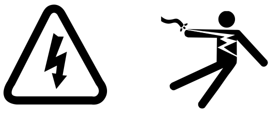
EasyLogic™ PM1000 Series Power Meter
User Guide

NHA1696401-02
07/2015

Hazard Categories and Special Symbols

Read these instructions carefully and look at the equipment to become familiar with the device before trying to install, operate, service or maintain it. The following special messages may appear throughout this manual or on the equipment to warn of potential hazards or to call attention to information that clarifies or simplifies a procedure.

SAFETY SYMBOLS



The addition of either symbol to a “Danger” or “Warning” safety label indicates that an electrical hazard exists which will result in personal injury if the instructions are not followed.

This is the safety alert symbol. It is used to alert you to potential personal injury hazards. Obey all safety messages that follow this symbol to avoid possible injury or death.

SAFETY MESSAGES

⚠ DANGER

DANGER indicates a hazardous situation which, if not avoided, **will result in** death or serious injury.

⚠ WARNING

WARNING indicates a hazardous situation which, if not avoided, **could result in** death or serious injury.

⚠ CAUTION

CAUTION indicates a potentially hazardous situation which, if not avoided, **could result in** minor or moderate injury.

CAUTION

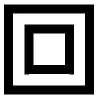
CAUTION used without the safety alert symbol, indicates a potentially hazardous situation which, if not avoided, **can result in** property damage.

NOTICE

NOTICE is used to address practices not related to physical injury.

OTHER SYMBOLS

This symbol indicates direct and alternating currents.



This is the double insulation symbol which indicates that, the user-accessible area is protected throughout by double insulation or reinforced insulation.

PLEASE NOTE

Electrical equipment should be installed, operated, serviced, and maintained only by qualified personnel. No responsibility is assumed by Schneider Electric for any consequences arising out of the use of this material.

REACH Compliance

Complies with Regulation (EC) n° 1907/2006 of Dec 18 2006 named REACH (related to the Registration, Evaluation, Authorization and restrictions applicable to Chemical substances)

FCC Notices

This equipment has been tested and found to comply with the limits for a class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at own expense.

This class A digital apparatus complies with Canadian CAN ICES-3 (A) /NMB-3(A).

Modifications: Modifications to this device which are not approved by Schneider Electric may void the authority granted to the user by the FCC to operate this equipment.

Chapter 1 – Product Description

The PM1000 series power meters are digital power meters that offer comprehensive 3-phase electrical instrumentation and load management facilities in a compact and rugged package.

This chapter contains the main operating instructions. The remaining chapters explain the installation and setup steps required before the meter is ready for use, and maintenance and troubleshooting procedures for the meter after installation.

The PM1000 series power meter is a universal power meter. Before use, please program the SYS (measurement system configuration) and the PT (VT) and CT ratios through the front panel keys. Otherwise, it will read your system incorrectly. Other settings, such as communication parameters, must also be programmed as needed.

Schneider Electric stands behind your PM1000 power meter with complete user support and service.

Intended use: The PM1000 series power meter is designed for use in industrial and commercial installations by trained and qualified professionals, not for domestic use.

Physical Description

FRONT: The front panel has three rows of four digits/characters each, with auto scaling Kilo (K), Mega (M), and minus (-) indications. The **K** and **M** indicators are lit together to show Giga readings. The load bar graph to the right of the display gives the indication of consumption in terms of the % Amperes Load with respect to the FS (full scale) selected. Five smart keys make navigating the parameters very quick and intuitive for viewing data and configuring the power meter.

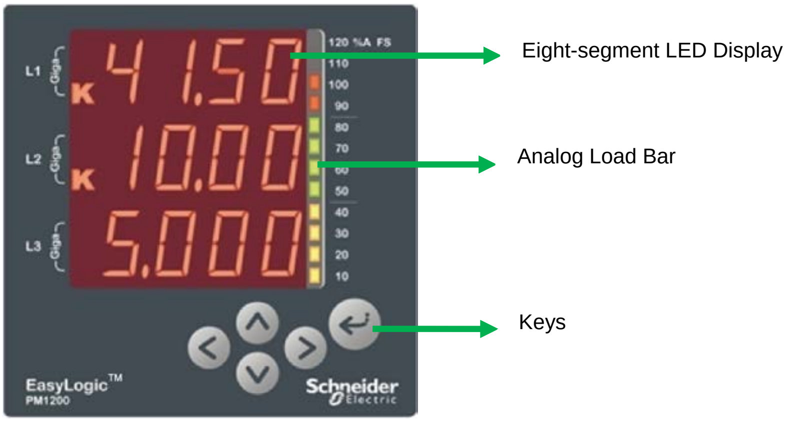
REAR: The voltage and current terminals and the RS-485 communication port are located on the back of the power meter. Refer to “Rear Panel” for more information.

Front Panel

The front panel contains the following indicators and controls:

- Three rows of alphanumeric displays, four digits each, display three RMS parameters simultaneously or one energy parameter. The displayed readings update every second.
- For each row: Kilo, Mega (Kilo + Mega = Giga) indicators, and a Negative (-) indicator.
- Load bar, which gives a unique analog indication of % loading (% FS CT Pri).
- Five keys to scroll through the display pages.

Figure 1-1: Parts of PM1000 series front panel



Eight-segment LED display

- The power meter solves the problem of tiny cluttered indicators by prominently displaying the parameter name right on the large, alphanumeric readouts.
- For the first time in a panel meter, the parameter name is as clearly readable as the value.
- In order to know which parameter value is currently displayed, the power meter displays the parameter name for two seconds, as well as each time you press a key, and then the value for eight seconds.
- This method also allows programmable phase soft-Labels in the power meters. You can choose from 123 (factory setting), ABC, RYB, PQR or RST.

Analog Load Bar

- Unique indication of total load % with respect to the full scale through the 12 LEDs at the right side of the display.
- This is bar graph, where each LED indicates 10% of load.
- To find the total load, count the number of illuminated LEDs, and then multiply by 10**.**

Table 1-1: Load percentage and bar graph indication

Load percentage	Bar graph display
Less than 10%	No LEDs are lit.
Between 10 to 40 %	Amber LEDs are lit.
Between 50 to 80%	Green LEDs are lit to indicate that the load is acceptable and should not increase further.
Above 80%	Red LEDs are lit to indicate that the load has exceeded the sanctioned limit and is dangerous.

The Indicators – Kilo, Mega, and Negative

Table 1-2: Indicators

	**Kilo:** When lit, indicates that the reading is in Kilo (10^3). 10,000 is displayed as 10.00 K and 1000 is displayed as 1.0 K.
	**Mega:** When lit, indicates that the reading is in Mega, (10^6). 10,000 K is displayed as 10.00 M and 1000 K is displayed as 1.0 M.
	**Giga:** When **Kilo** and **Mega** are lit together, the reading is in Giga (10^9). 10,000 M is displayed as 10.00 G and 1000 M is displayed as 1.0 G.
	**Negative:** When lit, indicates that the reading is **negative** as per IEEE 100 and industry standard practice. When PF (power factor) is lead (capacitive load): Both PF and VAR (reactive power) signs will be negative. When current is reversed: W (active power) is negative.

Table 1-3: Giga, Mega (M), Kilo (K), and decimal point scaling

RMS Reading	Indicator
Less than 0.001	K, M OFF, displays **0.000**
Less than 9999	K, M OFF
Above 9999	K ON, M OFF
Above 9999 K	M ON, K OFF
Above 9999 M	Giga (K + M indicators ON)
Up to 9999 G	Giga
Above 9999 G	Display shows **Hi** for positive numbers, **Lo** for negative numbers

RMS readings are four digits. Energy readings have eight digits, including four additional fractional digits. The maximum number the power meter handles is 9,999 G for RMS and energy values.

This means that the energy readings of the power meter will overflow at three values of Wh (active energy) or VAh (apparent energy) (selectable through the Setup menu) depending upon the PT (VT) and CT ratios programmed.

Smart Keys

Operating the power meter is easy, using the five smart keys to navigate through the keypad operations table. The display pages **expand** as you go to the right, much like the directory or explorer **tree** displayed on any computer. The display shows where you are headed.

Table 1-4: Smart keys description

	**Right Key** • Go **forward** into sub-parameter pages. • Going right past **EDIT** in **SET** and **CLR** requires code entry to enter the Setup menu (setup and clear). • During setup, select **next** (right side) digit.
	**Left Key:** • Go **back** towards to the main parameter pages. • During edit setup, selects **previous** (left side) digit. • Exits from Edit mode, back to the Setup menu. • The meter enters the SIM (simulation) mode when you press the left key continuously during power up of the power meter. See “SIM (Simulation) mode” for more information.
	**Up Key:** • Scroll **up** through display pages at the same level, **within the same function.** • Continuous pressing for three seconds initiates **limited auto-scroll (within the same function).** See “Auto-scroll” for more information. • **While editing, increases** the value of the blinking digit during edit.
	**Down Key:** • Scroll **down** through other display pages at the same level, through **all functions**. • Continuous pressing for three seconds initiates **the full auto-scroll mode,** through all functions. See “Auto-scroll” for more information. • **While editing, decreases** the value of the blinking digit.
	**TURBO Key:** TURBO key is simple one touch access to the most commonly used parameters pages (Factory set). The TURBO pages for PM1000 series are given below. **RMS (home page),** VLL, A, PF VLN, A, F VA, W, PF VA, W,VAR W, VAR, PF PF1, PF2, PF3, V% 1 2 3, A % 1 2 3, VAd RD TR, MD HR, VAh, Wh, VAh E, Wh E, RVAh, RWh, tVAh, tWh**.** This gives simple one-touch access to the most commonly used parameters, even for unskilled operators. **If you’re lost, the TURBO key is a quick way to get back to the RMS home page.** Continuous pressing for three seconds initiates auto scrolling through the above TURBO pages. See “Auto-scroll” for more information. **During the power up, if the TURBO key is pressed, then the power meter will go into Setup menu. This is the easiest way to enter into the setup menu.** **See “Quick setup – While powering on” for more information.**

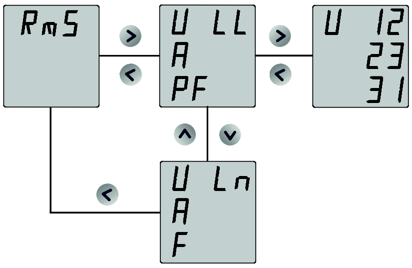
Keypad Operation

Navigating with the power meter is very easy and intuitive. Press the key in the direction you want to go. The display shows where you're headed. Press the key that takes you in the desired direction.

Follow these simple steps:

• First take a quick look at what the keys do.

Navigation Concept



The following example explains how you can navigate from the **RMS** page to the **VLN A F** page, and back to the **RMS** in the power meter.

1. From the RMS page, press . The display shows **VLL**
A
PF
2. Now press .The display shows **VLN**
A
F
3. To return to **RMS,** press .The display shows **RMS**.

Using the left key, you can go back towards to the main parameter pages from the sub-parameter pages.

• Now, try getting around to other parameters, by moving up, down, right, and left. The readings are organized as display pages to the right of **RMS** and **INTG**.

• The **Kilo**, **Mega,** and **Negative** Indicators are automatic. **Kilo** and **Mega** light up together to show **Giga**. See "The indicators" for more information.

• You cannot go right into CLR, to clear INTG and MD values, unless you enter a code.

• Going right through **SET**, you can go down to **VIEW** or **EDIT**. Going right through **EDIT** requires code entry to program these power meter settings. When done:

• Go Left all the way back to **SET**.

• Go down to **CLR**.

• Go Right into **RMS** to view the display pages again.

Auto-scroll

Auto-scroll allows you to monitor a group of display pages sequentially, every five seconds, without constant key pressing. This is convenient for viewing from a distance. The meter shows the parameter name (one second) followed by the value (four seconds) on the same large display.

- **To auto-scroll within a page group (e.g., Within RMS group)**

  Go to a particular page in the desired page group. Press continuously for three seconds and then release. The display flashes **AUTO** and starts auto-scroll within the page group.

- **To auto-scroll down the entire column of pages**

  Go to the desired page. Press continuously for three seconds and then release. The display flashes **AUTO** and starts auto-scroll down the entire column of pages.

- **To auto-scroll through TURBO pages**

  Press continuously for three seconds and then release. The display flashes **AUTO** and starts auto-scroll through the TURBO pages.

NOTE: Press any key to revert to manual scrolling. Auto scrolling is not possible in the setup parameters.

Default Display (View) Page

You can select any page as a **user-set** default display page. You can scroll to other display pages. The **user-set** page is displayed two minutes after manual scrolling is stopped by the user.

To lock the user-set default page:

- Go to the page you want to set as the default page.
- Press and simultaneously to lock the page. The power meter displays **LOCK**.

To unlock the user-set default page:

- Once the default display page is active, press and simultaneously to unlock the page. The power meter displays **ULOC**.

*NOTE: Entry into setup (PROG) is allowed only when the **display page** is unlocked.*

Rear Panel

The power meter terminals are located on the rear panel. 14 terminals are provided, seven terminals on each side:

- Six terminals for current, one **in** and one **out** per phase
- Four terminals for voltage, for three phases and neutral
- Two terminals for auxiliary power supply (control power)
- Two terminals for the RS-485 communication port (PM1200)

Figure 1-2: Rear panel

Models and Parameters

The power meter can measure, locally display, and remotely transfer over Modbus RTU protocol (PM1200), the following parameters:

Table 1-5: Models and parameters

Parameter		PM1000	PM1200
RMS	VLL V12, V23, V31 VLN V1, V2, V3	✓	✓
	A A1 A2 A3	✓	✓
	An - Neutral current	✓	✓
	F	✓	✓
	%L – Amps	✓	✓
	% V Unbal, % A Unbal	✓	✓
	PF PF1 PF2 PF3	✓	✓
	%A FS Analog color-coded load bar	✓	✓
	RPM	✓	✓
	A° Phase Angle A°1 A°2 A°3	✓	✓
	W W1 W2 W3	✓	✓
	VA VA1 VA2 VA3	✓	✓
	VAR VAR1 VAR2 VAR3	✓	✓
THD	V%1 V%2 V%3	✓	✓
	A%1 A%2 A%3	✓	✓
DM	Demand VA/ W/ A	✓	✓
	Rising demand	✓	✓
	Time remaining	✓	✓
	MD Maximum demand	✓	✓
	Hr MD occurred	✓	✓
INTG FWD	Wh	✓	✓
	VAh	✓	✓
	VARh	✓	✓
	-VARh	✓	✓
	Run hours	✓	✓
	ON hours	✓	✓
	INTR	✓	✓
INTG REV	R.Wh	✓	✓
	R.VAh	✓	✓
	R.VARh	✓	✓
	-R.VARh	✓	✓
	Run hours	✓	✓
	ON hours	✓	✓
INTG TOT	t.Wh	✓	✓
	t.VAh	✓	✓
	t.VAR	✓	✓
	-t.VAR	✓	✓
	t.Run	✓	✓
	On.h	✓	✓
	INTR	✓	✓
OLD FWD	Wh	✓	✓
	VAh	✓	✓
	VARh	✓	✓
	-VARh	✓	✓

Parameter		PM1000	PM1200
	Run hours	✓	✓
OLD REV	R.Wh	✓	✓
	R.VAh	✓	✓
	R.VARh	✓	✓
	-R.VARh	✓	✓
	Run hours	✓	✓
OLD TOT	t.Wh	✓	✓
	t.VAh	✓	✓
	t.VAR	✓	✓
	-t.VAR	✓	✓
	t.Run	✓	✓
	RS-485	-	✓

NOTE:

- *FWD: Forward indicating the import of power into the plant/grid*
- *REV: Reverse indicating the export of power from the plant/grid*

The PM1000 series displays:

- **Voltage:** Three voltage measurements line-to-line: 1-2, 2-3, 3-1, and average, Three voltage measurements line-to-neutral: 1-4, 2-4, 3-4, and average.
- **Current:** Three current measurements phase-wise (1, 2, 3), average current of all three phases, neutral current, and three current phase angles (A°1, A°2, A°3) with respect to the corresponding voltage line-neutral vector.
- **Phase wise load in %:** Three currents in % of the FS (%A FS).
- **Unbalanced load in %:** Current and voltage unbalance.
- **Frequency:** Measures from whichever phase is active.
- **RPM:** Measures the speed of the generator.
- **Power:** VA, W, VAR, per phase and total. PF per phase and average. Per-Phase W readings provide a quick CT Polarity Check. A negated W phase reading indicates CT reversal.
- **Energy:** VAh, Wh, +VARh (Ind), -VARh (Cap), Run hours, On Hrs, supply interruptions (outage).
- **Energy (OLD):** VAh, Wh, +VARh (Ind), -VARh (Cap), Run hours.
- **% Amperes load bar graph:** Load bar graph indicates consumption in terms of %Amperes total. You can quickly estimate the load by viewing the display without operating any keys. The bar graph consists of 12 segments. Each segment indicates a current load of 10% of CT primary.
- **Kilo, Mega, Giga** indication for the above parameters. See “The Indicators” for more information.

Technical Specifications

The PM1000 series is a high-accuracy, low cost, ultra-compact, power, and energy meter. It offers ISO 9001 quality, accuracy, and functional flexibility. Selective models of this series have Modbus RTU communications capability. The standard unit flush-mounts in a DIN 96 cutout and conforms to UL product standards.

The power meters are designed for retrofit applications such as replacement of analog meters. Each can be used as a standalone meter in electrical control panels, power distribution units (PDU), switch boards; uninterrupted power supplies (UPS), generator sets, and motor control centers (MCC) systems. It also provides easy communication to program logic controls (PLC), distributed control systems (DCS), building management systems (BMS), and other systems.

The following table gives the technical specifications of the power meters. Refer to “Technical Data” for more information.

Table 1-6: Technical specifications

Description	Specification
Sensing/Measurement	True RMS, one second update time, four quadrant power and energy
Accuracy*	0.5 % of reading** for voltage and current 1.0% of reading for power and energy
Auxiliary supply (Control power)	44 to 277 VAC/DC 50/60Hz
Burden	Voltage and current input < 0.2 VA per phase Auxiliary supply < 3 VA at 240 V, 5 VA Max (Control power) < 2 W at 300 V DC
Display	Alphanumeric bright LED
Resolution	RMS four digits, INTG eight digits
Input voltage	Four voltage inputs (V1, V2, V3, VN) IEC: 80 to 480 V-LL (50 to 277 V-LN) CAT III 80 to 600 V-LL (50 to 350 V-LN) CAT II UL: 80 to 600 V-LL
Input current* (Energy measurement)	Current inputs (A1, A2, A3) Class 1.0: 50 mA to 6 A (5 mA is the starting)
Frequency	45 to 65 Hz
Overload	10 A max continuous, 50 A for 5 sec/hr, 120 A for 1 sec/hr
Environmental	Operating temperature: -10 °C to 60 °C (14 °F to 140 °F) Storage temperature: -25 °C to +70 °C (-13 °F to 158 °F) Humidity 5% to 95% non-condensing Altitude ≤ 2000m
Standard	CAT III - Measurement, Pollution Degree 2, ⧈ - Double insulation at user-accessible area
Weight	400 gms (0.9 lb) approx, unpacked 500 gms (1.1 lb) approx, shipping
Communication (PM1200)	RS-485 serial channel connection Industry standard Modbus RTU protocol
PM1000 Series conforms to	Emission : CISPR11 Class A Fast Transient: 4kV IEC 61000-4-4 Surge withstand: IEC 61000-4-5 Damped Oscillatory: IEC 61000-4-12 ESD: IEC 61000-4- 2 Impulse voltage: 6 kV, IEC 60060, 1.2/50 µs
IP degree of protection	Front Display- IP 51 Meter Body- IP40 (excluding terminals)

NOTE:

- ** Additional error of 0.05% of full scale for input current below 100 mA.*
- ***Applicable only in star/wye wiring configuration.*

Chapter 2: Safety Precautions

This section contains important safety precautions that must be followed before attempting to install, service, or maintain electrical equipment. Carefully read and follow the safety precautions outlined below.

DANGER

HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH

- Apply appropriate personal protective equipment (PPE) and follow safe electrical work practices. In the USA, see NFPA 70E.
- Only qualified electrical workers should install this equipment. Such work should be performed only after reading this entire set of instructions.
- If the equipment is not used in a manner specified by the manufacturer, the protection provided by the equipment may be impaired.
- NEVER work alone.
- Before performing visual inspections, tests, or maintenance on this equipment, disconnect all sources of electric power. Assume that all circuits are live until they have been completely de-energized, tested, and tagged. Pay particular attention to the design of the power system. Consider all sources of power, including the possibility of back feeding.
- Turn off all power supplying the power meter and the equipment in which it is installed before working on it.
- Always use a properly rated voltage sensing device to confirm that all power is off.
- Before closing all covers and doors, inspect the work area for tools and objects that may have been left inside the equipment.
- When removing or installing panels do not allow them to extend into the energized bus.
- The successful operation of this equipment depends upon proper handling, installation, and operation. Neglecting fundamental installation requirements may lead to personal injury as well as damage to electrical equipment or other property.
- NEVER bypass external fusing.
- NEVER short the secondary of a PT.
- NEVER open circuit a CT; use the shorting block to short circuit the leads of the CT before removing the connection from the power meter.
- Before performing Dielectric (Hi-Pot) or Megger testing on any equipment in which the power meter is installed, disconnect all input and output wires to the power meter. High voltage testing may damage electronic components contained in the power meter.
- The power meter should be installed in a suitable electrical enclosure.
- Do not exceed the device’s ratings for maximum limits.
- Do not use this device for critical control or protection applications where human or equipment safety relies on the operation of the control circuit

Failure to follow these instructions will result in death or serious injury.

Chapter 3: Quick Start Guide

Setup Menu

- The power meter must be configured to match the application settings, before use. Otherwise, the readings will be wrong.
- All the setup values can be re-programmed at any time, using **SET** However, the settings: SYS (WYE (Star)/Delta/single-phase / 2-Phase), Vpri, Vsec, Apri, Asec critically determine the scaling of measured readings.
- The scaling may be used to reduce the errors in readings due to Instrument Transformer errors. However, wrong settings will introduce errors in readings of other running systems.

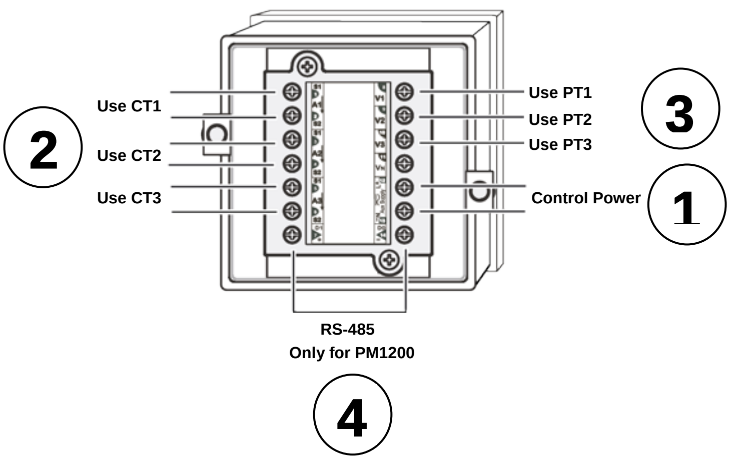
⚠ CAUTION
HAZARD OF UNINTENDED OPERATION Only qualified personnel are authorized to set up the power meter. **Failure to follow this instruction can result in injury or equipment damage**.

You can enter the Setup menu in
- **View only mode**: To view the set parameters.
- **Edit mode:** To view or edit set parameters.

Quick setup – While powering ON

- This is the easiest way to enter the Setup menu.
- To make connections, see “Connection diagrams”. Here are few tips.

Figure 3-1: Quick setup – connections



1. Connect auxiliary supply (control Power) 44 – 277 Vac/dc to terminals 12 and 13 in order to power ON the power meter.
   - Keep  pressed for two seconds, while powering up the power meter. The power meter directly enters into the Setup menu and displays **EDIT A.PRI 100.0**.

   Program the following setup parameters for accurate readings:
     - A.pri, A.sec: Set these values to match your CT primary and secondary values. For example, if your CT Ratio is 200:5, set A.pri = 200.0 and A.sec = 5.000.
     - V.pri, V.sec
       - Set these values to match the input voltage VLL of circuit, if the input voltage < 480 Vac LL. For example, if input voltage = 300 Vac LL, set V.pri = 300.0 and V.sec = 300.0.
       - Use potential transformer (PT/VT), if the input voltage > 480 Vac LL. Set the V.pri and V.sec values to match the primary and secondary of the PT (VT) respectively. For example, if PT (VT) ratio is 11 kV: 110, set V.pri = 11.00 k and V.sec = 110.0.

   Select one of the following systems according to your wiring configuration:
     - SYS: DLTA for 3-phase 3-wire system
     - SYS: WYE/Star for 3-phase 4-wire system
     - SYS: 2-phase for 2-phase 3-wire system
     - SYS: single-phase for single-phase 2-wire system

2. Connect the current transformers (CTs).

CT1	CT2	CT3
1, 2	3, 4	5, 6

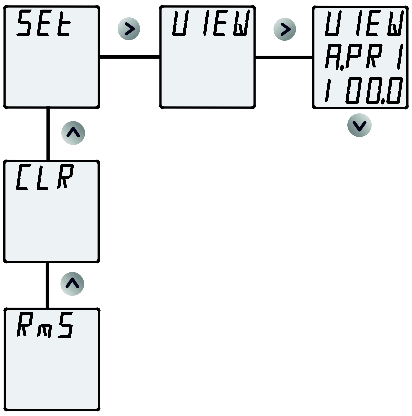
3. Connect the voltage inputs. Use PT(VT), if voltage exceeds 480 Vac LL.

PT1	PT2	PT3	Neutral
8	9	10	11

4. RS-485 terminals (PM1200)

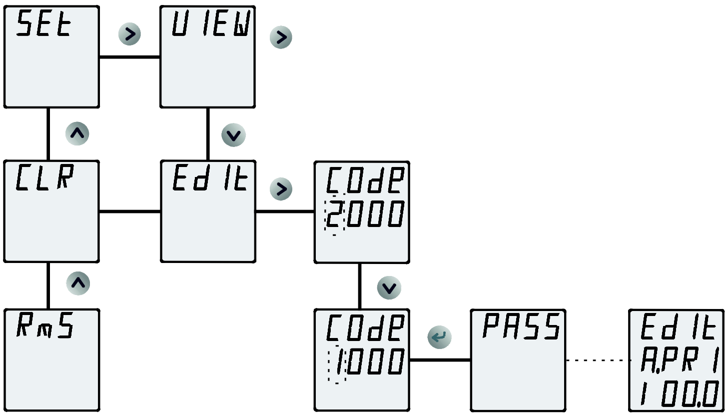
+ve	-ve
7	14

Enter Setup Menu in View (Read-Only) Mode



1. From RMS, press . The display shows **CLR.**
2. Press . The display shows **SET.**
3. Press . The display shows **VIEW.**
4. Press . Use and to scroll and view the setup parameters and their current settings.

Enter Setup Menu in Edit Mode

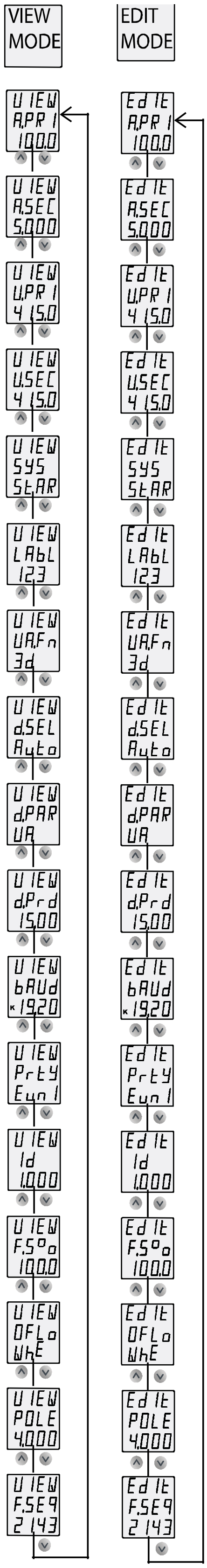


NOTE: means blinking
2 means blinking 2

1. From RMS, press . The display shows **CLR.**
2. Press . The display shows **SET**.
3. Press . The display shows **VIEW**.
4. Press . The display shows **EDIT**. CODE entry is required to enter the setup menu in edit mode.
5. Press for two seconds. The display shows **CODE 2000** with **2** blinking The factory set code is 1000.
6. Press . The display shows **CODE 1000** with **1** blinking.
7. Press once or four times to accept the new CODE value. The display shows **PASS** and then **EDIT A.PRI 100.0** indicating the successful entry to the setup menu in edit mode.

NOTE: If you enter a wrong code, the display flashes FAIL, and then displays EDIT. Repeat the procedure and make sure that you enter correct code.

Setup Parameters in View and Edit Modes



A.PRI = Current primary winding (CT)
Input rang: 1 A to 99 kA (**100.0**)

A.SEC = Current Secondary winding (CT) (**5.000**)

V.PRI = Voltage Primary Winding)PT), line-line
Input range: 100 V to 999 kV (**415.0**)

V.SEC = Voltage secondary winding (PT), line-line
Input range: 80 V to 480 V (**415.0**)

SYS = Power system's configuration
Select from: **STAR**, DELTA, 2-phase, single-phase, WYE

LABL = Phase labling
Select from: **123**, RYB, RST, PQR, ABC

VA.FN = VA function selection
Set the VA function to: **3D**, ARTH

d.SEL = Demand Selection
Select from: **auto**, user

d.PAR = Demand Parameter
Select from: **VA**, W, A

d.PRD = Demand Period
Select from: 5, 10, **15**, 20, 25, 30

BAUD = Baud rate
Select from : 4800, 9600, **19.20k**

PARTY = Parity & Stop bit settings: **EVN.1**, EVN.2, ODD.1, ODD.2, no.1, no.2

ID = RS-485 Device ID number: **1** to 247
(Evn.1 = Even.1 stop bit)

F.S% = Full scale %
Set the full scale between 1 to **100**

OFLO = Overflow parameters selection: Wh, VAh, VAh E, **Wh E**

POLE = Number of poles for RPM
Select from: 2, **4**, 6, 8, 10, 12, 14, 16

F.Seq = Float byte ordr sequence
Select from 4321 for Big-Endian
2143 for Swapped Big-Endian

NOTE:

- *Default setup values are given in BOLD.*
- *BAUD, PRTY, and ID are applicable only for PM1200.*

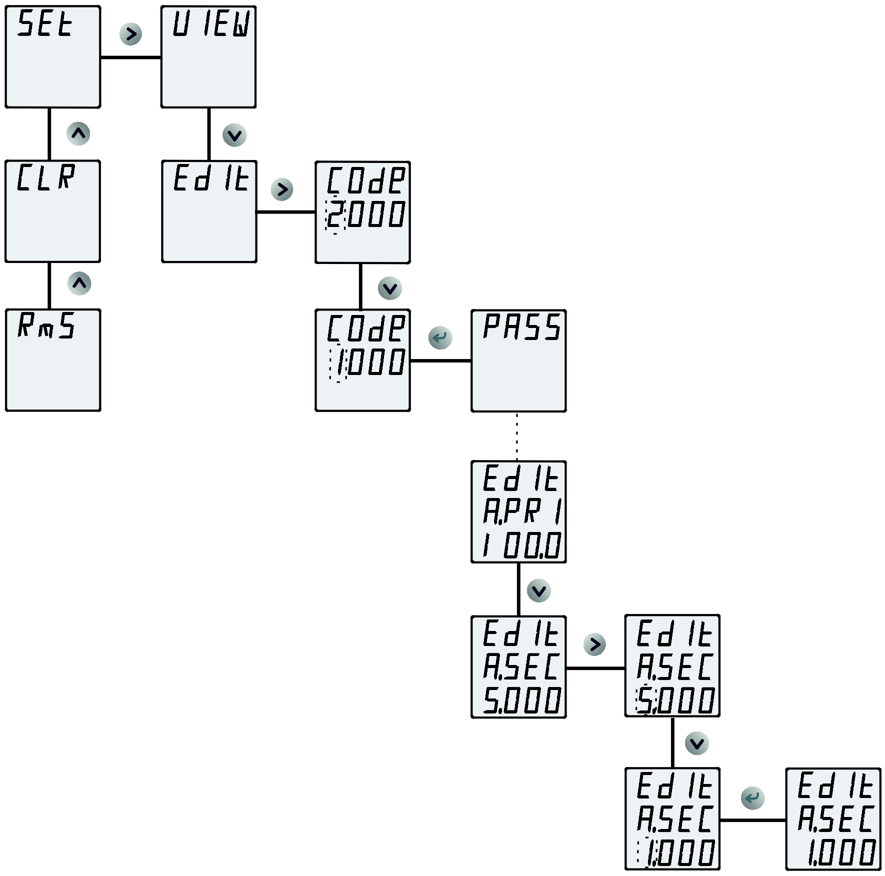
Edit Set Parameters

This example explains how to edit the value of A.SEC from **5.000** to **1.000** in the Setup menu of the power meter.

For easy understanding, setup parameter editing is explained two parts: **edit and accept setup, and save the new value in the setup**.

NOTE: After entering into setup, if there is no key press for > 2 minutes, the power meter will exit from the setup automatically.

Edit and Accept Setup

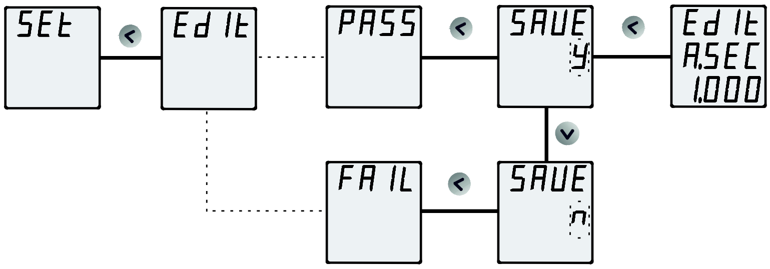


NOTE: means blinking
2 means blinking 2

1. After entering the setup menu in edit mode, (Refer to “Enter setup menu in Edit mode” for more information) press . The display shows **EDIT A.SEC 5.000**.
2. Press . The display shows **EDIT A.SEC 5.000** with blinking **5**. The value can be edited.
3. Press four times. The display shows **EDIT A.SEC 1.000** with blinking **1**.
4. Press to accept the new value.

To edit the next parameter, press and repeat the above steps.

Save the New Value in the Setup

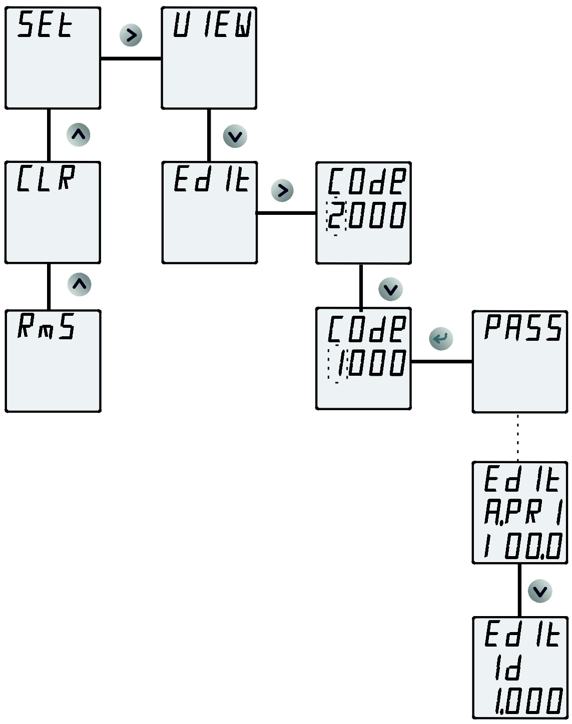


NOTE: means blinking
y means blinking y

1. After you edit and accept the parameter as previously described, press . The display shows **SAVE y** with blinking **y.**
2. Press or to save the new value. The display flashes **PASS** and then shows **EDIT**.
3. Press to return to **SET**.

NOTE: If you do not want to save the new value, press to change the value from ***SAVE y*** *to* ***SAVE n*** *in step 1. Then press or . The display flashes* ***FAIL*** *and shows* ***EDIT****. Proceed to step 3.*

Edit ID



NOTE: means blinking/editable
2 means blinking 2

1. From **RMS**, press . The display shows **CLR.**
2. Press . The display shows **SET**.
3. Press . The display shows **VIEW**.

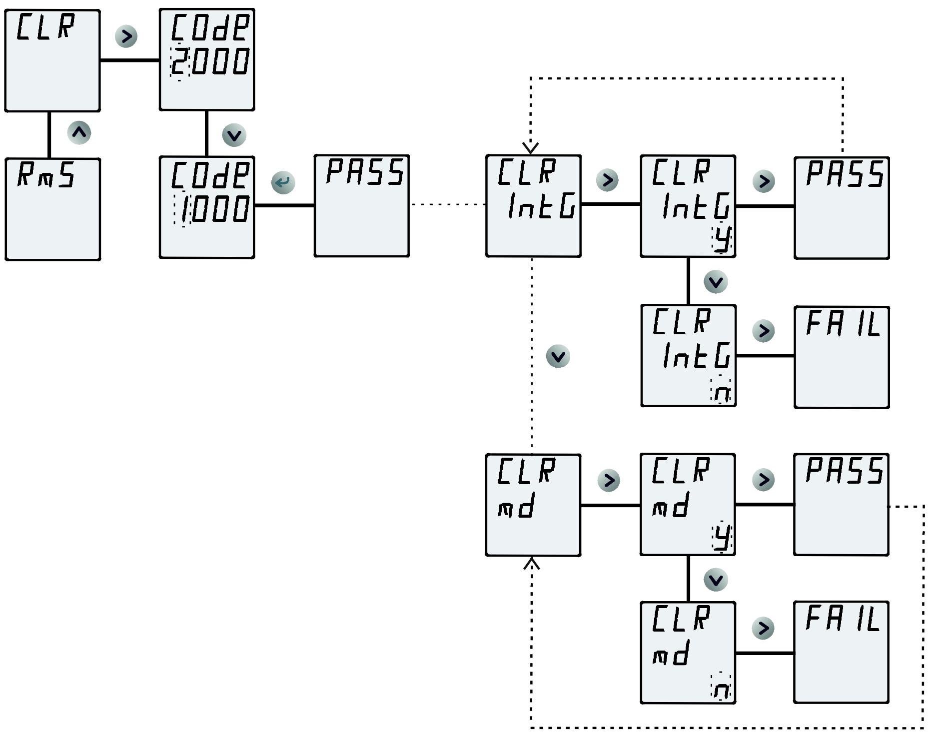
4. Press . The display shows **EDIT**.
5. Press for two seconds. The display shows **CODE 2000** with **2** blinking. The factory set **CODE** is **1000**.
6. Press . The display shows **CODE 1000** with **1** blinking.
7. Press once or four times to accept the new **CODE** value. The display shows **PASS** and then **EDIT A.PRI 100.0** indicating the successful entry to the setup menu in edit mode.
8. Press until the display shows **Edit ID 1.000** page.
   Press to set the desired **Edit ID** value. Press to view the **Edit ID** page set with the new values.

NOTE: If you enter a wrong code, the display flashes FAIL and then displays EDIT. Repeat the procedure and make sure that you enter correct code.

Clear INTG and MD

The power meters are equipped with energy integrator INTG, where the energy parameters are accumulated

- INTG CLR: Clear both INTG and MD values
- INTG MD: Clear only MD values (where MD is maximum demand)



NOTE: means blinking
Y means blinking y

INTG Clear

1. From **RMS**, press . The display shows **CLR.** CODE entry is required to clear the **INTG** values.
2. Press for two seconds. The display shows **CODE 2000** with blinking **2.** The factory set CODE is 1000.
3. Press . The display shows **CODE** 1000 with blinking 1.
4. Press once or four times to accept the new value.

After the successful **CODE** entry, the display shows **CLR INTG**.

5. In order to clear **INTG,** press . The display shows **CLR INTG y** with blinking **y**.
6. Press to clear **INTG**. The display flashes **PASS** and then **CLR INTG**.
7. Press . The display shows **CLR**.
8. Press to return to **RMS** page.

*NOTE: If you do not want to clear the integrators, press to change the value from **CLR INTG y** to **CLR INTG n** in step 5. Then press . The display flashes **FAIL** and shows **CLR INTG**. Proceed to step 7.*

MD Clear

1. From **RMS**, press . The display shows **CLR.**
   CODE entry is required to clear the **INTG** values.
2. Press for two seconds. The display shows **CODE 2000** with blinking **2.** The factory set CODE is 1000.
3. Press **.** The display shows **CODE** 1000 with blinking 1.
4. Press once or four times to accept the new value.
   After the successful **CODE** entry, the display shows **CLR INTG**.
5. Press . The display shows **CLR MD**
6. Press **.** The display shows **CLR MD y** with blinking **y**.
7. Press to clear **MD**. The display flashes **PASS** and then **CLR MD**.
8. Press . The display shows **CLR**.
9. Press to return to **RMS** page.

*NOTE: If you do not want to clear the maximum demand, press to change the value from **CLR MD y** to **CLR MD n** in step 6. Then press . The display flashes **FAIL** and show **CLR MD**. Proceed to step 8.*

Energy Integrator

The PM1000 series power meter is equipped with an energy integrator function. It provides several parameters for Energy Management: VAh, Wh, VARh (Ind), -VARh (Cap), run.h (run hours), on.h (on hours), INTR (Interruptions / outages).

A few of these need explanation:

RUN.h: Indicates the period the load has been ON and has run. This counter accumulates as long as the load is ON.

On.h: Indicates the period for which the power meter's auxiliary supply is ON, regardless of the voltage and the current inputs.

INTR: Number of supply outages, means the number of auxiliary supply interruptions. If the power meter auxiliary supply is from a UPS then the INTR (number of interruptions) will be zero (as long as the UPS stays ON), even if the voltage signals die out from time to time.

Integrator Overflow

The PM1000 series power meters contain a comprehensive **Integrator** to support energy management. It accumulates several parameters over time, as explained above. All values are direct readings and have a high resolution. This is necessary for accurate energy analysis over short intervals of time. It also means that the readings max out and reset sooner or later, as given below.

By setting the Integrator reset parameter to WhE or VAhE, the time it takes for the integrator to reset depends on the Power Ratio of the load. Below table shows the Max. Reading under different load conditions:

Table 3-1: Integrator overflow for Wh E / VAh E

Power Ratio (1.732 x V.PRI x A.PRI)	Maximum reading (Wh E / VAh E)	Minimum time to overflow (in months) at full scale
1 VA to 1000 VA	9999 k	13.88
1 kVA to 1000 kVA	9999 M	13.88
1 MVA to 1000 MVA	9999 G	13.88
> 1000 MVA		<1 year

$$\text{Approx. overflow time in years} = \left(\frac{\text{Max reading}}{\text{Power Ratio}}\right) \Big/ 24 \Big/ 30 \Big/ 12$$

Example: For a full scale of 200kVA constant load, the overflow duration can be calculated as follows:

$$\left(\frac{\text{Max reading}}{\text{Power Ratio}}\right) = \left(\frac{9999 \text{ X } 10^{6}}{200 \text{ X } 10^{3}}\right) = 49995$$

÷ 24 = 2083.12 days

÷ 30 = 69.43 months

÷ 12 = **5.78 years**

Selecting Wh or VAh as overflow parameters under the Setup menu, normally Run Hours reaches the maximum value (9999) and all other Integrators such as Wh, VAh, VARh, -VARH, On Hours and Interruptions are reset together.

Table 3-2: Integrator overflow for Wh / VAh

Power Ratio (1.732 x V.PRI x A.PRI)	Max reading (Wh / VAh)	Max time to reset the integrator in Run Hours	Max time to overflow in months at full scale
1 VA to 1000 VA	9999 k	9999	13.88
1 kVA to 1000 kVA	9999 M	9999	13.88
1 MVA to 1000 MVA	9999 G	9999	13.88
> 1000 MVA		<9999	<1 year

OLD Data Register

The power meters have an OLD data register, where the last cleared INTG values will be stored.

The energy values in the integrator are transferred to the OLD register when the INTG is cleared (manually/due to overflow). Thus the OLD energy values are not lost even after the integrator is cleared and can be viewed with the OLD parameter.

The values of parameters Wh, VAh, VARh, -VARh, and Run.h are stored in the OLD register when the INTG is cleared.

Demand Power Calculation Methods

Demand power is the energy accumulated during a specified period divided by the length of that period. How the power meter performs this calculation depends on the method you select. To be compatible with electric utility billing practices, the power meter provides the following types of demand power calculations:

- Auto (sliding block)
- User (fixed block)

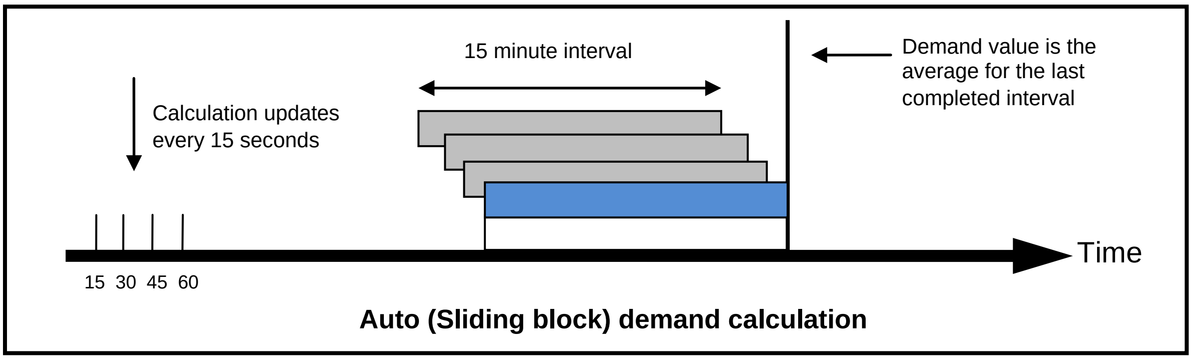
Auto (sliding block)

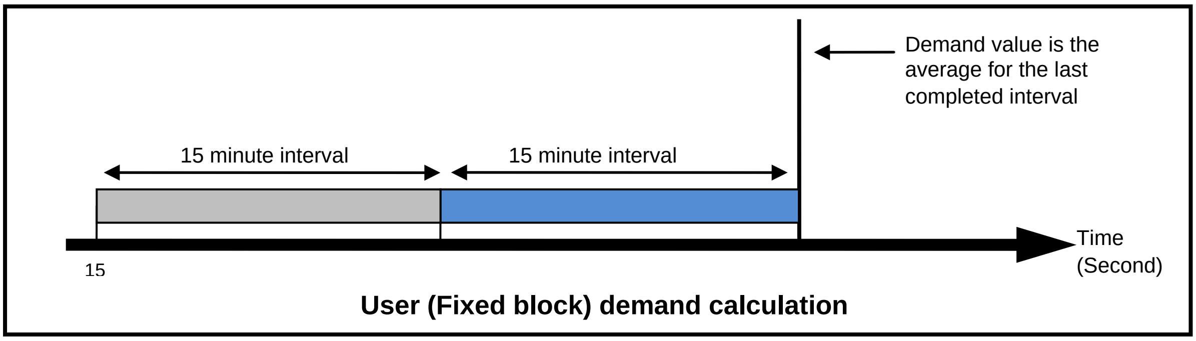
In the auto demand power calculation, you select an interval between five and 30 minutes in steps of five minutes. The demand calculation updates every 15 seconds.

Auto demand power calculation is the default calculation for PM1000 series power meters.

User (fixed block)

In the user demand power calculation, you select an interval between five and 30 minutes in steps of five minutes. The demand calculation updates at the end of the interval. User demand power calculation can be selected through setup. See “Setup parameters in View and Edit modes” for more information.


15 minute interval
Demand value is the average for the last completed interval
Calculation updates every 15 seconds
Time
15 30 45 60
Auto (Sliding block) demand calculation


Demand value is the average for the last completed interval
15 minute interval
15 minute interval
Time (Second)
15
User (Fixed block) demand calculation

Menu Hierarchy

Table 3-2: Description of Parameters

Parameters	Description
A	Current average of 3-Phases (**Amps**)
A1	RMS current, phase 1 (**Amps**)
A2	RMS current, phase 2 (**Amps**)
A3	RMS current, phase 3 (**Amps**)
A°1	Current phase angle, phase 1 in degrees
A°2	Current phase angle, phase 2 in degrees
A°3	Current phase angle, phase 3 in degrees
A%1	Current THD, phase 1 (**ATHD**)

Parameters	Description
A%2	Current THD, phase 2 (**ATHD**)
A%3	Current THD, phase 3 (**ATHD**)
An	Neutral current (**Amps**)
A.UNB	Current unbalance between 3-Phases
CLR	To clear integrators and Maximum Demand
CLR INTG	Clears Integrators
CLR MD	Clears Maximum Demand
DIAG	Diagnostics pages
Dia1	Communication settings
Dia2	Product model and version number
Dia3	Display scanning for display LED check
DMD VA	VA Demand
Edit	To edit parameter values
F	Frequency in Hz
FAIL	Confirms the unsuccessful completion of a command
HR	Hours at which maximum demand has occurred (hours)
INTG.tot	Total Integrator
INTR	No. of power interruptions
INTG. REV	Reverse Integrator
INTG. Fwd	Forward Integrator
L%1	% of load, phase 1
L%2	% of load, phase 2
L%3	% of load, phase 3
MD	Maximum Demand
OLD.tot	OLD Total Integrator
OLD. REV	OLD Reverse Integrator
OLD. Fwd	OLD Forward Integrator
On.h	Duration of supply ON hours
PASS	Confirms the successful completion of a command
PF	Power Factor average of 3-Phases
PF1	Power Factor, phase 1
PF2	Power Factor, phase 2
PF3	Power Factor, phase 3
Rd	Rising demand within the demand cycle
RMS	Root Mean Square
RPM	Revolution Per Minute of the motor
R.Run	Reverse Run hours
Run.h	Forward Run hours
R.VAh	Reverse Volt-Ampere hours (**VAh**)
R.VAR	Reverse Reactive energy, Inductive (**VARh**)
-R.VAR	Reverse Reactive energy, Capacitive (-**VARh**)
R.Wh	Reverse Watt hours (**Wh**)
Save	Saves the information
Set	To edit set parameter values
THD	Total Harmonic Distortion
TR	Time remaining to complete the demand cycle (**Minutes:Seconds**)
t.run	Total Run hours
t.VAh	Total Volt-Ampere hours (**VAh**)
t.VAR	Total Reactive energy, Inductive (**VARh**)
-t.VAR	Total Reactive energy, Capacitive (-**VARh**)
t.Wh	Total Watt hours (**Wh**)
V1	RMS Voltage, phase 1 to neutral (**Volts**)
V2	RMS Voltage, phase 2 to neutral (**Volts**)
V3	RMS Voltage, phase 3 to neutral (**Volts**)
V12	RMS Voltage, phase 12 (**Volts**)
V23	RMS Voltage, phase 23 (**Volts**)

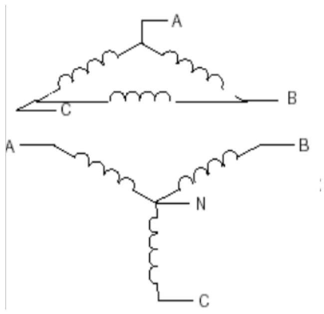
Parameters	Description
V31	RMS Voltage, phase 31 (**Volts**)
V%1	Voltage THD, phase 1 (**VTHD**)
V%2	Voltage THD, phase 2 (**VTHD**)
V%3	Voltage THD, phase 3 (**VTHD**)
VA	Apparent power total (**VA**)
VA1	Volt-Amperes, phase 1 (**VA**)
VA2	Volt-Amperes, phase 2 (**VA**)
VA3	Volt-Amperes, phase 3 (**VA**)
VAd	VA Demand
VAh	Forward Volt-Ampere hours
VAR	Reactive power total (**VAR**)
VAR1	VAR, phase 1 (**VAR**)
VAR2	VAR, phase 2 (**VAR**)
VAR3	VAR, phase 3 (**VAR**)
VARh	Forward Reactive energy, Inductive
-VARh	Forward Reactive energy, Capacitive
View	To view set parameter values
VLL	Phase-phase voltage average (**Volts**)
VLN	Phase-neutral voltage average (**Volts**)
V.UNB	Voltage unbalance between 3-Phases
W	Active power total (**Watts**)
W1	Watts, phase 1 (**Watts**)
W2	Watts, phase 2 (**Watts**)
W3	Watts, phase 3 (**Watts**)
Wh	Forward Watt hours
Wh E	Integrator reset based on only Wh overflow
VAh E	Integrator reset based on only VAh overflow

Chapter 4: AC Power Measurement

3-Phase Systems

A 3-phase system delivers higher levels of power for industrial and commercial applications. The three phases correspond to three potential lines. A 120° phase shift exists between the three potential lines.
A typical configuration has either a Delta connection or a Wye (Star) connection

In a 3-phase system, the voltage levels between the phases and the neutral are ideally defined by V1 = V2 = V3 = V12 / √3 = V23 / √3 = V31 / √3. In practice, there will be some unbalance (difference).

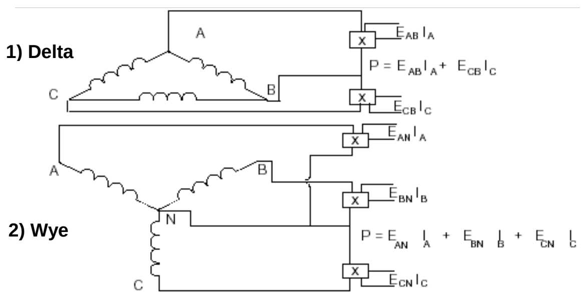


1) Delta

2) Wye

Voltages between the phases vary, depending on loading factors and the quality of distribution transformers.

Power measurement in a poly-phase system is governed by Blondel's Theorem. Blondel’s Theorem states that, in a power distribution network, which has N conductors, the number of measurement elements required to determine power is N-1. A typical configuration of a poly-phase system has either a Delta connection or a Wye (Star) connection (see Figure below).



Where E_{AB}= Voltage across points A and B
E_{CB}= Voltage across points C and B
E_{AN}= Voltage across points A and N (Neutral)
E_{BN}= Voltage across points B and N (Neutral)
E_{CN}= Voltage across points C and N (Neutral)
I_A = Current through conductor A
I_B = Current through conductor B
I_C = Current through conductor C

Consumption and Poor Power Factor

CONSUMPTION: Wh = W x T, T = where W = insta
time in hours.

The total electric energy usage over a time period is the consumption of Wh. Typically, the unit in which consumption is specified is the kilowatt-hour (kWh): one thousand watts consumed over one hour. Utilities use the Wh equation to determine the overall consumption in a billing period.

Poor power factor: Results in reactive power consumption. Transferring reactive power over a distribution network causes energy loss. To force consumers to correct their power factor, utilities monitor reactive power consumption and penalize the user for poor power factor.

“3D” kVA Measurement

The power meters are equipped with 3D Measurement of kVA. This advanced method provides the most accurate and predictable measurement under unbalanced as well as distorted waveform conditions.

However, in case the power meters need to match the reading of older or simpler power meters, which use the Arithmetic kVA definition, this too is available as a Setup option.

Table 4-1: “3D” kVA Measurement

kVA Function	Formula	Other Names	Which one?
3D Factory setting	$kVA_{3D} = \sqrt{\sum W^2 + \sum VAR^2 + \sum D^2}$ Where D = Distortion Power per IEEE 100	U, Apparent, Vector kVA	Best, all around
Arth	$kVA_{Arth} = kVA_1 + kVA_2 + kVA_3$	Arithmetic, Scalar kVA	Good under Low unbalance, to match simpler meters without 3D capability

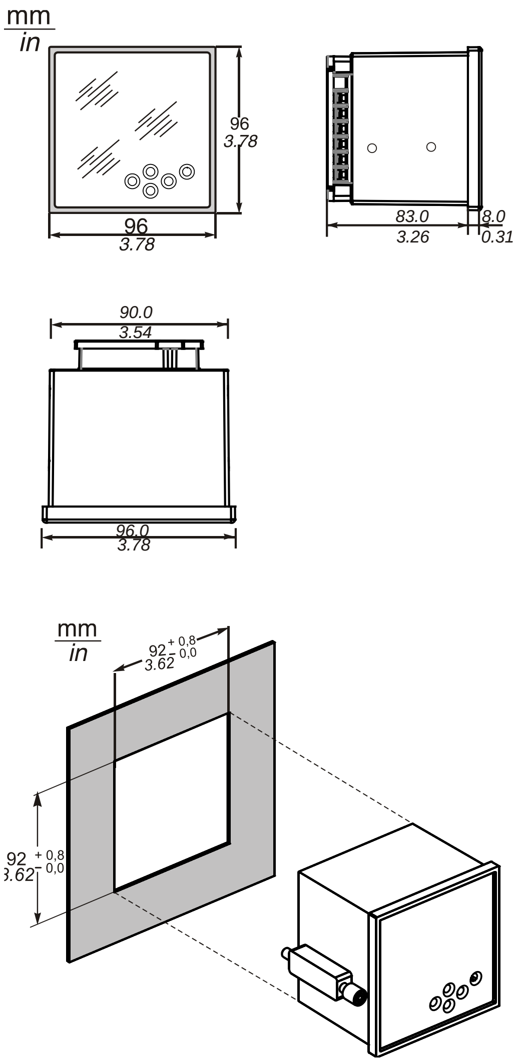
Chapter 5: Installation

Mechanical Installation

The PM1000 series power meters are panel-mounted and have reliable, rear-mounted terminal strips rated at 480 V.
The 92 x 92 mm (3.62 x 3.62 in.) cut-out and 96 x 96 mm (3.78 x 3.78 in.) bezel dimensions adhere to IEC 61554 and DIN 43700.

The diagram below displays the various dimensions of mechanical installations.

Figure 5-1: Mechanical dimensions and recommended panel cut-out



Installation Procedure

Usage

First, decide how the power meter is to be used. If you do not already have an energy management program in operation, then your energy consultant should be able to help you identify which load(s) offer maximum savings potential. This will help you decide which point is to be monitored, where the readings will be viewed from, who must have access to the instrument and how often. Otherwise, decide the location of the power meter and install it. For best performance, choose a location that provides all the required signals with minimum wiring lengths.

Panel Considerations and Environment

The power meter is high-precision measuring instrument, and its operating environment is of utmost importance. For maximum performance, the instrument should be mounted in a dry, dust-free location, away from heat sources and strong electromagnetic fields. To operate reliably, the following conditions must be met:

Table 5-1: Environmental Conditions

Description	Specification
Storage temperature	-25 °C to 70 °C, (-13 °F to 158 °F)
Operating temperature	-10 °C to 60 °C, (14 °F to 140 °F)
Relative humidity	5% to 95%, non-condensing
Altitude	≤ 2000m

The power meters should be separated from other equipment and sufficient space must be provided all around for cooling air to rise vertically past the instrument. The cooling air temperature must be below the specified operating temperature.

The panel or housing, in which the PM1000 power meter is mounted, should protect it from dust, moisture, oil, corrosive vapors, etc.

The panel doors must be easily opened to provide easy access to the power meter wiring for troubleshooting. Allow clearance if the unit is going to swing out, as well as adequate slack in the wiring. Allow space for terminal blocks, CT shorting blocks, fuses, auxiliary contactors, and other necessary components.

Viewing

For ease of operation, the location should be preferably at, or slightly above, eye-level. For viewing comfort, minimize glare and reflections from strong light sources.

Mounting

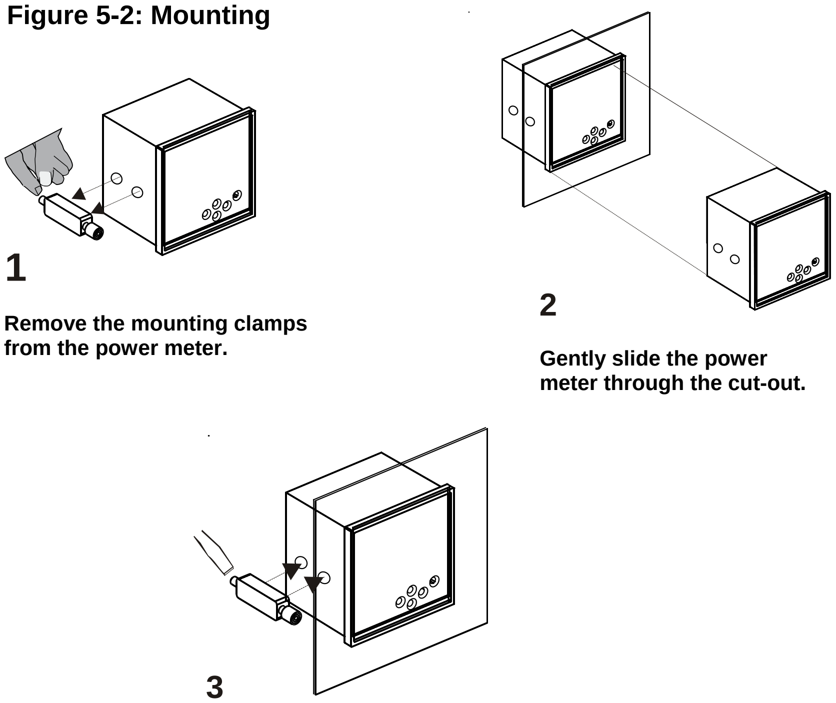
The power meters are panel mountable.

Table 5-2: Mounting

Description	Specification
Panel cut-out	$92^{+0.5}_{-0}$ mm (w) x $92^{+0.5}_{-0}$ mm(h) ($3.62^{+0.02}$ x $3.62^{+0.02}$ in.) IEC 61554 and DIN 43700
Panel thickness	0.5 to 4.0 mm (0.02 to 0.16 in.)
Instrumental bezel dimension	96 x 96 mm (3.78 x 3.78 in,)
Depth behind bezel	83 mm (3.26 in.)
Mounting clamps screws	Two in numbers, Slotted
Terminal screws	Combination Phillips and Slotted head

The cut-out should be punched with the proper tool and should be free from burrs. The following figure explains the mounting of the power meter.

Figure 5-2: Mounting



While supporting the power meter from the front, tighten both side clamp screws in a criss-cross pattern till all slack is taken up and then apply one full turn. Do not over-tighten. Over-tightening could result in breaking of the clamps.

The power meter should be separated from other equipments and sufficient space must be provided all around the power meter, to allow air to rise vertically around the power meter. Lack of sufficient air for cooling may result in over heating of the power meter.

NOTE: It is much easier to set up the meter before you mount the power meter on the panel. See "Quick setup" for more information.

Electrical Installation

This section describes the following:

- The need for, and selection of, potential transformers (PTs) and current transformers (CTs).
- Auxiliary supply (control power), PT (VT), and CT connections.

NOTICE

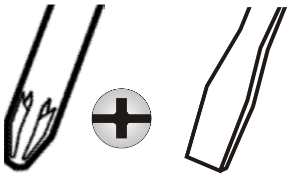
DAMAGE TO THE DEVICE

- Use only the specified tool for tightening and loosening the screw
- Do not over-torque the screw above the specified range

Failure to follow these instructions can result in equipment damage.

For best results, ensure the following specifications:

- Torque driver preferred, hand screwdriver OK.
- TIP: Phillips head is preferred, but flat head is acceptable. Do not use Pozidriv tips.



M3.5 screw; screw head diameter = 6 mm (0.24 in.)
TIP shaft diameter < 5 mm (0.2 in.)

IMPORTANT: Screwdriver shafts inserted angularly or of diameter ≥ 5 mm (0.2 in.) will get stuck in the cover.
Tightening Torque: 0.25 to 1 N.m (2.21 to 8.85 lb-in)

NOTE: If the torque is more than 1 N.m (8.85 lb-in), then it may damage the screw or the screw head.

Loosening Torque: 1.2 N.m (10.62 lb-in)

Connecting Cable Recommendations

Table 5-3: Connecting cable

	Insulation Rating	Current Rating
Voltage Circuit	> 600 Vac	> 0.1 A
Current Circuit		> 7.5 A (1.5-2.5 mm^2 /16-14 AWG)

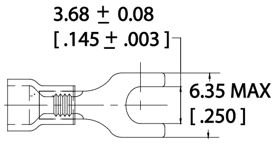
NOTE: Installations should include a disconnecting device, like a switch or circuit breaker, with clear ON/OFF markings to turn-off the auxiliary supply (control power). The disconnecting device should be placed within the reach of the equipment and the operator.

Terminal connections using lugs

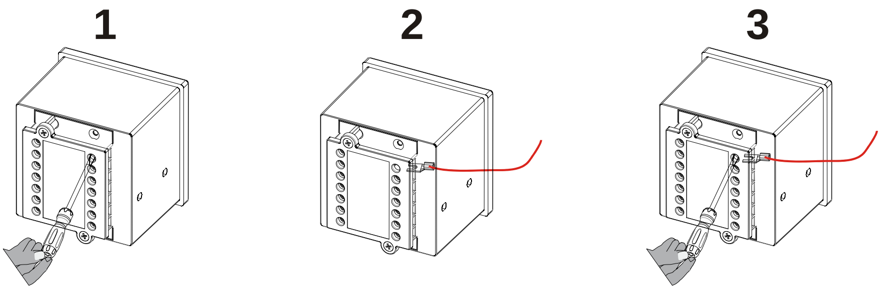
Terminal connection using U lugs

Lug type: Insulated sleeved U lugs

Cross-section: 1.5-2.5 mm^2 /16-14 AWG



It is very simple and easy to connect the terminals using the U lugs. The following steps explain how to connect the power meter terminals using U lugs.

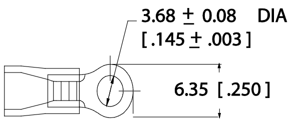


1. Loosen the terminal screw.
2. Connect the wire with the U lug to the power meter terminal.
3. Tighten the terminal screw.

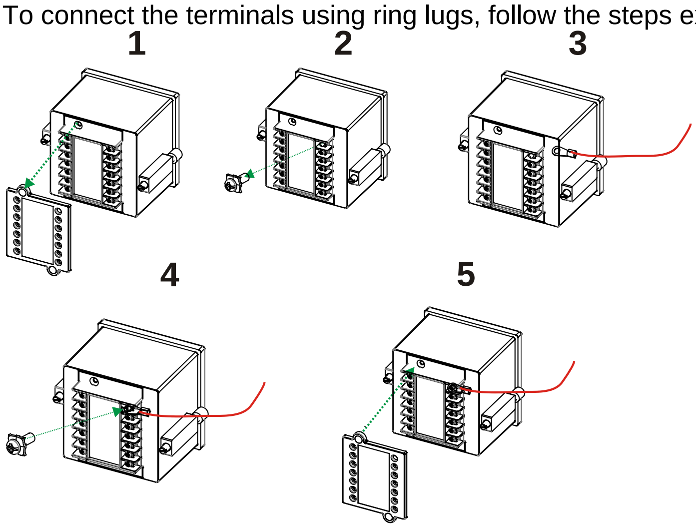
Terminal connections using ring lugs

Lug type: Ring lugs

Cross-section: 1.5-2.5 mm^2 /16-14 AWG



To connect the terminals using ring lugs, follow the steps explained below.



1. Remove the protective cover from the power meter.
2. Remove the terminal screw from the power meter.

3. Connect the wire with the ring lug to the power meter terminal.
4. Place the terminal screw back in the terminal and tighten the terminal screw.
5. Place the protective cover back and tighten the protective cover.

NOTE: The above example explains connection for only one terminal. In order to connect the other terminals, repeat the steps 2 and 3 for as many numbers of terminals. Then proceed to the remaining steps.

Auxiliary Supply (Control Power)

The PM1000 series power meter requires a single-phase AC/DC auxiliary (control) power supply to power up its internal electronic circuitry. External surge suppressors are necessary in the auxiliary supply circuit for proper operation during extreme surge conditions, where the voltage surges exceed the auxiliary supply limits (e.g., rural areas and outlying areas prone to lightning strikes).

Range:

- 44 to 277 Vac/dc.
- Burden (load) < 3 VA at 240 V, 5VA Max.
- The control power may be derived from the voltage signals.
- If you have a 440 V 3-wire delta system and a reliable neutral is not available, use a 440 V: 240 V supply transformer to provide the standard 240 V auxiliary supply.

NOTE: It is much easier to set up the meter before you mount the meter on the panel. See “Quick setup” for more information.

PTs (VTs) and CTs

Large electrical installations have high voltages and currents, which may exceed the direct connection rating of the power meter. In this case, potential transformers (PTs) and current transformers (CTs) are used to precisely **step down** or reduce the voltage and current levels to suit the power meter rating. Potential transformers usually have a full scale output of 110 Vac RMS line-line and current transformers usually have a full scale output of 5 A or sometimes 1 A.

The PTs (VTs) and CTs must be planned, installed, and tested by a qualified electrical contractor before wiring the power meter. The accuracy of the measurement also depends on the accuracy and phase angle error of the PTs (VTs) and CTs. Instrument class 1 or better PTs and CTs are recommended. Do not use protection class (10P10, etc.) CTs to feed the power meters; they have poor accuracy and phase characteristics.

Ensure that the CT primary rating has been selected so that your normal load variation lies between 40% and 80% of its full scale. If your CT is over-rated, say if the load is always less than 10% of the CT primary rating, accuracy suffers. On the other hand, if the CT is under-rated, then you may exceed its full scale and burn out both the CT and the power meter.

PT (VT), CT Wiring

The PTs (VTs) and CTs must have adequate VA rating to support the burden (loading) on the secondaries. You may want to support the auxiliary supply burden from one of the PTs (VTs). CT wiring can impose additional burden (loading) on the CT. For example, if the CT has a 5 A secondary and the wire resistance is 1.0 Ω, then the CT has to support an additional burden of 5 VA. If the wiring distance from the CT secondary is greater than stated in Table 5-5, then the CT could get over-burdened and give large errors. Choosing a 1 A CT secondary can reduce this error. The CT secondary value must be user programmed into the power meter.

The power meters should be conveniently located for easy connections of voltage (PT), current (CT) signals, and auxiliary (control) supply.

NOTE: The power meters user programmable PT and CT primary or secondary settings may be utilized to Calibrate out the PT and CT amplitude error, for improved accuracy.

Voltage Signal Connections

For proper power meter operation, the voltage connection must be maintained. The voltage must correspond to the correct terminal. The cable required to terminate the voltage sense circuit should have an insulation rating greater than 480 Vac and a current rating greater than 0.1 A.
There are four input voltage terminals marked V1, V2, V3, and Vn. See the "Connection Diagrams " that follow, for details. For Delta connection, the Vn terminal should be left unconnected.

PT Connections

The power meters directly accept LV voltage inputs of up to 480 Vac RMS line to line (277 VLN). Voltages greater than this, typically HV systems, must be connected through Potential transformers (PTs). The power meters allow user programming of both PT primary and secondary voltages.

- User programmable PT primary range: 0.1 to 999 kVac RMS LL
- User programmable PT secondary range: 80 to 481 Vac RMS LL
- Power meter voltage Input burden: 0.2 VA per input

NOTE: The PT primary and secondary values must be user programmed before using the power meter. Otherwise, the readings will be wrong.

Selecting the voltage fuses

We strongly recommend using fuses on each of the sense voltages (except for neutral) and the control / auxiliary power.

Table 5-4: Fuse recommendation

Power Source	Source voltage	Fuse (A)
Line voltage	80 to 480 VLL	0.25
Auxiliary supply (Control power)	44 to 300 VAC/DC	0.25

Current Signal Connections

The power meter accepts up to 6 A AC RMS per channel directly. Above that, a current transformer must be interposed to scale down the current.
There are three pairs of current input terminals marked A1, A2, and A3. Each pair of input terminals is labeled as S1, S2 and has an arrow indicating the direction of current flow. For proper measurements, the phase identification, and the polarity of the current signals must be correct. The forward flow (import by consumer) current direction must be into the S1 terminal and the exit from the S2 terminal. Maintain the correct sequence and polarity to avoid wrong readings.

Any unused current input terminals must be shorted together, e.g., in Delta connection, the terminals A2 (S1, S2) must be shorted together. The shorted terminals do not need to be grounded.

The wiring used for the current inputs should have an insulation rating greater than 480 Vac. The cable connection should be rated for 7.5 A or greater and have a cross-sectional area of 1.5-2.5 mm^2 /16-14 AWG minimum.

CT Connections

Mount the current transformers (CTs) as close as possible to the power meter for best accuracy. The following table illustrates the maximum recommended distances for various CT sizes, assuming the connection is via 1.5-2.5 mm^2 /16-14 AWG cable.

Table: 5-5: CT size and maximum distance

5 A CT size	Maximum Distance in meters (in feet/inch) (CT to PM1000 power meter)
2.5 VA	3.05 m (10 ft/120 in.)
5.0 VA	4.6 m (15 ft/181 in,)
7.5 VA	9.15 m (30 ft/360 in.)
10.0 VA	12.2 m (40 ft/480 in.)
15.0 VA	18.3 m (60 ft/720 in.)
30.0 VA	36.6 m (120 ft/1441 in.)

- User programmable CT primary range: 1 A to 99 kA AC.
- CT secondary: 1 A or 5 A AC (programmable)
  Other values are also programmable to compensate CT errors if desired.
- Power meters CT burden: 0.2 VA maximum per input.

See the “Setup Menu” on for more information.

NOTE:
The PT primary and secondary values must be user programmed before using the power meter. Otherwise, the readings will be wrong.
With dual- range CTs; select the best range for programming the power meter. If you change the range thereafter without re-programming the power meter, the power meter will read erroneous values.

CT Polarity

When the power meter is connected using the CTs, you must maintain correct CT polarities. CT polarities are dependent upon correct connections of CT leads, and upon the direction the CTs are facing when clamped around conductors. The dot on the CT must face the line side; the corresponding secondary connection must connect to the appropriate input on the power meter.

Failure to connect CTs properly results in inaccurate power readings. If your power meter is not reading power properly, it is more than likely that the CT is incorrectly wired. If one or two CTs are reversed, then energy parameters accumulate only one phase value. If two or all the phases of the CT are reversed, energy will not accumulate. (Energy import will not be measured).

CT Connection Reversal

To check the polarity of the CT after the power meter has been installed, simply look at the phase-wise W (Watt) readings to see that each of the readings are positive (assuming you are consuming power). If one of the W readings is negative, that particular phase CT is reversed and must be corrected. On the other hand if you are exporting power, all three phase-wise W readings must be negative.

Setup — System Type

The power meter needs to know the type of system to which it is connected. This information is programmed in the setup procedure, before using the power meter. The power meter does allow you to change this setting while it is running; however, this capability is meant for correcting a gross error, or for training or educational purposes; it is not to be changed on regular basis.

The options are:

- **Wye/Star:** For 3-phase 4-wire, **three Watt-meter** or **three Element** circuits. Here, all three voltage phase signals, the neutral voltage connection, and all three current input signals need to be wired in. This means all the four voltage terminals, and six current terminals described in the following section, need to be wired. For wye/star wiring configuration, see “3-phase 4-wire WYE connection with 3 CTs and 3 PTs” for more information.
- **Delta:** For 3-phase 3-wire, **two Watt-meter** or **two Element** circuits. For delta and open delta wiring configuration, see “3-phase 3-wire Delta connection with 2 CTs and 3 PTs” and “3-Phase 3-Wire Open Delta connection with 2 CTs and 2 PTs” for more information.
- **2-phase:** For 2-phase 3-wire, **two Watt-meter** or **two Element** circuits. Here, the two voltage phase signals, the neutral voltage connection, and two current input signals need to be wired in. This means that the three voltage terminals and four current terminals described in the following section, need to be wired. For two phase wiring configuration, see “2-phase 3-wire connection with 2 CTs” for more information.
- **Single-phase:** For single-phase 2-wire, **one Watt-meter** or **one Element** circuits. Here a single voltage Phase signal, the neutral voltage connection, and a single current input signal need to be wired in. This means that two voltage terminals and one current terminal described in the following section need to be wired. For Single phase wiring configuration, see “Single phase connection with 1 CT” for more information.

Phase Labels

The phase labels shown on the display are programmable via the power meters front panel Setup menu. You can setup the meter to display phase labels convenient to your practice. The choices available are: 123 (factory set), RYB, RST, PQR, ABC.

Connection Diagrams

Choose the diagram below that best describes your application. You must ensure that the CT phase and corresponding PT phase are identical and that the CT polarity is correct. Follow the outlined procedure to verify correct connection.

Connection Diagram Symbols

Table 5-6: Connection diagrams symbols

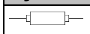
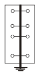
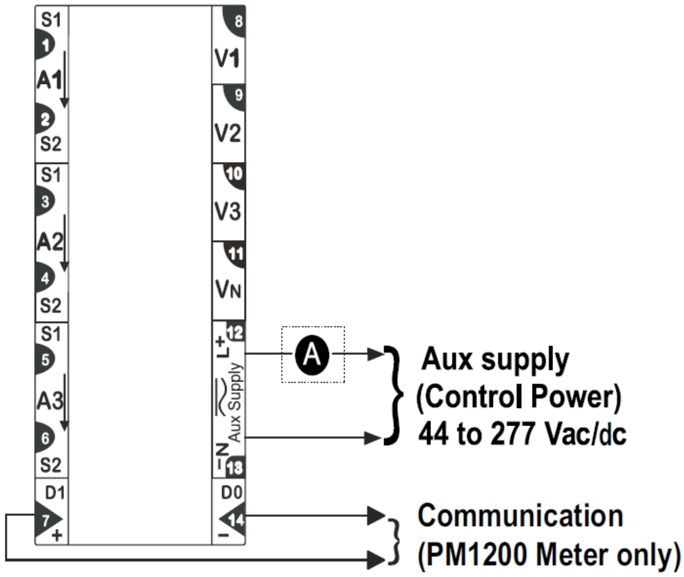
Symbol	Description
	Fuse
	Current transformer
	Shorting block
	Potential transformer
A	Protection (to be adapted to suit the short-circuit current at the connection point)

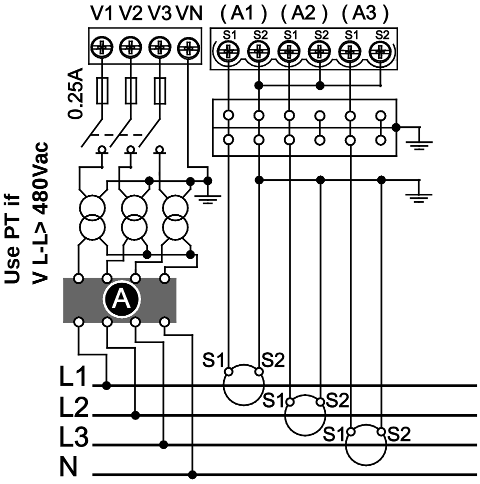
Figure 5-3: Terminal Block Label



3-phase 4-wire WYE connection with 3 CTs and 3 PTs

Direct voltage connection for the input voltages L-L up to 480 Vac.

Figure 5-4: 3-phase 4-wire WYE connection

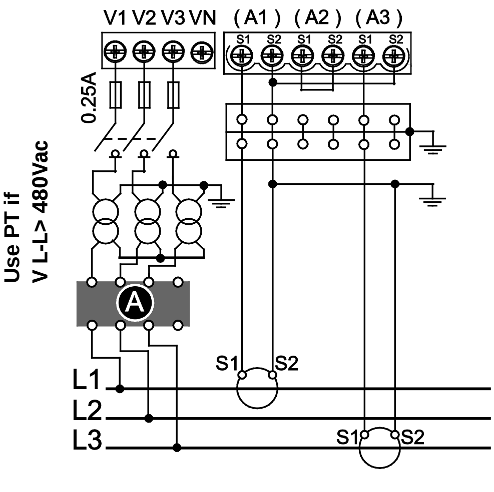


NOTE:
Make sure WYE/Star is programmed in the power meter Setup menu.
For High – leg (US connection)
L1 – N = 120 V
L2 – N = 208 V
L3 – N = 120 V

3-phase 3-wire delta connection with 2 CTs and 3 PTs

Direct voltage connection for the input voltages L-L up to 480 Vac.

Figure 5-5: 3-phase 3-wire delta connection

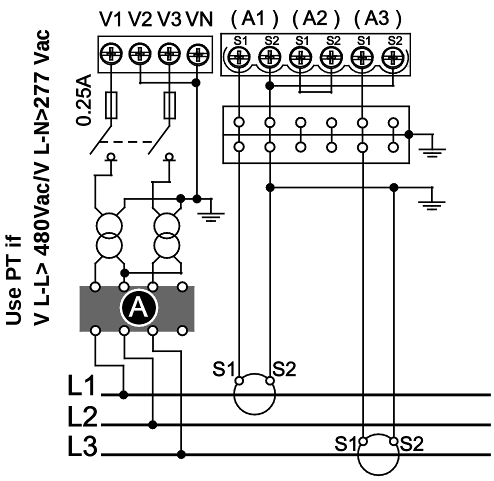


NOTE: Make sure Delta is programmed in the power meter Setup menu. Leave the Vn terminal disconnected.

3-phase 3-wire open delta connection with 2 CTs and 2 PTs

Direct voltage connection for the input voltages L-L up to 480 Vac.

Figure 5-6: 3-phase 3-wire open delta connection

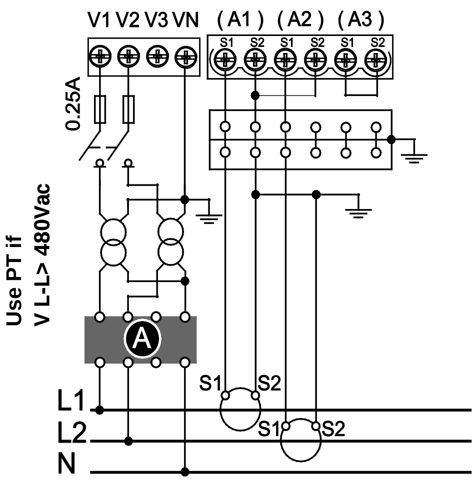


NOTE: Make sure Delta is programmed in the power meter Setup menu.

2-phase 3-wire connection with 2 CTs

Direct voltage connection for the input voltages is L-L up to 480 Vac. Otherwise, it is two PTs.

Figure 5-7: 2-phase 3-wire connection



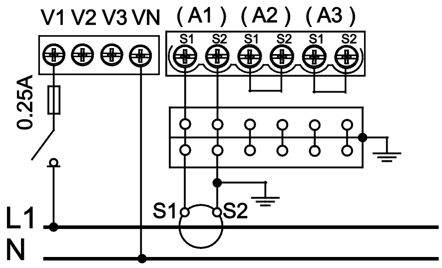
NOTE: Make sure 2-phase is programmed in the power meter Setup menu.

Single-phase connection with 1 CT

Direct voltage connection for the input voltages L-L up to 480 Vac. Otherwise, use one PT.

1. Program the power meter in single-phase mode.
   However, voltages primary and secondary need to be programmed as Line to Line.
2. Connect the voltage and current inputs only to the V1 and A1 voltage and current terminals of the power meter.
3. The unused current terminals (A2 and A3) must be shorted together to reduce noise picked up in the power meter.
4. However, the energy parameter readings will be accurate.

Figure 5-8: Single-phase connection



Chapter 6: Data Communication

This section is applicable only for PM1200 power meter.

Float Byte Register

Float Byte Characteristics:

- Block wise access.
- If Read and Write values are matching, then it means the float byte sequence is in sync with the master.
- The float byte number is fixed.

Table 6-1: Float Byte Test Sequence Register

Addr: 320-321 (2 registers)	Data Type	Description	Property
4030201.0	Float	Before starting the communication, you must write this number and read	Normal Read and Write

NOTE:

- *If any other write value is given as input other than the mentioned write value in the above table, then the meter will give a data exception response.*
- *If you do not want the default value, you can always set the desired values in the Edit page.*

Health Check Register

Health Check Register Characteristics:

- Normal Read Only.
- 16bit UNIT.
- Identifies the meter existence in the network.

Table 6-2: Health Check Register

Addr: 0304 (1 register)	Data Type	Description	Property
Model Type	UNIT16	To identify the meter presence in the network	Normal Read

Float Byte Order Detection

Float Byte Order Detection Characteristics:

- Normal Read Only.
- 16bit UNIT.
- Identifies the float byte order in the meter.

Table 6-3: Float Byte Order Detection

Addr: 0306 (1 register)	Data Type	Description	Property
Model Type	UNIT16	To identify the float byte order in the meter	Normal Read

RS-485 Data Port

Data Port advantages:

- Rapid, on-line, real time readings into
- Your own SCADA software or PLC.
- Schneider Electric energy management software products such as Vijeo Citect, PowerLogic SCADA for pinpointing the energy usage and waste.
- It supports ION™ enterprise.
- Data port has built-in impedance matched design for low reflectance on long data cables at high Baud rates. Eliminates need for complicated impedance matching resistors at the ends of long data cables.
- Fast 16 ms power meter response, average time to read 10 parameters is 90 to 100 ms (9600 Baud, Even parity, One stop bit).
- Direct reading, pre-scaled Float readings. Accurate, full precision low and high readings. No need for additional scaling factors or decimal adjustment.
- Fast, easy-to-use grouping of parameters tuned for field requirements.
- TURBO area for single point polling (upto 50 per query)
- Block area for even faster access to pre-configured data blocks

Installation

Figure 6-1: 2-wire half duplex communication connection

PM1200 power meters rear view

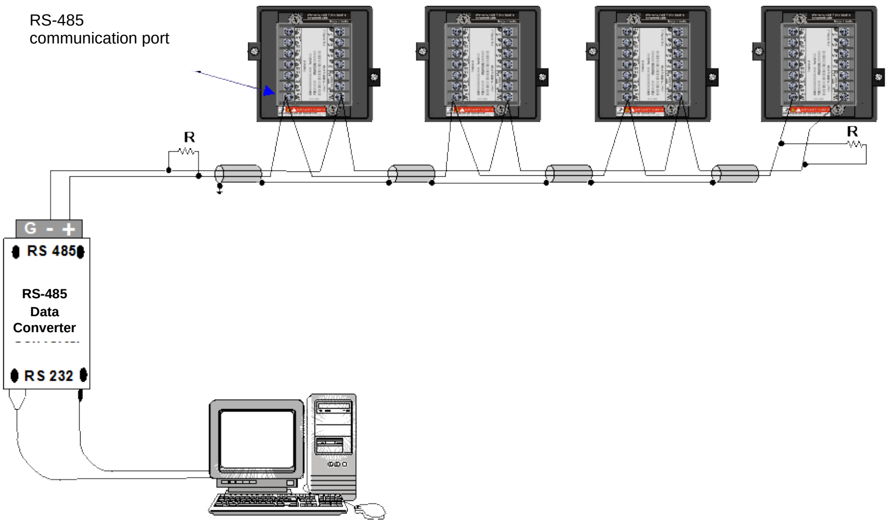
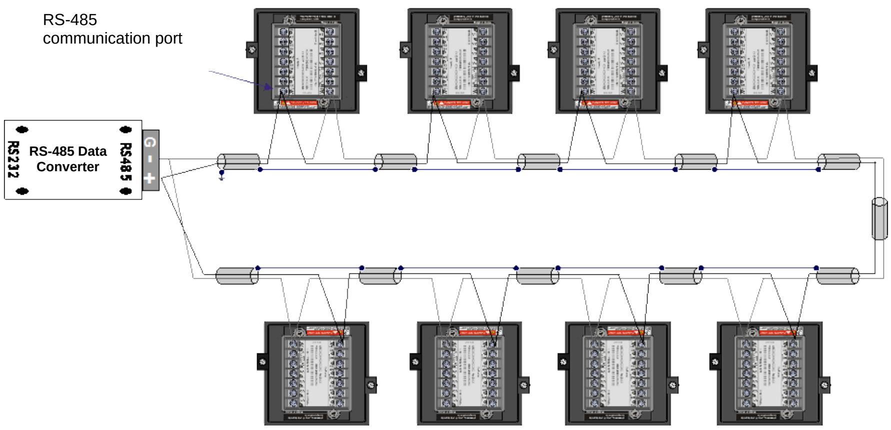


Figure 6-2: Closed loop, 2-wire half duplex.
Advantage – Reliable communications, tolerant to one break in the cable.

PM1200 power meters rear view



Communication Capabilities

Table 6-4: RS-485 communication distances

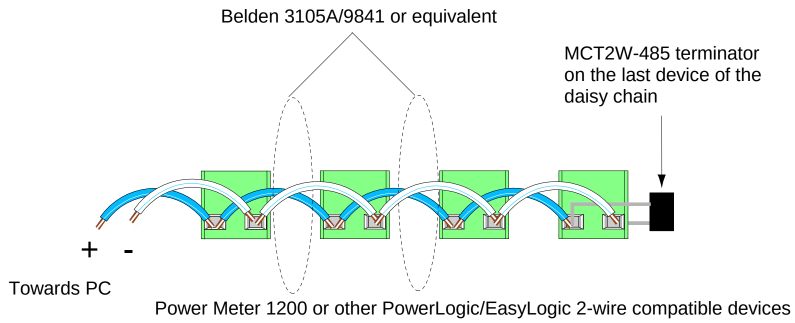
Baud Rate	Maximum communication distances 1 to 32 devices
	Meters (Typical with Belden 3105A cables)
9600	1200
19200	900

NOTE: Distances listed should be used as guide only and cannot be guaranteed for non-EasyLogic devices. Above distances subject to vary based on the quality of the cable.

Daisy-chaining Devices to the Power Meter

The RS-485 slave port allows the power meter to be connected in a daisy chain with up to 31 2-wire devices. In this bulletin, *communications link* refers to a chain of devices that are connected by a communications cable. See Figure 6-3.

Figure 6-3: Daisy-chaining 2-wire devices



NOTE: Belden 3105A/9841 colors: Blue (+), White (-)

- If the power meter is the first device on the daisy chain, connect it to the host device using a RS-232 to RS-422/RS-485 converter or RS-485 to Ethernet converter.
- If the power meter is the last device on the daisy chain, terminate it with the terminator provided.
- See “Table 6-4”, for the maximum daisy-chain communications distances for 2-wire devices.
- The terminal’s voltage and current ratings are compliant with the requirements of the EIA RS-485 communications standard.

Data Formats and Settings

Your SCADA software must be configured for Modbus RTU communication, before integrating the Schneider Electric PM1200 power meter.
The mode of transmission is defined in the following which is compatible with Modbus RTU Mode:

Table 6-5: Power meter communication and protocol settings

Power meter communication settings	
Protocol	Modbus RTU
Data bits	8
Baud rate	9600 Baud, User set 4800 to 19200 Range: 4800, 9600, 19200 Normal use: 19200 Baud Noisy, EMI, RFI, long data cable: 4800 Baud Short cable (<300 meters or 975 feet): 19200 Baud
Parity	Even
Device Address	1
Stop bit	1
Modbus Protocol	
Device Address	1 to 247 Upto 247 meters per COM port with repeaters
Function Code	03 (Read)
Data Address	Refer to "Data address" for more information
Data type	32-bit float (real) : • All parameters • Direct reading, little-endian float, big-endian float, no scaling required 32-bit unsigned integer • INTR (number of interruptions (outages) - RMS Blocks) • RunSec (Run seconds – Integ Block)
No of Registers	2 to 50 (optional) per PM1200 data block of 10 x 32 bit values must be configured to suit the power meter

NOTE: The polling interval to poll the data from PM1200 will depend on baud rate. We recommend polling interval of one second at 9600 Baud rate.

Modbus Standard Device Identification

Addressing the Modbus standard device identification

You can use Modbus command 0x2B/0x0E on these device identification parameters.

Table 6-6: Modbus standard device identification parameters

Object ID	Object Name	Format	Access
00	Manufacturer name	String	R
01	Product code	String	R
02	FW Version	String	R

NOTE:

- *The Read device identification can be read as stream access and as individual access.*
- *The product code is the same file name without version number.*

Parameter Settings for Different SCADA Software

The following table explains how to read the parameter VA (See “Individual parameter address” for more information) in different Modbus master software/PLC’s.

Table 6-7: Parameter settings

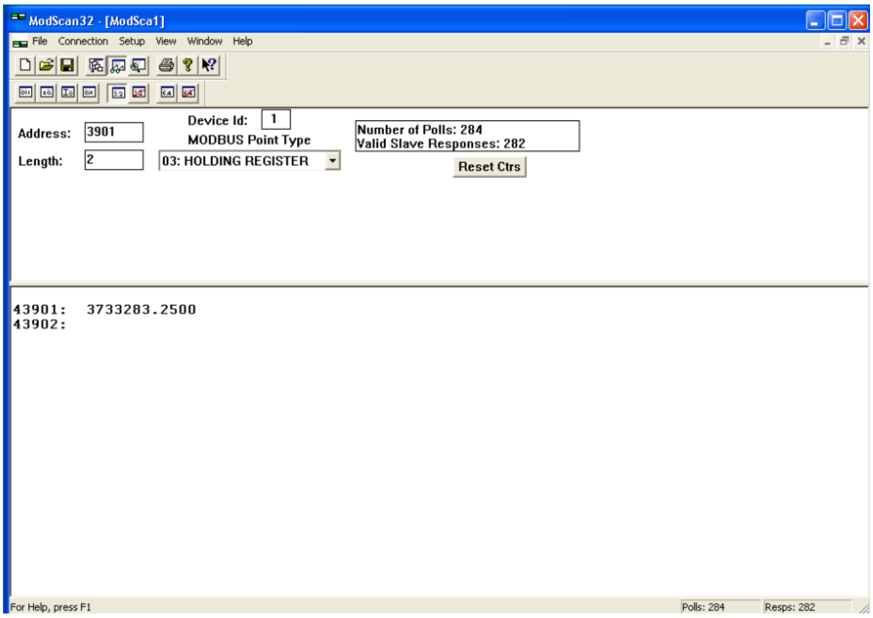
SL. No	SCADA software	Start Address	Function Code	No. of Register	Data Type	Remarks
1	ION™ Enterprise	4 01	Internally configured	2	Swapped Float	Direct conversion
2	PowerLogic SCADA	43901	Internally configured	2	Real	Direct conversion
3	Vijeo Citect	43901	Internally configured	2	Real	Direct conversion
4	Intouch	43901 F	Nil	2	Float	Direct conversion
5	Modscan (Master)	3901	03 – HOLDING REGISTERS	2	Floating point	Unswapped FP mode
6	MODTEST	43901	03 – Rosemount	Points -1	Float-Rosemount	
7	CIMPLICITY	43901	Nil	100	Real	Direct conversion. The array concept can be used here to poll all the data in single scan.
8	Allenbradly – Micrologix PLC (Slave/Master)	43901	03-HOLDING REGISTERS	2	Floating point	Direct
9	GE Fanuc PLC	43901	03-HOLDING REGISTERS	2	Real	Direct
10	ABB RTU 560 (Mater)	Index-3900	03- Read HOLDING REGISTERS	Query Range - 2	MFI – Analog measured Floating value	Under sub parameters, “Sign and Exponent in First Register” should be disabled (Unchecked)
11	SEIMENS PLC (Master)	3900	03-HOLDING REGISTERS	2	Real	Direct
12	MOVICON	43901	Nil	2	Real	Direct
13	RSVIEW	43901	03-HOLDING REGISTERS	2	Real	Direct
14	ABB Microscada	3900	Format – 9	Interval – 2	Real	Direct

Communication Test

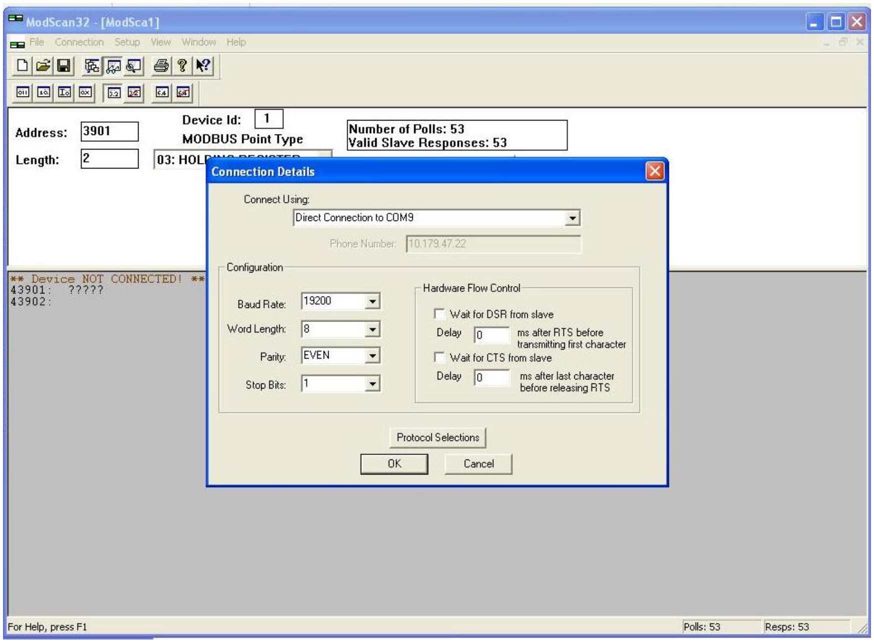
Communication test: PM1200 power meter can be successfully used for communication using Modscan software as Modbus master in PC. Details of the settings in Modscan are given below.

Settings in Modscan v3.D05-00 software to establish communication with PM1200 power meters:

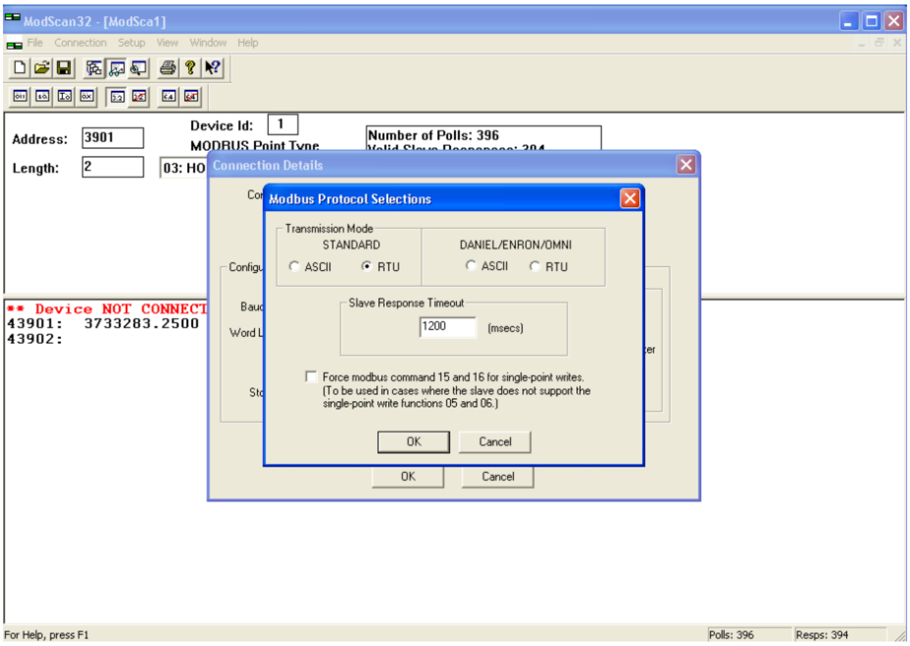
- Free download demo Modscan software from http://www.win-tech.com.
- The following explains how to read apparent power total (VA total) from register 3901.



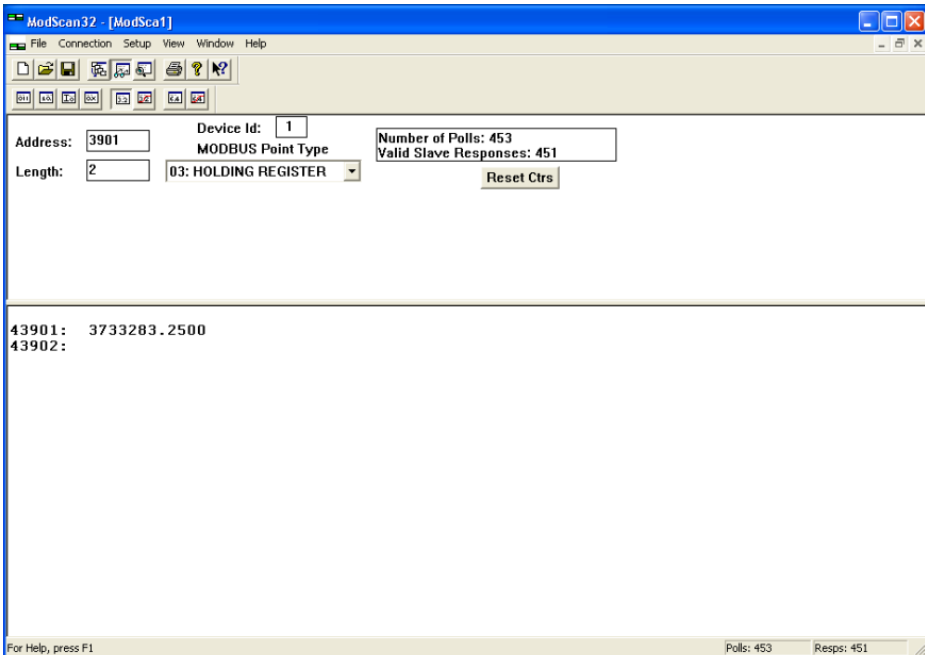
1. After starting the Modscan, to read Apparent power total (VA total), enter address as 3901 (decimal), length as 2, device ID as 1, Modbus point type as 03, and HOLDING REGISTER.
2. **Modify the connection details:** Click connection > connect, to see the **connection detail window**. Change all the settings to match the following screen. These are default settings of PM1200 power meter.



3. Set the Modbus protocol selections: On **Connection details** window (shown in previous step), click on **Protocol Selections.** Enter the protocol settings as shown below and click **OK** in all the windows.



4. The Modscan software starts polling the configured COM port for the Device ID 1.
   Modscan Demo software will stop polling after 3.5 minutes.



This shows that the power meter is communicating with the Modbus Modscan master software successfully on the PC. The power meter is Modbus RTU compliant.

Data Address

The PM1200 power meter supports the transfer of whole block and also of individual data values (two registers are used for storing single data values).

- In the transfer of individual data values, it treats two registers as an object with the starting address (e.g., 3900) considered as the object name. This enables you to transfer required data values for energy management.
- In the transfer of a whole block, it treats each block as an object with the starting address (e.g., 3000) considered as the object name. This enables fast block transfers, since energy management usually requires a block of related readings for the same point of time. This method also eliminates time-skew within readings of that block.
- The device address, block start address, and the number of registers, must be configured to suit the power meter. You must also make the related SCADA settings for polling priority, logging, and viewing the data. Refer your SCADA software instructions to learn how to do this.

Individual Parameter Address

- Function Code: 03 Read
- No scaling required
- Read as block or individual parameters

Table 6-8: Individual parameter address

Parameter	Description	Address	Type	PM1200
Metering				
Metering - Current				
A	Current average of 3-Phases	3913	Float	✓
A1	Current, phase 1	3929	Float	✓
A2	Current, phase 2	3943	Float	✓
A3	Current, phase 3	3957	Float	✓
Metering – Voltage				
VLL	Line to line average voltage	3909	Float	✓
VLN	Line to neutral voltage	3911	Float	✓
V12	Voltage phase 1 to phase 2	3925	Float	✓
V23	Voltage phase 2 to phase 3	3939	Float	✓
V31	Voltage phase 3 to phase 1	3953	Float	✓
V1	Voltage phase 1 to neutral	3927	Float	✓
V2	Voltage phase 2 to neutral	3941	Float	✓
V3	Voltage phase 3 to neutral	3955	Float	✓
Metering - Power				
W	Active power, total	3903	Float	✓
W1	Active power, phase 1	3919	Float	✓
W2	Active power, phase 2	3933	Float	✓
W3	Active power, phase 3	3947	Float	✓
VAR	Reactive power, total	3905	Float	✓
VAR1	Reactive power, phase 1	3921	Float	✓
VAR2	Reactive power, phase 2	3935	Float	✓
VAR3	Reactive power, phase3	3949	Float	✓
VA	Apparent power, total	3901	Float	✓
VA1	Apparent power, phase 1	3917	Float	✓
VA2	Apparent power, phase 2	3931	Float	✓
VA3	Apparent power, phase 3	3945	Float	✓
Metering – Power Factor				
PF	Power factor average of 3-Phases	3907	Float	✓
PF1	Power factor, phase 1	3923	Float	✓
PF2	Power factor, phase 2	3937	Float	✓
PF3	Power factor, phase 3	3951	Float	✓

Parameter	Description	Address	Type	PM1200
Metering - Frequency				
F	Frequency, Hz	3915	Float	✓
Power Quality				
THD				
%V1	Voltage THD, phase 1	3861	Float	✓
%V2	Voltage THD, phase 2	3863	Float	✓
%V3	Voltage THD, phase 3	3865	Float	✓
%A1	Current THD, phase 1	3867	Float	✓
%A2	Current THD, phase 2	3869	Float	✓
%A3	Current THD, phase 3	3871	Float	✓
THD measurement range: i. 0.5A to 6A measurement current ii. 50V to 600V line-to-line measurement voltage iii. 45 to 65Hz measurement line frequency *NOTE: The PM1200 power meter may show current and voltage THD% as "----" on the meter display and "-999" through communications, under any of the following conditions:* • *When the current through the internal CT of the meter is ≤ 0.5A or ≥ 6A* • *When the voltage at measurement terminals of meter is ≤ 50V or ≥ 600V* • *When the measurement line frequency is > 65 Hz*				
Energy				
FwdVAh	Forward apparent energy	3959	Float	✓
FwdWh	Forward active energy	3961	Float	✓
FwdVARh	Forward reactive inductive energy	3963	Float	✓
FwdVARh	Forward reactive capacitive energy	3965	Float	✓
RevVAh	Reverse apparent energy	3967	Float	✓
RevWh	Reverse active energy	3969	Float	✓
RevVARh	Reverse reactive inductive Energy	3971	Float	✓
RevVARh	Reverse reactive capacitive Energy	3973	Float	✓
On hrs	On hours	3993	Long	✓
FwdRun secs	Forward run seconds	3995	Long	✓
RevRun secs	Reverse run seconds	3997	Long	-
Intr	Number of power interruptions	3999	Long	✓
Demand				
Present Demand	Present demand	3975	Float	✓
Rising Demand	Rising demand	3977	Float	✓
Max MD	Maximum demand	3979	Float	✓
Max DM Occurrence Time	Maximum demand occurrence time	3981	Long	✓
Percentage of Load parameters				
% Avg Load	Average load percentage	3881	Float	✓
%L1	Percentage of phase 1 load	3883	Float	✓
%L2	Percentage of phase 2 load	3885	Float	✓
%L3	Percentage of phase 3 load	3887	Float	✓
Unbalanced %Load	Unbalanced %load	3889	Float	✓
Unbalanced % voltage	Unbalanced % voltage	3891	Float	✓

Block Parameter Address

Total RMS Block :

- Function Code: 03H Read
- Number of registers: 20
- No scaling required
- Read as block only

Table 6-9: Total RMS block

Parameter	Description	Address	Type	PM1200
VA	Apparent power, total	3001	Float	✓
W	Active power, total	3003	Float	✓
VAR	Reactive power, total	3005	Float	✓
PF	Average Power Factor of 3-Phases	3007	Float	✓
VLL	Average line to line voltage	3009	Float	✓
VLN	Average line to neutral voltage	3011	Float	✓
A	Average current	3013	Float	✓
F	Frequency, Hz	3015	Float	✓
Reserved	Reserved	3017	Long	-
Intr	Number of interruption	3019	Long	✓

R phase RMS Block:

- Function Code: 03H Read
- Number of registers: 20
- No scaling required
- Read as block only

Table 6-10: R phase RMS block

Parameter	Description	Address	Type	PM1200
VA1	Apparent power, phase1	3031	Float	✓
W1	Active power, phase1	3033	Float	✓
VAR1	Reactive power, phase1	3035	Float	✓
PF1	Power factor, phase1	3037	Float	✓
V12	Voltage phase1 to phase2	3039	Float	✓
V1	Voltage phase1 to neutral	3041	Float	✓
A1	Current, phase1	3043	Float	✓
F1	Frequency, Hz	3045	Float	✓
Reserved	Reserved	3047	Long	-
Intr1	Number of interruption	3049	Long	✓

Y phase RMS Block:

- Function Code: 03H Read
- Number of registers: 20
- No scaling required
- Read as block only

Table 6-11: Y phase RMS block

Parameter	Description	Address	Type	PM1200
VA2	Apparent power, phase 2	3061	Float	✓
W2	Active power, phase 2	3063	Float	✓
VAR2	Reactive power, phase 2	3065	Float	✓
PF2	Power factor, phase 2	3067	Float	✓
V23	Voltage phase 2 to phase 3	3069	Float	✓
V2	Voltage phase 2 to neutral	3071	Float	✓
A2	Current, phase 2	3073	Float	✓
F2	Frequency, Hz	3075	Float	✓
Reserved	Reserved	3077	Long	-
Intr2	Number of interruption	3079	Long	✓

B phase RMS Block:

- Function Code: 03H Read
- Number of registers: 20
- No scaling required
- Read as block only

Table 6-12: B phase RMS block

Parameter	Description	Address	Type	PM1200
VA3	Apparent power, phase 3	3091	Float	✓
W3	Active power, phase 3	3093	Float	✓
VAR3	Reactive power, phase 3	3095	Float	✓
PF3	Power factor, phase 3	3097	Float	✓
V31	Voltage phase 3 to phase 1	3099	Float	✓
V3	Voltage phase 3 to neutral	3101	Float	✓
A3	Current, phase 3	3103	Float	✓
F3	Frequency, Hz	3105	Float	✓
Reserved	Reserved	3107	Long	-
Intr3	Number of interruption	3109	Long	✓

Forward Integrated Block :
- Function Code: 03H Read
- Number of registers: 20
- No scaling required
- Read as block only

Table 6-13: Forward integrated block

Parameter	Description	Address	Type	PM1200
FwdVAh	Forward apparent energy	3121	Float	✓
FwdWh	Forward active energy	3123	Float	✓
FwdVARh	Forward reactive inductive energy	3125	Float	✓
Reserved	Reserved	3127	Float	-
Reserved	Reserved	3129	Float	-
FwdVARh	Forward reactive capacitive energy	3131	Float	✓
Reserved	Reserved	3133	Float	-
Reserved	Reserved	3135	Float	-
Reserved	Reserved	3137	Long	-
FwdRunsecs	Forward run seconds	3139	Long	✓

Reverse Integrated Block:
- Function Code: 03H Read
- Number of registers: 20
- No scaling required
- Read as block only

Table 6-14: Reverse integrated block

Parameter	Description	Address	Type	PM1200
RevVAh	Reverse apparent energy	3151	Float	✓
RevWh	Reverse active energy	3153	Float	✓
RevVARh	Reverse reactive inductive energy	3155	Float	✓
Reserved	Reserved	3157	Float	-
Reserved	Reserved	3159	Float	-
RevVARh	Reverse reactive capacitive energy	3161	Float	✓
Reserved	Reserved	3163	Float	-
Reserved	Reserved	3165	Float	-
Reserved	Reserved	3167	Long	-
RevRunsecs	Reverse run seconds	3169	Long	✓

Total Integrated Block:

- Function Code: 03H Read
- Number of registers: 20
- No scaling required
- Read as block only

Table 6-15: Total integrated block

Parameter	Description	Address	Type	PM1200
TotVAh	Total apparent energy	3181	Float	✓
TotWh	Total active energy	3183	Float	✓
TotVARh	Total reactive inductive energy	3185	Float	✓
Reserved	Reserved	3187	Float	-
Reserved	Reserved	3189	Float	-
TotVARh	Total reactive capacitive energy	3191	Float	✓
Reserved	Reserved	3193	Float	-
Reserved	Reserved	3195	Float	-
Reserved	Reserved	3197	Long	-
TotRunsecs	Total run seconds	3199	Long	✓

Demand Block:

- Function Code: 03H Read
- Number of registers: 22
- No scaling required
- Read as block only

Table 6-16: Demand block

Parameter	Description	Address	Type	PM1200
Reserved	Reserved	3721	Long	-
Reserved	Reserved	3723	Float	-
Reserved	Reserved	3725	Float	-
Reserved	Reserved	3727	Float	-
Reserved	Reserved	3729	Float	-
Reserved	Reserved	3731	Float	-
Reserved	Reserved	3733	Float	-
Present demand	Present demand	3735	Float	✓
Rising demand	Rising demand	3737	Float	✓
Time remaining	Time remaining	3739	Long	✓
Reserved	Reserved	3741	Float	-

NOTE: The address 3741 is overlapped between the demand and max demand blocks.

Max Demand Block:

- Function Code: 03H Read
- Number of registers: 36
- No scaling required
- Read as block only

Table 6-17: Max demand block

Parameter	Description	Address	Type	PM1200
MaxDM	Maximum demand	3741	Float	✓
MaxDMTime	Maximum demand occurrence time	3743	Long	✓
Reserved	Reserved	3745	Float	-
Reserved	Reserved	3747	Long	-
Reserved	Reserved	3749	Float	-
Reserved	Reserved	3751	Long	-
Reserved	Reserved	3753	Float	-
Reserved	Reserved	3755	Long	-
Reserved	Reserved	3757	Float	-
Reserved	Reserved	3759	Long	-
Reserved	Reserved	3761	Float	-
Reserved	Reserved	3763	Long	-
Reserved	Reserved	3765	Float	-

Reserved	Reserved	3767	Long	-
Reserved	Reserved	3769	Float	-
Reserved	Reserved	3771	Long	-
Reserved	Reserved	3773	Float	-
Reserved	Reserved	3775	Long	-

NOTE: The address 3741 is overlapped between the Demand and Max Demand blocks

Old Forward Integrated Block:

- Function Code: 03H Read
- Number of registers: 20
- No scaling required
- Read as block only

Table 6-18: Old forward integrated block

Parameter	Description	Address	Type	PM1200
OldFwdVAh	Old forward apparent energy	3122	Float	✓
OldFwdWh	Old forward active energy	3124	Float	✓
OldFwdVARh	Old forward reactive inductive energy	3126	Float	✓
Reserved	Reserved	3128	Float	-
Reserved	Reserved	3130	Float	-
OldFwdVARh	Old forward reactive capacitive energy	3132	Float	✓
Reserved	Reserved	3134	Float	-
Reserved	Reserved	3136	Float	-
Reserved	Reserved	3138	Long	-
OldFwdRunsecs	Old forward run seconds	3140	Long	✓

Old Reverse Integrated Block:

- Function Code: 03H Read
- Number of registers: 20
- No scaling required
- Read as block only

Table 6-19: Old reverse integrated block

Parameter	Description	Address	Type	PM1200
OldRevVAh	Old reverse apparent energy	3152	Float	✓
OldRevWh	Old reverse active energy	3154	Float	✓
OldRevVARh	Old reverse reactive inductive energy	3156	Float	✓
Reserved	Reserved	3158	Float	-
Reserved	Reserved	3160	Float	-
OldRevVARh	Old reverse reactive capacitive energy	3162	Float	✓
Reserved	Reserved	3164	Float	-
Reserved	Reserved	3166	Float	-
Reserved	Reserved	3168	Long	-
OldRevRunsecs	Old reverse run seconds	3170	Long	✓

Old Total Integrated Block:

- Function Code: 03H Read
- Number of registers: 20
- No scaling required
- Read as block only

Table 6-20: Old total integrated block

Parameter	Description	Address	Type	PM1200
OldTotVAh	Old total apparent energy	3182	Float	✓
OldTotWh	Old total active energy	3184	Float	✓
OldTotVARh	Old total reactive inductive energy	3186	Float	✓
Reserved	Reserved	3188	Float	-
Reserved	Reserved	3190	Float	-
OldTotVARh	Old total reactive capacitive energy	3192	Float	✓
Reserved	Reserved	3194	Float	-
Reserved	Reserved	3196	Float	-
Reserved	Reserved	3198	Long	-
OldTotRunsecs	Old total run seconds	3200	Long	✓

Phase Angle Block:

- Function Code: 03H Read
- Number of registers: 18
- No scaling required
- Read as block only

Table 6-21: Phase angle block

Parameter	Description	Address	Type	PM1200
Neutral voltage	Neutral voltage	3701	Float	✓
An	Neutral current	3703	Float	✓
V1	Voltage phase angle, phase 1	3705	Float	✓
V2	Voltage phase angle, phase 2	3707	Float	✓
V3	Voltage phase angle, phase 3	3709	Float	✓
A1	Current phase angle, phase 1	3711	Float	✓
A2	Current phase angle, phase 2	3713	Float	✓
A3	Current phase angle, phase 3	3715	Float	✓
RPM	Rotations per minute	3717	Float	✓

NOTE: The parameters V1, V2, V3 (voltage phase angles) and neutral voltage are available only through communication.

Setup Block:

- Function Code: 03H Read, 10H Write
- Number of registers: 40/42
- No scaling required
- Read and write as block only

Table 6-22: Setup block

Parameter	Description	Address	Type	Range	Default value	PM1200
A.Pri	Current primary	0101	Float	1.0 to 99 k	100.0	✓
A.Sec	Current secondary	0103	Float	1.0 to 6.5	5.000	✓
V.Pri	Voltage primary	0105	Float	100.0 to 999 k	415.0	✓
V.Sec	Voltage secondary	0107	Float	50.00 to 601.0	415.0	✓
SYS	System Configuration	0109	Float	2.0 to 6.0 2.0 – Delta 3.0 – Star 4.0 – Wye 5.0 – 2 Ph 6.0 – 1 Ph	3.000	✓
LABL	Phase Labeling	0111	Float	0.0 to 4.0 0.0 – 123 1.0 – ABC 2.0 – RST	0.000	✓

Parameter	Description	Address	Type	Range	Default value	PM1200
				3.0 – PQR 4.0 – RYB		
VA Fn	VA Function selection	0113	Float	0.0 to 1.0 0.0 – 3D 1.0 – Arth	0.000	✓
D sel	Demand Selection	0115	Float	0.0 to 1.0 0.0 – Auto 1.0 – User	0.000	✓
D Par	Demand parameter	0117	Float	0.0 to 2.0 0.0 – VA 1.0 – W 2.0 A	0.000	✓
D Prd	Demand period	0119	Float	1.0 to 6.0 1.0 – 5 Min 2.0 – 10 Min 3.0 – 15 Min 4.0 – 20 Min 5.0 – 25 Min 6.0 – 30 Min	3.000	✓
BAUD	Baud rate	0121	Float	3.0 to 5.0 3.0 – 4800 4.0 – 9600 5.0 – 19200	5.000	✓
PRTY	Parity and stop bit	0123	Float	0.0 to 5.0 0.0 – Even 1 1.0 – Even 2 2.0 – Odd 1 3.0 – Odd 2 4.0 – No 1 5.0 – No 2	0.000	✓
ID	Unit ID	0125	Float	1.0 to 247.0	1.000	✓
F.S%	% Full scale	0127	Float	1 to 100	100.0	✓
OFLO	Overflow parameter selection: Wh (Integrator reset based on either Wh or Run hours whichever reach max value), VAh (Integrator reset based on either VAh or Run hours whichever reach max value); INTG Clears when 9999 Run hours (almost 13.88 months) Wh E (Integrator reset based on only Wh overflow) VAh E (Integrator reset based on only VAh overflow)	0129	Float	0.0 to 3.0 0.0 – Wh 1.0 – VAh 2.0 – Wh E 3.0 – VAh E	2.000	✓
POLE	Number of poles for RPM	0131	Float	1.0 to 8.0 1.0 – 2 2.0 – 4 3.0 – 6 4.0 – 8 5.0 – 10 6.0 – 12 7.0 – 14 8.0 – 16	2.000	✓

Parameter	Description	Address	Type	Range	Default value	PM1200
PWD	Password	0133	Float	1000	1000	✓
Reserved	Reserved	0135	Float	-	2.0	-
Reserved	Reserved	0137	Float	-	4126	-
Reserved	Reserved	0139	Float	-	0.0	-
F.SEQ	Float byte sequences	0141	Float	1.0 to 2.0 1.0 – 4321 2.0 – 2143	2.0	✓

NOTE: For efficient setup, read the setup parameters first and then edit the required setup parameter value.

Clear Block:

- Function Code: 10H Write
- Number of registers: 2
- No scaling required
- Write as block only

Table 6-23: Clear block

Parameter	Description	Address	Type	Range	PM1200
CLR_INTG_DMD_SETDEFAULT	INTG and demand clearing and setting up the setup default	0311	Long	1 - INTG and MD Clear 2 - MD Clear 256 - Setup default	✓

NOTE: For setup default, the power meter will send an exception for values other than 256.

Model Info Block:

- Function Code: 03H Read
- Number of registers: 14
- No scaling required
- Read as block only

Table 6-24: Model Info Block

Parameter	Description	Address	Type	Range	PM1200
Reserved	Reserved	0081	Long		-
Reserved	Reserved	0083	Long		-
Model Version	Model, Options and version numbers	0085	Long	Bits 30 to 24 for model number; Bits 23 to 16 for options Bits 15 to 0 for version number E.g., PM1200 model no is 22	✓
Reserved	Reserved	0087	Long		-
Reserved	Reserved	0089	Long		-
Reserved	Reserved	0091	Long		-
Reserved	Reserved	0093	Long		-

Model Register Details

This section explains about the model register and helps you to understand the model number, version number, and options.
The following figure explains how the bits are organized in the model register.

Figure 6-4: Bits in model register

MSB LSB

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

30 – 24 Model No | 23 – 16 Options | 15 – 0 Version No

Meter Model and Number: The following table bitwise explanation for Meter model and number.

Table 6-25: Meter model and number

Meter Model	Model Number 5A Meter	Option bit wise
PM1200	22(0x16)	-
PM1000	24(0x18)	-

Model options description: The following table gives the model options bitwise description.

Table 6-26: Model options description

Bit23	Bit22	Bit21	Bit20	Bit19	Bit18	Bit17	Bit16	Remarks
0	0	0	0	0	0	0	0	No options available
0	0	0	0	0	0	0	1	Imp/Exp option available
0	0	0	0	0	0	1	0	DM option available
0	0	0	0	0	0	1	1	Imp/Exp and DM option available
0	0	0	0	0	1	0	0	THD option available
0	0	0	0	0	1	0	1	Imp/Exp and THD available
0	0	0	0	0	1	1	0	DM and THD available
0	0	0	0	0	1	1	1	Imp/exp, DM and THD available

Interpretation of firmware version number: The following steps clearly explain how to interpret the firmware (FW) version number.

1. Convert the hexadecimal values both MSB and LSB into decimal values.
2. Apply the formula ((MSB*256) +LSB).
3. The resulting value will be 30400 for the hexadecimal value 0x76 0xC0.
4. Insert a **0** before the result and parse it from the right with two digits each.
5. The result will be the FW version = 03.05.01.

Table 6-27: Firmware version interpretation

	MSB	LSB
Hexadecimal	0x76	0xC0
Decimal	118	192
VALUE=((MSB*256)+LSB)	30400	
FW Version	03.05.01	

NOTE: Firmware version representation only. To determine your power meter's present firmware version, refer the diagnostic page in the power meter. See "PM1000 series power meter menu hierarchy", to navigate through the diagnostic page.

NOTE:

- *Most of the reserved and unavailable parameters return zero value.*
- *The SCADA software must support register blocks consisting of different data types (integers and floats) to transfer of the whole block.*
- *Each Modbus register size is 16 bits. All PM1200 readings are 32 bits. Therefore, each PM1200 reading occupies two consecutive Modbus registers. For example, VA parameter absolute address is 3901. It occupies both 3901 and 3902 Modbus registers.*

- *Address configuration: All addresses are in decimal. Some SCADA software supports Modbus register address instead of absolute register address. In this case add 40000 to the above address and use it. For example, VA parameter absolute address is 3901. Modbus address can be 43901 (40000+3901).*
- *Phase Angle Block: Voltage phase angles (0,120,240) are hard coded (not measured). Hence, these values are also available in communication in the absence of input signals; however, these voltage phase angles are not available in the power meter display.*
- *TURBO, and Percentage of Load Blocks: These parameters can be read individually or as a block*
- *TURBO block: 50 parameters maximum*
- *Percentage of Load block: 5 parameters maximum*
- *All power meters addresses should be set between 1 and 247.*
- *All power meters should have uniform communication settings like Baud rate, parity and stop bit.*
- *Use Diagnostic mode display in the power meter to analyze the problem in communication.*
- *Error: u – Invalid unit ID*
  A – Invalid Address
  c – CRC error (cyclic redundancy checking)
  t – Transmitting
  r – Receiving
  F – Invalid function code
  o – Parity, framing or overrun error
  O– Buffer overflow

Chapter 7: Maintenance and Troubleshooting

Introduction

This chapter describes information related to maintenance of your power meter.

The power meter does not contain any user-serviceable parts. If the power meter requires service, contact your local sales representative. Do not open the power meter. Opening the power meter voids the warranty.

CAUTION

HAZARD OF EQUIPMENT DAMAGE

- Do not perform a Dielectric (Hi-Pot) or Megger test on the power meter, test voltages may damage the power meter.
- Before performing Hi-Pot or Megger testing on any equipment in which the power meter is installed, disconnect all input and output wires to the power meter.

Failure to follow these instructions will result in equipment damage.

Troubleshooting

The information in Table 7–1 describes potential problems and their possible causes. It also includes possible checks to perform or solutions to the problems. After referring to this table, if you cannot resolve the problem, contact your local Schneider Electric sales representative for assistance.

⚠ DANGER

HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH

- Apply appropriate personal protective equipment (PPE) and follow safe electrical practices. For example, in the United States, see NFPA 70E.
- This equipment must be installed and serviced only by qualified personnel.
- Turn off all power supplying this equipment before working on or inside.
- Always use a properly rated voltage sensing device to confirm that all power is off.
- Carefully inspect the work area for tools and objects that may have been left inside the equipment.
- Use caution while removing or installing panels so that they do not extend into the energized bus; avoid handling the panels, which could cause personal injury.

Failure to follow these instructions will result in death or serious injury.

Table 7-1: Trouble shooting

Potential Problem	Possible Causes	Possible Solution
The data being displayed is inaccurate or not what you expect	Incorrect setup values	Check that the correct values have been entered for power meter setup parameters (CT and PT ratings, system type, and so on). See "Setup Menu" on for setup instructions.
	Usage of protection class (10P10 etc.) CTs/PTs	Use instrument class 1 or better CTs/PTs, which will have better accuracy than the protection class CTs/PTs.
	Improper wiring	Check whether all the PTs and CTs are connected properly (proper polarity is observed) and that they are energized. Check shorting terminals. See "Connection Diagrams " for more information.
Active Power (W) reading is negative	CT may be reversed	Check and correct the CT connections.
	Power may be in export mode	1. Check the mode. If the mode is in import, s1 s2 need to be interchanged in one or two or in all the three phases. Under this condition, the energy will update in INTG Rev. 2. Check the mode. If it is in export, then the energy will update in INTG Rev.
The display went blank suddenly	Over voltage/temperature	Interrupt the power supply or reduce the voltage or temperature within the limit.
	Fuse connection	Check whether a fuse with rating of 0.25 A is connected on each voltage input. If not connect the 0.25 A rated fuse to the voltage input.

Potential Problem	Possible Causes	Possible Solution
The power meter stopped communication abruptly	Communications lines are improperly connected	Verify the power meter communications connections. See “Chapter 6 – Data communication” for more information.
	Over voltage/temperature	Interrupt the power supply or reduce the voltage or temperature within the allowable limits.
Wrong Load bar indication	Incorrect F.S% selection	Select the full scale load percentage setting as per your circuit.
The power meter is over heated	Lack of sufficient air for cooling	Provide sufficient space all around the power meter. Separate the power meter from other equipment for cooling air.

Appendix A – Technical Data

Accuracy

Table A-1: Accuracy

Measurement	Accuracy % of Reading*
	Class 1.0
Voltage LN per phase and average	0.5
Voltage LL per phase and average	0.5
Amp per phase and average	0.5
Amp, phase angle per phase	2º
Frequency	0.1
Total Active power, (kW)	1.0
Total Reactive power, (kVAR)	2.0
Total Apparent power, (kVA)	1.0
Active energy (kWh) Import/Export	1.0
Reactive energy (kVARh) (Inductive / Capacitive)	2.0
Apparent energy (kVAh)	1.0
RPM	1.0

NOTE:

- *Additional error of 0.05 % of full scale for input current below 100 mA.*
- *PF error limit is same as W error limit in %.*
- **In Delta mode configuration the accuracy will be 1.0% of reading.*

Auxiliary supply (Control power)

The power meter needs a single-phase AC or DC control supply to power its internal electronics.
Range: 44 to 277 Vac/dc.
Burden (load): 3 VA max on Auxiliary supply.

Front Panel Display

- Brilliant three lines four digit (digit height 14.2 mm/0.56 in.) per line, high readability alpha numeric LED display with auto scaling capability for Kilo, Mega, Giga.
- The display provides the user access to all phase voltages (phase to neutral and phase to phase), currents (per phase and average), Watts, VARs, VA, power factor, frequency, kWh, kVAh, and kVARh.
- The power meters display average volts, amps, and frequency simultaneously.
- Load bar graph for the indication of consumption in terms of % amperes total.
- Set of four red LED’s in the load bar start blinking when the load is greater than 120%, to indicate overload.
- Easy setup through keys located on the faceplate for common configuration parameters.
- Password protection for setup parameters.
- User-selectable default display page through keypad lock.

Installation and Input Ratings

- Auto-ranging voltage inputs should allow direct connection up to 277 VLN/480VLL AC systems, no PTs (VTs) required up to 480 VLL phase to phase).
- Supports the following configurations (field configurable):
  Direct 4-wire Wye (Star); 3-wire Wye (Star); 3-wire Delta; 2-phase 3-wire (2-phase); and single-phase.
- 3-phase voltage, and current inputs
- Volts : 46 to 277 Vac phase-neutral, 80 to 480 Vac phase-phase, Overload: Continuous 480 VLL with full accuracy, 750 VLL Max, Hz. 50 / 60
- Amps: 50 mA to 6 A, Overload: 10 A continuous, 50 A for 5 sec/hr, 120 A for 1 sec/hr
- User programmable for 5 A or 1 A secondary CTs
- Burden (Load): Less than 0.2 VA per Volt / Ampere input
- Frequency (Both input and auxiliary): 50 / 60 Hz, 45 to 65 Hz

Environmental Conditions

- Sealed dust- proof construction. Meets IP51 for the front display and IP40 for meter body (excluding terminals).
- Operating temperature: -10 °C to 60 °C , (14 °F to 140 °F)
- Storage temperature: -25 °C to 70 °C, (-13 °F to 158 °F)
- Humidity: 5% to 95%, non-condensing
- Altitude ≤ 2000m

Construction

- Self-extinguishable V0 plastic, double insulation at accessible areas.
- Pollution Degree II.
- Measurements Category III.

Dimensions and Shipping

- Basic unit installed depth 83 mm (3.26 in.) with 92 x 92 mm (3.62 x 3.62 in.) panel cutout, flush mount.
- Bezels dimension 96 x 96 mm (3.78 x 3.78 in.). Panel Cut-out 92x92 mm (3.62 x 3.62 in.).
- Weight 400 gms (0.9 lb) approx unpacked, 500 gms (1.1 lb) approx shipping. See “Mechanical Installation” for more information.

Appendix B: SIM (simulation) Mode

The PM1000 series power meters are provided with SIM mode for demo and exhibition display, where the user can see the functioning of the power meter without any input signals. The power meter will show a fixed voltage, current, frequency, and 0.5PF. Power and energy parameters are calculated based on the V, A, and PF displayed.

To Enter SIM mode

- Keep the pressed, while powering up the power meter. The display shows **RUN**.
- Press . The display shows **SIM**.
- Press . The display shows **RMS SIM**. You have successfully entered the SIM mode of the power meters.

To Exit from SIM mode

- Press and hold the , until you reach the RMS page.
- Press . The display shows **SIM**.
- Press . The display shows **RUN**.
- Press . The display shows **RMS** indicating the exit from SIM mode

Appendix C: Glossary

Terms

Auto (sliding block): An interval selected from 5 to 30 minutes. The power meter calculates and updates the demand every 15 seconds.

Baud rate: Specifies how fast data is transmitted across a serial network port.

Communications link: A chain of devices connected by a communications cable to a communications port.

Current Transformer (CT): Current transformers for current inputs.

Demand: Average value of a quantity, such as power, over a specified interval of time.

Firmware: Operating system within the power meter.

Float: A 32-bit floating point value returned by a register (See “Data Address” for more information).

Forward: Importing the power into the plant/grid.

Frequency: Number of cycles in one second.

Line-to-line voltages: Measurement of the RMS line-to-line voltages of the circuit.

Line-to-neutral voltages: Measurement of the RMS line-to-neutral voltages of the circuit.

LOCK: Default display page lock (See “Default display (View) page” for more information).

Long: A 32-bit value returned by a register (See “Data Address” for more information).

Maximum demand: Highest average load during a specific time interval.

Nominal: Typical or average.

Parity: Refers to binary numbers sent over the communications link. An extra bit is added so that the number of ones in the binary number is either even or odd, depending on your configuration. It is used to detect errors in the transmission of data.

Power factor: True power factor is the ratio of real power to apparent power using the complete harmonic content of real and apparent power.

Reverse: Exporting the power from the plant/grid.

RMS: Root mean square. The power meters are true RMS sensing devices.

Run mode: This is the normal operating mode of the power meter, where the readings are taken.

Total Harmonic Distortion (THD): Indicates the degree to which the voltage or current signal is distorted in a circuit.

ULOC: Default display page unlock (See “Default display (View) page” for more information).

User (fixed block): An interval selected between 5 to 30 minutes. The power meter calculates and updates the demand at the end of each interval.

Abbreviations

%A FS	% Amperes full scale
A, Amps	Amperes
An	Neutral current
A.PRI	Current primary winding
A.SEC	Current secondary winding
Avg	Average
CLR	Clear
CT	Current transformer
Dia, DIAG	Diagnostic
ft	Feet/foot
F.Seq	Float Byte Sequence
FW	Firmware
FWD	Forward
Hz	Hertz
ID	Identity
in.	Inch
INTG	Integrator
IP	Ingress protection
kVAh	Kilo volt-ampere hour
kVARh	Kilo volt-ampere reactive hour
kWh	Kilo watt hour
LSB	Least significant bit
MD	Maximum demand
Min	Minimum
ms	Milliseconds
MSB	Most significant bit
O.F	Overflow
PF	Power factor
PT	Potential transformer
R.d	Rising demand
Rev	Reverse
RPM	Revolution per minute
SYS	System configuration
THD	Total harmonic distortion
ULOC	Unlock
Unb	Unbalance
V	Voltage
VA	Apparent power
VAh	Apparent energy
VAR	Reactive power
VARh	Reactive energy (inductive)
-VARh	Reactive energy (capacitive)
V.PRI	Voltage primary winding
V.SEC	Voltage secondary winding
VT	Voltage transformer
W	Active power
Wh	Active energy

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