

PEM400CT Series

Three Phase Multifunction DIN Rail Energy Meter



DIN RAIL SMART METER FOR SINGLE AND THREE PHASE ELECTRICAL SYSTEMS

User Manual V3.7

1. Introduction

This document provides operating, maintenance and installation instructions. This unit measures and displays the characteristics of single phase two wires(1p2w), three phase three wires(3p3w) and three phase four wires(3p4w) networks. The measuring parameters include voltage(V), frequency(Hz), current(A), power(kW/Kva/Kvar), import, export and total Energy(kWh/kVarh). The unit can also measure Maximum demand current and power, this is measured over preset periods of up to 60 minutes.

This unit is a 1A or 5A current transformer operated and can be configured to work with a wide range of CTs. Built-in pulse and Modbus or M-Bus 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 by linking the voltage reference and neutral reference in to terminals 5 and 6 (Please refer to wiring diagram).

1.1 Unit Characteristics

The unit can measure and display:

- Voltage and THD% of all phases
- Line frequency
- Current, current demand and 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 setup screens for:

- Changing passcode
- Supply system selection 1P2, 3P3, 3P4
- Demand interval time
- Reset for demand measurements
- Pulse output duration

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

1.2 Current Transformer Primary Current

The PEM400CT meter is a current transformer supplied device and the correct ratio will need to be set. As an example: If using a 100/5A CT, you will need to insure CT2 (secondary rating) is set to 5 and CT Rate is set to 0020. The CT Rate is derived by dividing the primary by the secondary (100 ÷ 5 = 20).

1.3 RS485 Serial – Modbus RTU

The RS485 serial port with Modbus RTU protocol provides a means of remotely monitoring and controlling the unit. Setup screens are provided for setting up the RS485 port (Refer to Section 4.8).

1.4 Pulse outputs

Two pulse outputs pulse measured active and reactive energy. Pulse 1 (Terminals 9 & 10) can be configured in the setup menu (Refer to Section 4.7) Pulse 2 (Terminals 11 & 12) is fixed for active energy at 3200imp/kWh.

2. Start Up Screens

	The first screen lights up all display segments and can be used as a display check.
	The second screen indicates the firmware installed in the unit and its build number. * The actual version maybe different.
	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.

3. Measurements

The buttons operate as follows:

	Selects the Voltage and Current display screens. In Setup Mode, this is the "Left" or "Back" button.
	Select the Frequency and Power factor display screens. In Setup Mode, this is the "Up" button.
	Select the Power display screens. In Setup Mode, this is the "Down" button.
	Select the Energy display screens. In Setup mode, this is the "Enter" or "Right" button.

3.1 Voltage and Current

Each successive press of the U/I button selects a new parameter:

	Phase Voltage.
	Phase Current.
	Phase Voltage THD% (Total Harmonic Distortion).
	Phase Current THD% (Total Harmonic Distortion).

3.2 Frequency, Power Factor and Demand

Each successive press of the M button selects a new range:

	Frequency and Total Power Factor.
	Phase Power Factor.
	Maximum Power Demand.
	Maximum Current Demand.

3.3 Power

Each successive press of the P button select a new range:

	Instantaneous Active Power in kW.
	Instantaneous Reactive Power in kVar.
	Instantaneous Volt-Amps in kVA.
	Total kW, kVar, kVA.

3.4 Energy Measurements

Each successive press of the E button selects a new range:

	Import Active Energy in kWh.
	Export Active Energy in kWh.
	Import Reactive Energy in kVarh.
	Export Reactive Energy in kVarh.
	Total Active Energy in kWh.
	Total Reactive Energy in kVarh.

4. Setup Mode

To enter Setup Mode, press the E button for 3 seconds, until the passcode screen appears.

	Setup Mode is passcode protected. The correct passcode (default '1000') must be entered before progression.
	If an incorrect passcode is entered, the display will show: PASS Err

To exit Setup Mode, press U/I repeatedly until the measurement screen is restored.

4.1 Setup Entry Methods

Some menu items, such as passcode and CT, require a passcode entry while others, such as supply system, require selection from a number of menu options.

4.1.1 Menu Option Selection

1. Use the M and P buttons to scroll through the different options of the setup menu.
2. Press E to confirm your selection
3. If an item flashes, then it can be adjusted by the M and P buttons.
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 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 setup, press the U/I repeatedly until the measurement screen is restored.

4.1.2 Passcode Procedure

When setting the unit, some screens require the entering of a passcode. In particular, on entry to the setup menu, a passcode 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 to exit the passcode routine. The SET indicator will be removed.

4.2 Change Passcode

	Use the M and P buttons to choose the Change Passcode option.
	Press the E to enter the change passcode routine. The new passcode screen will appear with the first digit flashing.
	Use M and P buttons to set the first digit and press E to confirm your selection. The next digit will flash.
	Repeat the procedure for the remaining three digits.
	After setting the last digit, SET will show.

Press U/I to exit the change passcode routine and return to the setup menu. SET will be removed

4.3 DIT Demand Integration Time

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

	From the setup menu, use M and P buttons to select the DIT option. The screen will show the currently selected integration time.
	Press E to enter the selection routine. The current time interval will flash.
	Use M and P buttons to select the time required.
	Press E to confirm the selection. SET indicator will appear.

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

Warnings

Important Safety Information is contained in the Maintenance section. Familiarise yourself with this information before attempting installation or other procedures. Symbols used in this document:

- Risk of Danger: These instructions contain important safety information. Read them before starting installation or servicing of the equipment.
- Caution: Risk of Electric Shock

4.4 Supply System

The unit has a default setting of WKUHHShase IRXUwire (3P4). Use this section to set the type of electrical system.

	From the setup menu, use M and P buttons to select the System option. The screen will show the currently selected power supply.
	Press E to enter the selection routine. The current selection will flash.
	Use M and P buttons to select the required system (1P2, 3P3 or 3P4).
	Press E to confirm the selection. SET indicator will appear.

Press U/I to exit the system selection routine and return to the menu. SET will disappear and you will be returned to the main setup menu.

4.5 Current Transformer (CT)

The CT option sets the parameters of the current transformer that is used with the meter.

	From the setup menu, use M and P buttons to select the CT option.
	Set Secondary CT Press E to enter the CT secondary current (1A or 5A).
	Set CT Rate Press E to enter the CT Rate screen. The range set between 0001 to 9999.

For example, if using a 100/5A current transformer you will enter 0020, the CT Rate is derived by dividing the primary by the secondary (100 ÷ 5 = 20).

4.6 Voltage Transformer (PT)

The PT option sets the parameters of the voltage transformer that may be used with the meter.

	Use M and P buttons to select the PT option. The screen will show the voltage PT secondary voltage value. The default value is 400V.
	Set Secondary PT Press E to enter the PT secondary voltage (100V to 500V).
	Set PT Rate Press E to enter the PT Rate screen. The range is set between 0001 to 9999.

For example, if the rate is set to 100, this means the primary voltage equals secondary voltage x100.

4.7 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 relay pulse output type (kWh, kVarh).

	From the setup menu, use M and P buttons to select the Pulse Output option.
	Press E to enter the selection routine. The unit symbol will flash.
	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 to return to the main setup menu.

4.7.1 Pulse rate

Use this section to set the energy represented by each pulse. Rate can be set to 1 pulse 0.p.e0r1kWh, 0.1kWh, 1kWh, 10kWh or 100kWh.



(The display represents 1 impulse = 10kWh/kVAh)



From the setup menu, use **M** and **P** buttons to select the Pulse Rate option.



Press **E** to enter the selection routine. The current setting will flash.

Use **M** and **P** buttons to choose the pulse rate (0.01, 0.1, 1, 10 or 100).
On completion of the entry procedure, press **E** to confirm the setting and press **W** to return to the main setup menu.

4.7.2 Pulse Duration

The pulse width of the energy monitored can be adjusted to either 200ms, 100ms or 60ms.



(The display represents a pulse width of 200ms)



From the setup menu, use **M** and **P** buttons to select the Pulse Duration option.



Press **E** to enter the selection routine. The current setting will flash.

Use **M** and **P** buttons to choose the pulse width (200, 100 or 60).

On completion of the entry procedure press **E** to confirm the setting and press **W** to return to the main setup menu.

4.8 Communication

There is a RS485 port that can be used for communication using a Modbus RTU protocol. The Modbus RTU settings can be adjusted from the front display.

4.8.1 RS485 Address



(The range is from 001 to 247)



From the setup menu, use **M** and **P** buttons to select the Modbus address option.



Press **E** to enter the selection routine. The current setting will flash.



Use **M** and **P** buttons to choose the Modbus address (001 to 247).

On completion of the entry procedure, press **E** to confirm the setting and press **W** to return the main setup menu.

4.8.2 Baud Rate



From the setup menu, use **M** and **P** buttons to select the Baud Rate option.



Press **E** to enter the selection routine. The current setting will flash.



Use **M** and **P** buttons to choose the Baud Rate (2.4k, 4.8k, 9.6k, 19.2k or 38.4k).

On completion of the entry procedure, press **E** to confirm the setting and press **W** to return to the main setup menu.

4.8.3 Parity



From the setup menu, use **M** and **P** buttons to select the Parity option.



Press **E** to enter the selection routine. The current setting will flash.



Use **M** and **P** buttons to choose the Parity (None, Even or Odd).

On completion of the entry procedure, press **E** to confirm the setting and press **W** to return to the main setup menu.

4.8.4 Stop Bits



From the setup menu, use **M** and **P** buttons to select the Stop Bit option.



Press **E** to enter the selection routine. The current setting will flash.



Use **M** and **P** buttons to choose the Stop Bit (1 or 2).

On completion of the entry procedure, press **E** to confirm the setting and press **W** to return to the main setup menu.

4.9 Backlight Setup

The meter provides a function to set the blue backlight duration time (0, 5, 10, 30, 60 or 120 minutes).

Option 0 means the backlight is always on.



The backlight duration is on default for 60 minutes. If set to 5, the backlight will turn off after 5 minutes from last user interaction.

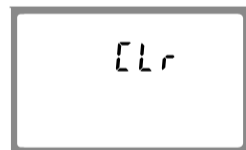


Use **M** and **P** buttons to choose the duration.

On completion of the entry procedure, press **E** to confirm the setting and press **W** to return to the main setup menu.

4.10 Clear Demand Values

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



From the setup menu, use **M** and **P** buttons to select the Clear option.



Press **E** to enter the selection routine. DIT will flash.

Press **E** to confirm the setting and press **W** to return to the main setup menu.

5. Specifications

5.1 Measured Parameters

The unit can monitor and display the following parameters of a single phase two wire (1P2), three phase three wire (3P3) or three phase four wire (3P4) system.

5.1.1 Voltage and Current

- Phase voltages - 100 to 289V a.c. (excluding 3P3 systems)
- Line-to-line voltages - 173 to 500V a.c. (3P* systems only)
- Phase voltage THD% (excluding 3P3 systems)
- Line-to-line voltage THD% (3P* systems only)
- Phase Current THD%

5.1.2 Power factor and Frequency and Maximum Demand

- Frequency in Hz
- Instantaneous power
- Power - 0 to 3600 MW
- Reactive power - 0 to 3600 MVAR
- Volt-amps - 0 to 3600 MVA
- Power Factor
- Maximum demanded power, since last the demand reset
- Maximum demanded current, since the last demand reset (3P* systems only)

5.1.3 Energy Measurements

- Import/Export active energy 0 to 9999999.9 kWh
- Import/Export reactive energy 0 to 9999999.9 kVAh
- Total active energy 0 to 9999999.9 kWh
- Total reactive energy 0 to 9999999.9 kVAh

5.2 Measured Inputs

Voltage inputs via a 4-way fixed connector with 2.5mm² stranded wire capacity. Single phase two wire (1P2), three phase three wire (3P3) or three phase four wire (3P4) unbalanced. Line frequency measured from L1 voltage or L3 voltage.

Three current inputs (six physical terminals) with 2.5mm² stranded wire capacity for connection of external CTs. Nominal rated input current of 1A or 5A.

5.3 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) ±0.5% of range maximum
- Reactive power (VAR) ±1% of range maximum
- Apparent power (VA) ±1% of range maximum
- Active energy (Wh) Class 0.5S IEC 62053-22
- Reactive energy (VAh) ±1% 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.

5.4 Auxiliary Supply

Two-way fixed connector with 2.5mm² stranded wire capacity. 85 to 275V a.c. 50/60Hz ±10% or 120V to 380V d.c. ±20%. Consumption - <2W / 10VA.

5.5 Interfaces for External Monitoring

Three interfaces are provided:

- RS485 communication channel that can be programmed for Modbus RTU protocol
- Relay output indicating real-time measured energy (configurable)
- Pulse output 3200imp/kWh (not configurable)

The Modbus configuration (baud rate etc.) and the pulse relay output assignments (kWh/kVAh, import/export etc.) are configured through the setup screens.

5.5.1 Pulse Output

The pulse output can be set to generate pulses to represent kWh or kVAh.

Rate can be set to generate 1 pulse per:

- 0.01 = 10 Wh/VAh
- 0.1 = 100 Wh/VAh
- 1 = 1 kWh/kVAh
- 10 = 10 kWh/kVAh
- 100 = 100 kWh/kVAh

Pulse width - 200, 100 or 60 ms

Relay rating - 240V a.c. 50mA

5.5.2 RS485 Output for Modbus RTU

For Modbus RTU, the following RS485 communication parameters can be configured from the setup menu:

- Baud rate - 2400, 4800, 9600, 19200 or 38400
- Parity - None, Odd or Even
- Stop bits - 1 or 2
- RS485 Modbus address - 1 to 247

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

5.6 Reference Conditions of Influence Quantities

Influence quantities are variables that affect measurement errors to a minor degree. Accuracy is verified under a 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 a.c.) Sinusoidal (distortion factor < 0.05)
- Magnetic field of external origin Terrestrial flux

5.7 Environment

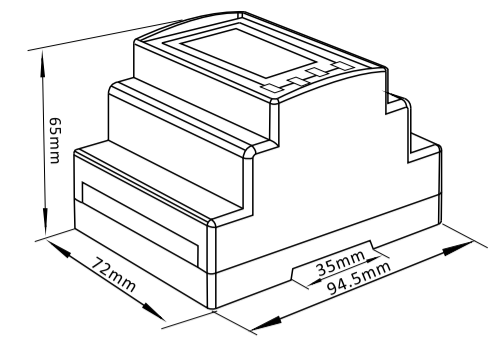
- Operating temperature -25°C to +55°C*
- Storage temperature -40°C to +70°C*
- Relative humidity 0 to 95%, non-condensing
- Altitude Up to 3000m
- Warm up time 1 minute
- Vibration 10Hz to 50Hz, IEC 60068-2-6, 2g
- Shock 30g in 3 planes

* Maximum operating and storage temperatures are in the context of typical daily and seasonal variation.

5.8 Mechanics

- DIN rail dimensions 72 x 94.5 mm (WxH) per DIN 43880
- Mounting DIN rail (DIN 43880)
- Sealing IP51 (indoor)
- Material Self-extinguishing UI94 V-0

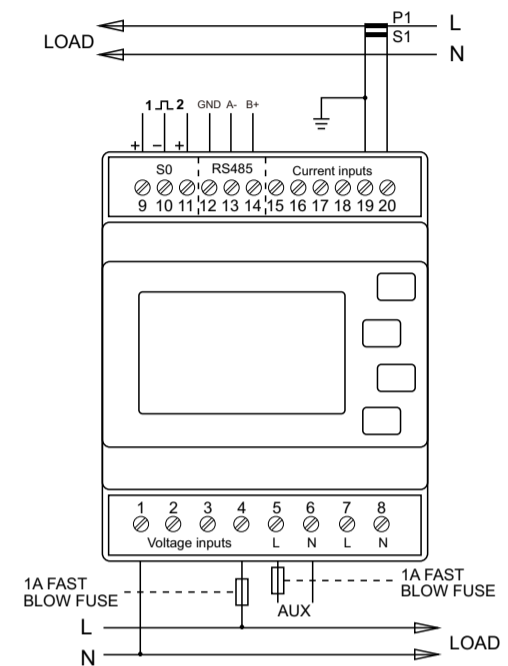
6. Dimensions



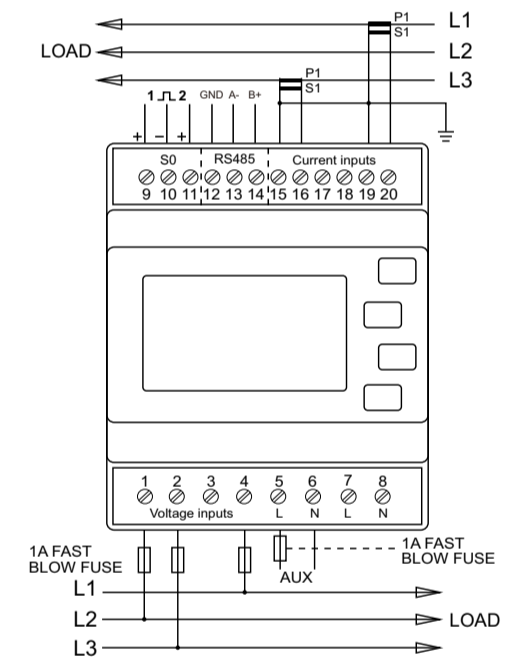
7. Installation

* Terminals 7&8 are power outputs that can be the auxiliary power for the next ia.20D CT meter.

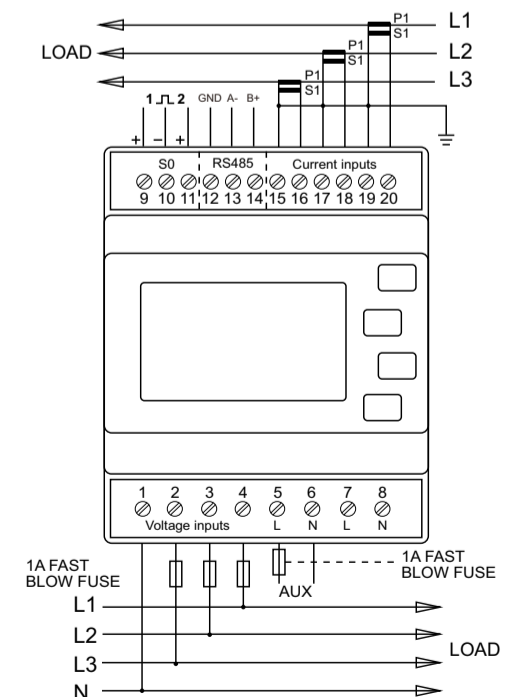
7.1 Single phase two wires (1P2)



7.2 Three phase three wires



7.3 Three phase four wires



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