Micrologic X
Control Unit
User Guide

05/2016

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www.schneider-electric.com

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All pertinent state, regional, and local safety regulations must be observed when installing and using this product. For reasons of safety and to help ensure compliance with documented system data, only the manufacturer should perform repairs to components.

When devices are used for applications with technical safety requirements, the relevant instructions must be followed.

Failure to use Schneider Electric software or approved software with our hardware products may result in injury, harm, or improper operating results.

Failure to observe this information can result in injury or equipment damage.

Table of Contents

Safety Information

Important Information

NOTICE

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

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

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

⚠ DANGER

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

⚠ WARNING

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

⚠ CAUTION

CAUTION indicates a hazardous situation which, if not avoided, **could result** in minor or moderate injury.

NOTICE

NOTICE is used to address practices not related to physical injury.

PLEASE NOTE

Electrical equipment should be installed, operated, serviced, and maintained only by qualified personnel. No responsibility is assumed by Schneider Electric for any consequences arising out of the use of this material.

A qualified person is one who has skills and knowledge related to the construction and operation of electrical equipment and its installation, and has received safety training to recognize and avoid the hazards involved.

About the Book

At a Glance

Document Scope

The aim of this guide is to provide users, installers, and maintenance personnel with the technical information needed to operate Micrologic™ X control units in Masterpact™ MTZ circuit breakers.

Validity Note

This guide applies to the following control units:

- Micrologic 2.0 X
- Micrologic 5.0 X
- Micrologic 6.0 X
- Micrologic 7.0 X

Related Documents

Title of Documentation	Reference Number
Masterpact MTZ1 Circuit Breakers and Switch-Disconnectors - User Guide	DOCA0100EN DOCA0100ES DOCA0100FR DOCA0100ZH
Masterpact MTZ2/MTZ3 Circuit Breakers and Switch-Disconnectors - User Guide	DOCA0101EN DOCA0101ES DOCA0101FR DOCA0101ZH
Masterpact MTZ - Modbus Communication Guide	DOCA0105EN DOCA0105ES DOCA0105FR DOCA0105ZH
Masterpact MTZ Cyber Security Guide	DOCA0122EN
IO Input/Output Application Module for One Circuit Breaker User Guide	DOCA0055EN DOCA0055FR DOCA0055ES DOCA0055ZH
IFE Ethernet Interface User Guide	DOCA0084EN DOCA0084FR DOCA0084ES DOCA0084ZH
EIFE Embedded Ethernet Interface User Guide	DOCA0106EN

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Chapter 1
Introduction to the Micrologic X Control Unit

What Is in This Chapter?

This chapter contains the following topics:

Presentation

Micrologic X Control Unit Overview

Masterpact MTZ circuit breakers with Micrologic X control units provide functions of protection, metering, diagnostics, communication and remote operation. The control unit can be customized with optional Digital Modules.

Micrologic X control units allow operation and monitoring of Masterpact MTZ circuit breakers locally or remotely.

Protection

In addition to the standard range of protection (long-time overcurrent (L), short-time overcurrent (S), instantaneous overcurrent (I), ground-fault (G), and earth-leakage (V)), additional features include:

- Dual settings
- Fine settings
- Zone selective interlocking
- Fast tripping

Metering

Micrologic X control units measure the following parameters:

- Current
- Voltage
- Frequency
- Power
- Energy
- Power factor
- Minimum, maximum, and average values of a wide range of parameters are available.

Diagnostics and Maintenance

Diagnostic features help to:

- Start the circuit breaker again after a trip as quickly as possible.
- Limit the risk of power interruptions by monitoring the health of the Micrologic X control unit. Pop-up messages alert the user in the case of necessary preventive maintenance.

Communication

Micrologic X control units support the following means of communication:

- Wireless
  - Bluetooth
  - NFC
- Ethernet
  - Through IFE webpages
  - Through embedded EIFE, with associated webpages (drawout devices only)
- Local through connection to mini USB port

Wireless communication allows you to access status and measurements readings directly on a smartphone using the Masterpact MTZ mobile App available to download and install.

Optional Digital Modules

The following Digital Modules can be downloaded from the Schneider Electric website to extend the features available:

- Energy per phase
- Power restoration assistant
- Masterpact operation assistant
- Waveform capture on trip event

The Range of Micrologic X Control Units

Micrologic X Control Units

The range of Micrologic X control units offers different standard functions, described below.

Optional Digital Modules can be added to extend the functions available *(see page 17)*.

Presentation of Standard Functions

The following table indicates the standard features available on Masterpact MTZ with Micrologic X control units:

	Micrologic 2.0 X	Micrologic 5.0 X	Micrologic 6.0 X	Micrologic 7.0 X
Long-time overcurrent protection (L)	X	X	X	X
Short-time overcurrent protection (S)	–	X	X	X
Instantaneous overcurrent protection (I)	X	X	X	X
Ground-fault protection (G)	–	–	X	–
Earth-leakage protection (V)	–	–	–	X
Neutral protection	X	X	X	X
Dual settings	X	X	X	X
Overcurrent and trip cause indicators	X	X	X	X
Zone selective interlocking	–	X	X	X
Trip history	X	X	X	X
Setting change traceability	X	X	X	X
Embedded power meter	X	X	X	X
Embedded diagnostics	X	X	X	X

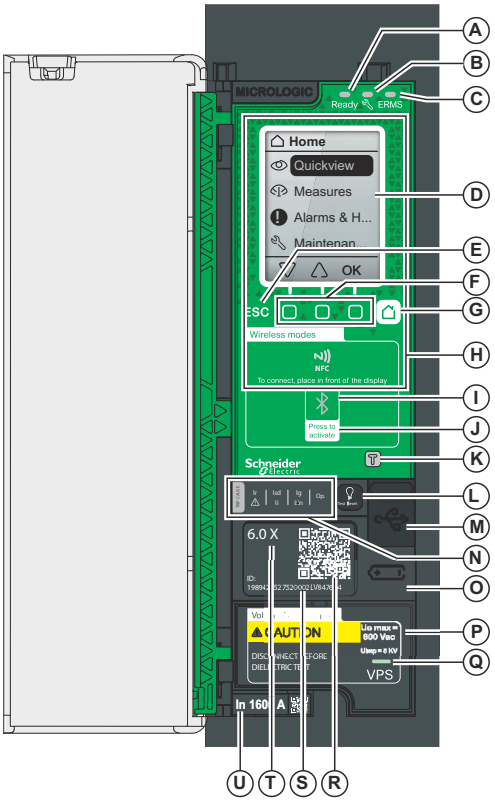
Micrologic X Control Unit Description

Introduction

The Micrologic X control unit includes:

- Micrologic X health status LEDs
- A local HMI comprising a graphic display with colored backlight, contextual buttons, and dedicated buttons
- LEDs to monitor circuit breaker operations, including the source of trips and alarms

Control Unit Description



A **Ready** LED
B Service LED
C **ERMS** LED (Reserved for future use)
D Graphic display screen
E Escape button **ESC**
F Three contextual buttons
G Home button
H NFC wireless communication zone
I Bluetooth LED
J Bluetooth activation button
K Test button for ground-fault and earth-leakage protection (Micrologic 6.0 X and 7.0 X)
L **Test/Reset** button for trip cause LEDs and alarms
M Mini USB port under rubber cover
N Overload and trip cause LEDs
O Cover for battery
P VPS voltage power supply module (optional)
Q VPS LED to indicate that the VPS is supplying the control unit
R QR code to product information
S Control unit identification number
T Control unit type
U Sensor plug with the rated current of the circuit breaker

Micrologic X Health Status LEDs

LED	Description
Ready	The **Ready** LED flashes when the control unit is ready to provide protection.
	The service LED alerts the user to the overall health of the circuit breaker. There are three states: ● Unlit LED: the circuit breaker is in good working order. ● Orange LED: Non-urgent alert message. ● Red LED: Alert message that requires immediate intervention.
ERMS	The **ERMS** (Energy Reduction Maintenance Setting) LED is reserved for future use.

Local HMI Display Screen with Contextual Buttons and Dedicated Buttons

The local HMI screen and buttons *(see page 32)* are used to:

- Navigate the menu structure.
- Display monitored values.
- Access and edit configuration settings.

NFC Communication Zone

The NFC communication zone is used to establish an NFC connection *(see page 156)* between a smartphone that has the Masterpact MTZ mobile App and the Micrologic X control unit. When the connection is established, the circuit breaker operating data is automatically uploaded to the smartphone.

Bluetooth Activation Button and LED

The Bluetooth activation button is used to establish a Bluetooth Low Energy connection *(see page 154)* between a smartphone that has the Masterpact MTZ mobile App and the Micrologic X control unit. When the connection is established, the circuit breaker can be monitored and controlled from the smartphone.

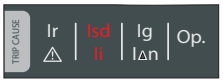
When the Bluetooth LED is flashing, it indicates that a Bluetooth connection is in progress.

Test Button

The test button is used to test the ground-fault protection for Micrologic 6.0 X *(see page 73)* and the earth-leakage protection for Micrologic 7.0 X *(see page 74)*.

Overload and Trip Cause LEDs

The assignment of the four trip cause LEDs depends on the type of Micrologic X control unit.

LEDs	Description
	• Micrologic 2.0 X, 5.0 X, 6.0 X, 7.0 X: Overload pre-alarm, the load exceeds 90% of the Ir setting of the long-time protection
	• Micrologic 2.0 X, 5.0 X, 6.0 X, 7.0 X: Overload alarm, the load exceeds 105% of the Ir setting of the long-time protection
	• Micrologic 2.0 X, 5.0 X, 6.0 X, 7.0 X: trip due to the long-time protection.
	• Micrologic 2.0 X: trip due to the short-time protection. • Micrologic 5.0 X, 6.0 X, 7.0 X: trip due to the short-time protection or instantaneous protection.
	• Micrologic 2.0 X, 5.0 X: Not used. • Micrologic 6.0 X: trip due to the ground-fault protection. • Micrologic 7.0 X: trip due to the earth-leakage protection.
	• Micrologic 2.0 X, 5.0 X, 6.0 X, 7.0 X: Trip due to other protection (optional protections).

NOTE: If the Micrologic X control unit is not powered the trip cause LEDs go off after 4 hours. Press the **Test/Reset** button to light them again.

Test/Reset Button

The **Test/Reset** button performs the following functions:

- Battery test. Press the**Test/Reset** button. The four trip cause LEDs light up for 1 second. If the LEDs do not light, replace the battery.
- Reset trip cause LED. When a trip cause LED is lit, press and hold the **Test/Reset** button for 3 seconds to reset and switch off the trip cause LED and the service LED.
- Reset the control unit (except standard protection functions). Press and hold the **Test/Reset** button for 15 seconds.

NOTE: After a battery test, any active trip cause LED is displayed again.

Mini USB Port

Remove the rubber cover of the mini USB port to connect the following devices:
- A Mobile Power Pack to supply power to the Micrologic X control unit *(see page 23)*
- A PC equipped with Ecoreach software *(see page 159)*.

NOTE: It is not possible to connect a USB key to the Micrologic X control unit.

QR Code

When the QR code on the front face of a Micrologic X control unit is flashed by using a smartphone running a QR code reader, a landing page is displayed.

The landing page displays some basic information about the device in a header, and a list of menus:
- Characteristics
- Download documents related to Masterpact and Micrologic X devices
- Customer Care Center
- Safe Repository
- Masterpact MTZ mobile App
- GoDigital

Control Unit Identification Number

The identification number is made up as follows:
- The serial number of the Micrologic X control unit in the format FFFFFFYYWWDXXXXX
- The sales reference of the control unit in the format LV8xxxxx

Use the identification number to register your Micrologic X control unit.

Registering your Micrologic X control unit ensures that your records are up to date and enables traceability.

Control Unit Type

This code denotes the type of Micrologic control unit:
- The number (for example, 2.0) defines the types of protection provided by the control unit.
- The letter (X) denotes the range.

Battery

The battery powers the trip cause LEDs in the absence of other power supply *(see page 25)*.

VPS

The VPS power supply module provides an internal voltage supply to the Micrologic X control unit *(see page 23)*.

The VPS module is optional for Micrologic 2.0 X, 5.0 X and 6.0 X.

The VPS module is supplied as standard for Micrologic 7.0 X.

Sensor Plug

The protection ranges depend on the rated current In, defined by the sensor plug inserted into the Micrologic X control unit *(see page 60)*.

Masterpact MTZ Mobile App

Presentation

The Masterpact MTZ mobile App enables a smartphone to be used for rapid setting changes and a follow-up of Masterpact MTZ circuit breakers with Micrologic X control units. It also enables information to be shared, (for example, by email).

Downloading the Application

The Masterpact MTZ mobile App can be downloaded in the following ways:

- Flashing the QR code on the front face of the Micrologic X control unit gives access to a landing page where the mobile application is proposed *(see page 19)*
- From Google Play Store for Android smartphones
- From App Store for iOS smartphones

The Masterpact MTZ mobile App is optimized for a 12.7 cm (5 inch) display screen.

Communicating with a Micrologic X Control Unit

Two means of communication are available to connect the Masterpact MTZ mobile App to a Micrologic X control unit:

- Bluetooth:
  - Display data
  - Configure general and protection settings
- NFC (also available when control unit is not powered) (only available for Android smartphones):
  - Display selection of data

Establishing a Connection with a Micrologic X Control Unit

For the connection procedure refer to the specific topic:

- Bluetooth connection procedure *(see page 154)*
- NFC connection procedure *(see page 156)*

Using a Bluetooth Connection

Connecting to Masterpact MTZ mobile App with a Bluetooth connection gives access to and allows sharing of the following information types:

- Quick View: gives an overview of current levels per phase, the health of the circuit breaker, and recent event history
- Metering: displays values of current, rms voltages, network and energy in real-time
- Protection Setting: displays settings currently selected and allows modification of settings
- Status and Control: displays status of the circuit breaker and allows opening and closing operations to be carried out.

Using an NFC Connection

Connecting to Masterpact MTZ mobile App with an NFC connection is possible when the Micrologic X control unit is not powered. It gives access to the following information:

- Information about the Micrologic X control unit
- Last trip context: trip type; date and time of last trip; current values before trip
- Protection settings (display only)
- Access to Digital Modules *(see page 17)* for assistance after a trip

Ecoreach Software

Presentation

Ecoreach is an electrical asset management software package intended to assist with the designing, testing, commissioning and maintenance phases of a project. It provides a simple way to configure, test and commission electrical smart devices.

Ecoreach automatically discovers smart devices and allows them to be added for easy configuration. Comprehensive reports can be generated as part of Factory Acceptance Test and Site Acceptance Test reports to replace heavy manual work. Additionally, when the panels are under operation, any change of settings made can be easily identified to provide system consistency during the operation and maintenance phases.

Ecoreach software enables the configuration of Masterpact devices:

- Micrologic X control unit
- Communication interface modules: IFE interface and EIFE interface
- ULP IO modules
- M2C output module

For more information, refer to the *Ecoreach Online Help*.

The Ecoreach software is available at *www.schneider-electric.com*.

Key Features

Ecoreach performs the following actions for the supported devices and modules:

- Create projects by device discovery
- Perform communication wiring test on entire project, generate and print test reports
- Configuration or settings download and upload for multiple devices
- Install digital modules
- Compare settings between project (original settings) and device (current settings)
- Generate comprehensive project reports
- Check system-level firmware status and upgrade devices
- Provide safe repository of projects in Ecoreach Cloud
- Read information (alarms, measurements, parameters) and display diagnosis information
- Export logbook of events and waveform capture

Optional Digital Modules for Micrologic X Control Units

Presentation

Digital Modules are optional modules that extend the features available across the range of Micrologic X control units.

They are available to purchase:
- When the Micrologic X control unit is initially ordered
- At any time after installation of the circuit breaker and Micrologic X control unit, by accessing the GoDigital marketplace

Digital Modules can be purchased, downloaded and installed on a Micrologic X control unit without interrupting the services of the functions provided by the control unit.

Take the following steps to purchase and install optional Digital Modules:
- Access GoDigital *(see page 20)*
- Choose Digital Modules for your control unit and purchase them
- Open the email and click the link to download the Digital Module delivery package to your PC
- Connect Ecoreach software to your Micrologic X control unit to install your Digital Module *(see page 21)*

Digital Modules

The following table presents the Digital Modules available for installation:

Digital Module	Description	Function	
Energy per phase *(see page 129)*	Analysis of energy consumption per phase.		Metering
Power restoration assistant *(see page 145)*	Assistance in restoring power quickly after a trip.		Diagnostics
Masterpact operation assistant *(see page 146)*	Assistance in closing the circuit breaker after a trip.		Diagnostics
Waveform capture on trip event *(see page 147)*	Displays interrupted phase and neutral currents after a trip.		Diagnostics

Micrologic X Control Units in Digital Systems

Presentation

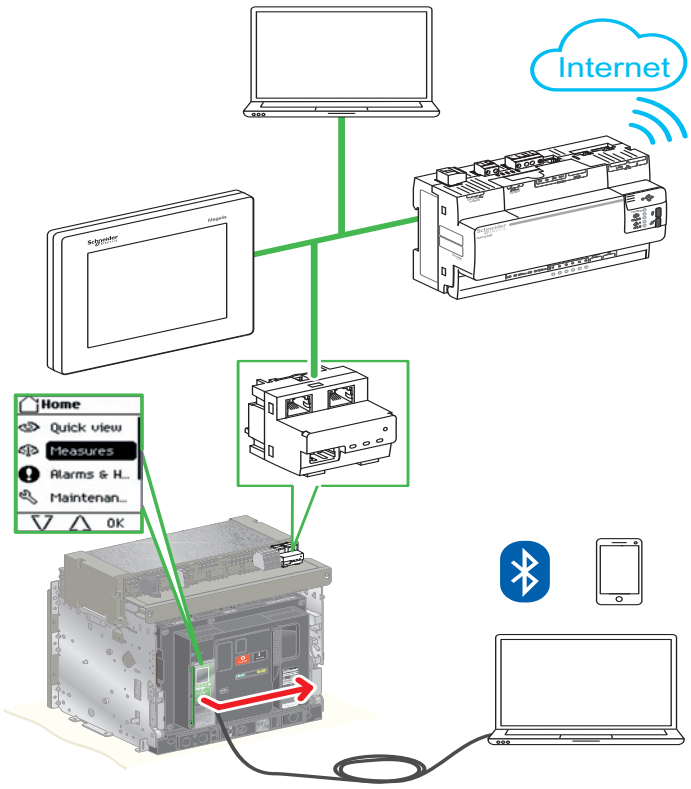
Masterpact circuit breakers with Micrologic X control unit, in conjunction with Enerlin'X, provide simple and reliable access to data from a smart panel or PC.

The following communication channels are offered:

- Ethernet through IFE or EIFE
- Masterpact MTZ mobile App through Bluetooth or NFC
- Ecoreach software through USB port
- Internet through Com'X through Ethernet

Micrologic X Control Units in Digital Systems

The following diagram shows how Micrologic X control units communicate within a digital system:



Ethernet
USB
Wireless communication

Go2SE Landing Page

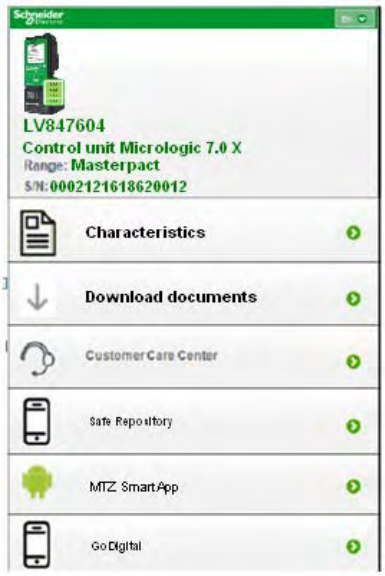
Presentation

When the QR code on the front face of a Micrologic X control unit is flashed by using a smartphone running a QR code reader, a landing page is displayed. The landing page displays some basic information about the device in a header and a list of menus.

Header

The header displays the following information:
- The product reference of the Micrologic X control unit
- The type of control unit
- The range of associated circuit breaker
- The unique serial number of the Micrologic X control unit

Landing Page Menus



The landing page displays the following list of menus:
- Characteristics
- Download documents related to Masterpact and Micrologic X devices
- Customer Care Center
- Safe Repository
- Masterpact MTZ mobile App
- GoDigital

Characteristics

Selecting this menu gives access to a product datasheet which gives detailed information about the product.

Download Documents

Selecting this menu gives access to the following documents:
- *Micrologic X Control Unit - User Guide*
- *Masterpact MTZ1 Circuit Breakers and Switch-Disconnectors - User Guide*
- *Masterpact MTZ2/MTZ3 Circuit Breakers and Switch-Disconnectors - User Guide*

Download Customer Care Application

The customer care application for Android smartphones can be downloaded by following the link.

Safe Repository Access

Download Masterpact MTZ mobile App

Selecting this menu gives access to the smartphone application or the possibility to purchase/install it.

GoDigital

Selecting this menu gives direct access to the GoDigital marketplace webpage *(see page 20)*.

GoDigital

GoDigital Marketplace

GoDigital is a marketplace to enable users to purchase and download Digital Modules to extend the performance of Micrologic X control units.

Prerequisites

The following list indicates the necessary prerequisites for purchasing optional Digital Modules:

- Unique Schneider Electric account with user name and password
- Validated CRM internal user account to enable purchase of Digital Modules
- Creation of a buyer account in GoDigital
- Connection to a single Micrologic X control unit to read its unique serial number (see below)

Accessing GoDigital

You can access GoDigital using one of the following means:

- From Ecoreach software either with a PC connected to a Micrologic X control unit or by selecting one Micrologic X control unit (or project) from the software. Ecoreach reads the unique serial number of the Micrologic X control unit, proposes available Digital Modules and gives direct access to the GoDigital site.
- Through the Masterpact MTZ mobile App, after connection to one Micrologic X control unit through Bluetooth or NFC. A direct link gives access to the GoDigital webpage for mobile devices.
- By flashing the QR code on the front face of the Micrologic X control unit from a smartphone. A landing page opens and a direct link to GoDigital is proposed.
- Directly to the GoDigital website (*http://godigital.schneider-electric.com/*). This access can only be used to purchase Digital Modules for a second order for the same Micrologic X control unit using the serial number listed in the **My Asset** tab.

Purchasing in GoDigital

After accessing the GoDigital website through one of the access points described in the previous paragraph, follow this procedure to purchase Digital Modules:

Step	Action
1	Log in to the GoDigital website **NOTE:** If user is unknown, a link to create a new account is proposed. If the user is recognized but no buyer account exists in GoDigital, a link to create this account is proposed.
2	Choose Digital Modules required and add to cart. The cart can be saved for future validation and purchase.
3	Submit the cart. The purchase is validated and the invoice, order confirmation and a link to the delivery package are sent by email.
4	Click the link in the email to download the delivery package to a PC.

Useful Information

The following points provide additional information on the use of GoDigital:

- In Ecoreach software, Digital Modules can be selected from a list available for the unique serial number of the selected Micrologic X control unit. Clicking on **Buy** gives direct access to the list of Digital Modules in the GoDigital marketplace. The Digital Modules selected in Ecoreach are already checked.
- To buy Digital Modules for more than one Micrologic X control unit, save the cart, select the serial number of another control unit, and repeat step 2 in the procedure.

Installing and Removing Optional Digital Modules

Presentation

Once a Digital Module has been purchased in the GoDigital marketplace it can be installed in the associated Micrologic X control unit using Ecoreach software.

Prerequisites

The following conditions must be met to install a Digital Module:

- The Digital Module purchased in the GoDigital marketplace
- The Digital Module delivery package downloaded onto a PC
- The PC with Ecoreach software connected by a USB cable to the Micrologic X control unit to recognize its serial number and ID

Installing a Digital Module

Follow this procedure to install purchased Digital Modules on a Micrologic X control unit:

Step	Action
1	Connect a PC running Ecoreach software directly to the mini USB port on the front of the Micrologic X control unit.
2	Click the **Connect device** button to establish a connection between Ecoreach and the Micrologic X control unit. Ecoreach displays the Micrologic X control unit serial number on the screen.
3	Select **Digital Modules**.
4	Check that the delivery package for the Digital Module to be installed is present on the PC being used.
5	Choose Digital Modules to be installed by clicking **Install**. **NOTE:** Only modules that have been purchased previously can be installed directly by clicking **Install**.
6	When installation is completed and before unplugging the PC, disconnect Ecoreach from the device by clicking the **Disconnect** button.

Removing a Digital Module

Follow this procedure to remove a Digital Module from a Micrologic X control unit:

Step	Action
1	Connect a PC running Ecoreach software directly to the mini USB port on the front of the Micrologic X control unit.
2	Click the **Connect device** button to establish a connection between Ecoreach and the Micrologic X control unit. Ecoreach displays the Micrologic X control unit serial number on the screen.
3	Select **Digital Modules**.
4	Choose Digital Modules to be removed by clicking **Remove**.
5	When removal is completed and before unplugging the PC, disconnect Ecoreach from the device by clicking the **Disconnect** button.

Predefined Events

The following events are generated when a Digital Module is installed or removed:

User message	History	Severity
License installed	Configuration	Low
License uninstalled	Configuration	Low

Micrologic X Date and Time

Presentation

Micrologic X date and time are used for time stamping events to provide a temporal order.

Setting the Date and Time Manually

Micrologic X date and time can be set manually:

- On Micrologic X display screen at **Home → Configuration → General → Date & Time.** The first component of the date is day (dd) and the second component is month (mm).
- With Ecoreach software
- With Masterpact MTZ mobile App

Synchronizing the Date and Time Automatically

Micrologic X date and time can be automatically synchronized with the date and time of a smartphone, using the Masterpact MTZ mobile App.

Micrologic X date and time can be automatically updated with the IFE or EIFE Ethernet interface with the following conditions:

- Ethernet interface is configured in SNTP mode
- Ethernet interface receives an update date and time request (from Ecoreach software or a web browser connected to the Ethernet interface webpage or third-party software)

NOTE: If the Micrologic X control unit is connected to an Ethernet interface configured in SNTP mode, manual update of the Micrologic X date and time is possible but is immediately replaced by the date and time of the IFE Ethernet interface.

Predefined Events

Setting the date and time generates the following low-severity event, which is logged in the Configuration history: Clock setup

Micrologic X Power Supply

Internal and External Power Supplies

The Micrologic X control unit is powered by the current through internal current transformers (CT). Different optional power supplies can also be used. The following list indicates the possible permanent power supplies:

- Internal voltage power supply (VPS) module, up to 600 Vac
- External 24 Vdc power supply module with or without battery module (battery life 4 hours)

The following temporary power supplies can be used to power the control unit when other supplies are unavailable. They provide access to all functions of the Micrologic X control unit:

- PC through USB connection
- External Mobile Power Pack through USB connection

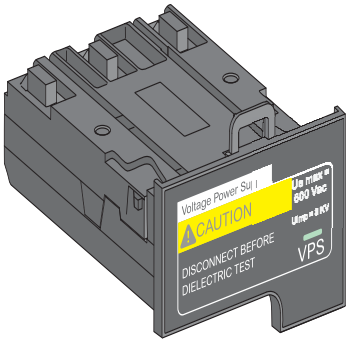
During operation, when the load current is higher than 20% of the rated current, the internal current supply ensures full functioning of the control unit and all protection functions, including long-time overcurrent protection, short-time overcurrent protection, instantaneous overcurrent protection, and ground-fault protection.

When the circuit breaker is not powered, an alternative power supply is necessary. More details are given in the following presentation of each power supply.

An external 24 Vdc power supply is necessary to power IFE and EIFE Ethernet interfaces, and IO modules (ULP).

Voltage Power Supply (VPS) Module

The VPS module is optional for Micrologic 2.0 X, 5.0 X, and 6.0 X. It is installed as standard on Micrologic 7.0 X to maintain earth-leakage protection.



The internal voltage power supply (VPS) module for Micrologic X control unit powers the main functions of the control unit, including the display screen, keypad, and wireless communication, in the following circumstances:

- When the circuit breaker is in low load conditions (< 20% In)
- When there is no load but the circuit breaker is supplied with power, for example, there is a tri-phase or bi-phase power voltage available downstream of the circuit breaker

The VPS module is installed in the lower part of the Micrologic X control unit.

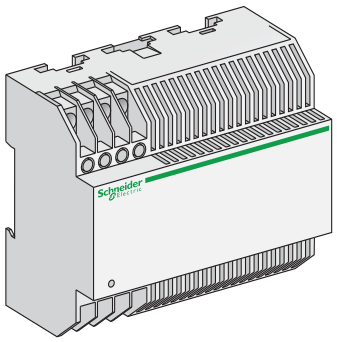
A green LED on the front face indicates that the VPS module is powered and a 24 Vdc output is supplied.

Characteristics of the VPS module:

Power supply	Values	
Input Vac 50/60 Hz	Three phase 208–600 V	+10 / –30%

External 24 Vdc Power Supply (ABL8) Module

External 24 Vdc Power Supply (AD) Module

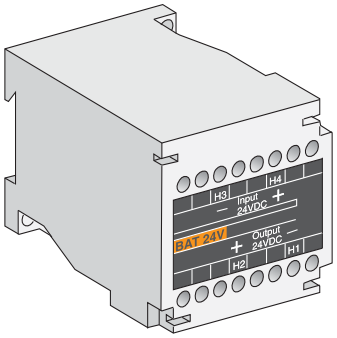


The 24 Vdc power supply module (with or without battery module) maintains the operation of all functions of the Micrologic X control unit when the circuit breaker is open and not energized.
The 24 Vdc power supply module maintains the functions of the Micrologic X control unit in low load conditions (load below 20%).
The 24 Vdc power supply module provides a power supply during periods of setting, commissioning, testing, and maintenance.
The 24 Vdc power supply module is mandatory to supply power to the IFE/EIFE Ethernet interfaces and IO modules, when these are present.

Characteristics of the AD module:

Characteristic	Values
Power supply	110/130, 200/240, 380/415 Vac, 50/60 Hz (+10%, –15%) 24/30, 48/60, 100/125 Vdc (+20% –20%)
Output voltage	24/30, 48/60, 100/125 Vdc (+20% -20%)
Ripple	< 1%
Dielectric withstand	3.5 kV rms between input/output, for 1 minute
Overvoltage category	Defined by IEC 60947-1 cat. 4

Battery Module



The battery module maintains the operation of the Micrologic X display screen and keypad if the power supply is interrupted. It also enables wireless communication. It is installed in series between the control unit and the 24 Vdc power supply module.
The battery module is a lithium type battery, with a service life of approximately ten years. If there is no power supply to the 24 Vdc power supply module, the battery module provides power to the control unit for four hours.

Characteristics of the battery module:

Characteristic	Values
Battery run-time	4 hours
Mounting	Vertical backplate or symmetrical rail

PC Power Supply

A PC provides a temporary power supply which can be used when the circuit breaker is not powered, and during periods of setting, commissioning, testing, and maintenance.

It is connected by using a USB cable connected to the mini USB port on the Micrologic X control unit.

Mobile Power Pack

The Mobile Power Pack is an external battery that enables power to be supplied temporarily to the Micrologic X control unit.
The Mobile Power Pack enables use of the Micrologic X display screen and keypad for basic setting and displaying when the power supply to the Micrologic X control unit is interrupted.
The external Mobile Power Pack can be connected by using a USB cable connected to the mini USB port on the Micrologic X control unit.

Check the charge level of the Power Pack by pressing the test button for one second. The indicator on the Power Pack lights up to indicate the remaining charge.

Internal Battery

When no other power supply is supplying the Micrologic X control unit, the internal battery powers:

- The trip cause LEDs
- The red service LED
- The Micrologic internal clock (date and time)

The internal battery of the Micrologic X control unit can be replaced on site when discharged.

Chapter 2
Using Micrologic X Control Units

What Is in This Chapter?

This chapter contains the following sections:

Section 2.1
Presentation of HMIs

What Is in This Section?

This section contains the following topics:

Micrologic X HMIs

Introduction

HMI from the following products can be used to communicate with the Micrologic X control unit:

- Micrologic X display screen
- Masterpact MTZ mobile App (Wireless NFC or Bluetooth)
- Ecoreach software (USB connection and remote LAN connection))
- FDM128
- Webpages on IFE/EIFE server

Functions per HMI

Introduction

List of functions available according to the HMI:

- All features on Ecoreach software
- A wide selection of features on Masterpact MTZ mobile App
- Essential features on the Micrologic X display screen
- FDM128
- Webpages on IFE/EIFE server

Section 2.2
Using the Micrologic X HMI

What Is in This Section?

This section contains the following topics:

Micrologic X HMI Description

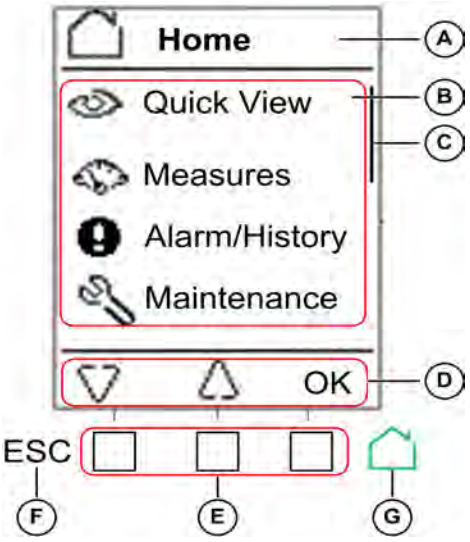
Introduction

The human machine interface (HMI) of the Micrologic X control unit includes:

- A graphic display screen with colored backlight
- Buttons to navigate through the menu structure, and access monitored parameters and configuration settings

Display Screen and Buttons

The Micrologic X control unit includes the following display screen with contextual and dedicated buttons:



A Screen name
B Functional screen content
C Scroll bar indicating the relative position of the items in a list larger than the display screen
D Context-specific function icons
E Contextual buttons that perform the context-specific function described by the icon immediately above each button
F Escape button, used to return to the previous screen and/or trigger a data saving confirmation screen
G Home button, used to jump to the **Home** screen and/or trigger a data saving confirmation screen

Button Functional Types

Use the buttons beneath the display screen to:

- Navigate the menu structure
- Display monitored values
- Access and edit configuration settings

The control unit provides the following types of buttons:

- Contextual buttons: each screen can have up to three contextual buttons. The function of each button is determined by an icon located on the display screen directly above it.
- Dedicated buttons, that perform the escape and home functions.

Contextual Buttons

Icon displayed	Description
▽ △	Use the up and down buttons to move between: ● Screen names within the same level of menu hierarchy ● List items The up and down arrows do not support looping back. At a terminus of a menu structure or item list, either the up or down arrow is no longer displayed (depending on whether the terminus is the beginning or end of the list). The up and down navigation behavior is the same for all menus and lists.
OK	Use the **OK** button: ● To validate a selection ● To navigate from the level currently displayed in the hierarchy to the selected sublevel immediately below it. In this way, navigation is possible from: ❍ The active menu to the immediate submenu ❍ A submenu to a monitored item or configuration parameter ❍ A monitored item to its monitored value ❍ A configuration parameter to its configuration setting ● To view details and acknowledge an event pop-up screen or error code

Icon displayed	Description
Y **N**	Use the **Y** (Yes) and **N** (No) buttons to acknowledge actions, for example, when a confirmation screen is displayed.
+ **–**	Use the **+** and **–** buttons to increment or decrement a configuration setting, either numerical values or predefined list items.

Dedicated Buttons

Icon displayed	Description
ESC	Use the **ESC** (escape) button to: ● Navigate from the level currently displayed in the hierarchy to the level immediately above ● Save a change to a configuration setting. A confirmation screen pops up and must be acknowledged before returning to the menu on the level above.
	Use the home button to: ● Return to the **Home** screen ● Save a change to a configuration setting. A confirmation screen pops up and must be acknowledged before returning to the home screen.

Display Screen Backlight

The backlight color and intensity depends on the operating state of the control unit, as follows:

Backlight color	Control unit operating state
White[1]	● Quick View scrolling is enabled and running ● Tree navigation mode is enabled for navigating among menus in display screens ● Bluetooth wireless communication is enabled and the Bluetooth pairing message is displayed.
Red	A trip or a high severity event message is displayed.
Orange	A medium severity alarm message is displayed, and no trip or high severity alarm is active.
1 The backlight of the Health screen in Quick View is ● Red if a high severity event is active. ● Orange if a medium severity event is active.	

NOTE: When Quick View scrolling is off, the backlight changes from high intensity to low intensity when in standby. High intensity resumes when a button is pressed.

Display Screen Language

To change the display screen language go to:

Home → Configuration → General → Language

Selections include:

- Deutsch
- English(US)
- Español
- Français
- Italiano
- Русский
- 中文
- Português
- English(UK)

HMI Display Modes

Presentation

The Micrologic X control unit HMI supports the following display modes:
- Quick View mode to display a selection of data
- Tree Navigation mode to access all data through a menu structure

NOTE: Both Quick View and Tree Navigation display modes are overridden by event messages *(see page 57)*.

Quick View Mode

Quick View is the default HMI display mode. It displays a selection of data screens.

When Quick View scrolling is enabled, the screens are displayed automatically one after the other with a configurable time delay.

When Quick View scrolling is disabled the Quick View screens are viewable in the **Quick View** menu, accessed from the **Home** menu.

Tree Navigation Mode

In Tree Navigation display mode, use the contextual buttons to navigate in the menu structure. Tree Navigation display mode presents a single network of menus, with monitoring values and editable configuration settings.

Tree navigation is always accessible from Quick View screens by pressing the **Home** button.

Refer to the Micrologic X local HMI description *(see page 32)* for information on how to use the HMI buttons to:
- Navigate the menu structure
- Access and edit settings

Quick View Mode

Quick View

Quick View presents a sequence of screens, depending on the type of Micrologic X control unit. Each screen displays a snapshot of operating values for the control unit.

With automatic scrolling enabled, the screens are displayed in sequence with a configurable time delay. With automatic scrolling disabled, the screens can be navigated manually.

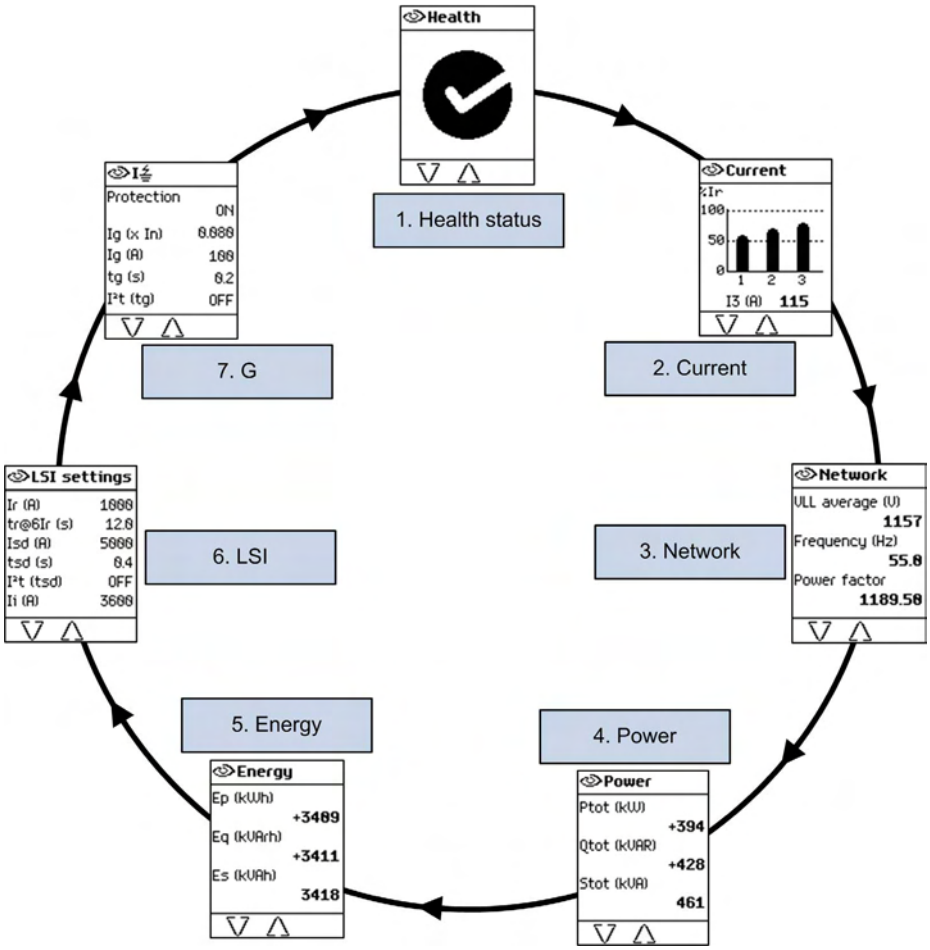
Quick View scrolling is enabled as the factory setting.

When the Micrologic X control unit is switched on, Quick View scrolling begins after the configured time-out if there are no active event messages

Configure the Quick View display mode by setting:

- The display time for each screen in the Quick View scrolling sequence.
- The time delay for automatically resuming scrolling, after scrolling has been interrupted. If scrolling is off, the current bar graph is displayed after this time delay.

The following is an example of the Quick View screens for the Micrologic 6.0 X control unit, with dual settings disabled.



List of Quick View Screens

Depending on the type of the Micrologic X control unit, Quick View mode displays the following screens:

Screen	Description	Micrologic X type
Health[1]	Displays the health of the circuit breaker: ●  OK (white) ●  Alarm - medium-level (orange) ●  Alarm - high-level (red)	Micrologic 2.0 X, 5.0 X, 6.0 X, 7.0 X
Current[1]	Displays I1, I2, I3 RMS current on phase 1, 2, 3 values as bar graphs expressed in % of Ir.The highest phase current value is displayed in A (Amps) under the bar graph.	Micrologic 2.0 X, 5.0 X, 6.0 X, 7.0 X
Network[1]	Displays real-time values for: ● Average of 3 RMS phase-to-phase voltage ● Frequency ● Power factor	Micrologic 2.0 X, 5.0 X, 6.0 X, 7.0 X
Power[1]	Displays real time values for: ● P tot: total active power ● Q tot: total reactive power ● S tot: total apparent power	Micrologic 2.0 X, 5.0 X, 6.0 X, 7.0 X
Energy[1]	Displays real time values for: ● Ep: total active energy ● Eq: total reactive energy ● Es: total apparent energy	Micrologic 2.0 X, 5.0 X, 6.0 X, 7.0 X
Trip curve	Indicates, when dual setting is on: ● A curve activated or ● B curve activated **NOTE:** The screen is not displayed when dual setting is off.	Micrologic 2.0 X, 5.0 X, 6.0 X, 7.0 X
LI	Displays a selection of protection settings: ● Long time overcurrent protection threshold Ir ● Long time overcurrent protection time delay tr ● Short time overcurrent protection threshold Isd	Micrologic 2.0 X
LSI	Displays a selection of protection settings: ● Long time overcurrent protection threshold Ir ● Long time overcurrent protection time delay tr ● Short time overcurrent protection threshold Isd ● Short time overcurrent protection time delay tsd ● Instantaneous overcurrent protection threshold Ii	Micrologic 5.0 X, 6.0 X, 7.0 X
G	Displays a selection of protection settings: ● Ground fault protection threshold Ig ● Ground fault protection time delay tg	Micrologic 6.0 X
V	Displays a selection of protection settings: ● Earth fault protection threshold IΔn ● Earth fault protection time delay tΔn	Micrologic 7.0 X
1 Screen data is refreshed every second.		

Configuring Quick View Mode

To configure Quick View settings, go to **Home → Configuration → General → Quick View**. The following settings are available:

- **Scrolling**: Set this to **ON** to enable automatic scrolling in Quick View. (When **OFF** is selected, the current bar graph screen is displayed after the configured timeout.)

When Quick View scrolling is enabled the following settings are available:

- **Pageflow**: The length of time each Quick View screen is displayed while scrolling.
- **Auto start**: The time delay before Quick View scrolling resumes after an interruption. This time delay is also the event timeout, which is the time delay before an event message is displayed again if the event cause is not acknowledged by pressing **OK**.

When Quick View scrolling is disabled the following setting is available:

Time out: The time delay before the current bar graph is displayed. This time delay is also the event timeout, which is the time delay before an event message is displayed again if the event cause is not acknowledged by pressing **OK**.

The configurable settings are shown in the following table.

Setting	Unit	Range	Step	Factory Setting
Scrolling	–	ON/OFF	–	ON
Pageflow	seconds	3–60	1	3
Auto start	minutes	1–60	1	15
Time out	minutes	1–60	1	15

Starting Quick View Scrolling

With Quick View mode enabled, resume Quick View scrolling:
- automatically
- manually

To begin Quick View scrolling automatically, wait for the **Auto start** timeout to elapse.

To begin Quick View scrolling manually:

Step	Action
1	In the **Home** menu, select **Quick View**.
2	Press **OK** to resume Quick View scrolling.

Stopping Quick View Scrolling

Stop Quick View scrolling as follows:
- Press the **ESC** or home button. The display screen displays the **Home** menu. From here, use the up and down buttons to navigate through the menu structure.
  NOTE: If no button is pressed before the **Auto start** timeout expires, Quick View scrolling resumes.
- Press one of the three contextual buttons. Quick View scrolling stops. Use the up and down buttons to scroll manually through the Quick View screens.

Disabling Quick View Automatic Scrolling

To disable scrolling in Quick View mode:

Step	Action
1	Press the **Home** button.
2	Navigate to **Home** → **Configuration** → **General** → **Quick View**.
3	Press **OK**.
4	Use the **+** or **-** contextual buttons to set the **Scrolling** setting to: ● **ON** to select Quick View automatic scrolling. ● **OFF** to disable Quick View automatic scrolling.
5	Press **OK** to save the selection.
6	Press **ESC** or the **Home** button. A confirmation screen is displayed.
7	Press **Y** to save the settings.

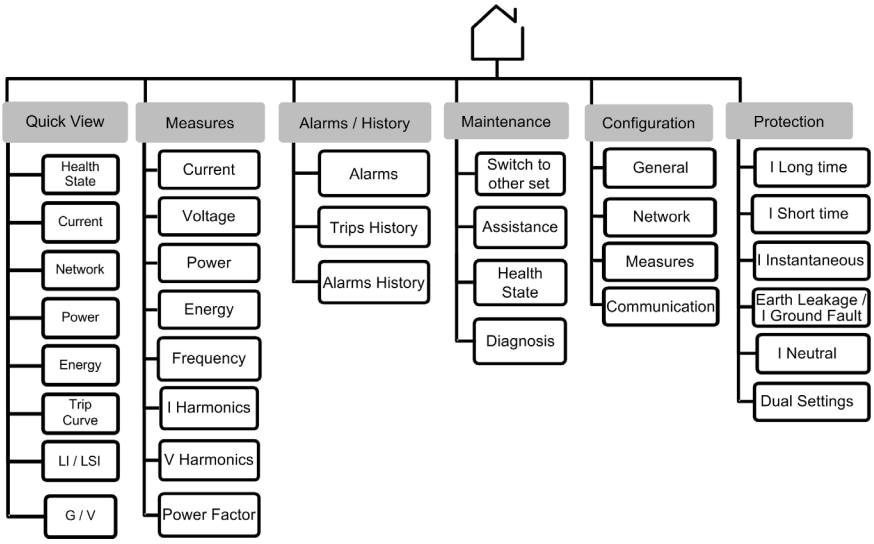
Tree Navigation Mode

Tree Structure Screen Display

Use Tree Navigation mode to navigate manually through the Micrologic X control unit menu structure. Tree Navigation mode enables the following actions:

- Display measurement values for the control unit
- View active alarms, and event history
- View maintenance items, and a history of service records
- Display and edit control unit configuration settings
- Display and edit protection settings

All Tree Navigation menu selections begin at the home button:



Display Screen Menus

The Micrologic X control unit presents data, commands, and settings in a tree structure. Click the link on one of the following level 2 sub-menu items to see its content:

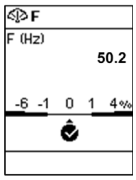
Level 1	Level 2
Home	Quick View *(see page 35)*
	Measures *(see page 45)*
	Alarms/History *(see page 50)*
	Maintenance *(see page 51)*
	Configuration *(see page 52)*
	Protection *(see page 54)*

Measures Screens with Quality Gauge

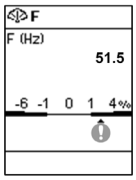
A quality gauge is displayed on the following screens to give a graphical representation of the measurement compared to the expected range:

- 3-phase current unbalances **IUnb**
- Average of 3 rms phase-to-neutral voltages **Vavg VLL(V)**
- Maximum of 3 rms phase-to-neutral voltage unbalances **Vunb VLL(%)**
- Frequency **F(Hz)**

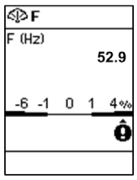
For example, for the frequency screen, the following icons indicate the measurement compared to the expected range:



OK if the difference between the measured and expected frequencies is less than 1%



Medium-level alarm if the difference between the measured and expected frequencies is +1– 4% or -1– -6%



High-level alarm if the difference between the measured and expected frequencies is greater than +4% or less than -6%

Navigating in the Menu Structure

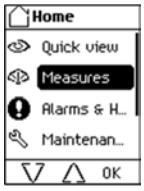
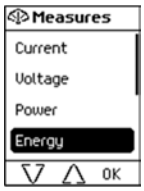
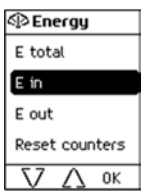
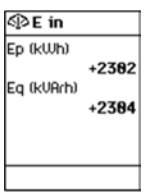
Use the contextual and dedicated buttons on the face of the Micrologic X control unit to navigate in the menu structure, and to access displayed values and configurable settings.

The possible operations are listed below, and are illustrated with an example:

- Display data, for example, energy values
- Reset values or counters, for example, reset the maximum RMS current
- Select options in a list, for example, language
- Edit a value, for example, nominal voltage
- Set protection settings, for example, long-time overcurrent protection
- Validate a pop-up message, for example, a pop-up trip message

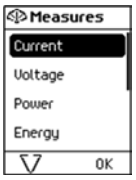
Displaying Data

The following example shows how to display energy values:

Step	Action	Screen
1	Press the home button. The **Home** menu opens. Press the down arrow to select **Measures**.	
2	Press **OK.** The **Measures** menu opens. Press the down arrow to select **Energy**.	
3	Press **OK.** The **Energy** menu opens. Press the down arrow to select **E in**.	
4	Press **OK**. The **E in** screen is displayed.	
5	To exit the **E in** screen, either: ● Press the home button to return to the **Home** menu. ● Press the **ESC** button to return to the **Energy** menu.	

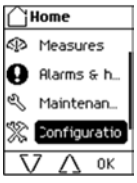
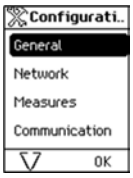
Resetting Values

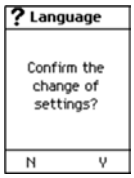
Some menus present values or counters that can be reset. The following example shows how to navigate to and reset the maximum RMS current:

Step	Action	Screen
1	Press the home button. The **Home** menu opens. Press the down arrow to select **Measures**.	
2	Press **OK**. The **Measures** menu opens. Select **Current**.	
3	Press **OK**. The **Current** menu opens. Press the down arrow to select **Reset Max**.	
4	Press **OK**. The **Reset Max** confirmation screen opens.	
5	Do one of the following: ● Press **Y** to reset the maximum RMS current and return to the **Current** screen. ● Press **N** to return to the **Current** screen without resetting the value.	

Selecting Options in a List

Some menus present options in a list. The following example shows how to navigate to and select language options:

Step	Action	Screen
1	Press the home button. The **Home** menu opens. Press the down arrow to select **Configuration**.	
2	Press **OK**. The **Configuration** menu opens. Select **General**.	

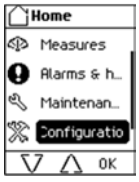
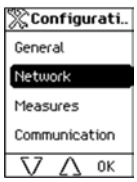
Step	Action	Screen
3	Press **OK**. The **General** menu opens. Select **Language**	
4	Press **OK**. The **Language** menu opens.	
5	Press the up and down arrow buttons to select a language and press **OK**. A confirmation check appears next to the selected language.	
6	To save the selection, press: ● The **ESC** button to return to the **General** menu. ● The home button to return to the **Home** menu.	–
7	In the confirmation screen: ● Press **Y** to confirm the change of settings. ● Press **N** to undo the edit.	

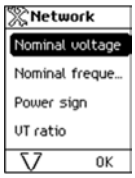
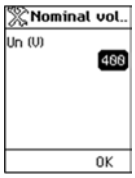
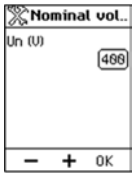
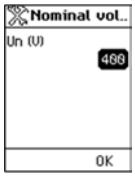
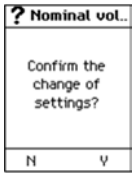
Editing and Saving Parameter Settings

When editing a parameter setting, use the **+** or **–** buttons to increment or decrement the setting by a single-step amount. Hold down the button to accelerate the process.

This function applies to both numeric values and list selections.

The following example shows how to edit the nominal voltage:

Step	Action	Screen
1	Press the home button. The **Home** menu opens. Press the down arrow to select **Configuration**.	
2	Press **OK.** The **Configuration** menu opens. Press the down arrow to select **Network**.	

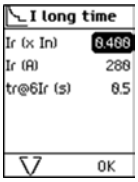
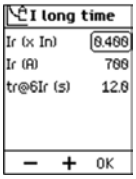
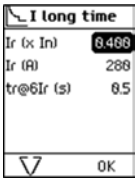
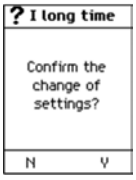
Step	Action	Screen
3	Press **OK.** The **Network** menu opens. Select **Nominal Voltage**.	
4	Press **OK.** The **Nominal Voltage** menu opens.	
5	In the **Nominal Voltage** menu, select **Un(V)** and press **OK** to enable editing of the **Un(V)** parameter. The parameter is displayed in black on a white background to indicate that editing is enabled. In this example, **400**, the factory setting value, is displayed.	
6	Press the **+** and **–** buttons to scroll through available settings. Possible values are 208, 220, 230, 240, 380, 400, 415, 440, 480, 500, 525, 550, 575, 600, 660, 690, and 1,000. Press **OK** to select a setting. The background changes to black.	
7	To save the change of settings, press one of the following: ● The **ESC** button to return to the **Nominal Voltage** screen ● The home button to return to the **Home** menu	–
8	In the confirmation screen: ● Press **Y** to confirm and save the change of settings. ● Press **N** to undo the edit.	

If the edit did not succeed, a detected error message appears. Click **OK** to confirm the message, and then the previous menu is displayed.

Setting Protection Settings

The following example shows how to set the long-time overcurrent protection:

Step	Action	Screen
1	Press the home button. The **Home** menu opens. Press the down arrow to select **Protection**.	

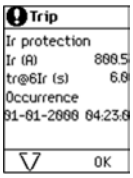
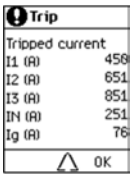
Step	Action	Screen
2	Press **OK.** The **Protection** menu opens. Select **I Long time**.	
3	Press **OK.** The **I Long time** menu opens. In the **I Long time** menu, select the **Ir** parameter.	
4	Press **OK** to enable editing of the **Ir** parameter. The parameter is displayed in black on a white background to indicate that editing is enabled.	
5	Press the **+** and **–** buttons to scroll through available settings. Press **OK** to select a setting. The parameter is displayed in white on a black background to indicate that a setting has been selected.	
6	Use the down arrow to select the next parameter to be set and repeat step 5.	
7	To save the change of settings, press: ● The **ESC** button to return to the **Protection** screen ● The home button to return to the **Home** menu	–
8	In the confirmation screen: ● Press **Y** to confirm and save the change of settings. ● Press **N** to undo the edit.	

Validating a Pop-Up Message

A trip or alarm event displays a pop-up message on the display screen. The message overrides the screen currently displayed.

The following example shows how to handle a pop-up trip message.

Step	Action	Screen
1	A pop-up trip message appears on the screen.	

Step	Action	Screen
2	Press **OK** to view details of the trip.	
3	If a down arrow appears at the bottom of the screen, press the down arrow to view more details about the trip event.	
4	After taking steps to resolve the cause of the trip, click **OK** to acknowledge the trip context. The **Alarm/History** screen is displayed.	–
5	Press **ESC** to return to the screen displayed before the pop-up message appeared, or **Home** to return to the Home screen.	

Measures Menu

Description

The **Measures** menu contains the following sub-menus:

Level 1	Level 2	Level 3	Function description
Home	**Measures**	**Current**	Current real-time measurements
		Voltage	Voltage real-time measurements
		Power	Power real-time measurements
		Energy	Energy real-time measurements
		Frequency	Frequency real-time measurements
		I Harmonics	Current harmonics real-time measurements
		V Harmonics	Voltage harmonics real-time measurements
		Power Factor	Power factor real-time measurement

Current

The **Current** menu presents the following measurements:

Level 3	Level 4	Level 5	Parameter name
Current	**I**	**I1 (A)**	RMS current on phase 1
		I2 (A)	RMS current on phase 2
		I3 (A)	RMS current on phase 3
		IN (A)[1]	RMS current on neutral
		Ig (A)[2]	RMS current on ground
		IΔn (A)[3]	RMS current on earth leakage
	I MAX	**I1 (A)**	Maximum RMS current on phase 1
		I2 (A)	Maximum RMS current on phase 2
		I3 (A)	Maximum RMS current on phase 3
		IN (A)[1]	Maximum RMS current on neutral
		Ig (A)[2]	Maximum of RMS current on ground
		IΔn (A)[3]	Maximum of RMS current on earth leakage
	I Avg	**I (1,2,3) (A)**	Average of 3-phase RMS currents
	I Unb	**I (1,2,3) (%)**	3-phase current unbalances, with quality gauge
	I Unb MAX	**I (1,2,3) (%)**	Maximum of 3-phase current unbalances
	Reset MAX		Reset of maximum RMS current, plus date and time of last reset

1 Applies to 4-pole circuit breakers or 3-pole circuit breakers with ENCT option.
2 Applies to Micrologic 2.0 X, 5.0 X, 6.0 X
3 Applies to Micrologic 7.0 X.

Voltage

The **Voltage** menu presents the following measurements:

Level 3	Level 4	Level 5	Parameter name
Voltage	**V**	**V12 (V)**	RMS phase-to-phase voltage 1-2
		V23 (V)	RMS phase-to-phase voltage 2-3
		V31 (V)	RMS phase-to-phase voltage 3-1
		V1N (V)[1]	RMS phase-to-neutral voltage 1-N
		V2N (V)[1]	RMS phase-to-neutral voltage 2-N
		V3N (V)[1]	RMS phase-to-neutral voltage 3-N
	V MAX	**V12 (V)**	Maximum RMS phase-to-phase voltage 1-2
		V23 (V)	Maximum RMS phase-to-phase voltage 2-3
		V31 (V)	Maximum RMS phase-to-phase voltage 3-1
		V1N (V)[1]	Maximum RMS phase-to-neutral voltage 1-N
		V2N (V)[1]	Maximum RMS phase-to-neutral voltage 2-N
		V3N (V)[1]	Maximum RMS phase-to-neutral voltage 3-N
	V MIN	**V12 (V)**	Minimum RMS phase-to-phase voltage 1-2
		V23 (V)	Minimum RMS phase-to-phase voltage 2-3
		V31 (V)	Minimum RMS phase-to-phase voltage 3-1
		V1N (V)[1]	Minimum RMS phase-to-neutral voltage 1-N
		V2N (V)[1]	Minimum RMS phase-to-neutral voltage 2-N
		V3N (V)[1]	Minimum RMS phase-to-neutral voltage 3-N
	V Avg	**VLL (V)**	Average of 3 RMS phase-to-phase voltages (V12+V23+V31)/3, with quality gauge
		VLN (V)[1]	Average of 3 RMS phase-to-neutral voltages (V1N+V2N+V3N)/3
	V Unb	**VLL (%)**	3 phase-to-phase voltage unbalances, with quality gauge
		VLN (%)[1]	3 phase-to-neutral voltage unbalances
	VUnb MAX	**VLL (%)**	Maximum V Unb VLL value since last reset
		VLN (%)[1]	Maximum V Unb VLN value since last reset
	Reset MIN/MAX		Reset of minimum and maximum RMS voltage, plus date and time of last reset

1 Applies to 4-pole circuit breakers or 3-pole circuit breakers with ENVT option.

Power

The **Power** menu presents the following measurements:

Level 3	Level 4	Level 5	Parameter name
Power	**P**	**P1 (kW)**	Active power on phase 1
		P2 (kW)	Active power on phase 2
		P3 (kW)	Active power on phase 3
		Ptot (kW)	Total active power
	P MAX	**Ptot (kW)**	Maximum total active power
	Q	**Q1 (kVAR)**[1]	Reactive power on phase 1
		Q2 (kVAR)[1]	Reactive power on phase 2
		Q3 (kVAR)[1]	Reactive power on phase 3
		Qtot (kVAR)	Total reactive power
	Q MAX	**Qtot (kVAR)**	Maximum total reactive power
	S	**S1 (kVA)**[1]	Apparent power on phase 1
		S2 (kVA)[1]	Apparent power on phase 2
		S3 (kVA)[1]	Apparent power on phase 3
		Stot (kVA)	Total apparent power
	S MAX	**Stot (kVA)**	Maximum total apparent power
	Reset MAX		Reset of maximum power, plus date and time of last reset
1 Applies to 4-pole circuit breakers or 3-pole circuit breakers with ENVT option.			

Energy

The **Energy** menu presents the following measurements:

Level 3	Level 4	Level 5	Parameter name
Energy	**E total**	**Ep (kWh)**	Total active energy
		Eq (kVArh)	Total reactive energy
		Es (kVAh)	Total apparent energy
	E received	**Ep (kWh)**	Total active energy delivered (counted positively)
		Eq (kVArh)	Total reactive energy delivered (counted positively)
	E delivered	**Ep (kWh)**	Total active energy received (counted negatively)
		Eq (kVArh)	Total reactive energy received (counted negatively)
	Reset counters		Reset of accumulated energy, plus date and time of last reset

Frequency

The **Frequency** menu presents the following measurements:

Level 3	Level 4	Level 5	Parameter name
Frequency	**F**	**F (Hz)**	Frequency, with quality gauge
	F MAX	**F (Hz)**	Maximum frequency
	F MIN	**F (Hz)**	Minimum frequency
	Reset MIN/MAX		Reset of minimum and maximum frequency, plus date and time of last reset

I Harmonics

The **I Harmonics** menu presents the following measurements:

Level 3	Level 4	Level 5	Level 6	Parameter name
I Harmonics	**I THD**	**I1 (%)**		Total Harmonic Distortion (THD) of current on phase 1 compared to the fundamental
		I2 (%)		Total Harmonic Distortion (THD) of current on phase 2 compared to the fundamental
		I3 (%)		Total Harmonic Distortion (THD) of current on phase 3 compared to the fundamental
		IN (%)[1]		Total Harmonic Distortion (THD) of current on neutral compared to the fundamental
	I THD IN MAX[1]	**IN (%)**		Maximum of Total Harmonic Distortion (THD) of current on neutral compared to the fundamental
	I THD Avg	**I (1, 2, 3)%**		Average of 3 phase current Total Harmonic Distortions (THD) compared to the fundamental
	I THD Avg MAX	**I (1, 2, 3)%**		Maximum average of 3 phase current Total Harmonic Distortions (THD) compared to the fundamental, plus date and time of occurrence
	Reset MAX			Reset of minimum and maximum THD/thd, plus date and time of last reset
1 Applies to 4-pole circuit breakers or 3-pole circuit breakers with ENVT option.				

V Harmonics

The **V Harmonics** menu presents the following measurements:

Level 3	Level 4	Level 5	Level 6	Parameter name
Voltage	**V THD**	**V12 (%)**		Total harmonic distortion (THD) of phase-to-phase voltage 1-2 compared to the fundamental
		V23 (%)		Total harmonic distortion (THD) of phase-to-phase voltage 2-3 compared to the fundamental
		V31 (%)		Total harmonic distortion (THD) of phase-to-phase voltage 3-1 compared to the fundamental
		V1N (%)[1]		Total harmonic distortion (THD) phase-to-neutral voltage 1-N compared to the fundamental
		V2N (%)[1]		Total harmonic distortion (THD) phase-to-neutral voltage 2-N compared to the fundamental
		V3N (%)[1]		Total harmonic distortion (THD) phase-to-neutral voltage 3-N compared to the fundamental
	V THD Avg	**VLL (%)**		Average of 3 phase-to-phase voltage Total Harmonic Distortions (THD) compared to the fundamental
		VLN (%)[1]		Average of 3 phase-to-neutral voltage Total Harmonic Distortions (THD) compared to the fundamental
	V THD Avg MAX	**VLL (%)**		Maximum value since last reset of average of 3 phase-to-phase voltage Total Harmonic Distortions (THD) compared to the fundamental
		VLN (%)[1]		Maximum value since last reset of average of 3 phase-to-neutral voltage Total Harmonic Distortions (THD) compared to the fundamental
	Reset MAX			Reset all maximum and minimum voltages
1 Applies to 4-pole circuit breakers or 3-pole circuit breakers with ENVT option.				

Power Factor Menu

The **Power Factor** menu presents the following data:

Level 3	Level 4	Parameter name
Power Factor	**PF**	Total power factor
	Cos Φ	Total fundamental power factor
	Network Capacitive[1]	Lead
	Network Inductive[2]	Lag
1 In the case of lead. 2 In the case of lag.		

Alarms & History Menu

Description

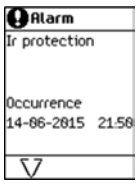
The **Alarms & History** menu contains the following sub-menus:

Level 1	Level 2	Level 3	Function description
Home	**Alarms & History**	**Alarms 3**[1]	Contains active alarms of medium and high-level severity. Trips are not included.
		Trips history	Contains trip history.
		Alarms history	Contains alarm history, not including trip history.
1 The figure indicates the number of active alarms			

NOTE: Trip history and alarm history events are listed in chronological order, with the most recent event first.

Alarm Screen

An alarm screen contains the following information:

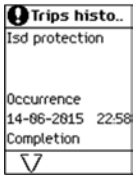


Screen title: Alarm
Alarm description: up to 3 lines of text describing the nature of the alarm
Occurrence
The date and time that the alarm occurred

A down arrow at the bottom of the screen indicates that another alarm screen can be displayed.

Trips History and Alarms History Screens

A trips history or alarms history screen contains the following information:



Screen title: Trip history or Alarms history
Alarm description: up to 3 lines of text describing the nature of the alarm
Occurrence
The date and time of the occurrence of the alarm
Completion
The date and time of the completion of the alarm

Maintenance Menu

Description

The **Maintenance** menu contains the following sub-menus:

Level 1	Level 2	Level 3	Function description
Home	**Maintenance**	**Switch to other set**[1]	Dual setting configuration
		Assistance	Contains information describing the maintenance providers, schedule, equipment and type of the circuit breaker.
		Health	Describes the monitored health of the circuit breaker.
		CB overview	Presents information about the circuit breaker and its internal and external accessories.
1 Displayed only when Dual Settings is enabled and configured mode for switching between set A and set B is Local HMI			

Switch to Other Set

The **Switch to other set** menu is displayed only when Dual Settings is enabled and presents the following data:

Level 3	Level 4	Parameter name
Switch to other set	**Switch to set B**	Selection of the setting group A or B, when the dual settings function is enabled.

Assistance

The **Assistance** menu presents the following data:

Level 3	Level 4	Level 5	Parameter name
Assistance	**Firmware Version**	**µLogic version**	Micrologic X firmware version
		ASIC version	
		TCI version	
		M&P version	
		Measure version	
		CRC32	

Health

The **Health** menu presents the following data:

Level 3	Parameter name
Health	Health is represented by one of three icons: ●  no alarm detected ●  Orange icon: medium-level alarm detected ●  Red icon: high-level alarm detected

CB Overview

The **CB overview** menu presents the following data:

Level 3	Level 4	Parameter name
CB overview	**CB block**	Circuit breaker, frame size, power system, performance level and version.

Configuration Menu

Description

The **Configuration** menu contains the following sub-menus:

Level 1	Level 2	Level 3	Function description
Home	**Configuration**	**General**	Settings of the HMI display and access to protection settings.
		Network	Settings of nominal voltage and frequency, power, or power sign and VT ratio *(see page 52)*.
		Measures	Settings of measurement calculation *(see page 53)*.
		Communication	Settings enabling wireless access and the control mode *(see page 53)*.

General

The **General** menu presents the following data:

Level 3	Level 4	Level 5	Parameter name
General	**Language** *(see page 33)*		List of display screen languages.
	Date & Time *(see page 22)*	**dd/mm/yyyy**	Today's date.
		hh:mm:ss	Local time.
	Quick View *(see page 36)*	**Scrolling**	Enable/disable Quick View scrolling.
		Auto start (min)	The time delay before Quick View scrolling resumes after an interruption if no button is pressed. **NOTE:** Only available when Quick View is enabled.
		Pageflow (sec)	The length of time for which each Quick View screen is displayed. **NOTE:** Only available when Quick View is enabled.
		Timeout (min)	The time delay before the current bar graph is displayed if no button is pressed. **NOTE:** Only available when Quick View is not enabled.
	Lock protection *(see page 63)*	**Keypad**	Enable locking of access to the **Protection** menu either through the local HMI keypad or through external access, to help prevent unauthorized users from editing protection settings. ● Not Allowed: to lock the **Protection** menu ● Allowed: to unlock the **Protection** menu
		External access	

Network

The **Network** menu presents the following data:

Level 3	Level 4	Level 5	Parameter name
Network	**Nominal Voltage**	**Un (V)**	Rated voltage. Setting values include: 208 / 220 / 230 / 240 / 380 / 400 / 415 / 440 / 480 / 500 / 525 / 550 / 575 / 600 / 660 / 690 / 1000 V. Factory setting = 400.
	Nominal Frequency	**Hz**	Rated frequency ● 50 Hz (factory setting) ● 60 Hz
	Power Sign *(see page 119)*		Power flow sign setting: ● **P+** = the active power flows from upstream (top) to downstream (bottom) (factory setting). ● **P–** = the active power flows from downstream (bottom) to upstream (top).
	VT Ratio	**VT in**	VT primary voltage. Values from 100 to 1,250, in increments of 1.
		VT out	VT secondary voltage. Values from 100 to 690, in increments of 1.

Measures

The **Measures** menu presents the following data:

Level 3	Level 4	Level 5	Parameter name
Measures	**PF/VAR Conv** *(see page 128)*		Sign convention for cos Φ, PF power factor, and reactive power: **IEC** or **IEEE** (for display only)
	System Type *(see page 114)*	**Nb of poles**	**3P** or **4P**, for display only.
		ENVT	External neutral voltage tap. Setting values include: ● If **4P**: **NO** (for display only) ● If **3P**: **YES** or **NO**
		ENCT	External neutral current transformer. Setting values include: ● If **4P**: **NO** (for display only) ● If **3P**: **YES** or **NO**
	Total P Calcul *(see page 117)*		Total power calculation method: ● **Vector** ● **Arithmetic**
	E Calcul *(see page 121)*		Energy Accumulation mode. Energy values to be used in energy calculations: ● **Absolute** ● **Signed**

Communication

The **Communication** menu presents the following data:

Level 3	Level 4	Level 5	Parameter name
Communication	**Bluetooth**	–	Enables Bluetooth control: **ON** or **OFF**
		BLE timer	Time delay before Bluetooth is automatically deactivated: ● if no connection is established ● if no activity is detected From 5 to 60 minutes. Factory setting = 15 minutes
	IEEE 802.15.4		Enables IEEE 802.15.4 communication: **ON** or **OFF** **NOTE:** Enabled only if IEEE 802.15.4 has already been commissioned through Ecoreach software.
	Control mode	**Mode**	Selection of source for open/close function ● **MANU**: manually using local mechanical button. Displays **(Push button command only)**. The control unit will reject remote open/close orders. ● **AUTO**: In addition to manual orders, the control unit will accept certain open/close orders, depending on the configuration of the remote/local parameter. The configuration is displayed as **(Remote control)** or **(Local control)**

Protection Menu

Description

The **Protection** menu contains the following sub-menus:

Level 1	Level 2	Level 3	Function description
Home	**Protection**	**I Long time**	Long-time overcurrent protection *(see page 65)*, L or ANSI code 49RMS
		I Short time[1]	Short-time overcurrent protection *(see page 68)*, S or ANSI code 51
		I Instantaneous	Instantaneous overcurrent protection *(see page 70)*, I or ANSI code 50
		I Ground Fault[2]	Ground-fault protection *(see page 72)*, G or ANSI code 50G/51G
		Earth Leakage[3]	Earth-leakage protection *(see page 74)*, ANSI code 50G/51G
		I Neutral	Neutral protection *(see page 76)*
		Dual Settings	Dual settings *(see page 78)*
1 Applies to Micrologic 5.0 X, 6.0 X, 7.0 X 2 Applies to Micrologic 6.0 X 3 Applies to Micrologic 7.0 X			

I Long Time

The **I Long time** menu presents the following data and settings:

Level 3	Level 4	Parameter name
I Long time	**Ir (x In)**	Ir long-time overcurrent protection threshold expressed according to the control unit rated current In. Used for quick settings: 0.4, 0.5, 0.6, 0.7, 0.8, 0.9, 0.95, 0.98, 1 x In.
	Ir (A)	Ir long-time overcurrent protection threshold expressed in Amps. Used for settings with 1 A resolution.
	tr @6Ir (s)	tr long-time overcurrent protection time delay.

I Short Time

The **I Short time** menu for Micrologic 5.0 X, 6.0 X, 7.0 X presents the following data and settings:

Level 3	Level 4	Parameter name
I Short time	**Ir (A)**	Ir long-time overcurrent protection threshold expressed according to the control unit rated current In, for display only
	Isd (x Ir)	Isd short-time overcurrent protection threshold expressed according to the Ir long-time overcurrent protection threshold. Step = 0.5 x Ir; Rang = 0.5–10 x Ir
	Isd (A)	Isd short-time overcurrent protection threshold expressed in Amps, for display only.
	tsd (s)	tsd short-time overcurrent protection time delay.
	I^2t (tsd)	Enable inverse time curve function: **ON** or **OFF**

I Instantaneous

The **I Instantaneous** menu for Micrologic 2.0 X presents the following data and settings:

Level 3	Level 4	Parameter name
I Instantaneous	**Ir (A)**	Ir long-time overcurrent protection threshold expressed in Amps, for display only
	Isd (x Ir)	Isd short-time overcurrent protection threshold expressed according to the Ir long-time overcurrent protection threshold. Step = 0.5 x Ir. Range = .5–10 x Ir
	Isd (A)	Isd short-time overcurrent protection threshold expressed in Amps, for display only.

The **I Instantaneous** menu for Micrologic 5.0 X, 6.0 X, and 7.0 X presents the following data and settings:

Level 3	Level 4	Parameter name
I Instantaneous	**Protection**	Enable instantaneous overcurrent protection mode: **ON** or **OFF**
	Ii (x In)	Ii instantaneous overcurrent protection threshold expressed according to the control unit rated current In. Step = 0.5 x In. Range = .2–15 x In
	Ii (A)	Ii instantaneous overcurrent protection threshold expressed in Amps, for display only.
	Ii mode	Instantaneous overcurrent protection time delay mode: **Standard** or **Fast**

Earth Leakage

The **Earth Leakage** menu for Micrologic 7.0 X presents the following data and settings:

Level 3	Level 4	Parameter name
Earth Leakage	**IΔn (A)**	Earth fault protection threshold expressed in Amps
	tΔn (s)	Earth fault protection time delay

I Ground Fault

The **I Ground Fault** menu presents the following data and settings:

Level 3	Level 4	Level 5	Parameter name
I Ground Fault	**I** 	**Protection**	Enable Ground Fault protection mode: **ON** or **OFF**
		Ig (x In)	Ground fault protection threshold expressed according to the control unit rated current In
		Ig (A)	Ground fault protection threshold expressed in Amps
		tg (s)	Ground fault protection time delay
		I^2t (tg)	Enable ground fault protection curve function: **ON** or **OFF**

I Neutral

The **I Neutral** menu presents the following data and settings:

Level 3	Level 4	Parameter name
I Neutral[1]	**Nb of poles**	Number of poles **3P** or **4P**, for display only
	Ir (A)	Long time overcurrent protection threshold, for display only.
	Protection	Set neutral protection: • **OFF** • **0.5** • **1** • **Oversized Neutral**
	IN (A)	RMS current on neutral, for display only
1 Applies to 4-pole circuit breakers and 3-pole circuit breakers with ENCT option		

Dual Settings

The **Dual Settings** menu presents the following data and settings:

Level 3	Level 4	Parameter name
Dual Settings	**Dual Settings**	Enables dual settings: **YES** or **NO**
	Settings	Displays the active configuration **A** or **B**, if **Dual Settings** is enabled.
	Switch mode[1]	Displays the configured mode for switching between setting group A and setting group B: • **Local HMI** • **IO module** • **Remote ctrl**
1 Displayed if Dual Settings is enabled. Configurable through Ecoreach software		

If the **Dual Settings** menu is enabled the following data and settings are shown and can be configured:

Level 4	Level 5	Level 6	Parameter name
Dual settings: Settings B	**I Long time**[1]	**Ir (x In)**	Ir long-time overcurrent protection threshold expressed according to the control unit rated current In, for display only.
		Ir (A)	Ir long-time overcurrent protection threshold expressed in Amps.
		tr @6Ir (s)	tr long-time overcurrent protection time delay.
	I Short time[1]	**Ir (A)**	Ir long-time overcurrent protection threshold expressed according to the control unit rated current In, for display only.
		Isd (x Ir)	Isd short-time overcurrent protection threshold expressed according to the Ir long-time overcurrent protection threshold.
		Isd (A)	Isd short-time overcurrent protection threshold expressed in Amps, for display only.
		tsd (s)	tsd short-time overcurrent protection time delay.
		I^2t	Enable inverse time curve function: **ON** or **OFF**
	I Instantaneous[1]	**Protection**[2]	Enable instantaneous protection: **ON** or **OFF**
		Ii (x In)[2]	Ii instantaneous overcurrent protection threshold expressed according to the control unit rated current In.
		Ii (A)[2]	Ii instantaneous overcurrent protection threshold expressed in Amps, for display only.
		Ii mode[2]	Instantaneous overcurrent protection time delay mode: **Standard** or **Fast**
	I [1]	**Protection**	Enable I Ground Fault protection mode: **ON** or **OFF**
		Ig (x In)	Ground fault protection threshold expressed according to the control unit rated current In
		Ig (A)	Ground fault protection threshold expressed in Amps
		tg (s)	Ground fault protection time delay
		I^2t (tg)	Enable ground fault protection curve function: **ON** or **OFF**
1 If Dual Settings is enabled, B is displayed on the upper left side of these screens. 2 Applies to Micrologic 5.0 X, 6.0 X, 7.0 X			

Pop-up Event Messages

Event Message Types and Priority

When the Micrologic X control unit detects any of the following events, a pop-up message is displayed, in this order of priority:

- Bluetooth pairing
- Trip
- High-level alarm
- Medium-level alarm

An event message overrides another event message with lower priority.

An event message overrides both **Quick View** scrolling and tree navigation operating mode displays.

Bluetooth Pairing Display

The Bluetooth pairing message is displayed during the Bluetooth pairing procedure *(see page 157)*.

The Bluetooth pairing message has the highest priority and overrides all other messages.

The Bluetooth pairing screen is closed when:

- The pairing is confirmed on the mobile device
- The Bluetooth button on the local HMI is pressed
- The Bluetooth pairing timeout expires

If an event message was displayed before or occurs during the Bluetooth pairing, it is displayed after the Bluetooth pairing message closes. Otherwise the **Home** screen is displayed.

Pop-up Trip and Alarm Message Displays

Message type	Description	Example
Trip	When a trip occurs, the trip message is displayed with a red backlight.	
High-level alarm	When a high-level alarm occurs, the high-level alarm message is displayed with a red backlight.	
Medium-level alarm	When a medium-level alarm occurs, the medium-level alarm message is displayed with an orange backlight.	

Handling Pop-up Trip and Alarm Messages

A trip or alarm message indicates that a potentially serious operating event has occurred. To address the event, take the following steps:

Step	Action
1	When the trip or alarm event message displays, press **OK**. The display screen displays a message explaining the context of the trip or details of the alarm event. The backlight color turns white.
2	After reading the explanatory message, take the remedial steps necessary to resolve the underlying condition that caused the trip or alarm.

Step	Action
3	After resolving the cause of the event, press **OK** to acknowledge the message. The explanatory message closes, and the display screen shows the Alarm/History menu screen. **NOTE:** Return to the Home screen by pressing **ESC** or the Home button while a pop-up screen or trip/alarm context screen is displayed.

NOTE: The display screen displays the trip or alarm message again, with the appropriate backlight color, when the message is not acknowledged by pressing **OK** before the event timeout expires.

For information about handling trip and alarm events, refer to the *Masterpact MTZ2/MTZ3 Circuit Breakers and Switch-Disconnectors - User Guide*.

For information about how Micrologic X control units handle events, refer to Event Management *(see page 164)*.

Event Timeout

The event timeout can be configured in **Configuration → General → Quick View**.

If Quick View scrolling is on, the event timeout is the same as the **Auto start** for Quick View.

If Quick View scrolling is off, the event timeout is displayed as **Time out**.

For more information about event timeout configuration, refer to Configuring Quick View Scrolling *(see page 36)*.

Chapter 3
Protection Functions

What Is in This Chapter?

This chapter contains the following sections:

Section 3.1
Introduction

Electrical Distribution Protection

Presentation

Micrologic X control units are designed to provide protection against overcurrents and ground-fault currents.

Micrologic X control units offer protection characteristics that comply with the requirements of standard IEC 60947-2.

Description

When choosing protection characteristics, take into account:
- Overcurrents (overloads and short-circuits) and potential ground-fault currents
- Conductors that need protection
- Coordination and selectivity between the devices
- The presence of harmonic currents

Protection characteristics can be represented on a trip curve that shows the circuit breaker trip time as a function of the measured current and protection settings. Protection settings are indexed on the rated current In of the Micrologic X control unit.

Rated Current In

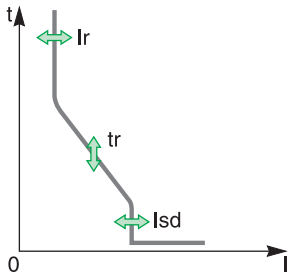
The protection setting ranges depend on the rated current In, defined by the sensor plug inserted in the Micrologic X control unit.

The sensor plug can be replaced or modified. Mechanical mismatch protection prevents the installation of a sensor plug that is not compatible with the circuit breaker frame.

For each circuit breaker frame size, the range of sensor plugs available is shown in the following table.

Sensor plug	MTZ1 frame rated current					MTZ2 frame rated current								MTZ3 frame rated current		
In	06	08	10	12	16	08	10	12	16	20	25	32	40	40	50	63
400 A	X	X	X	–	–	X	X	–	–	–	–	–	–	–	–	–
630 A	X	X	X	X	–	X	X	X	–	–	–	–	–	–	–	–
800 A	–	X	X	X	X	X	X	X	X	–	–	–	–	–	–	–
1000 A	–	–	X	X	X	–	X	X	X	X	–	–	–	–	–	–
1250 A	–	–	–	X	X	–	–	X	X	X	X	–	–	–	–	–
1600 A	–	–	–	–	X	–	–	–	X	X	X	X	–	–	–	–
2000 A	–	–	–	–	–	–	–	–	–	X	X	X	X	X	–	–
2500 A	–	–	–	–	–	–	–	–	–	–	X	X	X	X	X	–
3200 A	–	–	–	–	–	–	–	–	–	–	–	X	X	X	X	X
4000 A	–	–	–	–	–	–	–	–	–	–	–	–	X	X	X	X
5000 A	–	–	–	–	–	–	–	–	–	–	–	–	–	–	X	X
6300 A	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	X

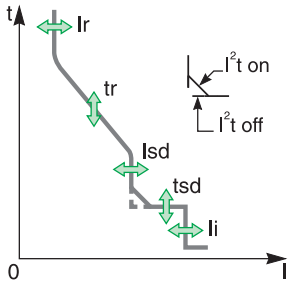
Micrologic 2.0 X Control Unit



Micrologic 2.0 X control units provide:
- Long-time overcurrent protection (Ir)
- Instantaneous overcurrent protection (Isd)

The protection functions of Micrologic 2.0 X control units operate without an auxiliary power supply. The control unit is powered by the current flowing through the circuit breaker.

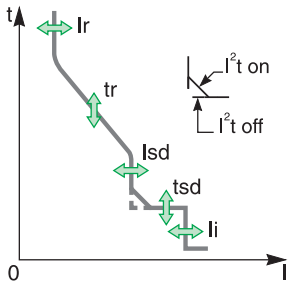
Micrologic 5.0 X Control Unit



Micrologic 5.0 X control units provide:
- Long-time overcurrent protection (Ir)
- Short-time overcurrent protection (Isd)
- Instantaneous overcurrent protection (Ii)

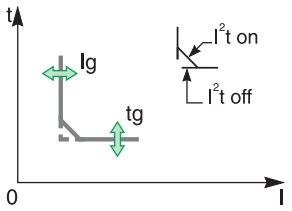
The protection functions of Micrologic 5.0 X control units operate without an auxiliary power supply. The control unit is powered by the current flowing through the circuit breaker.

Micrologic 6.0 X Control Unit

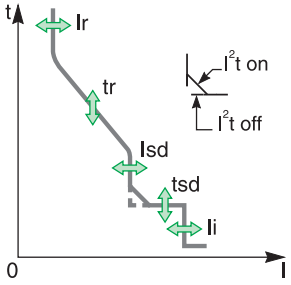


Micrologic 6.0 X control units provide:
- Long-time overcurrent protection (Ir)
- Short-time overcurrent protection (Isd)
- Instantaneous overcurrent protection (Ii)
- Ground-fault protection (Ig)

The protection functions of Micrologic 6.0 X control units operate without an auxiliary power supply. The control unit is powered by the current flowing through the circuit breaker.

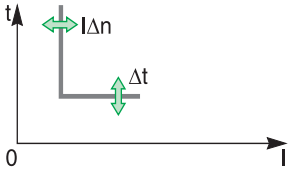


Micrologic 7.0 X Control Unit



Micrologic 7.0 X control units provide:
- Long-time overcurrent protection (Ir)
- Short-time overcurrent protection (Isd)
- Instantaneous overcurrent protection (Ii)
- Earth-leakage protection (IΔn)

The protection functions of Micrologic 7.0 X control units operate without an auxiliary power supply.
- The long-time, short-time and instantaneous overcurrent protections are powered by the current flowing through the circuit breaker.
- The earth-leakage protection is powered by the system voltage via the VPS voltage power supply module.



DIN / DINF and SELLIM Instantaneous Protections

DIN / DINF and SELLIM instantaneous protections are internal protections used when the short-circuit current reaches the withstand limit of the circuit breaker. These protections are not adjustable and are unlikely to be triggered in normal operating conditions.

The following events can be generated by the DIN / DINF and SELLIM instantaneous protections. Refer to the event tables *(see page 173)* for more information.

Events	History	Severity
Ultimate self-protection trip (SELLIM)	Trip	High
Ultimate self-protection trip (DIN / DINF)	Trip	High
Ultimate self-protection trip (SELLIM) operate	Protection	Medium
Ultimate self-protection trip (DIN / DINF) operate	Protection	Medium

Setting the Protection

Protection functions can be set as follows:
- On the Micrologic X display screen, at **Home → Protection**
- With Ecoreach software (password protected)
- With Masterpact MTZ mobile App (password protected)
- By sending a setting command using the communication network (password protected)

Setting Change Traceability

Changing the protection settings generates one of two events, depending on where the settings are changed from. The events are logged in the Protection history *(see page 173)*:
- Protection setting changed (display screen).
- Protection setting changed (Bluetooth, USB or IFE).

Setting changes recorded in the Protection history include the following:
- Date and time of the setting change
- Previous settings
- Unlocking protection settings (refer to following paragraph)

When the circuit breaker is open and the Micrologic X control unit is not connected to a power supply, long-time, short-time, instantaneous and ground-fault protection settings and the date of the last change can be accessed through NFC communication.

Locking the Protection Settings

Locking the protection settings is only possible from the Micrologic X display screen at **Home → Configuration → General → Lock protection**. It enables you to lock access to protection settings:

- From the Micrologic X display screen
- From an external access

Select **Not Allowed** to lock access. Access is allowed by default.

Changing the access to protection settings generates two events, which are logged in the Protection history *(see page 173)*:

- Protection settings on local screen is unlocked
- Remote lock for protection settings is unlocked

Section 3.2
Standard Protection Functions

What Is in This Section?

This section contains the following topics:

Long-Time Overcurrent Protection (L or ANSI Code 49RMS)

Presentation

Long-time overcurrent protection protects cables, busbars, and busbar trunking against overloads, based on the true RMS current. It is implemented independently for each phase and for the neutral.

This protection function is an overcurrent time-dependent protection with thermal memory. It operates as a thermal image, using the heating and cooling model of a conductor. After tripping, the protection continues to integrate the cooling of the conductor.

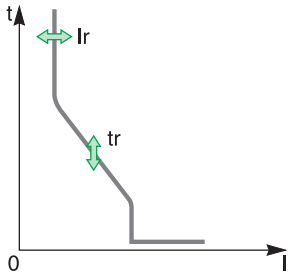
This protection function can be used also for transformer or generator protection thanks to the wide range of settings offered.

Availability

Long-time overcurrent protection is available on:
- Micrologic 2.0 X, 5.0 X, 6.0 X, and 7.0 X control units
- 3-pole and 4-pole circuit breakers

Long-time overcurrent protection is powered by the current flowing through the internal current transformers of the circuit breaker and it does not require additional external power supply.

Operating Principle



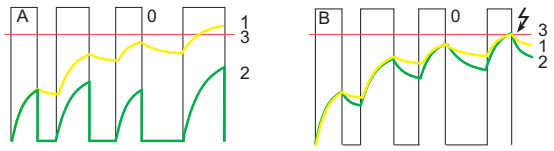
Long-time overcurrent protection is based on the true RMS current of phases and neutral, up to harmonic 15.
Long-time overcurrent protection is implemented independently for each phase and for neutral when present *(see page 76)*.

Thermal Image

The control unit uses the calculation of a thermal image to evaluate the conductor heat rise and precisely monitor the thermal state of the conductors.

Example:

Comparison of the heat rise calculation without thermal image (diagram **A**) and with thermal image (diagram **B**):



0 Instantaneous current (cyclical) in the load
1 Conductor temperature
2 Thermal state calculated without thermal image (diagram **A**), with thermal image (diagram **B**)
3 Long-time overcurrent protection threshold

- Control unit without thermal image: On each current pulse, the control unit only considers the thermal effect on the pulse under consideration. No tripping occurs despite the build-up in conductor heat rise.
- Control unit with thermal image: The control unit adds the thermal effect of successive current pulses. Tripping occurs based on the actual thermal state of the conductor.

The thermal image function protects cables and busbars from overheating in case of low-amplitude repetitive faults. Such faults can be due to repetitive motor starts, fluctuating load, intermittent ground faults, or subsequent closing after a fault.

Traditional electronic protection does not protect against repetitive faults because the duration of each overload detected above the threshold setting is too short to trigger effective tripping. However, each overload involves a temperature rise in the installation. When cumulated, overloads can overheat the system.

Thanks to its thermal memory, the thermal image function remembers and integrates thermal heating caused by each overload detected above the threshold setting:
- Before tripping, the integrated heating value reduces the associated time delay. The reaction of the control unit is closer to the real heating of the power network system.
- After tripping, the thermal function reduces the time delay when closing the circuit breaker on an overload.

The thermal memory works whatever the current value. It offers an accurate image of the cable or busbar thermal status. The time constant is the same for heating and cooling.

In the case of a control unit that is not supplied, the thermal memory is performed by a capacitor, which implies a fixed cooling time constant. The time constant is equivalent to a tr setting of 12 seconds.

Thermal Memory Reset

The thermal memory can be reset with Ecoreach software.

The thermal memory reset is recorded as an event.

Setting the Protection

The long-time overcurrent protection settings are:
- Ir long-time overcurrent protection threshold
- tr long-time overcurrent protection time delay

They can be set as follows:
- On the Micrologic X display screen, at **Home → Protection → I Long time**
- With Ecoreach software
- With Masterpact MTZ mobile App
- By sending a setting command using the communication network.

Long-time overcurrent protection can be duplicated when dual settings are activated *(see page 78)*.

Protection Settings

Setting	Unit	Range	Step	Factory setting
Ir threshold	A	0.4–1 x In	1 A	1 x In
tr time delay	s	0.5–24	0.5	0.5

The tr long-time overcurrent protection time delay is given in cold-state conditions, and for a phase or neutral current equal to 6 x Ir.

When the current is higher than Isd or Ii, only short-time overcurrent protection and instantaneous protection are operational.

Tripping Time According to tr Time Delay

tr setting (tripping time at 6 x Ir)	0.5 s	1 s	2 s	4 s	8 s	12 s	16 s	20 s	24 s
Resulting tripping time at 1.5 x Ir	12.5 s	25 s	50 s	100 s	200 s	300 s	400 s	500 s	600 s
Resulting tripping time at 7.2 x Ir	0.34 s	0.69 s	1.38 s	2.7 s	5.5 s	8.3 s	11 s	13.8 s	16.6 s

Protection Characteristics

The accuracy on the tr time delay is:
- -20% to 0% when tr > 2 s
- -25% to 0% when tr = 2 s
- -30% to 0% when tr < 2 s

Ir characteristics:
- I < 1.05 x Ir: no trip
- I > 1.2 x Ir: trip

Predefined Events

The function generates the following predefined events:

Event	History	Severity
Ir trip	Trip	High
Ir operate	Protection	Medium
Ir prealarm (I>90%Ir)	Protection	Low
Ir start (I>105%Ir)	Protection	Medium
Thermal memory reset order	Protection	Low

Predefined events cannot be modified by the user. For general information on events, refer to Event management. *(see page 164)*

Short-Time Overcurrent Protection (S or ANSI Code 51)

Presentation

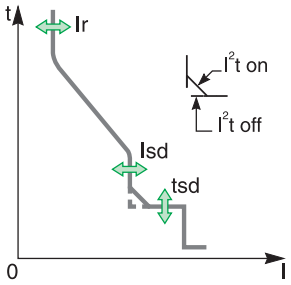
Short-time overcurrent protection protects equipment against phase-to-phase, phase-to-neutral and phase-to-ground short circuits with total selectivity. It includes two characteristics, definite time and inverse time, which depend on the status of the I²t setting.

Availability

Short-time overcurrent protection is available on:
- Micrologic 5.0 X, 6.0 X, and 7.0 X control units
- 3-pole and 4-pole circuit breakers

Short-time overcurrent protection is powered by the current flowing through the internal current transformers of the circuit breaker and it does not require an additional external power supply.

Operating Principle



The short-time overcurrent threshold Isd sets the level of short-circuit current at which the circuit breaker trips when reaching the short-time overcurrent time delay.
The short-time overcurrent time delay tsd sets the length of time during which the circuit breaker carries a short circuit within the short-time overcurrent threshold range.
The short-time overcurrent time delay can be adjusted to:
- Four setting values with I^2t ON.
  - Up to 10 Ir, the tripping curve is an inverse time curve. The time delay decreases as the current increases.
  - Above 10 Ir, the tripping curve is a definite time curve with a constant tripping time.
- Five setting values with I^2t OFF. The tripping curve is a definite time curve with a constant tripping time.

Short-time overcurrent protection is based on the true RMS current of phases and neutral, up to harmonic 15.

In order to trip on an intermittent fault, the control unit accumulates the intermittent currents in the short-time tripping range that do not last long enough to trigger a trip. This accumulation may lead to shorter tripping times than those set.

Setting the Protection

The short-time overcurrent protection settings are:
- Isd short-time overcurrent protection threshold
- tsd short-time overcurrent protection time delay
- I²t short-time overcurrent protection curve (I²t ON or I²t OFF)

They can be set as follows:
- On the Micrologic X display screen, at **Home → Protection → I Short time**
- With Ecoreach software
- With Masterpact MTZ mobile App
- By sending a setting command using the communication network. This function is password protected.

Short-time overcurrent protection can be duplicated when dual settings are activated *(see page 78)*.

Protection Settings

The following Isd settings are available:

Setting	Unit	Range	Step	Factory setting	Accuracy
Isd threshold	A	1.5 to 10 x Ir	0.5 x Ir[1]	1.5 x Ir	+/- 10%
1 Finer resolution settings are possible with Ecoreach software and Masterpact MTZ mobile App					

tsd time delay setting is as follows:

Setting	Unit	Setting Value				
tsd with I²t OFF	s	0	0.1	0.2	0.3	0.4

Setting	Unit	Setting Value				
tsd with I²t ON	s	–	0.1	0.2	0.3	0.4
Non-tripping time	s	> 0.02	> 0.08	> 0.14	> 0.23	> 0.35
Maximum breaking time	s	< 0.08	< 0.14	< 0.20	< 0.32	< 0.50

The tsd time delay factory setting is 0 s with I²t OFF.

Zone Selective Interlocking (ZSI)

The ZSI characteristics and external wiring of the zone selective interlocking function, are described specifically *(see page 80)*.

If ZSI IN is not set to 1 (open circuit between Z3 and Z4 terminals), the maximum breaking time is 0.08 s regardless of the tsd setting value.

When ZSI IN is set to 1 and connected to the ZSI OUT of a downstream device (or when the ZSI function is not used and there is a jumper between the Z3 and Z4 terminals), the tsd time delay is used.

The Isd pick up activates ZSI OUT (Z1 and Z2 terminals).

NOTE: Masterpact MTZ circuit breakers are delivered with a jumper installed between Z3 and Z4.

Predefined Events

The function generates the following predefined events:

Event	History	Severity
Isd trip	Trip	High
Isd operate	Protection	Medium
Isd start (I > Isd)	Protection	Medium

Predefined events cannot be modified by the user. For general information on events, refer to Event Management *(see page 163)*.

Instantaneous Overcurrent Protection (I or ANSI Code 50)

Presentation

Instantaneous protection protects equipment against phase-to-phase, phase-to-neutral and phase-to-ground short circuits. The protection operates with a definite time characteristic. It trips without additional time delay as soon as the setting current is exceeded.

The protection offers two typical total breaking times:

- Standard breaking time of 50 ms, used for applications requiring selectivity. Full selectivity can be ensured with any Compact NSX circuit breaker installed downstream of a Masterpact device (for Ue ≤ 440V and MTZ other than type L. Refer to selectivity tables for details).
- Fast breaking time of 30 ms, typically used for applications where the thermal constraints of the equipment need to be limited and when selectivity is not required.

NOTE: On Micrologic 2.0 X, instantaneous protection is a short-time protection without time setting.

Availability

Instantaneous overcurrent protection is available on:

- Micrologic 2.0 X, 5.0 X, 6.0 X, and 7.0 X control units
- 3-pole and 4-pole circuit breakers

It is powered by the current flowing through the internal current transformers of the circuit breaker and it does not require an additional external power supply.

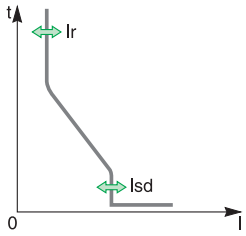
Operating Principle

The instantaneous overcurrent protection threshold sets the level of short-circuit current at which the circuit breaker trips with no intentional time delay.

For Micrologic 5.0 X, 6.0 X, 7.0 X control units, instantaneous overcurrent protection can be disabled.

Instantaneous overcurrent protection overrides short-time overcurrent protection when the instantaneous overcurrent threshold is adjusted to the same or a lower setting than the short-time overcurrent threshold.

Setting the Protection for Micrologic 2.0 X



The instantaneous overcurrent protection setting for Micrologic 2.0 X is:

- Isd short-time overcurrent protection threshold (without time setting)

It can be set as follows:

- On the Micrologic X display screen, at **Home → Protection → I Instantaneous**
- With Ecoreach software
- With Masterpact MTZ mobile App
- By sending a setting command using the communication network. This function is password-protected.

Instantaneous overcurrent protection can be duplicated when dual settings are activated *(see page 78)*.

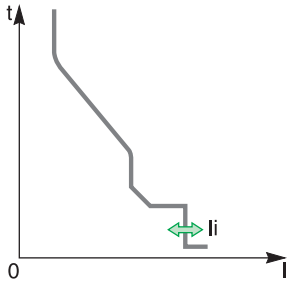
Protection Settings for Micrologic 2.0 X

Setting	Unit	Range	Step	Factory setting
Isd threshold	A	1.5–10 x Ir	0.5 x Ir[1]	1.5 x Ir
1 Finer resolution settings are possible with Ecoreach software and Masterpact MTZ mobile App				

Protection Characteristics for Micrologic 2.0 X

Characteristic	Unit	tsd
Breaktime at 2 x threshold	ms	≤ 80
Non-tripping time	ms	> 20
Accuracy on threshold	%	+/- 10

Setting the Protection for Micrologic 5.0 X, 6.0 X, 7.0 X



The instantaneous overcurrent protection settings are:
- Ii enable
- Ii type
- Ii instantaneous overcurrent protection threshold

They can be set as follows:
- On the Micrologic X display screen, at **Home → Protection → I Instantaneous**
- With Ecoreach software
- With Masterpact MTZ mobile App
- By sending a setting command using the communication network. This function is password-protected.

Instantaneous overcurrent protection can be duplicated when dual settings are activated *(see page 78)*.

Protection Settings for Micrologic 5.0 X, 6.0 X, 7.0 X

Setting	Unit	Range	Step	Factory setting
Ii enable	–	ON/OFF	–	ON
Ii type	–	Standard / Fast	–	Standard
Ii threshold	A	1.5–15 x In	0.5 x Ir[1]	1.5 x In
1 Finer resolution settings are possible with Ecoreach software and Masterpact MTZ mobile App				

Protection Characteristics for Micrologic 5.0 X, 6.0 X, 7.0 X

Characteristic	Unit	Ii type is set to Standard	Ii type is set to Fast
Breaktime at 2 x threshold	ms	≤ 50	≤ 30
Non-tripping time	ms	> 20	0
Accuracy on threshold	%	+/- 10	+/- 10

Predefined Events

The function generates the following predefined events:

Event	History	Severity
Ii trip	Trip	High
Ii operate	Protection	Medium

Predefined events cannot be modified by the user. For general information on events, refer to Event Management *(see page 163)*.

Ground-Fault Protection (G or ANSI Code 50G/51G)

Presentation

Ground-fault protection ensures protection against phase-to-ground fault, which is more sensitive than protection based on phase current only. It is generally used in TN-S systems but could also be used in other earthing systems. Ground-fault protection is based either on the summation of the phases and neutral current or on the signal delivered by an external sensor, source ground return (SGR) current transformer through the MDGF module.

NOTE: Ground-fault protection is also called earth-fault protection.

Availability

Ground-fault protection is available on:
- Micrologic 6.0 X control units
- 3-pole and 4-pole circuit breakers

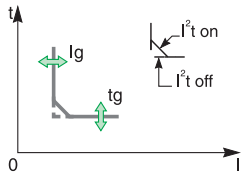
External sensors can be used:
- Source ground return protection: including ground-fault protection and an SGR sensor installed around the connection of the transformer neutral point to ground.
- External Neutral Current Transformer (ENCT): measurement of the current on neutral

Ground-fault protection is powered by the current flowing through the internal current transformers of the circuit breaker and it does not require an additional external power supply.

Operating Principle

The ground-fault current is calculated or measured according to the circuit breaker configuration, as shown in the following table.

Circuit breaker configuration	Ig ground-fault current
3P	Ig = I1 + I2 + I3
4P	Ig = I1 + I2 + I3 + IN
3P + ENCT	Ig = I1 + I2 + I3 + IN (ENCT)
3P or 4P + SGR	Ig = ISGR



The ground-fault protection threshold Ig sets the level of ground-fault current at which the circuit breaker trips when reaching the ground-fault protection time delay tg.
The time delay tg sets the length of time during which the circuit breaker carries a ground-fault within the ground-fault protection threshold Ig range.
The time delay tg can be adjusted to:
- Four setting values with I²t ON. In this case, the tripping curve is an inverse time curve up to 2 x Ir, meaning that the time delay decreases as the current increases. Above 2 x Ir, the tripping curve is a definite time curve with a constant tripping time.
- Five setting values with I²t OFF. In this case, the tripping curve is a definite time curve with a constant tripping time.

Ground-fault protection is based on the true RMS current of phases and neutral, up to harmonic 15.

In order to trip on an intermittent fault, the control unit accumulates the intermittent currents in the ground-fault tripping range that do not last long enough to trigger a trip. This accumulation leads to shorter tripping times than those set.

Setting the Protection

Ground-fault protection can be enabled or disabled.

The ground-fault protection settings are:
- Ig enable
- Ig ground-fault protection threshold
- tg ground-fault protection time delay
- Ground-fault protection curve (I²t ON or I²t OFF)

They can be set as follows:
- On the Micrologic X display screen, at **Home → Protection → I Ground Fault**
- With Ecoreach software

- With Masterpact MTZ mobile App
- By sending a setting command using the communication network. This function is password-protected.

The ground-fault protection can be duplicated when dual settings are activated *(see page 78)*.

Protection Settings

Setting	Unit	Range	Step	Factory setting	Accuracy
Ig enable	–	ON / OFF	–	ON	–
Ig threshold	A	0.2–1 x In	0.1 x In[1]	0.2 x In	+/– 10%
1 Finer resolution settings are possible with Ecoreach software and Masterpact MTZ mobile App					

Setting	Unit	Setting Value				
tg with I²t OFF	s	0	0.1	0.2	0.3	0.4
tg with I²t ON	s	–	0.1	0.2	0.3	0.4
Non-tripping time	s	> 0.02	> 0.08	> 0.14	> 0.23	> 0.36
Maximum breaking time	s	< 0.08	< 0.14	< 0.20	< 0.32	< 0.50

The default tg time delay setting value is 0 s with I²t OFF.

Testing the Protection

Test the operation of ground-fault protection as follows:

Step	Action
1	Check that the circuit breaker is closed and the control unit is supplied with power (ready LED is flashing).
2	Press the test button (**T**) on the front face of the Micrologic X control unit. This action is recorded as an event.
3	The circuit breaker trips. An event is generated.
4	If the circuit breaker does not trip, an event is generated. Contact your field service representative.

Zone Selective Interlocking (ZSI)

The ZSI characteristics and external wiring of the zone selective interlocking function, are described specifically *(see page 80)*.

If ZSI IN is not set to 1(open circuit between Z3 and Z4 terminals), the maximum breaking time is 0.08 s regardless of the tg setting value.

When ZSI IN is set to 1 and connected to the ZSI OUT of a downstream device (or when ZSI is not used, there is a jumper between the Z3 and Z4 terminals), the tg time delay is used.

The Ig pick up activates ZSI OUT (Z1 and Z2 terminals).

NOTE: Masterpact MTZ circuit breakers are delivered with a jumper installed between Z3 and Z4.

Predefined Events

The function generates the following predefined events:

Event	History	Severity
Ig trip	Trip	High
IΔn/Ig test trip	Trip	High
Ig start	Protection	Low
Ig operate	Protection	Medium
IΔn/Ig test button pressed	Diagnostic	Low
IΔn/Ig test trip failed	Diagnostic	High

Predefined events cannot be modified by the user. For general information on events, refer to Event Management *(see page 163)*.

Earth-Leakage Protection (ANSI Code 50G/51G)

Presentation

Earth-leakage protection is a protection against earth fault with a very high sensitivity. It is generally used in TT or IT earthing systems but could also be used in TN earthing systems in some circumstances. Earth-leakage protection is a residual current protection based on current measured by a rectangular sensor encompassing the three phases or the three phases and neutral. Micrologic 7.0 X earth-leakage protection with VPS module complies with IEC 60947-2 Annex B. It is a type A residual-current device (RCD).

Availability

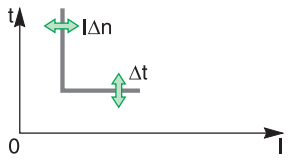
Earth-leakage protection is available on:
- Micrologic 7.0 X control units connected to an external rectangular sensor
- 3-pole and 4-pole circuit breakers

The external rectangular sensor is required to measure the residual current.

The VPS voltage power supply module is delivered with Micrologic 7.0 X control units to supply power to the control unit in case of a low level fault and no load, where the power supply based on current flowing through the circuit breaker is not high enough.

The VPS is mandatory to comply with IEC 60947-2 Annex B.

Operating Principle



Earth-leakage protection is definite time.
The earth-leakage protection threshold IΔn sets the level of earth-leakage at which the circuit breaker trips when reaching the earth-leakage protection time delay tΔn.

Setting the Protection

The earth-leakage protection settings are:
- IΔn earth-leakage protection threshold
- tΔn earth-leakage protection time delay

They can be set as follows:
- On the Micrologic X display screen, at **Home → Protection → I Earth Leakage**
- With Ecoreach software
- With Masterpact MTZ mobile App
- By sending a setting command using the communication network.

Protection Settings

Setting	Unit	Range	Step	Factory setting
IΔn threshold	A	0.5 – 30	0.1	0.5

Setting	Unit	Setting Value				
tΔn time delay	s	0.06	0.15	0.23	0.35	0.80
Non-tripping time	s	> 0.06	> 0.15	> 0.23	> 0.35	> 0.80
Maximum breaking time	s	< 0.14	< 0.23	< 0.35	< 0.80	< 1.00

Testing the Protection

Test the operation of earth-leakage protection as follows:

Step	Action
1	Check that the circuit breaker is closed and the control unit is supplied with power (ready LED is flashing).

Step	Action
2	Press the test button (**T**) on the front face of the Micrologic X control unit. This action is recorded as an event.
3	The circuit breaker trips. An event is generated.
4	If the circuit breaker does not trip, an event is generated. Contact your field service representative.

Predefined Events

The function generates the following predefined events:

Event	History	Severity
IΔn trip	Trip	High
IΔn/Ig est trip	Trip	High
IΔn start	Protection	Low
IΔn operate	Protection	Medium
IΔn/Ig test button pressed	Diagnostic	Low
IΔn/Ig test trip failed	Diagnostic	High

Predefined events cannot be modified by the user. For general information on events, refer to Event Management *(see page 164)*.

Neutral Protection

Presentation

A long time overcurrent protection function is dedicated to the neutral protection.

Availability

Neutral protection is available on:
- Micrologic 2.0 X, 5.0 X, 6.0 X, and 7.0 X control units
- 3-pole circuit breakers with the ENCT option (External Neutral Current Transformer) to measure the neutral current
- 4-pole circuit breakers

Description

Where the cross-sectional area of the neutral conductor is at least equivalent to that of the phase conductor, and the current in the neutral is expected not to exceed the value in the phase conductor, it is not necessary to provide overcurrent protection for the neutral conductor.

The neutral conductor must have protection against short-circuit current if:
- The cross-sectional area of the neutral conductor is less than the cross-sectional area of the phase conductors
- Non-linear loads generating third order harmonics (or multiples thereof) are installed

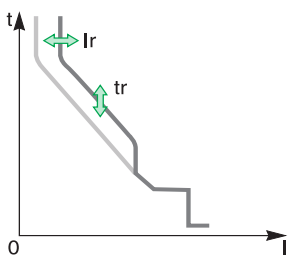
It may be necessary to switch off the neutral for operational reasons (multiple source diagram) or safety reasons (working with power off).

To summarize, the neutral conductor can be:
- Non-distributed (3-pole circuit breaker)
- Distributed, not switched off and not protected (3-pole circuit breaker)
- Distributed, not switched off but protected (3-pole circuit breaker with ENCT option)
- Distributed, switched off and protected (4-pole circuit breaker)

Micrologic X control units are suitable for all protection types. They incorporate the OSN (Oversized Neutral) function, which manages protection of the neutral conductor when third-order harmonic currents (and multiples thereof) are present.

Circuit Breaker	Possible Types	Neutral Protection
3-pole circuit breaker	3P, 3D	Off
3-pole circuit breaker with ENCT option	3P, 3D	Off
	3P, 3D + N/2	Half neutral
	3P, 3D + N	Full neutral
	3P, 3D + OSN	Oversized neutral
4-pole circuit breaker	4P, 3D	Off
	4P, 3D + N/2	Half neutral
	4P, 4D	Full neutral
	4P, 4D + OSN	Oversized neutral
P: Pole, D: Control unit, N: Neutral protection		

Operating Principle



Neutral protection has the same characteristics as phase protection:
- Its threshold is proportional to the long-time protection threshold Ir.
- It has the same tr time delay values as long-time protection.
- Its short-time and instantaneous protections are identical.

Declaring the External Neutral Current Transformer (ENCT) on 3-Pole Circuit Breakers

On 3P circuit breakers the ENCT option must be declared in one of the following ways:

- On the Micrologic X display screen, at **Home → Configuration → Measures → System Type → ENCT**
- With Ecoreach software
- With Masterpact MTZ mobile App
- By sending a setting command using the communication network. This function is password-protected.

Setting the Neutral Protection for 3-Pole and 4-Pole Circuit Breakers

Set the type of neutral protection in one of the following ways:

- On the Micrologic X display screen, at **Home → Protection → Neutral**
- With Ecoreach software
- With Masterpact MTZ mobile App
- By sending a setting command using the communication network. This function is password-protected.

The table below shows the setting values of the neutral long-time protection and threshold for the type of neutral protection selected:

Neutral protection type		Neutral long-time threshold value
OFF		No long-time protection for neutral
0.5		Ir/2
1		Ir
OSN	3-pole (ENCT)	1.6 x Ir
	4-pole	1.6 x Ir limited to In

Dual Settings

Presentation

Dual settings function consists of two sets of parameters on the following protections, according to the type of Micrologic X control unit:
- Long-time overcurrent protection
- Short-time overcurrent protection
- Instantaneous overcurrent protection
- Ground-fault protection

The user may switch from one set to the other under certain operating conditions. A typical application is to adjust short-circuit protection when the circuit breaker can be supplied by two sources with very different short-circuit currents. For example, the circuit breaker is supplied by either the grid or a generator.

Availability

The dual settings function is available on Micrologic 2.0 X, 5.0 X, 6.0 X, 7.0 X.

Operating Principle

When the dual settings function is enabled, two sets of protection parameters are available:
- Set A corresponds to the settings currently selected
- Set B is a new set of protection parameters, which can be set as described in Setting the Function *(see page 78)*.

Set B is activated as follows:
- On the Micrologic X display screen at **Home → Maintenance → Switch to other set → Switch to set B**.
- By sending a setting command using the communication network. For more information refer to the *Masterpact MTZ - Modbus Communication Guide*.
- By a digital input provided by IO module. For more information refer to the *IO Input/Output Application Module for One Circuit Breaker - Instruction Sheet*

Without an external command, Ir, tr, Isd, tsd, Ii, Ig, and tg settings are those of Set A.

When the **Activate Set B** external command is sent, the Ir, tr, Isd, tsd, Ii, Ig, and tg settings switch to those of Set B.

When the **Dual settings** function is enabled, the settings on the display screen are marked **_A** or **_B**.

Activating Set B generates a low-level event, B curve active, which is logged in the protection history.

Setting the Function

The Set A protection parameters are set as follows:
- On the Micrologic X display screen, at **Home → Protection**
- With Ecoreach software
- With Masterpact MTZ mobile App
- By sending a setting command using the communication network. This function is password-protected.

The Set B protection parameters are set as follows:
- On the Micrologic X display screen, at **Home → Protection → Dual Settings**
- With Ecoreach software
- With Masterpact MTZ mobile App
- By sending a setting command using the communication network. This function is password-protected.

Function Settings

Function	Settings	Factory settings	Setting range	Micrologic X version
Dual settings	Activation	NO	YES/NO	Micrologic 2.0 X, 5.0 X, 6.0 X, 7.0 X
	Mode	Local HMI	• Local HMI • Module IO • Remote Ctrl	Micrologic 2.0 X, 5.0 X, 6.0 X, 7.0 X
Long-time Set B	Ir	1 x In	Same as set A	Micrologic 2.0 X, 5.0 X, 6.0 X, 7.0 X
	tr	0.5 s	Same as set A	
Short-time Set B	Isd	1.5 Ir	Same as set A	Micrologic 2.0 X, 5.0 X, 6.0 X, 7.0 X
	tsd	0	Same as set A	

Function	Settings	Factory settings	Setting range	Micrologic X version
Instantaneous Set B	Ii mode	ON	Same as set A	Micrologic 5.0 X, 6.0 X, 7.0 X
	Ii type	Standard	Same as set A	
	Ii value	1.5 In	Same as set A	
Ground-fault Set B	Ig mode	ON	Same as set A	Micrologic 6.0 X
	Ig	0.2	Same as set A	
	tg	0	Same as set A	

Zone Selective Interlocking (ZSI)

Presentation

Zone-selective interlocking (ZSI), also called zone restraint, is a system designed to reduce the stress on electrical distribution equipment during short-circuit or ground-fault conditions.

ZSI works with a previously coordinated distribution system to limit fault stress on the system by reducing the time it takes to clear the fault while maintaining system coordination between overcurrent and ground-fault protective devices.

ZSI allows Micrologic X control units to communicate with each other so that a short-circuit or ground-fault can be isolated and cleared by the nearest upstream circuit breaker with no intentional time delay. Devices in all other areas of the system (including upstream) remain closed to maintain service to unaffected loads.

Without ZSI, a coordinated system results in the circuit breaker closest to the fault clearing the fault, but usually with an intentional delay. With ZSI, the device closest to the fault ignores its preset short-time and ground-fault delays and clears the fault with no intentional delay.

Zone-selective interlocking eliminates intentional delay without sacrificing coordination and it results in faster tripping times. This limits fault stress by reducing the amount of let-through energy the system is subjected to during an overcurrent.

The use of ZSI does not cause circuit breakers that are not coordinated (due to improper settings) to coordinate.

Availability

Zone-selective interlocking is available on Micrologic 5.0 X, 6.0 X, and 7.0 X control units.

For more information on compatibility and hard wiring, refer to the *ZSI Instruction Sheet*.

Masterpact circuit breakers with ZSI capability are shipped with self-restraint jumpers installed. Self-restraint jumpers must be in place unless zone selective interlocking is activated. If jumpers are removed and zone selective interlocking is not activated, the circuit breaker ignores its programmed delay and trips with no intentional delay.

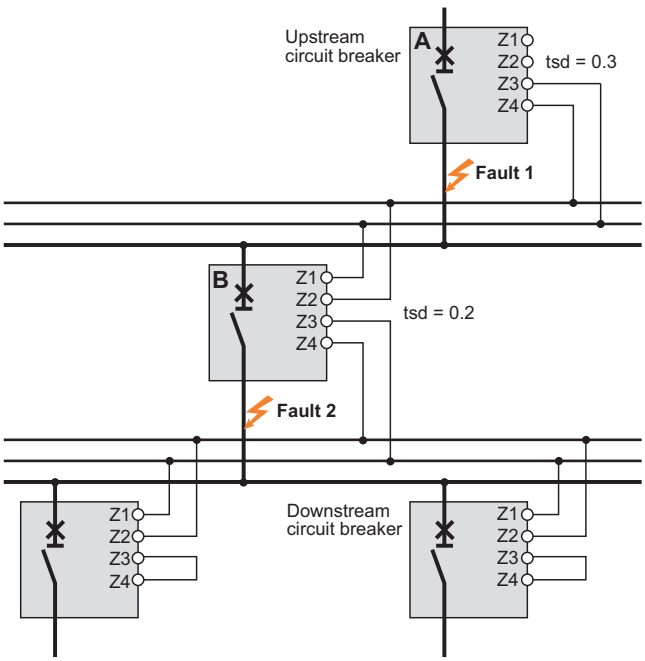
Operating Principle

A pilot wire interconnects a number of circuit breakers equipped with Micrologic X control units, as illustrated in the following diagram.

The control unit detecting a fault sends a signal upstream and checks for a signal arriving from downstream. If there is a signal from downstream, the circuit breaker remains closed for the full duration of its tripping delay. If there is no signal from downstream, the circuit breaker opens immediately, regardless of the tripping-delay setting.

Fault 1: Only circuit breaker **A** detects the fault. Because it receives no signal from downstream, it opens immediately, regardless of its tripping delay set to 0.3.

Fault 2: Circuit breakers **A** and **B** detect the fault. Circuit breaker **A** receives a signal from circuit breaker **B** and remains closed for the full duration of its tripping delay, set to 0.3. Circuit breaker **B** does not receive a signal from downstream and opens immediately, in spite of its tripping delay set to 0.2.



NOTE: On device **A**, the tsd and tg tripping delays must not be set to zero because this would make selectivity impossible.

Setting the Function

The following settings can be assigned to the ZSI input:

- Ground-fault protection (Micrologic 6.0 X)
- Short-time overcurrent protection
- Both protections (factory setting)

Setting changes can be made as follows:

- With Ecoreach software
- By sending a setting command using the communication network. This function is password-protected.

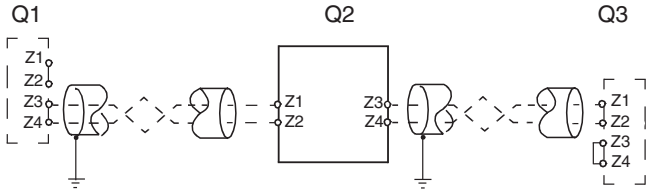
Predefined Events

The function generates the following event:

Event	History	Severity
ZSI test	Diagnostic	Low

Connection Principles

The figure below explains how the signal wire is connected to the Micrologic X control unit:

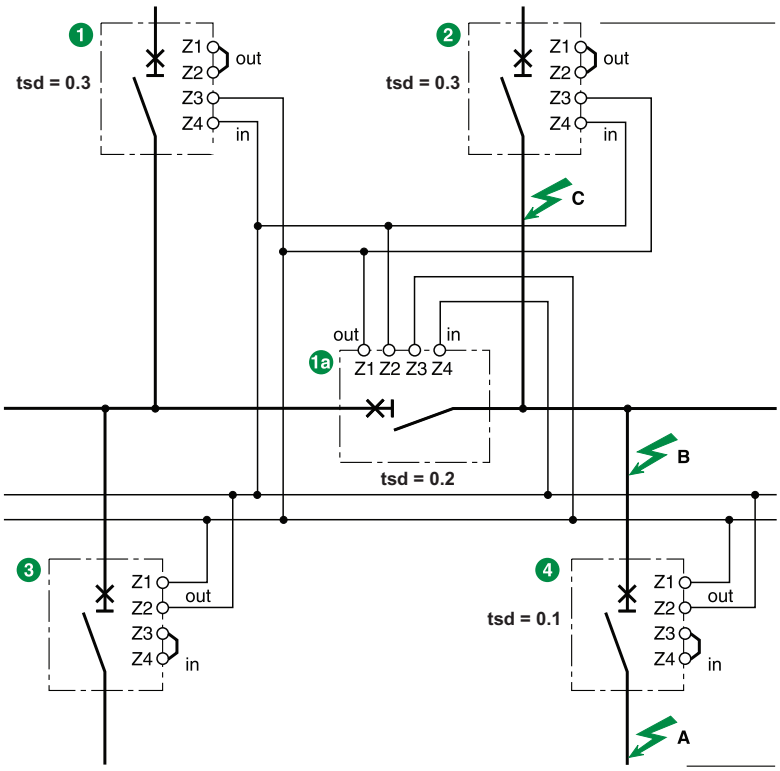


Q1 Upstream circuit breaker
Q2 Circuit breaker to be wired
Q3 Downstream circuit breaker
Z1 ZSI-OUT source
Z2 ZSI-OUT
Z3 ZSI-IN source
Z4 ZSI-IN

NOTE: When ZSI is not used downstream, short circuit inputs Z3 and Z4. The setting of the short-time and ground-fault protection time delays can be inhibited if this principle is not applied.

Multi-Source Distribution

If a number of circuit breakers are installed upstream (multi-source distribution), the same principles apply.



NOTE: Management of this configuration does not require any additional relays to ensure that ZSI is controlled for the sources used.

Connection Wire Characteristics

The table below indicates the characteristics of the inter-device signal wire:

Characteristics	Values
Impedance	2.7 Ω per 300 m
Maximum length	300 m
Type of cable	Shielded twisted (Belden 8441 or equivalent)
Permissible conductor cross-section	0.4–2.5 mm^2
Interconnection limit on inputs Z3 and Z4 (to downstream devices)	15 devices
Interconnection limit on outputs Z1 and Z2 (to upstream devices)	5 devices

ZSI Interface Module

For more information about the ZSI Interface module, refer to the *ZSI Interface Module Instruction Sheet*.

Testing the ZSI Function

The ZSI function can be tested using Ecoreach software, as follows:

Step	Action	Result
1	Use Ecoreach to test the tripping time of short-time overcurrent protection and/or ground-fault protection of upstream Masterpact MTZ with a jumper between Z3 - Z4	The tripping time should be equal to tsd and/or tg

Step	Action	Result
2	Use Ecoreach to test the tripping time of short-time overcurrent protection and/or ground-fault protection of downstream Masterpact MTZ	The tripping time should be equal to tsd and/or tg
3	Remove Jumper between Z3-Z4 of upstream Masterpact MTZ and connect wiring from downstream Masterpact MTZ Z1-Z2.	–
4	Test wiring between downstream Masterpact MTZ and upstream Masterpact MTZ by using Ecoreach connected to downstream Masterpact MTZ	The trip cause indication LEDs of the upstream Masterpact MTZ blink

Section 3.3
Setting Guidelines

What Is in This Section?

This section contains the following topics:

Protection Setting Guidelines

Presentation

The setting of overcurrent protection relies on installation short-circuit and fault calculation. The setting guideline cannot replace this calculation.

Masterpact MTZ circuit breakers with Micrologic X control units offer setting flexibility to ensure the required overcurrent protection whilst maintaining selectivity and stability on transient phenomena when necessary.

For each circuit, the installation designer needs to provide the following:
- Iz: continuous current capacity of the circuit
- Ifault min: minimum fault current at the end of the circuit depending on earthing system
- Tmax short-circuit: maximum time for maximum short-circuit current

Guidelines are given for the following settings:
- Ir: long-time overcurrent protection threshold
- tr: long-time overcurrent protection time delay
- Isd: short-time overcurrent protection threshold
- tsd: short-time overcurrent protection time delay

Overcurrent Protection Setting Guidelines by Application

The following table gives the guidelines for overcurrent protection setting by application:

Application	Micrologic 2.0 X	Micrologic 5.0 X, 6.0 X, 7.0 X[1]
Secondary side of MV/LV transformer (switchboard main incomer) with other Masterpact or Compact NS 630–3200 A downstream as feeder	Ir = Iz tr ≤ 24 s Isd ≤ Ifault min No selectivity possible with feeders except Compact NSX	Ir = Iz tr ≤ 24 s Isd ≤ Ifault min tsd < Tmax short-circuit tsd > tsd of downstream Masterpact or Compact NS 630–3200 A Ii enable: OFF
Secondary side of MV/LV transformer (switchboard main incomer) without other Masterpact or Compact NS 630–3200 A downstream as feeder	Ir = Iz tr ≤ 24 s Isd ≤ Ifault min	Ir = Iz tr ≤ 24 s Isd ≤ Ifault min tsd = 0 Ii enable: ON Ii mode: Standard Ii = Isd
Generator output with other Masterpact or Compact NS 630–3200 A downstream as feeder	Ir = Iz tr ≤ 1 s Isd ≤ Ifault min No selectivity possible with feeders except Compact NSX	Ir = Iz tr ≤ 1 s Isd ≤ Ifault min tsd > tsd of downstream Masterpact or Compact NS 630–3200 A Ii enable: OFF
Generator output without other Masterpact or Compact NS 630–3200 A downstream as feeder	Ir = Iz tr ≤ 1 s Isd ≤ Ifault min	Ir = Iz tr ≤ 1 s Isd ≤ Ifault min tsd = 0 Ii enable: ON Ii mode: Standard Ii = Isd
Feeder with other Masterpact or Compact NS 630–3200 A downstream	Ir = Iz tr ≤ 16 s Isd ≤ Ifault min No selectivity possible except with Compact NSX	Ir = Iz tr ≤ 16 s Isd ≤ Ifault min tsd > tsd of downstream circuit breaker Ii enable: OFF

1 Ground-fault protection and earth-leakage protection depend on the earthing system and local regulations. As a general rule ground-fault and earth-leakage sensitivity should be as low as possible without being disturbed by permanent or transient leakage current.The ground-fault and earth-leakage time delay ensures selectivity with downstream devices.

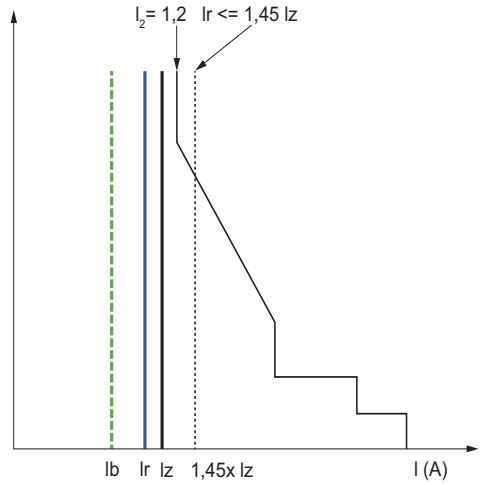
Application	Micrologic 2.0 X	Micrologic 5.0 X, 6.0 X, 7.0 X[1]
Feeder without other Masterpact or Compact NS 630–3200 A downstream as feeder	Ir = Iz tr ≤ 16 s Isd ≤ Ifault min	Ir = Iz tr ≤ 16 s Isd ≤ Ifault min tsd = 0 Ii enable: ON Ii mode: Standard Ii = Isd
Power electronic (for example, uninterruptible power supplies, variable speed drives, photovoltaic inverters) with no other circuit breaker downstream	Ir = Iz tr ≤ 8 s Isd ≤ Ifault min	Ir = Iz tr ≤ 16 s Isd ≤ 1.5–2 x Ir tsd = 0 Ii enable: ON Ii mode: Fast Ii = 2–3 x In
1 Ground-fault protection and earth-leakage protection depend on the earthing system and local regulations. As a general rule ground-fault and earth-leakage sensitivity should be as low as possible without being disturbed by permanent or transient leakage current.The ground-fault and earth-leakage time delay ensures selectivity with downstream devices.		

Setting the Long-Time Overcurrent Protection (L or ANSI Code 49RMS)

Setting Guidelines for Ir

The Ir setting depends on the maximum expected current flow through the breaker and the maximum current that can be withstood by the protected equipment (for example, cables, busbars, generators, and transformers).

The installation rules, such as IEC 60364 Chapter 4.43 or similar national standards, require overload protection for conductors as follows:



Ib Maximal load current
Ir Long time protection setting
Iz Continuous current-carrying capacity of the circuit
I_2 Conventional operating current of the circuit breaker = 1.2 x Ir for Schneider Electronic control unit
I(A) Current through circuit breaker (phase(s) or neutral)

Setting Guidelines for tr

The tr setting depends on the maximum duration at maximum current and the maximum current that can be withstood by the protected equipment (for example, cables, busbars, generators, and transformers).

Thermal memory: As described in long-time overcurrent protection *(see page 65)*, this protection function is an overcurrent time-dependent protection with thermal memory. It operates as a thermal image, using the heating and cooling model of a conductor. It can be considered as a first order thermal model with one heating time constant.

The following table shows the relationship between the tr setting and the thermal time constant of the first thermal model:

tr setting (s)	Unit	0.5	1	2	4	8	12	16	20	24
Equivalent time constant for heating and cooling when control unit is energized	seconds	14	28	56	112	224	335	447	559	671
	minutes	–	–	–	–	3.5	5.6	7.5	9.3	11.2
Time constant for cooling when control unit is not energized	minutes	5								

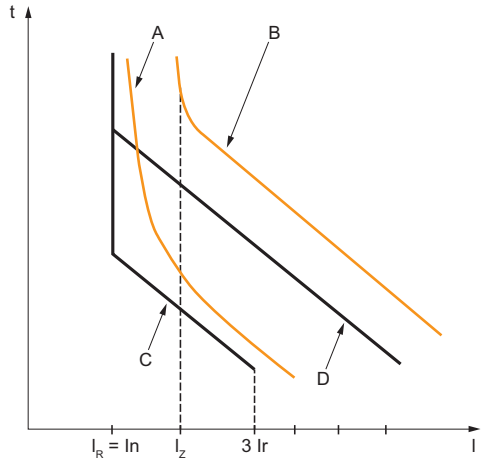
Summary of tr Setting Guidelines by Application

The following table gives the tr setting guidelines by application:

Application	Principle	Usual value
Secondary side of MV/LV transformer (switchboard main incomer) Tie circuit breaker between two switchboards	Tripping time according to circuit thermal withstand for busbars, busbar trunking, cable > 240 mm^2: ● Time constant > 11 min ● tr = 24 s When smaller cables are used in parallel, a lower setting should be used.	tr ≤ 24 s

Application	Principle	Usual value
Generators	tr ≤ 1 s in order to achieve tripping time < 30 s for 1.5 x Ir (IEC 60034-1 Clause 9.3.2)	tr ≤ 1 s
Feeder (cable or busbar trunking protection)	Tripping time according to circuit thermal withstand for busbars, busbar trunking, cable > 240 mm^2: ● Time constant >11 min ● tr = 24 s To achieve selectivity with incomer, it can be useful to reduce tr.	tr ● ≤ 24 s for busbar trunking or cable ≥240 mm² ● ≤ 16 s for lower cross section cables
Primary side of LV/LV transformer	According to cable or busbar trunking withstand (transformer withstand is generally higher) To achieve selectivity with incomer, it can be useful to reduce tr.	tr ● ≤ 24 s for busbar trunking or cable ≥240 mm² ● ≤ 16 s for lower cross section cables
Power electronic (for example, uninterruptible power supplies, variable speed drives, photovoltaic inverters)	Ir = Iz tr ≤ 16 s Isd ≤ Ifault min	tr ● ≤ 24 s for busbar trunking or cable ≥240 mm² ● ≤ 16 s for lower cross section cables
Motors	If motor is protected against overload by a separate relay, long time setting is done according to circuit thermal withstand. If the Micrologic ensures also motor thermal overload, motor class must be taken in consideration.	tr ● = 12 s for a feeder ● ≥ 8 s for a class 10 motor ● ≥ 12 s for a class 20 motor ● ≥ 16 s for a class 30 motor

Example of tr setting according to the application:



A Generator thermal limit
B Cable thermal limit
C Protection setting generator t_{LT} (minimum notch)
D Protection setting cable t_{LT} (maximum notch)

Neutral Protection Setting Guidelines

Some indications for setting neutral protection is given here. For more information refer to the neutral protection section *(see page 76)*.

The following table indicates the long-time protection settings according to the neutral cable cross section:

Cross-sectional area of neutral conductor	Harmonics expected	Neutral protection setting	Long-time protection
Less than cross-sectional area of phase conductors	No	0.5	Ir is set according to Iz of cable, Ir applied to neutral is divided by 2

Cross-sectional area of neutral conductor	Harmonics expected	Neutral protection setting	Long-time protection
Equal to cross-sectional area of phase conductors	No	OFF	No harmonics expected: the protection of neutral is not necessary
	Yes	1	Harmonics expected: the neutral must be protected by the long-time protection, set as for the phase protection
Greater than cross-sectional area of phase conductors	No	OFF	No harmonics expected: the protection of neutral is not necessary
	Yes	Oversized neutral	Harmonics expected: the neutral must be protected by the long-time protection, set as for the phase protection multiplied by 1.6 (OSN)

NOTE: On 3-pole circuit breakers the ENCT option must be declared.

NOTE: In IT systems, a distributed neutral conductor must be protected. (0.5, 1 or OSN position)

Setting the Short-Time Overcurrent Protection (S or ANSI Code 51)

Settings Guideline

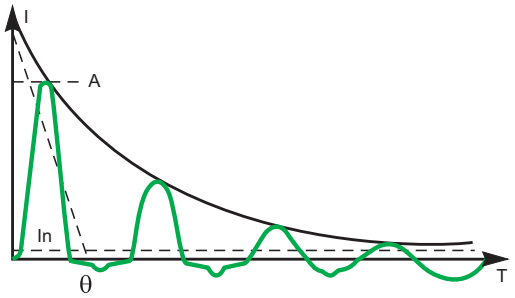
The Isd and tsd settings ensure that the short-time withstand current of protected equipment is not exceeded.

Setting Guidelines for Isd

Application	Principle	Isd usual value
Secondary side of MV/LV transformer (switchboard main incomer or tie circuit breaker between two switchboards)	Lower than minimum short-circuit or ground-fault current at the end of the protected circuit. Selectivity with downstream circuit breakers	10 x Ir
Generators	Lower than minimum short-circuit or ground-fault current supplied by the generator. Selectivity with downstream circuit breakers	2–3 x Ir
Feeder with other Masterpact or Compact NS 630–3200 A downstream	Lower than minimum short-circuit or ground-fault current at the end of the protected circuit. Selectivity with downstream circuit breakers	10 x Ir
Feeder without other Masterpact or Compact NS 630–3200 A downstream	Lower than minimum short-circuit or ground-fault current at the end of the protected circuit. Selectivity with downstream circuit breakers	10 x Ir
Primary side of LV/LV transformer	Lower than minimum secondary short-circuit current.	10 x Ir
Power electronic (for example, uninterruptible power supplies, variable speed drives, photovoltaic inverters)	Lower than minimum short-circuit or ground-fault current at the end of the protected circuit. Lower setting possible as no selectivity or transient current is expected.	1.5–2 x Ir
Motors	Lower than minimum short-circuit or ground-fault current at the end of the protected circuit. Lower setting possible above starting current.	10 x Ir

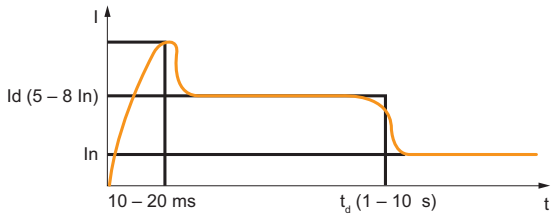
When LV/LV transformers are switched on, very high inrush currents are produced which must be taken into account when choosing overcurrent protection devices. The peak value of the first current wave often reaches 10 to 15 times the rated rms current of the transformer and may reach values of 20 to 25 times the rated current even for transformers rated less than 50 kVA.

Example of inrush current: when transformer is switched on:



A 1st peak 10 to 25 x In

Example of inrush current of direct on line motor when started:



Setting Guidelines for tsd

tsd is set according to selectivity.

Time-based selectivity is ensured between two circuit breakers when the supply side circuit breaker short-time delay is at least one step higher than the load side short-time delay.

When downstream circuit breakers are Compact NSX circuit breakers, selectivity is always ensured with Masterpact MTZ with Micrologic 2.0 X control units, and with Micrologic 5.0 X, 6.0 X and 7.0 X control units, for all values of tsd.

Short-time tripping time can be definite time type (tripping time is independent of current level) or time dependent with I^2t = constant curve. This function allows the curve to be smoothed for low level overcurrent, ensuring fast trip at high current. This is recommended for selectivity with fuses.

Application	Principle	tsd usual value
Secondary side of MV/LV transformer (switchboard main incomer or tie circuit breaker between two switchboards)	Selectivity with downstream circuit breakers	tsd > tsd of downstream power circuit breaker (tsd = 0.2 s if installation includes three levels of power circuit breaker)
Feeder **with** selectivity with other Masterpact MTZ or Compact > 630 A downstream	Selectivity with downstream circuit breakers	tsd > tsd of downstream power circuit breaker (tsd = 0.1 s if installation includes three levels of power circuit breaker)
Feeder **without** selectivity with other Masterpact MTZ or Compact > 630 A downstream	No need for delayed short-time protection	tsd = 0 s
Primary side of LV/LV transformer	Stability during inrush. Selectivity with downstream circuit breakers	tsd = 0.1 s or tsd > tsd of downstream power circuit breaker, if any
Power electronic (Uninterrupted power supplies, variable speed drives, photovoltaic inverters, etc.)	No need for delayed short-time protection	tsd = 0 s
Motors	Stability during inrush	tsd = 0 s or 0.1 s

Setting the Instantaneous Overcurrent Protection (I or ANSI Code 50)

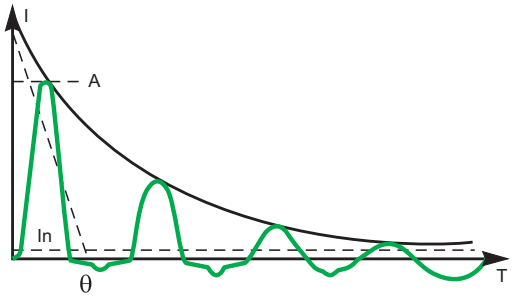
Settings Guideline

Rules for Isd also apply to the Ii threshold.

Isd is set below the minimum value of short-circuit current and ground-fault in protected equipment:

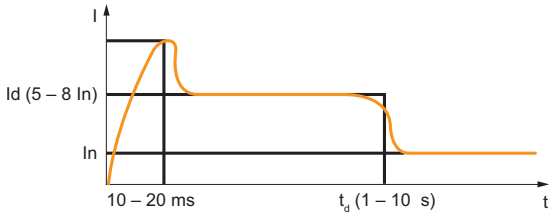
Application	Principle	Usual value
Secondary side of MV/LV transformer (switchboard main incomer)	Selectivity with downstream circuit breakers	Ii enable : OFF if other Masterpact downstream Ii = 15 x In if Compact NSX only downstream
Feeder **with** selectivity with other Masterpact or Compact > 630 A downstream	Same rule as for Isd	Ii enable : OFF
Feeder **without** selectivity with other Masterpact or Compact > 630 A downstream	–	Ii enable : ON Ii type : Standard Ii = 10-15 x In
Primary side of LV/LV transformer	–	Ii enable : OFF
Generators	–	Ii enable : OFF
Power electronic (for example, uninterruptible power supplies, variable speed drives, photovoltaic inverters)	Lower than minimum short-circuit or ground-fault at the end of the protected circuit. Lower setting possible as no selectivity or transient current is expected.	Ii enable : ON Ii type : Fast Ii = 2 x In
Motor	Lower than minimum short-circuit or ground-fault at the end of the cable. Lower setting possible above starting current.	Ii enable : ON Ii type : Fast Ii ≥ 13 x Flc motor

Ii setting allows normal transient overcurrent inrush current for transformers:



A 1st peak 10 to 25 x In

Motor direct on line starting current:



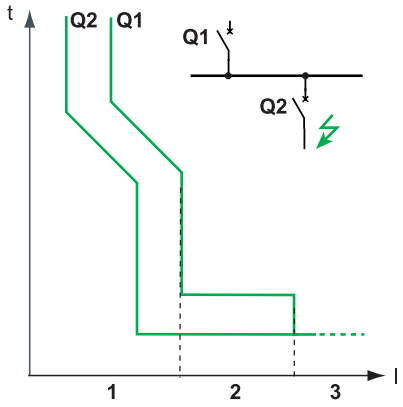
Selectivity

Coordination Between Devices

Coordination between the upstream and downstream devices, especially selectivity, is essential to optimize continuity of service. The large number of options for setting the protection functions on Micrologic X control units improves the natural coordination between circuit breakers.

Three selectivity techniques can be used:

- Current selectivity, which corresponds to staging of the long-time overcurrent protection threshold.
- Time selectivity, which corresponds to staging of the short-time overcurrent protection threshold.
- Energy selectivity, which corresponds to staging of the circuit breaker energy levels: this applies for high intensity short-circuit currents.



Selectivity Rules

The selectivity rules depend on:

- The type of control unit on the circuit breakers installed upstream and downstream: electronic or thermal-magnetic.
- The accuracy of the settings.

Selectivity of Overcurrent Protection

For overcurrent protection, the selectivity rules between electronic control units are as follows:

- Current and time selectivity:
  - A ratio of Ir Q1/Ir Q2 greater than or equal to 1.3 is sufficient between the Ir threshold for long-time protection of the control unit on the upstream circuit breaker **Q1** and that of the control unit on the downstream circuit breaker **Q2**.
  - The tr time delay for long-time protection of the control unit on the upstream circuit breaker **Q1** is identical or greater than that of the control unit on the downstream circuit breaker **Q2**.
  - A ratio of 1.5 is sufficient between the Isd threshold for short-time protection of the control unit on the upstream circuit breaker **Q1** and that of the control unit on the downstream circuit breaker **Q2**.
  - The tsd time delay for short-time protection of the control unit on the upstream circuit breaker **Q1** is greater than that of the control unit on the downstream circuit breaker **Q2**.
  - If the upstream circuit breaker is in the I^2t off position, the downstream circuit breakers must not be in the I^2t on position.
- Energy selectivity is provided by the circuit breaker design and build characteristics. The selectivity limit can only be guaranteed by the manufacturer.

Ground-Fault Protection Selectivity

For ground-fault protection, only the rules for time selectivity should be applied to the Ig protection threshold and tg time delay:

- A ratio of 1.3 is sufficient between the Ig threshold for ground-fault protection of the control unit on the upstream circuit breaker **Q1** and that of the control unit on the downstream circuit breaker **Q2**.
- The tg time delay for ground-fault protection of the control unit on the upstream circuit breaker **Q1** is greater than that of the control unit on the downstream circuit breaker **Q2**.
- If the upstream circuit breaker is in theI^2t off position, the downstream circuit breakers must not be in theI^2t on position.

Selectivity Limit

Depending on the staging of circuit breaker ratings and protection parameter settings, selectivity can be:

- Limited (partial selectivity) up to a value lower than the maximum expected short-circuit current.
- Total (total selectivity), performed irrespective of the value of the short-circuit current.

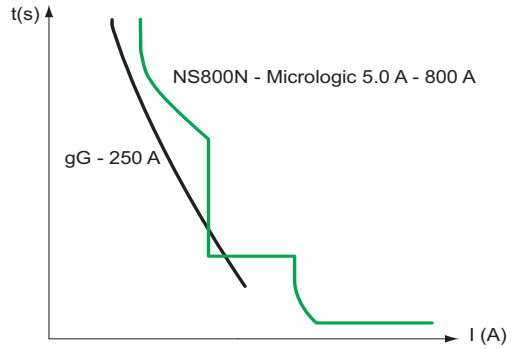
Selectivity Table

Schneider Electric provides selectivity tables showing the type of selectivity (partial or total) between each circuit breaker for its entire range of circuit breakers (refer to the *Complementary Technical Information Catalog*).

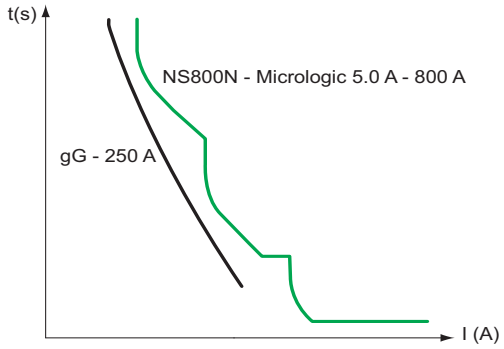
I^2t ON/OFF Function

Use the I^2t inverse time curve function to improve circuit breaker coordination. Use it when a protection device using inverse time only is installed upstream or downstream, for example a fuse protection device.

I^2t OFF



I^2t ON



Chapter 4
Metering Functions

What Is in This Chapter?

This chapter contains the following sections:

Section 4.1
Standard Metering Functions

What Is in This Section?

This section contains the following topics:

Measurement Accuracy in Accordance with IEC 61557-12

Measurements and Electrical Parameters Available on the Micrologic X Control Unit

Based on the measurement of line currents, neutral current, phase-to-phase voltages, and phase-to-neutral voltages, the Micrologic X control unit displays the following parameters:

- RMS values of currents and voltages
- Active, reactive, and apparent powers
- Active, reactive, and apparent energies
- Power factor
- Frequency
- Unbalance and THD of voltages and currents

Average and predicted values are calculated for the main basic electrical parameters.

The maximum and minimum values are time stamped and logged in the Micrologic X non-volatile memory. They can be reset as follows:

- On the Micrologic X display screen
- With Ecoreach software
- With the Masterpact MTZ mobile App
- By a remote controller using the communication network

Electrical parameters, which are refreshed once a second, can be displayed as follows:

- On the Micrologic X display screen, at **Home → Measures** *(see page 45)*
- With Ecoreach software
- With the Masterpact MTZ mobile App
- By a remote controller using the communication network

The availability of parameters depends on the type of interface used to display data. All parameters are not displayed on all interfaces *(see page 107)*.

An optional external 24 Vdc supply or VPS module is mandatory to measure and display parameters, including energy counters, for currents below 20% of the rated current.

Measurement Accuracy

Power and energy metering accuracy in Masterpact MTZ with Micrologic X control unit is classified as Class 1, according to IEC 61557-12. This standard specifies performance requirements of measuring and monitoring devices that measure and monitor the electrical parameters within electrical distribution systems. It covers both performance measuring devices with external sensors (PMD-S), such as current and/or voltage transformers, for example, stand-alone power meters, and performance measuring devices with embedded sensors (PMD-D), for example, circuit breakers.

Masterpact MTZ, with Micrologic X control unit and embedded sensors, is a PMD-DD device with Class 1 accuracy, according to IEC 61557-12 for power and energy metering. It complies with the requirements of K70 temperature class, according to table 6 of IEC 61557-12.

The IEC 61557-12 standard defines the following three levels of uncertainty that need to be checked to establish accuracy class:

- Intrinsic uncertainty *(see page 98)*
- Operating uncertainty *(see page 99)*
- Overall system uncertainty *(see page 100)*

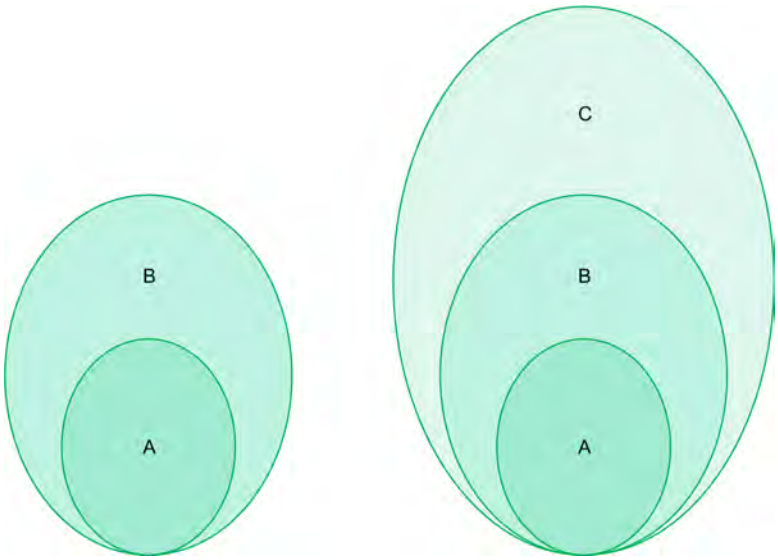
A PMD-DD device avoids overall system uncertainty and variation, thanks to its embedded sensors and wiring.

Measured Electrical Parameter Uncertainty

Uncertainty is the estimated percentage by which a measured electrical parameter may differ from the true electrical parameter. In the context of this standard, the total uncertainty of a measured electrical parameter depends on the instrument, the environment, and other elements to be considered.

The graphic below shows the total uncertainty of a measured electrical parameter made by:

- A PMD-D device, with embedded sensors
- A PMD-S device, with external sensors



PMD-D device, with embedded sensors **PMD-S** device, with external sensors

A Uncertainty under reference conditions: Intrinsic uncertainty according to IEC 61557-12
B Variations due to influence quantity: Operating Uncertainty according to IEC 61557-1; Measurement uncertainty according to IEC 61000-4-30
C Overall system uncertainty according to IEC 61557-12

Intrinsic Uncertainty: IEC 61557-12 definition

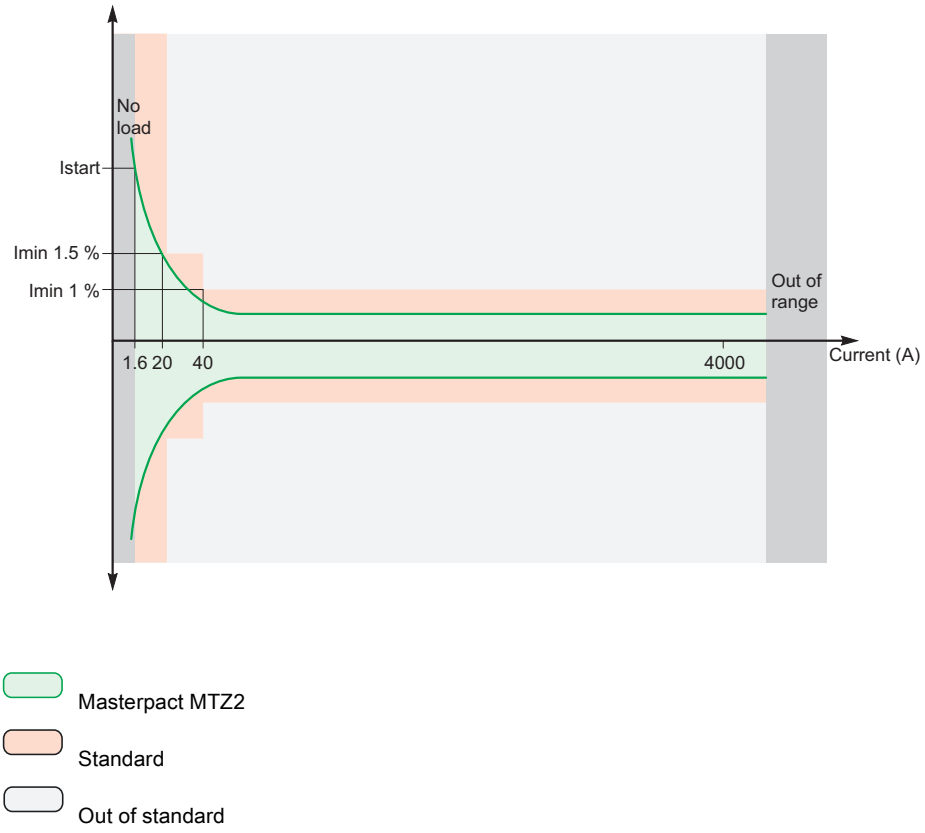
Intrinsic uncertainty is the uncertainty of a measuring instrument when used under reference conditions. In the context of this standard, it is a percentage of the measured electrical parameter defined within the rated range of the measuring instrument.

For Masterpact MTZ with Micrologic X control unit, the main values are current and power factor.

The following table indicates the current range for different Masterpact MTZ circuit breakers, to ensure uncertainty is less than or equal to 1%:

Current values for active power with 1% uncertainty (in A)		**Masterpact**		
Description of current value	**Current value as percentage of maximal load current**	**MTZ1**	**MTZ2**	**MTZ3**
Lowest value of the current at which the circuit breaker starts and continues to register	Ist = 0.04% Ib	1.6 A	1.6 A	3.2 A
Lowest value of the current to ensure accuracy less than or equal to 1.5% for active power and energy	5% Ib	20 A	20 A	40 A
Lowest value of the current to ensure accuracy less than or equal to 1% for active power and energy with PF = 1	10% Ib	40 A	40 A	80 A
Lowest value of the current to ensure accuracy less than or equal to 1% for active power and energy with PF = 0.5 Ind to 0.8 Cap	20% Ib	80 A	80 A	160 A
Value of current in accordance with which the relevant performance of a direct connected PMD (PMD Dx) is fixed	Ib	400 A	400 A	800 A
Highest value of current at which the Masterpact MTZ meets the uncertainty requirements of this standard	Imax	1600 A x 1.2	4000 A x 1.2	6300 A x 1.2

Intrinsic uncertainty for active power and energy versus current. Example graph for Masterpact MTZ2



Operating Uncertainty

IEC 61557-12 defines operating uncertainty as uncertainty under the rated operating conditions.

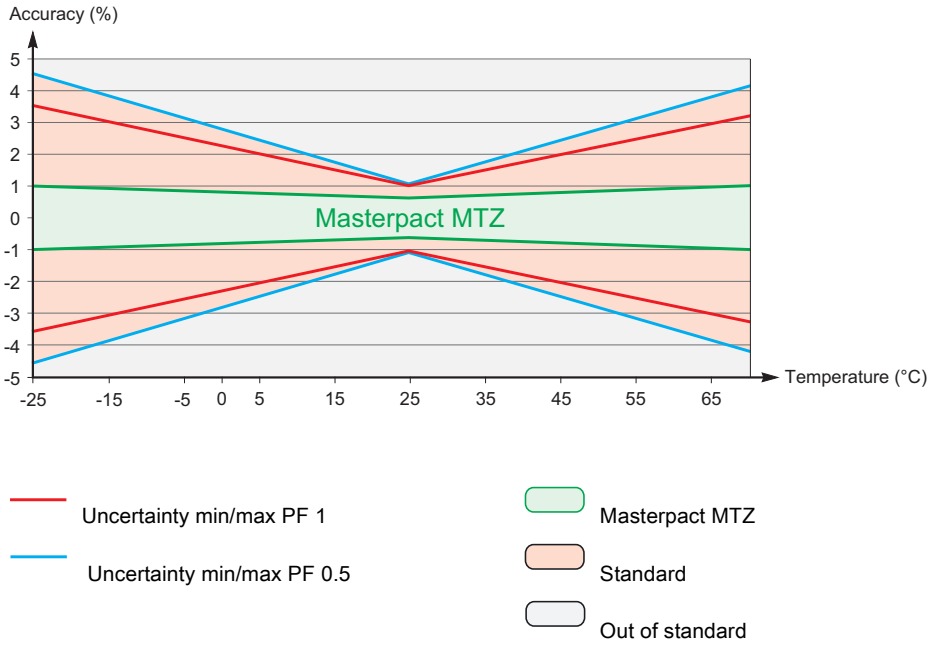
IEC 61557-12 specifies tests and maximum variation of uncertainty according to the following influence quantities:

- Ambient temperature (T°)
- Frequency, unbalance, harmonics, EMC

For Masterpact MTZ with Micrologic X control unit, the main influence quantity is temperature. Masterpact MTZ devices are designed to carry high currents, which induce self-heating. The measurement has been designed to offer high stability in a wide range of temperatures.

Effect of Temperature on Masterpact MTZ Measurement System

The temperature variation around the internal current transformer and the Micrologic X control unit, between minimum current and nominal current load can be up to 90 K. The effect of temperature on measurement accuracy has been carefully managed to ensure an operating ambient temperature of between -25 °C and 70 °C (-13 °F and 158 °F).



Effect of Electromagnetic Compatibility (EMC) and Other Influence Quantities on Masterpact MTZ Measurement Performance

Masterpact MTZ with Micrologic X control unit offers a high immunity to influence quantities, with a low operating uncertainty for active power, as specified by Class 1, for a wide range of operating conditions.

The following table summarizes standard requirements and Masterpact MTZ performance with regard to influence quantities for active power:

Influence quantity	Table 9 IEC 61557-12 PMD DD Cl 1 additional uncertainty variation tolerance		Masterpact MTZ additional uncertainty
Ambient temperature	PF 1	0.05% / K	< 0.01% / K
	PF 0.5 Ind	0.07% / K	< 0.01% / K
Auxiliary power supply	24 Vdc ±15%	0.1%	0%
Voltage	PF 1: 80% / 120% Un	0.7%	0%
	PF 0,5 Ind: 80% / 120% Un	1%	0%
Frequency	PF 1: 49–51 Hz / 59–61 Hz	0.5%	0%
	PF 0.5: 49–51 Hz / 59–61 Hz	0.7%	0%
Reversed phase sequence		1.5%	0%
Voltage unbalance	0 to 10%	2%	0%
Phase missing	1 or 2 phase missing	2%	0%
Harmonics in current and voltage	10% Un 5th	0.8%	< 0.1%
	20% Imax 5th		
	Odd harmonic in current	3%	< 0.1%
	Sub harmonic in current	3%	< 0.1%
Common mode voltage rejection	0–690 Vac / ground	0.5%	0%
Permanent ac magnetic induction	IEC 61326	2%	0%
Electromagnetic RF fields	IEC 61326	2%	< 1%
Conducted disturbances induced by RF fields	IEC 61326	2%	< 1%

Overall System Uncertainty

IEC 61557-12 defines overall system uncertainty as uncertainty including the instrumental uncertainty of several separated instruments (for example, sensors, wires, measuring instruments) under the rated operating conditions.