint
4	IACT	O	Current feedback
5	0 V _{DC}	O	0 V _{DC} I/O ground for pin 25
6	+10 V _{DC}	O	Analogue reference voltage +10 V _{DC}
7	COM	I	(connected with Pin 17) 0V _{DC} DigIn; Common ground for pins 8–9, 18–20, 24
8	APP_DIGITALIN_4; CLEAR_ERROR	I	Digital input
9	VOLTAGE_ON	I	Digital input
10	OK/ALARM_b	O	Relay output 1 normally open
11	OK/ALARM_a	O	Relay output 1 common
12	RUN_b	O	Relay output 2 normally open
13	RUN_a	O	Relay output 2 common
14	PREF	I	Power limit analogue input
15	RREF	I	Ri-simulation analogue input
16	VACT	O	Voltage feedback output
17	COM	I	(connected to pin 7) Common ground to pins 8–9, 18–20, 24
18	APP_DIGITALIN_1	I	Digital input
19	APP_DIGITALIN_2	I	Digital input
20	APP_DIGITALIN_3; ANAOG_REFERENCE_SELECT	I	Digital input (Analogue reference voltage)
21	WARN_a	O	Relay output 3 normally open
22	WARN_b	O	Relay output 3 normally closed
23	WARN_c	O	Relay output 3 common
24	INTERLOCK_IN_+	I	Input Interlock +
25	+24 V _{DC}	O	Auxiliary supply + 24 V _{DC}

Table 91 Pin definition for the X105 interface.

Electrical properties – analogue/digital interface	
Analogue inputs	
Pins used	Pin 2, 3, 14, 15
Input voltage range ¹	0 – 10 V _{DC} (or -10 V _{DC} – 10 V _{DC})
Input impedance	20 kΩ
Reference ground	Pin 1
Analogue outputs	
Pins used	Pin 4, 16
Output voltage range ¹	0 – 10 V _{DC} (or -10V _{DC} – 10 V _{DC})
Output impedance	335 Ω
Reference ground	Pin 1
Digital inputs	
Pins used	Pin 8, 9, 18, 19, 20, 24
Input voltage range	High level: 10 V _{DC} – 28 V _{DC} Low level: 0 V _{DC} – 2 V _{DC}
Input impedance	4.7 kΩ
Reference ground	Pin 7, 17
Digital outputs	
Pins used	Pin 10, 11, 12, 13, 21, 22, 23
Switching voltage (max.)	30 V _{DC}
Switching current (max.)	1 A

Table 92 Electrical properties – analogue/digital interface.

¹ Can be changed to bipolar signal voltage using a configuration flag.
If necessary contact Regatron support.

Mechanical properties – analogue/digital interface	
Type of connection	D-Sub 25-pin; socket

Table 93 Mechanical properties – analogue/digital interface

10.1.4.7. Interface X112/ X112-2

Please note that interface X112 is available only if ISR option is built in.

D-Sub Buchse
9pol (female)

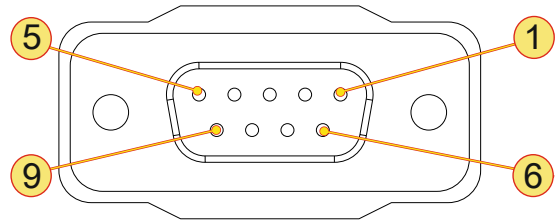


Fig. 2 Pin layout of interface X112/ X112-2, front view

Pin	Signal	I/O	Description
1	+24VDC	O	Low voltage internal supply + 24 V _{DC}
2	RELAY2¹	I	Coil a) of ISR relay#2
3	NC	I/O	Relay contact NC
4	RELAY1¹	I	Coil a) of ISR relay#1
5	COMMON	I/O	Common contact
6	GND	O	Low voltage 0 V _{DC}
7	RELAY2¹	I	Coil b) of ISR#2
8	---	---	---
9	RELAY1¹	I	Coil b) of ISR#1
Cover	Shield	---	Cable screen, tied to earth (PE) internally

Table 94 Interface X112/ X112-2, pin assignment.

¹ Polarity of relay coil pins 2 and 7 resp. 4 and 9 of no importance.

10.1.4.8. System current sense - interface X108



The interface X108 is not currently supported.

Pin	Signal	I/O	Description
1	Res1	I/O	Res signal
2	A_Res	I	Res analogue input
3	Q4_Enable	I/O	Indicates the active quadrant Q4 with 24 V _{DC}
4	AGND	I/O	GND Isys, current sensor for pin -5-
5	I_Sys	I	System current from current sensor; to the shunt resistors
6	+15V	O	+15 V supply for current sensor, max. 200mA
7	-15V	O	- 15 V supply for current sensor, max. 200mA
8	GND_IO	O	Auxiliary ground for pin -9-
9	24V IO	O	Auxiliary supply + 24 V _{DC}
	Shield		Connected with PE

Table 95 Pin definition for the System current sense interface.

Electrical properties – System current sense	
Current consumption (max.)	I _{NOM} approx. 2000 A
Reference ground	Pin 4

Table 96 Electrical properties – System current sense interface.

Mechanical properties – System current sense	
Type of connection	D-Sub 9-pin; socket

Table 97 Mechanical properties – System current sense interface.