ES3100D-Mbus

DIN Rail Smart Meter for Single and Three Phase Electrical Systems

- Measures kWh Kvarh, KW, Kvar, KVA, P, F, PF, Hz, dmd, V, A, etc.
- Bi-directional measurement IMP & EXP
- Two pulse outputs
- Mbus
- Din rail mounting 35mm
- 100A direct connection
- Better than Class 1 / B accuracy

USER MANUAL

2016 V1.2

Introduction

The ES3100D-Mbus 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 to the supply required to power the product.

ES3100D-Mbus supports max. 100A direct connection, saves the cost and avoid the trouble to connect external CTs, giving the unit a cost-effective and easy operation. Built-in interfaces provides pulse and Mbus outputs. Configuration is password protected.

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(DIT)
- 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.

Mbus

This uses an MBus port with EN13753-3 protocol to provide a means of remotely monitoring and controlling the Unit.
Set-up screens are provided for setting up the MBus port.

Pulse output

This provides two pulse outputs that clock up measured active and reactive energy. The constant of pulse output 2 for active energy is 400imp/kWh (unconfigurable), its width is fixed at 100ms. The default constant of configurable pulse output 1 is 400imp/kWh, default pulse width is 100ms.The configurable pulse output 1 can be set from the set-up menu.

1		The first screen lights up all display segments and can be used as a display check
2		The second screen indicates the firmware installed in the unit and its build number.
3		The interface performs a self-test and indicates the result if the test passes.

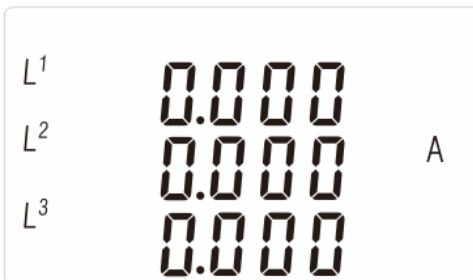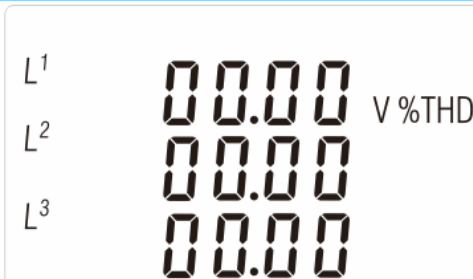After a short delay, the screen will display active energy measurements.
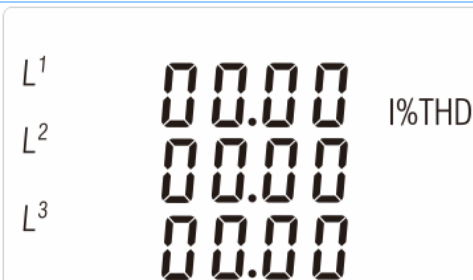
Measurements

The buttons operate as follows:

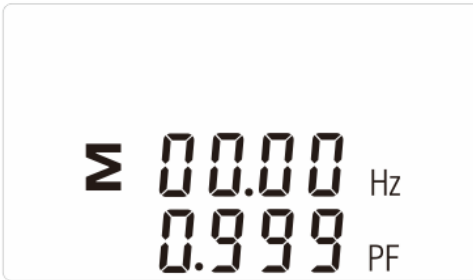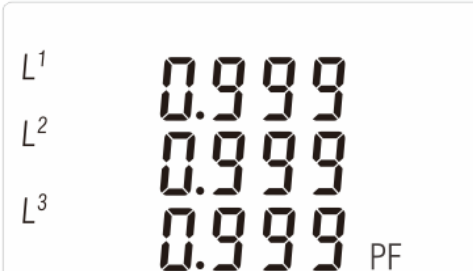| 1		Selects the Voltage and Current display screens In Set-up Mode, this is the "Left" or "Back" button.
2		Select the Frequency and Power factor display screens In Set-up Mode, this is the "Up" button
3		Select the Power display screens In Set-up Mode, this is the "Down" button
4		Select the Energy display screens In Set-up mode, this is the "Enter" or "Right" button

Voltage and Current

Each successive pressing of the button selects a new range:

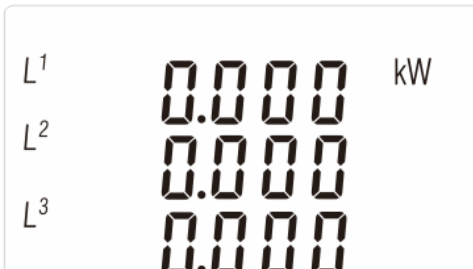| 1-1	L^1 000.0 L^2 000.0 V L^3 000.0	Phase to neutral voltages(3p4w)
1-2	L^{1-2} 380.0 L^{2-3} 380.0 V L^{3-1} 380.0	Phase to neutral voltages(3p3w)
2	L^1 0.000 L^2 0.000 A L^3 0.000	Current on each phase
3-1	L^1 00.00 V %THD L^2 00.00 L^3 00.00	Phase to neutral voltage THD%(3p4w)
3-2	L^{1-2} 00.10 V %THD L^{2-3} 00.10 L^{3-1} 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	M 00.00 Hz 0.999 PF	Frequency and Power Factor (total)
2	L¹ 0.999 L² 0.999 L³ 0.999 PF	Power Factor of each phase
3	MD ` 0.000 kW M	Maximum Power Demand
4	MD L¹ 0.000 L² 0.000 A L³ 0.000	Maximum Current Demand

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	L^1 0.000 L^2 0.000 kVAr L^3 0.000	Instantaneous Reactive Power in kVAr
3	L^1 0.000 L^2 0.000 L^3 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 03.14	Imported active energy in kWh
1-2	(EXPORT) 0000 kWh 00.00	Exported active energy in kWh

2-1	IMPORT 0000 00.00 kVArh	Imported reactive energy in kVArh
2-2	EXPORT 0000 00.00 kVArh	Exported reactive energy in kVArh
3-1	0000 kWh Σ 031.4	Total active energy in kWh
3-2	0000 Σ 00.00 kVArh	Total reactive energy in kVArh

Set-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: 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, 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. 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 [M ▲] and [P ▼] buttons. If not, there maybe 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 set-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
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: 0, 5, 8, 10, 15, 20, 30, 60 minutes
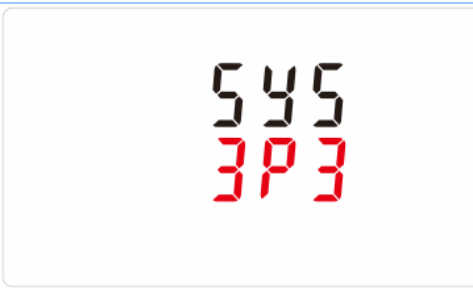
1	SEt dIt 10	From the set-up menu, use M▲ and P▼ buttons to select the DIT option. The screen will show the currently selected integration time.
2-1	SEt dIt 10	Press E to enter the selection routine. The current time interval will flash
2-2	SEt dIt	Use M▲ and P▼ buttons to select the time required.
2-3	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

1	S E t L P 60	The backlit lasting time is settable Default lasting time is 60minutes For example, if it's set as 5, the backlit will be off in 5minutes from the last time operation on the meter.
2	S E t L P **60**	Press [E] to enter the selection routine. The current time interval will flash **The options can be:** **0(always on),5,10,30,60,120minutes**

Use [M] and [P] buttons to select the time required. Press [E] to confirm the set-up,

Supply System

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

1	S Y S 3 P 3	From the Set-up menu, use [M] and [P] buttons to select the System option. The screen will show the currently selected power supply.
2-1	S Y S **3 P 3**	Press [E] to enter the selection routine. The current selection will flash
2-2	S Y S 1 P 2	Use [M] and [P] buttons to select the required system option: 1P2(W),3P3(W) ,3P4(W)

2-3	**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		

Pulse output

This option allows you to configure the pulse output 1. 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 for:

Total kWh/ Total kVArh

Import kWh/Export kWh

Import KVArh/Export KVArh

1	**SEt rLY** kWh	From the Set-up menu, use [M] and [P] buttons to select the Pulse output option.
2-1	**SEt rLY** kWh	Press [E] to enter the selection routine. The unit symbol will flash.
2-2	**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 dFt/0.01/0.1/1/10/100kWh/kVArh.

```
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. Note: When it's dFt, it means 2.5Wh/VArh

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 selected as 200, 100(default) or 60ms.

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

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 Mbus port can be used for communication using Mbus protocol. For Mbus communication, parameters are selected from Front panel.

RS485 Address

SEt
Addr
001

(The range is from 001 to 250)

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 250)
2-3	Id 8888 8888	Mbus secondary address It ranges from 00 00 00 01 to 99 99 99 99

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	SEt bAUd 9.6 k	Press [E] to enter the selection routine. The current setting will flash.

2-2	SEt bAud 2.4 k	Use [M ▲] and [P ▼] buttons to choose Baud rate 0.3k, 0.6k, 1.2k, 2.4k, 4.8k, 9.6k Default is 2.4k
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.		

Parity

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

Stop bits

1	SEt StoP 2	From the Set-up menu, use M▲ and P▼ buttons to select the Stop Bit option.
2-1	SEt StoP 2	Press E↵ to enter the selection routine. The current setting will flash.
2-2	SEt StoP 1	Use M▲ and P▼ buttons to choose Stop Bit (2 or 1)

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.

Note: Default is 1, and only when the parity is NONE that the stop bit can be changed to 2.

CLR

The meter provides a function to reset the maximum demand value of current and power.

1	CLr	From the Set-up menu, use M▲ and P▼ 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.

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)

Basic current (Ib): 10A

Max current : 100A

Min. Current: 5% of Ib

Starting current: 0.4% of Ib

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 99999 W

Reactive Power 0 to 99999 VAr

Volt-amps 0 to 99999 VA

Maximum demanded power since last Demand reset Power factor

Maximum neutral demand current, since the last Demand reset (for 3p4w supply only)

Energy Measurements

- Imported active energy   0 to 999999.99 kWh
- Exported active energy   0 to 999999.99 kWh
- Imported reactive energy   0 to 999999.99 kVArh
- Exported reactive energy   0 to 999999.99 kVArh
- Total active energy   0 to 999999.99 kWh
- Total reactive energy   0 to 999999.99 kVArh

Measured Inputs

Voltage inputs through 4-way fixed connector with 25mm^2 stranded wire capacity. single phase two wire(1p2w), three phase three wire(3p3w) or four phase four wire(3p4w) unbalanced. Line frequency measured from L1 voltage or L3 voltage.

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 19st harmonic
- Temperature co-efficient   Voltage and current = 0.013%/°C typical
                                          Active energy = 0·018%/°C, typical
- Response time to step input 1s, typical, to >99% of final reading, at 50 Hz.

Interfaces for External Monitoring

Three interfaces are provided:
- an MBus communication channel that can be programmed for MBus EN13757-3 protocol
- an Pulse output(Pulse 1) indicating real-time measured energy.(configurable)
- an Pulse output(Pulse 2) 400imp/kWh

The Modbus configuration (Baud rate etc.) and the pulse output assignments (kW/kVArh, import/export etc.) 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 / import/export kWh or kVarh.

The pulse constant can be set to generate 1 pulse per:

dFt = 2.5 Wh/VArh

0.01 = 10 Wh/VArh

0.1 = 100 Wh/VArh

1 = 1 kWh/kVArh

10 = 10 kWh/kVArh

100 = 100 kWh/kVArh

Pulse width: 200/100/60ms

Pulse output 2 is non-configurable. It is fixed up with active kWh. The constant is 400imp/kWh.

MBus Output for EN_13757-3

For MBus **EN13757-3**, the following MBus communication parameters can be configured from the Set-up menu:

  Baud rate 300, 600, 1200, 2400, 4800, 9600

  Parity none (default)/odd/even

  Stop bits 1 or 2

  MBus network primary address *nnn* – 3-digit number, 001 to 250

  MBus network secondary address 00 00 00 01 to 99 99 99 99(The secondary address can not be setted directly on meter, but can be done via Mbus communication)

## 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 ±2°C
- Input frequency   50Hz/60Hz ±2%
- Input waveform   Sinusoidal (distortion factor < 0·005)
- Magnetic field of external origin   Terrestrial flux

Environment
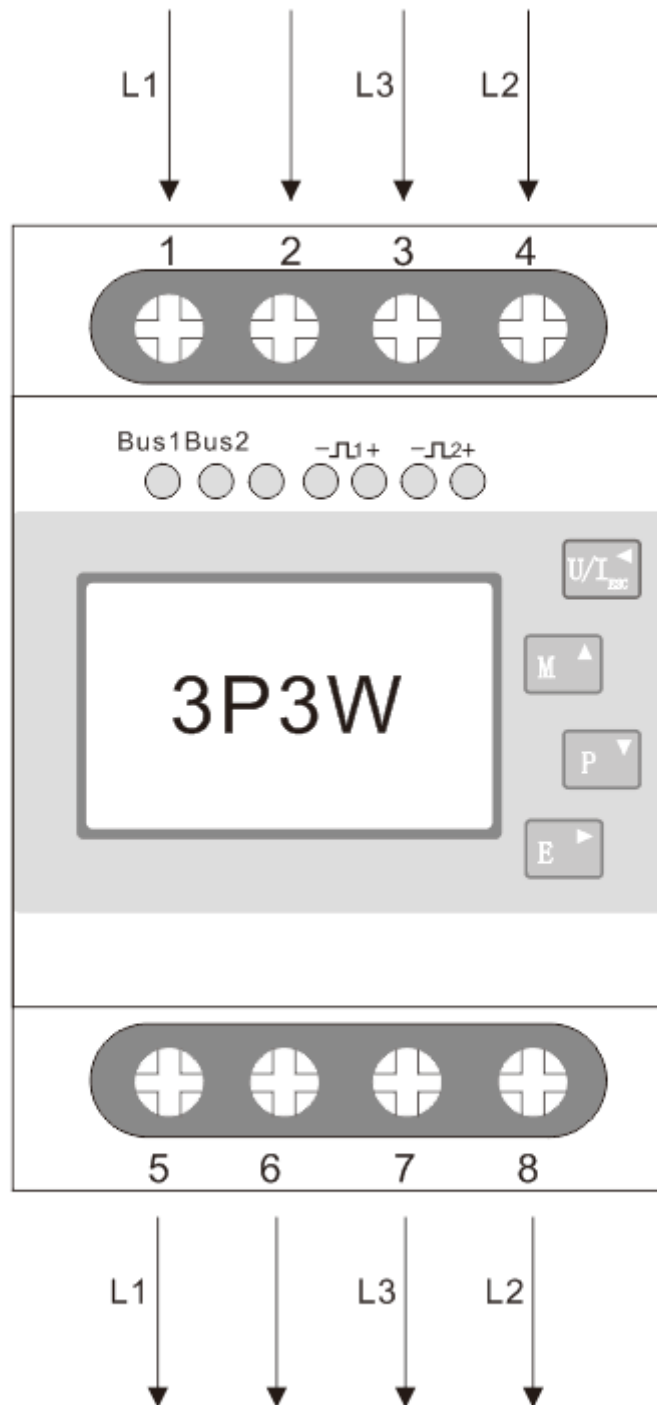
- Operating temperature   -25°C to +55°C*
- Storage temperature   -40°C to +70°C*
- Relative humidity   0 to 90%, non-condensing
- Altitude   Up to 2000m
- Warm up time   10s
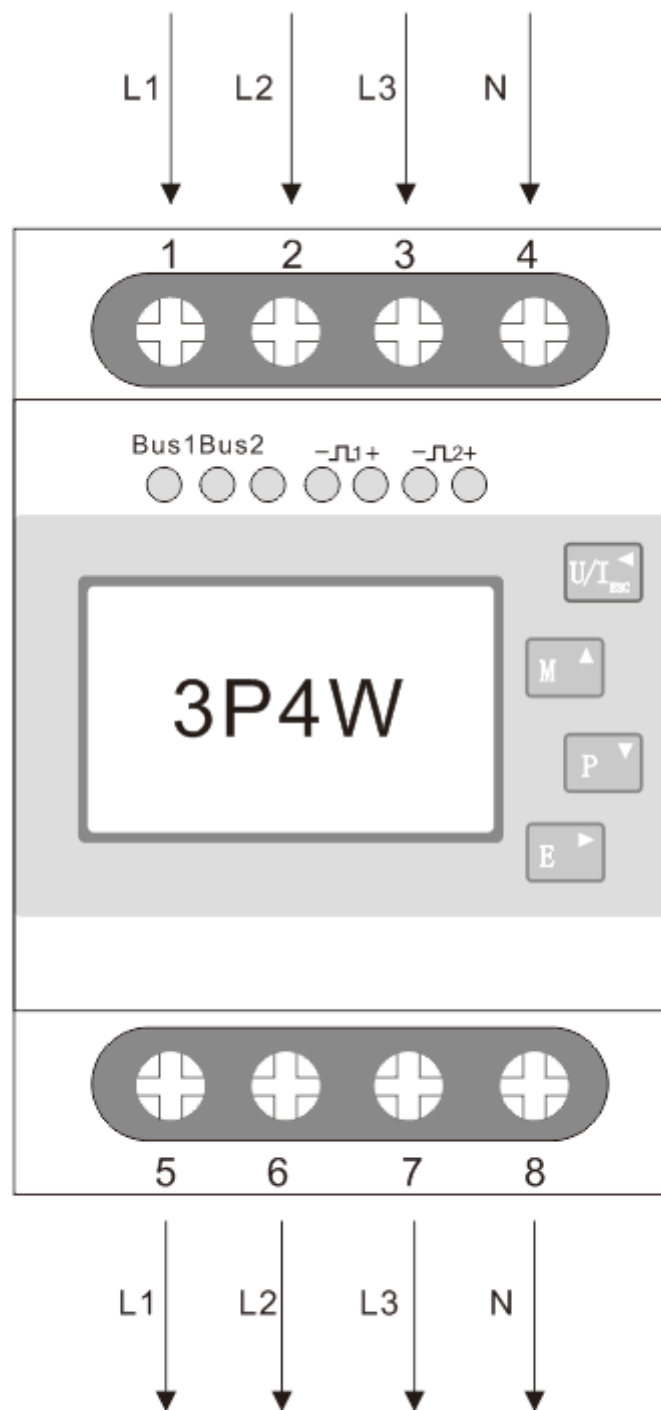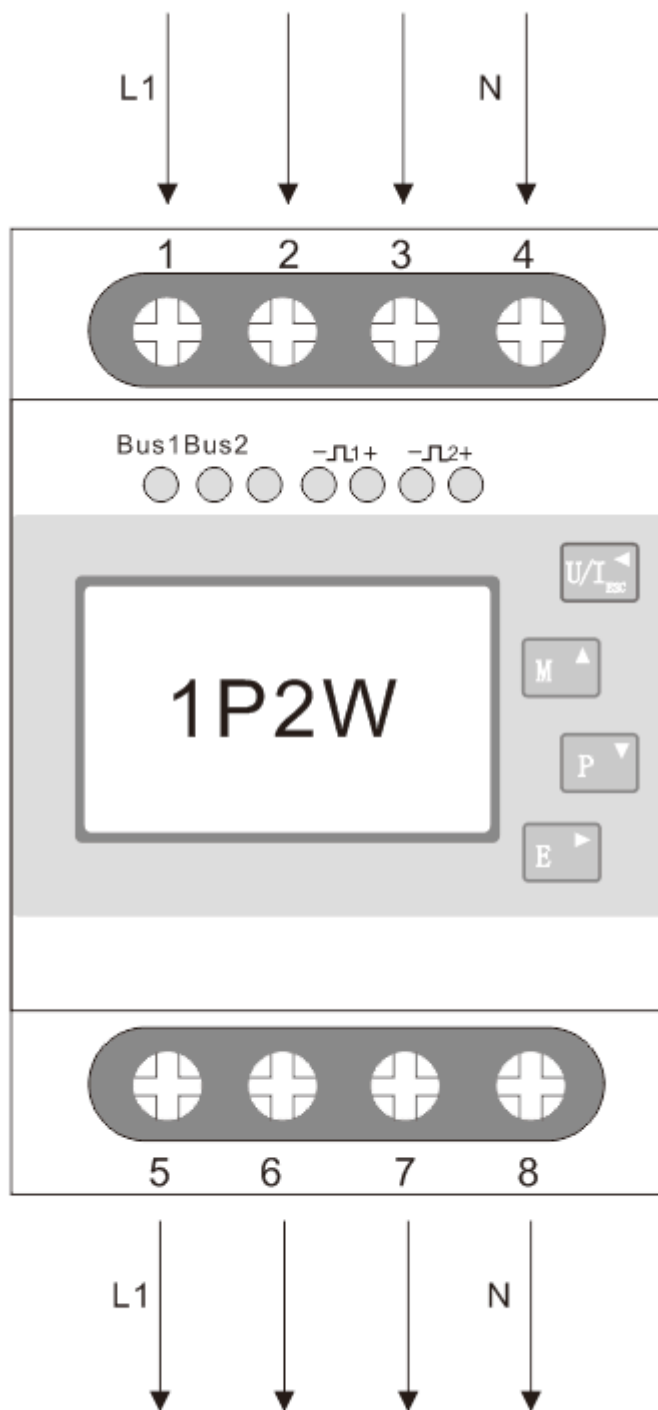- Vibration   10Hz to 50Hz, IEC 60068-2-6, 2g

Dimensions
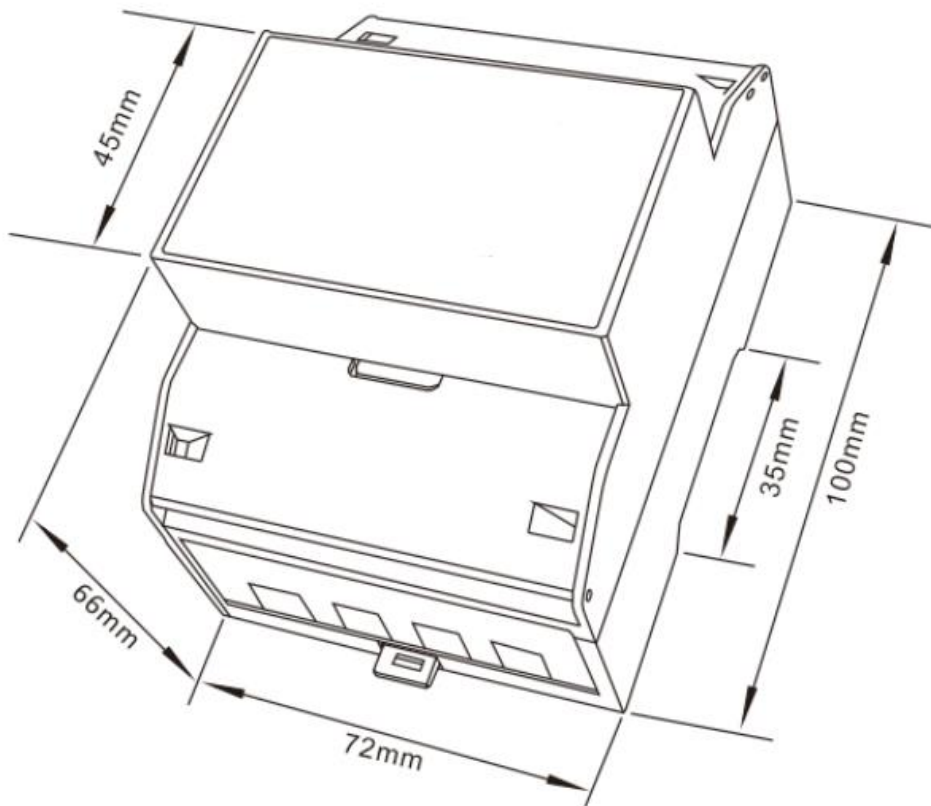
Wiring diagram

- Three Phase Three Wires：

- Three Phase Four Wires：

- Single Phase two Wires：

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