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

Measurement Characteristics

Presentation

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

Current

Measurement	Unit	Range	Accuracy	Accuracy range
• RMS current on phases 1, 2, 3 • Maximum RMS current on phases 1, 2, 3 (I1 MAX, I2 MAX, I3 MAX) • Maximum value (MAXMAX) of all phase currents • Minimum RMS current on phases 1, 2, 3 (I1 MIN, I2 MIN, I3 MIN) • Minimum value (MINMIN) of all phase currents	A	0–20 In	+/-0.5%	MTZ1 : 40–1600 x 1.2 In MTZ2 : 40–4000 x 1.2 In MTZ3 : 80–6300 x 1.2 In
• RMS current on neutral [1] • Maximum RMS current on neutral IN MAX [1] • Minimum RMS current on neutral IN MIN [1]	A	0–20 In	+/-1%	MTZ1 : 40–1600 x 1.2 In MTZ2 : 40–4000 x 1.2 In MTZ3 : 80–6300 x 1.2 In
• Average of 3 phase RMS currents • Maximum average of 3 phase RMS currents Iavg MAX • Minimum average of 3 phase RMS currents Iavg MIN	A	0–20 In	+/-0.5%	MTZ1:40–1600 x 1.2 In MTZ2:40–4000 x 1.2 In MTZ3:80–6300 x1.2 In
• RMS current on ground [2] • Maximum/minimum RMS current on ground [2]	A	0–20 In	5%	MTZ1:40–1600 x 1.2 In MTZ2:40–4000 x 1.2 In MTZ3:80–6300 x1.2 In
• Earth-leakage current measurement [3] • Maximum/minimum value of the earth-leakage current [3]	A	0–30 A	10%	0.1–30 A
1 Applies to 4-pole circuit breakers or 3-pole circuit breakers with ENCT wired and configured. 2 Applies to Micrologic 6.0 X control unit 3 Applies to Micrologic 7.0 X control unit				

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

Current Unbalance

Measurement	Unit	Range	Accuracy	Accuracy range
• Phase current unbalance on phase 1, 2, 3 (I1 unbal, I2 unbal, I3 unbal) • Maximum of 3 phase current unbalances (I1 unbal MAX, I2 unbal MAX, I3 unbal MAX) • Maximum of maximum of 3 phase current unbalances (MAXMAX)	%	0–100%	+/-5	0–100%

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

Voltage

Measurement	Unit	Range	Accuracy	Accuracy range
• RMS phase-to-phase V12, V23, V31 voltage measurements [1] • Maximum RMS phase-to-phase voltages V12 MAX L-L, V23 MAX L-L, V31 MAX L-L [1] • Minimum RMS phase-to-phase voltages V12 MIN L-L, V23 MIN L-L, V31 MIN L-L[1] • Maximum of the maximum phase-to-phase voltages (V12, V23, V31) • Minimum of the minimum phase-to-phase voltages (V12, V23, V31)	V	0–1,150 V	+/-0.5%	208–690 x 1.2 V
• RMS phase-to-neutral V1N, V2N, V3N voltage measurements[1] • Maximum RMS phase-to-neutral voltages V1N MAX L-N, V2N MAX L-N, V3N MAX L-N [1] • Minimum RMS phase-to-neutral voltages V1N MIN L-N, V2N MIN L-N, V3N MIN L-N [1] • Maximum of the maximum phase-to-neutral voltages (V1N, V2N, V3N) [1] • Minimum of the minimum phase-to-neutral voltages (V1N, V2N, V3N) [1]	V	0–660 V	+/-0.5%	120–400 x 1.2 V
• Average of 3 RMS phase-to-phase voltages Vavg: (V12+V23+V31)/3 • Maximum of average of 3 RMS phase-to-phase voltages Vavg MAX: (V12+V23+V31)/3 • Minimum of average of 3 RMS phase-to-phase voltages Vavg MIN: (V12+V23+V31)/3	V	0–1,150 V	+/-0.5%	208–690 x 1.2 V
1 Applies to 4-pole circuit breakers or 3-pole circuit breakers with ENVT wired and configured.				

Voltage Unbalance

Measurement	Unit	Range	Accuracy	Accuracy range
• Phase-to-phase voltage unbalances V12unbal L-L, V23unbal L-L, V31unbal L-L [1] • Maximum of 3 phase-to-phase voltage unbalances V12unbal MAX L-L, V23unbal MAX L-L, V31unbal MAX L-L[1] • Maximum of maximum (MAXMAX) of 3 phase-to-phase voltage unbalances [1]	%	0–100%	+/-0.5	0–10%
• Phase-to-neutral voltage unbalances V1Nunbal L-N, V2Nunbal L-N, V3Nunbal L-N unbalance measurements [1] • Maximum of 3 phase-to-neutral voltage unbalances V1Nunbal MAX L-L, V2Nunbal MAX L-L, V3Nunbal MAX L-L [1] • Maximum of maximum (MAXMAX) of 3 phase-to-neutral voltage unbalances[1]	%	0–100%	+/-0.5	0–10%
1 Applies to 4-pole circuit breakers or 3-pole circuit breakers with ENVT wired and configured.				

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

Power

Measurement	Unit	Range	Accuracy	Accuracy range
• Active power on phase 1, phase 2, phase 3 [1] • Maximum active power on phase 1, phase 2, phase 3 P1 MAX, P2 MAX, P3 MAX[1]) • Minimum active power on phase 1, phase 2, phase 3 P1 MIN, P2 MIN, P3 MIN [1]	kW	-16,000–16,000 kW	+/-1%	2
• Total active power Ptot • Maximum total active power Ptot MAX • Minimum total active power Ptot MIN	kW	-16,000–16,000 kW	+/-1%	2
• Reactive power on phase 1, phase 2, phase 3 Q1, Q2, Q3 [1] • Maximum reactive power on phase 1, phase 2, phase 3 Q1 MAX, Q2 MAX, Q3 MAX [1] • Minimum reactive power on phase 1, phase 2, phase 3 Q1 MIN, Q2 MIN, Q3 MIN [1]	kVAR	-16,000–16,000 kVAR	+/-2%	2
• Total reactive power Qtot • Maximum total reactive power Qtot MAX • Minimum total reactive power Qtot MIN	kVAR	-16,000–16,000 kVAR	+/-1%	2
• Apparent power on phase 1, phase 2, phase 3 S1, S2, S3 [1] • Maximum apparent power on phase 1, phase 2, phase 3 S1 MAX, S2 MAX, S3 MAX [1] • Minimum apparent power on phase 1, phase 2, phase 3 S1 MIN, S2 MIN, S3 MIN [1]	kVA	0–16,000 kVA	+/-1%	2
• Total apparent power Stot • Maximum total apparent power Stot MAX • Minimum total apparent power Stot MIN	kVA	0–16,000 kVA	+/-1%	2
• Fundamental reactive power on phase 1, phase 2, phase 3 Qfund 1, Qfund 2, Qfund 3[1] • Maximum fundamental reactive power on phase 1, phase 2, phase 3 Qfund 1 MAX, Qfund 2 MAX, Qfund 3 MAX [1] • Minimum fundamental reactive power on phase 1, phase 2, phase 3 Qfund 1 MIN, Qfund 2 MIN, Qfund 3 MIN [1]	kVAR	-16,000–16,000 kVAR	+/-1%	2
• Total fundamental reactive power Qfundtot • Maximum total fundamental reactive power Qfundtot MAX • Minimum total fundamental reactive power Qfundtot MIN	kVAR	-16,000–16,000 kVAR	+/-1%	2
1 Applies to 4-pole circuit breakers or 3-pole circuit breakers with ENVT wired and configured. 2 The power measurement range according to IEC 61557-12 is defined by current range, voltage, and power factor values.				

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

Power Factor PF and cos ϕ

Measurement	Unit	Range	Accuracy	Accuracy range
• Total power factor PF • Maximum total power factor PF MAX • Minimum total power factor PF MIN	–	-1.00–1.00	+/-0.02	0.5 ind - 0.8 cap
• Power factors on phase 1, phase 2, phase 3 PF1, PF2, PF3 [1] • Maximum power factor on phase 1, phase 2, phase 3 PF1 MAX, PF2 MAX, PF3 MAX [1] • Minimum power factor on phase 1, phase 2, phase 3 PF1 MIN, PF2 MIN, PF3 MIN [1]	–	-1.00–1.00	+/-0.02	0.5 ind - 0.8 cap
1 Applies to 4-pole circuit breakers or 3-pole circuit breakers with ENVT wired and configured.				

Measurement	Unit	Range	Accuracy	Accuracy range
• Total fundamental power factor cos ϕ • Maximum total fundamental power factor cos ϕ MAX • Minimum total fundamental power factor cos ϕ MIN	–	-1.00–1.00	+/-0.02	0.5 ind - 0.8 cap
• cos ϕ 1, cos ϕ 2, cos ϕ 3 on phase 1, phase 2, phase 3 [1] • Maximum cos ϕ 1 MAX, cos ϕ 2 MAX, cos ϕ 3 MAX on phase 1, phase 2, phase 3[1] • Minimum cos ϕ 1 MIN, cos ϕ 2 MIN, cos ϕ 3 MIN on phase 1, phase 2, phase 3[1]	–	-1.00–1.00	+/-0.02	0.5 ind - 0.8 cap
1 Applies to 4-pole circuit breakers or 3-pole circuit breakers with ENVT wired and configured.				

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

Total Harmonic Distortion of Currents and Voltages

Measurement	Unit	Range	Accuracy	Accuracy range
• Total harmonic distortion (THD) of current on phase 1, phase 2, phase 3 THD(I1), THD(I2), THD(I3) • Maximum total harmonic distortion (THD) of current on phase 1, phase 2, phase 3 THD(I1) MAX, THD(I2) MAX, THD(I3) MAX • Minimum total harmonic distortion (THD) of current on phase 1, phase 2, phase 3 THD(I1) MIN, THD(I2) MIN, THD(I3) MIN	%	0–1,000%	+/-1.5	0–100% when I > 80 A
			+/-1.5 x THD/100	100–200%
• Total harmonic distortion (THD) of phase-to-phase voltage THD(V12) L-L, THD(V23) L-L, THD(V31) L-L • Maximum total harmonic distortion (THD) of phase-to-phase voltage THD(V12) MAX L-L, THD(V23) MAX L-L, THD(V31) MAX L-L • Minimum total harmonic distortion (THD) of phase-to-phase voltage THD(V12) MIN L-L, THD(V23) MIN L-L, THD(V31) MIN L-L	%	0–1,000%	+/-0.6	0–20% when V > 208 V
• Total harmonic distortion (THD) phase-to-neutral voltage THD(V1N) L-N, THD(V2N) L-N, THD(V3N) L-N [1] • Maximum total harmonic distortion (THD) phase-to-neutral voltage THD(V1N) MAX L-N, THD(V2N) L-L MAX L-N, THD(V3N) MAX L-N [1] • Minimum total harmonic distortion (THD) phase-to-neutral voltage THD(V12) MIN L-N, THD(V2N) MIN L-N, THD(V31) MIN L-N [1]	%	0–1,000%	+/-0.6	0–20% when V > 120 V

Frequency

Measurement	Unit	Range	Accuracy	Accuracy range
• Frequency • Maximum frequency • Minimum frequency	Hz	15–440 Hz	+/-0.2%	45–65 Hz

Energy Meters

Measurement	Unit	Range	Accuracy	Accuracy range
Active energy Ep, EpIn delivered, and EpOut received	kWh	-10,000,000 to 10,000,000	+/-1%	1
Reactive energy Eq, EqIn delivered, and EqOut received	kVARh	-10,000,000 to 10,000,000	+/-2%	1
1 The energy measurement range according to IEC 61557-12 is defined by current range, voltage, and power factor values.				

Measurement	Unit	Range	Accuracy	Accuracy range
Apparent energy Es	kVAh	-10,000,000 to 10,000,000	+/-1%	1
1 The energy measurement range according to IEC 61557-12 is defined by current range, voltage, and power factor values.				

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

Measurement Availability

Presentation

Measurements can be displayed through the following interfaces:
- The Micrologic X display screen
- The Masterpact MTZ mobile App
- The FDM128
- The Ecoreach software
- The communication network

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

Current

Measurement	Micrologic X HMI	Masterpact MTZ mobile App	FDM128	Ecoreach software	Communication
Phase I1, I2, I3 current measurements	X	X	X	X	X
Maximum phase current values I1 MAX, I2 MAX, I3 MAX	X	X	X	X	X
Maximum value (MAXMAX) of all phase currents	–	X	–	X	X
Minimum phase current values I1 MIN, I2 MIN, I3 MIN	–	X	–	X	X
Minimum value (MINMIN) of all phase currents	–	X	–	X	X
Neutral IN current measurement [1]	X	X	–	X	X
Maximum neutral current value IN MAX[1]	X	X	–	X	X
Minimum neutral current value IN MIN[1]	–	X	–	X	X
Average current Iavg measurements	X	X	X	X	X
Maximum average current value Iavg MAX	–	X	X	X	X
Minimum average current value Iavg MIN	–	X	–	X	X
Ground-fault current measurement [2]	–	X	–	X	X
Maximum/minimum value of the ground-fault current [2]	–	X	–	X	X
Earth-leakage current measurement [3]	–	X	–	X	X
Maximum/minimum value of the earth-leakage current [3]	–	X	–	X	X
1 With 4-pole circuit breakers or 3-pole circuit breakers with ENCT wired and configured. 2 Applies to Micrologic 6.0 X control unit 3 Applies to Micrologic 7.0 X control unit					

Current Unbalance

Measurement	Micrologic X HMI	Masterpact MTZ mobile App	FDM128	Ecoreach software	Communication
Phase current unbalance measurements I1 unbal, I2 unbal, I3 unbal	X	X		X	X
Maximum values of phase current unbalances I1 unbal MAX, I2 unbal MAX, I3 unbal MAX	X	X		X	X
Maximum value (MAXMAX) of all phase current unbalances	–	X		X	X

Voltage

Measurement	Micrologic X HMI	Masterpact MTZ mobile App	FDM128	Ecoreach software	Communication
Phase-to-phase V12, V23, V31 voltage measurements[1]	X	X		X	X
Maximum values of phase-to-phase voltages V12 MAX L-L, V23 MAX L-L, V31 MAX L-L [1]	X	X		X	X
Minimum values of phase-to-phase voltages V12 MIN L-L, V23 MIN L-L, V31 MIN L-L ([1])	X	X		X	X
Maximum value of the maximum phase-to-phase voltages (V12, V23, V31	–	X		X	X
Minimum value of the minimum phase-to-phase voltages (V12, V23, V31)	–	X		X	X
Phase-to- neutral V1N, V2N, V3N voltage measurements [1]	X	X		X	X
Maximum values of phase-to-neutral voltages V1N MAX L-N, V2N MAX L-N, V3N MAX L-N [1]	X	X		X	X
Minimum values of phase-to-neutral voltages V1N MIN L-N, V2N MIN L-N, V3N MIN L-N [1]	X	X		X	X
Maximum value of the maximum phase-to-neutral voltages (V1N, V2N, V3N) [1]	–	X		X	X
Minimum value of the minimum phase-to-neutral voltages (V1N, V2N, V3N) [1]	–	X		X	X
Average voltage Vavg measurements	X	X		X	X
Maximum average voltage value Vavg MAX	–	X		X	X
Minimum average voltage Vavg MIN	–	X		X	X
1 4-pole circuit breakers or 3-pole circuit breakers with ENVT wired and configured.					

Voltage Unbalance

Measurement	Micrologic X HMI	Masterpact MTZ mobile App	FDM128	Ecoreach software	Communication
Phase-to-phase voltage V12unbal L-L, V23unbal L-L, V31unbal L-L and phase-to-neutral voltage V1Nunbal L-N, V2Nunbal L-N, V3Nunbal L-N unbalance measurements [1]	X	X		X	X
Maximum values of phase-to-phase voltage unbalances V12unbal MAX L-L, V23unbal MAX L-L, V31unbal MAX L-L and phase-to-neutral voltage unbalances V1Nunbal MAX L-L, V2Nunbal MAX L-L, V3Nunbal MAX L-L [1]	X	X		X	X
Maximum values (MAXMAX) of all phase-to-phase and phase-to-neutral voltage unbalances	–	X		X	X
Maximum values of phase-to-phase voltage unbalances V12unbal MAX L-L, V23unbal MAX L-L, V31unbal MAX L-L[1]	X	X		X	X
1 4-pole circuit breakers or 3-pole circuit breakers with ENVT wired and configured.					

Measurement	Micrologic X HMI	Masterpact MTZ mobile App	FDM128	Ecoreach software	Communication
Maximum values (MAXMAX) of the maximum of the phase-to-phase voltage unbalances [1]	–	X		X	X
Phase-to-neutral voltage V1Nunbal L-N, V2Nunbal L-N, V3Nunbal L-N unbalance measurements [1]	X	X		X	X
Maximum values of phase-to-neutral voltage unbalances V1Nunbal MAX L-L, V2Nunbal MAX L-L, V3Nunbal MAX L-L[1]	X	X		X	X
Maximum values (MAXMAX) of the maximum of the phase-to-neutral voltage unbalances [1]	–	X		X	X
1 4-pole circuit breakers or 3-pole circuit breakers with ENVT wired and configured.					

Power

Measurement	Micrologic X HMI	Masterpact MTZ mobile App	FDM128	Ecoreach software	Communication
Active power measurements for each phase P1, P2, P3 [1]	X	X		X	X
Maximum values of active powers for each phase P1 MAX, P2 MAX, P3 MAX [1]	–	X		X	X
Minimum values of active powers for each phase P1 MIN, P2 MIN, P3 MIN [1]	–	X		X	X
Total active power measurement Ptot	X	X		X	X
Maximum value of total active power Ptot MAX	X	X		X	X
Minimum value of total active power Ptot MIN	–	X		X	X
Reactive power measurements for each phase Q1, Q2, Q3 [1]	X	X		X	X
Maximum values of reactive powers for each phase Q1 MAX, Q2 MAX, Q3 MAX [1]	–	X		X	X
Minimum values of reactive powers for each phase Q1 MIN, Q2 MIN, Q3 MIN [1]	–	X		X	X
Total reactive power measurement Qtot	X	X		X	X
Maximum value of total reactive power Qtot MAX	X	X		X	X
Minimum value of total reactive power Qtot MIN	–	X		X	X
Apparent power measurements for each phase S1, S2, S3 [1]	X	X		X	X
Maximum values of apparent powers for each phase S1 MAX, S2 MAX, S3 MAX [1]	–	X		X	X
Minimum values of apparent powers for each phase S1 MIN, S2 MIN, S3 MIN [1]	–	X		X	X
Total apparent power measurement Stot	X	X		X	X
1 With 4-pole circuit breakers or 3-pole circuit breakers with ENVT wired and configured.					

Measurement	Micrologic X HMI	Masterpact MTZ mobile App	FDM128	Ecoreach software	Communication
Maximum value of total apparent power Stot MAX	X	X		X	X
Minimum value of total apparent power Stot MIN	–	X		X	X
Fundamental reactive power measurements for each phase Qfund 1, Qfund 2, Qfund 3 [1]	–	X		X	X
Maximum values of fundamental reactive powers for each phase Qfund 1 MAX, Qfund 2 MAX, Qfund 3 MAX [1]	–	X		X	X
Minimum values of fundamental reactive powers for each phase Qfund 1 MIN, Qfund 2 MIN, Qfund 3 MIN [1]	–	X		X	X
Total fundamental reactive power measurement Qfundtot	–	X		X	X
Maximum value of total fundamental reactive power Qfundtot MAX	–	X		X	X
Minimum value of total fundamental reactive power Qfundtot MIN	–	X		X	X
1 With 4-pole circuit breakers or 3-pole circuit breakers with ENVT wired and configured.					

Operating Indicators

Measurement	Micrologic X HMI	Masterpact MTZ mobile App	FDM128	Ecoreach software	Communication
Operating quadrant measurement	???	X		X	X
Type of load measurement	???	X		X	X

Power Factor PF and cos ϕ

Measurement	Micrologic X HMI	Masterpact MTZ mobile App	FDM128	Ecoreach software	Communication
Total power factor PF	X	X		X	X
Maximum value of the total power factor PF MAX	–	X		X	X
Minimum value of the total power factor PF MIN	–	X		X	X
Power factors PF1, PF2, PF3 for each phase [1]	–	X		X	X
Maximum values of the power factors PF1 MAX, PF2 MAX, PF3 MAX for each phase [1]	–	X		X	X
Minimum values of the power factors PF1 MIN, PF2 MIN, PF3 MIN for each phase [1]	–	X		X	X
Total cos ϕ	X	X		X	X
Maximum value cos ϕ MAX	–	X		X	X
Minimum value cos ϕ MIN	–	X		X	X
cos ϕ 1, cos ϕ 2, cos ϕ 3 for each phase [1]	–	X		X	X
1 4-pole circuit breakers or 3-pole circuit breakers with ENVT wired and configured.					

Measurement	Micrologic X HMI	Masterpact MTZ mobile App	FDM128	Ecoreach software	Communication
Maximum values cos ϕ 1 MAX, cos ϕ 2 MAX, cos ϕ 3 MAX for each phase [1]	–	X		X	X
Minimum values cos ϕ 1 MIN, cos ϕ 2 MIN, cos ϕ 3 MIN for each phase [1]	–	X		X	X
1 4-pole circuit breakers or 3-pole circuit breakers with ENVT wired and configured.					

Total Harmonic Distortion of Currents and Total Harmonic Voltages

Measurement	Micrologic X HMI	Masterpact MTZ mobile App	FDM128	Ecoreach software	Communication
Total harmonic distortion (THD) of current for each phase THD(I1), THD(I2), THD(I3)	X	X		X	X
Maximum values of the total harmonic distortion (THD) of current for each phase THD(I1) MAX, THD(I2) MAX, THD(I3) MAX	–	X		X	X
Minimum values of the total harmonic distortion (THD) of current for each phase THD(I1) MIN, THD(I2) MIN, THD(I3) MIN	–	X		X	X
Total harmonic phase-to-phase voltage THD(V12) L-L, THD(V23) L-L, THD(V31) L-L distortion	–	X		X	X
Maximum values of the total harmonic phase-to-phase voltage THD(V12) MAX L-L, THD(V23) MAX L-L, THD(V31) MAX L-L distortion	–	X		X	X
Minimum values of the total harmonic phase-to-phase voltage THD(V12) MIN L-L, THD(V23) MIN L-L, THD(V31) MIN L-L distortion	–	X		X	X
Total harmonic phase-to-neutral voltage THD(V1N) L-N, THD(V2N) L-N, THD(V3N) L-n distortion [1]	–	X		X	X
Maximum values of the total harmonic phase-to-neutral voltage THD(V1N) MAX L-N, THD(V2N) L-L MAX L-N, THD(V3N) MAX L-N distortion [1]	X	X		X	X
Minimum values of the total harmonic phase-to-neutral voltage THD(V12) MIN L-N, THD(V2N) MIN L-N, THD(V31) MIN L-N distortion [1]	–	X		X	X

Frequency

Measurement	Micrologic X HMI	Masterpact MTZ mobile App	FDM128	Ecoreach software	Communication
Frequency measurement	X	X		X	X
Maximum frequency	X	X		X	X
Minimum frequency	X	X		X	X

Energy Meters

Measurement	Micrologic X HMI	Masterpact MTZ mobile App	FDM128	Ecoreach software	Communication
Active energy measurements: Ep, EpIn supplied, and EpOut consumed	X	X		X	X
Reactive energy measurements: Eq, EqIn supplied, and EqOut consumed	X	X		X	X
Apparent energy measurement Es	X	X		X	X

Network Settings

Presentation

The following settings are related to the characteristics of the local network. They are used by the measurement functions of the Micrologic X control unit.

Rated Voltage

Available settings include: 208 V / 220 V / 230 V / 240 V / 380 V / 400 V / 415 V / 440 V / 480 V / 500 V / 525 V / 550 V / 575 V / 600 V / 660 V / 690 V / 1000 V.

Default = 400 V.

The rated voltage can be set in the following ways:

- On the Micrologic X display screen, at **Home** → **Configuration** → **Network** → **Nominal Voltage**
- With Ecoreach software
- With Masterpact MTZ mobile App
- By sending a setting command using the communication network.

Rated Frequency

Available settings are:

- 50 Hz
- 60 Hz

The rated frequency can be set in the following ways:

- On the Micrologic X display screen, at **Home** → **Configuration** → **Network** → **Nominal Frequency**
- With Ecoreach software
- With Masterpact MTZ mobile App
- By sending a setting command using the communication network.

VT Ratio

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

The value range for the primary voltage (VT in) is from 100–1250 in increments of 1.

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

The primary and secondary voltages can be set in the following ways:

- On the Micrologic X display screen, at **Home** → **Configuration** → **Network** → **VT Ratio**
- With Ecoreach software
- With Masterpact MTZ mobile App
- By sending a setting command using the communication network.

Real-Time Measurements

Presentation

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

- Measure the following currents in real time and as an rms value:
  - Current for each phase and the neutral (if present)
  - Ground-fault current
  - Earth-leakage current (Micrologic 7.0 X)
- Calculate the average current in real time
- Determine the maximum and minimum values for these electrical quantities
- Measure the phase-to-phase and phase-to-neutral voltage (if present), in real time and as an rms value
- Calculate the associated electrical quantities from the rms values of the currents and voltages:
  - Average phase-to-phase voltage and phase-to-neutral voltage (if present)
  - Current unbalances
  - Phase-to-phase voltage unbalances and phase-to-neutral voltage unbalances (if present)
- Calculate the associated electrical quantities from the current and voltage samples:
  - Powers *(see page 117)*
  - Quality indicators: frequency, THD(I) and THD(V) *(see page 124)*, and power factor PF and cos ϕ measurement *(see page 126)*
- Display operating indicators: quadrants, and type of load
- Determine the maximum and minimum values for these electrical quantities
- Increment in real time three energy meters (active, reactive, apparent) using the total power real-time values *(see page 117)*

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

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

System Type Setting

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

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

The system type can be set as follows:

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

Measuring the Neutral Current

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

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

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

Measuring the Ground-Fault Current

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

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

Measuring the Earth-Leakage Current (Micrologic 7.0 X)

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

Measuring the Phase-to-Neutral Voltages

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

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

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

Calculating the Average Current and Average Voltage

Micrologic X control units calculate the:

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

  Iavg = (I1 + I2 + I3)/3

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

    Vavg = (V12 + V23 + V31)/3

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

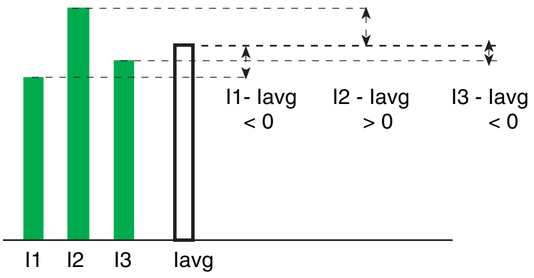
    Vavg = (V1N + V2N + V3N)/3

Measuring the Current and Voltage Phase Unbalances

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

The current unbalance is a percentage of the average current:

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



Micrologic X control units calculate:

- The phase-to-phase voltage unbalance for each phase (3 values)
- The phase-to-neutral (if present) voltage unbalance for each phase (3 values)

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

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

Maximum/Minimum Values

The Micrologic X control unit determines in real time the maximum (MAX) and minimum (MIN) value reached by the following electrical quantities for the period from the last reset to the present time:
- Current: phase and neutral currents, average currents and current unbalances
- Voltage: phase-to-phase and phase-to-neutral voltages, average voltages, and voltage unbalances
- Power: total power and phase power (active, reactive, and apparent)
- Total harmonic distortion: the total harmonic distortion THD for both current and voltage
- Frequency
- The maximum value (MAXMAX) of all phase currents
- The minimum value (MINMIN) of all phase currents

Resetting Maximum/Minimum Values

The maximum and minimum values can be reset:
- On the Micrologic X display screen, at:
  - Home → Measures → Current
  - Home → Measures → Voltage
  - Home → Measures → Power
  - Home → Measures → Frequency
  - Home → Measures → I Harmonics
  - Home → Measures → V Harmonics
- With Ecoreach software
- With Masterpact MTZ mobile App
- By sending a command using the communication network. This function is password-protected.

NOTE: The maximum and minimum power factors and cos Φ can be reset only:
- With Ecoreach software
- With Masterpact MTZ mobile App
- By sending a command using the communication network. This function is password protected.

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

Resetting maximum and minimum generates a low severity event, which is logged in the Metering history, as follows:

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

Power Metering

Presentation

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

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

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

Principle of Power Metering

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

The calculation principle is based on:

- Definition of the powers
- Algorithms depending on the type of circuit breaker (4-pole or 3-pole)
- Set value of the power sign (circuit breaker powered from the top or underside)

The calculation algorithm is explained in the specific topic *(see page 120)*.

Calculations use harmonics up to the fifteenth.

Total Power Calculation Method

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

- Vector
- Arithmetic

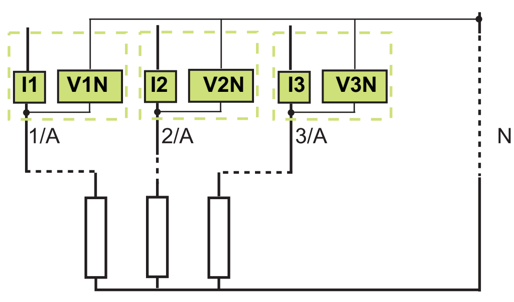
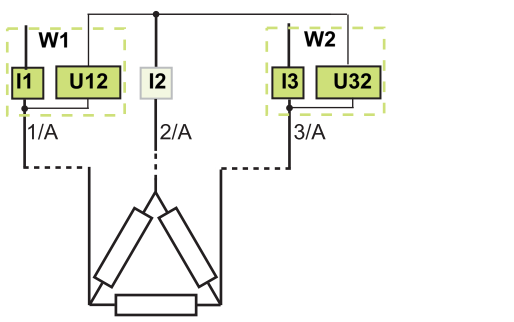
NOTE: The total active power is calculated as a sum of the phase powers: Ptot = P1 + P2 + P3

The calculation method can be set in the following ways:

- On the Micrologic X display screen, at **Home** → **Configuration** → **Measures** → **Total P Calcul**
- With Ecoreach software
- With Masterpact MTZ mobile App

3-Pole Circuit Breaker, 4-Pole Circuit Breaker

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

<table>
<tr><th>4-pole or 3-pole with ENVT: 3-wattmeter method</th><th>3-pole without ENVT: 2-wattmeter method</th></tr>
<tr><td>
</td><td>
</td></tr>
</table>

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

The following table lists the metering options:

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

3-Pole Circuit Breaker, Distributed Neutral

Declare the ENVT in the system type setting *(see page 114)*.

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

Power Sign and Operating Quadrant

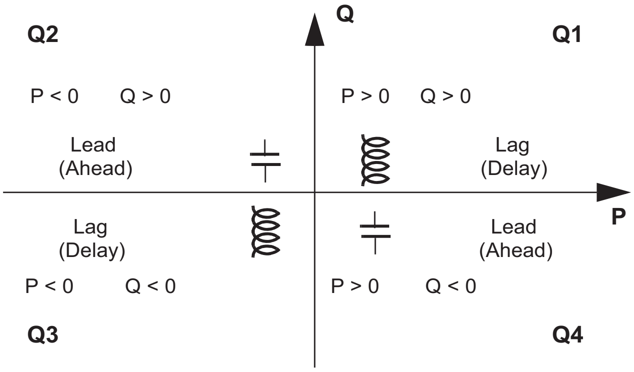
By definition, the active powers are:

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

By definition, the reactive powers have:

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

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



NOTE: The power values are:

- Signed when read using the communication network.
- Not signed when displayed on the Micrologic X display screen.

Power Sign Convention

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

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

Set the power sign convention as follows:

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

Power Calculation Algorithm

Presentation

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

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

All the calculated quantities are displayed:
- On the Micrologic X display screen, on the screens **Home** → **Measures** → **Power**
- On the Ecoreach software
- On the Masterpact MTZ mobile App
- By a remote controller using the communication network

Active Powers

Metering on a 3-pole or 4-pole circuit breaker with ENVT wired and configured	Metering on a 3-pole circuit breaker without ENVT wired and configured
The active power for each phase and total active power is calculated.	Only the total active power can be calculated.
$Pp = \frac{1}{T}\int_T Vp(t)Ip(t)dt$ Where p=1, 2, 3 (phase)	–
Ptot = P1 + P2 + P3	Ptot = Pw1 + Pw2

P_{W1} and P_{W2} are the fictitious powers calculated by the 2-wattmeter method.

Reactive Power

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

Apparent Power

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

Energy Metering

Presentation

The control unit calculates the different types of energy using energy meters and provides the values of:
- The total active energy Ep, the active energy supplied EpOut, and the active energy consumed EpIn
- The total reactive energy Eq, the reactive energy supplied EqOut, and the reactive energy consumed EqIn
- The total apparent energy Es

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

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

NOTE: The energies per phase are available as an option *(see page 129)*. They are calculated using the same principles as total energies.

Principle of Energy Calculation

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

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

Partial Energy Meters

For each type of energy, active or reactive, a partial consumed energy meter and a partial supplied energy meter calculate the accumulated energy by incrementing once a second:
- The contribution of the consumed power to the consumed energy meter
  Ein(t)(consumed) = Ein(t - 1) + (Gin(t))/3600 where Gin = Ptot or Qtot consumed
- The contribution as an absolute value of the supplied power for the supplied energy meter (supplied power is always counted negatively)
  Eout(t)(supplied) = Eout(t - 1) + (|Gout(t)|)/3600 where Gin = Ptot or Qtot supplied

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

Energy Meters

From the partial energy meters and for each type of energy, active or reactive, an energy meter provides either of the following measurements once a second:
- The absolute energy, by adding the consumed and supplied energies together. The energy accumulation mode is absolute.
  E(t)absolute = Ein(t) + Eout(t)
- The signed energy, by differentiating between consumed and supplied energies. The energy accumulation mode is signed.
  E(t)signed = Ein(t) - Eout(t)

The apparent energy Es is always counted positively.

Selecting Energy Calculation

The information sought determines calculation selection:
- The absolute value of the energy that has crossed the poles of a circuit breaker or the cables of an item of electrical equipment is relevant for maintenance of an installation.
- The signed values of the energy supplied and the energy consumed are required to calculate the economic cost of an item of equipment.

By default, absolute energy accumulation mode is configured.

Select the energy calculation mode using any of the following methods:
- On the Micrologic X display screen, on the screens **Home → Configuration → Measures → E calcul**
- With Ecoreach software
- With Masterpact MTZ mobile App
- By or sending a setting command using the communication network.This function is password-protected.

Resetting Energy Meters

The energy meters can be reset:

- On the Micrologic X display screen, on the screens **Home → Measures → Energy → Reset Counter**
- With Ecoreach software
- With Masterpact MTZ mobile App
- By writing a reset command using the communication network. This function is password-protected.

All energy meters are reset together, except the 2 active energy accumulation meters (EpIn and EpOut) that cannot be reset.

Resetting the energy meters generates a low severity event, which is logged in the Metering history.

Presetting Energy Meters

Harmonic Currents and Voltages

Origin and Effects of Harmonics

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

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

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

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

Definition of a Harmonic

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

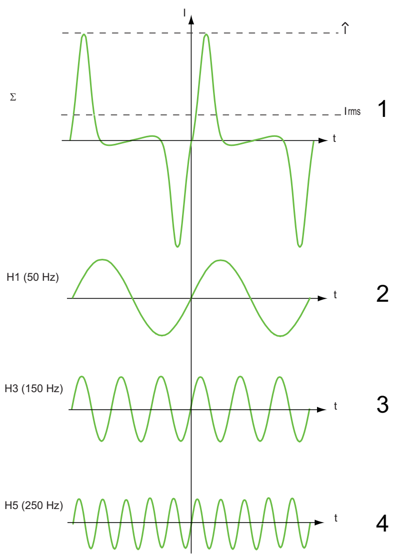
This periodic signal is broken down into a sum of terms:

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

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

NOTE: The first harmonic is called the fundamental.

Example of a current wave distorted by a harmonic component:



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

Power Quality Indicators

Presentation

The control unit calculates total harmonic distortion for voltages and currents.

Total harmonic distortions related to the fundamental value (THD(V), THD(I)) are displayed on the Micrologic X display screen.

In addition, total harmonic distortions related to rms values (THD-R(V), and THD-R(I)) can be displayed with Ecoreach software

Displaying the Total Harmonic Distortion

The total harmonic distortion THD can be displayed in the following ways:

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

Current THD

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

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

The current THD can be higher than 100%.

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

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

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

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

Voltage THD

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

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

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

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

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

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

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

Current THD-R

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

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

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

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

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

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

Voltage THD-R

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

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

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

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

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

Power Factor PF and cos ϕ Measurement

Power Factor PF

The control unit calculates:

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

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

NOTE: Stot is the vector or arithmetic total apparent power, depending on the setting *(see page 120)*.

This indicator qualifies:

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

cos ϕ

The control unit calculates:

- The cos ϕ per phase from the phase active and apparent powers of the fundamental
- the cos ϕ from the total active power Pfundtot and the total apparent power Sfundtot of the fundamental (first order)

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

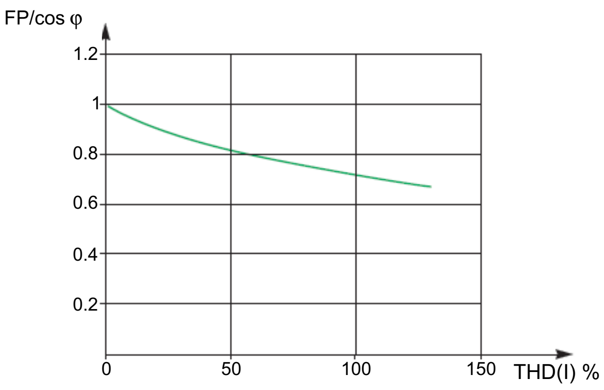
This indicator qualifies use of the energy supplied.

Power Factor PF and cos ϕ when Harmonic Currents are Present

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

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

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



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

Sign for the Power Factor PF and cos ϕ

2 sign conventions can be applied for these indicators:

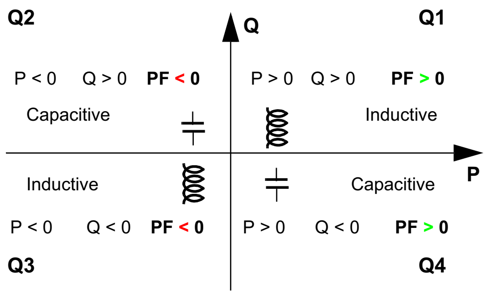
- IEC convention: The sign for these indicators complies strictly with the signed calculations of the powers (that is, Ptot, Stot, Pfundtot, and Sfundtot).
- IEEE convention: The indicators are calculated in accordance with the IEC convention but multiplied by the inverse of the sign for the reactive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

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

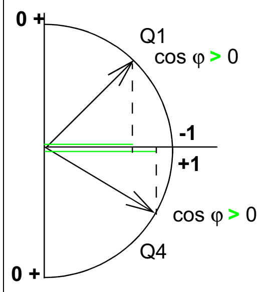
The figures below define the sign for the power factor PF and cos ϕ by quadrant (Q1, Q2, Q3 and Q4) for both conventions:

IEC Convention

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

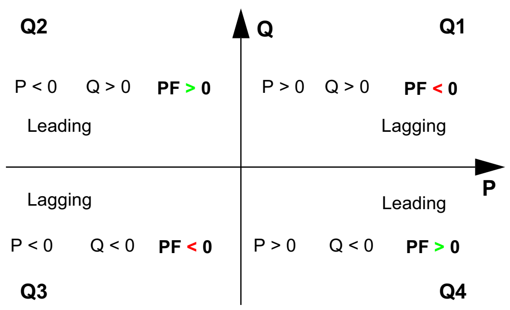


Values of cos ϕ in receiver operation (Q1, Q4)

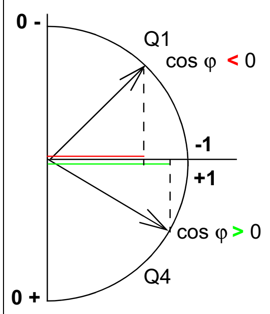


IEEE Convention

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



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



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

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

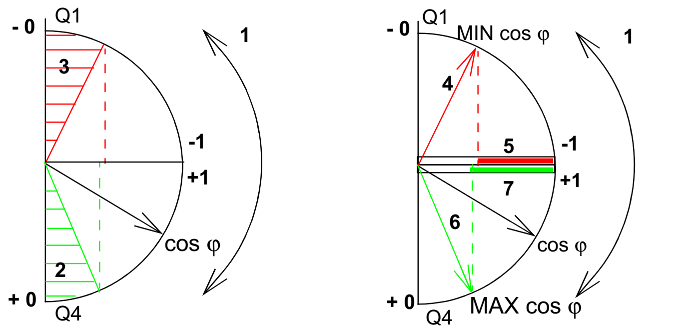
Managing the Power Factor PF and cos ϕ: Minimum and Maximum Values

Managing the PF and cos ϕ indicators consists of:

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

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

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



1 Arrows indicating the cos ϕ variation range for the load in operation
2 Critical zone + 0 for highly capacitive devices (shaded green)

3 Critical zone - 0 for highly inductive devices (shaded red)
4 Minimum position of the load cos ϕ (lagging): red arrow
5 Variation range of the value of the load cos ϕ (lagging): red
6 Maximum position of the load cos ϕ (leading): green arrow
7 Variation range of the value of the load cos ϕ (leading): green

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

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

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

Monitoring the cos ϕ and Power Factor PF Indicators

According to the IEEE convention, critical situations in receiver mode on a capacitive or inductive load are detected and discriminated (2 values).

The table below indicates the direction in which the indicators vary and their value in receiver mode.

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

The quality indicator MAX and MIN indicate both critical situations.

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

The table below indicates the direction in which the indicators vary and their value in receiver mode.

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

The quality indicator MAX indicates both critical situations.

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

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

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

The IEEE convention is applied by default.

The selection is displayed on the Micrologic X display screen, at **Home** → **Configuration** → **Measures** → **PF/VAR Conv**.

Section 4.2
Optional Metering Functions

Energy per Phase

Presentation

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

The energy per phase is calculated using the method described for calculating energy *(see page 121)*.

Prerequisites

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

The prerequsites are:

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

Measurement Availability

The measurements can be consulted in the following ways:

- With Masterpact MTZ mobile App
- With Ecoreach software
- By sending a command using the communication network

Examples of Screens in the Masterpact MTZ mobile App

The following table shows examples of screens from the Masterpact MTZ mobile App:

Characteristics

Measurement	Range	Accuracy range
Active energy IN per phase	-10,000,000–10,000,000 kWh	+/-1 %
Active energy OUT per phase	-10,000,000–10,000,000 kWh	+/-1 %
Reactive energy IN per phase	-10,000,000–10,000,000 kVARh	+/-1 %
Reactive energy OUT per phase	-10,000,000–10,000,000 kVARh	+/-1 %
Apparent energy per phase	0–10,000,000 kVARh	+/-1 %

Resetting Energy Per Phase

Energy per phase can be reset and preset as other energy measurements *(see page 122)*.

Chapter 5
Diagnostic and Maintenance Functions

What Is in This Chapter?

This chapter contains the following sections:

Section 5.1
Maintenance Assistance

What Is in This Section?

This section contains the following topics:

Maintenance Schedule

Presentation

The maintenance schedule function records the date of the last maintenance operation.

Operating Principle

The date of the last maintenance operation is either recorded automatically after a secondary injection test or configured manually.

Function Settings

Manual configuration can be made in the following ways:

- With Ecoreach software
- By sending a setting command using the communication network

Circuit Breaker Overview

Presentation

The overview function displays a description of the circuit breaker, including:
- Name
- Rating
- Performance
- Number of poles

Function Output

The information is available as follows:
- On the Micrologic X display screen at **Home → Maintenance → CB overview**
- With Ecoreach software
- With Masterpact MTZ mobile App
- On a remote controller using the communication network

Section 5.2
Standard Diagnostic Functions

What Is in This Section?

This section contains the following topics:

Health Monitoring

Presentation

The health of the Micrologic X control unit is assessed by an internal analysis of the following indicators:

- Circuit breaker monitoring state
- Contact state *(see page 140)*
- Circuit breaker lifespan *(see page 143)*

Health is presented with one of the following icons:

- OK if no high- or medium-level event is detected
- Orange icon if at least one medium-level event is detected
- Red icon if at least one high-level event is detected

NOTE: Quick View on the Micrologic X display screen displays health with the OK icon when no event is detected. When an event is detected a pop-up screen is displayed *(see page 169)*.

Function Outputs

Details about health can be accessed:

- With Ecoreach software
- With Masterpact MTZ mobile App through Bluetooth
- On a remote controller using the communication network

Circuit Breaker Monitoring

Presentation

The Micrologic X control unit assesses the health of the circuit breaker by an internal monitoring of the following functions:

- Tripping function
- Closing and opening function
- Earth-leakage function (for Micrologic 7.0 X)
- Control unit state

Circuit Breaker Monitoring Outputs

The circuit breaker monitoring state is presented with one of the following icons:

-  if no high- or medium-level event is detected
-  if at least one medium-level event is detected
-  if at least one high-level event is detected

The circuit breaker monitoring state is displayed:

- On Ecoreach software
- On Masterpact MTZ mobile App through Bluetooth
- On a remote controller using the communication network

Monitoring the Tripping Function

Presentation

The Micrologic X control unit provides constant monitoring of the internal circuit of the circuit breaker, from the current sensors to the tripping actuator (Mitop).

Operating Principle

The result of the monitoring is indicated by the ready LED on the front face of the Micrologic X control unit, as follows:
- The ready LED is flashing
  - The circuit breaker is closed and the internal current is greater than 50 A (if the Micrologic X control unit is not powered by an auxiliary source)
  - The internal circuit of the circuit breaker is functioning correctly
- The ready LED is off: a malfunction detected in the internal circuit

Tripping Data

The following data about the tripping function is logged by the Micrologic X control unit:
- Total number of trips
- The name and date of the last test trip

The tripping data is displayed:
- With Ecoreach software
- With the Masterpact MTZ mobile App through Bluetooth
- With the Masterpact MTZ mobile App through NFC
- On a remote controller using the communication network

Predefined Events

The function generates the following events:

Event message	History	Severity
Micrologic self-test major malfunction	Diagnostic	High
Internal current sensors (CT) disconnected	Diagnostic	High
External neutral current sensor (ENCT) disconnected	Diagnostic	High
Earth leakage (Vigi) sensor disconnected	Diagnostic	High

Monitoring the Opening/Closing Function

Presentation

The Micrologic X control unit monitors communicating voltage releases.

It also counts the number of charging sequences performed by the MCH gear motor.

Monitoring the Communicating Voltage Releases

The function monitors the presence and functioning of the following:
- The communicating MN undervoltage release
- The communicating MX opening voltage release
- The communicating XF closing voltage release

Events are generated for a detected malfunction or when the presence of a communicating voltage release is no longer detected.

Counting MCH Gear Motor Charging Sequences

The Micrologic X control unit counts the number of charging sequences performed by the MCH gear motor to rearm the closing mechanism after each circuit breaker closure.

Events are generated when the number reaches 80% and 100% of the maximum.

Predefined Events

The function generates the following events:

Event	History	Severity
MX1 opening release malfunction	Diagnostic	Medium
MX1 opening release is no longer detected.	Diagnostic	Medium
MX2/MN opening release malfunction	Diagnostic	Medium
MX2/MN opening release is no longer detected.	Diagnostic	Medium
XF closing release malfunction	Diagnostic	Medium
XF closing release is no longer detected.	Diagnostic	Medium
MCH has reached 80% of the maximum number of operations	Diagnostic	Medium
MCH has reached the maximum number of operations	Diagnostic	High

Monitoring the Contact State

Presentation

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

The contact wear increases every time the circuit breaker interrupts or establishes the circuit with current.

Function Outputs

The function displays the contact wear on Ecoreach and Masterpact MTZ mobile App:

-  OK if wear < 60%
-  Medium level alarm if wear > 60% or > 95%
-  High-level alarm if wear > 99%

Predefined Events

The function generates the following events:

User message	History	Severity
Contact 60% worn out	Diagnostic	Medium
Contact 95% worn out	Diagnostic	Medium
Contact 100% worn out	Diagnostic	High

Monitoring the Internal Functioning of the Micrologic X control unit

Presentation

The Micrologic X control unit carries out a series of autotests to monitor:
- Correct internal functioning
- The state of the internal battery for power for power supply to trip-cause LEDs and red service LED
- The external sensors (ENCT)
- Wireless communication

Operating Principle

The ready LED and fault-trip indication LEDs provide visual information on the health of the Micrologic X control unit. Detected malfunctions can be classified as high or medium severity events:
- Medium severity event indicating minor malfunction detected
  - All fault-trip LEDs are lit
  - The ready LED is flashing
  - An orange pop-up screen is displayed
  - Current (LSI G/V) protection unaffected
- High severity event indicating major malfunction detected:
  - All fault-trip LEDs are lit
  - The ready LED is off
  - A red pop-up screen is displayed
  - Current (LSI G/V) protection can be affected
  - Control unit must be replaced

An event is generated each time a malfunction is detected.

Predefined Events

The function generates the following events:

User message	History	Severity
Current protection reset to default settings	Diagnostic	High
Reading accessing protection settings error	Diagnostic	Medium
Product self-test minor malfunction	Diagnostic	Medium
Metering and advanced protection malfunction	Diagnostic	Medium
Display screen or wireless malfunction	Diagnostic	Medium
Replace battery	Diagnostic	Medium
Minor- Corrected ASIC internal error warning	Diagnostic	Medium
FW internal error	Diagnostic	Medium
Sensor plug reading error	Diagnostic	High
Discrepancy ASIC configuration	Diagnostic	High
Critical hardware module discrepancy	Diagnostic	Medium
Critical firmware module discrepancy	Diagnostic	Medium
Non-critical hardware module discrepancy	Diagnostic	Medium
Non-critical firmware module discrepancy	Diagnostic	Medium
ULP module address conflict	Diagnostic	Medium
Firmware discrepancy within product	Diagnostic	Medium
NFC malfunction	Diagnostic	Medium
Bluetooth malfunction	Diagnostic	Medium
IEEE 802.15.4 malfunction	Diagnostic	Medium

Monitoring the ULP Modules

Presentation

The Micrologic X control unit monitors the connection and compatibility of settings of the following ULP modules:
- IO modules
- IFE Ethernet Interface

Predefined Events

The function generates the following events:

User message	History	Severity
IO1 module connection lost	Diagnostic	Medium
IO2 module connection lost	Diagnostic	Medium
IFE connection lost	Diagnostic	Medium
Conflict with IO module configuration	Configuration	Medium
ULP module address conflict	Diagnostic	Medium

Monitoring the Circuit Breaker Service Life

Presentation

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

Operating Principle

Each time the circuit breaker operates (performs an open and close cycle with or without current), the corresponding mechanical or electrical operating counter is incremented. The Micrologic X control unit calculates the number of cycles performed as a percentage of the maximum number of operations. The percentage of lifetime remaining for the device is calculated.

Function Outputs

The circuit breaker service life is presented as one of the following:

- OK if remaining life > 20%
- Medium level alarm if remaining life < 20%
- High-level alarm if remaining life = 0%

It is displayed in the following ways:

- With Ecoreach software
- With Masterpact MTZ mobile App through Bluetooth
- On a remote controller using the communication network

Predefined Events

The function generates the following events:

User message	History	Severity
Circuit breaker operations has passed 80% of service life	Diagnostic	Medium
Circuit breaker operations has passed the service life	Diagnostic	High

Section 5.3
Optional Diagnostic Functions

What Is in This Section?

This section contains the following topics:

Power Restoration Assistant Digital Module

Presentation

The Power Restoration Digital Module helps to reduce the time without a power supply for critical load (mean time to recovery (MTTR)) after a trip, an opening, or a loss of upstream supply.

The Digital Module provides the following assistance to help in the decision to restore power:
- Displays information on events and circuit breaker status
- Assists in determining the cause of events

Prerequisites

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

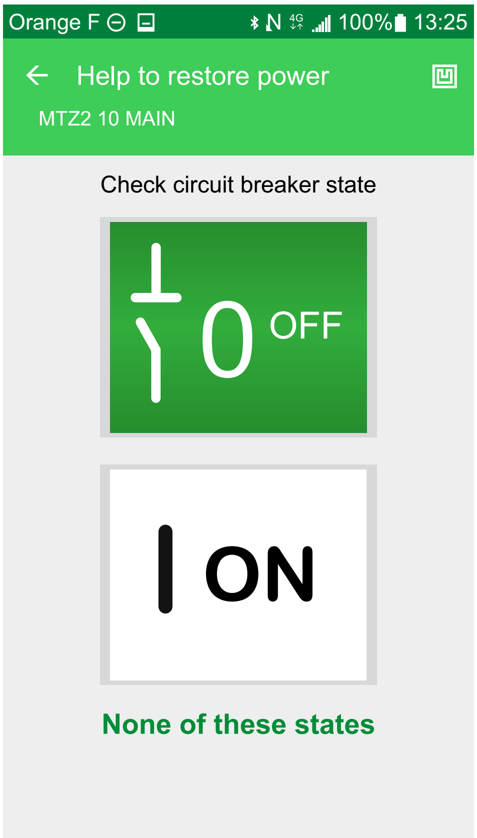
The prerequsites are:
- The Masterpact MTZ mobile App must be installed on a smartphone
- The smartphone must be connected to the Micrologic X control unit through:
  - Bluetooth: the control unit must be powered
  - NFC: the control unit does not need to be powered
- The Micrologic X date and time must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

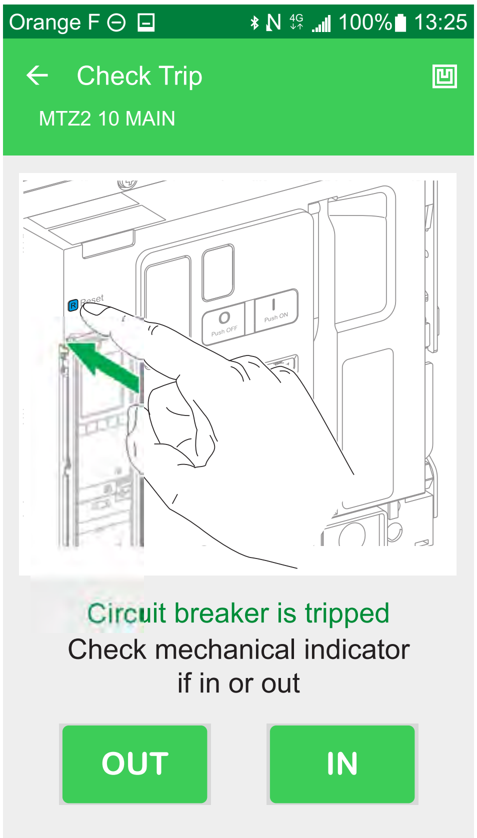
Availability of Assistance

Availability of features differs depending on the type of connection to the Digital Module:
- Through Bluetooth
- Through NFC (connection can be made when control unit is not powered)

Examples of Screens

Some examples of the screens available on the Digital Module are provided:





Masterpact Operation Assistant Digital Module

Presentation

The Masterpact Operation Assistant Digital Module helps to close the circuit breaker after a trip or opening.

The following features are available:
- Ready-to-close status
- Reset (if applicable)
- Spring charging (if applicable)
- Diagnostics on related reclosing information, for example, no power supply to MX, MN, or MCH

Prerequisites

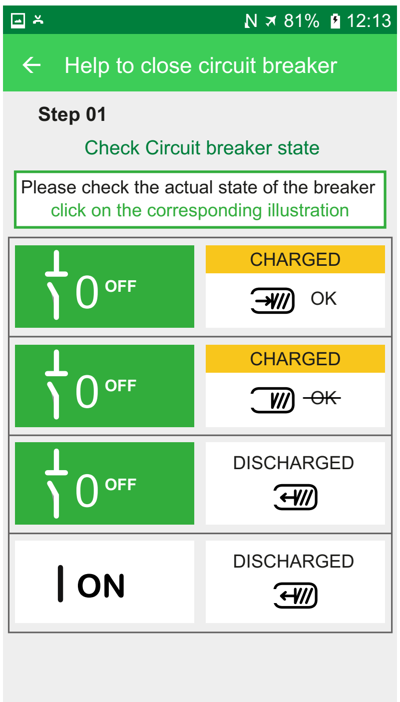
The Masterpact Operation Assistant Digital Module is an optional Digital Module, which can be purchased and installed on a Micrologic X control unit *(see page 20)*.

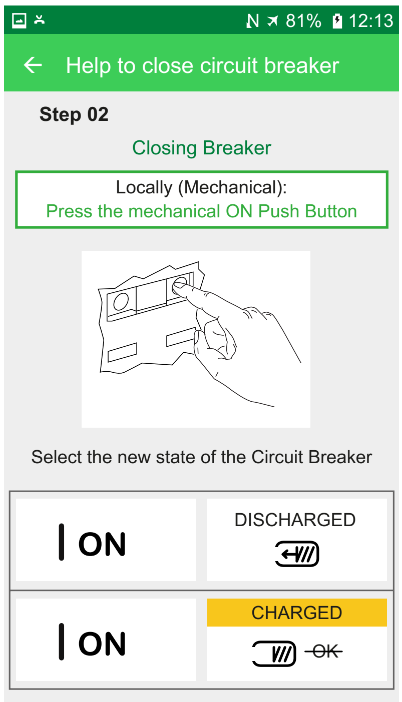
The prerequsites are:
- The Masterpact MTZ mobile App must be installed on a smartphone
- The smartphone must be connected to the Micrologic X control unit through:
  - Bluetooth: the control unit must be powered
  - NFC: the control unit does not need to be powered
- The Micrologic X date and time must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

Availability of Assistance

Availability of features differs depending on the type of connection to the Digital Module:
- Through Bluetooth: all features are available
- Through NFC (connection can be made when control unit is not powered): ???

Examples of Screens





Waveform Capture on Trip Event Digital Module

Presentation

The Waveform Capture on Trip Event Digital Module allows five cycles of phase and neutral currents to be logged after a trip on LSI or G protection, with a sampling period of 512 ms. One cycle before and four after the trip are logged.

In addition, the waveform capture function records the digital status of the following:

- Circuit breaker trip orders
- ZSI-IN signal
- SDE
- Open position of circuit breaker

One waveform capture is available at any one time. Generating a new waveform capture replaces the previous one.

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

Prerequisites

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

The prerequsites are:

- The Masterpact MTZ mobile App must be installed on a smartphone
- The smartphone must be connected to the Micrologic X control unit through Bluetooth:
- The Micrologic X date and time must be up to date

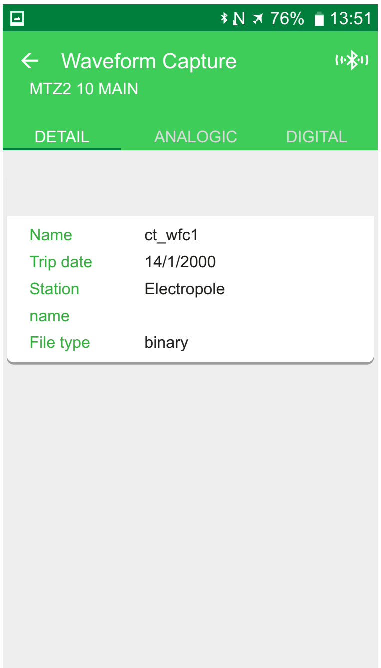
Availability of Data

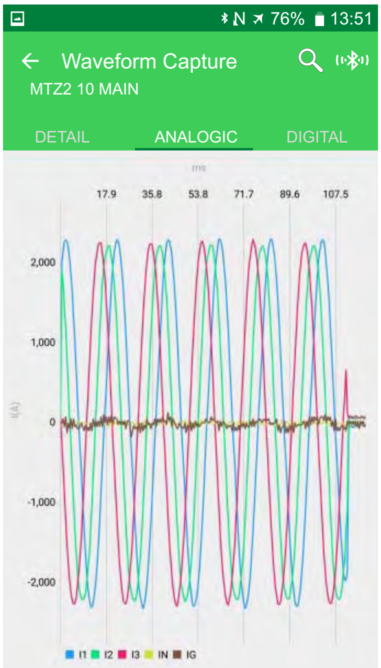
The waveform capture is displayed in the following ways:

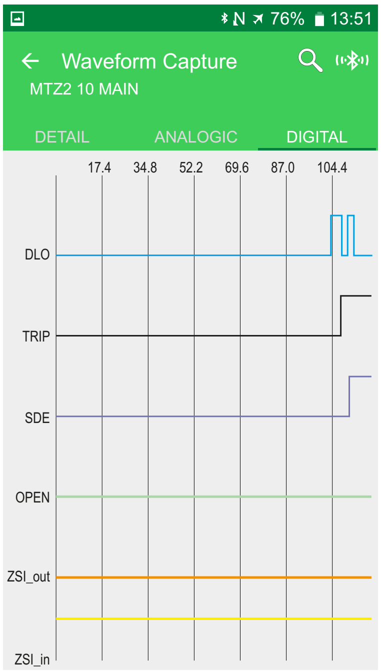
- On the Masterpact MTZ mobile App from the **Logs** menu
- In Ecoreach software
- As a COMTRADE file exported through the Masterpact MTZ mobile App or Ecoreach software, for use with Schneider Electric Wavewin-SE software

Examples of Screens

The following screens give examples of the type of information available on the Waveform Capture on Trip Event Digital Module:







Chapter 6
Operation Functions

What Is in This Chapter?

This chapter contains the following topics:

Control Modes

Control Mode Settings for Micrologic X

The following table summarizes the available control modes for operating Masterpact MTZ circuit breakers with Micrologic X control units:

Control Modes		Description
Manual		Only manual opening and closing of the circuit breaker by local mechanical buttons is accepted.
Auto	Local	In addition to accepting manual orders, enables open/close commands to be sent through Bluetooth, USB or IO module[1]
	Remote	In addition to accepting manual orders, enables open/close commands to be sent through Modbus/TCP, IFE/EIFE webpages or IO module[1]
1 According to IO input mode setting		

Operation According to Control Mode Configured

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

Type of order	Delivery	Manual	Auto	
			Local	Remote
Mechanical	Pushbutton	X	X	X
Electrical	BPFE	X	X	X
	BPFET	?	X	?
	Point to point (voltage release)	–	X	X
	IO module	–	X[1]	X[1]
Through Communication	Ecoreach software through USB connection	–	X	–
	Masterpact MTZ mobile App through Bluetooth	–	X	–
	Ethernet Modbus/TCP	–	–	X
	Webpages	–	–	X
1 According to IO input mode setting				

Configuring the Control Mode

The function can be set in the following ways:

- With Masterpact MTZ mobile App running the Masterpact Operation Assistant Digital Module
- On the Micrologic X display screen, at **Home** → **Configuration** → **Communication** → **Control Mode** → **Mode** (Manual or Auto)
- With Ecoreach software

Predefined Events

The following events are generated when control mode settings are changed:

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

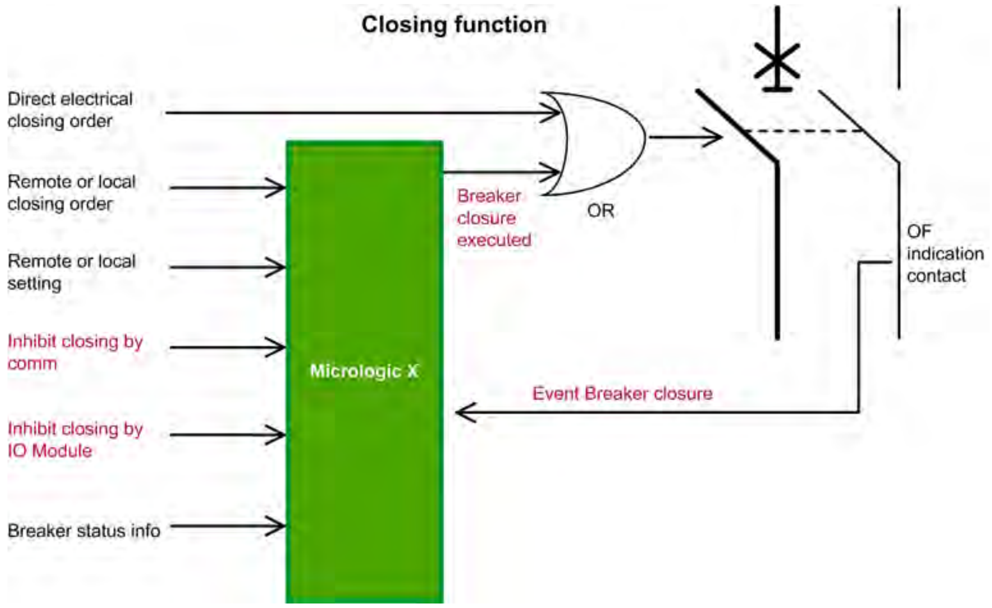
Closing Function

Presentation

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

Operating Principle

Closing orders can be sent in the following ways:
- Through a voltage release (direct electrical closing order)
- Through a local or remote order, which is managed by the Micrologic X control unit



Management of Closing Function

Micrologic X control units manage closing orders issued by the following means:
- BPFET connected to Micrologic X control unit
- IO module breaker operation
- Ecoreach via USB connection
- Masterpact MTZ mobile App via Bluetooth
- TCP via Ethernet Modbus
- IFE/EIFE webpages

Inhibiting the Closing Function

The closing functions can be inhibited by sending a command through:
- The communication network via Ethernet Modbus/TCP
- The IO module

Predefined Events

The following events are generated by the closing function:

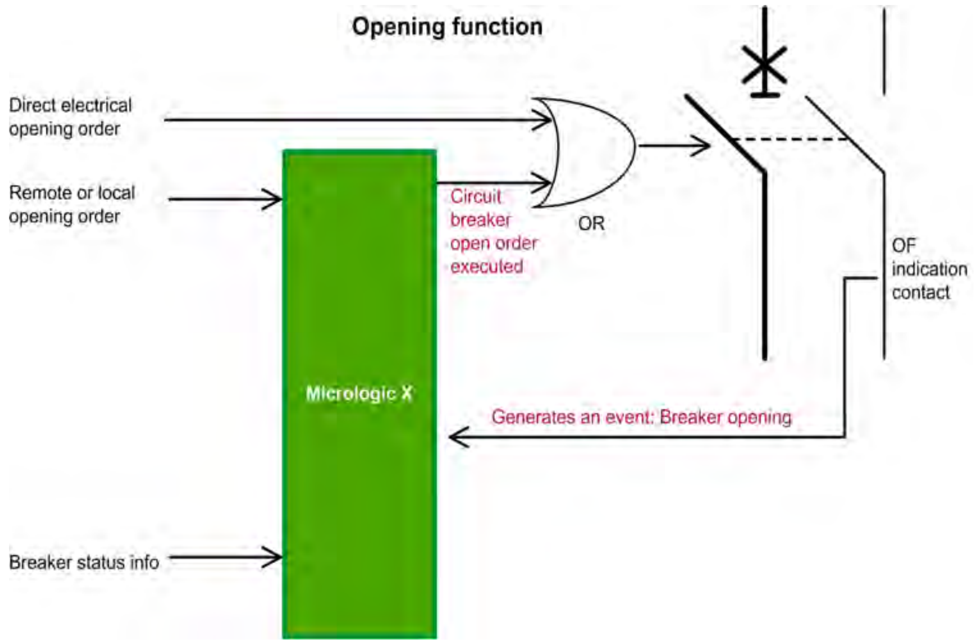
Event message	History	Severity
Circuit breaker moved from open to close position	Operation	Low
Circuit Breaker failed to open/close	Diagnostic	Medium
Close inhibited by communication	Operation	Low
Close inhibited by wired input	Operation	Low

Opening Function

Presentation

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

Operating Principle



Management of Opening Function

Micrologic X manages closing orders issued by the following means:
- IO module breaker operation
- Ecoreach via USB connection
- Masterpact MTZ mobile App via Bluetooth
- TCP via Ethernet Modbus
- IFE/EIFE web pages

Predefined Events

The following events are generated by the opening function:

Event message	History	Severity
Circuit breaker moved from close to open position	Operation	Low
Circuit Breaker failed to open/close	Diagnostic	Medium

Chapter 7
Communication Functions

What Is in This Chapter?

This chapter contains the following topics:

Bluetooth Low Energy Communication

Description

Using Bluetooth Low Energy (BLE communications, you can access the Micrologic X control unit from a smartphone running Masterpact MTZ mobile App *(see page 15)*. This application offers a task-oriented interface with the control unit. In particular, you can:

- Consult an overview of the main parameters of the circuit breaker
- Get detailed information on measurements, alarms and events, health state and current status of the circuit breaker
- Consult and modify protection settings
- Set the date and time parameters
- Set the protection parameters
- Share data by email

You can establish a Bluetooth connection with only one Micrologic X control unit at the same time. During the connection, the control unit is identified by the last digits of its serial number.

Note that you can consult data and send orders but you cannot download and save data on your smartphone.

Digital modules allow you to extend the features of the Micrologic X control unit and Masterpact MTZ mobile App.

Prerequisites for Using Bluetooth

The prerequisites for establishing a Bluetooth connection are:

- The Micrologic X control unit must be powered.
- Bluetooth communication must be enabled on the control unit.
- You must have a smartphone with Masterpact MTZ mobile App installed.
- You must have access to the Micrologic X control unit, and be physically within range (usually within 20 to 30 meters or yards) for the duration of the connection.

NOTE: If using a backup power supply for the Micrologic X control unit, some functions such as operating the circuit breaker might not be available.

Enabling and Disabling Bluetooth Communication

By default, Bluetooth communication is disabled.

You can enable or disable Bluetooth communication as follows:

- On the Micrologic X display screen, go to **Configuration** → **Communication** → **Bluetooth**, and set **Bluetooth** to **ON** or **OFF**.
- With Ecoreach software, go to **Configuration** → **Communication** → **Bluetooth**, and set **Bluetooth activation** to **OFF**.

An event is generated each time Bluetooth communication is enabled or disabled.

Setting the Bluetooth Disconnection Timer

When Bluetooth communication is enabled, there is a timer on the connection with a smartphone that ends the communication after a period of idle time. By default, this automatic disconnection timer is set to 15 minutes.

You can change the setting for the Bluetooth disconnection timer as follows:

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

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

Establishing a Bluetooth Connection

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

Step	Action
1	Start Masterpact MTZ mobile App on your smartphone.
2	Select **Connect to device through Bluetooth**.

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

While your smartphone remains within the communication range (20 to 30 meters or yards from the Micrologic X control unit), the Bluetooth connection remains active and the information displayed is refreshed.

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

Bluetooth LED

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

- **ON**: A Bluetooth connection procedure is in progress.
- **OFF**: Bluetooth is in idle mode or disabled.
- **Blinking**: A Bluetooth connection is established and active.

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

About Bluetooth Low Energy in Micrologic X Control Unit

Troubleshooting Bluetooth Commmunication Issues

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

Problem description	Probable causes	Solutions
The LED does not light up when you press the BLE pushbutton on the Micrologic X control unit	● The Bluetooth function is not enabled in the Micrologic X control unit ● The Micrologic X control unit is not powered	● Enable Bluetooth communication in the Micrologic X control unit ● Check the power supply of the Micrologic X control unit
The Bluetooth connection was established but the signal is lost	● The smartphone has been moved out of range ● Perturbation in electromagnetic compatibility	● Place the smartphone within the range for Bluetooth and establish a new connection ● Check whether another Micrologic X control unit within range is also activated. If so, deactivate it and establish a new connection
	A smartphone is already connected to the Micrologic X control unit	

NFC Communication

Description

Using near field communication (NFC), you can access the Micrologic X control unit from a smartphone running Masterpact MTZ mobile App. With NFC, you can access the control unit and download data to your smartphone, even when the control unit is not powered.

You can establish an NFC connection with only one Micrologic X control unit at the same time.

NOTE: NFC communication is only accessible from the Android version of the Masterpact MTZ mobile App.
NFC communication is always enabled and cannot be disabled.

Prerequisites for Using NFC

The prerequisites for establishing an NFC connection are:
- You must have a smartphone with Masterpact MTZ mobile App installed.
- You must have physical access to the Micrologic X control unit.

Establishing an NFC Connection

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

Step	Action
1	Start Masterpact MTZ mobile App on your smartphone.
2	Select **Connect to device through NFC**.
3	Place your smartphone against the Micrologic X display screen, in the NFC wireless communication zone. A beep indicates that the communication is established. The Masterpact MTZ mobile App then starts downloading data. Another beep indicates that the data download is complete. If the operation fails, a message is displayed. Start the procedure again.
4	Remove your smartphone from the Micrologic X display screen.

NOTE: You must not remove your smartphone from the Micrologic X display screen while the data download is in progress or you will lose the NFC connection.

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

About NFC in Micrologic X Control Unit

IEEE 802.15.4 Communication

Description

When your installation includes the Com'X data logger and Ethernet gateway, you can set up wireless IEEE 802.15.4 communication between this gateway and the Micrologic X control unit. When the communication is set up, data about key Micrologic X parameters is automatically transferred to theCom'X every minute. Data transferred over IEEE 802.15.4 is crypted using AES 128 bit encryption.

You can connect up to two Micrologic X control units to one Com'X gateway.

IEEE 802.15.4 communication between the Com'X gateway and the Micrologic X control unit can replace an Ethernet LAN for monitoring your industrial network. The Com'X gateway is accessible from anywhere over the Ethernet LAN.

Prerequisites for Using IEEE 802.15.4

The prerequisites for establishing an IEEE 802.15.4 connection are:

- The Micrologic X control unit must be powered. The power supply modes are:
  - CPS high
  - VPS
  - USB
  - Vaux
- IEEE 802.15.4 communication between the Micrologic X control unit and the Com'X gateway must be commissioned.
- You must have access to the Com'X gateway over an Ethernet LAN.

Commissioning IEEE 802.15.4 Communication

The IEEE 802.15.4 connection between the Micrologic X control unit and the Com'X gateway is set up once at the time of commissioning and is valid thereafter. You can pair up to two Micrologic X control units with one Com'X gateway.

Follow the steps below to commission IEEE 802.15.4 communication between the Com'X gateway and the Micrologic X control unit.

Step	Action
1	From the Com'X web page, create the IEEE 802.15.4 network.
2	Activate the IEEE 802.15.4 signal and launch the discovery of IEEE 802.15.4 emitting devices.
3	Start Ecoreach on a laptop connected to the USB port of the Micrologic X control unit.
4	On the **Configuration** tab, under the **Communication** section, click **Start scanning IEEE 802.15.4 devices** to start the scan to detect the Com'X unit. IEEE 802.15.4 is automatically activated in the Micrologic X control unit, the scan begins, and Ecoreach displays the list of detected IEEE 802.15.4 networks within the radio range.
5	From the list, select the Extended PAN ID corresponding to the Com'X device and click **Pair** to confirm pairing. A popup box is displayed to report that IEEE 802.15.4 pairing was successful. The Micrologic X control unit joins the IEEE 802.15.4 network of the Com'X, and starts sending data over the network.
6	In Ecoreach, check the link quality indicator (LQI) for the IEEE 802.15.4 signal.
7	On the Com'X web page, check the pairing and IEEE 802.15.4 indicators. You can also consult the data sent by the Micrologic X control unit over the IEEE 802.15.4 connection.

Decommissioning IEEE 802.15.4 Communication

The IEEE 802.15.4 connection between the Micrologic X control unit and the Com'X gateway is valid until it is removed by unpairing the devices.

Follow the steps below to decommission IEEE 802.15.4 communication between the Com'X gateway and the Micrologic X control unit.

Step	Action
1	Start Ecoreach on a laptop connected to the USB port of the Micrologic X control unit.
2	On the **Configuration** tab, under the **Communication** section, click **Unpair** in the IEEE 802.15.4 area. Click **Yes** in the popup window to confirm unpairing. IEEE 802.15.4 is automatically disabled in the Micrologic X control unit.

Step	Action
3	Check the network status indicator for IEEE 802.15.4, and the link quality indicator (LQI).
4	On the Com'X web page, check the unpairing.

Enabling and Disabling IEEE 802.15.4 Communication

By default, IEEE 802.15.4 communication is disabled in the Micrologic X control unit. when it is delivered.

After commissioning, you can enable or disable IEEE 802.15.4 communication at any time as follows:
- On the Micrologic X display screen, go to **Configuration** → **Communication** → **IEEE 802.15.4**, and set **IEEE 802.15.4** to **ON** or **OFF**.
- With Ecoreach software, go to **Configuration** → **Communication** → **IEEE 802.15.4**, and set **IEEE 802.15.4 activation** to **ON** or **OFF**.

Note that:
- You cannot enable IEEE 802.15.4 on the Micrologic X control unit if IEEE 802.15.4 communication has not been commissioned as explained previously.
- Even when you disable IEEE 802.15.4 communication, the pairing between the Micrologic X control unit and the Com'X gateway remains valid until you decommission or unpair the devices.
- When you disable IEEE 802.15.4 communication, data transfers between the Micrologic X control unit and the Com'X gateway stop.

An event is logged in the Com'X log book each time IEEE 802.15.4 communication is enabled or disabled.

IEEE 802.15.4 Network Status

IEEE 802.15.4 network status is displayed in Ecoreach at **Configuration** → **Trip unit functioning** → **Wireless communication access**.

The following IEEE 802.15.4 states can be displayed in the **IEEE 802.15.4 network status** field:
- **Network None**: indicates that the Micrologic X control unit is not commissioned, and not in the process of being commissioned
- **Network Discovering**: indicates that a scan is in progress to detect IEEE 802.15.4 devices within range
- **Network Discovery Complete**: indicates that the scan is complete and a list of discovered devices is displayed
- **Networking**: indicates that the pairing process is in progress
- **Networked**: indicates that IEEE 802.15.4 the Micrologic X control unit is commissioned

About IEEE 802.15.4 in Micrologic X Control Unit

The characteristics of IEEE 802.15.4 communication are:
- Radio frequency 2.4 GHz, IEEE 802.15.4
- Encryption and authentication AES 128 bits
- "Listen before talk" (carrier sense multiple access with collision avoidance CSMA/CA)

Troubleshooting IEEE 802.15.4 Commmunication Issues

-
-

USB Connection

Description

From a PC that runs Ecoreach software, you can access all of the monitoring and control functions of the Micrologic X control unit. You can connect a laptop directly to the mini USB port of the control unit.

Connecting a PC with Ecoreach to USB Port

Follow the steps below to connect to the Micrologic X control unit using the mini USB port. This procedure assumes that you have the appropriate cable (reference LV850067).

Step	Action
1	Connect your laptop PC to the mini USB port of the Micrologic X control unit using a cable with reference LV850067. The PC provides power to the Micrologic X control unit if necessary.
2	Start Ecoreach on the PC and log in.
3	...
4	
5	
6	

About Mini USB in Micrologic X Control Unit

Troubleshooting USB Connection Issues

Cybersecurity Recommendations

Overview

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

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

The communication paths to protect include:
- Wireless Bluetooth communication
- Wireless NFC communication
- Wireless IEEE 802.15.4 communication
- The mini USB port
- The Ethernet LAN when the EIFE or IFE interface is present

For more detailed information on cybersecurity for the Masterpact MTZ, refer to *Masterpact MTZ - Cyber Security Guide*.

⚠ WARNING

POTENTIAL COMPROMISE OF SYSTEM AVAILABILITY, INTEGRITY, AND CONFIDENTIALITY
- Change default passwords to help prevent unauthorized access to device settings and information.
- Disable unused ports and default accounts to help minimize pathways for malicious attackers.
- Place networked devices behind multiple layers of cyber defenses (such as firewalls, network segmentation, and network intrusion detection and protection).
- Use industry-accepted Informational Technology (IT) and Operational Technology (OT) cybersecurity practices to help prevent loss or exposure of data, modification or deletion of logs and data, and interruption of services.

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

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

Cybersecurity Recommendations for Bluetooth Communication

To protect access to functions accessible through Bluetooth, it is recommended to:
- Disable Bluetooth communications, as explained in Enabling or Disabling Bluetooth Communication *(see page 154)*.
- Set the Bluetooth automatic disconnection timer to 5 minutes.
- Keep locked the enclosure where the Masterpact MTZ is located, so that no unauthorized person can change the settings on the Micrologic X control unit.
- Limit the number of users allowed to have the Masterpact MTZ mobile App installed on their smartphones.
- Make sure that the smartphones that have the Masterpact MTZ mobile App are password protected and used for work only.
- Do not give away information about the smartphone (telephone number, MAC address) if it is not necessary.
- Disconnect the smartphone from the Internet during a Bluetooth connection with the Micrologic X control unit.
- Do not store confidential or sensitive information on smartphones.

Cybersecurity Recommendations for NFC Communication

To protect access to data accessible through NFC, it is recommended to:
- Keep locked the enclosure where the Masterpact MTZ is located, so that no unauthorized person can change the settings on the Micrologic X control unit.
- Limit the number of users allowed to have the Masterpact MTZ mobile App installed on their smartphones.
- Make sure that the smartphones that have the Masterpact MTZ mobile App are password protected and used for work only.

Cybersecurity Recommendations for IEEE 802.15.4 Communication

Data transfers using IEEE 802.15.4 communication are crypted, therefore, the risk of an unauthorized person gaining access to confidential information during transmission is limited. Mostly, if IEEE 802.15.4 is the only way of accessing information about the Micrologic X remotely, you must protect the IEEE 802.15.4 connection itself.

It is recommended to:

- Keep locked the enclosure where the Masterpact MTZ is located, so that no unauthorized person can disable IEEE 802.15.4 communication on the Micrologic X control unit.
- Protect the Micrologic X control unit from electromagnetic interference that could perturb the IEEE 802.15.4 communication.
- Design and implement security rules for remote access to your network, in particular to the Com'X.

Cybersecurity Recommendations for USB Connection

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

- Keep locked the enclosure where the Masterpact MTZ is located, so that no unauthorized person can access the Micrologic X control unit.
- Limit the number of users allowed to use Ecoreach or other monitoring software.
- Make sure that the PCs running the monitoring software are hardened following the guidelines provided in *Masterpact MTZ - Cyber Security Guide*, and the most up-to-date hardening methods for the operating system running on your PCs.

Cybersecurity Recommendations for an Ethernet LAN

When the Micrologic X IMU includes the EIFE module or the IFE module to connect it to the Ethernet LAN, to protect access to the Micrologic X control unit, it is recommended to:

- Limit the number of users allowed to use Ecoreach or other monitoring software.
- Make sure that the PCs running the monitoring software are hardened following the guidelines provided in *Masterpact MTZ - Cyber Security Guide*, and the most up-to-date hardening methods for the operating system running on your PCs.
- ...

Chapter 8
Event Management

What Is in This Chapter?

This chapter contains the following topics:

Event Management

Definition

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

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

Events are categorized according to a level of severity:
- High
- Medium
- Low

All high and medium-level events generate an alarm and a pop-up notification screen *(see page 169)* on the Micrologic X control unit display screen.

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

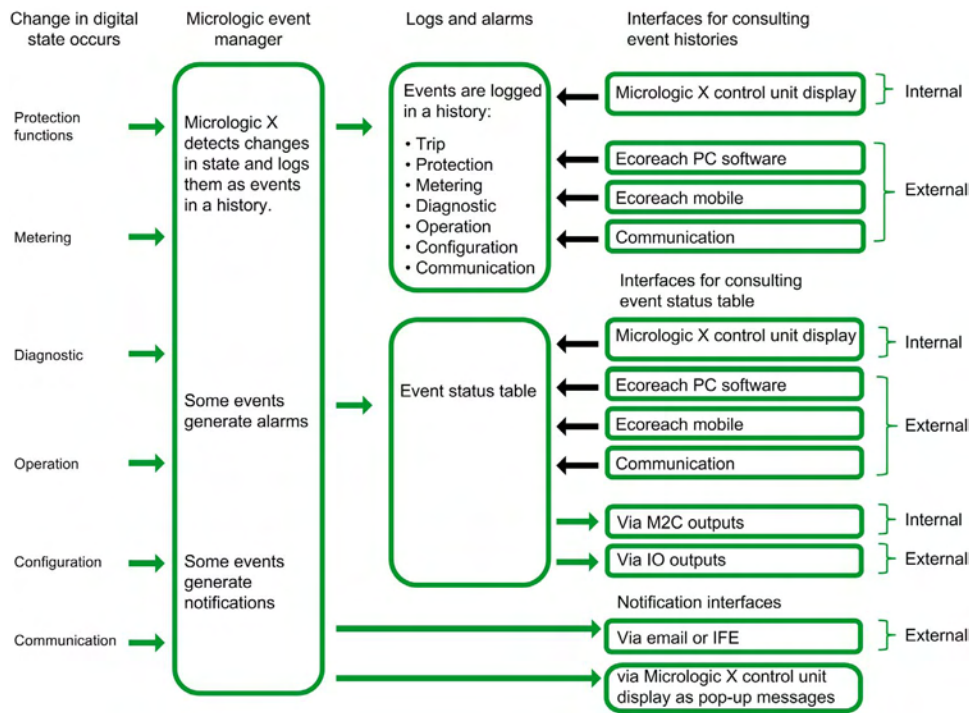
Alarms and trips are events that require specific attention from the user:
- A trip is an event generated when the circuit breaker trips.
- An alarm is an event with medium or high severity.

The information in this chapter is valid for events detected by the Micrologic X control unit. Refer to the following documents for events detected by the IFE or EIFE Ethernet interface, or by IO modules:

- For information about IFE events, refer to the *IFE Ethernet Interface for LV Circuit Breaker - User Guide*
- For information about EIFE events, refer to the *EIFE Embedded Ethernet Interface for One Masterpact MTZ Drawout Circuit Breaker - User Guide*
- For information about IO events, refer to the *IO Input/Output Application Module for One Circuit Breaker - User Guide*

Management of Events by Micrologic X Control Unit

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



Event Time Stamping

Each event is time stamped with the date and time of the Micrologic X internal clock.

Event Status Overview

Event Status Definition

The status of an event is *active*, *inactive*, or *held*. It depends on the event type and whether it is latched or unlatched. The status of all events can be consulted at any time *(see page 170)*.

Event Type

Events can be the following types:

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

The event type cannot be customized.

Latched or Unlatched Events

An event can be unlatched or latched:

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

The latched/unlatched mode for certain events *(see page 173)* can be customized on Ecoreach software.

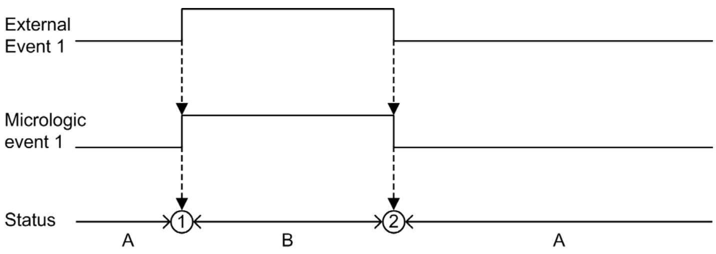
Disabling Events

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

Events can be disabled through Ecoreach software. For more information about which events can be disabled, refer to the event list *(see page 173)*. Events can be enabled again after being disabled.

Unlatched Occurrence/Completion Events

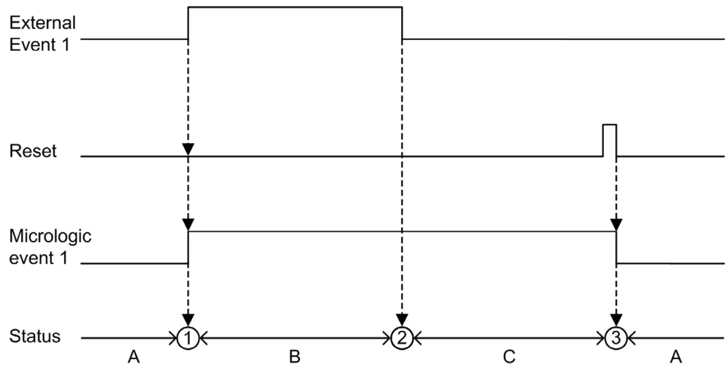
The following graph shows the event status for an unlatched occurrence/completion event.



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

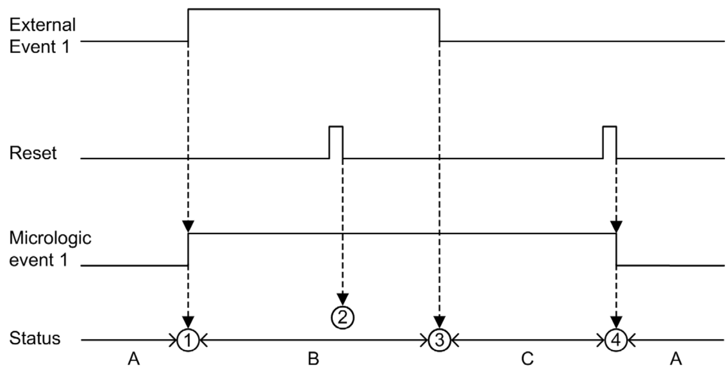
Latched Occurrence/Completion Events

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



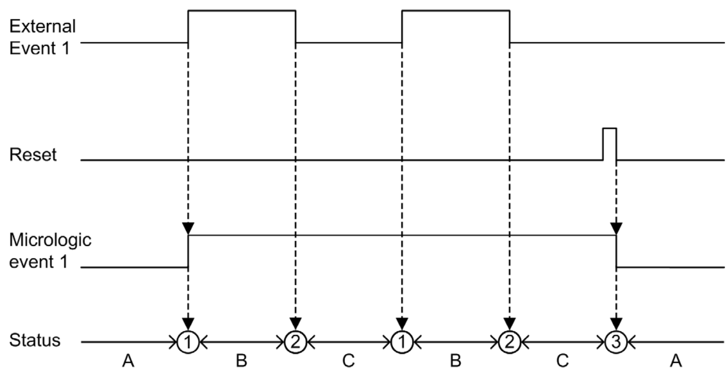
A Event inactive
B Event active
C Event held
1 Event occurrence: event is time stamped, logged in a history and notified, depending on severity
2 Event completion: event is time stamped and logged in a history
3 Event reset: reset command is time stamped and logged in operation history. All held events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

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



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

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

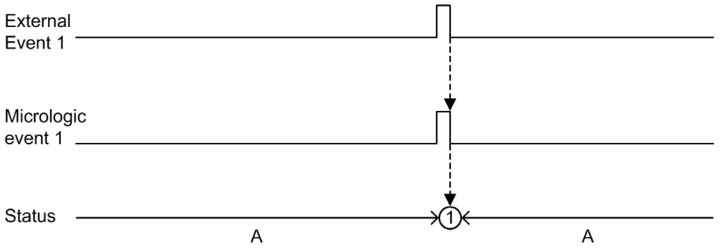


A Event inactive

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

Unlatched Instantaneous Events

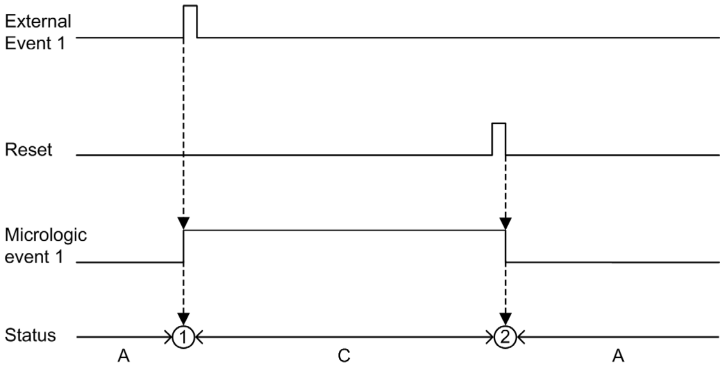
The following graph shows the event status for an unlatched instantaneous event.



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

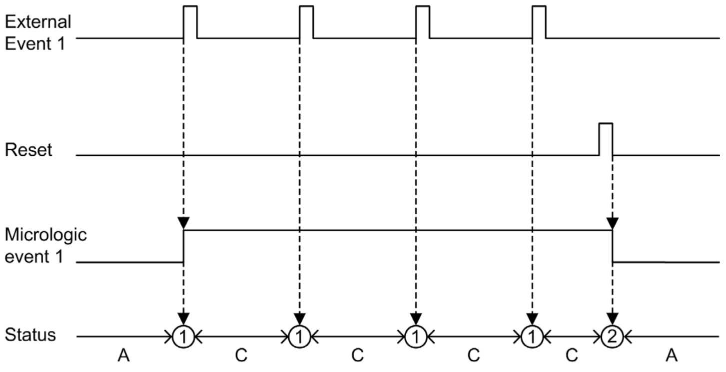
Latched Instantaneous Events

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



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

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



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

Resetting Events

Events can be reset in the following ways:

- By pressing the **Test/Reset** button on the front of the Micrologic X control unit for 3–15 seconds.
- With Ecoreach software.
- With Masterpact MTZ mobile App.
- By sending a reset command using the communication network. This function is password protected.

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

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

The reset command generates an event and it is logged in the operation history.

Event Notifications

Presentation

Events that are notified in the following ways cannot be configured:
- By a pop-up screen on the Micrologic X control unit (high and medium-level events).
- By SDE1 standard fault-trip indication contact and SDE2 optional fault-trip indication contact (Trip events).

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

Pop-up Screen

All high and medium-level events generate a pop-up screen on the Micrologic X display screen *(see page 57)*.
- A red pop-up screen indicates a trip or high-level event, needing immediate attention.
- An orange pop-up screen indicates a medium-level alarm, recommending action.

SDE Fault-Trip Indication Contacts

M2C Notifications

Ecoreach software allows the assignment of one or more events to each M2C output.

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

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

Forcing or unforcing a M2C output generates the following events:
- M2C output 1 unforced / forced change.
- M2C output 2 unforced / forced change.

IO Module Notifications

Ecoreach software allows the assignment of one or more events to IO module outputs available according to the IO module predefined or user-defined applications selected. The IO module output remains on as long as one of the events assigned is active or held. The operating mode of the IO module output must be set as non-latching. Refer to the *IO Input/Output Application Module for One Circuit Breaker - User Guide*.

Email Notification

The occurrence of an event is notified by email, if configured to do so.

Email notifications have to be configured through the IFE or EIFE web pages. The notification by email is not configured by default.

Refer to the *IFE Ethernet Interface for LV Circuit Breaker - User Guide* and the *EIFE Embedded Ethernet Interface for One Masterpact MTZ Drawout Circuit Breaker - User Guide*

Event Status Table

Introduction

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

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

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

Displaying the Event Status Table on the Micrologic X Display Screen

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

High and medium-level active and held events are displayed.

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

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

Displaying the Event Status Table on Ecoreach Software

High and medium-level active and held events are displayed.

By default, events are sorted chronologically.

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

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

Displaying the Event Status Table on Masterpact MTZ mobile App

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

Event History

Overview

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

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

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

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

The event histories can be downloaded using the communication network.

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

Number of Events in Each History

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

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

Displaying Event History on Micrologic X Display Screen

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

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

Only occurrences of occurrence/completion events are displayed.

Displaying Event History on Ecoreach Software

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

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

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

Displaying Event History on Masterpact MTZ mobile App

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

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

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

Erase History Content

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

Erasing the history generates the following event: Event history deleted

Event List

Event Characteristics

The events are listed according to the history in which they are logged *(see page 171)*.

Each event is defined by the following characteristics:

- User message: message displayed on Ecoreach software.
- Type *(see page 165)*: not customizable
  - On/off: occurrence/completion event.
  - Instant: instantaneous event.
- Latched *(see page 165)*: can be customized with Ecoreach software
  - Yes: the event is latched and the user must reset the event status.
  - No: the event is unlatched.
- Activity *(see page 165)*:
  - Enabled: the event is always enabled.
  - Enabled1: the event is enabled by default and can be disabled with Ecoreach software.
  - Disabled1: the event is disabled by default and can be enabled with Ecoreach software.
- Severity:
  - High-level trips and alarms.
  - Medium-level alarms.
  - Low-level events.

Trip Events

User message	History	Type	Latched	Activity	Severity
Ir trip *(see page 65)*	Trip	Instant	Yes	Enabled	High
Isd trip *(see page 68)*	Trip	Instant	Yes	Enabled	High
Ii trip *(see page 70)*	Trip	Instant	Yes	Enabled	High
Ig trip *(see page 72)*	Trip	Instant	Yes	Enabled	High
IΔn trip *(see page 74)*	Trip	Instant	Yes	Enabled	High
Ultimate self-protection trip (Sellim) *(see page 62)*	Trip	Instant	Yes	Enabled	High
Internal failure trip	Trip	Instant	Yes	Enabled	High
Ultimate self-protection trip (DIN/DINF) *(see page 62)*	Trip	Instant	Yes	Enabled	High
IΔn / Ig test trip *(see page 73)*	Trip	Instant	Yes	Enabled	High

Protection Events

User message	History	Type	Latched	Activity	Severity
Ultimate self-protection (DIN/DINF) operate *(see page 62)*	Protection	On/off	No	Enabled	Medium
Ultimate self-protection (Sellim) operate *(see page 62)*	Protection	On/off	No	Enabled	Medium
Thermal memory reset order *(see page 65)*	Protection	Instant	No	Enabled	Low
Ir prealarm (I>90%Ir) *(see page 67)*	Protection	On/off	No	Enabled	Low
Ir start (I>105%Ir) *(see page 67)*	Protection	On/off	No	Enabled	Medium
Ir operate *(see page 67)*	Protection	On/off	No	Enabled	Medium
Isd start *(see page 69)*	Protection	On/off	No	Enabled	Low
Isd operate *(see page 69)*	Protection	On/off	No	Enabled	Medium
Ii operate *(see page 70)*	Protection	On/off	No	Enabled	Medium
Ig start *(see page 72)*	Protection	On/off	No	Enabled	Low
Ig operate *(see page 72)*	Protection	On/off	No	Enabled	Medium
IΔn start *(see page 74)*	Protection	On/off	No	Enabled	Low
IΔn operate *(see page 74)*	Protection	On/off	No	Enabled	Medium
1 Customizable with Ecoreach software					

User message	History	Type	Latched	Activity	Severity
B curve active *(see page 78)*	Protection	On/off	No	Enabled	Low
Protection settings on local screen is unlocked *(see page 63)*	Protection	On/off	No[1]	Enabled	Low
Remote lock for protection settings is unlocked *(see page 63)*	Protection	On/off	No[1]	Enabled	Low
Protection setting change (display screen) *(see page 62)*	Protection	Instant	No[1]	Enabled	Low
Protection setting changed (Bluetooth, USB or IFE) *(see page 62)*	Protection	Instant	No[1]	Enabled	Medium
1 Customizable with Ecoreach software					

Diagnostic Events

User message	History	Type	Latched	Activity	Severity
IO 1 module connection lost *(see page 142)*	Diagnostic	Instant	Yes	Enabled[1]	Medium
IO 2 module connection lost *(see page 142)*	Diagnostic	Instant	Yes	Enabled[1]	Medium
IFE connection lost *(see page 142)*	Diagnostic	Instant	Yes	Enabled[1]	Medium
Product in test mode	Diagnostic	On/off	No	Enabled	Low
Injection test	Diagnostic	On/off	No	Enabled	Low
Test aborted by user	Diagnostic	Instant	No	Enabled	Low
Product self test major malfunction *(see page 138)*	Diagnostic	On/off	No	Enabled	High
Internal current sensors (CT) disconnected *(see page 138)*	Diagnostic	On/off	No	Enabled	High
ENCT disconnected *(see page 138)*	Diagnostic	On/off	No	Enabled	High
Earth leakage (Vigi) sensor disconnected *(see page 138)*	Diagnostic	On/off	No	Enabled	High
Current protection reset to default settings *(see page 141)*	Diagnostic	On/off	No	Enabled	High
Reading accessing protection settings error *(see page 141)*	Diagnostic	On/off	No	Enabled	Medium
Metering and advanced protection malfunction *(see page 141)*	Diagnostic	On/off	No	Enabled	Medium
NFC malfunction *(see page 141)*	Diagnostic	On/off	No	Enabled[1]	Medium
Display screen or wireless malfunction *(see page 141)*	Diagnostic	On/off	No	Enabled	Medium
IEEE 802.15.4 malfunction *(see page 141)*	Diagnostic	On/off	No	Enabled[1]	Medium
Bluetooth malfunction *(see page 141)*	Diagnostic	On/off	No	Enabled[1]	Medium
Replace battery *(see page 141)*	Diagnostic	On/off	No	Enabled[1]	Medium
Minor- Corrected ASIC internal error warning *(see page 141)*	Diagnostic	On/off	No	Enabled	Medium
FW internal error *(see page 141)*	Diagnostic	On/off	No	Enabled	Low
Sensor plug reading error *(see page 141)*	Diagnostic	On/off	No	Enabled	High
Minor-Open/Close coils failure *(see page 141)*	Diagnostic	On/off	No	Enabled	Medium
Discrepancy ASIC configuration *(see page 141)*	Diagnostic	On/off	No	Enabled	High
Critical hardware module discrepancy *(see page 141)*	Diagnostic	On/off	No	Enabled	Medium
Critical firmware module discrepancy *(see page 141)*	Diagnostic	On/off	No	Enabled	Medium
Non-critical hardware module discrepancy *(see page 141)*	Diagnostic	On/off	No	Enabled	Medium
1 Customizable with Ecoreach software					

User message	History	Type	Latched	Activity	Severity
Non-critical firmware module discrepancy *(see page 141)*	Diagnostic	On/off	No	Enabled	Medium
ULP module address conflict *(see page 141)*	Diagnostic	On/off	No	Enabled	Medium
Firmware discrepancy within product *(see page 141)*	Diagnostic	On/off	No	Enabled	Medium
IΔn/Ig test trip failed (IΔn *(see page 74)* Ig *(see page 73)*)	Diagnostic	Instant	No	Enabled	High
IΔn/Ig test button pressed (IΔn *(see page 74)* Ig *(see page 73)*)	Diagnostic	Instant	No	Enabled	Low
ZSI Test *(see page 81)*	Diagnostic	Instant	No	Enabled	Low
Contact 60% worn out *(see page 140)*	Diagnostic	On/off	No	Enabled[1]	Medium
Contact 95% worn out *(see page 140)*	Diagnostic	On/off	No	Enabled	Medium
Contact 100% worn out *(see page 140)*	Diagnostic	On/off	No	Enabled	High
CB operations has passed 80% of service life *(see page 143)*	Diagnostic	On/off	No	Enabled[1]	High
CB operations has passed the service life *(see page 143)*	Diagnostic	Instant	No	Enabled	Low
MX1 opening release malfunction *(see page 139)*	Diagnostic	On/off	No	Enabled	Medium
MX1 opening release is no longer detected *(see page 139)*	Diagnostic	On/off	No	Enabled	Medium
MCH has reached 80% of the max nb of operations *(see page 139)*	Diagnostic	On/off	No	Enabled	Medium
MCH has reached the max nb of operations *(see page 139)*	Diagnostic	On/off	No	Enabled	Medium
XF closing release malfunction *(see page 139)*	Diagnostic	On/off	No	Enabled	Medium
XF closing release is no longer detected *(see page 139)*	Diagnostic	On/off	No[1]	Enabled[1]	Medium
MX2 / MN opening release malfunction *(see page 139)*	Diagnostic	On/off	No	Enabled	High
MX2 / MN opening release is no longer detected *(see page 139)*	Diagnostic	On/off	No	Enabled	Medium
Circuit Breaker failed to Open/Close *(see page 139)*	Diagnostic	Instant	Yes	Enabled	Medium
Event history deleted *(see page 172)*	Diagnostic	Instant	No	Enabled	Low
1 Customizable with Ecoreach software					

Metering Events

User message	History	Type	Latched	Activity	Severity
Reset Min/Max currents *(see page 116)*	Metering	Instant	No[1]	Enabled	Low
Reset Min/Max voltages *(see page 116)*	Metering	Instant	No[1]	Enabled	Low
Reset Min/Max power *(see page 116)*	Metering	Instant	No[1]	Enabled	Low
Reset Min/Max frequency *(see page 116)*	Metering	Instant	No[1]	Enabled	Low
Reset Min/Max harmonics *(see page 116)*	Metering	Instant	No[1]	Enabled	Low
Reset Min/Max power factor *(see page 116)*	Metering	Instant	No[1]	Enabled	Low
Reset energy counters *(see page 122)*	Metering	Instant	No[1]	Enabled	Low
1 Customizable with Ecoreach software					

Operation Events

User message	History	Type	Latched	Activity	Severity
CB moved from close to open position *(see page 152)*	Operation	Instant	No[1]	Enabled[1]	Low
CB moved from open to close position *(see page 151)*	Operation	Instant	No[1]	Enabled[1]	Low
Closing release activation *(see page 151)*	Operation	Instant	No	Enabled	Low
Opening release activation *(see page 152)*	Operation	Instant	No	Enabled	Low
Manual mode enabled *(see page 150)*	Operation	On/off	No	Enabled	Low
Local mode enabled *(see page 150)*	Operation	On/off	No	Enabled	Low
Close inhibited by communication *(see page 151)*	Operation	On/off	No	Enabled	Low
Close inhibited by wired input *(see page 151)*	Operation	On/off	No	Enabled	Low
M2C output 1 forced *(see page 169)*	Operation	On/off	No	Enabled	Low
M2C output 2 forced *(see page 169)*	Operation	On/off	No	Enabled	Low
Alarm reset (trip and non-trip) *(see page 168)*	Operation	Instant	No	Enabled	Low
1 Customizable with Ecoreach software					

Configuration Events

User message	History	Type	Latched	Activity	Severity
Conflict with IO module configuration *(see page 142)*	Configuration	On/off	No	Enabled	Medium
Product in upgrade mode	Configuration	On/off	No	Enabled	Low
Product upgrade failed	Configuration	Instant	No	Enabled	Medium
Clock setup *(see page 22)*	Configuration	Instant	No	Enabled	Low
License installed *(see page 21)*	Configuration	Instant	No	Enabled	Low
License uninstalled *(see page 21)*	Configuration	Instant	No	Enabled	Low

Communication Events

User message	History	Type	Latched	Activity	Severity
USB connection *(see page 159)*	Communication	On/off	No	Enabled	Low
BLUETOOTH communication enabled *(see page 154)*	Communication	On/off	No	Enabled[1]	Low
IEEE 802.15.4 communication enabled *(see page 157)*	Communication	On/off	No	Enabled[1]	Low
1 Customizable with Ecoreach software					

Appendices

Appendix A
Title of Chapter