Conzerv EM1000/EM1200/EM1220 Power and Energy Meter

User Manual

EAV95462-01
06/2014

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.

NOTICE

NOTICE is used to address practices not related to physical injury. The safety alert symbol shall not be used with this signal word.

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 – Product Description

The EM1000/EM1200/EM1220 is a compact and rugged package digital meter that offers basic power and energy measurement capabilities required to monitor an electrical installation.

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

The EM1000/EM1200/EM1220 power and energy meter is a universal meter. Before use, program the SYS (measurement system configuration), and the PT (VT) and CT ratios through the front display keys. Otherwise, the meter will read your system incorrectly. Other settings, such as communication parameters, must also be programmed as needed.

Schneider Electric stands behind your EM1000/EM1200/EM1220 power and energy meter with complete user support and service.

Intended use: The EM1000/EM1200/EM1220 power and energy meter is designed for use in industrial and commercial installations by trained and qualified professionals, not for domestic use.

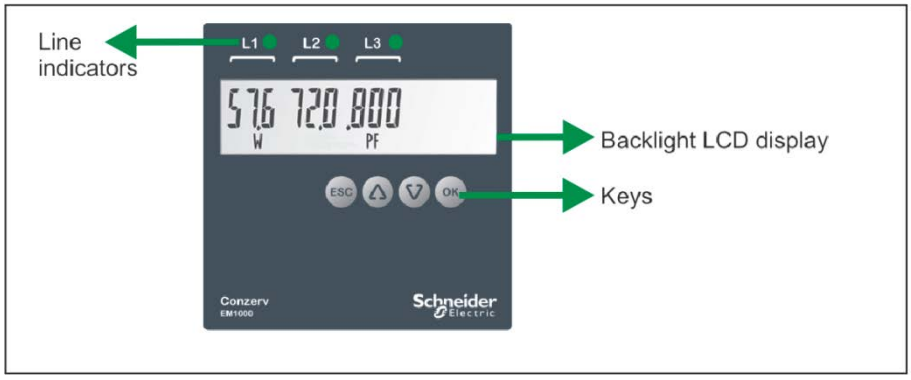
Physical Description

FRONT: The front display has an LCD display, four keys for quick and easy navigation, and indicators (Kilo, Mega, Giga, and Negative).
Refer to “Front Display” on page 8 for more information.

REAR: The voltage terminals, current terminals, and RS 485 communication port are located on the back of the digital meter.
Refer to “Meter Body” on page 11 for more information.

Front Display

Figure 1-1: Parts of meter front display



Single ROW, Backlight LCD Display

- Simultaneous display of three RMS parameters along with the parameter name and value.
- Resolution:
  - **RMS:** Three digits for both phase wise and average values.
  - **INTG:** Nine digits**.**

The Indicators – Kilo, Mega, Giga and Negative

Table 1-1 Indicators

	**Kilo:** When lit, indicates that the reading is in Kilo (10^3). 1000 is displayed as 1.00 K (as shown) and 10,000 is displayed as 10.0 K.
	**Mega:** When lit, indicates that the reading is in Mega, (10^6). 1000 K is shown as 1.00 M (as shown) and 10,000 K as 10.0 M.
	**Giga:** When **Kilo** and **Mega** are lit together, the reading is in Giga (10^9). 1000 M is shown as 1.00 G (as shown) and 10,000 M as 10.0 G.
	**Negative:** When lit, indicates that the reading is **negative** as per IEEE 100 and industry standard practice.

Table 1-2: Giga, Mega (M), Kilo (K), and decimal point scaling

RMS Reading	Indicator
Less than 999	K, M OFF
Above 999	K ON, M OFF
Above 999 K	M ON, K OFF
Above 999 M	Giga (k + M indicators ON)
Up to 999 G	Giga

Table 1-3: Energy Readings

Energy Reading, 3-Phase	Range	As shown in the Display
Active(Wh) / Apparent(VAh) / Reactive(VARh)	00001.0000 to 9999999.00 K	000 0 10 000 (k) to 999 999 9.00 (k)
	10000.0000 to 9999999.00 M	100 000 000 (M) to 999 999 9.00 (M)
	10000.0000 to 9999999.00 G	100 000 000 (Mk) to 999 999 9.00 (Mk)

You can view the accumulated energy from the display. The resolution of the energy value will automatically change through the range of 00001.0000 to 9999999.00 K.

Keys

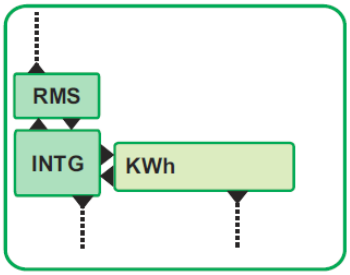
Operating the EM1000/EM1200/EM1220 meter is easy, using the four smart keys to navigate through the keypad operations table. The display pages **expand** as you go to the right, much like the directory or explorer **tree** displayed on any computer. The display shows where you are headed to.

Table 1-3: Smart keys description

OK	**OK Key** • Go **forward** into sub-parameter pages. • Going right past **EDIT** in **SET**. • In setup, selects **next** (right side) digit.
ESC	**ESC Key:** • Go **back** towards to the main parameter page. • In setup, selects **previous** (left side) digit. • Exits from Edit mode, back to the setup.
△	**Up Key:** • Scroll **up** through display pages at the same level, **within the same function.** • Continuous pressing for three seconds initiates **auto-scroll mode.** See “Auto-scroll” on page 10 for more information. • **In setup, while editing, increases** the value of the blinking digit.
▽	**Down Key:** • Scroll **down** through other display pages at the same level, through **all functions**. • Continuous pressing for three seconds initiates **auto-scroll mode**. See “Auto-scroll” on page 10 for more information. • **In setup, while editing, decreases** the value of the blinking digit.

Keys – Operation

This section explains the operation of different keys (as explained above) and the navigation of the meter.
The following example explains the navigation from the **RMS** page to the **KWh** display page and back to the **RMS** page.



1. Press ▽ from **RMS**. The display shows **INTG**.
2. Press OK from **INTG**. The display shows **KWh**.
3. Press ESC. The display shows **INTG**.
4. Press △ to return to the **RMS** page.

NOTE: In general,

Use OK to go forward to the sub-parameter pages.

Use ESC to go back to the main parameter page.

Use △ and ▽ to scroll up and down through the display pages.

Keys – Features

Auto-scroll

- Auto-scroll allows you to view a group of display pages sequentially every **five** seconds, without manual key operation.
- During auto-scroll, the meter displays the parameter name and value for **four** seconds.
- Auto-scroll is possible only within the page groups i.e. the parameters within the page groups like **RMS** or **INTG** or **DIAG** will be auto-scrolled sequentially.
- Auto-scroll is not possible within the setup parameters.
- The following table explains the auto-scroll operation in the **RMS** parameter pages in EM1000/EM1200/EM1220 power and energy meters.

Table 1-4: Auto-scroll

Step	Perform	Output
1	Press OK from RMS.	The display shows A VLL PF.
2	Press and hold △ or ▽ for three seconds.	The display flashes AUTO and scrolls through the RMS parameters group.
NOTE: Press any key to revert to manual scrolling		

Default Display page

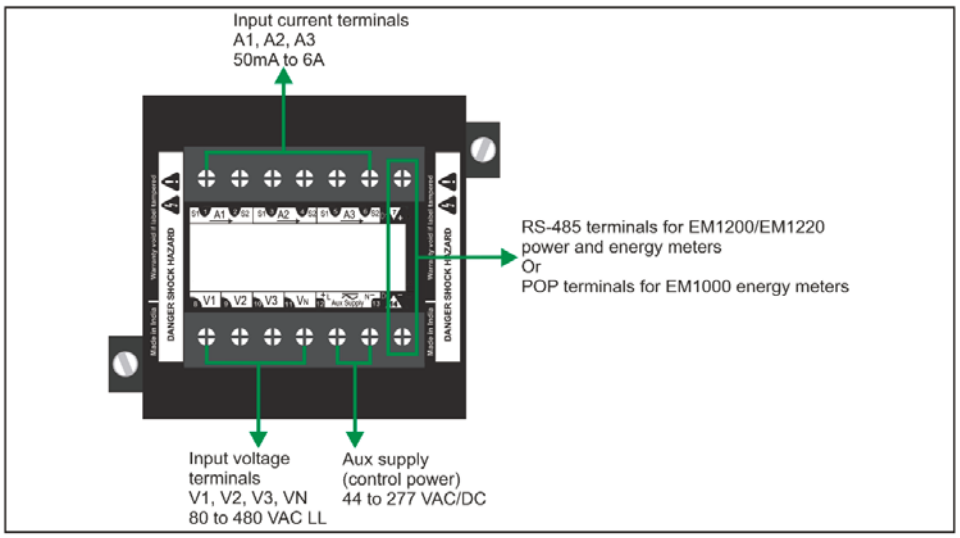
- This feature enables you to select any page as the default display page.
- The default display page is displayed two minutes after the manual key operation is stopped.
- **To Set or LOCK the Default Display page**
  - Go to the desired page you want to set as default display page.
  - Press △ and ▽ together until the display shows **LOCK**. The default display page is set or locked.
- **To UNLOCK the Default Display page**
  - Once the default display page is active, press △ and ▽ together until the display shows **UNLOCK**. The default display page is unlocked.
- You can scroll through the other display pages, when the default display page is active.
- Entry to the **SET EDIT** and **CLR** is possible only when the default display page is unlocked.

Meter Body

The EM1000/EM1200/EM1220 power and energy meter terminals are located on the meter body.

- 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 POP (EM1000) or RS 485 communications port (EM1200/EM1220)

Figure 1-2: Meter body



Models and Parameters

The meter can measure, locally display, and remotely transfer over Modbus RTU protocol (EM1200):

Table 1-5: Models and parameters

Parameter		EM1000	EM1200	EM1220
RMS	VLL - V12 V23 V31 VLN - V1 V2 V3			■
	A A1 A2 A3			■
	F			■
	PF - PF1 PF2 PF3	■	■	■
	W W1 W2 W3 / VA VA1 VA2 VA3 / VAR VAR1 VAR2	■	■	■
INTG & OLD	kWh / kVAh / kVARh	■	■	■
	Run.h	■	■	■
	On.h	■	■	■
	INTR	■	■	■
	Pulse output – POP	■	-	
	RS 485 communication	-	■	■
	Class 0.5 Accuracy	☐	☐	☐
	Class 1.0 Accuracy	☐	☐	☐

NOTE: ■ *Standard* ☐ *Option specified while ordering*

The power/energy parameters are user-programmable. Only one power related parameter will be available at a time in the meter.

The EM1000/EM1200/EM1220 power and energy meter displays:

- **Power factor:** Power factor for all the three phases and total.
- **Power:** W, PF per phase and total.
- **Energy (INTG & OLD):** Wh, VAh, VARh, Run hours (input voltage, input current), On hours (input voltage), and INTR (input voltage interruptions or outages).
- **Kilo, Mega, Giga** indications for the above parameters. See “The Indicators” on page 8 for more information.

Technical Specifications

The EM1000/EM1200/EM1220 power and energy meter is a high-accuracy, low cost, ultra-compact meter. It offers ISO 9001 quality, accuracy and functional flexibility. The standard unit flush-mounts in a DIN 96 cut-out and conforms to UL product standards.

The meters are designed for retrofit applications, such as replacement of analog meters. Each can be used as a standalone meter in electrical control panels, power distribution 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 meters. Refer to “Technical data” on page 61 for more information.

Table 1-6: Technical specifications

Description	Specification			
Sensing/ Measurement	True RMS two quadrant power and energy, one second update time			
Measurement Accuracy (3 Phase)		**Accuracy % of Full Scale**		
		Applicable for	**CL 1.0**	**CL 0.5**
	Voltage LN and LL per phase and average	EM1220	**1.0**	**0.5**
	Amp per phase* and average		**1.0**	**0.5**
	Frequency		**0.2**	**0.2**
	Active power (kW) & Active energy**[1] (kWh)	EM1220/ EM1200/ EM1000	**1.0**	**0.5**
	Apparent power (kVA) & Apparent energy**[1] (kVAh)		**1.0**	**0.5**
	Reactive power (kVAR) & Reactive energy** (kVARh)		**2.0**	**1.0**
Auxiliary supply (control power)	AC: 44 to 277 V LN ~ 50 Hz +/- 5% DC: 44 to 277 V			
Input voltage	Three voltage inputs (V1, V2, V3, VN) 110 or 415 VLL nominal (Range 80 to 480 V LL) ~ 50 Hz +/- 5%			
Input current(energy measurement)	Current inputs (A1, A2, A3) 50 mA to 6 A (5 mA is the starting) ~ 50 Hz +/- 5%			
Burden	Voltage and current input < 0.2 VA per phase Auxiliary supply (control power): • AC burden: 4 VA Max • DC burden: 2 W Max			
Overload	10 A max continuous			
Display and Resolution	Single row backlight LCD display. Three digits for RMS parameters (phase wise and average values). Nine digits for energy values.			
Safety	CAT III - Measurement, Pollution Degree 2 ⧈ - Double insulation at user-accessible area			
Communication (EM1200 /EM1220)	RS 485 serial channel connection Industry standard Modbus RTU protocol			
Environmental	Operating temperature: -10 ºC to 60 ºC (14 ºF to 140 ºF) Storage temperature: -25 ºC to +70 ºC (-13 ºF to 158 ºF) Humidity 5% to 95% non condensing			
Weight	400 gms approx, unpacked 500 gms approx, shipping			
Altitude	≤ 2000m			

EM1000/EM1200/EM1220 conforms to	Emission : CISPR11 class A; Fast Transient: IEC 61000-4-4***; Surge withstand: IEC 61000-4-5***; ESD: IEC 61000-4- 2***;Impulse voltage: IEC 60060-1;
IP degree of protection	Front display: IP 51 Meter body: IP 40

NOTE:

* *In delta system configuration, the accuracy for ampere per phase would be CL 1.0.*

** *For 5A nominal CT, from 250 mA to 6 A*

[1] *Class 1.0 for delta system configuration*

*** *As per IEC 61326-1*

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 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 meter.
- Before performing Dielectric (Hi-Pot) or Megger testing on any equipment in which the meter is installed, disconnect all input and output wires to the meter. High voltage testing may damage electronic components contained in the meter.
- The 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 EM1000/EM1200/EM1220 power and energy meter must be configured to match the application settings, before use. Otherwise, the readings will be wrong.
- All the setup values can be re-programmed at any time, using **SET**. However, the settings: SYS (WYE (Star)/Delta/single-phase/2-phase), Vpri, Vsec, Apri, Asec critically determine the scaling of measured readings.
- The scaling can be used to reduce the errors in readings due to Instrument Transformer errors. However, wrong settings will introduce errors in readings of other running systems.

⚠ CAUTION

HAZARD OF UNINTENDED OPERATION

Only qualified personnel are authorized to set up the meter.

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

You can enter the PROG menu-setup in the following modes:

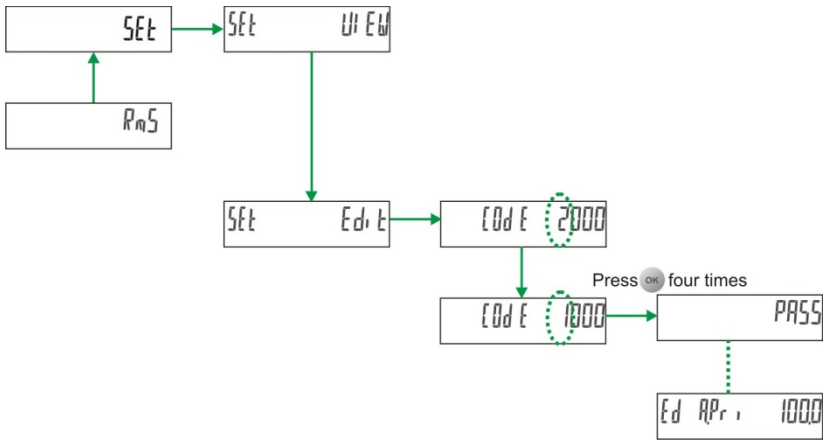
- **View only mode**: To view the set parameters.
- **Edit mode**: To view or edit set parameters.

NOTE: During PROG menu-setup mode, if the page is locked then refer to "Default Display Page on page 10" to unlock the page.

Enter Setup Menu in View (Read-Only) Mode

1. From **RMS**, press △. The display shows **SET.**
2. Press OK. The display shows **SET VIEW.**
3. Press OK. The display shows **VI A.PRI 5.000k.**
   Use △ and ▽ to scroll and view the setup parameters and their current settings.

Enter Setup Menu in Edit Mode



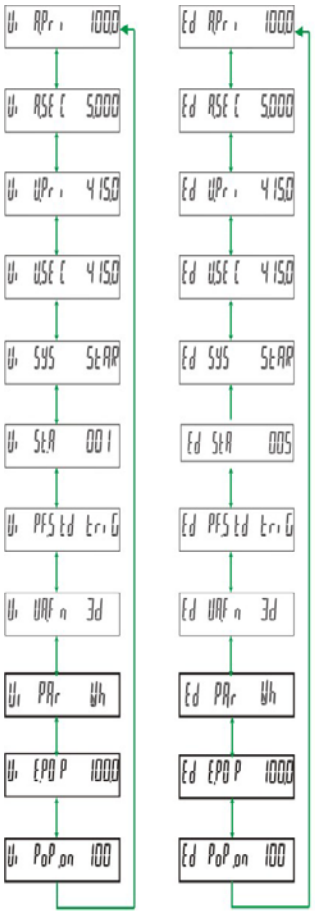
NOTE: means blinking
2 means blinking 2

1. From **RMS**, press . The display shows **SET.**
2. Press . The display shows **SET VIEW**.
3. Press . The display shows **SET EDIT**.
   You are required to enter **CODE** to enter the setup menu in edit mode.
4. Press . The display shows **CODE 2000** with blinking **2.**The factory set code is **1000**.
5. Press . The display shows **CODE 1000** with blinking **1**.
6. Press four times to accept the new **CODE** value. The display shows **PASS** and then **EDIT A.PRI 5.000k.** This indicates that you have successfully entered the setup menu in edit mode.

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

Setup Parameters in View and Edit Modes

Setup Parameters in View and Edit Modes of EM1000 Energy Meter



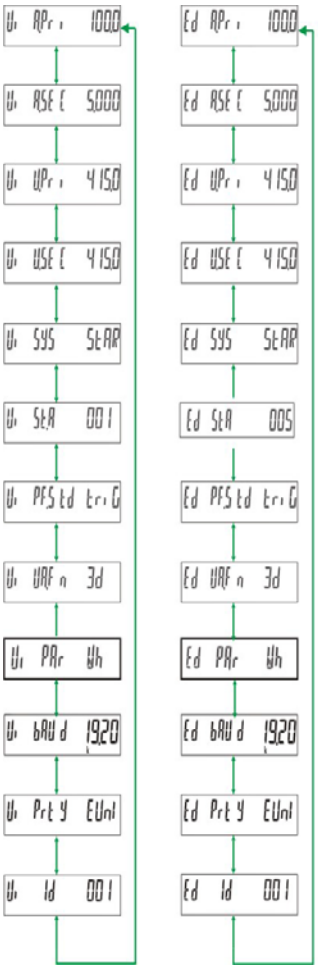
NOTE:

** Parameters such as Wh, VA VAh, and VAR VARh are User Selectable.*

If a parameter is changed in setup, the integrator will get reset. The following integrators will be reset:

- *VA h/ Wh/ VAR h*
- *Run.h,*
- *On.h*
- *No. of INTR.*

Setup parameters in View and Edit modes of EM1200/EM1220 Energy Meter



A.PRI = Current primary winding (CT); Input range 1 A to 99 kA. Default value is 100.0

A.SEC = Current secondary winding (CT); Default value is 5.000.

V.PRI = Voltage primary winding (PT), line to line; Input range 100 V to 999 kV; Default value is 415.0.

V.SEC = Voltage secondary winding (PT), line to line; Input range 50 V to 600 V; Default value is 415.0.

SYS = System configuration; Select from StAR, dLtA, 2 ph, 1 ph; Default value is StAR.

St.A = Starting current; 1 to 200 mA
Default value is 005.

PF.STD = PF standard; Select from IEC, IEEE, TRIG
Default value is TRIG.

VA.FN = VA function selection; Select between 3D and Arth; Default value is 3D.

*PAR = Parameter selection ; Select from Wh, VA VAh, VAR VARh; Default value is Wh.

Baud = Baud rate; Select from 4800, 9600, 19200; Default value is 19200.

PRTY = Parity and stop bit settings; Select from EVN.1, ODD.1, no.2; Default value is EVN.1.

ID = RS 485 device ID number; 001 to 247; Default value is 001.

NOTE:

** Parameters such as Wh, VA VAh, and VAR VARh are User Selectable.*

If a parameter is changed in setup, the integrator will get reset. The following integrators will be reset:

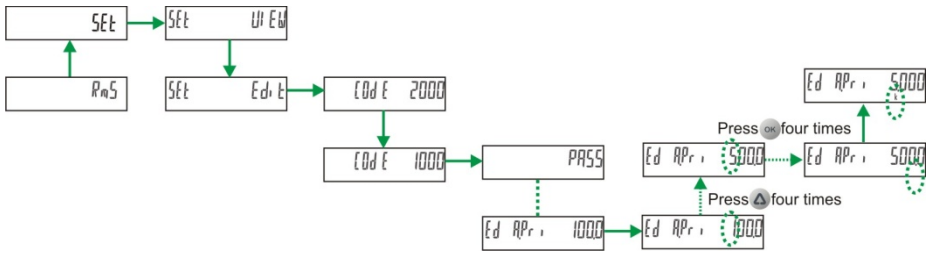
- *VA h/ Wh/ VAR h*
- *Run.h,*
- *On.h*
- *No. of INTR.*

Edit Set Parameters in PROG Menu

This example explains how to edit the value of **A.PRI** from **100.0** to **5000** in the EM1000/EM1200/EM1220 power and energy meter.
For better understanding, the editing is explained in two parts, **edit and accept setup,** and **save the new value to setup**.

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

Edit and Accept Setup



NOTE: means blinking
means blinking 2

1. After entering the setup menu in the edit mode, (Refer to “Enter Setup Menu in Edit Mode” on page 18 for more information) press OK. The display shows **EDIT A.PRI 100.0** with blinking **1**. This indicates that the value can be edited.
2. Press △ four times. The display shows **EDIT A.PRI 500.0** with blinking **5**.
3. Press OK four times.The disp**l**ay shows **EDIT A.PRI 500.0** with blinking **“.”**.
4. Press △. The display shows **EDIT A.PRI 5.000** with blinking **“.” and k indicator.**
   Here, the **5000** is represented as **5.00** with **k** indicator. Refer to “Indicators” on page 8 for more information.
5. Press OK. The new value is accepted.

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

Save the New Value to Setup

NOTE: *means blinking*
y means blinking y

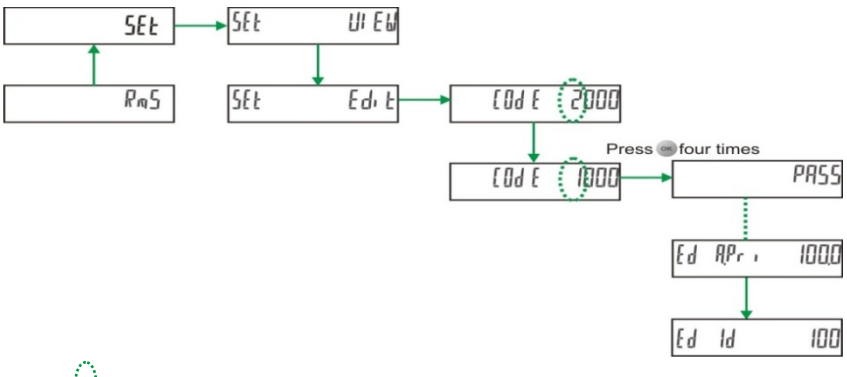
1. After you edit and accept the parameter as previously described, press ESC. The display shows **SAVE y** with blinking **y.**

   NOTE:

   1. If you do not want to save the new value, press ▽ to change the value from SAVE y to SAVE n in step 1, and press ESC. The display flashes FAIL and shows SET EDIT. Proceed to step 3.
   *2. If you want to go back to the **ED A.PRI 5.000** page from **SAVE y** in step 1, then press ESC.*

2. Press ESC to save the new value. The display flashes **PASS** and then shows **SET EDIT**.
3. Press ESC to return to **SET**.

Edit ID

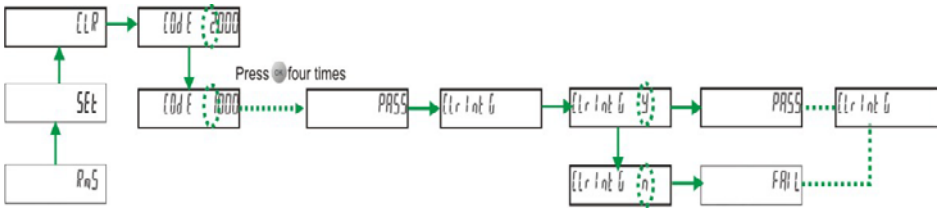


NOTE: *means blinking*
2 means blinking 2

1. From **RMS**, press △. The display shows **SET.**
2. Press OK. The display shows **SET VIEW**.
3. Press ▽. The display shows **SET EDIT**.
4. Press OK.
   You are required to enter **CODE** to enter the setup menu in edit mode.
5. Press OK. The display shows **CODE 2000** with blinking **2.**The factory set code is **1000**.
6. Press ▽. The display shows **CODE 1000** with blinking **1**.
7. Press OK four times to accept the new **CODE** value. The display shows **PASS** and then **EDIT A.PRI 100.0.**
8. Press △. The display shows **ED ID 001**.
   To edit the values, press OK and set the values as required.
9. Press ESC two times to save the new ID.

CLR INTG

The EM1000/EM1200/EM1220 power and energy meter is equipped with energy integrator INTG where the energy parameters are accumulated. This section explains how to clear the integrator in the meter.
Refer to “Energy Integrator” on page 24 for more information.



NOTE: *means blinking*

means blinking 2

1. Press ▲ from the **RMS** page. The display shows **SET**.
2. Press ▲. The display shows **CLR**.
   You are required to enter **CODE** to clear the **INTG** values.
3. Press OK. The display shows **CODE 2000** with blinking **2**. The factory set **CODE** is **1000**.
4. Press ▼. The display shows **CODE 1000** with blinking **1**.
5. Press OK four times to accept the new **CODE** value. The display flashes **PASS** and then **CLR INTG**.
6. Press OK. The display shows **CLR INTG y** with blinking **y**.

   NOTE:

   *If you do not want to clear **INTG**, press ▼ to change the value from **CLR INTG y** to **CLR INTG n**, do as in step 6, press OK. The display flashes **FAIL** and then display **CLR INTG**. Proceed to step 8*
7. Press OK to clear the **INTG**. The display flashes **PASS** and then **CLR INTG**.
8. Press ESC. The display shows **CLR**.
9. Press ▼ twice. The display shows **RMS**.

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Energy Integrator

The EM1000/EM1200/EM1220 power and energy meter is equipped with an energy integrator function. It provides several parameters for Energy Management: VAh, Wh, VARh, Run.h, On.h, and INTR. All the values are direct readings and have a high resolution.

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 input voltage is ON.
INTR: Number of supply outages, means the number of input voltage interruptions or input voltage outages.

Integrator Overflow

- The energy values stored in the INTG are based on the V.PRI x A.PRI; they are independent of the secondary values of the V and A.
- The energy value readings overflow based on V.PRI x A.PRI of the primary settings in the setup.
- The energy parameter is user selectable (Wh, VARh or VAh) through setup. By default, it is Wh. See “Setup Parameters in View and Edit Modes” on page 19 for more information.

Table 3-1: Integrator overflow

V.PRI x A.PRI x 1.732	Overflow Value (Wh/VAh/VARh)	Min time to overflow at full scale (in months)
< 1000 k	9999999.0 k	13.88
< 1000 M	9999999.0 M	13.88
< 1000 G	9999999.000 G	13.88

OLD Data Register

The meters have an OLD data register, where the cleared INTG values (manually/INTG overflow) are stored. Thus, the OLD energy values are not lost even after the integrator is cleared and can be viewed with the OLD parameter.

NOTE: For energy studies, clear the Integrator at the end of each observation. This transfers all the stored energy values to the OLD register, where they are stored, while the integrator begins accumulating data for the next observation.
When the integrator is cleared next time, the OLD values will be overwritten.

kVA Measurement

The EM1000/EM1200/EM1220 power and energy meter has two different kVA measurements, namely **3D** and **Arithmetic**. The desired kVA measurement method can be selected through setup. See “Setup Parameters in View and Edit Modes” on page 19 for more information.

- **3D measurement (factory-set):** An advanced method which provides most accurate and predictable measurement under unbalanced as well as distorted waveform conditions.
- **Arithmetic measurement:** It is used when the meter needs to match the readings of the older or simpler meters.

Table 3-2: kVA measurement selection

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

Power Factor Sign Conventions

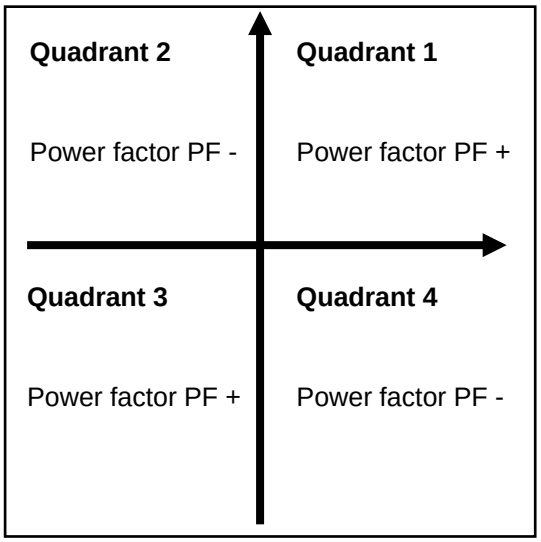
The EM1000/EM1200/EM1220 power and energy meter offers three different sign conventions for power factor (PF), they are as following:

1. Trigonometry (TRIG) sign convention (default)
2. IEC standard sign convention
3. IEEE standard sign convention

Trigonometry (TRIG) Sign Convention

This is the default sign convention. The following figure 3-1 explains the TRIG sign convention for PF.

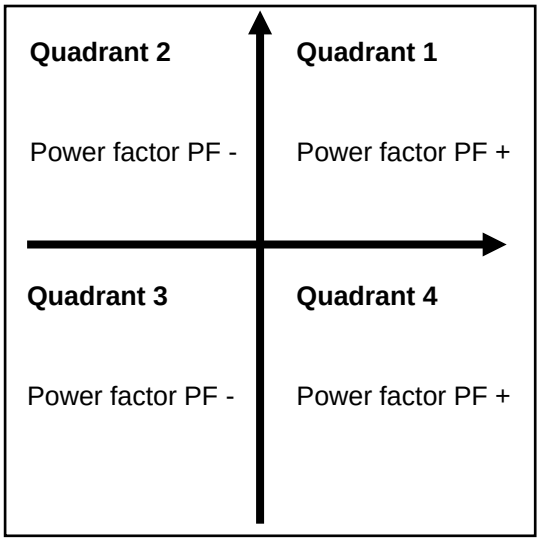
Figure 3-1: TRIG sign convention for PF



IEC Standard Sign Convention

You can select the IEC sign convention through setup. Refer to “Setup Parameters in View and Edit Modes” on page 19 for more information. The following figure 3-2 explains the IEC sign convention for PF.

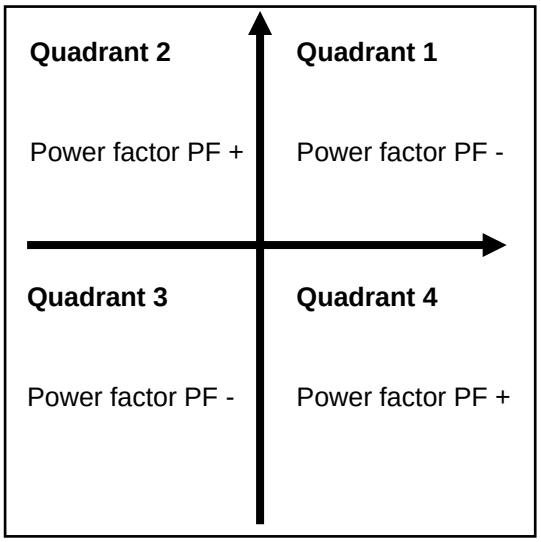
Figure 3-2: IEC standard sign convention for PF



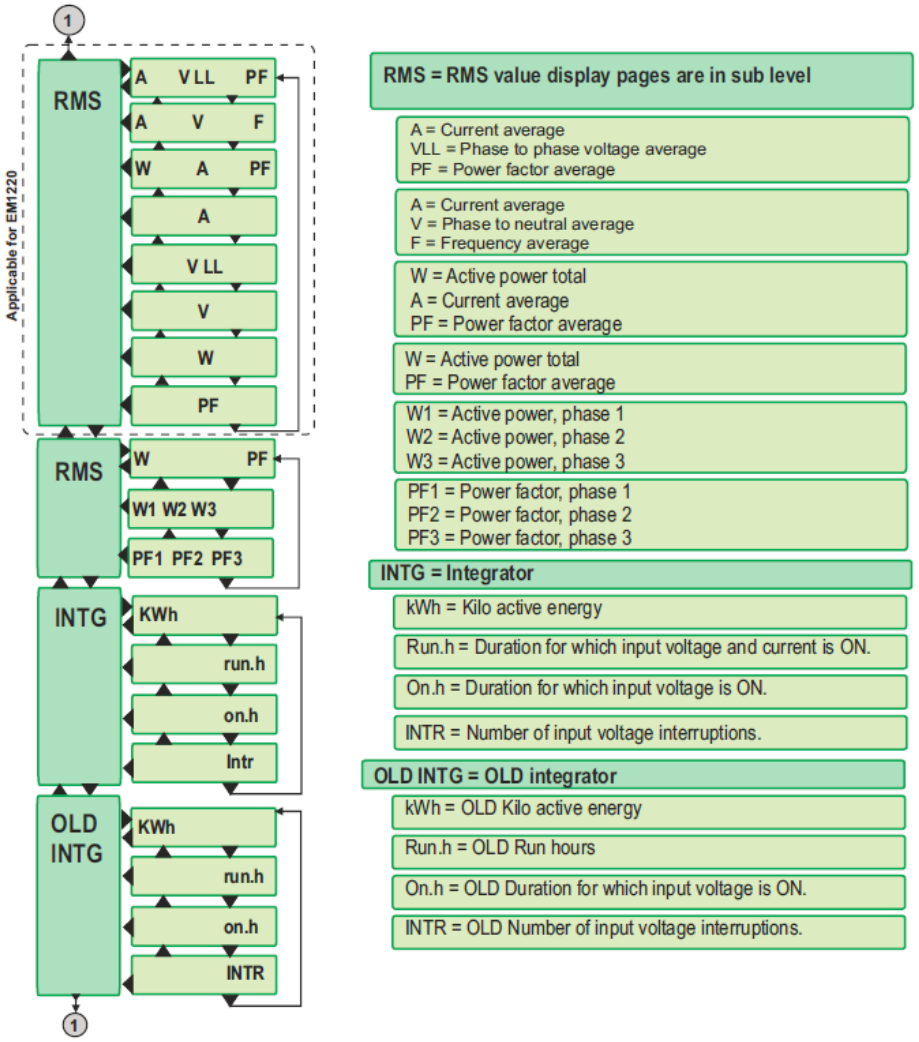
IEEE Standard Sign Convention

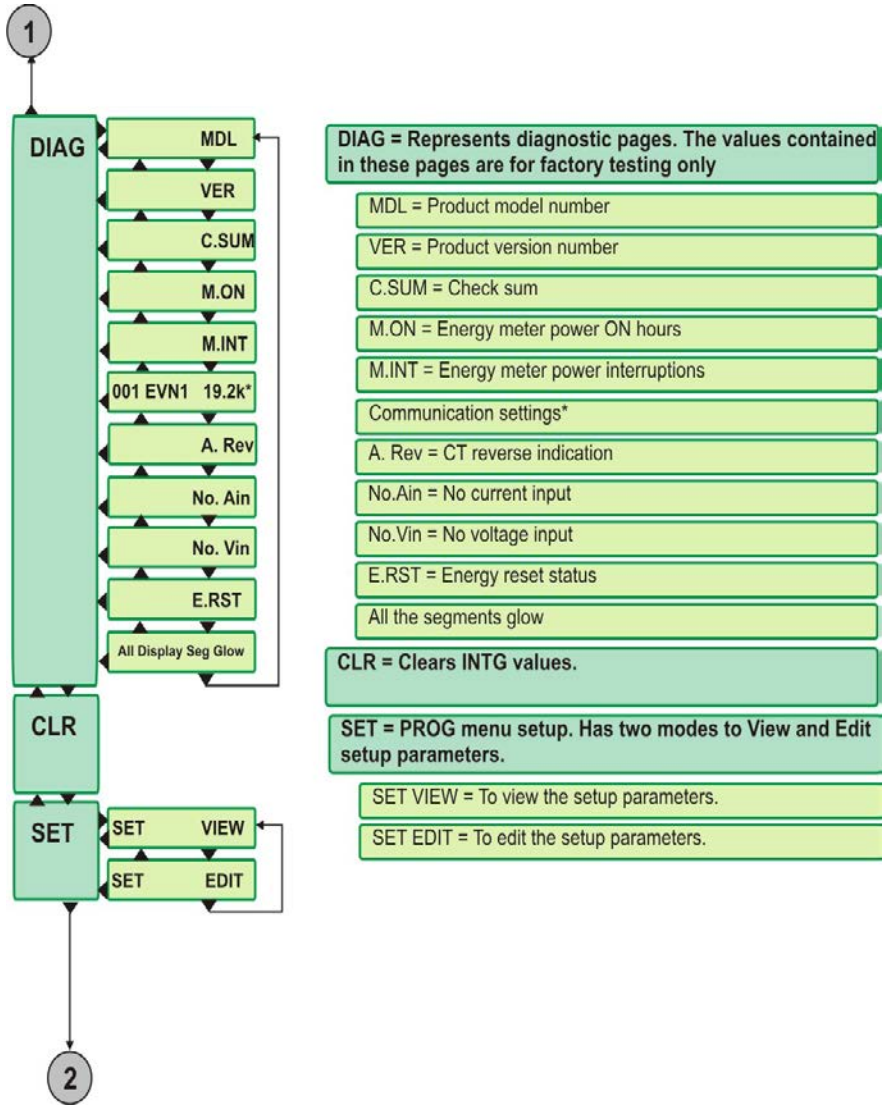
You can select the IEEE sign convention through setup. Refer to “Setup Parameters in View and Edit Modes” on page 19 for more information. The following figure 3-3 explains the IEEE sign convention for PF.

Figure 3-3: IEEE standard sign convention for PF



EM1000/EM1200/EM1220 Menu Hierarchy





*NOTE: * Communication Setting is available only for EM1200 energy meter.*

***No.Ain = No current input** displays:*

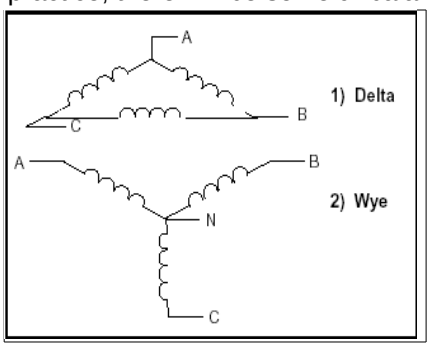
- ***123** when there is no current or Phase 1, Phase 2, and Phase 3 are missing.*
- ***- -** when there is current available in all 3 phases.*
- ***2 3** is when current is available only in Phase 1.*
- ***1 - 3** is when current is available only in Phase 2.*
- ***1 2 -** is when current is available only in Phase 3.*

Chapter 4: AC Power Measurement

3-Phase Systems

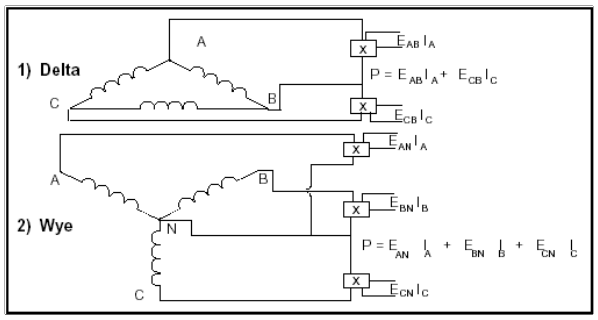
A 3-phase system delivers higher levels of power for industrial and commercial applications. The three phases correspond to three potential lines. A 120° phase shift exists between the three potential lines.
A typical configuration has either a Delta connection or a Wye (Star) connection.

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.

Chapter 5: Installation

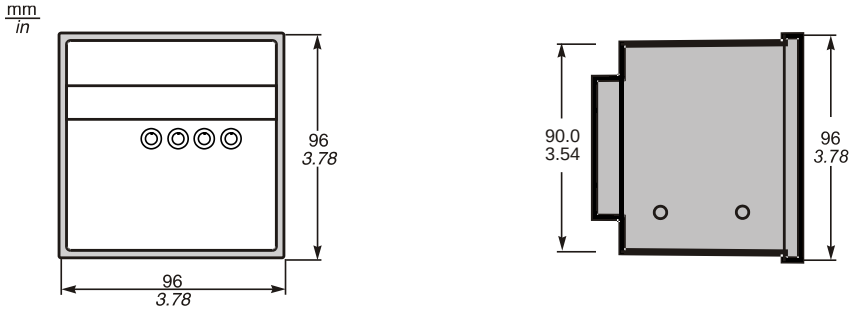
Mechanical Installation

The EM1000/EM1200/EM1220 power and energy meters are panel-mounted and have reliable, rear-mounted terminal strips rated at 480 V.

The 92 x 92 mm cut-out and 96 x 96 mm bezel dimensions adhere to IEC 61554 and DIN 43700.

The below diagram gives the mechanical dimensions and the recommended panel cut-out for the meter.

Figure 5-1: Mechanical dimensions



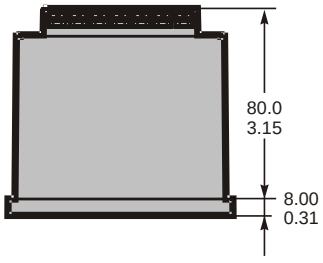
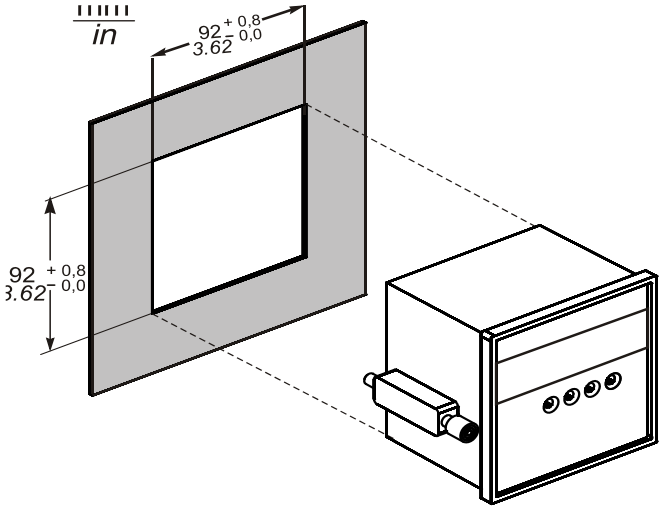


Figure 5-2: Recommended panel cut-out



Installation Procedure

Usage

First, decide how the meter is to be used. If you do not have an energy management program in operation, then your energy consultant should be able to help you to identify which load(s) offer maximum savings potential. This will help you to decide which point is to be monitored, where the readings will be viewed from, who must have access to the instrument, and how often. Otherwise, decide the location of the 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 meter is a 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 meter should be separated from the other equipment, and sufficient space must be provided all around, for cooling air to rise vertically past the instrument. The cooling air temperature should be below the specified operating temperature.

The panel or housing, in which the 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 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, choose the mounting location preferably at, or slightly above, the eye level.
- For viewing comfort, minimize glare and reflections from the strong light sources.

Mounting

The meters are panel mountable.

Table 5-2: Mounting

Description	Specification
Panel cut-out	$92^{+0.5}_{-0}$ mm (w) x $92^{+0.5}_{-0}$ mm(h) ($3.62^{+0.02}$ x $3.62^{+0.02}$ in.) IEC 61554 and DIN 43700
Panel thickness	0.5 to 4.0 mm (0.02 to 0.16 in.)
Instrumental bezel dimension	96 x 96 mm (3.78 x 3.78 in.)
Depth behind bezel	80 mm (3.15 in.) (82 mm (3.23 in.) with terminal cover. Leave clearance for wires)
Mounting clamps screws	Two in numbers, Slotted.
Terminal screws	Combination Phillips and Slotted head

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

Figure 5-3: Mounting angle

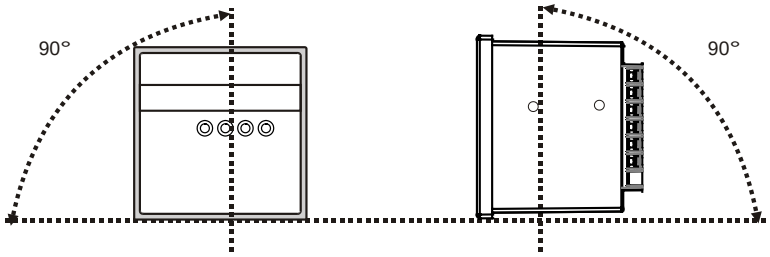
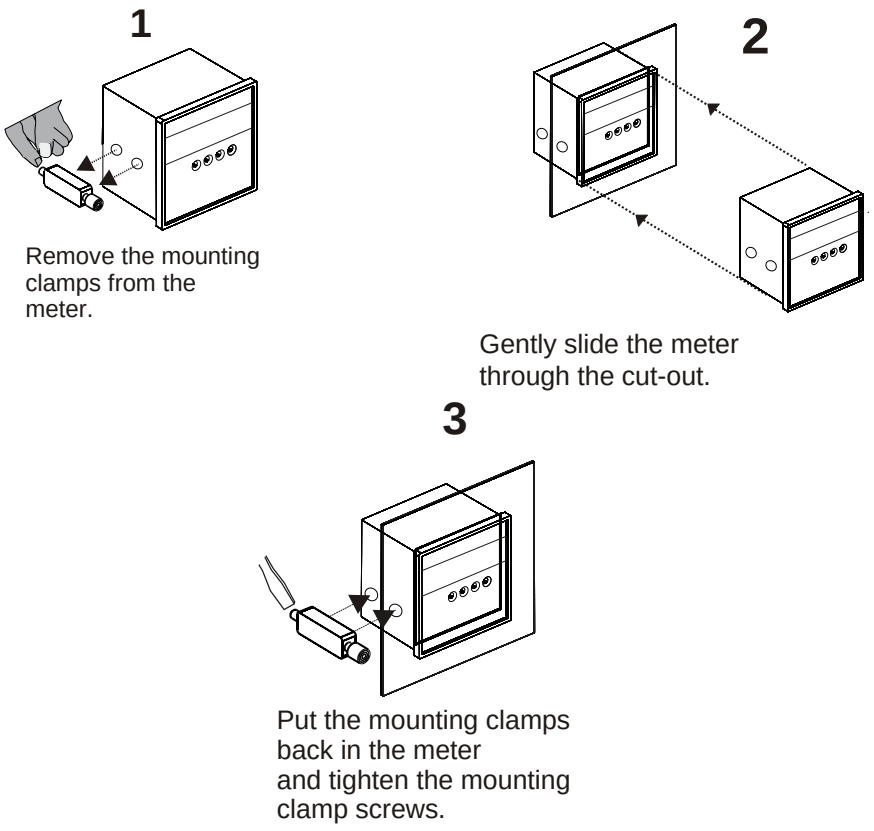


Figure 5-4: Steps to mount the meter



While supporting the 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 meters should be separated from other equipments, and sufficient space must be provided all around the meter, to allow air to rise vertically around the meter. Lack of sufficient air for cooling may result in overheating of the meters.

Electrical Installation

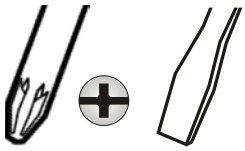
This section describes the following:

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

NOTICE
DAMAGE TO THE DEVICE • Use only the specified tool for tightening and loosening the screw • Do not over-torque the screw above the specified range **Failure to follow these instructions can result in equipment damage.**

For best results, ensure the following specifications:

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



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)

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

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

Connecting Cable Recommendations

Table 5-3: Connecting cable recommendations

	Current Rating	Wire size	Temperature Rating	Insulation Rating
Voltage Circuit	> 0.1 A	0.82 - 3.31 mm^2 (18 - 12 AWG)	> 75 °C (167 °F)	> 600 VAC
Current Circuit	> 7.5 A Or 2.5 mm^2/14 AWG minimum	2.08 - 3.31 mm^2 (14 - 12 AWG)		

Schneider Electric recommends the use of insulated sleeved U lugs (2.5 mm^2/14 AWG) for wiring terminals.

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.*
- *To disassemble the meter, refer to "To Disassemble" on page 59.*

Auxiliary Supply (Control Power)

The 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 voltage surges exceed the auxiliary supply limits (e.g., rural areas and outlying areas prone to lightning strikes).

Range:

- 44 to 277 V AC/DC.
- Burden (load) < 4 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, then use a 440 V: 240 V supply transformer to provide the standard 240 V auxiliary supply.

PTs (VTs) and CTs

Large electrical installations have high voltages and currents, which may exceed the direct connection rating of the 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 meter rating. Potential transformers usually have a full scale output of 110 VAC RMS line-line; current transformers usually have a full scale output of 5 A or sometimes 1 A.

The accuracy of the measurement also depends on the accuracy and phase angle error of the PTs (VTs) and CTs. We recommend the usage of instrument class 1 or better PTs and CTs. Do not use protection class (10P10, etc.) CTs to feed the meters as there is a possibility of reduction in the accuracy.

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

PT (VT), CT Wiring

The PTs (VTs) and CTs must have adequate VA rating to support the burden (loading) on the secondaries. You may want to support the auxiliary supply burden from one of the PTs (VTs). CT wiring can impose additional burden (loading) on the CT. For example, if the CT has a 5 A secondary, and the wire resistance is 1.0 Ω, then the CT has to support an additional burden of 5 VA. If the wiring distance from the CT secondary is greater than the distances mentioned in the "Table 5-5" on page 35, 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 meter.
The meters should be conveniently located for easy connections of voltage (PT), current (CT) signals, and auxiliary (control) supply.

Note: The 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 meter operation, the voltage connection must be maintained. The voltage must correspond to the correct terminal. The cable required to terminate the voltage sense circuit should have an insulation rating greater than 480 VAC and a current rating greater than 0.1 A.
There are four input voltage terminals marked V1, V2, V3, and VN. See the "Connection Diagrams" on page 41 for more information. For Delta connection, the VN terminal should be left unconnected.

PT Connections

The meters directly accept LV voltage inputs of up to 480 VAC RMS line to line (277 VLN). Voltages greater than this, typically HV systems, must be connected through potential transformers (PTs). The meter allows the user to program both the PT primary and secondary voltages.

- User programmable PT primary range: 0.1 to 999 kVAC RMS LL
- User programmable PT secondary range: 80 to 481 VAC RMS LL
- Meters voltage input burden: < 0.2 VA per input

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

Selecting the voltage fuses

Schneider Electric strongly recommends the use of fuses on each sense voltage (except for neutral) and the auxiliary supply (control power).

Table 5-4: Fuse recommendation

Power Source	Source voltage	Fuse (A)
Line voltage	80 to 480 VLL	0.25
Auxiliary supply (Control power)	44 to 277 Vac/Vdc	0.25

Current Signal Connections

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

Any unused current input terminals must be shorted together, e.g., in delta connection, the terminals A2 (S1, S2) must be shorted together. The shorted terminals do not need to be grounded.
The current sense circuit should have an insulation rating greater than 480 VAC. The cable connection should be rated for 7.5 A or greater and have a cross-sectional area of 2.5 mm^2 (14 AWG) minimum.

CT Connections

Mount the current transformers (CTs) as close as possible to the 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 meters (in feet) (CT to EM1000/EM1200/EM1220 Power and Energy 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.
- Meters CT burden: 0.2 VA maximum per input.

Refer to the “PROG menu — Setup” on page 17 for more information.

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

CT Polarity

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

CT Connection Reversal

To check the polarity of the CT after the meter has been installed, go to the **DIAG** (diagnostic) pages and check the **CT REV** display page. Refer to “EM1000/EM1200/EM1220 Power and Energy Meters Menu Hierarchy” on page 28 for more information.

Assuming that you are consuming power (import), check for one of the following conditions in the meter:

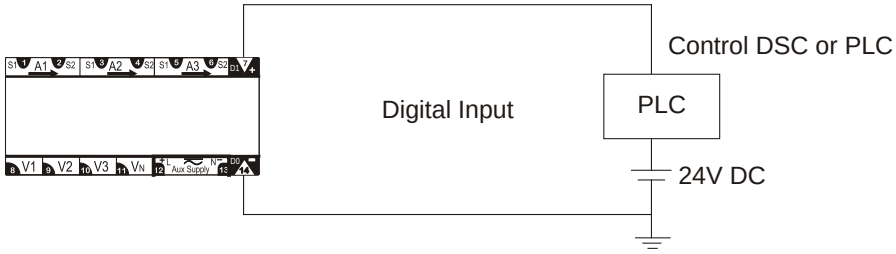
1. If the display shows **L 1 or L 2 or L 3**, then **CT phase 1 or CT phase 2 or CT phase 3** is reversed and the corresponding CT phase must be corrected.
2. If the display shows **L 12 or L 23 or L 32**, then **CT phases (1 and 2) or CT phases (2 and 3) or CT phases (3 and 1)** are reversed and the corresponding CT phases must be corrected.
3. If the display shows **L 123,** then all the phases are reversed and must be corrected.
4. If the display shows **L-**, then no CTs are reversed.

Pulse Output

It is an optically isolated solid state pulse output which drives the remote counter, PLC, DCS stations etc. It does not require multiplication factor.

Pulse output settings (like Energy per Pulse and Pulse on Time) are user programmable in the field. The parameters for POP are selectable between Wh and VAh. The minimum energy per pulse depends upon the CT and PT primary settings.

Figure 5-5: Pulse Output



Following are some of the applications of POP:

- Offline monitoring of energy data
- Online control of energy optimization
- Online control of power optimization
- Online control of process optimization, and
- Correlating energy input to product output

For online control of energy content in a process, the pulse output from EM1000 can be integrated into the process through PLC/DCS. If the PLC/DCS has a self excited (in-built supply - 12V or 24V) Digital Input, then an external 24V DC supply is not required.

NOTE: The kWh pulses can also be used to derive average kW information at the PLC.

Setup — System Type

The EM1000/EM1200/EM1220 power and energy meter needs to know the type of system to which it is connected. This information is programmed in the setup procedure, before using the meter. The 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 meter supports the following system types:

Table 5-6: System types supported by the meter

System type	Configuration in meter	Connection
Star/Wye Or 3-phase 4-wire Or Three watt-meter Or Three element circuits	**StAr** Select this configuration through meter's setup. See "Setup Parameters in View and Edit Modes" on page 19 for more information.	All the four voltage terminals (V1, V2, V3, VN) and six current terminals (A1, A2, A3 each having S1 and S2 terminals) need to be connected. See "3-phase 4-wire Star/Wye connection" on page 41 for more information.
System type	**Configuration in meter**	**Connection**
Delta, Open delta Or 3-phase 3-wire Or Two watt-meter Or Two element circuits	**dLtA** Select this configuration through meter's setup. See "Setup Parameters in View and Edit Modes" on page 19 for more information.	Three phase voltage terminals (V1, V2, V3) and four current terminals (A1, A3 each having S1 and S2) need to be connected. Leave the neutral voltage terminal unconnected. See "3-phase 3-wire delta connection" and "3-phase 3-wire open delta connection" on page 42 for more information.
2-phase Or 2-phase 3-wire Or Two watt-meter Or Two element circuits	**2 ph** Select this configuration through meter's setup. See "Setup Parameters in View and Edit Modes" on page 19 for more information.	Two phase voltage terminals (V1, V2), neutral voltage terminal (VN), and four current terminals (A1, A2 each having S1 and S2) need to be connected. See "2-phase 3-wire connection" on page 43 for more information.
Single-phase Or Single-phase 2-wire Or One watt-meter Or One element circuits	**1 ph** Select this configuration through meter's setup. See "Setup Parameters in View and Edit Modes" on page 19 for more information.	One phase voltage terminal (V1), neutral voltage terminal (VN), and two current terminals (A1 with S1 and S2) need to be connected. See "Single-phase connection" on page 43 for more information.

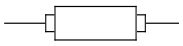
NOTE: Each current input A1, A2, A3 has two terminals S1 and S2For one current input, you need to connect two terminals; for two current inputs, you need to connect four terminals; for three current inputs, you need to connect six terminals.

Connection Diagrams

- Select the connection diagram that best describes your application. Refer to “Setup – System Type” on page 40 for more information.
- Ensure,
  - CT phase and the corresponding PT phase are identical.
  - The CT polarity is correct.

Connection Diagram Symbols

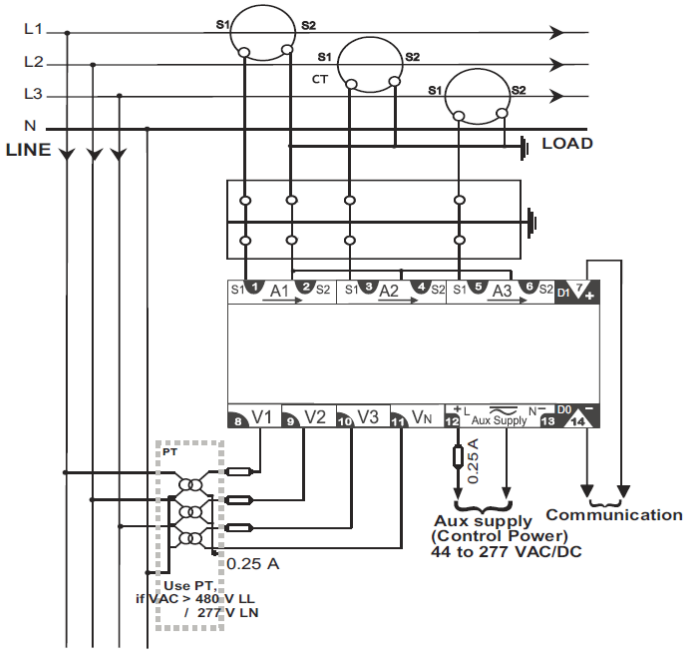
Table 5-7: Connection diagrams symbols

Symbol	Description
	Fuse (Slow blow)
	Current transformer (CT)
	Potential transformer (PT)

3-phase 4-wire WYE connection

Direct voltage connections for the input voltages L-L up to 480 VAC. Otherwise, use three PTs.

Figure 5-6: 3-phase 4-wire WYE connection



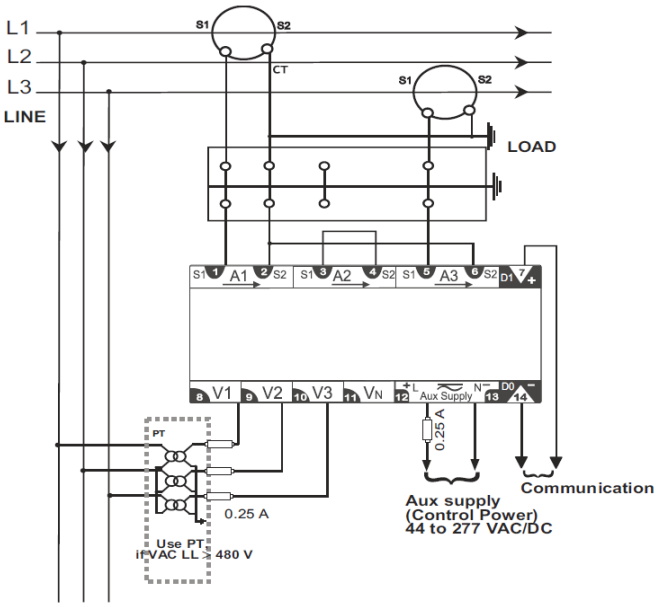
NOTE:
Ensure that WYE/Star is programmed in the meter PROG menu- Setup.
For High-leg (US connection)

L1 – N = 120 V
L2 – N = 208 V
L3 – N = 120

3-phase 3-wire delta connection

Direct voltage connections for the input voltages L-L up to 480 VAC. Otherwise, use three PTs.

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

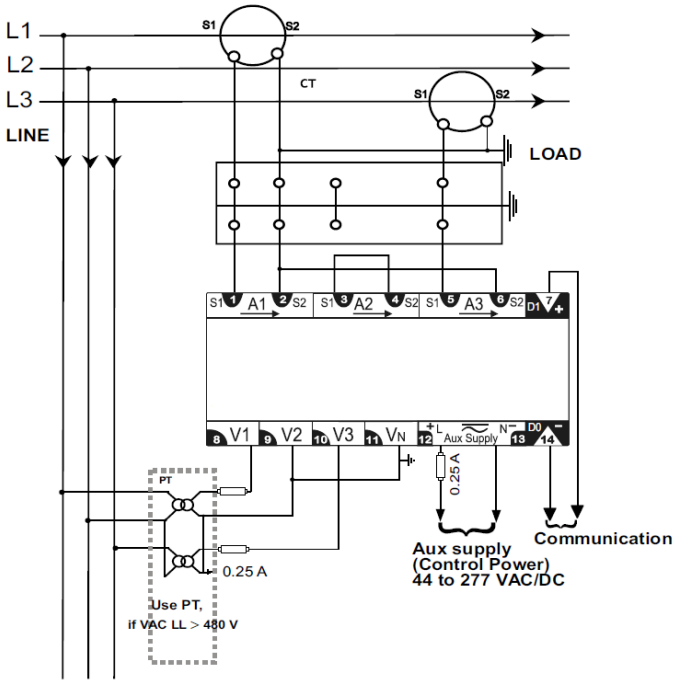


NOTE: Ensure that Delta is programmed in the meter PROG menu-setup. Leave the Vn terminal disconnected.

3-phase 3-wire open delta connection

Direct voltage connections for the input voltages L-L up to 480 VAC. Otherwise, use two PTs.

Figure 5-8: 3-phase 3-wire open delta connection

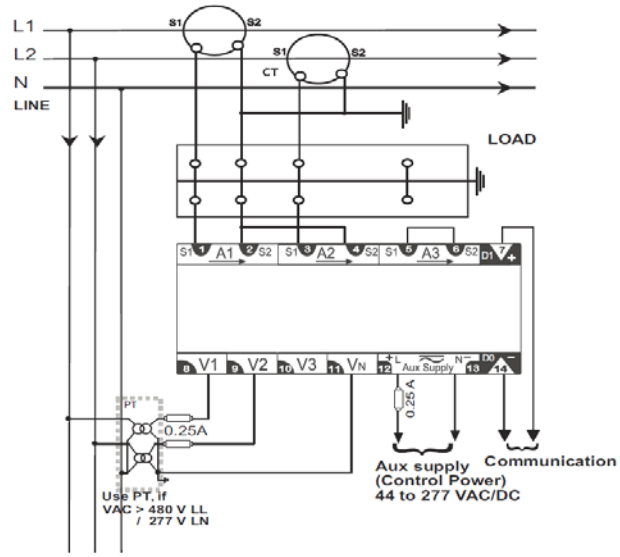


NOTE: Ensure that Delta is programmed in the meter PROG menu-Setup.

2-phase 3-wire connection

Direct voltage connections for the input voltages L-L up to 480 VAC. Otherwise, use two PTs.

Figure 5-9: 2-phase 3-wire connection



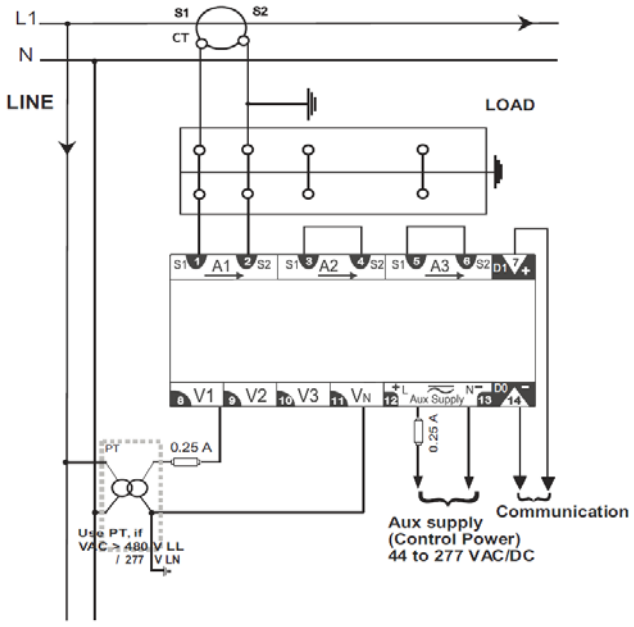
NOTE: Ensure that 2 p h is programmed in the meter PROG menu- Setup.

Single-phase connection

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

1. Program the 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 meter.
3. The unused current terminals (A2 and A3) must be shorted together to reduce noise picked up in the meter.

Figure 5-10: Single-phase connection



Chapter 6: Data Communication

This section is applicable only for EM1200/EM1220 power and energy meter.

RS 485 Data Port

Advantages

- Rapid, online, real time readings into,
  - Your own SCADA software or PLC.
  - Schneider Electric SCADA software products such as , PowerLogic SCADA and Vijeo Citect to indicate the energy usage and wastage.
  - It supports ION™ enterprise.
- The data port has built-in impedance matched design for low reflectance on long data cables at high Baud rates. This eliminates need for complicated impedance matching resistors at the wiring ends of long data cables.
- Fast 16 ms energy meter response; Average time to read 10 parameters is 90 to100 ms (19200 Baud, Even parity, One stop bit).
- Direct, accurate, full precision low and high readings. No additional scaling or decimal adjustment required for the readings.

Communication Capabilities

Table 6-1: 2-wire, RS 485 port capabilities

Communications port	RS 485 • 2-wire with shield. • EIA compliant • Enables the energy meter to be connected to a daisy chain of up to 31 devices (See “Daisy chaining devices to the energy meter” on page 47 for more information).
Baud rate	4800, 9600, and 19200; Default value is 19200. Noisy, EMI, RFI, long data cable: 4800 Baud Short cable (<300 meters or 975 feet): 19200 Baud
Communications distances	See Table 6-2.
Protocol	Modbus RTU.
Parity	Even, ODD, None; Default is Even.
Data bits	8
Stop bit	1 or 2; Default value is 1.
Device address	1 to 247; Up to 247 meters per COM port with repeaters.

NOTE: The polling interval to poll the data from EM1200/EM1220 power and energy meter depends on the Baud rate. Schneider Electric recommends the polling interval of one second at 9600 Baud rate.

Table 6-2: 2-wire, RS 485 communication distances

Baud Rate	Maximum Communication Distances 1 to 32 Devices
	Meters (Typical with Belden 3105A cables)
9600	1200
19200	900

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

Installation

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

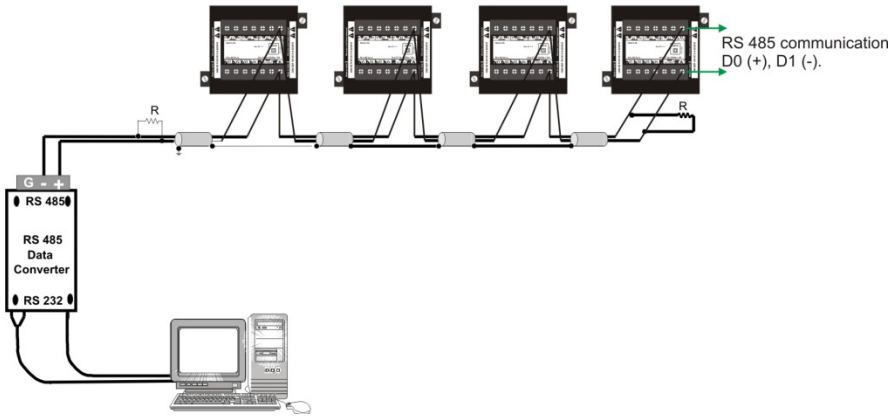
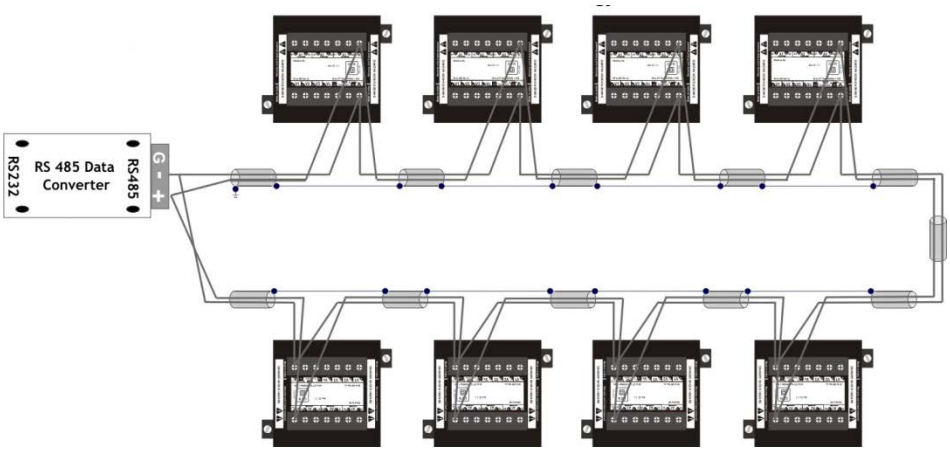


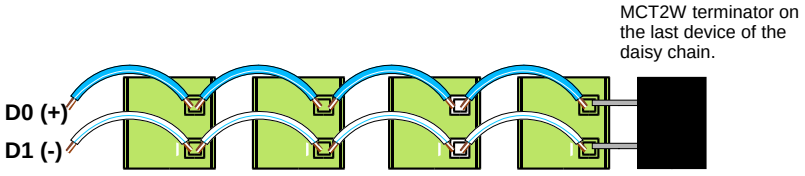
Figure 6-2: closed loop, 2-wire half duplex
Advantage — Reliable communications, tolerant to one break in the cable.



Daisy-chaining Devices to the Energy Meter

The RS 485 slave port allows the energy 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



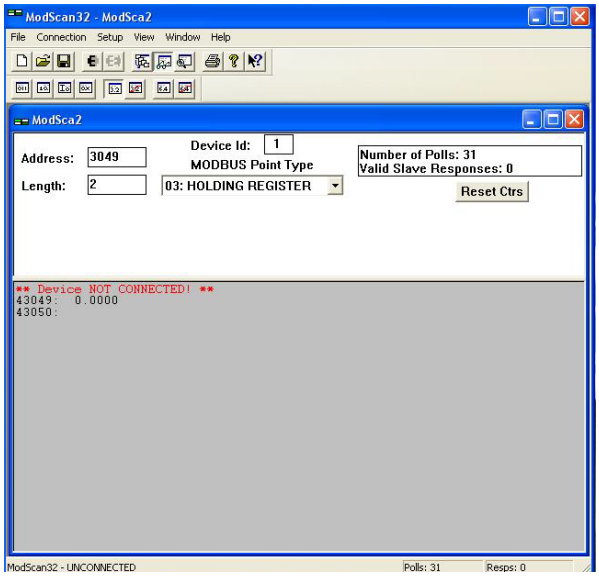
- If the energy meter is the first device on the daisy chain, connect it to the host device using a RS 232 to RS 422/RS 485 converter or RS 485 to Ethernet converter.
- See Table 6-1 on page 45 for the maximum daisy-chain communications distances for 2-wire devices.
- The terminal's voltage and current ratings are compliant with the requirements of the EIA RS 485 communications standard.

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

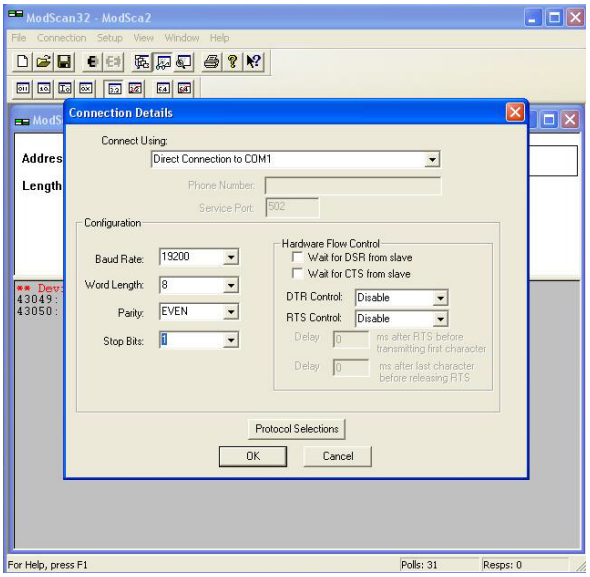
Communication Test

- The EM1200/EM1220 power and energy meter communication can be tested using the Modscan software.
- This section explains how to test the EM1200/EM1220 power and energy meter communication using Modscan software as Modbus master in PC.
- Download the demo version of the Modscan software from http://www.win-tech.com.
- The following example explains how to read the parameter **VA total** from register **3049** using the Modscan software.

1. After starting the Modscan, to read VA total, enter address as 3049 (decimal), length as 2, device ID as 1, Modbus point type as 03, and HOLDING REGISTER. The screen appears as shown below.

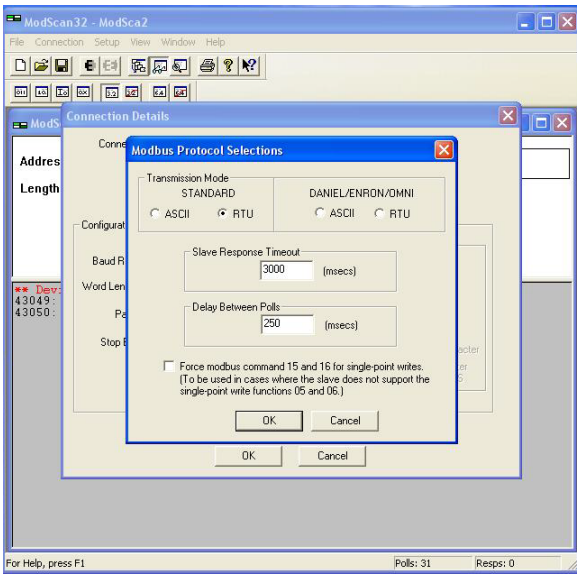


2. **Modify the connection details:** Click Connection >Connect to display the **connection detail window**. Change all the settings to match the following screen. These are the default settings for the energy meter.

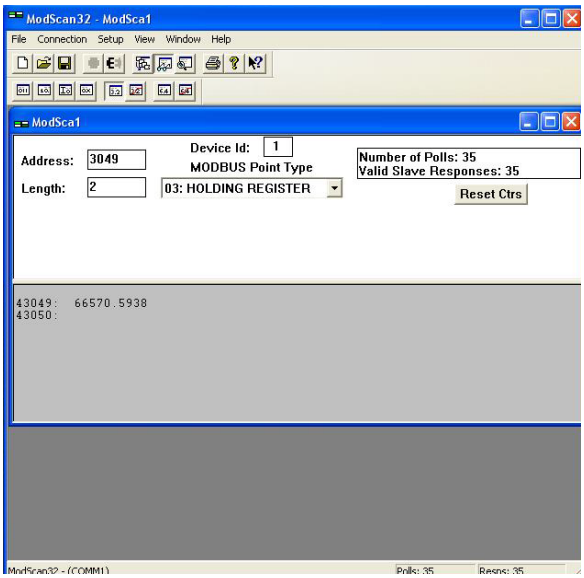


3. Set the Modbus protocol selections: On “Connection details” window

(shown in previous step), click Protocol Selections. Enter the protocol settings as shown below and click OK in all the windows.



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



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

NOTE: In case of Modscan 32 software, select the data type as "Swapped FP" instead of "Float".

Data Address

The EM1200/EM1220 power and energy meter supports the transfer of whole block and also of individual data values (two registers are used for storing single data values).

- In the transfer of individual data values, it treats two registers as an object, with the starting address (e.g., 3000) considered as the object name. This enables you to transfer required data values for energy management.
- In the transfer of a whole block, it treats each block as an object with the starting address (e.g., 1000) considered as the object name. This enables fast block transfers, since energy management usually requires a block of related readings for the same point of time. This method also eliminates time-skew within readings of that block.
- The device address, block start address, and the number of registers, must be configured to match the energy meter. You must also make the related SCADA settings for polling priority, logging, and viewing data. Refer to the 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 6-3: Individual parameter address

Parameter	Description	Address	Data type
Metering			
Metering – Power			
A	Current average	3057	Float*
A1	Current, phase 1	3009	Float*
A2	Current, phase 2	3025	Float*
A3	Current, phase 3	3041	Float*
V LL	Voltage (LL) average	3059	Float*
V12	Voltage(LL), phase 1-2	3011	Float*
V23	Voltage(LL), phase 2-3	3027	Float*
V31	Voltage(LL), phase 3-1	3043	Float*
V LN	Voltage(LN) average	3061	Float*
V1	Voltage(LN), phase 1	3013	Float*
V2	Voltage(LN), phase 2	3029	Float*
V3	Voltage(LN), phase 3	3045	Float*
F	Frequency	3063	Float*
W	Active power, total	3051	Float*
W1	Active power, phase 1	3003	Float*
W2	Active power, phase 2	3019	Float*
W3	Active power, phase 3	3035	Float*
VAR	Reactive power, total	3053	Float*
VAR1	Reactive power, phase 1	3005	Float*
VAR2	Reactive power, phase 2	3021	Float*
VAR3	Reactive power, phase 3	3037	Float*
VA	Apparent power, total	3049	Float*
VA1	Apparent power, phase 1	3001	Float*
VA2	Apparent power, phase 2	3017	Float*
VA3	Apparent power, phase 3	3033	Float*
Metering – Power Factor			
PF	Power factor total	3055	Float*
PF1	Power factor, phase 1	3007	Float*

PF2	Power factor, phase 2	3023	Float*
PF3	Power factor, phase 3	3039	Float*
Energy			
FwdVAh	Forward apparent energy	3201	Float*
FwdWh	Forward active energy	3203	Float*
FwdVARh	Forward reactive energy	3205	Float*
FwdRun secs	Forward run seconds	3265	Unsigned long
FwdOn Sec	ON Seconds	3267	Unsigned long
Intr	Number of input voltage interruptions	3269	Unsigned long

NOTE:

The User selectable parameters are displayed based on the Parameters set in the Setup page. Thus, only the selected parameters will return the value, and the other parameter will be returned as 0.

- Current, Voltage, and Frequency parameter registers are applicable for EM1220 only.

TURBO Parameter Address

- Function Code: 03 Read
- No scaling required
- Read as block or individual parameters
- The user can configure desired parameters in the TURBO block, using parameter address configuration block. Refer to “Parameter Address Configuration Block” on page 52 for more information.
- The TURBO parameters and addresses shown in the following are the default (factory-set) parameters and addresses.

Table 6-4: TURBO parameter address

Parameter	Description	Address	Data type
Metering			
Metering – Power			
A	Current average	2507	Float*
A1	Current, phase 1	2501	Float*
A2	Current, phase 2	2503	Float*
A3	Current, phase 3	2505	Float*
V LL	Voltage (LL) average	2515	Float*
V12	Voltage(LL), phase 1-2	2509	Float*
V23	Voltage(LL), phase 2-3	2511	Float*
V31	Voltage(LL), phase 3-1	2513	Float*
V LN	Voltage(LN) average	2523	Float*
V1	Voltage(LN), phase 1	2517	Float*
V2	Voltage(LN), phase 2	2519	Float*
V3	Voltage(LN), phase 3	2521	Float*
F	Frequency	2531	Float*
W	Active power, total	2547	Float*
W1	Active power, phase 1	2541	Float*
W2	Active power, phase 2	2543	Float*
W3	Active power, phase 3	2545	Float*
VAR	Reactive power, total	2555	Float*
VAR1	Reactive power, phase 1	2549	Float*
VAR2	Reactive power, phase 2	2551	Float*
VAR3	Reactive power, phase3	2553	Float*
VA	Apparent power, total	2539	Float*
VA1	Apparent power, phase 1	2533	Float*
VA2	Apparent power, phase 2	2535	Float*

VA3	Apparent power, phase 3	2537	Float*
Metering – Power Factor			
PF	Power factor total	2563	Float*
PF1	Power factor, phase 1	2557	Float*
PF2	Power factor, phase 2	2559	Float*
PF3	Power factor, phase 3	2561	Float*
Energy			
FwdVAh	Forward apparent energy	2565	Float*
FwdWh	Forward active energy	2567	Float*
FwdVARh	Forward reactive energy	2569	Float*
FwdRun secs	Forward run seconds	2595	Unsigned long
FwdOn Sec	ON Seconds	2597	Unsigned long
Intr	Number of input voltage interruptions	2599	Unsigned long

NOTE:

- Current, Voltage, and Frequency parameter registers are applicable for EM1220 only.

OLD Integrator

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

Table 6-5: OLD integrator

Parameter	Description	Address	Data type
FwdVAh	Forward apparent energy	7001	Float*
FwdWh	Forward active energy	7003	Float*
FwdVARh	Forward reactive energy	7005	Float*
FwdRun secs	Forward run seconds	7065	Unsigned long
FwdOn Sec	ON Seconds	7067	Unsigned long
Intr	Number of input voltage interruptions	7069	Unsigned long

Setup Block

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

Table 6-6: Setup block

Parameter	Description	Address	Data type	Range	Default value
A.PRI	Current Primary	1001	Float	1 to 99000A	100.0
A.SEC	Current Secondary	1003	Float	1 to 5A	5.000
V.PRI	Voltage Primary	1005	Float	100 to 999000	415.0
V.SEC	Voltage Secondary	1007	Float	50 to 600V	415.0
SYS	System Configuration	1009	Unsigned Integer	1-1ph, 2-2ph, 3-Delta, 4-Star	StAR
ST.A	Starting current	1010	Unsigned Integer	00 to 200mA	001
PF.STD	PF standard selection	1011	Unsigned Integer	1- IEC, 2-IEEE, 3-TRIG	TRIG
VA.FN	VA function selection	1012	Unsigned Integer	1-Arth, 2-3d	3d
PAR	Parameter selection	1013	Unsigned Integer	1-VAh, 2-Wh	Wh
E.POP	Energy per pulse	1014	Unsigned Integer	1-100, 2-1k, 3-10k, 4-100k, 5-1000k, 6-10000k	1000
POP.ON	Pulse on time	1015	Unsigned Integer	50 - 500mS	50
Baud rate	Baud rate	1017	Unsigned Integer	3-4800, 4-9600, 5-19200	19200
PRTY	Parity	1018	Unsigned Integer	1-Evn1, 2-Odd1, 3-no2	Evn1
ID	Unit ID	1019	Unsigned Integer	1 to 247	001

NOTE:

- *For efficient setup, read the setup parameters first and then edit the required setup parameter value.*
- *The E.POP and POP.ON parameters are available only in EM1000.*
- *The Baud Rate, PRTY and ID parameters are available only in EM1200.*

ID Status Block:

- Function Code: 03H Read
- Number of registers: 30
- No scaling required
- Individual parameters access for Normal read (0x03) and block wise access for Special Read/Write

Table 6-7: ID status block

Parameter	Description	Address	Data type	No. of registers
Mfg Name	"SCHNEIDER ELECTRIC"	0001	String	10
Product code	"EM1200" / "EM1220" ASCII char	0011	String	10
FW version	"V01.02.02", ASCII char	0021	String	5
Firmware Version	10202 (0x27DA)	0026	INT16U	1
Model no(model tag)	403-"EM1000", 404-"EM1200" 405- "EM1220"	0027	INT16U	1
HW_version	"V01_01"	0028	String	3

Note: If string length is not matching with the allocated number of registers, then it is added as null characters (dec 0) at end of the string.

CLR INTG

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

Table 6-8: CLR INTG

Parameters	Address	Data type	Range
INTG Clear	2001	Unsigned long	0x0000 0001: Integrator clear

Default Settings Block:

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

Table 6-9: Default settings lock block

Parameters	Address	Data type	Range
Default setup	2003	Unsigned long	0x0000 0001: Default setup.

Default Display Page Lock Block:

- Function Code: 03H Read, 10H Write
- Number of registers: 2
- No scaling required
- Read and write as block only.

Table 6-10: Default display page block

Parameter	Address	Data type	Range
Supervisor lock/ unlock Operator lock/ unlock	2005	Unsigned long	0x00000202 (514): Supervisor lock 0x00000200 (512): Supervisor unlock 0x00000101 (257): Operator lock 0x00000100 (256): Operator unlock

Diagnostic (DIAG) Block Information:

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

Table 6-11: Diagnostic block

Parameter	Description	Address	Data type	Range
Meter ON hours	Duration of meter ON	2701	Unsigned long	
Meter interruptions	Number of times meter interrupted	2703	Unsigned long	
A reverse	Reverse current	2705	Unsigned long	0 – No phases are reversed. 1 – Phase 1 is reversed 2 – Phase 2 is reversed. 3 – Phase 1 and 2 are reversed 4 – Phase 3 is reversed. 5 – Phase 1 and 3 are reversed. 6 – Phases 2 and 3 are reversed. 7 – All the phases are reversed.
No Amps (CT miss / No CT / No Ain)	Missing current input	2707	Unsigned long	0 – All the current inputs are present 1 – Current input (A1) is missing. 2 – Current input (A2) is missing. 3 – Current inputs A1 and A2 are missing. 4 – Current input (A3) is missing. 5 – Current inputs A1 and A3 are missing. 6 – Current inputs A2 and A3 are missing 7 – All the current inputs are missing.
No voltage (PT miss / No PT / N0 Vin)	Missing voltage input	2709	Unsigned long	0 – All the voltage inputs are present 1 – Voltage input (V1) is missing. 2 – Voltage input (V2) is missing. 3 – Voltage inputs V1 and V2 are missing. 4 – Voltage input (V3) is missing. 5 – Voltage inputs V1 and V3 are missing. 6 – Voltage inputs V2

				and V3 are missing 7 – All the voltage inputs are missing.
INTG reset	Integrator reset information	2723	Unsigned long	0 – No reset 1 – Auto reset 2 – Manual reset 3 – Communication reset
Reset parameter	Reset parameter	2725	Unsigned long	0 – None 1 – VAh 2 – Wh
Number of reset	Number of reset	2727	Unsigned long	0 to 65536

NOTE:

- *Most of the reserved and unavailable parameters returns zero value.*
- *The SCADA software must support register blocks consisting of different data types (integers and floats) to transfer the whole block.*
- *Each Modbus register size is 16 bits. All EM1200/EM1220 power and energy meters readings are 32 bits. Therefore, each EM1200 energy meter reading occupies **two** consecutive Modbus registers. For example, VA total parameter absolute address is 3049. It occupies both 3049 and 3050 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 total parameter absolute address is 3049. Modbus address can be 43049 (40000+3049).*
- *All energy meter addresses should be set between 1 and 247.*
- *All energy meters should have uniform communication settings like Baud rate, parity, and stop bit.*
- *Use communication diagnostic mode display page in the digital meter to analyze the status of the communication.*
- *Status:*

  t – Transmitting
  r – Receiving
  u – Invalid unit ID
  A – Invalid Address
  F – Invalid function code
  d – Illegal data
  b –Meter is busy
  c – CRC error (cyclic redundancy checking)
  o – Overrun error
  P – Parity error
  S – Stop bit error

Chapter 7: Maintenance and Troubleshooting

Introduction

This chapter describes about the information related to maintenance of your meter.

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

CAUTION
HAZARD OF EQUIPMENT DAMAGE • Do not perform a Dielectric (Hi-Pot) or Megger test on the meter, test voltages may damage the meter. • Before performing Hi-Pot or Megger testing on any equipment in which the meter is installed, disconnect all the input and output wires connected to the meter. **Failure to follow these instructions will result in equipment damage.**

Troubleshooting

The information in Table 7–1 describes about the potential problems and their possible causes. It also includes possible checks to perform or provide solutions to the problem. 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 17 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 the shorting terminals. See “Connection Diagrams “on page 41 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, then s1 s2 need to be interchanged in one or two or in all the three phases. Under this condition, the energy will update in INTG Rev. 2. Check the mode. If it is in export, then the energy will update in INTG Rev.
The display went blank suddenly	Over voltage/temperature	Interrupt the power supply or reduce the voltage or temperature within the limit.
	Fuse connection	Check whether a fuse with rating of 0.25 A is connected on each voltage input. If not connect the 0.25 A rated fuse to the voltage input.
The power meter stopped communication abruptly	Communications lines are improperly connected.	Verify the power meter communications connections. See “Chapter 6 – Data communication” on page 45 for more information.
	Over voltage/temperature	Interrupt the power supply or reduce the voltage or temperature within the allowable limits.
Wrong Load bar indication	Incorrect F.S% selection	Select the full scale load percentage setting as per your circuit.
The Power meter is over heated	Lack of sufficient air for cooling	Provide sufficient space all around the power meter. Separate the power meter from other equipment for cooling air.

Disposal and Recycle

Dispose off or recycle the device in accordance with the applicable laws and regulations in your country.

To Disassemble

1. Ensure to shut down the device, before you begin to disassemble the meter.
2. Disconnect all the connected terminals from the meter.
3. Loosen the mounting clamps at the back of the meter.
4. Remove the side clamps on both the sides of the meter by sliding them forward.
5. Remove the meter from the panel-cutout carefully.

Note: For the use of proper tool, refer “Electrical Installation” on page 36 for more information.

Appendix A – Technical Data

Auxiliary Supply (Control Power)

The meter needs a single-phase AC or DC control supply to power its internal electronics.
Range: 44 to 277 VAC/DC.
Burden (load): < 4 VA on auxiliary supply.

Front Display

- Single row LCD display with auto-scaling capability for Kilo, Mega, Giga.
- The display provides the user access Watts, VARs, VA, power factor, frequency, kWh, kVAh, and kVARh.
- Password protection for setup parameters.
- User-selectable default display page through keypad lock.

Installation and Input Ratings

- Auto-ranging voltage inputs should allow direct connection up to 277 VLN/480VLL AC systems (no PTs/VTs required up to 480 VLL phase to phase).
- Supports the following configurations (field configurable):
  Direct 4-wire Wye (Star); 3-wire Wye (Star); 3-wire Delta; 2-phase 3-wire (2-phase); single-phase.
- 3-phase voltage and current inputs
- Volts : 44 to 277 VAC phase-neutral, 80 to 480 VAC phase-phase, Overload: Continuous 480 VLL with full accuracy, 750 VLL Max, Hz. 50 Amps: 50 mA to 6 A, Overload: 10 A continuous.
- User programmable for 5 A or 1 A secondary CTs
- Burden (Load): < 0.2 VA per Volt / Ampere input
- Frequency (Both input and auxiliary): 50 Hz +/- 5%

Environmental Conditions

- Sealed dust-proof construction. Meets IP51 for the front display and IP40 for meter body.
- 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.
- Measurement Category III.

Dimensions and Shipping

- Basic unit installed depth 82 mm (3.23 in.) with protected cover with 92 x 92 mm (3.62 x 3.62 in.) panel cut-out, flush mount.
- Bezels dimension 96 x 96 mm (3.78 x 3.78 in.). Panel cut-out 92x92 mm (3.62 x 3.62 in.).
- Weight 400 gms (0.9 lb) approx unpacked, 500 gms (1.1 lb) approx shipping. See “Mechanical Installation” on page 33 for more information.

Appendix B: Glossary

Terms

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

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

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

Firmware: Operating system within the power meter.

Float: A 32-bit floating point value returned by a register (See “Data Address” on page 50 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 Page” on page 10 for more information).

Long: A 32-bit value returned by a register (See “Data Address” on page 50 for more information).

Nominal: Typical or average

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

PT: Potential Transformers are used to control the large value of voltage.

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.

ULOC: Default display page unlock (See “Default Display Page” on page 10 for more information).

Abbreviations

Table B-1: Abbreviations

%A FS	% Amperes full scale
A, Amps	Amperes
A.PRI	Current primary winding
A.SEC	Current secondary winding
Avg	Average
CLR	Clear
CT	Current transformer
Dia, DIAG	Diagnostic
DCS	Distributed Control System
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
Min	Minimum
ms	Milliseconds
MSB	Most significant bit
O.F	Overflow
PF	Power factor
PLC	Programming Logic Controller
PT	Potential transformer
POP	Pulse Output
SYS	System configuration
ULOC	Unlock
V	Voltage
VA	Apparent power
VAh	Apparent energy
VAR	Reactive power
VARh	Reactive energy
V.PRI	Voltage primary winding
V.SEC	Voltage secondary winding
VT	Voltage transformer
W	Active power
Wh	Active energy

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