Low voltage electrical distribution

Micrologic

Control units
5.0 H, 6.0 H and 7.0 H

User manual
01/2009

Schneider Electric

Contents

Contents

Identification

All Masterpact NT and NW circuit breakers are equipped with a Micrologic control unit that can be changed on site.
Control units are designed to protect power circuits and connected loads.
They offer current, voltage, frequency, power and energy measurements.
The functions provided by Micrologic 5.0 H, 6.0 H and 7.0 H control units optimise continuity of service and power management in your installation.

E71926A

Micrologic 5.0 H

X Y Z

X: type of protection
- 2 for basic protection
- 5 for selective protection
- 6 for selective + ground-fault protection
- 7 for selective + earth-leakage protection

Y: version number
Identification of the control-unit generation:
"0" signifies the first generation.

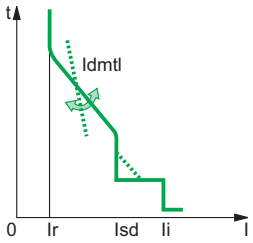
Z: type of measurement
- A for "ammeter"
- P for "power meter"
- H for "harmonic meter"
- no indication = no measurements

Micrologic 5.0 H

Selective protection + Idmtl, power measurements and additional protection

E71927A

DB119909



Selective protection + Idmtl

Micrologic 6.0 H

Selective protection + Idmtl + ground-fault protection, power measurements and additional protection

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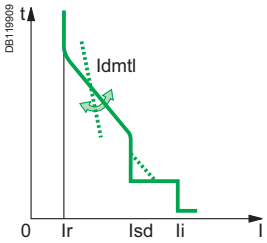
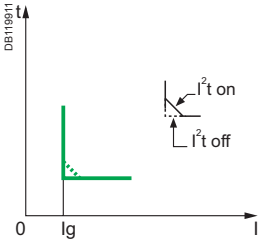
DB119909



Selective protection + Idmtl

DB119911



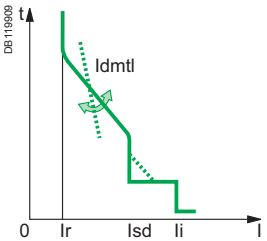
Ground-fault protection

Micrologic 7.0 H

Selective protection + Idmtl + earth-leakage protection, power measurements and additional protection

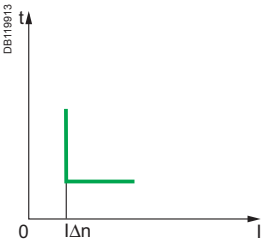
E71929A

DB119909



Selective protection + Idmtl

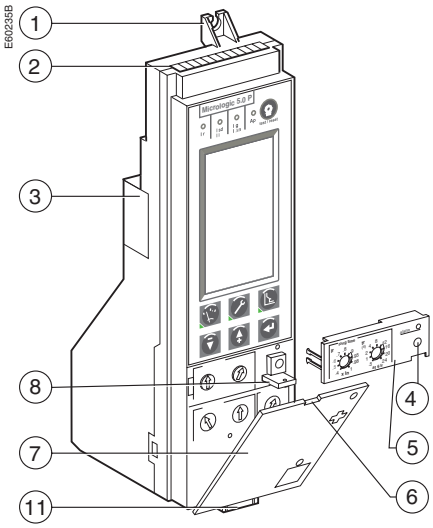
DB119913

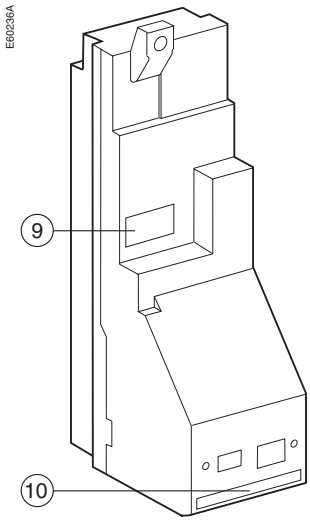


Earth-leakage protection

Presentation

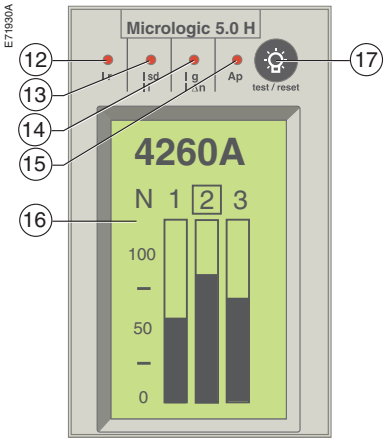
1 top fastener
2 terminal block for external connections
3 housing for battery
4 screw for long-time rating plug
5 long-time rating plug
6 cover opening point
7 protective cover
8 lead-seal fixture for protective cover
9 infrared link with communications interfaces
10 connection with circuit breaker
11 bottom fastener





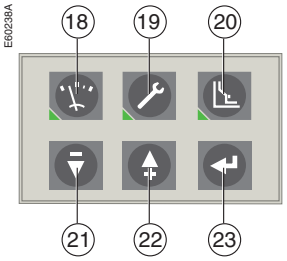
Indications

12 LED indicating long-time tripping
13 LED indicating short-time or instantaneous tripping
14 LED indicating ground-fault or earth-leakage tripping
15 LED indicating additional-protection or auto-protection tripping
16 graphics display
17 button for reset of fault-trip LED reset and battery test



Navigation

18 access button to the "Metering" menu (1)
19 access button to the "History, maintenance and setup" menu (1)
20 access button to the "Protection" menu (1)
21 button used to scroll down or reduce the displayed value
22 button used to scroll up or increase the displayed value
23 button used to select or confirm a choice

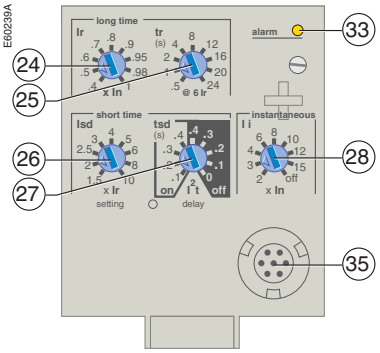


Adjustment dials

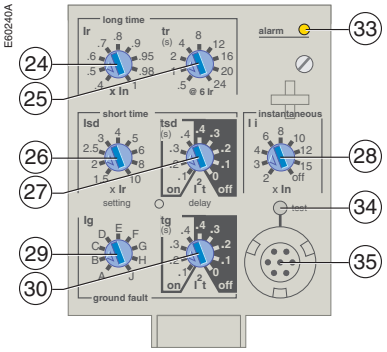
24 long-time current setting Ir
25 long-time tripping delay tr
26 short-time pickup Isd
27 short-time tripping delay tsd
28 instantaneous pickup Ii
29 ground-fault pickup Ig
30 ground-fault tripping delay tg
31 earth-leakage pickup IΔn
32 earth-leakage tripping delay Δt
33 LED indicating an overload
34 test button for ground-fault and earth-leakage protection
35 test connector

(1) These buttons include a LED indicating the active menu.

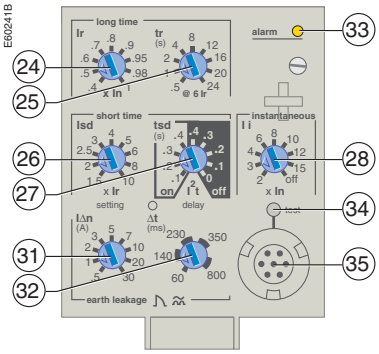
Micrologic 5.0 H control unit



Micrologic 6.0 H control unit



Micrologic 7.0 H control unit



Setting procedure

Dials

■ Dials are used to set Micrologic H protection thresholds and tripping delays for overloads, short-circuits, ground faults and earth leakage.

■ If the set thresholds are overrun, these protection functions systematically trip the circuit breaker.

Buttons

■ Buttons on the keypad are used for fine adjustments of the protection thresholds and tripping delays for overloads, short-circuits, ground faults and earth leakage. The value previously set using a dial automatically becomes the maximum value for the keypad settings.

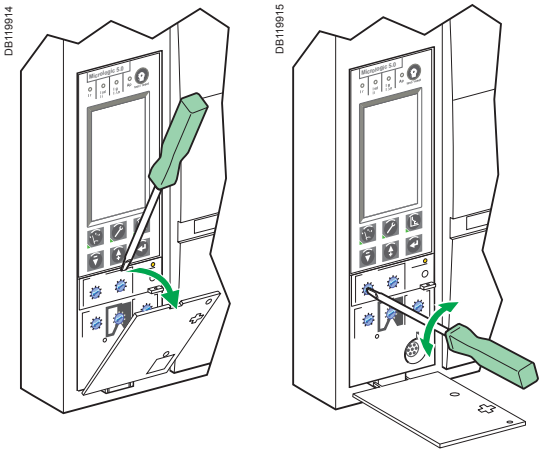
■ They may also be used to activate other factory-disabled protection functions available on Micrologic H. These other protection functions are not accessible via the dials.

With the protective cover open, make all the necessary settings for your control unit.

All fine adjustments are permanently stored in memory, unless the setting is modified using the adjustment dial.

For remote settings using the communications option, see the "Remote settings" section in the "Com setup" menu under "History, maintenance and setup".

Settings using the dials



■ Open the protective cover.

■ Make the necessary settings using the dials

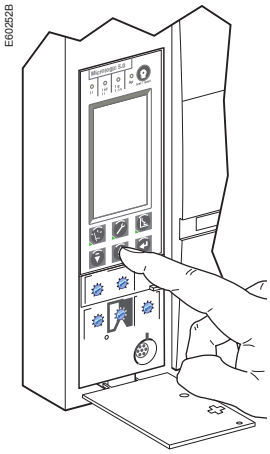
■ The screen automatically displays the relevant curve

■ Check the set value on the screen, in absolute value in amperes (A) and in seconds (s).

Settings using the keypad

■ The  and  buttons under the screen may be used for fine adjustments of the settings made using the dials.

■ All the settings not available via the dials are made in the same manner, using the keypad.



Caution!
A new overload (long-time) or short-circuit (short-time and instantaneous) protection setting made using one of the dials:
■ deletes all the fine adjustments previously made using the keypad for the overload (long-time) and short-circuit (short-time and instantaneous) protection
■ does not affect the fine adjustments made using the keypad for ground-fault and earth-leakage protection
■ does not affect any other settings made using the keypad.

Similarly, a new ground-fault or earth-leakage protection setting made using one of the dials:
■ deletes all the fine adjustments previously made using the keypad for the ground-fault and earth-leakage protection
■ does not affect the fine adjustments made using the keypad for the overload (long-time) and short-circuit (short-time and instantaneous) protection
■ does not affect any other settings made using the keypad.

Setting procedure

With the protective cover closed, it is not possible to set the protection functions. However, it is possible to set metering functions and alarms, as well as view all measurements, settings and histories.

View the settings and measurements

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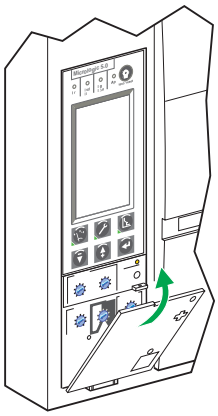
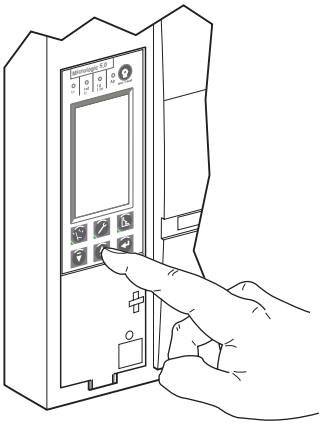


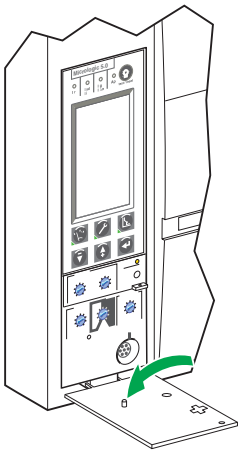
■ Close the protective cover for the dials
■ Access to the dials is blocked and it is no longer possible to make fine adjustments using the keypad

E60254B



■ If necessary, install a lead seal to protect the settings
■ Settings may be viewed at any time using the keypad.

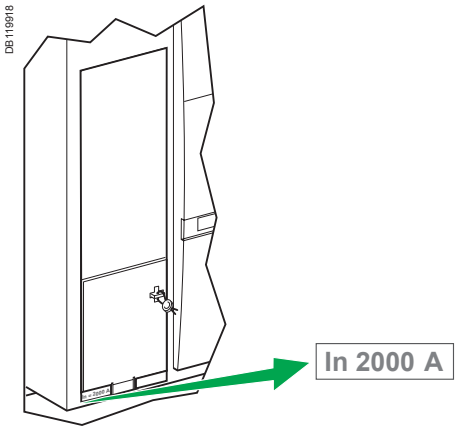
DB119917



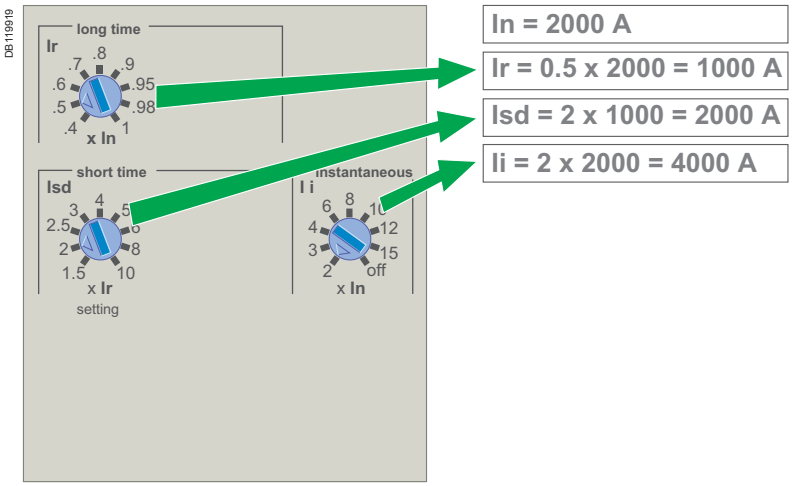
Caution!
If you notice that the tab on the back of the protective cover has been broken off, contact the Schneider Electric after-sales support department to replace the cover.

Setting Micrologic 5.0 H using the dials

Consider a 2000 A circuit breaker.

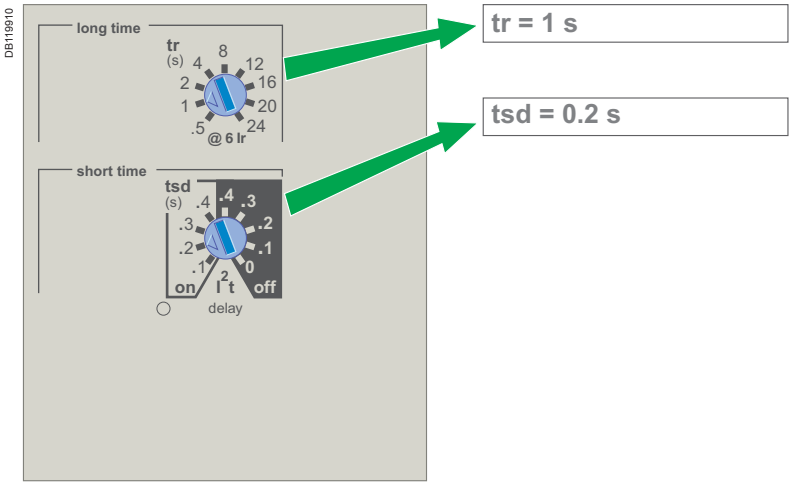


Set the thresholds



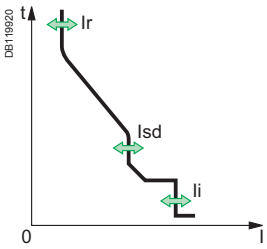
See pages 22 and 24 for selection of the setting ranges.

Set the time delays

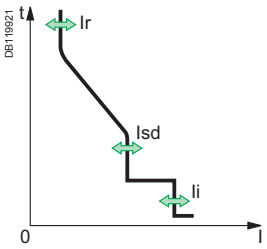


Thresholds

I²t ON curve



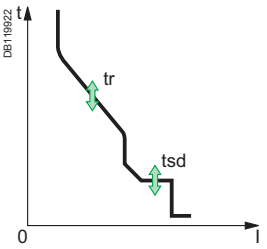
I²t OFF curve



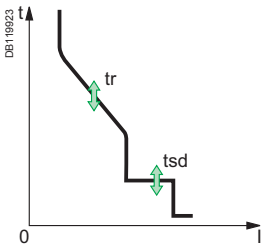
Ir: LT threshold
Isd: ST pickup
Ii: Instantaneous pickup

Time delays

I²t ON curve



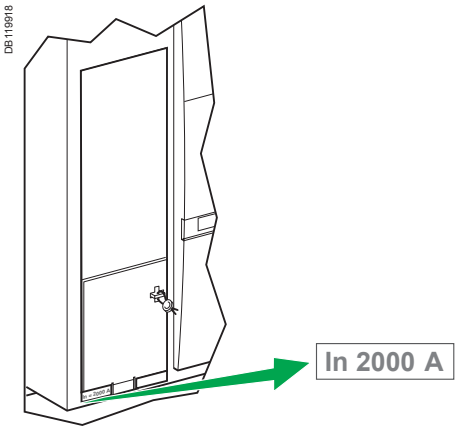
I²t OFF curve



tr: LT tripping delay
tsd: ST tripping delay

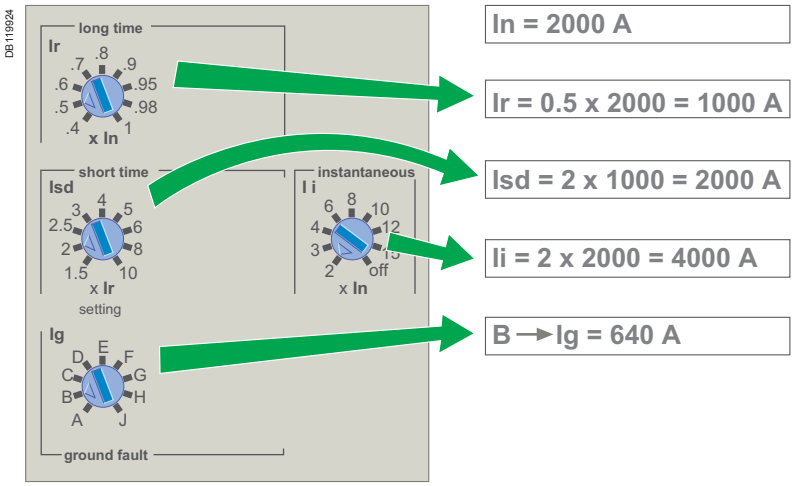
Setting Micrologic 6.0 H using the dials

Consider a 2000 A circuit breaker.

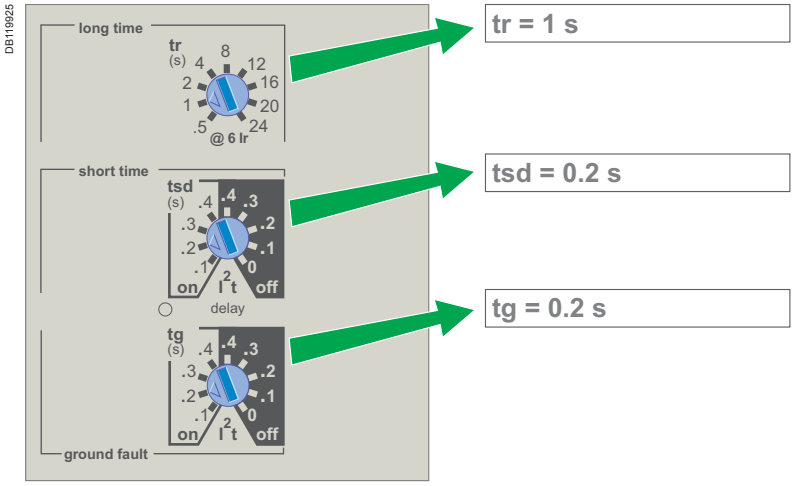


See pages 22 to 26 for selection of the setting ranges.

Set the thresholds

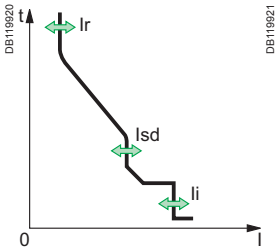


Set the time delays

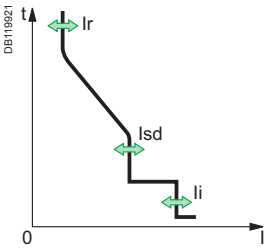


Thresholds

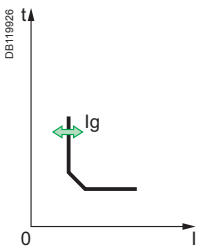
I²t ON curve

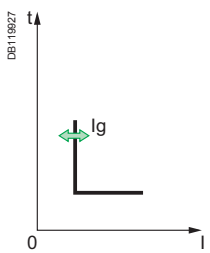


I²t OFF curve



Ir: LT threshold
Isd: ST pickup
Ii: Instantaneous pickup

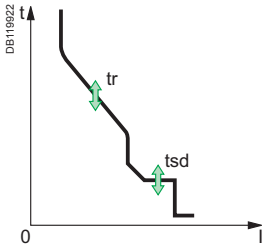




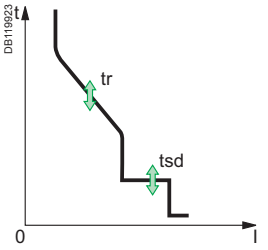
Ig: ground-fault pickup

Time delays

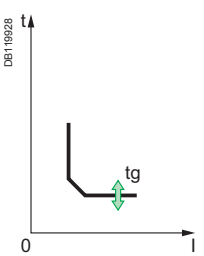
I²t ON curve

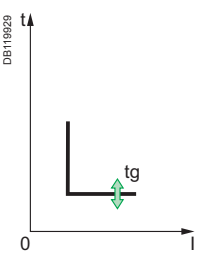


I²t OFF curve



tr: LT tripping delay
tsd: ST tripping delay

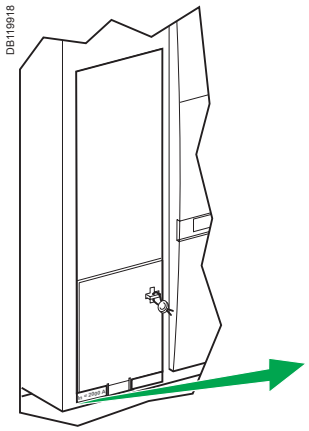




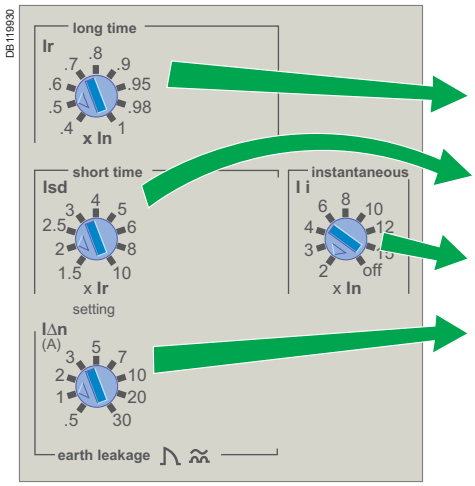
tg: ground-fault tripping delay

Setting Micrologic 7.0 H using the dials

Consider a 2000 A circuit breaker.



Set the thresholds



In = 2000 A

Ir = 0.5 x 2000 = 1000 A

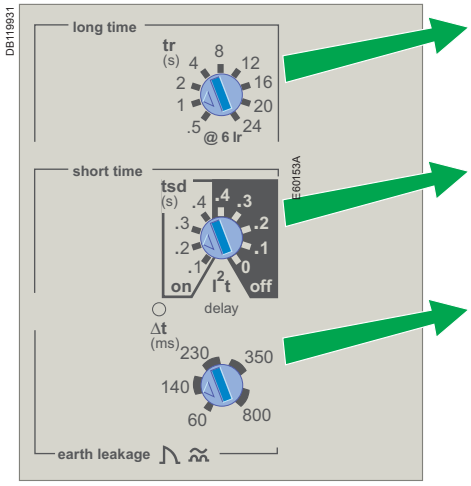
Isd = 2 x 1000 = 2000 A

Ii = 2 x 2000 = 4000 A

IΔn = 1 A

See pages 22 to 26 for selection of the setting ranges.

Set the time delays



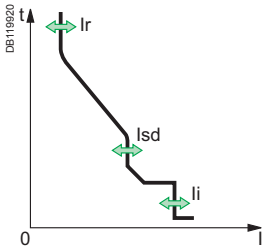
tr = 1 s

tsd = 0.2 s

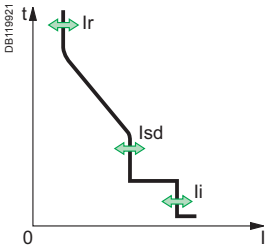
Δt = 140 ms

Thresholds

I²t ON curve



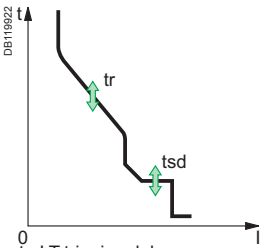
I²t OFF curve



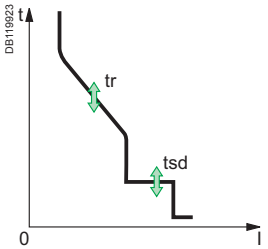
Ir: LT threshold
Isd: ST pickup
Ii: Instantaneous pickup

Time delays

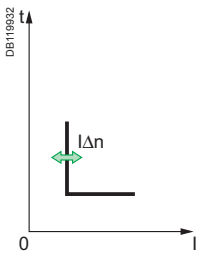
I²t ON curve



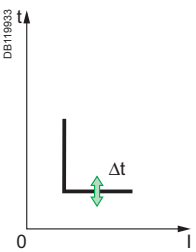
I²t OFF curve



tr: LT tripping delay
tsd: ST tripping delay

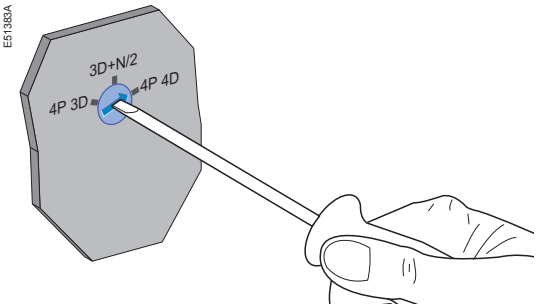


IΔn: earth-leakage pickup



Δt: earth-leakage tripping delay

Selecting the type of neutral protection



Caution!
With the 4P 3D setting, the current in the neutral must not exceed the rated current of the circuit breaker.

Selection dial on four-pole circuit breakers

On four-pole circuit breakers, it is possible to select the type of neutral protection for the fourth pole using the three-position dial on the circuit breaker:

- no neutral protection 4P 3D
- half neutral protection 3D + N/2
- full neutral protection 4P 4D

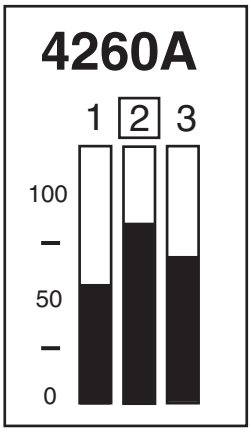
The factory default setting is 3D + N/ 2.

Main menus

The Micrologic H control unit offers access to the main screen and three menus:
- the main screen displaying the continuous measurement of the phase currents (I1, I2, I3) and the neutral current (IN), if it exists
- the "Metering" menu
- the "History, maintenance and setup" menu
- the "Protection" menu.

Main screen

E60101A



As long as no functions are activated, Micrologic H control units display in real time the current on the most heavily loaded phase.
The number for that phase is presented in a square.

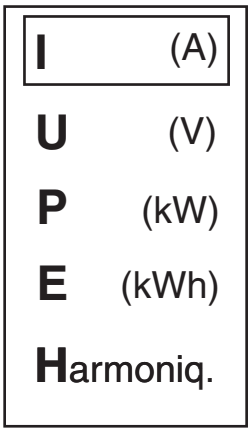
The current in the neutral is displayed if the neutral CT is set as internal or external (see "Ineutral (A)" settings in the "Current protection" menu).

When a menu button is pressed, a presentation screen is displayed and the green LED on the button goes ON.

"Metering", "History, maintenance and setup" and "Protection" menus

- "Metering" menu

E71931B

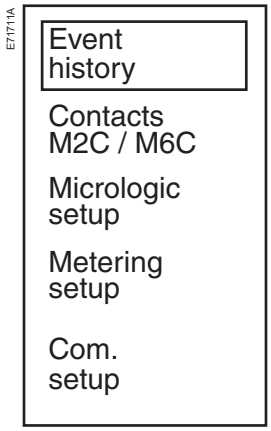


□ press the  or  button to return to the main screen

□ press the  button to return to the previous screen
□ whatever the screen displayed, if no further action is taken, the system returns to the main screen after a few minutes
□ the LED goes OFF on exiting the menu.

Main menus

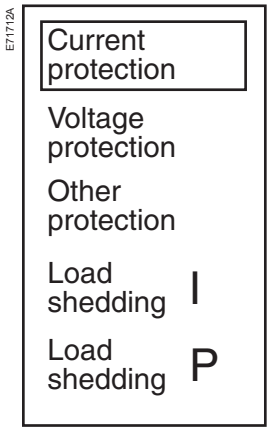
■ "History, maintenance and setup" menu



□ press the  or  button to return to the main screen

□ press the  button to return to the previous screen
□ whatever the screen displayed, if no further action is taken, the system returns to the main screen after a few minutes
□ the LED goes OFF on exiting the menu.

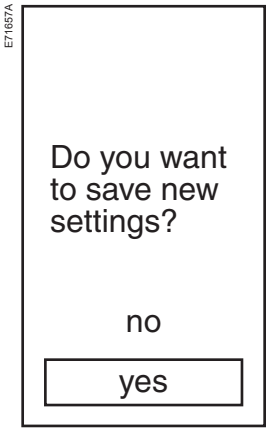
■ "Protection" menu



□ press the  or  button to return to the main screen

□ press the  button to return to the previous screen
□ whatever the screen displayed, if no further action is taken, the system returns to the main screen after a few minutes
□ the LED goes OFF on exiting the menu.

■ Saving settings



When a setting is made in any of the three menus, the screen used to save the modification(s) may be accessed by pressing one of the three buttons  ,  or  .

□ select yes to save the modifications
□ select no to cancel and maintain the previous settings
□ this screen remains displayed until yes or no are selected.

Metering

Press the button to select the "Metering" menu.

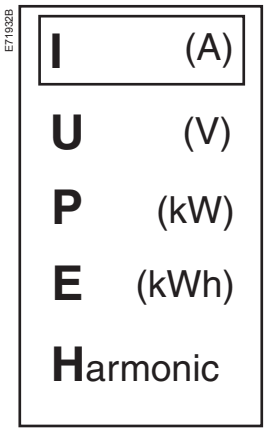
move the cursor down the screen or decrement a value.

move the cursor up the screen or increment a value.

select an option in a list, confirm a selection or the value of a setting.

indicates that the operator is in the "Metering" menu and returns to the previous screen.

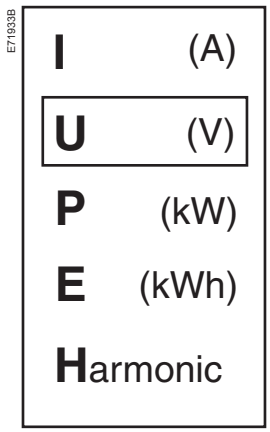
return to the main screen.



Current measurements

I (A) access to the following sections:

- **Instant.**
  - **I1, I2, I3, IN** — I1, I2, I3, IN currents (depending on the type of system)
  - **Max** — Storing and reset of the maximum instantaneous currents
- **Demand**
  - **$\overline{I1}$, $\overline{I2}$, $\overline{I3}$, $\overline{IN}$** — Demand current on the phases $\overline{I1}$, $\overline{I2}$, $\overline{I3}$ and on $\overline{IN}$ (depending on the type of system)
  - **Max** — Storing and reset of the maximum demand currents.

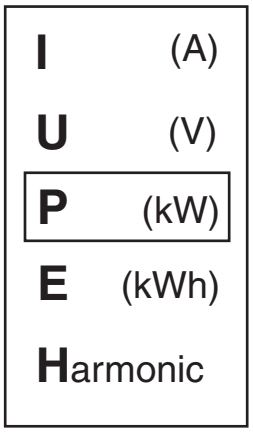


Voltage measurements

U (V) access to the following sections:

- **Instant.** — Instantaneous phase-to-phase U12, U23, U31 and phase-to-neutral V1N, V2N, V3N voltages (depending on the type of system)
- **Average 3 Φ** — Average voltage U average of the phase-to-phase voltages.
- **Unbal 3 Φ** — Unbalance voltage U unbal. of the phase-to-phase voltages.
- **Phase rotation** — Phase sequence.

E71934B

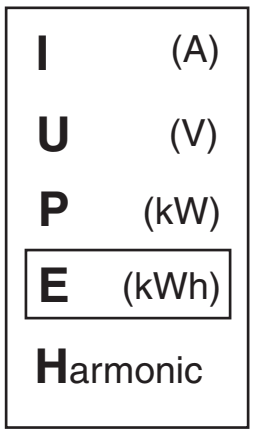


Power measurements

P (kW) access to the following sections:

- Instant.
  - P, Q, S, — Total active power P; Total reactive power Q; Total apparent power S
  - Power factor — Power factor PF
- Demand
  - $\overline{P}$, $\overline{Q}$, $\overline{S}$ — Demand values for the:
    - total active power P
    - total reactive power Q
    - total apparent power S
  - Max — Storing and reset of the maximum demand power values

E71935B



Energy measurements

E (kWh) access to the following sections:

- E total — Total active energy E.P; Total reactive energy E.Q; Total apparent energy E.S
- E in — Positive component of:
  - the total active energy E.P
  - the total reactive energy E.Q
- E out — Negative component of:
  - the total active energy E.P
  - the total reactive energy E.Q
- Reset Energy — Reset all the energy values to zero

E71938B

I (A)

U (V)

P (kW)

E (kWh)

Harmonic

Harmonic measurements

Harmonic

Waveform — access to the following sections:

- $I_{1, 2, 3}$ — Waveform capture for currents I1, I2 and I3
- I_N — Waveform capture for the neutral current IN
- $U_{12, 23, 31}$ — Waveform capture for voltages U12, U23 and U31

Fundament.

- I (A) — Measurement of the fundamental of currents I1, I2, I3 and IN
- U (V) — Measurement of the fundamental of voltages U12, U23 and U31 and V1N, V2N and V3N
- P (W) — Measurement of the fundamental of active power P, reactive power Q and apparent power S.

THD

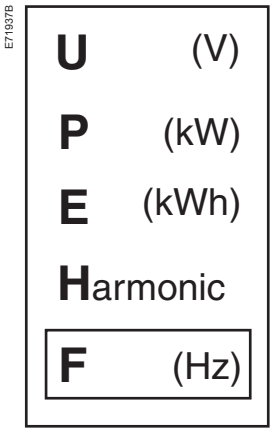
- I (%) — Total harmonic distortion of currents I1, I2, I3 and IN
- U (%) — Total harmonic distortion of voltages U12, U23 and U31 and V1N, V2N and V3N

thd

- I (%) — Total harmonic distortion of currents I1, I2, I3 and IN
- U (%) — Total harmonic distortion of voltages U12, U23 and U31 and V1N, V2N and V3N

FFT

- I (3, 5, 7,..., 31) — Amplitude spectrum of odd current harmonics up to H31
- U (3, 5, 7,..., 31) — Amplitude spectrum of odd voltage harmonics up to H31



Frequency measurement

F (Hz) access to the frequency measurement

History, maintenance and setup

Press the button to select the "History, maintenance and setup" menu.

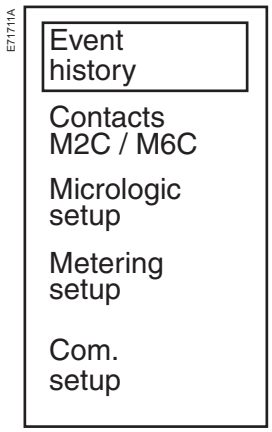
move the cursor down the screen or decrement a value.

move the cursor up the screen or increment a value.

select an option in a list, confirm a selection or the value of a setting.

indicates that the operator is in the "History, maintenance and setup" menu and returns to the previous screen.

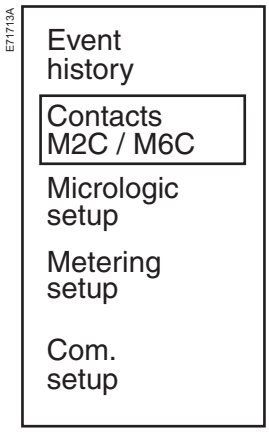
return to the main screen.



Event history

Event history — access to the following sections:

- Trip history — The last ten faults recorded
- Alarm history — The last ten alarms recorded
- Operation counter — Number of operations (opening or closing)
- Contact wear — Wear of the circuit-breaker main contacts



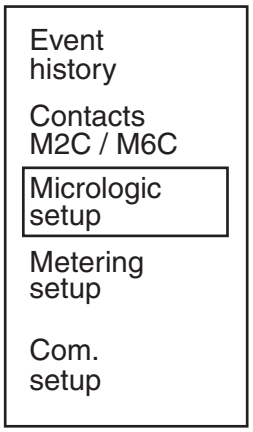
M2C / M6C Contacts

Contacts M2C / M6C — access to the following sections:

- Alarm type — Assignment of a protection alarm to an M2C or an M6C contact
- Setup — Latching mode for each M2C or M6C contact
- Reset — Reset of the M2C or M6C contacts

History, maintenance and setup

E71714A

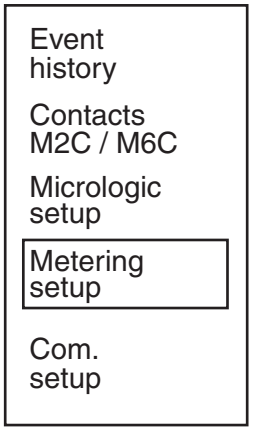


Micrologic setup

Micrologic setup → access to the following sections:

- **Language** — Selection of the display language
- **Date / time** — Setting of the date and time
- **Breaker selection** — Indication of the circuit-breaker type
- **Power sign** — Setting the power sign
- **VT ratio** — Select of the primary and secondary voltages on the instrument transformer
- **System frequency** — Indication of the rated system frequency

E71715A

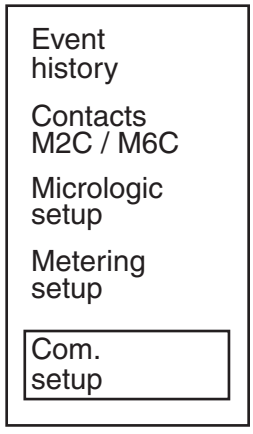


Metering setup

Metering setup → access to the following sections:

- **System type** — ■ 3 phases, 3 wires, 3 CTs: method using two wattmeters ■ 3 phases, 4 wires, 3 CTs: method using three wattmeters ■ 3 phases, 4 wires, 4 CTs: method using three wattmeters with measurement of the neutral current.
- **Current demand** — Selection of the calculation method and setting of the time interval for the calculation
- **Power demand** — Selection of the calculation method and setting of the parameters for the calculation
- **Sign convention** — Setting of the sign convention for the power factor and reactive power, i.e. IEEE, IEEE alternate or IEC (see page 106 to determine the sign convention)

E71716A



COM communications-option setup

Com. setup → access to the following sections:

- **Com. parameter** — Setting of parameters for the COM communications option (address, baud rate, parity)
- **Remote settings** — Authorisation of access to settings via the COM communications option.
- **Remote control** — Authorisation of access to the circuit-breaker ON and OFF commands via the COM communications option.

Protection

Press the button to select the "Protection" menu.

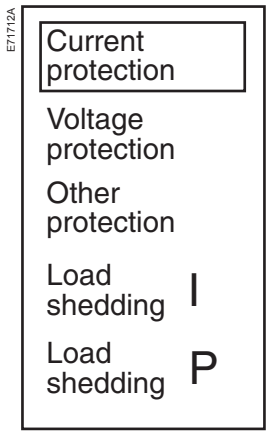
move the cursor down the screen or decrement a value

move the cursor up the screen or increment a value

select an option in a list, confirm a selection or the value of a setting

indicates that the operator is in the "Protection" menu and returns to the previous screen

return to the main screen

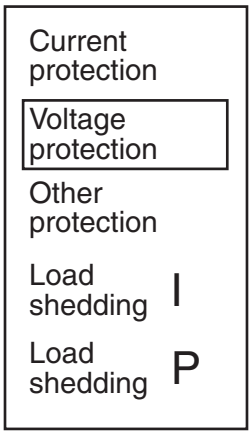


Current protection

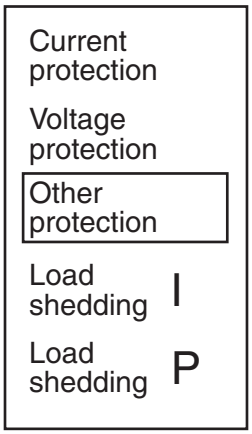
Current protection — access to the following sections:

I (A)	Fine settings of the long-time I^2t, short-time and instantaneous protection functions
Idmtl (A)	Fine settings of the long-time Idmtl, short-time and instantaneous protection functions
I⏚ (A)	Fine settings of the: ■ ground-fault (Micrologic 6.0 H) ■ earth-leakage (Micrologic 7.0 H) protection functions
Ineutral (A)	Selection of the type of neutral sensor and type of neutral protection
I⏚ Alarm	Setting of the I⏚ alarm
Iunbal (%)	Setting of the current-unbalance protection I unbal
$\overline{I1}$ max (A)	Setting of the maximum-current protection $\overline{I1}$ max
$\overline{I2}$ max (A)	Setting of the maximum-current protection $\overline{I2}$ max
$\overline{I3}$ max (A)	Setting of the maximum-current protection $\overline{I3}$ max
$\overline{IN}$ max (A)	Setting of the maximum-current protection $\overline{IN}$ max

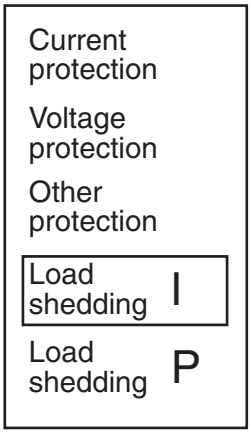
E71719A



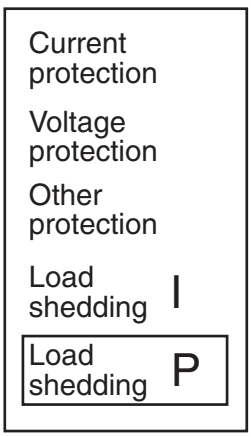
E71720A



E71721A



E71722A



Voltage protection

Voltage protection → access to the following sections:

- **U**min (V) — Setting of the minimum-voltage protection U min.
- **U**max (V) — Setting of the maximum-voltage protection U max.
- **U**unbal (%) — Setting of the voltage-unbalance protection U unbal.

Other protection

Other protection → access to the following sections:

- **rP**max (W) — Setting of the reverse-power protection rP max
- **F**min (Hz) — Setting of the minimum-frequency protection F min
- **F**max (Hz) — Setting of the maximum-frequency protection F max
- Phase rotation — Setting of the phase-rotation protection

Load shedding depending on current

Load shedding I → Access to load shedding and reconnection depending on current

Load shedding depending on power

Load shedding P → Access to load shedding and reconnection depending on power

Current protection
I^2t long-time protection

For the default values, the setting ranges, increment steps and setting accuracies, see the technical appendix.

The long-time protection function protects cables against overloads. This function is based on true rms measurements.
It is possible to select either I^2t long-time protection or Idmtl long-time protection.

I^2t long-time protection

Long-time current setting Ir and standard tripping delay tr

Micrologic control unit	Accuracy		5.0 H, 6.0 H and 7.0 H								
Current setting	**Ir = In (*) x …**		**0.4**	**0.5**	**0.6**	**0.7**	**0.8**	**0.9**	**0.95**	**0.98**	**1**
tripping betweeen 1.05 and 1.20 Ir			other ranges or disable by changing rating plug								
Time setting			**0,5**	**1**	**2**	**4**	**8**	**12**	**16**	**20**	**24**
Time delay (s)	tr at 1.5 x Ir	0 to -30%	12.5	25	50	100	200	300	400	500	600
	tr at 6 x Ir	0 to -20%	0.7 (1)	1	2	4	8	12	16	20	24
	tr at 7.2 x Ir	0 to -20%	0.7 (2)	0.69	1.38	2.7	5.5	8.3	11	13.8	16.6

(*) In: circuit breaker rating
(1) 0 to -40%
(2) 0 to -60%

■ It is possible to enhance the Ir setting accuracy (reduced range) or disable the long-time protection function by using a different long-time rating plug.
See the technical appendix "Changing the long-time rating plug".

Thermal memory
■ The thermal memory continuously accounts for the amount of heat in the cables, both before and after tripping, whatever the value of the current (presence of an overload or not). The thermal memory optimises the long-time protection function of the circuit breaker by taking into account the temperature rise in the cables.
■ The thermal memory assumes a cable cooling time of approximately 15 minutes.

Current protection
Idmtl long-time protection

Idmtl Protection

Long-time current setting Ir and Idmtl tripping delay tr

Micrologic control unit		Accuracy	5.0 H, 6.0 H and 7.0 H								
Current setting	**Ir = In (*) x …**		**0.4**	**0.5**	**0.6**	**0.7**	**0.8**	**0.9**	**0.95**	**0.98**	**1**
tripping between 1.05 and 1.20 Ir			other ranges or disable by changing rating plug								
Time setting			**0,5**	**1**	**2**	**4**	**8**	**12**	**16**	**20**	**24**
DT											
Time delay (s)	tr at 1.5 x Ir	0 to -20%	0.53	1	2	4	8	12	16	20	24
	tr at 6 x Ir	0 to -20%	0.53	1	2	4	8	12	16	20	24
	tr at 7.2 x Ir	0 to -20%	0.53	1	2	4	8	12	16	20	24
	tr at 10 x Ir	0 to -20%	0.53	1	2	4	8	12	16	20	24
SIT											
Time delay (s)	tr at 1.5 x Ir	0 to -30%	1.9	3.8	7.6	15.2	30.4	45.5	60.7	75.8	91
	tr at 6 x Ir	0 to -20%	0.5	1	2	4	8	12	16	20	24
	tr at 7.2 x Ir	0 to -20%	0.7 (1)	0.88	1.77	3.54	7.08	10.6	14.16	17.7	21.2
	tr at 10 x Ir	0 to -20%	0.7 (2)	0.8	1.43	2.86	5.73	8.59	11.46	14.33	17.19
VIT											
Time delay (s)	tr at 1.5 x Ir	0 to -30%	3.6	7.2	14.4	28.8	57.7	86.5	115.4	144.2	173.1
	tr at 6 x Ir	0 to -20%	0.5	1	2	4	8	12	16	20	24
	tr at 7.2 x Ir	0 to -20%	0.7 (1)	0.81	1.63	3.26	6.52	9.8	13.1	16.34	19.61
	tr at 10 x Ir	0 to -20%	0.7 (2)	0.75	1.14	2.28	4.57	6.86	9.13	11.42	13.70
EIT											
Time delay (s)	tr at 1.5 x Ir	0 to -30%	12.5	25	50	100	200	300	400	500	600
	tr at 6 x Ir	0 to -20%	0.7 (1)	1	2	4	8	12	16	20	24
	tr at 7.2 x Ir	0 to -20%	0.7 (2)	0.69	1.38	2.7	5.5	8.3	11	13.8	16.6
	tr at 10 x Ir	0 to -20%	0.7 (2)	0.7 (1)	0.7 (1)	1.41	2.82	4.24	5.45	7.06	8.48
HVF											
Time delay (s)	tr at 1.5 x Ir	0 to -30%	164.5	329	658	1316	2632	3950	5265	6581	7900
	tr at 6 x Ir	0 to -20%	0.7 (1)	1	2	4	8	12	16	20	24
	tr at 7.2 x Ir	0 to -20%	0.7 (2)	0.7 (1)	1.1 (1)	1.42	3.85	5.78	7.71	9.64	11.57
	tr at 10 x Ir	0 to -20%	0.7 (2)	0.7 (2)	0.7 (1)	0.7 (1)	1.02	1.53	2.04	2.56	3.07

(*) In: circuit breaker rating
(1) 0 to -40 %
(2) 0 to -60 %

■ These curves with different slopes are used to improve:
□ discrimination with fuses positioned upstream (HV) and/or downstream
□ protection for certain types of loads
■ Five types of curves are available:
□ DT: definite time curve
□ SIT: standard inverse time curve ($I^{0.5}t$)
□ VIT: very inverse time curve (It)
□ EIT: extremely inverse time curve (I^2t)
□ HVF: compatible with high-voltage fuses (I^4t).

■ **Neutral protection**

Overload protection (long time) for the neutral is disabled if the Idmtl protection function is selected. However, the short-circuit protection (short time and instantaneous) remains operational.

■ **Intermittent overloads**

As long as the Micrologic H control unit remains supplied with power, the effects of intermittent overloads on cables are calculated. If power is cut, temperature rise in cables is not calculated.

■ **Circuit-breaker thermal limit**

For certain settings, the Idmtl curves may be limited by the I^2t curve when the tripping delay tr is set to 24 seconds or by its thermal memory. The maximum I^2t curve remains active for the phases and the neutral even when the Idmtl curves are activated.

Current protection
Short-time and instantaneous protection

For the default values, the setting ranges, increment steps and setting accuracies, see the technical appendix.

Short-time protection

■ The short-time protection function protects the distribution system against impedant short-circuits
■ The short-time tripping delay and the I^2t ON and I^2t OFF options can be used to ensure discrimination with a downstream circuit breaker
■ This function carries out true rms measurements.

■ Use of I^2t curves with short-time protection:
□ I^2t OFF selected: the protection function implements a constant time curve
□ I^2t ON selected: the protection function implements an I^2t inverse-time curve up to 10 Ir. Above 10 Ir, the time curve is constant.

For the characteristics and external wiring of the zone selective interlocking function, see the technical appendix on "Zone selective interlocking".

■ Zone selective interlocking (ZSI)
The short-time and ground-fault protection functions enable time discrimination by delaying the upstream devices to provide the downstream devices the time required to clear the fault. Zone selective interlocking can be used to obtain total discrimination between circuit breakers using external wiring.

■ Intermittent faults are taken into account by Micrologic H and may lead to shorter tripping times than those set.

Short-time pickup Isd and tripping delay tsd

Micrologic control unit		5.0 H, 6.0 H and 7.0 H								
Pickup	Isd = Ir x ... accuracy ± 10 %	1.5	2	2.5	3	4	5	6	8	10
Time delay (ms)	setting	I^2t Off	0	0.1	0.2	0.3	0.4			
at 10 Ir		I^2t On		0.1	0.2	0.3	0.4			
I^2t On or	tsd (max resettable time)	20	80	140	230	350				
I^2t Off	tsd (max break time)	80	140	200	320	500				

If the "without long-time protection" plug is used and the long-time protection function is disabled, the short-time pickup Isd is automatically multiplied by In instead of Ir as is the standard case.

Instantaneous protection

■ The instantaneous-protection function protects the distribution system against solid short-circuits. Contrary to the short-time protection function, the tripping delay for instantaneous protection is not adjustable. The tripping order is sent to the circuit breaker as soon as current exceeds the set value, with a fixed time delay of 20 milliseconds.
■ This function carries out true rms measurements.

Instantaneous pickup Ii

Micrologic control unit		5.0 H, 6.0 H and 7.0 H								
Pickup	Ii = In (*) x ... accuracy ± 10 %	2	3	4	6	8	10	12	15	OFF

(*) In: circuit-breaker rating

■ Circuit breakers have two types of instantaneous protection:
□ adjustable instantaneous protection Ii
□ self-protection.
Depending on the circuit breaker, the OFF position corresponds to the self-protection pickup.

Current protection
Neutral protection

For the default values, the setting ranges, increment steps and setting accuracies, see the technical appendix.

Three-pole circuit breakers

Protection of the neutral is possible on a three-pole circuit breaker by connecting an external sensor.
Settings are made using the  and  buttons on the control unit.

Micrologic control unit	5.0 H, 6.0 H and 7.0 H			
Setting	OFF	N/2	N	1.6xN

Type of neutral	Description
No neutral protection	The distribution system does not require protection of the neutral conductor.
Half neutral protection	The cross-sectional area of the neutral conductor is half that of the phase conductors. ■ The long-time current setting Ir for the neutral is equal to half the setting value ■ The short-time pickup Isd for the neutral is equal to half the setting value ■ The instantaneous pickup Ii for the neutral is equal to the setting value ■ For ground-fault protection (Micrologic 6.0 P), pickup Ig for the neutral is equal to the setting value.
Full neutral protection	The cross-sectional area of the neutral conductor is equal to that of the phase conductors. ■ The long-time current setting Ir for the neutral is equal to the setting value ■ The short-time pickup Isd for the neutral is equal to the setting value ■ The instantaneous pickup Ii for the neutral is equal to the setting value ■ For ground-fault protection (Micrologic 6.0 P), pickup Ig for the neutral is equal to the setting value.
Oversized neutral protection	In installations with a high level of third-order harmonic currents (or multiples thereof), the current in the neutral conductor may exceed that of the phase currents under steady-state conditions ■ The long-time current setting Ir for the neutral is 1.6 times that of the setting value ■ The short-time pickup Isd for the neutral is 1.6 times that of the setting value, but may not exceed 10 In to limit transients and self-protect the installation ■ The instantaneous pickup Ii for the neutral is equal to the setting value ■ For ground-fault protection (Micrologic 6.0 P), pickup Ig for the neutral is equal to the setting value.

Four-pole circuit breakers

The initial protection setting is made using the dial on the neutral pole of the circuit breaker.

The  and  buttons on the control unit may then be used for a more precise setting. The dial setting constitutes the upper limit for adjustments using the keypad.

Micrologic control unit	5.0 H, 6.0 H and 7.0 H		
Setting	OFF	N/2	N

Type of neutral	Description
No neutral protection	The distribution system does not require protection of the neutral
Half neutral protection	The cross-sectional area of the neutral conductor is half that of the phase conductors. ■ The long-time current setting Ir for the neutral is equal to half the setting value ■ The short-time pickup Isd for the neutral is equal to half the setting value ■ The instantaneous pickup Ii for the neutral is equal to the setting value
Full neutral protection	The cross-sectional area of the neutral conductor is equal to that of the phase conductors. ■ The long-time current setting Ir for the neutral is equal to the setting value ■ The short-time pickup Isd for the neutral is equal to the setting value ■ The instantaneous pickup Ii for the neutral is equal to the setting value.

Current protection
Ground-fault and earth-leakage protection

For the default values, the setting ranges, increment steps and setting accuracies, see the technical appendix.

Ground-fault protection on Micrologic 6.0 H

■ An ground fault in the protection conductors can provoke local temperature rise at the site of the fault or in the conductors. The purpose of the ground-fault protection function is to eliminate this type of fault.
■ There are two types of ground-fault protection.

Type	Description
Residual	■ The function determines the zero-phase sequence current, i. e. the vector sum of the phase and neutral currents (depending on the type of installation)
Source Ground Return	■ Using a special external sensor, this function directly measures the fault current returning to the transformer via the earth cable ■ It detects faults both upstream and downstream of the circuit breaker ■ The maximum distance between the sensor and the circuit breaker is ten metres.

■ Ground-fault and neutral protection are independent and can therefore be combined.

Ground-fault pickup Ig and tripping delay tg
The pickup and tripping-delay values can be set independently and are identical for both the residual and "source ground return" ground-fault protection functions.

Micrologic control unit			6.0 H								
Pickup	Ig = In (*) x ... accuracy ±10 %		A	B	C	D	E	F	G	H	J
	In ⩽ 400 A		0.3	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1
	400 A < In ⩽ 1200 A		0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1
	In > 1200 A		500 A	640 A	720 A	800 A	880 A	960 A	1040 A	1120 A	1200 A
Time delay (ms)	settings	I^2t Off	I^2t Off	0	0.1	0.2	0.3	0.4			
at In or 1200 A		I^2t On		0.1	0.2	0.3	0.4				
I^2t On or	tg (max resettable time)		20	80	140	230	350				
I^2t Off	tg (max. break time)		80	140	200	320	500				

(*) In: circuit-breaker rating

Earth-leakage protection on sur Micrologic 7.0 H

■ The earth-leakage protection function primarily protects people against indirect contact because an earth-leakage current can provoke an increase in the potential of the exposed conductive parts. The earth-leakage pickup value IΔn is displayed directly in amperes and the tripping delay follows a constant-time curve.
■ An external rectangular sensor is required for this function
■ This function is inoperative if the long-time rating plug is not installed
□ ⎍ Protected against nuisance tripping
□ ⩘ DC-component withstand class A up to 10 A.
■ If the optional external voltage-measurement input is used, a 24 V DC external power supply must be connected to Micrologic H (terminals F1-, F2+).

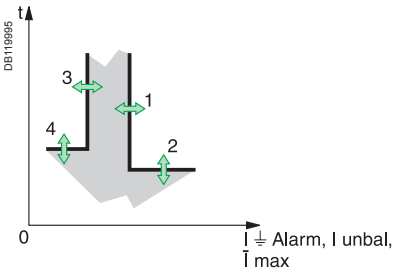
Pickup value IΔn and tripping delay Δt

Micrologic control unit		7.0 H								
Pickup (A)	IΔn accuracy 0 to -20 %	0.5	1	2	3	5	7	10	20	30
Time delay (ms)										
settings	Δt (max resettable time)	60	140	230	350	800				
	Δt (max. break time)	140	200	320	500	1000				

Current protection
I ⏚ Alarm, current unbalance, maximum current

For the pickup and dropout thresholds and time delays, see the technical appendix.

Operating principle
protection tripped by a maximum value

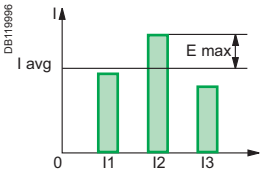


1: pickup threshold
2: pickup time delay
3: dropout threshold
4: dropout time delay

■ For protection tripped by a maximum value, it is possible to set:
□ a pickup threshold (1) that activates an alarm, a contact and/or tripping
□ a pickup time delay (2) that steps in when the pickup threshold (1) is reached
□ a dropout threshold (3) corresponding to deactivation of the alarm and/or contact
□ a dropout time delay (4) that steps in when the dropout threshold (3) is reached
■ The dropout threshold is always less than or equal to the pickup threshold.

I ⏚ Alarm
■ The alarm function is tripped by the rms value of an earth-leakage current
■ This alarm signals an earth-leakage current under the pickup value and does not produce circuit-breaker tripping.

Current-unbalance protection I unbal
■ This protection is activated by an adjustable level of unbalance between the RMS values of the three phase currents.



■ From:
□ I avg is the average value of the rms currents of the three phases

$$I\,avg = \frac{I1 + I2 + I3}{3}$$

□ E max is the maximum difference between the current of each phase and I avg
■ Micrologic H uses the two values above to calculate the current unbalance:

$$I\,unbal = \frac{|E\,max|}{I\,avg}$$

Maximum-current protection per phase Īmax
■ Protection values may be set for each of the following currents:
□ $\bar{I}1$ max: maximum current on phase 1
□ $\bar{I}2$ max: maximum current on phase 2
□ $\bar{I}3$ max: maximum current on phase 3
□ $\bar{I}N$ max: maximum current in the neutral
■ This function calculates the rms demand value of the current for the given phase ($\bar{I}1$, $\bar{I}2$, $\bar{I}3$) or the neutral ($\bar{I}N$), over a sliding time interval.
The time interval is the same as that for the calculation of the demand currents in the "Metering" menu.
Settings are made in the "Metering setup" menu.

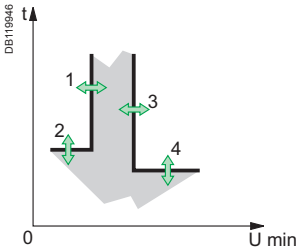
Note:
$\bar{I}N$ max protection does not take into account the neutral-protection setting (N, N/2, 1.6 x N, OFF).

Voltage protection
Minimum voltage, maximum voltage, voltage unbalance

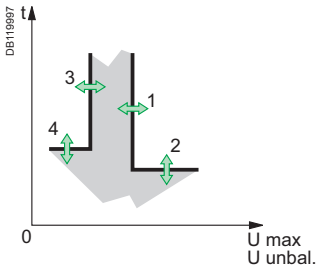
For the pickup and dropout thresholds and time delays, see the technical appendix.

Operating principle

protection tripped by a minimum value



protection tripped by a maximum value



1: pickup threshold
2: pickup time delay
3: dropout threshold
4: dropout time delay

■ For protection tripped by a minimum or maximum value, it is possible to set:
□ a pickup threshold (1) that activates an alarm, a contact and/or tripping
□ a pickup time delay (2) that steps in when the pickup threshold (1) is reached
□ a dropout threshold (3) corresponding to deactivation of the alarm and/or contact
□ a dropout time delay (4) that steps in when the dropout threshold (3) is reached
■ For protection tripped by a minimum value, the dropout threshold is always greater than or equal to the pickup threshold
■ For protection tripped by a maximum value, the dropout threshold is always less than or equal to the pickup threshold
■ If both the minimum and maximum protection functions are activated at the same time, the minimum threshold is automatically limited to the value of the maximum and vice versa.

If the voltage protection functions are activated and the voltage measurement inputs are still energised, it is impossible to reset and close the circuit breaker.

Minimum-voltage protection U min

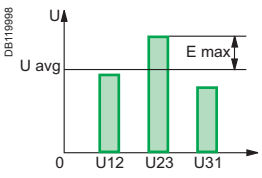
■ This function calculates the minimum rms value of the three phase-to-phase voltages
■ Protection is activated when at least one of the three phase-to-phase voltages (U12, U23, U31) is below the threshold set by the user
■ This protection function does not detect phase failure.

Maximum-voltage protection U max

■ This function calculates the maximum rms value of the three phase-to-phase voltages
■ Protection is activated when the three phase-to-phase voltages (U12, U23, U31) are simultaneously above the threshold set by the user.

Voltage-unbalance protection U unbal

This protection is activated by an adjustable level of unbalance between the rms values of the three phase-to-phase voltages.
This function calculates the rms value of the unbalance between the three phase-to-phase voltages.



■ From:
□ U avg is the average value of the rms voltages of the three phases

$$U\,avg = \frac{U12 + U23 + U31}{3}$$

□ E max: is the maximum difference between the voltage of each phase and U avg
■ Micrologic H uses the two values above to calculate the voltage unbalance:

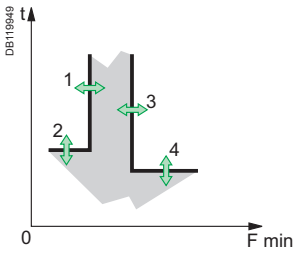
$$U\,unbal = \frac{|E\,max|}{U\,avg}$$

Other protection
Reverse power, min. frequency, max. frequency, phase rotation

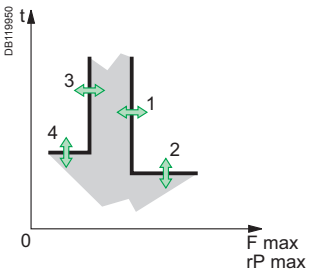
For the pickup and dropout thresholds and time delays, see the technical appendix.

Operating principle

protection tripped by a minimum value



protection tripped by a maximum value



1: pickup threshold
2: pickup time delay
3: dropout threshold
4: dropout time delay

■ For protection tripped by a minimum or maximum value, it is possible to set:
□ a pickup threshold (1) that activates an alarm, a contact and/or tripping
□ a pickup time delay (2) that steps in when the pickup threshold (1) is reached
□ a dropout threshold (3) corresponding to deactivation of the alarm and/or contact
□ a dropout time delay (4) that steps in when the dropout threshold (3) is reached
■ For protection tripped by a minimum value, the dropout threshold is always greater than or equal to the pickup threshold
■ For protection tripped by a maximum value, the dropout threshold is always less than or equal to the pickup threshold
■ If both the minimum and maximum protection functions are activated at the same time, the minimum threshold is automatically limited to the value of the maximum and vice versa.

Reverse-power protection rP max

■ This function calculates the value of the total active power on the three phases
■ The function is activated when the total active power of the three phases flows in the direction opposite that set by the user is greater than the pickup threshold (1) for a time greater than the time delay (2).

Note:
the direction of flow is set by the user in the "Power sign" section of the "Micrologic setup" menu under "History, maintenance and settings".
■ *+ corresponds to the normal direction of flow, i.e. from the top terminals on the circuit breaker to the bottom terminals*
■ *- is the opposite.*

If the voltage protection functions are activated and the voltage measurement inputs are still energised, it is impossible to reset and close the circuit breaker.

Minimum and maximum-frequency protection F min. and F max

These functions monitor the value of the frequency on the distribution system.

Phase-rotation alarm

This alarm is activated if two of the three phases are inverted.

Note:
the alarm is activated following a fixed 300-millisecond time delay. If one of the phases is absent, the alarm will not operate. If the 400 Hz frequency is set, the alarm cannot be activated.

Load shedding and reconnection

For the pickup and dropout thresholds and time delays, see the technical appendix.

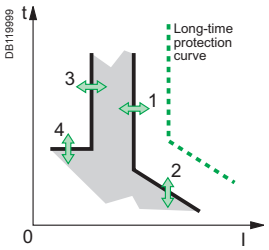
Load shedding and reconnection depending on current

The pickup curve for load shedding and reconnection depending on current is parallel to the LT I^2t and Idmtl curves. If a "without long-time protection" rating plug is installed, the load shedding/reconnection function based on current cannot be activated.

- I^2t protection: the neutral is taken into account
- Idmtl: the neutral is not taken into account.

This function does not trip the circuit breaker, but can be used to set off an alarm linked to an M2C or M6C contact (disconnection and reconnection of non-priority loads).

The load-shedding and reconnection function is determined by thresholds and time delays.



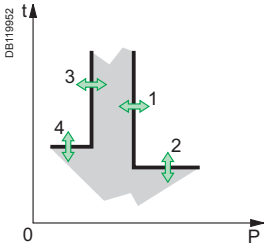
1: pickup threshold
2: pickup time delay
3: dropout threshold
4: dropout time delay

The pickup threshold is always greater than or equal to the dropout threshold.

Load shedding and reconnection depending on power

Load shedding and reconnection depending on power calculates the total active power on the three phases. This function does not trip the circuit breaker, but can be used to set off an alarm linked to an M2C or M6C contact (disconnection and reconnection of non-priority loads).

The load-shedding and reconnection function is determined by thresholds and time delays.



1: pickup threshold
2: pickup time delay
3: dropout threshold
4: dropout time delay

The pickup threshold is always greater than or equal to the dropout threshold.

Measurements
Current and voltage

For the setting ranges and measurement accuracies, see the technical appendix.

Instantaneous current
Micrologic H control units offer two, non-exclusive measurement possibilities.
■ On the bargraph display on the main screen
The instantaneous current of the most heavily loaded phase is automatically displayed in amperes for phases 1, 2, 3 and the neutral (depending on the neutral protection settings). The bargraph indicates the percent load of the three phases.
■ In the I inst. section of the instantaneous currents
□ display in amperes of the instantaneous currents I (rms) on phases I1, I2 and I3 and the neutral current IN, the ground-fault current Ig (Micrologic 6.0 H), the earth-leakage current IΔn (Micrologic 7.0 H)
□ the maximum instantaneous currents are displayed and stored in memory
□ the stored maximums can be reset at any time.

Demand current
■ Display of the demand current on phases $\overline{I1}$, $\overline{I2}$, $\overline{I3}$ and the neutral $\overline{IN}$ (depending on the type of distribution system)
■ Selection of the demand calculation method
■ Display of the interval over which the value is calculated
■ The maximum demand values are displayed and stored in memory
■ The stored maximums can be reset at any time.

Note:
the calculation method, the type of calculation window (fixed or sliding) and its duration may be set in the "Metering setup" menu under "History, maintenance and setup".

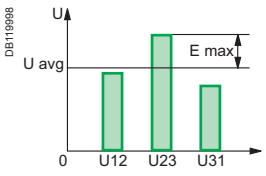
Phase-to-neutral and phase-to-phase voltages
Micrologic H offers different voltage measurements:
■ phase-to-phase voltages (rms) between phases U12, U23 and U31, displayed in volts
■ phase-to-neutral voltages (rms) between the phases and the neutral V1N, V2N and V3N, displayed in volts.

Average voltage
Average Uavg of the instantaneous voltages between phases U12, U23 and U31.

Phase rotation
Displays the phase sequence.

Voltage unbalance
Display of the unbalance Uunbal between the three phase-to-phase voltages, displayed as a percentage.

To display the phase-to-neutral voltages, select the "3Φ 4w 4CT" option in "System type" in the "Metering setup" menu under "History, maintenance and setup".



■ From:
□ U avg is the average value of the rms voltages of the three phases

$$U\ avg = \frac{U12 + U23 + U31}{3}$$

□ E max is the maximum difference between the voltage of each phase and U avg
■ Micrologic H uses the two values above to calculate the voltage unbalance

$$U\ unbal = \left|\frac{E\ max}{U\ avg}\right|$$

Measurements
Power, energy and frequency

For the setting ranges and measurement accuracies, see the technical appendix.

Instantaneous power and power factor
Micrologic H offers a number of different measurements.
- ■ Total power measurements:
  - □ instantaneous active power P in kW
  - □ instantaneous reactive power Q in kvar
  - □ instantaneous apparent power S in kVA
- ■ Measurement of the power factor PF.

Demand power
- ■ Display of the demand values for the active power P, reactive power Q and apparent power S
- ■ Selection of the demand calculation method
- ■ Display of the interval over which the value is calculated
- ■ The maximum demand values are displayed and stored in memory
- ■ The stored maximums can be reset at at any time.

Note:
- ■ *the calculation method, the type of calculation window (fixed or sliding) and its duration may be set in the "Metering setup" menu under "History, maintenance and setup".*
- ■ *the synchronisation function (Synchro.Com) is available only with the COM communication option; with this function, the demand power is determined on the basis of a signal synchronised by the communication module.*
- ■ *these settings apply to all demand powers (active power P, reactive power Q and apparent power S). If the settings are modified, the demand values are systematically recalculated.*

Energy
Micrologic H offers a number of different measurements:
- ■ total energy:
  - □ total active energy E.P in kWh
  - □ total reactive energy E.Q in kvarh
  - □ total apparent energy E.S in kVAh
- ■ energy consumed (Energy in), positively incremented:
  - □ active energy E.P in kWh
  - □ reactive energy E.Q in kvarh
- ■ energy supplied (Energy out), negatively incremented:
  - □ active energy E.P in kWh
  - □ reactive energy E.Q in kvarh
- ■ energy values can be reset.

Note:
- ■ *the Energy in and Energy out values are incremented according to the power sign set in the "Metering setup" menu under "History, maintenance and setup".*
- ■ *as standard, the total calculated energy values are "absolute total values".*

They represent the sum of the energy in and out values:
- □ *EP = Σ EP in + Σ EP out*
- □ *EQ = Σ EQ in + Σ EQ out*
- ■ *as an option (access exclusively via the COM communications option), energy can be calculated algebraically:*
  - □ *EP = Σ EP in - Σ EP out*
  - □ *EQ = Σ EQ in - Σ EQ out*

These values are called "signed" energies.

Frequency
The frequency of the distribution system is displayed in Hz.

Harmonic measurements
Origin and effects

Harmonics represent the most common power problem encountered in today's electrical installations.
When harmonics are present, the current or voltage waveform is distorted, i.e. it is no longer perfectly sinusoidal.

A distorted current or voltage waveform disturbs the distribution of electrical power and power quality is not optimum.

Definition of harmonics

A periodic signal is a combination of:
□ the original sinusoidal signal at the fundamental frequency
□ other sinusoidal signals (the harmonics) with frequencies that are whole-number multiples of the fundamental frequency
□ a DC component, where applicable.
Any periodic signal can therefore be represented as the sum of a number of terms:

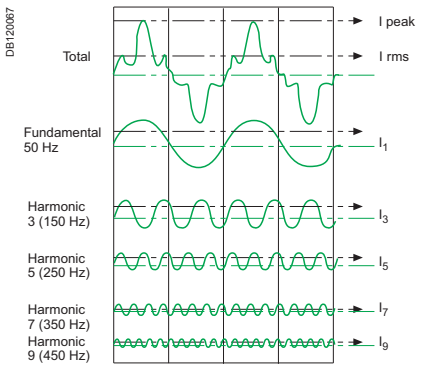
$$y(t) = Yo + \sum_{n=1}^{\infty} Y_n \sqrt{2} \sin(n\omega t - \varphi_n)$$

where:
■ Yo is the value of the DC component (generally equal to zero and considered as such hereinafter)
■ Yn is the rms value of the nth harmonic
■ ω is the angular frequency of the fundamental
■ φn is the phase displacement of the harmonic component at t = 0.

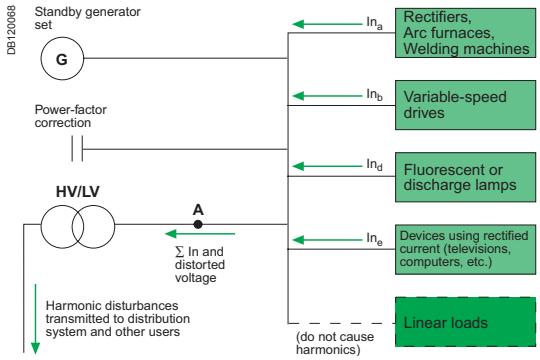
A **harmonic of order n**, referred to as the nth harmonic, is the sinusoidal component of a signal with a frequency that is n times higher than the fundamental frequency.

For example, the current and voltage waveforms distributed on the European electrical power grid have the following characteristics:
■ the fundamental frequency is 50 hertz (Hz)
■ the 2nd harmonic has a frequency of 100 Hz
■ the 3rd harmonic has a frequency of 150 Hz
■ the 4th harmonic has a frequency of 200 Hz
■ …

A distorted waveform is the result of superimposing the various harmonics on the fundamental.
The figure opposite shows a current distorted by harmonics.



Harmonic measurements
Origin and effects



Origin of harmonics

Harmonics are caused by **non-linear loads**.

A load is said to be **non-linear** when the current that it draws does not have the same waveform as the voltage. Typical examples of non-linear loads are those using **power electronics**. Such loads are increasingly numerous and their share in overall electrical consumption is growing.

Examples are:
- industrial equipment including welding machines, arc furnaces, induction furnaces, rectifiers, etc.
- variable speed drives for asynchronous or DC motors
- office equipment including computers, photocopy machines, fax machines, etc.
- household equipment including televisions, microwave ovens, neon lighting, UPSs, etc.

Non-linear phenomena may also be caused by the saturation of transformers and other equipment.

Effects of harmonics

The flow of harmonics in distribution systems can cause serious problems:
- increased currents flowing in the system and overloads
- additional losses and premature ageing of equipment
- disturbances to loads due to voltage harmonics
- disturbances in communication networks.

The above effects can also have major financial impact due to:
- the cost of equipment (premature replacement, oversizing)
- increased power losses and the need to subscribe to higher power levels
- losses in productivity (unnecessary tripping of protection devices).

Harmonic measurements
Origin and effects

What is an acceptable level of harmonics?

The presence of harmonics in a distribution system should be assessed:
- as a preventive measure, to gain information on the system and detect any drift
- as a corrective measure, to diagnose a disturbance or check the effectiveness of a solution.

Harmonic disturbances are subject to a number of standards and regulations:
- compatibility standards designed for public utilities:
  - low voltage: IEC 61000-2-2
  - medium voltage: IEC 61000-2-4
- electromagnetic compatibility (EMC) standards:
  - for loads drawing less than 16 A: IEC 61000-3-2
  - for loads drawing more than 16 A: IEC 61000-3-4
- utility recommendations for installations.

A number of international studies have produced data used to estimate the typical harmonic values encountered in utility distribution systems. Below is a table presenting the levels of harmonics that, in the opinion of many utility companies, should not be exceeded.

Voltage individual harmonics of even and odd orders for:
- low-voltage (LV) systems
- medium-voltage (MV) systems
- extra high voltage (EHV) systems.

Odd harmonics (not multiples of 3)				Odd harmonics (multiples of 3)				Even harmonics			
Order n	LV	MV	EHV	Order n	LV	MV	EHV	Order n	LV	MV	EHV
5	6	6	2	3	5	2.5	1.5	2	2	1.5	1.5
7	5	5	2	9	1.5	1.5	1	4	1	1	1
11	3.5	3.5	1.5	15	0.3	0.3	0,3	6	0.5	0.5	0.5
13	3	3	1.5	21	0.2	0.2	0.2	8	0.5	0.2	0.2
17	2	2	1	>21	0.2	0.2	0.2	10	0.5	0.2	0.2
19	1,5	1.5	1						12	0.2	0.2
23	1.5	1	0.7						>12	0.2	0.2
25	1.5	1	0.7								

Note:
the individual harmonic content of a harmonic of order n is defined as the percentage of its rms value with respect to the rms value of the fundamental. This value is displayed on the graphic screen of the Micrologic H.

Which harmonics are we concerned with?

- Individual harmonics of odd orders at low frequency
- Mainly order 3, 5, 7, 11 and 13.

Harmonic measurements
Quality indicators

Micrologic H control units can quantify and evaluate the harmonic distortion of current and voltage waves using the quality indicators listed below:
- measurement of the fundamental signal
- phase displacement of the fundamental signals
- harmonic distortion THD and thd
- cos φ
- power factor
- K factor
- distortion power
- distortion factor
- crest factor
- amplitude spectrum of even and odd harmonics up to order 31
- displacement spectrum with respect to V1N of even and odd harmonics up to order 31.

These indicators are the indispensable tools used to determine any required corrective action.

Access to quality indicators

The quality indicators may be accessed on the Micrologic H screen and/or via the communication module.

Quality indicator	On the Micrologic H screen	Via the communication module
Measurement of the fundamental	■	■
Phase displacement of the fundamental	-	■
Harmonic distortion THD and thd	■	■
Cos φ	-	■
Power factor	■	■
K factor	-	■
Distortion power	-	■
Distortion factor	-	■
Crest factor	-	■
Amplitude spectrum of odd harmonics up to order 31	■	■
Amplitude spectrum of even harmonics up to order 31	-	■
Displacement spectrum ith respect to V1N of even and odd harmonics up to order 31	-	■

Harmonic measurements
Quality indicators

Fundamental
Micrologic H control units can determine the value of the fundamental signals for:
- ■ currents: I1, I2, I3 and IN (in amperes)
- ■ voltages:
  - □ phase-to-neutral V1N, V2N, V3N (in volts)
  - □ phase-to-phase U12, U23, U31 (in volts)
- ■ power:
  - □ active P (kW)
  - □ reactive Q (kVAR)
  - □ apparent S (kVA).

Current and voltage rms values
■ The rms current is the square root of the sum of the squares of the rms voltage values for each harmonic from the fundamental to an infinite order.

$$I_{rms} = \sqrt{\sum_{n=1}^{\infty} I_n^2}$$

■ The rms voltage is the square root of the sum of the squares of the rms current values for each harmonic from the fundamental to an infinite order.

$$U_{rms} = \sqrt{\sum_{n=1}^{\infty} U_n^2}$$

Total harmonic distortion of current THD(I)
The total harmonic distortion of current is the ratio of the square root of the sum of the squares of the harmonic currents from the 2nd to an infinite order to the **fundamental** current.

$$THD(I) = \frac{\sqrt{\sum_{n=2}^{\infty} I_n^2}}{I_{fund}} \qquad THD(I) = \sqrt{\left(\frac{I_{rms}}{I_{fund}}\right)^2 - 1}$$

Note:
- ■ *Ifund is the fundamental current.*
- ■ *Irms is the rms current.*

Distortion is expressed as a percentage and may exceed 100%.

Defined by standard IEC 61000-2-2, total harmonic distortion THD(I) is a single value that expresses the distortion of the current flowing at a given point in a distribution system.

■ Micrologic H control units measure the THD for currents I1, I2, I3 and IN (in amperes), taking into account harmonic orders up to 31.

■ The total harmonic distortion of current characterises the distortion of the current waveform.

■ Loads causing distortion are identified by measuring the THD(I) on the incoming and outgoing circuits.

■ THD(I) values measured and the corresponding phenomena in an installation.
□ THD(I) under 10% is considered normal. There is no particular risk of malfunctions.
□ THD(I) between 10 and 50% signals a significant level of harmonic disturbance. There is a risk of temperature rise, which means that cables and sources must be oversized.
□ THD(I) greater than 50% signals major harmonic distortion. Malfunctions are probable. An in-depth analysis and the installation of compensation equipment is required.

Harmonic measurements
Quality indicators

Total harmonic distortion of voltage THD(U)

The total harmonic distortion of voltage is the ratio of the square root of the sum of the squares of the harmonic voltages from the 2nd to an infinite order to the **fundamental** voltage.

$$THD(U) = \frac{\sqrt{\sum_{n=2}^{\infty} U_n^2}}{U_{fund}}$$

Note:
Ufund is the fundamental voltage.

Distortion is expressed as a percentage and may exceed 100 %.

Defined by standard IEC 61000-2-2, total harmonic distortion THD(U) is a single value that expresses the distortion of the voltage at a given point in a distribution system.

■ Micrologic H control units measure the THD for:
□ phase-to-neutral voltages V1N, V2N, V3N (in volts)
□ phase-to-phase voltages U12, U23, U31 (in volts)
taking into account harmonic orders up to 31.

■ Total harmonic distortion of voltage characterises the distortion of the voltage waveform.

■ THD(U) values measured and the corresponding phenomena in an installation:
□ THD(U) under 5 % is considered normal.
There is no particular risk of malfunctions.
□ THD(U) between 5 and 8 % signals a significant level of harmonic disturbance. Malfunctions may occur.
□ THD(U) greater than 8 % signals major harmonic distortion. Malfunctions are probable. An in-depth analysis and the installation of compensation equipment is required.

Harmonic measurements
Quality indicators

Total harmonic distortion of current thd(I)

The total harmonic distortion of current is the ratio of the square root of the sum of the squares of the harmonic currents from the 2nd to an infinite order to the **rms** current.

$$thd(I) = \frac{\sqrt{\sum_{n=2}^{\infty} I_n^2}}{Irms}$$

Note:
Irms is the rms current.

■ Micrologic H control units measure the thd(I) for currents I1, I2, I3 and IN, taking into account harmonic orders up to 31.
Defined by standard IEC 61000-2-2, total harmonic distortion thd(I) is a single value that expresses the distortion of the current flowing at a given point in a distribution system.

Total harmonic distortion of voltage thd(U)

The total harmonic distortion of voltage is the ratio of the square root of the sum of the squares of the harmonic voltages from the 2nd to an infinite order to the **rms** voltage.

$$thd(U) = \frac{\sqrt{\sum_{n=2}^{\infty} U_n^2}}{Urms}$$

Note:
Urms is the rms voltage.

■ Micrologic H control units measure the thd(U) for:
□ phase-to-neutral voltages V1N, V2N, V3N (in volts)
□ phase-to-phase voltages U12, U23, U31 (in volts) taking into account harmonic orders up to H31.

Harmonic measurements
Quality indicators

Cos φ
Cos φ is the ratio between the active power Pfund and the apparent power Sfund of the fundamental (1).

$$\cos \varphi = \frac{Pfund}{Sfund}$$

Note:
- *Pfund is the active power of the fundamental.*
- *Sfund is the apparent power of the fundamental.*

Cos φ pertains exclusively to the fundamental frequency. Consequently, if there are harmonics, the value of the cos φ is not the same as that of the power factor.

Power factor PF
The power factor is the ratio between the active power P and the apparent power S.

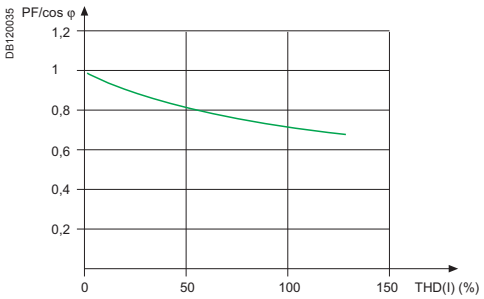
$$PF = \frac{P}{S}$$

Note:
- *P is the active power.*
- *S is the apparent power.*
- *the power factor must not be confused with the cos φ. The power factor is equal to the cos φ only when the signal is perfectly sinusoidal (no harmonics).*

- If the measured power factor is not equal to the cos φ (the power factor is lower), that may be an initial indication of harmonic disturbances in an installation.
- The power factor PF is the means to evaluate the oversizing required for the power sources in an installation.
- There is a relation between the power factor and the total harmonic distortion of current THD(I). When the voltage signal is (virtually) sinusoidal, the power factor may be roughly calculated using the equation below:

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

When plotted, the above equation produces the graph below showing the PF to cos φ ratio, depending on the THD(I)



Harmonic measurements
Quality indicators

K factor
The K factor is a quality indicator that indicates high-order harmonics.

$$K\ factor = \frac{\sqrt{\sum_{n=2}^{\infty} n^2 I_n^2}}{I_{rms}}$$

Note:
I is the amplitude of the current.

The K factor is used to:
- calculate temperature rise in the busbars
- size the transformers for non-linear loads.

Distortion power
When there are harmonics, the relation $S^2 = P^2 + Q^2$ is no longer valid.
The distortion power D is defined by the equation below:

$$D = \sqrt{S^2 - P^2 - Q^2}$$

Distortion factor
The distortion factor is the relation between the power factor and the cos φ.

Crest factor
The crest factor is the relation between the peak value of the current or voltage and the corresponding rms value.

$$Crest\ factor = \frac{I_{peak}}{I_{rms}} \text{ or crest factor } = \frac{U_{peak}}{U_{rms}}$$

Note:
- *Irms is the rms current.*
- *Urms is the rms voltage.*

- Possible values:
  - for a sinusoidal signal, the crest factor is equal to $\sqrt{2}$
  - for a non-sinusoidal signal, the crest factor may be less than or greater than $\sqrt{2}$.
- The crest factor is used to characterise the capacity of a source (UPS or generator) to supply high instantaneous currents. In particular, it draws attention to the presence of exceptional peak values with respect to the rms value.
Computer equipment, for example, draws highly distorted current with a crest factor that can reach 3 or even 5.
- Typical crest factors for the currents drawn by non-linear loads are much higher than $\sqrt{2}$. They are often equal to 1.5 or 2 and can reach 5 in critical cases.
- A very high crest factor means that there can be high temporary overcurrents, which, when detected by the protective devices, may result in nuisance tripping.

Harmonic measurements
Quality indicators

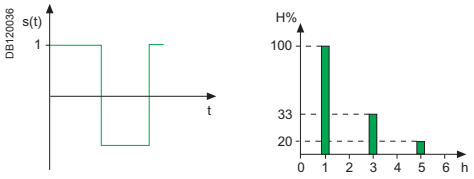
The communication module can be used to determine for each harmonic order up to 31:
- the amplitude spectrum
- the displacement spectrum with respect to the phase-to-neutral voltage V1N.

FFT amplitude spectrum of odd harmonic orders from 3 up to 31

Each type of distorting device has its own harmonic-current "fingerprint", with different amplitudes and displacements.
These values, in particular the amplitude for each harmonic order, are essential for the analysis of power quality.

■ FFT (Fast Fourier Transform) frequency spectrum

The Micrologic H control unit can display the FFT amplitude spectrum of odd harmonics from the 3rd up to 31st.
The Micrologic H control unit presents the amplitude of each harmonic order with respect to its frequency in the form of a histogram, called a spectral analysis.



Above is an example of the spectral analysis of a square-wave signal.

■ Harmonic content of the nth harmonic for the phases I1, I2, I3

The individual harmonic content of a harmonic of order n is defined as the percentage of its rms value with respect to the rms value of the fundamental:

$$i_n\,(\%) = 100\,\frac{I_n}{I_{fund}} \quad \text{or} \quad u_n\,(\%) = 100\,\frac{U_n}{U_{fund}}$$

Note :
- I_{fund} *is the fundamental current.*
- U_{fund} *is the fundamental voltage*

■ Harmonic content of the nth harmonic for neutral current.

The individual harmonic content of a harmonic of order n is defined as the percentage of its rms value with respect to the rms value of the Neutral:

$$i_n\,(\%) = 100\,\frac{I_n}{I_{N\,rms}} \quad \text{or} \quad u_n\,(\%) = 100\,\frac{U_n}{U_{N\,rms}}$$

Note:
- $I_{N\,rms}$ *is the Neutral rms current.*
- $U_{N\,rms}$ *is the Neutral rms voltage.*

■ The Micrologic H control unit indicates the FFT amplitude spectrum and the individual distortion level for harmonic orders from 3 to 31 for:
- □ each current I1, I2, I3 and IN
- □ each phase-to-phase voltage U12, U23 and U31.

■ The Micrologic H control unit also indicates for each current or voltage the corresponding level of total harmonic distortion THD (thd for Neutral current).

Harmonic measurements
Waveform and waveform capture

The communication module may be used to:
- set up "Measurement" or "Protection" alarms
- capture and analyse waveforms; capture may be tripped by the alarms
- captured waveforms are recorded over 4 cycles (resolution of 64 points per cycle).

Micrologic H control units can capture and store current and voltage waveforms using digital sampling techniques similar to those used in oscilloscopes.

Waveform capture is the means to detect weak points in the system and the equipment. Using the information available in the captured waveform, it is possible to determine the level of harmonics as well as the direction and amplitude of the flow of harmonic power.

- Users of Micrologic H control units can record manually via the keypad the following waveforms:
  - the four currents I1, I2, I3 and IN
  - the three phase-to-neutral voltages V1N, V2N and V3N.

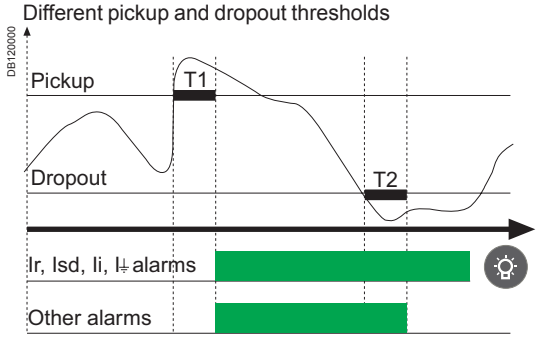
- Waveforms may be displayed on the graphic screen of Micrologic H control units. The recording takes place over one cycle with a measurement range of 0 to 1.5 In for current and 0 to 690 volts for voltage. The resolution is 64 points per cycle.

Alarms

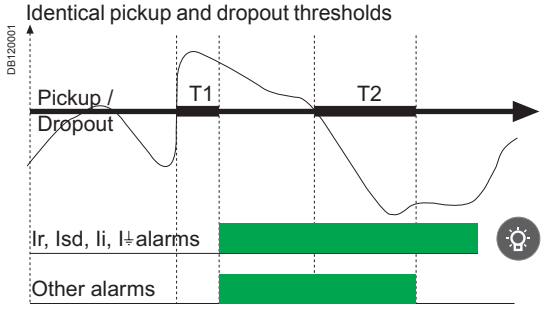
For information on the communications option and the portable test kit, see the respective user guides.

■ An alarm may be viewed using:
□ the "Alarm history" menu
□ the COM communications option
□ the portable test kit.
■ The commands in the "Protection" menu are used to attribute a specific operating mode to each of the protection functions:
□ OFF: protection disabled
□ Alarm: the function issues an alarm, but does not trip the circuit breaker
□ Trip + Alarm: the function issues an alarm and trips the circuit breaker.
■ The protection functions against overloads (long time), short circuits (short time and instantaneous) and ground faults (ground-fault and earth-leakage currents) automatically result in tripping and cannot be deactivated (Trip mode only).
■ The "I ⏚ Alarm" and phase rotation alarms can be set exclusively to OFF or Alarm mode.
■ The other protection functions for current, voltage, power and frequency may be set to any of the three modes, OFF, Alarm or Trip + Alarm.
■ The load shedding and reconnection function may be set to ON or OFF.
■ The resettable alarms linked to device tripping are activated when the Ir, Isd/Ii or I ⏚ thresholds are overrun.
The Ir alarm is reset one second after tripping. The Isd/Ii and ⏚ alarms are reset by pressing the button.

Different pickup and dropout thresholds



Identical pickup and dropout thresholds



Current protection	Off	Alarm	Trip + Alarm
Ir			■
Isd / Ii			■
I ⏚			■

■ Delayed alarms are activated when the pickup and dropout thresholds are overrun and the corresponding time delays have expired.

Current protection	Off	Alarm	Trip + Alarm
I ⏚ Alarm	■	■	
I unbal	■	■	■
$\overline{I1}$ max	■	■	■
$\overline{I2}$ max	■	■	■
$\overline{I3}$ max	■	■	■
$\overline{IN}$ max	■	■	■
Voltage protection	**Off**	**Alarm**	**Trip + Alarm**
U min	■	■	■
U max	■	■	■
U unbal	■	■	■
Other protection	**Off**	**Alarm**	**Trip + Alarm**
rP max	■	■	■
F min	■	■	■
F max	■	■	■
Phase rotation	■	■	
Shedding/reconnection	**Off**	**On**	
Current I	■	■	
Power P	■	■	

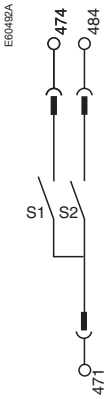
■ History logging
□ Alarm mode: as soon as a given protection threshold is overrun, an alarm is recorded in the "Alarm history"
□ Trip mode: as soon as a given protection threshold is overrun, the circuit breaker trips and the fault is recorded in the "Trip history".
■ The "Protection setup" menu under "History, maintenance and setup" is used to enable or disable the Trip mode that is displayed in the protection-setting screens. On leaving the factory, the protection functions are set to Alarm mode.
■ The "M2C / M6C contacts" menu under "History, maintenance and setup" is used to link an M2C or M6C contact to an alarm. M2C and M6C contacts may not be used together. They require a 24 V external power supply.
■ The COM communications module can be used to transmit alarms to a supervisor.

Optional M2C and M6C contacts

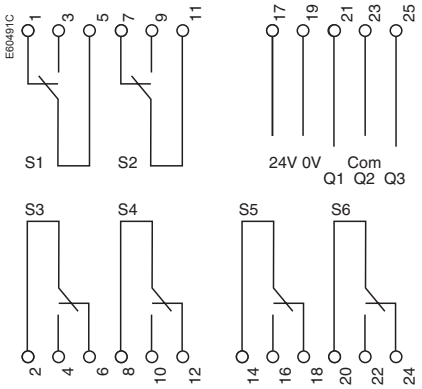
An alarm is issued if the Alarm or the Trip + Alarm mode was set for the given protection function.

Caution!
The M2C and M6C contacts require an auxiliary power supply. See the "Power supply" section in the technical appendix.

Wiring diagram for M2C contacts.



Wiring diagram for M6C contacts



■ Available types of contacts:
□ M2C: up to two contacts maximum, S1 and S2
□ M6C: up to six contacts maximum, S1 to S6.

■ Current protection:
□ Ir
□ Isd
□ Ii
□ I ⏚
□ I ⏚ Alarm
□ I unbal
□ $\overline{I1}$ max
□ $\overline{I2}$ max
□ $\overline{I3}$ max
□ $\overline{IN}$ max.

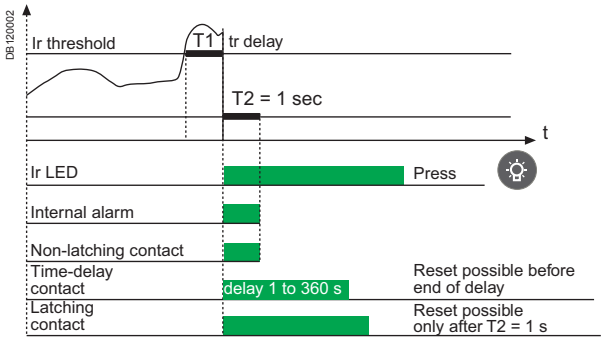
■ Voltage protection:
□ U min
□ U max
□ U unbal.

■ Other protection:
□ F min
□ F max
□ rP max
□ phase rotation.

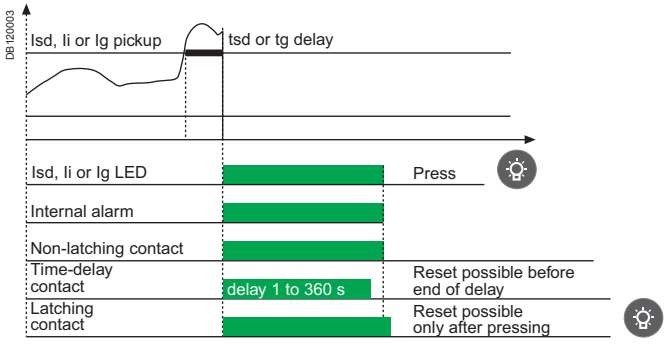
■ Load shedding and reconnection:
□ current I
□ power P.

■ Latching settings:
□ non-latching contact: the contact remains activated as long as the fault that caused the alarm has not been cleared
□ latching contact: the contact remains activated until it is reset ("Reset menu")
□ time-delay contact: the contact remains activated for the duration of an adjustable time delay or until it is reset ("Reset menu").
□ locked to 1: the contact is forced to 1 for an automation test
□ locked to 0: the contact is forced to 0 for an automation test.

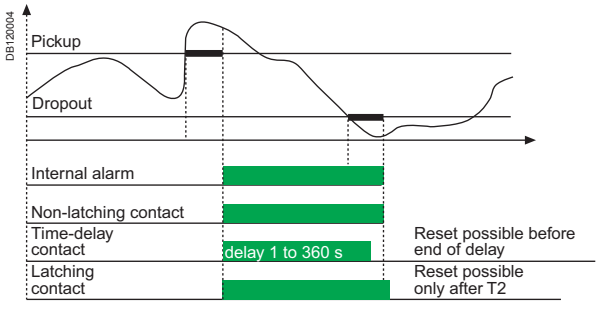
■ Contact operating diagram for long-time protection



■ Contact operating diagram for short-time, instantaneous and ground-fault protection



■ Contact operating diagram for the other protection functions



Event histories

The interrupted currents are indicated in terms of their peak values.

Trip history

■ The trip history is the means to display at any time the parameters measured during the last ten trips.
■ For each trip, the following parameters are recorded:
□ tripping cause
□ trip threshold
□ interrupted currents in amperes (only if an external power supply is present) for Ir, Isd/Ii, Ig or IΔn trips
□ date
□ time (hours, minutes and seconds).

Alarm history

■ The alarm history is the means to display at any time the parameters measured during the last ten alarms.
■ For each alarm, the following parameters are recorded:
□ alarm cause
□ alarm threshold
□ date
□ time (hours, minutes and seconds).

Operation counter

This function is available only via the COM communications option.
■ Micrologic H:
□ stores and displays the total number of operations (incremented each time the circuit breaker opens) since the initial installation of the circuit breaker
□ stores and displays the total number of operations since the last reset.

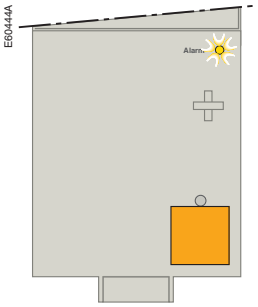
Contact wear indication

This function can be used to:
■ Determine the condition of the most worn contact in the circuit breaker. A counter is displayed on the screen. The contacts must be inspected each time the counter reaches a hundred mark. The message "Not available or circuit breaker type not defined" is displayed if the type of circuit breaker has not been defined. In this case, see "Breaker selection" in the "Micrologic setup" menu under "History, maintenance and setup".
■ Reset the indicator after changing the main contacts. Reset is also carried out via "Breaker selection" in the "Micrologic setup" menu.

Note:
if the control unit is changed, the circuit breaker must be defined again. In this case, see "Breaker selection" in the "Micrologic setup" menu under "History, maintenance and setup".

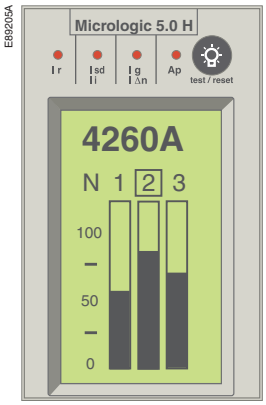
LEDs and display screens

LED indicator



Signals overrun of the long-time current setting (1.125 x Ir).

Overload bargraph on the main screen



Signals the load level on each phase as a percentage of Ir.

The procedure required to reclose the circuit-breaker following a fault trip is presented in the circuit-breaker user guide.

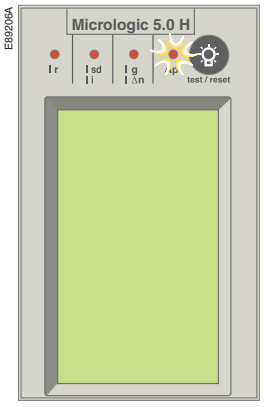
Concerning the presence or absence of an external power supply, see the "Power supply" section in the technical appendix.

Caution!
The battery maintains the trip indications.
If no indications are displayed, check the battery.

Fault-trip indications

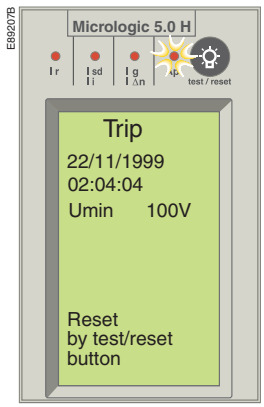
■ Control-unit status
The circuit breaker has tripped.
The control unit may or may not have an external power supply.
The voltage measurement inputs may be connected upstream or downstream.

□ control unit without an external power supply and with voltage measurement input connected downstream



A LED signals the type of fault (Ir, Isd, Ii, Ig, IΔn or Ap).

□ control unit with an external power supply and with voltage measurement input connected upstream

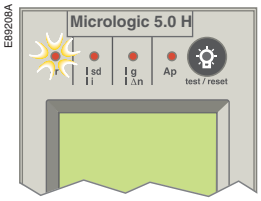


The type of fault is signalled by a LED and on the graphic display.

LEDs and display screens

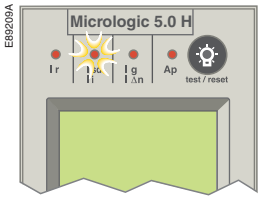
■ Fault-trip LEDs
■ The LEDs indicate the type of fault that tripped the circuit breaker
■ The LEDs are located in the upper part of the front panel (red Ir, Isd, Ii, Ig, I^2n and Ap LEDs)
■ When activated, a LED remains ON until it is locally reset.

■ Ir LED



Signals tripping following overrun of the long-time current setting Ir.

■ Isd, Ii LED

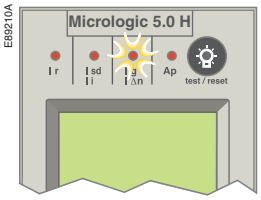


Signals tripping following overrun of the short-time pickup Isd or the instantaneous pickup Ii.

The self-protection function (excessive temperature, fault detected in ASIC power supply or instantaneous self-protection built into the device) trips the circuit breaker and turns the Ap LED on.

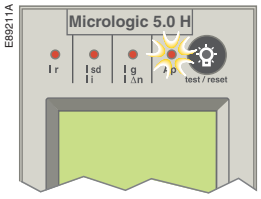
A number of simultaneous causes may result in tripping. For example, a short-circuit and a distribution-system voltage under a set value.
The LED signalling the last fault chronologically is the only one to remain ON. E.g., the Ap LED may signal a voltage drop under a set value where the voltage drop was caused by a short-circuit.

■ Ig, IΔn LED



Signals tripping following overrun of the ground-fault pickup Ig or the earth-leakage pickup IΔn.

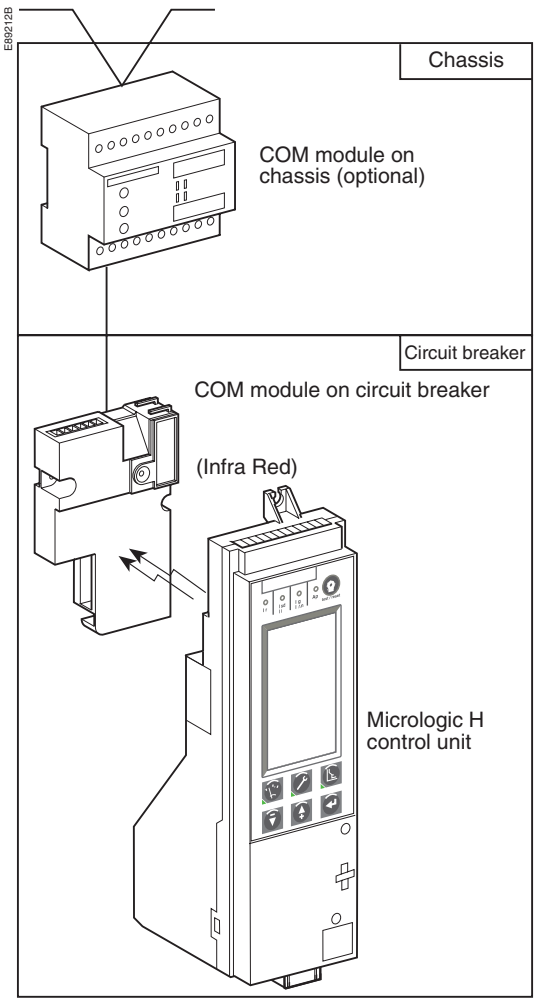
■ Ap LED



Signals tripping due to:
■ self-protection function:
□ temperature
□ ASIC power supply
□ instantaneous pickup for circuit-breaker self protection
■ protection functions:
□ current unbalance I unbal
□ maximum current $\overline{I1}$ max, $\overline{I2}$ max, $\overline{I3}$ max, $\overline{IN}$ max;
□ voltage unbalance U unbal
□ maximum voltage U max
□ minimum voltage U min
□ reverse power rP max
□ maximum frequency F max
□ minimum frequency F min.

■ LEDs on buttons to access the menus
The activated LED indicates the menu for which the screen is displayed:
□ "Metering"
□ "History, maintenance and setup"
□ "Protection".

COM communications option



Communication options

Digipact and ModBus are the indispensable elements when integrating Micrologic H in the Digivision and SMS Powerlogic installation-management systems which communicate via the BatiBus and ModBus protocols.
External gateways are available for communication over other networks, including ProfiBus, Ethernet, etc.

The communications option makes possible the following remote functions:
- ■ device identification:
  - □ address
  - □ device type
  - □ control-unit type
  - □ type of long-time rating plug

- ■ settings:
  - □ reading of the dial settings
  - □ fine adjustments within the range determined by the dial
  - □ protection and alarm settings
  - □ setup of the M2C / M6C contacts.

Operating and maintenance aids

- ■ Protection and alarm values:
  - □ standard
  - □ set.

- ■ Measurement values:
  - □ currents
  - □ voltages, frequencies, power, etc.

- ■ Fault values:
  - □ fault type
  - □ interrupted current.

- ■ Histories and logs:
  - □ trip history
  - □ alarm history
  - □ event history.

- ■ Indicators:
  - □ contact wear, counters, etc.
  - □ maintenance register.

Setting up the optional M2C / M6C contacts

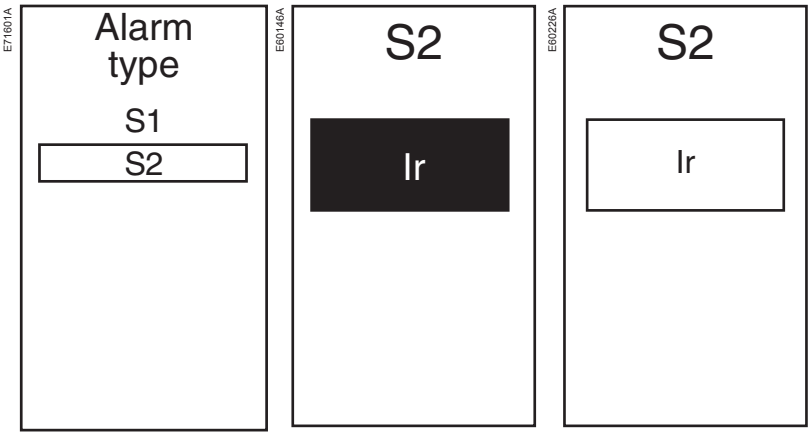
Select the command

Contacts M2C / M6C

Alarm type

Select an alarm

Note:
an alarm may be selected if the "Alarm" or "Trip + Alarm" mode was selected during setup of the given protection function, in the "Protection" menu.



then
Select a contact.

then
Select an alarm.

Confirm.

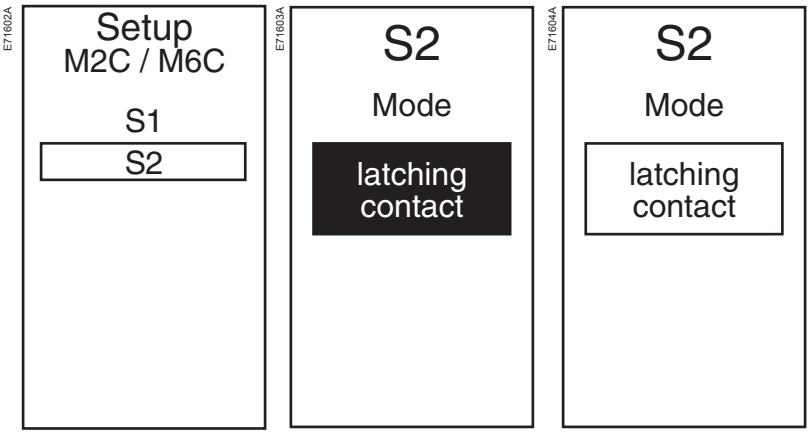
Select the command

Contacts M2C / M6C

Setup

Set up each contact

- Select the latching mode



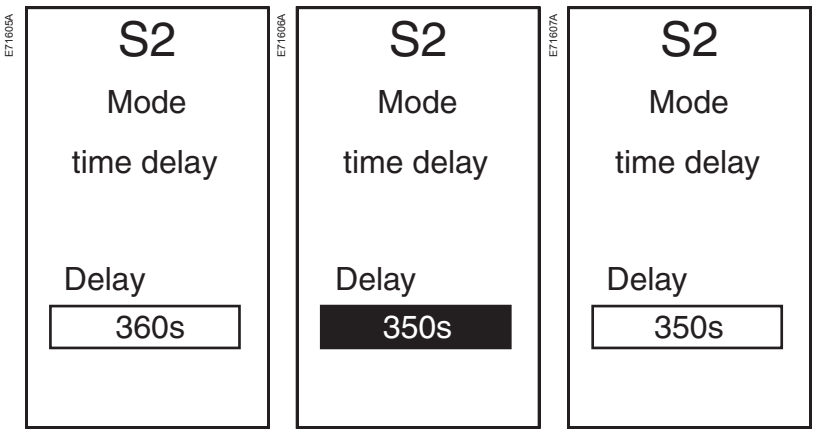
then
Select a contact.

then
Select a latching mode:
- non-latching
- latching
- time-delay
- locked to 1
- locked to 0.

Confirm.

Setting up the optional M2C / M6C contacts

■ Set the time delay for time-delay latching



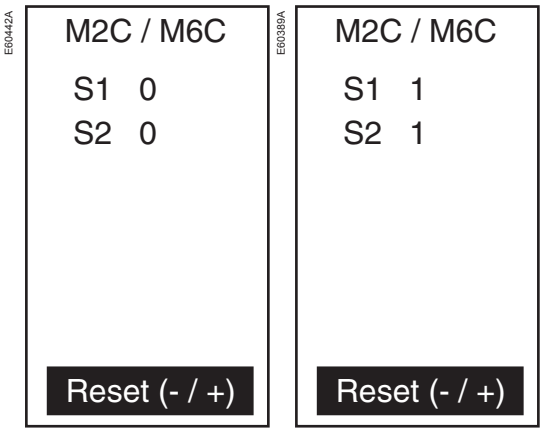
Select the time delay. then Adjust. Confirm.

Select the command

M2C / M6C Contacts

Reset

Reset the contacts to 0



Reset the contacts to 0… then or cancel the reset, then confirm.

Setting up the Micrologic control unit

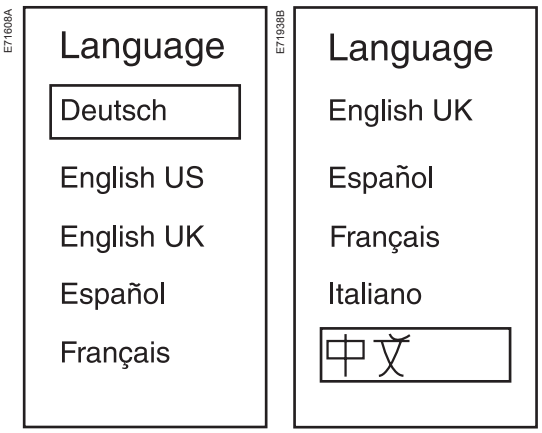
Prior to setting up the protection functions or carrying out measurements, the following operations are required:
- selection of the display language
- entry of the date and time
- entry of the circuit-breaker type
- entry the power sign
- selection of the transformation ratio between the primary and secondary windings if an auxiliary voltage transformer is installed
- entry of the rated frequency.

Select the command

Micrologic setup

Language

Select the display language



Select.

Confirm.

To return to English

1. Return to the main screen by pressing any of the three buttons

or press the button

followed by any of the three buttons

2. Select the "History, maintenance and setup" menu by pressing

3. Select the "Micrologic setup" menu by moving the cursor up on the first menu. Move the cursor down on the third menu and confirm by pressing

4. Select the "Language" menu by moving the cursor up on the first menu.
Confirm by pressing

Select the command

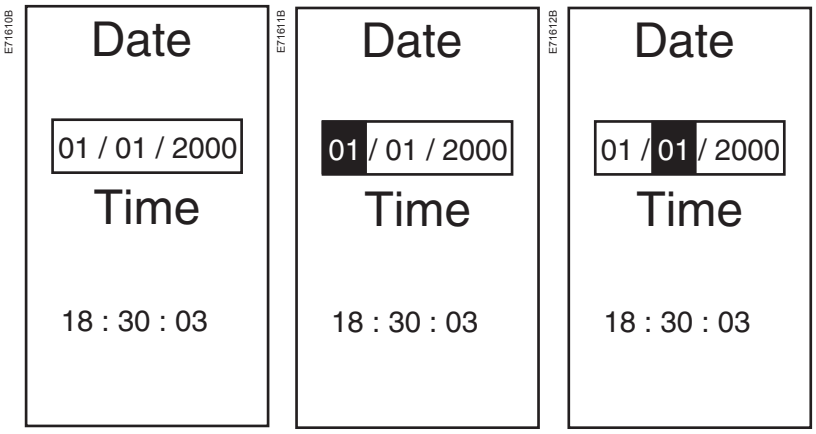
Micrologic setup

Date / time

If the time is set via a communications module, any previous manual setting is automatically erased.

Set the date and time

- Enter the date and time for time-stamping purposes in the trip and alarm histories.



then
Select the date.

then
Enter the day.

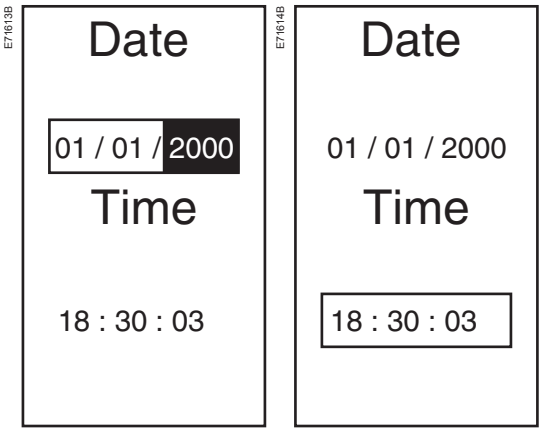
then
Enter the month.

- The resolution of the time setting is 20 ms.

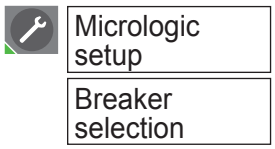
Setting up the Micrologic control unit

Date and time are backed up by battery.

If time is not synchronised by the supervisor via the communication module, a drift of up to one hour per year may be observed.



Select the command



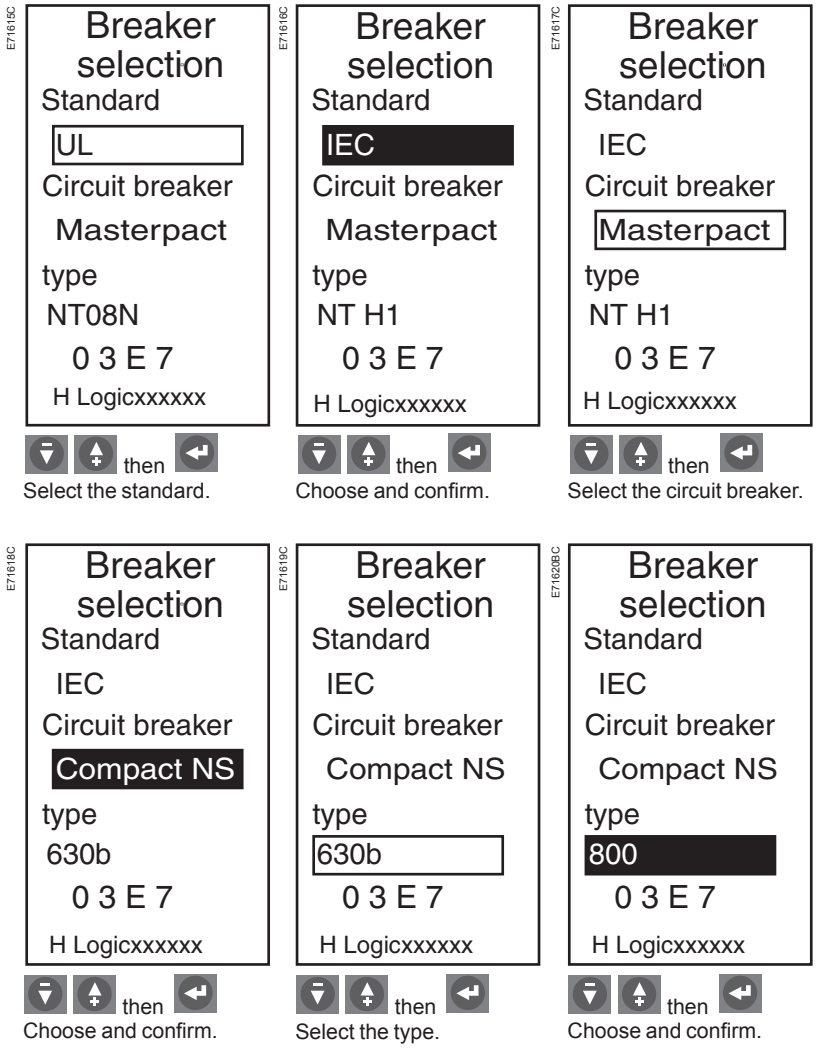
The circuit-breaker code is required to identify the device and activate the contact-wear counter.

Note this code if the control unit must be changed (example 03E7).

Enter this code when setting up a new control unit on the circuit breaker.
For a new device, the code is set to zero.

When the main circuit-breaker contacts are replaced, this code must be reset to zero.

Circuit-breaker selection



Setting up the Micrologic control unit

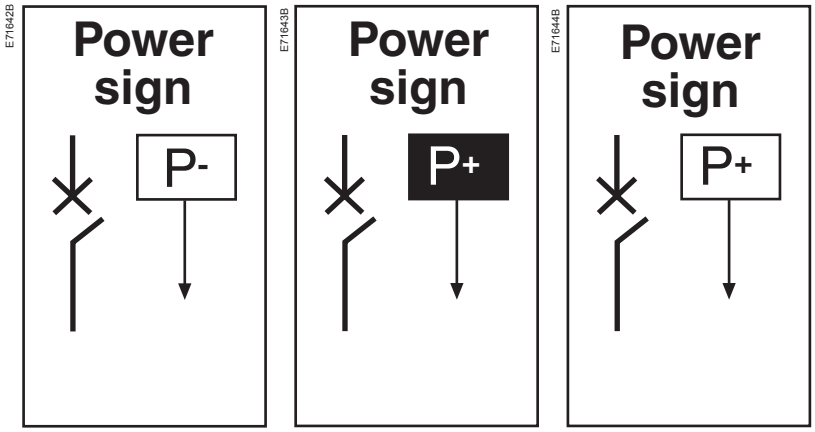
Select the command

Micrologic setup

Power sign

By default, Micrologic H uses P+ for the power flowing from top to bottom terminals. The selected direction of flow is valid for:
- measurement of power and the power factor
- measurement of energy
- load shedding and reconnection depending on power.

Select the sign of the power



Select. Choose. Confirm.

Select the command

Micrologic setup

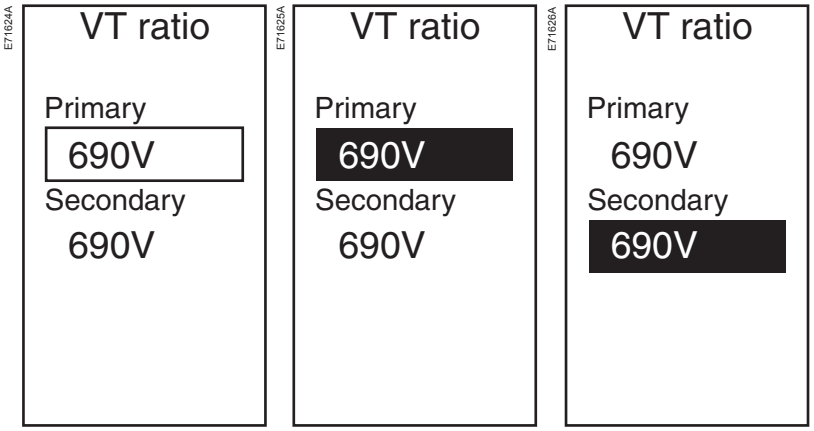
VT ratio

If the supply voltage for the control unit exceeds 690 V, an external voltage transformer must be installed.

To display the true voltage values, enter the transformation ratio between the primary and secondary voltages of the transformer.

Note that if Digipact display modules are used, the rated distribution-system voltage must be entered.

Enter the voltage-transformation ratio



then then

Select either the:
- primary voltage
- secondary voltage.

Enter the voltage.

Go on to the next setting.

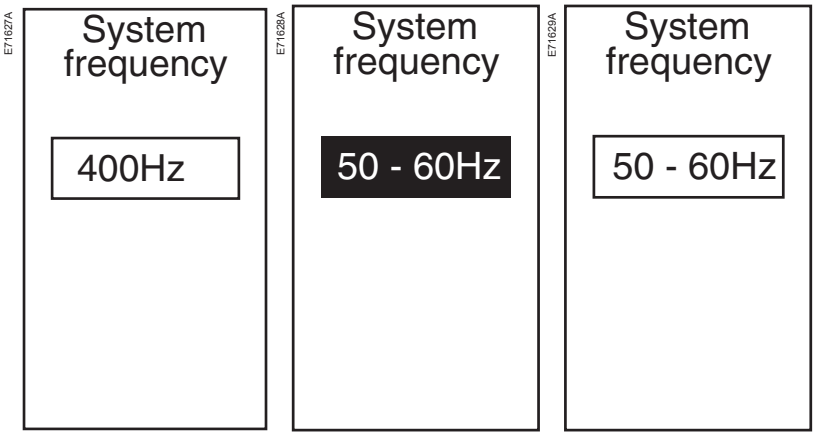
Select the command

Micrologic setup

System frequency

If the phase-rotation protection function is activated, the 400 Hz frequency may not be selected. If the 400 Hz frequency is selected, the phase-rotation protection function is disabled.

Enter the rated frequency



Select. Choose. Confirm.

Setting up the metering functions

Prior to setting up the protection functions or carrying out measurements, the following operations are required:
- entry of the system type
- selection of the calculation mode for the demand current
- selection of the calculation mode for the demand power
- select the power sign
- select the sign convention for the power factor measurement.

Select the system type

Select the command

Metering setup

System type

The Micrologic H control unit offers three measurement options:
- 3 phases, 3 wires, 3 CTs (method using two wattmeters)

The currents on phases I1, I2 and I3 are displayed.
The current on the neutral IN is not displayed.
The phase-to-phase voltages U12, U23 and U31 are displayed.
The phase-to-neutral voltages V1N, V2N and V3N are not displayed.
- 3 phases, 4 wires, 3 CTs (method using three wattmeters)

The currents on phases I1, I2 and I3 are displayed.
The current on the neutral IN is not displayed.
The phase-to-phase voltages U12, U23 and U31 are displayed.
The phase-to-neutral voltages V1N, V2N and V3N are displayed.
- 3 phases, 4 wires, 4 CTs (method using three wattmeters)

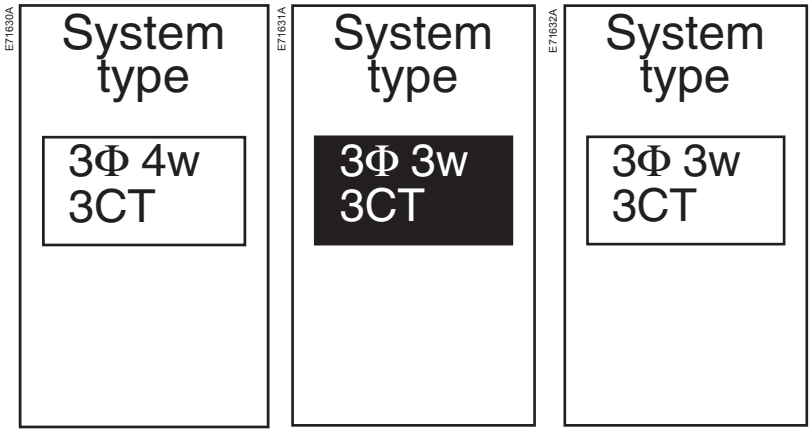
The currents on phases I1, I2 and I3 are displayed.
The current on the neutral IN is displayed.
The phase-to-phase voltages U12, U23 and U31 are displayed.
The phase-to-neutral voltages V1N, V2N and V3N are displayed.

Caution!
The neutral current IN cannot be measured with the "3-phase, 3-wire, 3-CT" and "3-phase, 4-wire, 3-CT" types.

For a 3-pole device, the neutral, if distributed, must be connected to terminal VN of the Micrologic H control unit.

See the "Overview of functions" section for information on the available types of measurements.

Note:
it is advised not to use the "3-phase, 4-wire, 4-CT" type of measurement unless the neutral is effectively connected to the control unit (four-pole circuit breaker with an external voltage-measurement input).



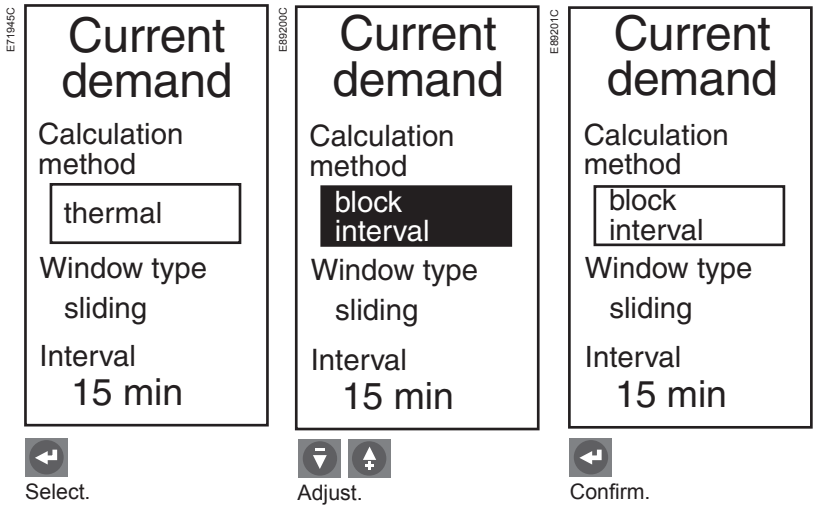
Select the calculation method for demand current

Select the command

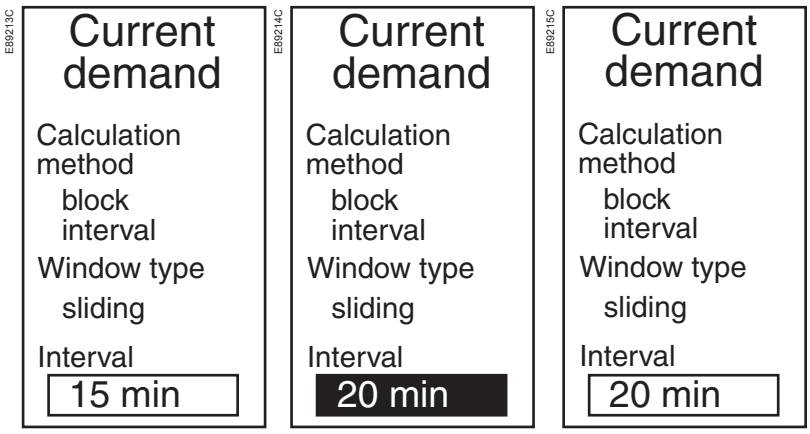
Metering setup

Current demand

Thermal method based in I^2t calculation.



Setting up the metering functions



Select. Adjust. Confirm.

Select the command

Metering setup

Power demand

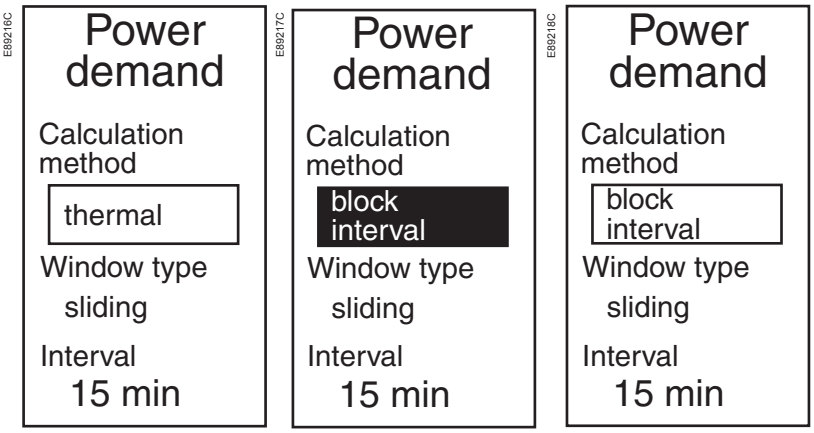
The synchronisation function "Synchro.Com" is available only with the COM communication option. With this function, the demand power is determined on the basis of a signal synchronised by the communication module.

Thermal method based on I^2t calculation.

Sliding window:
power demand is refreshed every 15 secondes.

Fixed window:
power demand is refreshed at the end of the time interval.

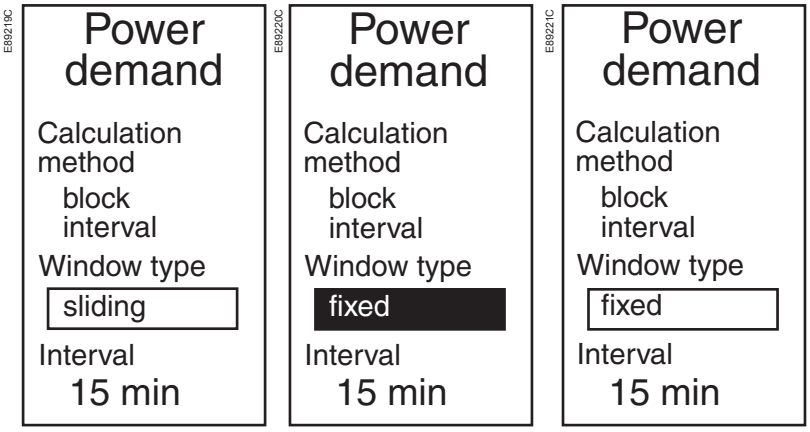
Select the calculation method for demand power



Select.

Choose between:
- thermal
- block interval
- sync. to comms

Confirm.

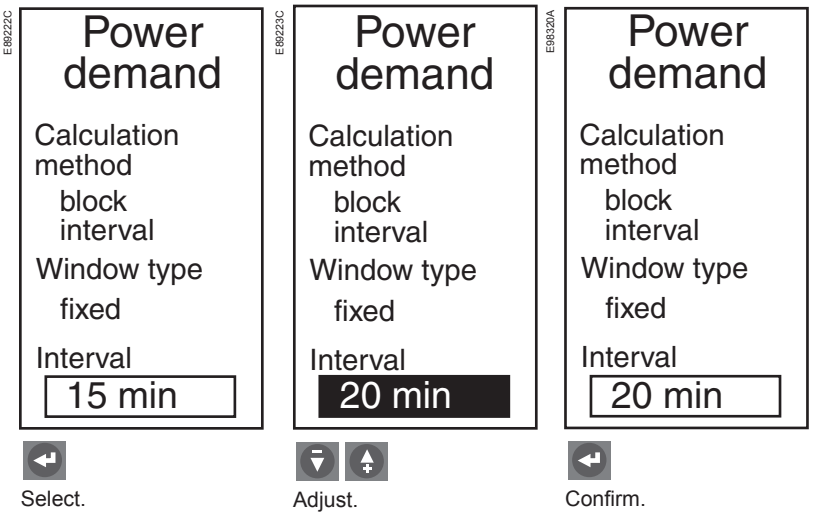


Select.

Choose between fixed or sliding.

Confirm.

Setting up the metering functions



Select. Adjust. Confirm.

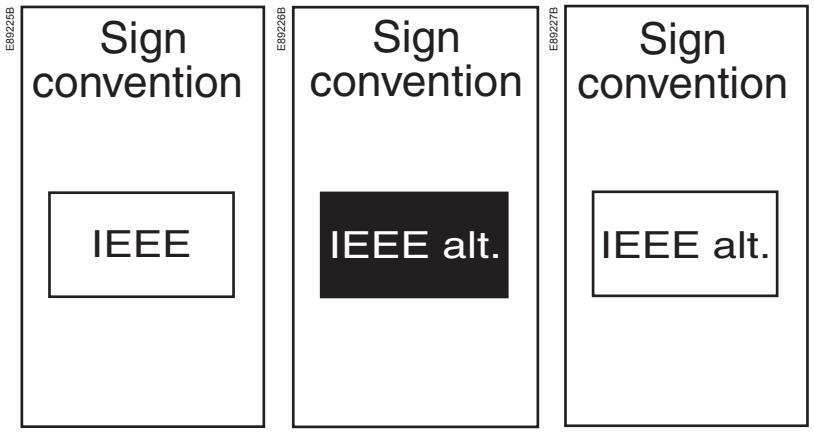
Select the command

Metering setup

Sign convention

See page 106 for the description of power factor sign conventions.

Set up the power-factor calculation



Select. Choose between IEEE, IEEE alternate and IEC. Confirm.

Setting up the COM communications option

Select the command

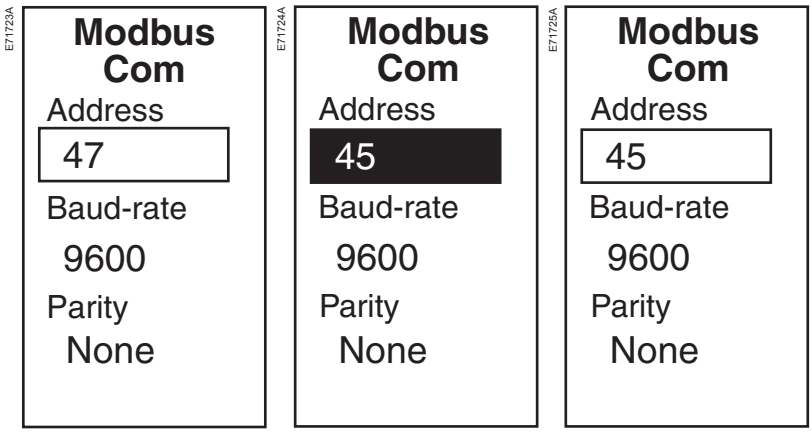
Com. setup

Com. parameter

As soon as the Digipact or Modbus communications option is connected, the control unit recognises it and displays the type of module on the graphic screen. Automatic time updates are possible only with the Modbus system.

When a COM communications option is used, it is necessary to:
- set up the COM communications option
- authorise remote setting of the Micrologic control unit
- authorise remote control of the circuit breaker.

View and set up the communications option



then
Select an existing parameter.

Adjust.

Confirm.

Adjust all the other parameters for the communications option in the same manner.

	DIGIPACT (read only)	MODBUS (read and set up)
Address	1 - 255	1 - 47
Baud rate		9600 bauds 19200 bauds
Parity		Even None

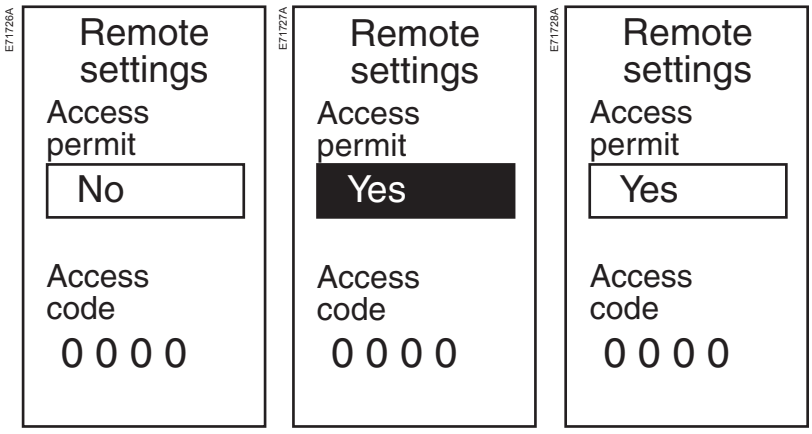
Select the command

Com. setup

Remote settings

The access code is a password that must be provided by the supervisor prior to accessing the Micrologic settings.

Authorise remote setup of Micrologic



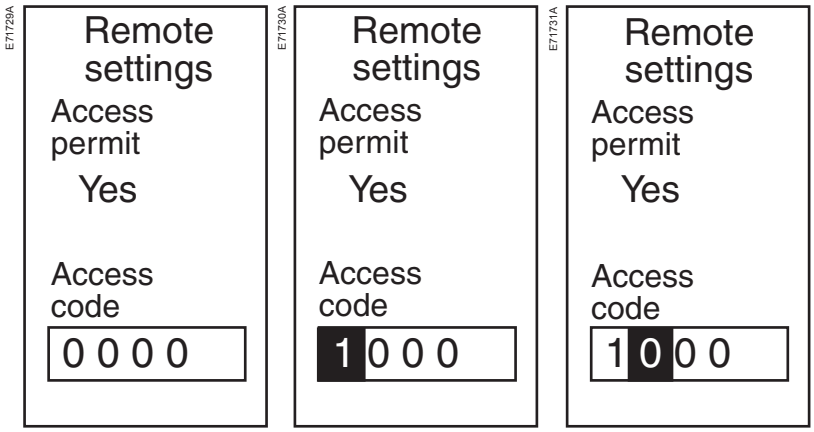
then
Select existing setting.

Choose.

Confirm.

Setting up the COM communications option

If the operator does not enter a specific access code, the default access code is 0000 and is requested by the supervisor.

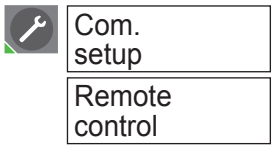


Select the existing access code setting.

Enter the first digit.

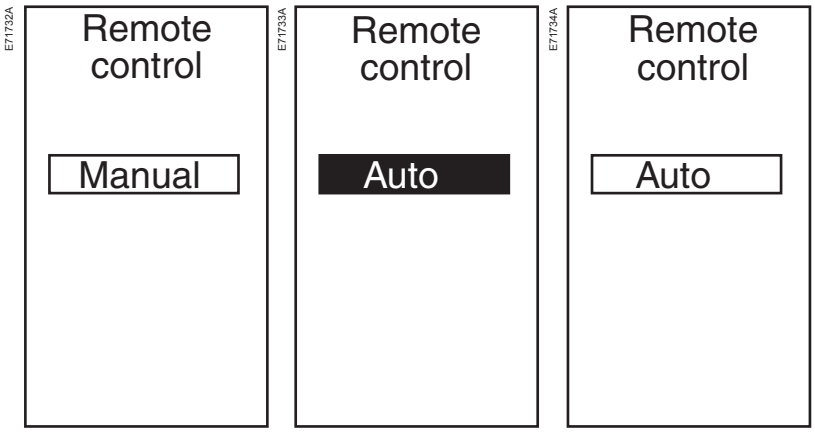
Confirm and proceed in the same manner for the other digits.

Select the command



It is possible to set circuit-breaker control to local only ("Manual") or to local and remote ("Auto").

Authorise remote control of the circuit breaker



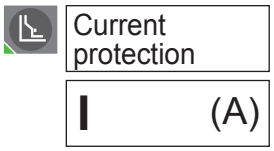
Press enter.

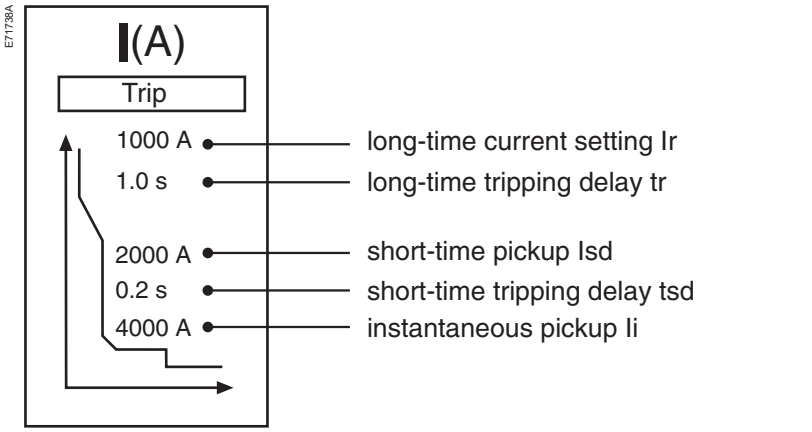
Select Auto or Manual.

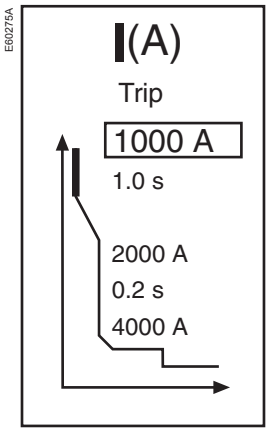
Confirm.

Fine adjustment of the long-time I^2t, short-time and instantaneous settings using the keypad

Select the command.

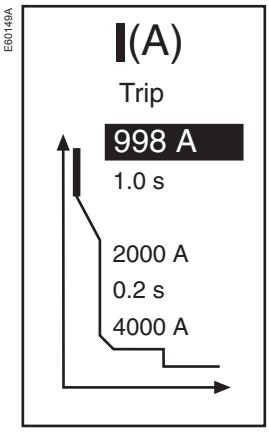




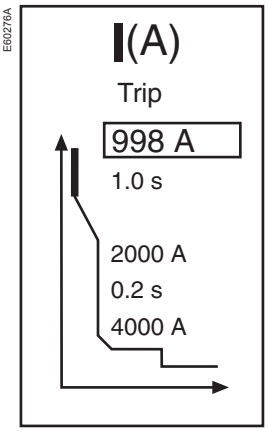


then

Select a setting.

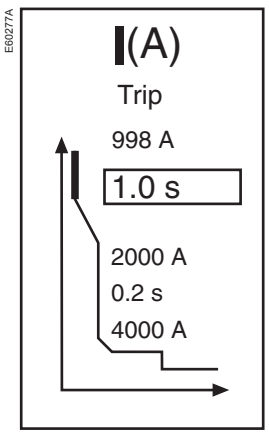


Adjust the value.



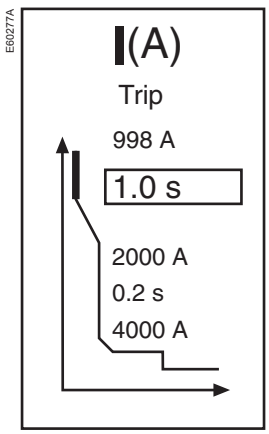
Confirm.

When all the settings have been adjusted, quit the screen by pressing one of the menu-access buttons. This saves the new values.

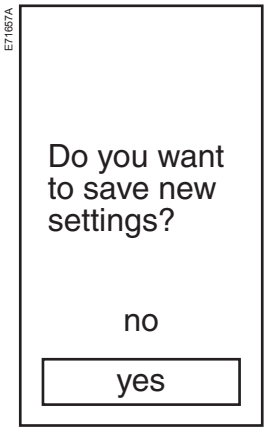


then

Adjust the other settings and confirm.



Quit the setting screen.



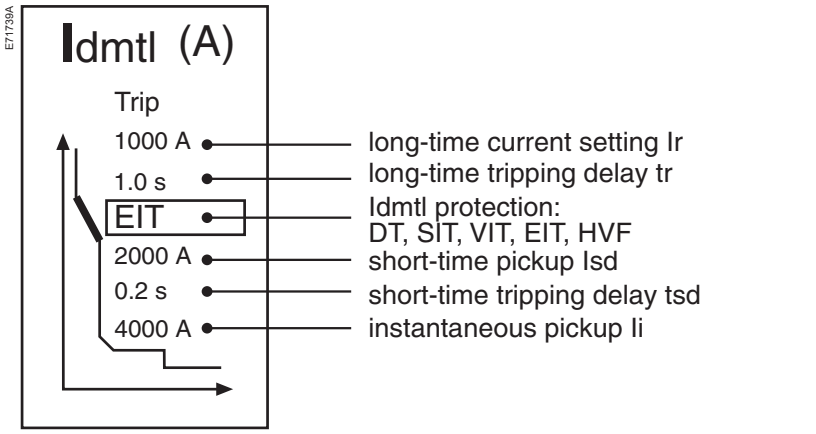
Confirm.

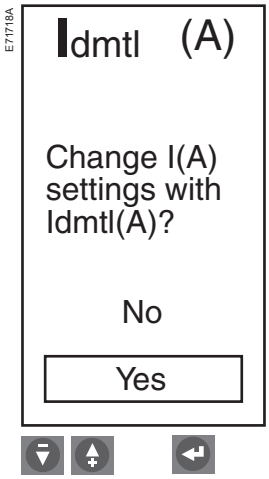
Fine adjustment of the long-time Idmtl, short-time and instantaneous settings using the keypad

Select the command

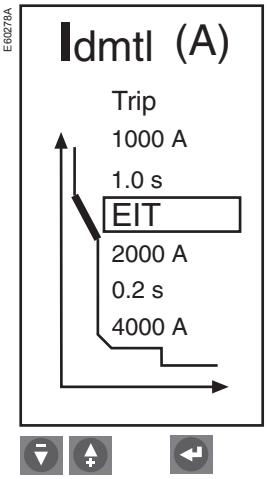
Current protection

Idmtl (A)

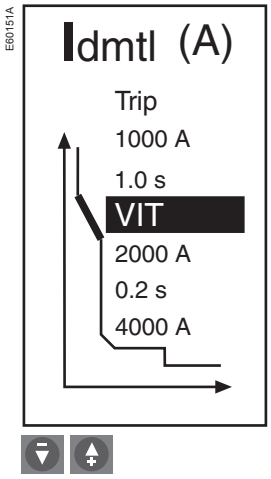




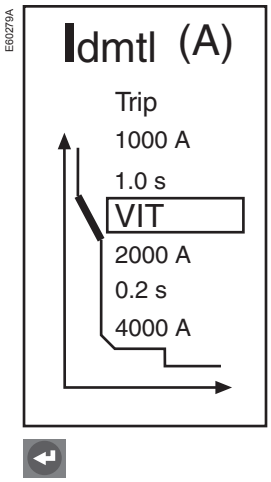
Select yes.



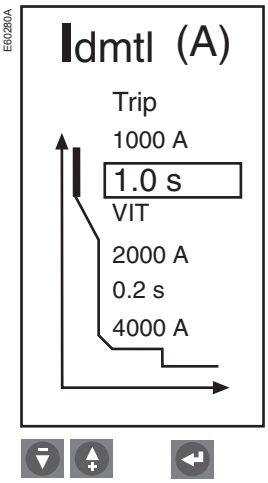
Select a setting.



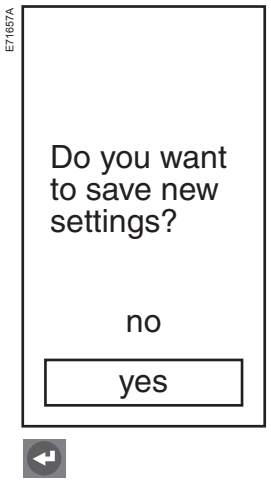
Change the setting.



Confirm.



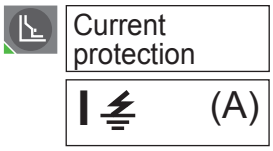
Adjust the other settings.

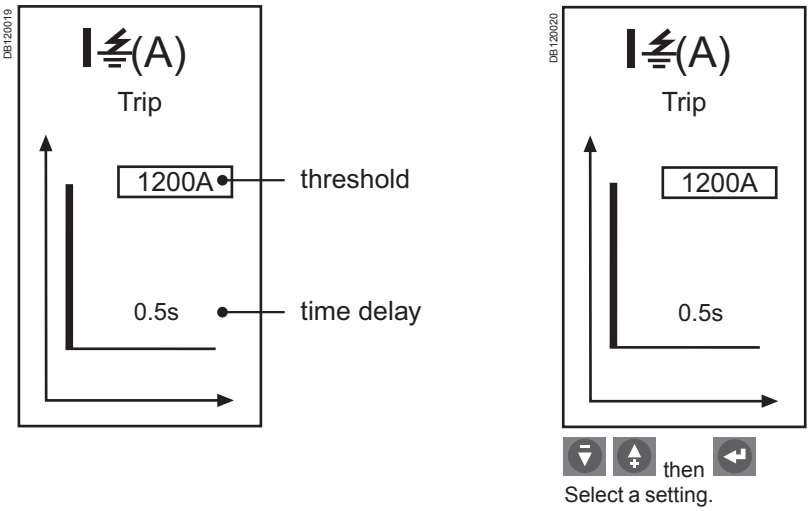


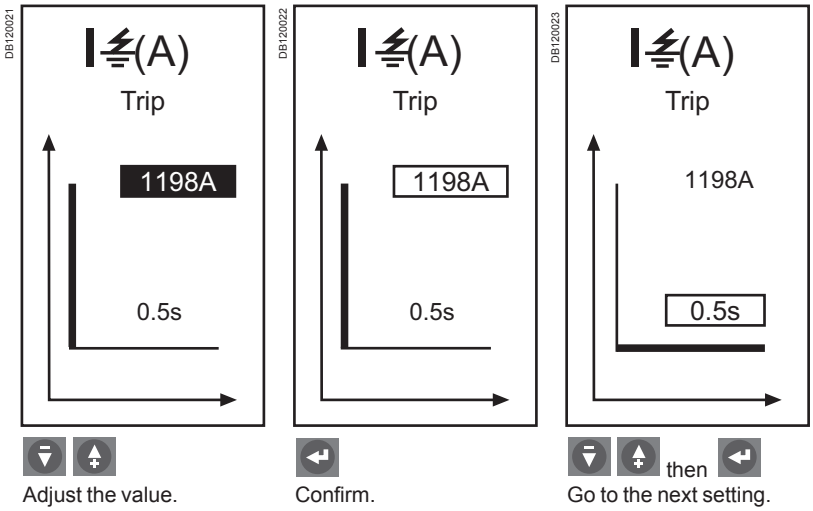
Confirm.

Fine adjustment of the ground-fault and earth-leakage protection setting using the keypad

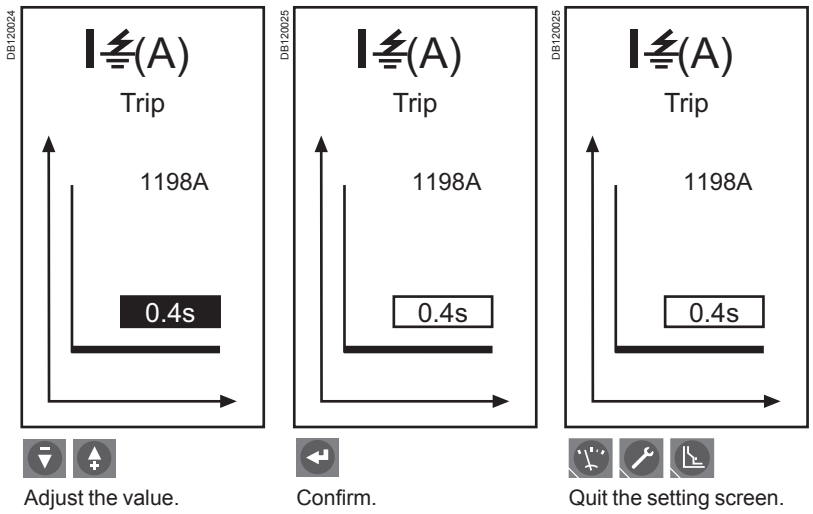
Select the command





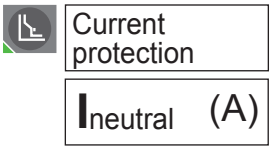


When all the settings have been adjusted, quit the screen by pressing one of the menu-access buttons. This saves the new values.



Setting the neutral protection

Select the command

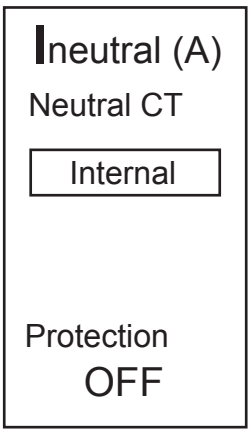


Caution!
Selection of the CT type determines the "Ineutral" protection in the "Protection" menu.
- "none" disables the neutral protection.
- "Internal" for a four-pole circuit breaker provides access to the N/2, N and OFF protection functions.
- "External" for a three-pole circuit breaker provides access to the N/2, N, 1.6 x N and OFF protection functions.

Type of circuit breaker	Possibles choices
Four-pole	OFF: no neutral protection N / 2: half neutral protection N: full neutral protection
Three-pole	OFF: no neutral protection N / 2: half neutral protection N: full neutral protection 1.6 x N: oversized neutral protection

Using the keypad on the control unit

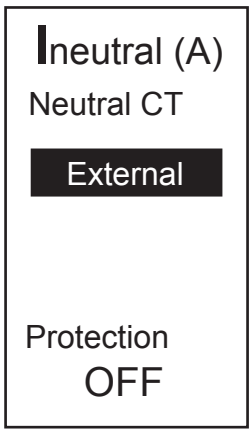
E89237B



then

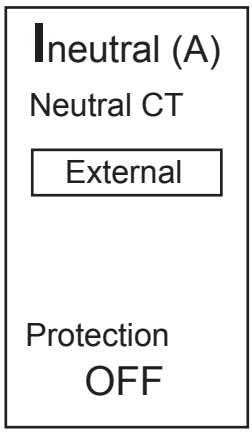
Select.

E89238B



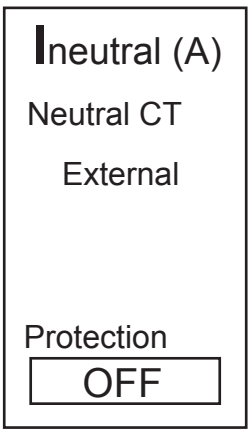
Choose between:
- internal
- external
- none.

E89239B



Confirm.

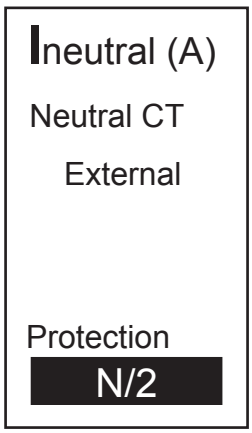
E89240B



then

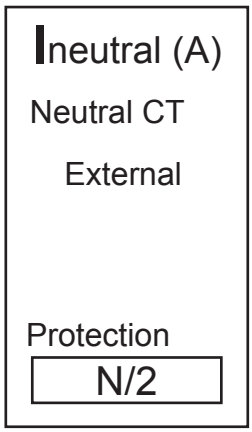
Select.

E89241B



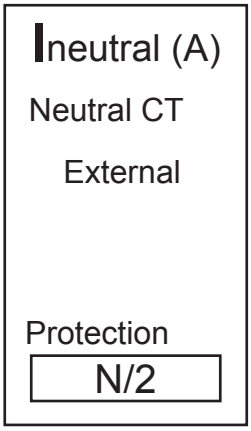
Choose.

E89242B



Confirm.

E89242B



Quit the setting screen.

E71657A

Confirm.

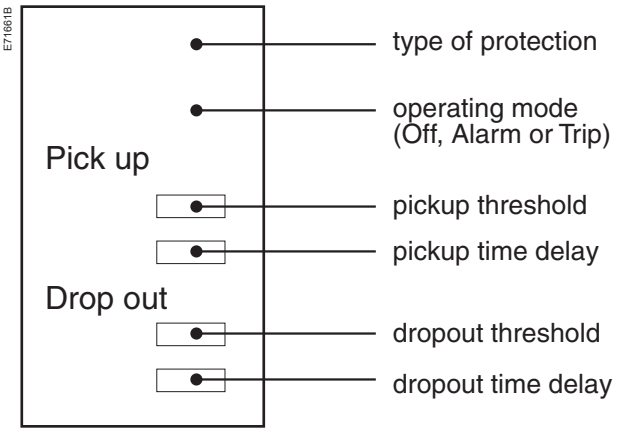
Note:
On four-pole circuit breakers, setting of the neutral using the keypad is limited by the dial setting.

Setting the I⏚, I unbal, Imax, U min, U max, U unbal, rP max, F min, F max, and phase-rotation protection functions using the keypad

Select the corresponding menu

- Current protection
  - I⏚ Alarm
  - I unbal (%)
  - I1 max (A)
  - I2 max (A)
  - I3 max (A)
  - IN max (A)
- Voltage protection
  - Umin (V)
  - Umax (V)
  - Uunbal (%)
- Other protection
  - rPmax (W)
  - Fmin (Hz)
  - Fmax (Hz)
  - Phase rotation

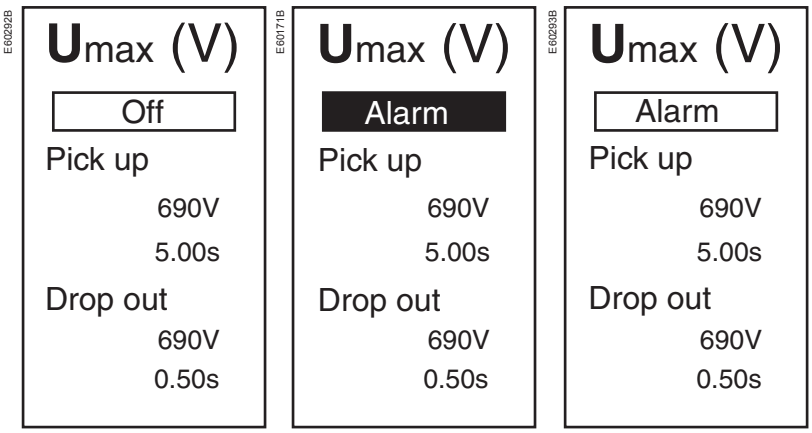
In trip mode, the dropout threshold is equal to the pickup threshold.
The dropout time delay is fixed and equal to 1 second.



Specific case for I⏚ alarm
- Only the following choices are available:
  - On: activation of the alarm without fault tripping by the circuit breaker
  - Off: alarm disabled.

Example: Maximum voltage setting (U max)

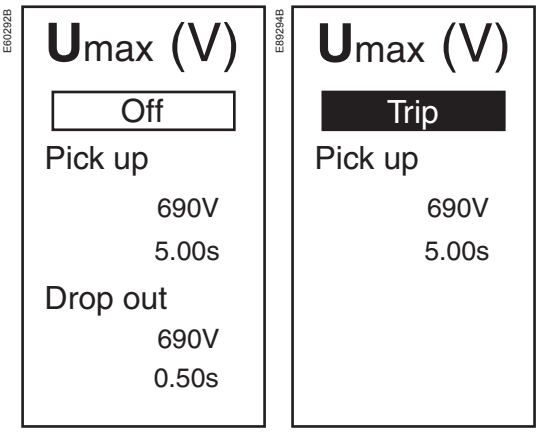
- Select Alarm mode



then
Select the first setting.

Choose Off or Alarm.

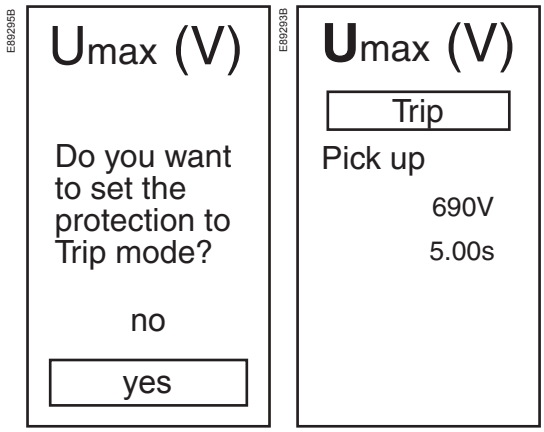
Confirm.



then
Select the first setting.

Choose Trip.

Setting the I⇜, I unbal, Ī max, U min, U max, U unbal, rP max, F min, F max, and phase-rotation protection functions using the keypad



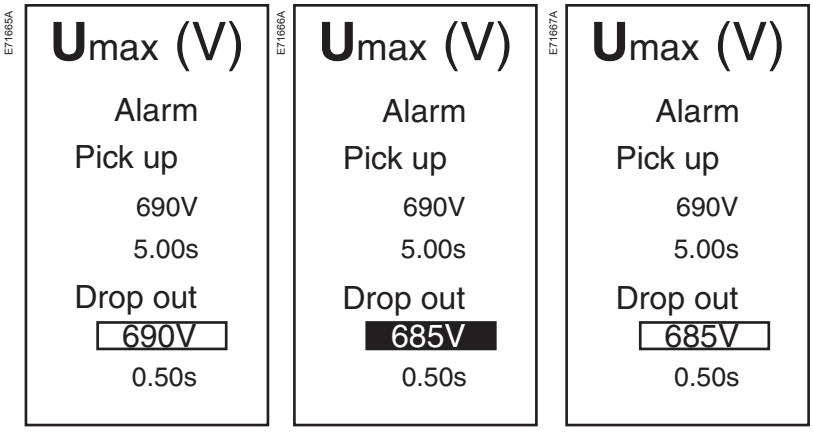
then
Confirm.

For protection tripped by a maximum value, the dropout threshold is always less than or equal to the pickup threshold.

For protection tripped by a minimum value, the dropout threshold is always greater than or equal to the pickup threshold.

If both the minimum and maximum protection values are activated, the minimum threshold is automatically limited to the value of the maximum and vice versa.

■ Set the pickup and dropout thresholds and time delays

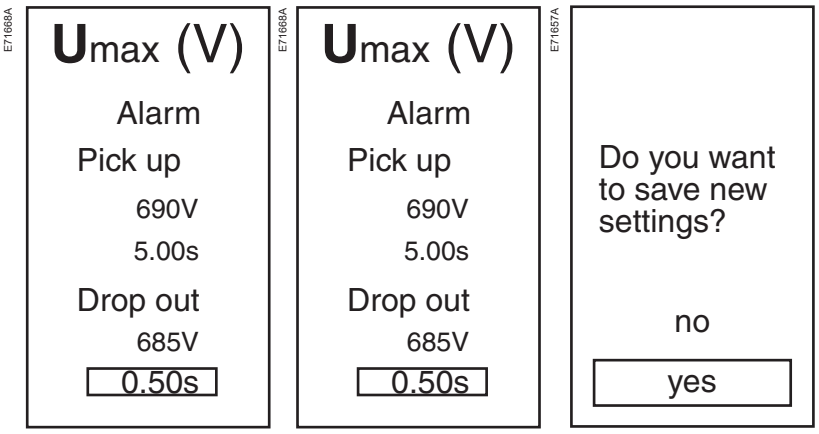


then
Select the existing dropout threshold setting

Adjust.

Confirm.

When all the settings have been made, quit the screen by pressing one of the menu-access buttons. This saves the new values.



then
Set the other parameters.

Quit the setting screen.

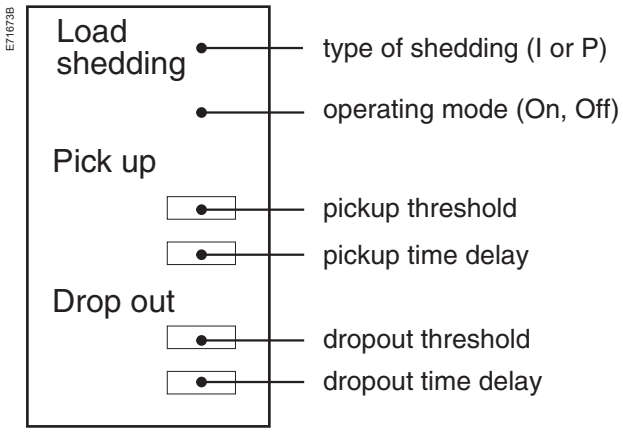
Confirm

Setting load shedding / reconnection

Select the command

Load shedding I

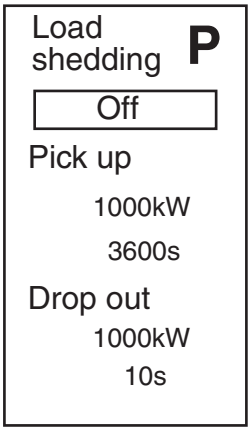
Load shedding P



Setting load shedding / reconnection

Example: Take load shedding / reconnection depending on power.

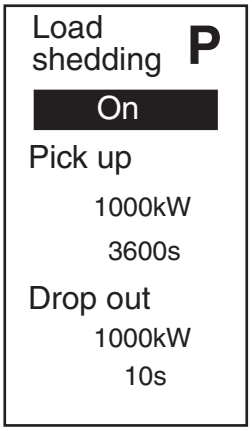
E71670A



then

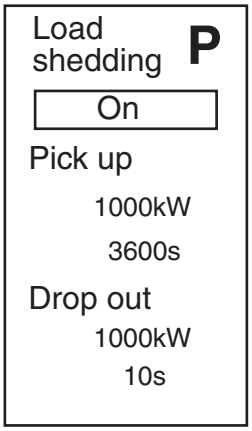
Select the first setting.

E71671A



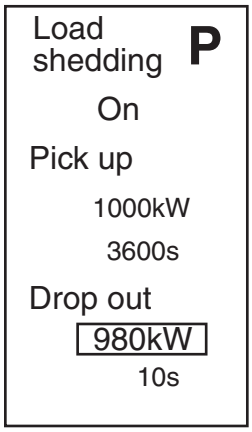
Select:
- Off: load shedding disabled
- On: load shedding enabled.

E71672A



Confirm.

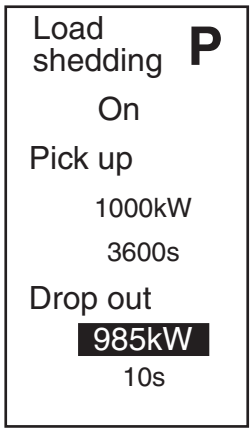
E71674A



then

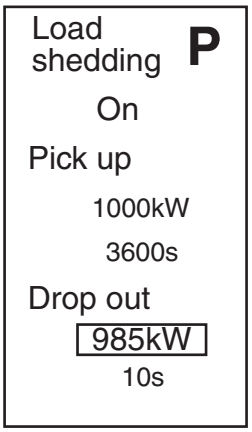
Select the existing dropout threshold.

E71675A



Adjust.

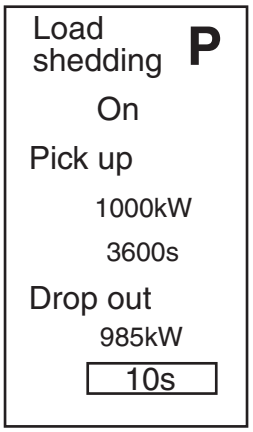
E71676A



Confirm.

When all the settings have been made, quit the screen by pressing one of the menu-access buttons. This saves the new values.

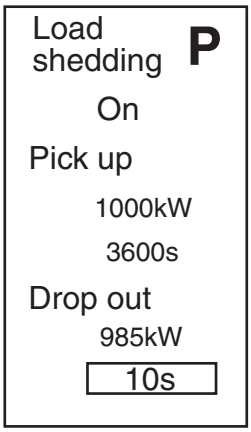
E71677A



then

Set the other parameters.

E71677A



Quit the setting screen.

E71657A

Confim.

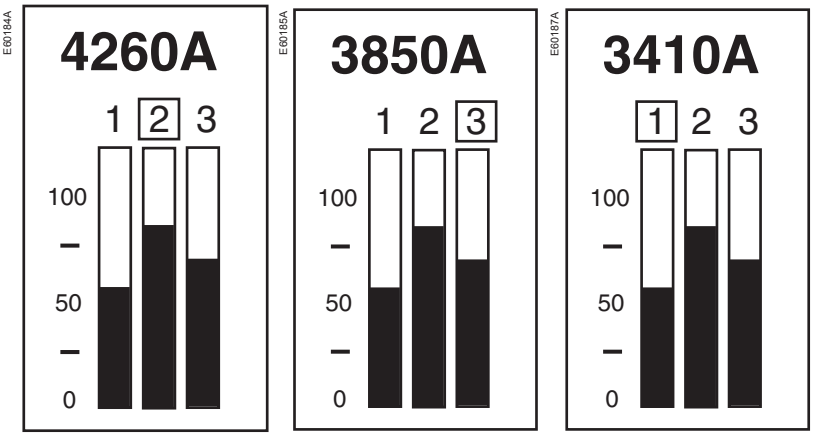
Current measurements

Only the measurements for the phase (1, 2, 3) and neutral currents are displayed on the main screen.

The neutral current is displayed if the neutral CT is set to internal or external (see "Ineutral (A)" settings in the "Current protection" menu).

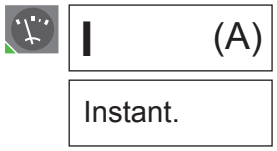
Continuous current measurement

The bargraph displays the value in amperes of the most heavily loaded phase.



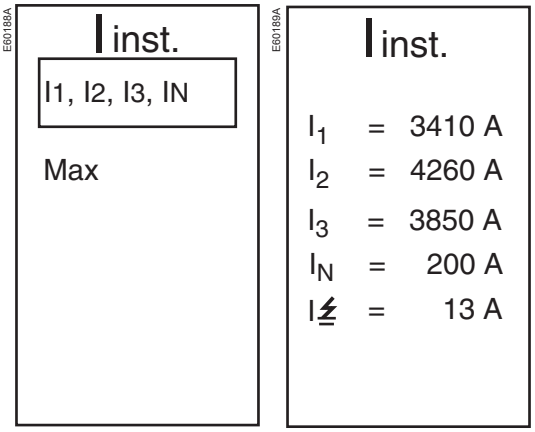
The and buttons may be used to display the currents on the three phases. If the operator no longer uses the buttons for a few seconds, the bargraph returns to the display of the most heavily loaded phase.

Select the command



Measure an instantaneous-current value

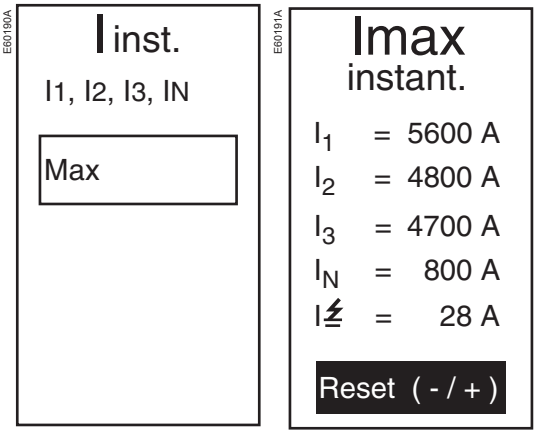
■ Measure the instantaneous currents



then

Select. View.

■ Check the instantaneous-current maximeter

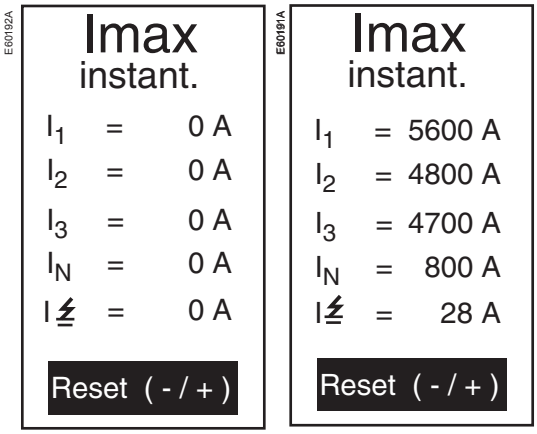


then

Select. View.

Current measurements

■ Reset the maximeter



Reset the maximeter or... cancel the reset.

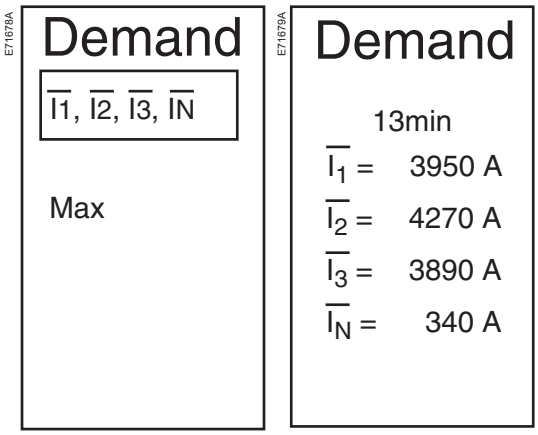
Select the command

I (A)

Demand.

Measure a demand-current value

■ Measure the demand currents

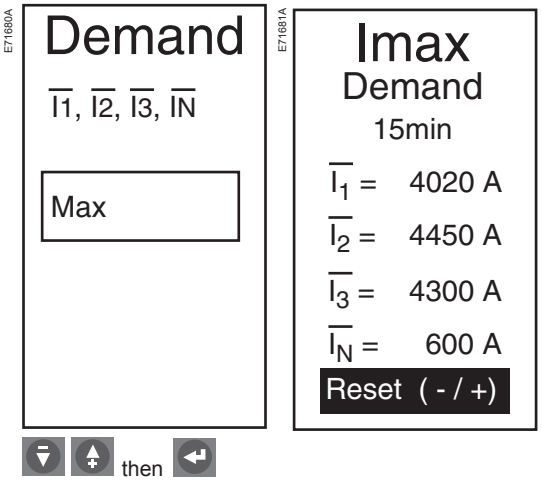


then

Select. View.

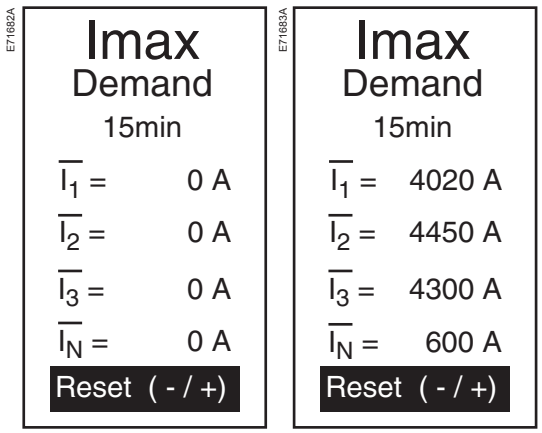
Current measurements

■ Check the demand-current maximeter



Select. then View.

■ Reset the maximeter



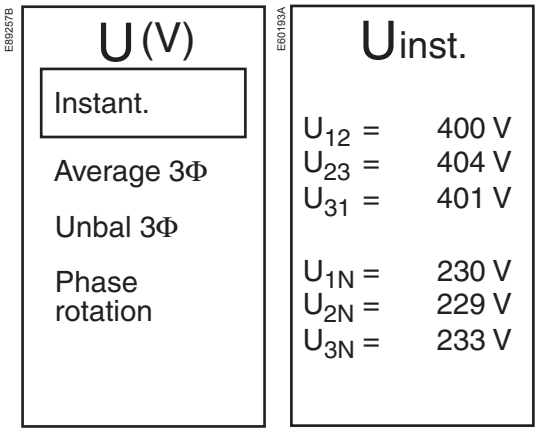
Reset the maximeter or... cancel the reset.

Voltage measurements

Select the command

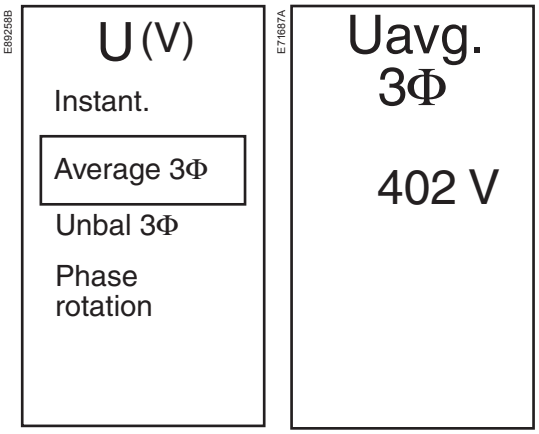
The phase-to-neutral voltages are displayed if the selected system type is 3-phase, 4-wire (see page 55).

Measure an instantaneous-voltage value (U or V)



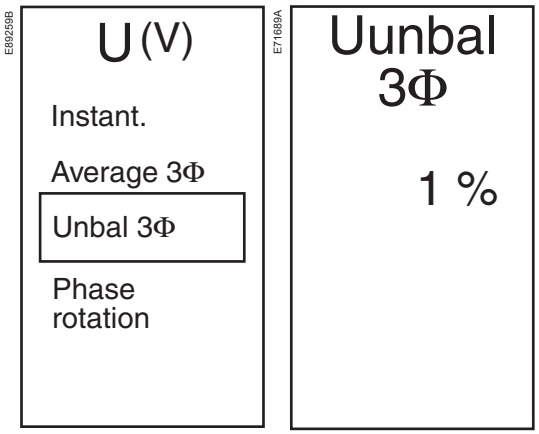
Select. then View.

Measure the average voltage U avg



Select. then View.

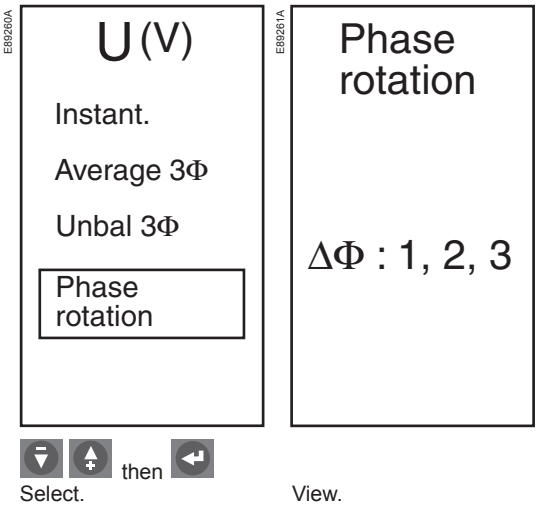
Measure the voltage unbalance U unbal



Select. then View.

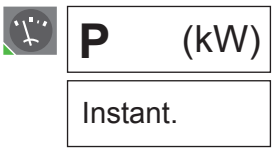
Voltage measurements

Determine the phase sequence



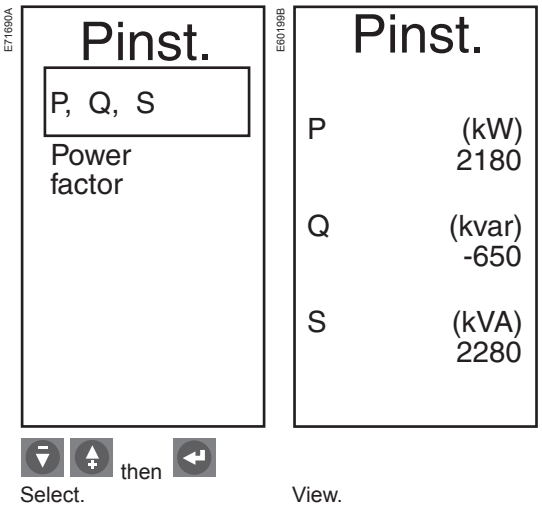
Power measurements

Select the command



To ensure reliable power and power-factor measurements, the "Power sign" and "Sign convention" parameters must be set.

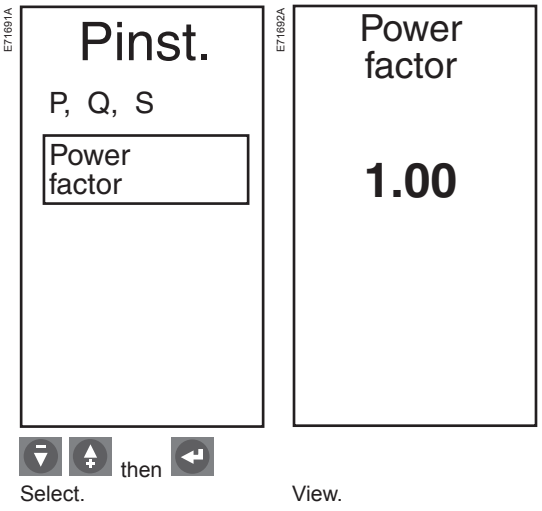
Measure an instantaneous-power value



then

Select. View.

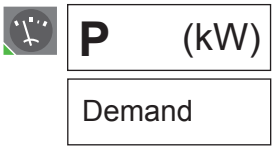
Measure the power factor



then

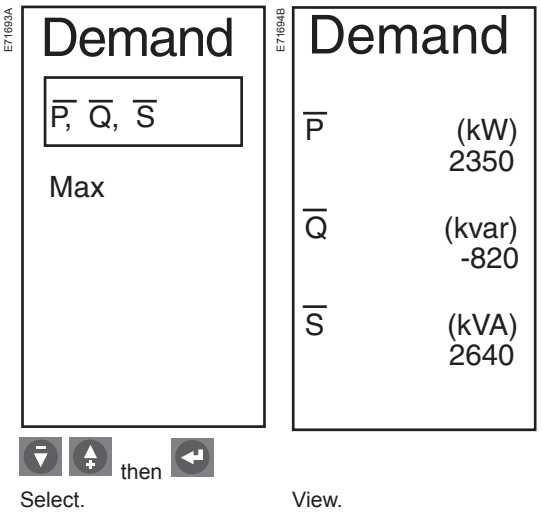
Select. View.

Select the command



Measure a demand-power value

■ Display the demand power

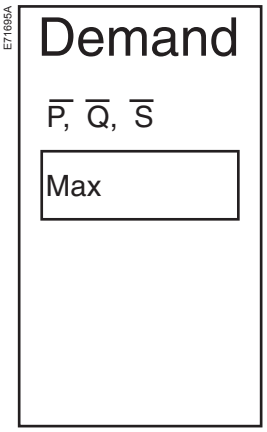


then

Select. View.

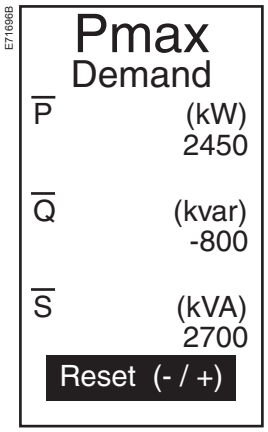
Power measurements

■ Check the demand-power maximeter



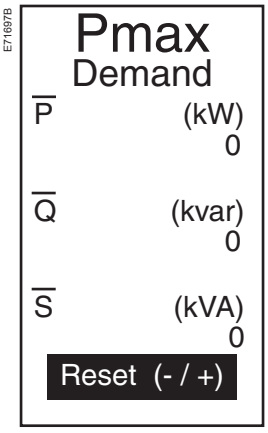
Select.

then

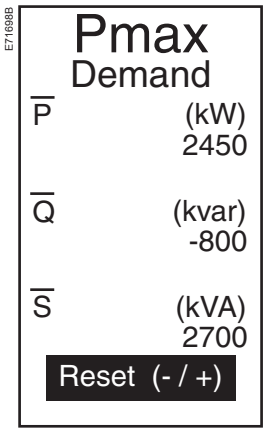


View.

■ Reset the maximeter



Reset the maximeter or...



cancel the reset.

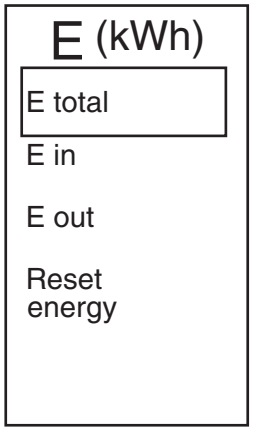
Energy measurements

Select the command

To ensure reliable energy measurements, the "Power sign" and "Sign convention" parameters must be set.

Measure the energy values

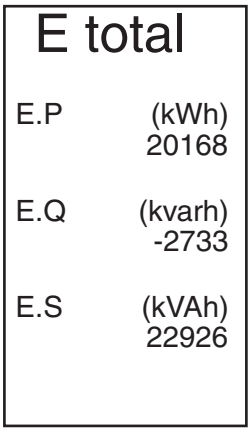
E71699A



Select the energy value to be measured:
- total energy
- energy in (positive component in the total energy)
- energy out (negative component in the total energy).

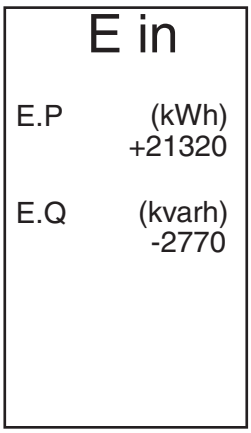
Select.

E71700B



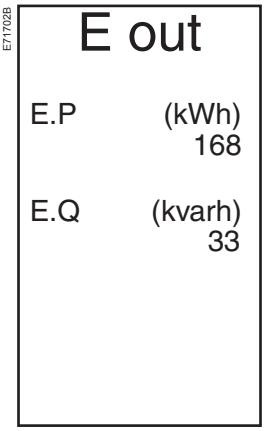
View the total energy values.

E71701B



View the energy in values.

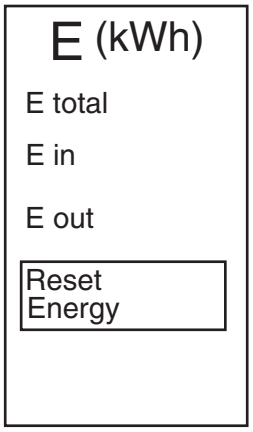
E71702B



View the energy out values.

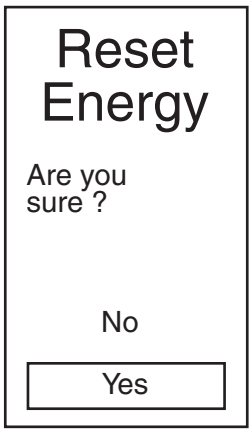
Reset the energy values

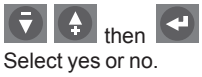
E71703A



Select.

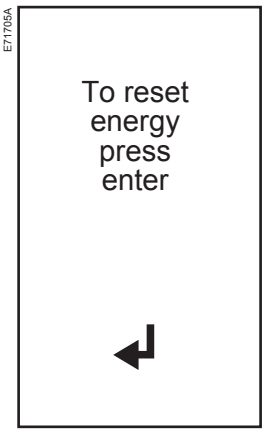
E71704A





Select yes or no.

E71705A



If yes, confirm.

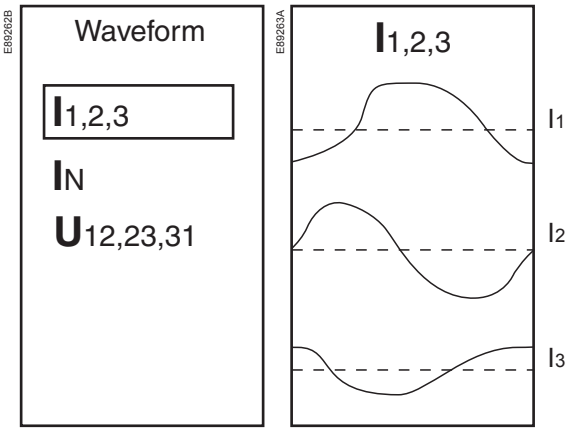
Harmonic measurements
Waveform capture

Select the command

Harmonic

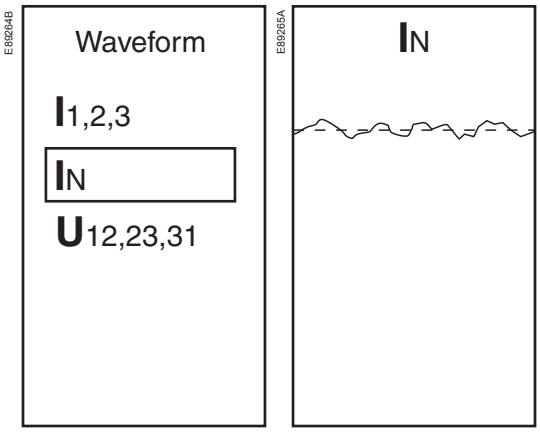
Waveform

Waveform capture for currents I1, I2 and I3



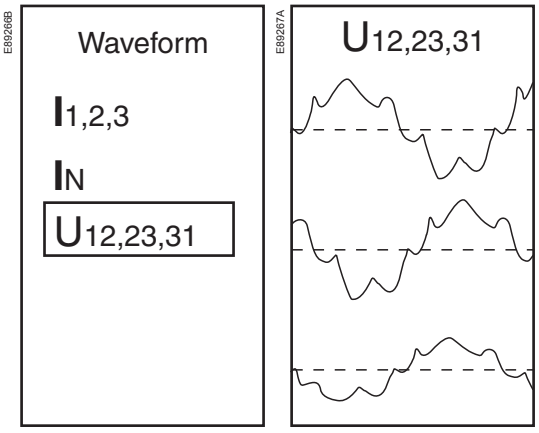
Select. then View.

Waveform capture for neutral current IN



Select. then View.

Waveform capture for voltages U12, U23 and U31



Select. then View.

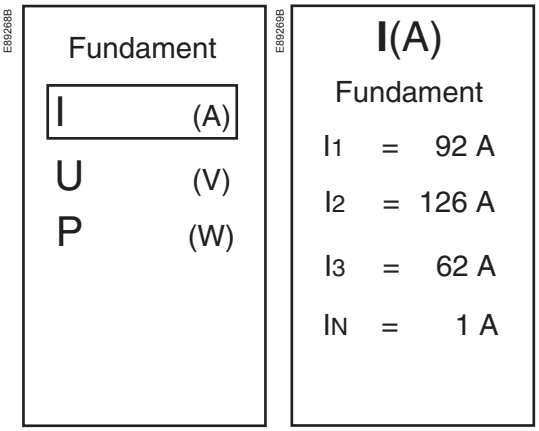
Harmonic measurements
Fundamentals

Select the command

Harmonic

Fundamant.

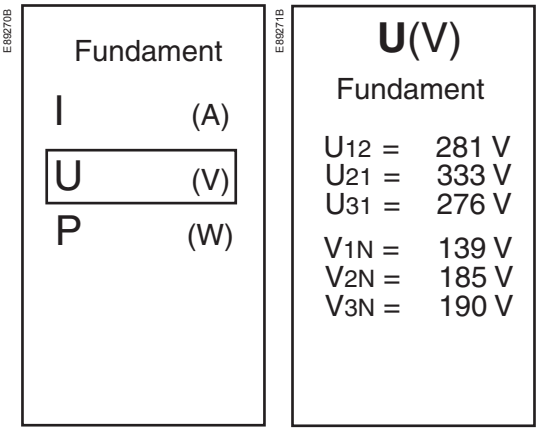
Measure the fundamental currents



then

Select. View.

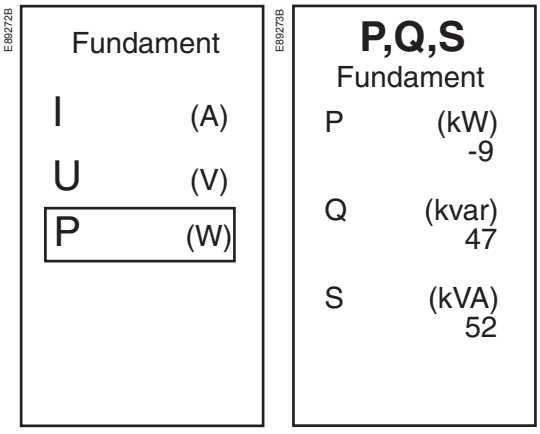
Measure the fundamental voltages



then

Select. View.

Measure the fundamental power values



then

Select. View.

Harmonic measurements
THD

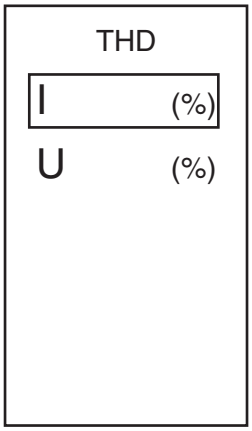
Select the command


Harmonic

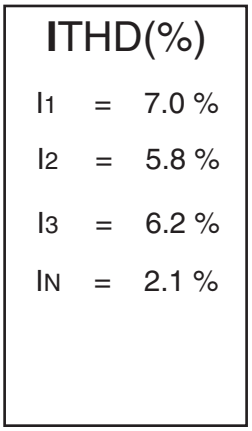
THD

Measure the total harmonic distortion (THD) of the current (with respect to fundamental)

E89274A



E89275B

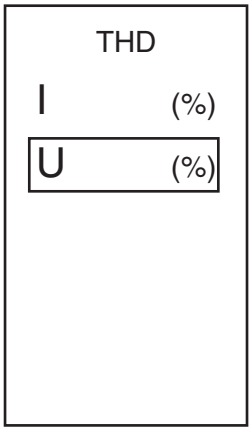



then

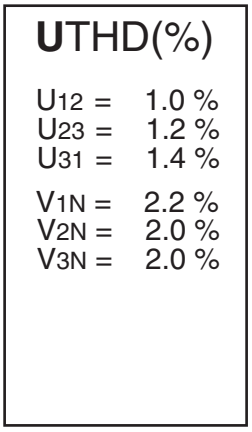
Select. View.

Measure the total harmonic distortion (THD) of the voltage (with respect to fundamental)

E89276A



E89277B

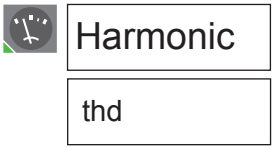



then

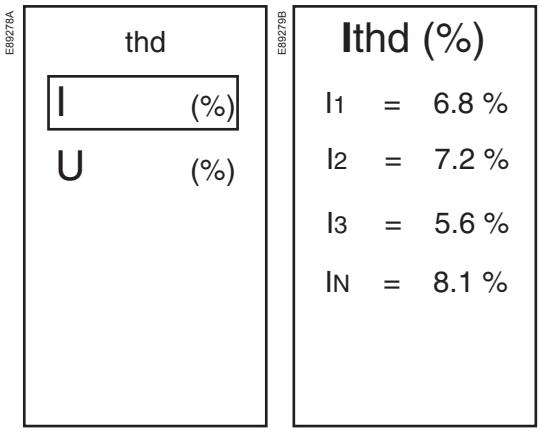
Select. View.

Harmonic measurements
thd

Select the command



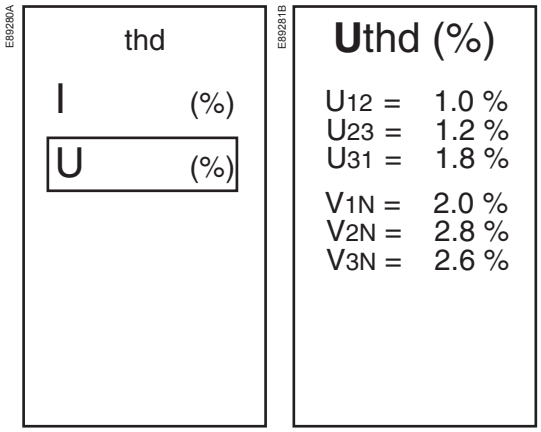
Measure the total harmonic distortion (thd) of the current (with respect to rms value)



then

Select. View.

Measure the total harmonic distortion (thd) of the voltage (with respect to rms value)



then

Select. View.

Harmonic measurements
FFT amplitude spectrum

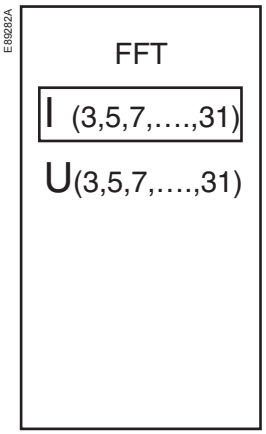
Select the command

Harmonic

FFT

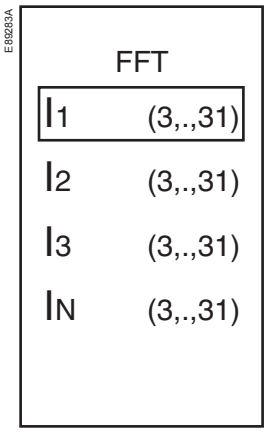
Note :
FFT= Fast Fourier Transform

Measure the amplitude spectrum of the current harmonics



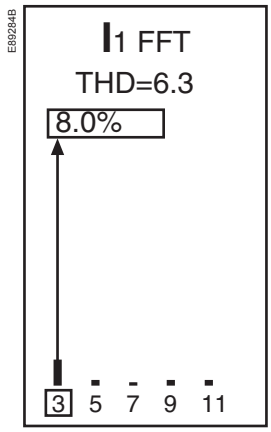
then

Select.

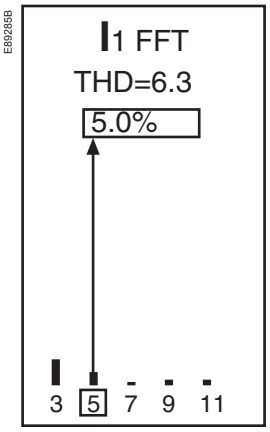


then

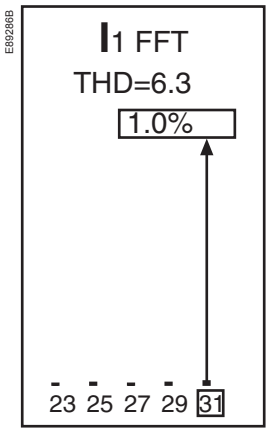
Select a current.



View the individual distortion of the 3rd harmonic



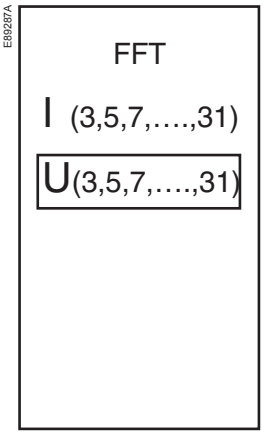
View the 5th harmonic...



... and the other odd harmonics up to the 31st.

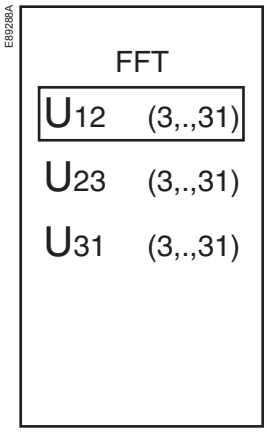
Harmonic measurements
FFT amplitude spectrum

Measure the amplitude spectrum of the voltage harmonics



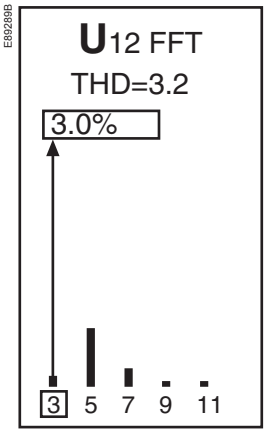
then

Select.

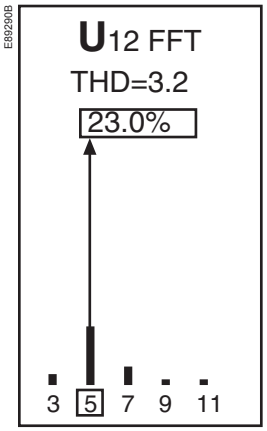


then

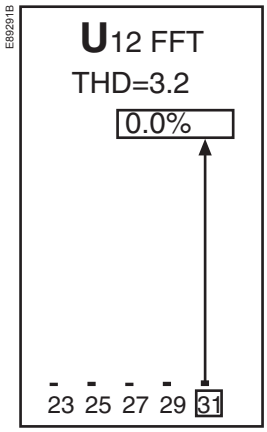
Select a voltage.



View the individual distortion of the 3rd harmonic



View the 5th harmonic...

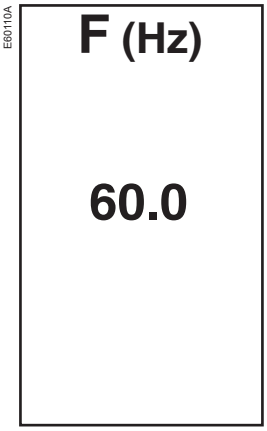


... and the other odd harmonics up to the 31st.

Frequency measurements

Select the command

F (Hz)

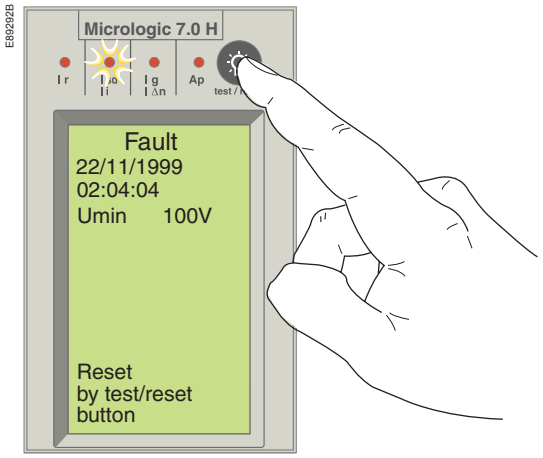


View.

Resetting fault indications

Caution!
If the circuit breaker remains closed and the Ap LED remains ON after the reset, open the circuit breaker and contact the after-sales support department.

The fault indication is maintained until it is reset on the control panel.
Press the reset button.



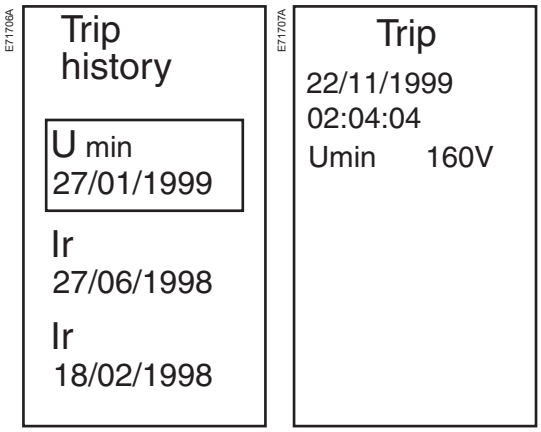
Viewing the event histories

Select the command

Event history

Trip history

Trip history



then

Select a fault.

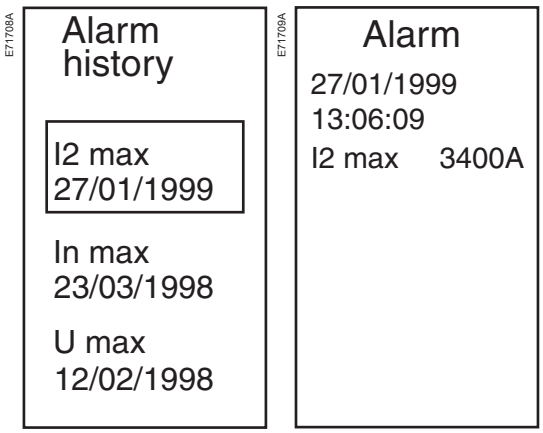
View.

Select the command

Event history

Alarm history

Alarm history



then

Select an alarm.

View.

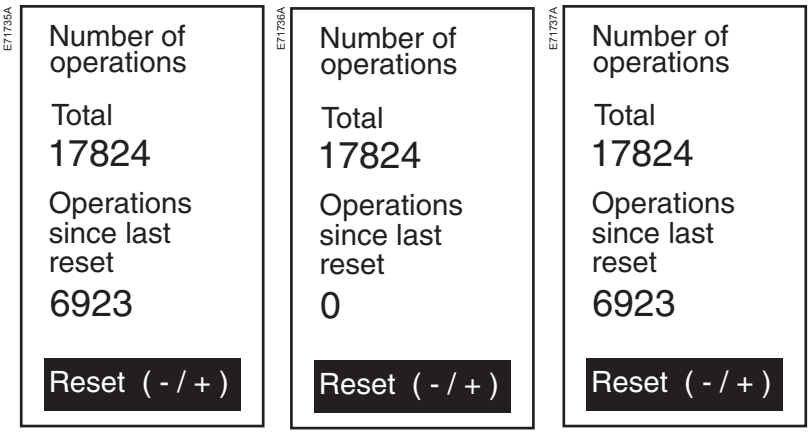
Operation counter and contact-wear indicator

Select the command

Event history

Operation counter

View and/or reset the operation counter



Reset…

then

… or cancel the reset, then confirm.

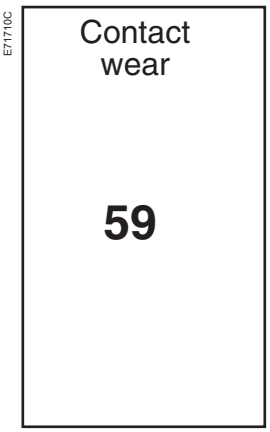
Select the command

Event history

Contact wear

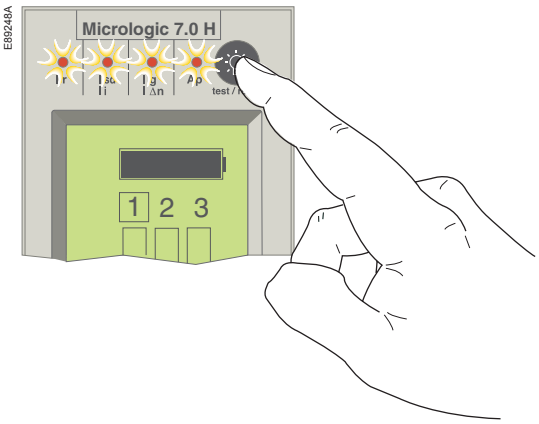
Contact wear is indicated from 0 to 900. The contacts should be inspected every time the counter reaches a multiple of 100.

Check the wear of the contacts



Checking/replacing the battery

Check the control-unit battery



Press and hold down the test button on the control unit to check the LEDs and the battery. The battery information is displayed if the control unit is equipped with an external power supply or if the circuit breaker is ON.

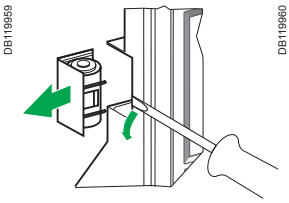
Battery fully charged
Battery half charged
No battery or must be replaced

Replacing the control-unit battery

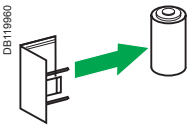
If the battery needs to be changed, order a new battery with the Schneider Electric catalogue number 33593.

- Lithium battery
- 1.2 AA, 3.6 V, 800 mA/h
- Ambient temperature: 130°C.

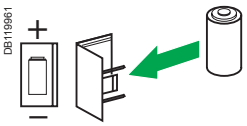
1. remove the battery cover



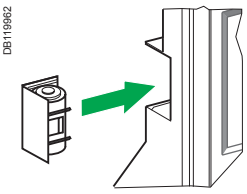
2. remove the battery



3. insert a new battery. Check the polarity.



4. put the cover back in place. Press the battery-test button to check the new battery.

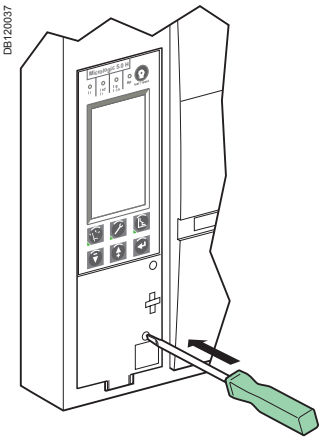


Tests

Test the ground-fault (Micrologic 6.0 H) and earth-leakage (Micrologic 7.0 H) protection functions

The circuit breaker must be supplied with power and closed for the test.

Press the TEST button. The circuit breaker should trip.

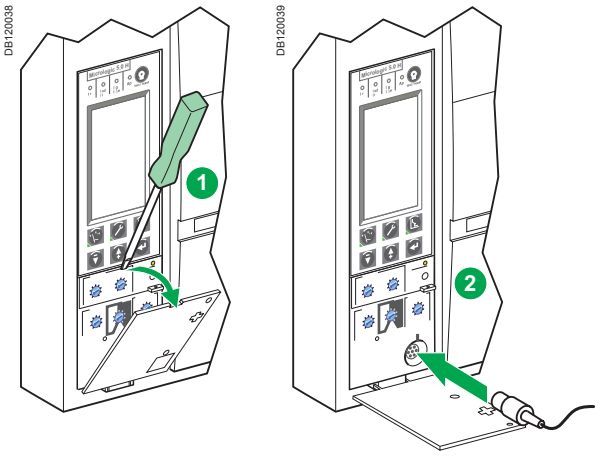


If the circuit breaker does not trip, contact the after-sales support department.

Refer to the manual that comes with the test kits.

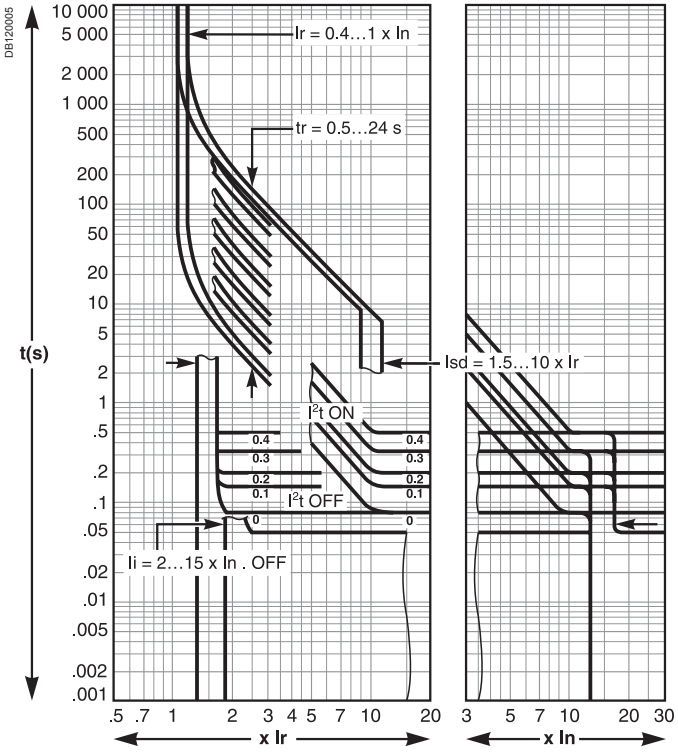
Mini test kit and portable test kit

The test connector is used to connect the mini or the portable test kit to check that the control unit is operating correctly.

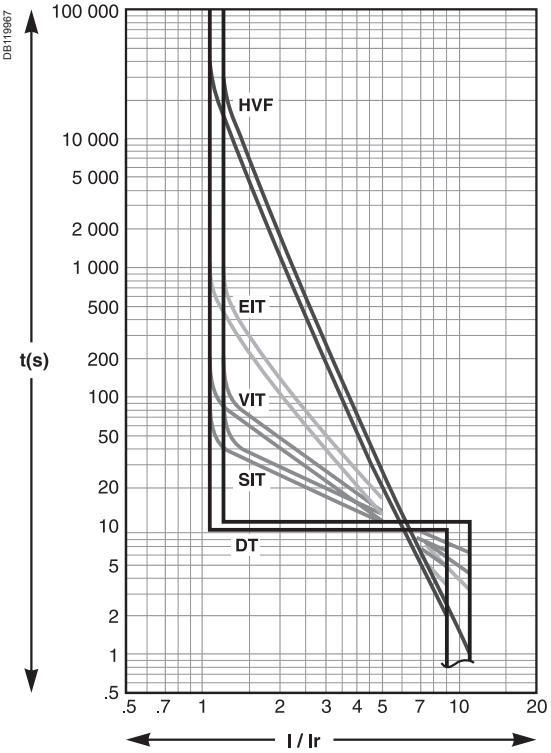


Tripping curves

Long-time I^2t, short-time and instantaneous protection Micrologic 5.0 H, 6.0 H, 7.0 H

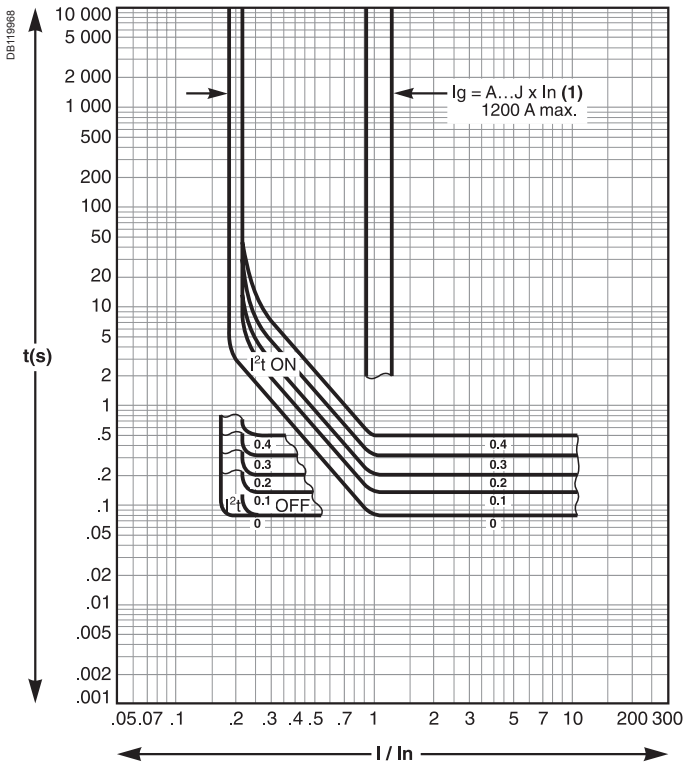


Long-time Idmtl, short-time and instantaneous protection Micrologic 5.0 H, 6.0 H, 7.0 H



Tripping curves

Ground-fault protection - Micrologic 6.0 H



Voltage measurements

Micrologic H is equipped with a three-phase voltage power supply that, with respect to the distribution system, may be considered a delta load. The three-phase power supply reinjects voltage on an open phase.
The voltage-protection functions react as indicated below.

Minimum-voltage protection

This function is based on the measurement of the phase-to-phase voltages.

In diagrams 1, 3 and 4 on the next page, a fuse has blown. The control unit reinjects voltage on the failed phase and measures a phase-to-phase voltage higher than the actual voltage.
The phase-to-neutral voltage should be zero, but the value measured is not zero.

In diagram 2, the phase-to-neutral voltage is effectively zero and the measurement indicates zero as well.

By limiting the pickup threshold of the minimum-voltage protection to the 80% - 100% range of the rated distribution-system voltage, the differences between the real voltages and the measured values are not significant and Micrologic will operate under all circumstances in the expected manner.

Voltage-unbalance protection

This function is based on the measurement of the phase-to-phase voltages.

In diagrams 1, 3 and 4 on the next page, a fuse has blown. The control unit reinjects voltage on the failed phase and measures a phase-to-phase voltage higher than the actual voltage.
The phase-to-neutral voltage should be zero, but the value measured is not zero.

In diagram 2, the phase-to-neutral voltage is effectively zero and the measurement indicates zero as well.

By limiting the pickup threshold of the voltage-unbalance protection to the 0 % - 20 % range, the differences between the real voltages and the measured values are not significant and Micrologic will operate under all circumstances in the expected manner.

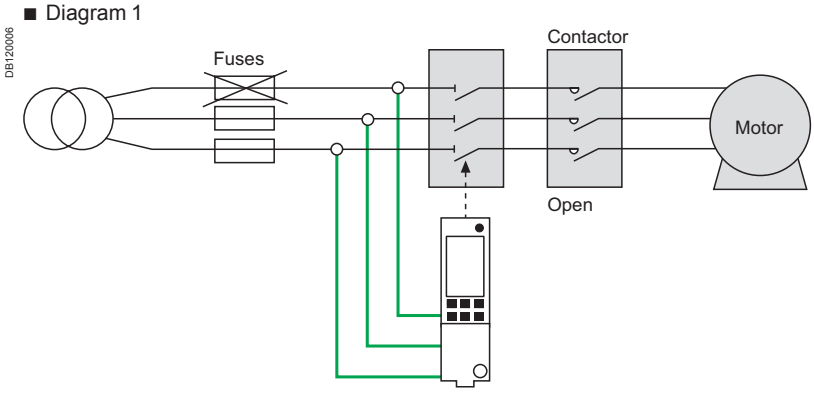
Phase failure

Detection of phase failure is not possible on the basis of the minimum-voltage and voltage-unbalance protection functions.
The Micrologic power supply requires at least two phases (between 100 and 690 V).

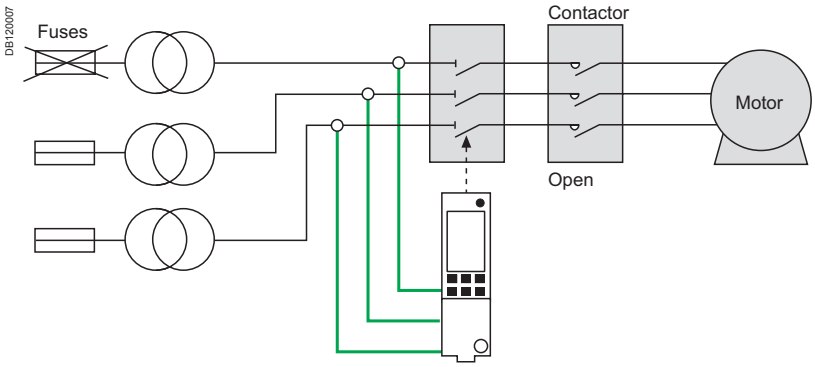
In diagrams 1, 3 and 4, if two phases have failed, Micrologic H measures for the three phases the value of the single voltage present (e.g. U12 = U23 = U31 = 410 V).

Voltage measurements

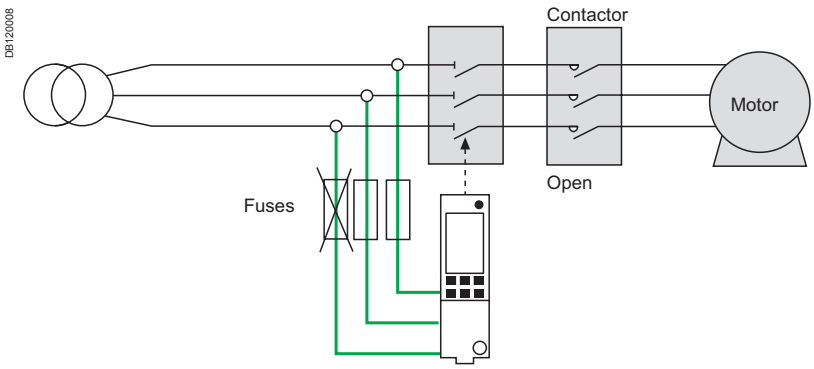
■ Diagram 1



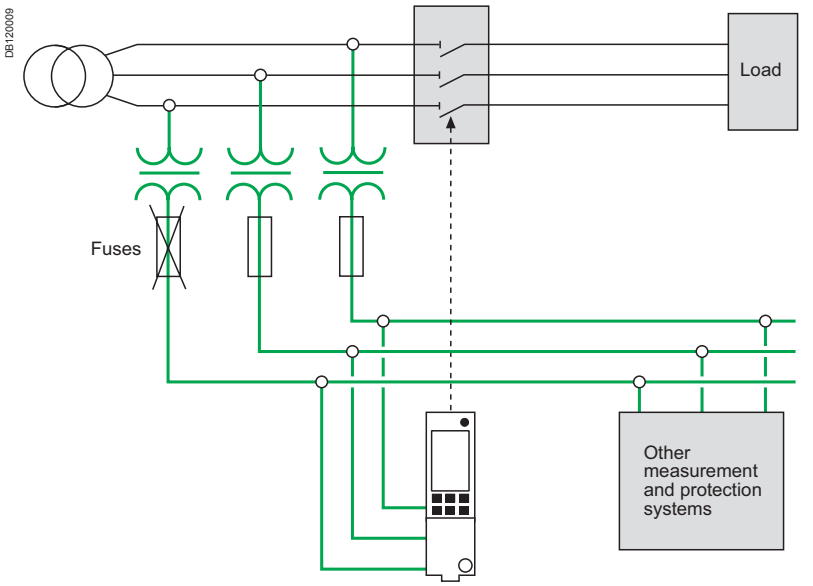
■ Diagram 2



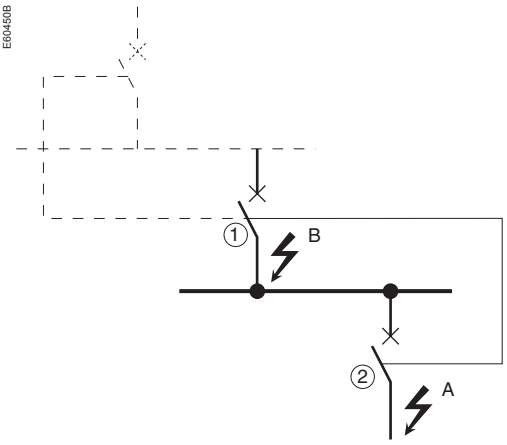
■ Diagram 3



■ Diagram 4



Zone selective interlocking (ZSI)



Operating principle

■ A fault occurs at point A

Downstream device no. 2 clears the fault and sends a signal to upstream device no. 1, which maintains the short-time tripping delay tsd or the ground-fault tripping delay tg to which it is set.

■ A fault occurs at point B

Upstream device no. 1 detects the fault. In the absence of a signal from a downstream device, the set time delay is not taken into account and the device trips according to the zero setting. If it is connected to a device further upstream, it sends a signal to that device, which delays tripping according to its tsd or tg setting.

Note:

on device no. 1, the tsd and tg tripping delays must not be set to zero because this would make discrimination impossible.

Connections between control units

A logic signal (0 or 5 volts) can be used for zone selective interlocking between the upstream and downstream circuit breakers.

■ Micrologic 5.0 A, 6.0 A, 7.0 A
■ Micrologic 5.0 P, 6.0 P, 7.0 P
■ Micrologic 5.0 H, 6.0 H, 7.0 H.

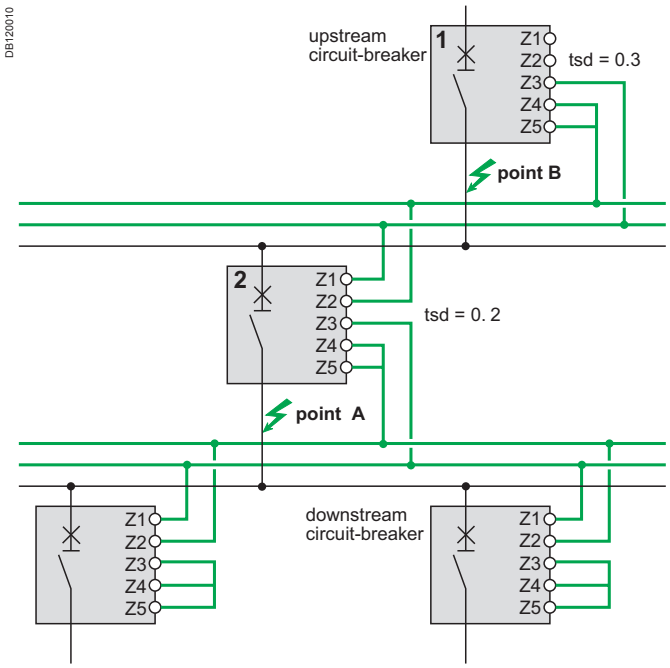
An interface is available for connection to previous generations of trip units.

Caution!
If the protection function is not used on circuit breakers equipped for ZSI protection, a jumper must be installed to short terminals Z3, Z4 and Z5. If the jumper is not installed, the short-time and ground-fault tripping delays are set to zero, whatever the position of the adjustment dial.

Wiring

■ Maximum impedance: 2.7 Ω / 300 metres
■ Capacity of connectors: 0.4 to 2.5 mm^2
■ Wires: single or multicore
■ Maximum length: 3000 metres
■ Limits to device interconnection:
□ the common ZSI - OUT (Z1) and the output ZSI - OUT (Z2) can be connected to a maximum of ten inputs
□ a maximum of 100 devices may be connected to the common ZSI - IN (Z3) and to an input ZSI - IN CR (Z4) or GF (Z5).

Terminals Z1 to Z5 correspond to the identical indications on the circuit-breaker terminal blocks.



Test

The portable test kit may be used to check the wiring and operation of the zone selective interlocking between a number of circuit breakers.

Power supply

Caution!
It is advised to use the AD power-supply module rather than an off-the-shelf 24 V power supply to ensure Class II insulation on the front panel of the Micrologic H control unit.

The power supply must have the following characteristics:
- output voltage 24 V DC
- DC ripple less than 5%
- power rating 5 W / 5 VA
- Dielectric withstand (input/output): 3 kV rms

AD power-supply module

The AD power-supply module provides auxiliary 24 V DC power for the control-unit functions listed below:
- graphic display:
  - device OFF or not supplied
  - the long-time, short-time, instantaneous and ground-fault protection functions operate under all circumstances on their own power
- activation of an M2C programmable contact

The AD power-supply module is required to assign an M2C programmable contact to an alarm.

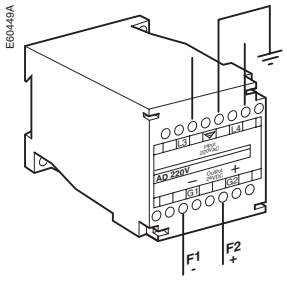
The AD power-supply module can supply the following voltages:
- 110 V AC
- 220 V AC
- 380 V AC
- 24 / 30 V DC
- 48 / 60 V DC
- 125 V DC.

Battery module

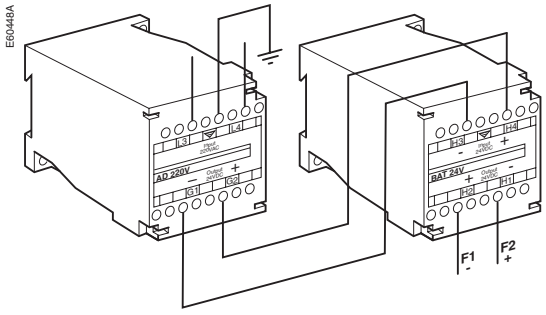
Use of a BAT battery module, mounted in series with the AD power-supply module, ensures a continous supply of 24 V DC power for 12 hours if the AD module fails.

Wiring diagrams

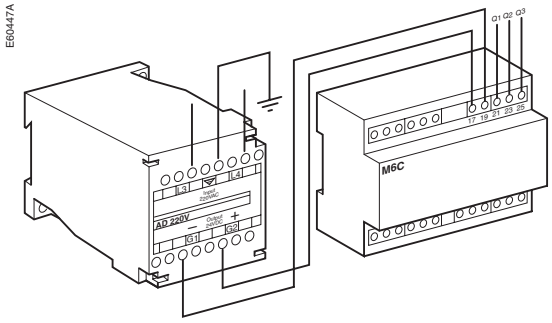
- reliable or backed-up auxiliary system



- auxiliary system without back-up



- Supply with the MC6 module



Power supply

Using the AD power-supply module

The 24 V DC external power-supply (AD module) is required for certain operating configurations as indicated in the table below:

- yes means the power supply is required
- no means it is not required.

Circuit breaker	Closed	Open	Open
AC power present for Micrologic H	**yes**	**yes**	**no**
M2C, M6C programmable-contacts option	yes	yes	yes
Display function	no	no	yes
Time-stamping function	no	no	no
Circuit-breaker status indications and control via communications bus	no	no	no
Identification, settings, operation and maintenance aids via communications bus	no	no	yes

- If the 24 V DC external power supply (AD module) is used, the maximum cable length between 24 V DC (G1, G2) and the control unit (F1-, F2+) must not exceed 10 metres.
- The communications bus requires its own 24 V DC power source (E1, E2). This source is not the same as the 24 V DC external power-supply module (F1-, F2+).

Selection of the voltage-measurement inputs

The voltage-measurement inputs are standard equipment on the downstream connectors of the circuit breaker.

It is possible to measure distribution-system voltage externally using the PTE external voltage-measurement input option.

With this option, the internal voltage-measurement inputs are disconnected. The PTE option is required for voltages greater than 690 V (in which case a voltage transformer is required).

When the PTE option is implemented, the supply circuit of the voltage-measurement input must be protected against short-circuits. Installed as close as possible to the busbars, this protection function is ensured by a P25M circuit breaker (1 A rating) with an auxiliary contact (cat. no. 21104 and 21117).

The supply circuit of the voltage-measurement input is reserved exclusively for the control unit and must never be used to supply other circuits.

Changing the long-time rating plug

Select the long-time rating plug

A number of long-time rating plugs are available for Micrologic H control units.

Part number	Setting range for the Ir value	
33542	standard	0.4 to 1 x Ir
33543	low setting	0.4 to 0.8 x Ir
33544	high setting	0.8 to 1 x Ir
33545	without long-time protection ■ Ir = In for the short-time protection setting ■ Frequency protection not available ■ Load shedding / reconnection based on current not available	

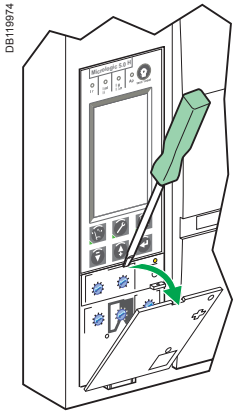
Caution!
Following any modifications to the long-time rating plug, all control-unit protection parameters must be checked.

Change the long-time rating plug

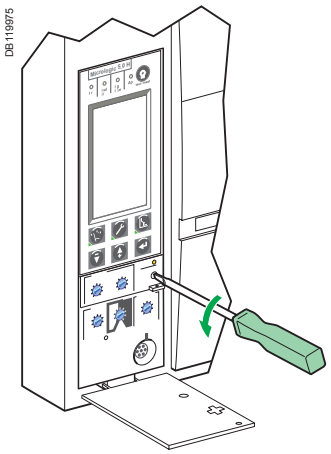
Proceed in the following manner.

1. open the circuit breaker

2. open the protective cover of the control unit

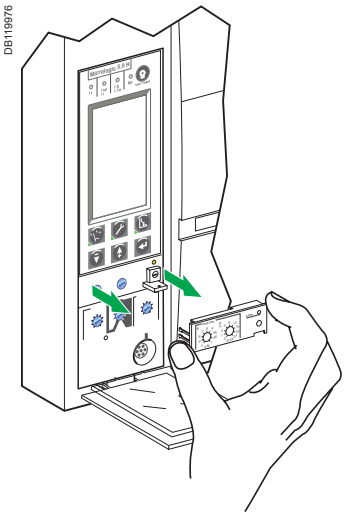


3. completely remove the long-time rating plug screw



Caution!
If no long-time rating plug is installed, the control unit continues to operate under the following downgraded conditions:
- the long-time current setting Ir is 0.4
- the long-time tripping delay tr corresponds to the value indicated by the adjustment dial
- the earth-leakage protection function is disabled
- the voltage-measurement inputs are disconnected.

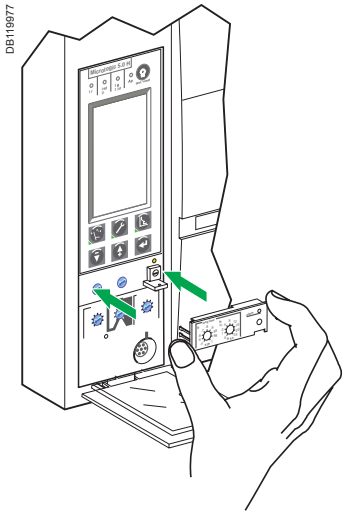
4. snap out the rating plug



5. clip in the new rating plug

6. refit the screw for the long-time rating plug

7. check and/or modify the control-unit settings



Thermal memory

Thermal memory

The thermal memory is the means to take into account temperature rise and cooling caused by changes in the flow of current in the conductors.

These changes may be caused by:
- repetitive motor starting
- loads fluctuating near the long-time protection settings
- repeated circuit-breaker closing on a fault.

Control units with a thermal memory record the temperature rise caused by each overload, even very short ones. This information stored in the thermal memory reduces the tripping time.

Micrologic control units and thermal memory

All Micrologic control units are equipped as standard with a thermal memory.

- For all protection functions, prior to tripping, the temperature-rise and cooling time constants are equal and depend depend on the tr tripping delay:
  - if the tripping delay is short, the time constant is low
  - if the tripping delay is long, the time constant is high.

- For long-time protection, following tripping, the cooling curve is simulated by the control unit. Closing of the circuit breaker prior to the end of the time constant (approximately 15 minutes) reduces the tripping time indicated in the tripping curves.

Short-time protection and intermittent faults

For the short-time protection function, intermittent currents that do no provoke tripping are stored in the Micrologic H memory.
This information is equivalent to the long-time thermal memory and reduces the tripping delay for the short-time protection.
Following a trip, the short-time tsd tripping delay is reduced to the value of the minimum setting for 20 seconds.

Ground-fault protection and intermittent faults

The ground-fault protection implements the same function as the short-time protection (see above).

Data available via the COM communications option

The COM communications option can be used to remotely access the Micrologic H measurement, setting, maintenance and protection values.

Measurements

■ Currents
□ instantaneous currents
□ maximum and minimum instantaneous currents
□ average instantaneous currents
□ instantaneous-current unbalance per phase
□ maximum and minimum instantaneous-current unbalance per phase
■ Demand current
□ demand current per phase
□ maximum and minimum demand current per phase since last reset
□ prediction of demand current per phase
□ time-stamping of demand-current maximums and minimums
■ Voltages
□ phase-to-neutral and phase-to-phase voltages
□ average phase-to-neutral and phase-to-phase voltages
□ phase-to-neutral and phase-to-phase voltage unbalance
□ maximum and minimum phase-to-neutral and phase-to-phase voltage unbalance
■ Active, reactive and apparent power per phase
■ Demand power
□ demand power per phase
□ maximum and minimum demand power per phase since last reset
□ maximum and minimum recommended demand power per phase
□ time-stamping of demand-power maximums and minimums
■ Energy
□ total active and reactive energy
□ positively incremented energy
□ negatively incremented energy
■ System frequency
■ Power factor
■ Reset date of demand currents, demand power and energy
■ Power quality indicators:
□ instantaneous measurements together with maximums and minimums:
- fundamental apparent currents
- fundamental phase-to-neutral and phase-to-phase voltages
- fundamental rms currents
- fundamental active, reactive and apparent power per phase and total
- distortion power per phase and total
- THD and thd of the phase-to-neutral and phase-to-phase voltages
- THD and thd of the currents
- phase angle between the voltages and the currents
- K factors
- peak voltages
- peak currents
- phase angle between the voltages
- K factors averages
□ demand K factors:
- demand K factors per phase
- maximum demand K factor per phase since last reset
- prediction of demand K factors
- time-stamping of demand K factor maximums per phase
□ harmonics:
- phase-to-neutral and phase-to-phase voltage harmonic amplitudes
- current harmonic amplitudes
- phase-to-neutral and phase-to-phase voltage harmonic phase angle
- current harmonic phase angle
□ monitoring of electrical parameters
□ dates of last resets of minimums and maximums
□ waveform capture
□ event history file in the measurement module
□ minimum and maximum file with time-stamping
□ maintenance file in the measurement module
- minimum and maximum reset counters with time-stamping
- maximum demand-current reset counters with time-stamping
- maximum demand-power reset counters with time-stamping
- energy reset counters with time-stamping.

Data available via the COM communications option

Setup / Maintenance

- Setting of the control-unit date and time
- Password for the measurement module
- Control-unit ID code
- Control-unit ID name
- Selection of the measurement calculation algorithm
- Sign convention for the active power
- Total-energy measurement mode
- Interval for the demand-current calculation window
- Power quality indication
- Demand-power calculation mode
- Interval for the demand-power calculation window
- Battery-charge indication
- Trip and alarm histories
- Operation counter and contact-wear indicator
- Assignment and setup of programmable contacts
- Event log and maintenance register
- Power factor sign conventions
- Monitoring parameters
- Monitoring priorities levels
- Waveform capture.

Protection

- Circuit-breaker rated current
- Type of neutral protection
- Long-time I^2t protection settings
- Long-time Idmtl protection settings
- Short-time protection settings
- Instantaneous-protection settings
- Ground-fault protection settings
- Earth-leakage protection settings
- Current-unbalance, $I_{\triangleq}$ alarm and maximum-current protection settings
- Voltage-protection settings
- Setting for other protection functions.

Threshold and time-delay settings

Long-time I²t and Idmtl protection

Type	Range	Factory setting	Step	Accuracy
Ir current setting	0.4 to In	maximum	1 A	1.05 to 1.20 Ir
tr tripping delay	0.5 to 24 s	maximum	0.5 s	-20 %, +0 %

Short-time protection

Type	Range	Factory setting	Step	Accuracy
Isd pickup	1.5 to 10 Ir	maximum	10 A	±10 %
tsd tripping delay	0 - 0.1 - 0.2 - 0.3 - 0.4 s	maximum	0.1 s	

Instantaneous protection

Type	Range	Factory setting	Step	Accuracy
Ii pickup	2 to 15 In or off	maximum	10 A	±10 %

Ground-fault protection on Micrologic 6.0 H

Type	Range	Factory setting	Step	Accuracy
Ig pickup	depends on rating	maximum	1 A	±10 %
tg tripping delay	0 - 0.1 - 0.2 - 0.3 - 0.4 s	maximum	0.1 s	

Earth-leakage protection on Micrologic 7.0 H

Type	Range	Factory setting	Step	Accuracy
IΔn pickup		maximum	0.1 A	-20 %, +0 %
Δt tripping delay	60 -140 - 230 - 350 - 800 ms	maximum	1 setting	

Neutral protection

Type	Range	Factory setting
Three-pole device	Off, N/2, N, 1.6 x N	off
Four-pole device	Off, N/2, N	N/2

Threshold and time-delay settings

Current protection

Type	Range	Factory setting	Step	Accuracy
Current unbalance I unbal				
Pickup threshold	5 % to 60 %	60 %	1 %	-10 %, +0 %
Dropout threshold	5 % of pickup threshold	pickup threshold	1 %	-10 %, +0 %
Pickup time delay	1 s to 40 s	40 s	1 s	-20 %, +0 %
Dropout time delay	10 s to 360 s	10 s	1 s	-20 %, +0 %
Ground-fault I ⏚ alarm				
Pickup threshold	20 A to 1200 A	120 A	1 A	±15 %
Dropout threshold	20 A to pickup threshold	pickup threshold	1 A	±15 %
Pickup time delay	1 s to 10 s	10 s	0.1 s	-20 %, +0 %
Dropout time delay	1 s to 10 s	1 s	0.1 s	-20 %, +0 %
Earth-leakage I ⏚ alarm				
Pickup threshold	0.5 A to 30 A	30 A	0.1 A	-20 %, +0 %
Dropout threshold	0.5 A to pickup threshold	pickup threshold	0.1 A	-20 %, +0 %
Pickup time delay	1 s to 10 s	10 s	0.1 s	-20 %, +0 %
Dropout time delay	1 s to 10 s	1 s	0.1 s	-20 %, +0 %
Maximum current T1 max, T2 max, T3 max, TN max				
Pickup threshold	0.2 In to In	In	1 A	±6.6%
Dropout threshold	0.2 In to pickup threshold	pickup threshold	1 A	±6.6%
Pickup time delay	15 s to 1500 s	1500 s	1 s	-20 %, +0 %
Dropout time delay	15 s to 3000 s	15 s	1 s	-20 %, +0 %

Voltage protection

Type	Range	Factory setting	Step	Accuracy
Minimum voltage U min				
Pickup threshold	100 V to U max pickup threshold	100 V	5 V	-5 %, +0 %
Dropout threshold	pickup threshold to U max pickup threshold	pickup threshold	5 V	-5 %, +0 %
Pickup time delay	1.2 s to 5 s	5 s	0.1 s	-0 %, +20 %
Dropout time delay	1.2 s to 36 s	1.2 s	0.1 s	-0 %, +20 %
Maximum voltage U max				
Pickup threshold	U min pickup threshold to 1200 V	725 V	5 V	-0 %, +5 %
Dropout threshold	100 V to pickup threshold	pickup threshold	5 V	-0 %, +5 %
Pickup time delay	1.2 s to 5 s	5 s	0.1 s	-0 %, +20 %
Dropout time delay	1.2 s to 36 s	1.2 s	0.1 s	-0 %, +20 %
Voltage unbalance U unbal				
Pickup threshold	2 % to 30 %	30 %	1 %	-20 %, +0 %
Dropout threshold	2 % to pickup threshold	pickup threshold	1 %	-20 %, +0 %
Pickup time delay	1 s to 40 s	40 s	1 s	-20 %, +0 %
Dropout time delay	10 s to 360 s	10 s	1 s	-20 %, +0 %

Threshold and time-delay settings

Other protection

Type	Range	Factory setting	Step	Accuracy
Reverse power rP max				
Pickup threshold	5 to 500 kW	500 kW	5 kW	±2.5%
Dropout threshold	5 kW to pickup threshold	pickup threshold	5 kW	±2.5%
Pickup time delay	0.2 s to 20 s	20 s	0.1 s	-0 %, +20 % (1)
Dropout time delay	1 s to 360 s	1 s	0.1 s	-0 %, +20 %
Maximum frequency F max				
Pickup threshold	F min pickup threshold to 440 Hz	65 Hz	0.5 Hz	±0.5 Hz
Dropout threshold	45 Hz to pickup threshold	pickup threshold	0.5 Hz	±0.5 Hz
Pickup time delay	1.2 s to 5 s	5 s	0.1 s	-0 %, +20 % (2)
Dropout time delay	1.2 s to 36 s	1.2 s	0.1 s	-0 %, +20 % (2)
Minimum frequency F min				
Pickup threshold	45 Hz to F max pickup threshold	45 Hz	0.5 Hz	±0.5 Hz
Dropout threshold	pickup threshold to F max pickup threshold	pickup threshold	0.5 Hz	±0.5 Hz
Pickup time delay	1.2 s to 5 s	5 s	0.1 s	-0 %, +20 % (2)
Dropout time delay	1.2 s to 36 s	1.2 s	0.1 s	-0 %, +20 % (2)
Phase rotation				
Pickup threshold	Ph1, Ph2, Ph3 or Ph1, Ph3, Ph2	Ph1, Ph2, Ph3	none	none
Dropout threshold	pickup threshold	pickup threshold	none	none
Pickup time delay	0.3 s	0.3 s	none	-0 %, +50 %
Dropout time delay	0.3 s	0.3 s	none	-0 %, +50 %

(1) +30 % on dial 0.2 s
(2) +30 % up to 1.5 s

Load shedding and reconnection

Type	Range	Factory setting	Step	Accuracy
Current I				
Pickup threshold	50 % to 100 % Ir	100 % Ir	1 %	±6 %
Dropout threshold	30 % Ir to shedding threshold	shedding threshold	1 %	±6 %
Pickup time delay	20 % to 80 % tr	80 % tr	1 %	-20 %, +0 %
Dropout time delay	10 s to 600 s	10 s	1 s	-20 %, +0 %
Power P				
Pickup threshold	200 kW to 10 000 kW	10 000 kW	50 kW	±2.5 %
Dropout threshold	100 kW to shedding threshold	shedding threshold	50 kW	±2.5 %
Pickup time delay	10 s to 3600 s	3600 s	10 s	-20 %, +0 %
Dropout time delay	10 s to 3600 s	10 s	10 s	-20 %, +0 %

Other settings

M2C / M6C contacts

Type	Range	Factory setting	Step
Time-delay latching time delay	1 - 360 s	360 s	1 s

Micrologic setup

Type	Range	Factory setting	Step
Language	German English US English UK Italian French Spanish Chinese	English UK	
Date / time			1 s
Circuit-breaker selection		"no def"	
Neutral TC		no TC	
VT ratio			
Primary voltage	min. 100 V, max. 1150 V	690 V	1 V
Secondary voltage	min. 100 V, max. 690 V	690 V	1 V
System frequency	50/60 Hz or 400 Hz	50/60 Hz	

Measurement setup

Type	Range	Factory setting	Step
System type	3 Φ, 3 w, 3 CT 3 Φ, 4 w, 3 CT 3 Φ, 4 w, 4 CT	3 Φ, 4 w, 4 CT	
Demand-current			
Calculation method	thermal or block interval	block interval	
Type of window	fixed or sliding	sliding	
Calculation interval	5 to 60 minutes	15 minutes	1 minute
Demand-power			
Calculation method	thermal or block interval or sync. to comms	block interval	
Type of window	fixed or sliding	sliding	
Calculation interval	5 to 60 minutes	15 minutes	1 minute
Power sign	P+ P-	P+ (flow from top to bottom)	
Sign convention	IEEE IEEE alternate IEC	IEEE	

Communication setup

Type	Range	Factory setting
Com parameter	MODBUS	
Adress	1-47	47
Baud rate	9600 to 19200 bauds	19200 bauds
Parity	even none	even
Remote settings		
Access authorisation	yes / no	yes
Access code	0000 to 9999	0000
Remote control	manual automatic	automatic

Protection setup

Type	Range	Factory setting
Current protection **voltage protection** **other protection**	alarm / trip / OFF	OFF

Measurement setting ranges and accuracy

■ The accuracy of the current measurements depends on both the value displayed (or transmitted) and the circuit-breaker rating, where:
Accuracy = 0.5 % In + 1.5 % reading

Example:
For a circuit breaker with a 4000 A rating and a current displayed on Micrologic of 49 A, the accuracy is:
0.5 % x 4000 + 1.5 % x 49 = ±21 A

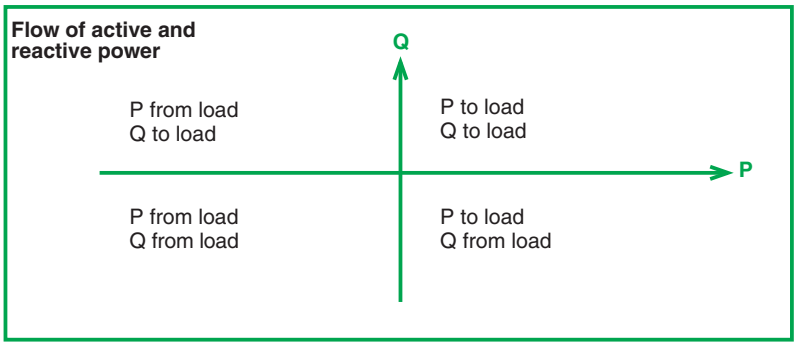
Measurement setting ranges and accuracy

Type	Range	Accuracy at 25 °C
Instantaneous current		
I1, I2, I3	0.05 x In to 20 x In	±1.5 %
IN	0.05 x In to 20 x In	±1.5 %
I ⏚ ground	0.05 x In to In	±10 %
I ⏚ earth leakage	0 to 30 A	±1.5 %
I1 max, I2 max, I3 max	0.05 x In to 20 x In	±1.5 %
IN max	0.05 x In to 20 x In	±1.5 %
I ⏚ max ground	0.05 x In to In	±10 %
I ⏚ max earth leakage	0 to 30 A	±1.5 %
Demand current		
$\overline{I1}$, $\overline{I2}$, $\overline{I3}$	0.05 x In to 20 x In	±1.5 %
$\overline{IN}$	0.05 x In to 20 x In	±1.5 %
$\overline{I1}$ max, $\overline{I2}$ max, $\overline{I3}$ max	0.05 x In to 20 x In	±1.5 %
$\overline{IN}$ max	0.05 x In to 20 x In	±1.5 %
Phase-to-phase voltages		
U12	170 to 1150 V	±0.5 %
U23	170 to 1150 V	±0.5 %
U31	170 to 1150 V	±0.5 %
Phase-to-neutral voltages		
V1N	100 to 1150 V	±0.5 %
V2N	100 to 1150 V	±0.5 %
V3N	100 to 1150 V	±0.5 %
Average voltage		
U avg	170 to 1150 V	±0.5 %
Voltage unbalance		
U unbal	0 to 100 %	±0.5 %
Instantaneous power		
P	0.015 to 184 MW	±2 %
Q	0.015 to 184 Mvar	±2 %
S	0.015 to 184 MVA	±2 %
Power factor		
PF	-1 to +1	±2 %
Demand power		
P	0.015 to 184 MW	±2 %
Q	0.015 to 184 Mvar	±2 %
S	0.015 to 184 MVA	±2 %
P max	0.015 to 184 MW	±2 %
Q max	0.015 to 184 Mvar	±2 %
S max	0.015 to 184 MVA	±2 %
Total energy		
E.P	-10^{10} GWh to $+10^{10}$ GWh	±2 %
E.Q	-10^{10} Gvarh to $+10^{10}$ Gvarh	±2 %
E.S	-10^{10} GVAh to $+10^{10}$ GVAh	±2 %
Total energy in		
E.P	-10^{10} GWh to $+10^{10}$ GWh	±2 %
E.Q	-10^{10} Gvarh to $+10^{10}$ Gvarh	±2 %
Total energy out		
E.P	-10^{10} GWh to $+10^{10}$ GWh	±2 %
E.Q	-10^{10} Gvarh to $+10^{10}$ Gvarh	±2 %
Frequency		
F	45 Hz to 440 Hz	±0.1 %
Fundamentals		
I	0.005 x In to 1.5 x In	±1.5 % (1)
U	30 to 1150 V	±0.5 %
P, Q, S	0.15 to 13.8 kW	±2 %
THD, thd		
I	2 to 1000%	±5 %
U	2 to 1000%	±5 %
FFT		
I	0 to 1000%	±5 %
U	0 to 1000%	±5 %

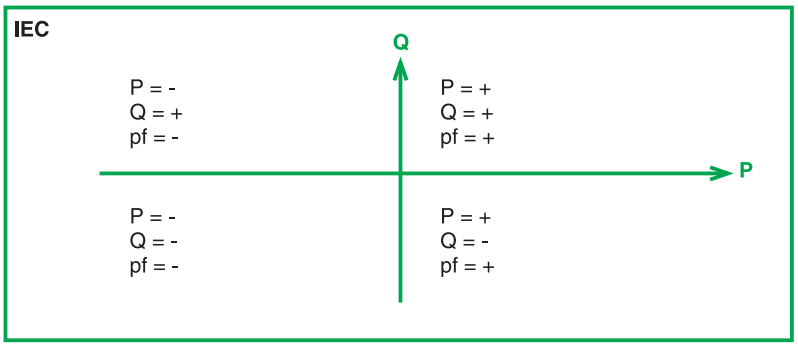
(1) Over the range 0.7 x In to 1.5 x

Power factor sign conventions

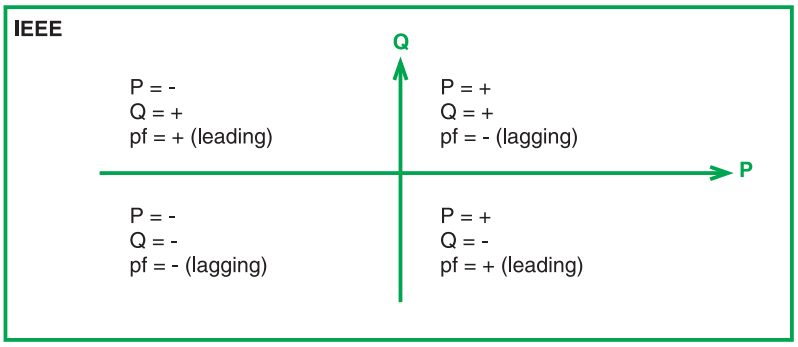
DB120011



DB119979



DB119980



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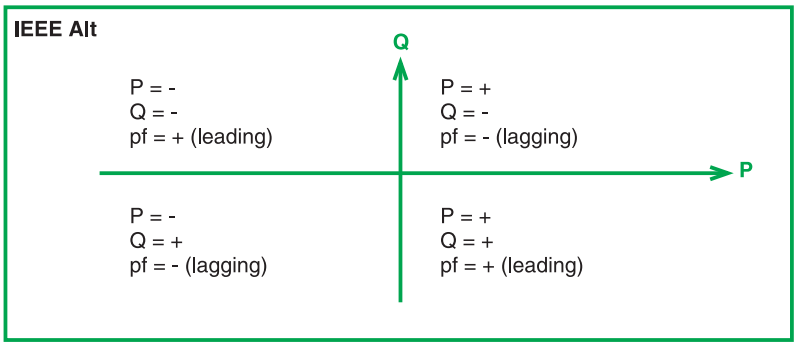

Notes

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