LE-03MB CT

DIN Rail Energy Meter for Single and Three Phase Electrical Systems

User manual 2014 v.4.1

- ✓ Measures: kWh Kvarh, KW, Kvar, KVA, P, F, PF, Hz, dmd, V, A, THD, etc.
- ✓ Bi-directional measurement IMP & EXP
- ✓ Two pulse outputs
- ✓ RS485 Modbus
- ✓ DIN rail mounting 35 mm
- ✓ 1/5 A CT connection
- ✓ Better than Class 1 / B accuracy

Introduction

This document provides operating, maintenance and installation instructions. The unit measures and displays the characteristics of single phase two wires (1p2w), three phase three wires (3p3w) and three phase four wires (3p4w) supplies, including voltage, frequency, current, power, active and reactive energy, imported or exported. Energy is measured in terms of kWh, kVArh. Maximum demand current can be measured over preset periods of up to 60 minutes. In order to measure energy, the unit requires voltage and current inputs in addition tot he supply required to power the product. The requisite current input(s) are obtained via current transformers (CT). This meter can be configured to work with a wide range of CTs, giving the unit a wide range of operation. Built-in interfaces provides pulse and RS485Modbus RTU outputs. Configuration is password protected.

This unit can be powered from a separate auxiliary (AC or DC) supply. Alternatively it can be powered from the monitored supply, where appropriate.

Unit Characteristics

The Unit can measure and display:
- ✓ Line voltage and THD% (total harmonic distortion) of all phases
- ✓ Line Frequency
- ✓ Currents, Current demands and current THD% of all phases
- ✓ Power, maximum power demand and power factor
- ✓ Active energy imported and exported
- ✓ Reactive energy imported and exported

The unit has password-protected set-up screens for:
- ✓ Changing password
- ✓ Supply system selection 1p2w, 3p3w, 3p4w
- ✓ Demand interval time
- ✓ Reset for demand measurements
- ✓ Pulse output duration

Two pulse output indicates real-time energy measurement. An RS485 output allows remote monitoring from another display or a computer.

Current Transformer Primary Current

The unit can be configured to operate with CT ratio between primary current and secondary current.The secondary CT has two options: 1A/5A.

RS485 Serial – Modbus RTU

This uses an RS485 serial port with Modbus RTU protocol to provide a means of remotely monitoring and controlling the Unit. Set-up screens are provided for setting up the RS485 port.

Pulse output

This provides two pulse outputs that clock up measured active and reactive energy. The constant for active energy is 3200imp/kWh (Terminals 11&12).

The pulse width for pulse 1   (Terminals 9&10) can be set from the set-up menu.

Start Up Screens

1	1 ⊓ ⊓ 2 MD 📞 (IMPORT) (EXPORT) .ₐ𝗂𝗂𝗂𝗂 L¹⁻² T -8.8.8.8 MkWh VI%THD L²⁻³ N ∑ -8.8.8.8 MkVArh Hz L³⁻¹ ⊠ 🕐 -8.8.8.8 MkVA PF C1 C2	The first screen lights up all display segments and can be used as a display check.
2	SoFt 1.231 2014	The second screen indicates the firmware installed in the unit and its build number.
3	INSt tESt PASS	The interface performs a self-test and indicates the result if the test passes.

* After a short delay, the screen will display active energy measurements.

Measurements

The buttons operate as follows:

1	U/I ◄ ESC	Selects the Voltage and Current display screens In Set-up Mode, this is the "Left" or "Back" button.
2	M ▲	Select the Frequency and Power factor display screens In Set-up Mode, this is the "Up" button.
3	P ▼	Select the Power display screens In Set-up Mode, this is the "Down" button.
4	E ▶ ↵	Select the Energy display screens In Set-up mode, this is the "Enter" or "Right" button.

Voltage and Current

Each successive pressing of the [U/I ESC ◀] button selects a new range:

1-1	L¹ 000.0 L² 000.0 V L³ 000.0	Phase to neutral voltages (3p4w)
1-2	L¹⁻² 380.0 L²⁻³ 380.0 V L³⁻¹ 380.0	Phase to neutral voltages (3p3w)
2	L¹ 0.000 L² 0.000 A L³ 0.000	Current on each phase
3-1	L¹ 00.00 V %THD L² 00.00 L³ 00.00	Phase to neutral voltage THD% (3p4w)
3-2	L¹⁻² 00.10 V %THD L²⁻³ 00.10 L³⁻¹ 00.10	Phase to neutral voltage THD% (3p3w)

4	L^1 00.00 I%THD L^2 00.00 L^3 00.00	Current THD% for each phase

Frequency and Power factor and Demand

Each successive pressing of the [M ▲] button selects a new range:

1	Σ 00.00 Hz 0.999 PF	Frequency and Power Factor (total)
2	L^1 0.999 L^2 0.999 L^3 0.999 PF	Power Factor of each phase
3	MD 0.000 kW Σ	Maximum Power Demand
4	MD L^1 0.000 L^2 0.000 A L^3 0.000	Maximum Current Demand

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- 4 -

Power

Each successive pressing of the [P ▼] button select a new range:

1	L¹ 0.000 kW L² 0.000 L³ 0.000	Instantaneous Active Power in kW
2	L¹ 0.000 L² 0.000 kVAr L³ 0.000	Instantaneous Reactive Power in kVAr
3	L¹ 0.000 L² 0.000 L³ 0.000 kVA	Instantaneous Volt-amps in KVA
4	0.000 kW M 0.000 kVAr 0.000 kVA	Total kW, kVArh, kVA

Energy Measurements

Each successive pressing of the [E ▶] button selects a new range:

1-1	IMPORT 0000 kWh 031.4	Imported active energy in kWh

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- 5 -

1-2	EXPORT 0000 000.0 kWh	Exported active energy in kWh
2-1	IMPORT 0000 000.0 kVArh	Imported reactive energy in kVArh
2-2	EXPORT 0000 000.0 kVArh	Exported reactive energy in kVArh
3-1	0000 Σ 031.4 kWh	Total active energy in kWh
3-2	0000 Σ 000.0 kVArh	Total reactive energy in kVArh

Setting Up

To enter set-up mode, pressing the [E] button for 3 seconds, until the password screen appears.

PASS

0000

Setting up is password-protected so you must enter the correct password (default '1000') before processing.

If an incorrect password is entered, the display will show: PASS   Err

PASS

Err

To exit setting-up mode, press [U/I ESC] repeatedly until the measurement screen is restored.

Set-up Entry Methods

Some menu items, such as password and CT, require a four-digit number entry while others, such as supply system, require selection from a number of menu options.
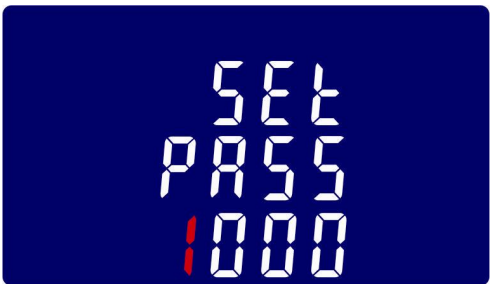
Menu Option Selection

1) Use the [M ▲] and [P ▼] buttons to select the required item from the menu shown in section 4.1. selection does not roll over between bottom and top of list

2) Press [E ▶] to confirm your selection.

3) If an item flashes, then it can be adjusted by the [maybe ▲] and [P ▼] buttons. If not, there a further layer.

4) Having selected an option from the current layer, press [E ▶] to confirm your selection. The SET indicator will appear.

5) Having completed a parameter setting, press [U/I ESC] to return to a higher menu level. The SET indicator will be removed and you will be able to use the [M ▲] and [P ▼] buttons for further menu selection.

6) On completion of all setting-up, press [U/I ESC] repeatedly until the measurement screen is restored.

Number Entry Procedure

When Setting up the unit , some screens require the entering of a number. In particular, on entry to the setting up section, a password must be entered. Digits are set individually, from left to right. The procedure is as follows:

1) The current digit to be set flashes and is set using the [M ▲] and [P ▼] buttons

2) Press [E ▶] to confirm each digit setting. The SET indicator appears after the last digit has been set.

3) After setting the last digit, press [U/I ◀ ESC] to exit the number setting routine. The SET indicator will be removed.

Change password

1	SEt PASS 1000	Use the [M ▲] and [P ▼] to choose the change password option.
2-1	SEt PASS 1000	Press the [E ▶] to enter the change password routine. The new password screen will appear with the first digit flashing.
2-2	SEt PASS 1000	Use [M ▲] and [P ▼] to set the first digit and press [E ▶] to confirm your selection. The next digit will flash.
2-3	SEt PASS 1100	Repeat the procedure for the remaining three digits.

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- 8 -

2-4	SEt PASS 1100	After setting the last digit, SET will show.
Press U/I ESC to exit the number setting routine and return to the Set-up menu. SET will be removed.		

DIT Demand Integration Time

This sets the period in minutes over which the current and power readings are integrated for maximum demand measurement. The options are: off, 5,10,15 30,60 minutes.

1	SEt dIt 10	From the set-up menu, use M ▲ and P ▼ buttons to select the DIT option. The screen will show the currently selected integration time.
2-1	SEt dIt 10	Press E to enter the selection routine. The current time interval will flash.
2-2	SEt dIt	Use M ▲ and P ▼ buttons to select the time required.
2-3	SEt dIt 20	Press E to confirm the selection. SET indicator will appear.

Press [U/I ESC] to exit the DIT selection routine and return to the menu.	

Backlit set-up

The meter provides a function to set the blue backlit lasting time.

1	SEt LP 60	The backlit lasting time is settable. Default lasting time is 60 minutes. For example, if it's setted as 5, the backlit will be off in 5minutes from the last time operation on the meter. Notes: If it's setted as 0, the backlit will always be on.
2	SEt LP 60	Press [E] to enter the selection routine. The current time interval will flash. **The options can be: 0/5/10/30/60/120 minutes**

Use [M ▲] and [P ▼] buttons to select the time required. Then press [E] to confirm the set-up.

Supply System
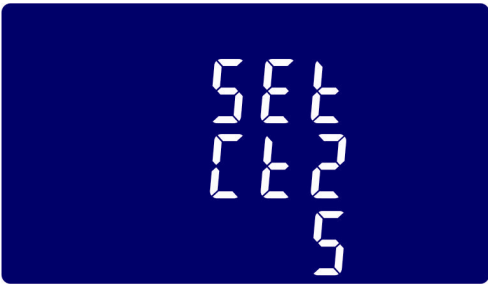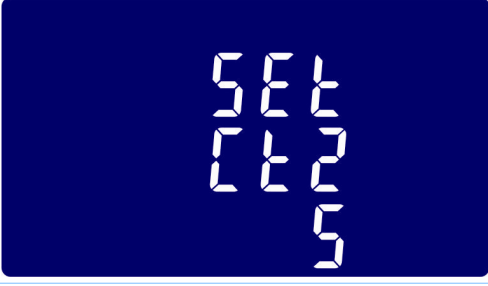
Use this section to set the type of power supply being monitored.

1	SYS 3P3	From the Set-up menu, use [M ▲] and [P ▼] buttons to select the System option. The screen will show the currently selected power supply.
2	SYS 3P3	Press [E] to enter the selection routine. The current selection will flash.

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- 10 -

3-1	SYS 1P2	Use [M ▲] and [P ▼] buttons to select the required system option: 1P2(W), 3P3(W), 3P4(W).
3-2	SYS 3P4	Press [E ▶] to confirm the selection. SET indicator will appear.
Press [U/I ◀ ESC] to exit the system selection routine and return to the menu. SET will disappear and you will be returned to the main Set-up Menu.		

CT

The CT option sets the secondary current (CT2 1A or 5A) of the current transformer (CT) that wires to the meter.

1	SEt Ct2 5	From the Set-up menu, use [M ▲] and [P ▼] buttons to select the CT option.
2	SEt Ct2 5	Secondary CT setting Press [E ▶] to enter the CT secondary current selection routine: 5A/1A
3	Ct rAtE 0001	Set CT Ratio value Press [E ▶] to enter the CT Ratio setting screen. The range is from 0001 to 9999.
Example: If set the ratio to be 100, it means the primary current equals secondary current ×100.		

PT

The PT option sets the secondary voltage (PT2 100 to 500V) of the Voltage transformer (PT) that wires to the meter.

1	SEt Pt2 400	From the Set-up menu, use [M ▲] and [P ▼] buttons to select the PT option. The screen will show the voltage PT secondary voltage value. The default value is 400 V.
2	SEt Pt2 400	Secondary PT setting Press [E ▶] to enter the PT secondary voltage selection routine. The range is from 100 to 500 V.
3	Pt rAtE 0001	Set PT ratios value Press [E ▶] to enter the PT ratio screen. The range is from 0001 to 9999.
For example,if set the ratio to be 100, it means the primary voltage equals secondary voltage ×100.		

Pulse output

This option allows you to configure the pulse output. The output can be set to provide a pulse for a defined amount of energy active or reactive.

Use this section to set up the pulse output 1-Units: Total kWh, Total kVArh.

1	SEt rLY kWh	From the Set-up menu, use [M ▲] and [P ▼] buttons to select the Pulse output option.

2	SEt rLY kWh	Press ⟨E ▷⟩ to enter the selection routine. The unit symbol will flash.
3	SEt rLY kVArh	Use ⟨M ▲⟩ and ⟨P ▼⟩ buttons to choose kWh or kVArh.

On completion of the entry procedure, press ⟨E ▷⟩ to confirm the setting and press ⟨U/I ◁ ESC⟩ to return to the main set up menu.

Pulse rate

Use this to set the energy represented by each pulse. Rate can be set to 1 pulse per 0.01kWh/0.1kWh/1kWh/10kWh/100kWh.

SEt rAtE 10

(It shows 1 impulse = 10kWh/kVArh)

1	SEt rAtE 10	From the Set-up menu, use ⟨M ▲⟩ and ⟨P ▼⟩ buttons to select the Pulse Rate option.
2	SEt rAtE 10	Press ⟨E ▷⟩ to enter the selection routine. The current setting will flash. 0.01/0.1/1/10/100kWh/kVArh per pulse.

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- 13 -

Use [M ▲] and [P ▼] buttons to choose pulse rate. On Completion of the entry procedure, press [E ▶] to confirm the setting and press [U/I ◀ ESC] to return to the main set up menu.

Pulse Duration

The energy monitored can be active or reactive and the pulse width can be 200, 100 or 60 ms.

```
SEt
PULS
200
```
(It shows pulse width of 200 ms).

1-1	``` SEt PULS 200 ```	From the Set-up menu, use [M ▲] and [P ▼] buttons to select the Pulse width option.
1-2	``` SEt PULS 200 ```	Press [E ▶] to enter the selection routine. The current setting will flash. Use [M ▲] and [P ▼] buttons to choose pulse width.

On completion of the entry procedure, press [E ▶] to confirm the setting and press [U/I ◀ ESC] to return to the main set up menu.

Communication

There is a RS485 port can be used for communication using Modbus RTU protocol.
For Modbus RTU, parameters are selected from Front panel.

RS485 Address

SEt
Addr
001

(The range is from 001 to 247)

1	SEt Addr 001	From the Set-up menu, use M▲ and P▼ buttons to select the Address ID.
2-1	SEt Addr 101	Press E▶ button to enter the selection routine.The current setting will be flashing.
2-2	SEt Addr 101	Use M▲ and P▼ buttons to choose Modbus Address (001 to 247).

On completion of the entry procedure,press E▶ button to confirm the setting and press U/I ESC◀ button to return the main set-up menu.

Baud Rate

1	SEt bAud 9.6 k	From the Set-up menu, use M▲ and P▼ buttons to select the Baud Rate option.

2-1	![Display: SEt bAUd 9.6 k]	Press ![E button] to enter the selection routine. The current setting will flash.
2-2	![Display: SEt bAUd 38.4 k]	Use ![M button] and ![P button] buttons to choose Baud rate 2.4k, 4.8k, 9.6k, 19.2k, 38.4k

On completion of the entry procedure, press ![E button] to confirm the setting and press ![U/I ESC button] to return to the main set up menu.

Parity

1	![Display: SEt PArI EVEN]	From the Set-up menu, use ![M button] and ![P button] buttons to select the Parity option.
2-1	![Display: SEt PArI EVEN]	Press ![E button] to enter the selection routine. The current setting will flash.
2-2	![Display: SEt PArI NONE]	Use ![M button] and ![P button] buttons to choose Parity [EVEN / ODD / NONE (default)].

	On completion of the entry procedure, press $\boxed{E \blacktriangleright}$ to confirm the setting and press $\boxed{U/I \blacktriangleleft_{ESC}}$ to return to the main set up menu.	

Stop bits

1	SEt StoP 2	From the Set-up menu, use $\boxed{M \blacktriangle}$ and $\boxed{P \blacktriangledown}$ buttons to select the Stop Bit option.
2-1	SEt StoP 2	Press $\boxed{E \blacktriangleright}$ to enter the selection routine. The current setting will flash.
2-2	SEt StoP 1	Use $\boxed{M \blacktriangle}$ and $\boxed{P \blacktriangledown}$ buttons to choose Stop Bit (2 or 1)

On completion of the entry procedure, press $\boxed{E \blacktriangleright}$ to confirm the setting and press $\boxed{U/I \blacktriangleleft_{ESC}}$ to return to the main set up menu.

CLR

The meter provides a function to reset the maximum demand value of current and power.
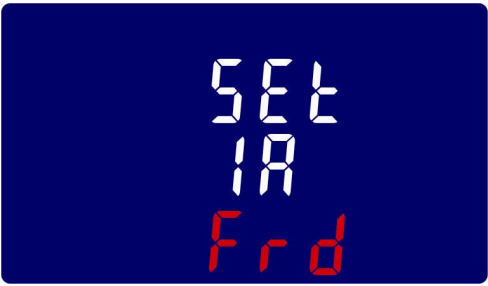
1	CLr	From the Set-up menu, use $\boxed{M \blacktriangle}$ and $\boxed{P \blacktriangledown}$ buttons to select the reset option.

2	MD CLr	Press E ▶ to enter the selection routine. The MD will flash.

Press E ▶ to confirm the setting and press U/I ◀ ESC to return to the main set up menu.

Reverse connected current inputs correction set-up

1	SEt SYS COSt	Use M ▲ and P ▼ buttons to select page "SET sys cont".
2-1	SEt IA Frd	Press to E ▶ enter Phase A, the default is Frd (forward).
2-2	SEt Ib Frd	use M ▲ and P ▼ buttons to Phase B or C setting pages.

- 18 -

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How to operate if phase A is reversely connected

1		Go to phase A setting page.
	SEt 1A Frd	
2	**SEt 1A Frd**	Press [E] to enter the selection routine. The Frd will flash. Use [P] button to change Frd to Rev.

Press [E] to confirm the setting and press [U/I ESC] to return to the main set up menu.

Specifications

Measured Parameters

The unit can monitor and display the following parameters of a single phase two wire (1p2w), three phase three wire (3p3w) or four phase four wire (3p4w) supply.

Voltage and Current

Phase to neutral voltages 100 to 289V a.c. (not for 3p3w supplies).

Voltages between phases 173 to 500V a.c. (3p supplies only).

Percentage total voltage harmonic distortion (THD%) for each phase to N (not for 3p3w supplies).

Percentage voltage THD% between phases (three phase supplies only).

Current THD% for each phase.

Power factor and Frequency and Max. Demand

Frequency in Hz

Instantaneous power:

Power 0 to 3600 MW

Reactive Power 0 to 3600 MVAr

Volt-amps 0 to 3600 MVA

Maximum demanded power since last Demand reset Power factor.

Maximum neutral demand current, since the last Demand reset (for three phase supplies only).

Energy Measurements

✓ Imported/Exported active energy 0 to 9999999.9 kWh

✓ Imported/Exported reactive energy   0 to 9999999.9 kVArh
✓ Total active energy   0 to 9999999.9 kWh
✓ Total reactive energy   0 to 9999999.9 kVArh

Measured Inputs

Voltage inputs through 4-way fixed connector with 2.5mm^2 stranded wire capacity. single phase two wire (1p2w), three phase three wire (3p3w) or four phase four wire (3p4w) unbalan-ced. Line frequency measured from L1 voltage or L3 voltage. Three current inputs (six physical terminals) with 2.5 mm^2 stranded wire capacity for connection of external CTs. Nominal rated input current 5A or 1A a.c. Rms.

Accuracy

✓ Voltage	0·5% of range maximum
✓ Current	0·5% of nominal
✓ Frequency	0·2% of mid-frequency
✓ Power factor	1% of unity (0.01)
✓ Active power (W)	±1% of range maximum
✓ Reactive power (VAr)	±2% of range maximum
✓ Apparent power (VA)	±1% of range maximum
✓ Active energy (Wh)	Class 1 IEC 62053-21
✓ Reactive energy (VARh)	±2% of range maximum
✓ Total harmonic distortion	1% up to 31st harmonic
✓ Response time to step input	1s, typical, to >99% of final reading, at 50 Hz.

*Auxiliary Supply

Two-way fixed connector with 2·5mm2 stranded wire capacity.
85 to 275 V a.c. 50/60 Hz ±10% or 120 V to 380 V d.c. ±20%. Consumption <10W.

Interfaces for External Monitoring

Three interfaces are provided:
✓ an RS485 communication channel that can be programmed for Modbus RTU protocol
✓ an output indicating real-time measured energy (configurable)
✓ an pulse output 3200 imp/kWh (not configurable)

The Modbus configuration (Baud rate etc.) and the pulse output assignments (kW/kVArh) are configured through the Set-up screens.

Pulse Output

The unit provides two pulse outputs. Both pulse outputs are passive type.
Pulse output 1 is configurable. The pulse output can be set to generate pulses to represent total kWh or kVarh.
The pulse constant can be set to generate 1 pulse per:
0.01 = 10 Wh/VArh
0.1 = 100 Wh/VArh
1 = 1 kWh/kVArh

10 = 10 kWh/kVArh

100 = 100 kWh/kVArh

Pulse width: 200/100(default)/60ms

Pulse output 2 is non-configurable. It is fixed up with total kWh. The constant is 3200 imp/kWh.

RS485 Output for Modbus RTU

For Modbus RTU, the following RS485 communication parameters can be configured from the Set-up menu:

Baud rate 2400, 4800, 9600, 19200, 38400

Parity none(default)/odd/even

Stop bits 1 or 2

RS485 network address *nnn* – 3-digit number, 001 to 247

Modbus™ word order Hi/Lo byte order is set automatically to normal or reverse. It cannot be configured from the set-up menu.

Reference Conditions of Influence Quantities

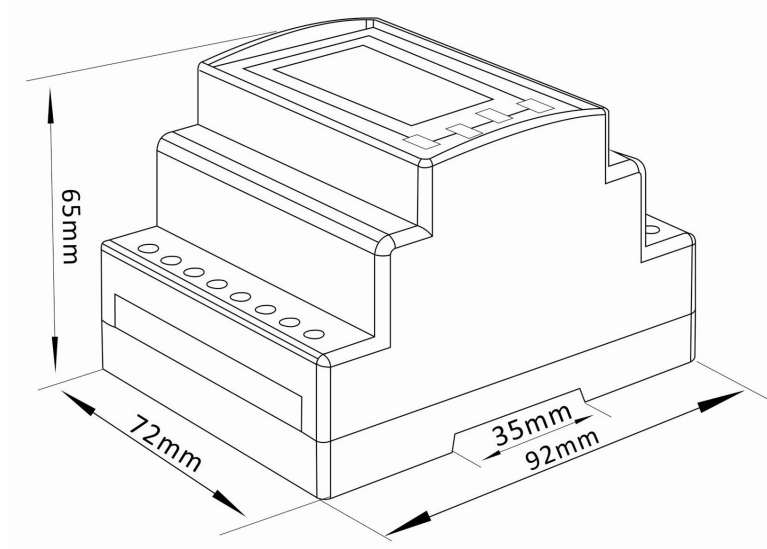Influence quantities are variables that affect measurement errors to a minor degree.

Accuracy is verified under nominal value (within the specified tolerance) of these conditions:

✓ Ambient temperature   23°C ±1°C

✓ Input waveform   50 or 60Hz ±2%

✓ Input waveform   Sinusoidal (distortion factor <0·005)

✓ Auxiliary supply voltage   Nominal ±1%

✓ Auxiliary supply frequency   Nominal ±1%

✓ Auxiliary supply waveform (if AC)   Sinusoidal (distortion factor <0·05)

✓ Magnetic field of external origin Terrestrial flux

Environment

✓   Operating temperature   -25°C to +55°C*

✓   Storage temperature   -40°C to +70°C*

✓   Relative humidity   0 to 90%, non-condensing

✓   Altitude   Up to 2000 m

✓   Warm up time   1 minute

✓   Vibration   10 Hz to 50 Hz, IEC 60068-2-6, 2g

✓   Shock   30g in 3 planes

Dimensions

Installation

3 Phase, 3 Wires

3 Phase, 4 Wires

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- 22 -

Single Phase, 2 Wires

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- 23 -