Conzerv EM6400 Series Power Meters
User manual

CTD7303
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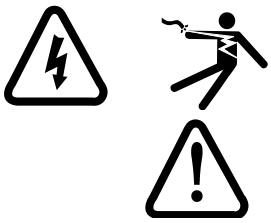
Schneider Electric

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 an imminently hazardous situation which, if not avoided, **will result in** death or serious injury.

⚠ WARNING

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

⚠ CAUTION

CAUTION indicates a potentially hazardous situation which, if not avoided, **can 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.

OTHER SYMBOLS

This symbol indicates direct and alternating currents

This is 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.

Chapter 1 – EM6400 Series Power Meters Product Description

The EM6400 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 before the power meter is ready for use, and maintenance and troubleshooting procedures for the power meter after installation.

The EM6400 series power meter is an 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 EM6400 power meters with complete user support and service.

Intended use: EM6400 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 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 full scale (FS) selected. Five smart keys make navigating the parameters very quick and intuitive for viewing data and configuring the power meter.

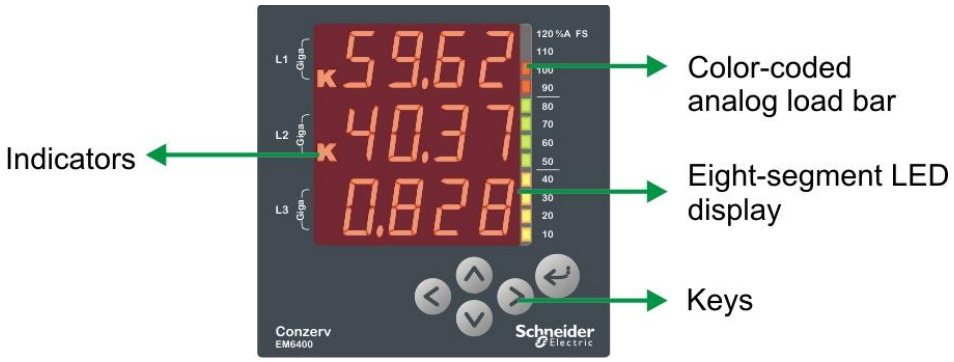
REAR: The voltage and current terminals and the communication port are located on the back of the power meter. Refer to “Rear Panel” on page 13 for more information.

Front Panel

The front panel contains the following indicators and controls:

- **Eight-segment LED display:** Three rows of alphanumeric displays, four digits each, display three RMS parameters simultaneously or one energy parameter. The displayed readings update every second.
- **Analog load bar:** Unique indication of % load with respect to the full scale (FS).
- **Indicators:** For each row Kilo, Mega (Kilo + Mega = Giga) indicators, and a Negative (-) indicator.
- **Keys:** Five smart keys to scroll through the display pages.

Figure 1-1: Parts of EM6400 series power meter front panel



Eight-segment LED display

- Four line, three digits, eight-segment LED display.
- The power meter displays the parameter name prominently right on the large, alphanumeric readouts.
- The power meter displays the parameter name for **two** seconds and then the value for **eight** seconds. The parameter name is also displayed each time when you press a key. This helps the user to know which parameter is currently displayed.
- 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 be increased 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 1.0 K as 1000.
	**Mega:** When lit, indicates that the reading is in Mega, (10^6). 10,000 K is shown as 10.00 M. and 1.0 M as 1000 K.
	**Giga:** When **Kilo** and **Mega** are lit together, the reading is in Giga (10^9). 10,000 M is shown as 10.00 G and 1.0 G as 1000 M.
	**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) sign 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 PROG menu - setup) depending upon the PT (VT) and CT ratios programmed.

Smart Keys

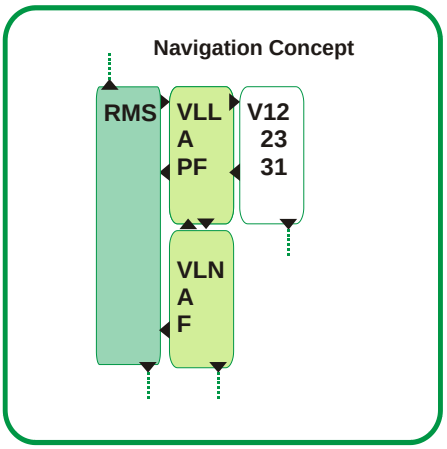
Operating the power meter is easy, using the five smart keys to navigate through the display pages. The display pages **expand** as you go to the right, much like the directory or explorer **tree** displayed on any computer. The display shows where you are headed.

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 PROG 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 PROG menu – setup. • The meter enters the SIM (simulation) mode when you press the left key continuously during the powerup of the power meter. See “SIM (Simulation) mode” on page 73 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” on page 12 for more information. • **While editing, increases** the value of the blinking/selected digit.
	**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” on page 12 for more information. • **While editing, decreases** the value of the blinking/selected digit.
	**TURBO Key:** • TURBO key is simple one touch access to the most commonly used parameters pages (factory set). The TURBO pages for EM6400 series power meters are given below. • **EM6400: 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, RVAh, RWh, tVAh, tWh**.** • **EM6433:** RMS (home page), A, W, Wh. • **EM6459:** RMS (home page), VLL A PF, VLN A F. • **EM6434:** RMS (home page), VA W PF, VA W VAR, W VAR PF PF1 PF2 PF3 VAh and Wh. • **EM 6436:** RMS (home page), 'VLL, A, PF' 'VLN, A, F', ‘A, W, PF’, 'PF1, PF2, PF3’, Wh, and Run.h. • 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” on page 12 for more information. • During the powerup, if the TURBO key is pressed, the power meter goes directly in to PROG menu – Setup. This is the easiest way to enter in to the setup menu. See “Quick setup – While powering on” on page 19 for more information.

Keypad Operation
Press the key in the direction you want to go. The display shows where you are headed. Press the key that takes you in the desired direction.

The following example explains how to navigate from the **RMS** page to the **VLN A F** page and back to the **RMS** page in the EM6400 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**.

Use to go forward to the sub-parameter page and use to go backward to the main parameter pages. Use and to scroll up and down through the display 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” on page 9 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 manual key operation. This is convenient for viewing from a distance. The power meter shows the parameter name for **one second** followed by the value for **four seconds**.

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

To lock the user-set default page:

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

To unlock the user-set default page:

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

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

Default Display Page through Communication

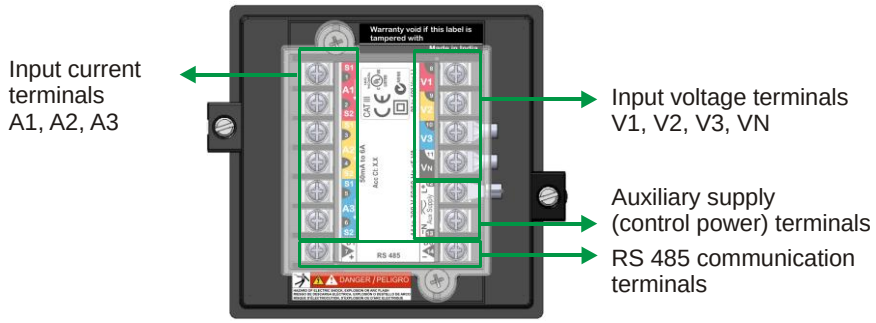
- You can lock and unlock the default display page through communication (ConPAD).
- If the default display page is locked by operator through communication, the default display page can be unlocked through front panel.
- If the default display page is locked by supervisor through communication, the operator cannot unlock the default display page through front panel and communication. Only supervisor can unlock through communication.

Rear Panel

The EM6400 series 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.

Figure 1-2: Rear panel



Models and Parameters with EM6400 Series Power Meters

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

Table 1-5: Models and parameters with EM6400 series power meters

Parameter		EM 6459	EM 6433	EM 6434	EM 6436	EM 6400
RMS	VLLV12, V23, V31 VLN V1, V2, V3	•			•	•
	A A1 A2 A3	•	•		•	•
	An Neutral current	C				C
	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			•		•
DM	Demand VA/ W/ A					DM ☐
	Rising demand					
	Time remaining					
	Maximum Demand (MD)					
	Hr MD occurred					
INTG FWD	Wh		⊙	•	⊙	•
	VAh		⊙	•	⊙	•
	VARh			•		•
	-VARh			•		•
	Run hours		•	•	•	•
	ON hours	•	•	•	•	•
	INTR	•	•	•	•	•
INTG REV	R.Wh					**I/E** ☐
	R.VAh					
	R.VARh					
	-R.VARh					
	Run hours					
OLD FWD	Wh		⊙	•	⊙	•
	VAh		⊙	•	⊙	•
	VARh			•		•
	-VARh			•		•
	Run hours		•	•	•	•
OLD REV	R.Wh					**I/E** ☐
	R.VAh					
	R.VARh					
	-R.VARh					
	Run hours					
	RS 485	☐	Built-in	Built-in	☐	☐

NOTE:
• – Standard; ☐ – Option specified while ordering; C – Only through communication; ⊙ – Selectable through setup.
FWD: Forward indicating the import of power into the plant/grid
REV: Reverse indicating the export of power from the plant/grid

The EM6400 series power meter 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 ($A^{\circ}1$, $A^{\circ}2$, $A^{\circ}3$) 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” on page 9 for more information.

EM6400 Series Power Meters Technical Specification

The EM6400 series power meters are high-accuracy, low cost, ultra-compact, power, and energy meter series. 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 standalone meter in electrical control panels, power distribution unit (PDU), switch boards, uninterrupted power supply (UPS), generator sets, and motor control center (MCC) systems. It also provides easy communication to program logic control (PLC), distributed control system (DCS), building management system (BMS), and other systems. The following table gives the technical specifications of the power meters. Refer to “Technical data” on page 71 for more information.

Table 1-6: Technical specifications

Description	Specification
Sensing/Measurement	True RMS, one second update time, four quadrant power and energy
Accuracy*	Class 1.0 as per IEC 62052-11 and IEC 62053-21 Optional: Class 0.5S, 0.2S as per IEC 62052-11, 62053-22 and ANSIC12.20
Auxiliary supply (Control power)	44 to 300 VAC/DC
Burden	Voltage and current input < 0.2 VA per phase Auxiliary supply (Control power) < 3 VA at 240 V
Display	Alphanumeric bright LED
Resolution	RMS four digits, INTG eight digits
Input voltage	Four voltage inputs (V1, V2, V3, VN) 110 or 415 VACLL nominal (Range 80 to 600 VAC LL)
Input current (Energy measurement)	Current inputs (A1, A2, A3)\ 5 A Class 1.0/0.5: 5 mA (starting) to 6 A* 5 A Class 0.5S/0.2S: 5 mA (starting) to 6 A 1 A Class 0.5S/0.2S: 1 mA (starting) to 1.2 A
Frequency	45 to 65 Hz
Overload	5 A: 10 A max continuous 1 A: 2 A max continuous
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
Standard	CAT III - Measurement category III, Pollution Degree 2, ⧈ - Double insulation at user-accessible area
Weight	400 gms approx, unpacked 500 gms approx, shipping
Communication (optional)	RS 485 serial channel connection Industry standard Modbus RTU protocol
EM6400 series conforms to	Emission : CISPR22; 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
Isolation	2k VAC isolation for one min between all isolated circuits including communication port
Protection against dust and water	Front – IP 51; Back – IP 40

*NOTE: * For 5 A universal power meter additional error of 0.05% of full scale, for power meter input current below 100 mA.*

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.

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

Chapter 3: Quick Start Guide

PROG Menu — Setup

- The power meter must be configured to match the application settings, before use. Otherwise, the readings will be incorrect.
- 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, incorrect 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.

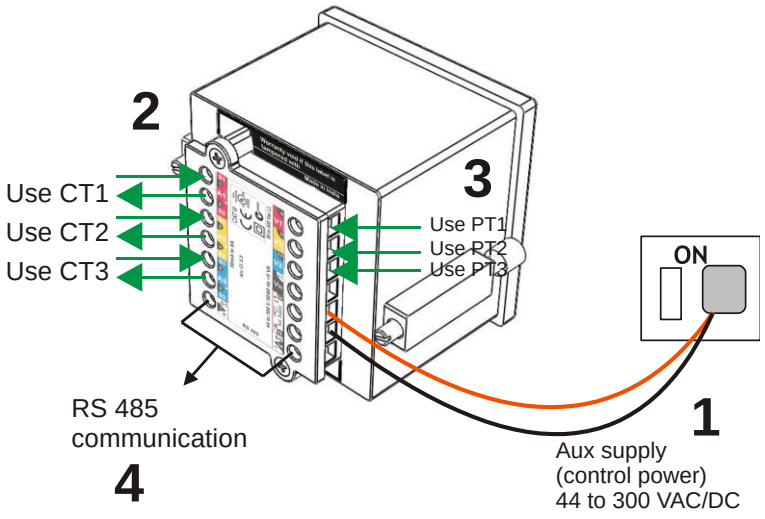
Failure to follow this instruction can result in injury or equipment damage.

You can enter the PROG menu - setup 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 PROG menu setup.
- To make connections, see “Connection diagrams” on page 48. Here are few tips.

Figure 3-1: Quick setup - connections



1. Connect auxiliary supply (control power) 44 to 300 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 enters directly into PROG menu setup 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 < 600 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 > 600 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

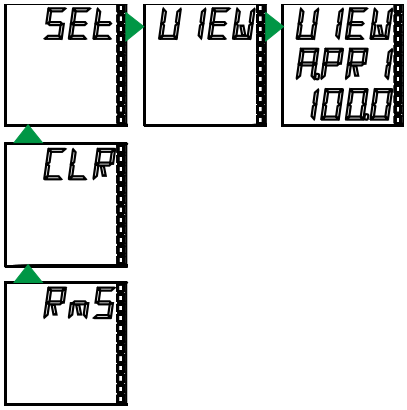
3. Connect the voltage inputs. Use PT (VT), if voltage exceeds 600 VAC LL.

PT1	PT2	PT3	Neutral
8	9	10	11

4. RS 485 terminals

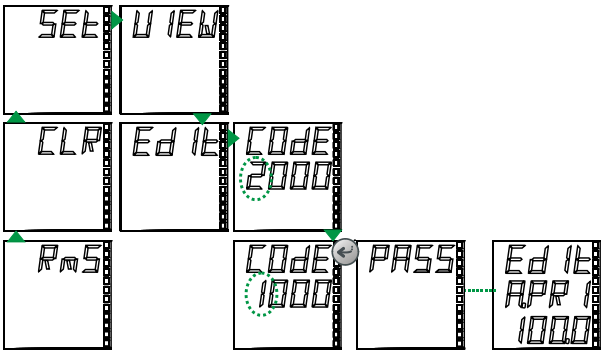
+ve	-ve
7	14

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 v to scroll and view the setup parameters and their current settings.

Enter Setup Menu in Edit Mode

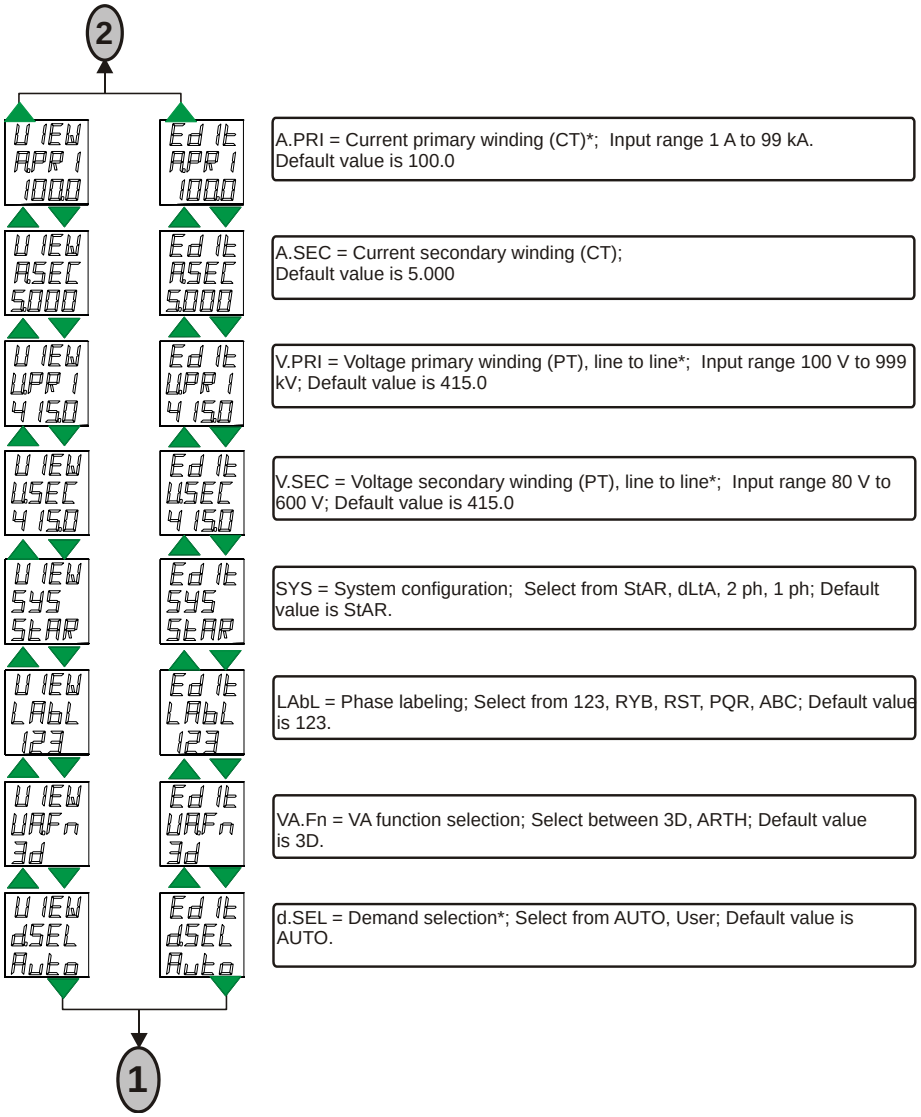


NOTE: 1 means blinking
2 Means blinking 2

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

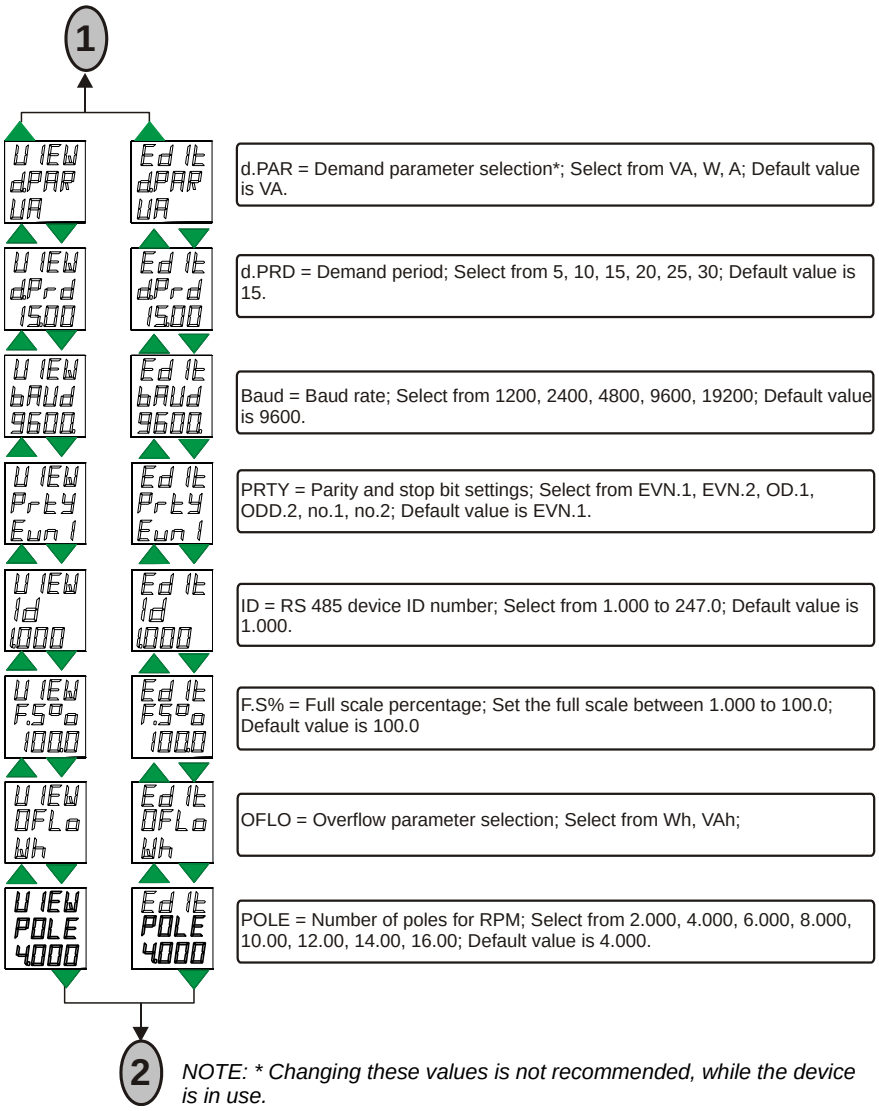
*NOTE: If you enter an incorrect code, the display flashes **FAIL**, and then displays **EDIT**. Repeat the procedure and make sure that you enter the correct code.*

Setup Parameters in View and Edit Modes



NOTE: Changing these values while device is in use is not recommended.*
BAUD, PRTY, and ID are applicable only for EM6400 series power meters with RS 485 communication option.

Setup Parameters in View and Edit Modes (continued)



*NOTE: * Changing these values is not recommended, while the device is in use.*

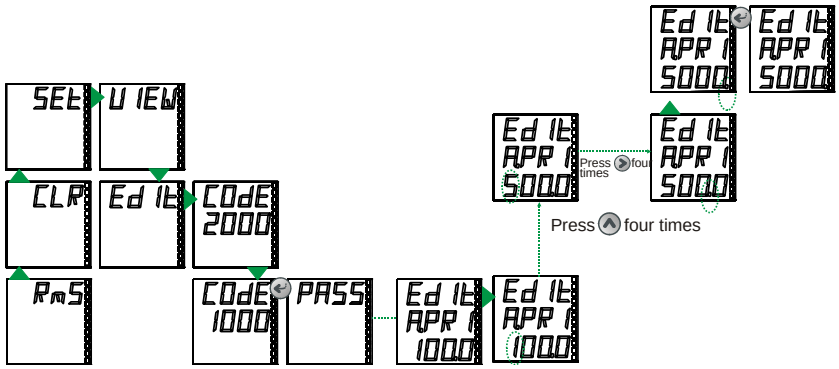
NOTE: Changing these values while device is in use is not recommended.*
BAUD, PRTY, and ID are applicable only for EM6400 series power meters with RS 485 communication option.

Edit Set Parameters in PROG Menu

This example explains how to edit the value of **A.PRI** from **100.0** to **5000** in PROG menu setup of the EM6400 series power meter. Then it shows how to save the value to the setup.

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

Edit and Accept Setup

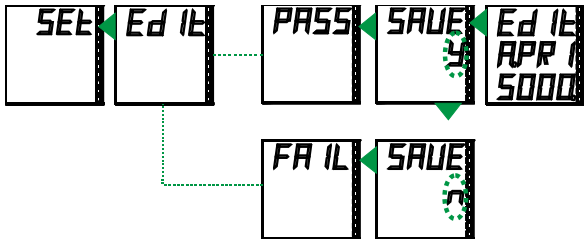


NOTE: *means blinking*
2 Means blinking 2

1. After you have successfully entered setup menu in edit mode, (Refer to “Enter setup menu in Edit mode” on page 21 for more information) press . The display shows **EDIT A.PRI 100.0** with blinking **1**. This indicates that the value can be edited.
2. Press for four times. The display shows **EDIT A.PRI 5.000** with blinking **5**. The value can be edited.
3. Press four times. Th**e** display shows **EDIT A.PRI 500.0** wi**t**h blinking “**.**”.
4. Press . The display shows **EDIT A.PRI 5000.** with blinking “**.**”.
5. Press to accept the new value.

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

Save the New Value to Setup



NOTE: y means blinking
y means blinking y

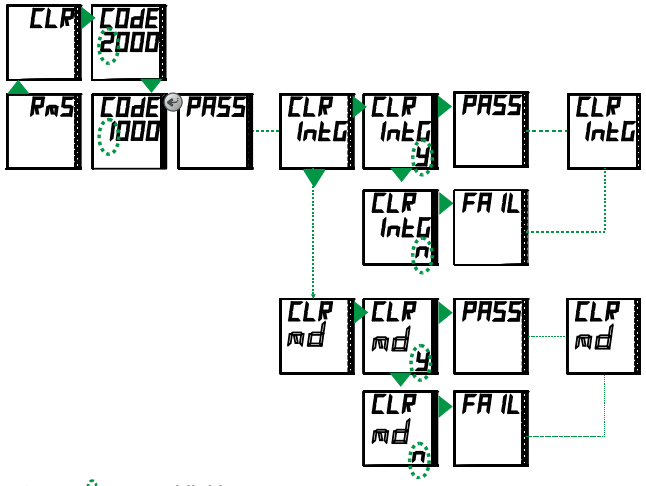
1. After you edit the parameter as described above, press . The display shows **SAVE y** with blinking **y.**
2. Press or to save the new value. The display flashes **PASS** and then shows **EDIT**.
3. Press to return to **SET**.

*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.*

Clear INTG and Maximum Demand (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



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 then show **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 **MD**, press to change the value from **CLR MD y** to **CLR MD n** in step 6. Then press . The display flashes **FAIL** and then show **CLR MD**. Proceed to step 8.*

Energy Integrator

The EM6400 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: The period for which the power meter (supply) is ON.
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.

NOTE:
CT Reversal: Auto-correction for energy integration in star (wye) mode. In star (wye) mode energy integration always be in forward direction irrespective of the direction of current flow or sign of the power reading per phase (not applicable IE models).

Integrator Overflow

The EM6400 series power meter contains 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. Since the Integrator contains counters for several parameters (VAh, Wh, VARh, -VARh, Run Hours, On Hours, Interruptions), they all reset together when any one of them overflows (usually Wh – but can be changed to VAh through the Setup). This makes energy management calculations such as average PF very easy.

The maximum number that the power meter handles is 9,999 Giga for RMS and energy values. The value at which the power meter overflows is given below.

The overflow value depends on the product of the primary voltage and current rating.

Table 3-1: Integrator overflow

V.PRI x A.PRI x 1.732	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 cleared INTG values are 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. Remember that the OLD values will be

overwritten, when the INTG is cleared next time.

- 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 depending 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)

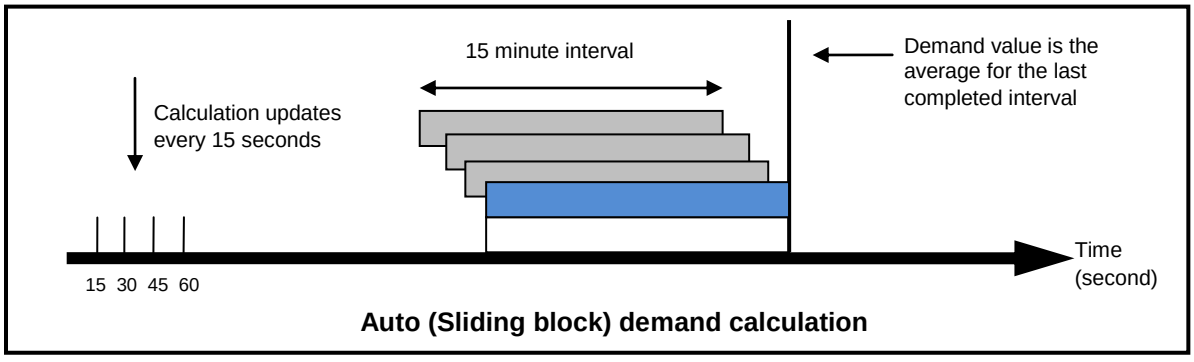
Auto (sliding block)

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.

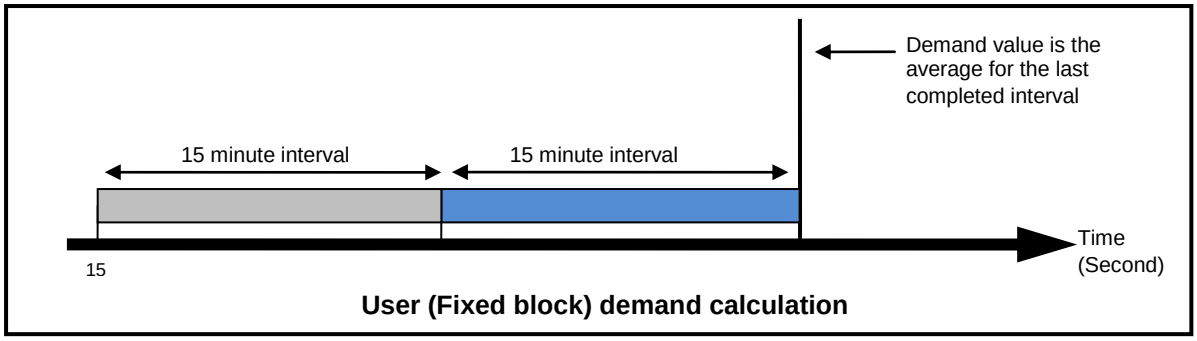
Auto demand power calculation is the default calculation for EM6400 series power meters.

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” on page 22 for more information.



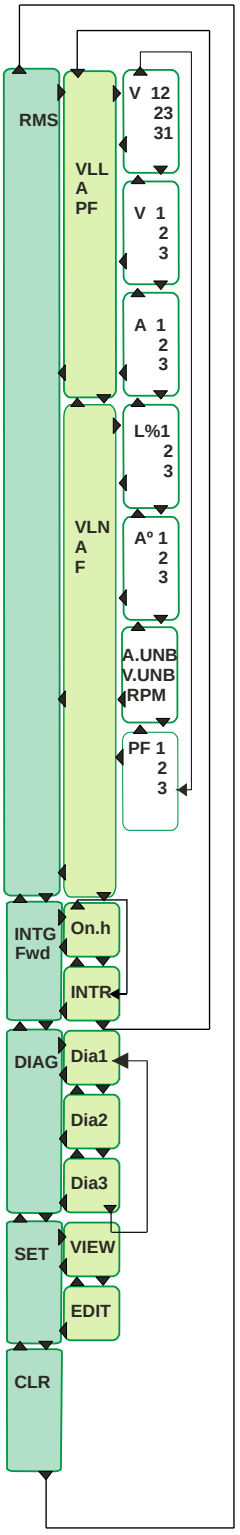
Auto (Sliding block) demand calculation



User (Fixed block) demand calculation

EM6400 Series Power Meters Menu Hierarchy

EM6459 Meter Menu Hierarchy



RMS = RMS value display pages are in sub level

VLL = Phase-Phase voltage average
A = Current average
PF = Power Factor average

VLN = Phase-Neutral voltage average
A = Current average
F = Frequency in Hz

V12 = RMS voltage, phase 12
V23 = RMS voltage, phase 23
V31 = RMS voltage, phase 31

V1 = RMS voltage phase 1 to neutral
V2 = RMS voltage phase 2 to neutral
V3 = RMS voltage phase 3 to neutral

A1 = RMS current, phase 1
A2 = RMS current, phase 2
A3 = RMS current, phase 3

L1% = % of load, phase 1
L2% = % of load, phase 2
L3% = % of load, phase 3

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.UNB = Current unbalance
V,UNB = Voltage unbalance
RPM = RPM of the motor

PF1 = Power factor, phase 1
PF2 = Power factor, phase 2
PF3 = Power factor, phase 3

An = Neutral current

INTG Fwd = Forward Integrator

On.h = Duration of supply ON

INTR = No of power interruptions

DIAG = represents diagnostic pages. The values contained in these pages are for factory testing only

Dia1 = Communication settings

Dia2 = Product model and version number

Dia3 = Display scanning for display LED check

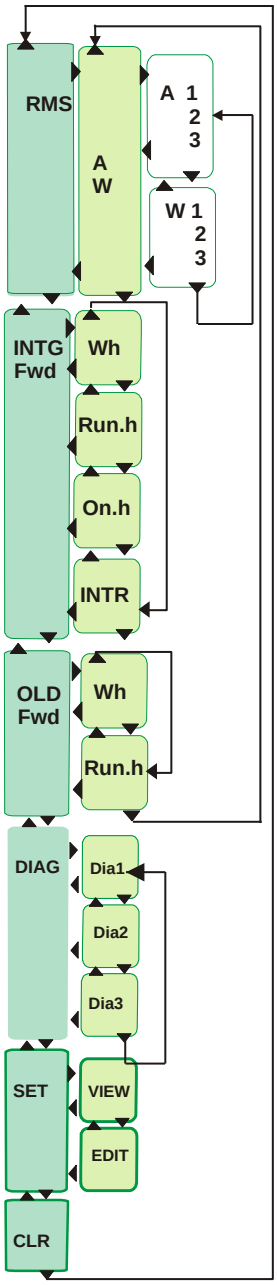
SET = Has two modes: EDIT/VIEW set parameters

VIEW = To view simultaneous setup parameter name and value display

EDIT = To edit simultaneous setup parameter name and value display

CLR = Clears INTG values

EM6433 Power Meter Menu Hierarchy



RMS = RMS value display pages are in sub level

A = Current average
W = Watt total

A1 = RMS current, phase 1
A2 = RMS current, phase 2
A3 = RMS current, phase 3

W1 = Watts, phase 1
W2 = Watts, phase 2
W3 = Watts, phase 3

INTG Fwd = Forward Integrator

Wh = Forward Watt hours. Wh integrates always in the forward direction irrespective of the direction of flow of current for star (Wye) mode

Run.h = Forward run hours, Total hours the load was ON

On,h = Duration of supply ON

INTR = No of power interruptions

OLD Fwd = The energy values stored in the integrator will be transferred to the OLD register when the integrator is cleared (manually or due to overflow)

Wh = OLD Forward Watt hours.

Run.h = OLD Forward run hours

DIAG = Represents diagnostic pages. The values contained in these pages are for factory testing only

Dia1 = Communication settings

Dia2 = Product model and version number

Dia3 = Display scanning for display LED check

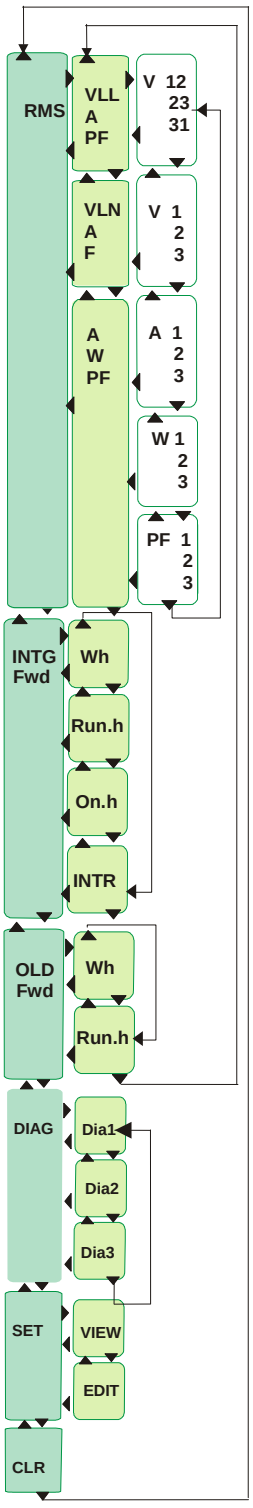
SET = Has two modes EDIT/VIEW set parameters

VIEW= To view simultaneous setup parameter name and value display

EDIT = To edit simultaneous setup parameter name and value display

CLR = Clears INTG values

EM6436 Power Meter Menu Hierarchy



RMS = RMS value display pages are in sub level

VLL = Phase-Phase voltage average
A = Current average
PF = Power Factor average

VLN = Phase-Neutral voltage average
A = Current average
F = Frequency in Hz

VA = Apparant power total
W = Active power total
PF = Power factor average

V12 = RMS voltage, phase 12
V23 = RMS voltage, phase 23
V31 = RMS voltage, phase 31

V1 = RMS voltage phase 1 to neutral
V2 = RMS voltage phase 2 to neutral
V3 = RMS voltage phase 3 to neutral

A1 = RMS current, phase 1
A2 = RMS current, phase 2
A3 = RMS current, phase 3

W1 = Watts, phase 1
W2 = Watts, phase 2
W3 = Watts, phase 3

PF1 =Power factor, Phase 1
PF2 =Power factor, Phase 2
PF3 =Power factor Phase 3

INTG Fwd = Forward Integrator

Wh = Forward Watt hours. Wh integrates always in the forward direction irrespective of the direction of flow of current for star (Wye) mode

Run.h = Forward run hours, Total hours the load was ON

On,h = Duration of supply ON

INTR = No of power interruptions

OLD Fwd = The energy values stored in the integrator will be transferred to the OLD register when the integrator is cleared (manually or due to overflow)

Wh = OLD Forward Watt hours.

Run.h = OLD Forward run hours

DIAG = Represents diagnostic pages. The values contained in these pages are for factory testing only

Dia1 = Communication settings

Dia2 = Product model and version number

Dia3 = Display scanning for display LED check

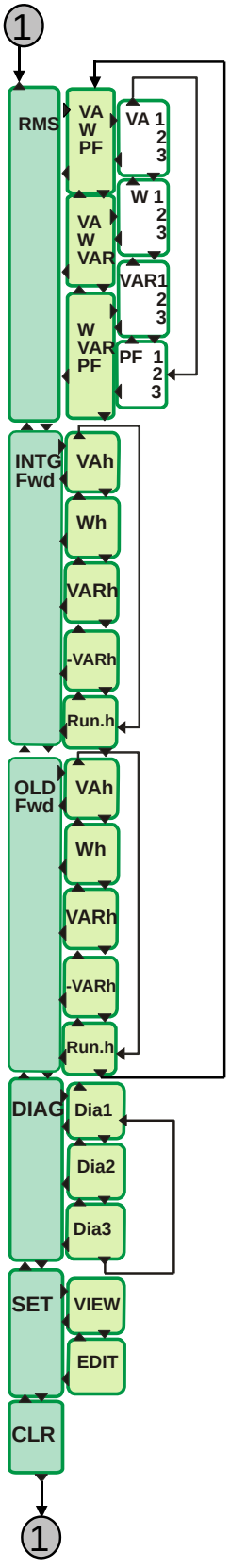
SET = Has two modes EDIT/VIEW set parameters

VIEW= To view simultaneous setup parameter name and value display

EDIT = To edit simultaneous setup parameter name and value display

CLR = Clears INTG values

EM6434 Power Meter Menu Hierarchy



RMS = RMS value display pages are in sub level

- VA = Apparent power total
  W = Active power total
  PF = Power factor average
- VA = Apparent power total
  W = Active power total
  VAR = Reactive power total
- W = Active power total
  VAR = Reactive power total
  PF = Power factor average
- VA1 = Volt-amperes, phase 1
  VA2 = Volt-amperes, phase 2
  VA3 = Volt-amperes, phase 3
- W1 = Watts, phase 1
  W2 = Watts, phase 2
  W3 = Watts, phase 3
- VAR1 = VAR, phase 1
  VAR2 = VAR, phase 2
  VAR3 = VAR, phase 3
- PF1 = Power factor, phase 1
  PF2 = Power factor, phase 2
  PF3 = Power factor, phase 3

INTG Fwd = Forward Integrator

- VAh = Fwd Volt-ampere hours
- Wh = Fwd Watt hours
- VARh = Fwd Reactive energy, inductive
- -VARh = Fwd Reactive energy, capacitive
- Run.h = Fwd Run hours

OLD Fwd = OLD Forward Integrator

- VAh = OLD Fwd Volt-ampere hours
- Wh = OLD Fwd Watt hours
- VARh = OLD Fwd Reactive energy, inductive
- -VARh = OLD Fwd Reactive energy, capacitive
- Run.h = OLD Fwd Run hours

DIAG = represents diagnostic pages. The values contained in these pages are for factory testing only

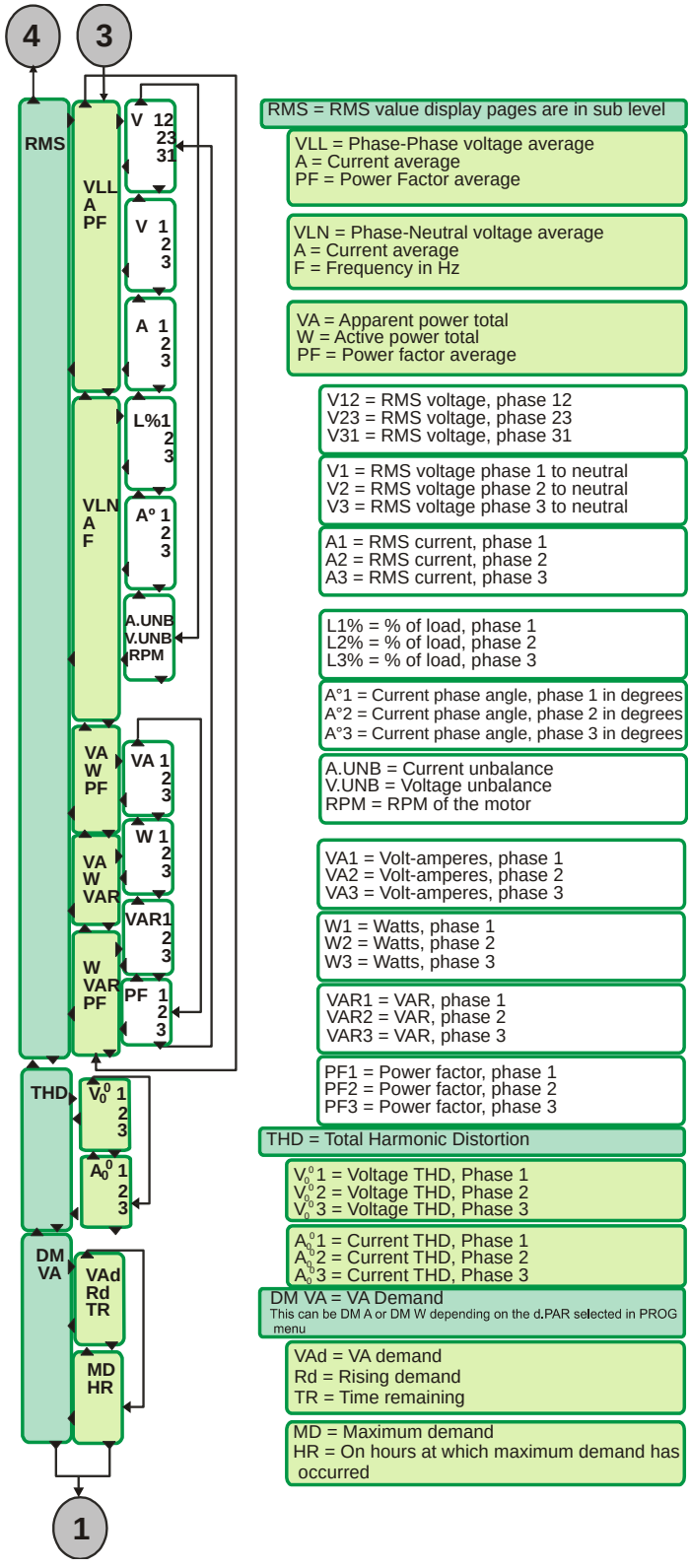
- Dia1 = Communication settings
- Dia2 = Product model and version number
- Dia3 = Display scanning for display LED check

SET = Has two modes: EDIT/VIEW set parameters

- VIEW = To view simultaneous setup parameter name and value display
- EDIT = To edit simultaneous setup parameter name and value display

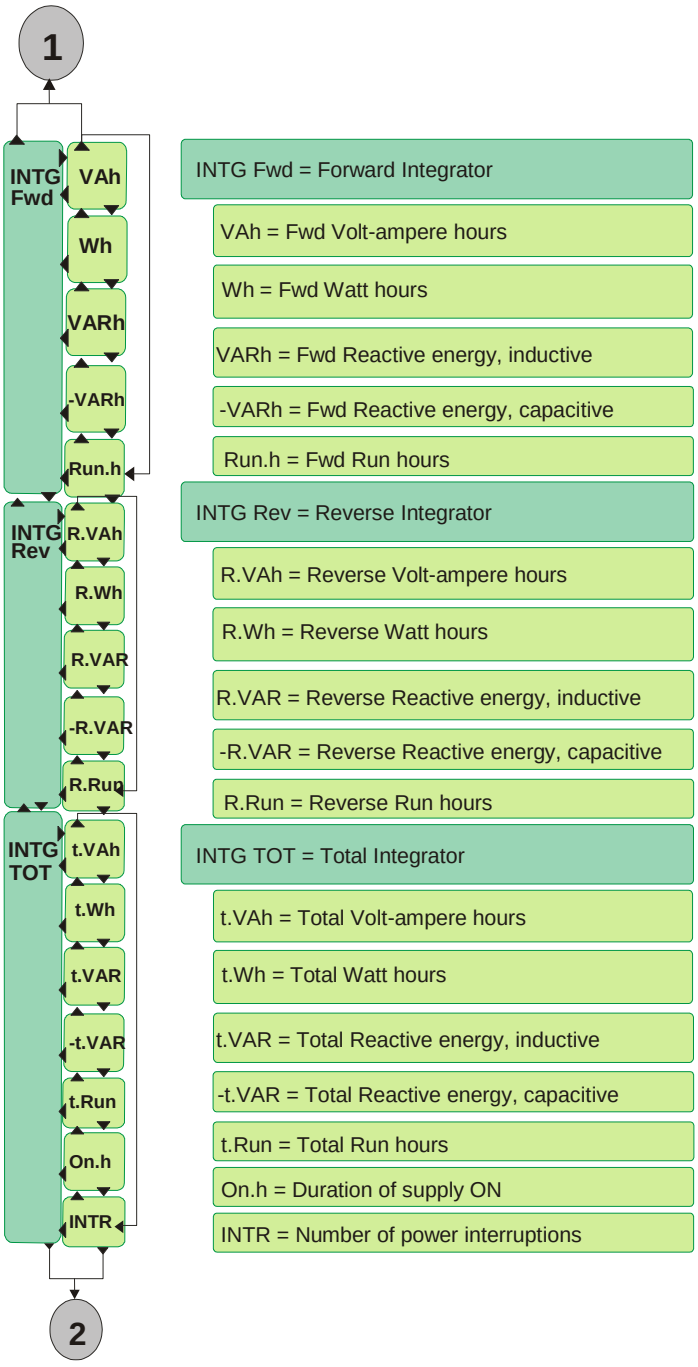
CLR = Clears INTG values

EM6400 Power Meter Menu Hierarchy

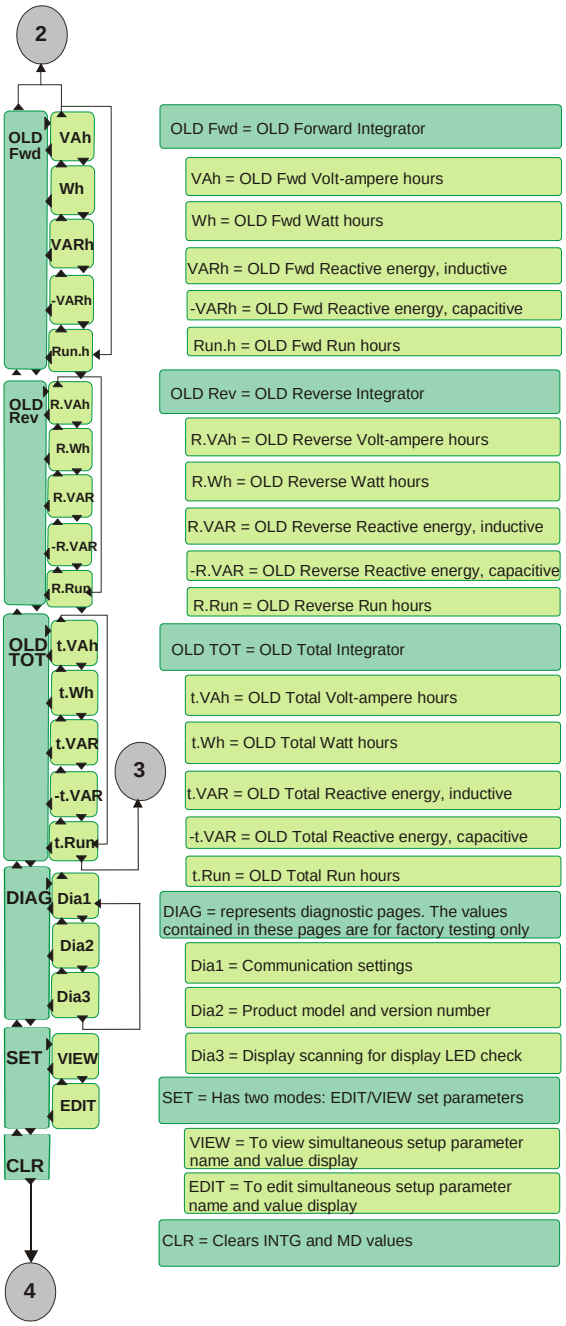


NOTE: THD values are indicative only

EM6400 Power Meter Menu Hierarchy (Continued)



EM6400 Power Meter Menu Hierarchy (Continued)

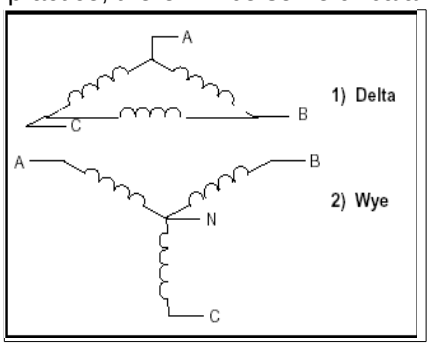


Chapter 4: AC Power Measurement

3-Phase Systems

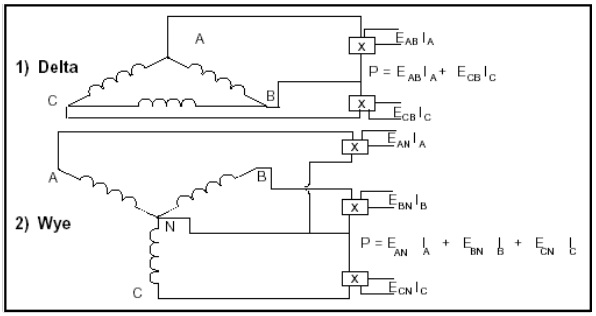
A 3-phase system delivers higher levels of power for industrial and commercial applications. The three phases correspond to three potential lines. A 120° phase shift exists between the three potential lines.
A typical configuration has either a Delta connection or a Wye (Star) connection

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).



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, where W = instantaneous power, T = 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

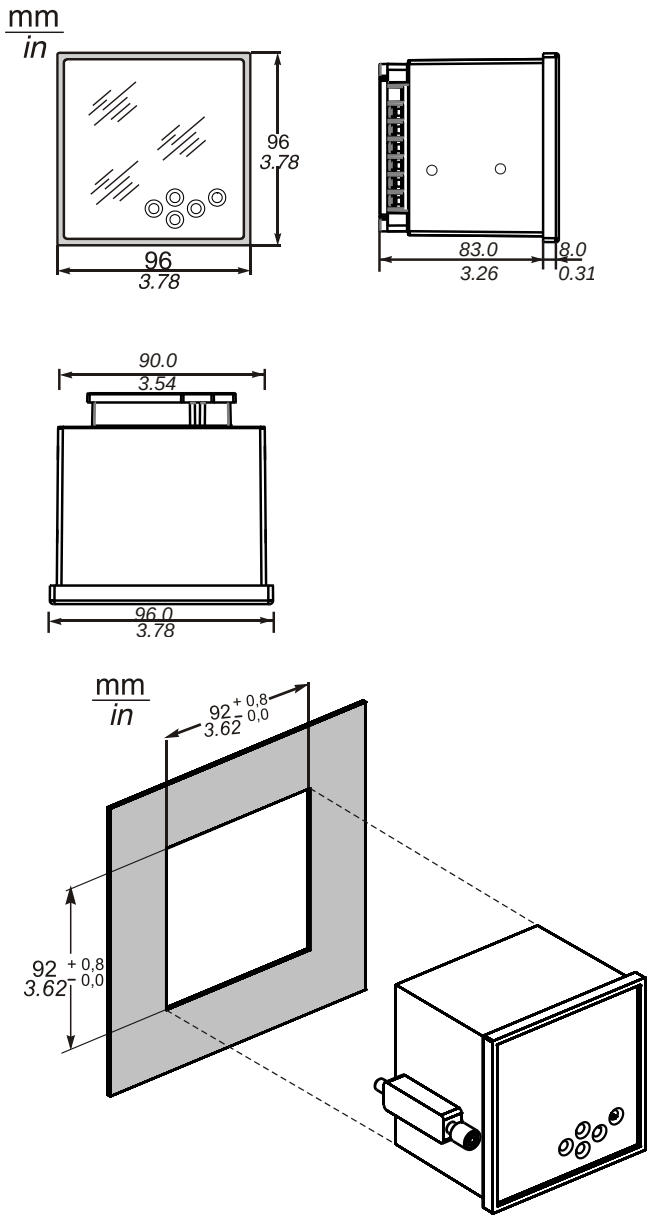
Chapter 5: Installation

Mechanical Installation

The EM6400 series power meters are panel-mounted and have reliable, rear-mounted terminal strips rated at 600 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, from 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

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 EM6400 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

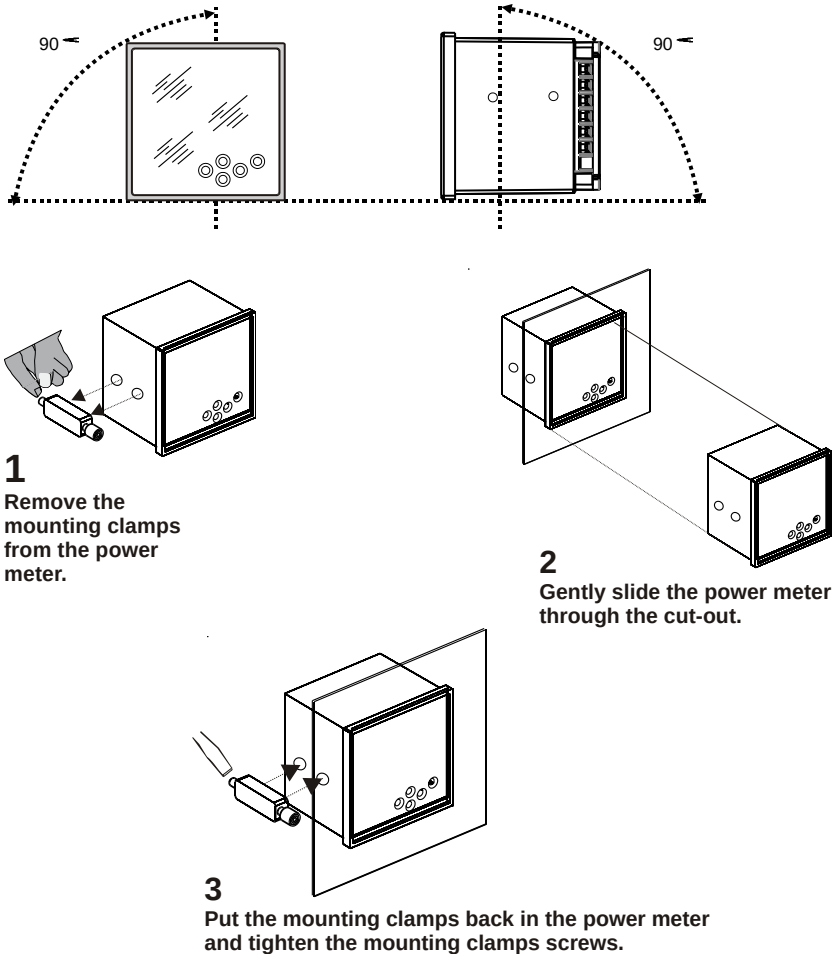
The power meters are panel mountable.

Table 5-2: Mounting

Description	Specification
Panel cut-out	$92^{+0.5}_{-0}$ mm (w) x $92^{+0.5}_{-0}$ mm(h) IEC 61554 and DIN 43700
Panel thickness	0.5 to 4.0 mm
Instrumental bezel dimension	96 x 96 mm
Depth behind bezel	83 mm
Mounting clamps screws	Slotted, two numbers
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" on page 19 for more information.

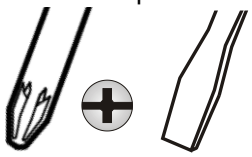
Electrical Installation

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.

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.



Screw head diameter = 3.5 mm (0.14 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)
Torque > 1 N.m (8.85 lb-in) may strip the screw or break the cover.
Loosening Torque: 1.2 N.m (10.62 lb-in)
Screw Travel: 6 mm (0.24 in.) less wire thickness

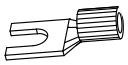
Connecting cable

Table 5-3: Connecting cable

	Insulation Rating	Current Rating
Voltage Circuit	> 600 VAC	> 0.1 A
Current Circuit	> 600 VAC	> 7.5 A Or 2.5 mm^2/ 14 AWG minimum

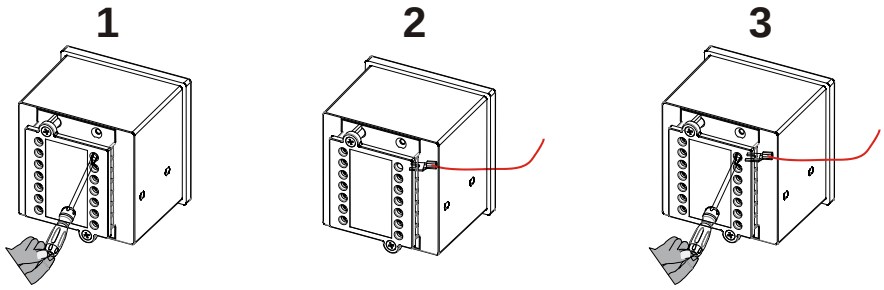
NOTE: Installations should include a disconnecting device, like a switch or circuit breaker, with clear ON/OFF markings to turn-off the auxiliary supply (control power). The disconnecting device should be placed within the reach of the equipment and the operator.

Terminal connections using lugs

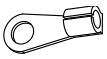
Terminal connection using U lugs 

Lug type: Insulated sleeved U lugs
Cross-section: 2.5 mm^2/14 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.

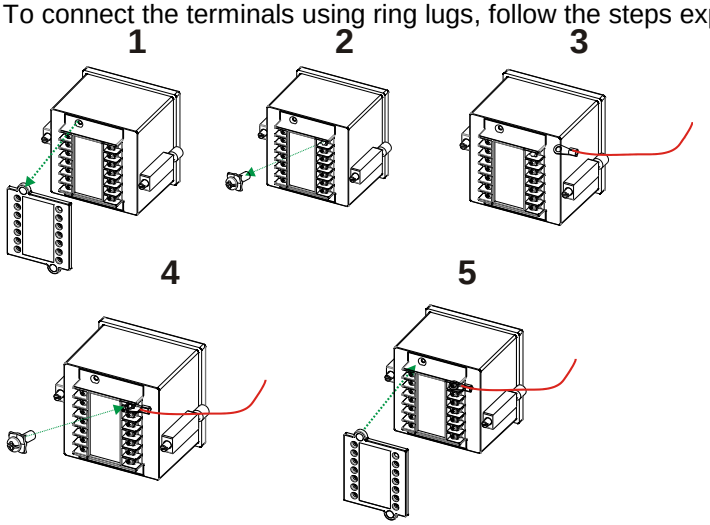


1. Loosen the terminal screw.
2. Connect the wire with the U lug to the power meter terminal.
3. Tighten the terminal screw.

Terminal connections using ring lugs 

Lug type: Ring lugs
Cross-section: 2.5 mm^2/14 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 EM6400 power meter requires a single-phase AC/DC auxiliary (control) power supply to powerup 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 (for example, rural areas and outlying areas prone to lightning strikes).

Range:

- 44 to 300 VAC/DC.
- Burden (load) < 3 VA at 240 V.
- 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" on page 19 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, e.g., if the load is always less than 10% of the CT primary rating, then the accuracy suffers. On the other hand, if the CT is under-rated, then you may exceed its full-scale. As a result, both the CT and the power meter will burn out.

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 on page 41, 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 600 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 600 VAC RMS line to line (347 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 601 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 incorrect.

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 600 VLL	0.25
Auxiliary supply (Control power)		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 incorrect 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.

Install the wiring for the current circuit at 600 VAC insulation as a minimum. The cable connection should be rated for 7.5 A or greater and have a cross-sectional area of 2.5 mm^2 (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 2.5 mm^2 (14 AWG) cable.

Table: 5-5: CT size and maximum distance

5 A CT size	Maximum Distance in metres (in feet/inch) (CT to EM6400 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 “PROG menu — Setup” on page 19 for more information.

NOTE:
The PT primary and secondary values must be user programmed before using the power meter. Otherwise, the readings will be incorrect.
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 to. 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" on page 48 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" on page 49 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" on page 50 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" on page 50 for more information.

Phase Labels

The phase labels shown on the display are programmable via the power meters front panel PROG 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

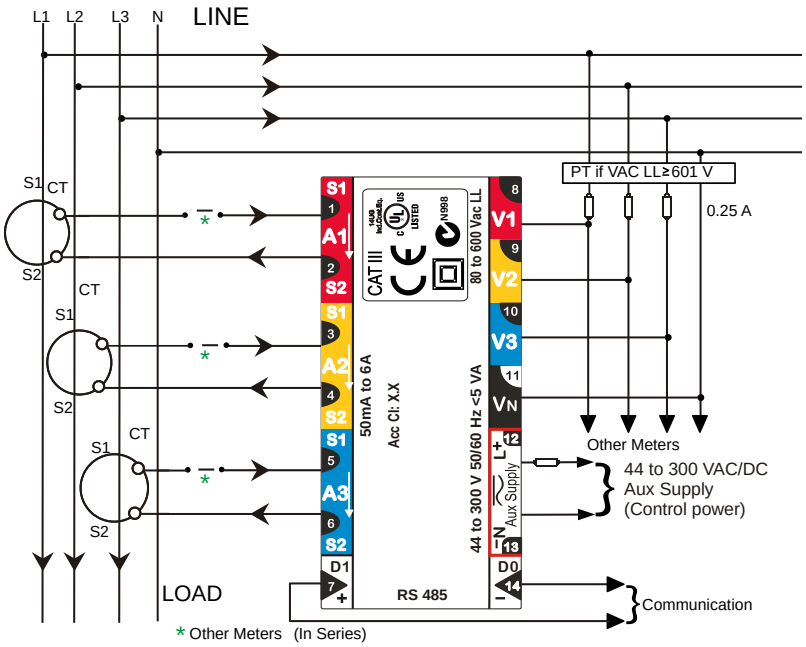
Table 5-6: Connection diagrams symbols

Symbol	Description
	Fuse
	Current transformer

3-phase 4-wire WYE connection

Direct voltage connection for the input voltages L-L up to 600 VAC. Otherwise use three PTs.

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

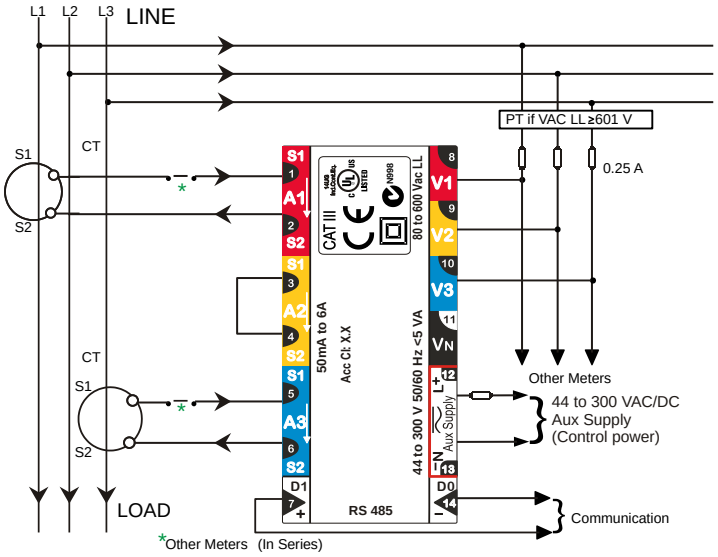


NOTE:
Make sure WYE/Star is programmed in the power meter PROG menu- Setup.
For High – leg (US connection)
L1 – N = 120 V
L2 – N = 208 V
L3 – N = 120 V

3-phase 3-wire delta connection

Direct voltage connection for the input voltages L-L up to 600 VAC. Otherwise use three PTs

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

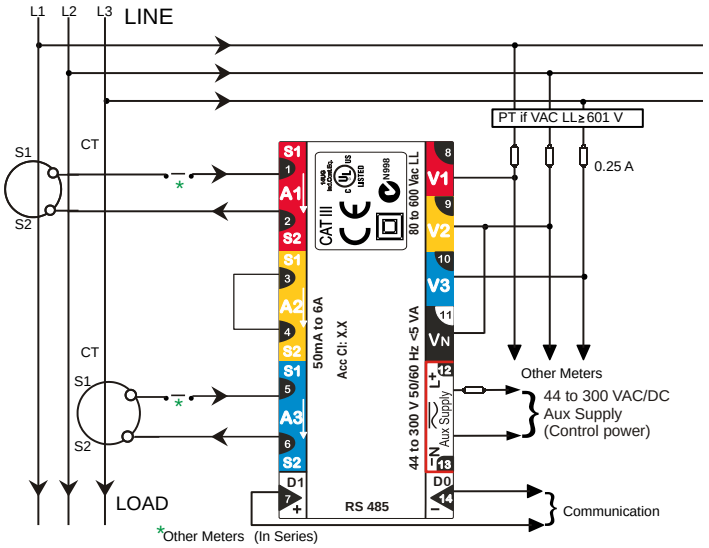


NOTE : Make sure Delta is programmed in the power meter PROG menu- setup. Leave the Vn terminal disconnected.

3-phase 3-wire open delta connection

Direct voltage connection for the input voltages L-L up to 600 VAC. Otherwise use two PTs.

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

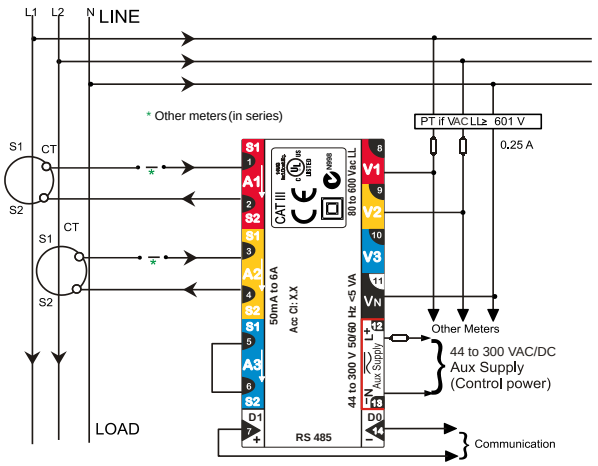


NOTE: Make sure Delta is programmed in the power meter PROG menu-setup.

2-phase 3-wire connection

Direct voltage connection for the input voltages L-L up to 600 VAC. Otherwise use two PTs.

Figure 5-6: 2-phase 3-wire connection



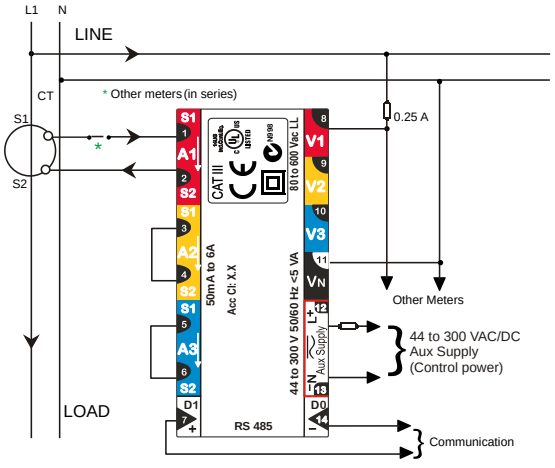
NOTE: Make sure 2-phase is programmed in the power meter PROG menu- setup.

Single-phase connection

Direct voltage connection for the input voltages L-L up to 600 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 5-7: Single-phase connection



Chapter 6: Data Communication

This section is applicable only for EM6400 series power meters with RS 485 communication option.

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 ION™ Enterprise, Vijeo Citect, PowerLogic SCADA for pinpointing energy usage and waste.
- Schneider Electric ConPAD: Power meter programming and basic data reading utility.
- 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

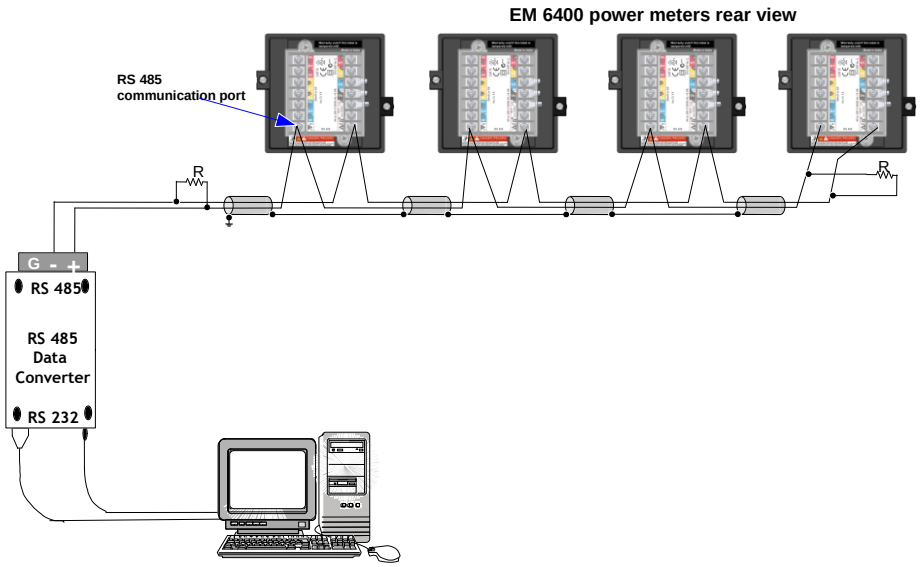
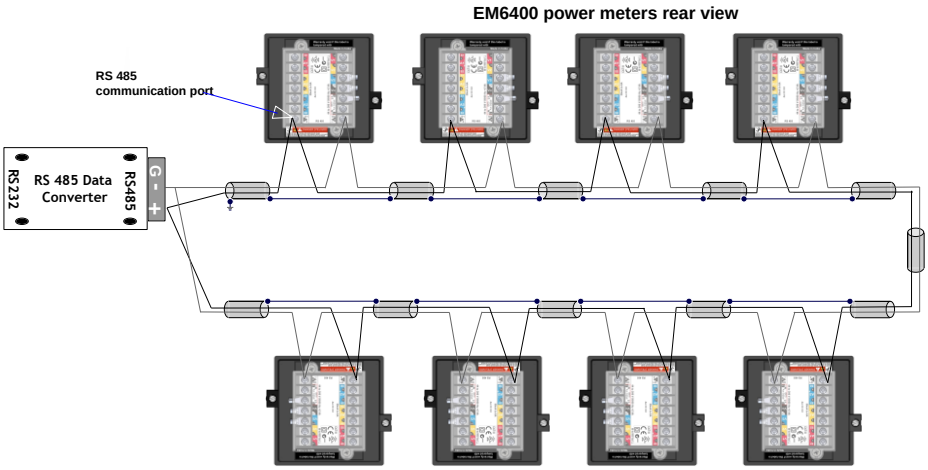


Figure 6-2: Closed loop, 2-wire half duplex.
Advantage – Reliable communications, tolerant to one break in the cable.



Communication Capabilities

Table 6-1: RS 485 communication distances

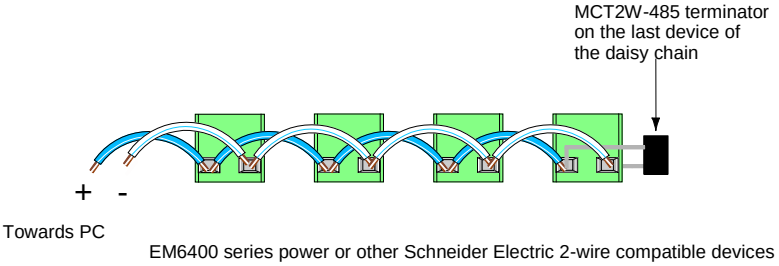
Baud Rate	Maximum communication distances 1 to 32 devices
	Meters
9600	1200
19200	900

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

Daisy-chaining Devices to the Power Meter

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



- 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 6-1” on page 52, 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.

NOTE: For better performance, Schneider Electric recommend to use SWG 100 % shielded cable with low resistance (Belden or Lapp make).

Data Formats and Settings

Your SCADA software must be configured for Modbus RTU communication, before integrating the Schneider Electric EM6400 series power meter. The mode of transmission is defined in the following which is compatible with Modbus RTU Mode:

Table 6-2: Power meter communication and protocol settings

Power meter communication settings	
Protocol	Modbus RTU
Data bits	8
Baud rate	9600 Baud, User set 1200 to 19200 Range:1200, 2400, 4800, 9600, 19200 Normal use: 9600 Baud Noisy, EMI, RFI, long data cable: 4800/2400 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” on page 57 for more information
Data type	32-bit float (real) : • All parameters. • Direct reading, little end • ian 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 power meter 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 EM6400 power meter will depend on baud rate. We recommend polling interval of one second at 9600 Baud rate.

Parameter Settings for Different SCADA Software

The following table explains how to read the parameter VA (See “Individual parameter address” on page 57 for more information) in different Modbus master software/PLC’s.

Table 6-3: Parameter settings

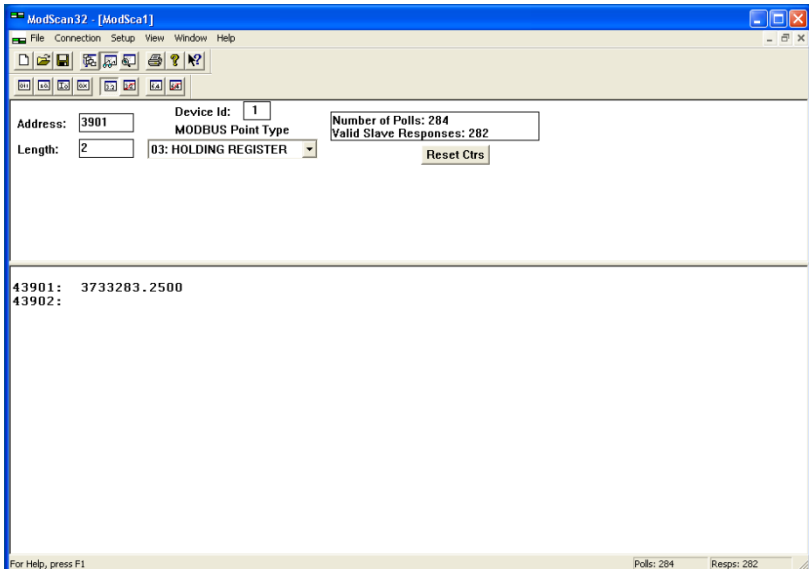
SL. No	SCADA software	Start Address	Function Code	No. of Register	Data Type	Remarks
1	ION™ Enterprise	43901	Internally configured	2	Swapped Float	Direct conversion
2	PowerLogic SCADA	43901	Internally configured	2	Real	Direct conversion
3	Vijeo Citect	43901	Internally configured	2	Real	Direct conversion
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

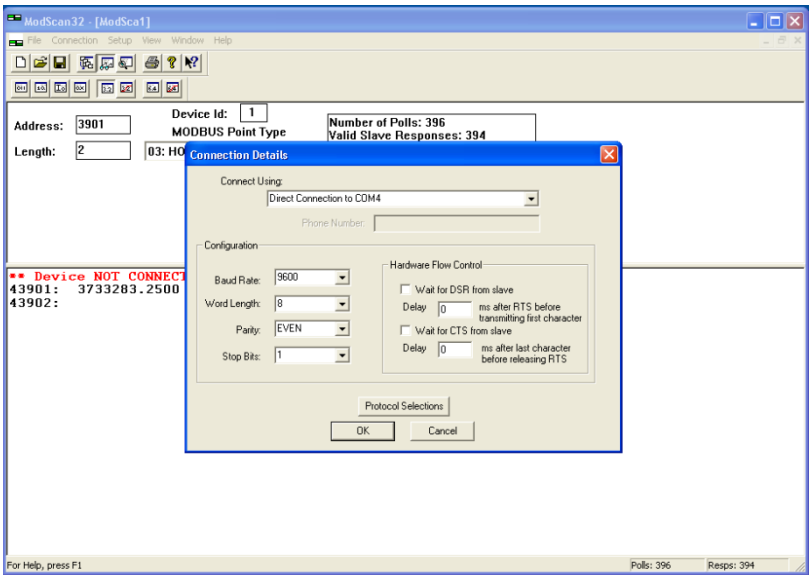
Communication test: EM6400 series power meter can be successfully used for communication using Modscan software as Modbus master in PC. Details of the settings in Modscan are given below.

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

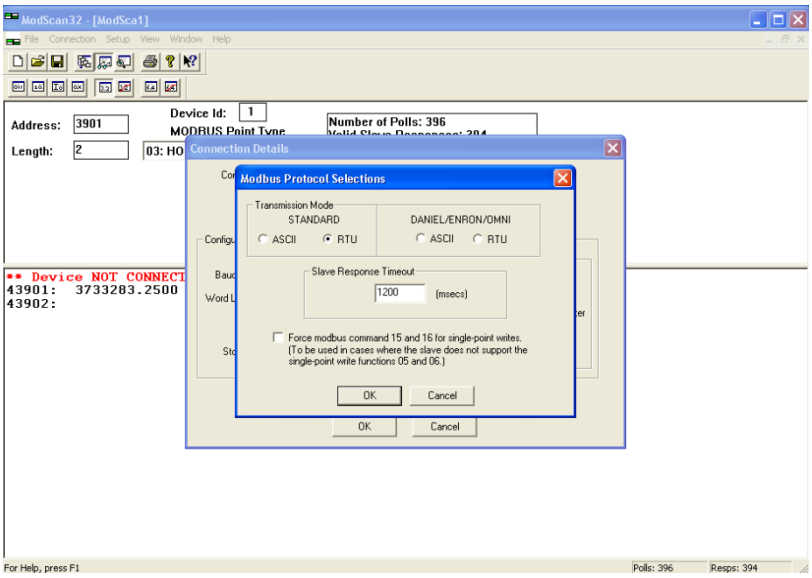
- Free download demo Modscan software from http://www.win-tech.com.
- The following explains how to read apparent power total (VA total) from register 3901.



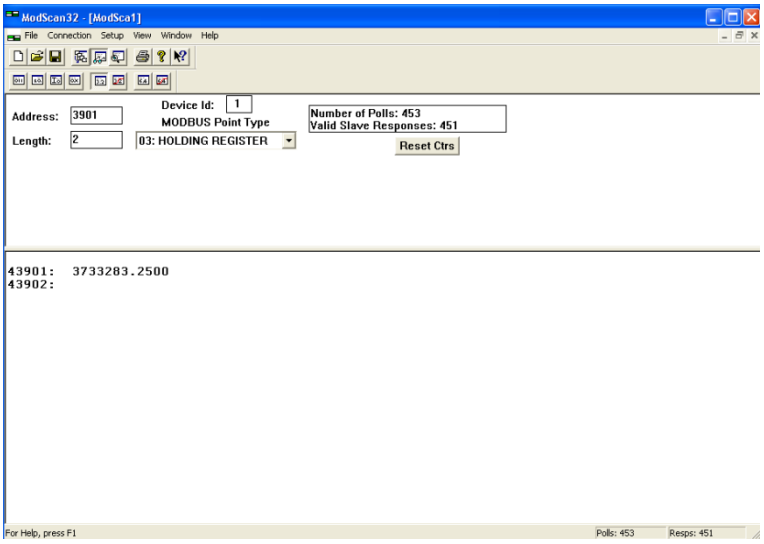
1. After starting the Modscan, to read Apparent power total (VA total), enter address as 3901 (decimal), length as 2, device ID as 1, Modbus point type as 03, and HOLDING REGISTER.
2. **Modify the connection details:** Click connection > connect, to see the **connection detail window**. Change all the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



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 EM6400 power meter supports the transfer of whole block and also of individual data values (two registers are used for storing single data value).

- 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 the whole block, it basically 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, 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 6-4: Individual parameter address

Parameter	Description	Address	Type	EM 6400	EM 6459	EM 6434	EM 6436	EM 6433
Metering								
Metering - Current								
A	Current average	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	3907	Float	●	●	●	●	
PF1	Power factor, phase 1	3923	Float	●	●	●	●	
PF2	Power factor, phase 2	3937	Float	●	●	●	●	

Parameter	Description	Address	Type	EM 6400	EM 6459	EM 6434	EM 6436	EM 6433
PF3	Power factor, phase 3	3951	Float	●	●	●	●	
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	●				
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	n 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	laximum 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	●				

NOTE: THD values are indicative only.

Block Parameter Address

Total RMS Block

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

Table 6-5: Total RMS block

Parameter	Description	Address	Type	EM 6400	EM 6459	EM 6434	EM 6436	EM 6433
VA	Apparent power, total	3001	Float	●		●	●	●
W	Active power, total	3003	Float	●		●	●	●
VAR	Reactive power, total	3005	Float	●		●		
PF	Average PF	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 6-6: R phase RMS block

Parameter	Description	Address	Type	EM 6400	EM 6459	EM 6434	EM 6436	EM 6433
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 6-7: Y phase RMS block

Parameter	Description	Address	Type	EM 6400	EM 6459	EM 6434	EM 6436	EM 6433
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 6-8: B phase RMS block

Parameter	Description	Address	Type	EM 6400	EM 6459	EM 6434	EM 6436	EM 6433
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 6-9: Forward integrated block

Parameter	Description	Address	Type	EM 6400	EM 6459	EM 6434	EM 6436	EM 6433
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 6-10: Reverse integrated block

Parameter	Description	Address	Type	EM 6400	EM 6459	EM 6434	EM 6436	EM 6433
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 6-11: Total integrated block

Parameter	Description	Address	Type	EM 6400	EM 6459	EM 6434	EM 6436	EM 6433
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 6-12: Demand block

Parameter	Description	Address	Type	EM 6400	EM 6459	EM 6434	EM 6436	EM 6433
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 6-13: Max demand block

Parameter	Description	Address	Type	EM 6400	EM 6459	EM 6434	EM 6436	EM 6433
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 6-14: Old forward integrated block

Parameter	Description	Address	Type	EM 6400	EM 6459	EM 6434	EM 6436	EM 6433
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 6-15: Old reverse integrated block

Parameter	Description	Address	Type	EM 6400	EM 6459	EM 6434	EM 6436	EM 6433
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 6-16: Old total integrated block

Parameter	Description	Address	Type	EM 6400	EM 6459	EM 6434	EM 6436	EM 6433
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 6-17: Phase angle block

Parameter	Description	Address	Type	EM 6400	EM 6459	EM 6434	EM 6436	EM 6433
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), neutral voltage, and neutral current are available only through communication.

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 whole block.*
- *Each Modbus register size is 16 bits. All the power meter readings are 32 bits. Therefore, each power meter 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 Cause	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 “PROG menu - Setup” on page 19 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 “on page 48 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.

Potential Problem	Possible Cause	Possible Solution
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.
The power meter stopped communication abruptly.	Communications lines are improperly connected.	Verify the power meter communications connections. See “Chapter 6 – Data communication” on page 51 for more information.
	Over voltage/temperature	Interrupt the power supply or reduce the voltage or temperature within the allowable limits.
Incorrect 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	Class 0.5S	Class 0.2S
Voltage LN per phase and average	1.0	0.5	0.2
Voltage LL per phase and average	1.0	0.5	0.2
Amp per phase and average	1.0	0.5	0.2
Amp, phase angle per phase	2º	1º	1º
Frequency	0.1	0.1	0.1
Active power, (kW) per phase and total	1.0	0.5	0.2
Reactive power, (kVAR) per phase and total	2.0	1.0	0.5
Apparent power, (kVA) per phase and total	1.0	0.5	0.2
Active energy (kWh) Import/Export	1.0	0.5	0.2
Reactive energy (kVARh) (Inductive / Capacitive)	2.0	1.0	0.5
Apparent energy (kVAh)	1.0	0.5	0.2
RPM	1.0	0.5	0.2

NOTE:
5 A meter - Additional error of 0.05 % of full scale for meter input current below 100 mA.
1 A meter - Additional error of 0.05 % of full scale for meter input current below 20 mA.
PF error limit is same as W error limit in %.

Auxiliary supply (Control power)

The power meter needs a single-phase AC or DC control supply to power its internal electronics.
Range: 44 to 300 VAC/DC.
Burden (load): 3 VA max on Auxiliary supply.

Front Panel Display

- Brilliant three lines four digits (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 347 VLN/600VLL AC systems, no PTs (VTs) required up to 600 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 347 VAC phase-neutral, 80 to 600 VAC phase-phase, Overload: Continuous 600 VLL with full accuracy, 750 VLL Max, Hz. 50 / 60
- Amperes: 5 mA (starting)to 6 A, Overload: 10 A continuous, 50 A for three seconds
- 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 panel and IP40 for rear panel.
- 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

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 with 92 x 92 mm panel cut-out, flush mount.
- Bezels dimension 96 x 96 mm. Panel Cut-out 92 x 92 mm.
- Weight 400 gms approx unpacked, 500 gms approx shipping. See “Mechanical Installation” on page 39 for more information.

Appendix B: SIM (simulation) Mode

The EM6400 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 sh**o**ws **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 five to 30 minutes. The power meter calculates and updates the demand every 15 seconds.

Baud rate: Specifies how fast data is transmitted across a 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” on page 57 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” on page 12 for more information).

Long: A 32-bit value returned by a register (See “Data Address” on page 57 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. 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” on page 12 for more information).

User (fixed block): An interval selected between five 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
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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