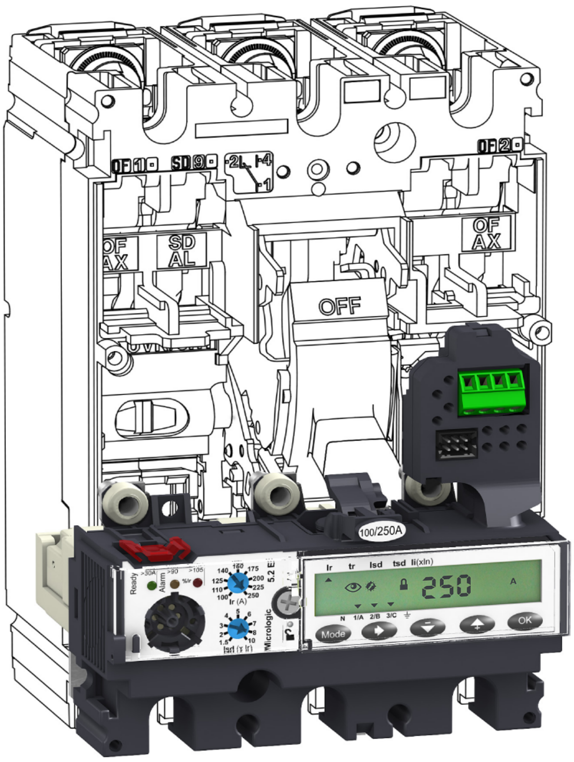
Low voltage electrical distribution

Compact NSX Micrologic 5/6

Electronic trip units

User manual
09/2009



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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.

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

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

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

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

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 the installation, and has received safety training to recognize and avoid the hazards involved.

About the Book

At a Glance

Document Scope

The aim of this manual is to provide users, installers and maintenance personnel with the technical information needed to operate the Micrologic trip units in Compact NSX circuit breakers.

Validity Note

This document is applicable to the trip units:
- Micrologic 5.2 A, 5.3 A, 5.2 E and 5.3 E
- Micrologic 6.2 A, 6.3 A, 6.2 E and 6.3 E
- Micrologic 6.2 E-M and 6.3 E-M

The other trip units in the Micrologic range and the thermal-magnetic trip units on Compact NSX circuit breakers are described in the *Compact NSX circuit breakers - User manual.*.

Related Documents

Title of Documentation	Reference Number
Compact NSX circuit breakers - User manual	LV434100
Modbus Compact NSX - User manual	LV434106
ULP system - User manual	TRV99100
Compact NSX Catalogue from 100 to 630 A	LVPED208001FR

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User Comments

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Using Micrologic Trip Units

1

Aim

This chapter describes the navigation principles for Micrologic 5, 6 and 6 E-M trip units.

What's in this Chapter?

This chapter contains the following topics:

The Micrologic Range of Trip Units

Presentation

Micrologic trip units are used on the Compact NSX range of circuit breakers. The range of Micrologic trip units consists of 2 families of electronic trip unit:

- Micrologic 1 and 2 trip units without display
- Micrologic 5 and 6 trip units with display

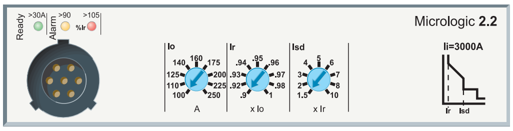
Description of the Micrologic 1 and 2 Trip Units

Micrologic trip units are grouped by application. A distinction is made between distribution and motor applications:

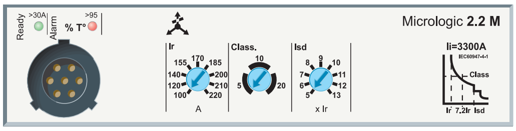
- In the distribution application, Micrologic 2 trip units are adapted to protecting conductors in commercial and industrial electrical distribution.
- In the motor application:
  - Micrologic 1.3 M trip units are adapted to short-circuit protection of motor-feeders.
  - Micrologic 2 M trip units are adapted to protecting motor-feeders on standard applications. The thermal trip curves are calculated for self-cooled motors.

The class is set via dials.

The Micrologic 1 and 2 trip units are described in the *Compact NSX circuit breakers - User manual*.



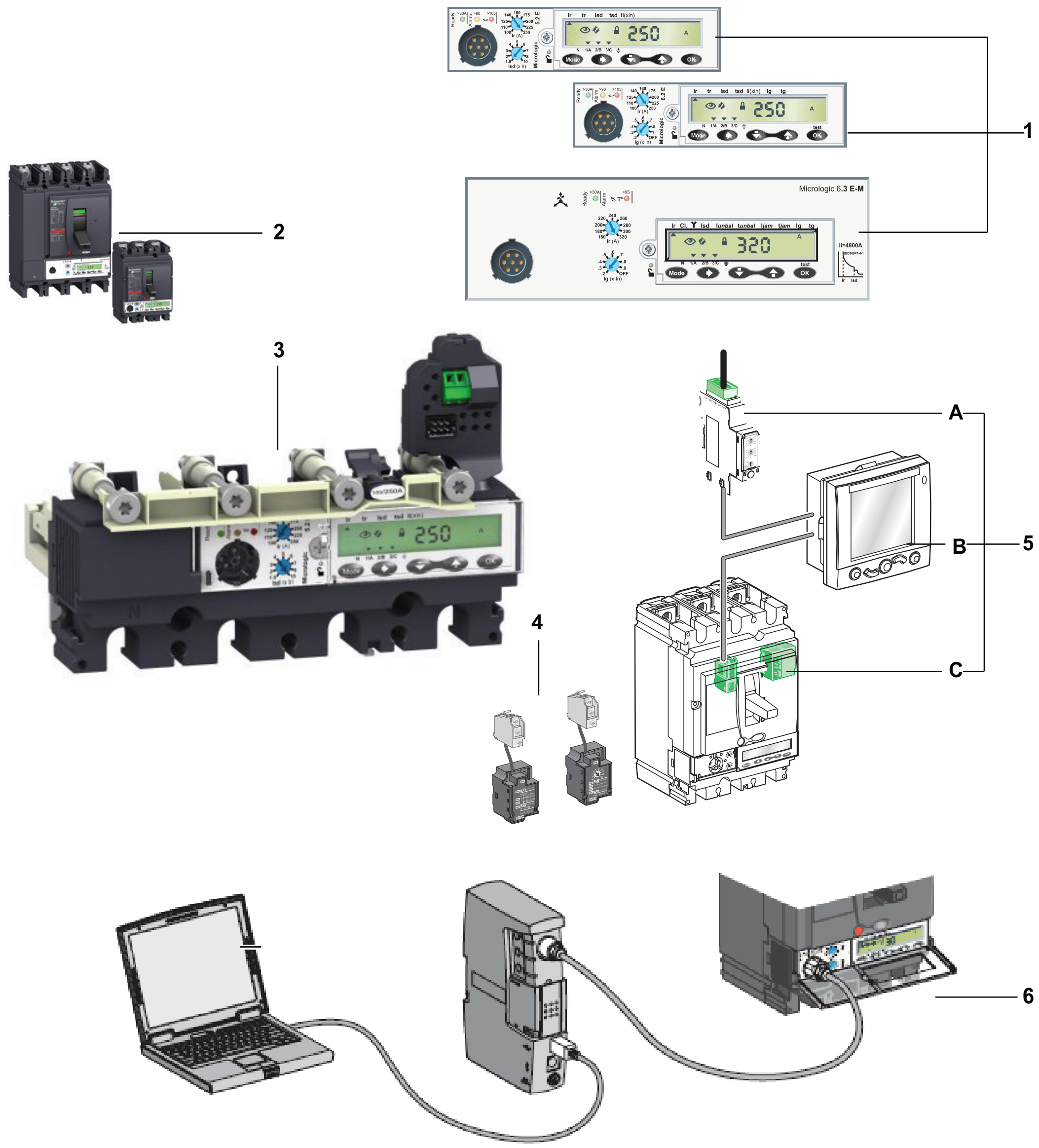
Micrologic 2.2 100 A trip unit



Micrologic 2.2 M 220 A trip unit

Description of the Micrologic 5 and 6 Trip Units

Micrologic trip units 5 and 6 are designed to provide multiple functions:
- Protecting the electrical distribution system or specific applications
- Metering instantaneous values, metering demand values for electrical quantities
- Kilowatt hour metering
- Operating assistance (peak demand values, customized alarms, operation counters, etc.)
- Communication



1 Front faces of Micrologic trip units for distribution and motor protection
2 Compact NSX 250 and 630 circuit breakers (3-pole)
3 Micrologic 5.2 A 250 trip unit (4-pole)
4 SDx and SDTAM indication modules
5 Compact NSX communicating intelligent functional unit with ULP system consisting of:
A: Modbus communication interface
B: Front display module FDM121
C: Compact NSX circuit breaker equipped with a Micrologic trip unit, a BSCM module and the NSX cord
6 Micrologic maintenance interface

For more information on the maintenance interface, indication and communication modules, refer to the *Compact NSX circuit breakers - User manual*.

Identification

The trip unit installed on the circuit breaker is identified by a combination of 4 characters on the front face:

Micrologic 6.3 E-M
X.Y Z -T

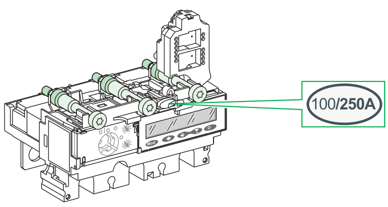
Identification on Micrologic electronic trip units

	Protection (X)	Case (Y)	Measurements (Z)	Application (T)
	1 I	**2** Compact NSX 100/ 160/250	**A** Ammeter	Distribution
	2 LS_0		**E** Energy	**G** Generator
	5 LSI	**3** Compact NSX 400/ 630		**AB** Subscriber
	6 LSIG			**M** Motor
				Z 16 Hz 2/3
Examples				
Micrologic 1.3 M	I	400 or 630 A		Motor
Micrologic 2.2 G	LS_0	100, 160 or 250 A		Generator
Micrologic 2.3	LS_0	400 or 630 A		Distribution
Micrologic 2.3 M	LS_0	400 or 630 A		Motor
Micrologic 5.2 A	LSI	100, 160 or 250 A	Ammeter	Distribution
Micrologic 5.3 E	LSI	400 or 630 A	Energy	Distribution
Micrologic 6.3 E-M	LSIG	400 or 630 A	Energy	Motor

Definition of LSIG Parameters	
I	Instantaneous
L	Long time
S_0	Short time (fixed time delay)
S	Short time
G	Ground

In Rating of Micrologic Trip Units

The In rating (in amps) of a Micrologic trip unit corresponds to the trip unit setting range maximum value. The setting range is indicated on the label on the front face of the trip unit (this label is visible on the front face of the Compact NSX circuit breaker after the trip unit has been fitted).



Example: Micrologic 5.2 A 250 trip unit:
- Setting range: 100...250 A
- In rating = 250 A

Integrating Micrologic Trip Units on the Compact NSX Range of Circuit Breakers

Micrologic 2, 5 and 6 trip units can be used on any Compact NSX circuit breaker.

The table below indicates which devices can be used according to the In rating of the distribution trip units and the circuit breaker size:

In Rating	40	100	160	250	400	630
Compact NSX100	x	x				
Compact NSX160	x	x	x			
Compact NSX250	x	x	x	x		
Compact NSX400				x (1)	x	
Compact NSX630				x (1)	x	x
(1) Micrologic 2 only						

Micrologic 2-M and 6 E-M trip units can be used on any Compact NSX circuit breaker.

The table below indicates which devices can be used according to the In rating of the motor trip units and the circuit breaker size:

In Rating	25	50	80	100	150	220	320	500
Compact NSX100	x	x	x (1)	x (2)				
Compact NSX160	x	x	x (1)	x (2)	x			
Compact NSX250	x	x	x (1)	x (2)	x	x		
Compact NSX400							x	
Compact NSX630							x	x
(1) Micrologic 6 E-M only (2) Micrologic 2 M only								

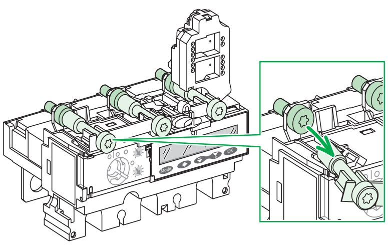
Micrologic 1.3-M trip units can be used on any Compact NSX400 and Compact NSX630 circuit breaker.

The table below indicates which devices can be used according to the In rating of the motor trip units and the circuit breaker size:

In Rating	320	500
Compact NSX400	x	
Compact NSX630	x	x

Upgradability of Trip Units

Onsite swapping of trip units is simple and safe:
- No connections to make
- No special tools (e.g. calibrated torque wrench)
- Compatibility of trip units ensured by mechanical cap
- Torque limited screw ensures safe mounting (see drawing below)

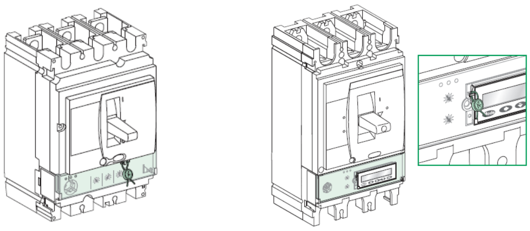


The safety of the swapping process eliminates the risk of incorrect tightening or oversights. The simplicity of the swapping process means it is easy to make the necessary adjustments as operation and maintenance processes evolve.

NOTE: When the trip unit has been mounted by this means, the trip unit can still be removed: the screw head is accessible.

Sealing the Protection

The transparent cover on Micrologic trip units can be sealed to prevent modification of the protection settings and access to the test port.



On Micrologic 5 and 6 trip units, it is possible to use the keypad, with the cover sealed, to read the protection settings and measurements.

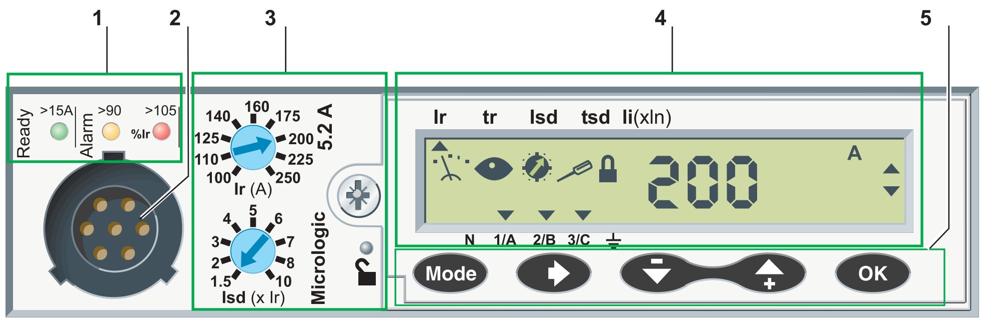
Description of the Micrologic 5 and 6 Trip Units

Presentation of the Front Face

The front face of Micrologic 5 and 6 trip units contains:

1. Indication LEDs
2. A test port
3. A set of 2 dials and 1 microswitch
4. An LCD display
5. A keypad

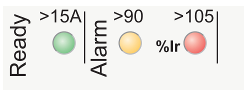
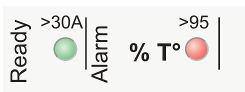
Front face of a Micrologic 5.2 A trip unit for a 3-pole circuit breaker



Indication LEDs

Indication LEDs on the front of the trip unit indicate its operational state.

The number of LEDs and their meaning depend on the type of Micrologic trip unit.

Type of Micrologic Trip Unit	Description
Distribution 	● Ready LED (green): Blinks slowly when the electronic trip unit is ready to provide protection. ● Overload pre-alarm LED (orange): Shows a steady light when the load exceeds 90% of the Ir setting. ● Overload alarm LED (red): Shows a steady light when the load exceeds 105% of the Ir setting.
Motor 	● Ready LED (green): Blinks slowly when the electronic trip unit is ready to provide protection. ● Overload temperature alarm LED (red): Shows a steady light when the motor thermal image exceeds 95% of the Ir setting.

Test Port

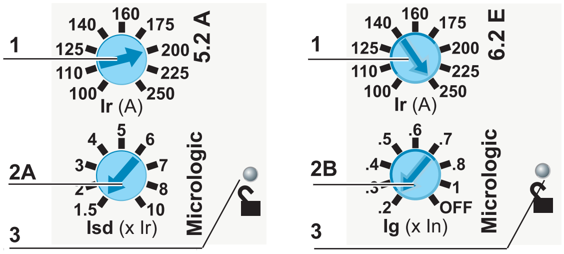
Micrologic trip units feature a test port specifically for maintenance actions (see *Compact NSX circuit breakers - User manual*).

This port is designed for:

- Connecting a pocket battery module for local testing of the Micrologic trip unit
- Connecting the maintenance module for testing, setting the Micrologic trip unit and/or for installation diagnostics

Set of 2 Dials and a Microswitch

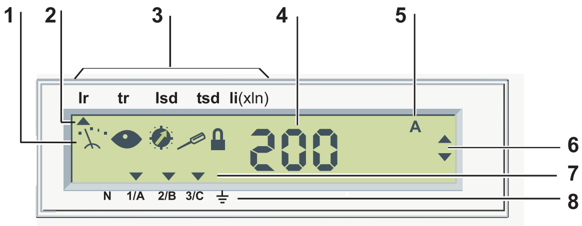
Both dials are assigned to presetting the protection parameters. The microswitch is assigned to locking/unlocking the protection parameter settings.



No.	Description
1	Pick-up Ir preset dial for all Micrologic trip unit types
2	Preset dial: ● 2A (Micrologic 5): For the short time protection pick-up Isd ● 2B (Micrologic 6): For the ground fault protection pick-up Ig
3	Microswitch for locking/unlocking the protection parameter settings

Display

The LCD display provides all the information needed to use the trip unit. The list of protection parameters is customized according to the Micrologic trip unit type: 5, 6 or 6 E-M.



No.	Description
1	5 pictograms (how these are combined defines the mode): : Metering : Readout : Protection parameter : Setting : Locking
2	Up arrow pointing to protection parameter currently being set
3	List of protection parameters according to the Micrologic trip unit type: ● Micrologic 5:  ● Micrologic 6:  ● Micrologic 6 E-M: 
4	Value of the measured quantity
5	Unit of the measured quantity
6	Navigation arrows
7	Down arrow(s) pointing to the selected phase(s), neutral or the ground
8	Phases (1/A, 2/B, 3/C), neutral (N) and ground

Display Backlighting

When the trip unit is powered by an external 24 V DC power supply, the Micrologic trip unit display has white backlighting that is:
- Low intensity continuously
- High intensity for one minute, after pressing one of the keys on the keypad

The display backlighting is:
- Deactivated if the temperature exceeds 65°C
- Reactivated once the temperature drops back below 60°C

If the trip unit is powered by the pocket battery module, the display unit is not backlit.

Keypad

The 5-button keypad is used for navigation.

Key	Description
Mode	Selecting the mode
	Scrolling navigation
	Navigation back (metering) or - (setting the protection parameters)
	Navigation forward (metering) or + (setting the protection parameters)
OK	Confirmation

Micrologic Trip Unit Power Supply

- The Micrologic trip unit is powered with its own current in order to guarantee the protection functions. If there is no optional external 24 VDC power supply, the Micrologic trip unit only works when the circuit breaker is closed. When the circuit breaker is open or the through current is low (15 to 50 A depending on the rating), the Micrologic trip unit is no longer powered and its display switches off.
- An external 24 VDC power supply for the Micrologic trip unit is optional for:
  - Modifying the setting values when the circuit breaker is open
  - Displaying measurements when there is a low current through the circuit breaker (15 to 50 A depending on the rating) when the circuit breaker is closed
  - Continuing to display the reason for the trip and the breaking current when the circuit breaker is open

The external 24 VDC power supply is available to the Micrologic trip unit once it has been connected to another module in the ULP system (Modbus communication interface module, front display module FDM121 or maintenance module).

When the Micrologic trip unit is not connected to a ULP module, it can be connected directly to an external 24 V DC power supply with the help of the optional 24 VDC supply terminal block (reference LV434210).

Navigation Principle

Locking/Unlocking the Protection Parameter Settings

The protection parameter settings are locked when the transparent cover is closed and sealed to prevent access to the adjustment dials and the locking/unlocking microswitch.

A pictogram on the display indicates whether the protection parameter settings are locked:

- Padlock locked : The protection parameter settings are locked.
- Padlock unlocked : The protection parameter settings are unlocked.

To unlock the protection parameter settings:

1. Open the transparent cover
2. Press the locking/unlocking microswitch or turn one of the adjustment dials

To lock the protection parameter settings, press the unlocking microswitch again.

The protection parameter settings also lock automatically 5 minutes after pressing a key on the keypad or turning one of the dials on the Micrologic trip unit.

Mode Definition

The information that can be accessed on the Micrologic display is split between different modes.

The modes that can be accessed depend on:

- Whether the protection parameter settings are locked
- The Micrologic trip unit version (3-pole or 4-pole)

A mode is defined by a combination of 5 pictograms.

The tables below show all the possible modes:

Pictograms	Mode Accessible With Padlock Locked
	• Instantaneous measurement **readout** • Kilowatt hour meter **readout** and reset
Max Reset ? Ok	Peak demand **readout** and reset
	Protection parameter **readout**
	Neutral declaration **readout** (3-pole Micrologic trip unit)

Pictograms	Mode Accessible With Padlock Unlocked
	• Instantaneous measurement **readout** • Kilowatt hour meter **readout** and reset
Max Reset ? Ok	Peak demand **readout** and reset
	Protection parameter **setting**
	Neutral declaration **setting** (3-pole Micrologic trip unit)

Mode Selection

A mode is selected by successive presses on the Mode button:

- The modes scroll cyclically.
- The unlocking/locking microswitch is pressed to switch from a readout mode to a setting mode (and vice versa).

Screensaver

The Micrologic display automatically reverts to a screensaver:
- In padlock locked mode, 20 seconds after the last action on the keypad
- In padlock unlocked mode, 5 minutes after the last action on the keypad or dials

The screensaver displays the current intensity of the most heavily loaded phase (Instantaneous measurement **readout** mode).

Readout Mode

Measurement Readout

A measurement is read using the  and  keys.

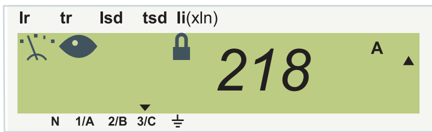
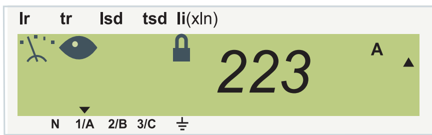
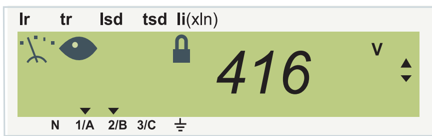
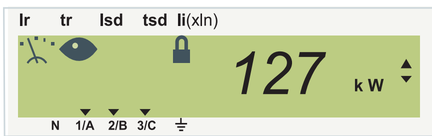
- The  keys are used to select the measurement to be displayed on-screen. The associated navigation arrows indicate the navigation options:
  -  : possible to press the  key
  -  : possible to press the  key
  -  : possible to press one of the 2  keys
- For the current and voltage measured quantities, the navigation key  can be used to select the metering screen for each of the phases:
  - The down arrow indicates the phase relating to the measurement value displayed.
    Examples:
    Quantity measured on phase 2 

    Quantity measured on all 3 phases 

  - Press the  key successively to scroll through the metering screens. Scrolling is cyclical.

Example of Measurement Readout (Micrologic E)

The table below gives the readout values of the 3 phase currents, the phase-to-phase voltage V12 and the total active power (Ptot).

Step	Action	Using	Display
1	Select the Instantaneous measurement **readout** mode (the most heavily loaded phase is displayed). Read the value of current I2.		 Ir tr Isd tsd Ii(xIn) 229 A N 1/A 2/B 3/C
2	Select the next current measurement: current I3. Read the value of current I3.		 Ir tr Isd tsd Ii(xIn) 218 A N 1/A 2/B 3/C
3	Select the next current measurement: current I1. Read the value of current I1.		 Ir tr Isd tsd Ii(xIn) 223 A N 1/A 2/B 3/C
4	Select the phase-to-phase voltage V12 measurement. Read the value of voltage V12.		 Ir tr Isd tsd Ii(xIn) 416 V N 1/A 2/B 3/C
5	Select the Ptot power measurement. Read the Ptot active power.		 Ir tr Isd tsd Ii(xIn) 127 kW N 1/A 2/B 3/C

Energy Meter Readout (Micrologic E)

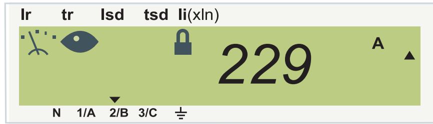
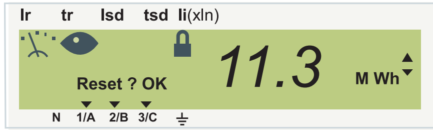
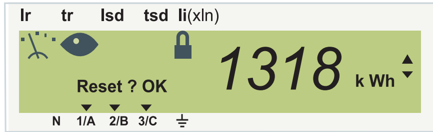
Energy meters change measurement unit automatically:

- For active energy, Ep, displayed in kWh from 0 to 9999 kWh then in MWh
- For reactive energy, Eq, displayed in kvarh from 0 to 9999 kvarh then in Mvarh
- For apparent energy, Es, displayed in kVAh from 0 to 9999 kVAh then in MVAh

When energies are indicated in MWh or Mkvarh or MVAh, the values are displayed on 4 digits. The Micrologic trip unit incorporates the option of full energy meter readout.

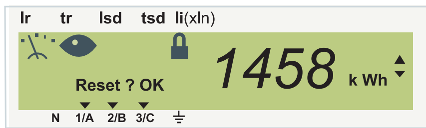
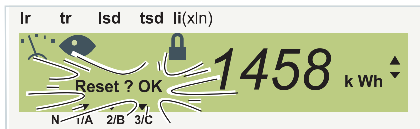
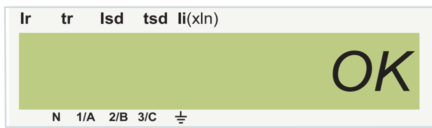
Full Energy Meter Readout

The table below gives the full readout values of the Ep active energy meter.

Step	Action	Using	Display
1	Select the **Readout and reset the energy meter** mode (main screen displayed).		
2	Select the Ep active energy meter. The value displayed is 11.3 MWh (in the example): this corresponds to 10 MWh +1300 kWh (approximately).		
3	Specify the measurement. The value displayed is 1318 kWh (in the example): the full energy meter value is 11318 kWh.		
4	Return to the energy meter normal display. The display reverts automatically after 5 minutes.		

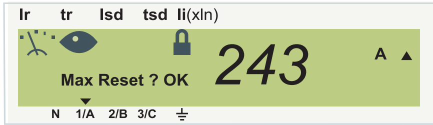
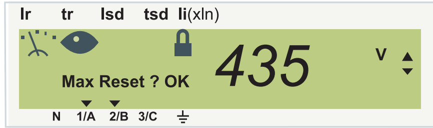
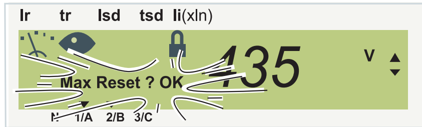
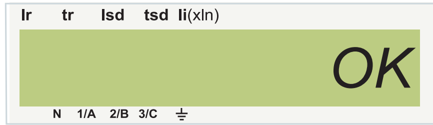
Energy Meter Reset

The energy meters can be reset with the padlock locked or unlocked .

Step	Action	Using	Display
1	Select the Measurement **readout** and reset energy meter mode (main screen displayed).		
2	Select the energy meter to be reset.		
3	Validate the reset. The OK pictogram blinks.		
4	Confirm the reset. The confirmation OK is displayed for 2 s.		

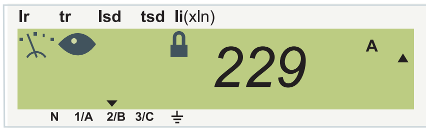
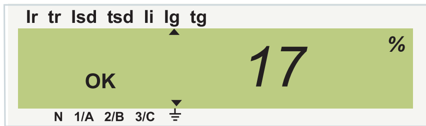
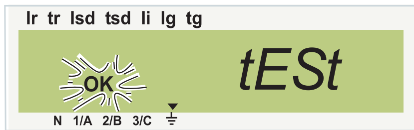
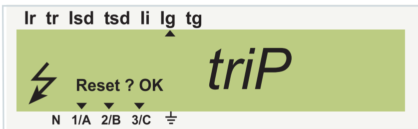
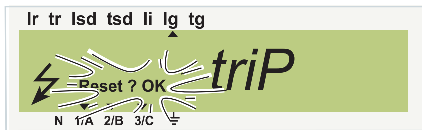
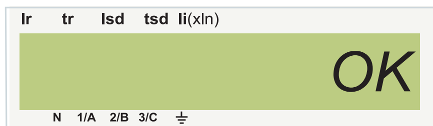
Peak Demand Values Reset

The peak demand values can be reset with the padlock locked or unlocked .

Step	Action	Using	Display
1	Select the **Readout** and reset peak demand values mode (main screen displayed).	Mode	
2	Select the peak demand to be reset.		
3	Validate the reset. The OK pictogram blinks.	OK	
4	Confirm the reset. The confirmation OK is displayed for 2 s.	OK	

Ground Fault Protection Test (Micrologic 6)

The ground fault protection test can be performed with the padlock locked or unlocked .

Step	Action	Using	Display
1	Select the Instantaneous measurement **readout** mode (the most heavily loaded phase is displayed).	Mode	
2	Select the ground fault current measurement (the value is displayed as a % of the Ig setting).		
3	Access the ground fault protection test function by pressing OK. The tESt pictogram appears and the OK pictogram blinks.	OK	
4	Prompt the ground fault protection test by pressing OK. The circuit breaker trips. The ground fault protection trip screen is displayed.	OK	
5	Acknowledge the ground fault trip screen by pressing OK. The Reset OK pictogram blinks.	OK	
6	Confirm acknowledgment by pressing OK again The confirmation OK is displayed for 2 s.	OK	

Protection Parameter Readout

A protection parameter is selected using the  key. This selection is only possible in **Readout** mode, i.e. when the padlock is locked.

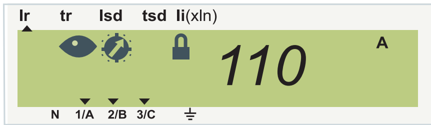
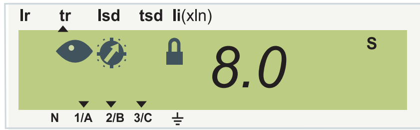
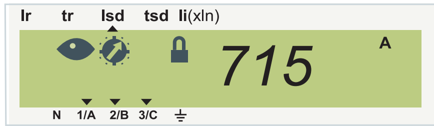
- Scrolling is cyclical.
- The up arrow (1) indicates the selected protection parameter.

Example: Ir pick-up selected 

(1) For the neutral protection parameters, the up arrow is replaced by the down arrow which points to N.

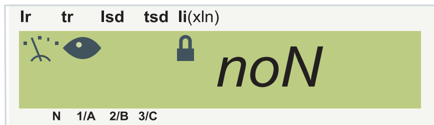
Example of Protection Parameter Readout

Readout of the setting values for the long time protection Ir pick-up, tr time delay and the short time protection Isd pick-up:

Step	Action	Using	Display
1	Select the Protection parameter **readout** mode (main screen displayed). The long time protection Ir pick-up setting value is displayed in amps.		
2	Select the long time protection tr time delay. The long time protection tr time delay setting value is displayed in seconds.		
3	Select the short time protection Isd pick-up The short time protection Isd pick-up setting value is displayed in amps.		

Neutral Declaration Readout (3-Pole Trip Unit)

The Neutral declaration **readout** mode is dedicated to this parameter: navigation is therefore limited to the  key.

Step	Action	Using	Display
1	Select the Neutral declaration **readout** mode. The neutral declaration value is displayed: ● N: Neutral protection active (3-pole trip unit with ENCT option declared) ● noN: Neutral protection not active (3-pole trip unit without ENCT option or with ENCT option not declared)		

Setting Mode

Protection parameter setting

The protection parameter settings can be accessed:
- By a dial and fine-tuned on the keypad for the main protection parameters
- On the keypad for all protection parameters

⚠ CAUTION
RISK OF NO PROTECTION OR NUISANCE TRIPPING
Only qualified persons are authorized to modify the protection parameters.
Failure to follow these instructions can result in injury or equipment damage.

The up arrow on the display indicates the protection parameter currently being set.

Setting a Protection Parameter Using a Dial

Setting using a dial (or presetting) involves the following protection parameters:
- The Ir and Isd pick-ups for Micrologic 5
- The Ir and Ig pick-ups for Micrologic 6

Turning a dial results simultaneously in:
- Selection of the screen for the protection parameter assigned to the dial
- Unlocking (if necessary) the padlock (the navigation interface is in protection parameter setting mode)
- Setting the protection parameter assigned to the dial to the value indicated on the dial and on-screen.

The protection parameter is fine-tuned on the keypad: the setting value cannot exceed that indicated by the dial

Setting a Protection Parameter on the Keypad

All the protection parameters settings can be accessed on the keypad. The user can navigate through the protection parameter settings by means of the and keys.

- The key can be used to select the parameter to be set:
  - The up arrow indicates the selected parameter.
  - The down arrows indicate that all phases are set to the same value (except for the neutral protection setting).
  - Scrolling is cyclical.
- The protection parameters are set on the keypad by means of the keys.
  The associated navigation arrows indicate the setting options:
  -  : possible to press the key (increases the setting value)
  -  : possible to press the key (decreases the setting value)
  -  : possible to press one of the 2 keys

Validation and Confirmation of a Protection Parameter Setting

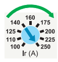
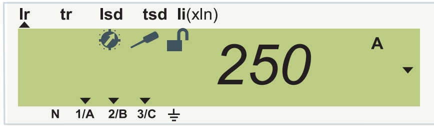
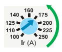
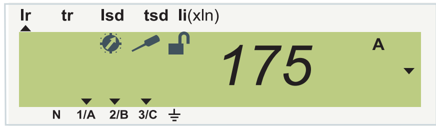
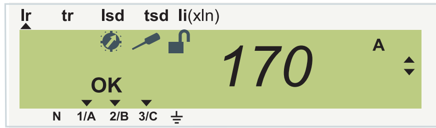
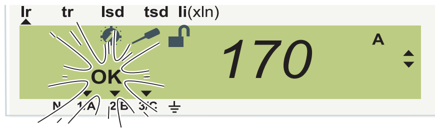
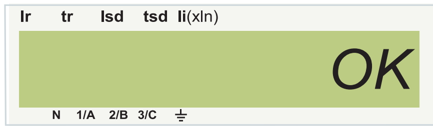
The value of a protection parameter set on the keypad must be:

1. Validated by pressing the OK key once (the OK pictogram blinks on the display)
2. then confirmed by pressing the OK key again (the text OK is displayed for 2 s).

NOTE: Setting using a dial does not require any validation/confirmation action.

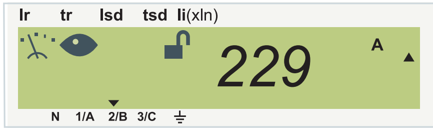
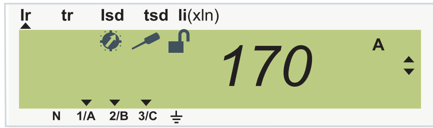
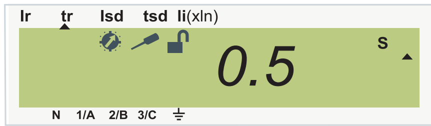
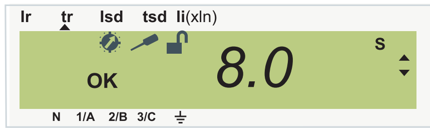
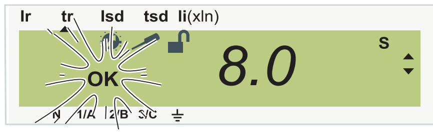
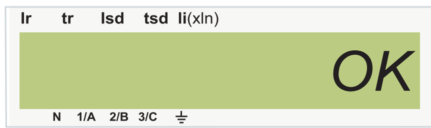
Example of Presetting a Protection Parameter Using a Dial

The table below illustrates presetting and setting the long time protection Ir pick-up on a Micrologic trip unit 5.2 rated 250 A:

Step	Action	Using	Display
1	Set the Ir dial to the maximum value (the padlock unlocks automatically). The down arrows indicate all 3 phases (the setting is identical on each phase).		
2	Turn the Ir dial to the setting above the value required.		
3	Presetting is complete: ● If the pick-up setting value is correct, exit the setting procedure (no validation is required). The long time protection Ir pick-up is set at 175 A. ● If the pick-up setting value is not suitable, fine-tune it on the keypad.		
4	Set the exact value requested for Ir on the keypad (in steps of 1 A).		
5	Validate the setting (the OK pictogram blinks).		
6	Confirm the setting (the confirmation OK is displayed for 2 s).		

Example of Setting a Protection Parameter on the Keypad

The table below illustrates setting the long time protection tr time delay on a Micrologic 5.2 trip unit:

Step	Action	Using	Display
1	Unlock the protection settings (if the 🔒 pictogram is displayed).		
2	Select the Protection parameter **setting** mode.		
3	Select the tr parameter: the up arrow moves under tr.		
4	Set the tr value required on the keypad.		
5	Validate the setting (the OK pictogram blinks).		
6	Confirm the setting (the confirmation OK is displayed for 2 s).		

Verification of the Protection Parameter Setting Value

In Protection parameter **setting** mode, a parameter setting can be expressed as a relative value.

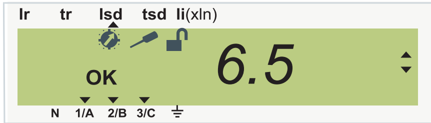
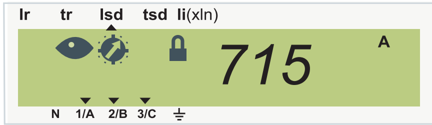
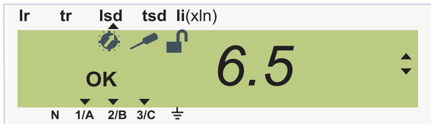
In Protection parameter setting value **readout** mode, the parameter setting is expressed directly as an actual value (for example in amps).

To determine the actual value of a parameter currently being set as a relative value, for example before validating the setting:

1. Press the locking/unlocking microswitch  once (the display switches to **Readout** mode on the parameter currently being set and indicates the actual parameter setting value).
2. Press the  microswitch again (the display reverts to **Setting** mode on the parameter currently being set).

Example of Verification of a Protection Parameter Setting Value

The table below illustrates as an example the verification of the setting value for the short time protection Isd pick-up on a Micrologic 5.2 trip unit currently being set:

Step	Action	Using	Display
1	The display is in **Setting** mode on the Isd parameter: ● The pictogram is displayed. ● The Isd pick-up setting is expressed in multiples of Ir.	–	
2	Lock the setting: ● The display switches to Setting **readout** mode on the Isd parameter (the pictogram is displayed). ● The Isd pick-up setting is expressed as a value (715 A in the example).		
3	Unlock the setting: ● The display reverts to **Setting** mode on the Isd parameter. ● The pictogram is displayed.		

List of Metering Screens

Micrologic A Ammeter

Mode	Description of Screens	Unit	Down Arrows
ou	Readout as instantaneous rms value of the: ● 3 phase currents I1/A, I2/B and I3/C	A	The down arrow indicates the conductor (phase, neutral or ground) corresponding to the value read.
	● Ground fault current (Micrologic 6)	% Ig	
	● Neutral current IN (4-pole or 3-pole with ENCT option)	A	
ou Max Reset ? Ok	Readout and resetting of the: ● Maximum Ii MAX for the 3 phase currents	A	The down arrow indicates the conductor (phase, neutral or ground) on which the maximum was measured.
	● Maximum ground fault current (Micrologic 6)	% Ig	
	● Maximum IN MAX for the neutral current (4-pole or 3-pole with ENCT option)	A	

Micrologic E Energy

Mode	Description of Screens	Unit	Down Arrows
ou	Readout as instantaneous rms value of the: ● 3 phase currents I1/A, I2/B and I3/C	A	The down arrow indicates the conductor (phase, neutral or ground) corresponding to the value read.
	● Ground fault current (Micrologic 6)	% Ig	
	● Neutral current IN (4-pole or 3-pole with ENCT option)	A	
	Readout as instantaneous rms value of the: ● Phase-to-phase voltages V12, V23 and V31 ● Phase-to-neutral voltages V1N, V2N and V3N (4-pole or 3-pole with ENVT option)	V	The down arrows indicate the conductors (phases or neutral) corresponding to the value read.
	Readout of the total active power Ptot	kW	The down arrows indicate the 3 phase conductors.
	Readout of the total apparent power Stot	kVA	
	Readout of the total reactive power Qtot	kvar	
ou Reset ? Ok	Readout and resetting of the active energy meter Ep	kWh, MWh	
	Readout and resetting of the apparent energy meter Es	kVAh, MVAh	
	Readout and resetting of the reactive energy meter Eq	kvarh, Mvarh	
ou	Readout of the phase rotation	–	
ou Max Reset ? Ok	Readout and resetting of the: ● Maximum Ii MAX for the 3 phase currents	A	The down arrow indicates the conductor (phase, neutral or ground) on which the maximum was measured.
	● Maximum ground fault current (Micrologic 6)	% Ig	
	● Maximum IN MAX for the neutral current (4-pole or 3-pole with ENCT option)	A	
	Readout and resetting of the: ● Maximum Vij MAX for the 3 phase-to-phase voltages ● Maximum ViN MAX for the 3 phase-to-neutral voltages (4-pole or 3-pole with ENVT option)	V	The down arrows indicate the phases between which the maximum V MAX L-L or L-N was measured.
	Readout and resetting of the maximum P MAX of the active power	kW	The down arrows indicate the 3 phase conductors.
	Readout and resetting of the maximum S MAX of the apparent power	kVA	
	Readout and resetting of the maximum Q MAX of the reactive power	kvar	

List of the Protection Parameter Screens

Micrologic 5 LSI: Protection Parameter Readout Screens

Mode	Description of Screens	Unit	Up/Down Arrows
	Ir: Long time protection pick-up value for the phases	A	The up arrow indicates the Ir parameter. The down arrows indicate the 3 phases.
	Ir(IN): Long time protection pick-up value for the neutral (4-pole or 3-pole trip unit with ENCT option and active neutral protection)	A	The up arrow indicates the Ir parameter. The down arrow indicates the neutral.
	tr: Long time protection time delay value (at 6 Ir)	s	The up arrow indicates the tr parameter.
	Isd: Short time protection pick-up value for the phases	A	The up arrow indicates the Isd parameter. The down arrows indicate the 3 phases.
	Isd(IN): short time protection pick-up value for the neutral (4-pole or 3-pole trip unit with ENCT option and active neutral protection)	A	The up arrow indicates the Isd parameter. The down arrow indicates the neutral.
	tsd: Short time protection time delay value The time delay is associated with the I^2t inverse time curve protection function: ● ON: I^2t function active ● OFF: I^2t function not active	s	The up arrow indicates the tsd parameter.
	Ii: Instantaneous protection pick-up value for the phases and the neutral (4-pole or 3-pole trip unit with ENCT option and active neutral protection).	A	The up arrow indicates the Ii parameter. The down arrows indicate the 3 phases.
	Neutral declaration (3-pole trip unit with ENCT option): ● N: Neutral protection active ● noN: Neutral protection not active	–	–

Micrologic 5 LSI: Protection Parameter Setting Screens

Mode	Description of Screens	Unit	Up/Down Arrows
	Ir: Long time protection pick-up setting for the phases Preset by a dial	A	The up arrow indicates the Ir parameter. The down arrows indicate the 3 phases.
	tr: Long time protection time delay setting	s	The up arrow indicates the tr parameter.
	Isd: Short time protection pick-up setting for the phases Preset by a dial	Isd/Ir	The up arrow indicates the Isd parameter. The down arrows indicate the 3 phases.
	tsd: Short time protection time delay setting Activation of the I^2t inverse time curve short time protection ● ON: I^2t inverse time curve active ● OFF: I^2t inverse time curve not active	s	The up arrow indicates the tsd parameter.
	IN: protection pick-up setting for the neutral (4-pole or 3-pole trip unit with ENCT option and active neutral protection)	IN/Ir	The down arrow indicates the neutral.
	Ii: Instantaneous protection pick-up value for the phases and the neutral (4-pole or 3-pole trip unit with ENCT option and active neutral protection).	Ii/In	The up arrow indicates the Ii parameter. The down arrows indicate the 3 phases.
	Activation of neutral declaration (3-pole trip unit with ENCT option): ● N: Neutral protection active ● noN: Neutral protection not active	–	–

Micrologic 6 LSIG: Protection Parameter Readout Screens

Mode	Description of Screens	Unit	Up/Down Arrows
	Ir: Long time protection pick-up value for the phases	A	The up arrow indicates the Ir parameter. The down arrows indicate the 3 phases.
	Ir(IN): Long time protection pick-up value for the neutral (4-pole or 3-pole trip unit with ENCT option and active neutral protection)	A	The up arrow indicates the Ir parameter. The down arrow indicates the neutral.
	tr: Long time protection time delay value (at 6 Ir)	s	The up arrow indicates the tr parameter.
	Isd: Short time protection pick-up value for the phases	A	The up arrow indicates the Isd parameter. The down arrows indicate the 3 phases.
	Isd(IN): short time protection pick-up value for the neutral (4-pole or 3-pole trip unit with ENCT option and active neutral protection)	A	The up arrow indicates the Isd parameter. The down arrow indicates the neutral.
	tsd: Short time protection time delay value The time delay is associated with the I^2t inverse time curve protection function: • ON: I^2t function active • OFF: I^2t function not active	s	The up arrow indicates the tsd parameter.
	Ii: Instantaneous protection pick-up value for the phases and the neutral (4-pole or 3-pole trip unit with ENCT option and active neutral protection).	A	The up arrow indicates the Ii parameter. The down arrows indicate the 3 phases.
	Ig: Ground fault protection pick-up value	A	The up arrow indicates the Ig parameter. The down arrows indicate the 3 phases.
	tg: Ground fault protection time delay value The time delay is associated with the I^2t inverse time curve protection function: • ON: I^2t function active • OFF: I^2t function not active	s	The up arrow indicates the tg parameter.
	Neutral declaration (3-pole trip unit with ENCT option): • N: Neutral protection active • noN: Neutral protection not active	–	–

Micrologic 6 LSIG: Protection Parameter Setting Screens

Mode	Description of Screens	Unit	Up/Down Arrows
	Ir: Long time protection pick-up setting for the phases Preset by a dial	A	The up arrow indicates the Ir parameter. The down arrows indicate the 3 phases.
	tr: Long time protection time delay setting	s	The up arrow indicates the tr parameter.
	Isd: Short time protection pick-up setting for the phases	Isd/Ir	The up arrow indicates the Isd parameter. The down arrows indicate the 3 phases.
	tsd: Short time protection time delay setting Activation of the I^2t inverse time curve short time protection ● ON: I^2t inverse time curve active ● OFF: I^2t inverse time curve not active	s	The up arrow indicates the tsd parameter.
	IN: protection pick-up setting for the neutral (4-pole or 3-pole trip unit with ENCT option and active neutral protection)	IN/Ir	The down arrow indicates the neutral.
	Ii: Instantaneous protection pick-up value for the phases and the neutral (4-pole or 3-pole trip unit with ENCT option and active neutral protection).	Ii/In	The up arrow indicates the Ii parameter. The down arrows indicate the 3 phases.
	Ig: Ground fault protection pick-up setting Preset by a dial	Ig/In	The up arrow indicates the Ig parameter. The down arrows indicate the 3 phases.
	tg: Ground fault protection time delay setting Activation of the I^2t inverse time curve ground fault protection ● ON: I^2t inverse time curve active ● OFF: I^2t inverse time curve not active	s	The up arrow indicates the tg parameter.
	Activation of neutral declaration (3-pole trip unit with ENCT option) ● N: Neutral protection active ● noN: Neutral protection not active	–	–

Micrologic 6 E-M LSIG: Protection Parameter Setting Readout Screens

Mode	Description of Screens	Unit	Up/Down Arrows
	Ir: Long time protection pick-up value for the phases	A	The up arrow indicates the Ir parameter. The down arrows indicate the 3 phases.
	Cl: Long time protection trip class (value at 7.2 Ir)	s	The up arrow indicates the Cl parameter.
	Y: Type of ventilation • Auto: Natural ventilation by the motor • Moto: Forced ventilation by a dedicated motor	–	The up arrow indicates the **Y** parameter.
	Isd: Short time protection pick-up value for the phases	A	The up arrow indicates the Isd parameter. The down arrows indicate the 3 phases.
	Iunbal: Phase unbalance protection pick-up value (expressed as a % of the average motor current)	%	The up arrow indicates the Iunbal parameter. The down arrows indicate the 3 phases.
	tunbal: Phase unbalance protection time delay value	s	The up arrow indicates the tunbal parameter.
	Ijam: Jam motor protection pick-up value (if OFF is indicated, jam motor protection is not active)	A	The up arrow indicates the Ijam parameter. The down arrows indicate the 3 phases.
	tjam: Jam motor protection time delay value	s	The up arrow indicates the tjam parameter.
	Ig: Ground fault protection pick-up value	A	The up arrow indicates the Ig parameter. The down arrows indicate the 3 phases.
	tg: Ground fault protection time delay value OFF is always indicated: the I^2t inverse time curve protection function is not available on Micrologic 6 E-M trip units.	s	The up arrow indicates the tg parameter.

Micrologic 6 E-M LSIG: Protection Parameter Setting Screens

Mode	Description of Screens	Unit	Up/Down Arrows
	Ir: Long time protection pick-up setting for the 3 phases Preset by a dial	A	The up arrow indicates the Ir parameter. The down arrows indicate the 3 phases.
	Cl: Selection of the long time protection trip class	s	The up arrow indicates the Cl parameter.
	Y: Choice of type of ventilation ● Auto: Natural ventilation by the motor active ● Moto: Forced ventilation by a dedicated motor active	–	The up arrow indicates the **Y** parameter.
	Isd: Short time protection pick-up setting for the 3 phases	Isd/Ir	The up arrow indicates the Isd parameter. The down arrows indicate the 3 phases.
	Iunbal: Phase unbalance protection pick-up setting (expressed as a % of the average motor current)	%	The up arrow indicates the Iunbal parameter. The down arrows indicate the 3 phases.
	tunbal: Phase unbalance protection time delay setting	s	The up arrow indicates the tunbal parameter.
	Ijam: Jam motor protection pick-up setting (if OFF is indicated, jam motor protection is not active)	Ijam/Ir	The up arrow indicates the Ijam parameter. The down arrows indicate the 3 phases.
	tjam: Jam motor protection time delay setting	s	The up arrow indicates the tjam parameter.
	Ig: Ground fault protection pick-up setting Preset by a dial	Ig/In	The up arrow indicates the Ig parameter.
	tg: Ground fault protection time delay setting	s	The up arrow indicates the tg parameter. The down arrows indicate the 3 phases.

The Protection Function

2

Aim

This chapter describes the protection function of Micrologic 5, 6 and 6 E-M trip units.

What's in this Chapter?

This chapter contains the following sections:

2.1 Electrical Distribution Application

Aim

This section describes the protection characteristics of Micrologic 5 and 6 trip units dedicated to protecting electrical distribution applications.

What's in this Section?

This section contains the following topics:

Electrical Distribution Protection

Presentation

Micrologic 5 and 6 trip units on Compact NSX circuit breakers provide protection against overcurrents and ground fault currents for all types of commercial or industrial application.

Micrologic 5 and 6 trip units offer protection characteristics that comply with the requirements of standard IEC 60947-2 (see *the Compact NSX circuit breakers - User manual*).

Description

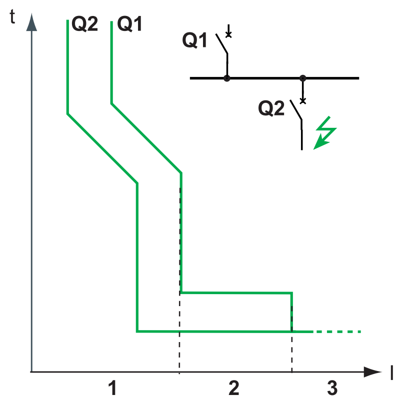
The installation rules closely define the protection characteristics to be used taking account of:
- Overcurrents (overloads and short-circuits) and potential ground fault currents
- Conductors to be protected
- The presence of harmonic currents
- Coordination between the devices

Micrologic 5 and 6 trip units are designed to satisfy all these requirements.

Discrimination Between Devices

Coordination between the upstream and downstream devices, especially discrimination, is essential to optimize continuity of service. The large number of options for setting the protection parameters on Micrologic 5 and 6 trip units improves the natural coordination between Compact NSX circuit breakers (see the *Compact NSX 100-630 A - Catalogue*).

3 discrimination techniques can be used:
1. Current discrimination, which corresponds to staging of the long time protection pick-up
2. Time discrimination, which corresponds to staging of the short time protection pick-up
3. Energy discrimination, which corresponds to staging of the circuit breaker energy levels: this applies for very high intensity short-circuit currents.



Discrimination Rules

The discrimination rules depend on:
- The type of trip unit on the circuit breakers installed upstream and downstream: electronic or thermal-magnetic
- The accuracy of the settings

Discrimination of Overload Protection

For overload protection, the discrimination rules between electronic trip units are as follows:

1. Current discrimination:
- A ratio of 1.3 between the Ir pick-up for long time protection of the trip unit on the upstream circuit breaker Q1 and that of the trip unit on the downstream circuit breaker Q2 is usually sufficient.
- The tr time delay for long time protection of the trip unit on the upstream circuit breaker Q1 is identical or higher than that of the trip unit on the downstream circuit breaker Q2.

2. Time discrimination:
- A ratio of 1.5 between the Isd pick-up for short time protection of the trip unit on the upstream circuit breaker Q1 and that of the trip unit on the downstream circuit breaker Q2 is usually sufficient.
- The tsd time delay for short time protection of the trip unit on the upstream circuit breaker Q1 is higher than that of the trip unit on the downstream circuit breaker Q2.
- If the upstream circuit breaker is in position I^2t OFF, the downstream circuit breakers must not be in position I^2t ON.

3. Energy discrimination:
- Energy discrimination is provided by the circuit breaker design and build characteristics. The discrimination limit can only be guaranteed by the manufacturer.
- For circuit breakers in the Compact NSX range, a ratio of 2.5 between the upstream circuit breaker Q1 and that of the downstream circuit breaker Q2 guarantees total discrimination.

Ground Fault Protection Discrimination

For ground fault protection, only the rules for time discrimination should be applied to the protection Ig pick-up and tg time delay:
- A ratio of 1.3 between the Ig pick-up for ground fault protection of the trip unit on the upstream circuit breaker Q1 and that of the trip unit on the downstream circuit breaker Q2 is usually sufficient.
- The tg time delay for ground fault protection of the trip unit on the upstream circuit breaker Q1 is higher than that of the trip unit on the downstream circuit breaker Q2.
- If the upstream circuit breaker is in position I^2t OFF, the downstream circuit breakers must not be in position I^2t ON.

Discrimination Limit

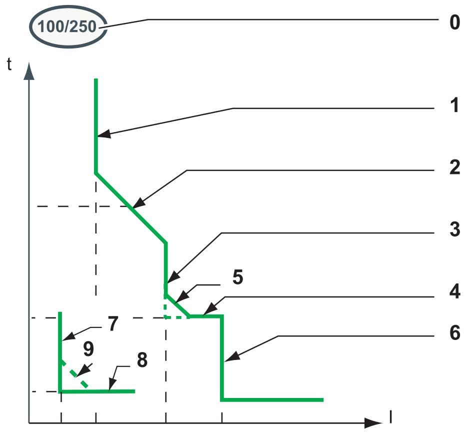
Depending on the staging of circuit breaker ratings and protection parameter settings, discrimination can be:
- Limited (partial discrimination) up to a value Is of the short-circuit current
- Total (total discrimination), performed irrespective of the value of the short-circuit current

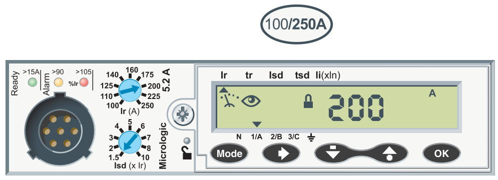
Discrimination Table

Schneider Electric provides discrimination tables showing the type of discrimination (partial or total) between each circuit breaker for its entire range of circuit breakers (see the *Compact NSX 100-630 A - Catalogue*). These coordinations are tested in accordance with the recommendations of standard IEC 60947-2.

Protection Functions

The figure and table below define the protection functions for Micrologic 5 and 6. Each function is reviewed in detail on the following pages.





No.	Parameter	Description		Micrologic	
				5	6
0	In	Trip unit setting range: Minimum setting/maximum setting = trip unit In rating		□	□
1	Ir	Long time protection pick-up	L	■	■
2	tr	Long time protection time delay		■	■
3	Isd	Short time protection pick-up	S	■	■
4	tsd	Short time protection time delay		■	■
5	I^2t ON/OFF	Short time protection I^2t curve in ON or OFF position		■	■
6	Ii	Instantaneous protection pick-up	I	■	■
7	Ig	Ground fault protection pick-up	G	–	■
8	tg	Ground fault protection time delay		–	■
9	I^2t ON/OFF	Ground fault protection I^2t curve in ON or OFF position		–	■
Function ■: Adjustable □: Non-adjustable – : Not present					

Setting the Protection

The protection parameters can be set as follows:

- On the Micrologic trip unit, using the preset dials (depending on the protection parameter and the Micrologic type) and on the keypad
- Via the communication option using the RSU software under the **Basic prot** tab

For more information on the protection parameter setting procedure using the RSU software, see *Protection parameter setting, page 121*.

Integrated Instantaneous Protection

In addition to the adjustable instantaneous protection, Micrologic trip units for electrical distribution protection feature a SELLIMnon-adjustable integrated instantaneous protection which can improve discrimination.

Reflex Protection

In addition to the devices integrated in the Micrologic trip units, Compact NSX circuit breakers are equipped with reflex protection (piston effect). As soon as a very high short-circuit current occurs (above the instantaneous protection pick-up), opening of the main contacts creates an electric arc pressure which acts on a piston instantaneously.

This piston frees the opening mechanism and causes ultra-fast circuit breaker tripping.

Long Time Protection

Presentation

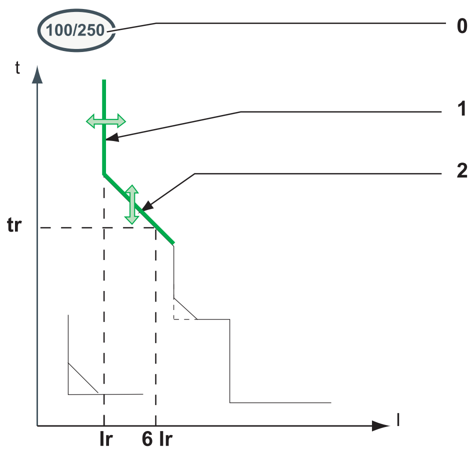
Long time protection on Micrologic 5 and 6 trip units is adapted to protecting all types of electrical distribution application against overload currents.

It is identical for Micrologic 5 and 6 trip units.

Operating Principle

Long time protection is I^2t IDMT:
- It incorporates the thermal image function.
- It can be configured as the Ir pick-up and as the tr trip time delay.

Tripping curve:



No.	Parameter	Description
0	In	Trip unit setting range: The maximum setting corresponds to the trip unit In rating
1	Ir	Long time protection pick-up
2	tr	Long time protection time delay

Setting the Long Time Protection

The Ir pick-up can be set as follows:
- On the Micrologic trip unit, preset by the Ir dial and fine-tuned on the keypad
- Via the communication option using the RSU software, preset by the Ir dial on the Micrologic trip unit and fine-tuned via the RSU software

The time delay tr can be set as follows:
- On the Micrologic trip unit, set on the keypad
- Via the communication option using the RSU software

Ir Pick-Up Setting Value

The long time protection tripping range is: 1.05...1.20 Ir according to standard IEC 60947-2.

The default Ir pick-up setting value is In (maximum dial position).

The table below shows the Ir pick-up value preset on the dial:

In Rating	Preset Values of Ir (A) Depending on the Trip Unit In Rating and the Dial Position								
40 A	18	18	20	23	25	28	32	36	40
100 A	40	45	50	55	63	70	80	90	100
160 A	63	70	80	90	100	110	125	150	160
250 A	100	110	125	140	150	175	200	225	250
400 A	160	180	200	230	250	280	320	360	400
630 A	250	280	320	350	400	450	500	570	630

The accuracy range is + 5%/+ 20%.

Fine-tuning is performed on the keypad in steps of 1A:
- The setting range maximum is the preset value displayed by the dial.
- The range minimum is 0.9 times the minimum preset value (for the 400 A rating, the setting range minimum is 100 A or 0.625 x Ir).

Example:

A Micrologic 5.2 trip unit rated In = 250 A is preset by the dial at 140 A:
- The minimum preset value is: 100 A
- The fine-tuning range on the keypad is: 90...140 A

tr Time Delay Setting Value

The setting value displayed is the value of the trip time delay for a current of 6 Ir.

The default tr time delay setting value is 0.5 (minimum value) i.e. 0.5 seconds at 6 Ir.

The table below shows the value of the trip time delay (in seconds) according to the current in the load for the setting values displayed on-screen:

Current in the Load	Setting Value					
	0.5	**1**	**2**	**4**	**8**	**16**
	tr Trip Time Delay (s)					
1.5 Ir	15	25	50	100	200	400
6 Ir	0.5	1	2	4	8	16
7.2 Ir	0.35	0.7	1.4	2.8	5.5	11

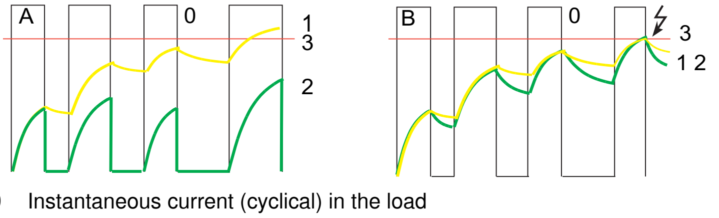
The accuracy range is -20%/+0%.

Thermal Image

The model representing the conductor heat rise is constructed according to the calculation of a thermal image. It allows the thermal state of the conductors to be monitored precisely.

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 Current calculated without thermal image (diagram A), with thermal image (diagram B)
3 Long time protection pick-up: Ir

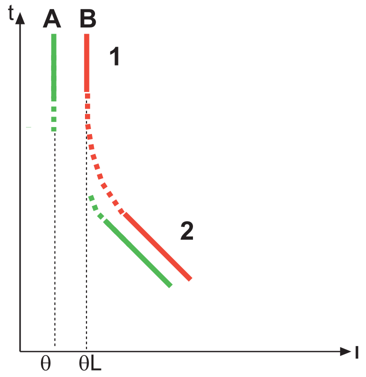
- Trip unit without thermal image: On each current pulse, the trip unit only takes account of the thermal effect on the pulse under consideration. No tripping occurs despite the build-up in conductor heat rise.
- Trip unit with thermal image: The trip unit adds together the thermal effect of successive current pulses. Tripping intervenes to take account of the actual thermal state of the conductor.

Conductor Heat Rise and Tripping Curves

Analysis of the equation of heat rise in a conductor, through which a current I runs, can be used to determine the nature of physical phenomena:

- For low or medium intensity currents (I < Ir), the conductor equilibrium temperature (for an infinite time) only depends on the current quadratic demand value (see *Quadratic Demand Value (Thermal Image), page 79*). The limit temperature corresponds to a limit current (Ir pick-up for trip unit long time protection).
- For low overcurrents (Ir < I < Isd), the conductor temperature only depends on the I^2t energy provided by the current. The limit temperature is an I^2t IDMT curve.
- For high overcurrents (I > Isd), the phenomenon is identical if the I^2t ON function of the short time protection has been configured (see *I2t ON/OFF Function, page 44*).

The figure below (in double log scales) represents a heat rise curve A (for an equilibrium temperature θ) and a trip curve B (for the limit temperature θL):



1 Low intensity current zone
2 Low overcurrent zone

Thermal Memory

Micrologic 5 and 6 trip units incorporate the thermal memory function which ensures that the conductors are cooled even after tripping: cooling lasts for 20 minutes before or after tripping.

Short Time Protection

Presentation

Short time protection on Micrologic 5 and 6 trip units is adapted to protecting all types of electrical distribution application against short-circuit currents.

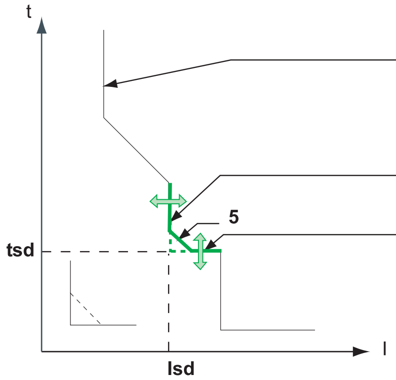
It is identical for Micrologic 5 and 6 trip units.

Operating Principle

Short time protection is definite time:

- It incorporates the possibility of an I^2t inverse time curve function
- It can be configured as the Isd pick-up and the tsd trip time delay.

Tripping curve:



No.	Parameter	Description
1	Ir	Long time protection pick-up
3	Isd	Short time protection pick-up
4	tsd	Short time protection time delay
5	I^2t	Inverse time curve function (ON or OFF)

Setting the Short Time Protection (Micrologic 5)

The Isd pick-up can be set as follows:

- On the Micrologic trip unit, preset by the Isd dial and fine-tuned on the keypad
- Via the communication option using the RSU software, preset by the Isd dial on the Micrologic trip unit and fine-tuned via the RSU software

The tsd time delay can be set as follows:

- On the Micrologic trip unit, set on the keypad
- Via the communication option using the RSU software

The tsd time delay setting incorporates activation/deactivation of the I^2t option.

Setting the Short Time Protection (Micrologic 6)

The Isd pick-up and tsd time delay can be set as follows:

- On the Micrologic trip unit, set on the keypad
- Via the communication option using the RSU software

The tsd time delay setting incorporates activation/deactivation of the I^2t option.

Isd Pick-Up Setting Value

The Isd pick-up setting value is expressed in multiples of Ir.

The default Isd pick-up setting value is 1.5 Ir (minimum dial value).

The table below shows the setting values (preset by a dial) and setting ranges (set on the keypad) of the Isd pick-up:

Type of Setting	Value or Setting Range (xIr)								
Preset by a dial (Micrologic 5)	1.5	2	3	4	5	6	7	8	10
Setting range on the keypad (1) Step: 0.5 Ir	1.5	1.5/2	1.5...3	1.5...4	1.5...5	1.5...6	1.5...7	1.5...8	1.5...10
(1) For Micrologic 6 trip units, the setting range value on the keypad is: 1.5...10 Ir.									

The accuracy range is +/- 10%.

tsd Time Delay Setting Value

The table below indicates the setting values for the tsd time delay with the I^2t OFF/ON option expressed in second(s) and the associated non-tripping and breaking times expressed in milliseconds (ms):

Parameter	Value				
tsd with I^2t OFF (s)	0	0.1	0.2	0.3	0.4
tsd with I^2t ON (s)	–	0.1	0.2	0.3	0.4
Non-tripping time (ms)	20	80	140	230	350
Maximum breaking time (ms)	80	140	200	320	500

The default tsd time delay setting value is 0 s with I^2t OFF.

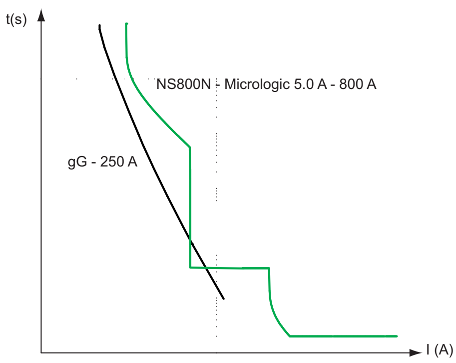
I^2t ON/OFF Function

The I^2t inverse time curve function is used to improve circuit breaker discrimination. It is particularly necessary when a protection device using inverse time only, for example a fuse protection device, is installed downstream.

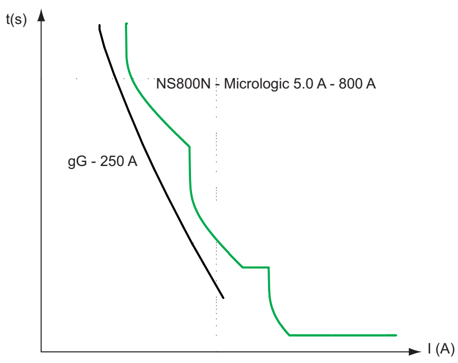
Example:

The figures below illustrate an example of discrimination between a Compact NSX630 upstream, and a gG-250 A fuse downstream (calculation performed by the Ecodial software):

I^2t OFF



I^2t ON



Total discrimination between the protections is provided by using the I^2t ON function on the short time protection.

Instantaneous Protection

Presentation

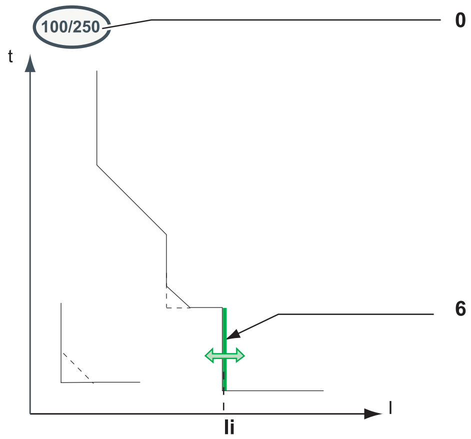
Instantaneous protection on Micrologic 5 and 6 trip units is adapted to protecting all types of electrical distribution application against very high intensity short-circuit currents.

It is identical for Micrologic 5 and 6 trip units.

Operating Principle

Instantaneous protection is definite time. It can be configured as Ii pick-up and without a time delay.

Tripping curve:



No.	Parameter	Description
0	In	Trip unit setting range: The maximum setting corresponds to the trip unit In rating
6	Ii	Instantaneous protection pick-up

Setting the Instantaneous Protection

The Ii pick-up can be set as follows:
- On the Micrologic trip unit, set on the keypad
- Via the communication option using the RSU software

Ii Pick-Up Setting Value

The Ii pick-up setting value is expressed in multiples of In.

The default Ii pick-up setting value is 1.5 In (minimum value).

The table below shows the setting ranges and steps according to the Micrologic trip unit In rating.

Trip Unit In Rating	Setting Range	Step
100 A and 160 A	1.5....15 In	0.5 In
250 A and 400 A	1.5....12 In	0.5 In
630 A	1.5....11 In	0.5 In

The accuracy range is +/- 10%.

The non-tripping time is 10 ms.

The maximum breaking time is 50 ms.

Ground Fault Protection

Presentation

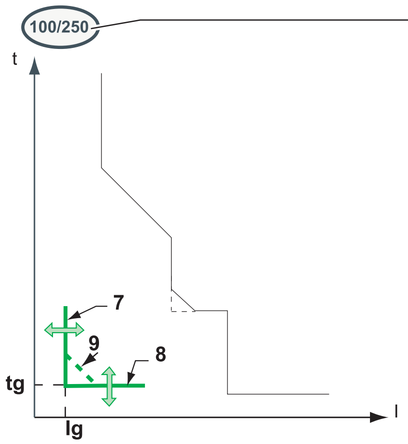
Ground fault protection on Micrologic 6 trip units is adapted to protecting all types of electrical distribution application against ground fault currents in the TN-S system.

For more details on ground fault currents, see the *Compact NSX circuit breakers - User manual*.

Operating Principle

Ground fault protection is definite time:
- It incorporates the possibility of an I^2t inverse time curve function
- It can be configured as Ig pick-up and as tg trip time delay.

Tripping curve:



No.	Parameter	Description
0	In	Trip unit setting range: Minimum setting/maximum setting = trip unit In rating
7	Ig	Ground fault protection pick-up
8	tg	Ground fault protection time delay
9	I^2t	Ground fault protection I^2t curve in ON or OFF position

Setting the Ground Fault Protection

The Ig pick-up can be set as follows:
- On the Micrologic trip unit, preset by the Ig dial and fine-tuned on the keypad
- Via the communication option using the RSU software, preset by the Ig dial on the Micrologic trip unit and fine-tuned via the RSU software

The tg time delay can be set as follows:
- On the Micrologic trip unit, set on the keypad
- Via the communication option using the RSU software

The tg time delay setting incorporates activation/deactivation of the I^2t option.

Ig Pick-Up Setting Value

The Ig pick-up setting value is expressed in multiples of In.

The default Ig pick-up setting value is the same as the minimum value read on the dial:
- 0.40 In for trip units rated 40 A
- 0.20 In for trip units rated > 40 A

Ground fault protection can be deactivated by setting the Ig dial to the OFF position.

Ground fault protection can be reactivated even with the Ig dial in the OFF position:
- By fine-tuning on the keypad
- Via the communication option

The 2 tables below specify the setting values (preset by a dial) and setting ranges (set on the keypad):
- For trip units rated 40 A
- For trip units rated higher than 40 A

On the keypad, the step is 0.05 In.

Rating 40 A

Type of Setting	Value or Setting Range (xIn)							
Preset by a dial	0.40	0.40	0.50	0.60	0.70	0.80	0.90	1	OFF
Setting range on the keypad	0.40	0.40	0.4...0.5	0.4...0.6	0.4...0.7	0.4...0.8	0.4...0.9	0.4...1	0.4...1 + OFF

Rating > 40 A

Type of Setting	Value or Setting Range (xIn)								
Preset by a dial	0.20	0.30	0.40	0.50	0.60	0.70	0.80	1	OFF
Setting range on the keypad	0.20	0.2...0.3	0.2...0.4	0.2...0.5	0.2...0.6	0.2...0.7	0.2...0.8	0.2...1	0.2...1 + OFF

The accuracy range is +/- 10%.

tg Time Delay Setting Value

The tg time delay setting value is expressed in seconds. The non-tripping and breaking times are expressed in milliseconds.

The default tg time delay setting value is 0 s with I^2t OFF.

Table of tg setting values with the I^2t OFF/ON option expressed in second(s) and the associated non-tripping and breaking times expressed in milliseconds (ms).

Parameter	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 (ms)	20	80	140	230	360
Maximum breaking time (ms)	80	140	200	320	500

I^2t ON/OFF Function

Ground fault protection is a short-circuit protection like short time protection. The same operating principle applies as for the I^2t function (see *Short Time Protection, page 43*).

Ground Fault Protection Test

The ground fault protection test can be performed on the keypad of the Micrologic trip unit (see *Ground Fault Protection Test (Micrologic 6), page 22*). This test can be used to check the trip unit's electronic tripping function.

Neutral Protection

Presentation

Neutral protection on Micrologic 5 and 6 trip units is adapted to protecting all types of electrical distribution applications against overload and short-circuit currents.

It is available on:

- 4-pole trip units
- on the 3-pole trip units with ENCT option

It is identical for Micrologic 5 and 6 trip units.

Description

The neutral conductor (if it is distributed and identical to the phases in size: i.e. full neutral) is normally protected by the phase protection.

The neutral must have specific protection if:

- It is reduced in size compared to the phases
- 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)

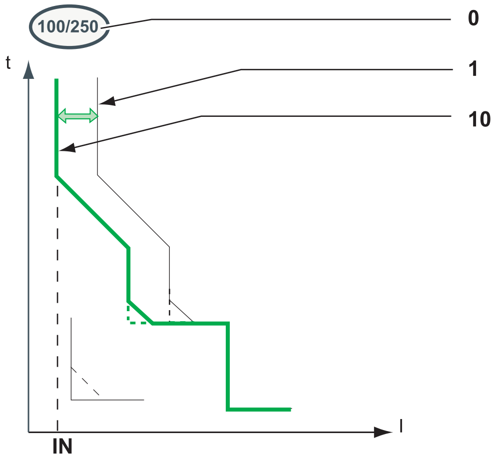
Compact NSX trip units are suitable for all protection types.

Compact NSX	Possible Types	Neutral Protection
3-pole circuit breaker	3P, 3D	None
3-pole circuit breaker with ENCT option	3P, 3D	None
	3P, 3D + N/2	Half neutral
	3P, 3D + N	Full neutral
	3P, 3D + OSN	Oversized neutral
4-Pole Circuit Breaker	4P, 3D	None
	4P, 3D + N/2	Half neutral
	4P, 4D	Full neutral
	4P, 4D + OSN	Oversized neutral
P: Pole; D: Trip unit; N: Neutral protection		

Operating Principle

Neutral protection has the same characteristics as those for phase protection:
- Its pick-up can be configured in proportion with the long time Ir and short time Isd protection pick-ups.
- It has the same trip time delay values as the long time Ir and short time Isd protections.
- Instantaneous protection is identical.

Tripping curve:



No.	Parameter	Description
0	In	Trip unit setting range: The maximum setting corresponds to the trip unit In rating
1	Ir	Long time protection pick-up
10	IN	Neutral protection pick-up

Setting the Neutral Protection

4-pole trip unit

The IN pick-up can be set as follows:
- On the Micrologic trip unit, using the keypad
- Via the communication option, using the RSU software

3-pole trip unit

Neutral declaration and the IN pick-up can be set as follows:
- On the Micrologic trip unit, using the keypad
- Via the communication option, using the RSU software

Neutral Protection Setting Value

Micrologic 5 and 6 trip units incorporate the OSN (OverSized Neutral) function, which enables protection of the neutral conductor to be managed when third-order harmonic currents (and multiples thereof) are present (see *Harmonic Currents, page 87*).

The table below shows, according to the value of the IN/Ir parameter, the setting values of the neutral long time protection and neutral short time protection pick-ups:

IN/Ir Parameter		Long Time Pick-Up Value Ir(IN)	Short Time Pick-Up Value Isd(IN)
OFF		N/A	N/A
0,5 (1)		Ir/2	Isd/2
1		Ir	Isd
OSN	3-pole (ENCT)	1.6 x Ir	1.6 x Isd
	4-pole	1.6 x Ir limited to In	1.6 x Isd limited to In x Isd/Ir
(1) For the 40 A rating, the IN/Ir = 0.5 parameter setting is not available.			

The setting values of the neutral long time and short time protection time delays are identical to those for the phases.

The table below details the setting values of the neutral protection pick-ups (set to OSN) according to the phase protection pick-up Ir setting and the In rating of the 4-pole trip unit:

Ir/In Values	Long Time Pick-Up Value Ir(IN)	Short Time Pick-Up Value Isd(IN)
Ir/In < 0.63	1.6 x Ir	1.6 x Isd
0.63 < Ir/In < 1	In	In xIsd/Ir

Selection of the ENCT option

The ENCT option is an external neutral CT for a 3-pole trip unit.

The table below indicates the reference for the ENCT option to be installed according to the In rating of the Micrologic trip unit and/or the need for OSN protection:

In Rating	Neutral Protection Limited to In	OSN > In neutral protection
40 A	LV429521	LV429521
100	LV429521	LV429521
160	LV430563	LV430563
250	LV430563	LV432575
400	LV432575	LV432575
630	LV432575	No (1)
(1) For the 630 A rating, the OSN function is limited to In (= 630 A).		

Using the ENCT Option

Step	Action
1	Connect the neutral conductor to the ENCT option primary (terminals H1, H2).
2	Remove the bridge, if present, between terminals T1 and T2 of the Micrologic trip unit.
3	Connect the ENCT option secondary (terminals T1, T2) to terminals T1 and T2 of the Micrologic trip unit.
4	Declare the ENCT option when setting the protection parameters for the Micrologic trip unit.

NOTE: If the ENCT option is declared before its installation, the Micrologic trip unit develops a fault (ENCT screen). It is then necessary to install the ENCT option or bridge between the T1 and T2 terminals of the Micrologic trip unit to acknowledge the ENCT screen. Acknowledgement is made by pressing the OK key twice (validation and confirmation).

ZSI Function

Presentation

The ZSI (Zone Selectivity Interlocking) function is a technique used to reduce the electrodynamic stress on equipment when time discrimination is used.

Principle of the ZSI Function

The ZSI function improves time discrimination by being selective about the position of the fault. A pilot wire links the installed circuit breaker trip units and can be used to manage the trip time delay for upstream circuit breaker Q1 according to the fault position.

The trip units on circuit breakers Q1 and Q2 have the same time delay settings as with time discrimination.

Diagram 3

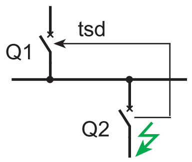
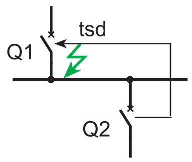


Diagram 4



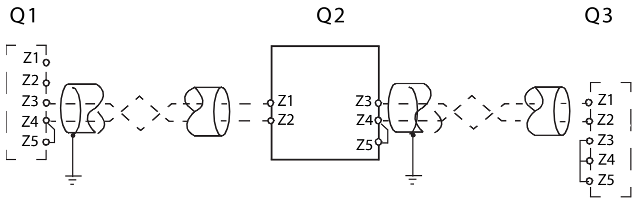
- In the event of a fault downstream of downstream circuit breaker Q2 (diagram 3), the trip units on circuit breakers Q1 and Q2 detect the fault simultaneously: via the pilot wire, the trip unit on circuit breaker Q2 sends a signal to the trip unit on circuit breaker Q1, which remains set on its time delay tsd. Circuit breaker Q2 trips and eliminates the fault (instantaneously if circuit breaker Q2 is not delayed). The other users downstream of circuit breaker Q1 are still supplied with power, the energy availability is optimized.
- In the event of a fault downstream of circuit breaker Q1 (diagram 4), the trip unit on circuit breaker Q1 does not receive a signal from the trip unit on circuit breaker Q2. Time delay tsd is therefore inhibited. Circuit breaker Q1 trips and eliminates the fault on the equipment instantaneously.
  The electrodynamic stress created by the short-circuit current on the equipment is reduced to the minimum.

The ZSI function can be used to optimize the availability of energy (just like time discrimination) and reduce electrodynamic stress on the equipment. The ZSI function is applicable to both short time and ground fault protection.

Using the ZSI Function with Compact NSX

Description

The Micrologic 5 and 6 trip units are designed to support the ZSI function. The figure below explains how the pilot wire is connected to the trip unit:



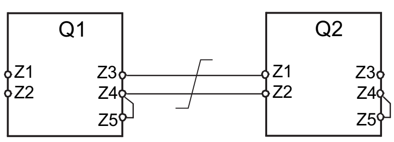
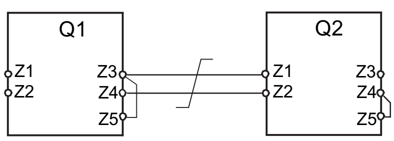
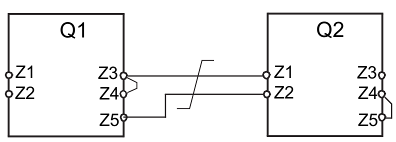
Q1 Upstream circuit breaker
Q2 Circuit breaker to be wired
Q3 Downstream circuit breaker
Z1 ZSI-OUT source
Z2 ZSI-OUT
Z3 ZSI-IN source
Z4 ZSI-IN ST short time protection
Z5 ZSI-IN GF ground fault protection (Micrologic 6)

Outputs Z3, Z4 and Z5 are only available on Compact NSX400/630 circuit breakers.

The short time and ground fault protection time delay settings (Micrologic 6) for the protections managed by the ZSI function must comply with the rules relating to time discrimination.

Connection Principles

The figures below show the options for connecting devices together:

Protection	Connection Diagram	
Ground fault and short time protection (Micrologic 6)		Output Z2 of the trip unit on the downstream circuit breaker Q2 is connected to inputs Z4 and Z5 of the trip unit on the upstream circuit breaker Q1.
Short time protection		• Output Z2 of the trip unit on the downstream circuit breaker Q2 is connected to input Z4 of the trip unit on the upstream circuit breaker Q1. • Inputs Z3 and Z5 must be short-circuited.
Ground fault protection (Micrologic 6)		• Output Z2 of the trip unit on the downstream circuit breaker Q2 is connected to input Z5 of the trip unit on the upstream circuit breaker Q1. • Inputs Z4 and Z3 must be short-circuited.

NOTE: When the ZSI function is not used downstream, inputs Z3, Z4 and Z5 must be short-circuited.

Failure to comply with this principle inhibits setting the short time and ground fault protection time delays.

Example of a Multi-Source Distribution

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

A downstream circuit breaker must be connected to all the circuit breakers installed directly upstream as follows:

- All the commons (outputs Z1/inputs Z2) are connected to one another.
- Output Z2 is connected simultaneously to inputs Z3 and/or Z4 and/or Z5 of all the trip units on the circuit breakers installed upstream.

NOTE: Management of this configuration does not require any additional relays to ensure the ZSI function is controlled according to the sources in service.

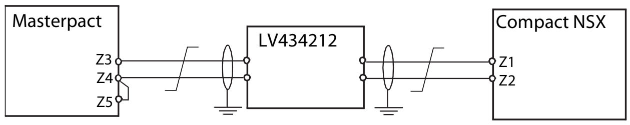
Characteristics of the Pilot Wire Connection

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

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, Z4 and Z5 (to downstream devices)	15 devices
Interconnection limit on outputs Z1 and Z2 (to upstream devices)	5 devices

NOTE: When using the Compact NSX ZSI function with circuit breakers in the Masterpact and Compact NS ranges, an RC filter, reference LV434212, must be added by a Masterpact or Compact NS circuit breaker (see *Compact NSX 100-630 A - Catalogue*).

The figure below shows the connection of the LV434212 filter:



Testing the ZSI Function

Connection and operation of the ZSI function can be tested using the LTU software.

2.2 Motor-Feeder Application

Aim

This section describes the protection characteristics of the Micrologic 6 E-M trip unit dedicated to protecting motor-feeders.

What's in this Section?

This section contains the following topics:

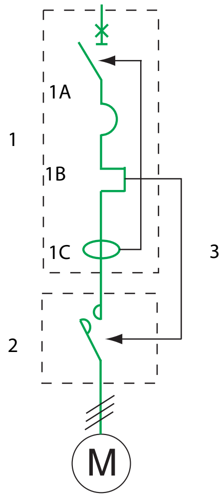
Protection for Motor-Feeders

Presentation

Micrologic 6 E-M trip units on Compact NSX circuit breakers:
- Provide protection for direct-on-line motor-feeders (direct-on-line starting is the most widely used type of motor-feeder)
- Integrate the basic protections (overload, short-circuit and phase unbalance) for the motor-feeder and additional protections and/or specific options for motor applications
- Allow protection and coordination of the motor-feeder components that comply with the requirements of standard IEC 60947-2 and IEC 60947-4-1 (see the *Compact NSX circuit breakers - User manual*).

Description

Compact NSX circuit breakers equipped with the Micrologic 6 E-M trip unit can be used to create motor-feeders to 2 devices.



1 Compact NSX circuit breaker equipped with a Micrologic 6 E-M trip unit
1A Short-circuit protection
1B Overload protection
1C Ground fault current protection
2 Contactor
3 SDTAM Module Option

Operating States

The Micrologic 6 E-M trip unit considers the application to be operating as soon as the 10% of Ir pick-up is crossed in a positive direction by the motor current.

2 operating states are considered:
- Startup
- Steady state

Startup

The Micrologic 6 E-M trip unit considers the application to be in startup mode according to the following criteria:

- Start: As soon as the 10% of Ir pick-up is crossed in a positive direction by the motor current
- End: As soon as the Id pick-up is crossed in a negative direction or at maximum after a td time delay defined as follows:
  - If long time protection has not been activated (default scenario), the Id pick-up equals 1.5 Ir and the td time delay equals 10 s (non-configurable values).
    Exceeding the 10 s time delay does not result in tripping.
  - If long time protection (see *Long Start Motor Protection, page 71*) has been activated, the Id pick-up equals I*long* and the td time delay equals t*long* (configurable values).
    Exceeding the t*long* time delay results in long time protection tripping.

NOTE: The Micrologic trip unit measurement electronics filters the subtransient state (first current peak of approximately 20 ms on contactor closing). This current peak is not therefore taken into account when assessing whether the Id pick-up has been crossed.

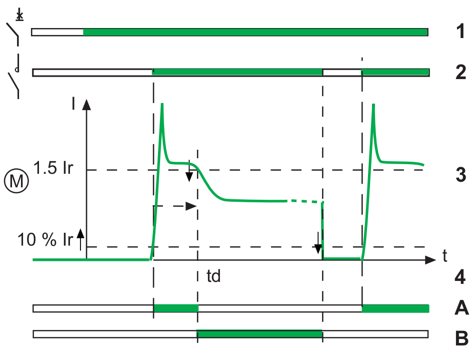
Steady State

The Micrologic 6 E-M trip unit considers the application to be in steady state according to the following criteria:

- Start: As soon as startup ends
- End: As soon as the 10% of Ir pick-up is crossed in a negative direction by the motor current

Operating Diagram

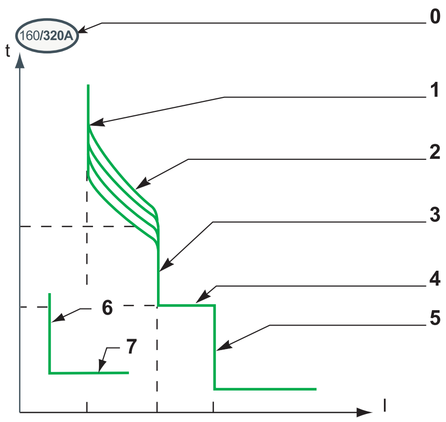
The diagram below shows the 2 operating states for a motor application:

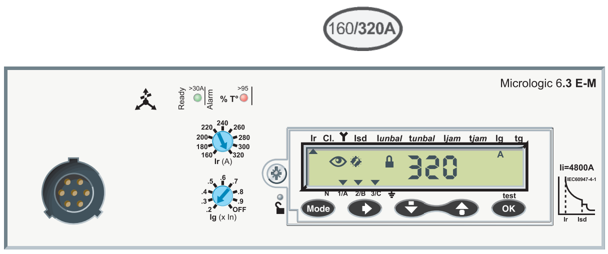


1 Compact NSX circuit breaker status (green = ON position)
2 Contactor status (green = ON position)
3 Current in the motor application
4 Operating states:
A: Startup B: Steady state (the active states are shown in green)

Protection Functions

The figure and table below define the protection functions for Micrologic 6 E-M trip units:





No.	Parameter	Description		Function
0	In	Trip unit setting range: Minimum setting/maximum setting = trip unit In rating		□
1	Ir	Long time protection pick-up	L	■
2	Cl	Long time protection trip class		■
3	Isd	Short time protection pick-up	S	■
4	tsd	Short time protection time delay		□
5	Ii	Instantaneous protection pick-up	I	□
6	Ig	Ground fault protection pick-up	G	■
7	tg	Ground fault protection time delay		■
	Iunbal	Phase unbalance protection pick-up		■
	tunbal	Phase unbalance protection time delay		■
Function ■: Adjustable □: Non-adjustable				

Each function is reviewed in detail on the following pages.

Additional Protection

The Micrologic 6 E-M trip unit incorporates additional protection functions for motor applications.

Protection	Default Activation	Default Setting	SDTAM Activation
Jam motor prot	OFF	I*jam*: OFF, t*jam*: 5 s	Yes
Under load	OFF	I*und*: OFF, t*und*: 10 s	Yes
Long start mtr prot	OFF	I*long*: OFF, t*long*: 10 s	No

The additional protections are activated for startup or steady state or in both cases.

Setting the Protection

The protection parameters can be set as follows:
- On the Micrologic trip unit, using the preset dials (depending on the protection parameter and the Micrologic type) and on the keypad
- Via the communication option using the RSU software under the **Basic prot** tab

For more information on the protection parameter setting procedure using the RSU software, see *Protection parameter setting, page 121*.

Reflex Protection

In addition to the devices integrated in the Micrologic trip units, Compact NSX circuit breakers are equipped with reflex protection (piston effect). As soon as a very high short-circuit current occurs (above the instantaneous protection pick-up), opening of the main contacts creates an electric arc pressure which acts on a piston instantaneously.

This piston frees the opening mechanism and causes ultra-fast circuit breaker tripping.

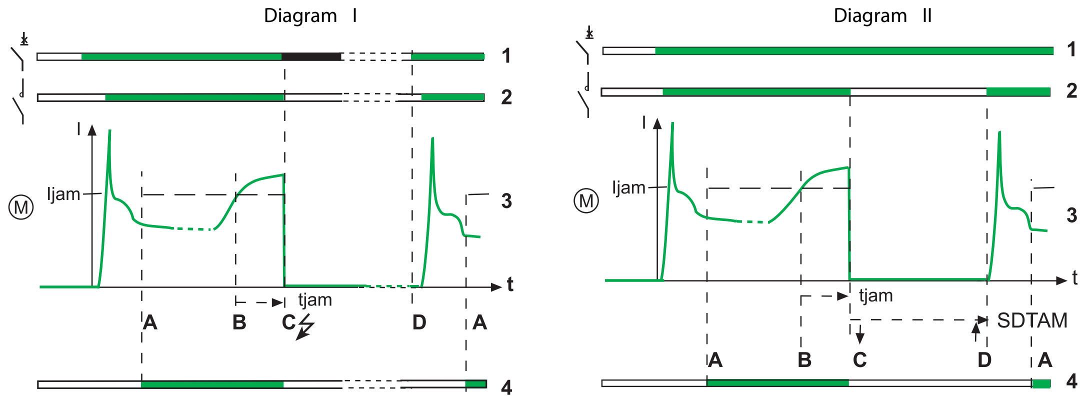
SDTAM Module Option

The SDTAM module early tripping function can be used to command contactor opening 400 ms before the calculated circuit breaker tripping in the case of:
- Long time protection
- Phase unbalance protection
- Jam motor protection
- Underload motor protection

The contactor can be closed again automatically or manually depending on the parameter setting of the SDTAM module (see the *Compact NSX circuit breakers - User manual*).

Example of Using the SDTAM Module

The figures below illustrate operation of the Jam motor protection without the SDTAM module (diagram I) and with the SDTAM module (diagram II):



1 Compact NSX circuit breaker status
White: Open; Green: Closed; Black: Tripped
2 Contactor status (SD contact in the contactor coil)
White: Open; Green: Closed
3 Motor current
4 Monitoring by jam motor protection
White: Not active (startup); Green: Active (steady state)

Analysis of Operation

The table below describes operation without the SDTAM module (diagram I)

Event	Comments
A	Application motor switches to steady state. Jam motor protection monitoring is activated.
B	Occurrence of an overload current on the application (for example, rotor braked due to high viscosity of one of the mixing fluids) The Jam motor protection t*jam* time delay is actuated as soon as the motor current crosses the I*jam* pick-up.
C	End of Jam motor protection time delay Jam motor protection causes the Compact NSX circuit breaker to trip.
D	Application returned to service manually after the motor has cooled and the circuit breaker has closed again.

The table below describes operation with the SDTAM module (diagram II)

Event	Comments
A	Identical to diagram I
B	Identical to diagram I
C	400 ms before the end of the Jam motor protection time delay, the SDTAM module: • Commands the contactor to open (output OUT2) • Sends a fault indication (output OUT1) Both outputs are activated for a time delay (which can be set between 1 and 15 minutes).
D	Application contactor returned to service automatically: the time delay allows the motor to cool down.

The SDTAM module can be set to the **OFF** position: the application is returned to service manually (by deactivating the SDTAM module power supply).

Long Time Protection

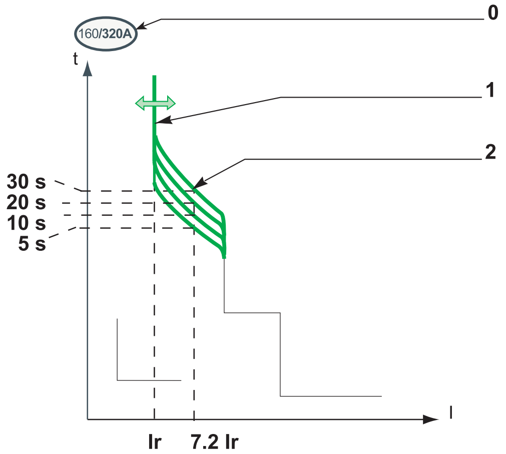
Presentation

Long time protection on the Micrologic 6 E-M trip unit is adapted to protecting all types of motor application against overload currents.

Operating Principle

Long time protection is I^2t IDMT:
- It incorporates the motor thermal image function.
- It can be configured as the Ir pick-up and as the trip class Cl.

Tripping curve:



No.	Parameter	Description
0	In	Trip unit setting range: The maximum setting corresponds to the trip unit rating In
1	Ir	Long time protection pick-up
2	Cl	Long time protection trip class (according to standard IEC 60947-4-1)

NOTE: The SDTAM module early tripping protection function can be used to command contactor opening (see *SDTAM Module Option, page 57*).

Setting the Long Time Protection

The Ir pick-up can be set as follows:
- On the Micrologic trip unit, preset by the Ir dial and fine-tuned on the keypad
- Via the communication option using the RSU software, preset by the Ir dial on the Micrologic trip unit and fine-tuned via the RSU software

The trip class Cl can be set as follows:
- On the Micrologic trip unit, set on the keypad
- Via the communication option using the RSU software

Ir Pick-Up Setting Value

The long time protection tripping range is: 1.05...1.20 Ir according to standard IEC 60947-2.

The default Ir pick-up setting value is In (maximum dial value).

The Ir pick-up is preset by a dial.

In Rating	Preset Values of Ir (A) Depending on the Trip Unit In Rating and the Dial Position								
25 A	12	14	16	18	20	22	23	24	25
50 A	25	30	32	36	40	42	46	47	50
80 A	35	42	47	52	57	60	63	72	80
150 A	70	80	90	100	110	120	133	140	150
220 A	100	120	140	155	170	185	200	210	220
320 A	160	180	200	220	240	260	280	300	320
500 A	250	280	320	360	380	400	440	470	500

The accuracy range is + 5%/+ 20%.

Fine-tuning is performed on the keypad in steps of 1 A:
- The setting range maximum is the preset value displayed by the dial.
- The setting range minimum is the minimum preset value.

Example:

A Micrologic 6 E-M trip unit In = 500 A is preset by the dial at 470 A. The fine-tuning range on the keypad is: 250...470 A

Trip Class Cl Setting Value

The trip class corresponds to the value of the trip time delay for a current of 7.2 Ir according to standard IEC 60947-4-1.

The class is set via the keypad, using any of the 4 defined values: 5, 10, 20, and 30.

The default class setting value is 5 (minimum value).

The table below shows the value of the trip time delay depending on the current in the load for all 4 trip classes.

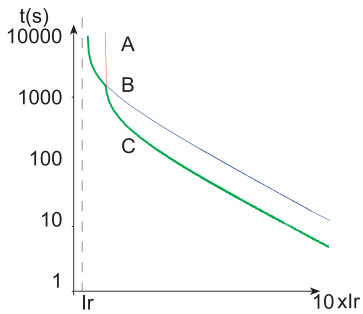
Current in the Load	Trip Class Cl			
	5	**10**	**20**	**30**
	tr Trip Time Delay (s)			
1.5 Ir	120	240	400	720
6 Ir	6.5	13.5	26	38
7.2 Ir	5	10	20	30

The accuracy range is -20%/+0%.

Motor Thermal Image

The model representing heat rise and cooling in a motor load is identical to that used for the conductors. It is constructed according to the algorithm for calculating the thermal demand but this model takes account of the iron and copper losses.

The figure below represents the limit curves for the iron and copper components calculated by the Micrologic 6 E-M trip unit (for class 20):



A Limit temperature curve for copper
B Limit temperature curve for iron
C Tripping curve (low envelope)

Thermal Memory

Micrologic 6 E-M trip units incorporate a thermal memory which ensures that the conductors are cooled even after tripping: cooling lasts for 20 minutes before or after tripping.

Cooling Fan

By default, the motor's thermal image is calculated taking account of the fact that the motor is self-cooled (fan mounted on the shaft end).

If the motor is force-cooled (forced ventilation), the calculation of the thermal image takes account of the shortest time constants for the cooling calculation.

The cooling ventilation parameters (**Auto** or **moto** position) are set on the Micrologic trip unit keypad or using the RSU software.

Short Time Protection

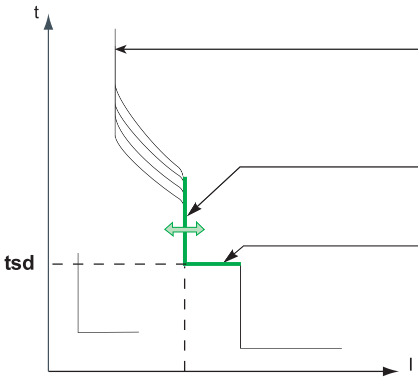
Presentation

Short time protection on Micrologic 6 E-M trip units is adapted to protecting all types of motor application against short-circuit currents.

Operating Principle

Short time protection is definite time. It can be configured as the Isd pick-up.

Tripping curve:



No.	Parameter	Description
1	Ir	Long time protection pick-up
3	Isd	Short time protection pick-up
4	tsd	Short time protection fixed time delay

Setting the Short Time Protection

The Isd pick-up and tsd time delay can be set as follows:
- On the Micrologic trip unit, set on the keypad
- Via the communication option using the RSU software

Isd Pick-Up Setting Value

The Isd pick-up setting value is expressed in multiples of Ir.

The default Isd pick-up setting value is 5 Ir (minimum value).

The pick-up setting range on the keypad is: 5...13 Ir. The step is 0.5 Ir.

The accuracy is +/- 10%.

tsd Time Delay Value

The time delay cannot be adjusted.
- The non-tripping time is: 20 ms.
- The maximum breaking time is: 60 ms.

Instantaneous Protection

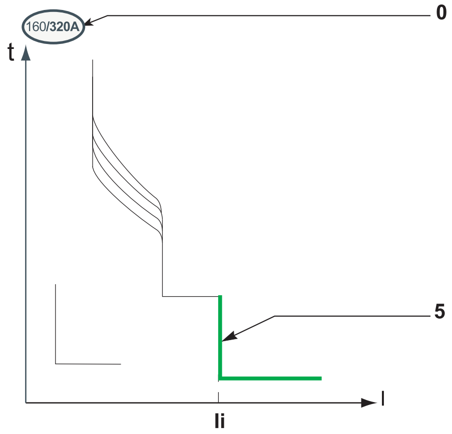
Presentation

Instantaneous protection on Micrologic 6 E-M trip units is adapted to protecting all types of motor application against very high intensity short-circuit currents.

Operating Principle

Instantaneous protection is fixed: the pick-up value is determined by the trip unit rating. Protection is instantaneous.

Tripping curve:



No.	Parameter	Description
0	In	Trip unit setting range: The maximum setting corresponds to the trip unit In rating
5	Ii	Instantaneous protection pick-up

Ii Pick-up Value

The Ii pick-up value is directly determined by the trip unit In rating and is expressed in xIn.

Ii pick-up value according to the Micrologic trip unit In rating (accuracy is +/- 10%).

In Rating (A)	**25**	**50**	**80**	**150**	**220**	**320**	**500**
Instantaneous Pick-up (A)	425	750	1200	2250	3300	4800	7500

The non-tripping time is: 0 ms.

The maximum breaking time is: 30 ms.

Ground Fault Protection

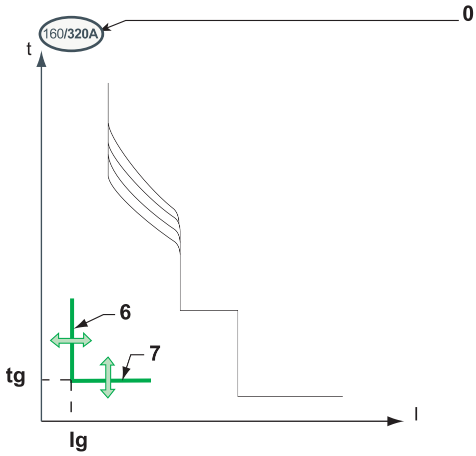
Presentation

Ground fault protection on Micrologic 6 E-M trip units is adapted to protecting all types of motor application against ground fault currents in the TN-S system (see *Compact NSX circuit breakers - User manual*).

Operating Principle

Ground fault protection is definite time. It can be configured as Ig pick-up and as tg trip time delay.

Tripping curve:



No.	Parameter	Description
0	In	Trip unit setting range: Minimum setting/maximum setting = trip unit In rating
6	Ig	Ground fault protection pick-up
7	tg	Ground fault protection time delay

Setting the Ground Fault Protection

The Ig pick-up can be set as follows:
- On the Micrologic trip unit, preset by the Ig dial and fine-tuned on the keypad
- Via the communication option using the RSU software, preset by the Ig dial on the Micrologic trip unit and fine-tuned via the RSU software

The tg time delay can be set as follows:
- On the Micrologic trip unit, set on the keypad
- Via the communication option using the RSU software

Ig Pick-Up Setting Values

The Ig pick-up setting value is expressed in multiples of In.

The default Ig pick-up setting value is the same as the minimum dial value:
- 0.60 In for trip units rated 25 A
- 0.30 In for trip units rated 50 A
- 0.20 In for trip units rated > 50 A

Ground fault protection can be deactivated by setting the Ig dial to the OFF position.

Ground fault protection can be reactivated even with the Ig dial in the OFF position:
- By fine-tuning on the keypad
- Via the communication option

The 3 tables below specify the setting values (preset by a dial) and setting ranges (set on the keypad):
- For trip units rated 25 A
- For trip units rated 50 A
- For trip units rated > 50 A

On the keypad, the step is 0.05 In.

Rating 25 A

Type of Setting	Value or Setting Range (xIn)								
Preset by a dial	0.60	0.60	0.60	0.60	0.70	0.80	0.90	1	OFF
Setting range on the keypad	0.60	0.60	0.60	0.60	0.6...0.7	0.6...0.8	0.6...0.9	0.6...1	0.6...1 + OFF

Rating 50 A

Type of Setting	Value or Setting Range (xIn)								
Preset by a dial	0.30	0.40	0.50	0.60	0.70	0.80	0.90	1	OFF
Setting range on the keypad	0.30	0.3...0.4	0.3...0.5	0.3...0.6	0.3...0.7	0.3...0.8	0.3...0.9	0.3...1	0.3...1 + OFF

Rating > 50 A

Type of Setting	Value or Setting Range (x In)								
Preset by a dial	0.20	0.30	0.40	0.50	0.60	0.70	0.80	1	OFF
Setting range on the keypad	0.20	0.2...0.3	0.2...0.4	0.2...0.5	0.2...0.6	0.2...0.7	0.2...0.8	0.2...1	0.2...1 + OFF

The accuracy range is +/- 10%.

Time Delay Setting Values

The tg time delay setting value is expressed in seconds. The non-tripping and breaking times are expressed in milliseconds.

The default tg time delay setting is 0 s.

Table of tg setting values expressed in second(s) and the associated non-tripping and breaking times expressed in milliseconds (ms):

Parameter	Value				
tg (s)	0	0.1	0.2	0.3	0.4
Non-tripping time (ms)	20	80	140	230	350
Maximum breaking time (ms)	80	140	200	320	500

Ground Fault Protection Test

The ground fault protection test can be performed on the keypad of the Micrologic trip unit (see *Ground Fault Protection Test (Micrologic 6), page 22*). This test can be used to check the trip unit's electronic tripping function.

Phase Unbalance Protection

Presentation

Unbalances of the motor phase currents lead to significant heat rise and braking torques that can cause premature deterioration of the motor. These effects are amplified during startup: protection must be almost immediate.

Description

Phase unbalance protection:

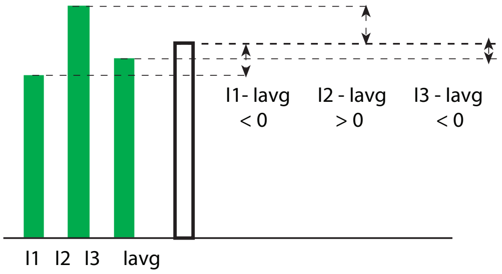
- calculates the current unbalance for each phase, compared to the average current, expressed as a %:

$$Iavg = \frac{(I1 + I2 + I3)}{3}$$

$$Ik\ unbalance\ (\%) = \frac{Ik - Iavg}{Iavg} \times 100 \text{ where } k = 1, 2, 3$$

- Compares the value of the maximum current unbalance with the Iunbal protection pick-up

The diagram below shows a maximum positive unbalance on phase 2:



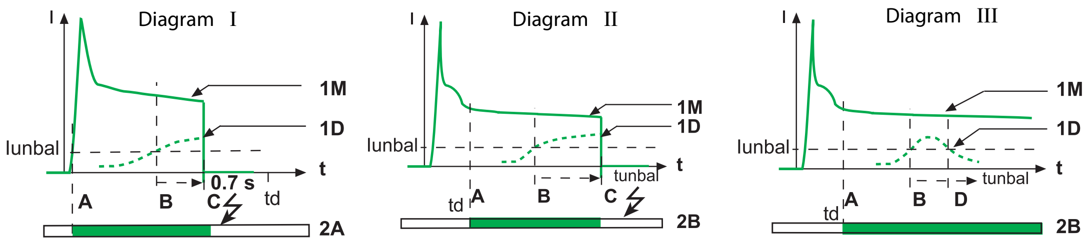
If the maximum current unbalance value is higher than the phase unbalance protection I*unbal* pick-up, the t*unbal* time delay is actuated.

Phase unbalance protection cannot be deactivated.

Phase unbalance protection is activated during startup and in steady state.

Operating Principle

The figures below illustrate the operating possibilities:



1M Motor current
1D Maximum unbalance of the motor phase currents
2A Monitoring by phase unbalance protection during startup (diagram I)
2B Monitoring by phase unbalance protection in steady state (diagrams II and III)
White: Not active; Green: Active

- The current unbalance does not fall below the I*unbal* pick-up before the end of the t*unbal* time delay: the phase unbalance protection trips. The behavior of the protection differs according to the motor operating conditions:
  - During startup (diagram I)
    A: Activation of startup
    B: Activation of protection time delay as soon as the pick-up threshold is crossed
    C: Protection tripped at the end of the fixed time delay of 0.7 s.
  - In steady state (diagram II)
    A: Activation of startup
    B: Activation of protection time delay as soon as the pick-up threshold is crossed
    C: Protection tripped at the end of the adjustable time delay
- The current unbalance falls below the I*unbal* pick-up before the end of the t*unbal* time delay. the phase unbalance protection does not trip (diagram III):
  - B: Activation of protection time delay as soon as the pick-up threshold is crossed
  - D: Deactivation of protection

NOTE: The SDTAM module early tripping protection function can be used to command contactor opening (see *SDTAM Module Option, page 57*).

Setting the Protection

The I*unbal* pick-up and the t*unbal* time delay can be set as follows:
- On the Micrologic trip unit, set on the keypad
- Via the communication option using the RSU software

Iunbal Pick-Up Setting Value

The I*unbal* pick-up setting value is expressed as a % of the average current.

The pick-up setting range on the keypad is: 10...40%. The step is 1%. The default pick-up setting value is 30%.

The accuracy range is +/- 10%.

tunbal Time Delay Setting Value

The t*unbal* time delay setting value is expressed in seconds.

The t*unbal* time delay setting depends on the operating conditions:
- During startup, the value of the time delay cannot be adjusted and equals 0.7 s.
- In steady state, the setting range is: 1...10 s. The step is 1 s.
  The default time delay setting value is 4 s.

Jam Motor Protection

Presentation

Jam motor protection provides additional protection in order to:
- Detect overtorque
- Monitor mechanical failure
- Detect malfunctions more quickly on machines for which the motor is oversized

Examples of machines with a significant risk of jamming: conveyors, crushers and kneaders, fans, pumps and compressors, etc.

Description

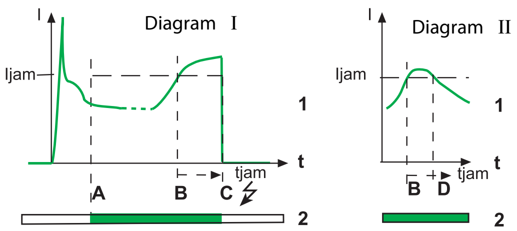
Jam motor protection compares the value of the average motor current Iavg with the setting value of the protection I*jam* pick-up. If the average motor current Iavg exceeds the I*jam* pick-up, the protection t*jam* time delay is actuated.

By default, jam motor protection is not active.

After parameter setting, jam motor protection is:
- Active in steady state
- Disabled during startup

Operating Principle

The figures below illustrate the operating possibilities:



1 Motor current
2 Monitoring by jam motor protection
White: Not active (startup); Green: Active (steady state)

- Diagram I: The average motor current Iavg does not fall back below the protection I*jam* pick-up before the end of the t*jam* time delay (jammed motor). Jam motor protection trips:
  - A: Protection activated (change to steady state)
  - B: Activation of protection time delay as soon as the pick-up threshold is crossed
  - C: Protection tripped at the end of the time delay
- Diagram II: The average motor current Iavg falls back and stays below the protection I*jam* pick-up before the end of the t*jam* time delay (occasional overload). Jam motor protection does not trip:
  - B: Activation of protection time delay as soon as the pick-up threshold is crossed
  - D: Protection disabled

NOTE: The SDTAM module early tripping protection function can be used to command contactor opening (see *SDTAM Module Option, page 57*).

Setting the Protection

The I*jam* pick-up and the t*jam* time delay can be set as follows:
- On the Micrologic trip unit, set on the keypad
- Via the communication option using the RSU software

Ijam Pick-Up Setting Value

The I*jam* pick-up setting value is expressed in multiples of Ir.

The pick-up setting range on the keypad is: 1...8 Ir. The step is 0.1 Ir. The default setting value is OFF: protection not active.

The accuracy range is +/- 10%.

tjam Time Delay Setting Value

The t*jam* time delay setting value is expressed in seconds.

The t*jam* time delay setting range is: 1...30 s. The step is 1 s. The default setting value for the time delay is 5 s.

Underload Motor Protection

Presentation

Underload motor protection provides additional protection for detection of motor no-load operation.

Examples of no-load operation: pump running dry, broken drive belt, broken geared motor, etc.

Description

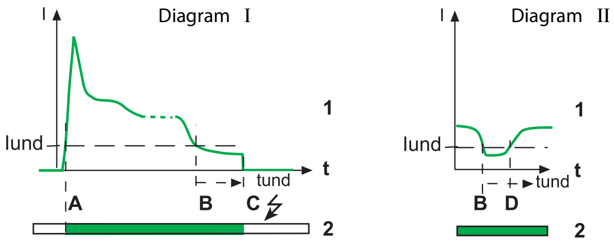
Underload motor protection compares the value of the phase current minimum I MIN with the setting value of the protection I*und* pick-up. If the current value I MIN falls below the I*und* pick-up, the protection t*und* time delay is actuated.

By default, underload motor protection is not active.

After parameter setting, underload protection is activated during startup and in steady state.

Operating Principle

The figures below illustrate the operating possibilities:



1 Motor current
2 Supervision by underload motor protection
White: Not active; Green: Active

- Diagram I: The phase current minimum value I MIN does not go above the protection I*und* pick-up before the end of the t*und* time delay (for example, a pump operating at no load). Underload motor protection trips:
  - A: Protection activated (change to steady state)
  - B: Activation of protection time delay as soon as the pick-up threshold is crossed
  - C: Protection tripped at the end of the time delay
- Diagram II: The phase current minimum value I MIN goes back and stays above the pick-up before the end of the t*und* time delay (for example, a pump temporarily running dry). The underload motor protection does not trip:
  - B: Activation of protection time delay as soon as the pick-up threshold is crossed
  - D: Protection disabled

NOTE: The SDTAM module early tripping protection function can be used to command contactor opening (see *SDTAM Module Option, page 57*).

Setting the Protection

The I*und* pick-up and the t*und* time delay settings can only be accessed by the communication option using the RSU software (see *Protection parameter setting, page 121*).

Iund Pick-Up Setting Value

The I*und* pick-up setting value is expressed in multiples of Ir.

The pick-up setting range is: 0.3...0.9 Ir. The step is 0.01 Ir. The default setting is OFF: protection not active.

The accuracy range is +/- 10%.

tund Time Delay Setting Value

The t*und* time delay setting value is expressed in seconds.

The time delay setting range is: 1...200 s. The step is 1 s. The default setting value for the time delay is 10 s.

Long Start Motor Protection

Presentation

Long start motor protection provides additional protection:
- For machines at risk of difficult starting:
  - High inertia machines
  - High resistive torque machines
  - Machines with fluctuating load from steady state

  Examples of machines with a significant risk of difficult starting:
  Fans, compressors
- To avoid no-load starts:
  - Load not present
  - Machines oversized for the application

Description

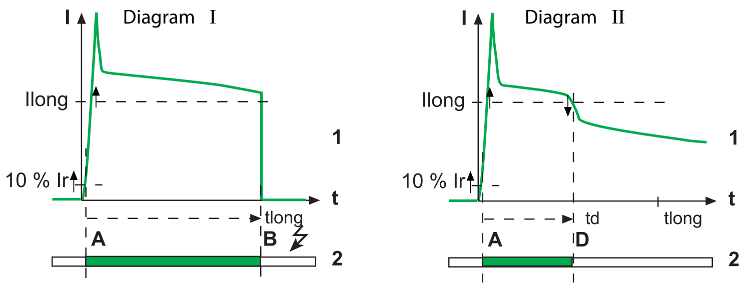
Long start motor protection is activated as soon as the average motor current Iavg exceeds 10% of the Ir setting value: the protection t*long* time delay is actuated. Long start motor protection compares the value of the average motor current Iavg with the setting value of the protection I*long* pick-up.

By default, long start motor protection is not active.

After parameter setting, long start motor protection is:
- Active during startup
- Not active in steady state

Operating Principle (Difficult Starting)

On starting, the average motor current Iavg overruns the long start motor protection I*long* pick-up. The protection remains active as long as the average motor current Iavg has not fallen below the I*long* pick-up.

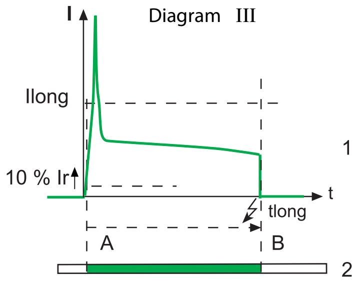


1 Motor current
2 Activation of long start motor protection tlong time delay
White: Protection not active; Green: Protection active

The curve can evolve in one of 2 ways:
- Diagram I: The average motor current Iavg has not fallen below the I*long* pick-up before the end of the t*long* time delay (starting with too big a load). Long start motor protection trips:
  - A: Activation of protection time delay (10% of Ir pick-up is exceeded)
  - B: Protection tripped at the end of the time delay
- Diagram II: The average motor current Iavg falls below the I*long* pick-up before the end of the t*long* time delay (correct starting). Long start motor protection does not trip:
  - A: Activation of protection time delay (10% of Ir pick-up is exceeded)
  - D: Deactivation of protection

Operating Principle (No-Load Starting)

On starting, the average motor current Iavg does not exceed the long start motor protection I*long* pick-up. The protection remains active as long as the value of the average current Iavg has not fallen below 10% of the Ir setting value.



1 Motor current
2 Activation of long start motor protection time delay
White: Protection not active; Green: Protection active

Diagram III: The motor current has not fallen below 10% of the Ir setting value before the end of the t*long* time delay: long start motor protection trips.

- A: Activation of protection time delay (10% of Ir pick-up is exceeded)
- B: Protection tripped at the end of the time delay

If the motor current falls back below 10% of the Ir setting value before the end of the protection t*long* time delay (for example on contactor opening), long start motor protection does not trip.

NOTE: The Micrologic trip unit measurement electronics filters the subtransient state (first current peak of approximately 20 ms on contactor closing). This current peak is not therefore taken into account when assessing whether the I*long* pick-up has been crossed.

Setting the Protection

The I*long* pick-up and the t*long* time delay settings can only be accessed by the communication option using the RSU software (see *Protection parameter setting, page 121*).

Ilong Pick-Up Setting Value

The I*long* pick-up setting value is expressed in multiples of Ir.

The pick-up setting range is: 1...8 Ir. The step is 0.1 Ir. The default setting is OFF: protection not active.

The accuracy range is +/- 10%.

tlong Time Delay Setting Value

The t*long* time delay setting value is expressed in seconds.

The t*long* time delay setting range is: 1...200 s. The step is 1 s. The default setting value for the time delay is 10 s.

The Metering Function

3

Aim

This chapter describes the metering function of Micrologic 5, 6 and 6 E-M trip units.

What's in this Chapter?

This chapter contains the following sections:

3.1 Measurement Techniques

Aim

This section describes the measurement characteristics and techniques used by Micrologic trip units.

What's in this Section?

This section contains the following topics:

Real-Time Measurements

Instantaneous Values

Micrologic A and E trip units:
- Measure the following in real time and as an rms value:
  - Instantaneous current for each phase and the neutral (if present)
  - Ground fault current (Micrologic 6)
- Calculate the average phase current in real time
- Determine the maximum and minimum values for these electrical quantities

Micrologic E trip units:
- Measure the instantaneous 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, such as:
  - 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)
  - Powers (see *Power Metering (Micrologic E), page 80*)
  - Quality indicators: frequency, THD(I) and THD(V) (see *Metering Energy Quality Indicators (Micrologic E), page 89* and *Power factor PF and cos φ measurement (Micrologic E), page 91*)
  - Operating indicators: quadrants, phase rotation and type of load
- Determine the maximum and minimum values for these electrical quantities
- Increment in real time 3 energy meters (active, reactive, apparent) using the total power real-time values (see *Power Metering (Micrologic E), page 80*)

The sampling method used takes account of the values of the harmonic currents and voltages up to the 15th. The sampling period is 512 microseconds.

The values of the electrical quantities, whether measured or calculated in real time, are updated once a second.

Measuring the Neutral Current

Micrologic 4-pole or 3-pole trip units with ENCT option measure the neutral current:
- For a 3-pole trip unit, the neutral current is measured by adding a special current transformer on the neutral conductor (ENCT option: for the transformer definition (see the *Compact NSX 100-630 A - Catalogue*).
- For a 4-pole trip unit, the neutral current is measured systematically.

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

Measuring the Phase-to-Neutral Voltages

Micrologic 4-pole or 3-pole trip units with ENVT option measure the phase-to-neutral (or line-to-neutral) voltages V1N, V2N and V3N:
- For a 3-pole trip unit, it is necessary to:
  - connect the wire from the ENVT option to the neutral conductor
  - declare the ENVT option (configured using the RSU software)
- For 4-pole trip units, the phase-to-neutral voltages are measured systematically.

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

Calculating the Average Current and Average Voltage

Micrologic trip 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 (Micrologic 4-pole or 3-pole trip unit equipped with the ENVT option):

    $$Vavg = (V1N + V2N + V3N)/3$$

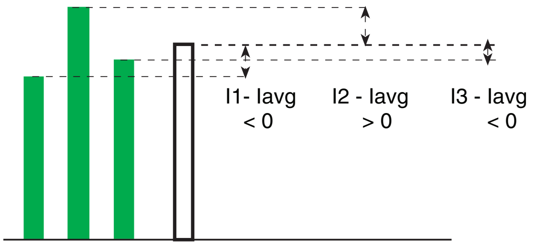
Measuring the Current and Voltage Phase Unbalances

Micrologic trip units calculate the current unbalance for each phase (3 values).

The current unbalance is expressed as a % compared to the average current:

$$Iavg = \frac{(I1 + I2 + I3)}{3}$$

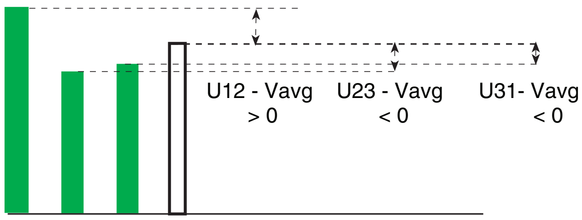
$$Ik\ unbalance\ (\%) = \frac{Ik - Iavg}{Iavg} \times 100 \text{ where } k = 1, 2, 3$$



Micrologic trip units calculate the:
- Phase-to-phase voltage unbalance for each phase (3 values)
- Phase-to-neutral (if present) voltage unbalance for each phase (3 values)

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

$$Vjk\ unbalance\ (\%) = \frac{Vjk - Vavg}{Vavg} \times 100 \text{ where } jk = 12, 23, 31$$



NOTE: The unbalance values are signed (relative values expressed as a %).

The maximum/minimum unbalance values are absolute values expressed as a %.

Maximum/Minimum Values

The Micrologic A trip unit determines in real time the maximum (MAX) and minimum (MIN) value of the current for each phase reached for the current period (1)(2).

The Micrologic E trip unit determines in real time the maximum (MAX) and minimum (MIN) value reached by the following electrical quantities organized in groups for the current period (1). The groups of electrical quantities measured in real time are:
- Current (2): 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 power for each phase (active, reactive, apparent, and distortion)
- Total harmonic distortion: The total harmonic distortion THD for both current and voltage
- Frequency

(1) The current period for a group is initialized by the last reset of one the maximum values in the group (see below).

(2) Micrologic A and E trip units also determine the maximum value (MAXMAX) of the maximum (MAX) values and the minimum (MINMIN) value of the minimum values (MIN) of the phase currents.

Resetting Maximum/Minimum Values

The maximum and minimum values in a group can be reset for the group via the communication option or on the front display module FDM121.

The maximum and minimum values in a group can be reset on the keypad via the menu (see *Peak Demand Values Reset, page 22*) for the following groups:

- Currents
- Voltages
- Powers

Only the maximum values are displayed, but both the maximum and minimum values are reset.

Calculating Demand values (Micrologic E)

Presentation

The Micrologic E trip unit calculates:
- The Demand values phase and neutral currents,
- The demand values of the total (active, reactive, and apparent) powers

For each demand value, the maximum demand value (peak) is stored in the memory.

The demand values are updated according to the type of window.

Definition

The demand value of a quantity can be called the:
- Average/mean value
- Demand
- Demand value (over an interval)

Example:

Demand in current or demand value of the current, Demand in power or demand value of the power.

The demand value should not be confused with the mean (which is an instantaneous value).

Example:

Mean current (or average current) Iavg = (I1 + I2 + I3)/3.

Calculation Principle

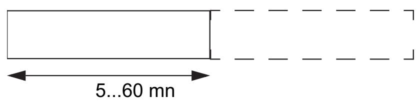
The demand value of a quantity over a defined interval (metering window) is calculated according to 2 different models:
- Arithmetic demand value for the powers
- Quadratic demand value (thermal image) for the currents

Metering Window

The specified time interval T is chosen according to 3 types of metering window:
- Fixed window
- Sliding window
- Synchronized window

Fixed Metering Window

The duration of the fixed metering window can be specified from 5 to 60 minutes in steps of 1 minute.

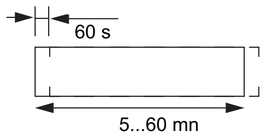


By default, the duration of the fixed metering window is set at 15 minutes.

At the end of each fixed metering window:
- The demand value over the metering window is calculated and updated.
- Calculation of a new demand value is initialized on a new metering window.

Sliding Metering Window

The duration of the sliding metering window can be specified from 5 to 60 minutes in steps of 1 minute.



By default, the duration of the sliding metering window is set at 15 minutes.

At the end of each sliding metering window and then once a minute:
- The demand value over the metering window is calculated and updated.
- Calculation of a new demand value is initialized on a new metering window:
  - By eliminating the contribution of the first minute of the previous metering window
  - By adding the contribution of the current minute

Synchronized Metering Window

Synchronization is performed via the communication network.

When the synchronization pulse is received:
- The calculation of the demand value over the synchronized metering window is updated.
- Calculation of a new demand value is initialized.

NOTE: The interval between 2 synchronization pulses must be less than 60 minutes.

Quadratic Demand Value (Thermal Image)

The quadratic demand value model represents the conductor heat rise (thermal image).

The heat rise created by the current I(t) over the time interval T is identical to that created by a constant current Ith over the same interval. This current Ith represents the thermal effect of the current I(t) over the interval T. If the period T is infinite, the current I(th) represents the thermal image of the current.

Calculation of the demand value according to the thermal model must be always be performed on a sliding metering window.

NOTE: The thermal demand value is similar to an rms value.

NOTE: Old measuring apparatus naturally display a type of thermal response for calculating demand values.

Arithmetic Demand Value

The arithmetic demand value model represents the consumption of electricity and the associated cost.

Calculation of the demand value according to the arithmetic model can be performed on any type of metering window.

Demand value peaks

The Micrologic E trip unit indicates the maximum value (peak) reached over a defined period for:
- The Demand values of phase and neutral currents
- The Demand values of the total powers (active, apparent, and reactive)

The demand values are organized into 2 groups (see *Real-Time Measurements, page 75*):
- Current demand values
- Power demand values

Resetting demand peaks

The peaks in a group can be reset for the group via the communication option or on the front display module FDM121.

Power Metering (Micrologic E)

Presentation

The Micrologic E trip unit calculates the electrical quantities required for power management:
- The instantaneous 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
  - Fundamental reactive powers (total Qfundtot and per phase) in kvar
  - Distortion powers (total Dtot and per phase) in kvar
- The maximum and minimum values for each of these powers
- The Demand values and the peaks for the total Ptot, Qtot and Stot powers
- The cos φ and power factor (PF) indicators
- The operating quadrant and type of load (leading or lagging)

All these electrical quantities are calculated in real time and their value is updated once a second.

Principle of Power Metering

The Micrologic E trip unit calculates the powers from the rms values of the currents and voltages.

The calculation principle is based on:
- Definition of the powers
- Algorithms depending on the type of trip unit (4-pole or 3-pole)
- Definition of the power sign (circuit breaker powered from the top or underside)

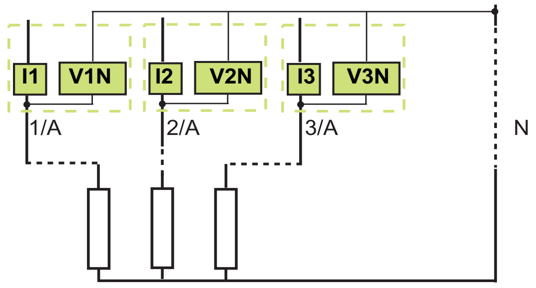
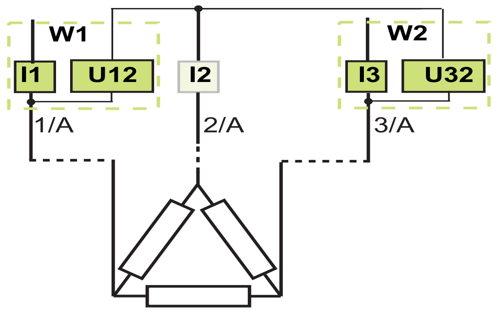
Calculation Algorithm

The calculation algorithm, based on the definition of the powers, is explained in *Power Calculation Algorithm, page 83*.

Calculations are performed taking account of harmonics up to the 15th.

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 option), the Micrologic E trip unit measures the power by taking account of 3 single-phase loads downstream.	When there is no voltage metering on the neutral (3-pole circuit breaker), the Micrologic E trip unit measures the power: ● Using the current from two phases (I1 and I3) and composite voltages from each of these two phases in relation to the third (V12 and V32) ● supposing (by definition) that the current in the neutral conductor is zero: $\vec{I}_1 + \vec{I}_2 + \vec{I}_3 = 0$
The calculated power Ptot equals: $V_{1N} I_1 \cos(\vec{V}_{1N}, \vec{I}_1) + V_{2N} I_2 \cos(\vec{V}_{2N}, \vec{I}_2) + V_{3N} I_3 \cos(\vec{V}_{3N}, \vec{I}_3)$	The calculated power Ptot equals PW1 + PW2: $V_{12} I_1 \cos(\vec{V}_{12}, \vec{I}_1) + V_{32} I_3 \cos(\vec{V}_{32}, \vec{I}_3)$

The table below 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 option)	4-Pole Circuit Breaker
2 wattmeters	X	X (1)	–	–
3 wattmeters	–	–	X	X
(1) The measurement is incorrect once there is current circulating in the neutral.				

3-Pole Circuit Breaker, Distributed Neutral

The ENVT option must be declared using the RSU software (see *Metering Setup, page 123*) and actually used.

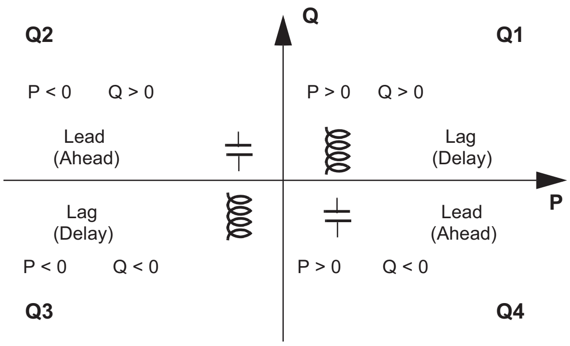
NOTE: Declaration of the ENCT option alone does not result in correct calculation of the powers. It is absolutely essential to connect the wire from the ENVT option to the neutral conductor.

Power Sign and Operating Quadrant

By definition, the active powers are:
- Signed + when they are consumed by the user, i.e. when the device is acting as a receiver
- Signed - when they are supplied by the user, i.e. when the device is acting as a generator

By definition, the reactive powers are:
- Signed with the same sign as the active energies and powers when the current lags behind the voltage, i.e. when the device is inductive (lagging)
- Signed with the opposite sign to the active energies and powers when the current is ahead of the voltage, i.e. when the device is capacitive (leading)

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



NOTE: The power values are:
- Signed on the communication (for example, when reading the front display module FDM121)
- Not signed when reading the Micrologic LCD display

Power Supply From the Top or Underside of the Device

Compact NSX circuit breakers can be powered from either the top (usual scenario, considered to be the default position) or from the underside: the sign for the power running through the circuit breaker depends on the type of connection.

NOTE: By default, the Micrologic E trip unit signs as positive the powers running through the circuit breaker supplied from the top with loads connected from the underside.

If the circuit breaker is powered from the underside, the powers must be signed as negative.

The Power sign parameter can be modified using the RSU software (see *Metering Setup, page 123*).

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.

All the calculated quantities are delivered by the Micrologic E trip unit (on-screen and/or via the communication network). With the 2-wattmeter calculation method, it is not possible to deliver power metering for each phase.

Input Data

The input data are the voltages and currents for each phase (for more information on calculating harmonics, see *Harmonic Currents, page 87*):

$$v_{ij}(t) = \sum_{n=1}^{15} V_{ijn}\sqrt{2}\sin(n\omega t) \quad \text{and} \quad V_{ij} = \sqrt{\sum_{n=1}^{15} V_{ijn}^{2}}$$

$$v_{iN}(t) = \sum_{n=1}^{15} V_{iNn}\sqrt{2}\sin(n\omega t) \quad \text{and} \quad V_{i} = \sqrt{\sum_{n=1}^{15} V_{in}^{2}}$$ (3-pole or 4-pole trip unit with ENVT option)

$$i_i(t) = \sum_{n=1}^{15} I_{in}\sqrt{2}\sin(n\omega t - \varphi_n) \quad \text{and} \quad I_i = \sqrt{\sum_{n=1}^{15} I_{in}^{2}}$$

where $i, j = 1, 2, 3$ (phase)

Using this data, the Micrologic E trip unit calculates the various power ratings according to the sequence described below.

Active Powers

Metering on a 3-Pole or 4-Pole Circuit Breaker With ENVT Option	Metering on a 3-Pole Circuit Breaker Without ENVT Option
The active power for each phase and total active power is calculated.	Only the total active power can be calculated.
$P_i = \frac{1}{T}\int_T v_i(t) i_i(t) dt = \sum_{n=1}^{15} V_{in} I_{in} \cos(V_{in}, I_{in})$ where i =1, 2, 3 (phase)	–
$Ptot = P_1 + P_2 + P_3$	$Ptot = Pw1 + Pw2$

Pw1 and Pw2 are the fictional active powers calculated by the 2-wattmeter method.

Apparent Powers for Each Phase

Metering on a 3-Pole or 4-Pole Circuit Breaker With ENVT Option	Metering on a 3-Pole Circuit Breaker Without ENVT Option
The apparent power is calculated for each phase.	–
$S_i = (V_i \cdot I_i)$ where i = 1, 2, 3 (phase)	–

Reactive Powers With Harmonics for Each Phase

Reactive power with harmonics is not physically significant.

Metering on a 3-Pole or 4-Pole Circuit Breaker With ENVT Option	Metering on a 3-Pole Circuit Breaker Without ENVT Option
The reactive power with harmonics is calculated for each phase.	–
$Q_i = \sqrt{S_i^2 - P_i^2}$ where i = 1, 2, 3 (phase)	–

Reactive Powers

The reactive power of the fundamental corresponds to the physical reactive power.

Metering on a 3-Pole or 4-Pole Circuit Breaker With ENVT Option	Metering on a 3-Pole Circuit Breaker Without ENVT Option
The reactive power for each phase and total reactive power is calculated.	Only the total reactive power can be calculated.
$Qfund_i = V_{1i} I_{1i} \sin\varphi_1$ where i =1,2,3 (phase)	–
$Qfundtot = Qfund_1 + Qfund_2 + Qfund_3$	$Qfundtot = Qfundw1 + Qfundw2$

Qfundw1 and Qfundw2 are the fictional reactive powers calculated by the 2-wattmeter method.

Distortion Power

Distortion power is the quadratic difference between the reactive power with harmonics and the reactive power (fundamental).

Metering on a 3-Pole or 4-Pole Circuit Breaker With ENVT Option	Metering on a 3-Pole Circuit Breaker Without ENVT Option
The distortion power for each phase and the total distortion power is calculated.	Only the total distortion power can be calculated.
$D_i = \sqrt{Q_i^2 - Qfund_i^2}$ where i =1, 2, 3 (phase)	–
$Dtot = D_1 + D_2 + D_3$	$Dtot = Dw1 + Dw2$

Dw1 and Dw2 are the fictional powers calculated by the 2-wattmeter method.

Total Reactive Power (With Harmonics)

The total reactive power (with harmonics) is not physically significant.

Metering on a 3-Pole or 4-Pole Circuit Breaker With ENVT Option	Metering on a 3-Pole Circuit Breaker Without ENVT Option
The total reactive power is calculated.	The total reactive power is calculated.
$Qtot = \sqrt{Qfundtot^2 + Dtot^2}$	$Qtot = \sqrt{Qfundtot^2 + Dtot^2}$

Total Apparent Power

Metering on a 3-Pole or 4-Pole Circuit Breaker With ENVT Option	Metering on a 3-Pole Circuit Breaker Without ENVT Option
The total apparent power is calculated.	The total apparent power is calculated.
$Stot = \sqrt{Ptot^2 + Qtot^2}$	$Stot = \sqrt{Ptot^2 + Qtot^2}$

Energy Metering (Micrologic E)

Presentation

The Micrologic E trip unit calculates the different types of energy by means of energy meters and provides the values of:

- The active energy Ep, the active energy supplied EpOut and the active energy consumed EpIn
- The reactive energy Eq, the reactive energy supplied EqOut and the reactive energy consumed EqIn
- The apparent energy Es

The energy values are indicated as an hourly consumption. These values are updated once a second. The energy values are stored in non-volatile memory once an hour.

NOTE: When there is a weak current through the circuit-breaker (15 to 50 A depending on the rating), it is necessary to power the Micrologic E with an external 24 VDC power supply to calculate the energies. See *Micrologic Trip Unit Power Supply, page 17*.

Principle of Energy Calculation

By definition

- Energy is the integration of the instantaneous power over a period T:

$$E = \int_T G\delta t \qquad \text{where } G = P, Q \text{ or } S$$

- The value of the instantaneous active power P and the reactive power Q can be positive (power consumed) or negative (power supplied) according to the operating quadrant (see *Power Sign and Operating Quadrant, page 82*).
- The value of the apparent power S is always counted positively.

Partial Energy Meters

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

- The contribution of the instantaneous power consumed for the energy consumed meter

$$E(t)In\ (consumed) = \left(\sum_{t-1} Gin(u) + Gin\right) / 3600 \qquad \text{where } Gin = \text{Ptot or Qtot consumed}$$

- The contribution as an absolute value of the power supplied for the energy supplied meter (power supplied is always counted negatively)

$$E(t)Out\ (supplied) = \left(\left|\sum_{t-1} Gout(u) + Gout\right|\right) / 3600 \qquad \text{where } Gout = \text{Ptot or Qtot supplied}$$

The calculation is initialized by the last Reset action (see *Resetting Energy Meters, page 86*).

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 consumed and supplied energies together: the energy accumulation mode is absolute

  $E(t)absolute = E(t)In + E(t)Out$

- The signed energy, by differentiating between consumed and supplied energies: the energy accumulation mode is signed

  $E(t)signed = E(t)In - E(t)Out$

The apparent energy Es is always counted positively.

Selecting Energy Calculation

The calculation selection is determined by the information sought:

- 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 a relevant parameter for maintenance of an installation.
- The signed values of the energy supplied and the energy consumed are needed to calculate the economic cost of an item of equipment.

By default, absolute energy accumulation mode is configured.

The parameter setting can be modified using the RSU software (see *Metering Setup, page 123*).

Resetting Energy Meters

The energy meters are arranged in the energy generating set (see *Real-Time Measurements, page 75*).

The energy meters can be reset via the communication option or on the front display module FDM121.

There are 2 additional active energy accumulation meters (EpIn and EpOut) that cannot be reset.

Harmonic Currents

Origin and Effects of Harmonics

The number of nonlinear loads present on electrical networks is always increasing, which results in a higher level of harmonic currents circulating in the electrical networks.

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

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

These various problems naturally result in additional 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:

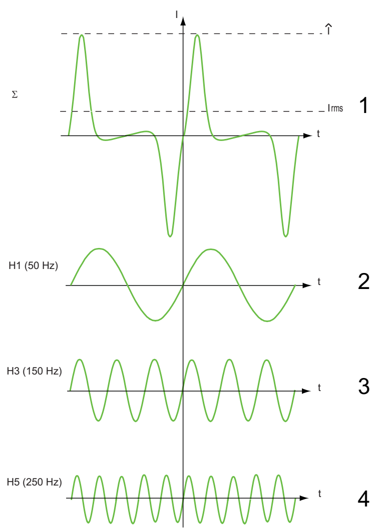
$$y(t) = y_0 + \sum_{1}^{\infty} y_n(\sqrt{2} \times \sin(n\omega t - \varphi_n))$$

where:
- y_0: Value of the DC component
- y_n: Rms value of the nth harmonic
- ω: Pulsing of the fundamental frequency
- φ_n: Phase displacement of harmonic component n

NOTE: The DC component is usually very low (even upstream of rectifier bridges) and can be deemed to be zero.

NOTE: The first harmonic is called the *fundamental* (original signal).

Example of a current wave distorted by harmonic currents:



1 Irms: Rms value of the total current
2 I1: Fundamental current
3 I3: Third order harmonic current
4 I5: Fifth order harmonic current

RMS Currents and Voltages

Micrologic E trip units display the rms values of currents and voltages (see *Real-Time Measurements, page 75*).

- The total rms current I_{rms} is the square root of the sum of the square of the rms currents of each harmonic:

$$I_{rms} = \sqrt{\sum_{1}^{\infty} I_{nrms}^2} = \sqrt{I_{1rms}^2 + I_{2rms}^2 + \ldots + I_{nrms}^2 + \ldots}$$

- The total rms voltage V_{rms} is the square root of the sum of the square of the rms voltages of each harmonic:

$$V_{rms} = \sqrt{\sum_{1}^{\infty} V_{nrms}^2} = \sqrt{V_{1rms}^2 + V_{2rms}^2 + \ldots + V_{nrms}^2 + \ldots}$$

Acceptable Harmonic Levels

The acceptable harmonic levels are stipulated by various standards and statutory regulations:

- Electromagnetic compatibility standard adapted to low voltage public networks: IEC 61000-2-2
- Electromagnetic compatibility standards:
  - For loads below 16 A: IEC 61000-3-2
  - For loads higher than 16 A: IEC 61000-3-4
- Recommendations from energy distribution companies applicable to the installations

The results of international studies have revealed a consensus on the typical harmonic values that should ideally not be exceeded.

The table below lists the typical harmonic values for voltage as a % of the fundamental:

Odd Harmonics That Are Not Multiples of 3		Odd Harmonics That Are Multiples of 3		Even Harmonics	
Order (n)	**Value as a % V_1**	**Order (n)**	**Value as a % V_1**	**Order (n)**	**Value as a % V_1**
5	6%	3	5%	2	2%
7	5%	9	1.5%	4	1%
11	3.5%	15	0.3%	6	0.5%
13	3%	> 15	0.2%	8	0.5%
17	2%	–	–	10	0.5%
> 19	1.5%	–	–	> 10	0.2%

NOTE: Harmonics of a high order (n > 15) have very low rms values and can therefore be ignored.

Metering Energy Quality Indicators (Micrologic E)

Presentation

The Micrologic E trip unit provides, via the communication network, the measurements and quality indicators required for energy management:

- Reactive power measurement (1)
- Power factor PF (1)
- cos φ (1)
- Total harmonic distortion THD
- Distortion power measurement

(1) For more information, see *Power Metering (Micrologic E), page 80* and *Energy Metering (Micrologic E), page 85*.

The energy quality indicators take account of:

- Reactive energy management (cos φ metering) to optimize the size of the equipment and/or avoid peak tariffs
- Management of harmonics to avoid degradation and malfunctions during operation

These measurements and indicators can be used to implement corrective actions in order to conserve an optimum level of energy quality.

Current THD

The current THD is defined by standard IEC 61000-2-2. It is expressed as a % of the rms value of harmonic currents greater than 1 in relation to the rms value of the fundamental current (order 1). The Micrologic E trip unit calculates the total harmonic current distortion THD up to the 15th harmonic:

$$THD(I) = \frac{\sqrt{\sum_{2}^{15} I_{nrms}^{2}}}{I_{1rms}} = \sqrt{\left(\frac{I_{rms}}{I_{1rms}}\right)^{2} - 1}$$

The current THD can be higher than 100%.

The total harmonic distortion THD(I) can be used to assess the deformation of the current wave by means of a single number. The limit values below should be taken into consideration:

THD(I) Value	Comments
THD(I) < 10%	Low harmonic currents: No need to worry about 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, dangerous heat rise are almost certain if the installation has not been specifically calculated and sized with this restriction in mind.

Deformation of the current wave created by a polluting device can lead to deformation of the voltage wave depending on the level of pollution and the source impedance. This deformation of the voltage wave is seen by all receivers powered by the supply. Sensitive receivers can therefore be disturbed. Hence a polluting receiver - with a high THD(I) - may not be affected by its pollution but it may cause malfunctions on other sensitive receivers.

NOTE: THD(I) metering is an effective way of determining the potential polluters on electrical networks.

Voltage THD

The voltage THD is defined by standard IEC > 61000-2-2. It is expressed as a % of the rms value of harmonic voltages greater than 1 in relation to the rms value of the fundamental voltage (first order). The Micrologic E trip unit calculates the voltage THD up to the 15th harmonic:

$$THD(V) = \frac{\sqrt{\sum_{2}^{15} V_{nrms}^{2}}}{V_{1rms}}$$

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

The total harmonic distortion THD(V) can be used to assess the deformation of the voltage wave by means of a single number. The limit values below are usually taken into account by energy distribution companies:

THD(V) Value	Comments
THD(V) < 5%	Insignificant deformation of the voltage wave: No need to worry about malfunctions.
5% < THD(V) < 8%	Significant deformation of the voltage wave: Risk of heat rise and malfunctions.
8% < THD(V)	Significant deformation of the voltage wave: The risks of malfunction are almost certain if the installation has not been specifically calculated and sized with this restriction in mind.

Deformation of the voltage wave is seen by all receivers powered by the supply.

NOTE: The THD(V) indication can be used to assess the risks of disturbance of sensitive receivers supplied with power.

Distortion Power D

When harmonic pollution is present, calculation of the total apparent power involves 3 terms:

$$Stot^2 = Ptot^2 + Qtot^2 + Dtot^2$$

The distortion power D qualifies the energy loss due to the presence of harmonic pollution.

Power factor PF and cos φ measurement (Micrologic E)

Power Factor PF

The Micrologic E trip unit calculates the power factor PF from the total active power Ptot and the total apparent power Stot:

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

This indicator qualifies:
- The oversizing to be applied to an installation’s 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 Micrologic E trip unit calculates the cos φ from the total active power Pfundtot and the total apparent power Sfundtot of the fundamental (first order):

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

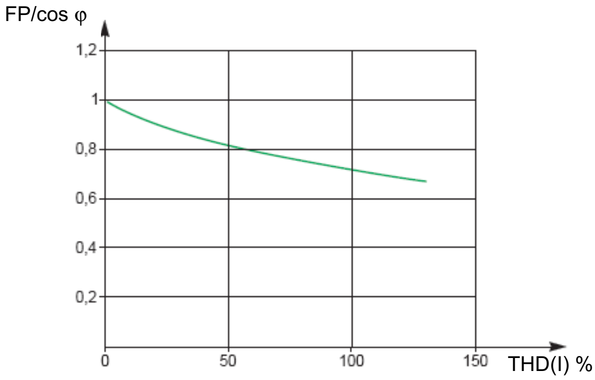
This indicator qualifies use of the energy supplied.

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 graph below 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 pollution on the supply.

Sign for the power factor PF and cos φ

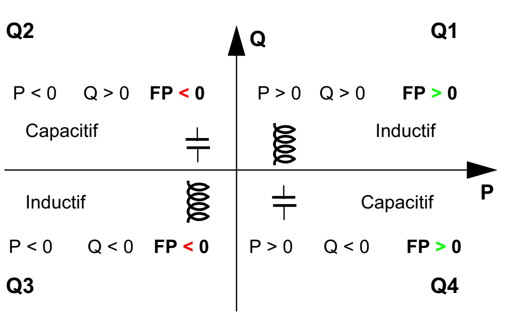
2 sign conventions can be applied for these indicators:

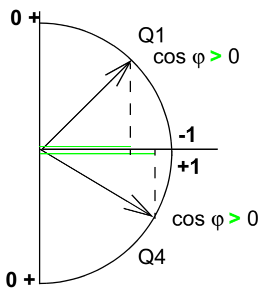
- IEC convention: The sign for these indicators complies strictly with the signed calculations of the powers (i.e. Ptot, Stot and Pfundtot, Sfundtot)
- IEEE convention: The indicators are calculated in accordance with the IEC convention but multiplied by the inverse of the sign for the reactive power (Q)

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

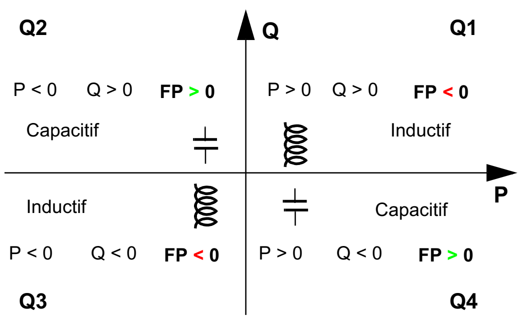
The figures below define the sign for the power factor PF and the cos φ in all 4 quadrants (Q1, Q2, Q3 and Q4) for both conventions:

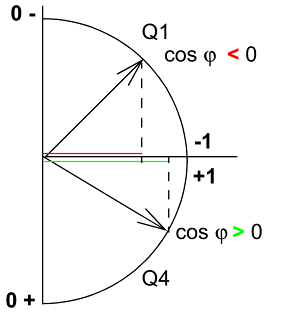
IEC Convention	
Operation in all 4 quadrants (Q1, Q2, Q3, Q4)	Values of cos φ in receiver mode (Q1, Q4)





IEEE Convention	
Operation in all 4 quadrants (Q1, Q2, Q3, Q4)	Values of cos φ in receiver mode (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

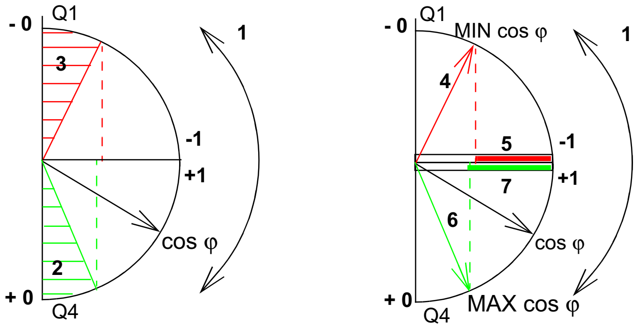
Management of the power factor PF and cos φ: Minimum and Maximum Values

Management of 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 said to be critical when the values of the indicators are around 0. The minimum and maximum values of the indicators are defined for these situations.

The figure below 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 smallest positive 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 (2 values).

The table below 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 table below 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

The sign convention for the cos φ and and PF indicators is configured in the RSU software (see *Metering Setup, page 123*).

The IEEE convention is applied by default.

NOTE: The sign convention selection also determines the alarm selection: monitoring of an alarm indicator supposed to be IEC (or IEEE) convention will be incorrect if the IEEE (or IEC) convention has been configured.

3.2 Measurement Accuracy Tables

Aim

This section presents the measurement accuracy tables for Micrologic A (Ammeter) and Micrologic E (Energy) trip units.

What's in this Section?

This section contains the following topics:

Measurement Accuracy

Presentation

Micrologic trip units provide measurements:
- Via the communication network
- On the front display module FDM121 in the **Services**/**Metering** menu.

Some measurements can be accessed on the Micrologic trip unit display (see *List of Metering Screens, page 28*).

The tables in this chapter indicate the measurements available and specify the following information for each measurement:
- Unit
- Measurement range
- Accuracy
- Accuracy range

Measurement Accuracy

The trip units comply with the requirements of standard IEC 61557-12 in accordance with:
- Class 1, for current metering
- Class 2, for energy metering

The accuracy of each measurement is defined:
- For a Micrologic trip unit powered in normal conditions
- At a temperature of 23°C +/- 2°C.

For a measurement taken at a different temperature, in the temperature range -25°C to +70°C, the derating coefficient for temperature accuracy is 0.05% per degree C.

The accuracy range is the part of the measurement range for which the defined accuracy is obtained: the definition of this range can be linked to the circuit breaker load characteristics.

Micrologic A - Real-Time Measurements

Current Metering

Measurement	Unit	Measurement Range	Accuracy	Accuracy Range
• Phase I1, I2, I3 and neutral IN current measurements (1) • Maximum current values of phases I1 MAX, I2 MAX, I3 MAX and the neutral IN MAX (1) • Maximum value (MAXMAX) of the MAX of the phase currents • Minimum current values of phases I1 MIN, I2 MIN, I3 MIN and neutral IN MIN (1) • Minimum value (MINMIN) of the MIN of the phase currents • Average current Iavg measurements • Maximum average current value Iavg MAX • Minimum average current value Iavg MIN	A	0...20 In	+/- 1%	0.2...1.2 In
Micrologic 6 • Ground fault current measurement • Maximum/minimum value of the ground fault current	% Ig	0...600%	–	–
(1) IN with 4-pole or 3-pole trip unit with ENCT option				

Micrologic E - Real-Time Measurements

Current Metering

Measurement	Unit	Measurement Range	Accuracy	Accuracy Range
• Phase I1, I2, I3 and neutral IN current measurements (1) • Maximum current values of phases I1 MAX, I2 MAX, I3 MAX and the neutral IN MAX (1) • Maximum value (MAXMAX) of the MAX of the phase currents • Minimum current values of phases I1MIN, I2 MIN, I3 MIN and neutral IN MIN (1) • Minimum value (MINMIN) of the MIN of the phase currents • Average current Iavg measurements • Maximum average current value Iavg MAX • Minimum average current value Iavg MIN	A	0...20 In	+/- 1 %	0.2...1.2 In
Micrologic 6 • Ground fault current measurement • Maximum/minimum value of the ground fault current	% Ig	0...600%	–	–
(1) IN with 4-pole or 3-pole trip unit with ENCT option				

Current Unbalance Metering

The accuracy range is indicated for Micrologic trip unit operation in the current range: 0.2 In...1.2 In.

Measurement	Unit	Measurement Range	Accuracy	Accuracy Range
• Current phase unbalance measurements I1unbal, I2unbal, I3unbal • Maximum values of current phase unbalances I1unbal MAX, I2 unbal MAX, I3 unbal MAX • Maximum value (MAXMAX) of the MAX of the phase unbalances	% Iavg	-100...100 %	+/- 2 %	-100...100 %

NOTE:

- The unbalance values are signed (relative values).
- The unbalance maximum values (MAX) are not signed (absolute values).

Voltage Metering

Measurement	Unit	Measurement Range	Accuracy	Accuracy Range
• Phase-to-phase V12, V23, V31 and phase-to-neutral V1N, V2N, V3N voltage measurements (1) • Maximum values of phase-to-phase voltages V12 MAX L-L, V23 MAX L-L, V31 MAX L-L and phase-to-neutral voltages V1N MAX L-N, V2N MAX L-N, V3N MAX L-N (1) • Maximum value of the MAX phase-to-phase voltages (V12,V23,V31) • Minimum values of phase-to-phase voltages V12 MIN L-L, V23 MIN L-L, V31MIN L-L and phase-to-neutral voltages V1N MIN L-N, V2N MIN L-N, V3N MIN L-N (1) • Minimum value of the MIN phase-to-phase voltages (V12,V23,V31) • Average voltage measurements Vavg L-L and Vavg L-N • Maximum value of average voltages Vavg MAX L-L and Vavg MAX L-N • Minimum value of average voltages Vavg MIN L-L and Vavg MIN L-N	V	0...850 V	+/- 0.5 %	70...850 V
(1) V1N, V2N, V3N with 4-pole or 3-pole trip unit with ENVT option				

Voltage Unbalance Metering

The accuracy range is indicated for Micrologic trip unit operation in the voltage range: 70...850 V

Measurement	Unit	Measurement Range	Accuracy	Accuracy Range
• Phase-to-phase voltage V12unb L-L, V23unb L-L, V31unb L-L and phase-to-neutral voltage V1Nunb L-N, V2Nunb L-N, V3Nunb L-N unbalance measurements (1) • Maximum values of phase-to-phase voltage unbalances V12unbMAX L-L, V23unbMAX L-L, V31unbMAX L-L and phase-to-neutral voltage unbalances V1NunbMAX L-L, V2NunbMAX L-L, V3NunbMAX L-L (1) • Maximum values (MAXMAX) of the MAX of the phase-to-phase and phase-to-neutral voltage unbalances (1)	% Vavg L-L % Vavg L-N	-100...100 %	+/- 1 %	-100...100 %
(1) V1N, V2N, V3N with 4-pole or 3-pole trip unit with ENVT option				

NOTE:

- The unbalance values are signed (relative values).
- The unbalance maximum values (MAX) are not signed (absolute values).

Power Metering

The accuracy range is indicated for a Micrologic trip unit operation:
- In the current range: 0.1...1.2 In
- In the voltage range: 70...850 V
- In the cos φ range: -1...-0.5 and 0.5...1

Measurement	Unit	Measurement Range	Accuracy	Accuracy Range
Only with 4-pole or 3-pole trip unit with ENVT option • Active power measurements for each phase P1, P2, P3 • Maximum values of active powers for each phase P1 MAX, P2 MAX, P3 MAX • Minimum values of active powers for each phase P1 MIN, P2 MIN, P3 MIN	kW	-1000... 1000 kW	+/- 2 %	-1000...-1 kW 1...1000 kW
• Total active power measurement Ptot • Maximum value of total active power Ptot MAX • Minimum value of total active power Ptot MIN	kW	-3000... 3000 kW	+/- 2 %	-3000...-3 kW 3...3000 kW
Only with 4-pole or 3-pole trip unit with ENVT option • Reactive power measurements for each phase Q1, Q2, Q3 • Maximum values of reactive powers for each phase Q1 MAX, Q2 MAX, Q3 MAX • Minimum values of reactive powers for each phase Q1 MIN, Q2 MIN, Q3 MIN	kvar	-1000... 1000 kvar	+/- 2 %	-1000...-1 kvar 1...1000 kvar
• Total reactive power measurement Qtot • Maximum value of total reactive power Qtot MAX • Minimum value of total reactive power Qtot MIN	kvar	-3000... 3000 kvar	+/- 2 %	-3000...-3 kvar 3...3000 kvar
Only with 4-pole or 3-pole trip unit with ENVT option • Apparent power measurements for each phase S1, S2, S3 • Maximum values of apparent powers for each phase S1 MAX, S2 MAX, S3 MAX • Minimum values of apparent powers for each phase S1 MIN, S2 MIN, S3 MIN	kVA	-1000... 1000 kVA	+/- 2 %	-1000...-1 kVA 1...1000 kVA
• Total apparent power measurement Stot • Maximum value of total apparent power Stot MAX • Minimum value of total apparent power Stot MIN	kVA	-3000... 3000 kVA	+/- 2 %	-3000...-3 kVA 3...3000 kVA
Only with 4-pole or 3-pole trip unit with ENVT option • Fundamental reactive power measurements for each phase Qfund1, Qfund2, Qfund3 (1) • Maximum values of fundamental reactive powers for each phase Qfund1 MAX, Qfund2 MAX, Qfund3 MAX • Minimum values of fundamental reactive powers for each phase Qfund1 MIN, Qfund2 MIN, Qfund3 MIN	kvar	-1000... 1000 kvar	+/- 2 %	-1000...-1 kvar 1...1000 kvar
• Total fundamental reactive power measurement Qfundtot • Maximum value of total fundamental reactive power Qfundtot MAX • Minimum value of total fundamental reactive power Qfundtot MIN	kvar	-3000... 3000 kvar	+/- 2 %	-3000...-3 kvar 3...3000 kvar
Only with 4-pole or 3-pole trip unit with ENVT option • Distorting power measurements for each phase D1, D2, D3 (1) • Maximum values of distorting powers for each phase D1 MAX, D2 MAX, D3 MAX • Minimum values of distorting powers for each phase D1 MIN, D2 MIN, D3 MIN	kvar	-1000... 1000 kvar	+/- 2 %	-1000...-1 kvar 1...1000 kvar
• Total distorting power measurement Dtot • Maximum value of total distorting power Dtot MAX • Minimum value of total distorting power Dtot MIN	kvar	-3000... 3000 kvar	+/- 2 %	-3000...-3 kvar 3...3000 kvar

Operating Indicators

Measurement	**Unit**	**Measurement Range**	**Accuracy**	**Accuracy Range**
Operating quadrant measurement	N/A	1, 2, 3, 4	N/A	N/A
Direction of phase rotation measurement	N/A	0, 1	N/A	N/A
Type of load measurement (leading/lagging)	N/A	0, 1	N/A	N/A

Energy Quality Indicators

The accuracy range is indicated for a Micrologic trip unit operation:
- In the current range: 0.1...1.2 In
- In the voltage range: 70...850 V

Measurement	**Unit**	**Measurement Range**	**Accuracy**	**Accuracy Range**

• Measurement of:
  • power factors PF1, PF2, PF3 and cos φ 1, cos φ 2, cos φ 3 for each phase
  Only with 4-pole or 3-pole trip unit with ENVT option
  • total power factor PF and cos φ
• Maximum values
  • power factors PF1 MAX, PF2 MAX, PF3 MAX and cos φ 1 MAX, cos φ 2 MAX, cos φ 3 MAX for each phase
  Only with 4-pole or 3-pole trip unit with ENVT option
  • of the power factor PF MAX and cos φ MAX
• Minimum values:
  • power factors PF1 MIN, PF2 MIN, PF3 MIN and cos φ 1 MIN, cos φ 2 MIN, cos φ 3 MIN for each phase
  Only with 4-pole or 3-pole trip unit with ENVT option
  • total power factor PF MIN and cos φ MIN
	–	-1,00...1,00	+/- 2 %	-1,00...-0,50
				0,50...1,00

• Measurement of the total harmonic current distortion THD for each phase THD(I1), THD(I2), THD(I3) • Maximum values of the total harmonic current distortion THD for each phase THD(I1) MAX, THD(I2) MAX, THD(I3) MAX • Minimum values of the total harmonic current distortion THD for each phase THD(I1) MIN, THD(I2) MIN, THD(I3) MIN	% Ifund	0....>1000 %	+/- 10 %	10...500 % I>20 % In
• Measurement of the total harmonic phase-to-phase voltage THD(V12) L-L, THD(V23) L-L, THD(V31) L-L and phase-to-neutral voltage THD(V1N) L-N, THD(V2N) L-N, THD(V3N) L-N distortion (1) • Maximum values of the total harmonic phase-to-phase voltage THD(V12) MAX L-L, THD(V23) MAX L-L, THD(V31) MAX L-L and phase-to-neutral voltage THD(V1N) MAX L-N, THD(V2N) MAX L-N, THD(V3N) MAX L-N distortion (1) • Minimum values of the total harmonic phase-to-phase voltage THD(V12) MIN L-L, THD(V23) MIN L-L, THD(V31) MIN L-L and phase-to-neutral voltage THD(V1N) MIN L-N, THD(V2N) MIN L-N, THD(V3N) MIN L-N distortion (1)	% Vfund L-L % Vfund L-N	0...>1000 %	+/- 5 %	2...500 % V>100 Volt
• Frequency measurement • Maximum frequency • Minimum frequency	Hz	15..0.440 Hz	+/- 0,2 %	45...65 Hz
(1) THD(V1N), THD(V2N), THD(V3N) with 4-pole or 3-pole trip unit with ENVT option				

Motor Thermal Image (Micrologic 6 E-M)

The accuracy range is indicated for Micrologic trip unit operation in the current range: 0.2 In...1.2 In.

Measurement	Unit	Measurement Range	Accuracy	Accuracy Range
• Motor thermal image measurements • Maximum value of the motor thermal image • Minimum value of the motor thermal image	% Ir	0...100 %	+/- 1 %	0...100 %

Micrologic E - Demand Value Measurements

Current Demand and Peak Values

Measurement	Unit	Measurement Range	Accuracy	Accuracy Range
• Phase (I1, I2, I3) and neutral (IN) current demand values • Phase (I1, I2, I3) and neutral (IN) peak current values	A	0...20 In	+/- 1.5%	0.2...1.2 In
IN with 4-pole or 3-pole trip unit with ENCT option				

Power Demand and Peak Values

The accuracy range is indicated for Micrologic trip unit operation:
- In the current range: 0.1...1.2 In
- In the voltage range: 70...850 V
- In the cos φ range: -1...-0.5 and 0.5...1

Measurement	Unit	Measurement Range	Accuracy	Accuracy Range
• Demand value of the total active power (Ptot) • Total active power peak value Ptot	kW	0...3000 kW	+/- 2%	3...3000 kW
• Demand value of the total reactive power (Qtot) • Total reactive power peak value (Qtot)	kvar	0...3000 kvar	+/- 2%	3...3000 kvar
• Demand value of the total apparent power (Stot) • Total apparent power peak value (Stot)	kVA	0...3000 kVA	+/- 2%	3...3000 kVA

Micrologic E - Energy Metering

Energy Meters

The accuracy range is indicated for Micrologic trip unit operation:
- In the current range: 0.1...1.2 In
- In the voltage range: 70...850 V
- In the cos φ range: -1...-0.5 and 0.5...1

Measurement	Unit	Measurement Range	Accuracy	Accuracy Range
Active energy measurements: Ep, EpIn supplied and EpOut consumed	kWh then MWh	1 kWh...> 1000 TWh	+/- 2%	1 kWh...1000 TWh
Reactive energy measurements: Eq, EqIn supplied and EqOut consumed	kvarh then Mvarh	1 kvarh...> 1000 Tvarh	+/- 2%	1 kvarh...1000 Tvarh
Apparent energy measurement Es	kVAh then MVAh	1 kVAh...> 1000 TVAh	+/- 2%	1 kVAh...1000 TVAh

Alarms

4

Aim

This chapter describes the alarms for Micrologic 5, 6 and 6 E-M trip units.

What's in this Chapter?

This chapter contains the following topics:

Alarms Associated with Measurements

Presentation

Micrologic 5 and 6 trip units are used to monitor measurements by means of:

- 1 or 2 pre-alarms (depending on the type of trip unit) assigned to:
  - Long time protection (PAL Ir) for the Micrologic 5 trip unit
  - Long time protection (PAL Ir) and ground fault protection (PAL Ig) for the Micrologic 6 trip unit

  By default, these alarms are active.
- 10 alarms defined by the user as required
  The user can assign each of these alarms to a measurement.
  By default, these alarms are not active.

All the alarms associated with measurements can be accessed:

- Via the communication network
- On the front display module FDM121.

The alarms associated with measurements can be assigned to an SDx module output (see *Setting the SDx Module Output Parameters, page 127*).

Alarm Setup

User-defined alarms can be selected and their parameters set using the RSU software under the **Alarms** tab (see *Alarm Setup, page 125*).

The alarm setup consists of:

- Selecting the alarm priority level
- Setting the alarm activation thresholds and time delays

The alarm description tables indicate for each of the alarms:

- The parameter setting range (thresholds and time delays)
- The default setting values

See *Detailed Tables of Alarms, page 110*.

Alarm Priority Level

Each alarm is given a priority level:

- High priority
- Medium priority
- Low priority
- No priority

Alarm indication on the front display module FDM121 depends on the alarm priority level.

The priority level of each alarm can be set by the user, according to the urgency of the action to be taken.

By default, alarms are medium priority, except for alarms associated with operating indicators which are low priority (see *Detailed Tables of Alarms, page 110*).

Alarm Activation Conditions

The activation of an alarm associated with a measurement is determined directly by:

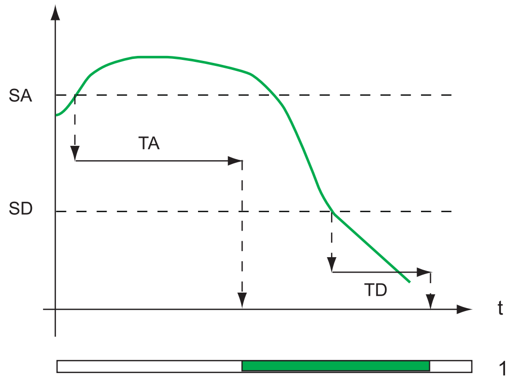
- Positive crossing of the associated measurement pick-up threshold (superiority condition)
- Negative crossing of the associated measurement pick-up threshold (inferiority condition)
- Equality with the associated measurement pick-up threshold (equality condition)

The type of monitoring is predetermined by the RSU software.

Alarm on Superiority Condition

Activation of the alarm on a superiority condition is determined using 2 thresholds and 2 time delays.

The figure below illustrates activation of an alarm on a superiority condition:

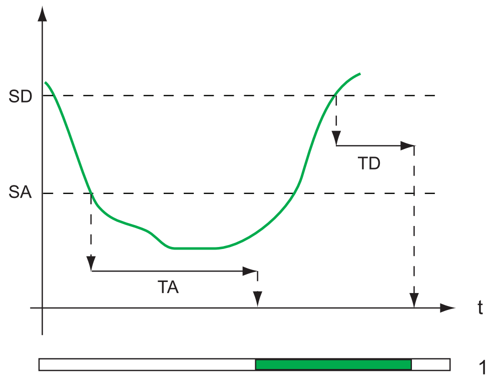


SA Pick-up threshold
TA Pick-up time delay
SD Drop-out threshold
TD Drop-out time delay
1 Alarm: pick-up zone (in green)

Alarm on Inferiority Condition

Activation of the alarm on an inferiority condition is determined according to the same principle.

The figure below illustrates activation of an alarm on an inferiority condition:



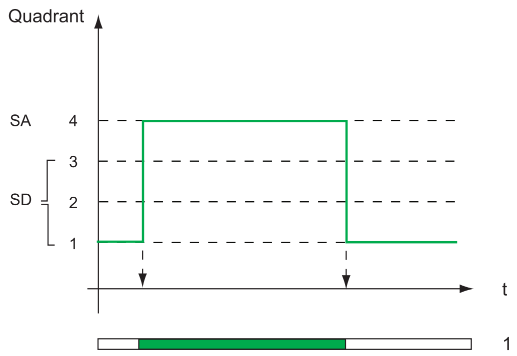
SA Pick-up threshold
TA Pick-up time delay
SD Drop-out threshold
TD Drop-out time delay
1 Alarm: pick-up zone (in green)

Alarm on Equality Condition

The alarm is activated when the associated monitored quantity equals the pick-up threshold. The alarm is deactivated when the associated monitored quantity is different from the pick-up threshold.

Alarm activation is determined using the pick-up/drop-out thresholds.

The figure below illustrates activation of an alarm on an equality condition (monitoring of quadrant4):



SA Pick-up threshold
SD Drop-out thresholds
1 Quadrant 4 alarm: pick-up zone (in green)

Management of Time Delays (Superiority or Inferiority Conditions)

The alarm time delays are managed by 2 counters that are normally at 0.

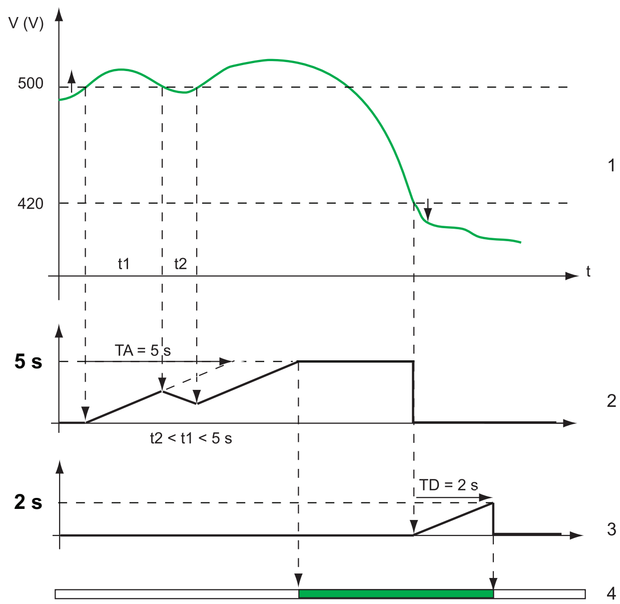
For the pick-up threshold, the time delay counter is:

- Incremented when the activation condition is fulfilled
- Decremented if the activation condition is no longer fulfilled (before the end of the pick-up time delay) If the deactivation condition is reached, the pick-up time delay counter is reset and the drop-out time delay counter is incremented.

For the drop-out threshold, the same principle is used.

Example:

Management of the time delay on an overvoltage alarm (code 79, see *Detailed Tables of Alarms, page 110*)



1 Evolution of the voltage
2 Pick-up time delay counter at 5 s
3 Drop-out time delay counter at 2 s
4 Overvoltage alarm: pick-up zone (in green)

The alarm pick-up time delay counter trips when the 500 V threshold is crossed by the voltage. It is incremented or decremented according to the value of the voltage in relation to the threshold.

The alarm drop-out time delay counter trips when the voltage drops back below the 420 V threshold.

Alarms on a Trip, Failure and Maintenance Event

Presentation

Alarms on a trip, failure and maintenance event are always active. They can be accessed:
- Via the communication network
- On the front display module FDM121

Certain alarms can be assigned to an SDx module output (see *Setting the SDx Module Output Parameters, page 127*).

Alarm Setup

The parameters of alarms on a trip and failure event are fixed and cannot be modified.

The parameters of the 2 maintenance alarms (OF operation counter threshold and Close command counter threshold) can be modified using the RSU software under the **Breaker I/O**I tab.

Alarm Priority Level

Each alarm is given a priority level:
- High priority
- Medium priority

Detailed Tables of Alarms

Pre-Alarms

By default, these alarms are active and are medium priority.

Label	Code	Setting Range		Default Setting			
		Thresholds (Pick-Up or Drop-Out)	Time Delay	Thresholds		Time Delay	
				Pick-Up	Drop-Out	Pick-Up	Drop-Out
Pre Alarm Ir (PAL Ir)	1013	40...100% Ir	1 s	90% Ir	85% Ir	1 s	1 s
Pre Alarm Ig(PAL Ig) (Micrologic 6 trip unit)	1014	40...100% Ig	1 s	90% Ig	85% Ig	1 s	1 s

User-Defined Alarms (Micrologic A)

By default, user-defined alarms are not active and are medium priority.

Label	Code	Setting Range		Default Setting		
		Thresholds (Pick-Up or Drop-Out)	Time Delay	Thresholds	Time Delay	
					Pick-Up	Drop-Out
Over Current inst I1	1	0.2...10 In	1...3000 s	In	40 s	10 s
Over Current inst I2	2	0.2...10 In	1...3000 s	In	40 s	10 s
Over Current inst I3	3	0.2...10 In	1...3000 s	In	40 s	10 s
Over Current inst IN	4	0.2...10 In	1...3000 s	In	40 s	10 s
Ground Fault alarm (Micrologic 6 trip unit)	5	10..0.100% Ig	1...3000 s	40% ig	40 s	10 s
Under Current inst I1	6	0.2...10 In	1...3000 s	0.2 In	40 s	10 s
Under Current inst I2	7	0.2...10 In	1...3000 s	0.2 In	40 s	10 s
Under Current inst I3	8	0.2...10 In	1...3000 s	0.2 In	40 s	10 s
Over Current Iavg	55	0.2...10 In	1...3000 s	In	60 s	15 s
Over I MAX (1,2,3)	56	0.2...10 In	1...3000 s	In	60 s	15 s
Under Current IN	57	0.2...10 In	1...3000 s	0.2 In	40 s	10 s
Under Current Iavg	60	0.2...10 In	1...3000 s	0.2 In	60 s	15 s
Under I MIN (1,2,3)	65	0.2...10 In	1...3000 s	0.2 In	60 s	15 s

User-Defined Alarms (Micrologic E)

By default:
- User-defined alarms are not active
- Alarms 1 to 144 are medium priority
- Alarms 145 to 150 are low priority

Label	Code	Setting Range		Default Setting		
		Thresholds (Pick-Up or Drop-Out)	Time Delay	Thresholds	Time Delay	
					Pick-Up	Drop-Out
Over Current inst I1	1	0.2...10 In	1...3000 s	In	40 s	10 s
Over Current inst I2	2	0.2...10 In	1...3000 s	In	40 s	10 s
Over Current inst I3	3	0.2...10 In	1...3000 s	In	40 s	10 s
Over Current inst IN	4	0.2...10 In	1...3000 s	In	40 s	10 s
Ground Fault alarm (Micrologic 6 trip unit)	5	10..0.100% Ig	1...3000 s	40% ig	40 s	10 s
Under Current inst I1	6	0.2...10 In	1...3000 s	0.2 In	40 s	10 s
Under Current inst I2	7	0.2...10 In	1...3000 s	0.2 In	40 s	10 s
Under Current inst I3	8	0.2...10 In	1...3000 s	0.2 In	40 s	10 s
Over Iunbal phase 1	9	5...60% Iavg	1...3000 s	25 %	40 s	10 s
Over Iunbal phase 2	10	5...60% Iavg	1...3000 s	25 %	40 s	10 s
Over Iunbal phase 3	11	5...60% Iavg	1...3000 s	25 %	40 s	10 s
Over Voltage V1N	12	100...1100 V	1...3000 s	300 V	40 s	10 s
Over Voltage V2N	13	100...1100 V	1...3000 s	300 V	40 s	10 s
Over Voltage V3N	14	100...1100 V	1...3000 s	300 V	40 s	10 s
Under Voltage V1N	15	100...1100 V	1...3000 s	180 V	40 s	10 s
Under Voltage V2N	16	100...1100 V	1...3000 s	180 V	40 s	10 s
Under Voltage V3N	17	100...1100 V	1...3000 s	180 V	40 s	10 s
Over Vunbal V1N	18	2%...30% Vavg	1...3000 s	10 %	40 s	10 s
Over Vunbal V2N	19	2%...30% Vavg	1...3000 s	10 %	40 s	10 s
Over Vunbal V3N	20	2%...30% Vavg	1...3000 s	10 %	40 s	10 s
Over total KVA	21	1...1000 kVA	1...3000 s	100 kVA	40 s	10 s
Over direct KW	22	1...1000 kW	1...3000 s	100 kW	40 s	10 s
Return KW power	23	1...1000 kW	1...3000 s	100 kW	40 s	10 s
Over direct KVAr	24	1...1000 kvar	1...3000 s	100 kvar	40 s	10 s
Return KVAr power	25	1...1000 kvar	1...3000 s	100 kvar	40 s	10 s
Under total KVA	26	1...1000 kVA	1...3000 s	100 kVA	40 s	10 s
Under direct KW	27	1...1000 kW	1...3000 s	100 kW	40 s	10 s
Under direct KVAr	29	1...1000 kvar	1...3000 s	100 kvar	40 s	10 s
Leading PF (IEEE) (1)	31	0...0,99	1...3000 s	0,80	40 s	10 s
Lead or Lag PF(IEC) (1)	33	0...0,99	1...3000 s	0,80	40 s	10 s
Lagging PF (IEEE) (1)	34	- 0,99...0	1...3000 s	- 0,80	40 s	10 s
Over THD Current I1	35	0...500 %	1...3000 s	15 %	40 s	10 s
Over THD Current I2	36	0...500 %	1...3000 s	15 %	40 s	10 s
Over THD Current I3	37	0...500 %	1...3000 s	15 %	40 s	10 s
Over THD V1N	38	0...500 %	1...3000 s	5 %	40 s	10 s
Over THD V2N	39	0...500 %	1...3000 s	5 %	40 s	10 s
Over THD V3N	40	0...500 %	1...3000 s	5 %	40 s	10 s
Over THD V12	41	0...500 %	1...3000 s	5 %	40 s	10 s
Over THD V23	42	0...500 %	1...3000 s	5 %	40 s	10 s
Over THD V31	43	0...500 %	1...3000 s	5 %	40 s	10 s
Over Current Iavg	55	0.2...10 In	1...3000 s	In	60 s	15 s
Over I MAX (1,2,3)	56	0.2...10 In	1...3000 s	In	60 s	15 s
(1) The type of alarms associated with monitoring the cos φ and PF indicators must always be consistent with the choice of sign convention (IEEE or IEC) for the PF indicator.						

Label	Code	Setting Range		Default Setting		
		Thresholds (Pick-Up or Drop-Out)	Time Delay	Thresholds	Time Delay	
					Pick-Up	Drop-Out
Under Current IN	57	0.2...10 In	1...3000 s	0.2 In	40 s	10 s
Under Current Iavg	60	0.2...10 In	1...3000 s	0.2 In	60 s	15 s
Over I1 Demand	61	0.2...10.5 In	1...3000 s	0.2 In	60 s	15 s
Over I2 Demand	62	0.2...10.5 In	1...3000 s	0.2 In	60 s	15 s
Over I3 Demand	63	0.2...10.5 In	1...3000 s	0.2 In	60 s	15 s
Over IN Demand	64	0.2...10.5 In	1...3000 s	0.2 In	60 s	15 s
Under I MIN (1,2,3)	65	0.2...10 In	1...3000 s	0.2 In	60 s	15 s
Under I1 Demand	66	0.2...10.5 In	1...3000 s	0.2 In	60 s	15 s
Under I2 Demand	67	0.2...10.5 In	1...3000 s	0.2 In	60 s	15 s
Under I3 Demand	68	0.2...10.5 In	1...3000 s	0.2 In	60 s	15 s
Under IN Demand	69	0.2...10.5 In	1...3000 s	0.2 In	60 s	15 s
Over Iunbal MAX	70	5...60% Iavg	1...3000 s	25 %	40 s	10 s
Over Voltage V12	71	100...1100 V	1...3000 s	500 V	40 s	10 s
Over Voltage V23	72	100...1100 V	1...3000 s	500 V	40 s	10 s
Over Voltage V31	73	100...1100 V	1...3000 s	500 V	40 s	10 s
Over Volt Vavg L-N	75	100...1100 V	1...3000 s	300 V	5 s	2 s
Under Voltage V12	76	100...1100 V	1...3000 s	320 V	40 s	10 s
Under Voltage V23	77	100...1100 V	1...3000 s	320 V	40 s	10 s
Under Voltage V31	78	100...1100 V	1...3000 s	320 V	40 s	10 s
Over V MAX L-L	79	100...1100 V	1...3000 s	300 V	5 s	2 s
Under Volt Vavg L-N	80	100...1100 V	1...3000 s	180 V	5 s	2 s
Under V MIN L-L	81	100...1100 V	1...3000 s	180 V	5 s	2 s
Over Vunb MAX L-L	82	2%...30% Vavg	1...3000 s	10 %	40 s	10 s
Over Vunbal V12	86	2%...30% Vavg	1...3000 s	10 %	40 s	10 s
Over Vunbal V23	87	2%...30% Vavg	1...3000 s	10 %	40 s	10 s
Over Vunbal V31	88	2%...30% Vavg	1...3000 s	10 %	40 s	10 s
Over Vunb MAX L-L	89	2%...30% Vavg	1...3000 s	10 %	40 s	10 s
Phase sequence	90	0,1	N/A	0	N/A	N/A
Under Frequency	92	45...65 Hz	1...3000 s	45 Hz	5 s	2 s
Over Frequency	93	45...65 Hz	1...3000 s	65 Hz	5 s	2 s
Over KW Power dmd	99	1....1000 kW	1...3000 s	100 kW	40 s	10 s
Leading cos φ (IEEE) (1)	121	0...0,99	1...3000 s	0,80	40 s	10 s
lead,/lag cos φ (IEC) (1)	123	0...0,99	1...3000 s	0,80	40 s	10 s
Lagging cos φ (IEEE) (1)	124	-0,99...0	1...3000 s	-0,80	40 s	10 s
Over T° image motor (Micrologic 6 E-M trip unit)	125	0.2...10.5 In	1...3000 s	In	60 s	15 s
Under T° image motor (Micrologic 6 E-M trip unit)	126	0.2...10.5 In	1...3000 s	In	60 s	15 s
Over I1 Peak Demand	141	0.2...10.5 In	1...3000 s	In	60 s	15 s
Over I2 Peak Demand	142	0.2...10.5 In	1...3000 s	In	60 s	15 s
Over I3 Peak Demand	143	0.2...10.5 In	1...3000 s	In	60 s	15 s
Over IN Peak Demand	144	0.2...10.5 In	1...3000 s	In	60 s	15 s
Lead	145	0,0	1...3000 s	0	40 s	10 s
Lag	146	1,1	1...3000 s	1	40 s	10 s
Quadrant 1	147	1,1	1...3000 s	1	40 s	10 s
Quadrant 2	148	2,2	1...3000 s	2	40 s	10 s
Quadrant 3	149	3,3	1...3000 s	3	40 s	10 s
Quadrant 4	150	4,4	1...3000 s	4	40 s	10 s

(1) The type of alarms associated with monitoring the cos φ and PF indicators must always be consistent with the choice of sign convention (IEEE or IEC) for the PF indicator.

Alarms on a Trip Event

Label	Code	SDx Output	Priority
Long time prot Ir	16384	Yes	High
Short time prot Isd	16385	Yes	High
Instant prot Ii	16386	Yes	High
Ground fault Ig	16387	Yes	High
Integ instant prot	16390	No	High
Trip unit fail (Stop)	16391	Yes	High
Instant vigi prot	16392	No	High
Reflex tripping	16393	No	High
Phase unbalance	16640	Yes	High
Jam motor prot	16641	Yes	High
Under load mtr prot	16642	Yes	High
Long start mtr prot	16643	Yes	High
Trip indicator SD	1905	Yes	Medium

Alarms on a Failure Event

Label	Code	SDx Output	Priority
BSCM failure (Stop)	1912	Yes	High
BSCM failure (Err)	1914	Yes	Medium

Alarms on a Maintenance Event

Label	Code	SDx Output	Priority
OF operation overrun	1916	Yes	Medium
Close command overrun	1919	Yes	Medium
Wear on contacts	256	Yes	Medium

Operation of SDx and SDTAM Module Outputs Assigned to Alarms

Presentation

2 alarms can be assigned to the 2 SDx module outputs.

The 2 outputs can be configured using the RSU software (**Outputs** tab) and are activated (or deactivated) by the occurrence (or completion) of:
- An alarm associated with a measurement (see *Alarms Associated with Measurements, page 106*)
- An alarm on a trip, failure and maintenance event (see *Alarms on a Trip, Failure and Maintenance Event, page 109*)

The 2 outputs on the SDTAM module (Micrologic M) cannot be configured:
- Output 1 is assigned to motor thermal fault indication
- Output 2 is used to open the contactor

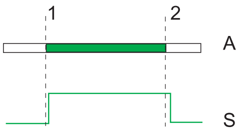
For more details on the SDx and SDTAM modules, see the *Compact NSX circuit breakers - User manual*.

SDx Module Output Operating Modes

The operating mode for the SDx module outputs can be configured as:
- Non-latching
- Latching
- Time-delayed non-latching
- Closed forced
- Open forced

Operation in Non-Latching Mode

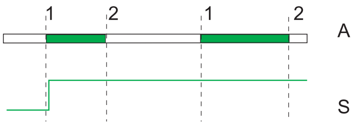
The output (S) position follows the associated alarm (A) transitions.



A Alarm: Green when activated, white when deactivated
S Output: High position = activated, low position = deactivated
1 Alarm activation transition
2 Alarm deactivation transition

Operation in Latching Mode

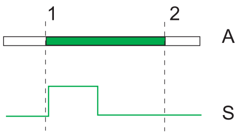
The position of the output (S) follows the active transition of the associated alarm (A) and remains latched irrespective of the alarm state.



A Alarm: Green when activated, white when deactivated
S Output: High position = activated, low position = deactivated
1 Alarm activation transitions
2 Alarm deactivation transitions

Operation in Time-delayed Non-Latching Mode

The output (S) follows the activation transition for the associated alarm (A). The output returns to the deactivated position after a time delay irrespective of the alarm state.



A Alarm: Green when activated, white when deactivated
S Output: High position = activated, low position = deactivated
1 Alarm activation transitions
2 Alarm deactivation transitions

The setting range for the time delay (via the RSU software) is: 1...360 s. By default, the time delay setting is 5 s.

Operation in Open or Closed Forced Mode

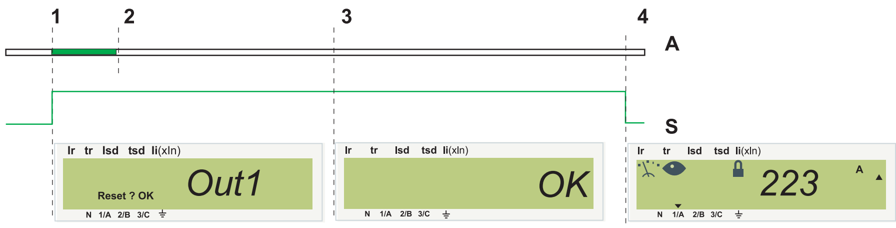
In Open forced mode, the output remains in the deactivated position irrespective of the alarm state.

In Closed forced mode, the output remains in the activated position irrespective of the alarm state.

NOTE: Both these modes can be used for debugging or checking an electrical installation.

Acknowledgment of Latching Mode

Latching mode is acknowledged via the Micrologic trip unit keypad by pressing the OK key twice.



A Alarm: Green when activated, white when deactivated
S Output: High position = activated, low position = deactivated

Step	Event/Action	Information on the Display
1	Alarm activation	The message Out1 is displayed.
2	Alarm deactivation	The Out1 message is still displayed.
3	Acknowledgment of active position of the output (press the OK key twice to confirm)	The message OK is displayed.
4	–	The screensaver is displayed.

Special Features of Latching Mode

If the acknowledge request is made when the alarm is still active:
- Acknowledgment of the output active position has no effect.
- Keypad navigation is possible.
- The screensaver returns to the Out1 message.

If 2 alarms associated with 2 outputs in latching mode are active:
- The first alarm message Out1 (or Out2) is displayed on the screen until the alarm is actually acknowledged (the output's active position is acknowledged after the alarm is deactivated).
- After acknowledgment of the first alarm, the screen displays the second alarm message Out2 (or Out1) until the second alarm is actually acknowledged.
- After both acknowledgments, the display returns to the screensaver.

Assignment of the SDTAM Module Outputs

Output 1 (SD2/OUT1), normally open, is assigned to indicating thermal faults.

Output 2 (SD4/OUT2), normally closed, is used to open the contactor.

They are activated 400 ms before the circuit breaker trips in the case of:
- Long time protection
- Phase unbalance protection
- Jam motor protection (Micrologic 6 E-M)
- Underload protection (Micrologic 6 E-M)

The RSU Parameter Setting Software

5

Aim

This chapter describes the protection parameter settings and setting the metering and alarm parameters using the RSU software.

What's in this Chapter?

This chapter contains the following topics:

Parameter Setting Using the RSU Software

Presentation

The RSU(Remote Setting Utility) software is a Micrologic utility designed to help the operator:

- To check and/or configure:
  - Protection parameters
  - Metering parameters
  - Alarm parameters
  - Assignment of the SDx module outputs
  - BSCM module parameters
  - Modbus interface module parameters
- To modify passwords
- To save these configurations
- To edit configurations
- To display trip curves
- To download the firmware

Using the RSU Software

The RSU software can be used:

- In stand alone mode, directly on the Micrologic trip unit by means of the test port
  For this type of use you need a standard PC and the maintenance module.
- Via the communication network

For more details, see the *RSU Software Online Help*.

Offline Mode

Offline mode can be used to configure the protection, metering and alarm functions of the Micrologic trip unit in the RSU software.

For more details on offline mode, see the *RSU Software Online Help*.

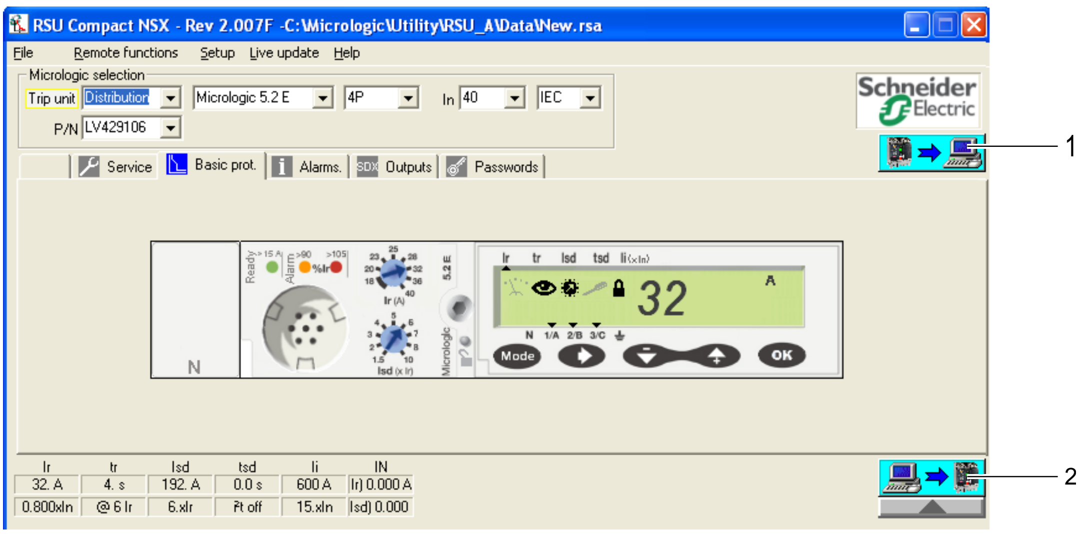
Online Mode

Online mode can be used to:

- Perform the same configuration functions as offline mode
- Download information from or to the Micrologic trip unit

For more details on online mode, see the *RSU Software Online Help*.

2 buttons located on the right of the screen activate the data transfer.



1 Button for downloading information from the trip unit to the PC
2 Button for downloading information from the PC to the trip unit

User Profiles

2 different user profiles are available in the RSU software: Commissioning and Schneider Service.

- The Commissioning profile is the default profile when you start the RSU software. This profile does not need a password.
- The Schneider Service profile allows the same access as the Commissioning profile plus the firmware updates and password resets. The firmware to be downloaded can be accessed on www.schneider-electric.com.

Description of the RSU Software Functions

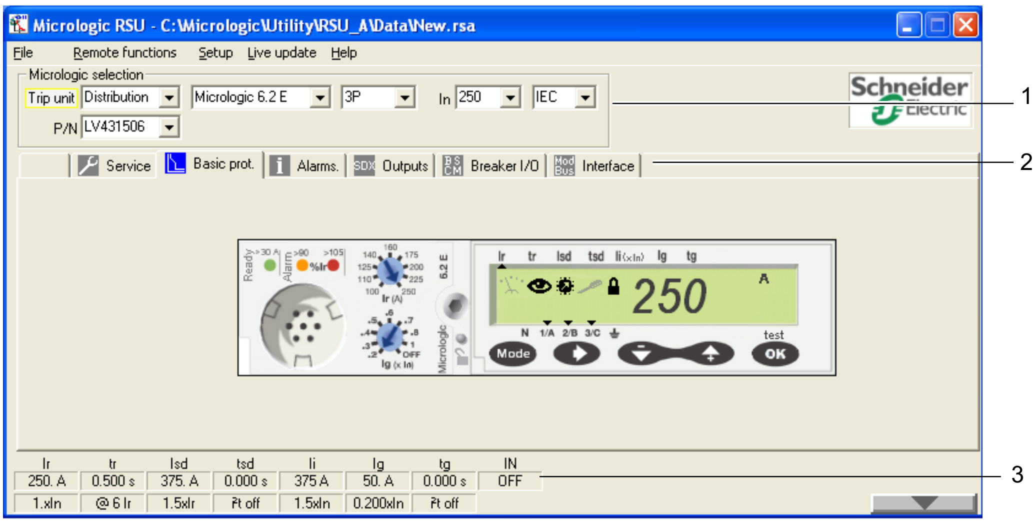
The RSU software configuration functions can be accessed via different tabs:

Tab	Functions
Service	Configuring the metering functions (Micrologic E)
Basic prot	Protection parameter setting
Alarms	Configuring pre-alarms and the 10 user-defined alarms
SDx Outputs	Assignment of the two SDx outputs
Passwords	Configuring four password levels
BSCM Module Option	
BSCM Breaker I/O	• Counters for OF operations and actions on SD and SDE faults • Alarm threshold associated with the OF counter • Communicating motor mechanism: Close command counter • Communicating motor mechanism: Configuring the motor reset command • Communicating motor mechanism: Alarm threshold associated with the close command counter
Modbus Interface Option	
Mod Bus Interface	• Reading Modbus addresses • Setting the Communication Parameters

The **Basic prot.** tab is displayed by default when the user starts RSU.

The active tab is indicated by a blue pictogram. For example, this pictogram indicates that the **Basic prot.** tab is the active tab.

In the example below, the user has manually selected a Micrologic 6.2.E trip unit (offline mode). The **Basic prot.** tab displays a reproduction of the front face of the Micrologic trip unit as well as its protection settings.



1 Micrologic selection windows
2 Accessible function tabs
3 Protection settings

In the context of this manual, only the functions relating to setup of the Micrologic trip unit and the SDx and SDTAM modules are described.

For more information on all functions, in particular configuring the BSCM module option, the Modbus communication interface option and passwords, see the *RSU Software Online Help*.

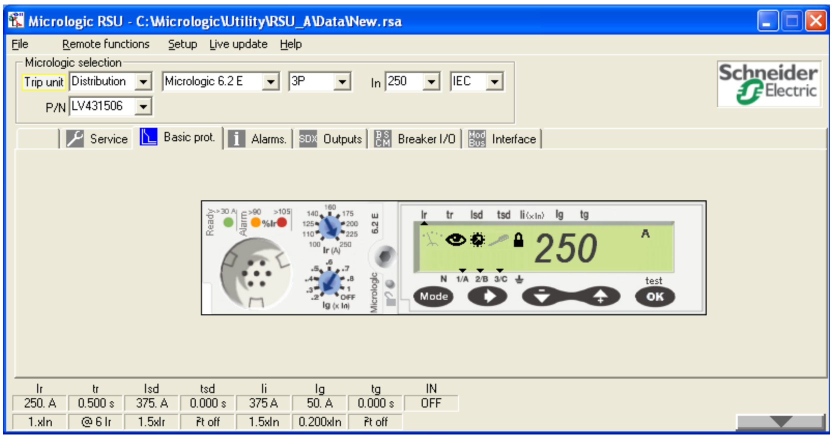
Saving and Printing

The different settings and data can be saved and printed.

Protection parameter setting

Presentation

The protection parameter settings can be accessed using the RSU software under the Basic prot. tab (default tab):



Protection parameter setting

The RSU software screen is exactly the same as the front face of the trip units: the setting and navigation principles are identical to those described in the *Readout Mode, page 20* and *Setting Mode, page 24* chapters.

NOTE: Access to the settings is only possible when the padlock is unlocked (for more information on unlocking the padlock, see *Navigation Principle, page 18*).

NOTE: The 2 additional protections on the Micrologic 6 E-M trip unit (Under load and Long start) can only be set using the RSU software.

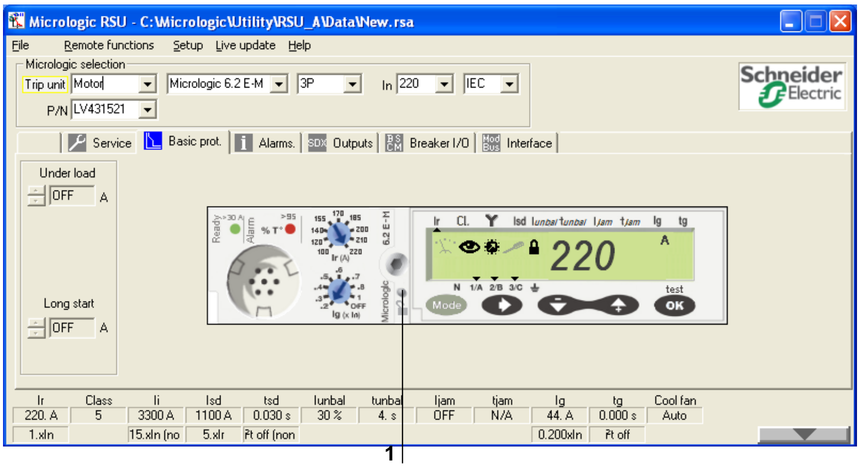
Presetting the Protection Parameters by a Dial

When a protection parameter is preset by a dial, the dial on the Micrologic trip unit and the virtual dial in the RSU software have to be in an identical position.

Underload and Long Start Motor Protection Setting (Micrologic 6 E-M)

The figure below describes the 

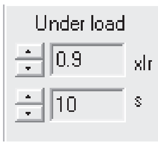
tab in the RSU software for the Micrologic 6 E-M trip unit:



1 Padlock unlock button

The table below illustrates the Underload and Long Start Motor protection setting:

Screen	Action

	• Unlock the padlock.
	• Select the **Under load** window on the left of the screen.
	• 2 dropdown lists can be used to set the underload protection:
	  • Select the pick-up value from the dropdown list marked **xIr**.
	  • Select the time delay from the dropdown list marked **s**.

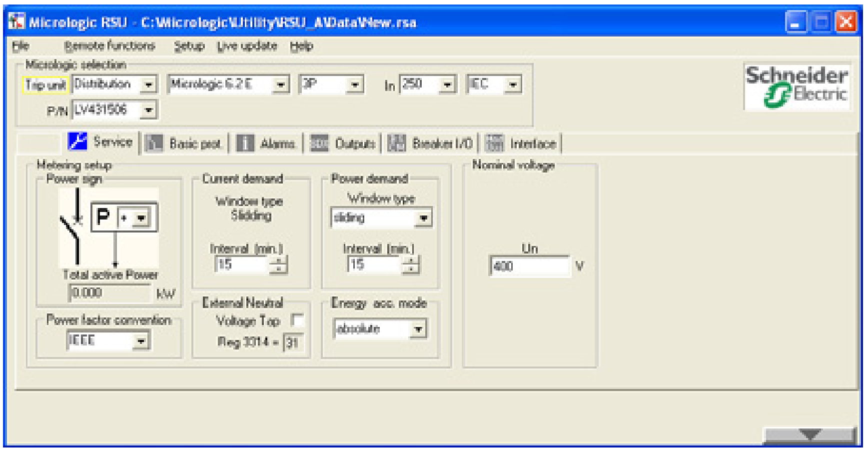
	• Unlock the padlock.
	• Select the **Long start** window on the left of the screen.
	• 2 dropdown lists can be used to set the long start motor protection:
	  • Select the pick-up value from the dropdown list marked **xIr**.
	  • Select the time delay from the dropdown list marked **s**.

Metering Setup

Presentation

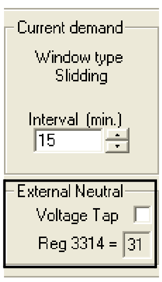
The metering setup and selection of calculation modes can be accessed using the RSU software under the 

tab:



ENVT Option Setup (3-Pole Device)

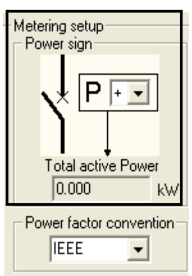
The table below illustrates the ENVT option parameter settings in the **Services** tab:

Screen	Action
	Check the declaration box for the ENVT option in the **Metering setup**/**External Neutral Voltage Tap** window. The content of Modbus 3314 register is described in the *Modbus Compact NSX - User manual*.

NOTE: The ENCT option parameter can be set directly on the Micrologic trip unit screen and/or using the RSU software under the **Basic prot** tab.

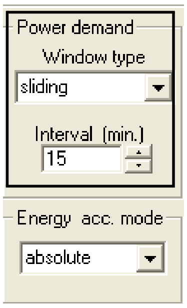
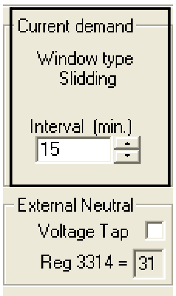
Power Setup

The table below illustrates the choice of power sign in the **Services** tab:

Screen	Action
	In the **Metering setup**/**Power sign** window, select the power sign: ● + : The power running through the circuit breaker from top to bottom is counted positively ● - : The power running through the circuit breaker from top to bottom is counted negatively The default value of the power sign is +.

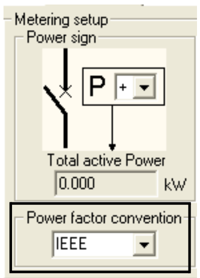
Demand Values Setup

The table below illustrates the parameter settings for the demand values calculation windows in the **Services** tab:

Screen	Action
	2 dropdown lists can be used to set the parameters for calculating the power demand value in the **Power demand** window: ● Select the type of calculation window in the **Window type** dropdown list: fixed window, sliding window, synchronized window. ● Indicate the duration of the calculation window using the scroll bars in the **Interval** dropdown list: the duration can be selected from 5 to 60 minutes in steps of 1 minute.
	Current demand setup: In the **Current demand/Interval** window indicate the duration of the calculation window using the scroll bars in the **Interval** dropdown list: the duration can be selected from 5 to 60 minutes in steps of 1 minute. The calculation window type must be *sliding window*.

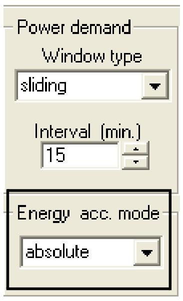
Quality Indicator Setup

The table below illustrates the parameter settings for the cos φ and power factor (PF) indicators in the **Services** tab:

Screen	Action
	Select the sign convention in the **Power factor sign** window. The default parameter setting for the sign convention is the IEEE convention.

Energy Accumulation Mode Setup

The table below illustrates the energy accumulation mode setup in the **Services** tab:

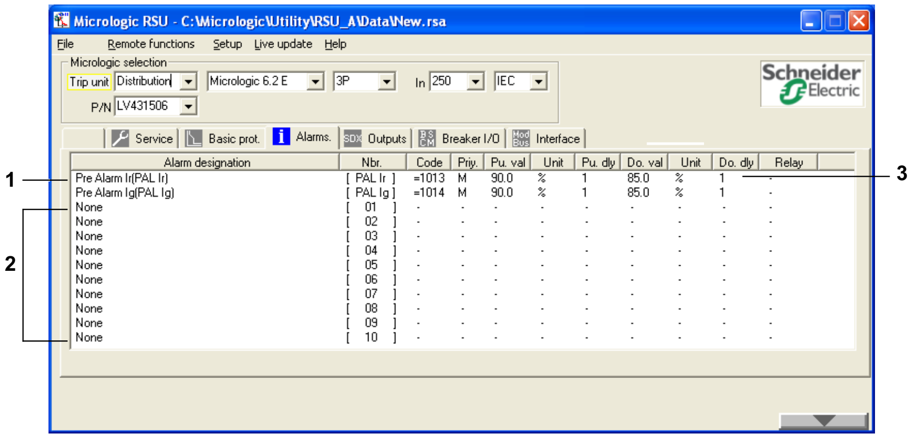
Screen	Action
	Select the energy accumulation mode in the **Energy accu. mode** window. ● Absolute energy: The energies supplied and consumed are counted positively ● Signed energy: The energy supplied is valued negatively, the energy consumed is valued positively The default parameter setting for the energy accumulation mode is absolute energy mode.

Alarm Setup

Presentation

Alarm selection and setup can be accessed using the RSU software under the 

tab:



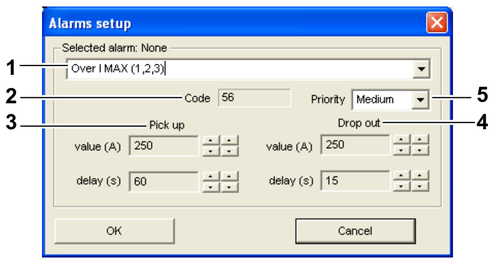
1 Alarms already activated and set up
2 List of possible alarm assignments
3 Alarm parameters

Activating an Alarm

Step	Action
1	Select *none* for a free assignment, for example the first available line.
2	Double-click on *none*; the **Alarm setup** selection and setting screen appears (see below).
3	Select the alarm to be activated from the dropdown list in the **Alarm setup** screen.
4	Once the alarm has been selected, there are 2 possible options: ● The default parameter setting is correct: Click on **OK** (the alarm is activated in the dropdown list of assignments with the default parameters) ● The default parameter setting needs to be modified: Set the alarm parameters.

Alarm Setup Screen

Alarm setup screen:



1 Alarm name
2 Alarm code
3 Activation parameters (pick-up and time delay)
4 Deactivation parameters (drop-out and time delay)
5 Priority Level

Setting an Alarm's Parameters

In the **Alarm setup** screen:

Step	Action
1	Set the priority level in the **Priority** window using the scroll bar (4 options).
2	Set the pick-up threshold value and time delay (if present) in the **Pick up/value** and **Pick up/delay** windows using the scroll bars.
3	Set the drop-out threshold value and time delay (if present) in the **Drop out/value** and **Drop out/delay** windows using the scroll bars.
4	Confirm the parameter setting by clicking **OK** (the alarm is activated in the dropdown list of assignments with its priority level and the values of its activation and deactivation parameters).

For parameters with a wide setting range, there are two scroll bars:
- Left-hand scroll bar for presetting
- Right-hand scroll bar for fine-tuning

The RSU software monitors the parameter setting ranges and prohibits setting anomalies (for example, if the pick-up threshold is set below the drop-out threshold for an alarm with a superiority condition, the software sets the thresholds to the same value by default).

Parameters which have not been set remain at their default value (except that modification of the value by the RSU software is mandatory to avoid any anomalies).

For more details on the list of alarms, the setting ranges and default settings, see *Detailed Tables of Alarms, page 110*.

Modifying an Alarm

Under the 

tab:

Step	Action
1	Double-click on the alarm in the **Alarms** tab.
2	Modify the parameters in the dropdown list in the **Alarm setup** screen.
3	Set the drop-out threshold value and time delay (if present) in the **Drop out/value** and **Drop out/delay** windows using the scroll bars.
4	Confirm by clicking **OK** (the new alarm parameters appear in the right-hand side of the dropdown list).

Deleting an Alarm

Under the 

tab:

Step	Action
1	Double-click on the alarm in the **Alarms** tab.
2	Select *none* from the dropdown list in the **Alarm setup** screen.
3	Confirm by clicking **OK** (*none* appears in place of the alarm in the dropdown list).

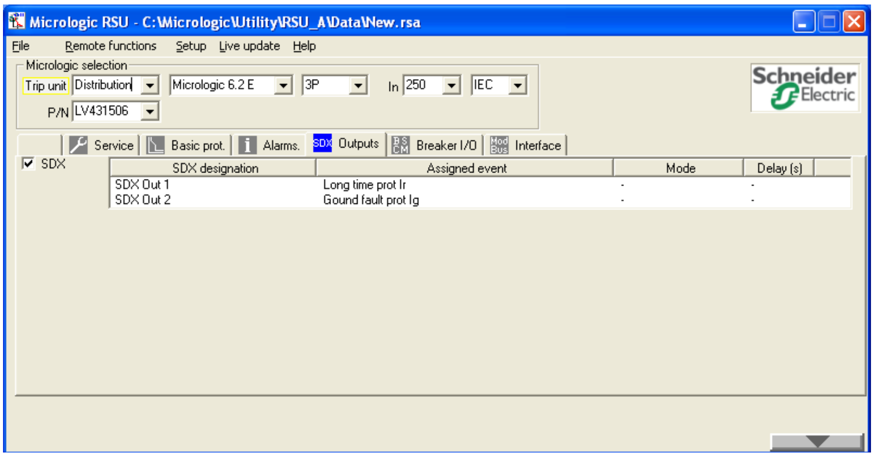
Setting the SDx Module Output Parameters

Presentation

All alarms on a trip, failure and maintenance event and all alarms associated with a measurement, activated beforehand in the **Alarms** tab, can be assigned to an SDx module output.

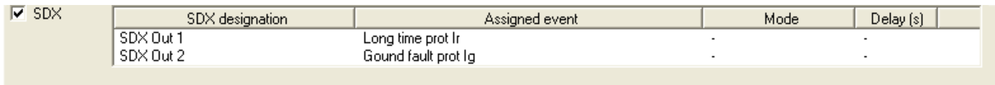
The SDx module output parameter settings can be accessed using the RSU software under the 

tab:



Default Assignment of the SDx Module Outputs

The figure below illustrates the **Outputs** tab for a Micrologic 6 trip unit:



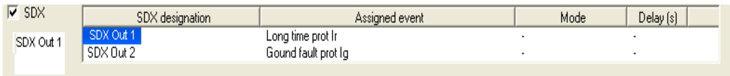
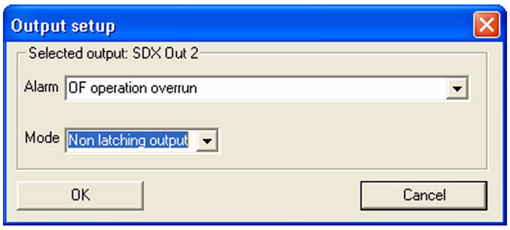
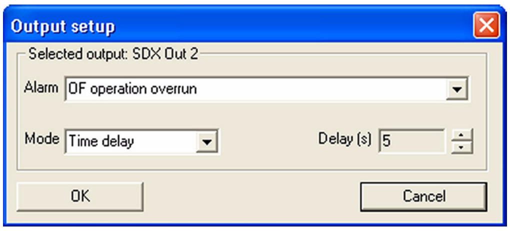
The SDx module output assignment depends on the type of Micrologic trip unit installed on the module.

Both outputs are assigned by default as follows:

- Micrologic 5 trip unit:
  - Output 1 is assigned to the thermal fault indication (SDT) function.
  - Output 2 is assigned to the long time pre-alarm (PAL Ir) function.
- Micrologic 6 trip unit:
  - Output 1 is assigned to the thermal fault indication (SDT) function for electrical distribution applications.
    Output 1 is assigned to None for motor-feeder applications.
  - Output 2 is assigned to the ground fault indication (SDG) function.

Assignment of an Alarm to an SDx Module Output

The procedure for assigning an alarm to an SDx module output is as follows:

Step	Action
1	Double-click on the output (Out1 or Out2) to be assigned.  An **Output setup** window appears.
2	Select the alarm to be assigned to the output from the **Alarm** dropdown list in the **Output setup** window. The dropdown list contains all the alarms on a trip, failure and maintenance event as well as the alarms associated with measurements activated in the **Alarms** tab (see *Alarm Setup, page 125*.). 
3	If necessary, select the output operating mode from the **Mode** dropdown list.  If necessary, set the time delay.

Operating Assistance

6

Aim

This chapter describes how to use the information and functions providing operating assistance for the electrical equipment, available with Micrologic 5, 6 and 6 E-M trip units and the associated tools (RCU software and FDM121 display module).

What's in this Chapter?

This chapter contains the following sections:

6.1 Micrologic Trip Unit Indicators

Aim

This section describes the supervision and monitoring options for an installation using the Micrologic trip unit local indicators, LEDs and LCD display.

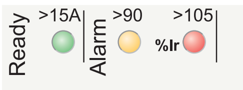
What's in this Section?

This section contains the following topics:

Local LED Indication

Local Indicator LED

The number of LEDs and their meaning depend on the type of Micrologic trip unit.

Type of Micrologic	Description
Distribution 	• Ready LED (green): Blinks slowly when the electronic trip unit is ready to provide protection. • Overload pre-alarm LED (orange): Shows a steady light when the load exceeds 90% of the Ir setting. • Overload alarm LED (red): Shows a steady light when the load exceeds 105% of the Ir setting.
Motor 	• Ready LED (green): Blinks slowly when the electronic trip unit is ready to provide protection. • Overload temperature alarm LED (red): Shows a steady light when the motor thermal image exceeds 95% of the Ir setting.

Operation of the Ready LED

The Ready LED (green) blinks slowly when the electronic trip unit is ready to provide protection. It indicates that the trip unit is operating correctly.

NOTE: Activation of the Ready LED is guaranteed for a value equal to the sum of the circuit breaker current intensities for each phase and the neutral above a limit value.

This limit value is indicated above the Ready LED, on the front face of the Micrologic trip unit.

The table below uses 2 examples to illustrate the comparison of the phase and neutral currents with the activation limit value of the Ready LED:

Micrologic 5.2 Trip Unit, 40 A Rating, 3-Pole	Micrologic 5.3 Trip Unit, 400 A Rating, 4-Pole
The limit value is 15 A.	The limit value is 50 A.

This limit value can correspond, for example:
• Either to the sum of the 5 A phase current intensities (3 balanced phases)
• Or to 7.5 A in 2 phases (the current intensity in the third phase is zero)
• Or to 15 A in one phase if the circuit breaker (3-pole):
  • Is installed on a distribution with distributed neutral
  • Only has one loaded phase on a single-phase load
The current intensity in the other 2 phases is zero.
	This limit value corresponds, for example:
	• Either to the sum of the three 15 A phase current intensities and a 5 A neutral current intensity
	• Or to 25 A in 2 phases (the current intensity in the third phase and in the neutral is zero)
	• Or to 25 A in one phase and in the neutral (the current intensity in the other 2 phases is zero)

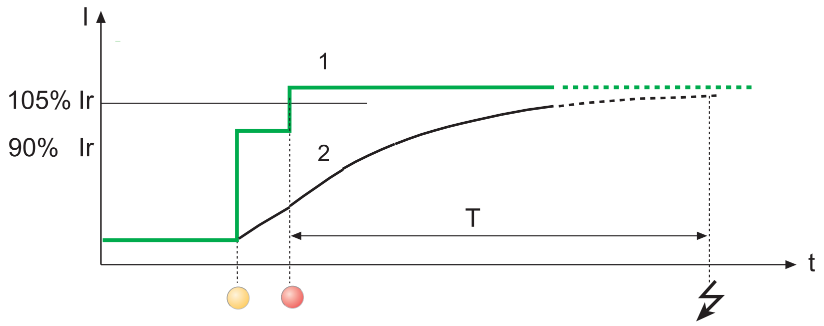
Operation of Pre-Alarm and Alarm LEDs (Electrical Distribution Protection)

The pre-alarm (orange LED) and alarm (red LED) indications are tripped as soon as the value of one of the phase currents exceeds 90% and 105% respectively of the Ir pick-up setting:

- Pre-alarm
  Exceeding the pre-alarm threshold at 90% of Ir has no effect on activation of the long time protection.
- Alarm
  Crossing the alarm threshold at 105% of Ir indicates that the long time protection (see *Long Time Protection, page 40*) has been activated with a trip time delay that depends on:
  - The value of the current in the load
  - The setting of the time delay tr

NOTE: If the pre-alarm and alarm LEDs keep lighting up, it is advisable to carry out load shedding in order to avoid tripping due to a circuit breaker overload.

The figure below illustrates the information supplied by the LEDs:



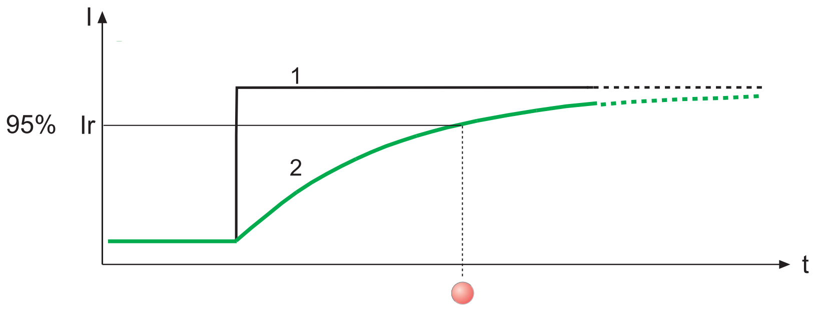
1 Current in the load (most heavily loaded phase)
2 Thermal image calculated by the trip unit

Operation of Alarm LEDs (Motor Protection)

The alarm indication (red LED) is tripped as soon as the value of the motor thermal image exceeds 95% of the Ir pick-up setting.

Crossing the threshold of 95% of Ir is a temperature alarm: long time protection is not activated.

The figure below illustrates the information supplied by the LED:



1 Current in the load
2 Thermal image calculated by the trip unit

Indication on the Micrologic Display

Presentation

Indication screens inform the user about the status of the installation.

Maintenance interventions should be executed according to the priority level:
- Configured (alarms: high, medium, low or no priority)
- Or pre-defined (trip and failure events: high or medium priority)

Stacking Screens

When a number of events arrive simultaneously, they are stacked according to their criticality level: 0 (no criticality) to 4 (high criticality):

Criticality	Screen (1)
0	Main screen
1	**Outx** alarm screen
2	**Err** internal failure screen
3	**Stop** internal fault screen
4	**Trip** screen
(1) The screens and their acknowledgment procedure are described below.	

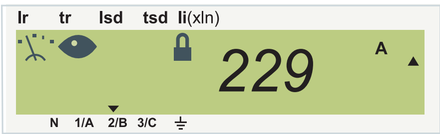
Example:

An alarm on a voltage measurement **Outx** then an internal failure **Err** have occurred (1):
- The screen displayed is the internal failure **Err** screen.
- After acknowledging the internal failure **Err** screen, the alarm **Outx** screen is displayed.
- After acknowledging the internal failure **Outx** screen, the main screen is displayed.

(1) The stacking example corresponds to 3 criticality levels: 0 for the main screen, 1 for the **Outx** screen and 2 for the internal failure **Err** screen.

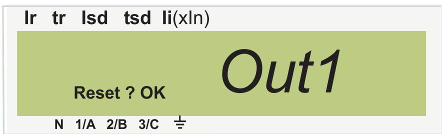
The same acknowledgment sequence should be performed if the internal failure **Err** occurred before the voltage measurement **Outx**.

Indication of Correct Installation Operation

Screen	Cause
I phase 2  	The main screen displays the current value of the most heavily loaded phase.

Alarm Indication

Circuit breaker with SDx module option

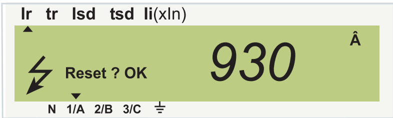
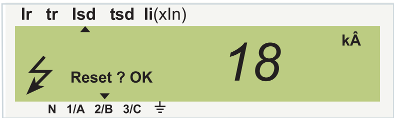
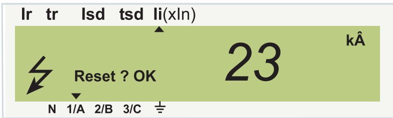
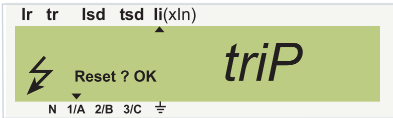
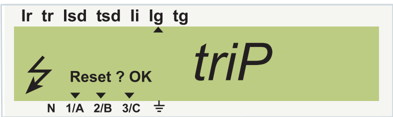
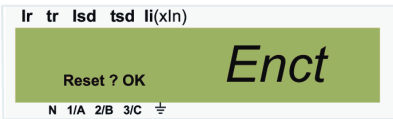
Screen	Cause
Outx  	An alarm configured on the SDx module in permanent latching mode has not been acknowledged (see *Acknowledgment of Latching Mode, page 115*) or the acknowledgment request is made when the alarm is still active.

Check the cause of the alarm and acknowledge the alarm by pressing the OK key twice (validation and confirmation).

The main screen (current value of the most heavily loaded phase) is displayed.

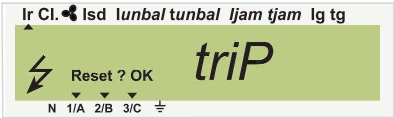
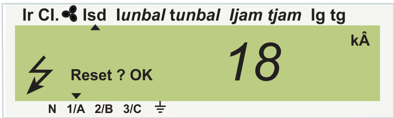
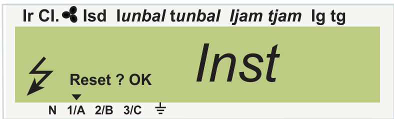
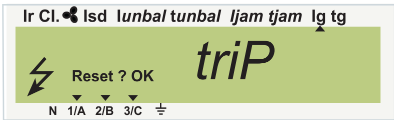
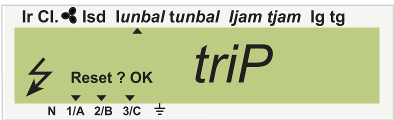
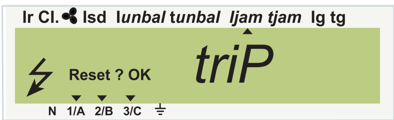
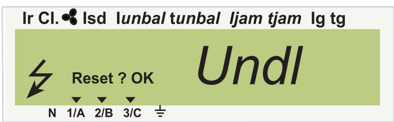
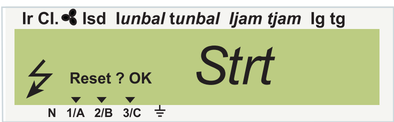
Indication of Faults With Micrologic 5 and 6

For more information on definitions of the fault protections associated with indications, see *Electrical Distribution Protection, page 37*.

Screen	Cause
Breaking current Ir 	Tripped by long time protection: Up arrow pointing to Ir, breaking value displayed
Peak breaking current Isd 	Tripped by short time protection: Up arrow pointing to Isd, breaking value displayed
Peak breaking current Ii 	Tripped by instantaneous protection or reflex protection: Up arrow pointing to Ii, breaking value displayed
	Tripped by integrated instantaneous protection: Up arrow pointing to Ii, **triP** displayed
	Micrologic 6 Tripped by ground fault protection: Up arrow pointing to Ig, **triP** displayed
	Tripped by absence of ENCT option, as the ENCT option was declared during the protection parameter settings of the Micrologic trip unit. It is then necessary to install the ENCT option or a bridge between the T1 and T2 terminals of the Micrologic trip unit to acknowledge the ENCT screen. Acknowledgement is made by pressing the OK key twice (validation and confirmation).

Indication of Faults With Micrologic 6 E-M

For more information on definitions of the fault protections associated with indications, see *Protection for Motor-Feeders, page 55*.

Screen	Cause
	Tripped by long time protection: Up arrow pointing to Ir, **triP** displayed (1)
Peak breaking current Isd 	Tripped by short time protection: Up arrow pointing to Isd, breaking value displayed
	Tripped by instantaneous protection or reflex protection: **Inst** displayed
	Tripped by ground fault protection: Up arrow pointing to Ig, **triP** displayed
	Tripped by unbalance protection: Up arrow pointing to Iunbal, **triP** displayed (1)
	Tripped by jam motor protection: Up arrow pointing to Ijam, **triP** displayed (1)
	Tripped by underload protection: **Undl** displayed (1)
	Tripped by long start protection: **Strt** displayed
(1) These trip causes can be managed automatically by SDTAM output 2 (OUT2) action on the contactor (see *SDTAM Module Option, page 57*).	

Acknowledging the Trip Screens

The trip screens are acknowledged by pressing the OK key twice (validation and confirmation).

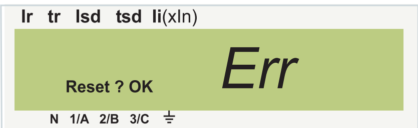
⚠ CAUTION
RISK OF CLOSING ON ELECTRICAL FAULT
Do not close the circuit breaker again without inspecting and, if necessary, repairing the downstream electrical equipment.
Failure to follow these instructions can result in injury or equipment damage.

The fact that a protection has tripped does not remedy the cause of the fault on the downstream electrical equipment.

Step	Action
1	Isolate the feed before inspecting the downstream electrical equipment.
2	Look for the cause of the fault.
3	Inspect and, if necessary, repair the downstream equipment.
4	Inspect the equipment (refastening of connections, etc.) in the event of a short-circuit trip.
5	Close the circuit breaker again.

For more information on troubleshooting and restarting following a fault, see the *Compact NSX circuit breakers - User manual.*

Indication on Internal Failure of the Micrologic Trip Unit

Screen	Cause
	An internal failure on the Micrologic trip unit, whether fleeting or permanent, has occurred without the circuit breaker tripping (the failure does not affect the trip unit protection functions).

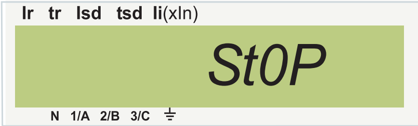
⚠ CAUTION
RISK OF INCORRECT INFORMATION
Replace the Micrologic trip unit at the next maintenance interval.
Failure to follow these instructions can result in injury or equipment damage.

Acknowledging the Err Screen

The *Err* screen is acknowledged by pressing the key twice OK (validation and confirmation), which brings up the main screen:

- The measurements and settings can still be accessed with the Mode key
- The *Err* screen becomes the main screen if the failure is permanent

Indication on Internal Fault of the Micrologic Trip Unit

Screen	Cause
	A serious internal fault has occurred in the Micrologic trip unit. This fault trips the circuit breaker.

⚠ CAUTION

RISK OF UNPROTECTED EQUIPMENT

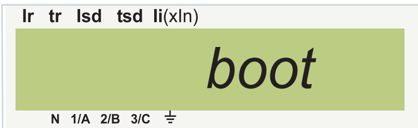
Replace the Micrologic trip unit immediately.

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

Acknowledging the St0P Screen

The *St0P* screen cannot be acknowledged using the OK key:
- It is no longer possible to close the Compact NSX circuit breaker
- The measurements and settings can no longer be accessed with the Mode key
- The *St0P* screen becomes the main screen

Indication of Downloading the Firmware

Screen	Cause
	The Micrologic trip unit is waiting for or in the process of downloading the firmware using the RSU software (duration: 3 minutes approx). • The trip unit protections are still operational. • Access to measurements and settings (via the Micrologic trip unit dials or keypad or via the communication option) is interrupted. If the boot message persists after several download attempts, replace the Micrologic trip unit.

For more details on delivery of and downloading the firmware, see *Parameter Setting Using the RSU Software, page 118* and the *RSU Software Online Help*.

Examples of Using Alarms

Presentation

The choice of which quantity is to be monitored and the alarm parameter settings are made using the RSU software (see *Alarm Setup, page 125*).

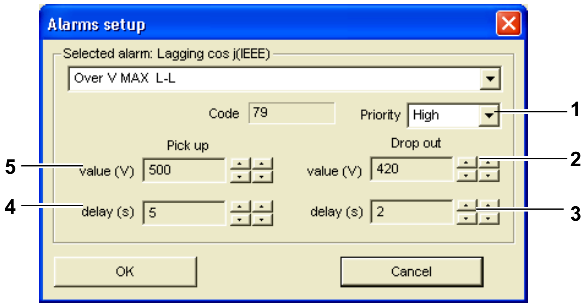
Alarms on Superiority Condition

Alarms on superiority condition are dedicated to monitoring:
- Overvoltages
- Phase unbalance (Micrologic 6 E-M)
- Overcurrents
- Overfrequencies
- Current unbalances
- Power overruns
- Total harmonic distortion (THD) overruns

The value of the drop-out threshold must always be lower than the pick-up threshold.

Example:

Setting the overvoltage monitoring parameters (code 79, see *Detailed Tables of Alarms, page 110*) using the RSU software.



1 Priority level: High
2 Drop-out threshold: 420 V
3 Drop-out time delay: 2 s
4 Pick-up time delay: 5 s
5 Pick-up threshold: 500 V

Alarms on Inferiority Condition

The value of the drop-out threshold must always be higher than the pick-up threshold.

Alarms on inferiority condition are dedicated to supervision of:
- Undervoltages
- Underloads (Micrologic 6 E-M)
- Underfrequencies

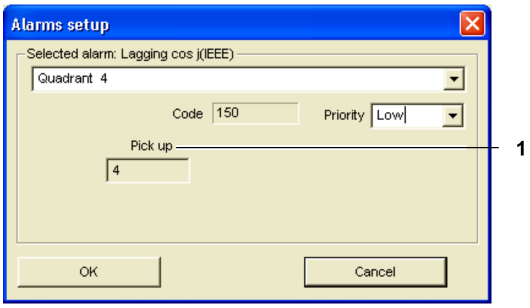
Alarms on Equality Condition

The measurements associated with alarms on an equality condition correspond to a load state:

- Operating quadrant
- Leading or lagging reactive power

Example:

Setting the parameters for monitoring a quadrant (code 150, see *Detailed Tables of Alarms, page 110*) using the RSU software.



1 Pick-up threshold: Quadrant 4
The drop-out thresholds are quadrant values other than 4.

Alarm Monitoring of the Cos φ and Power Factor

Managing the Cos φ and Power Factor PF

Monitoring of the cos φ and power factor PF indicators depends on the sign convention selected for the power factor PF (see *Power factor PF and cos φ measurement (Micrologic E), page 91*): IEEE or IEC convention.

NOTE: The alarm type associated with the indicators - for example, leading PF (IEEE) (code 31) or lead or lag PF (IEC) (code 33) - must be consistent with the sign convention selected (IEEE or IEC) for the PF indicator in the RSU software (see *Metering Setup, page 123*).

The IEEE convention is the default selection.

Indicator Maximum and Minimum Values

- The maximum value of the PF MAX or (cos φ MAX) indicator is obtained for the smallest positive value of the PF (or cos φ) indicator.
- The minimum value of the PF MIN or (cos φ MIN) indicator is obtained for the largest negative value of the PF (or cos φ) indicator.

Electrical Distribution Monitored According to IEEE Convention

The example below describes monitoring of the energy quality by the cos φ indicator.

The table below gives the history of the cos φ values of the load of a workshop downstream of a Compact NSX according to IEEE convention:

Time	Evolution of the Load	IEEE Convention		
		Cos φ	cos φ MIN	cos φ MAX
t1 = 8 h 00 min	Power startup	- 0.4	- 0.4	- 0.4
t2 = 8 h 01 min	Compensation system startup	- 0.9	- 0.4	- 0.9
t3 = 9 h 20 min	Power stops	+ 0.3	- 0.4	+ 0.3
t4 = 9 h 21 min	Compensation system stops	- 0.95	- 0.4	+ 0.3

Interpreting the Cos φ MIN/MAX and the Cos φ Values According to IEEE Convention

The cos φ MIN and cos φ MAX values indicate the cos φ variation range for the load: this gives the user information on how the equipment is performing from a cost point of view and allows him to install compensation devices, if necessary. The cos φ MIN and cos φ MAX values can be accessed on the front display module FDM121.

The load cos φ values indicate in real time any correction actions:

- The absolute value of too low a negative cos φ (= - 0.4) indicates that capacitors need to be installed to increase the value of the equipment cos φ.
- The value of too low a positive cos φ (= + 0.3) indicates that capacitors need to be removed to increase the value of the equipment cos φ.

The 2 alarms on the cos φ according to IEEE convention integrated in the Micrologic trip unit are used to monitor the 2 critical situations automatically.

Electrical Distribution Monitored According to IEC Convention

The table below gives the history of the cos φ values of the load of a workshop downstream of a Compact NSX according to IEC convention:

Time	Evolution of the Load	IEC Convention		
		Cos φ	cos φ MIN	cos φ MAX
t1 = 8 h 00 min	Power startup	+ 0.4	+ 0.4	+ 0.4
t2 = 8 h 01 min	Compensation system startup	+ 0.9	+ 0.9	+ 0.4
t3 = 9 h 20 min	Power stops	+ 0.3	+ 0.9	+ 0.3
t4 = 9 h 21 min	Compensation system stops	+ 0.95	+ 0.95	+ 0.3

The value of cos φ alone cannot be used to define the action to be taken to increase its value: should inductances or capacitors be installed?

Interpreting the Cos φ MAX and the Cos φ Values According to IEC Convention

The cos φ MAX value corresponds to the minimum value of the load cos φ, whether leading or lagging: this gives the user information on how the equipment is performing from a cost point of view.

The value of cos φ alone cannot be used to define the action to be taken to increase its value: should inductances or capacitors be installed?

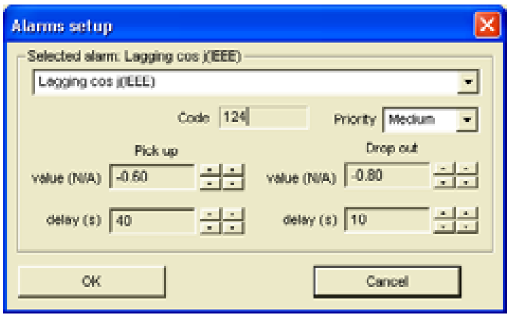
The alarm on the cos φ according to IEC convention integrated in the Micrologic trip unit is used to send an alert if a critical situation occurs. This alarm, associated with an alarm defining the type of load or the operating quadrant, can be used to monitor the 2 critical situations automatically.

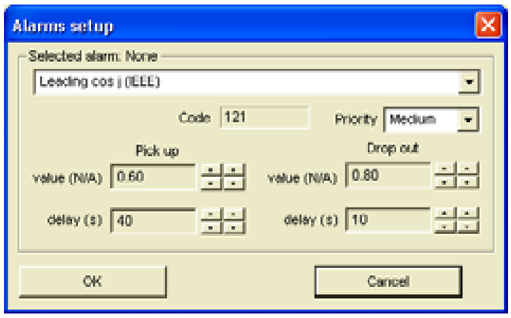
Setting the Cos φ Alarm Parameters According to IEEE Convention

Monitoring of the cos φ indicator is applied to management of the workshop described above:
- When the power is started, too high a value of cos φ (lagging), for example higher than – 0.6, results in tariff penalties. The capacitive compensation value to be used is determined by the value of the Qfund reactive power.
- When the power is stopped, too low a value of cos φ (leading), for example less than + 0.6, results in tariff penalties. The capacitive compensation element must be disconnected.

2 alarms monitor the indicators fully:
- Alarm 124 (monitoring of the lagging cos φ) on a superiority condition for operation in quadrant 1 (inductive reactive energy consumed)
- Alarm 121 (monitoring of the leading cos φ) on an inferiority condition for operation in quadrant 4 (capacitive reactive energy consumed)

Setting the parameters for monitoring the cos φ (codes 121 and 124) according to IEEE convention using the RSU software:



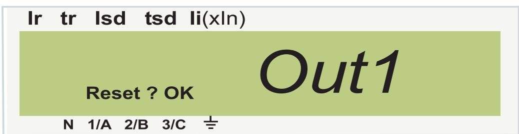


124 Monitoring the lagging cos φ
121 Monitoring the leading cos φ

Setting the SDx Output Parameters

The 2 alarms defined can each be associated with an SDx module output (see *Setting the SDx Module Output Parameters, page 127*):
- With output Out1, alarm code 124 (monitoring of the lagging cos φ)
- With output Out2, alarm code 121 (monitoring of the leading cos φ)

On starting the power at t2, since the load is lagging too much, output Out1 will be activated (1). The Micrologic trip unit display will indicate:



(1) The output must be configured in permanent latching mode.

Acknowledging the Out1 Screen

The Out1 screen can only be acknowledged if the alarm is no longer active.

After startup of the capacitive compensation, the alarm is no longer active. The Out1 output is acknowledged by pressing the OK key twice (validation and confirmation).

6.2 FDM121 Switchboard Display Unit

Aim

This section describes the FDM121 switchboard display unit.

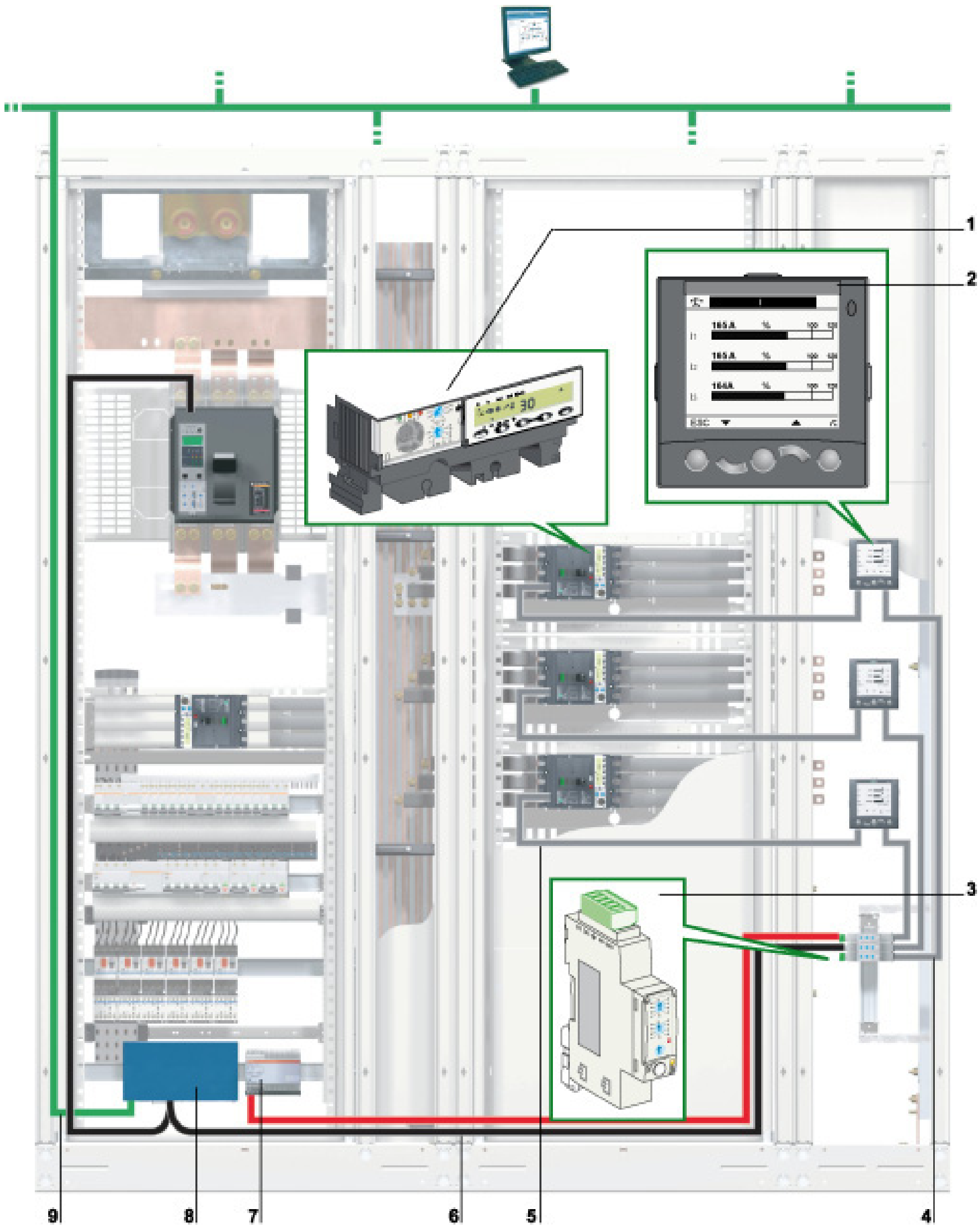
What's in this Section?

This section contains the following topics:

The ULP System

Definition

The ULP (Universal Logic Plug) system is a connection system which can be used to construct an electrical distribution solution integrating metering, communication and operating assistance functions for the Compact NSX circuit breaker.



1 Micrologic 5 or 6 trip unit
2 Front display module FDM121
3 Modbus communication interface module
4 ULP cord
5 NSX cord
6 Modbus network
7 24 VDC auxiliary power supply
8 Communication gateway (EGX or MPS100)
9 Ethernet network

The ULP system can be used to enhance the Compact NSX circuit breaker functions by:

- Local display of measurements and operating assistance data with the front display module FDM121
- A Modbus communication link for access and remote monitoring with the Modbus communication interface module
- Test, setup and maintenance functions with the maintenance module and the LTU and RSU software

Thanks to the ULP system, the Compact NSX circuit breaker becomes a metering and supervision tool to assist energy efficiency and can be used to:

- Optimize energy consumption by zone or by application, according to the load peaks or priority zones
- Manage the electrical equipment better

For more information on the ULP system and the FDM121 display module, refer to the *ULP system - User manual*.

Intelligent Functional Unit

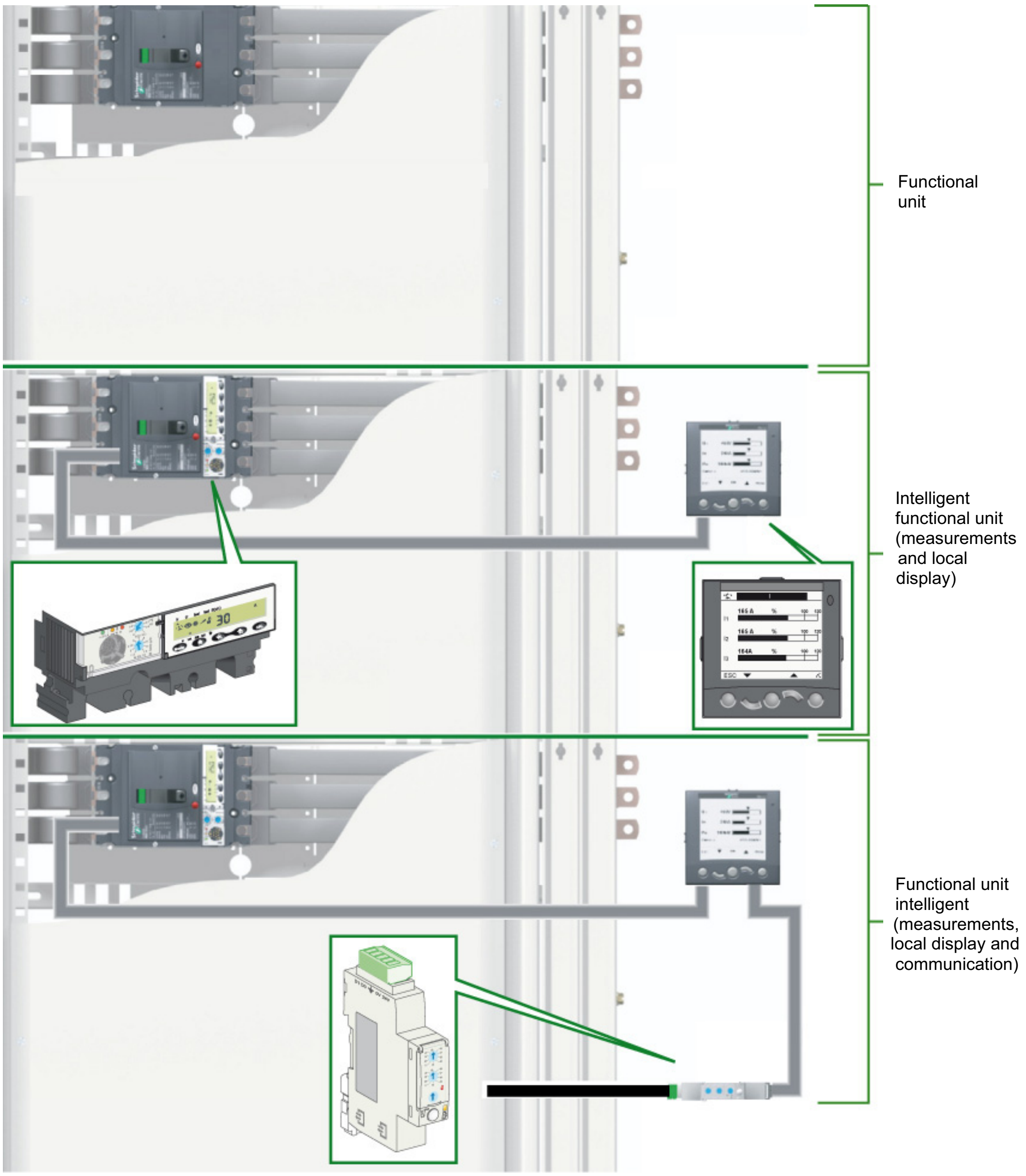
A functional unit is a mechanical and electrical assembly containing one or more products to perform a function in a switchboard (incoming protection, motor command and control). The functional units are modular and are easily installed in the switchboard.

Built around each Compact NSX circuit breaker, the functional unit consists of:

- A dedicated plate for installing the Compact NSX circuit breaker
- An escutcheon on the front face to avoid direct access to live parts
- Prefabricated links to the busbars
- Devices for creating the connection on site and running the auxiliary wiring through

The ULP system can be used to enhance the functional unit with a front display module FDM121 for a display of all the measurements and operating assistance data supplied by the Micrologic 5 or 6 trip units and/or a Modbus communication interface module for a link to a Modbus network.

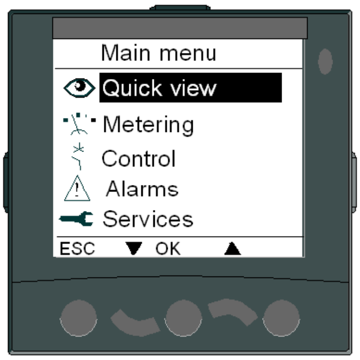
Thanks to the ULP system, the functional unit becomes intelligent since it includes metering functions and/or communication functions.



Main Menu

Presentation

The **Main** menu offers 5 menus containing the information required for monitoring and using the ULP system intelligent functional units. The description and content of the menus is set out for the Compact NSX circuit breakers.



The 5 menus offered in the **Main** menu are as follows:

Menu	Description
Quick view	**Quick View** menu The **Quick View** menu provides quick access to the information essential for operation.
Metering	**Metering** menu The **Metering** menu displays the data made available by the Micrologic trip unit: ● Current, voltage, power, energy and harmonic distortion measurements ● Minimum and maximum measurement values
Control	**Command** menu The **Command** menu controls a circuit breaker from the FDM121 display module which is equipped with a motorized communicating remote control. The proposed commands are: ● circuit breaker opening ● circuit breaker closing ● circuit breaker reset after tripping.
Alarms	**Alarms** menu The **Alarms** menu displays the alarm history of the last 40 alarms detected by the Micrologic trip unit since the last power up (see *Detailed Tables of Alarms, page 110* and *Alarms on a Trip, Failure and Maintenance Event, page 109*).
Services	**Services** menu The **Services** menu contains all the FDM121 display module set-up functions and the operating assistance information: ● Reset (peak demand values, energy meters) ● Set-up (display module) ● Maintenance (operation counters, load profile, etc.) ● Product version: Identification of the intelligent functional unit modules ● Language

For more information on the FDM121 display module menus, refer to the *ULP system - User manual*.

Navigation

Navigation within the **Main** menu is as follows:

- The ▲ and ▼ keys are used to select one of the 5 menus.
- The OK key is used to confirm the selection.
- The ESC key has no effect.

Quick View Menu

Presentation

The **Quick View** menu presents the information essential for operating the device connected to the front display module FDM121, divided into a number of screens.

The number of available screens and their content depend on the device connected to the front display module FDM121. For example, with Compact NSX circuit breakers, they depend on:
- The type of Micrologic trip unit (A or E)
- The number of circuit breaker poles (3-pole or 4-pole)
- The presence of options (ENVT or ENCT)

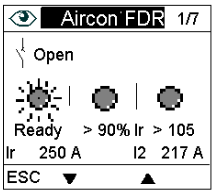
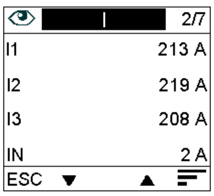
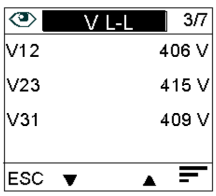
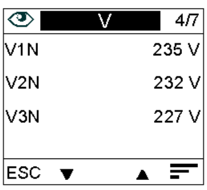
The screen number and number of available screens are indicated in the top right-hand corner of the display.

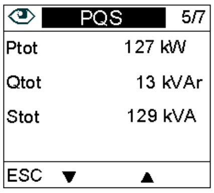
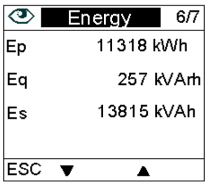
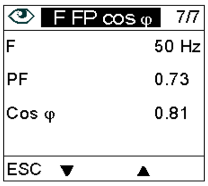
Navigation

Navigation within the **Quick View** menu is as follows:
- The ▲ and ▼ keys are used to go from one screen to another.
- The ESC key is used to return to the main menu.
- The ≡ key is used to modify the display mode.

Example of Screens in the Quick View Menu

The table below shows screens 1 to 7 of the **Quick View** menu for a Compact NSX 4-pole circuit breaker equipped with a Micrologic E trip unit:

Screen	Description
	Screen 1 in the **Quick View** menu displays: • The name of the IMU (Aircon FDR on the screen example opposite). The name of the IMU defined with RSU can be up to 45 characters long, but only the first 14 characters are visible on the front display module FDM121. • The *Open/Closed/Trip* status of the Compact NSX circuit breaker (if the BSCM module is present (Open on the screen example opposite) • The status of the LED indicators on the front of the trip unit • The long time protection Ir pick-up setting • The current intensity of the most heavily loaded phase (I2 = 217 A in the screen example opposite)
	Screen 2 in the **Quick View** menu displays the currents: • Phase 1 current I1 • Phase 2 current I2 • Phase 3 current I3 • Neutral current IN
	Screen 3 in the **Quick View** menu displays the phase to phase voltages: • Phase 1 to phase 2 voltage V12 • Phase 2 to phase 3 voltage V23 • Phase 3 to phase 1 voltage V31
	Screen 4 in the **Quick View** menu displays the phase to neutral voltages: • Phase 1 to neutral voltage V1N • Phase 2 to neutral voltage V2N • Phase 3 to neutral voltage V3N

Screen	Description
	Screen 5 in the **Quick View** menu displays the powers: ● Active power Ptot in kW ● Reactive power Qtot in kvar ● Apparent power Stot in kVA
	Screen 6 in the **Quick View** menu displays the energies: ● Active energy Ep in kWh ● Reactive energy Eq in kvarh ● Apparent energy Es in kVAh
	Screen 7 in the **Quick View** menu displays: ● The frequency F in Hz ● The power factor PF ● The cos φ

Number of Screens Available for Compact NSX

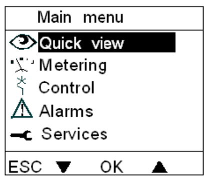
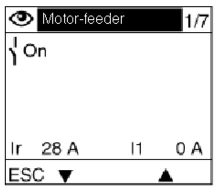
The examples below illustrate the number of screens available according to the type of Micrologic trip unit and/or the type of Compact NSX circuit breaker.

- If the Compact NSX circuit breaker type is 4-pole equipped with a Micrologic type A trip unit, screens 1 and 2 are available.
- If the Compact NSX circuit breaker type is 4-pole equipped with a Micrologic type E trip unit, screens 1 to 7 are available.
- If the Compact NSX circuit breaker type is 3-pole without ENCT option, the IN current is not available on screen 2.
- If the Compact NSX circuit breaker type is 3-pole without ENVT option equipped with a Micrologic type E trip unit, screen 4 is not available.

Intelligent Modular Unit (IMU) Name

For optimum use of the electrical equipment, the RSU software can be used to assign a name to the IMU relating to the function with which it is associated (for more information, see).

The procedure for displaying the IMU name is as follows:

Step	Action	Display
1	Select the **Quick view** menu in the main menu using the ▲ and ▼ keys. Pressing the OK key validates selection of the **Quick view** menu.	
2	Screen 1 in the **Quick View** menu displays the IMU name: Motor-feeder. The IMU name defined with RSU can consist of 45 characters maximum, but only the first 14 characters are visible on the front display module FDM121.	

6.3 RCU Operating Software

Description of the RCU Software

Presentation

The RCU (Remote Control Utility) software is a help utility for starting an electrical installation including devices connected to the communication network.

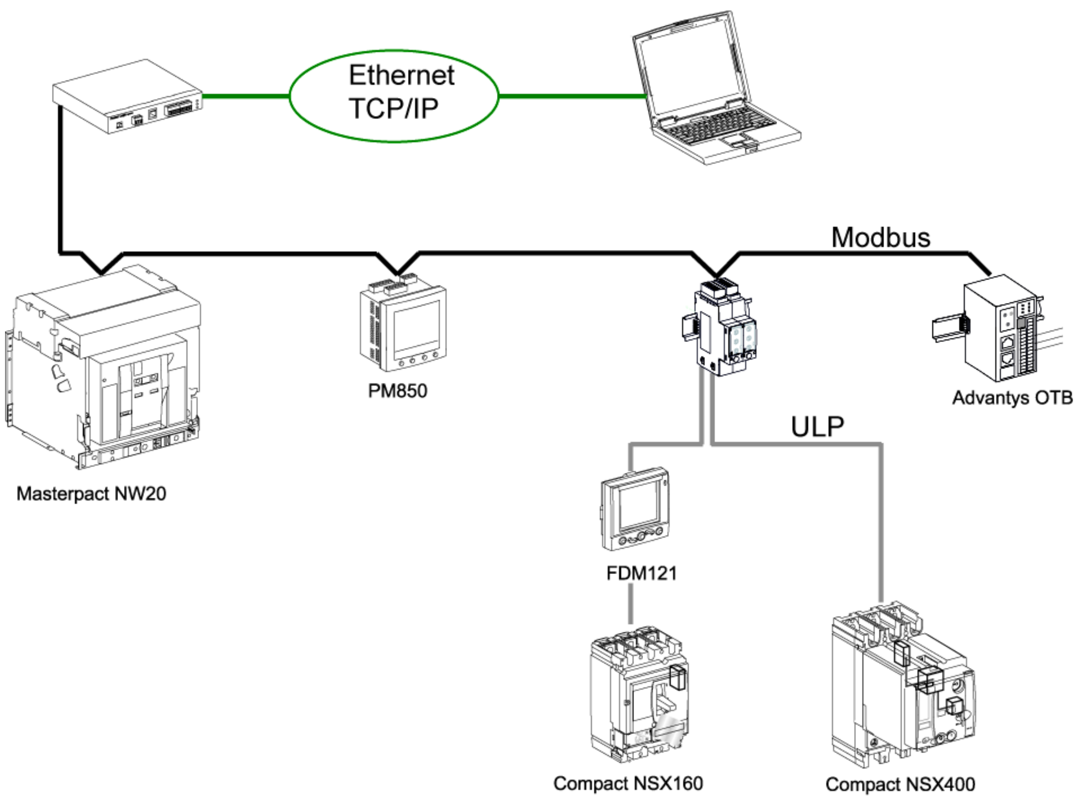
The RCU software installed on a standard PC can be used to:
- Validate communication
- Monitor the electrical equipment remotely

List of Recognized Devices

The RCU software takes account of:
- Micrologic trip units on Compact NSX and Masterpact NT/NW circuit breakers
- PM200/300/500/700/800 and PM9C power meters
- Advantys OTB interface modules

Example of Network Architecture

The figure below shows an example of communication network architecture, consisting of the communicating devices below:
- A Masterpact NW20 circuit breaker equipped with a Micrologic 6.0 H trip unit
- A PM850 power meter
- A Compact NSX160 circuit breaker equipped with a Micrologic 6.2 E-M trip unit and a display module FDM121
- A Compact NSX400 circuit breaker with communicating motor mechanism and equipped with a Micrologic 6.3 E trip unit
- An Advantys OTB interface module connected to the OF contacts of non-communicating circuit breakers



RCU Software Functions

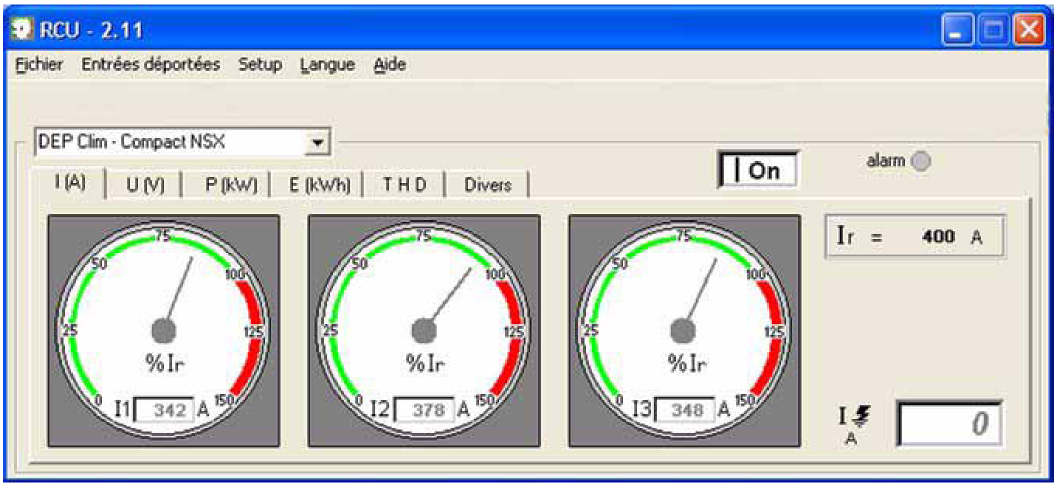
The RCU software includes the following functions, available depending on which devices are connected:

- Real-time display of measurements:
  - The currents for each phase
  - Voltages
  - Total powers
  - Energies
- Real-time display of quality indicators:
  - The power factor PF
  - The total harmonic distortion for both current and voltage
- Real-time display of maintenance indicators
- Real-time display of circuit breaker open/closed/trip states
- Viewing histories (trips, alarms, maintenance operations)
- Open/close command for circuit breakers with motor mechanism
- Reset meters and minimum and maximum values command

Command functions are protected by a password.

Example of RCU Screen

The figure below illustrates the current metering screen for a Compact NSX circuit breaker:



Using the RCU Software

For all information on using the RCU software, refer to the *RCU Software Online Help*.

6.4 The Communication Network

Aim

This chapter describes the supervision and monitoring options for an installation using the data transmitted by the communication network.

What's in this Section?

This section contains the following topics:

Compact NSX Circuit Breaker Communication

Presentation

Compact NSX circuit breakers are integrated in a communication network created using Modbus protocol. Modbus communication offers the options of:

- Reading remotely:
  - The circuit breaker states
  - Measurements
  - Operating assistance information
- Controlling the circuit breaker remotely

For more information on the Modbus communication network, see the *Modbus Compact NSX - User manual*.

For more information on communicating modules, refer to the *ULP system - User manual*.

Remote Readout of the Circuit Breaker States

Remote readout of the circuit breaker states can be accessed by all Compact NSX circuit breakers equipped with a BSCM module. The following data is made available via the communication network:

- Open/closed position (OF)
- Trip indicator (SD)
- Electrical fault indicator (SDE)

For more information, refer to the *Compact NSX circuit breakers - User manual*.

Remote Readout of the Measurements

The measurement readout can only be accessed with Micrologic 5 and 6 trip units.

For more information on measurements, see *The Metering Function, page 73*.

Remote Readout of the Operating Assistance Information

The operating assistance readout can only be accessed with Micrologic 5 and 6 trip units. The following operating assistance information is made available:

- Protection and alarm parameter settings (see *The RSU Parameter Setting Software, page 117*)
- History and tables of time-stamped events (see *History and Time-Stamped Information, page 152*)
- Maintenance indicators (see *Maintenance Indicators, page 153*)

Circuit Breaker Remote Control

The circuit breaker remote control can be accessed by all Compact NSX circuit breakers equipped with a BSCM module and a communicating motor mechanism. The following commands are made available via the communication network:

- Circuit breaker opening
- Circuit breaker closing
- Circuit breaker reset

For more information, refer to the *Compact NSX circuit breakers - User manual*.

History and Time-Stamped Information

History

Micrologic trip units generate 3 types of history:

- History of alarms associated with measurements (the last 10 alarms are recorded)
- History of trips (the last 18 trips are recorded)
- History of maintenance operations (the last 10 operations are recorded)

Time-Stamped Information

Time-stamped information informs the user of all the dates relating to important information such as previous protection settings and minimum/maximum current, voltage and network frequency values.

The table of time-stamped information describes:

- The previous protection configuration parameters and corresponding dates
- The minimum and maximum voltage measurement values and corresponding dates
- The maximum current measurement values and corresponding dates
- The minimum and maximum network frequencies and corresponding dates

The time when the minimum and maximum values were reset is also available.

Maintenance Indicators

BSCM Module Counters

The counters embedded in the BSCM module generate information relating to the number of volt-free contact operations. These volt-free contacts qualify:

- The number of open/close operations (OF contact) and open on a fault operations (SD and SDE contacts) on the Compact NSX circuit breaker
- The number of close, open and reset operations on the motor mechanism

Micrologic Trip Unit Counters

The maintenance counters embedded in the Micrologic trip unit can be accessed by the communication option.

- Counters are assigned to each type of protection:
  - Long time protection
  - Short time protection
  - Instantaneous protection
  - Ground fault protection
  - Jam motor protection
  - Phase unbalance protection
  - Long start motor protection
  - Underload motor protection
- 10 counters are assigned to the alarms associated with measurements. These counters are reset if the alarm is reconfigured.
- One counter indicates the number of operating hours. This counter is updated every 24 hours.
- 4 counters are assigned to the load profile: Each counter counts up the number of operating hours per loading section (for example, one counter indicates the number of operating hours for the loading section 50...79% of In).
- 6 counters are assigned to the temperature profile: Each counter counts up the number of operating hours per temperature section (for example, one counter indicates the number of operating hours for the temperature section 60...74°C).
- Maintenance counters are used to enter quantitative information about operations performed on the Micrologic trip unit (for example, number of push to trip tests, etc.) or the status of the Micrologic trip units (for example, number of Err screens, number of protection parameter setting lock/unlock operations, etc.).
- One counter indicates the amount of wear on the circuit breaker contacts as a %. When this figure reaches 100%, the contacts must be changed.

Appendices

Additional Characteristics

A

Aim

This chapter reproduces the tripping and limitation curves from part E of the *Compact NSX 100-630 A - Catalogue*.

What's in this Chapter?

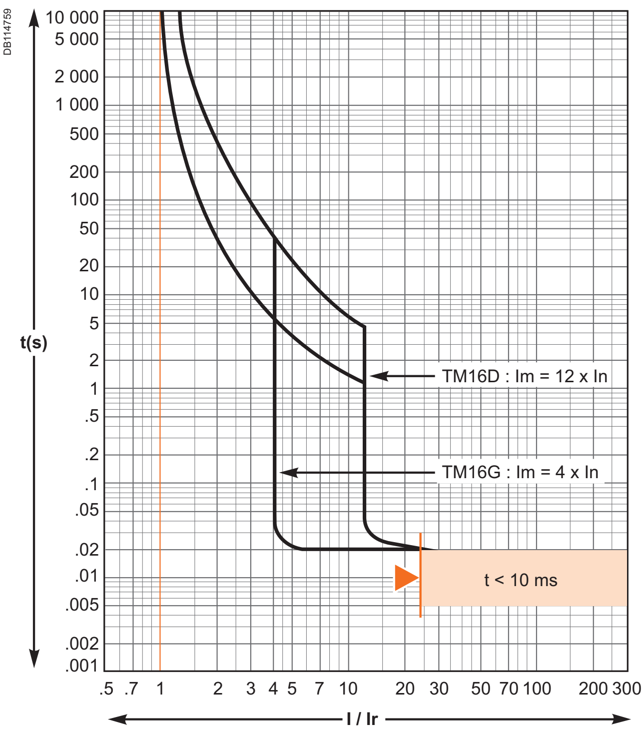
This chapter contains the following topics:

Compact NSX100 to 250 - Distribution Protection

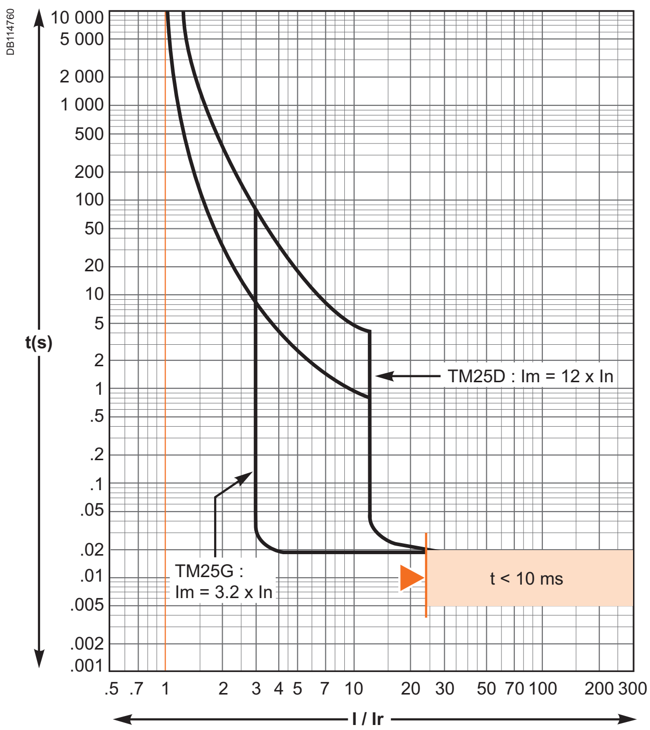
Tripping Curves

TM magnetic trip units

TM16D / TM16G

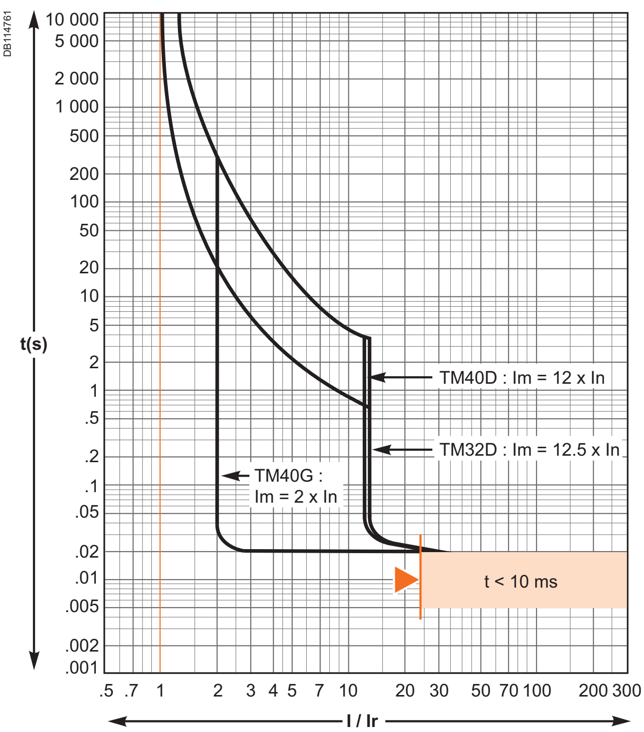


TM25D / TM25G

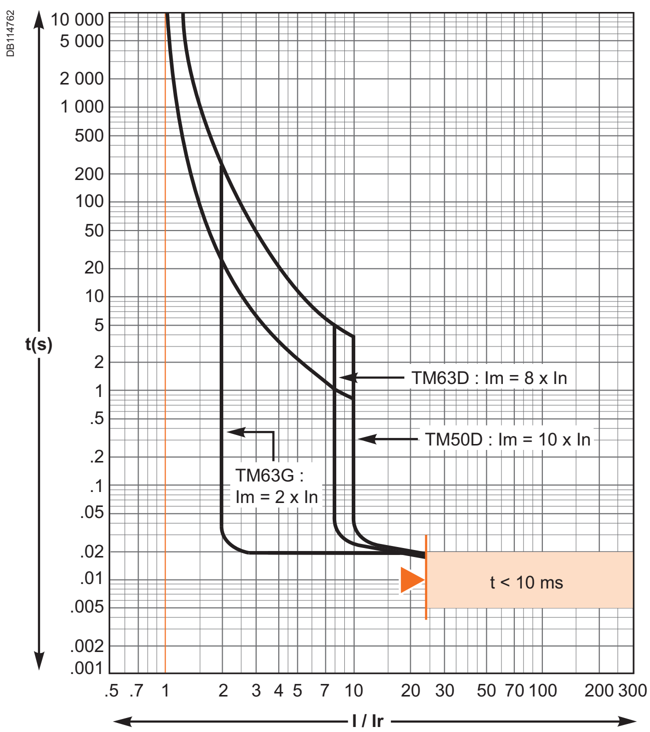


Reflex tripping.

TM32D / TM40D / TM40G



TM50D / TM63D / TM63G

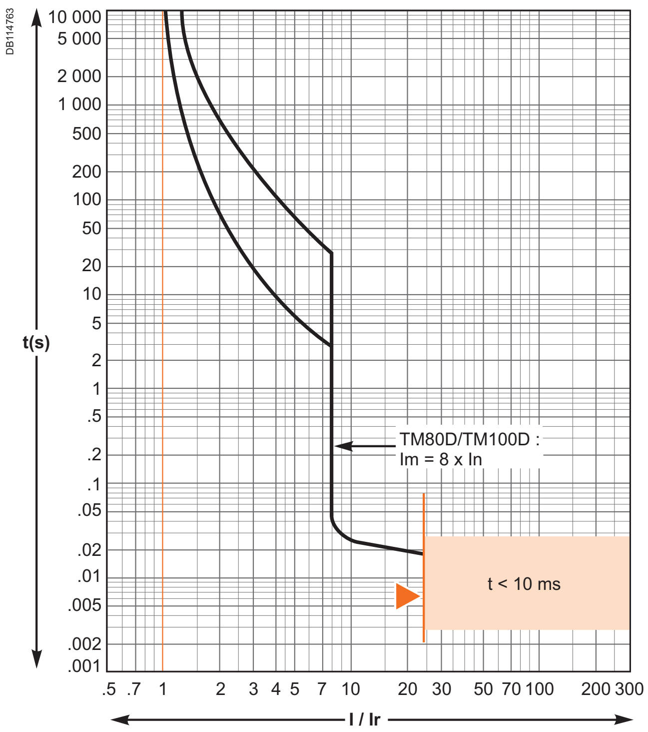


Reflex tripping.

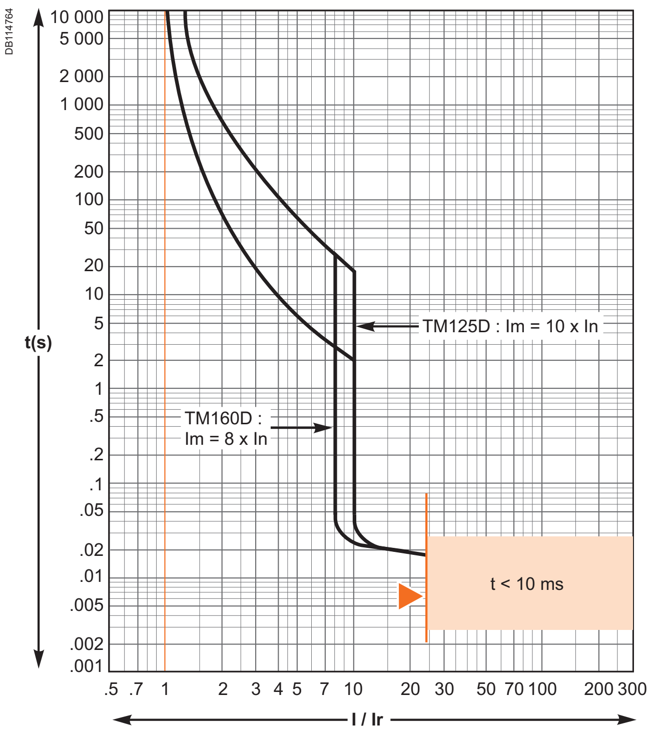
Tripping Curves

TM magnetic trip units (cont.)

TM80D / TM100D

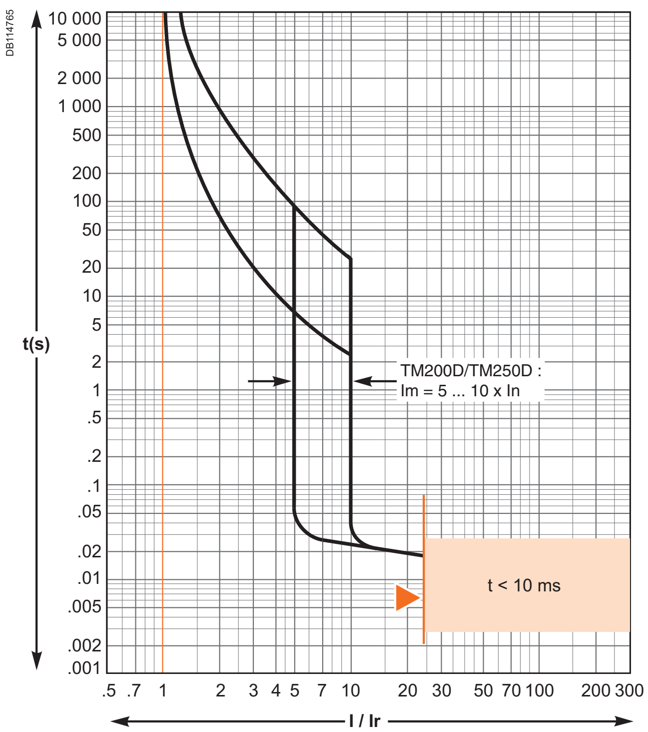


TM125D / TM160D



Reflex tripping.

TM200D / TM250D

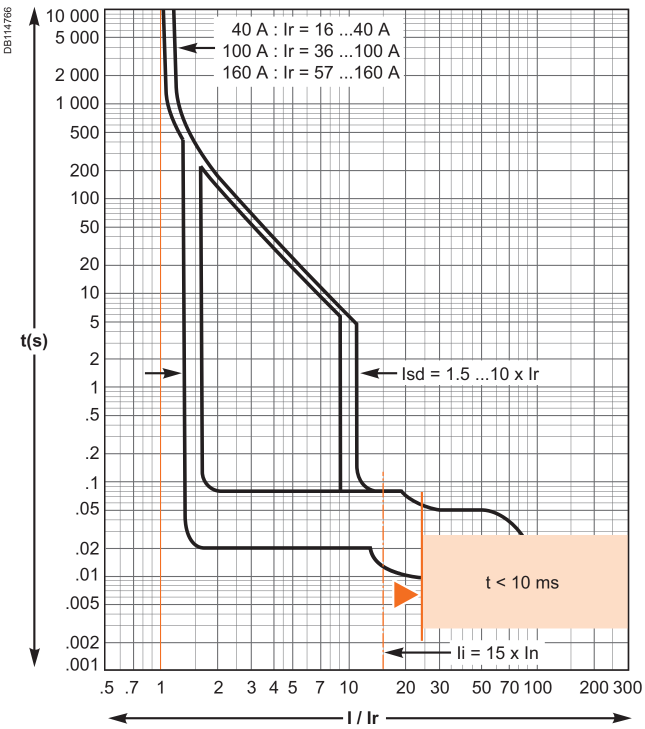


Reflex tripping.

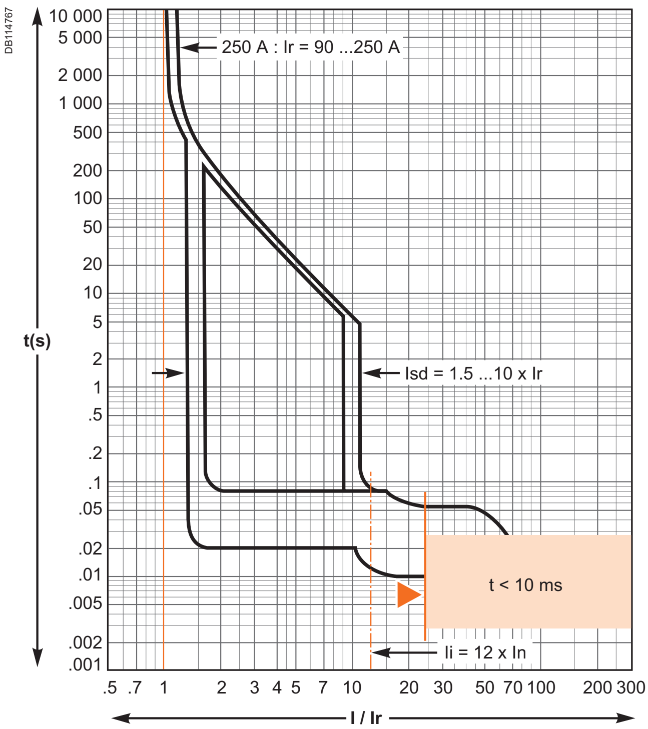
Tripping Curves

Micrologic 2.2 and 2.2 G electronic trip units

Micrologic 2.2 - 40... 160 A

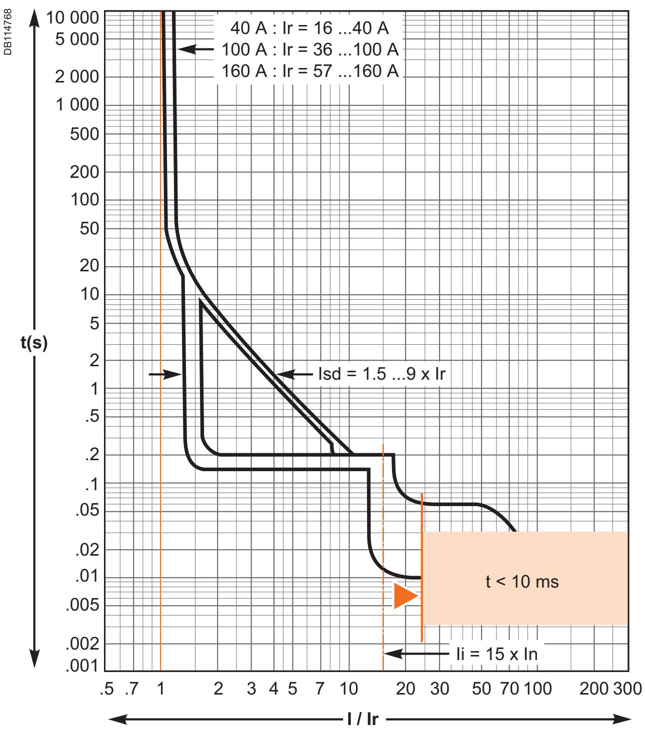


Micrologic 2.2 - 250 A

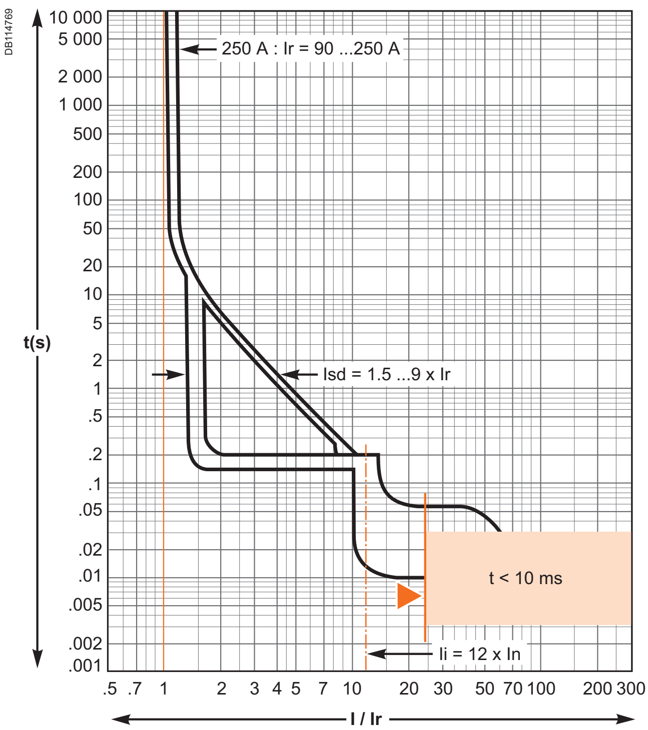


Reflex tripping.

Micrologic 2.2 G - 40... 160 A



Micrologic 2.2 G - 250 A

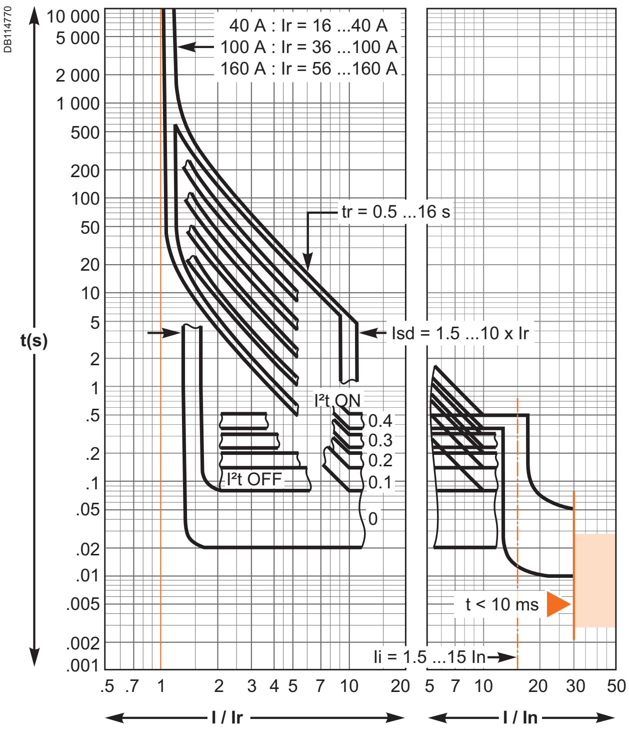


Reflex tripping.

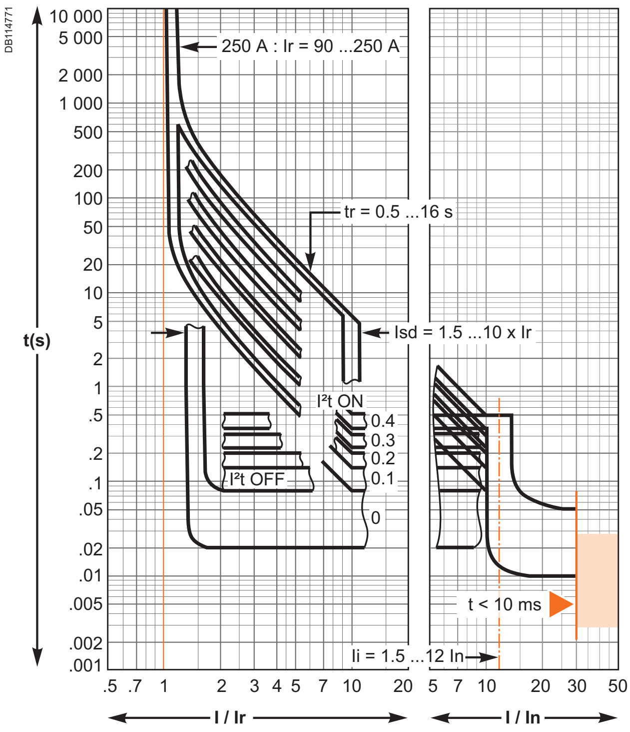
Tripping Curves

Micrologic 5.2 and 6.2 A or E electronic trip units

Micrologic 5.2 and 6.2 A or E - 40... 160 A

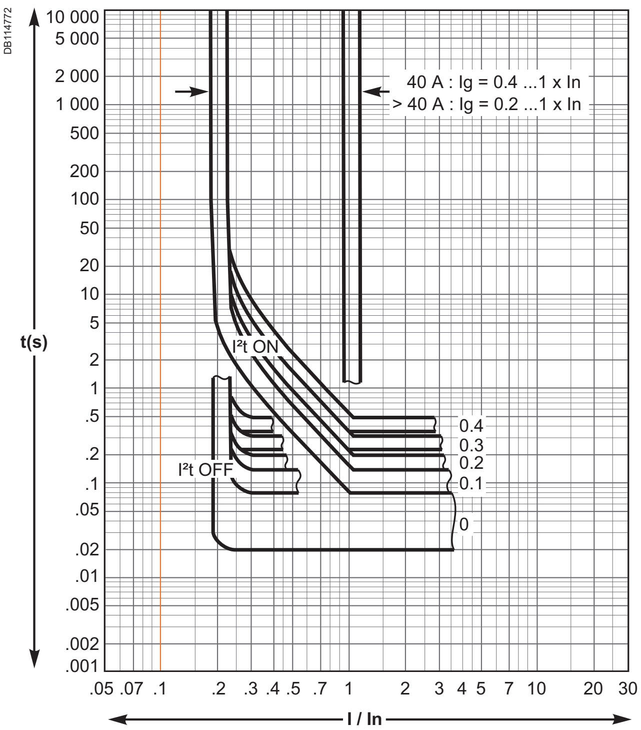


Micrologic 5.2 and 6.2 A or E - 250 A



Reflex tripping.

Micrologic 6.2 A or E (ground-fault protection)

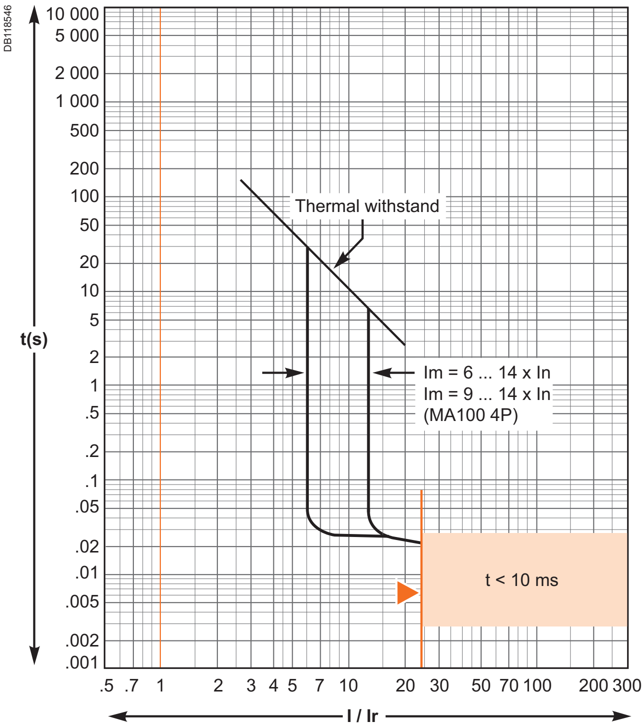


Compact NSX100 to 250 - Motor-Feeder Protection

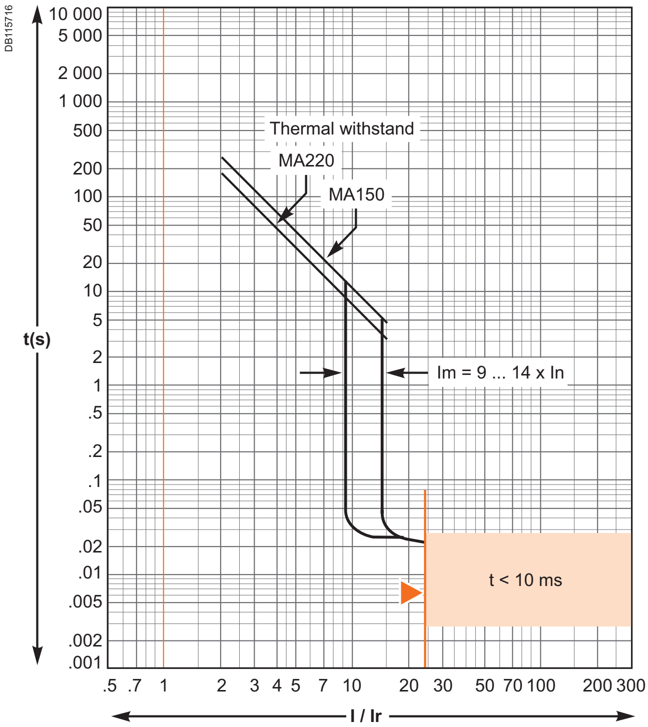
Tripping Curves

MA magnetic trip units

MA2.5... MA100



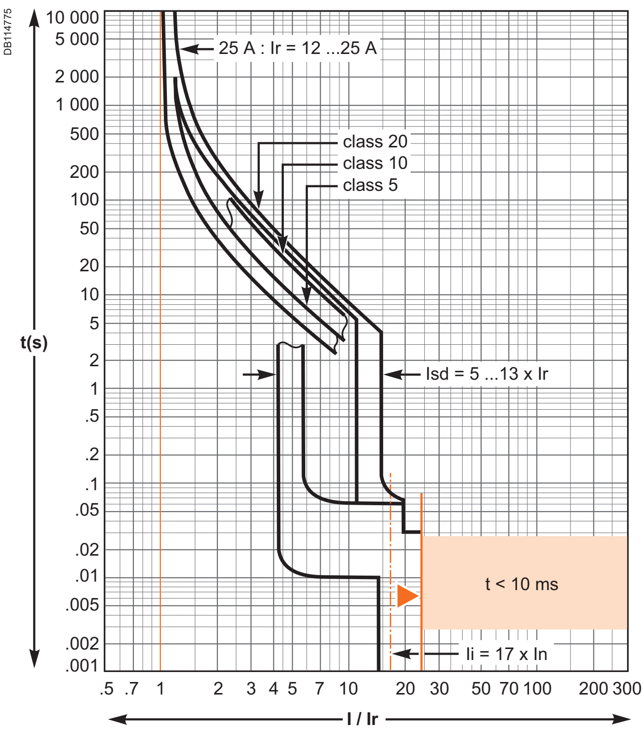
MA150 and MA220



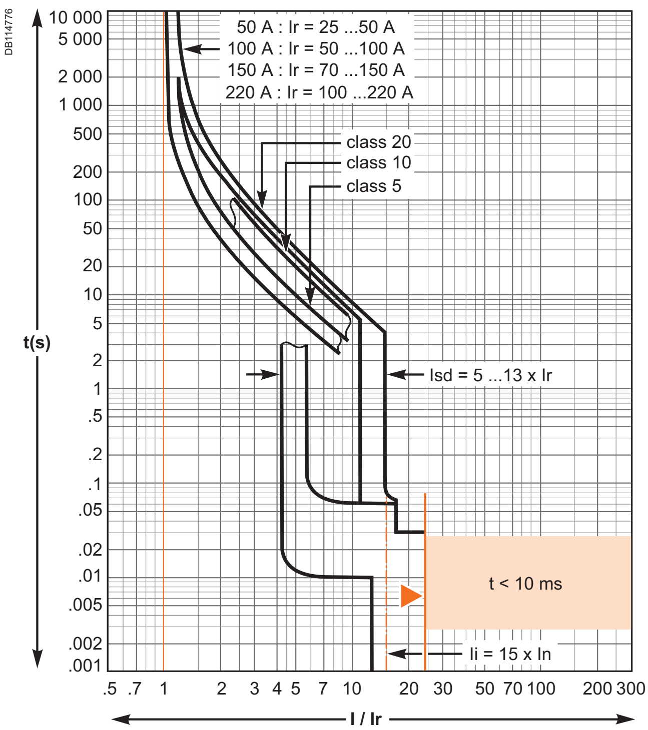
Reflex tripping.

Micrologic 2.2 M electronic trip units

Micrologic 2.2 M - 25 A



Micrologic 2.2 M - 50... 220 A

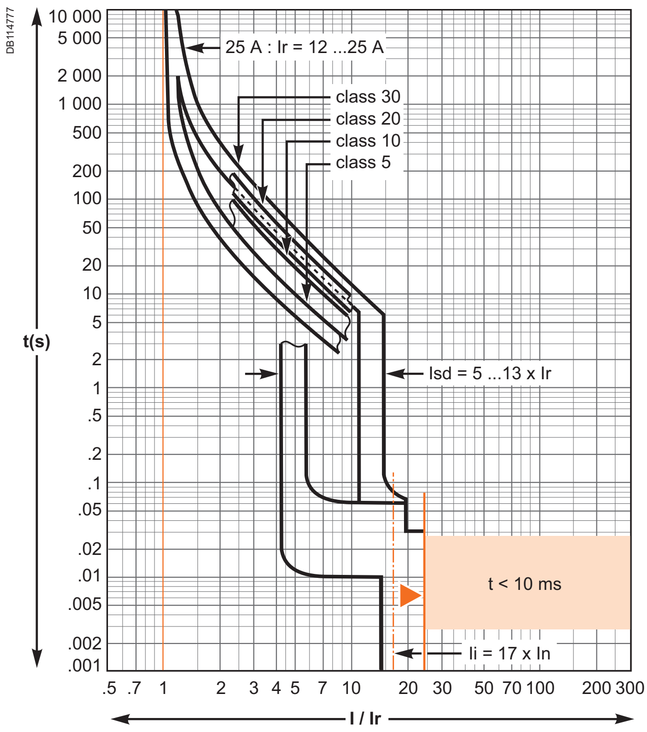


Reflex tripping.

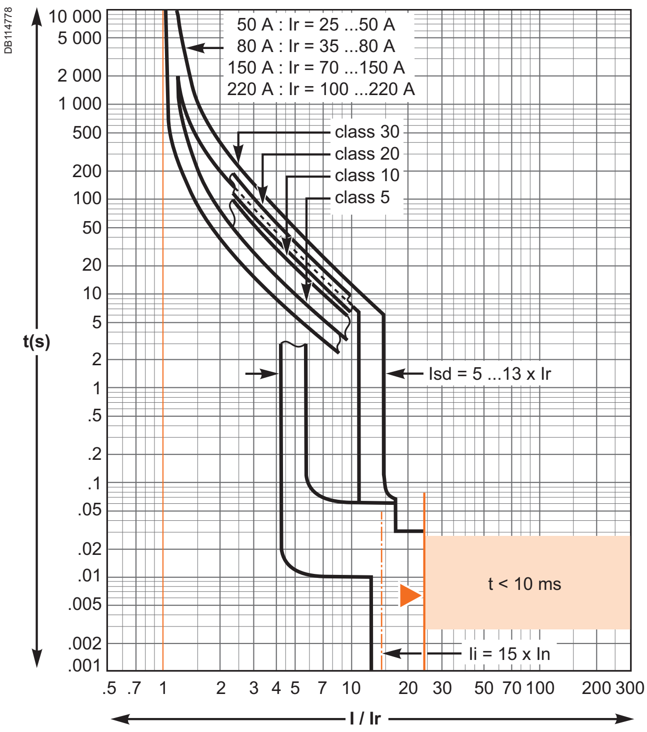
Tripping Curves

Micrologic 6.2 E-M electronic trip units

Micrologic 6.2 E-M - 25 A

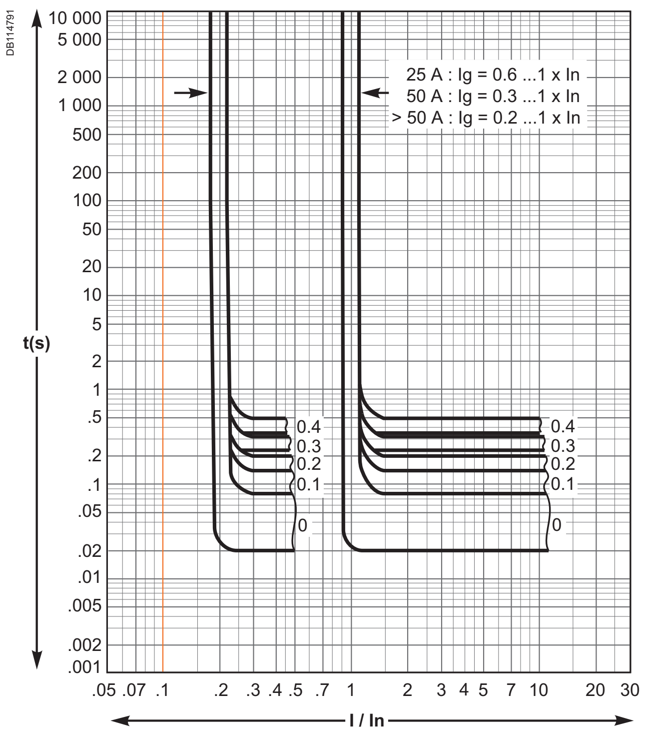


Micrologic 6.2 E-M - 50... 220 A



Reflex tripping.

Micrologic 6.2 E-M (ground-fault protection)

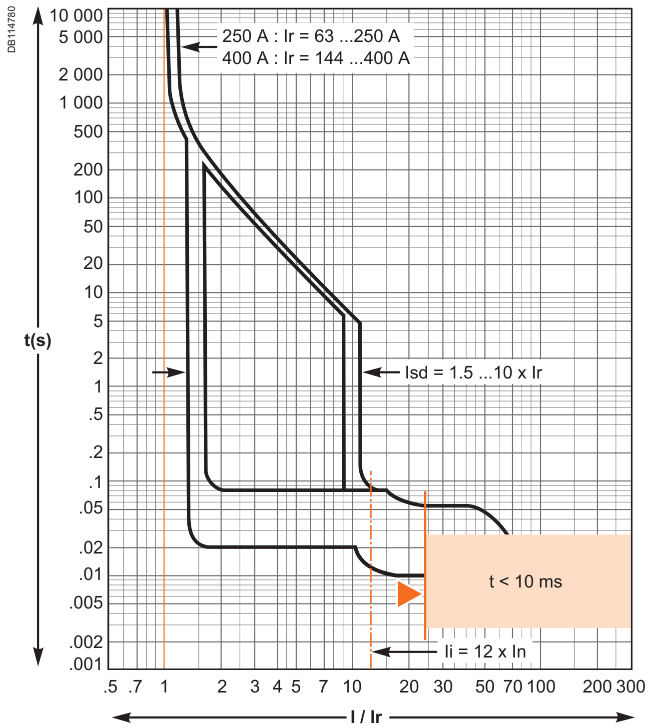


Compact NSX400 to 630 - Distribution Protection

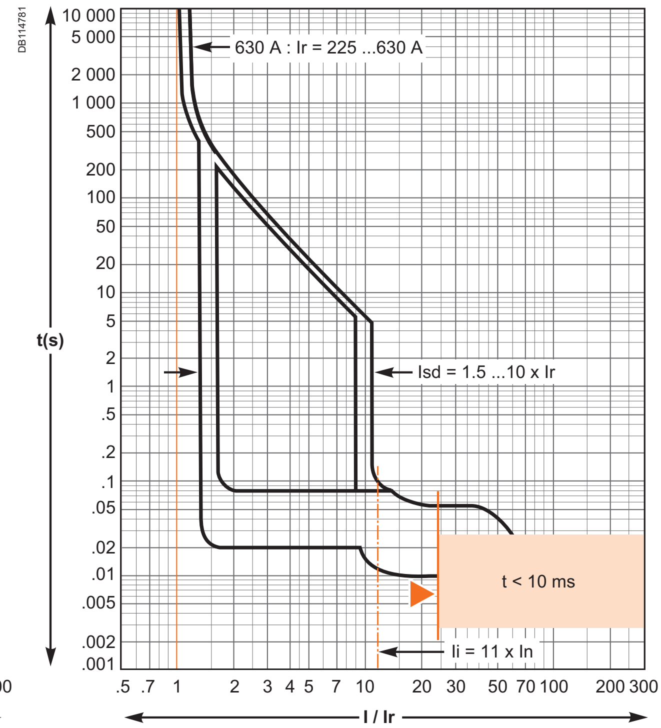
Tripping Curves

Micrologic 2.3, 5.3 and 6.3 A or E electronic trip units

Micrologic 2.3 - 250... 400 A

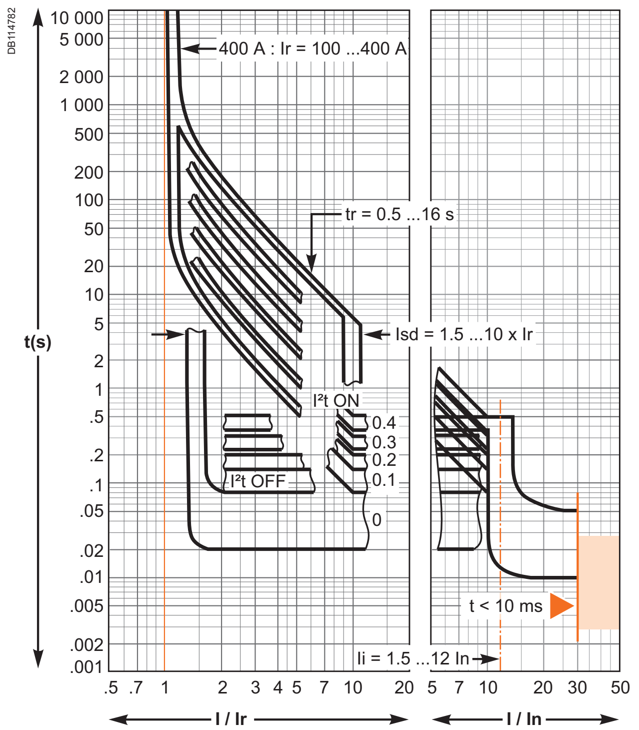


Micrologic 2.3 - 630 A

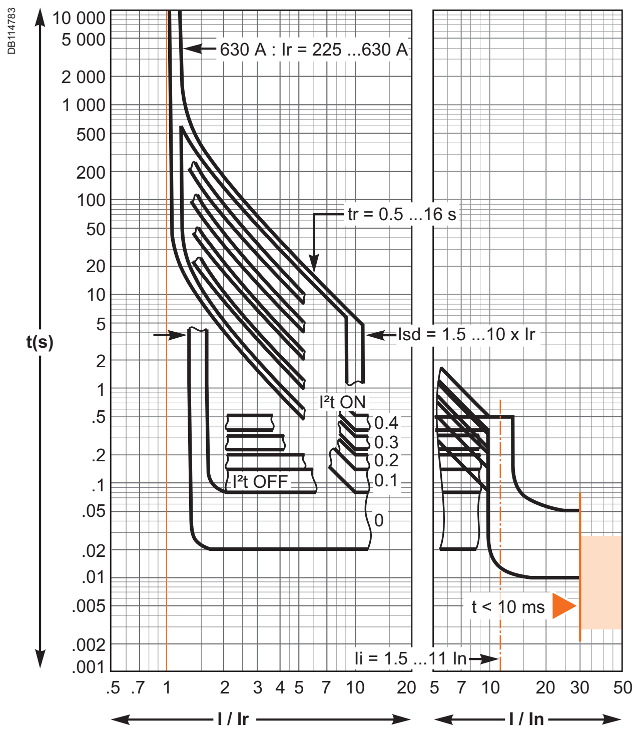


Reflex tripping.

Micrologic 5.3 and 6.3 A or E - 400 A



Micrologic 5.3 and 6.3 A or E - 630 A

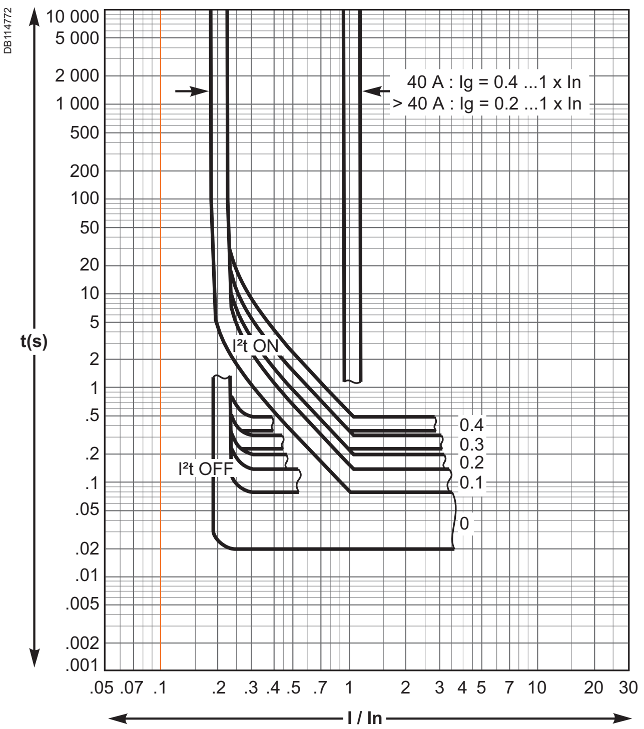


Reflex tripping.

Tripping Curves

Micrologic 6.3 A or E electronic trip units (cont.)

Micrologic 6.3 A or E (ground-fault protection)

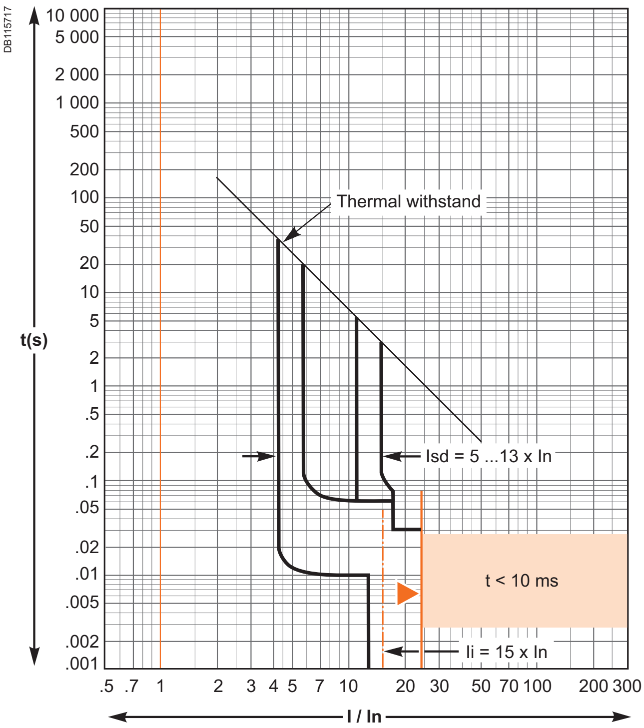


Compact NSX400 to 630 - Motor-Feeder Protection

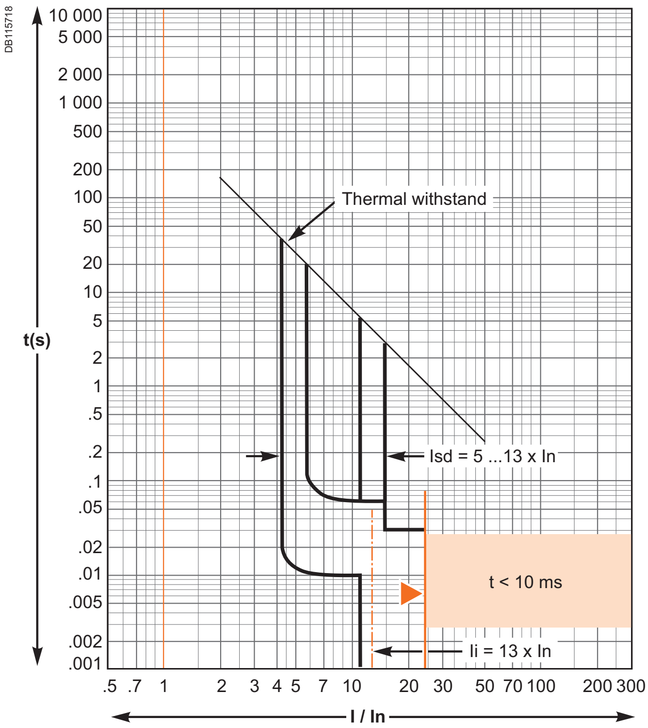
Tripping Curves

Micrologic 1.3 M and 2.3 M electronic trip units

Micrologic 1.3 M - 320 A

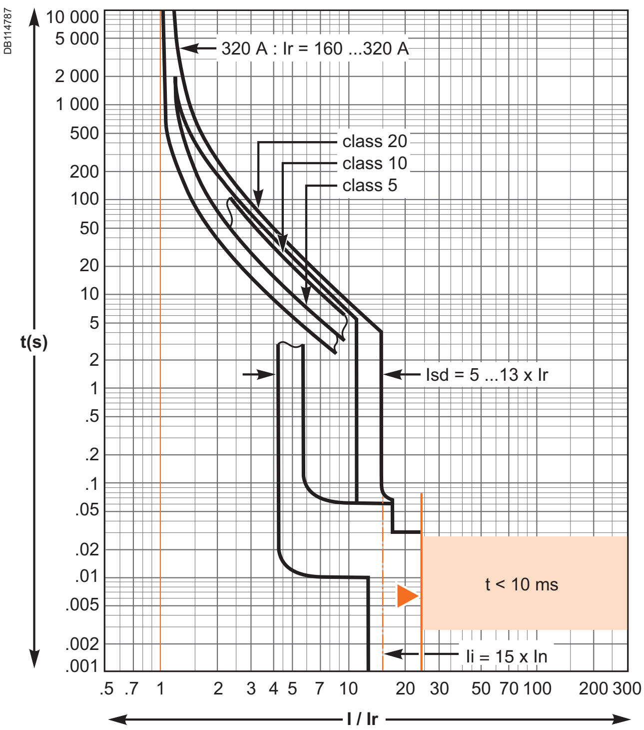


Micrologic 1.3 M - 500 A

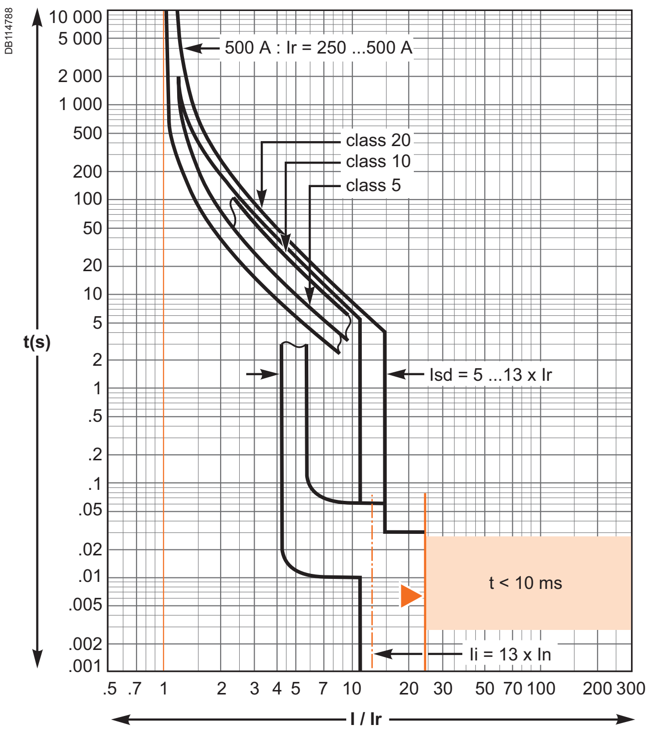


Reflex tripping.

Micrologic 2.3 M - 320 A



Micrologic 2.3 M - 500 A

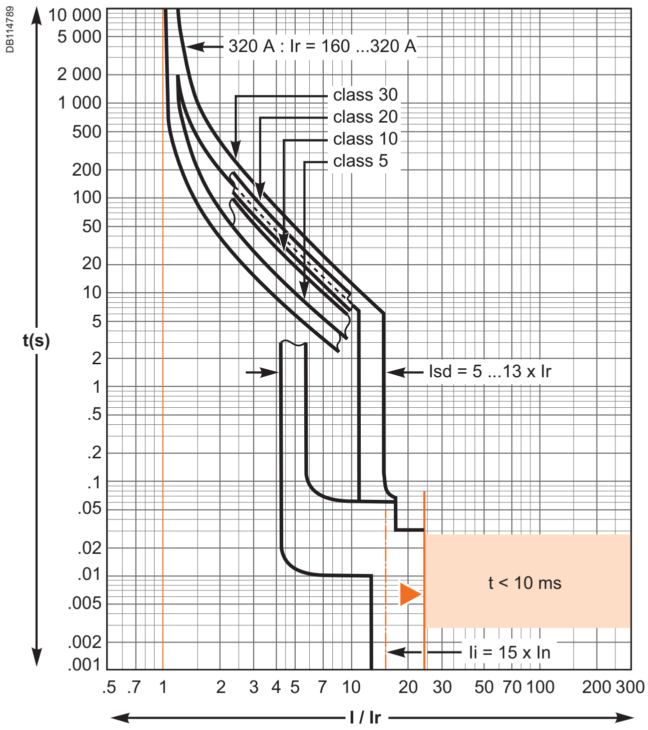


Reflex tripping.

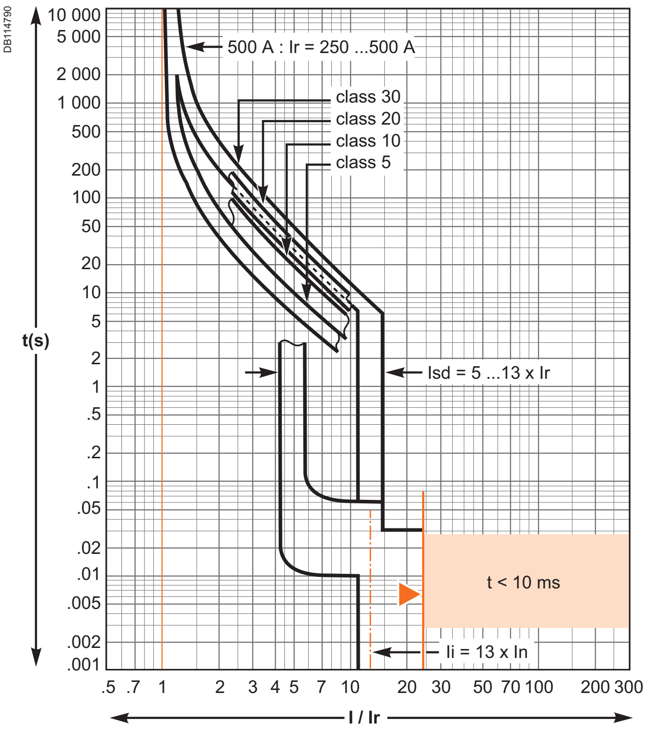
Tripping Curves

Micrologic 6.3 E-M electronic trip units

Micrologic 6.3 E-M - 320 A

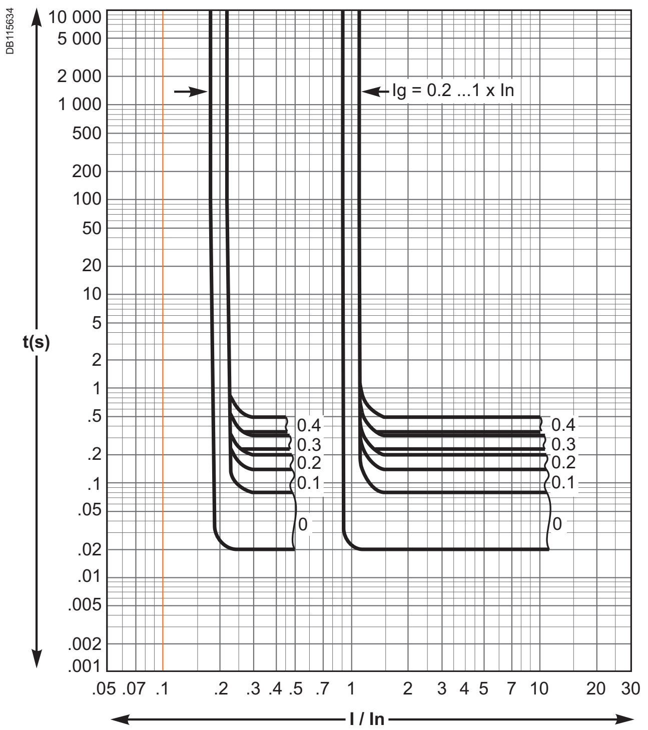


Micrologic 6.3 E-M - 500 A



Reflex tripping.

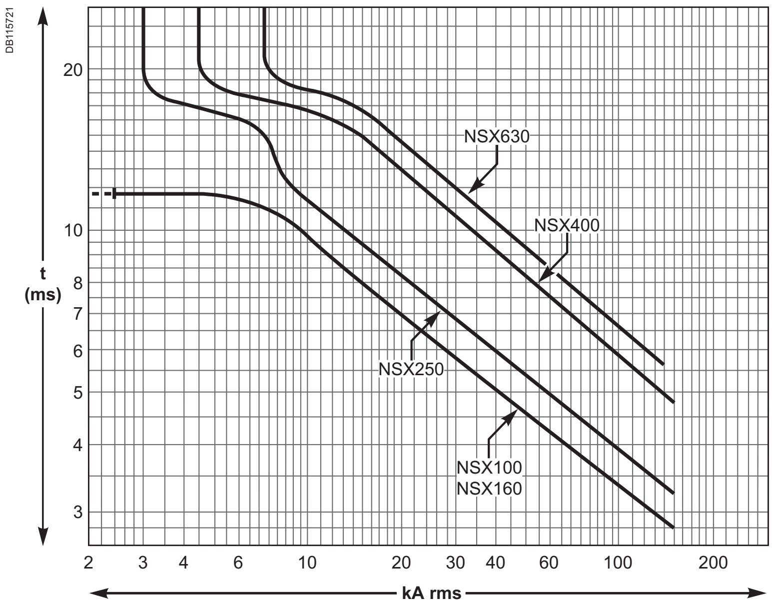
Micrologic 6.3 E-M (ground fault protection)



Compact NSX100 to 630 - Reflex Tripping

Tripping Curves

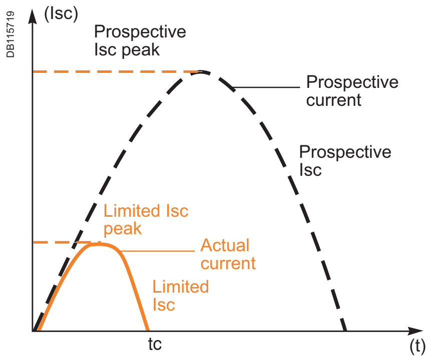
Compact NSX100 to 630 devices incorporate the exclusive reflex-tripping system.
This system breaks very high fault currents.
The device is mechanically tripped via a "piston" actuated directly by the pressure produced in the breaking units by the short-circuit.
For high short-circuits, this system provides a faster break, thereby ensuring discrimination.
Reflex-tripping curves are exclusively a function of the circuit-breaker rating.



Compact NSX100 to 630 - Limitation Curves

Limitation Curves

The limiting capacity of a circuit breaker is its aptitude to let through a current, during a short-circuit, that is less than the prospective short-circuit current.



The exceptional limiting capacity of the Compact NSX range is due to the rotating double-break technique (very rapid natural repulsion of contacts and the appearance of two arc voltages in-series with a very steep wave front).

Ics = 100 % Icu

The exceptional limiting capacity of the Compact NSX range greatly reduces the forces created by fault currents in devices.
The result is a major increase in breaking performance.
In particular, the service breaking capacity Ics is equal to 100 % of Icu.
The Ics value, defined by IEC standard 60947-2, is guaranteed by tests comprising the following steps:

- break three times consecutively a fault current equal to 100% of Icu
- check that the device continues to function normally, that is:
  - it conducts the rated current without abnormal temperature rise
  - protection functions perform within the limits specified by the standard
  - suitability for isolation is not impaired.

Longer service life of electrical installations

Current-limiting circuit breakers greatly reduce the negative effects of short-circuits on installations.

Thermal effects
Less temperature rise in conductors, therefore longer service life for cables.

Mechanical effects
Reduced electrodynamic forces, therefore less risk of electrical contacts or busbars being deformed or broken.

Electromagnetic effects
Fewer disturbances for measuring devices located near electrical circuits.

Economy by means of cascading

Cascading is a technique directly derived from current limiting. Circuit breakers with breaking capacities less than the prospective short-circuit current may be installed downstream of a limiting circuit breaker. The breaking capacity is reinforced by the limiting capacity of the upstream device. It follows that substantial savings can be made on downstream equipment and enclosures.

Current and energy limiting curves

The limiting capacity of a circuit breaker is expressed by two curves which are a function of the prospective short-circuit current (the current which would flow if no protection devices were installed):

- the actual peak current (limited current)
- thermal stress (A^2s), i.e. the energy dissipated by the short-circuit in a conductor with a resistance of 1 Ω.

Example
What is the real value of a 150 kA rms prospective short-circuit (i.e. 330 kA peak) limited by an NSX250L upstream ?
The answer is 30 kA peak (curve page E-14).

Maximum permissible cable stresses

The table below indicates the maximum permissible thermal stresses for cables depending on their insulation, conductor (Cu or Al) and their cross-sectional area (CSA). CSA values are given in mm² and thermal stresses in A^2s.

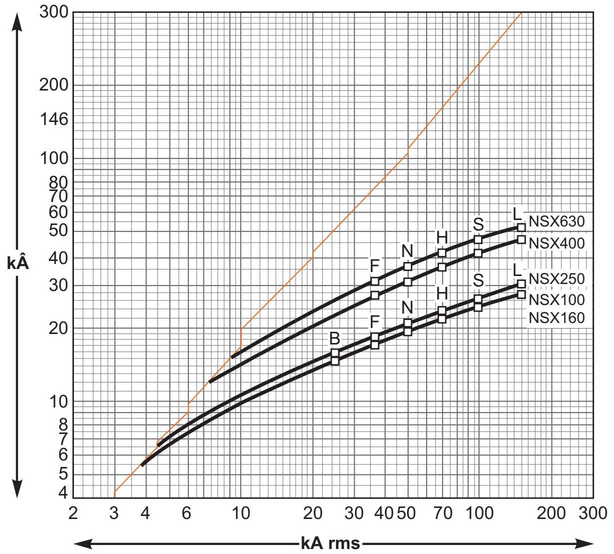
CSA		1.5 mm²	2.5 mm²	4 mm²	6 mm²	10 mm²
PVC	Cu	$2.97x10^4$	$8.26x10^4$	$2.12x10^5$	$4.76x10^5$	$1.32x10^6$
	Al					$5.41x10^5$
PRC	Cu	$4.10x10^4$	$1.39x10^5$	$2.92x10^5$	$6.56x10^5$	$1.82x10^6$
	Al					$7.52x10^5$
CSA		**16 mm²**	**25 mm²**	**35 mm²**	**50 mm²**	
PVC	Cu	$3.4x10^6$	$8.26x10^6$	$1.62x10^7$	$3.31x10^7$	
	Al	$1.39x10^6$	$3.38x10^6$	$6.64x10^6$	$1.35x10^7$	
PRC	Cu	$4.69x10^6$	$1.39x10^7$	$2.23x10^7$	$4.56x10^7$	
	Al	$1.93x10^6$	$4.70x10^6$	$9.23x10^6$	$1.88x10^7$	

Example
Is a Cu/PVC cable with a CSA of 10 mm² adequately protected by an NSX160F?
The table above indicates that the permissible stress is $1.32x10^6$ A^2s.
All short-circuit currents at the point where an NSX160F (Icu = 35 kA) is installed are limited with a thermal stress less than $6x10^5$ A^2s (curve page E-14).
Cable protection is therefore ensured up to the limit of the breaking capacity of the circuit breaker.

Current-limiting curves

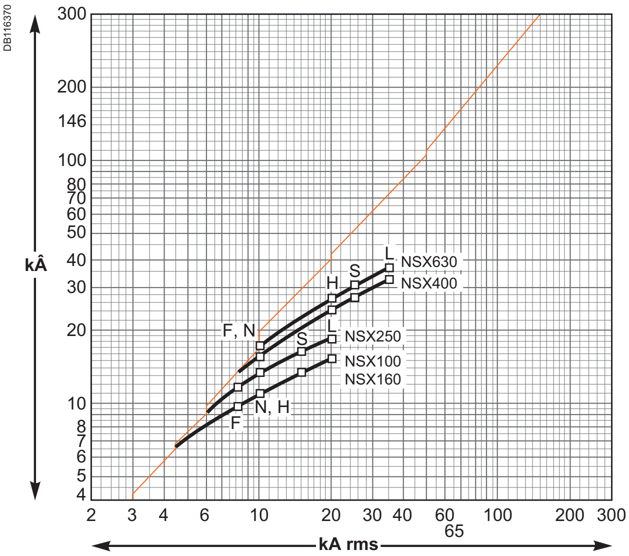
Voltage 400/440 V AC

Limited short-circuit current (kÂ peak)



Voltage 660/690 V AC

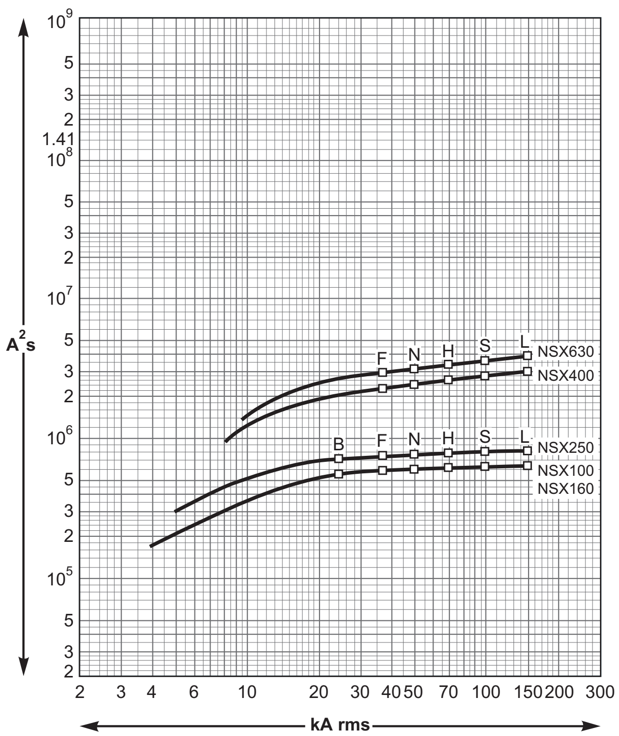
Limited short-circuit current (kÂ peak)



Energy-limiting curves

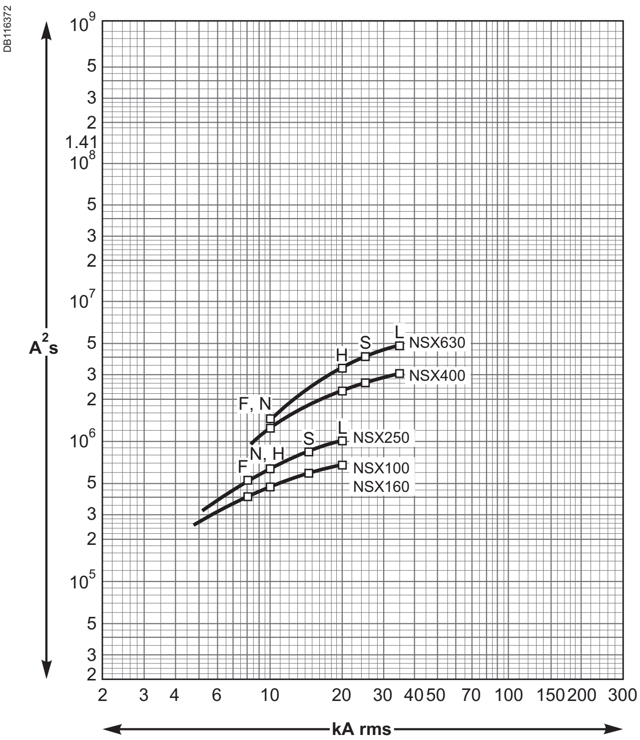
Voltage 400/440 V AC

Limited energy



Voltage 660/690 V AC

Limited energy



LV434104

Micrologic 5/6 electronic trip units
User manual

Compact NSX

LV434104 France

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