Masterpact MTZ Micrologic X
Control Unit
User Guide

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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.

Statements

Radio frequency compliance statements can be found in Appendix A *(see page 203)*.

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
Complementary Technical Information Catalogue	LVPED308005EN LVPED308005FR
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 - Circuit Breakers and Switch-Disconnectors - Maintenance Guide	DOCA0099EN DOCA0099ES DOCA0099FR DOCA0099ZH
Masterpact MTZ - Modbus Communication Guide	DOCA0105EN DOCA0105ES DOCA0105FR DOCA0105ZH
Masterpact MTZ - Cybersecurity Guide	DOCA0122EN DOCA0122ES DOCA0122FR DOCA0122ZH
ULP System - User Guide	DOCA0093EN DOCA0093ES DOCA0093FR DOCA0093ZH
Enerlin'X IO - Input/Output Application Module for One Circuit Breaker - User Guide	DOCA0055EN DOCA0055ES DOCA0055FR DOCA0055ZH
Enerlin'X IFE - Ethernet Interface for One Circuit Breaker - User Guide	DOCA0084EN DOCA0084ES DOCA0084FR DOCA0084ZH

Title of Documentation	Reference Number
Enerlin'X EIFE - Embedded Ethernet Interface for One Masterpact MTZ Drawout Circuit Breaker - User Guide	DOCA0106EN DOCA0106ES DOCA0106FR DOCA0106ZH
Enerlin'X FDM128 - Ethernet Display for Eight Devices - User Guide	DOCA0037EN DOCA0037ES DOCA0037FR DOCA0037ZH

You can download these technical publications and other technical information from our website at http://www.schneider-electric.com/en/download

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Chapter 1
Introduction to the Micrologic X Control Unit

What Is in This Chapter?

This chapter contains the following topics:

Micrologic X Control Unit: 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 *(see page 18)*.

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

Micrologic X Range

The following table indicates the standard functions available on Masterpact MTZ circuit breakers 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)	✓	✓	✓	✓
Short-time overcurrent protection (S)	–	✓	✓	✓
Instantaneous overcurrent protection (I)	✓	✓	✓	✓
Ground-fault protection (G)	–	–	✓	–
Earth-leakage protection (V)	–	–	–	✓
Neutral protection	✓	✓	✓	✓
Dual settings	✓	✓	✓	✓
Overcurrent and trip cause indicators	✓	✓	✓	✓
Zone selective interlocking	–	✓	✓	✓
Trip history	✓	✓	✓	✓
Setting change traceability	✓	✓	✓	✓
Embedded power meter class 1	✓	✓	✓	✓
Embedded diagnostics	✓	✓	✓	✓

Communication

Micrologic X control units support wireless and wired communication and enable local and network communication.

Local communication includes:

- Wireless connection to a smartphone running the Masterpact MTZ Mobile App *(see page 16)* through:
  - Bluetooth low energy
  - NFC
- Wired connection to:
  - A smartphone running the Masterpact MTZ Mobile App *(see page 16)* through USB OTG connection via mini USB port
  - A PC running Ecoreach software via mini USB port

Network communication includes:

- Ethernet (optional)
- Modbus-SL (optional)

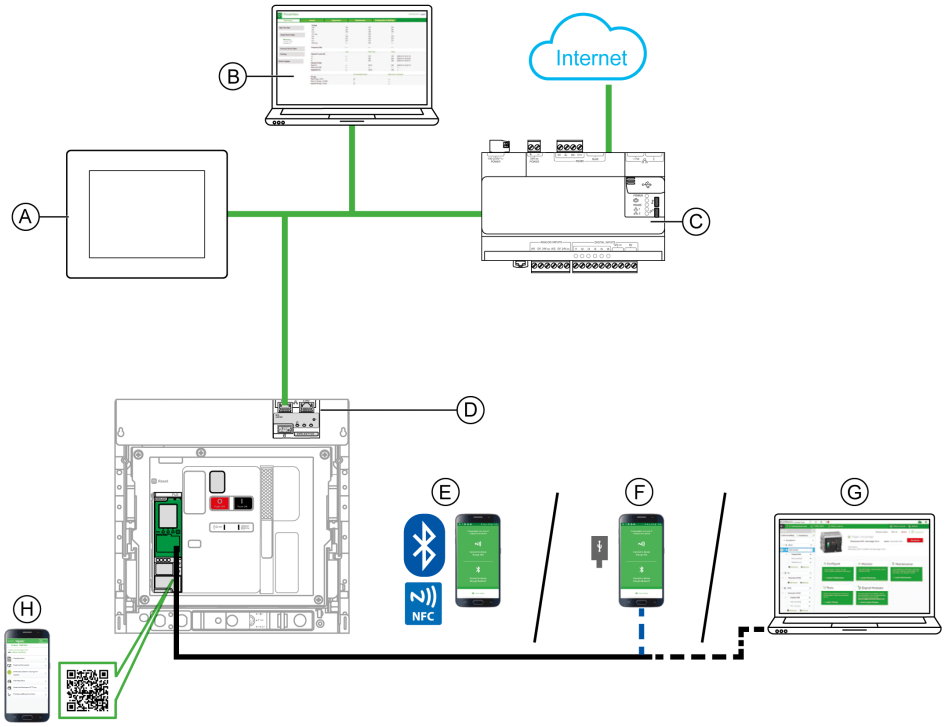
Micrologic X Control Units in Smart Panels

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

Micrologic X control units communicate using:

- Ethernet through an IFE or EIFE interface
- Modbus-SL through an IFM interface with reference LV434000 (IFM interface with reference TRV00210 is not compatible with Masterpact MTZ).
- Bluetooth low energy (BLE) or NFC for a wireless connection to the Masterpact MTZ Mobile App
- The mini USB port to connect to:
  - A PC running Ecoreach software
  - A smartphone running the Masterpact MTZ Mobile App (USB OTG connection)
- A Com'X energy server and Ethernet to connect to the Internet

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



Ethernet
USB
USB OTG connection

A FDM128 Ethernet display for eight devices
B IFE/EIFE webpages
C Com'X energy server
D EIFE interface
E Masterpact MTZ Mobile App through Bluetooth low energy or NFC wireless communication
F Masterpact MTZ Mobile App through USB OTG connection
G Ecoreach software
H Go2SE landing page

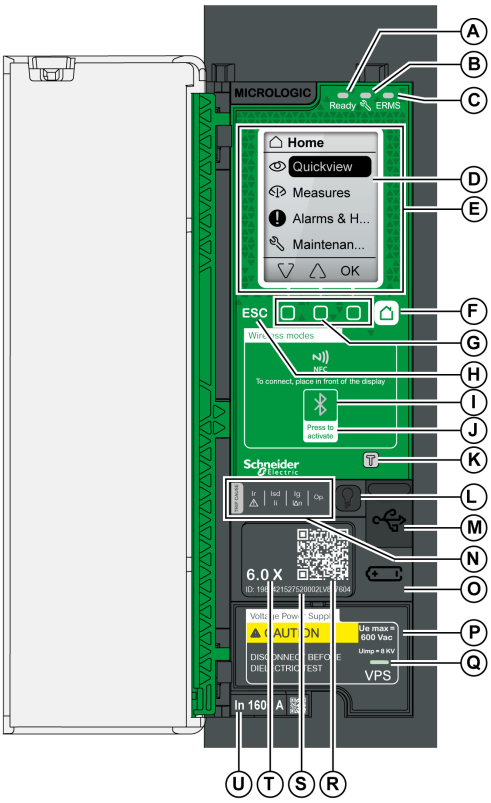
Micrologic X Control Unit: Description

Introduction

The Micrologic X control unit includes:

- Micrologic X status LEDs
- A local Human Machine Interface comprising a graphic display with colored backlight, contextual buttons, and dedicated buttons
- LEDs to monitor the Micrologic X status and the cause 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 NFC wireless communication zone
F Home button
G Three contextual buttons
H Escape button **ESC**
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 internal battery
P VPS voltage power supply module (optional)
Q VPS LED to indicate that the VPS module 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 Status LEDs

LED	Description
Ready	The **Ready** LED flashes when the standard protection functions of the control unit are operational.
	The service LED alerts the user to the overall health of the circuit breaker. ● Orange LED: medium-severity detected alarm that requires non-urgent action. ● Red LED: high-severity detected alarm that requires immediate action.
ERMS	The **ERMS** (Energy Reduction Maintenance Setting) LED is reserved for future use.

Display Screen with Contextual Buttons and Dedicated Buttons

The local HMI screen and buttons *(see page 30)* 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 179)* between a smartphone running 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 177)* between a smartphone running 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 blinking, it indicates that the Micrologic X control unit is in communication with a Bluetooth device.

Test Button

The test button is used to test the ground-fault protection for Micrologic 6.0 X *(see page 75)* and the earth-leakage protection for Micrologic 7.0 X *(see page 78)*.

Overload and Trip Cause LEDs

The indications of the four trip cause LEDs depend 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% and is lower than 105% 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 long-time protection.
	• Micrologic 2.0 X: Trip due to instantaneous protection. • Micrologic 5.0 X, 6.0 X, 7.0 X: Trip due to short-time protection or instantaneous protection.
	• Micrologic 2.0 X, 5.0 X: Not used. • Micrologic 6.0 X: Trip due to ground-fault protection. • Micrologic 7.0 X: Trip due to earth-leakage protection.
	• Micrologic 2.0 X, 5.0 X, 6.0 X, 7.0 X: Trip due to other protection (optional protections).
	• Micrologic 2.0 X, 5.0 X, 6.0 X, 7.0 X: Micrologic control unit malfunction detected during self test.

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

Test/Reset Button

The Test/Reset button performs the following functions:

- Test of the trip cause LEDs and the service LED: press the Test/Reset button, the five LEDs light up for 1 second. If all the LEDs do not light and the Micrologic X control unit is not powered, replace the internal battery.
  After a test, any active trip cause LED is lit again.
- Reset of the latched events: press and hold the Test/Reset button for 3 seconds to reset the latched events and switch off the trip cause LEDs and the service LED.

NOTE: When the Micrologic X control unit is not powered by an external 24 Vdc power supply or through a USB connection, the Micrologic X control unit can be restarted by pressing and holding the Test/Reset button for 15 seconds. **The standard protection functions remain active during the restart**.

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 27)*.
- A smartphone running the Masterpact MTZ Mobile App, throughUSB OTG connection *(see page 181)*.
- A PC running Ecoreach software *(see page 182)*.

NOTE: Micrologic X control unit cannot read a USB key even if a USB key is physically connected through an adaptor.

QR Code

When the QR code on the front face of a Micrologic X control unit is flashed with a smartphone running a QR code reader and connected to the Internet, the Go2SE landing page is displayed *(see page 19)*. The landing page displays some information about the device and a list of menus.

Control Unit Identification Number

The identification number is made up as follows:

- The serial number of the Micrologic X control unit in the format FFFFFFYYWWDLXXXX
- The commercial reference of the control unit in the format LV8•••••

Use the identification number to register your Micrologic X control unit through the Schneider Electric customer care mobile application mySchneider.

Registering your Micrologic X control unit enables you to keep your records up to date and enables traceability.

Control Unit Type

This code indicates the type of Micrologic control unit *(see page 10)*:

- The number (for example, 6.0) defines the types of protection provided by the control unit.
- The letter (X) identifies the range of the control unit.

Internal Battery

The internal battery powers the trip cause LEDs and the main diagnostic functions in the absence of any other power supply *(see page 27)*.

VPS Voltage Power Supply Module

The VPS module provides an internal voltage supply to the Micrologic X control unit *(see page 24)*.

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.

Sensor Plug

The protection ranges depend on the rated current In, defined by the sensor plug present below the Micrologic X control unit *(see page 62)*.

Ecoreach Software

Overview

Ecoreach software helps you to manage a project as part of testing, commissioning, and maintenance phases of the project life cycle. The innovative features in it provide simple ways to configure, test, and commission the smart electrical devices.

Ecoreach software automatically discovers the smart devices and allows you to add the devices for an easy configuration. You can generate comprehensive reports as part of Factory Acceptance Test and Site Acceptance Test to replace your heavy manual work. Additionally, when the panels are under operation, any change of settings made can be easily identified and hence provides a system consistency during the operation and maintenance phase.

The Ecoreach software enables the configuration of the Masterpact MTZ devices with:

- Micrologic X control unit
- Communication interface modules: IFE, EIFE, and IFM interfaces
- IO application 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 software performs the following actions for the supported devices and modules:

- Create projects by device discovery
- Save Ecoreach projects in Ecoreach cloud repository
- Upload settings to the device and download settings from the device
- Compare the settings between the project and the device
- Perform control actions in a secured way
- Generate and print the device settings report
- Perform a communication wiring test on the entire project and generate and print the test reports
- View the communication architecture between the devices in a graphical representation
- View the measurements, logs, and maintenance information
- Export Waveform capture
- View the status of device and IO module
- Check the system firmware compatibility status
- Upgrade to the latest device firmware
- Buy, install, or remove the Digital Modules

Masterpact MTZ Mobile App

Presentation

With the Masterpact MTZ Mobile App, a smartphone can be used as the primary interface for day-to-day and critical case maintenance.

The application provides daily operation information that can be shared (for example, by email).

With the addition of the Power Restoration Assistant Digital Module, tutorials are available, providing information about restoring power and identifying the causes of trips.

With the Masterpact Operation Assistant Digital Module, remote control of the circuit breaker is available.

Downloading the Application

The Masterpact MTZ Mobile App can be downloaded as follows:

- By flashing the QR code on the front face of the Micrologic X control unit to access to a landing page. Click the link to go to your application store from which the mobile application can be downloaded *(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 127 mm (5 in) display screen.

Communicating with a Micrologic X Control Unit

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

- Bluetooth low energy:
  - 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
- USB OTG connection (only available for Android smartphones compatible with USB OTG - see list of compatible smartphones available on the Schneider Electric website):
  - Display data
  - Configure general and protection settings
  - Supply power to Micrologic X control unit

Using a Bluetooth Low Energy Connection

The Micrologic X control unit must be powered to establish a Bluetooth low energy connection.

Using Masterpact MTZ Mobile App with a Bluetooth low energy connection gives access to and allows sharing of the following information types organized in four tabs:

-  **Quick View**: gives an overview of current values per phase, the health state 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.
  - Allows opening and closing operations to be carried out when the Masterpact Operation Assistant Digital Module is installed.

For the details on how to connect, refer to the Bluetooth low energy connection procedure *(see page 177)*.

When Digital Modules *(see page 18)* are installed on the Micrologic X control unit, additional information is available.

Using an NFC Connection

Connecting to Masterpact MTZ Mobile App with an NFC connection is always possible, even 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 Power Restoration Assistant or Masterpact Operation Assistant Digital Modules *(see page 18)*

For the details on how to connect, refer to the NFC connection procedure *(see page 179)*.

Using a USB OTG (On-The-Go) Connection

The Micrologic X control unit can be powered by a smartphone using the USB OTG connection, if necessary.

Using Masterpact MTZ Mobile App with a USB OTG connection gives access to and allows sharing of the following information types organized in four tabs:

-  **Quick View**: gives an overview of current values per phase, the health state 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.
  - Allows opening and closing operations to be carried out when the Masterpact Operation Assistant Digital Module is installed.

For the details on how to connect, refer to the USB OTG (On-The-Go) connection procedure *(see page 181)*.

When Digital Modules *(see page 18)* are installed on the Micrologic X control unit, additional information is available.

Micrologic X Control Unit: Optional Digital Modules

Presentation

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

Digital Modules can be purchased and installed on the Micrologic X control unit without changing the hardware or disrupting operations:

- When the Masterpact MTZ circuit breaker is initially ordered. They are pre-installed and functional when the Masterpact MTZ circuit breaker is delivered.
- At any time after the initial order by accessing the GoDigital marketplace *(see page 20)*.

NOTE: The standard protection functions of a Micrologic X control unit cannot be upgraded by purchasing a Digital Module, for example, it is not possible to convert a Micrologic 5.0 X control unit to a Micrologic 6.0 X control unit. This type of upgrade requires replacing the Micrologic X control unit.

Proceed as follows to purchase and install optional Digital Modules:

- Get the control unit identification number and access GoDigital webpage *(see page 20)*
- Select and purchase Digital Modules *(see page 20)*
- Download and install the Digital Modules *(see page 21)*

Digital Modules

The following table presents the Digital Modules available for installation:

Digital Module	Description	Function	
LV850002 Energy per phase *(see page 139)*	Calculates and displays imported and exported energy, and active, reactive, and apparent energy per phase, and total active, reactive, and apparent energy per phase.		Metering
LV850003 Waveform capture on trip event *(see page 161)*	Logs five cycles of phase and neutral currents in the case of a trip. Records the status of the circuit breaker (open/closed/tripped) and ZSI signals.		Diagnostics
LV850004 Power Restoration Assistant *(see page 157)*	Provides assistance for the power restoration procedure, determining potential causes of events, and guidance on potential solutions for restoring power.		Diagnostics
LV850005 Masterpact Operation Assistant *(see page 159)*	Provides assistance in reclosing the circuit breaker and displays circuit breaker status. Full benefits available when used with communicating diagnostic voltage releases (MX, MN, XF).		Diagnostics

Go2SE Landing Page

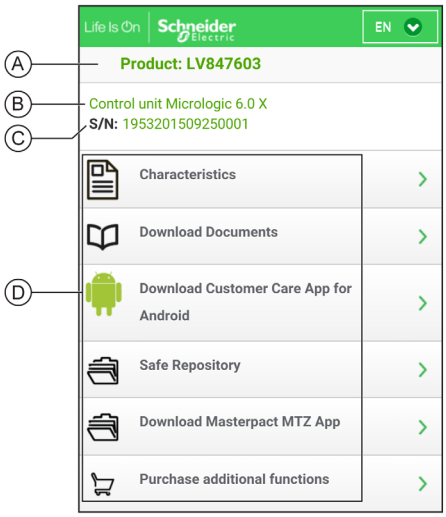
Presentation

When the QR code on the front face of a Micrologic X control unit is flashed with a smartphone running a QR code reader and connected to the Internet, the Go2SE landing page is displayed. The landing page displays information about the device and a list of menus.

Landing Page Description

The landing page is accessible from Android and iOS smartphones. It displays the same list of menus with slight differences in presentation.

The following example shows the landing page displayed on an Android smartphone:



A Commercial reference of Micrologic X control unit
B Type of Micrologic X control unit
C Serial number of Micrologic X control unit
D Landing page menus. See the following menu descriptions for details.

Characteristics

Selecting this menu gives access to a product datasheet with detailed information about the Micrologic X control unit.

Download Documents

Selecting this menu gives access to documentation, including the following documents:

- *Masterpact MTZ 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 App

Selecting this menu gives access to the Schneider Electric customer care mobile application **mySchneider** that can be downloaded on Android and iOS 9.0 or higher smartphones. The customer care application offers self-service instructions and easy access to expert support and information.

Safe Repository

Selecting this menu gives access to a web service allowing documentation linked to assets to be consulted, stored, and shared in a Schneider Electric environment. Access to the safe repository is restricted to authorized users.

Download Masterpact MTZ Mobile App

Selecting this menu gives access to the Masterpact MTZ Mobile App that can be downloaded and installed on Android and iOS 9.0 or higher smartphones.

Purchase Additional Functions

Selecting this menu gives direct access to the GoDigital marketplace webpage *(see page 20)*. Digital Modules are available for purchase in the marketplace.

Micrologic X Control Unit: Purchasing and Installing Digital Modules

Presentation

Digital Modules can be purchased on GoDigital, which is the Schneider Electric marketplace.

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

- Creation of a Schneider Electric user account with unique user name and password by user
- Creation of a GoDigital customer account
- Setting up of a GoDigital user account by the user. The user must set up the following predefined roles:
  - Admin (roles management)
  - Buyer (select Digital Modules)
  - Payer (pay for Digital Modules)
  - Entitlement (manage/add assets)

Proceed as follows to purchase and install optional Digital Modules:

- Get the control unit identification number and access GoDigital *(see page 20)*.
- Select and purchase Digital Modules *(see page 20)*.
- Download and install the Digital Modules *(see page 21)*.

Getting Control Unit Identification Number and Accessing GoDigital

You can get the control unit identification number and access GoDigital on site or off site using one of the following means:

- On site, by flashing the QR code on the front face of the Micrologic X control unit from a smartphone. The QR code identifies the Micrologic X control unit and a **Purchase additional functions** button provides a direct link to the GoDigital webpage for mobile devices. Click this link to select and purchase Digital Modules directly, or share this link with the person qualified to select and purchase Digital Modules.
- On site, through the Masterpact MTZ Mobile App, after connection to one Micrologic X control unit through Bluetooth low energy, NFC, or USB OTG. The Masterpact MTZ Mobile App identifies the Micrologic X control unit. Then, clicking **Purchase** gives direct access to the GoDigital webpage for mobile devices.
- On site, from Ecoreach software with a PC connected to the mini USB port of the Micrologic X control unit. Ecoreach software gets the control unit identification number and, from the **Buy** button, gives direct access to the GoDigital webpage for PC.
- Off site, from Ecoreach software. This access can only be used for a Micrologic X control unit previously registered in the relevant project. Ecoreach software gets the control unit identification number and, from the **Buy** button, gives direct access to the GoDigital webpage for PC.
- Off site, and without identifying the Micrologic X control unit, by pointing a web browser at *http://godigital.schneider-electric.com/* to display the GoDigital webpage for PC. This access can only be used to purchase Digital Modules for a second order for a previously identified Micrologic X control unit. The identification numbers of previously identified control units are listed in the **My Assets** tab.

NOTE: When using the Masterpact MTZ Mobile App, if the functionality required for a task is not present, a **Purchase** button provides a link to the GoDigital webpage for mobile devices offering the possibility to purchase the relevant Digital Module.

Selecting and Purchasing Digital Modules in GoDigital

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

Step	Action
1	Log in to the GoDigital website by using the Schneider Electric user account.
2	Select Digital Modules and add to cart. The cart can be saved for future validation and purchase.
3	To purchase Digital Modules for more than one Micrologic X control unit, save the cart, get the serial number of another control unit, and repeat step 2.
4	Submit the cart. The purchase is validated and the invoice, order confirmation, and a link to the delivery package are sent by email. **NOTE:** The validation of the purchase is possible only if the GoDigital customer account has been created *(see page 20)*.

Downloading and Installing a Digital Module

Follow this procedure to install a purchased Digital Module 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 software and the Micrologic X control unit. Ecoreach software displays the Micrologic X control unit identification number on the screen.
3	Open the Digital Modules page by clicking **Digital Modules**.
4	Check that the delivery package for the Digital Module to be installed is present on the PC being used.
5	Select the Digital Modules to be installed by clicking **Install**. **NOTE:** Only modules previously purchased can be installed directly by clicking **Install**.
6	When installation is complete and before unplugging the PC, disconnect Ecoreach software from the device by clicking the **Disconnect** button.

NOTE: To remove a Digital Module, use Ecoreach software.

Predefined Events

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

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

Micrologic X Control Unit: Date and Time

Presentation

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

The date and time of the Micrologic X control unit and the other ULP modules (IFE, EIFE or IFM interface, IO module) of the IMU are synchronized. Setting the date and time of one module sets the date and time of all the modules of the IMU.

NOTE: The date and time of Micrologic X and other ULP modules are automatically reset to default value for the date (Jan 01 2000) when the internal battery of the Micrologic X control unit is removed and the control unit has no other power supply.

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:
  - By manual setting
  - By user-initiated synchronization with date and time of the PC running Ecoreach software
- With Masterpact MTZ Mobile App:
  - By manual setting
  - By user-initiated synchronization with date and time of the smartphone running the application
- With a web browser connected to the IFE or EIFE webpage.
- By sending a setting command using the communication network (password-protected).

Synchronizing the Date and Time

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 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 Ethernet interface.
- With the IFM Modbus-SL interface receiving an update date and time request from third-party software

Predefined Events

The following event is generated when date and time are set manually:

Event	History	Severity
Date and time set	Configuration	Low

Micrologic X Control Unit: Power Supply

Internal and External Power Supplies

The Micrologic X control unit is powered by the current through the internal current transformers (CT).

- The standard protection functions of Micrologic X control units operate with the internal current supply.
  NOTE: The earth-leakage protection is powered by the system voltage through the VPS voltage power supply module, installed as standard on Micrologic 7.0 X.
- If the load current is higher than 20% of the rated current In, the internal current supply provides the power supply for the full functioning of the Micrologic X control unit. This includes:
  - The Micrologic X HMI, display screen and LEDs
  - The metering functions with accuracies in accordance with IEC 61557-12
  - The maintenance and diagnostic functions
  - Communication through ULP modules
  - Communication through Bluetooth low energy

To provide a power supply to the Micrologic X control unit when the load is below 20% of the rated current In, and maintain the full functioning of the Micrologic X control unit, optional power supplies can be used. Optional power supplies include the following:

- Permanent power supplies:
  - Internal voltage power supply (VPS) module, up to 600 Vac.
  - External 24 Vdc power supply module.
- Temporary power supplies connected to the mini USB port of the Micrologic X control unit:
  - External Mobile Power Pack through USB connection.
  - Android smartphone through USB OTG connection (smartphone should be compatible with USB OTG - see list of compatible smartphones available on the Schneider Electric website).
  - PC through USB connection.

Each optional Micrologic X power supply is described further.

VPS Voltage Power Supply Module

⚠⚠ DANGER

HAZARD OF ELECTRIC SHOCK, EXPLOSION OR ARC FLASH

- Do not install a VPS module on a network with a voltage above 600 Vac.
- Turn off all power supplies upstream and downstream of this equipment before installation and removal.

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

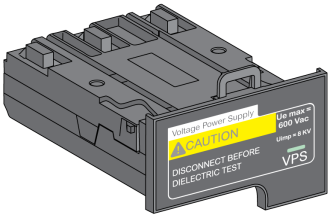
⚠ CAUTION

DETERIORATION OF VPS MODULE

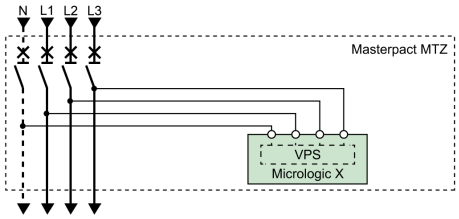
Disconnect the VPS module by pulling it out to the disconnected position before running a dielectric test on the equipment.

Failure to follow these instructions can result in injury or equipment damage.

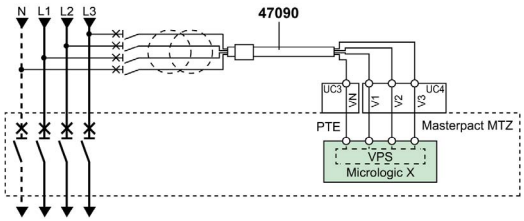
The VPS module is optional for Micrologic 2.0 X, 5.0 X, and 6.0 X. It is installed as standard on Micrologic 7.0 X.



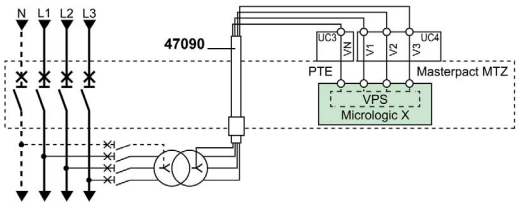
The VPS module is installed in the lower part of the Micrologic X control unit and can be replaced.
A green LED on the front face indicates that the VPS module is powered and a 24 Vdc output is supplied.
For information on spare part replacement and installation, consult the instruction sheet on the Schneider Electric website: *NVE40741*



The input voltage of the VPS module is limited to 600 Vac.
The module is directly connected to the internal pick up voltage (PTI) on the downstream side of the circuit breaker.



The VPS module can be supplied from an external voltage by means of the optional PTE voltage measurement inputs and voltage transformers (mandatory for voltages above 600 Vac).
The external voltage can be picked up either from the top or the bottom side of the circuit breaker.
When the power source and the PTE option are connected on the same side of the circuit breaker (for example, power source and PTE connected on top side), the Micrologic X control unit is energized as soon as the power source is live, whatever the position of the circuit breaker (open or closed).



When the power source and the PTE option are connected on different sides of the circuit breaker (for example, power source connected on top side and PTE on bottom side), the Micrologic X control unit is energized only when the circuit breaker is closed.

Characteristic	Values
Input supply voltage AC (50/60 Hz)	3 phase: 208–600 Vac (+10%, –30%), 2.6 W
	2 phase: 208–600 Vac (+10%, –15%), 1.7 W
Output supply voltage DC	Full load: 24 Vdc (+8%, –8%)
	No load: <35 Vdc

External 24 Vdc Power Supply Module

The 24 Vdc power supply module maintains the operation of all functions of the Micrologic X control unit in all circumstances, even 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%).

NOTICE

LOSS OF DOUBLE INSULATION

- Supply the Micrologic X control unit with a 24 Vdc SELV (Safety Extra Low Voltage) power supply only, connected through the ULP port module or through the terminal block for external power supply (F1- F2+). Pay attention to the polarity.
- Do not connect devices which do not have double insulation to the 24 Vdc SELV power supply which is being used to supply the Micrologic X control unit. For example, do not use the same 24 Vdc SELV power supply to supply a Micrologic X control unit for Masterpact MTZ circuit breakers and a Micrologic A/E/P/H trip unit for Masterpact NT/NW circuit breakers.

Failure to follow these instructions will result in a basic/single insulated system or equipment damage.

The design of Masterpact MTZ devices with Micrologic X control units provides double insulation at the front face and for circuit communication lines exiting the device. Double or reinforced insulation is one of the protective measures against electric shock which conforms to IEC and CENELEC HD 60364-4-41 (Low voltage installations - Protection against electric shock).

NOTICE

HAZARD OF EQUIPMENT DAMAGE

Use the same 24 Vdc SELV power supply to supply the Micrologic X control unit and the other ULP modules connected to the ULP port module.

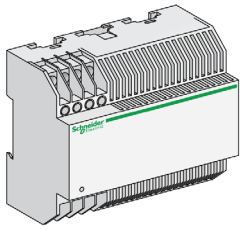
Failure to follow these instructions can result in equipment damage.

Recommendations for use of external 24 Vdc SELV power supply modules:

- The same 24 Vdc SELV power supply module can be used to supply several Micrologic X control units, depending on the overall power requirements of the system.
- Use a separate 24 Vdc power supply to supply the MN/MX/XF voltage releases or the MCH gear motor.

Recommended 24 Vdc Power Supply Modules

Available 24 Vdc power supply modules include the range of Phaseo ABL8 modules and the AD modules. For more information, refer to *Masterpact MTZ Catalogue*.

Characteristic	Phaseo ABL8 module	AD module
Illustration		
Overvoltage category defined by IEC/EN 60947-1	Category II	Category IV
Input supply voltage AC	● 110–120 Vac ● 200–500 Vac	● 110–130 Vac ● 200–240 Vac ● 380–415 Vac
Input supply voltage DC	–	● 24–30 Vdc ● 48–60 Vdc ● 100–125 Vdc
Dielectric withstand	● Input/output: 4 kV RMS for 1 minute ● Input/ground: 3 kV RMS for 1 minute ● Output/ground: 0.5 kV RMS for 1 minute	Input/output: ● 3.5 kV RMS for 1 minute (380 Vac model) ● 3 kV RMS for 1 minute (110–130 Vac and 200–240 Vac model) ● 3 kV RMS for 1 minute (110–125 Vdc model) ● 2 kV RMS for 1 minute (24–30 Vdc and 48–60 Vdc model)
Temperature	● 50 °C (122 °F) ● 60 °C (140 °F) with 80% nominal load maximum	70 °C (158 °F)
Output current	3 A or 5 A	1 A
Ripple	200 mV peak-peak	240 mV peak-peak
Output voltage setting for line loss compensation	24–28.8 Vdc	–

NOTE: For applications requiring an overvoltage category higher than II, install a surge arrester when using a 24 Vdc ABL8 module.

24 Vdc Backup Battery

If the 24 Vdc power supply is interrupted, a 24 Vdc backup battery can be used to maintain the operation of the Micrologic X control unit, including wireless communication. It is installed in series between the Micrologic X control unit and the 24 Vdc power supply module.

The 24 Vdc backup battery must have the following characteristics (compatible with the Micrologic X control unit):

- Output voltage 17 V–28.8 Vdc
  - Cut-off voltage 17 Vdc (24 Vdc backup battery must have a shutdown output voltage in case of low voltage level)
  - Hysteresis > 3 Vdc (to avoid power-on before the voltage is up to 21 Vdc)
- 24 Vdc backup battery should be able to power an Inrush current of 10 A

NOTE: Refer to the table of power consumption to calculate the necessary battery capacity for your installation.

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

NOTE: During periods of setting, commissioning, testing, and maintenance, a smartphone (with USB OTG connection) or a PC connected through mini USB port also provide a temporary power supply.

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 internal clock (date and time)

When no other power supply is supplying the Micrologic X control unit, the internal battery enables the generation of events and the recording of waveform capture when tripping, including for the following functions:
- SELLIM
- DIN/DINF
- Instantaneous protection in fast mode

The Micrologic X control unit monitors the state of the internal battery, and generates an event when the internal battery must be replaced:

Event	History	Severity
Replace battery	Diagnostic	Medium

The internal battery of the Micrologic X control unit can be replaced on site when discharged. The internal battery can be replaced with the circuit breaker in the open or closed position, and the control unit supplied with power. For information on spare part replacement and installation, consult the instruction sheet on the Schneider Electric website: *NHA57283*

ULP Module Consumption

The following table lists the ULP module consumption:

Module		Typical consumption (24 Vdc at 20 °C/68 °F)	Maximum consumption (19.2 Vdc at 60 °C/140 °F)
Micrologic X control unit for Masterpact MTZ circuit breaker	with external 24 Vdc power supply	200 mA	300 mA
	supplied through mini USB port	400 mA	500 mA
	supplied through ULP port module	200 mA	335 mA
M2C programmable contacts		25 mA	45 mA
IFE Ethernet interface for one circuit breaker		100 mA	140 mA
IFE Ethernet switchboard server		100 mA	140 mA
EIFE embedded Ethernet interface for one Masterpact MTZ drawout circuit breaker		115 mA	180 mA
IFM Modbus-SL interface or one circuit breaker		21 mA	30 mA
IO input/output application module for one circuit breaker		100 mA	130 mA
ULP port module for Masterpact MTZ circuit breaker		0 mA	0 mA

Chapter 2
Using the Micrologic X Human Machine Interface

What Is in This Chapter?

This chapter contains the following topics:

Micrologic X HMI Description

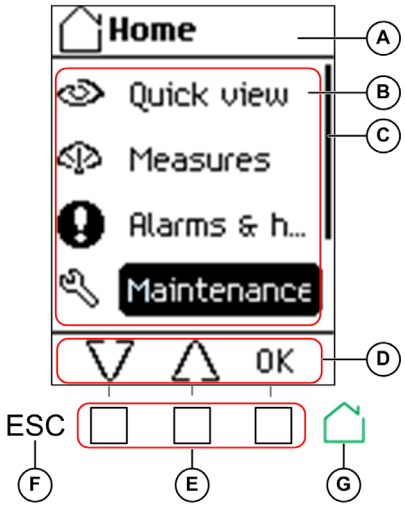
Introduction

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
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 low energy 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 event message is displayed, and no trip or high severity event is active.
1 The backlight of the Health screen in Quick View and in Maintenance 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
- English (UK)
- Português

Restart Screen

The restart screen is displayed every time the Micrologic X control unit is energized. None of the buttons on the control unit are functional while this screen is displayed. The screen is displayed for the period of the control unit start up time. At the end of this period, the **Home** screen or any active pop-up screen is displayed.

NOTE: Standard protection is operational during restart screen.

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 58)*.

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 available at **Home → Quick View**.

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 30)* 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.

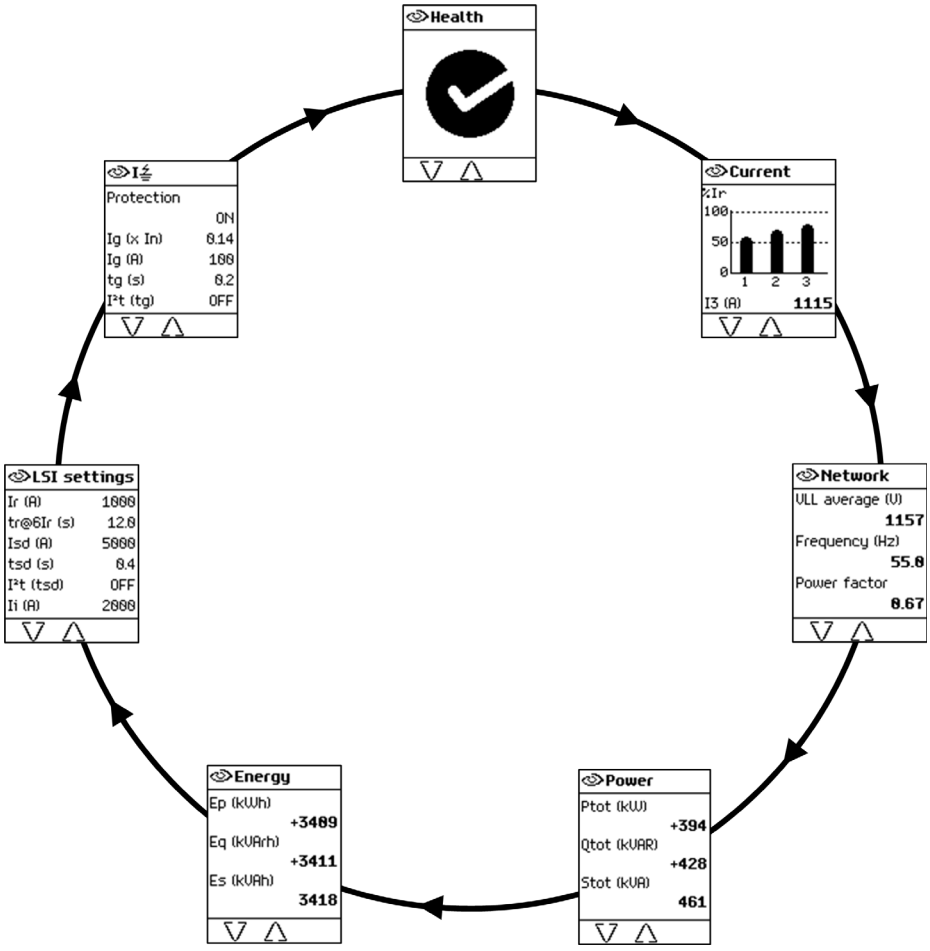
Quick View scrolling is enabled as the factory setting.

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 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 Quick View **Current** screen 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 displays the following screens:

Screen	Description	Micrologic X type
Health[1]	Displays the health state of the circuit breaker: ●  OK (white) ●  Alarm - medium severity (orange) ●  Alarm - high severity (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 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 settings	Displays a selection of protection settings: ● Long time overcurrent protection threshold Ir ● Long time overcurrent protection time delay tr ● Instantaneous overcurrent protection threshold Isd	Micrologic 2.0 X
LSI settings	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
I	Displays a selection of protection settings: ● Ground fault protection threshold Ig ● Ground fault protection time delay tg	Micrologic 6.0 X
I earth leakage	Displays a selection of protection settings: ● Earth-leakage protection threshold IΔn ● Earth-leakage protection time delay Δt	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 Quick View **Current** 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 Quick View **Current** screen 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

When Quick View scrolling is enabled, the scrolling can be restarted:

- 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 restart scrolling of the Quick View screens.

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 Quick View scrolling:

Step	Action
1	Press the home button.
2	Go 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	In the confirmation screen press one of the following: • **Y** to confirm the change of settings. • **N** to undo the edit.

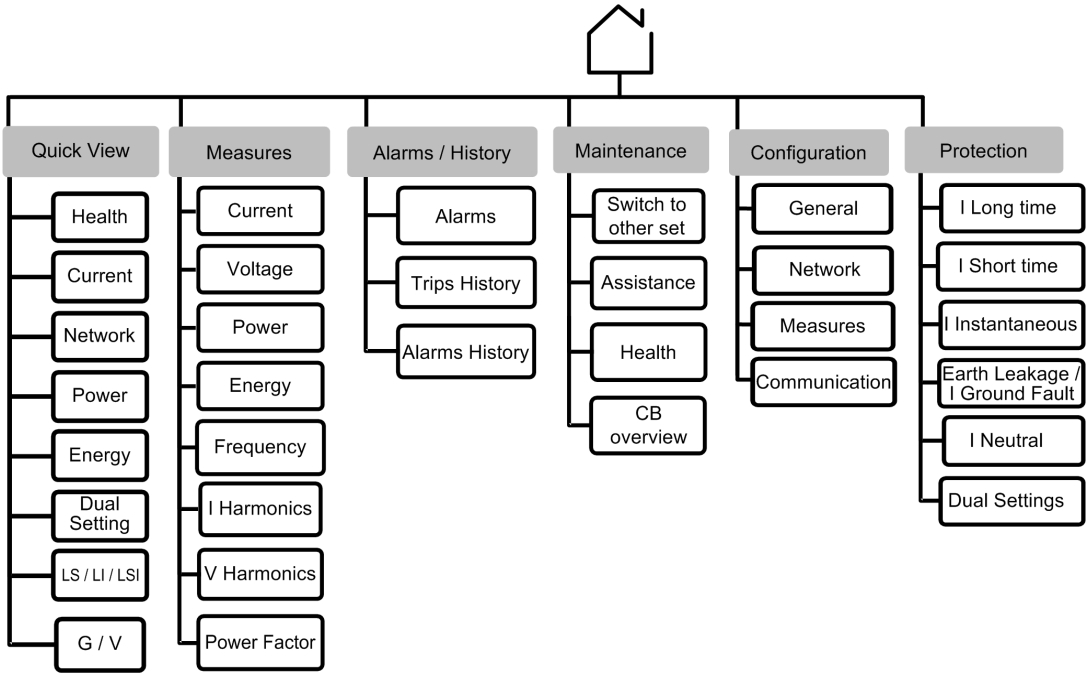
Tree Navigation Mode

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:



Click the link on one of the following level 2 menus to see its content:

Level 1	Level 2
Home	**Quick View** *(see page 33)*
	Measures *(see page 43)*
	Alarms & history *(see page 49)*
	Maintenance *(see page 50)*
	Configuration *(see page 51)*
	Protection *(see page 54)*

Navigating in the Menu Structure

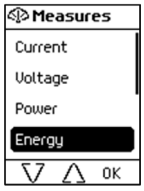
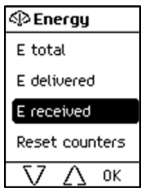
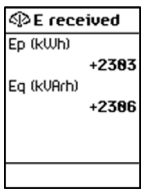
Use the contextual and dedicated buttons on the face of the Micrologic X control unit to navigate in the menu structure, and to access displayed values and configurable settings.

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

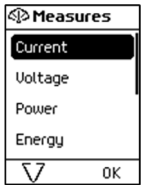
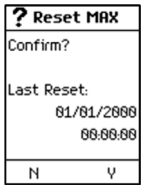
Displaying Data

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 received**.	
4	Press **OK**. The **E received** screen is displayed.	
5	To exit the **E received** screen, press one of the following: ● The **ESC** button to return to the **Energy** menu. ● The home button to return to the **Home** menu.	

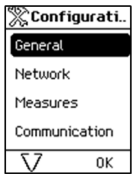
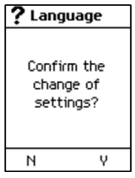
Resetting Values

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	In the confirmation screen, press one of the following: • **Y** to reset the maximum RMS current and return to the **Current** screen. • **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:

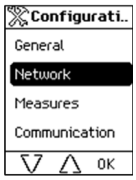
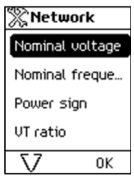
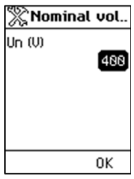
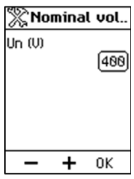
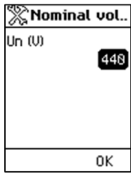
Step	Action	Screen
1	Press the home button. The **Home** menu opens. Press the down arrow to select **Configuration**.	
2	Press **OK**. The **Configuration** menu opens. Select **General**.	
3	Press **OK**. The **General** menu opens. Select **Language**.	
4	Press **OK**. The **Language** menu opens.	
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 one of the following: ● The **ESC** button to return to the **General** menu. ● The home button to return to the **Home** menu.	–
7	In the confirmation screen press one of the following: ● **Y** to confirm the change of settings. ● **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.

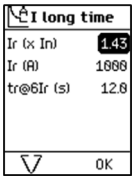
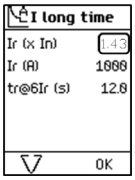
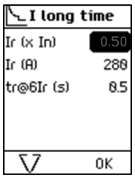
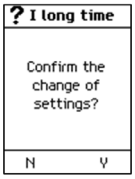
The following example shows how to edit the nominal voltage:

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**.	
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 one of the following: • **Y** to confirm and save the change of settings. • **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

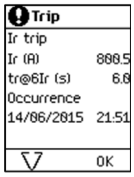
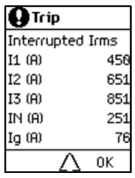
The following example shows how to set the long-time overcurrent protection:

Step	Action	Screen
1	Press the home button. The **Home** menu opens. Press the down arrow to select **Protection**.	
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 (x In)** parameter.	
4	Press **OK** to enable editing of the **Ir (x In)** 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 one of the following: ● The **ESC** button to return to the **Protection** screen ● The home button to return to the **Home** menu	–
8	In the confirmation screen, press one of the following: ● **Y** to confirm and save the change of settings. ● **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.	
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 **Alarms & history** screen is displayed.	–
5	To exit the **Alarms & history** screen, press one of the following: ● The **ESC** button to return to the screen displayed before the pop-up message appeared ● The home button to return to the **Home** menu	–

Measures Menu

Description

The **Measures** menu contains the following submenus:

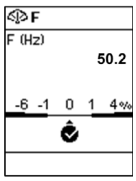
Level 1	Level 2	Level 3	Function description
Home	**Measures**	**Current**	Current real-time measurements
		Voltage	Voltage real-time measurements
		Power	Power real-time measurements
		Energy	Energy real-time measurements
		Frequency	Frequency real-time measurements
		I harmonics	Current harmonics real-time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

Measures Screens with Quality Gauge

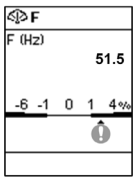
A quality gauge is displayed on the following screens to give a graphical representation of the measurement compared to the expected range:

- Real-time maximum of 3 phase current unbalances, **Iunb**
- Average of 3 RMS phase-to-phase voltages **Vavg VLL(V)**
- Real-time maximum of 3 phase-to-phase voltage unbalances **Vunb VLL(%)**
- Frequency **F(Hz)**

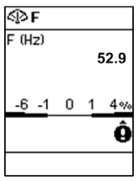
For example, for the frequency screen, the following icons indicate the measurement compared to the expected range:



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



Measurement out of range: the difference between the measured and expected frequencies is +1–4% or -1– -6%



Measurement significantly out of range: the difference between the measured and expected frequencies is greater than +4% or less than -6%

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) (%)**	Real-time maximum of 3 phase current unbalances, with quality gauge
	I unb MAX	**I (1,2,3) (%)**	Maximum of maximum of 3 phase current unbalances
	Reset MAX		Reset of maximum RMS current, with date and time of last reset

1 Applies to 4-pole circuit breakers or 3-pole circuit breakers with ENCT wired and configured.
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 (%)**	Real-time maximum of 3 phase-to-phase voltage unbalances, with quality gauge
		VLN (%)[1]	Real-time maximum of 3 phase-to-neutral voltage unbalances
	V unb MAX	**VLL (%)**	Maximum of maximum of 3 phase-to-phase voltage unbalances
		VLN (%)[1]	Maximum of maximum of 3 phase-to-neutral voltage unbalances
	Reset MIN/MAX		Reset of minimum and maximum RMS voltage, with date and time of last reset

1 Applies to 4-pole circuit breakers or 3-pole circuit breakers with ENVT wired and configured.

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, with date and time of last reset
1 Applies to 4-pole circuit breakers or 3-pole circuit breakers with ENVT wired and configured.			

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 delivered	**Ep (kWh)**	Total active energy delivered into the load (counted positively)
		Eq (kVArh)	Total reactive energy delivered into the load (counted positively)
	E received	**Ep (kWh)**	Total active energy received out of the load (counted negatively)
		Eq (kVArh)	Total reactive energy received out of the load (counted negatively)
	Reset counters		Reset of accumulated energy, with 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, with 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, with date and time of occurrence
	Reset MAX			Reset of minimum and maximum THD, with date and time of last reset
1 Applies to 4-pole circuit breakers or 3-pole circuit breakers with ENVT wired and configured.				

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 wired and configured.				

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	Displays: ● **Capacitive** in the case of lead ● **Inductive** in the case of lag

Alarms & History Menu

Description

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

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

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
Description: up to three lines of text describing the nature of the alarm (medium or high severity event).
Occurrence
The date and time that the alarm occurred.

Use the up and down arrows at the bottom of the screen to navigate between active alarm screens.

Trips History Screens

A trips history screen contains the following information:

Screen title: Trips history
Description: up to three lines of text describing the nature of the trip (high severity event).
Occurrence
The date and time that the event occurred.

Use the up and down arrows at the bottom of the screen to navigate between trips history screens.

Alarms History Screens

An alarms history screen contains the following information:

Screen title: Alarms history
Description: up to three lines of text describing the nature of the alarm (medium or high severity event).
Occurrence
The date and time that the event occurred.
Completed (displayed if an alarm is no longer active)

Use the up and down arrows at the bottom of the screen to navigate between alarms history screens.

Maintenance Menu

Description

The **Maintenance** menu contains the following submenus:

Level 1	Level 2	Level 3	Function description
Home	**Maintenance**	**Switch to other set**[1] *(see page 81)*	Dual setting configuration
		Assistance	Presents information about the firmware version of the Micrologic X control unit.
		Health	Describes the health state of the circuit breaker.
		CB overview	Presents information about the circuit breaker.
1 Displayed only when the parameter **Dual settings** is set to **Enabled** and the parameter **Switch Mode** is set to **Local HMI**.			

Switch to Other Set

The **Switch to other set** menu is displayed only when the parameter **Dual settings** is set to **Enabled** and the parameter **Switch Mode** is set to **Local HMI**. It 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	The health state of the circuit breaker is represented by one of three icons: •  No alarm detected •  Orange icon: medium severity alarm detected, indicating that corrective action needs to be scheduled. •  Red icon: high severity alarm detected, indicating that urgent corrective action is required.

CB Overview

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

Level 3	Level 4	Level 5	Parameter name
CB overview	**CB block**	**Masterpact**	Circuit breaker range
		MTZ1 08	Device size and rated current x 100 A
		H3	Performance level
		3P	Power system
		IEC	Standard

Configuration Menu

Description

The **Configuration** menu contains the following submenus:

Level 1	Level 2	Level 3	Function description
Home	**Configuration**	**General**	Settings of the HMI display and control of access to protection settings.
		Network	Settings of nominal voltage and frequency, power sign, and VT ratio *(see page 52)*.
		Measures	Settings of measurement calculation *(see page 52)*.
		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 31)*		List of display screen languages.
	Date & time *(see page 22)*	**dd/mm/yyyy**	Set the date.
		hh:mm:ss	Set the time.
	Quick view *(see page 35)*	**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 scrolling is enabled.
		Pageflow (s)	The length of time (in seconds) for which each Quick View screen is displayed. **NOTE:** Only available when Quick View scrolling is enabled.
		Time out (min)	The time delay before the Quick View Current screen is displayed if no button is pressed. **NOTE:** Only available when Quick View scrolling is not enabled.
	Lock protection *(see page 65)*	**Keypad**	Enable locking of local access to the **Protection** menu through the Micrologic X keypad. This helps to prevent unauthorized users from editing protection settings. • **Protection changes → Allowed** means that the **Protection** menu can be accessed from the Micrologic X keypad. • **Protection changes → Not allowed** means that the **Protection** menu cannot be accessed from the Micrologic X keypad.
		External access	Enable locking of external access to the **Protection** menu. This helps to prevent unauthorized users from editing protection settings. • **Protection changes → Allowed** means that the **Protection** menu can be externally accessed. • **Protection changes → Not allowed** means that the **Protection** menu cannot be externally accessed.

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 / 1,000 V. Factory setting = 400.
	Nominal frequency	**Hz**	Rated frequency ● **50 Hz** (factory setting) ● **60 Hz**
	Power sign *(see page 127)*	–	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 138)*		Sign convention for cos Φ, PF power factor, and reactive power: ● **IEC** ● **IEEE** (factory setting)
	System type *(see page 122)*	**Nb 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** (factory setting)
		ENCT	External neutral current transformer. Setting values include: ● If **4P**: **NO** (for display only) ● If **3P**: **YES** or **NO** (factory setting)
	Total P calcul *(see page 125)*		Total power calculation method: ● **Vector** ● **Arithmetic** (factory setting)
	E calcul *(see page 130)*		Energy Accumulation mode. Energy values to be used in energy calculations: ● **Absolute** (factory setting) ● **Signed**

Communication

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

Level 3	Level 4	Level 5	Parameter name
Communication	**Bluetooth** *(see page 176)*	**ON**	Enables Bluetooth control
		OFF (factory setting)	Disables Bluetooth control
		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	**OFF**	Reserved for future use.
	Control mode *(see page 164)*	**Mode**	Selection of source for open/close function ● **Manual**: manually using local mechanical button. Displays **(BP command only)**. ● **Automatic** (factory setting): In addition to manual orders, the control unit accepts 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 submenus:

Level 1	Level 2	Level 3	Function description
Home	**Protection**	**I long time**	Long-time overcurrent protection *(see page 67)*, L or ANSI code 49RMS
		I short time[1]	Short-time overcurrent protection *(see page 70)*, S or ANSI code 51
		I instantaneous	Instantaneous overcurrent protection *(see page 72)*, I or ANSI code 50
		I ground fault[2]	Ground-fault protection *(see page 74)*, G or ANSI code 50G/51G
		I earth leakage[3]	Earth-leakage protection *(see page 77)*, ANSI code 50G/51G
		I neutral	Neutral protection *(see page 79)*
		Dual settings	Dual settings *(see page 81)*
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. Range = 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 instantaneous overcurrent protection threshold expressed according to the Ir long-time overcurrent protection threshold. Step = 0.5 x Ir. Range = 0.5–10 x Ir
	Isd (A)	Isd instantaneous 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: ● **OFF**: the following menus are not displayed ● **ON**: the following menus are displayed
	Ii (x In)	Ii instantaneous overcurrent protection threshold expressed according to the control unit rated current In. Step = 0.5 x In. Range = 0.2–15 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**

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 overcurrent protection mode: ● **OFF**: the following menus are not displayed ● **ON**: the following menus are displayed
		Ig (x In)	Ig ground fault protection threshold expressed according to the control unit rated current In. Used for quick settings: 0.2, 0.3, 0.4, 0.5, 0.6, 0.7, 0.8, 0.9, 1 x In.
		Ig (A)	Ig ground fault protection threshold expressed in Amps. Used for settings with: ● 1 A resolution for In ≤1,000 A ● 10 A resolution for In > 1,000 A
		tg (s)	tg ground fault protection time delay. Settings: 0, 0.1, 0.2, 0.3, 0.4 s
		I^2t (tg)	Enable ground fault protection curve function: **ON** or **OFF**

⚠ WARNING

HAZARD OF EQUIPMENT DAMAGE

When using source ground return (SGR) with MDGF module:
- Ig enable setting in OFF position is forbidden.
- Ig threshold setting must be ≤1,200 A.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

I Earth Leakage

The **I earth leakage** menu for Micrologic 7.0 X presents the following data and settings:

Level 3	Level 4	Parameter name
I earth leakage	**IΔn (A)**	Earth-leakage protection threshold expressed in Amps. Step = 0.1 A Range = 0.5 – 30 A
	Δt (s)	Earth-leakage protection time delay. Settings: 0.06, 0.15, 0.23, 0.35, 0.80 s

I Neutral

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

Level 3	Level 4	Parameter name
I neutral[1]	**Nb poles**	Number of poles **3P** or **4P**, for display only.
	Ir (A)	Ir long-time overcurrent protection threshold expressed in Amps, for display only.
	Protection	Set neutral protection: • **OFF** • **N/2** • **N** • **Oversized N**
	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: **NO** (factory setting) or **YES**
	Settings	Displays the active configuration **A** or **B** when **Dual settings** is enabled.
	Switch mode[1]	Displays the configured mode for switching between setting group A and setting group B: • **Local HMI** • **IO - 1 Wire** • **IO - 2 Wires** • **Remote**
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. 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[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. Step = 0.5 x Ir; Range = 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	Enable inverse time curve function: **ON** or **OFF**
	I instantaneous[1]	**Ir (A)** [2]	Ir long-time overcurrent protection threshold expressed in Amps, for display only.
		Isd (x Ir) [2]	Isd instantaneous overcurrent protection threshold expressed according to the Ir long-time overcurrent protection threshold. Step = 0.5 x Ir. Range = 0.5–10 x Ir
		Isd (A) [2]	Isd instantaneous overcurrent protection threshold expressed in Amps, for display only.
	I instantaneous[1]	**Protection** [3]	Enable instantaneous overcurrent protection mode: ● **OFF**: the following menus are not displayed. ● **ON**: the following menus are displayed.
		Ii (x In) [3]	Ii instantaneous overcurrent protection threshold expressed according to the control unit rated current In. Step = 0.5 x In; Range = 0.2–15 x In.
		Ii (A) [3]	Ii instantaneous overcurrent protection threshold expressed in Amps, for display only.
		Ii mode [3]	Instantaneous overcurrent protection time delay mode: **Standard** or **Fast**
	I ⏚ [1]	**Protection**	Enable ground fault overcurrent protection mode: ● **OFF**: the following menus are not displayed. ● **ON**: the following menus are displayed.
		Ig (x In)	Ig ground fault protection threshold expressed according to the control unit rated current In. Used for quick settings: 0.2, 0.3, 0.4, 0.5, 0.6, 0.7, 0.8, 0.9, 1 x In.
		Ig (A)	Ig ground fault protection threshold expressed in Amps Used for settings with: ● 1 A resolution for In ≤1000 A ● 10 A resolution for In > 1000 A
		tg (s)	tg 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 2.0 X
3 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 severity alarm
- Medium severity 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 176)*.

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 smartphone
- The Bluetooth button on the Micrologic X control unit 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 severity alarm	When a high severity alarm occurs, the high severity alarm message is displayed with a red backlight.	
Medium severity alarm	When a medium severity alarm occurs, the medium severity 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.
3	After resolving the cause of the event, press **OK** to acknowledge the message. The explanatory message closes, and the display screen shows the **Alarms & 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 186)*.

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 35)*.

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

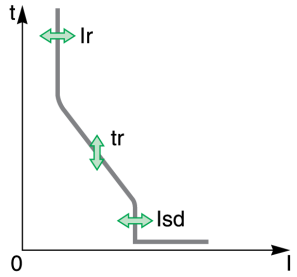
The protection setting ranges depend on the rated current In, defined by the sensor plug inserted in the Micrologic X control unit.

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	✓	✓	✓	–	–	✓	✓	–	–	–	–	–	–	–	–	–
630 A	✓	✓	✓	✓	–	✓	✓	✓	–	–	–	–	–	–	–	–
800 A	–	✓	✓	✓	✓	✓	✓	✓	✓	–	–	–	–	–	–	–
1,000 A	–	–	✓	✓	✓	–	✓	✓	✓	✓	–	–	–	–	–	–
1,250 A	–	–	–	✓	✓	–	–	✓	✓	✓	✓	–	–	–	–	–
1,600 A	–	–	–	–	✓	–	–	–	✓	✓	✓	✓	–	–	–	–
2,000 A	–	–	–	–	–	–	–	–	–	✓	✓	✓	✓	✓	–	–
2,500 A	–	–	–	–	–	–	–	–	–	–	✓	✓	✓	✓	✓	–
3,200 A	–	–	–	–	–	–	–	–	–	–	–	✓	✓	✓	✓	✓
4,000 A	–	–	–	–	–	–	–	–	–	–	–	–	✓	✓	✓	✓
5,000 A	–	–	–	–	–	–	–	–	–	–	–	–	–	–	✓	✓
6,300 A	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	✓

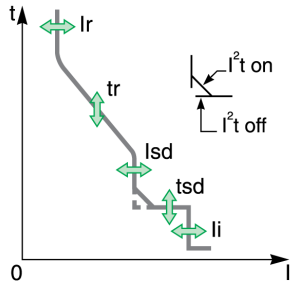
Micrologic 2.0 X Control Unit



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.

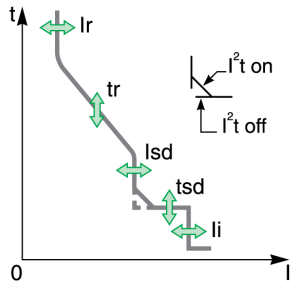
Micrologic 5.0 X Control Unit

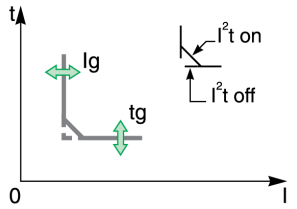


Micrologic 5.0 X control units provide:
- Long-time overcurrent protection (Ir)
- Short-time overcurrent protection (Isd)
- Instantaneous overcurrent protection (Ii)

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

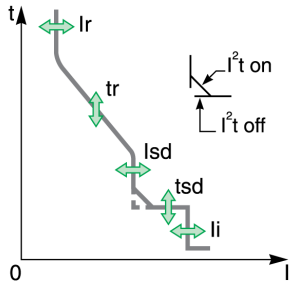


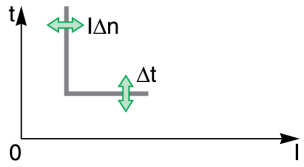


Micrologic 6.0 X control units provide:
- Long-time overcurrent protection (Ir)
- Short-time overcurrent protection (Isd)
- Instantaneous overcurrent protection (Ii)
- Ground-fault protection (Ig)

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 external 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 through 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.

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

Predefined events cannot be modified by the user. For general information on events, refer to Event management *(see page 185)*.

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 the following events, depending on where the settings are changed from:

Events	History	Severity
Protection setting changed by display	Protection	Low
Protection setting changed by Bluetooth/USB/IFE	Protection	Medium

The following data is available with Masterpact MTZ Mobile App through Bluetooth or USB OTG connection, in addition to the events generated:
- Date and time of the setting change
- Previous settings

Enabling and Disabling Access to the Protection Settings

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

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

Select **Not Allowed** to disable access. Access is enabled by default.

Changing the access to protection settings generates two events:

Events	History	Severity
Protection settings change by display enabled	Protection	Low
Remote protection settings change enabled	Protection	Low

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.

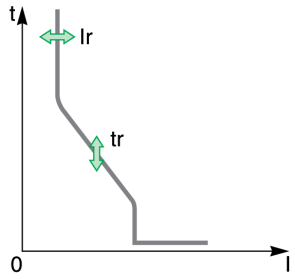
This protection function can be used also for transformer or generator protection thanks to the wide range of settings offered.

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



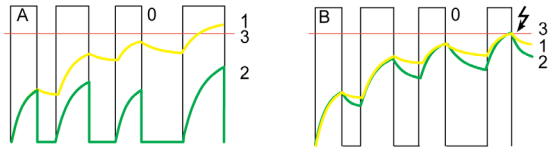
Long-time overcurrent protection is based on the true RMS current of phases and neutral, up to harmonic 15.
Long-time overcurrent protection is implemented independently for each phase and for neutral when present *(see page 79)*.

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 an electrical 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. The cumulative effect of successive 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.

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 (password-protected)
- With Masterpact MTZ Mobile App (password-protected)
- By sending a setting command using the communication network (password-protected).

Long-time overcurrent protection can be duplicated when dual settings are activated *(see page 81)*.

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

The tripping time according to tr time delay is given in cold-state conditions.

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	Medium
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 186)*.

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

Presentation

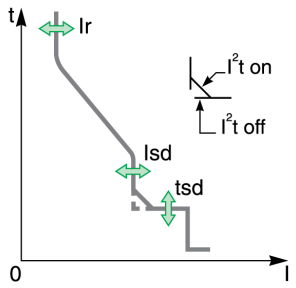
Short-time overcurrent protection protects equipment against phase-to-phase, phase-to-neutral and phase-to-ground short circuits with total selectivity. It includes two characteristics, definite time and inverse time, which depend on the status of the I²t setting.

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 I²t 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 I²t 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 (password-protected)
- With Masterpact MTZ Mobile App (password-protected)
- By sending a setting command using the communication network (password-protected).

Short-time overcurrent protection can be duplicated when dual settings are activated *(see page 81)*.

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
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 83)*.

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 185)*.

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 provided with any Compact NSX circuit breaker installed downstream of a Masterpact MTZ circuit breaker (for Ue ≤ 440V and 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 based on short-time protection without time setting with standard breaking time of 80 ms.

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.

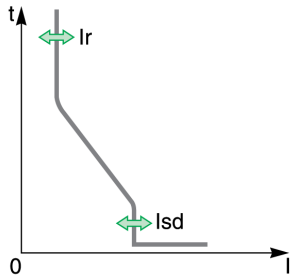
Operating Principle

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 instantaneous overcurrent protection threshold (corresponds to a 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 (password-protected)
- With Masterpact MTZ Mobile App (password-protected)
- By sending a setting command using the communication network (password-protected).

Instantaneous overcurrent protection can be duplicated when dual settings are activated *(see page 81)*.

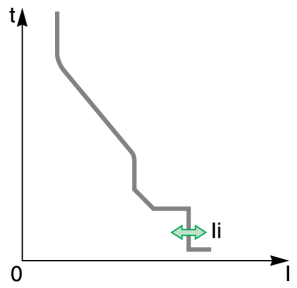
Protection Settings for Micrologic 2.0 X

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 mode
- 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 (password-protected)
- With Masterpact MTZ Mobile App (password-protected)
- By sending a setting command using the communication network (password-protected).

Instantaneous overcurrent protection can be duplicated when dual settings are activated *(see page 81)*.

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 mode	–	Standard/Fast	–	Standard
Ii threshold	A	2.0–15 x In	0.5 x In[1]	2.0 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 mode is set to Standard	Ii mode 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 for Micrologic 2.0 X

The function generates the following predefined events::

Event	History	Severity
Isd trip	Trip	High
Isd operate	Protection	Medium

Predefined events cannot be modified by the user. For general information on events, refer to Event Management *(see page 185)*.

Predefined Events for Micrologic 5.0 X, 6.0 X, 7.0 X

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 185)*.

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

Presentation

Ground-fault protection provides 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.

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

⚠ WARNING

HAZARD OF EQUIPMENT DAMAGE

When using source ground return (SGR) with MDGF module:
- Ig enable setting in OFF position is forbidden.
- Ig threshold setting must be ≤1,200 A.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

Availability

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

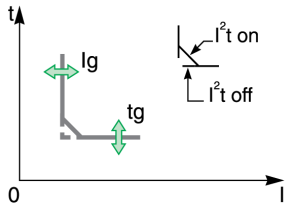
External sensors can be used:
- External Neutral Current Transformer (ENCT): measurement of the current on neutral. For information on installation of ENCT, consult the instruction sheet on the Schneider Electric website: *NHA14388*.
- Source ground return protection: including ground-fault protection and an SGR sensor installed around the connection of the transformer neutral point to ground.

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 electrical 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 (I^2t ON or I^2t OFF)

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

The ground-fault protection can be duplicated when dual settings are activated *(see page 81)*.

Protection Settings

Setting	Unit	Range	Step	Factory setting	Accuracy
Ig enable	–	ON/OFF	–	ON	–
Ig threshold[1]	A	0.2–1 x In	10 A	0.2 x In	+/– 10%
1 For In ≤ 400 A, the Ig setting range is 0.3–1 x In (factory setting: 0.3 x In)					

Setting	Unit	Setting Value				
tg with I^2t OFF	s	0	0.1	0.2	0.3	0.4
tg with I^2t 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 I^2t 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	Use a thin screwdriver to briefly push in (< 1s) 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 83)*.

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 pickup 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 185)*.

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 including VPS module complies with IEC 60947-2 Annex B. It is a type A residual-current device (RCD).

Availability

⚠ WARNING

HAZARD OF EARTH-LEAKAGE PROTECTION LOSS

- Do not use Masterpact MTZ with embedded Micrologic 7.0 X control unit without connected rectangular sensor for earth-leakage protection.
- Only ever use Schneider Electric LV833573SP or LV833574SP earth-leakage protection sensors with Masterpact MTZ with embedded Micrologic 7.0 X control unit.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

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

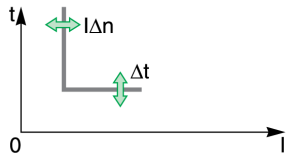
The external rectangular sensor is required to measure the residual current.

For information on installation of the rectangular sensor, consult the instruction sheet on the Schneider Electric website: *NVE35468*

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 electrical 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 Δt.

Setting the Protection

The earth-leakage protection settings are:
- IΔn earth-leakage protection threshold
- Δt 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 (password-protected)
- With Masterpact MTZ Mobile App (password-protected)
- By sending a setting command using the communication network (password-protected).

Protection Settings

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

Setting	Unit	Setting Value				
Δt 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).
2	Use a thin screwdriver to briefly push in (< 1s) 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 test 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 186)*.

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 overcurrent 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

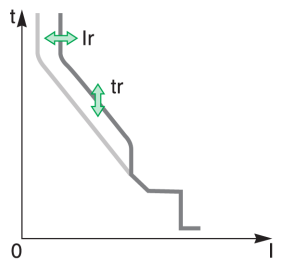
It may be necessary to switch off the neutral for operational reasons (multiple source diagram) or safety reasons (working with power off).

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 oversized neutral (OSN) 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
- By sending a setting command using the communication network (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 (password-protected)
- By sending a setting command using the communication network (password-protected).

The following table 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
N/2		Ir/2
N		Ir
Oversized N	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

By default, the dual settings function is disabled.

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 81)*.

The set of protection settings can be selected as follows:
- When the IO module is used to select the active setting group, the active setting group is defined only by the selector switch wired on digital inputs of the IO module. For more information, refer to *Enerlin'X IO - Input/Output Application Module for One Circuit Breaker - User Guide*.
- When the IO module is not used to select the active setting group, the active setting group is set 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 (password-protected).

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**.

Setting the Function

The Set A protection parameters are set as follows:
- On the Micrologic X display screen, at **Home → Protection**
- With Ecoreach software
- By sending a setting command using the communication network (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
- By sending a setting command using the communication network (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
	Switch mode	Local HMI	• Local HMI • IO - 1 Wire • IO - 2 Wires • 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 x Ir	Same as set A	Micrologic 5.0 X, 6.0 X, 7.0 X
	tsd	0	Same as set A	
Instantaneous Set B	Isd	1.5 x Ir	Same as set A	Micrologic 2.0 X
Instantaneous Set B	Ii enable	ON	Same as set A	Micrologic 5.0 X, 6.0 X, 7.0 X
	Ii mode	Standard	Same as set A	
	Ii	2.0 x In	Same as set A	
Ground-fault Set B	Ig enable	ON	Same as set A	Micrologic 6.0 X
	Ig	0.2 x In[1]	Same as set A	
	tg	0	Same as set A	
1 For In ≤ 400 A, the Ig factory setting is 0.3 x In.				

Predefined Events

Activating Set B generates the following event:

Event	History	Severity
B curve active	Protection	Low

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 stress on the system by reducing the time it takes to clear the electrical 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 electrical fault clearing it, usually with an intentional delay. With ZSI, the device closest to the electrical fault ignores its preset short-time and ground-fault delays and clears the electrical fault with no intentional delay.

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

The coordination of the system must be correctly set up for zone-selective interlocking to work.

Availability

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

For zone-selective interlocking compatibility with other ranges of circuit breakers, consult the ZSI Interface Module instruction sheet on the Schneider Electric website: *NHA12883*

Masterpact MTZ 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.

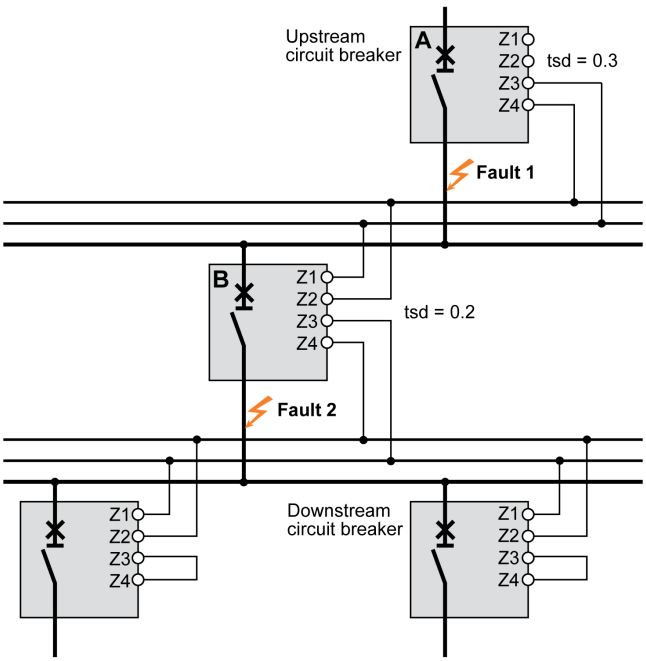
Operating Principle

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 an electrical 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.

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

Electrical Fault 2: Circuit breakers **A** and **B** detect the electrical 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:

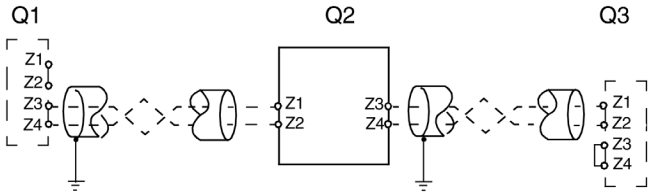
- Short-time overcurrent protection
- Ground-fault protection (Micrologic 6.0 X)
- Both protections (Micrologic 6.0 X)

Setting changes can be made as follows:

- With Ecoreach software
- By sending a setting command using the communication network (password-protected).

Connection Principles

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

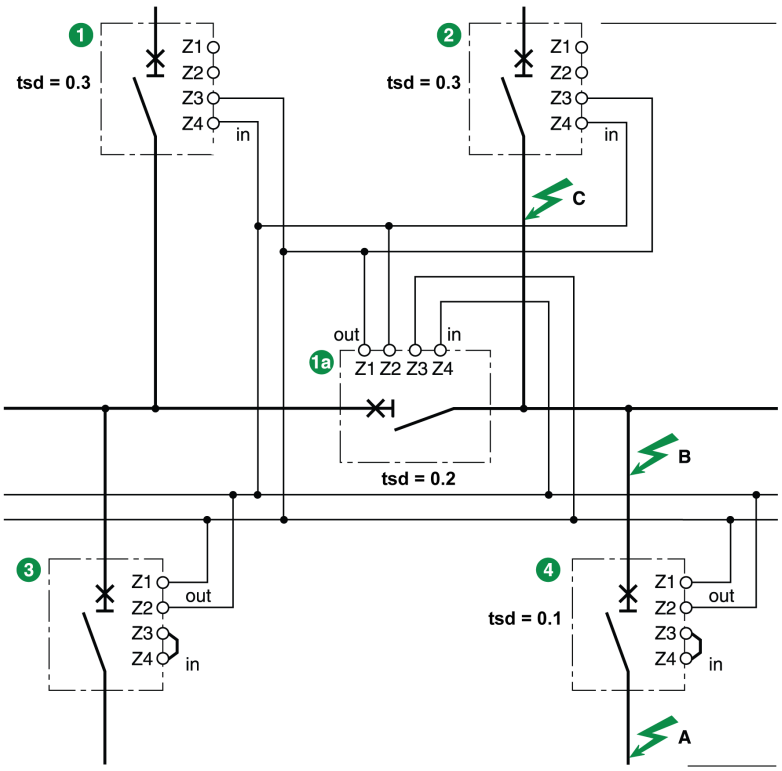


Q1 Upstream circuit breaker
Q2 Circuit breaker to be wired
Q3 Downstream circuit breaker
Z1 ZSI-OUT source
Z2 ZSI-OUT
Z3 ZSI-IN source
Z4 ZSI-IN

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 for ZSI to be controlled for the sources used.

Connection Wire Characteristics

The following table 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 or 15 devices, depending on the upstream device

Predefined Events

The function generates the following event:

Event	History	Severity
ZSI test	Diagnostic	Low

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 electrical fault calculation. The setting guideline cannot replace this calculation.

Masterpact MTZ circuit breakers with Micrologic X control units offer flexibility to set the required overcurrent protection while 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 electrical 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 630–3,200 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 630–3,200 A Ii enable: OFF
Secondary side of MV/LV transformer (switchboard main incomer) without other Masterpact or Compact NS 630–3,200 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 630–3,200 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 630–3,200 A Ii enable: OFF
Generator output without other Masterpact or Compact NS 630–3,200 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 630–3,200 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 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 enables selectivity with downstream devices.

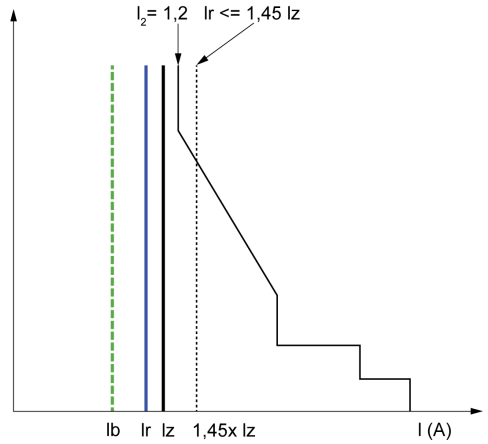
Application	Micrologic 2.0 X	Micrologic 5.0 X, 6.0 X, 7.0 X[1]
Feeder without other Masterpact or Compact NS 630–3,200 A downstream as feeder	Ir = Iz tr ≤ 16 s Isd ≤ Ifault min	Ir = Iz tr ≤ 16 s Isd ≤ Ifault min tsd = 0 Ii enable: ON Ii mode: Standard Ii = Isd
Power electronic (for example, uninterruptible 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 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 enables 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 Electric 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 68)*, 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 order thermal model:

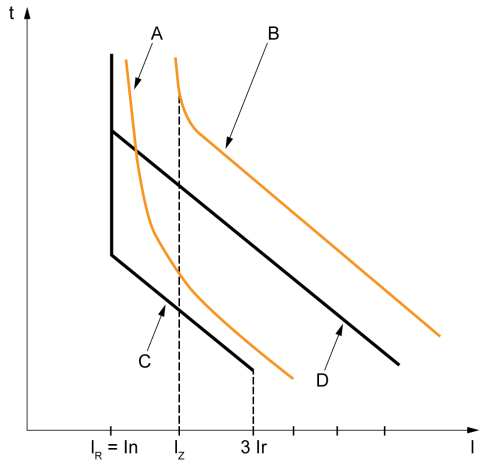
tr setting (s)	Unit	0.5	1	2	4	8	12	16	20	24
Equivalent time constant for heating and cooling when control unit is energized	seconds	14	28	56	112	224	335	447	559	671
	minutes	–	–	–	–	3.5	5.6	7.5	9.3	11.2
Time constant for cooling when control unit is not energized	minutes	5								

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 (500 MCM): ● Time constant > 11 min ● tr = 24 s When smaller cables are used in parallel, a lower setting should be used.	tr ≤ 24 s
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 (500 MCM): ● 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 (500 MCM) ● tr ≤ 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 (500 MCM) ● tr ≤ 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 (500 MCM) ● tr ≤ 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 is also used for motor thermal overload, motor class must be taken in consideration.	● tr = 12 s for a feeder ● tr ≥ 8 s for a class 10 motor ● tr ≥ 12 s for a class 20 motor ● tr ≥ 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 are given here. For more information, refer to the neutral protection section *(see page 79)*.

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	N/2	Ir is set according to Iz of cable, Ir applied to neutral is divided by 2
Equal to cross-sectional area of phase conductors	No	OFF	No harmonics expected: the protection of neutral is not necessary
	Yes	N	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 N	Harmonics expected: the neutral must be protected by the long-time protection, set as for the phase protection multiplied by 1.6 (Oversized neutral)

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

NOTE: In IT systems, a distributed neutral conductor must be protected. Set the neutral protection to N/2, N or Oversized N.

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

Settings Guideline

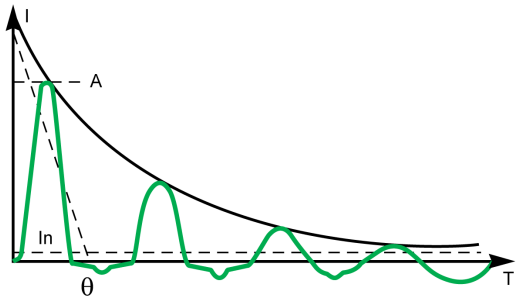
The Isd and tsd settings help to ensure that the short-time withstand current of protected equipment is not exceeded.

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 630–3,200 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 630–3,200 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

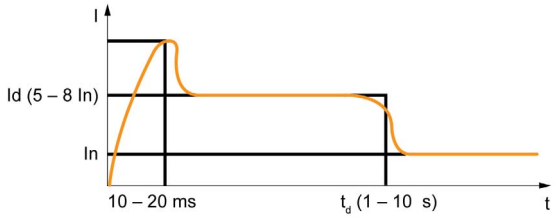
When LV/LV transformers are switched on, very high inrush currents are produced which must be taken into account when choosing overcurrent protection devices. The peak value of the first current wave often reaches 10 to 15 times the rated rms current of the transformer and may reach values of 20 to 25 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 provided 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 provided with Masterpact MTZ circuit breakers 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, providing 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 NS circuit breakers 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 NS circuit breakers 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)

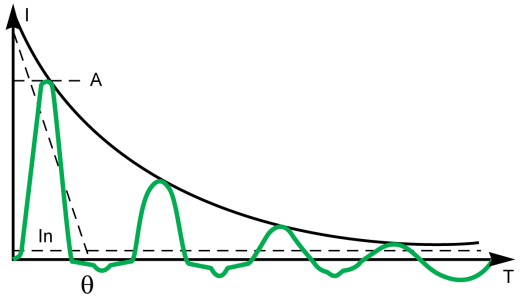
Settings Guideline

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:

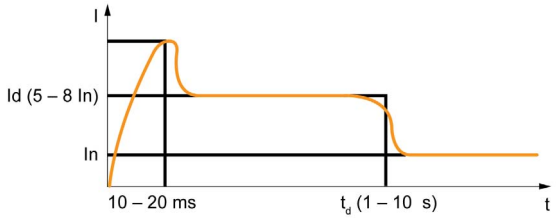
Application	Principle	Usual value
Secondary side of MV/LV transformer (switchboard main incomer)	Selectivity with downstream circuit breakers	Ii enable: OFF if other Masterpact downstream Ii = 15 x In if Compact NSX only downstream
Feeder **with** selectivity with other Masterpact or Compact NS circuit breakers downstream	Same rule as for Isd	Ii enable: OFF
Feeder **without** selectivity with other Masterpact or Compact NS circuit breakers downstream	–	Ii enable: ON Ii mode: 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 mode: 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 mode: Fast Ii ≥ 13 x Full load current of 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:



NOTE: Masterpact MTZ1 L1 type circuit breakers are equipped with an additional fast instantaneous trip set at 10 x In.

- If used for the protection of the supply side of a transformer, the risk of trip during energization must be considered.
- For motor application, select according to motor starter coordination tables.

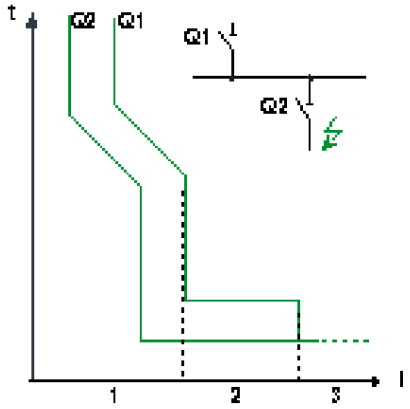
Selectivity

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 specified 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 the I^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.

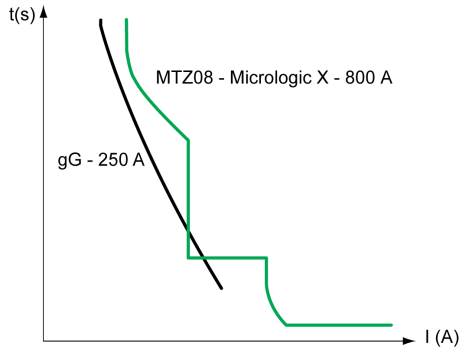
Selectivity Table

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 *Complementary Technical Information Catalogue*).

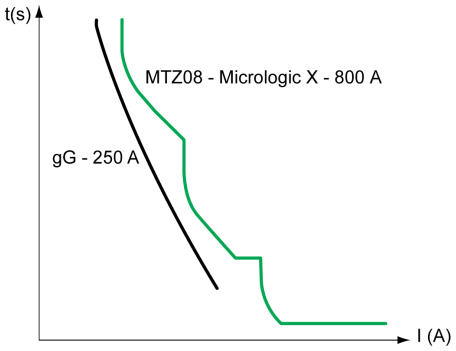
I^2t ON/OFF Function

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, THD, and THD-R of voltages and currents

Average 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
- On the FDM128 display
- By a remote controller using the communication network
- On the IFE/EIFE webpages

Electrical parameters are refreshed once a second. They can be displayed as follows:

- On the Micrologic X display screen, at **Home → Measures** *(see page 43)*
- With the Masterpact MTZ Mobile App
- With Ecoreach software
- On the FDM128 display
- By a remote controller using the communication network
- On the IFE/EIFE webpages

The availability of parameters depends on the type of interface used to display data. All parameters are not displayed on all interfaces *(see page 113)*.

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 In.

The start-up time is the time between when the control unit is energized and the availability of the first measurement. The start-up time is less than or equal to 45 seconds.

Measurement Accuracy

Power and energy metering accuracy in Masterpact MTZ circuit breakers 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.

A Masterpact MTZ circuit breaker, 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 and ‘Standard’ humidity and altitude operating conditions, according to table 6 and 7 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 103)*
- Operating uncertainty *(see page 104)*
- Overall system uncertainty *(see page 105)*

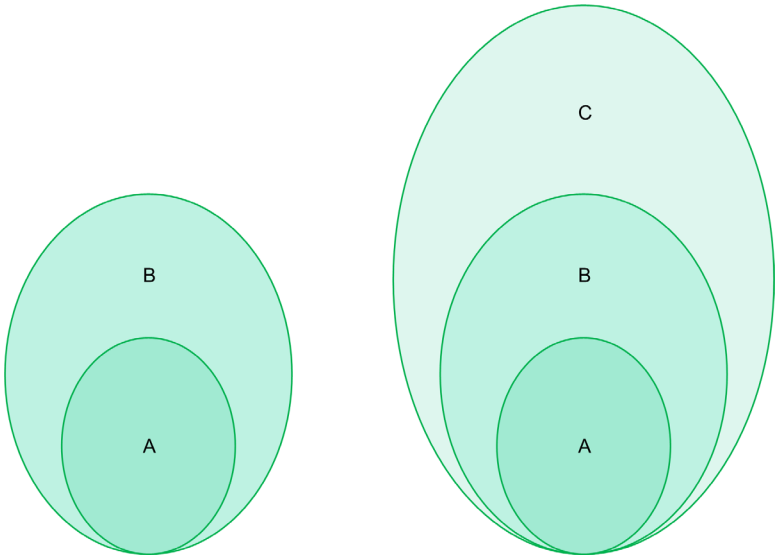
A PMD-DD device avoids overall system uncertainty and variation, thanks to its embedded sensors and wiring.

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 following graphic 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

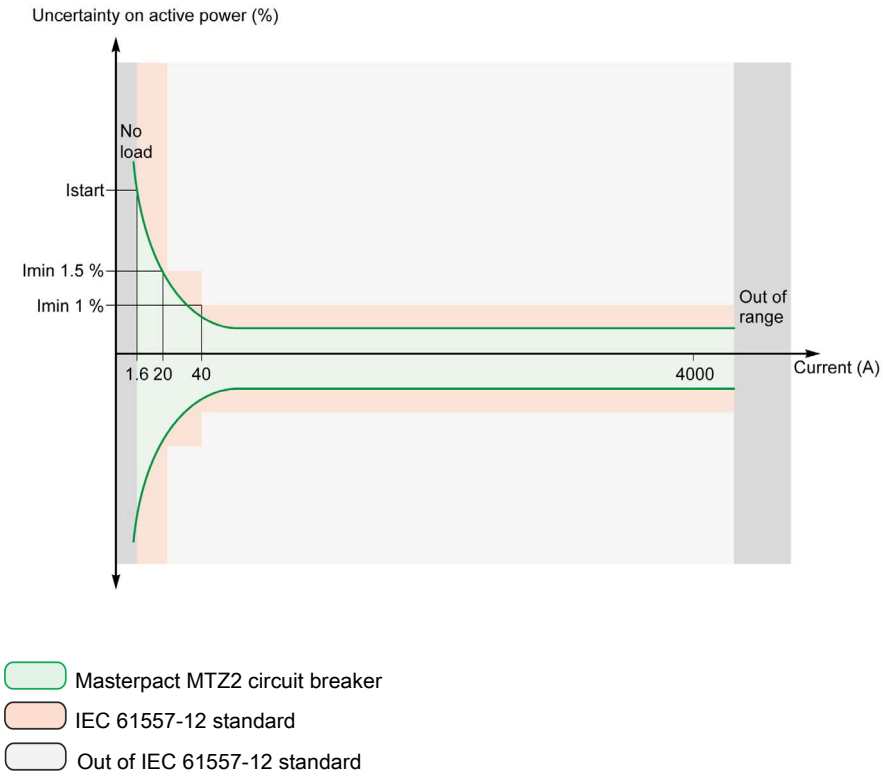
Intrinsic uncertainty is the uncertainty of a measuring instrument when used under reference conditions. In the context of this standard, it is a percentage of the measured electrical parameter defined within the rated range of the measuring instrument.

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

The following table indicates, for different Masterpact MTZ circuit breakers, the current values for an intrinsic uncertainty less than or equal to 1%:

Current values for active power with 1% uncertainty (in A)		Masterpact		
Description of current value	**Current value**	**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 for 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 for 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 for accuracy less than or equal to 1% for active power and energy with PF = 0.5 Inductive to 0.8 Capacitive	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 circuit breaker meets the uncertainty requirements of this standard	Imax	1,600 A x 1.2	4,000 A x 1.2	6,300 A x 1.2

The following graph gives an example of the intrinsic uncertainty for active power and energy versus current for the Masterpact MTZ2 circuit breaker. It shows that the performance of the Masterpact MTZ2 circuit breaker is equal to or better than the IEC 61557-12 standard.



Operating Uncertainty

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

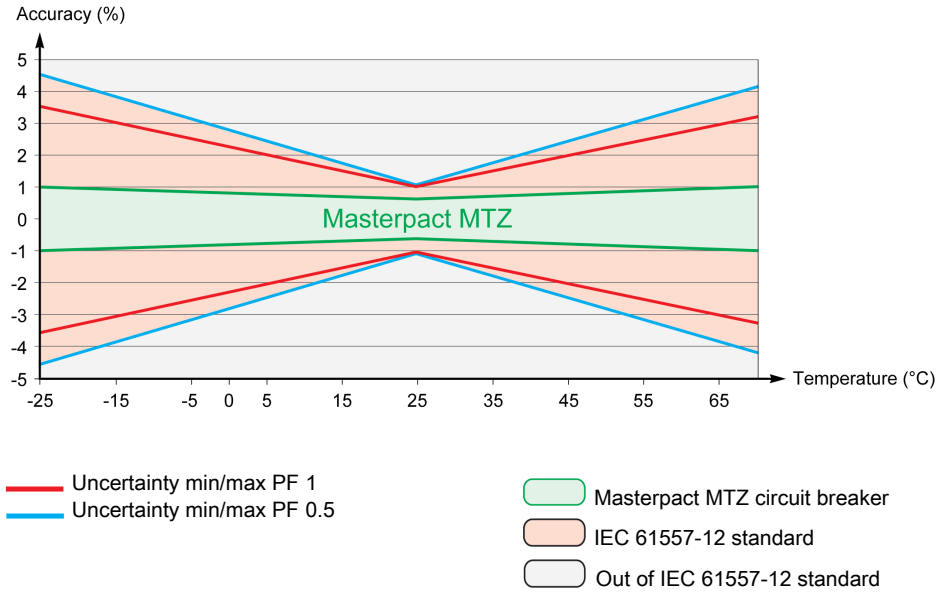
IEC 61557-12 specifies tests and maximum variation of uncertainty according to the following influence quantities:

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

For Masterpact MTZ circuit breakers with Micrologic X control unit, the main influence quantity is temperature. Masterpact MTZ circuit breakers 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 over an operating ambient temperature range of -25 °C (-13 °F) to 70 °C (158 °F).



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

Masterpact MTZ circuit breakers with Micrologic X control unit offer 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 regarding 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.

For Masterpact MTZ circuit breakers, the sensors are embedded in the device for applications up to 690 Vac phase-to-phase and the overall uncertainty is equal to the operating uncertainty.

Measurement Characteristics

Presentation

The following tables indicate the measurements available and specify the following information for each measurement:

- Unit
- Measurement range
- Accuracy
- Accuracy range

Current

Measurement	Unit	Range	Accuracy	Accuracy range
• Real-time phase current values I1, I2, I3 • Maximum phase current values I1 MAX, I2 MAX, I3 MAX • Real-time maximum of RMS current of phases I1, I2, I3, IN • Maximum of maximum phase current values • Minimum phase current values I1 MIN, I2 MIN, I3 MIN • Minimum of minimum phase current values	A	0–20 In	+/-0.5%	MTZ1: 40–(1,600 x 1.2) MTZ2: 40–(4,000 x 1.2) MTZ3: 80–(6,300 x 1.2)
• Real-time neutral current value IN[1] • Maximum neutral current value IN MAX[1] • Minimum neutral current value IN MIN[1]	A	0–20 In	+/-1%	MTZ1: 40–(1,600 x 1.2) MTZ2: 40–(4,000 x 1.2) MTZ3: 80–(6,300 x 1.2)
• Real-time average current value Iavg • Maximum average current value Iavg MAX • Minimum average current value Iavg MIN	A	0–20 In	+/-0.5%	MTZ1: 40–(1,600 x 1.2) MTZ2: 40–(4,000 x 1.2) MTZ3: 80–(6,300 x 1.2)
• Real-time ground-fault current value • Maximum value of the ground-fault current • Minimum value of the ground-fault current	A	0–20 In	5%	MTZ1: 40–(1,600 x 1.2) MTZ2: 40–(4,000 x 1.2) MTZ3: 80–(6,300 x 1.2)
• Real-time earth-leakage current value [2] • Maximum value of the earth-leakage current[2]	A	0–30 A	10%	0.1–30 A
1 Applies to 4-pole circuit breakers or 3-pole circuit breakers with ENCT wired and configured. 2 Applies to Micrologic 7.0 X control unit.				

Current Unbalance

Measurement	Unit	Range	Accuracy	Accuracy range
• Real-time phase current unbalance values I1 unbal, I2 unbal, I3 unbal • Maximum values of the 3 phase current unbalances I1 unbal MAX, I2 unbal MAX, I3 unbal MAX • Real-time maximum of 3 phase current unbalances • Maximum of maximum of 3 phase current unbalances	%	0–100%	+/-5	0–100%

NOTE: The accuracy range is for the current range: 0.2–1.2 In.

Voltage

Measurement	Unit	Range	Accuracy	Accuracy range
• Real-time phase-to-phase voltage values V12, V23, V31 • Maximum values of phase-to-phase voltages V12 MAX, V23 MAX, V31 MAX • Minimum values of phase-to-phase voltages V12 MIN, V23 MIN, V31 MIN	V	0–1,150 V	+/-0.5%	208–690 x 1.2 V
• Real-time phase-to-neutral voltagesV1N, V2N, V3N [1] • Maximum values of phase-to-neutral voltages V1N MAX, V2N MAX, V3N MAX[1] • Minimum values of phase-to-neutral voltages V1N MIN, V2N MIN, V3N MIN[1]	V	0–660 V	+/-0.5%	120–400 x 1.2 V
• Real-time average phase-to-phase voltage Vavg LL • Maximum average phase-to-phase voltage Vavg LL MAX • Minimum average phase-to-phase voltage Vavg LL MIN	V	0–1,150 V	+/-0.5%	208–690 x 1.2 V
• Real-time average phase-to-neutral voltage Vavg LN[1] • Maximum average phase-to-neutral voltage Vavg LN MAX[1] • Minimum average phase-to-neutral voltage Vavg LN MIN[1]	V	0–600 V	+/-0.5%	120–400 x 1.2 V
1 Applies to 4-pole circuit breakers or 3-pole circuit breakers with ENVT wired and configured.				

Voltage Unbalance

Measurement	Unit	Range	Accuracy	Accuracy range
• Real-time phase-to-phase voltage unbalances V12unbal, V23unbal, V31unbal • Maximum values of the 3 phase-to-phase voltage unbalances V12unbal MAX, V23unbal MAX, V31unbal MAX • Real-time maximum of 3 phase-to-phase voltage unbalances • Maximum of maximum of 3 phase-to-phase voltage unbalances	%	0–100%	+/-0.5	0–10%
• Real-time phase-to-neutral voltage unbalances V1Nunbal, V2Nunbal, V3Nunbal[1] • Maximum values of the 3 phase-to-neutral voltage unbalances V1Nunbal MAX, V2Nunbal MAX, V3Nunbal [MAX1] • Real-time maximum of 3 phase-to-neutral voltage unbalances[1] • Maximum of maximum of 3 phase-to-neutral voltage unbalances[1]	%	0–100%	+/-0.5	0–10%
1 Applies to 4-pole circuit breakers or 3-pole circuit breakers with ENVT wired and configured.				

NOTE: The accuracy range is for the voltage range: 208–690 x 1.2 Vac.

Power

Measurement	Unit	Range	Accuracy	Accuracy range
• Real-time active power for each phase P1, P2, P3[1] • Maximum values of active power for each phase P1 MAX, P2 MAX, P3 MAX[1] • Minimum values of active power for each phase P1 MIN, P2 MIN, P3 MIN[1]	kW	-16,000–+16,000 kW	+/-1%	See **NOTE** below
• Real-time total active power Ptot • Maximum value of total active power Ptot MAX • Minimum value of total active power Ptot MIN	kW	-16,000–+16,000 kW	+/-1%	See **NOTE** below
• Real-time reactive power for each phase Q1, Q2, Q3[1] • Maximum values of reactive power for each phase Q1 MAX, Q2 MAX, Q3 MAX[1] • Minimum values of reactive power for each phase Q1 MIN, Q2 MIN, Q3 MIN[1]	kVAR	-16,000–+16,000 kW	+/-2%	See **NOTE** below
• Real-time total reactive power Qtot • Maximum value of total reactive power Qtot MAX • Minimum value of total reactive power Qtot MIN	kVAR	-16,000–+16,000 kW	+/-1%	See **NOTE** below
• Real-time apparent power for each phase S1, S2, S3 [1] • Maximum values of apparent powers for each phase S1 MAX, S2 MAX, S3 MAX[1] • Minimum values of apparent powers for each phase S1 MIN, S2 MIN, S3 MIN[1]	kVA	-16,000–+16,0000 kW	+/-1%	See **NOTE** below
• Real-time total apparent power Stot • Maximum value of total apparent power Stot MAX • Minimum value of total apparent power Stot MIN	kVA	-16,000–+16,000 kW	+/-1%	See **NOTE** below
1 Applies to 4-pole circuit breakers or 3-pole circuit breakers with ENVT wired and configured.				

NOTE: The accuracy for the power measurement range according to IEC 61557-12 is defined by current range, voltage, and power factor values.

Operating Indicators

Measurement	Unit	Range	Accuracy	Accuracy range
Operating quadrant	–	1,2, 3, 4	–	–
Phase rotation	–	123 or 132	–	–
Type of load	–	leading or lagging	–	–

Power Factor PF and cos ϕ

Measurement	Unit	Range	Accuracy	Accuracy range
● Real-time total power factor PF ● Maximum value of the total power factor PF MAX ● Minimum value of the total power factor PF MIN	–	-1.00–+1.00	+/-0.02	0.5 ind - 0.8 cap
● Real-time power factors for each phase PF1, PF2, PF3[1] ● Maximum power factor for each phase PF1 MAX, PF2 MAX, PF3 MAX[1] ● Minimum power factor for each phase PF1 MIN, PF2 MIN, PF3 MIN[1]	–	-1.00–+1.00	+/-0.02	0.5 ind - 0.8 cap
● Real-time total cos ϕ ● Maximum cos ϕ MAX ● Minimum cos ϕ MIN	–	-1.00–+1.00	+/-0.02	0.5 ind - 0.8 cap
● Real-time cos ϕ for each phase cos ϕ 1, cos ϕ 2, cos ϕ 3[1] ● Maximum cos ϕ for each phase cos ϕ 1 MAX, cos ϕ 2 MAX, cos ϕ 3 MAX[1] ● Minimum cos ϕ for each phase cos ϕ 1 MIN, cos ϕ 2 MIN, cos ϕ 3 MIN[1]	–	-1.00–+1.00	+/-0.02	0.5 ind - 0.8 cap
1 Applies to 4-pole circuit breakers or 3-pole circuit breakers with ENVT wired and configured.				

NOTE: The accuracy for the power factor measurement range according to IEC 61557-12 is defined by current range and voltage values.

Total Harmonic Distortion Compared to the Fundamental (THD) of Currents and Voltages

Measurement	Unit	Range	Accuracy	Accuracy range
• Real-time total harmonic distortion (THD) of current for each phase THD(I1), THD(I2), THD(I3)	%	0–1,000%	+/-1.5	0–100% when I > 80 A
• Real-time total harmonic distortion (THD) of neutral current THD(IN)[1] • Maximum value of total harmonic distortion (THD) of neutral current THD(IN) MAX[1] • Minimum value of total harmonic distortion (THD) of neutral current THD(IN) MIN[1]	%	0–1,000%	+/-1.5 x THD/100	100–200%
• Real-time total harmonic distortion (THD) of phase-to-phase voltage THD(V12), THD(V23), THD(V31)	%	0–1,000%	+/-0.6	0–20% when V > 208 V
• Real-time total harmonic distortion (THD) of phase-to-neutral voltage THD(V1N), THD(V2N), THD(V3N)[1]	%	0–1,000%	+/-0.6	0–20% when V > 120 V
• Real-time average total harmonic distortion (THD) of the 3 phase currents • Maximum value of the average total harmonic distortion (THD) of the 3 phase currents • Minimum value of the average total harmonic distortion (THD) of the 3 phase currents	%	0–1,000%	+/-1.5	0–100% when I > 80 A
• Real-time average total harmonic distortion (THD) of the 3 phase-to-phase voltages • Maximum value of the average total harmonic distortion (THD) of the 3 phase-to-phase voltages • Minimum value of the average total harmonic distortion (THD) of the 3 phase-to-phase voltages	%	0–1,000%	+/-0.6	0–20% when V > 208 V
• Real-time average total harmonic distortion (THD) of the 3 phase-to-neutral voltages[1] • Maximum value of the average total harmonic distortion (THD) of the 3 phase-to-neutral voltages[1] • Minimum value of the average total harmonic distortion (THD) of the 3 phase-to-neutral voltages[1]	%	0–1,000%	+/-0.6	0–20% when V > 120 V
1 Applies to 4-pole circuit breakers or 3-pole circuit breakers with ENVT wired and configured.				

Total Harmonic Distortion Compared to the RMS Value (THD-R) of Currents and Voltages

Measurement	Unit	Range	Accuracy	Accuracy range
• Real-time total harmonic distortion (THD-R) of current for each phase THD-R(I1), THD-R(I2), THD-R(I3) • Real-time total harmonic distortion (THD-R) of neutral current THD-R(IN)[1] • Maximum value of total harmonic distortion (THD-R) of neutral current THD-R(IN) MAX[1] • Minimum value of total harmonic distortion (THD-R) of neutral current THD-R(IN) MIN[1]	%	0–100%	+/-1.5 x THD/100	0–100%
• Real-time total harmonic distortion (THD-R) of the phase-to-phase voltage THD-R(V12), THD-R(V23), THD-R(V31)	%	0–100%	+/-0.6	0–20% when V > 208 V
• Real-time total harmonic distortion (THD-R) of the phase-to-neutral voltage THD-R(V1N), THD-R(V2N), THD-R(V3N)[1]	%	0–100%	+/-0.6	0–20% when V > 120 V
• Real-time average total harmonic distortion (THD-R) of the 3 phase currents • Maximum value of the average total harmonic distortion (THD-R) of the 3 phase currents • Minimum value of the average total harmonic distortion (THD-R) of the 3 phase currents	%	0–100%	+/-1.5 x THD/100	0–100%
• Real-time average total harmonic distortion (THD-R) of the 3 phase-to-phase voltages • Maximum value of the average total harmonic distortion (THD-R) of the 3 phase-to-phase voltages • Minimum value of the average total harmonic distortion (THD-R) of the 3 phase-to-phase voltages	%	0–100%	+/-0.6	0–20% when V > 208 V
• Real-time average total harmonic distortion (THD-R) of the 3 phase-to-neutral voltages[1] • Maximum value of the average total harmonic distortion (THD-R) of the 3 phase-to-neutral voltages[1] • Minimum value of the average total harmonic distortion (THD-R) of the 3 phase-to-neutral voltages[1]	%	0–100%	+/-0.6	0–20% when V > 120 V
1 Applies to 4-pole circuit breakers or 3-pole circuit breakers with ENVT wired and configured.				

Frequency

Measurement	Unit	Range	Accuracy	Accuracy range
• Frequency • Maximum frequency • Minimum frequency	Hz	40–70 Hz	+/-0.2%	45–65 Hz

Resettable Energy Meters

Measurement	Unit	Range	Accuracy	Accuracy range
Total active energy value Ep	kWh	-10,000,000 to +10,000,000 kWh	+/-1%	See **NOTE** below
Total active energy values Epdelivered and Epreceived	kWh	-10,000,000 to +10,000,000 kWh	+/-1%	See **NOTE** below
Total reactive energy value Eq	kVARh	-10,000,000 to +10,000,000 kVARh	+/-2%	See **NOTE** below
Total reactive energy values Eqdelivered and Eqreceived	kVARh	-10,000,000 to +10,000,000 kVARh	+/-2%	See **NOTE** below
Apparent energy Es	kVAh	-10,000,000 to +10,000,000 kVAh	+/-1%	See **NOTE** below

NOTE: The accuracy for the energy measurement range according to IEC 61557-12 is defined by current range, voltage, and power factor values.

Non-Resettable Energy Meters

Measurement	Unit	Range	Accuracy	Accuracy range
Total active energy value Ep	kWh	-10,000,000 to +10,000,000 kWh	+/-1%	See **NOTE** below
Total active energy values Epdelivered and Epreceived	kWh	-10,000,000 to +10,000,000 kWh	+/-1%	See **NOTE** below
Total reactive energy value Eq	kVARh	-10,000,000 to +10,000,000 kVARh	+/-2%	See **NOTE** below
Total reactive energy values Eqdelivered and Eqreceived	kVARh	-10,000,000 to +10,000,000 kVARh	+/-2%	See **NOTE** below
Apparent energy Es	kVAh	-10,000,000 to +10,000,000 kVAh	+/-1%	See **NOTE** below

NOTE: The accuracy for the energy measurement range according to IEC 61557-12 is defined by current range, voltage, and power factor values.

Measurement Availability

Presentation

Measurements can be displayed through the following interfaces:
- On the Micrologic X display screen
- With the Masterpact MTZ Mobile App through Bluetooth or USB OTG connection.
- With Ecoreach software
- On the FDM128 display
- By a remote controller using the communication network
- On the IFE/EIFE webpages

The following tables indicate which measurements are displayed on each interface.

Current

The availability of parameters depends on the type of interface used to display data. All parameters are not displayed on all interfaces.

Measurement	Micrologic X HMI	Masterpact MTZ Mobile App	Ecoreach software	FDM128	Communication	IFE/EIFE webpages
Real-time phase current values I1, I2, I3	✓	✓	✓	✓	✓	✓
Maximum phase current values I1 MAX, I2 MAX, I3 MAX	✓	✓	✓	✓	✓	✓
Real-time maximum of RMS current of phases I1, I2, I3, IN	–	–	–	✓	✓	–
Maximum of maximum phase current values	–	–	–	–	✓	–
Minimum phase current values I1 MIN, I2 MIN, I3 MIN	–	✓	✓	✓	✓	✓
Minimum of minimum phase current values	–	–	–	–	✓	–
Real-time neutral current value IN [1]	✓	✓	✓	✓	✓	✓
Maximum neutral current value IN MAX[1]	✓	✓	✓	✓	✓	✓
Minimum neutral current value IN MIN[1]	–	✓	✓	✓	✓	✓
Real-time average current value Iavg	✓	✓	✓	✓	✓	✓
Maximum average current value Iavg MAX	–	✓	✓	✓	✓	✓
Minimum average current value Iavg MIN	–	✓	✓	✓	✓	✓
Real-time ground-fault current value	✓	✓	✓	✓	✓	✓
Maximum value of the ground-fault current	✓	✓	✓	✓	✓	✓
Minimum value of the ground-fault current	–	✓	✓	✓	✓	✓
Real-time earth-leakage current value [2]	✓	✓	✓	✓	✓	✓
Maximum value of the earth-leakage current[2]	✓	✓	✓	✓	✓	✓

1 Applies to 4-pole circuit breakers or 3-pole circuit breakers with ENCT wired and configured.
2 Applies to Micrologic 7.0 X control unit.

Current Unbalance

Measurement	Micrologic X HMI	Masterpact MTZ Mobile App	Ecoreach software	FDM128	Communication	IFE/EIFE webpages
Real-time phase current unbalance values I1 unbal, I2 unbal, I3 unbal	–	–	✓	–	✓	–
Maximum values of the 3 phase current unbalances I1 unbal MAX, I2 unbal MAX, I3 unbal MAX	–	–	✓	–	✓	–
Real-time maximum of 3 phase current unbalances	✓	✓	✓	✓	✓	–
Maximum of maximum of 3 phase current unbalances	✓	✓	✓	✓	✓	–

Voltage

Measurement	Micrologic X HMI	Masterpact MTZ Mobile App	Ecoreach software	FDM128	Communication	IFE/EIFE webpages
Real-time phase-to-phase voltage values V12, V23, V31	✓	✓	✓	✓	✓	✓
Maximum values of phase-to-phase voltages V12 MAX, V23 MAX, V31 MAX	✓	✓	✓	✓	✓	✓
Minimum values of phase-to-phase voltages V12 MIN, V23 MIN, V31 MIN	✓	✓	✓	✓	✓	✓
Real-time phase-to-neutral voltages V1N, V2N, V3N [1]	✓	✓	✓	✓	✓	✓
Maximum values of phase-to-neutral voltages V1N MAX, V2N MAX, V3N MAX[1]	✓	✓	✓	✓	✓	✓
Minimum values of phase-to-neutral voltages V1N MIN, V2N MIN, V3N MIN[1]	✓	✓	✓	✓	✓	✓
Real-time average phase-to-phase voltage Vavg LL	✓	✓	✓	✓	✓	✓
Maximum average phase-to-phase voltage Vavg LL MAX	–	✓	✓	✓	✓	✓
Minimum average phase-to-phase voltage Vavg LL MIN	–	✓	✓	✓	✓	✓
Real-time average phase-to-neutral voltage Vavg LN [1]	✓	–	✓	✓	✓	✓
Maximum average phase-to-neutral voltage Vavg LN MAX[1]	–	–	✓	✓	✓	✓
Minimum average phase-to-neutral voltage Vavg LN MIN[1]	–	–	✓	✓	✓	✓
1 Applies to 4-pole circuit breakers or 3-pole circuit breakers with ENVT wired and configured.						

Voltage Unbalance

Measurement	Micrologic X HMI	Masterpact MTZ Mobile App	Ecoreach software	FDM128	Communication	IFE/EIFE webpages
Real-time phase-to-phase voltage unbalances V12unbal, V23unbal, V31unbal	–	–	✓	–	✓	–
Maximum values of the 3 phase-to-phase voltage unbalances V12unbal MAX, V23unbal MAX, V31unbal MAX	–	–	✓	–	✓	–
Real-time maximum of 3 phase-to-phase voltage unbalances	✓	✓	✓	✓	✓	–
Maximum of maximum of 3 phase-to-phase voltage unbalances	✓	✓	✓	✓	✓	–
Real-time phase-to-neutral voltage unbalances V1Nunbal, V2Nunbal, V3Nunbal[1]	–	–	✓	–	✓	–
Maximum values of the 3 phase-to-neutral voltage unbalances V1Nunbal MAX, V2Nunbal MAX, V3Nunbal MAX[1]	–	–	✓	–	✓	–
Real-time maximum of 3 phase-to-neutral voltage unbalances[1]	✓	✓	✓	✓	✓	–
Maximum of maximum of 3 phase-to-neutral voltage unbalances[1]	✓	✓	✓	✓	✓	–
1 Applies to 4-pole circuit breakers or 3-pole circuit breakers with ENVT wired and configured.						

Power

Measurement	Micrologic X HMI	Masterpact MTZ Mobile App	Ecoreach software	FDM128	Communication	IFE/EIFE webpages
Real-time active power for each phase P1, P2, P3 [1]	✓	–	✓	✓	✓	–
Maximum values of active power for each phase P1 MAX, P2 MAX, P3 MAX [1]	–	–	✓	✓	✓	–
Minimum values of active power for each phase P1 MIN, P2 MIN, P3 MIN [1]	–	–	✓	✓	✓	–
Real-time total active power Ptot	✓	✓	✓	✓	✓	✓
Maximum value of total active power Ptot MAX	✓	✓	✓	✓	✓	✓
Minimum value of total active power Ptot MIN	–	✓	✓	✓	✓	✓
Real-time reactive power for each phase Q1, Q2, Q3 [1]	✓	–	✓	✓	✓	–
Maximum values of reactive powers for each phase Q1 MAX, Q2 MAX, Q3 MAX [1]	–	–	✓	✓	✓	–
Minimum values of reactive powers for each phase Q1 MIN, Q2 MIN, Q3 MIN [1]	–	–	✓	✓	✓	–
Real-time total reactive power Qtot	✓	✓	✓	✓	✓	✓
Maximum value of total reactive power Qtot MAX	✓	✓	✓	✓	✓	✓
Minimum value of total reactive power Qtot MIN	–	✓	✓	✓	✓	✓
Real-time apparent power for each phase S1, S2, S3 [1]	✓	–	✓	✓	✓	–
Maximum values of apparent powers for each phase S1 MAX, S2 MAX, S3 MAX [1]	–	–	✓	✓	✓	–
Minimum values of apparent powers for each phase S1 MIN, S2 MIN, S3 MIN [1]	–	–	✓	✓	✓	–
Real-time total apparent power Stot	✓	✓	✓	✓	✓	✓
Maximum value of total apparent power Stot MAX	✓	✓	✓	✓	✓	✓
Minimum value of total apparent power Stot MIN	–	✓	✓	✓	✓	✓
1 Applies to 4-pole circuit breakers or 3-pole circuit breakers with ENVT wired and configured.						

Operating Indicators

Measurement	Micrologic X HMI	Masterpact MTZ Mobile App	Ecoreach software	FDM128	Communication	IFE/EIFE webpages
Operating quadrant	–	–	–	–	✓	–
Phase rotation	–	✓	–	✓	✓	–
Type of load	✓	–	✓	✓	✓	–

Power Factor PF and cos ϕ

Measurement	Micrologic X HMI	Masterpact MTZ Mobile App	Ecoreach software	FDM128	Communication	IFE/EIFE webpages
Real-time total power factor PF	✓	✓	✓	✓	✓	✓
Maximum value of the total power factor PF MAX	–	✓	✓	✓	✓	✓
Minimum value of the total power factor PF MIN	–	✓	✓	✓	✓	✓
Real-time power factors for each phase PF1, PF2, sPF3 [1]	–	–	✓	✓	✓	–
Maximum power factor for each phase PF1 MAX, PF2 MAX, PF3 MAX[1]	–	–	✓	✓	✓	–
Minimum power factor for each phase PF1 MIN, PF2 MIN, PF3 MIN[1]	–	–	✓	✓	✓	–
Real-time total cos ϕ	✓	✓	✓	✓	✓	–
Maximum value cos ϕ MAX	–	✓	✓	✓	✓	–
Minimum value cos ϕ MIN	–	✓	✓	✓	✓	–
Real-time cos ϕ for each phase cos ϕ 1, cos ϕ 2, cos ϕ 3[1]	–	–	✓	✓	✓	–
Maximum cos ϕ for each phase cos ϕ 1 MAX, cos ϕ 2 MAX, cos ϕ 3 MAX[1]	–	–	✓	✓	✓	–
Minimum cos ϕ for each phase cos ϕ 1 MIN, cos ϕ 2 MIN, cos ϕ 3 MIN[1]	–	–	✓	✓	✓	–
1 Applies to 4-pole circuit breakers or 3-pole circuit breakers with ENVT wired and configured.						

Total Harmonic Distortion Compared to the Fundamental (THD) of Currents

Measurement	Micrologic X HMI	Masterpact MTZ Mobile App	Ecoreach software	FDM128	Communication	IFE/EIFE webpages
Real-time total harmonic distortion (THD) of current for each phase THD(I1), THD(I2), THD(I3)	✓	✓	✓	✓	✓	–
Real-time total harmonic distortion (THD) of neutral current THD(IN)[1]	✓	✓	✓	✓	✓	–
Maximum value of total harmonic distortion (THD) of neutral current THD(IN) MAX[1]	✓	✓	✓	✓	✓	–
Minimum value of total harmonic distortion (THD) of neutral current THD(IN) MIN[1]	–	✓	✓	✓	✓	–
Real-time average total harmonic distortion (THD) of the 3 phase currents	✓	✓	✓	–	✓	–
Maximum value of the average total harmonic distortion (THD) of the 3 phase currents	✓	✓	✓	–	✓	–
Minimum value of the average total harmonic distortion (THD) of the 3 phase currents	–	✓	✓	–	✓	–
1 Applies to 4-pole circuit breakers or 3-pole circuit breakers with ENVT wired and configured.						

Total Harmonic Distortion Compared to the Fundamental (THD) of Voltages

Measurement	Micrologic X HMI	Masterpact MTZ Mobile App	Ecoreach software	FDM128	Communication	IFE/EIFE webpages
Real-time total harmonic distortion (THD) of phase-to-phase voltage THD(V12), THD(V23), THD(V31)	✓	✓	✓	✓	✓	–
Real-time total harmonic distortion (THD) of phase-to-neutral voltage THD(V1N), THD(V2N), THD(V3N)[1]	✓	✓	✓	✓	✓	–
Real-time average total harmonic distortion (THD) of the 3 phase-to-phase voltages	✓	✓	✓	–	✓	–
Maximum value of the average total harmonic distortion (THD) of the 3 phase-to-phase voltages	✓	✓	✓	–	✓	–
Minimum value of the average total harmonic distortion (THD) of the 3 phase-to-phase voltages	–	✓	✓	–	✓	–
Real-time average total harmonic distortion (THD) of the 3 phase-to-neutral voltages[1]	✓	✓	✓	–	✓	–
Maximum value of the average total harmonic distortion (THD) of the 3 phase-to-neutral voltages[1]	✓	✓	✓	–	✓	–
Minimum value of the average total harmonic distortion (THD) of the 3 phase-to-neutral voltages[1]	–	✓	✓	–	✓	–
1 Applies to 4-pole circuit breakers or 3-pole circuit breakers with ENVT wired and configured.						

Total Harmonic Distortion Compared to the RMS Value (THD-R) of Currents

Measurement	Micrologic X HMI	Masterpact MTZ Mobile App	Ecoreach software	FDM128	Communication	IFE/EIFE webpages
Real-time total harmonic distortion (THD-R) of current for each phase THD-R(I1), THD-R(I2), THD-R(I3),	–	✓	✓	–	✓	–
Real-time total harmonic distortion (THD-R) of neutral current THD-R(IN)[1]	–	✓	✓	–	✓	–
Maximum value of total harmonic distortion (THD-R) of neutral current THD-R(IN) MAX[1]	–	✓	✓	–	✓	–
Minimum value of total harmonic distortion (THD-R) of neutral current THD-R(IN) MIN[1]	–	✓	✓	–	✓	–
Real-time average total harmonic distortion (THD-R) of the 3 phase currents	–	✓	✓	–	✓	–
Maximum value of the average total harmonic distortion (THD-R) of the 3 phase currents	–	✓	✓	–	✓	–
Minimum value of the average total harmonic distortion (THD-R) of the 3 phase currents	–	✓	✓	–	✓	–
1 Applies to 4-pole circuit breakers or 3-pole circuit breakers with ENVT wired and configured.						

Total Harmonic Distortion Compared to the RMS Value (THD-R) of Voltages

Measurement	Micrologic X HMI	Masterpact MTZ Mobile App	Ecoreach software	FDM128	Communication	IFE/EIFE webpages
Real-time total harmonic distortion (THD-R) of the phase-to-phase voltage THD-R(V12), THD-R(V23), THD-R(V31)	–	✓	✓	–	✓	–
Real-time total harmonic distortion (THD-R) of the phase-to-neutral voltage THD-R(V1N), THD-R(V2N), THD-R(V3N)[1]	–	✓	✓	–	✓	–
Real-time average total harmonic distortion (THD-R) of the 3 phase-to-phase voltages	–	✓	✓	–	✓	–
Maximum value of the average total harmonic distortion (THD-R) of the 3 phase-to-phase voltages	–	✓	✓	–	✓	–
Minimum value of the average total harmonic distortion (THD-R) of the 3 phase-to-phase voltages	–	✓	✓	–	✓	–
Real-time average total harmonic distortion (THD-R) of the 3 phase-to-neutral voltages[1]	–	✓	✓	–	✓	–
Maximum value of the average total harmonic distortion (THD-R) of the 3 phase-to-neutral voltages[1]	–	✓	✓	–	✓	–
Minimum value of the average total harmonic distortion (THD-R) of the 3 phase-to-neutral voltages[1]	–	✓	✓	–	✓	–
1 Applies to 4-pole circuit breakers or 3-pole circuit breakers with ENVT wired and configured.						

Frequency

Measurement	Micrologic X HMI	Masterpact MTZ Mobile App	Ecoreach software	FDM128	Communication	IFE/EIFE webpages
Frequency	✓	✓	✓	✓	✓	✓
Maximum frequency	✓	✓	✓	✓	✓	✓
Minimum frequency	✓	✓	✓	✓	✓	✓

Resettable Energy Meters

Measurement	Micrologic X HMI	Masterpact MTZ Mobile App	Ecoreach software	FDM128	Communication	IFE/EIFE webpages
Total active energy value Ep	✓	✓	✓	✓	✓	✓
Total active energy values: Epdelivered, and Epreceived	✓	✓	✓	✓	✓	–
Total reactive energy value Eq	✓	✓	✓	✓	✓	✓
Total reactive energy values: Eqdelivered, and Eqreceived	✓	✓	✓	✓	✓	–
Total apparent energy value Es	✓	✓	✓	✓	✓	✓

Non-Resettable Energy Meters

Measurement	Micrologic X HMI	Masterpact MTZ Mobile App	Ecoreach software	FDM128	Communication	IFE/EIFE webpages
Total active energy value Ep	–	–	✓	–	✓	–
Total active energy values: Epdelivered, and Epreceived	–	–	✓	✓	✓	–
Total reactive energy value Eq	–	–	✓	–	✓	–
Total reactive energy values: Eqdelivered, and Eqreceived	–	–	✓	–	✓	–
Total apparent energy value Es	–	–	✓	–	✓	–

Network Settings

Presentation

The following settings are related to the characteristics of the local network. They are used by the measurement functions of the Micrologic X control unit. These settings have no effect on protections.

Rated Phase-to-Phase Voltage

Available settings include: 208 V / 220 V / 230 V / 240 V / 380 V / 400 V / 415 V / 440 V / 480 V / 500 V / 525 V / 550 V / 575 V / 600 V / 660 V / 690 V / 1,000 V.

Default = 400 V.

The rated voltage can be set as follows:
- On the Micrologic X display screen, at **Home → Configuration → Network → Nominal Voltage**
- With Ecoreach software

Rated Frequency

Available settings are:
- 50 Hz
- 60 Hz

The rated frequency can be set as follows:
- On the Micrologic X display screen, at **Home → Configuration → Network → Nominal Frequency**
- With Ecoreach software

VT Ratio

The VT ratio is the ratio between the primary and the secondary rated voltages as measured by a voltage transformer (VT).

The value range for the primary voltage (VT in) is from 100–1,250 in increments of 1 (factory setting: 690).

The value range for the secondary voltage (VT out) is from 100–690 in increments of 1 (factory setting: 690).

The primary and secondary voltages can be set as follows:
- On the Micrologic X display screen, at **Home → Configuration → Network → VT Ratio**
- With Ecoreach software

Real-Time Measurements

Presentation

Micrologic X control units perform the following real-time tasks:

- Measure the following currents in real time and as an RMS value:
  - Current for each phase and the neutral (if present)
  - Ground-fault current
  - Earth-leakage current (Micrologic 7.0 X)
- Calculate the average current in real time
- Determine the maximum and minimum values for these electrical quantities
- Measure the phase-to-phase and phase-to-neutral voltage (if present), in real time and as an RMS value
- Calculate the associated electrical quantities from the RMS values of the currents and voltages:
  - Average phase-to-phase voltage and phase-to-neutral voltage (if present)
  - Current unbalances
  - Phase-to-phase voltage unbalances and phase-to-neutral voltage unbalances (if present)
- Calculate the associated electrical quantities from the current and voltage samples:
  - Powers *(see page 125)*
  - Quality indicators: frequency, THD(I), THD(V), THD-R(I), and THD-R(V) *(see page 132)*, and power factor PF and cos ϕ measurement *(see page 135)*
- Display operating indicators: quadrants, and type of load
- Determine the maximum and minimum values for these electrical quantities
- Increment in real time three energy meters (active, reactive, apparent) using the total power real-time values *(see page 125)*

The sampling method uses the values of the harmonic currents and voltages up to the fifteenth order. The sampling process tracks the fundamental frequency and provides 40 samples per fundamental cycle.

The values of the electrical quantities, whether measured or calculated in real time, update once a second at rated frequency.

System Type Setting

On 3-pole circuit breakers, the system type setting allows the activation of:

- The ENCT (external neutral current transformer)
- The ENVT (external neutral voltage tap)

The system type can be set as follows:

- On the Micrologic X display screen, at **Home → Configuration → Measures → System Type**.
- With Ecoreach software
- By sending a setting command using the communication network

Measuring the Neutral Current

4-pole circuit breakers or 3-pole circuit breakers with the ENCT wired and configured measure the neutral current:

- For a 3-pole circuit breaker, the neutral current is measured by adding a current transformer on the neutral conductor for the transformer information. Refer to the following documentation: *Masterpact MTZ Catalogue*.
- For a 4-pole circuit breaker, the neutral current is measured systematically.

The neutral current is measured in the same way as the phase currents.

Measuring the Ground-Fault Current

The ground-fault current is calculated or measured in the same way as the phase currents, 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 + I2I1 + I3 + IN
3P + ENCT	Ig = I1 + I2 +I3 + IN (ENCT)
3P or 4P + SGR	Ig = ISGR

Measuring the Earth-Leakage Current (Micrologic 7.0 X)

The earth-leakage current is measured by a rectangular sensor encompassing the three phases or the three phases and neutral.

Measuring the Phase-to-Neutral Voltages

4-pole circuit breakers, or 3-pole circuit breakers with the ENVT wired and configured, measure the phase-to-neutral (or line-to-neutral) voltages V1N, V2N, and V3N:

- For a 3-pole circuit breaker, it is necessary to:
  - Connect the wire from the ENVT to the neutral conductor
  - Declare the ENVT in the system type setting
- For 4-pole circuit breakers, the phase-to-neutral voltages are measured systematically.

The phase-to-neutral voltages are measured in the same way as the phase-to-phase voltages.

Calculating the Average Current and Average Voltage

Micrologic X control units calculate the:

- Average current Iavg, the arithmetic mean of the 3 phase currents:

  Iavg=(I1+I2+I3)/3

- Average voltages:
  - Phase-to-phase Vavg, the arithmetic mean of the 3 phase-to-phase voltages:

    Vavg=(V12+V23+V31)/3

  - Phase-to-neutral Vavg, the arithmetic mean of the 3 phase-to-neutral voltages (4-pole circuit breakers or 3-pole circuit breakers wired and configured with the ENVT):

    Vavg=(V1N+V2N+V3N)/3

Measuring the Current and Voltage Phase Unbalances

Micrologic X control units calculate the current unbalance for each phase (3 values) and the maximum current unbalance.

The current unbalance is a percentage of the average current:

$$I_k \text{ unbalance } (\%) = \frac{\left| I_k - I_{avg} \right|}{I_{avg}} \times 100 \quad \text{where } k = 1, 2, 3$$

Micrologic X control units calculate:

- The phase-to-phase voltage unbalance for each phase (3 values) and the maximum of 3 phase-to-phase voltage unbalances.
- The phase-to-neutral (if present) voltage unbalance for each phase (3 values) and the maximum of 3 phase-to-neutral voltage unbalances.

The voltage unbalance is expressed as a percentage compared to the average value of the electrical quantity (Vavg):

$$V_{jk} \text{ unbalance } (\%) = \frac{\left| V_{jk} - V_{avg} \right|}{V_{avg}} \times 100 \quad \text{where jk = 12, 23, 31 or 1N, 2N, 3N}$$

Maximum/Minimum Values

The Micrologic X control unit determines the maximum (MAX) and minimum (MIN) value reached by the following electrical quantities for the period from the last reset to the present time:

- Current: phase and neutral currents, average currents, and current unbalances
- Voltage: phase-to-phase and phase-to-neutral voltages, average voltages, and voltage unbalances
- Power: total power and phase power (active, reactive, and apparent)
- Total harmonic distortion: the total harmonic distortion THD and THD-R for both current and voltage
- Frequency
- The maximum of the maximum value of all phase currents
- The minimum of the minimum value of all phase currents
- The maximum of the maximum value of 3 phase current unbalances
- Maximum of maximum of 3 phase-to-phase voltage unbalances
- Maximum of maximum of 3 phase-to-neutral voltage unbalances

Resetting Maximum/Minimum Values

The maximum and minimum values can be reset as follows:

- On the Micrologic X display screen, at:
  - **Home → Measures → Current**
  - **Home → Measures → Voltage**
  - **Home → Measures → Power**
  - **Home → Measures → Frequency**
  - **Home → Measures → I Harmonics**
  - **Home → Measures → V Harmonics**
- With Ecoreach software
- With the Masterpact MTZ Mobile App
- By sending a command using the communication network (password-protected).
- On the IFE/EIFE webpages

NOTE: The maximum and minimum power factors and cos Φ can be reset only:

- With Ecoreach software
- By sending a command using the communication network (password-protected).
- On the IFE/EIFE webpages

All maximum and minimum values for the group of electrical quantity selected are reset.

Resetting maximum and minimum values generates the following events:

User message	History	Severity
Reset Min/Max currents	Metering	Low
Reset Min/Max voltages	Metering	Low
Reset Min/Max power	Metering	Low
Reset Min/Max frequency	Metering	Low
Reset Min/Max harmonics	Metering	Low
Reset Min/Max power factor	Metering	Low

Power Metering

Presentation

The control unit calculates the electrical quantities required for power management:

- The real-time values of the:
  - Active powers (total Ptot and per phase) in kW
  - Reactive powers (total Qtot and per phase) in kVAR
  - Apparent powers (total Stot and per phase) in kVA
- The maximum and minimum values for each of these powers
- The cos ϕ and power factor (PF) indicators (total and per phase)
- The operating quadrant and type of load (leading or lagging)

All these electrical quantities are continuously calculated and their value is updated once a second at rated frequency.

Principle of Power Metering

The control unit calculates the power values from the current and voltage samples.

The calculation principle is based on:

- Definition of the powers
- Algorithms depending on the type of circuit breaker (4-pole or 3-pole) *(see page 128)*
- Set value of the power sign (circuit breaker powered from upstream (top) or downstream (bottom))

Calculations use harmonics up to the fifteenth.

Total Power Calculation Method

The total reactive and apparent power can be calculated by one of the two following methods:

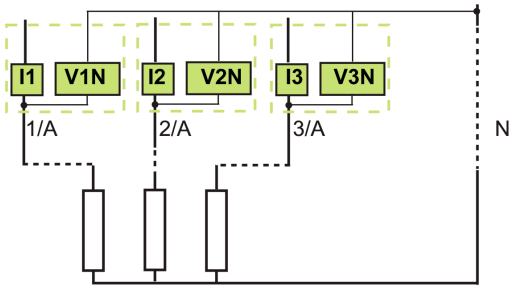
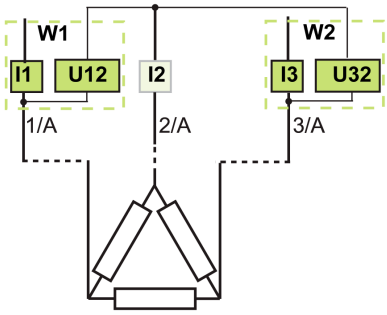
- Vector
- Arithmetic (factory setting)

The calculation method can be set as follows:

- On the Micrologic X display screen, at **Home → Configuration → Measures → Total P calcul**
- With Ecoreach software

3-Pole Circuit Breaker, 4-Pole Circuit Breaker

The calculation algorithm depends on the presence or absence of voltage metering on the neutral conductor.

4-pole or 3-pole with ENVT: 3-wattmeter method	3-pole without ENVT: 2-wattmeter method
	
When there is voltage metering on the neutral (4-pole or 3-pole circuit breaker with ENVT wired and configured), the control unit measures the power by using 3 single-phase loads downstream.	When there is no voltage metering on the neutral (3-pole circuit breaker), the control unit measures the power: ● Using the current from 2 phases (I1 and I3) and composite voltages from each of these 2 phases in relation to the third (V12 and V23) ● Using the fact that by definition the current in the neutral conductor is zero: $\vec{I1} + \vec{I2} + \vec{I3} = 0$

The following table lists the metering options:

Method	3-pole circuit breaker, non-distributed neutral	3-pole circuit breaker, distributed neutral	3-pole circuit breaker, distributed neutral (ENVT wired and configured)	4-pole circuit breaker
2 wattmeters	✓	✓ [1]	–	–
3 wattmeters	–	–	✓	✓
1 The measurement is incorrect once there is current circulating in the neutral.				

3-Pole Circuit Breaker, Distributed Neutral

Declare the ENVT in the system type setting *(see page 122)*.

NOTE: Declaration of the ENVT alone does not result in correct calculation of the powers. It is essential to connect the wire from the ENVT to the neutral conductor.

Power Sign and Operating Quadrant

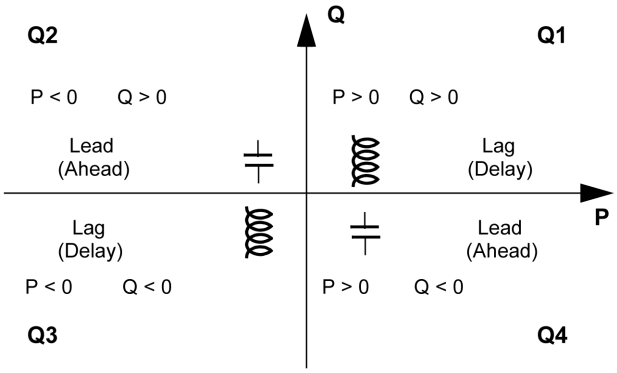
By definition, the active powers are:

- Signed + when they are received by the user, that is, when the device is acting as a receiver.
- Signed - when they are delivered by the user, that is, when the device is acting as a generator.

By definition, the reactive powers have:

- The same sign as the active energies and powers when the current lags behind the voltage, that is, when the device is inductive (lagging).
- The opposite sign to the active energies and powers when the current is ahead of the voltage, that is, when the device is capacitive (leading).

These definitions therefore determine 4 operating quadrants (Q1, Q2, Q3, and Q4):



Power Sign Convention

The sign for the power running through the circuit breaker depends on the type of connection:

- Circuit breakers with the active power flowing from upstream (top) to downstream (bottom) should be set with the power sign P+
- Circuit breakers with the active power flowing from downstream (bottom) to upstream (top) should be set with the power sign P-

Set the power sign convention as follows:

- On the Micrologic X display screen, on the screens **Home → Configuration → Network → Power sign**.
- With Ecoreach software
- By sending a setting command using the communication network (password-protected)

Power Calculation Algorithm

Presentation

The algorithms are given for both calculation methods (2 wattmeters and 3 wattmeters). The power definitions and calculation are given for a network with harmonics.

With the 2-wattmeter calculation method, it is not possible to deliver power metering for each phase.

Calculated quantities are displayed:
- On the Micrologic X display screen, at **Home → Measures → Power** (total power only)
- With Ecoreach software
- With the Masterpact MTZ Mobile App (total power only)
- On a remote controller using the communication network

Active Powers

Metering on a 3-pole or 4-pole circuit breaker with ENVT wired and configured	Metering on a 3-pole circuit breaker without ENVT wired and configured
The active power for each phase and total active power is calculated.	Only the total active power can be calculated.
$P_p = \frac{1}{T}\int_T V_p(t) I_p(t) dt$ where p=1, 2, 3 (phase)	–
Ptot = P1 + P2 + P3	Ptot = Pw1 + Pw2 P_{W1} and P_{W2} are the fictitious powers calculated by the 2-wattmeter method.

Reactive Power

Metering on a 3-pole or 4-pole circuit breaker with ENVT wired and configured	Metering on a 3-pole circuit breaker without ENVT wired and configured
The reactive power with harmonics for each phase and total reactive power is calculated.	Only the total reactive power can be calculated.
$Qp = \pm \sqrt{Sp^2 - Pp^2}$ where p=1, 2, 3 (phase)	–
• With vector method: $Qtot_V = Q1 + Q2 + Q3$ • With arithmetic method: $Qtot_A = \pm \sqrt{Stot_A^2 - Ptot^2}$	• With arithmetic method: $Qtot_A = \pm \sqrt{Stot_A^2 - Ptot^2}$

Apparent Power

Metering on a 3-pole or 4-pole circuit breaker with ENVT wired and configured	Metering on a 3-pole or 4-pole circuit breaker without ENVT wired and configured
The apparent power for each phase and total apparent power is calculated.	Only the total apparent power can be calculated.
Sp = (Vp x Ip) where p = 1, 2, 3 (phase)	–
• With vector method: $Stot_V = \sqrt{Ptot^2 + Qtot_V^2}$ • With arithmetic method: $Stot_A = S1 + S2 + S3$	With arithmetic method: $Stot_A = S1 + S2 + S3$

Energy Metering

Presentation

The control unit calculates the different types of energy using energy meters and provides the values of:

- The total active energy Ep, the active energy delivered (into the load) Epdelivered, and the active energy received (out of the load) Epreceived
- The total reactive energy Eq, the reactive energy delivered (into the load) Eqdelivered, and the reactive energy received (out of the load) Eqreceived
- The total apparent energy Es

The energy values are calculated, and shown as an hourly consumption. Values update once a second at rated frequency. Values are stored in non-volatile memory once an hour.

For each energy meter two types of counter are available: one which can be reset and one which cannot be reset.

NOTE: To perform reliable energy measurement across the current range the control unit must be powered with an external 24 Vdc power supply or VPS module *(see page 23)*.

NOTE: The energies per phase are available as an option *(see page 139)*. They are calculated using the same principles as total energies.

Principle of Energy Calculation

By definition energy is the integration of the real-time power over a period T. The integration period T is equal to a number of cycles equal to the rated frequency.

$$E = \int_{T} G\delta(t) \quad \text{where G = P, Q or S}$$

Partial Energy Meters

For each type of energy, active or reactive, a partial received energy meter and a partial delivered energy meter calculate the accumulated energy by incrementing once a second:

- Edelivered(t) = Edelivered(t - 1) + (Gdelivered(t))/3600 where Gdelivered = Ptot or Qtot > 0
- Received power is always counted negatively.

  Ereceived(t) = Ereceived(t - 1) + (|Greceived(t)|)/3600 where Greceived = Ptot or Qtot < 0

For each total and partial energy meter two types of counter are available: one which can be reset and one which cannot be reset.

Energy Meters

From the partial energy meters and for each type of energy, active or reactive, an energy meter provides either of the following measurements once a second:

- The absolute energy, by adding the received and delivered energies together. The energy accumulation mode is absolute.

  E(t)absolute = Edelivered(t) + Ereceived(t)

- The signed energy, by differentiating between received and delivered energies. The energy accumulation mode is signed.

  E(t)signed = Edelivered(t) - Ereceived(t)

The apparent energy Es is always counted positively.

Selecting Energy Calculation

The information sought determines calculation selection:

- The absolute value of the energy that has crossed the poles of a circuit breaker or the cables of an item of electrical equipment is relevant for maintenance of an installation.
- The signed values of the energy delivered and the energy received are required to calculate the economic cost of an item of equipment.

By default, absolute energy accumulation mode is configured.

Select the energy calculation mode using any of the following methods:

- On the Micrologic X display screen, on the screens **Home → Configuration → Measures → E calcul**
- With Ecoreach software
- By sending a setting command using the communication network (password-protected).

Resetting Energy Meters

The energy meters can be reset as follows:

- On the Micrologic X display screen, on the screens **Home → Measures → Energy → Reset Counter**
- With Ecoreach software
- With the Masterpact MTZ Mobile App
- By writing a reset command using the communication network (password-protected).
- On the IFE/EIFE webpages

All resettable energy meters are reset.

Resetting the energy meters generates the following event:

User message	History	Severity
Reset energy counters	Metering	Low

Presetting Energy Meters

All resettable energy meters can be preset separately, using Ecoreach software (password-protected).

Harmonic Currents and Voltages

Origin and Effects of Harmonics

Many nonlinear loads present on an electrical network create harmonic currents in the electrical network.

These harmonic currents:
- Distort the current and voltage waves.
- Degrade the quality of the distributed energy.

These distortions, if they are significant, can result in:
- Malfunctions or degraded operation in the powered devices.
- Unwanted heat rise in the devices and conductors.
- Excessive power consumption.

These various problems increase the system installation and operating costs. It is therefore necessary to control the energy quality carefully.

Definition of a Harmonic

A periodic signal is a superimposition of:
- The original sinusoidal signal at the fundamental frequency (for example, 50 Hz or 60 Hz).
- Sinusoidal signals whose frequencies are multiples of the fundamental frequency called harmonics.
- Any DC component.

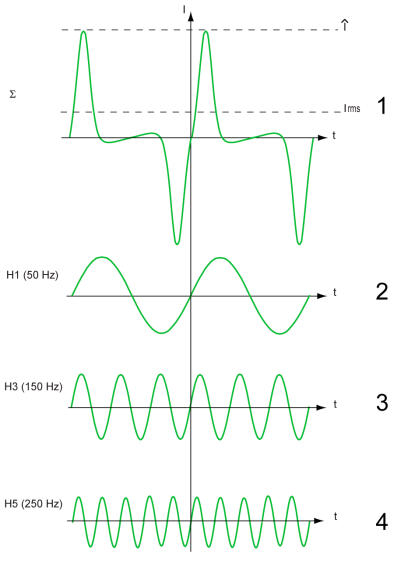
This periodic signal is broken down into a sum of terms:

$$y(t) = y_0 + \sum_{1}^{\infty} y_n (\sqrt{2} \times \sin(n\omega t - \varphi_n))$$

where:
- y_0: value of the DC component
- y_n: RMS value of the nth harmonic
- ω: pulsation of the fundamental frequency
- ϕ_n: phase displacement of harmonic component n

NOTE: The first harmonic is called the fundamental.

Example of a current wave distorted by a harmonic component:



1 I_{rms}: RMS value of the harmonic waveform
2 I1: fundamental current
3 I3: third order harmonic current
4 I5: fifth order harmonic current

Power Quality Indicators

Presentation

The control unit calculates total harmonic distortion related to the fundamental value THD, and total harmonic distortion related to RMS values THD-R for voltages and currents.

Displaying the Total Harmonic Distortion

The total harmonic distortion related to the fundamental value THD can be displayed as follows:

- On the Micrologic X display screen:
  - THD(I) at **Home → Measures → I Harmonics**
  - THD(V) at **Home → Measures → V Harmonics**
- With Ecoreach software
- With the Masterpact MTZ Mobile App
- On the FDM128 display
- Through the communication network

The total harmonic distortion related to RMS values THD-R can be displayed as follows:

- With Ecoreach software
- Through the communication network

Current THD

The current THD is a percentage of the RMS value of harmonic currents of ranks greater than 1, in relation to the RMS value of the fundamental current (first order). The control unit calculates the total harmonic current distortion THD up to the fifteenth harmonic:

$$THD(I) = 100 \frac{\sqrt{\sum_{n=2}^{15} Inrms^2}}{I1rms}$$

The current THD can be higher than 100%.

Use the total harmonic distortion THD(I) to assess the distortion of the current wave with a single number. The following table shows the THD limit values.

THD(I) Value	Comments
THD(I) < 10%	Low harmonic currents: little risk of malfunctions.
10% < THD(I) < 50%	Significant harmonic currents: risk of heat rise, oversizing of supplies.
50% < THD(I)	High harmonic currents: the risks of malfunction, degradation, and heat rise are almost certain unless the installation is calculated and sized with this restriction in mind.

Distortion of the current wave created by a nonlinear device with a high THD(I) can lead to distortion of the voltage wave, depending on the level of distortion and the source impedance. This distortion of the voltage wave affects all of the devices powered by the supply. Sensitive devices on the system can therefore be affected. A device with a high THD(I) may not be affected itself but could cause malfunctions on other, more sensitive devices on the system.

NOTE: THD(I) metering is an effective way of determining the potential for problems from the devices on electrical networks.

Voltage THD

The voltage THD is the percentage of the RMS value of harmonic voltages of ranks greater than 1, in relation to the RMS value of the fundamental voltage (first order). The control unit calculates the voltage THD up to the fifteenth harmonic:

$$THD(V) = \frac{\sqrt{\sum_{n=2}^{15} Vnrms^2}}{V1rms}$$

This factor can in theory be higher than 100% but is in practice rarely higher than 15%.

Use the total harmonic distortion THD(V) to assess the distortion of the voltage wave with a single number. The limit values below are commonly evaluated by energy distribution companies:

THD(V) Value	Comments
THD(V) < 5%	Insignificant distortion of the voltage wave: little risk of malfunctions.
5% < THD(V) < 8%	Significant distortion of the voltage wave: risk of heat rise and malfunctions.
8% < THD(V)	Significant distortion of the voltage wave: there is a high risk of malfunction unless the installation is calculated and sized based on this distortion.

Distortion of the voltage wave affects all devices powered by the supply.

NOTE: Use the THD(V) indication to assess the risks of disturbance of sensitive devices supplied with power.

Current THD-R

The current THD-R is a percentage of the RMS value of harmonic currents of ranks greater than 1 in relation to the total harmonic current. The control unit calculates the total harmonic current distortion THD-R up to the fifteenth harmonic using the following equation:

The current THD-R cannot be higher than 100%.

Use the total harmonic distortion THD-R(I) to assess the distortion of the current wave with a single number. The following table shows the THD-R limit values.

THD-R(I) Value	Comments
THD-R(I) < 10%	Low harmonic currents: little risk of malfunctions.
10% < THD-R(I) < 50%	Significant harmonic currents: risk of heat rise, oversizing of supplies.
50% < THD-R(I)	High harmonic currents: the risks of malfunction, degradation, and heat rise are almost certain unless the installation is calculated and sized with this restriction in mind.

Distortion of the current wave created by a nonlinear device with a high THD-R(I) can lead to distortion of the voltage wave, depending on the level of distortion and the source impedance. This distortion of the voltage wave affects all of the devices powered by the supply. Sensitive devices on the system can therefore be affected. A device with a high THD-R(I) may not be affected itself but could cause malfunctions on other, more sensitive devices on the system.

NOTE: THD-R(I) metering is an effective way of determining the potential for problems from the devices on electrical networks.

Voltage THD-R

The voltage THD-R is the percentage the RMS value of harmonic voltages greater than 1 in relation to the total harmonic voltage. The control unit calculates the total harmonic voltage distortion THD-R up to the fifteenth harmonic.

Use the total harmonic distortion THD-R(V) to assess the distortion of the voltage wave with a single number. The limit values below are commonly evaluated by energy distribution companies:

THD-R(V) Value	Comments
THD-R(V) < 5%	Insignificant distortion of the voltage wave: little risk of malfunctions.
5% < THD-R(V) < 8%	Significant distortion of the voltage wave: risk of heat rise and malfunctions.
8% < THD-R(V)	Significant distortion of the voltage wave: there is a high risk of malfunction unless the installation is calculated and sized based on this distortion.

Distortion of the voltage wave affects all devices powered by the supply.

NOTE: Use the THD-R(V) indication to assess the risks of disturbance of sensitive devices supplied with power.

Power Factor PF and cos ϕ Measurement

Power Factor PF

The control unit calculates:
- The power factor per phase PF1, PF2, PF3, from the phase active and apparent powers.
- The total power factor PF from the total active power Ptot and the total apparent power Stot:

$$PF = \frac{Ptot}{Stot}$$

NOTE: Stot is the vector or arithmetic total apparent power, depending on the setting *(see page 128)*.

This indicator qualifies:
- The oversizing necessary for the installation power supply when harmonic currents are present.
- The presence of harmonic currents by comparison with the value of the cos ϕ (see below).

cos ϕ

The control unit calculates:
- The cos ϕ per phase from the phase active and apparent fundamental powers.
- The cos ϕ from the total fundamental active power Pfundtot and the total fundamental apparent power Sfundtot:

$$\cos\varphi = \frac{Pfundtot}{Sfundtot}$$

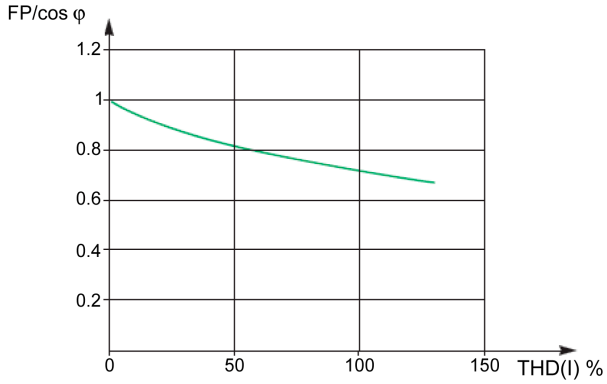
This indicator qualifies the usage of the fundamental energy and defines the quadrant of operation. The cos ϕ is also called the Displacement Power Factor (DPF).

Power Factor PF and cos ϕ when Harmonic Currents are Present

If the supply voltage is not too distorted, the power factor PF is expressed as a function of the cos ϕ and the THD(I) by:

$$PF \approx \frac{\cos\varphi}{\sqrt{1 + THD(I)^2}}$$

The following graph specifies the value of PF/cos ϕ as a function of the THD(I):



By comparing the 2 values, it is possible to estimate the level of harmonic deformation on the supply.

Sign for the Power Factor PF and cos ϕ

Two sign conventions can be applied for these indicators:

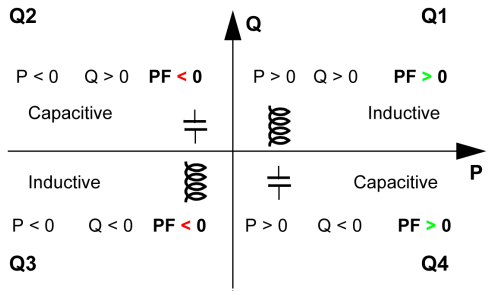
- IEC convention: The sign for these indicators complies strictly with the signed calculations of the powers (that is, Ptot, Stot, Pfundtot, and Sfundtot).
- IEEE convention: The indicators are calculated in accordance with the following formula:

$$PF = \frac{Ptot}{Stot} \times(-\text{sign}(Q)) \quad \text{and} \quad \cos\varphi = \frac{Pfundtot}{Sfundtot} \times(-\text{sign}(Q))$$

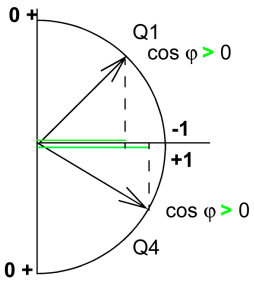
The following figures define the sign for the power factor PF and cos ϕ by quadrant (Q1, Q2, Q3 and Q4) for both conventions:

IEC Convention

Operation in all quadrants (Q1, Q2, Q3, Q4)

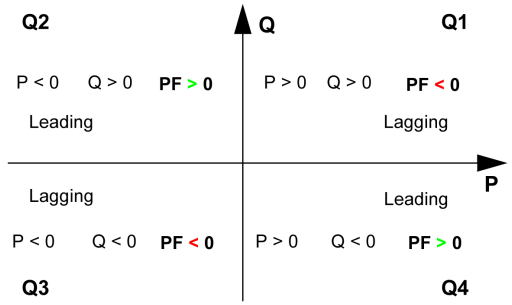


Values of cos ϕ in receiver operation (Q1, Q4)

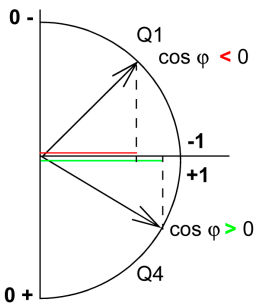


IEEE Convention

Operation in all quadrants (Q1, Q2, Q3, Q4)



Values of cos ϕ in receiver operation (Q1, Q4)



NOTE: For a device, a part of an installation which is only a receiver (or generator), the advantage of the IEEE convention is that it adds the type of reactive component to the PF and cos ϕ indicators:

- Lead: positive sign for the PF and cos ϕ indicators.
- Lag: negative sign for the PF and cos ϕ indicators.

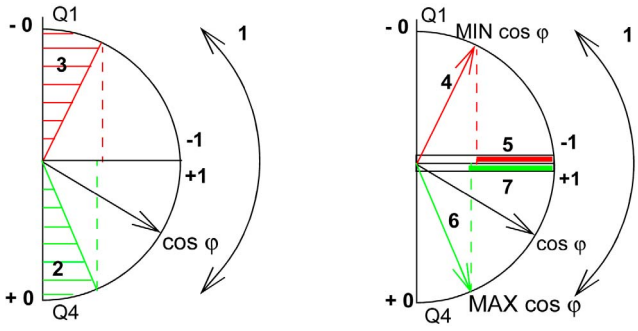
Managing the Power Factor PF and cos ϕ: Minimum and Maximum Values

Managing the PF and cos ϕ indicators consists of:

- Defining critical situations.
- Implementing monitoring of the indicators in accordance with the definition of critical situations.

Situations are considered critical when the values of the indicators are around 0. The minimum and maximum values of the indicators are defined for these situations.

The following figure illustrates the variations of the cos ϕ indicator (with the definition of the cos ϕ MIN/MAX) and its value according to IEEE convention for a receiver application:



1 Arrows indicating the cos ϕ variation range for the load in operation
2 Critical zone + 0 for highly capacitive devices (shaded green)
3 Critical zone - 0 for highly inductive devices (shaded red)
4 Minimum position of the load cos ϕ (lagging): red arrow
5 Variation range of the value of the load cos ϕ (lagging): red
6 Maximum position of the load cos ϕ (leading): green arrow
7 Variation range of the value of the load cos ϕ (leading): green

PF MAX (or cos ϕ MAX) is obtained for the smallest positive value of the PF (or cos ϕ) indicator.

PF MIN (or cos ϕ MIN) is obtained for the largest negative value of the PF (or cos ϕ) indicator.

NOTE: The minimum and maximum values of the PF and cos ϕ indicators are not physically significant: they are markers which determine the ideal operating zone for the load.

Monitoring the cos ϕ and Power Factor PF Indicators

According to the IEEE convention, critical situations in receiver mode on a capacitive or inductive load are detected and discriminated (two values).

The following table indicates the direction in which the indicators vary and their value in receiver mode:

IEEE Convention		
Operating quadrant	Q1	Q4
Direction in which the cos ϕ (or PFs) vary over the operating range	MIN → MAX	MIN → MAX
Value of the cos ϕ (or PFs) over the operating range	0...-0.3...-0.8...-1	+1...+0.8...+0.4...0

The quality indicator MAX and MIN indicate both critical situations.

According to the IEC convention, critical situations in receiver mode on a capacitive or inductive load are detected but not discriminated (one value).

The following table indicates the direction in which the indicators vary and their value in receiver mode:

IEC Convention		
Operating quadrant	Q1	Q4
Direction in which the cos ϕ (or PFs) vary over the operating range	MAX → MIN	MIN → MAX
Value of the cos ϕ (or PFs) over the operating range	0...+0.3...+0.8...+1	+1...+0.8...+0.4...0

The quality indicator MAX indicates both critical situations.

Selecting the Sign Convention for the cos ϕ and Power Factor PF

Set the sign convention for the cos ϕ and PF indicators as follows:

- On the Micrologic X display screen, at **Home → Configuration → Measures → PF/VAR Conv**.
- With Ecoreach software.
- By sending a setting command using the communication network (password-protected).

The factory setting of the sign convention is IEEE.

Section 4.2
Optional Metering Functions

Energy per Phase

Presentation

The Energy per Phase Digital Module enables the analysis of energy consumption per phase. It is especially recommended for low voltage installations having a large amount of unbalanced loads. At the point of measurement, it allows the calculation of and displays the received and delivered energy on each phase of the network. It calculates and displays active, reactive and apparent energy per phase.

The energy per phase is calculated using the method described for calculating energy *(see page 129)*.

The Energy per Phase Digital Module can be installed:
- On a 4-pole Masterpact MTZ circuit breaker.
- On a 3-pole Masterpact MTZ circuit breaker with neutral connected to the VN terminal and with ENVT wired and configured.

Prerequisites

The prerequisite is that the Energy per Phase Digital Module is purchased and installed on a Micrologic X control unit *(see page 20)*.

Energy Meter Characteristics

Measurement	Unit	Range	Accuracy	Accuracy range
Total active energy per phase Epdelivered(1,2,3)	kWh	-10,000,000 to 10,000,000 kWh	+/-1%	See **NOTE** below
Total active energy per phase Epreceived (1,2,3)	kWh	-10,000,000 to 10,000,000 kWh	+/-1%	See **NOTE** below
Total reactive energy per phase Eqdelivered(1,2,3)	kVARh	-10,000,000 to 10,000,000 kVARh	+/-1%	See **NOTE** below
Total reactive energy per phase Eqreceived (1,2,3)	kVARh	-10,000,000 to 10,000,000 kVARh	+/-1%	See **NOTE** below
Total apparent energy per phase Es(1,2,3)	kVARh	0 to 10,000,000 kVARh	+/-1%	See **NOTE** below

NOTE: The accuracy for the energy measurement range according to IEC 61557-12 is defined by current range, voltage, and power factor values.

Availability of Resettable Energy Meters

Measurement	Micrologic X HMI	Masterpact MTZ Mobile App	Ecoreach software	FDM128	Communication	IFE/EIFE webpages
Total active energy per phase: Epdelivered(1,2,3), and Epreceived (1,2,3)	–	✓	✓	✓	✓	–
Total reactive energy per phase: Eqdelivered(1,2,3), and Eqreceived (1,2,3	–	✓	✓	✓	✓	–
Total apparent energy per phase: Es(1,2,3)	–	✓	✓	✓	✓	–

Availability of Non-Resettable Energy Meters

Measurement	Micrologic X HMI	Masterpact MTZ Mobile App	Ecoreach software	FDM128	Communication TCP/IP	IFE/EIFE webpages
Total active energy value Ep	–	–	✓	–	✓	–
Total active energy values: Epdelivered, and Epreceived	–	–	✓	✓	✓	–
Total reactive energy value Eq	–	–	✓	–	✓	–
Total reactive energy values: Eqdelivered, and Eqreceived	–	–	✓	–	✓	–
Total apparent energy value Es	–	–	✓	–	✓	–

Resetting Energy Per Phase

Energy per phase resettable meters can be reset as other energy measurements *(see page 130)*.

Chapter 5
Maintenance and Diagnostic Functions

What Is in This Chapter?

This chapter contains the following sections:

Section 5.1
Maintenance Functions

What Is in This Section?

This section contains the following topics:

Assistance

Presentation

Assistance is available with the customer care application mySchneider. The application can be downloaded as follows:

- By flashing the QR code on the front face of the Micrologic X control unit to access to a landing page. Click the link to go to your application store from which the mobile application can be downloaded *(see page 19)*.
- From Google Play Store for Android smartphones.
- From App Store for iOS smartphones.

The Assistance menu on the Micrologic X display screen gives information on the firmware version of the microprocessors installed in the Micrologic X control unit.

Firmware upgrades are managed with Ecoreach software.

Data Availability

The firmware data is available as follows:

- On the Micrologic X display screen at **Home → Maintenance → Assistance → Firmware version**
- With Ecoreach software
- With Masterpact MTZ Mobile App
- On a remote controller using the communication network

Circuit Breaker Overview

Presentation

The circuit breaker overview function displays a description of the circuit breaker block, including:

- Circuit breaker family
- Rating
- Performance
- Number of poles
- Standard

Data Availability

The circuit breaker overview data is available as follows:

- On the Micrologic X display screen at **Home → Maintenance → CB overview**
- With Ecoreach software
- On a remote controller using the communication network

Section 5.2
Standard Diagnostic Functions

What Is in This Section?

This section contains the following topics:

Health State

Presentation

An overall indicator of the health state of the circuit breaker is given, taking into account the following monitoring:

- Circuit breaker monitoring *(see page 147)*
- Contact wear monitoring *(see page 153)*
- Circuit breaker service life monitoring *(see page 154)*

The overall health indicator is represented with one of the following icons:

-  OK if no high or medium severity event is detected.
-  Orange icon if at least one medium severity event is detected, indicating that corrective action needs to be scheduled.
-  Red icon if at least one high severity event is detected, indicating that urgent corrective action is required.

Data Availability

The overall health indicator with additional details about the health state of the circuit breaker is available as follows:

- On the Micrologic X display screen at:
  - **Home → Quick View → Health**
  - **Home → Maintenance → Health**
- With Ecoreach software
- With Masterpact MTZ Mobile App through Bluetooth or USB OTG connection
- On a remote controller using the communication network

NOTE: Quick View on the Micrologic X display screen displays the health state with the OK icon  when no high or medium severity event is detected. When a high or medium severity event is detected a pop-up screen is displayed *(see page 58)*. If the pop-up is acknowledged by pressing OK, the orange or red icon is displayed again in Quick View scrolling and is available at **Home → Quick View → Health** if scrolling is disabled.

Circuit Breaker Monitoring

Presentation

The monitoring of the circuit breaker consists in monitoring its ability to establish or interrupt a circuit and to provide protection against electrical faults. The Micrologic X control unit therefore monitors:

- The tripping circuit *(see page 148)*
- The closing and opening functions *(see page 150)*
- The internal functioning of the Micrologic X control unit *(see page 151)*

Data Availability

When the Micrologic X control unit detects a malfunction in one of the monitored functions listed, an event is generated with an orange or red pop-up screen and corresponding event message.

Circuit breaker monitoring state data is also available as follows:

- With Ecoreach software
- With the Masterpact MTZ Mobile App through Bluetooth or USB OTG connection
- On a remote controller using the communication network

Monitoring the Tripping Circuit

Presentation

When the Micrologic X control unit is energized, it provides constant monitoring of the following:

- The internal tripping circuit
- The connection of the internal sensors (internal current transformers, sensor plug, performer plug)
- The connection of the Mitop to the Micrologic X control unit
- The connection of the ENCT (External Neutral Current Transformer)

NOTE: The mechanism is not monitored. It is recommended to perform preventive maintenance as proposed by Schneider Electric. For more information, refer to *Masterpact MTZ - Circuit Breakers and Switch-Disconnectors - Maintenance Guide*.

Operating Principle: Ready LED

The result of the monitoring is indicated by the ready LED on the front face of the Micrologic X control unit, as follows:

- The ready LED is flashing green: the internal tripping circuit of the circuit breaker is functioning correctly
- The ready LED is off:
  - Either the Micrologic X control unit is not energized. Provide power to the control unit with a Mobile Power Pack. If the ready LED is still off, consult the log of active events at **Home → Alarms & History → Alarms** to diagnose the situation.
  - Or there is a detected malfunction in the tripping circuit. Consult the log of active events at **Home → Alarms & History → Alarms** to diagnose the situation.

Circuit Breaker Status

Following the detection of a malfunction in the tripping circuit the circuit breaker may be tripped or not, depending on the type of malfunction detected.

Tripping Data and Availability

The following data about the tripping function is logged by the Micrologic X control unit:

- Total number of trips
- The name and date of the last test trip

The tripping data is available as follows:

- With Ecoreach software
- On a remote controller using the communication network

Predefined Events

The monitoring of the tripping circuit generates the following events:

Event	History	Severity
Internal failure trip	Trip	High with trip
Control unit self test major malfunction	Diagnostic	High, with trip depending on the malfunction detected
Internal current sensor disconnected	Diagnostic	High with trip
External neutral current sensor disconnected	Diagnostic	High with trip
Protection reset to default setting if rebooted	Diagnostic	High
Error reading sensor plug	Diagnostic	High

Monitoring the Opening/Closing Function

Presentation

Monitoring of the opening/closing function by the Micrologic X control unit consists in:
- Monitoring the presence of the diagnostic and communicating voltage releases.
- Monitoring the state of the internal circuit of the diagnostic and communicating voltage releases.
- Monitoring the MCH gear motor.

NOTE: Standard voltage releases are not monitored by the Micrologic X control unit.

Devices Monitored

The Micrologic X control unit monitors the following:
- The diagnostic MN undervoltage release (MN diag).
- The diagnostic and communicating MX opening voltage release (MX diag&com).
- The diagnostic and communicating XF closing voltage release (XF diag&com).
- The MCH gear motor. The Micrologic X control unit:
  - Counts the number of charging sequences performed by the MCH gear motor to rearm the closing mechanism after each circuit breaker closure.
  - Measures and records the last charging time of the MCH gear motor to rearm the closing mechanism.

Data Availability

The MCH gear motor data is available on a remote controller using the communication network.

Predefined Events

The monitoring of the opening/closing function generates the following events:

Event	History	Severity
MX1 opening release malfunction	Diagnostic	Medium
MX1 opening release no longer detected	Diagnostic	Medium
MX2/MN opening release malfunction	Diagnostic	Medium
MX2/MN opening release no longer detected	Diagnostic	Medium
XF closing release malfunction	Diagnostic	Medium
XF closing release no longer detected	Diagnostic	Medium
MCH charging operations above threshold	Diagnostic	Medium
MCH has reached the maximum number of operations	Diagnostic	High

Monitoring the Internal Functioning of the Micrologic X Control Unit

Presentation

The Micrologic X control unit carries out a series of self tests to monitor:

- Correct internal functioning
- Wireless communication
- The ULP modules:
  - IO modules
  - IFE Ethernet interface
- The earth-leakage function (for Micrologic 7.0 X)

Operating Principle

The ready LED, service LED, and trip cause LEDs provide visual information on the health state of the Micrologic X control unit. Detected malfunctions can be classified as high or medium severity events:

- Medium severity event indicating minor malfunction detected. The current (LSI G/V) protection is unaffected, check must be performed at next maintenance.
  - All trip cause LEDs are off
  - The ready LED is flashing
  - The service LED is lit in orange
  - An orange pop-up screen is displayed
- High severity event indicating major malfunction detected. The current (LSI G/V) protection can be affected, the control unit must be replaced without delay.
  - All trip cause LEDs are lit
  - The ready LED is off
  - The service LED is lit in red
  - A red pop-up screen is displayed

An event is generated each time a malfunction is detected.

Data Availability

When the Micrologic X control unit internal functioning monitoring detects a problem, an event is generated with an orange or red pop-up screen and corresponding event message.

Monitoring data is also available as follows:

- With Ecoreach software
- With the Masterpact MTZ Mobile App through Bluetooth or USB OTG connection

Predefined Events

The function generates the following events:

Event	History	Severity
Earth leakage (Vigi) sensor disconnected	Diagnostic	High
Protection settings no longer accessible	Diagnostic	Medium
Control unit self test minor malfunction	Diagnostic	Low/medium
Metering malfunction	Diagnostic	Low/medium
Display screen or wireless malfunction	Diagnostic	Low/medium
Minor control unit malfunction corrected	Diagnostic	Medium
Critical hardware modules discrepancy	Diagnostic	Medium
Critical firmware modules discrepancy	Diagnostic	Medium
Non-critical hardware modules discrepancy	Diagnostic	Medium
Non-critical firmware modules discrepancy	Diagnostic	Medium
Address conflict between modules	Diagnostic	Medium
Firmware discrepancy within control unit	Diagnostic	Medium
NFC malfunction	Diagnostic	Medium
Bluetooth malfunction	Diagnostic	Medium
Loss of IO1 module	Diagnostic	Medium
Loss of IO2 module	Diagnostic	Medium
Loss of IFE module	Diagnostic	Medium
Configuration mismatch between IO and control unit	Configuration	Medium
Address conflict between modules	Diagnostic	Medium

Display Screen Replacement

The display screen can be replaced. For information on spare part installation, consult the instruction sheet on the Schneider Electric website: *NHA49910*

Monitoring the Contact Wear

Presentation

The pole contacts undergo wear due to the number of operating cycles with current and interrupted current during short circuits. It is recommended to check them at periodic intervals to decide whether the contacts must be changed or not. To avoid regular inspection of the contacts and the arc chute, the contact wear estimate helps with the planning of visual inspections based on the estimated wear (from 0% - new contact - to 100% - totally worn contact).

The contact wear increases every time the circuit breaker interrupts the circuit with or without current.

Data Availability

When the Micrologic X control unit contact wear algorithm calculates a value which is above one of the predefined thresholds (60%, 95%, and 100%) an event is generated with an orange or red pop-up screen and corresponding event message.

Contact wear monitoring data is also available as follows:

- With Ecoreach software
- With the Masterpact MTZ Mobile App through Bluetooth or USB OTG connection
- On a remote controller using the communication network

Predefined Events

The contact wear monitoring generates the following events:

Event	History	Severity
Contact wear is above 60%. Check contacts.	Diagnostic	Medium
Contact wear is above 95%. Plan for replacement.	Diagnostic	Medium
Contact wear 100% worn out. CB needs to be replaced.	Diagnostic	High

Monitoring the Circuit Breaker Service Life

Presentation

The service life indicator helps anticipate the replacement of the breaking block before mechanical or electrical breakdown. Circuit breaker service life depends on the daily number of operating cycles with or without current. The service life corresponds to the maximum number of operating cycles indicated in the catalog under mechanical and electrical durability.

Operating Principle

Each time the circuit breaker operates (performs an open and close cycle with or without current), the corresponding mechanical and electrical operating counters are incremented. Based on these counters, the Micrologic X control unit calculates two service life ratios as a percentage of the maximum number of mechanical and electrical operations. The highest ratio is taken into account to indicate the percentage of lifetime remaining for the device.

Data Availability

When the Micrologic X control unit service life algorithm calculates a value which is below one of the predefined thresholds (20% and 0%), an event is generated with an orange or red pop-up screen and corresponding event message.

Service life monitoring data is also available in the following ways:

- With Ecoreach software
- With the Masterpact MTZ Mobile App through Bluetooth or USB OTG connection
- On a remote controller using the communication network

Predefined Events

Service life monitoring generates the following events:

Event	History	Severity
Less than 20% CB operation remaining	Diagnostic	Medium
CB has reached the max number of operations.	Diagnostic	High

Control Unit Information

Presentation

Two operating times are measured by the Micrologic X control unit:

- Operating time with load: total time since energization of the control unit with current flowing through the circuit breaker.
- Operating time: total time when control unit is powered on by:
  - Current flowing through the circuit breaker
  - External 24Vdc power supply
  - External power source connected through mini USB port on the front face of the Micrologic X control unit

Data Availability

Data is available on a remote controller using the communication network.

Section 5.3
Optional Diagnostic Functions

What Is in This Section?

This section contains the following topics:

Power Restoration Assistant Digital Module

Presentation

The Power Restoration Assistant Digital Module extends and enhances the functions of the Masterpact MTZ Mobile App.

The Power Restoration Assistant Digital Module provides the maintenance operator with the following assistance on the power restoration procedure:
- Displays information on events and circuit breaker status.
- Assists in determining the cause of events such as an opening, a trip, or a loss of power supply.
- Provides guidance for potential solutions to restore the power supply.

The Power Restoration Assistant Digital Module helps to reduce the downtime of the power supply at critical load (mean time to repair (MTTR) after a trip, an opening, or a loss of upstream power supply.

⚠⚠ DANGER

HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH

Do not allow any person to work on the electrical network without physically validating the successful execution of the local or remote software actions for
- Opening the circuit breaker or switching off the electrical circuit.
- Closing the circuit breaker or switching on the electrical circuit.

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

⚠ WARNING

HAZARD OF CLOSING ON ELECTRICAL FAULT

Do not close the circuit breaker again without first inspecting and, if necessary, repairing the downstream electrical equipment.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

Prerequisites

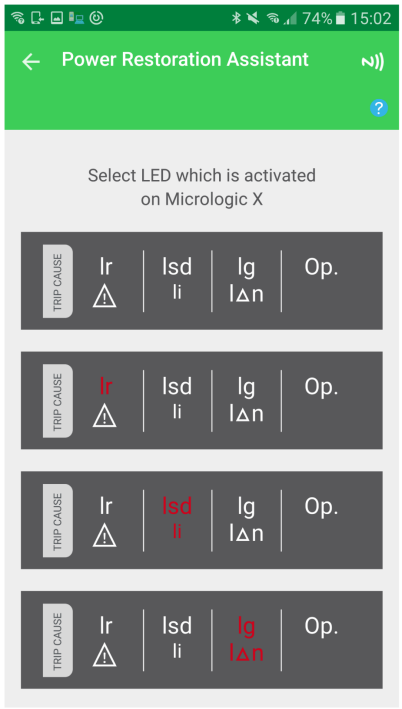
The Power Restoration Assistant Digital Module is an optional Digital Module, which can be purchased and installed on a Micrologic X control unit *(see page 20)*.

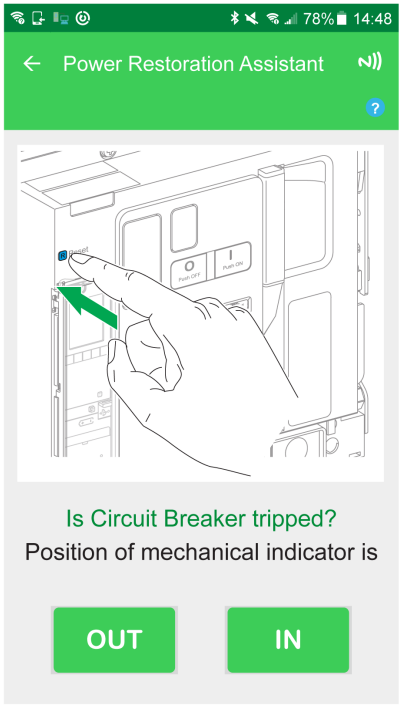
The prerequisites are:
- The Masterpact MTZ Mobile App must be installed on a smartphone
- The smartphone must be connected to the Micrologic X control unit through:
  - Bluetooth: the control unit must be powered
  - NFC: the control unit does not need to be powered
  - USB OTG: the control unit does not need to be powered
- The Micrologic X date and time must be up to date

Availability of Assistance

Availability of features differs depending on the type of connection to the Digital Module:
- Through Bluetooth or USB OTG connection: all features are available
- Through NFC (connection can be made when control unit is not powered): basic circuit breaker information is provided. It also provides step by step assistance by asking the user to provide circuit breaker status and giving guidance for power restoration.

Examples of Screens





Masterpact Operation Assistant Digital Module

Presentation

The Masterpact Operation Assistant Digital Module extends and enhances the functions of the Masterpact MTZ Mobile App.

The Masterpact Operation Assistant Digital Module assists the operator in operating the circuit breaker by delivering instructions to carry out actions.

It displays circuit breaker status, such as:
- Ready-to-close status
- Spring status
- Voltage release status (with communicating and diagnostic voltage releases)

By using the communicating and diagnostic voltage releases, it allows the circuit breaker to be opened or closed from a distance of a few meters.

⚠⚠ DANGER

HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH

Do not allow any person to work on the electrical network without physically validating the successful execution of the local or remote software actions for
- Opening the circuit breaker or switching off the electrical circuit.
- Closing the circuit breaker or switching on the electrical circuit.

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

⚠ WARNING

HAZARD OF CLOSING ON ELECTRICAL FAULT

Do not close the circuit breaker again without first inspecting and, if necessary, repairing the downstream electrical equipment.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

Prerequisites

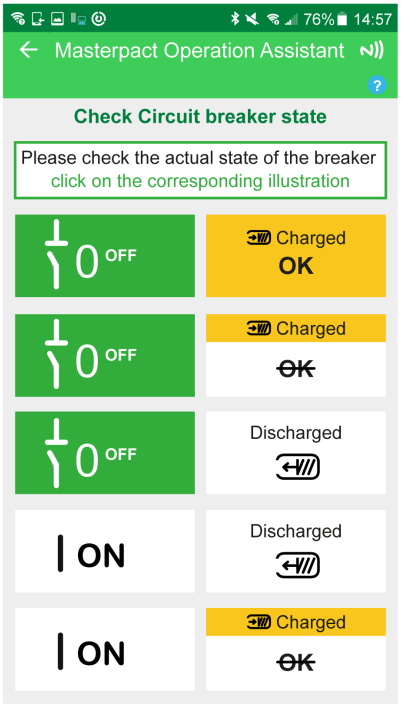
The Masterpact Operation Assistant Digital Module is an optional Digital Module, which can be purchased and installed on a Micrologic X control unit *(see page 20)*.

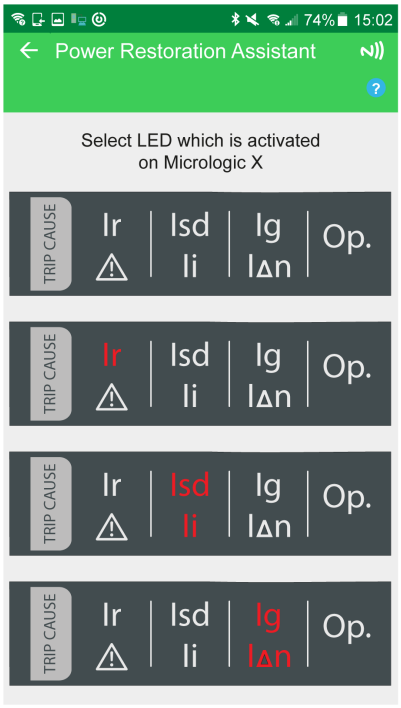
The prerequisites are:
- The Masterpact MTZ Mobile App must be installed on a smartphone.
- The smartphone must be connected to the Micrologic X control unit through:
  - Bluetooth: the control unit must be powered.
  - NFC: the control unit does not need to be powered.
  - USB OTG: the control unit can be powered by the smartphone.
- The Micrologic X date and time must be up to date.

Availability of Assistance

Availability of features differs depending on the type of connection to the Digital Module:
- Through Bluetooth, USB OTG, and the diagnostic and communicating voltage releases: all features are available.
- Through NFC (connection can be made when control unit is not powered): basic circuit breaker information and the context of the last trip are provided. It also provides step by step assistance by asking the user to provide circuit breaker status and giving guidance for manual operation of the circuit breaker.

Examples of Screens





Waveform Capture on Trip Event Digital Module

Presentation

The Waveform Capture on Trip Event Digital Module records five cycles of phase and neutral currents after a trip on long-time overcurrent, short-time overcurrent, instantaneous overcurrent, or ground-fault protection, with a sampling period of 512 µs. One cycle before and four after the trip are logged.

In addition, the waveform capture function records the digital status of the following:
- TRIP: circuit breaker trip orders
- SDE: fault-trip indication contact
- OPEN: open position of circuit breaker
- ZSI-out and ZSI-in: ZSI signals

Only one waveform capture on trip event is available at a time. Generating a new waveform capture replaces the previous one.

At delivery no waveform capture is available. A waveform capture on trip event is only available after the device has tripped due to overcurrent or ground-fault protection. Trips due to tests run with Ecoreach software are not recorded.

The waveform capture is a COMTRADE (Common Format for Transient Data Exchange) file. Refer to the IEEE C37.111 or IEC 60255-24 standard for more information on the COMTRADE file format.

Prerequisites

The Waveform Capture on Trip Event Digital Module is an optional Digital Module, which can be purchased and installed on a Micrologic X control unit *(see page 20)*.

The prerequisites are:
- The Masterpact MTZ Mobile App must be installed on a smartphone.
- The smartphone must be connected to the Micrologic X control unit through Bluetooth, or USB OTG.
- The Micrologic X date and time must be up to date.

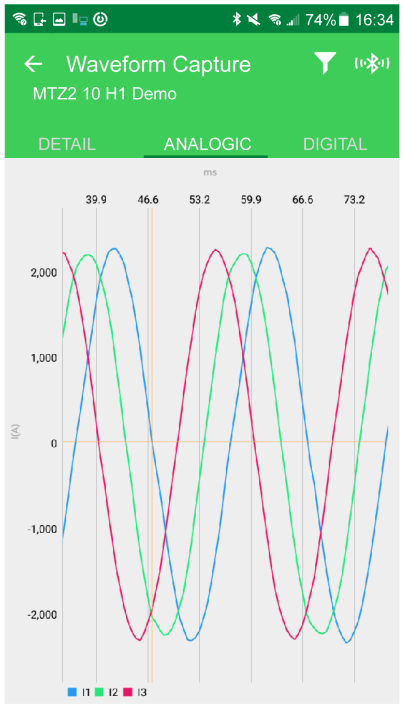
Data Availability

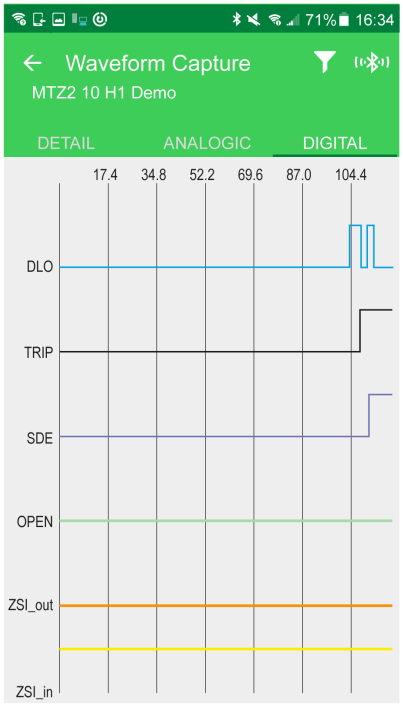
The waveform capture is displayed in the following ways:
- On the Masterpact MTZ Mobile App through Bluetooth, or USB OTG.
- In Ecoreach software

The waveform capture can be exported as a file in COMTRADE format through the Masterpact MTZ Mobile App or the Ecoreach software, for use with Schneider Electric Wavewin-SE software.

Examples of Screens

The following screens give examples of the type of information available on the Masterpact MTZ Mobile App thanks to the Waveform Capture on Trip Event Digital Module:





Chapter 6
Operation Functions

What Is in This Chapter?

This chapter contains the following topics:

Control Modes

Presentation

The control mode is a Micrologic X setting which defines the means to control the opening and closing functions of the circuit breaker.

Two control modes are available: Manual and Auto.

Manual mode only accepts orders made using one of the following:
- The mechanical buttons on the front of the circuit breaker.
- The external pushbutton connected to the MN/MX/XF voltage releases.
- The BPFE electrical closing pushbutton.

Auto mode has two settings: Local or Remote. All orders accepted in manual mode are accepted in auto mode, as well as orders from local or remote communication as follows:
- Auto Local: the operator needs to be close to the circuit breaker to establish communication and only orders sent from a local source through communication are accepted:
  - Ecoreach software through USB connection
  - Masterpact MTZ Mobile App through Bluetooth or USB OTG connection with Masterpact Operation Assistant Digital Module
- Auto Remote: the operator does not need to be next to the circuit breaker to establish communication and orders are accepted only when sent from a remote source through the communication network.

NOTE: Ecoreach software connected through the communication network can be used to send control orders to the circuit breaker.

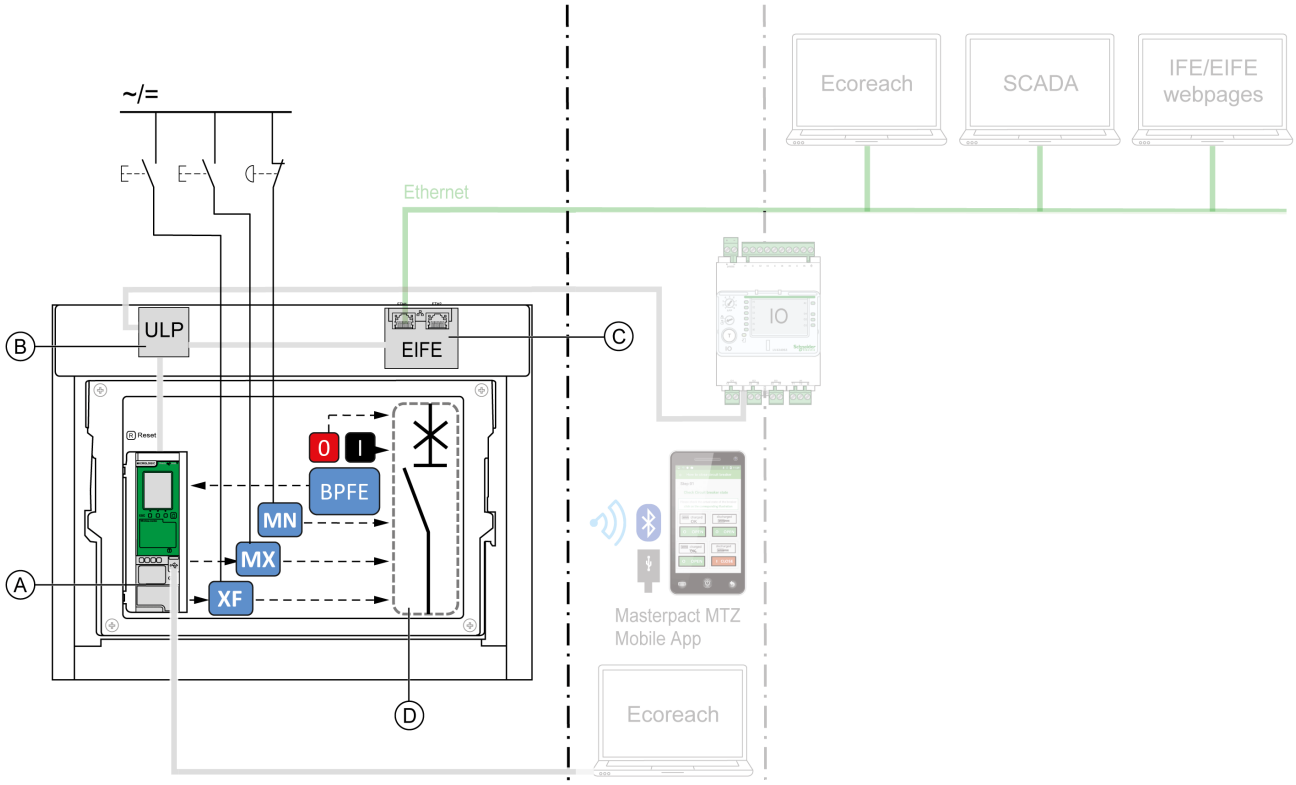
The control mode factory setting is Auto Remote.

Operation According to Control Mode Configured

The following table summarizes the opening and closing operations available, depending on the control mode configured:

Control mode	Type of order and delivery method							
	Mechanical	Electrical		Through communication				
	Pushbutton	BPFE	Point to point (voltage release)	IO module	Ecoreach software through USB	Masterpact MTZ Mobile App through Bluetooth or USB OTG + Masterpact Operation Assistant Digital Module	Communication network	IFE/EIFE Webpages
Manual	✓	✓	✓	–	–	–	–	–
Auto: Local	✓	✓	✓	✓[1]	✓	✓	–	–
Auto: Remote	✓	✓	✓	✓[1]	–	–	✓	✓
1 According to IO input mode setting								

Operation in Manual Mode

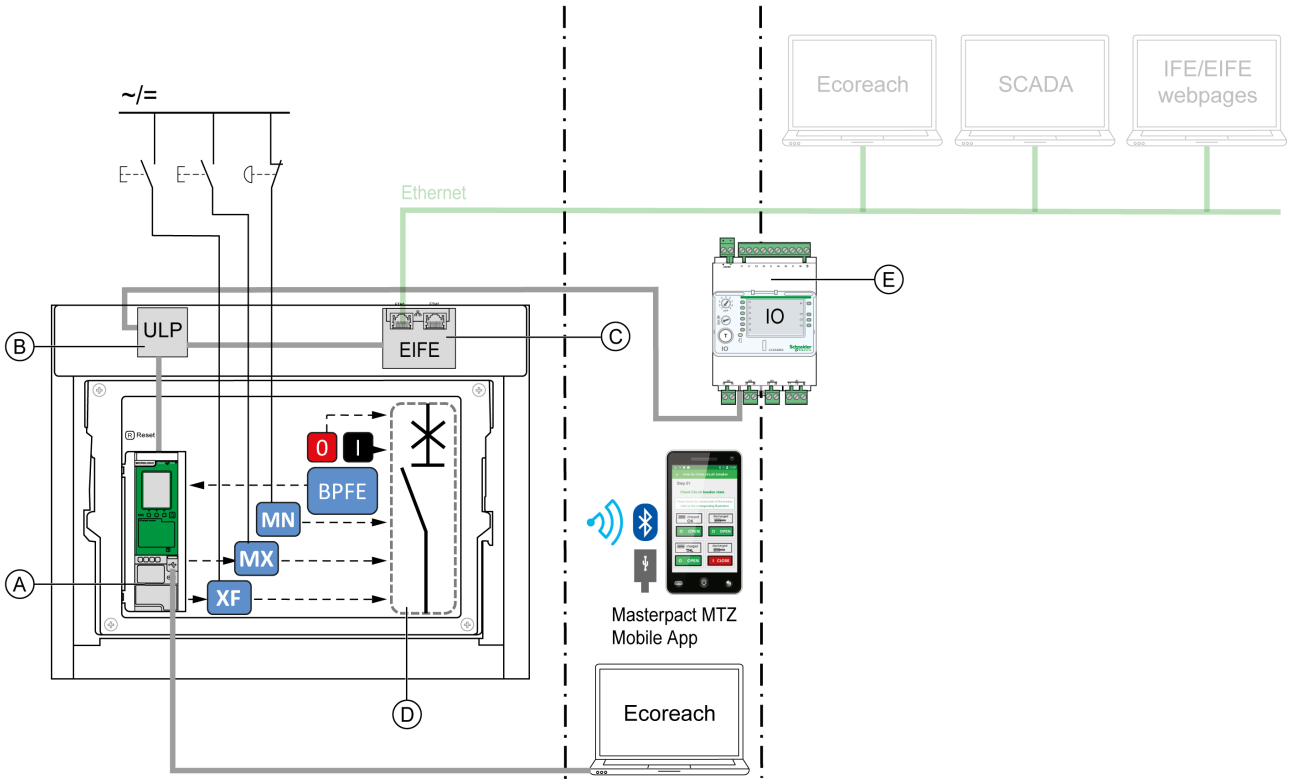


A Micrologic X control unit
B ULP port module
C EIFE embedded Ethernet interface
D Circuit breaker mechanism

Opening and closing operations available in Manual mode:

- 0: mechanical opening pushbutton
- 1: mechanical closing pushbutton
- BPFE: electrical closing pushbutton
- External pushbutton wired by customer, and connected to:
  - XF: standard or communicating and diagnostic closing voltage release
  - MX: standard or communicating and diagnostic opening voltage release
  - MN: standard or diagnostic undervoltage release

Operation in Auto: Local Mode

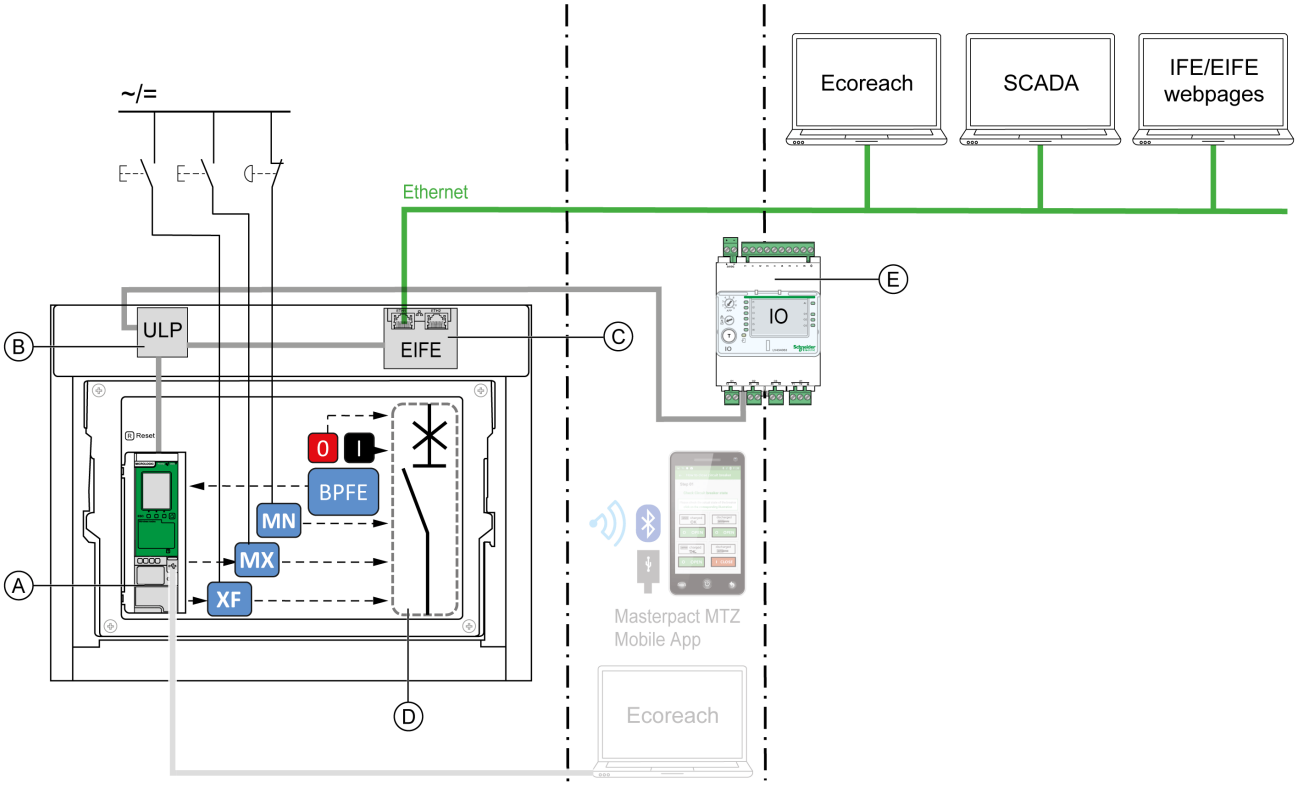


A Micrologic X control unit
B ULP port module
C EIFE embedded Ethernet interface
D Circuit breaker mechanism
E IO input/output application module

Opening and closing operations available in Auto: Local mode:

- 0: mechanical opening pushbutton
- 1: mechanical closing pushbutton
- BPFE: electrical closing pushbutton
- External pushbutton wired by customer, and connected to:
  - XF: communicating and diagnostic closing voltage release
  - MX: communicating and diagnostic opening voltage release
  - MN: standard or diagnostic undervoltage release
- IO: with the Breaker Operation predefined application of the IO module set to local control mode
- Ecoreach software: command sent through USB connection
- Masterpact MTZ Mobile App with Masterpact Operation Assistant Digital Module:
  - Through Bluetooth low energy wireless communication
  - Through USB OTG connection

Operation in Auto: Remote Mode



A Micrologic X control unit
B ULP port module
C EIFE embedded Ethernet interface
D Circuit breaker mechanism
E IO input/output application module

Opening and closing operations available in Auto: Remote mode:

- 0: mechanical opening pushbutton
- 1: mechanical closing pushbutton
- BPFE: electrical closing pushbutton
- External pushbutton wired by customer, and connected to:
  - XF: communicating and diagnostic closing voltage release
  - MX: communicating and diagnostic opening voltage release
  - MN: standard or diagnostic undervoltage release
- IO: with the Breaker Operation predefined application of the IO module set to remote control mode
- Communication: remote command through IFE, EIFE, or IFM interface.

Setting the Control Mode

The Auto or Manual mode can be set as follows:

- On the Micrologic X display screen, at **Home → Configuration → Communication → Control Mode → Mode**.
- With the Masterpact MTZ Mobile App through Bluetooth or USB OTG connection.

The Local or Remote mode can be set as follows:

- When the IO module is used with the Breaker Operation predefined application, the local or remote mode is defined only by the control mode selector switch wired on the digital input I1 of the IO module.
- When the IO module is not used with the Breaker Operation predefined application, the local or remote mode can be set as follows:
  - With Ecoreach software through USB connection
  - With the Masterpact MTZ Mobile App through Bluetooth or USB OTG connection.

NOTE:

- The Local or Remote mode cannot be set on the Micrologic X display screen.
- When Auto mode is set, the control mode is Auto Local or Auto Remote, depending on the last setting.

Displaying the Control Mode

The control mode (Manual, Auto Local, or Auto Remote) is displayed as follows:

- On the Micrologic X display screen, at **Home → Configuration → Communication → Control Mode → Mode**
- With Ecoreach software through USB connection
- With the Masterpact MTZ Mobile App through Bluetooth or USB OTG connection.
- On the IFE/EIFE webpages
- By a remote controller using the communication network

Predefined Events

Changing the control mode settings generates the following events:

Event	History	Severity
Manual mode enabled	Operation	Low
Local mode enabled	Operation	Low

Opening Function

Presentation

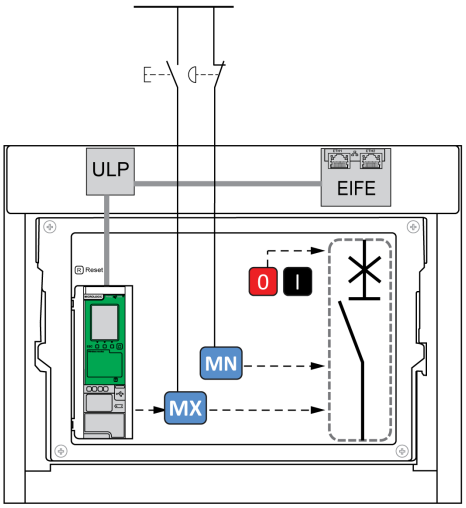
Micrologic X control units receive and process electrical opening orders. An event is generated on opening.

Operating Principle

Opening orders can be sent as follows:

- Directly through a mechanical opening pushbutton.
- Locally through an external opening pushbutton.
- Remotely through a remote order which is managed by the Micrologic X control unit.

Opening orders have priority over closing orders. No closing orders are taken into account as long as an open order is active.



The open orders on MN or MX voltage releases by external pushbutton can be maintained to force the circuit breaker in open position and reject any close order. The Micrologic X open orders are not maintained.

Management of Opening Function

⚠⚠ DANGER

HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH

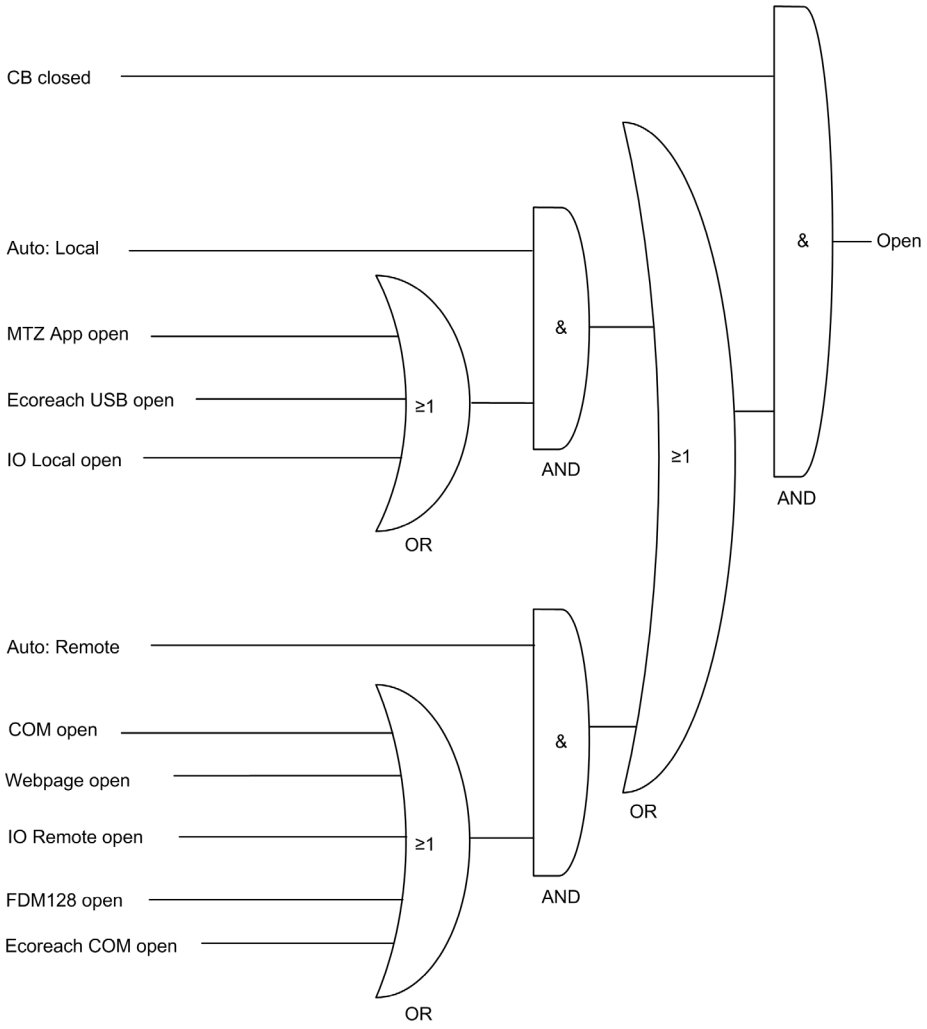
Do not allow any person to work on the electrical network without physically validating the successful execution of the local or remote software actions for opening the circuit breaker or switching off the electrical circuit.

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

The Micrologic X control unit manages opening orders issued by the following means:

- IO module with the Breaker Operation predefined application (refer to *Enerlin'X IO - Input/Output Application Module for One Circuit Breaker - User Guide*).
- Ecoreach software.
- Masterpact MTZ Mobile App through Bluetooth or USB OTG with Masterpact Operation Assistant Digital Module installed and activated.
- Remote controller connected to the communication network (refer to *Masterpact MTZ - Modbus Communication Guide*).
- IFE/EIFE webpages (refer to *Enerlin'X IFE - Ethernet Interface for One Circuit Breaker - User Guide* and *Enerlin'X EIFE - Embedded Ethernet Interface for One Masterpact MTZ Drawout Circuit Breaker - User Guide*).
- FDM128 display through IFE or EIFE interface (refer to *Enerlin'X FDM128 - Ethernet Display for Eight Devices - User Guide*).

The opening function is monitored by the Micrologic X control unit *(see page 150)*.



CB closed	Circuit breaker is closed
Auto: Local	Control mode is Auto Local
MTZ App open	Open order from Masterpact MTZ Mobile App with Masterpact Operation Assistant Digital Module
Ecoreach USB open	Open order from Ecoreach software connected to the mini USB port on control unit
IO local open	Local open order from IO module with the Breaker Operation predefined application (I5)
Auto: Remote	Control mode is Auto Remote
COM open	Open order from a remote controller
Webpage open	Open order from IFE/EIFE webpage
IO remote open	Remote open order from IO module with the Breaker Operation predefined application (I2)
FDM128 open	Open order from FDM128 display
Ecoreach COM open	Open order from Ecoreach software through the communication network
Open	Micrologic X open order to the MX communicating opening voltage release

Predefined Events

The function generates the following predefined events:

Event	History	Severity
CB moved from close to open	Operation	Low
Opening order sent to MX	Operation	Low

Closing Function

Presentation

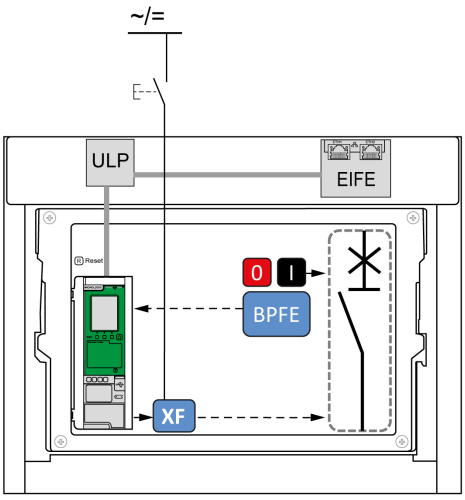
Micrologic X control units receive and process electrical closing orders. An event is generated on closure.

Operating Principle

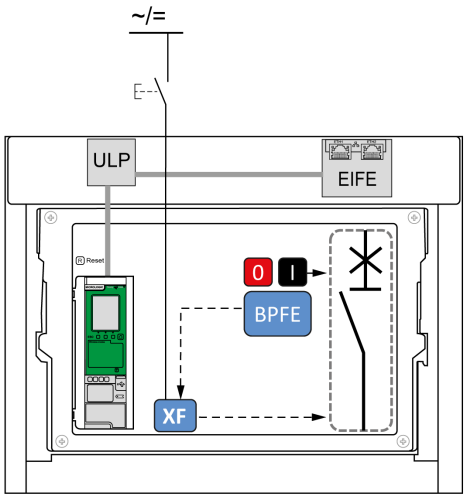
Closing orders can be sent as follows:

- Directly through a mechanical closing pushbutton.
- Locally through an external closing pushbutton.
- Remotely through a remote order which is managed by the Micrologic X control unit .

Opening orders have priority over closing orders. No closing orders are taken into account as long as an open order is active.



NOTE: The BPFE electrical closing pushbutton can be connected to Micrologic X control unit, as shown in the preceding diagram. In this case the control unit manages the closing function and the closing orders from the BPFE. The BPFE closing order is available in both Manual and Auto control modes.
Alternatively, the BPFE electrical closing pushbutton can be connected to the XF communicating closing voltage release, as shown in the following diagram. In this case the Micrologic X control unit does not manage the closing function and only closing orders in Manual mode are valid.



Management of Closing Function

⚠ ⚠ DANGER

HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH

Do not allow any person to work on the electrical network without physically validating the successful execution of the local or remote software actions for closing the circuit breaker or switching on the electrical circuit.

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

⚠ WARNING

HAZARD OF CLOSING ON ELECTRICAL FAULT

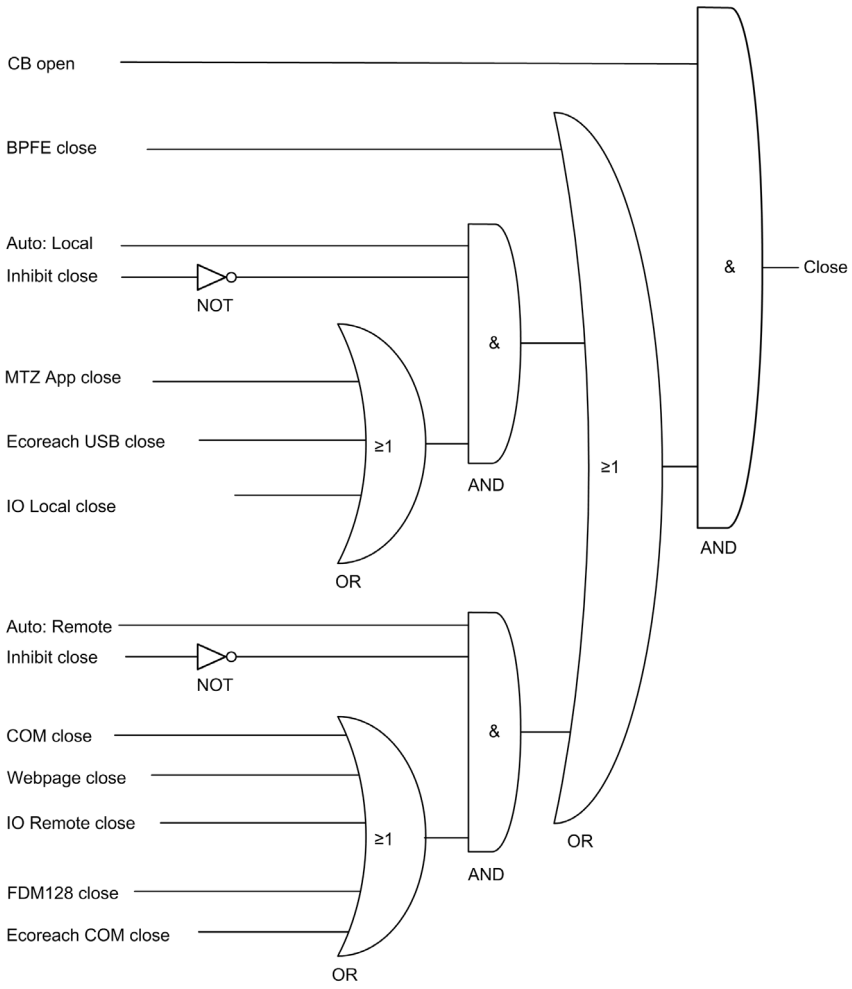
Do not close the circuit breaker again without first inspecting and, if necessary, repairing the downstream electrical equipment.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

The Micrologic X control unit manages closing orders issued by the following means:

- BPFE connected to Micrologic X control unit.
- IO module with the Breaker Operation predefined application.
- Ecoreach software.
- Masterpact MTZ Mobile App through Bluetooth or USB OTG with Masterpact Operation Assistant Digital Module installed and activated.
- Remote controller connected to the communication network (refer to *Masterpact MTZ - Modbus Communication Guide*).
- IFE/EIFE webpages (refer to *Enerlin'X IFE - Ethernet Interface for One Circuit Breaker - User Guide* and *Enerlin'X EIFE - Embedded Ethernet Interface for One Masterpact MTZ Drawout Circuit Breaker - User Guide*).
- FDM128 display through IFE or EIFE interface (refer to *Enerlin'X FDM128 - Ethernet Display for Eight Devices - User Guide*).

The closing function is monitored by the Micrologic X control unit *(see page 150)*.

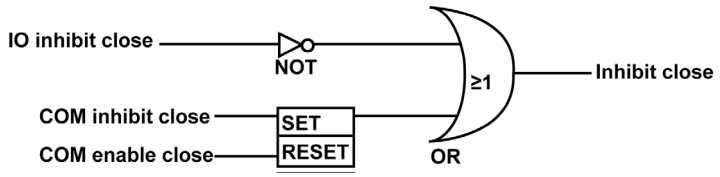


CB open	Circuit breaker is open
BPFE close	Close order from BPFE (when BPFE connected to Micrologic X control unit)
Auto: Local	Control mode is Auto Local
Inhibit close	Close orders allowed in Auto control mode are inhibited
MTZ App close	Close order from Masterpact MTZ Mobile App with Masterpact Operation Assistant Digital Module
Ecoreach USB close	Close order from Ecoreach software connected to mini USB port on control unit
IO local close	Local close order from IO module with the Breaker Operation predefined application (I6)
Auto: Remote	Control mode is Auto Remote
COM close	Close order from a remote controller
Webpage close	Close order from IFE/EIFE webpage
IO remote close	Remote close order from IO module with the Breaker Operation predefined application (I3)
FDM128 close	Close order from FDM128 display
Ecoreach COM close	Close order from Ecoreach software through the communication network
Close	Micrologic X close order to the XF communicating closing voltage release

Inhibiting the Closing Function

The closing function can be inhibited by sending a command through:

- The communication network
- The IO module



IO Inhibit close	Inhibit close order from IO module with the Breaker Operation predefined application (I4)
COM inhibit close	Inhibit close order from a remote controller using the communication network
COM enable close	Enable close order from a remote controller using the communication network
Inhibit close	Close orders allowed in Auto control mode are inhibited (1) or enabled (0)

⚠ WARNING

RESTRICTED CLOSING INHIBITION

Do not use the inhibit closing order to lock the device in open position.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

The inhibit close order inhibits only the closing orders allowed in Auto control mode. The closing orders issued from the mechanical closing pushbutton or BPFE, or from the pushbutton directly connected to the XF voltage release are not inhibited.

Predefined Events

The function generates the following predefined events:

Event	History	Severity
CB moved from open to close	Operation	Low
Closing inhibited by communication	Operation	Low
Closing inhibited by wired input	Operation	Low

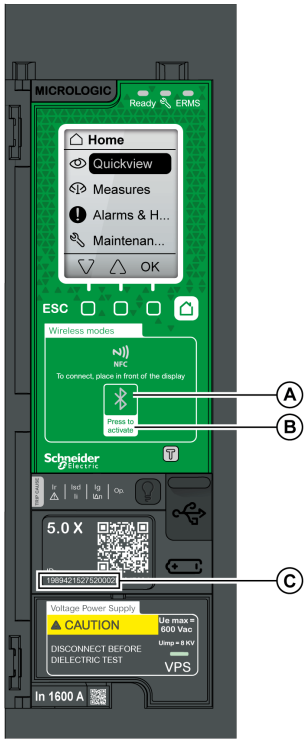
Chapter 7
Communication Functions

What Is in This Chapter?

This chapter contains the following topics:

Bluetooth Low Energy Communication

Description



Using Bluetooth low energy BLE communications, you can access the Micrologic X control unit from a smartphone running the Masterpact MTZ Mobile App *(see page 16)*. This application offers a task-oriented interface with the control unit. You can establish a BLE connection with only one Micrologic X control unit at the same time. Only one smartphone at a time can connect to a control unit.
During the connection, the control unit is identified by the last digits of its serial number. The format of the identifier is **MTZ** *<ProtectionType> <EndOfSerialNumber>*, for example, MTZ 5 012345, where 5 indicates Micrologic 5.0 X control unit and 012345 are the last 6 digits of the serial number.
BLE communications are encrypted using Advanced Encryption Standard (AES) 128-bit encryption.

A Bluetooth LED
B Bluetooth activation button
C Serial number of Micrologic X control unit

Prerequisites for Using Bluetooth Low Energy

The prerequisites for establishing a BLE connection are:
- The Micrologic X control unit must be powered *(see page 23)*.
- BLE communication must be enabled on the control unit.
- You must have a smartphone running the Masterpact MTZ Mobile App.
- The smartphone must support Android 4.4 or iOS 9 or above, and be compatible with Bluetooth low energy.
- You must have access to the Micrologic X control unit, and be physically within an open field range of 20 to 30 meters (22 to 32 yards) (within 10 meters (11 yards) for optimized connection) for the duration of the connection.

Enabling and Disabling Bluetooth Low Energy Communication

By default, BLE communication is disabled.

BLE communication can be enabled or disabled as follows:
- On the Micrologic X display screen, at **Home → Configuration → Communication → Bluetooth**, set **Bluetooth** to **ON** or **OFF**.
- With Ecoreach software, at **Home → Configuration → Communication → Bluetooth**, set **Bluetooth activation** to **ON** or **OFF**.

The BLE communication status (enabled or disabled) can be displayed as follows:
- On the Micrologic X display screen, at **Home → Communication → Bluetooth**
- With Ecoreach software
- On a remote controller using the communication network

Predefined Events

Enabling Bluetooth communication generates the following event:

Event	History	Severity
Bluetooth communication enabled	Communication	Low

Setting the Bluetooth Disconnection Timer

When Bluetooth communication is activated using the activation pushbutton on the Micrologic X control unit, there is a timer on the connection with a smartphone that ends the communication after a period of idle time. By default, this automatic disconnection timer is set to 15 minutes.

The setting for the Bluetooth disconnection timer can be changed as follows:

- On the Micrologic X display screen, at **Home → Configuration → Communication → Bluetooth**, set **Bluetooth** to **ON**, and then set the **BLE timer (min)** value.
- With Ecoreach software, at **Home → Configuration → Communication → Bluetooth**, set **Bluetooth time out delay (min)** to the appropriate value.

You can set the value from 5 to 60 minutes (default = 15 minutes) in increments of 1.

Establishing a Bluetooth Low Energy Connection

Follow the steps below to establish a BLE connection from your smartphone to the Micrologic X control unit.

Step	Action
1	Start Masterpact MTZ Mobile App on your smartphone.
2	Select **Connect to device through Bluetooth**.
3	On the Micrologic X control unit, press the Bluetooth activation pushbutton. The Bluetooth LED lights up. If it does not, you must enable the Bluetooth communication feature first. On your smartphone, the Masterpact MTZ Mobile App starts scanning and displays a list of Bluetooth devices in the neighborhood. Micrologic X control units are identified by their ID number.
4	Select the Micrologic X control unit to which you want to connect. A 6-digit pairing code is displayed on the Micrologic X display screen.
5	Enter the pairing code in Masterpact MTZ Mobile App within 30 seconds. ● If the pairing code is incorrect, or if more than 30 seconds have elapsed, Bluetooth communication is deactivated (the LED turns off), and you must start the connection procedure again at Step 3. ● If the connection is established, the Bluetooth LED starts blinking.
6	To end the connection, you can either: ● Press the Bluetooth pushbutton on the Micrologic X control unit. ● Disconnect from Masterpact MTZ Mobile App.

While your smartphone remains within the communication range (an open field range of 20 to 30 meters (22 to 32 yards) from the Micrologic X control unit), the BLE connection remains active and the information displayed is refreshed.

NOTE: Each connection is unique, you cannot save the connection parameters for your next BLE connection.

Bluetooth LED

The Bluetooth LED on the front face of the Micrologic X control unit can be:

- **ON**: A Bluetooth connection procedure is in progress.
- **OFF**: Bluetooth is not activated or disabled.
- **Blinking**: A Bluetooth connection is established and active.

NOTE: The Bluetooth LED does not indicate whether the BLE communication feature is enabled or disabled in the Micrologic X control unit. When this feature is disabled, the LED does not light up when you press the Bluetooth activation button.

Troubleshooting Bluetooth Low Energy Communication Issues

The following table lists the common problems you may meet when establishing a Bluetooth connection to the Micrologic X control unit.

Problem description	Probable causes	Solutions
The Bluetooth LED does not light up when you press the Bluetooth activation pushbutton on the Micrologic X control unit.	The Bluetooth function is not enabled in the Micrologic X control unit.	Enable Bluetooth communication in the Micrologic X control unit.
	The Micrologic X control unit is not powered.	Check the power supply of the Micrologic X control unit.
The Bluetooth connection was established but the signal is lost.	The smartphone has been moved out of range.	Place the smartphone within the range for Bluetooth and establish a new connection.
The Bluetooth LED is blinking on the control unit but you cannot see its ID number in the list of devices available.	A smartphone is already connected to the Micrologic X control unit.	Check whether another smartphone within range is also connected to the control unit.

NFC Communication

Description

Using Near Field Communication (NFC), you can access the Micrologic X control unit from a smartphone running the Masterpact MTZ Mobile App *(see page 16)*. With NFC, you can access the control unit and download data to your smartphone, even when the control unit is not powered.
NFC communication is always enabled and cannot be disabled.
You can establish an NFC connection with only one Micrologic X control unit at the same time and only one smartphone at a time can connect to a control unit.
Micrologic X control units use a passive NFC tag, which does not have a power source. It draws power from the smartphone that reads it, and therefore does not emit any electromagnetic waves when NFC communication is not in use.

NOTE: NFC communication is only accessible from the Android version of the Masterpact MTZ Mobile App.

A NFC wireless communication zone

Prerequisites for Using NFC

The prerequisites for establishing an NFC connection are:

- You must have a smartphone running the Masterpact MTZ Mobile App.
- The smartphone must support NFC.
- You must have physical access to the Micrologic X control unit. The smartphone must be held within 20 mm (0.8 in) of the display screen of the control unit.

Establishing an NFC Connection

Follow the steps below to establish an NFC connection from your smartphone to the Micrologic X control unit.

Step	Action
1	Start Masterpact MTZ Mobile App on your smartphone.
2	Select **Connect to device through NFC**.
3	Place your smartphone against the Micrologic X display screen at a maximum distance of 20 mm (0.8 in), in the wireless NFC communication zone. **NOTE:** The NFC antenna of the control unit is located around the Micrologic X display screen. The position of the NFC antenna on the smartphone depends on the model used. If communication is not established, check where the NFC antenna is located on your smartphone and repeat the procedure. The first beep indicates that the communication is established. The Masterpact MTZ Mobile App then starts downloading data. The second beep indicates that the data download is complete. If the operation fails, a message is displayed on the smartphone. Start the procedure again. **NOTE:** You must not remove your smartphone from the Micrologic X display screen while the data download is in progress. If you do, the download is incomplete (you lose the NFC connection).
4	Remove your smartphone from the Micrologic X display screen.

NFC data downloaded from the Micrologic X control unit is not automatically refreshed. To get updates, you must establish a new NFC connection. Be aware that each new set of data downloaded overwrites the previous data. You can use the Masterpact MTZ Mobile App to consult downloaded data.

Troubleshooting NFC Communication Issues

The following table lists the common problems you might meet when establishing an NFC connection to the Micrologic X control unit.

Problem description	Probable causes	Solutions
The NFC connection is not established. (No beep)	The smartphone is out of the NFC wireless communication zone.	Move your smartphone so that its antenna is in the NFC wireless communication zone and repeat the connection procedure.
	Your smartphone has a reinforced case (for example, metallic) which is blocking the signal.	Remove the case of your smartphone and repeat the connection procedure.
	Your smartphone does not have NFC capability.	–
	NFC communication is not activated on your smartphone.	Make sure NFC communication is activated on your smartphone.
The NFC connection was established but the signal is lost. (No second beep)	The smartphone was moved out of NFC wireless communication zone before the data transmission finished.	Move your smartphone into the NFC wireless communication zone and repeat the connection procedure. Keep the smartphone in the zone until you hear the second beep.
The data is not transmitted. The message **Memory fail. Please try again.** is displayed on the smartphone.		
Information not available, or limited.	The internal battery charge is too low to record the information.	Replace the internal battery for information to be recorded in future.

USB On-The-Go (OTG) Connection

Description

Using a USB OTG connection, you can access the Micrologic X control unit from a smartphone running the Masterpact MTZ Mobile App *(see page 16)*. This application offers a task-oriented interface with the control unit.

Prerequisites for Using a USB OTG Connection

The prerequisites for establishing a USB OTG connection are:

- You must have a smartphone running the Masterpact MTZ Mobile App.
- The smartphone must support Android 4.4 or iOS 9 or above.
- You must have physical access to the Micrologic X control unit to connect the cable directly to the mini USB port of the control unit.
- You must have a USB OTG adaptor (not supplied) and a USB Type A cable to connect the USB port of the smartphone to the mini USB port of the Micrologic X control unit:.
  The USB Type A cable must correspond to one of the following conditions:
  - L ≤ 1 m, minimum diameter AWG 26/28
  - L ≤ 2 m, minimum diameter AWG 24 (example: Molex Ref 88732-8902)

Connecting a Smartphone with Masterpact MTZ Mobile App to Mini USB Port

Follow the steps below to connect to the Micrologic X control unit using the mini USB port.

Step	Action
1	Connect your smartphone to the mini USB port of the Micrologic X control unit using a USB OTG adaptor and a USB Type A cable. The smartphone provides power to the Micrologic X control unit if necessary.
2	Start Masterpact MTZ Mobile App on your smartphone.

Predefined Events

The function generates the following events:

Event	History	Severity
USB port connected	Communication	Low

USB Connection

Description

From a PC running Ecoreach software, you can access all of the monitoring and control functions of the Micrologic X control unit by connecting a PC directly to the mini USB port of the control unit.

Prerequisites for Using a USB Connection

The prerequisites for establishing a USB connection are:

- You must have the USB driver installed on the PC.
- You must have physical access to the Micrologic X control unit to connect the cable directly to the mini USB port of the control unit.
- You must have a USB cable (reference LV850067SP) to connect the USB port of the PC to the mini USB port of the Micrologic X control unit.

Connecting a PC Running Ecoreach Software to Mini USB Port

Follow the steps below to connect to the Micrologic X control unit using the mini USB port.

Step	Action
1	Connect your PC to the mini USB port of the Micrologic X control unit using a cable with reference LV850067SP. The PC provides power to the Micrologic X control unit if necessary.
2	Start Ecoreach software on the PC and log in.
3	On the Ecoreach home page, connect to the Micrologic X control unit. There are different ways to connect Ecoreach software to the Micrologic X control unit, depending on whether it is the first connection and how the device was discovered. For more information, refer to *Ecoreach Online Help*.
4	With Ecoreach software connected to the Micrologic X control unit you have access to all functions of the software.

Control Unit Test Mode

The test mode is activated when Ecoreach software is connected to the device through a PC connected to the mini USB port on the Micrologic X control unit and the **Force trip** button is clicked. For more information, refer to *Ecoreach Online Help*.

Predefined Events

The function generates the following events:

Event	History	Severity
USB port connected	Communication	Low
Control unit in test mode	Diagnostic	Low
Injection test in progress	Diagnostic	Low
Test aborted by user	Diagnostic	Low

Cybersecurity Recommendations

Overview

The Masterpact MTZ circuit breaker with its Micrologic X control unit is a key component of your installation. It offers multiple communication features that bring greater efficiency and flexibility in managing your installation. However the features also make it potentially vulnerable to cyber attacks.

This section lists some of the elementary precautions that you must take to protect the communications paths that give access to information about your installation, and control over it.

The communication paths to protect include:

- Local access communication paths
  - Wireless Bluetooth low energy communication
  - Wireless NFC communication
  - The mini USB port
- Remote access communication paths
  - The Ethernet network when the IFE or EIFE interface is present
  - The Modbus-SL network when the IFM interface is present

For more detailed information on cybersecurity for the Masterpact MTZ circuit breakers, refer to *Masterpact MTZ - Cybersecurity Guide*.

General Cybersecurity Recommendations

There are some general rules to follow to protect the availability, integrity, and confidentiality of your systems and network.

For general guidelines on securing remote access to your network and for implementing a secure operating environment, refer to *How Can I Reduce Vulnerability to Cyber Attacks?*.

⚠ WARNING

POTENTIAL COMPROMISE OF SYSTEM AVAILABILITY, INTEGRITY, AND CONFIDENTIALITY

- Change default passwords to help prevent unauthorized access to device settings and information.
- Disable unused ports/services and default accounts to help minimize pathways for malicious attackers.
- Place networked devices behind multiple layers of cyber defenses (such as firewalls, network segmentation, and network intrusion detection and protection).
- Use cybersecurity best practices (for example, least privilege, separation of duties) to help prevent unauthorized exposure, loss, modification of data and logs, or interruption of services.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

Cybersecurity Recommendations for Local Access Communication Paths

To help protect local access communication paths, it is recommended to:

- Keep locked the enclosure where the Masterpact MTZ circuit breaker is located so that no unauthorized person can access the Micrologic X control unit.

Specific Cybersecurity Recommendations for Wireless Bluetooth Low Energy Communication

Data transfers using BLE wireless communication are encrypted, therefore the risk of an unauthorized person gaining access to confidential information during transmission is limited.

To protect access to functions accessible through Bluetooth, it is recommended to:

- Disable Bluetooth communications *(see page 176)* if you do not want to use Bluetooth.
- Set the Bluetooth automatic disconnection timer to the minimum time (5 minutes).
- Make sure that the smartphones running the Masterpact MTZ Mobile App are password-protected and for professional use only.
- Do not give away information about the smartphone (telephone number, MAC address) if it is not necessary.
- Disconnect the smartphone from the Internet during a Bluetooth connection with the Micrologic X control unit.
- Do not store confidential or sensitive information on smartphones.

Specific Cybersecurity Recommendations for Wireless NFC Communication

To protect access to data accessible through NFC, it is recommended to make sure that the smartphones running the Masterpact MTZ Mobile App are password-protected and for professional use only.

Specific Cybersecurity Recommendations for USB Connection

To protect access to functions accessible through a USB connection on the Micrologic X control unit, it is recommended that:

- The PCs running the monitoring software are hardened following the guidelines provided in *Masterpact MTZ - Cybersecurity Guide*
- The most up-to-date hardening methods for the operating system are running on your PCs.

Specific Cybersecurity Recommendations for USB OTG Connection

To protect access to functions accessible through a USB OTG connection on the Micrologic X control unit, it is recommended that:

- The smartphones running the Masterpact MTZ Mobile App are hardened following the guidelines provided in *Masterpact MTZ - Cybersecurity Guide*
- The most up-to-date hardening methods for the operating system are running on your smartphones.

Cybersecurity Recommendations for Remote Access Communication Paths Through a Communication Network

When the Masterpact MTZ circuit breaker is connected to a communication network through the IFE, EIFE or IFM interface, it is recommended to:

- Follow general security rules to protect your network.
- Make sure that the PCs running the monitoring software are hardened following the guidelines provided in *Masterpact MTZ - Cybersecurity Guide*, and with the most up-to-date hardening methods for the operating system running on your PCs.

Chapter 8
Event Management

What Is in This Chapter?

This chapter contains the following topics:

Event Management

Definition

An event is a change in state of digital data, or any incident detected by the Micrologic X control unit, EIFE Ethernet interface, or IO modules.

Events are time stamped and logged in the event history of each module.

Events are categorized according to a level of severity:
- High: urgent corrective action is required.
- Medium: corrective action needs to be scheduled.
- Low: for information only.

All high and medium severity events generate an alarm and a pop-up notification screen *(see page 191)* on the Micrologic X control unit display screen.

Low severity events are information-type events. They can be consulted as follows:
- With Ecoreach software.
- With Masterpact MTZ Mobile App

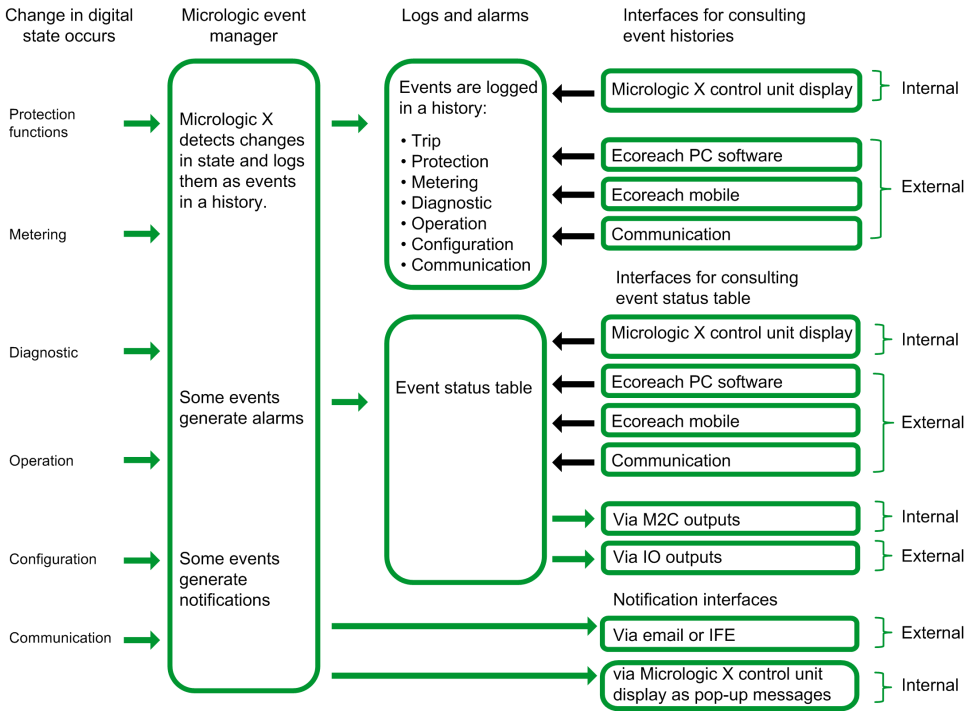
Low severity events are information-type events. They can be consulted through Ecoreach software.

Alarms and trips are events that require specific attention from the user:
- A trip is a high severity event generated when the circuit breaker trips.
- An alarm is an event with medium or high severity.

The information in this chapter is valid for events detected by the Micrologic X control unit. Refer to the following documents for events detected by the EIFE Ethernet interface, or by IO modules:
- For information about EIFE events, refer to *Enerlin'X EIFE - Embedded Ethernet Interface for One Masterpact MTZ Drawout Circuit Breaker - User Guide*.
- For information about IO events, refer to *Enerlin'X IO - Input/Output Application Module for One Circuit Breaker - User Guide*.

Management of Events by Micrologic X Control Unit

The following diagram gives an overview of how events are managed by the Micrologic X control unit.



Event Time Stamping

Each event is time stamped with the date and time of the Micrologic X internal clock *(see page 22)*.

Event Status Overview

Event Status Definition

The status of an event is *active*, *inactive*, or *held*. It depends on the event type and whether it is latched or unlatched. The status of all events can be consulted at any time *(see page 192)*.

Event Type

Events can be the following types:

- **Occurrence/completion** (on/off): Events which have a defined beginning and end, representing the beginning or end of a system state. The occurrence and completion are both time-stamped and logged in a history. For example, control unit overheating is an occurrence/completion event.
- **Instantaneous**: Events with no duration. For example, the reception of an opening order, a change to settings, or a circuit breaker trip are instantaneous events.

The event type cannot be customized.

Latched or Unlatched Events

An event can be unlatched or latched:

- **Unlatched**: The event status is active while the cause of the event is present. It automatically returns to inactive when the cause of the event disappears or is resolved.
- **Latched**: The event status does not automatically return to inactive when the cause of the event disappears or is resolved. It stays in the held state until it is reset by the user.

The latched/unlatched mode for certain events *(see page 195)* can be customized through Ecoreach software.

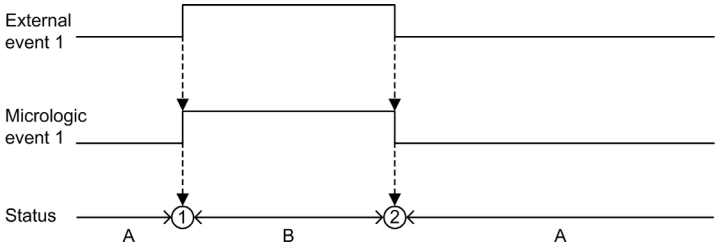
Disabling Events

Certain events can be disabled so that the event is not taken into consideration by the Micrologic X control unit. In this case, the event is not logged in a history and does not generate an alarm.

Events can be disabled through Ecoreach software. For more information about which events can be disabled, refer to the event list *(see page 195)*. Events can be enabled again after being disabled.

Unlatched Occurrence/Completion Events

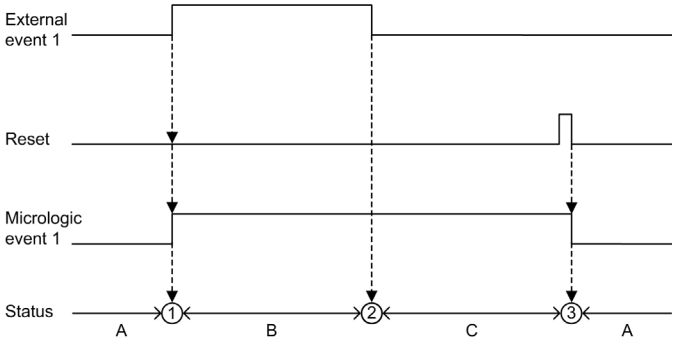
The following graph shows the event status for an unlatched occurrence/completion event:



A Event inactive
B Event active
1 Event occurrence: event is time stamped, logged in a history and notified, depending on severity
2 Event completion: event is time stamped and logged in a history

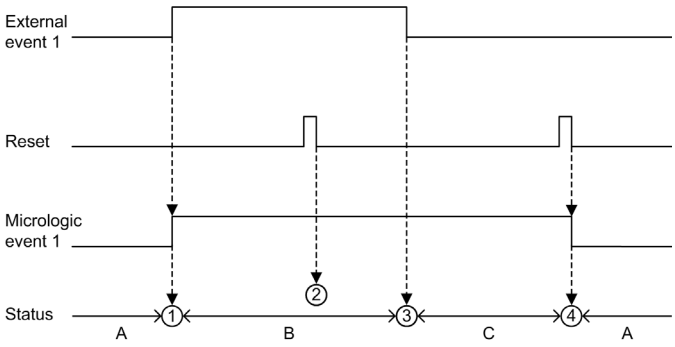
Latched Occurrence/Completion Events

The following graph shows the event status for a latched occurrence/completion event:



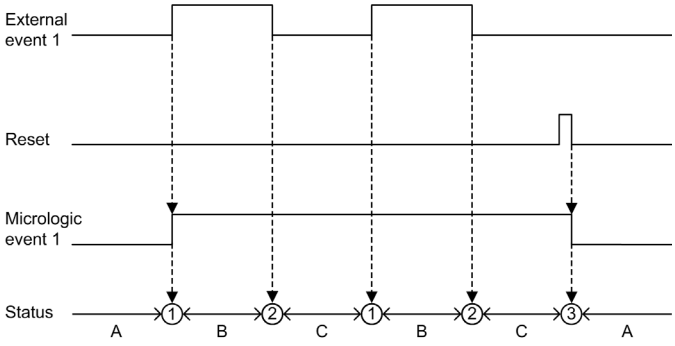
A Event inactive
B Event active
C Event held
1 Event occurrence: event is time stamped, logged in a history and notified, depending on severity
2 Event completion: event is time stamped and logged in a history
3 Event reset: reset command is time stamped and logged in operation history. All held events are reset.

The following graph shows the event status for a latched event where a reset is attempted before completion of the event:



A Event inactive
B Event active
C Event held
1 Event occurrence: event is time stamped, logged in a history and notified, depending on severity
2 Event reset: reset command is time-stamped and logged in the operation history but has no effect on Micrologic event 1 as external event is not completed
3 Event completion: event is time stamped and logged in a history
4 Event reset: reset command is time stamped and logged in the operation history. All held events are reset.

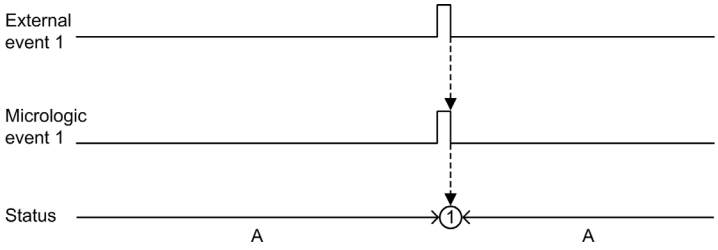
The following graph shows the event status for a latched, recurring occurrence/completion event:



A Event inactive
B Event active
C Event held
1 Event occurrence: event is time stamped, logged in a history and notified, depending on severity
2 Event completion: event is time stamped and logged in a history
3 Event reset: reset command is time stamped and logged in the operation history. All held events are reset.

Unlatched Instantaneous Events

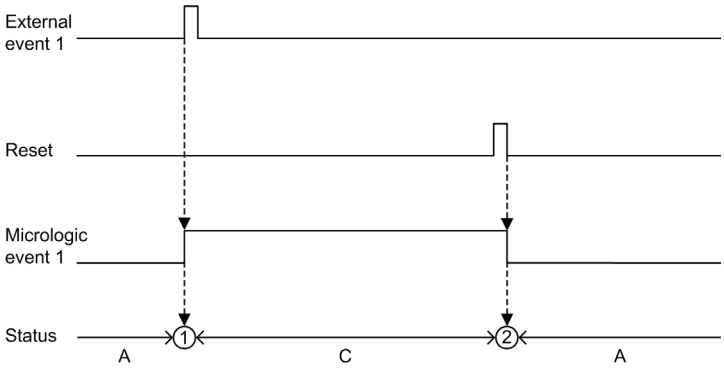
The following graph shows the event status for an unlatched instantaneous event:



A Event inactive
1 Event occurrence: event is time stamped, logged in a history and notified, depending on severity

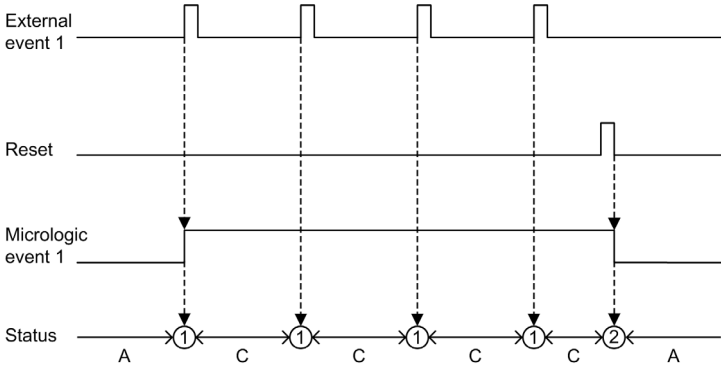
Latched Instantaneous Events

The following graph shows the event status for a latched instantaneous event:



A Event inactive
C Event held
1 Event occurrence: event is time stamped, logged in a history and notified, depending on severity
2 Event reset: reset command is time stamped and logged in the operation history. All held events are reset.

The following graph shows the event status for a latched, recurring instantaneous event:



A Event inactive
C Event held
1 Event occurrence: event is time stamped, logged in a history and notified, depending on severity
2 Event reset: reset command is time stamped and logged in the operation history. All held events are reset.

Resetting Events

Events can be reset as follows:

- By pressing the Test/Reset button on the front of the Micrologic X control unit for 3–15 seconds.
- With Ecoreach software.

Reset commands do not target specific events. All held event states managed by the Micrologic X control unit are reset, and all trip cause LEDs are cleared.

Reset commands target a specific module. For example, pressing the Test/Reset button for 3–15 seconds resets the events of the Micrologic X control unit but does not reset the events of the IO module.

The reset command generates the following event:

Event	History	Severity
Alarm reset	Operation	Low

Event Notifications

Presentation

The following events are notified as standard and cannot be configured:
- High severity events (including trips) and medium severity events are notified by a pop-up screen on the Micrologic X control unit.
- Trip events are notified by SDE1 standard fault-trip indication contact and SDE2 optional fault-trip indication contact.

In addition, all events can be configured to be notified in the following ways:
- By optional M2C module.
- By optional IO module.
- By email from IFE or EIFE Ethernet interface.

Pop-up Screen

All high and medium severity events generate a pop-up screen on the Micrologic X display screen *(see page 58)*:
- A red pop-up screen indicates a trip or high severity event, needing immediate attention.
- An orange pop-up screen indicates a medium severity event, recommending action.

M2C Notifications

Ecoreach software allows the assignment of one or more events to either of the two M2C outputs.

The M2C output remains on as long as one of the events assigned is active or held.

Ecoreach software also enables the status of the M2C outputs to be forced.

Forcing an M2C output generates the following events:

Event	History	Severity
M2C output 1 is forced	Operation	Low
M2C output 2 is forced	Operation	Low

IO Module Notifications

Ecoreach software allows the assignment of one or more events to IO module outputs available according to the IO module predefined or user-defined applications selected.

The IO module output remains on as long as one of the events assigned is active or held. The operating mode of the IO module output must be set as non-latching.

Ecoreach software also enables the status of IO module outputs to be forced.

Refer to *Enerlin'X IO - Input/Output Application Module for One Circuit Breaker - User Guide*.

Email Notification

IFE or EIFE webpages allow events to be selected for notification by email. The notification by email is not configured by default.

Refer to the following documentation:
- *Enerlin'X IFE - Ethernet Interface for One Circuit Breaker - User Guide*
- *Enerlin'X EIFE - Embedded Ethernet Interface for One Masterpact MTZ Drawout Circuit Breaker - User Guide*

Event Status Table

Introduction

The event status table contains the status of all events at the time of consultation. The status can be inactive, active, or held.

Event status for active and held events is displayed:
- On the Micrologic X display screen.
- With Ecoreach software.
- With the Masterpact MTZ Mobile App.

The status of an event can be checked using the communication network.

Displaying the Event Status Table on the Micrologic X Display Screen

Display the event status table on the Micrologic X display screen at **Home → Alarms & History → Alarms**.

High and medium severity active and held events are displayed.

The events are displayed in no specific order, with the description of the event and the time it occurred.

If the event is completed while the screen is open, the message **Completed** is displayed on the screen.

Displaying the Event Status Table on Ecoreach Software

High and medium severity, active and held events are displayed.

By default, events are sorted chronologically.

Events can be filtered by:
- Severity:
  - Alarms: High severity events
  - Warnings: Medium severity events
- Topic (History)

Once filtered, events can be sorted by other parameters, such as date, status, or message.

Displaying the Event Status Table on Masterpact MTZ Mobile App

By default, events are sorted chronologically. They can be sorted by other parameters such as status, history, message, date, or severity.

Event History

Overview

All events are logged in one of the histories of the Micrologic X control unit:
- Trip
- Protection
- Diagnostic
- Metering
- Configuration
- Operation
- Communication

All severities of events are logged, including low-severity events.

The occurrence and completion of an event are logged as two separate events.

Events logged in histories are displayed as follows:
- On the Micrologic X display screen
- With Ecoreach software
- With the Masterpact MTZ Mobile App

The event histories can be downloaded using the communication network.

The following information is logged in a history for each event:
- Event ID: name or code or user message
- Event type: occurrence/completion or instant
- Time stamp: date and time of occurrence/completion
- Context data (only for certain events)

Number of Events in Each History

Each history has a predefined maximum size. When a history is full, each new event overwrites the oldest event in the relevant history.

Event history	Number of events stored in history
Trip	50
Protection	100
Diagnostic	300
Metering	300
Configuration	100
Operation	300
Communication	100

Displaying Event History on Micrologic X Display Screen

Only high severity and medium severity events logged in histories are displayed on the Micrologic X display screen:
- Display events logged in the trip history at **Home → Alarms & History → Trip History**
- Display events logged in other histories at **Home → Alarms & History → Alarm History**

Events are displayed in chronological order, with the event name and time stamp, starting with the most recent.

Only occurrences of occurrence/completion events are displayed.

Displaying Event History on Ecoreach Software

All events logged in histories are displayed on the Ecoreach software.

Events in histories are displayed in chronological order, starting with the most recent event.

Events can be sorted and filtered by using the following criteria:
- Date and time
- Severity
- History

Displaying Event History on Masterpact MTZ Mobile App

All events logged in histories are displayed on the Masterpact MTZ Mobile App.

Events in histories are displayed in chronological order, starting with the most recent event.

Events can be sorted and filtered by using the following criteria:

- Date and time
- Severity
- History

Erase History Content

The content of all histories can be erased with Ecoreach software.

Erasing the history generates the following event:

Event	History	Severity
Events in history log have been erased	Diagnostic	Low

Event List

Event Characteristics

The events are listed according to the history in which they are logged *(see page 193)*.

Each event is defined by the following characteristics:

- User message: message displayed on Ecoreach software.
- Code: event code in hexadecimal.
- Type *(see page 187)*: not customizable
  - On/off: occurrence/completion event.
  - Instant: instantaneous event.
- Latched *(see page 187)*:
  - Yes: the event is latched and the user must reset the event status.
  - No: the event is unlatched.

  NOTE: The latched status of events marked [1] in the following tables can be customized with Ecoreach software.
- Activity *(see page 187)*:
  - Enabled: the event is enabled by default.
  - Disabled: the event is disabled by default.

  NOTE: The activity of events marked [1] in the following tables can be customized with Ecoreach software.
- Severity:
  - High severity trips and events.
  - Medium severity events.
  - Low severity events.

Trip Events

User message	Code	History	Type	Latched	Activity	Severity
Ir trip *(see page 67)*	0x6400	Trip	Instant	Yes	Enabled	High
Isd trip *(see page 70)*	0x6401	Trip	Instant	Yes	Enabled	High
Ii trip *(see page 72)*	0x6402	Trip	Instant	Yes	Enabled	High
Ig trip *(see page 74)*	0x6403	Trip	Instant	Yes	Enabled	High
IΔn trip *(see page 77)*	0x6404	Trip	Instant	Yes	Enabled	High
Ultimate self-protection trip (SELLIM) *(see page 64)*	0x6406	Trip	Instant	Yes	Enabled	High
Internal failure trip *(see page 151)*	0x6407	Trip	Instant	Yes	Enabled	High
Ultimate self-protection trip (DIN/DINF) *(see page 64)*	0x641D	Trip	Instant	Yes	Enabled	High
IΔn / Ig test trip *(see page 75)*	0x641E	Trip	Instant	Yes	Enabled	High

Protection Events

User message	Code	History	Type	Latched	Activity	Severity
Ultimate self-protection (DIN/DINF) operate *(see page 64)*	0x0631D	Protection	On/off	No	Enabled	Medium
Ultimate self-protection (SELLIM) operate *(see page 64)*	0x6306	Protection	On/off	No	Enabled	Medium
Thermal memory reset order *(see page 68)*	0x0F11	Protection	Instant	No[1]	Enabled	Low
Ir prealarm (I>90%Ir) *(see page 69)*	0x03F5	Protection	On/off	No	Enabled[1]	Medium
Ir start (I>105%Ir) *(see page 69)*	0x6200	Protection	On/off	No[1]	Enabled	Medium
Ir operate *(see page 69)*	0x6300	Protection	On/off	No	Enabled	Medium
Isd start *(see page 71)*	0x6201	Protection	On/off	No[1]	Enabled	Low
Isd operate *(see page 71)*	0x6301	Protection	On/off	No	Enabled	Medium
Ii operate *(see page 72)*	0x6302	Protection	On/off	No	Enabled	Medium
Ig start *(see page 74)*	0x6203	Protection	On/off	No[1]	Enabled	Low
Ig operate *(see page 74)*	0x6303	Protection	On/off	No	Enabled	Medium
IΔn start *(see page 77)*	0x6204	Protection	On/off	No	Enabled	Low
IΔn operate *(see page 77)*	0x6304	Protection	On/off	No	Enabled	Medium
B curve active *(see page 81)*	0x1300	Protection	On/off	No	Enabled	Low
Protection settings change by display enabled *(see page 65)*	0x1309	Protection	On/off	No[1]	Enabled	Low
Remote protection settings change enabled *(see page 65)*	0x130A	Protection	On/off	No[1]	Enabled	Low
Protection settings changed by display *(see page 64)*	0x1100	Protection	Instant	No[1]	Enabled	Low
Protection changed by Bluetooth/USB/IFE *(see page 64)*	0x1108	Protection	Instant	No[1]	Enabled	Medium
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Diagnostic Events

User message	Code	History	Type	Latched	Activity	Severity
Loss of IO1 module *(see page 151)*	0x1120	Diagnostic	Instant	Yes	Enabled[1]	Medium
Loss of IO2 module *(see page 151)*	0x1121	Diagnostic	Instant	Yes	Enabled[1]	Medium
Loss of IFE module *(see page 151)*	0x1122	Diagnostic	Instant	Yes	Enabled[1]	Medium
Control unit in test mode *(see page 182)*	0x1302	Diagnostic	On/off	No	Enabled	Low
Injection test in progress *(see page 182)*	0x1303	Diagnostic	On/off	No	Enabled	Low
Test aborted by user *(see page 182)*	0x1304	Diagnostic	Instant	No	Enabled	Low
Control unit self test major malfunction *(see page 148)*	0x1400	Diagnostic	On/off	No	Enabled	High
Internal current sensor disconnected *(see page 148)*	0x1402	Diagnostic	On/off	No	Enabled	High
External neutral current sensor disconnected *(see page 148)*	0x1403	Diagnostic	On/off	No	Enabled	High
Earth leakage (Vigi) sensor disconnected *(see page 148)*	0x1408	Diagnostic	On/off	No	Enabled	High
Protection reset to default setting if rebooted ! *(see page 151)*	0x1430	Diagnostic	On/off	No	Enabled	High
Protection settings no longer accessible error 1–5 *(see page 151)*	0x140F–0x1477	Diagnostic	On/off	No	Enabled	Medium
Control unit self test minor malfunction 1–5 *(see page 151)*	0x1407–0x1473	Diagnostic	On/off	No	Enabled	Low/Medium
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User message	Code	History	Type	Latched	Activity	Severity
Metering malfunction 1–3 *(see page 151)*	0x1411–0x1479	Diagnostic	On/off	No	Enabled	Low/ Medium
NFC malfunction *(see page 151)*	0x1412	Diagnostic	On/off	No	Enabled[1]	Medium
Display screen or wireless malfunction 1–3 *(see page 151)*	0x140A–0x147B	Diagnostic	On/off	No	Enabled	Low/ Medium
Bluetooth malfunction *(see page 151)*	0x1422	Diagnostic	On/off	No	Enabled[1]	Medium
Replace battery *(see page 151)*	0x1433	Diagnostic	On/off	No	Enabled[1]	Medium
Minor control unit malfunction corrected *(see page 151)*	0x1436	Diagnostic	Instant	No	Enabled	Medium
Error reading sensor plug *(see page 151)*	0x1409	Diagnostic	On/off	No	Enabled	High
Control unit factory configuration error *(see page 151)*	0x0D0A	Diagnostic	On/off	No	Enabled	High
Critical hardware modules discrepancy *(see page 151)*	0x0D00	Diagnostic	On/off	No	Enabled	Medium
Critical firmware modules discrepancy *(see page 151)*	0x0D01	Diagnostic	On/off	No	Enabled	Medium
Non-critical hardware modules discrepancy *(see page 151)*	0x0D02	Diagnostic	On/off	No	Enabled	Medium
Non-critical firmware modules discrepancy *(see page 151)*	0x0D03	Diagnostic	On/off	No	Enabled	Medium
Address conflict between modules *(see page 151)*	0x0D08	Diagnostic	On/off	No	Enabled	Medium
Firmware discrepancy within control unit *(see page 151)*	0x0D09	Diagnostic	On/off	No	Enabled	Medium
IΔn/Ig test trip failed (IΔn *(see page 78)* Ig *(see page 75)*)	0x1413	Diagnostic	Instant	No	Enabled	High
IΔn/Ig test button pressed (IΔn *(see page 78)* Ig *(see page 75)*)	0x142A	Diagnostic	Instant	No	Enabled	Low
ZSI test in progress *(see page 86)*	0x1305	Diagnostic	Instant	No	Enabled	Low
Contact wear is above 60%. Check contacts *(see page 153)*	0x1440	Diagnostic	On/off	No	Enabled[1]	Medium
Contact wear is above 95%. Plan for replacement *(see page 153)*	0x1441	Diagnostic	On/off	No	Enabled[1]	Medium
Contact wear 100% worn out. CB needs to be replaced. *(see page 153)*	0x1442	Diagnostic	On/off	No	Enabled	High
Less than 20% CB operation remaining *(see page 154)*	0x1443	Diagnostic	On/off	No	Enabled[1]	Medium
CB has reached the max number of operations *(see page 154)*	0x1444	Diagnostic	Instant	No	Enabled[1]	High
MX1 opening release malfunction *(see page 150)*	0x1460	Diagnostic	On/off	No	Enabled	Medium
MX1 opening release no longer detected *(see page 150)*	0x1461	Diagnostic	On/off	No	Disabled[1]	Medium
MCH charging operations above threshold *(see page 150)*	0x1450	Diagnostic	On/off	No	Enabled[1]	Medium
MCH has reached the max number of operations *(see page 150)*	0x1451	Diagnostic	On/off	No	Enabled[1]	High
XF closing release malfunction *(see page 150)*	0x1462	Diagnostic	On/off	No	Enabled	Medium
XF closing release no longer detected *(see page 150)*	0x1463	Diagnostic	On/off	No[1]	Disabled[1]	Medium
MX2 / MN opening release malfunction *(see page 150)*	0x1464	Diagnostic	On/off	No	Enabled	Medium
MX2 / MN opening release no longer detected *(see page 150)*	0x1465	Diagnostic	On/off	No	Disabled[1]	Medium
Events in history log have been erased *(see page 194)*	0x1435	Diagnostic	Instant	No	Enabled	Low
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Metering Events

User message	Code	History	Type	Latched	Activity	Severity
Reset Min/Max currents *(see page 124)*	0x0F12	Metering	Instant	No[1]	Enabled	Low
Reset Min/Max voltages *(see page 124)*	0x0F13	Metering	Instant	No[1]	Enabled	Low
Reset Min/Max power *(see page 124)*	0x0F14	Metering	Instant	No[1]	Enabled	Low
Reset Min/Max frequency *(see page 124)*	0x0F15	Metering	Instant	No[1]	Enabled	Low
Reset Min/Max harmonics *(see page 124)*	0x0F16	Metering	Instant	No[1]	Enabled	Low
Reset Min/Max power factor *(see page 124)*	0x0F17	Metering	Instant	No[1]	Enabled	Low
Reset energy counters *(see page 130)*	0x0F18	Metering	Instant	No[1]	Enabled	Low
1 Customizable with Ecoreach software						

Operation Events

User message	Code	History	Type	Latched	Activity	Severity
CB moved from close to open position *(see page 169)*	0x1000	Operation	Instant	No[1]	Enabled[1]	Low
CB moved from open to close position *(see page 172)*	0x1001	Operation	Instant	No[1]	Enabled[1]	Low
Closing release activation *(see page 172)*	0x0411	Operation	Instant	No	Enabled[1]	Low
Opening release activation *(see page 169)*	0x0410	Operation	Instant	No	Enabled[1]	Low
Manual mode enabled *(see page 168)*	0x1002	Operation	On/off	No	Enabled	Low
Local mode enabled *(see page 168)*	0x1004	Operation	On/off	No	Enabled	Low
Closing inhibited by communication *(see page 172)*	0x1008	Operation	On/off	No	Enabled	Low
Closing inhibited by wired input *(see page 172)*	0x1009	Operation	On/off	No	Enabled	Low
M2C output 1 is forced *(see page 191)*	0x130B	Operation	On/off	No	Enabled	Low
M2C output 2 is forced *(see page 191)*	0x130C	Operation	On/off	No	Enabled	Low
Alarm reset *(see page 190)*	0x1307	Operation	Instant	No	Enabled	Low
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Configuration Events

User message	Code	History	Type	Latched	Activity	Severity
Configuration mismatch between IO and control unit *(see page 151)*	0x1000	Configuration	On/off	No	Enabled	Medium
Control unit in upgrade mode	0x112B	Configuration	On/off	No	Enabled	Low
Control unit firmware upgrade failed	0x112C	Configuration	Instant	No	Enabled	Medium
Date and time set *(see page 22)*	0x1107	Configuration	Instant	No[1]	Enabled	Low
Digital module license installed *(see page 21)*	0x1130	Configuration	Instant	No	Enabled	Low
Digital module license uninstalled *(see page 21)*	0x1131	Configuration	Instant	No	Enabled	Low

Communication Events

User message	Code	History	Type	Latched	Activity	Severity
USB port connected *(see page 182)*	0x1301	Communication	On/off	No	Enabled	Low
Bluetooth communication enabled *(see page 176)*	0x1429	Communication	On/off	No	Enabled[1]	Low
1 Customizable with Ecoreach software						

Appendices

Appendix A
Appendix A

What Is in This Chapter?

This chapter contains the following topics:

Licensing Information

Licensing Information for Cryptographic Software

This product includes cryptographic software written by Eric Young (eay@cryptsoft.com).

This product includes software developed by the OpenSSL Project for use in the OpenSSL Toolkit (http://www.openssl.org/).

Licensing Information for USB Communication

This product includes software developed by Texas Instruments Incorporated (http://www.ti.com/).

Radio Frequency Compliance Statements

Presentation

The following statements indicate radio frequency compliance for Masterpact MTZ circuit breakers with Micrologic X control unit, according to the requirements of the countries or geographical areas.

Europe

Hereby, Schneider Electric Industries SAS, declares that the Micrologic X control unit installed inside Masterpact MTZ circuit breaker is in compliance with the essential requirements and other relevant provisions of RED Directive 2014/53/EU.

The EU declarations of conformity for Masterpact MTZ devices can be downloaded on *www.schneider-electric.com/docs*:

- PB16070602: EU declaration of conformity for Masterpact MTZ1 devices
- PB16070601: EU declaration of conformity for Masterpact MTZ2 devices
- PB16112201: EU declaration of conformity for Masterpact MTZ3 devices

USA

Federal Communication Commission Interference Statement

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

FCC Caution: Any changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate this equipment.

This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.

Radiation Exposure Statement

This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with minimum distance 20cm between the radiator & your body.

Canada

Industry Canada Statement

This device complies with RSS-247 of the Industry Canada Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

Ce dispositif est conforme à la norme CNR-247 d'Industrie Canada applicable aux appareils radio exempts de licence. Son fonctionnement est sujet aux deux conditions suivantes: (1) le dispositif ne doit pas produire de brouillage préjudiciable, et (2) ce dispositif doit accepter tout brouillage reçu, y compris un brouillage susceptible de provoquer un fonctionnement indésirable.

Radiation Exposure Statement:

This equipment complies with IC radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with minimum distance 20cm between the radiator & your body.

Déclaration d'exposition aux radiations:

Cet équipement est conforme aux limites d'exposition aux rayonnements IC établies pour un environnement non contrôlé. Cet équipement doit être installé et utilisé avec un minimum de 20 cm de distance entre la source de rayonnement et votre corps.

Brasil

ANATEL Statement

Este equipamento opera em caráter secundário, isto é, não tem direito à proteção contra interferência prejudicial, mesmo de estações do mesmo tipo e não pode causar interferência a sistemas operando em caráter primário.

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