

EasyLogic™ EM6400NG+

User Manual

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Safety information

Important information

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.



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 accompany this symbol to avoid possible injury or death.

⚠️⚠️ DANGER
DANGER indicates a hazardous situation which, if not avoided, will result in death or serious injury. Failure to follow these instructions will result in death or serious injury.
⚠️ WARNING
WARNING indicates a hazardous situation which, if not avoided, could result in death or serious injury.
⚠️ CAUTION
CAUTION indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.
NOTICE
NOTICE is used to address practices not related to physical injury.

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. A qualified person is one who has skills and knowledge related to the construction, installation, and operation of electrical equipment and has received safety training to recognize and avoid the hazards involved.

Notices

FCC

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

The user is cautioned that any changes or modifications not expressly approved by Schneider Electric could void the user's authority to operate the equipment.

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

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Safety precautions

Installation, wiring, testing and service must be performed in accordance with all local and national electrical codes.

⚠️ DANGER

HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH

- Apply appropriate Personal Protective Equipment (PPE) and follow safe electrical work practices. See NFPA 70E, CSA Z462 or other local standards.
- Turn off all power supplying this device and the equipment in which it is installed before working on or in the equipment.
- Always use a properly rated voltage sensing device to confirm that all power is off.
- Follow guidelines in the Wiring section of the related Installation Sheet.
- Assume communications and I/O wiring are hazardous live until determined otherwise.
- Do not exceed the maximum ratings of this device.
- Do not short secondary terminals of Voltage Transformer (VT).
- Do not open secondary terminals of Current Transformer (CT).
- Ground secondary circuit of CTs.
- Do not use the data from the meter to confirm power is off.
- Replace all devices, doors and covers before turning on power to this equipment.

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

NOTE: See IEC 60950-1 for more information on communications and I/O wiring connected to multiple devices.

⚠️ WARNING

UNINTENDED OPERATION

- Do not use this device for critical control or protection of persons, animals, property or equipment.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

⚠️ WARNING

POTENTIAL COMPROMISE OF SYSTEM AVAILABILITY, INTEGRITY, AND CONFIDENTIALITY

- Change default passwords/passcodes to help prevent unauthorized access to device settings and information.
- Disable unused ports/services and default accounts, where possible, to minimize pathways for malicious attacks.
- Place networked devices behind multiple layers of cyber defenses (such as firewalls, network segmentation, and network intrusion detection and protection).
- Use cybersecurity best practices (for example: least privilege, separation of duties) to help prevent unauthorized exposure, loss, modification of data and logs, interruption of services, or unintended operation.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

Introduction

Meter overview

The EM6400NG+ series meters are digital meters that offer comprehensive 3-phase electrical instrumentation and load management facilities in a compact and rugged package.

The EM6400NG+ meters offer value for the demanding needs of your energy monitoring and cost management applications. All meters in the EM6400NG+ series range comply with Class 1, Class 0.5S, or Class 0.2 accuracy standards and feature high quality, reliability and affordability in a compact and easy to install format.

Meter features

The EM6400NG+ meter supports many features, a few of the features are listed below:

- LED display screen: Intuitive self-guided navigation using three buttons LED display, with three lines of concurrent values. Two columns of LEDs given on the either side of the meter's front panel indicate the parameter name being displayed.
- Energy accounting and balancing.
- Measurement of both True PF and Displacement PF.
- EM6400NG+ POP (Class 1 and 0.5S) and RS-485 (Class 1, 0.5S, and 0.2) models.
- THD% and individual harmonics up to 15th order for voltage and current.
- Active, reactive, and apparent energy readings.
- Min/Max values of instantaneous parameters with timestamp.
- Cybersecurity: The meter supports the disabling of RS-485 port through front panel keys to prevent unauthorized access. Toggle the RTU devices in case of limited availability of nodes in software system.
- Suppression current: The meter can be configured to disregard the measurement of induced / auxiliary load current in the circuit (can be set from 5 to 99 mA).

You can use the meter as a stand-alone device, but its extensive capabilities are fully realized when used as part of an energy management system.

For applications, feature details and the most current and complete specifications of the EM6400NG+ meters, see the EM6400NG+ technical datasheet at www.se.com.

Feature summary

Parameter	EM6400NG+ POP	EM6400NG+ RS-485
Accuracy Class for Wh	Class 1 Class 0.5S	Class 1 Class 0.5S Class 0.2
Accuracy Class for VARh	2.0 1.0	2.0 1.0
Sampling rate per cycle	64	64
Current: <ul style="list-style-type: none"> • Per-phase and 3 phase average • Calculated neutral current 	✓	✓

Parameter	EM6400NG+ POP	EM6400NG+ RS-485
Voltage: <ul style="list-style-type: none"> V L-N - per-phase and 3 phase average V L-L - per-phase and 3 phase average 	✓	✓
Power Factor <ul style="list-style-type: none"> Per phase and 3 phase total 	True PF	True PF Displacement PF ¹
Frequency	✓	✓
Power: <ul style="list-style-type: none"> Active power (kW) - Phase wise and total Apparent power (kVA) - Phase wise and total Reactive power (kVAR) - Phase wise and total 	✓	✓
3 Phase unbalance	Current	Current Voltage ¹
Demand parameters (kW, kVA, kVAR, I) <ul style="list-style-type: none"> Last demand Present demand Predictive demand Peak demand: Timestamp for peak demand ¹ 	✓ (no timestamp)	✓
Energy: kWh, kVAh, kVARh (4 Quadrant) <ul style="list-style-type: none"> Delivered (Import / Forward) Received (Export / Reverse) 	Delivered Received	Delivered Received Total ¹ Net ¹ Last cleared (Old) ¹
Meter On hours Load Run hours Power Interruptions	—	✓
THD: <ul style="list-style-type: none"> Voltage L-N per phase Voltage L-L per phase Current per phase 	✓	✓
Individual Harmonics ¹	—	Up to 15th odd harmonics
Min / Max with timestamp ¹ <ul style="list-style-type: none"> V L-L average V L-N average Current average Frequency Active power, Total Apparent power, Total Reactive power, Total Power factor, Total 	—	✓
RTC	—	✓
Communication	POP	RS-485 Modbus RTU
Retrofit (RtFt) For configuring legacy communication data models	—	✓

1. Indicates features that can be read through communication only.

Measured parameters

Energy

The meter provides bi-directional, 4-quadrant, Class 1 / Class 0.5S / Class 0.2 accurate energy metering.

The meter stores all accumulated active, reactive and apparent energy parameters in non-volatile memory:

- kWh, kVARh, kVAh (delivered)
- kWh, kVARh, kVAh (received)
- kWh, kVARh, kVAh (delivered + received)
- kWh, kVARh, kVAh (delivered - received)

NOTE: Based on the energy scale selection, when any of energy parameters overflow at 999999999.999 all energy parameters value resets.

Demand

The meter provides last, present, predicted, and maximum (peak) demand values, and a timestamp when the maximum (peak) demand occurred.

The meter supports standard demand calculation methods, including sliding block, fixed block, rolling block, thermal and synchronized.

Peak demand registers can be reset manually (password protected).

Demand measurements include:

- W, VAR, VA demand total
- Amps demand average

Instantaneous

The meter provides highly accurate 1-second measurements, average values, including true RMS, per phase and total for:

- Per phase and average voltage (line-to-line, line-to-neutral)
- Per phase and average current, and neutral current

NOTE: Neutral current is calculated.

- Per phase and total power (VA, W, Var)
- Per phase and average for true and displacement power factor
- System frequency
- Per phase and maximum of all three for voltage unbalance and current unbalance

Power quality

The meter provides complete harmonic distortion metering, recording, and real-time reporting, up to the 15th harmonic for all voltage and current inputs.

The following power quality measurements are available:

- Individual odd harmonics up to 15th order (voltage and current, per phase)
- Total harmonic distortion (THD%) for current and voltage (displays line-to-line or line-to-neutral, based on selected system configuration)

Data display and analysis tools

Power Monitoring Expert

EcoStruxure™ Power Monitoring Expert is a complete supervisory software package for power management applications.

The software collects and organizes data gathered from your facility's electrical network and presents it as meaningful, actionable information via an intuitive web interface.

Power Monitoring Expert communicates with devices on the network to provide:

- Real-time monitoring through a multi-user web portal
- Trend graphing and aggregation
- Power quality analysis and compliance monitoring
- Preconfigured and custom reporting

See the EcoStruxure™ Power Monitoring Expert online help for instructions on how to add your device into its system for data collection and analysis.

Related Topics

- See the StruxureWare™ PowerSCADA Expert online help for instructions on how to add your meter into its system for data collection and analysis. StruxureWare™ PowerSCADA Expert user documentation is available in PDF format and can be downloaded from www.schneider-electric.com.

Power SCADA Operation

EcoStruxure™ Power SCADA Operation is a complete real-time monitoring and control solution for large facility and critical infrastructure operations.

It communicates with your device for data acquisition and real-time control. You can use Power SCADA Operation for:

- System supervision
- Real-time and historical trending, event logging
- PC-based custom alarms

See the EcoStruxure™ Power SCADA Operation online help for instructions on how to add your device into its system for data collection and analysis.

Related Topics

- See the StruxureWare™ PowerSCADA Expert online help for instructions on how to add your meter into its system for data collection and analysis. StruxureWare™ PowerSCADA Expert user documentation is available in PDF format and can be downloaded from www.schneider-electric.com.

Meter configuration

Meter configuration is performed through the display or through ION Setup.

ION Setup is a meter configuration tool that can be downloaded for free at www.se.com.

See the EasyLogic™ EM6400NG Load Manager topic in the ION Setup online help or in the *ION Setup device configuration guide*. To download a copy, go to www.se.com and search for *ION Setup device configuration guide*.

Hardware references

Meter types

The EM6400NG+ series is available in one physical form factor.

Commercial Reference	Description
METSEEM6400NGPOCL1	Class 1 panel mount meter with pulse output and integrated display.
METSEEM6400NGPOCL5	Class 0.5S panel mount meter with pulse output and integrated display.
METSEEM6400NGRSL1	Class 1 panel mount meter with RS-485 and integrated display.
METSEEM6400NGRSL5	Class 0.5S panel mount meter with RS-485 and integrated display.
METSEEM6400NGRSL2	Class 0.2 panel mount meter with RS-485 and integrated display.

Supplemental information

This document is intended to be used in conjunction with the installation sheet that ships in the box with your device and accessories.

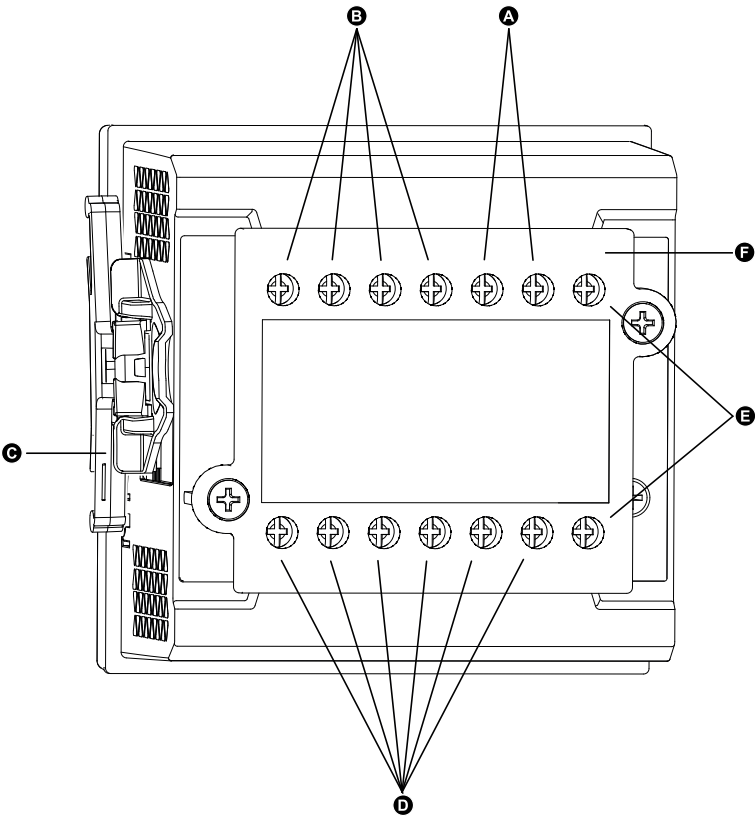
See your device's installation sheet for information related to installation.

See your product's catalog pages at www.se.com for information about your device, its options and accessories.

You can download updated documentation from www.se.com or contact your local Schneider Electric representative for the latest information about your product.

Panel meter

The back of your meter supports various power system connections.



A	Auxiliary power supply (control power) terminals (L+, N-)
B	Input voltage terminals (V1, V2, V3, VN)
C	Retainer clip
D	Input current terminals [A1(S1, S2), A2 (S1, S2), A3 (S1, S2)]
E	RS-485 communications/POP terminals (D1+, D0-)
F	Protective cover

Tamper-resistant cover

The tamper-resistant cover helps prevent tampering with the meter's voltage and current measurement inputs.

The tamper-resistant cover encloses the terminals, the conductor fixing screws and a length of the external conductors and their insulation. The covers are secured by tamper-resistant meter seals.

The meter's tamper-resistant cover must be installed by a qualified installer.

Meter mounting

For mounting instructions and safety precautions, see the installation sheet that was shipped with your device

You can also download the latest copy at www.se.com.

Meter wiring

For wiring instructions and safety precautions, see the meter installation sheet that was shipped with your meter.

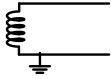

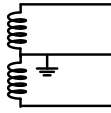
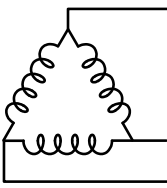
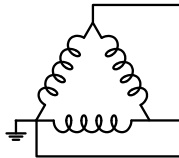
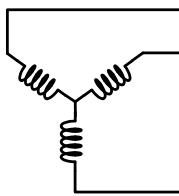
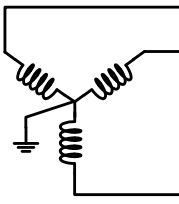
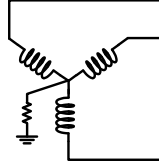
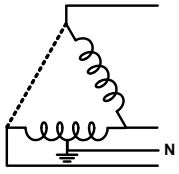
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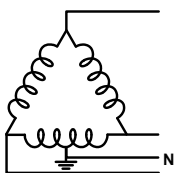
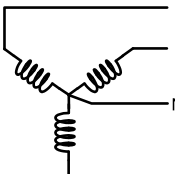
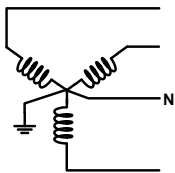
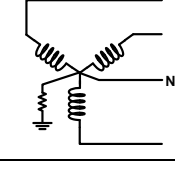
Direct connect voltage limits

You can connect the meter's voltage inputs directly to the phase voltage lines of the power system if the power system's line-to-line or line-to-neutral voltages do not exceed the meter's direct connect maximum voltage limits.

The meter's voltage measurement inputs are rated by the manufacturer for up to 277 V L-N / 480 V L-L. However, the maximum voltage allowed for direct connection may be lower, depending on the local electrical codes and regulations. As per installation category II / III the maximum voltage on the meter voltage measurement inputs should not exceed 277 V L-N / 480 V L-L for CAT III and 347 V L-N / 600 V L-L for CAT II.

If your system voltage is greater than the specified direct connect maximum voltage, you must use VTs (voltage transformers) to step down the voltages.

Power system description	Meter setting		Symbol	Direct connect maximum (UL / IEC)		# of VTs (if required)
	Display (meter)	Display (communication)		Installation category III	Installation category II	
Single-phase 2-wire line-to-neutral	1P.LN	1PH 2Wire L-N		≤ 277 V L-N	≤ 347 V L-N	1 VT
Single-phase 2-wire line-to-line	1P.LL	1PH 2Wire L-L		480 V L-L	600 V L-L	1 VT
Single-phase 3-wire line-to-line with neutral	1P.3L	1PH 3Wire L-L with N		≤ 277 V L-N / 480 V L-L	≤ 347 V L-N / 600 V L-L	2 VT
3-phase 3-wire Delta ungrounded	3P.3L	3PH 3Wire Ungrounded Delta		480 V L-L	600 V L-L	2 VT
3-phase 3-wire Delta corner grounded		3PH 3Wire Corner Grounded Delta		480 V L-L	600 V L-L	2 VT
3-phase 3-wire Wye ungrounded		3PH 3Wire Ungrounded Wye		480 V L-L	600 V L-L	2 VT
3-phase 3-wire Wye grounded		3PH 3Wire Grounded Wye		480 V L-L	600 V L-L	2 VT
3-phase 3-wire Wye resistance-grounded		3PH 3Wire Resistance Grounded Wye		480 V L-L	600 V L-L	2 VT
3-phase 4-wire open Delta center-tapped	3P.4L	3PH 4Wire Center-Tapped Open Delta		240 V L-N / 480 V L-L	240 V L-N / 480 V L-L	3 VT

Power system description	Meter setting		Symbol	Direct connect maximum (UL / IEC)		# of VTs (if required)
	Display (meter)	Display (communication)		Installation category III	Installation category II	
3-phase 4-wire Delta center-tapped		3PH 4Wire Center-Tapped Delta		240 V L-N / 480 V L-L	240 V L-N / 480 V L-L	3 VT
3-phase 4-wire ungrounded Wye		3PH 4Wire Ungrounded Wye		≤ 277 V L-N / 480 V L-L	≤ 347 V L-N / 600 V L-L	3 VT or 2 VT
3-phase 4-wire grounded Wye		3PH 4Wire Grounded Wye		≤ 277 V L-N / 480 V L-L	≤ 347 V L-N / 600 V L-L	3 VT or 2 VT
3-phase 4-wire resistance-grounded Wye		3PH 4Wire Resistance Grounded Wye		≤ 277 V L-N / 480 V L-L	≤ 347 V L-N / 600 V L-L	3 VT or 2 VT

Balanced system considerations

In situations where you are monitoring a balanced 3-phase load, you may choose to connect only one or two CTs on the phase(s) you want to measure, and then configure the meter so it calculates the current on the unconnected current input(s).

NOTE: For a balanced 4-wire Wye system, the meter's calculations assume that there is no current flowing through the neutral conductor.

Balanced 3-phase Wye system with 2 CTs

The current for the unconnected current input is calculated so that the vector sum for all three phases equal zero.

Balanced 3-phase Wye or Delta system with 1CT

The currents for the unconnected current inputs are calculated so that their magnitude and phase angle are identical and equally distributed, and the vector sum for all three phase currents equal zero.

NOTE: You must always use 3 CTs for 3-phase 4-wire center-tapped Delta or center-tapped open Delta systems.

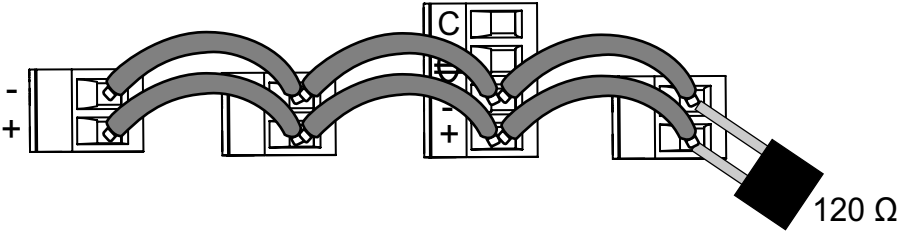
Serial communications

The meter supports serial communications through the RS-485 port. Up to 32 devices can be connected on a single RS-485 bus.

In an RS-485 network, there is one master device, typically an Ethernet to RS-485 gateway. It provides the means for RS-485 communications with multiple slave devices (for example, meters). For applications that require only one dedicated computer to communicate with the slave devices, an RS-232 to RS-485 converter can be used as the master device.

RS-485 wiring

Connect the devices on the RS-485 bus in a point-to-point configuration, with the (+) and (-) terminals from one device connected to the corresponding (+) and (-) terminals on the next device.



NOTE:


Straight-line topology only. Loop or ring topology is not supported.

Resistor is an optional accessory that you can order separately. To terminate a series, it is recommended to use a 120 Ω / 0.5 W resistor.

RS-485 cable

Use a shielded 2 wires or 1 twisted pair RS-485 cable to wire the devices. Use the twisted pair to connect the (+) and (-) terminals.

RS-485 terminals

C	Common. This provides the voltage reference (zero volts) for the data plus and data minus signals
	Shield. Connect the bare wire to this terminal to help suppress signal noise that may be present. Ground the shield wiring at one end only (either at the master or the last slave device, but not both).
-	Data minus. This transmits/receives the inverting data signals.
+	Data plus. This transmits/receives the non-inverting data signals.

NOTE: If some devices in your RS-485 network do not have the C terminal, use the bare wire in the RS-485 cable to connect the C terminal from the meter to the shield terminal on the devices that do not have the C terminal.

RS-485 maximum cable length

The total distance for devices connected on an RS-485 bus should not exceed 900 m (2953 ft).

RS-485 network configuration

After you have wired the RS-485 port and powered up the meter, you must configure the serial communications port in order to communicate with the meter. Each device on the same RS-485 communications bus must have a unique address and all connected devices must be set to the same protocol, baud rate, and parity (data format).

NOTE: To communicate with the meter using ION Setup, you must set the serial site and all connected devices in the RS-485 network to the same parity setting.

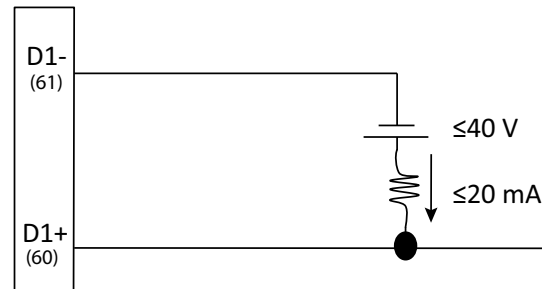
Pulse output

The meter is equipped with one pulse output port (D1+, D0-).

You can configure the pulse outputs for use in the following application:

- Energy pulsing applications, where a receiving device determines energy usage by counting the k_h pulses coming from the meter's pulse output port.

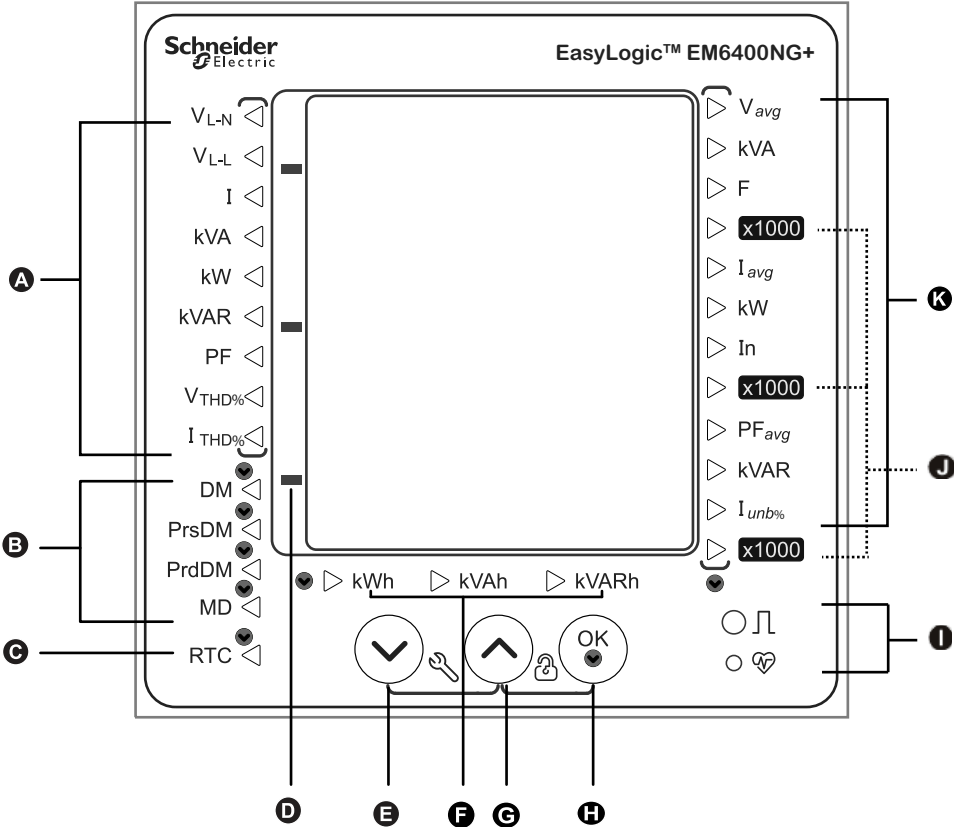
One pulse output can handle voltage less than or equal to 40 V DC (20 mA maximum). For higher voltage applications, use an external relay in the switching circuit.



Display and meter setup

Display overview

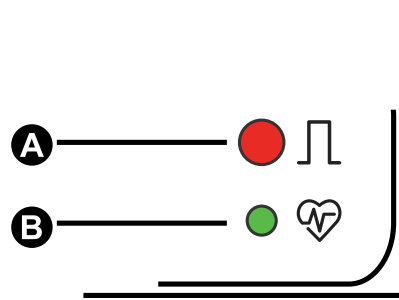
The display lets you use the meter to perform various tasks such as setting up the meter, displaying data screens, or performing resets.



A	Phase measurements	V _{L-N} , V _{L-L} , I, kVA, kW, kVAR, PF, V _{THD} %, I _{THD} %
B	Demand measurements	DM, PrsDM, PrdDM, MD
C	RTC	Date and time
D	Negative indicator	
E	Navigation key	To navigate down
F	Energy readings	Apparent energy, Active energy, and Reactive energy
G	Navigation key	To navigate up
H	OK	Enter key To toggle between measurement parameters
I	Energy pulsing LED (Red) Heartbeat / communications LED (Green)	
J	x 1000 indicator	
K	System measurements	V _{avg} , kVA, F, I _{avg} , kW, In, PF _{avg} , kVAR, I _{unb} %

LED indicators

The LED indicators alert or inform you of meter activity.



A	Alarm / energy pulsing LED (Red)
B	Heartbeat / serial communications LED (Green)

Energy pulsing LED

The EM6400NG+ meter has an energy pulsing LED that can be configured for energy pulsing.

This LED flashes at a rate proportional to the amount of energy consumed. This is typically used to verify the meter's accuracy.

NOTE: EM6400NG+ meter does not support alarm function.

Related Topics

- Troubleshooting LED indicators

Heartbeat / serial communications LED

The heartbeat / serial communications LED blinks to indicate the meter's operation and serial Modbus communications status.

The LED blinks at a slow, steady rate to indicate the meter is operational. The LED flashes at a variable, faster rate when the meter is communicating over a Modbus serial communications port.

You cannot configure this LED for other purposes.

NOTE: A heartbeat LED that remains lit and does not blink (or flash) can indicate a problem. In this case, power down the meter and reapply power. If the LED still does not blink or flash, contact Technical Support.











Related Topics

- Troubleshooting LED indicators

Button functions

The meter supports single press and combination press functions of the buttons.

Symbol	Description
	To navigate down the list of items.
Press and hold for 2 seconds.	To move cursor to the left.

Symbol	Description
	To navigate up the list of items.
 Press and hold for 2 seconds.	To move cursor to the right.
	To select a parameter.
 Press and hold for 2 seconds.	To enter into or exit Clear page.
 + 	To enter into or exit Setup page.
 + 	To enter into or exit Diagnostics page.
 + 	To lock or unlock a meter page.

Meter screen menus

All meter screens are grouped logically, according to their function. You can access any available meter screen by first selecting the Level 1 (top level) screen that contains it.

With the meter front panel, you can view parameter values; configure parameters; perform demand resets; perform LED checks; and view meter information. Each of these functions can be accomplished by pressing the Up, Down, and OK buttons on the front panel.

These button actions achieve different results according to the mode that the meter is in:

- Display mode (default): view parameter measurements
- Setup mode: configure a parameter
- Clear mode: reset measurements
- Lock mode: lock or unlock a screen

This section describes front panel navigation within each mode.

Display screen menus

In Display mode, you can view values from the following measurement groups:

- System measurements
- Phase measurements
- Energy measurements
- Demand measurements
- RTC

Viewing display parameters

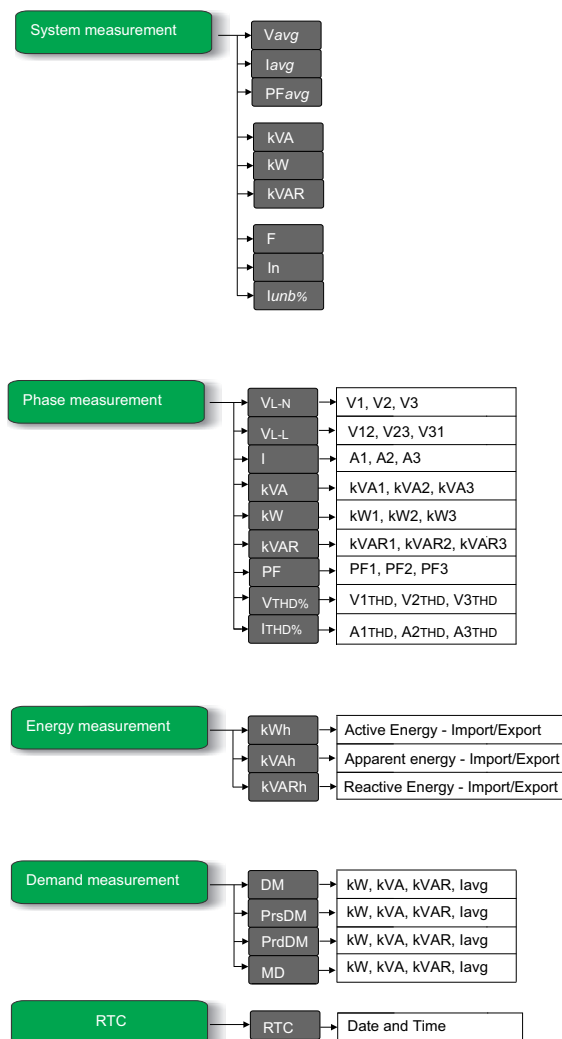
The meter's display screen and buttons allow you to view the required parameters.

1. Press the OK button to navigate to different measurement types.
2. Press the Up or Down button to navigate to the previous or next value under each measurement type.

Display screen menu tree

Use the menu tree to navigate to the setting you want to view.

The below image summarizes the available meter screens and parameters:



Display parameters

The meter displays various power system measurements.




Measurement Group	Parameters Measured
System measurements	V _{avg} , kVA, F, I _{avg} , kW, In, PF _{avg} , kVAR, I _{unb}
Phase measurements	V _{L-N} , V _{L-L} , I, kVA, kW, kVAR, PF, V _{THD} , I _{THD}
Demand measurements	DM, PrsDM, PrdDM, MD

Measurement Group	Parameters Measured
RTC	Date and time NOTE: RTC is only applicable for meters with RS-485 communication. Meters with POP do not support this function.
Energy readings	kWh (Active energy): Delivered / Received kVAh (Apparent energy): Delivered / Received kVARh (Reactive energy): Delivered / Received

NOTE: When the x 1000 LED is lit, multiply the displayed value by 1000 for the actual value.

Button functions in viewing display parameters

Display mode is the default page when you power up the meter.

Mode	Button	Function
Display Mode		To view the next parameter value.
		To view the previous parameter value.
		To move from one measurement group to the next measurement group.

Setup screen menus

Setup screen enables you to configure various setup parameters.

Below is the list of setup parameters and the configurations it supports.

EM6400NG+ meter setup menus

Setup parameters	tYPE	1P.LN, 1P.LL, 1P.3L, 3P.3L, 3P.4L
	Vt	no.Vt , 2.VT, 3.VT, 1.VT
	Vt.Pr	0100 V to 999000 V
	Vt.SE	100, 110, 115, 120
	Ct	A.1, A.2, A.3, A.12, A.23, A.31, A.123
	Ct.Pr	1 A to 32760 A
	Ct.SE	1 A, 5 A
	FrEq	50 Hz , 60 Hz
	A.SuP	5 mA
	Ct.Sq	A.123 , A.321, A.312, A.231, A.213, A.132
	Ct.rV	nonE , A.1, A.2, A.3, A.12, A.23, A.31, A.123
	Pd	Ther, t.Sb, t.b , t.rb, CS.b, CS.rb, CL.b, Cl.rb
	Pd.CY	1 to 60 mins
	Pd.ut	1 to 60 mins
	Pd.SY	00:00 - 23:59
	Ad	Ther, t.Sb, t.b , t.rb, CS.b, CS.rb, CL.b, Cl.rb
	Ad.CY	1 to 60 mins
	Ad.ut	1 to 60 mins
	Ad.SY	00:00 - 23:59
	LED	Off, EnrG, ALM
	L.PLS	1 to 9999000(Pulse per k_h)
	L.PAr	d.Wh , r.Wh, t.Wh, d.Vrh, r.Vrh, t.Vrh, d.VAh, r.VAh, t.VAh, nonE
	PASS	0000 - 9999
	CoM	ON , OFF
	Id	1 to 247
	bAud	4800, 9600, 19200 , 38400
	PrtY	Even , Odd, None
	YEA r	YYYY (2000 to 2127)
	dAtE	M(month) - 1 to 12, dd(day) - 1 to 31
	hour	HH(hours) - 00 to 23, M(minutes) - 00 to 59
	PoP	Off, EnrG
	P.PLS	1 to 9999000 (k_h)
	P.PAr	Wh , Vrh, VAh

NOTE: The setup parameters CoM, Id, bAud, Prty, YEAr, dAtE, and hour are applicable for the commercial references METSEEM6400NGRSL1, METSEEM6400NGRSL5, and METSEEM6400NGRSL2. The setup parameters PoP, P.PLS, and P.PAr are available for the commercial references.METSEEM6400NGPOCL1, and METSEEM6400NGPOCL5.

Entering setup





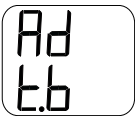



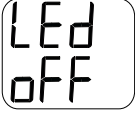


The meter's display screen and buttons allow you to navigate to and edit the required parameters.











1. Press and hold the Up key and Down key simultaneously for 2 seconds.
2. Enter the password. Default password is **0000**.
3. Press OK key to enter setup.
4. Press and hold the Up key and Down key simultaneously for 2 seconds to exit Setup after viewing parameters.



Setup parameters

The meter supports configuration of various measurement parameters.

Name on display	Description	Input range	Default value
	tYPE = Power System Configurations	Input range = 1P.Ln, 1P.LL, 1P.3L, 3P.3L, 3P.4L Default value = 3P.4L NOTE: Other power system configurations can be set through ION setup.	3P.4L
	Vt= VT Connect	Input range = no.Vt, 2.VT, 3.VT, 1.VT NOTE: The VT Connect parameters are enabled based on selected power system configuration.	no.Vt
	Vt.Pr = Primary Voltage (V L-L)	100 V to 999000 V NOTE: Vt.Pr will not be enabled if VT Connect is no. VT.	120
	Vt.SE = Secondary Voltage (V L-L)	100, 110, 115, 120 V NOTE: Vt.SE will not be enabled if VT Connect is no. VT.	120
	Ct = CT Terminal	A.1, A.2, A.3, A.12, A.23, A.31, A.123 NOTE: The Ct terminal parameters are enabled based on the selected power system and VT connect configuration.	A.123
	Ct.Pr = CT Primary	1 A to 32760 A NOTE: Ct primary can be set to 32767 A through communication.	100
	Ct.SE = CT Secondary	1 A, 5 A	5
	FrEq = System Frequency	50 Hz, 60 Hz	50
	A.SuP: A.Suppression (Minimum current at which meter starts functioning)	5 mA to 99 mA	5
	Ct.Sq = CT Sequence	Input range = A.123, A.321, A.312, A.231, A.213, A.132 NOTE: The CT Sequence is applicable for 3P.3L and 3P.4L configurations and A.123 CT Terminal value. If you change the Power System Configurations or CT Terminal value, then the CT sequence resets to the default value.	A.123
	Ct.rV = CT Polarity Correction	Input range = nonE, A1, A.2, A.3, A.12, A.23, A.31, A.123 NOTE: The CT Polarity Correction parameters are enabled based on selected Power System Configurations and CT	nonE






Name on display	Description	Input range	Default value
		Terminal value. If you change the Power System Configurations or CT Terminal value, then the CT Polarity Correction resets to the default value.	
	Pd = Power Demand	tHEr, t.Sb, t.b, t.rb, CS.b, CS.rb, CL.b, CL.rb	t.b
	Pd.CY = Power Demand Period	1 to 60 mins NOTE: The demand update time is available for rolling block methods under power demand.	15
	Pd.ut = Power Demand Update Time	1 to 60 mins NOTE: The power demand update time is available for rolling block methods under power demand.	15
	Pd.SY = Power Demand Clock Sync Time	00:00 to 23:59 NOTE: The clock sync time is available only for clock sync block and clock sync roll block methods under power demand.	00.00
	Ad = Current Demand	tHEr, t.Sb, t.b, t.rb, CS.b, CS.rb, CL.b, CL.rb	t.b
	Ad.CY = Current Demand Period	1 to 60 mins	15
	Ad.ut = Current Demand Update Time	1 to 60 mins NOTE: The current demand update time is available for rolling block methods under current demand.	15
	Ad.SY = Current Demand Clock Sync Time	00:00 to 23:59 NOTE: The clock sync time is available only for clock sync block and clock sync roll block methods under current demand.	00.00
	LEd = LED	Off, EnrG	Off
	L.PLS = LED Pulse Weight	1 to 9999000 (Pulse per k_h) NOTE: Pulse per energy values cannot be viewed if LED is off.	1
	LPAr = LED Energy Parameter	d.Wh, r.Wh, t.Wh, d.Vrh, r.Vrh, t.Vrh, d.VAh, r.VAh, t.VAh, nonE NOTE: LED parameter values cannot be viewed if LED is off.	nonE

Name on display	Description	Input range	Default value
	PASS = Password	0000 - 9999	0000
	CoM = Communication NOTE: Id, baud rate, and parity cannot be viewed if com is off.	ON, OFF, RTFT NOTE: ON / OFF: To enable / disable communications port. NOTE: Retrofit (RTFT): For configuring legacy communication data models (Applicable only in EM6400NG+ RS-485 meter model).	ON
	Id = Unit Id	1 to 247	1
	bAud = Baud Rate	4800, 9600, 19200, 38400	19200
	Prty = Parity	EVEn, odd, nonE	EVEn
	YEAr = RTC	YYYY (2000 to 2127)	NA
	dAtE = Month:Date	MM (month) - 1 to 12 dd (day) - 1 to 31	NA
	hour = Hours:Minutes	HH (hours) - 00 to 23 MM (minutes) - 00 to 59	NA
	PoP = Communication Pulse Output	Off, EnrG NOTE: Pulse weight and energy parameter cannot be viewed if POP is off.	EnrG
	P.PLS = POP Pulse Weight	1 to 9999000 (pulse per k_h)	200

Name on display	Description	Input range	Default value
	P.PAr = POP Energy Parameter	Wh, VAh, Vrh	Wh
	Indicates optional setup parameters		





Button functions in viewing setup parameters


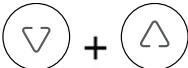
The meter supports single press and combination press functions of the buttons to view setup parameters.

Mode	Button	Function
Setup Menu		To navigate to the next parameter configuration screen.
		To navigate to the previous parameter configuration screen.
		Enter setup mode to configure the displayed parameter value.
	 + 	Press and hold the Up and Down buttons simultaneously for 2 seconds to enter Setup. Exit setup with the same button sequence.

Button functions in editing setup parameters

The meter supports single press and combination press functions of the buttons to edit setup parameters.

Mode	Button	Function
Setup Menu		Flashing Digit: To decrease the numeric value. Flashing Value: To view the next value from the list. Flashing Decimal Point: To move the decimal point to the left.
		Flashing Digit: To increase the numeric value. Flashing Value: To view the previous value from the list. Flashing Decimal Point: To move the decimal point to the right.
	 Press and hold for 2 seconds.	Flashing Digit / Flashing Decimal Point: To move the position of the cursor to left.
	 Press and hold for 2 seconds.	Flashing Digit / Flashing Decimal Point: To move the position of the cursor to right.

Mode	Button	Function
		To select a parameter to edit the values. To select configured parameter values. To save the changes made to setup parameter.
		Press and hold the Up and Down buttons simultaneously for 2 seconds to enter Setup. Exit setup with the same button sequence.

Editing setup parameters

You can edit various measurement parameters as required.

1. Press and hold the Up and Down buttons simultaneously for 2 seconds to enter Setup.
2. Enter password. Default password is **0000**.
3. Press OK.
4. Press the Up or Down button to select a parameter to edit.
The selected parameter flashes the digit, value, or decimal point that is required to be set (the meter automatically determines which option to flash for editing, depending on the parameter).
5. Increase or decrease the digit value, move the decimal point, or select a value from a pre-programmed list using the Up or Down button.
6. Press OK after making the required changes.
7. Press and hold the Up and Down buttons simultaneously for 2 seconds to exit Setup.
8. Select Yes to save your settings.

Exiting setup parameters

The following steps describe how to exit setup mode without editing any parameter values.

1. Press and hold the Up and Down buttons simultaneously for 2 seconds to enter Setup.
2. Enter password. Default password is **0000**.
3. Press OK.
4. Press the Up or Down button to view various setup parameters.
5. Press and hold the Up and Down buttons simultaneously for 2 seconds to exit Setup without making any changes to the parameter values.

Demand

Demand parameters

Demand is a measure of average consumption (typically power or current) over a fixed programmed time interval.

Power / current demand setup parameters

Parameter	Values	Description
Method	<ul style="list-style-type: none"> Thermal: Ther Timed Sliding Block: t.Sb Timed Block: t.b Timed Rolling Block: t.rb Command Sync Block: CS.b Command Sync Rolling Block: CS.rb Clock Sync Block: CL.b Clock Sync Rolling Block: CL.rb <p>NOTE: Command sync and clock sync methods are applicable for meters with RS-485 communication only.</p>	Select the appropriate demand calculation method for your needs.
Interval	1 – 60	Set the demand interval, in minutes.
Subinterval (update time)	1 – 60	Applies only to rolling block methods. Define how many subintervals the demand interval should be equally divided into.
Clock Sync Time	00:00 – 23:59	Applies only to clock sync methods (these synchronize the demand interval to the meter's internal clock). Define what time of day you want to synchronize the demand.

Viewing demand values on Display screen

You can view the demand values provided on the display screen by navigation through display parameters.

1. Press OK to navigate to demand values on display screen.
2. The LED indicates last demand (DM). The values displayed on the screen indicate kVA, kW, and kVAR.
3. Press the Down button to view I_{avg} values.
4. Repeat the steps to view present demand (PrsDM), predictive demand (PrdDM), and max demand (MD) values.

Viewing demand values in Setup screen

The meter supports editing power and current demand through setup mode.

1. Press and hold the Up and Down buttons simultaneously for 2 seconds to enter Setup.
2. Enter password. Default password is **0000**.
3. Press OK.
4. Press the Down button to select Pd (power demand) or Ad (current demand) parameter.
5. Press OK.
6. Press the Down button to select required values from the existing list.
7. Press OK.
8. Press and hold the Up and Down buttons simultaneously for 2 seconds to exit Setup.

9. Select Yes to save your settings.

Communications setup

After wiring the meter's serial communications ports, you can configure these ports so you can connect to the meter remotely and use device configuration software such as ION Setup to configure the meter.

The setup screen allows you to configure the meter's RS-485 communications port so you can use software to access the meter's data or configure the meter remotely.

To turn on communication in setup screen, follow these steps:

1. Press and hold the Up and Down buttons simultaneously for 2 seconds to enter setup.
2. Enter password. Default password is **0000**.
3. Press OK.
4. Press the Down button to select a CoM (communication) parameter.
5. Press OK.
6. Press the Down button to select **on** from the list.
7. Press OK.
8. Press and hold the Up and Down buttons simultaneously for 2 seconds to exit Setup.
9. Select Yes to save your settings.

RS-485 communication parameters

Parameter	Values	Description
Address	1 to 247	Set the address for this device. The address must be unique for each device in a communications loop.
Baud Rate	4800, 9600, 19200, 38400	Select the speed for data transmission. The baud rate must be the same for all devices in a communications loop.
Parity – Number of stop bits	Even – 1 Odd – 1 None – 2	Select None if the parity bit is not used. The parity setting must be the same for all devices in a communications loop.

NOTE: Communication parameters display ON / OFF / Retrofit (RTFT).

NOTE: Retrofit provides you an option of configuring legacy data models for your device to communicate with newer models. (Applicable only in EM6400NG+ RS-485 meter model).

Setting up the password

The meter password can only be configured through the front panel.

The factory-default setting for all passwords is "0000" (zero). Changing the default password for screens that are password protected prevents unauthorized personnel from accessing certain screens such as the Setup and Clear screens.

To change the meter password using Setup, follow these steps:

1. Press and hold the Up and Down buttons simultaneously for 2 seconds to enter Setup.
2. Enter password. Default password is **0000**.
3. Press OK.
4. Press the Down button to select PASS (password) parameter.
5. Press OK.

- Press the Down button to change the digits.

NOTE: Hold Down button for 2 seconds to move the cursor to the next digit.

- Press OK.
- Press and hold the Up and Down buttons simultaneously for 2 seconds to exit Setup.
- Select Yes to save your settings.

Password settings

Parameter	Values	Description
Pass	0000 - 9999	Sets the password for accessing the meter setup screen. NOTE: Common password applies across all parameters.

Lost password

Visit www.se.com for support and assistance with lost passwords or other technical problems with the meter. Make sure you include your meter's model, serial number and firmware version in your email or have it readily available if calling Technical Support.

Setting up date and time

The Clock setup allows you to set the meter's date and time.

- Press and hold the Up and Down buttons simultaneously for 2 seconds to enter Setup.
- Enter password. Default password is **0000**.
- Press OK.
- Press the Down button to select year, date, and hour parameter.
- Press OK.
- Press Down button to change the digits.

NOTE: Hold the Down button for 2 seconds to move the cursor to the next digit.

- Press OK.
- Press and hold the Up and Down buttons simultaneously for 2 seconds to exit Setup.
- Select Yes to save your settings.

NOTE: You must always set or sync the meter time to local time.

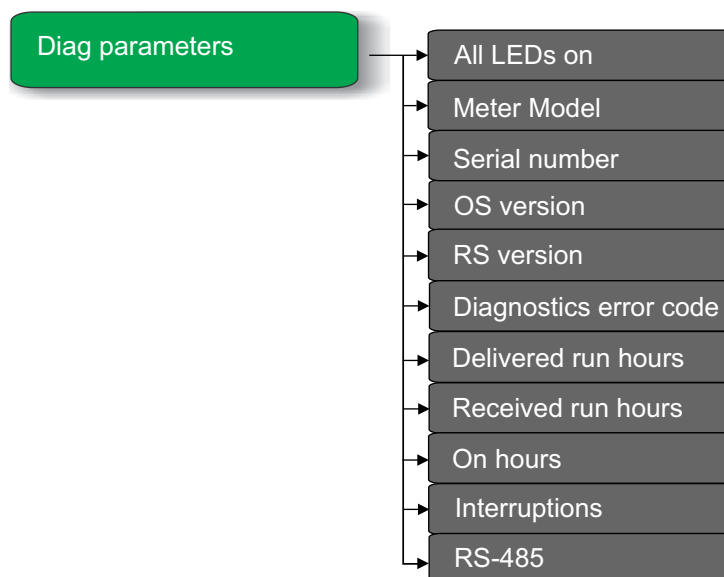
Clock setup parameters

Parameter	Values	Description
Year	YYYY	Set the current year using format displayed on screen.
Date	MM:DD	Set the current date using the format displayed on screen, where date is in MM (month) and DD (date) format.
Hour	HH:MM	Use the 24 hours format to set the current time in local time, where the time is in HH (hour) and MM (minutes) format.

Diagnostics (Diag) screen menus

In Diag, you can verify the front panel LEDs, and view meter information.

Below is the list of Diag parameter that are displayed on the meter screen.

EM6400NG+ meter diag menus**Viewing Diag**

The meter's display screen and buttons allow you to navigate to the Diag.

1. Press and hold the Down and OK buttons simultaneously for 2 seconds to view Diag.
2. Press the Down button to navigate to the next screen.
3. Press and hold the Down and OK buttons simultaneously for 2 seconds to exit Diag.

Diag screens





The meter displays various diagnostics screens.

Screens	Description	
All LEDs on	On entering diag screen, all LEDs on the front panel light up. The display shows four eights (8888), four decimal points (....) per line, negative indicators, and parameter LEDs. This indicates that the front panel LEDs and display are operating correctly.	
Meter Model	Displays the meter model number.	
Serial number	Displays the meter serial number, for example SN.0500005174. NOTE: Ensure you have your meter's serial number information available while contacting Technical Support for help.	
OS version	Displays the operating system version number, for example OS 1.00.0.	
RS version	Displays the reset (boot code) version number, for example RS 1.00.0.	
Diagnostics error code	Displays the error codes of the meter for diagnostics. The following are the diagnostics error codes. <ul style="list-style-type: none"> • 0003 is the error code for RAM failure. • 0005 is the error code for NVRAM failure. • 0009 is the error code for RTC failure. • 0011 is the error code for Calibration failure. • 0021 is the error code for Clipping detected. • 0041 is the error code for Over-Running energy pulse output. • 0081 is the error code for Backup RAM failure. • 0101 is the error code for Language file mismatch. • 0201 is the error code for Language string mismatch. 	
Run hours	Delivered / Import	Indicates the period the load has been delivered. This counter accumulates as long as the load is ON.

Screens	Description	
	Received / Export	Indicates the period the load has been received. This counter accumulates as long as the load is ON.
On hours	Indicates the period for which the power meter's auxiliary supply is ON, regardless of the voltage and current inputs.	
Interruptions	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.	
RS-485	Communication error code	Displays the communication errors of the meter. The following are the communication error codes. <ul style="list-style-type: none"> • F is the error code for Illegal function error • A is the error code for Data Address error • D is the error code for Data value error • E is the error code for Slave device failure error • B is the error code for Device busy error • C is the error code for CRC error • O is the error code for Over Run error • U is the error code for Unit ID error
	Communication settings screen	Displays the unit ID, baud rate, and parity values of the meter.

Button functions in viewing Diag screen

The meter supports single press and combination press functions of the buttons to view Diag screens.

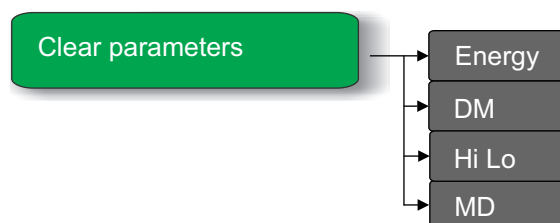
Mode	Button	Function
Setup Menu		To navigate to the next screen.
		To navigate to the previous screen.
	 + 	Press and hold the Down and OK buttons simultaneously for 2 seconds to view Diag. Exit Diag screen with the same button sequence.

Clear screen menus

Clear screen enables you to reset energy, demand, min / max, or max demand values.

Below is the list of clear screen parameter that are displayed on the meter screen.

Meter clear screen menus



Entering Clear screen

The meter's display screen and buttons allow you to navigate to Clear.

1. Press and hold the OK button for 2 seconds.

2. Press the Up button to select Yes.
3. Press OK.
4. Enter password. Default password is **0000**.
5. Press OK.
6. Press the Down or Up button to navigate to the required parameter for clearing the values.
7. Press and hold the OK button simultaneously for 2 seconds to exit Clear screen.




Clear parameters

The meter supports reset of various parameters.

Parameters	Description
Energy	Resets the energy values. The meter supports reset of the following parameter values: <ul style="list-style-type: none"> • Active energy - Import / Export • Reactive energy - Import / Export • Apparent energy - Import / Export • Run Hour
DM	Used for demand synchronization function. The meter supports reset of the following parameter values: <ul style="list-style-type: none"> • Last demand • Present demand • Predictive demand
Hi Lo	Resets the minimum and maximum (min/max) values. The meter supports reset of the following parameter values: <ul style="list-style-type: none"> • V L-L average • V L-N average • Current average • Frequency • Active power, Total • Apparent power, Total • Reactive power, Total • Power factor, Total
MD	Resets the maximum demand values. <ul style="list-style-type: none"> • W, VA, VAR, and current demand with timestamp

Button functions in editing Clear parameters

The meter supports single press functions of the buttons to enter Clear screens.

Mode	Button	Function
Clear Screen		Press and hold OK button for 2 seconds to enter Clear. Press OK button to clear/reset parameter values. Press and hold OK button for 2 seconds to exit Clear.
		To navigate to the next parameter.
		To navigate to the previous parameter.

Lock / Unlock

Lock enables you to set the a meter screen to default screen. You can scroll to other display screens while a screen has been locked. Once the manual scrolling is stopped, the meter displays the default (lock) screen after four minutes.

The meter's display screen and buttons allow you to lock or unlock any screen.

To lock / unlock a meter screen:

- Press and hold the Up and OK buttons simultaneously for 2 seconds to lock or unlock a meter screen.



NOTE:

You can only lock the display parameters.

You cannot enter the Setup or Clear when a meter screen is locked.

Button functions in locking / unlocking meter screen

The meter supports a combination press function of the buttons to lock or unlock a screen.

Mode	Button	Function
Lock / Unlock	 + 	Press and hold the Up and OK buttons simultaneously for 2 seconds to lock or unlock a meter screen.

Remote meter setup

Overview

You can configure the meter's setup parameters through the meter's RS-485 communications port.

The meter is factory-configured with default RS-485 communications port settings. You must modify the default settings before connecting the meter to your RS-485 network. To configure the RS-485 port, you need:

- ION Setup

NOTE: Remote meter setup is applicable only for meter models supporting RS-485 communication.

ION setup

Go to www.se.com and search for ION Setup to download a copy of the installation file.

If you already have an existing installation of ION Setup, it is recommended that you upgrade to the latest version in order to access new features or enhancements and properly configure features available on your device.

Refer to the online help to learn how to use ION Setup.

RS-485 port setup

The meter is factory-configured with default serial communications settings that you may need to modify before connecting the meter to the RS-485 bus.

The meter is factory-configured with the following default serial communications settings:

- Protocol = Modbus RTU
- Address = 1
- Baud rate = 19200
- Parity = Even

You can use a communications converter (USB to RS-485 or RS-232 to RS-485) device to connect to the meter.

Using a serial communications converter to set up RS-485

You can use a communications converter (USB to RS-485 or RS-232 to RS-485) to connect to the meter.

NOTE: Configuring the serial communications settings using this method may cause ION Setup to lose communications when the changes are sent to your meter. You must reconfigure ION Setup to match the new settings to re-establish communications with your meter.

1. Configure the serial communications converter's settings to be compatible with the meter's default communications settings.
2. Connect the meter's RS-485 port to the serial communications converter.
3. Connect the communications converter to the computer.
4. Start ION Setup in Network mode.

5. Add a serial site and set its properties:
 - Comm link = Serial
 - Comm port = select which serial (or USB) port the communications converter is attached to
 - Baud rate = 19200
 - Format = select a format with even parity
6. Add a meter to the site and set its properties:
 - Type = EM6400NG series load manager
 - Unit ID = 1
7. Use the setup screens to modify the meter's setup parameters.
8. Use the **RS-485 Base Comm** setup screen to modify the meter's serial communication settings.
9. Click **Send** to save your changes to the meter. You need to reconfigure ION Setup to match the changed settings in order to re-establish communications with your meter.
10. Exit ION Setup.

RS-485 port settings

Parameter	Values	Description
Protocol	Modbus RTU	Select the communications format used to transmit data. The protocol must be the same for all devices in a communications loop. ION Setup does not support ASCII 8, ASCII 7 or JBus protocols.
Address	1 to 247	Set the address for this device. The address must be unique for each device in a communications loop.
Baud rate	4800, 9600, 19200, 38400	Select the speed for data transmission. The baud rate must be the same for all devices in a communications loop.
Parity	Even, Odd, None	Select None if the parity bit is not used. The parity setting must be the same for all devices in a communications loop.

Meter setup through RS-485

After the meter's RS-485 port is configured and connected to the RS-485 network, you can use ION Setup to configure all other meter setup parameters.

Related Topics

- Using a serial communications converter to set up RS-485

Meter configuration using ION setup

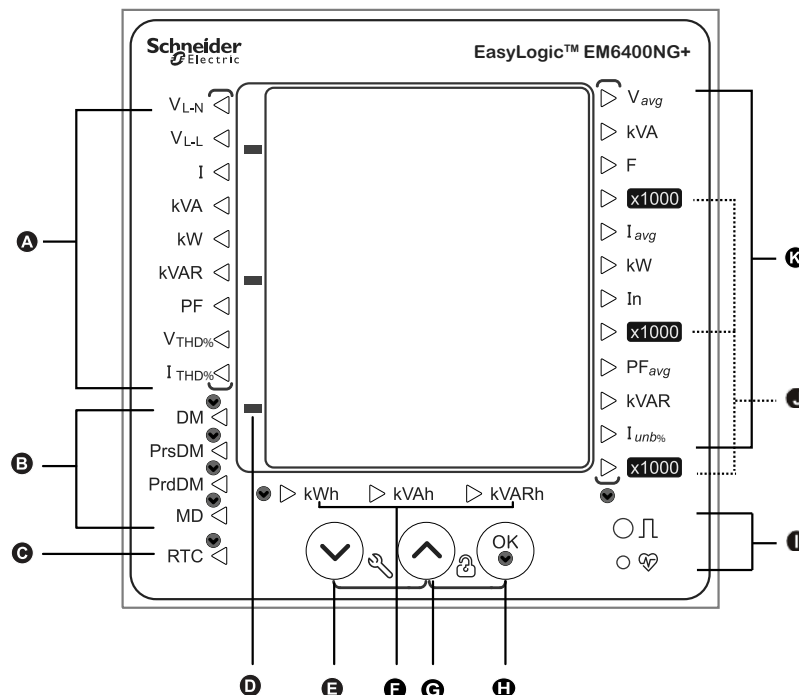
Start ION Setup, create a site (or if applicable, use an existing site), then add your meter to the site.

See the "EM6400NG series" topic in the ION Setup online help or in the ION Setup device configuration guide. To download a copy, go to www.se.com and search for ION Setup device configuration guide.

Viewing meter data

Viewing meter data from the display

Voltage average, current average, and power factor average are displayed the first time a meter is powered up, after which the last viewed screen or locked (default) screen is displayed every time the meter is powered up.



Meters data screens

The meter screens in EM6400NG+ meter is divided as per phase measurements, system measurements, demand measurements, energy measurements, and RTC.

Meter data display screens

The screen menu items are listed below:

System measurements

V _{avg}	Voltage 3 phase average
kVA	Apparent power total
F	Frequency (Hz)
x1000	Multiplication factor
I _{avg}	Current 3 phase average
kW	Active power total
In	Neutral current
x1000	Multiplication factor
PF _{avg}	Power factor average
kVAR	Reactive power total
I _{unb}	Current unbalance
x1000	Multiplication factor

Phase measurements

V _{L-N}	Voltage Line to neutral		V1	V2	V3
V _{L-L}	Voltage Line to Line		V12	V23	V31
I	Current		A1	A2	A3
kVA	Apparent Power		kVA1	kVA2	KVA3
kW	Active Power		kW1	kW2	kW3
kVAR	Reactive Power		kVAR1	KVAR2	KVAR3
PF	Power factor	– : Leading PF	PF1	PF2	PF3
		+: Lagging PF			
V _{THD}	Voltage THD%		V1 _{THD}	V2 _{THD}	V3 _{THD}
I _{THD}	Current THD%		A1 _{THD}	A2 _{THD}	A3 _{THD}

Energy measurements

kWh	Active energy - Import / Delivered (+)				
	Active energy - Export / Received (-)				
kVAh	Apparent energy - Import / Delivered (+)				
	Apparent energy - Export / Received (-)				
kVARh	Reactive energy - Import / Delivered (+)				
	Reactive energy - Export / Received (-)				

Demand measurements

DM	Last Demand	kVA	kVAR	kW	I _{avg}
PrsDM	Present/ Raising demand	kVA	kVAR	kW	I _{avg}
PrdDM	Predictive demand	kVA	kVAR	kW	I _{avg}
MD	Max demand	kVA	kVAR	kW	I _{avg}

RTC

RTC	Date and time	Year / Date / Hour
-----	---------------	--------------------

Using ION Setup to view or modify configuration data

You can use ION setup to view or modify the meter setup parameters.

Using software to view meter data

There are different software systems and methods you can use to access or display the meter data. This can range from using a simple Modbus register interface to read stored values in the meter's registers, to viewing intelligent information from the meter through an energy management system.

Power Monitoring Expert

EcoStruxure™ Power Monitoring Expert is a complete supervisory software package for power management applications.

The software collects and organizes data gathered from your facility's electrical network and presents it as meaningful, actionable information via an intuitive web interface.

Power Monitoring Expert communicates with devices on the network to provide:

- Real-time monitoring through a multi-user web portal
- Trend graphing and aggregation
- Power quality analysis and compliance monitoring
- Preconfigured and custom reporting

See the EcoStruxure™ Power Monitoring Expert online help for instructions on how to add your device into its system for data collection and analysis.

Related Topics

- See the StruxureWare™ PowerSCADA Expert online help for instructions on how to add your meter into its system for data collection and analysis. StruxureWare™ PowerSCADA Expert user documentation is available in PDF format and can be downloaded from www.schneider-electric.com.

Power SCADA Operation

EcoStruxure™ Power SCADA Operation is a complete real-time monitoring and control solution for large facility and critical infrastructure operations.

It communicates with your device for data acquisition and real-time control. You can use Power SCADA Operation for:

- System supervision
- Real-time and historical trending, event logging
- PC-based custom alarms

See the EcoStruxure™ Power SCADA Operation online help for instructions on how to add your device into its system for data collection and analysis.

Related Topics

- See the StruxureWare™ PowerSCADA Expert online help for instructions on how to add your meter into its system for data collection and analysis. StruxureWare™ PowerSCADA Expert user documentation is available in PDF format and can be downloaded from www.schneider-electric.com.

Modbus command interface

Most of the meter's real-time and logged data, as well as basic configuration and setup of meter features, can be accessed and programmed using a Modbus command interface as published in the meter's Modbus register list.

This is an advanced procedure that should only be performed by users with advanced knowledge of Modbus, their meter, and the power system being monitored. For further information on the Modbus command interface, contact Technical Support.

See your meter's Modbus register list at www.se.com for the Modbus mapping information and basic instructions on command interface.

Measurements and calculations

Meter initialization

Meter Initialization is a special command that clears the meter's energy, power, demand values, and meter operation timer.

It is common practice to initialize the meter after its configuration is completed, before adding it to an energy management system.

After configuring all the meter setup parameters, navigate through the different meter display screens and make sure the displayed data is valid then perform meter initialization.

NOTE: You can perform meter initialization using ION setup and secured command interface.

Real-time readings

The meter measures currents and voltages, and reports in real time the RMS (Root Mean Squared) values for all three phases and neutral.

The voltage and current inputs are continuously monitored at a sampling rate of 64 samples per cycle. This amount of resolution helps enable the meter to provide reliable measurements and calculated electrical values for various commercial, buildings and industrial applications.

Energy measurements

The meter provides fully bi-directional, 4-quadrant energy metering.

The meter stores all accumulated active, reactive and apparent energy measurements in nonvolatile memory:

- kWh, kVARh, kVAh (delivered)
- kWh, kVARh, kVAh (received)
- kWh, kVARh, kVAh net (delivered - received)
- kWh, kVARh, kVAh absolute (delivered + received)

All energy parameters represent the total for all three phases.

NOTE: Based on the energy scale selection, when kWh, kVARh, kVAh (delivered) or kWh, kVARh, kVAh (received) of the energy parameters overflow at 999999999.999 all energy parameters value resets.

Quadrant based VARh

NOTE: Applicable only in EM6400NG+ RS-485 meter model.

Quadrant based reactive energy values are available only on communication. These reactive energies are for Q1, Q2, Q3 and Q4 quadrants.

On communication quadrant based reactive energies will be recorded as follows:

- Q1 (00 to 90 Degree) = Q1 VARh, Del
- Q2 (90 to 180 Degree) = Q2 VARh, Del
- Q3 (180 to 270 degree) = Q3 VARh, Rec
- Q4 (270 to 360 degree) = Q4 VARh, Rec

If energy is cleared, all quadrant based VARhs will be cleared.

Min/max values

When the readings reach their lowest or highest value, the meter updates and saves these min/max (minimum and maximum) quantities in non-volatile memory.

The meter's real-time readings are updated once every 50 cycles for 50 Hz systems, or once every 60 cycles for 60 Hz systems.

Power demand

Power demand is a measure of average power consumption over a fixed time interval.

NOTE: If not specified, references to demand are assumed to mean power demand.

The meter measures instantaneous consumption and can calculate demand using various methods.

Power demand calculation methods

Power demand is calculated by dividing the energy accumulated during a specified period by the length of that period.

How the meter performs this calculation depends on the method and time parameters you select (for example, timed rolling block demand with a 15-minute interval and 5-minute subinterval).

To be compatible with electric utility billing practices, the meter provides the following types of power demand calculations:

- Block interval demand
- Synchronized demand
- Thermal demand

You can configure the power demand calculation method from the display or software.

Block interval demand

For block interval demand method types, you specify a period of time interval (or block) that the meter uses for the demand calculation.

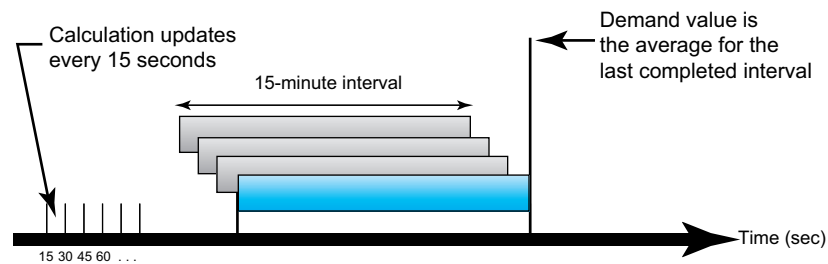
Select/configure how the meter handles that interval from one of these different methods:

Type	Description
Timed Sliding Block	Select an interval from 1 to 60 minutes (in 1-minute increments). If the interval is between 1 and 15 minutes, the demand calculation <i>updates every 15 seconds</i> . If the interval is between 16 and 60 minutes, the demand calculation <i>updates every 60 seconds</i> . The meter displays the demand value for the last completed interval.
Timed Block	Select an interval from 1 to 60 minutes (in 1-minute increments). The meter calculates and updates the demand at the end of each interval.
Timed Rolling Block	Select an interval and a subinterval. The subinterval must divide evenly into the interval (for example, three 5-minute subintervals for a 15-minute interval). Demand is <i>updated at the end of each subinterval</i> . The meter displays the demand value for the last completed interval.

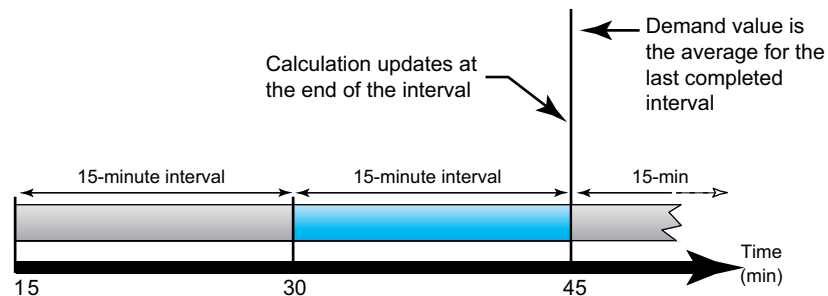
Block interval demand example

The following illustration shows the different ways power demand is calculated using the block interval method. In this example, the interval is set to 15 minutes.

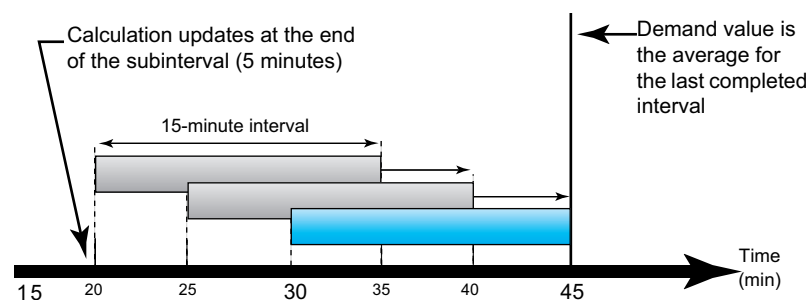
Timed Sliding Block



Timed Block



Timed Rolling Block



Synchronized demand

You can configure the demand calculations to be synchronized using an external pulse input, a command sent over communications, or the device's internal real-time clock.

Type	Description
Command synchronized demand	This method allows you to synchronize the demand intervals of multiple meters on a communications network. For example, if a programmable logic controller (PLC) input is monitoring a pulse at the end of a demand interval on a utility revenue meter, you can program the PLC to issue a command to multiple meters whenever the utility meter starts a new demand interval. Each time the command is issued, the demand readings of each meter are calculated for the same interval.
Clock synchronized demand	This method allows you to synchronize the demand interval to the meter's internal real-time clock. This helps you synchronize the demand to a particular time, typically on the hour (for example, at 12:00 am). If you select another time of day when the demand intervals are to be synchronized, the time must be specified in minutes from midnight. For example, to synchronize at 8:00 am, select 480 minutes.

NOTE: For these demand types, you can choose block or rolling block options. If you select a rolling block demand option, you need to specify a subinterval.

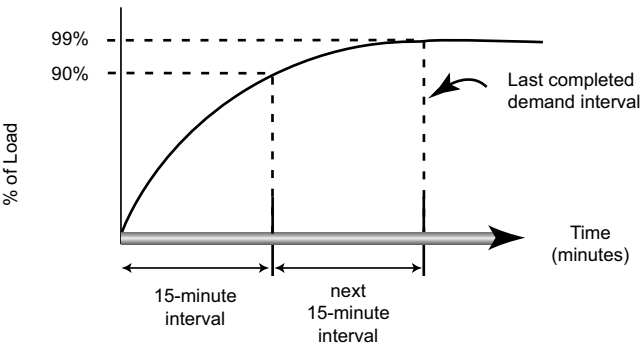
Thermal demand

Thermal demand calculates the demand based on a thermal response, which imitates the function of thermal demand meters.

The demand calculation updates at the end of each interval. You can set the demand interval from 1 to 60 minutes (in 1-minute increments).

Thermal demand example

The following illustration shows the thermal demand calculation. In this example, the interval is set to 15 minutes. The interval is a window of time that moves across the timeline. The calculation updates at the end of each interval.



Current demand

The meter calculates current demand using the block interval, synchronized or thermal demand methods.

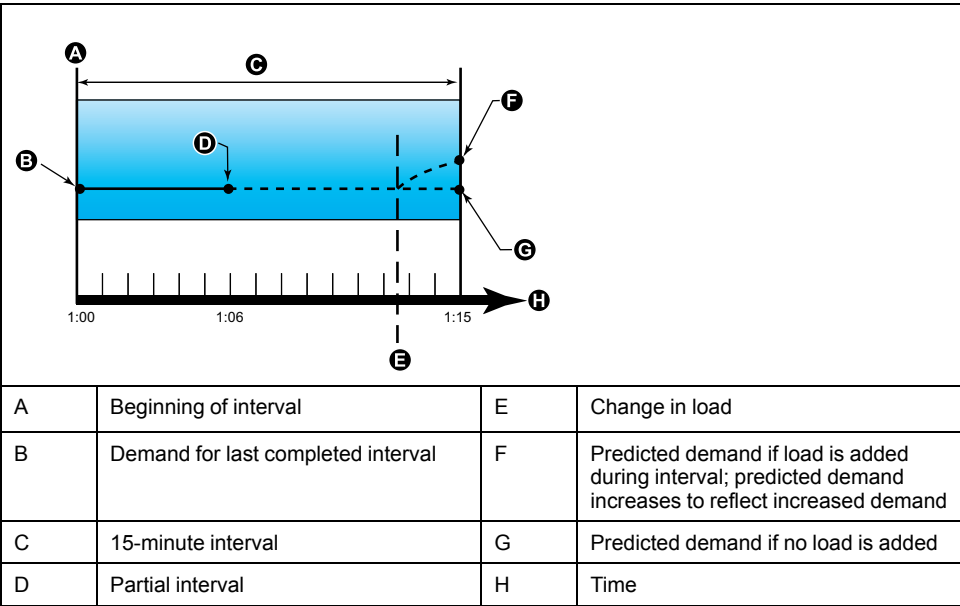
You can set the demand interval from 1 to 60 minutes in 1 minute increments (for example, 15 minutes).

Predicted demand

The meter calculates predicted demand for the end of the present interval for kW, kVAR, and kVA demand, taking into account the energy consumption so far within the present (partial) interval and the present rate of consumption.

Predicated demand is updated according to the update rate of your meter.

The following illustration shows how a change in load can affect predicted demand for the interval. In this example, the interval is set to 15 minutes.



Peak demand

The meter records the peak (or maximum) values for kWD, kVARD, and kVAD power (or peak demand).

The peak for each value is the highest average reading since the meter was last reset. These values are maintained in the meter's non-volatile memory.

The meter also stores the date and time when the peak demand occurred.

Timer

The meter supports an active load timer, meter operation timer, and load run hours

Active load timer

Active load timer shows how much time a load has been running, based on the specified minimum current for the load timer setpoint setting.

The active load timer data can be read through communication only.

Meter operation timer

Meter operating timer shows how long the meter has been powered up.

Load run hours

Load run hours show how much time a load has been running, based on accumulated energy - received and delivered.

Load run hour counter is available under diag page. Run hours are displayed with 6 digits for Hours and 2 digits for Minutes. These run hour counters shall reset along with energy values.

Power quality

Harmonics overview

This section describes the meter's power quality features and how to access power quality data. The meter measures voltage and current harmonics up to the 15th harmonic, and calculates Total Harmonic Distortion (THD%).

Harmonics are integer multiples of the fundamental frequency of the power system. Harmonics information is required for compliance to system power quality standards such as EN50160 and meter power quality standards such as IEC 61000-4-30.

The meter measures fundamental and higher harmonics relative to the fundamental frequency. The meter's power system setting defines which phases are present and determines how line-to-line or line-to-neutral voltage harmonics and current harmonics are calculated.

Harmonics are used to identify whether the supplied system power meets required power quality standards, or if non-linear loads are affecting your power system. Power system harmonics can cause current flow on the neutral conductor, and damage to equipment such as increased heating in electric motors. Power conditioners or harmonic filters can be used to minimize unwanted harmonics.

Total harmonic distortion %

Total harmonic distortion (THD%) is a measure of the total per-phase voltage or current harmonic distortion present in the power system.

THD% provides a general indication of the quality of a waveform. THD% is calculated for each phase of both voltage and current.

Harmonic content calculations

Harmonic content (H_C) is equal to the RMS value of all the non-fundamental harmonic components in one phase of the power system.

The meter uses the following equation to calculate H_C :

$$H_C = \sqrt{(H_2)^2 + (H_3)^2 + (H_4)^2 \dots}$$

THD% calculations

THD% is a quick measure of the total distortion present in a waveform and is the ratio of harmonic content (H_C) to the fundamental harmonic (H_1).

By default, the meter uses the following equation to calculate THD%:

$$THD = \frac{H_C}{H_1} \times 100\%$$

Displaying harmonics data

The meter displays voltage and current THD% data on the front panel, while the phase wise THD% data can be read through communication.

1. Press OK button to navigate to phase parameters.

2. Press Down button to view V_{THD} and I_{THD} values.

NOTE:

The LED rows display $V1_{THD}$, $V2_{THD}$, and $V3_{THD}$ for V_{THD} values, and $A1_{THD}$, $A2_{THD}$, and $A3_{THD}$ for I_{THD} values.

Maintenance and upgrades

Maintenance overview

The meter does not contain any user-serviceable parts. If the meter requires service, contact your local Schneider Electric Technical Support representative.

NOTICE

METER DAMAGE

- Do not open the meter case.
- Do not attempt to repair any components of the meter.

Failure to follow these instructions can result in equipment damage.

Do not open the meter. Opening the meter voids the warranty.

Troubleshooting LED indicators

Abnormal heartbeat / serial communications LED behavior could mean potential problems with the meter.

Problem	Probable causes	Possible solutions
LED flash rate does not change when data is sent from the host computer.	Communications wiring	If using a serial-to-RS-485 converter, trace and check that all wiring from the computer to the meter is properly terminated.
	Internal hardware problem	Perform a hard reset: turn off control power to the meter, then re-apply power. If the problem persists, contact Technical Support.
Heartbeat / serial communications LED remains lit and does not flash ON and OFF	Internal hardware problem	Perform a hard reset: turn off control power to the meter, then re-apply power. If the problem persists, contact Technical Support.
Heartbeat / serial communications LED flashes, but the display is blank.	Display setup parameters incorrectly set	Review display parameter setup.

If the problem is not fixed after troubleshooting, contact Technical Support for help and ensure you have your meter’s firmware version, model and serial number information available.

Related Topics

- Energy pulsing LED
- Heartbeat / serial communications LED

Meter memory

The meter stores configuration and logging information in non-volatile memory and a long-life memory chip.

The meter uses its non-volatile memory (NVRAM) to retain all data and metering configuration values.

Meter battery

The internal battery in the meter keeps the meter's clock running when it is powered down to help maintain the meter time.

The life expectancy of the meter's internal battery is estimated to be over 10 years at 25 °C under typical operating conditions.

Viewing firmware version, model and serial number

You can view the meter's firmware version, model and serial number from the display panel.

1. Press and hold Down and OK button for 2 seconds to enter Diag page. Meter display shows all LEDs turned on.
2. Press Down button to view meter model, serial number, OS version, and RS version.
3. Press and hold Down and OK button for 2 seconds to exit Diag page.

Firmware upgrades

There are a number of reasons why you may want to upgrade your meter's firmware.

- Improve meter performance (e.g., optimize processing speed)
- Enhance existing meter features and functions
- Add new functionality to the meter
- Achieve compliance to new industry standards

Firmware upgrade using DLF3000

The meter contains firmware that can be upgraded using DLF3000.

1. Download the latest version of DLF3000 from www.se.com, then install it on your computer.

NOTE: DLF3000 is a free Schneider Electric utility for downloading firmware to your meter.

2. Download your meter's firmware from www.se.com.
3. Start DLF3000.
4. Click **Add**. Navigate to the folder where you saved your meter's firmware.
5. Select the firmware file and click **Open**.
6. Select the firmware, then click **Next**.
7. If you haven't defined an upgrade system yet:
 - Click **New**, then type in the box to assign a system name
 - Click **Add**, then type in the box to assign a communications connection name
 - Select the communications driver as Serial Driver
8. Click **Continue**.

9. Click **Add Device**.
 - Type in the box to assign a device name
 - Select the **NG6400LED** device type from the list
 - Select the connection name, i.e., the one you defined in the previous step
10. Click **Next**.
11. Make sure the connection name, i.e., the one you defined in the previous step, is still selected. Enter the device address.
12. Select the protocol (e.g., Modbus).
13. Click **OK**.
14. Click **Next**.
15. Select the device name from the **Download Candidate Devices** pane, then click the right arrow button to move the selection to the **Download Target Devices** pane.
16. Select the meter firmware in the **Firmware to** field.
17. Click **Next**.
18. Click **Health Check** to confirm the meter is communicating. The Health Status shows **Passed** to indicate successful communications.
19. Click **Next**.
20. The Firmware Update Group shows the connection name, the firmware version and status (should be "Queued"). The Group Device List shows the device or devices being upgraded. Click **Download**.

NOTE: A warning message displays, "Warning: Relays on PowerLogic Metering Devices will be de-energized if selected for download and will remain in this mode until a successful download is completed. Press **OK** to start the download."
21. Click **OK**.
 - The Firmware Upgrade Group status changes to Active, then updates to show the current upgrade progress (in percent complete).
 - The Group Device List status shows "Entering Download Mode", then changes to "Downloading" when the firmware is being downloaded to the meter. "Estimated Time Remaining" shows the firmware download progress.
 - You can also check the progress on meters display panel. The meter display shows "Download in progress" and a shows a dynamically incrementing number for "Percent Complete" (up to 100%).
22. When the firmware upgrade is complete, the Firmware Update Group status shows Complete (Passed). The Group Device List status shows Successful Download. Click **Finished**.
23. To exit the download firmware program, click **Yes** when prompted to quit DLF.

NOTE: A maximum of 32 devices can be upgraded in parallel through DLF.

Technical assistance

Make sure you include your meter's model, serial number and firmware version in your email or have it readily available if calling Technical Support.

Verifying accuracy

Overview of meter accuracy

All meters are tested and verified at the factory in accordance with International Electrotechnical Commission (IEC) and Institute of Electrical and Electronics Engineers (IEEE) standards.

Your meter typically does not require re-calibration. However, in some installations a final accuracy verification of the meters is required, especially if the meters will be used for revenue or billing applications.

Accuracy test requirements

The most common method for testing meter accuracy is to apply test voltages and currents from a stable power source and compare the meter's readings with readings from a reference device or energy standard.

Signal and power source

The meter maintains its accuracy during voltage and current signal source variations but its energy pulsing output needs a stable test signal to help produce accurate test pulses. The meter's energy pulsing mechanism needs approximately 10 seconds to stabilize after every source adjustment.

The meter must be connected to control power in order to conduct accuracy verification testing. Refer to your meter's installation documentation for power supply specifications.

DANGER

HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH

Verify the device's power source meets the specifications for your device's power supply.

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

Control equipment

Control equipment is required for counting and timing the pulse outputs from an energy pulsing LED.

- Most standard test benches have an arm equipped with optical sensors to detect LED pulses (the photodiode circuitry converts detected light into a voltage signal).
- The reference device or energy standard typically has digital inputs that can detect and count pulses coming from an external source (i.e., the meter's pulse output).

NOTE: The optical sensors on the test bench can be disrupted by strong sources of ambient light (such as camera flashes, florescent tubes, sunlight reflections, floodlights, etc.). This can cause test errors. Use a hood, if necessary, to block out ambient light.

Environment

The meter should be tested at the same temperature as the testing equipment. The ideal temperature is about 23 °C (73 °F). Make sure the meter is warmed up sufficiently before testing.

A warm-up time of 30 minutes is recommended before beginning energy accuracy verification testing. At the factory, the meters are warmed up to their typical operating temperature before calibration to help ensure that the meters will reach their optimal accuracy at operating temperature.

Most high precision electronic equipment requires a warm up time before it reaches its specified performance levels. Energy meter standards allow the manufacturers to specify meter accuracy derating due to ambient temperature changes and self-heating.

Your meter complies with and meets the requirements of these energy metering standards.

For a list of accuracy standards that your meter complies to, contact your local Schneider Electric representative or download the meter brochure from www.se.com.

Reference device or energy standard

To help ensure the accuracy of the test, it is recommended that you use a reference device or reference energy standard with a specified accuracy that is 6 to 10 times more accurate than the meter under test. Before you start testing, the reference device or energy standard should be warmed up as recommended by its manufacturer.

NOTE: Verify the accuracy and precision of all measurement equipment used in accuracy testing (for example, voltmeters, ammeters, power factor meters).

Verifying accuracy test

The following tests are guidelines for accuracy testing your meter; your meter shop may have specific testing methods.

DANGER

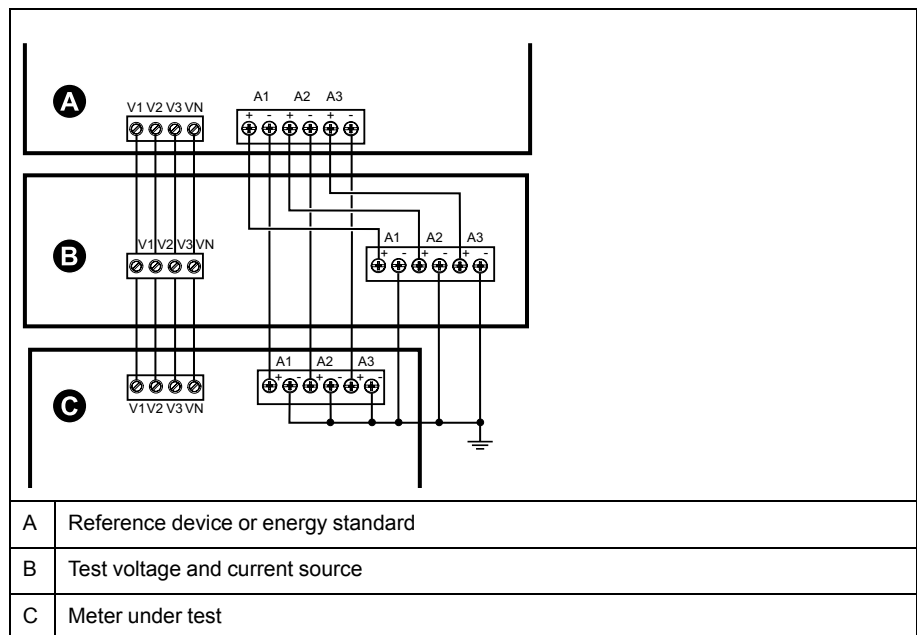
HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH

- Apply appropriate Personal Protective Equipment (PPE) and follow safe electrical work practices. See NFPA 70E, CSA Z462 or other local standards.
- Turn off all power supplying this device and the equipment in which it is installed before working on or in the equipment.
- Always use a properly rated voltage sensing device to confirm that all power is off.
- Do not exceed the maximum ratings of this device.
- Verify the device's power source meets the specifications for your device's power supply.

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

1. Turn off all power supplying this device and the equipment in which it is installed before working on the device or equipment.
2. Use a properly rated voltage sensing device to confirm that all power is off.

- Connect the test voltage and current source to the reference device or energy standard. Ensure all voltage inputs to the meter under test are connected in parallel and all current inputs are connected in series.



- Connect the control equipment used for counting the standard output pulses using one of these methods:

Option	Description
Energy pulsing LED	Align the red light sensor on the standard test bench armature over the energy pulsing LED.
Pulse output	Connect the meter's pulse output to the standard test bench pulse counting connections.

NOTE: When selecting which method to use, be aware that energy pulsing LEDs and pulse outputs have different pulse rate limits.

- Before performing the verification test, let the test equipment power up the meter and apply voltage for at least 30 seconds. This helps stabilize the internal circuitry of the meter.
- Configure the meter's parameters for verifying accuracy testing.
- Depending on the method selected for counting the energy pulses, configure the meter's energy pulsing LED or one of the pulse outputs to perform energy pulsing. Set the meter's energy pulse constant so it is in sync with the reference test equipment.
- Perform accuracy verification on the test points. Run each test point for at least 30 seconds to allow the test bench equipment to read an adequate number of pulses. Allow 10 seconds of dwell time between test points.

Required pulses calculation for accuracy verification testing

Accuracy verification test equipment typically requires you to specify the number of pulses for a specific test duration.

The reference test equipment typically requires you to specify the number of pulses required for a test duration of "t" seconds. Normally, the number of pulses required is at least 25 pulses, and the test duration is greater than 30 seconds.

Use the following formula to calculate the required number of pulses:

$$\text{Number of pulses} = P_{\text{tot}} \times K \times t / 3600$$

Where:

- P_{tot} = total instantaneous power in kilowatts (kW)
- K = the meter's pulse constant setting, in pulses per kWh
- t = test duration, in seconds (typically greater than 30 seconds)

Total power calculation for accuracy verification testing

Accuracy verification testing supplies the same test signal (total power) to both the energy reference/standard and the meter under test.

Total power is calculated as follows, where:

- P_{tot} = total instantaneous power in kilowatts (kW)
- V_{LN} = test point line-to-neutral voltage in volts (V)
- I = test point current in amps (A)
- PF = power factor

The result of the calculation is rounded up to the nearest integer.

For a balanced 3-phase Wye system:

$$P_{tot} = 3 \times V_{LN} \times I \times PF \times 1 \text{ kW}/1000 \text{ W}$$

NOTE: A balanced 3-phase system assumes that the voltage, current and power factor values are the same for all phases.

For a single-phase system:

$$P_{tot} = V_{LN} \times I \times PF \times 1 \text{ kW}/1000 \text{ W}$$

Percentage error calculation for accuracy verification testing

Accuracy verification testing requires you to calculate the percentage error between the meter being tested and the reference/standard.

Calculate the percentage error for every test point using the following formula:

$$\text{Energy error} = (EM - ES) / ES \times 100\%$$

Where:

- EM = energy measured by the meter under test
- ES = energy measured by the reference device or energy standard.

NOTE: If accuracy verification reveals inaccuracies in your meter, they may be caused by typical sources of test errors. If there are no sources of test errors present, please contact your local Schneider Electric representative.

Accuracy verification test points

The meter should be tested at full and light loads and at lagging (inductive) power factors to help ensure testing over the entire range of the meter.

The test amperage and voltage input rating are labeled on the meter. Refer to the installation sheet or data sheet for your meter's nominal current, voltage and frequency specifications.

Watt-hour test point	Sample accuracy verification test point
Full load	100% to 200% of the nominal current, 100% of the nominal voltage and nominal frequency at unity power factor or one (1).
Light load	10% of the nominal current, 100% of the nominal voltage and nominal frequency at unity power factor or one (1).
Inductive load (lagging power factor)	100% of the nominal current, 100% of the nominal voltage and nominal frequency at 0.50 lagging power factor (current lagging voltage by 60° phase angle).

VAR-hour test point	Sample accuracy verification test point
Full load	100% to 200% of the nominal current, 100% of the nominal voltage and nominal frequency at zero power factor (current lagging voltage by 90° phase angle).
Light load	10% of the nominal current, 100% of the nominal voltage and nominal frequency at zero power factor (current lagging voltage by 90° phase angle).
Inductive load (lagging power factor)	100% of the nominal current, 100% of the nominal voltage and nominal frequency at 0.87 lagging power factor (current lagging voltage by 30° phase angle).

Energy pulsing considerations

The meter's energy pulsing LED and pulse outputs are capable of energy pulsing within specific limits.

Description	Energy pulsing LED	Pulse output
Maximum pulse frequency	35 Hz	20 Hz
Minimum pulse constant	1 pulse per k_h	
Maximum pulse constant	9,999,000 pulses per k_h	

The pulse rate depends on the voltage, current and PF of the input signal source, the number of phases, and the VT and CT ratios.

If P_{tot} is the instantaneous power (in kW) and K is the pulse constant (in pulses per kWh), then the pulse period is:

$$\text{Pulse period (in seconds)} = \frac{3600}{K \times P_{tot}} = \frac{1}{\text{Pulse frequency (Hz)}}$$

VT and CT considerations

Total power (P_{tot}) is derived from the values of the voltage and current inputs at the secondary side, and takes into account the VT and CT ratios.

The test points are always taken at the secondary side, regardless of whether VTs or CTs are used.

If VTs and CTs are used, you must include their primary and secondary ratings in the equation. For example, in a balanced 3-phase Wye system with VTs and CTs:

$$P_{tot} = 3 \times V_{LN} \times \frac{V_{T_p}}{V_{T_s}} \times I \times \frac{CT_p}{CT_s} \times PF \times \frac{1 \text{ kW}}{1000 \text{ W}}$$

where P_{tot} = total power, V_{T_p} = VT primary, V_{T_s} = VT secondary, CT_p = CT primary, CT_s = CT secondary and PF = power factor.

Example calculations

This example calculation shows how to calculate power, pulse constants and maximum pulse frequency, and how to determine a pulse constant that reduces the maximum pulse frequency.

A balanced 3-phase Wye system uses 480:120 volt VTs and 120:5 amp CTs. The signals at the secondary side are 119 volts line-to-neutral and 5.31 amps, with a power factor of 0.85. The desired pulse output frequency is 20 Hz (20 pulses per second).

1. Calculate the typical total output power (P_{tot}):

$$P_{tot} = 3 \times 119 \times \frac{480}{120} \times 5.31 \times \frac{120}{5} \times 0.85 \times \frac{1 \text{ kW}}{1000 \text{ W}} = 154.71 \text{ kW}$$

2. Calculate the pulse constant (K):

$$K = \frac{3600 \times (\text{pulse frequency})}{P_{tot}} = \frac{3600 \text{ seconds/hour} \times 20 \text{ pulses/second}}{154.71 \text{ kW}}$$

$$K = 465.5 \text{ pulses / kWh}$$

3. At full load (120% of nominal current = 6 A) and power factor (PF = 1), calculate the maximum total output power (P_{max}):

$$P_{max} = 3 \times 119 \times \frac{480}{120} \times 6 \times \frac{100}{5} \times 1 \times \frac{1 \text{ kW}}{1000 \text{ W}} = 205.6 \text{ kW}$$

4. Calculate the maximum output pulse frequency at P_{max} :

$$\text{Maximum pulse frequency} = \frac{K \times P_{max}}{3600} = \frac{465.5 \text{ pulses / kWh} \times 205.6 \text{ kW}}{3600 \text{ seconds/hour}}$$

$$\text{Maximum pulse frequency} = 26.6 \text{ pulses/second} = 26.6 \text{ Hz}$$

5. Check the maximum pulse frequency against the limits for the LED and pulse outputs:

- 26.6 Hz \leq LED maximum pulse frequency (35 Hz)
- 26.6 Hz $>$ pulse output maximum pulse frequency (20 Hz)

NOTE: The maximum pulse frequency is within the limits for LED energy pulsing. However, the maximum pulse frequency is greater than the limits for pulse output energy pulsing. Pulse output frequencies greater than 20 Hz will saturate the pulse output and cause it to stop pulsing. Therefore in this example, you can only use the LED for energy pulsing.

Adjustments to allow energy pulsing at the pulse outputs

If you want to use the pulse output, you must reduce the output pulse frequency so it is within the limits.

Using the values from the above example, the maximum pulse constant for the pulse output is:

$$K_{max} = \frac{3600 \times (\text{pulse output maximum pulse frequency})}{P_{max}} = \frac{3600 \times 20}{205.6}$$

$$K_{max} = 350.14 \text{ pulses per kWh}$$

1. Set the pulse constant (K) to a value below K_{max} , for example, 300 pulses/kWh. Calculate the new maximum output pulse frequency at P_{max} :

$$\text{New maximum pulse frequency} = \frac{K \times P_{max}}{3600} = \frac{300 \text{ pulses/kWh} \times 205.6 \text{ kW}}{3600 \text{ seconds/hour}}$$

$$\text{New maximum pulse frequency} = 17.1 \text{ pulses/second} = 17.1 \text{ Hz}$$

2. Check the new maximum pulse frequency against the limits for the LED and pulse outputs:
 - $17.1 \text{ Hz} \leq \text{LED maximum pulse frequency (35 Hz)}$
 - $17.1 \text{ Hz} \leq \text{pulse output maximum frequency (20 Hz)}$As expected, changing K to a value below Kmax allows you to use the pulse output for energy pulsing.
3. Set the new pulse constant (K) on your meter.

Typical sources of test errors

If you see excessive errors during accuracy testing, examine your test setup and test procedures to eliminate typical sources of measurement errors.

Typical sources of accuracy verification testing errors include:

- Loose connections of voltage or current circuits, often caused by worn-out contacts or terminals. Inspect terminals of test equipment, cables, test harness and the meter under test.
- Meter ambient temperature is significantly different than 23 °C (73 °F).
- Floating (ungrounded) neutral voltage terminal in any configuration with unbalanced phase voltages.
- Inadequate meter control power, resulting in the meter resetting during the test procedure.
- Ambient light interference or sensitivity issues with the optical sensor.
- Unstable power source causing energy pulsing fluctuations.
- Incorrect test setup: not all phases connected to the reference device or the energy standard. All phases connected to the meter under test should also be connected to the reference meter/standard.
- Moisture (condensing humidity), debris or pollution present in the meter under test.

Power and power factor

Power and power factor

The sampled measurements taken at the meter’s voltage and current inputs provide data for calculating power and power factor.

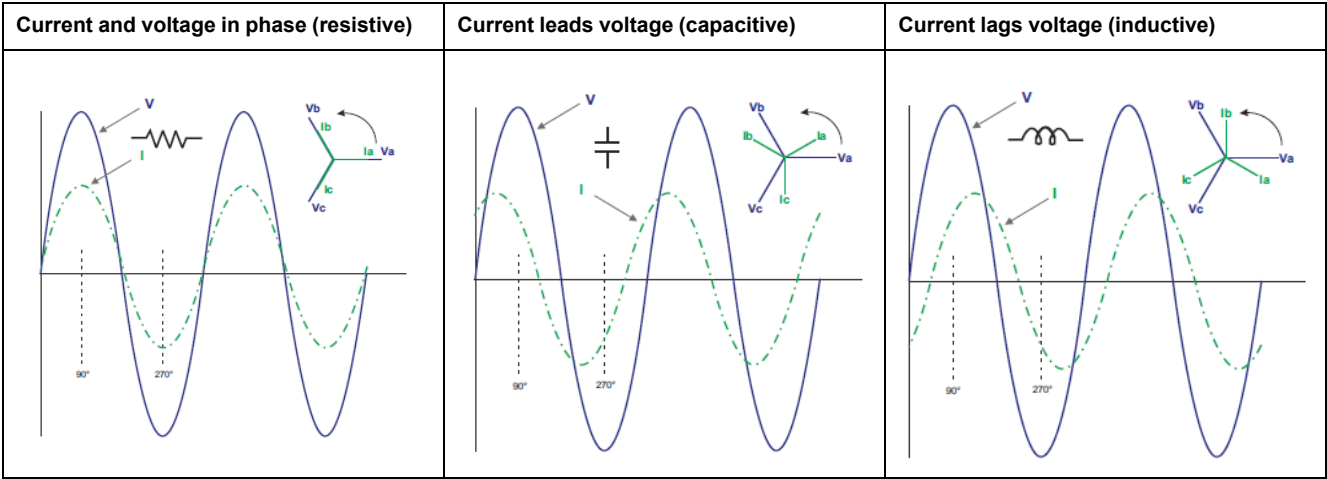
In a balanced 3-phase alternating current (AC) power system source, the AC voltage waveforms on the current-carrying conductors are equal but offset by one-third of a period (a phase angle shift of 120 degrees between the three voltage waveforms).

Current phase shift from voltage

Electrical current can lag, lead, or be in phase with the AC voltage waveform, and is typically associated with the type of load — inductive, capacitive or resistive.

For purely resistive loads, the current waveform is in phase with the voltage waveform. For capacitive loads, current leads voltage. For inductive loads, current lags voltage.

The following diagrams show how voltage and current waveforms shift based on load type under ideal (laboratory) conditions.



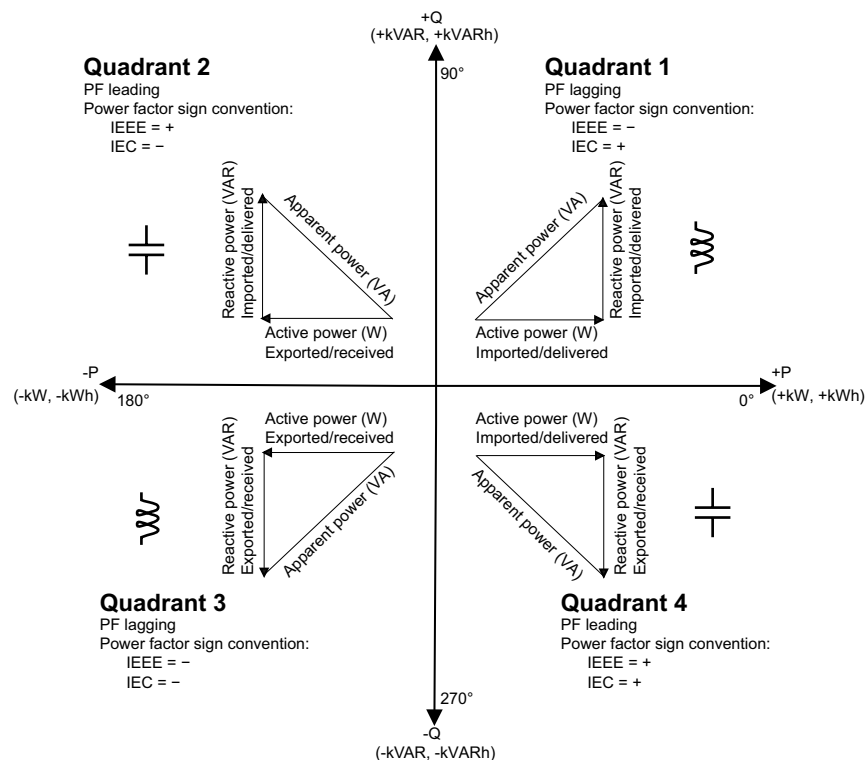
Real, reactive and apparent power (PQS)

A typical AC electrical system load has both resistive and reactive (inductive or capacitive) components.

Real power, also known as active power (P) is consumed by resistive loads. Reactive power (Q) is either consumed by inductive loads or generated by capacitive loads.

Apparent power (S) is the capacity of your measured power system to provide real and reactive power.

The units for power are watts (W or kW) for real power P, vars (VAR or kVAR) for reactive power Q, and volt-amps (VA or kVA) for apparent power S.



Power flow

Positive real power P(+) flows from the power source to the load. Negative real power P(-) flows from the load to the power source.

Power factor (PF)

Power factor (PF) is the ratio of real power (P) to apparent power (S).

PF is provided as a number between -1 and 1 or as a percentage from -100% to 100%, where the sign is determined by the convention.

$$PF = \frac{P}{S}$$

A purely resistive load has no reactive components, so its power factor is 1 (PF = 1, or unity power factor). Inductive or capacitive loads introduce a reactive power (Q) component to the circuit which causes the PF to become closer to zero.

True PF and displacement PF

The meter supports true power factor and displacement power factor values:

- True power factor includes harmonic content.
- Displacement power factor only considers the fundamental frequency.

NOTE: Unless specified, the power factor displayed by the meter is true power factor.

Power factor sign convention

Power factor sign (PF sign) can be positive or negative, and is defined by the conventions used by the IEEE or IEC standards.

You can set the power factor sign (PF sign) convention that is used on the display to either IEC or IEEE.

PF sign convention: IEC

PF sign correlates with the direction of real power (kW) flow.

- Quadrant 1 and 4: Positive real power (+kW), the PF sign is positive (+).
- Quadrant 2 and 3: Negative real power (-kW), the PF sign is negative (-).

PF sign convention: IEEE

PF sign is correlates with the PF lead/lag convention, in other words, the effective load type (inductive or capacitive):

- For a capacitive load (PF leading, quadrant 2 and 4), the PF sign is positive (+).
- For an inductive load (PF lagging, quadrant 1 and 3), the PF sign is negative (-).

PF value display

First digit of PF value indicates the Lag and Lead.

Lag is indicated by “i” and Lead is indicated by “c” for first digit of PF value.

NOTE: “i” = Inductive load/Lag PF and “c” = capacitive load/Lead PF.

NOTE: Without the load, the PF value is displayed as “- - -”

Sample screen

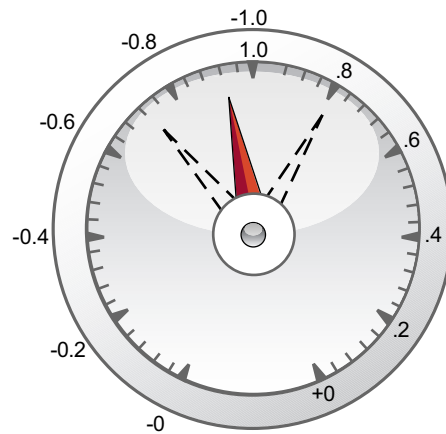


Power factor min/max convention

The meter uses a specific convention for determining the power factor minimum and maximum values.

- For negative PF readings, the minimum PF value is the measurement closest to -0 for PF readings between -0 to -1. For positive PF readings, the minimum PF value is the measurement closest to +1 for PF readings between +1 to +0.

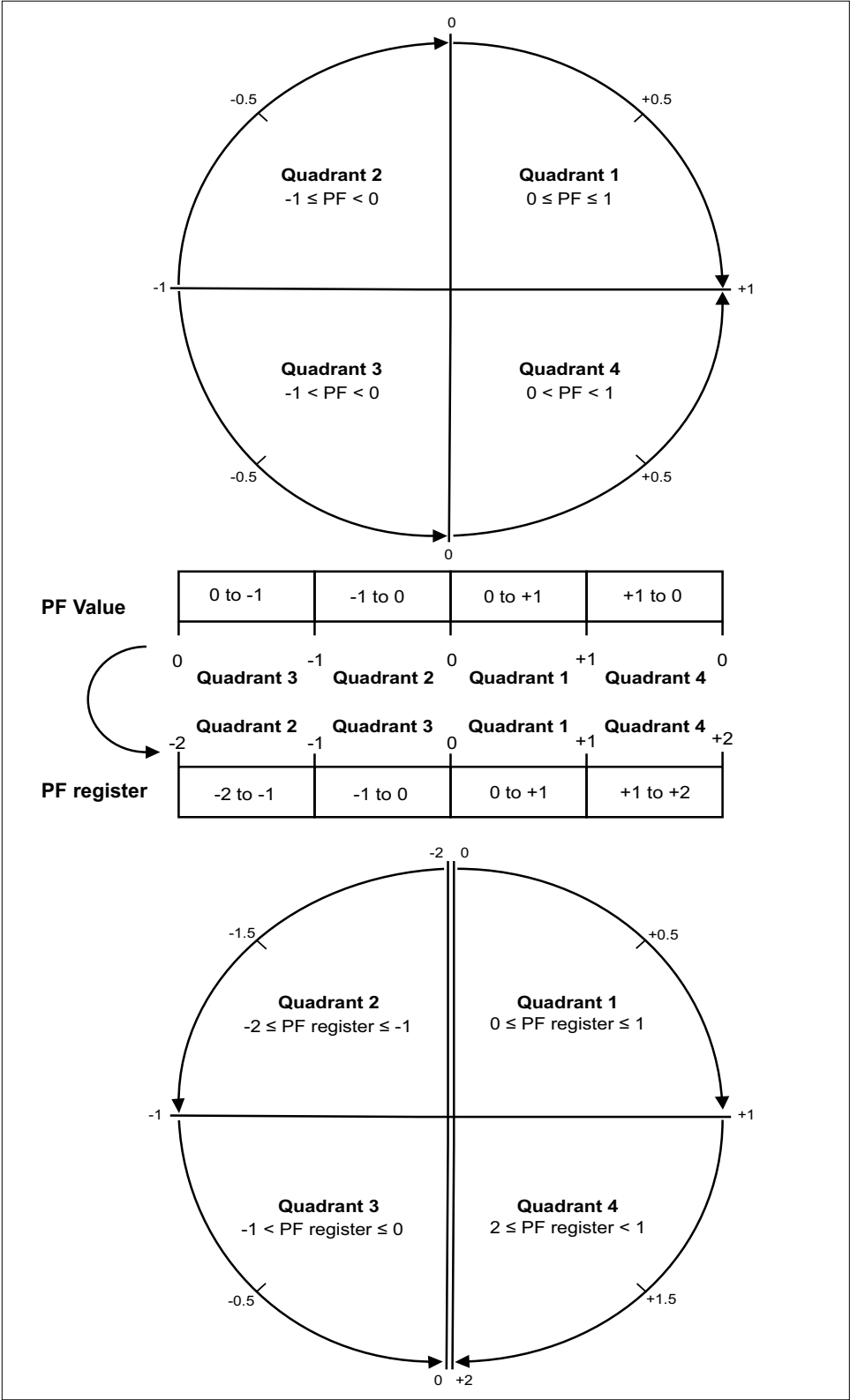
- For negative PF readings, the maximum PF value is the measurement closest to -1 for PF readings between -0 to -1. For positive PF readings, the maximum PF value is the measurement closest to +0 for PF readings between +1 to +0.



Power factor register format

The meter performs a simple algorithm to the PF value then stores it in the PF register.

Each power factor value (PF value) occupies one floating point register for power factor (PF register). The meter and software interpret the PF register for all reporting or data entry fields according to the following diagram:



The PF value is calculated from the PF register value using the following formulae:

Quadrant	PF range	PF register range	PF formula
Quadrant 1	0 to +1	0 to +1	PF value = PF register value
Quadrant 2	-1 to 0	-2 to -1	PF value = (-2) - (PF register value)
Quadrant 3	0 to -1	-1 to 0	PF value = PF register value
Quadrant 4	+1 to 0	+1 to +2	PF value = (+2) - (PF register value)

Specifications

The specifications contained in this section are subject to change without notice.

For installation and wiring information, refer to the meter installation sheet.

Mechanical characteristics

IP degree of protection (IEC 60529-1)	Front display: IP51 Front display: Upgrade to IP54 with optional accessory kit METSEIP54GK96X96FD Front display: Upgrade to IP65 with optional accessory kit METSEIP65OP96X96FD Meter body: IP30 (except terminals)
Panel thickness maximum	6.0 mm (0.25 in) maximum
Mounting position	Vertical
Display type	LED display - 7 Segment
Keypad	3 button
Front panel LED indicators	Green LED (heartbeat / serial communications activity) Red LED (energy pulse output)
Weight	~ 600 gms
Dimensions W x H x D	96 x 96 x 73 mm max

Electrical characteristics

Measurement accuracy

- IEC 61557-12: PMD/[SD|SS]/K55/1 (for firmware version 1.3.0 and higher)

Measurement type	Class of accuracy as per IEC 61557-12 (for firmware version 1.3.0 and higher, at $I_n = 5A$ nominal CT)	Error
Active energy	Class 1 (Class 1 ² as per IEC 62053-21 at $I_n = 5A$ nominal CT)	±1%
Reactive energy	Class 2 (Class 1 as per IEC 62053-24 at $I_n = 5A$ nominal CT)	±1%
Apparent energy	Class 1 at $I_n = 5A$ nominal CT	±1%
Active power	Class 1	±1%
Reactive power	Class 1	±1%
Apparent power	Class 1	±1%
Current	Class 1	±0.5%
Voltage (L-L)	Class 1	±0.5%
Voltage (L-N)	Class 1	±0.5%
Frequency	Class 0.05	±0.05%
Power factor	Class 1	±0.01 Count
THD and individual harmonics	Class 5	±5%

Measurement accuracy

- IEC 61557-12: PMD/[SD|SS]/K55/0.5 (for firmware version 1.3.0 and higher)

Measurement type	Class of accuracy as per IEC 61557-12 (for firmware version 1.3.0 and higher, at $I_n = 5A$ nominal CT)	Error
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2. For 1 A nominal CT, when $I > 0.150 A$. For 1 A nominal CT, when $I > 0.500 A$ under temperature influence

Measurement accuracy (Continued)

Active energy	Class 0.5 (Class 0.5S ³ as per IEC 62053-22 at I _n = 5A nominal CT)	±0.5%
Active energy	Class 0.2 ⁴ (Class 0.2 ⁴ as per IEC 62053-22 at I _n = 5A nominal CT)	±0.2%
Reactive energy	Class 2 (Class 1 as per IEC 62053-24 at I _n = 5A nominal CT)	±1%
Apparent energy	Class 0.5 (Class 0.5 at I _n = 5A nominal CT)	±0.5%
Active power	Class 0.5	±0.5%
Active power	Class 0.2	±0.2%
Reactive power	Class 1	±1%
Apparent power	Class 0.5	±0.5%
Current	Class 0.5	±0.2% ⁵
Voltage (L-L)	Class 0.5	±0.2% ⁶
Voltage (L-N)	Class 0.5	±0.2% ⁶
Frequency	Class 0.05	±0.05%
Power factor	Class 0.5	±0.01 Count
THD and individual harmonics	Class 5	±5%

Voltage inputs

VT primary	999 kV L-L max, starting voltage depends on VT ratio
V nominal	UL: 20 - 277 V L-N / 35 - 480 V L-L IEC: 20 - 347 V L-N / 35 - 600 V L-L
Measured V with full range	35 to 600 V AC L-L
Permanent overload	750 V AC L-L
Impedance	≥ 5 MΩ
Frequency	50 / 60 Hz nominal ± 5%
VA burden	< 0.2 VA at 240 V AC L-N

Current inputs

CT ratings	Primary adjustable 1 A to 32767 A Secondary 1 A or 5 A I-nominal
Measured Amps with over range & Crest Factor	Starting current: 5 mA Operating range: 50 mA to 8.5 A
Suppression current (to disregard negligible load)	5 mA to 99 mA
Withstand	Continuous 12 A; 50 A at 10 sec/hr, 500 A at 1 sec/hr
Impedance	< 0.3 mΩ
Frequency	50 / 60 Hz nominal
VA Burden	< 0.1 VA at 6 A

AC control power

Operating range	44 - 277 V AC ± 10%
Burden	< 6 VA at 277 V L-N

3. For 1ph 2W, when system voltage is ≥ 110 V L-N
4. For 2ph 3W and 3ph 3W, when system voltage is ≥ 110 V L-L. Not applicable for 1ph 2W configuration
5. 250 mA to 6 A
6. 100 V to 300 V

AC control power (Continued)

Frequency range	45 - 65 Hz
Ride-through time	80 ms at 120 V AC 100 ms at 230 V AC 100 ms at 277 V AC

DC control power

Operating range	44 - 277 V DC \pm 10%
Burden	< 2 W at 277 V DC
Ride-through time	50 ms at 125 V DC

Displays update

Instantaneous	1 s
Demand	15 s
Harmonics	5 s

Wiring configuration

User programmable	Configuration through both HMI and ION setup	Configuration through only ION setup
	1ph 2W, L-N 1ph 2W, L-L 1ph 3W, L-L with N (2 phase) 3ph 3W, Delta, Ungrounded 3ph 4W, Wye Grounded	3ph 3W, Delta, Corner Grounded 3ph 3W, Wye, Ungrounded 3ph 3W, Wye Grounded 3ph 3W, Wye, Resistance Grounded 3ph 4W, Open Delta, Center-Tapped 3ph 4W, Delta, Center-Tapped 3ph 4W, Wye, Ungrounded 3ph 4W, Wye, Resistance Grounded

Environmental characteristics

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 rating	5% to 95% RH at 50 °C (122 °F) (non-condensing)
Pollution degree	2
Altitude	\leq 2000 m (6562 ft)
Location	Not suitable for wet locations
Product life	> 7 years

EMC (Electromagnetic Compatibility)+1

Electrostatic discharge	IEC 61000-4-2
Immunity to radiated field	IEC 61000-4-3
Immunity to fast transients	IEC 61000-4-4
Immunity to impulse waves	IEC 61000-4-5
Conducted immunity	IEC 61000-4-6

Immunity to magnetic field	IEC 61000-4-8
Immunity to voltage dips	IEC 61000-4-11
Emissions (IEC61326-1)	Emissions FCC Part 15 Class A/CE

+1 Tested as per IEC 61326-1 standard for Emission

Safety

Europe	CE, as per IEC 61010-1 Ed-3 and IEC 61326-1
US and Canada	cULus per UL 61010-1 CAN / CSA-C22.2 No. 61010-1, for 600 V AC
Measurement category (Voltage and Current inputs)	CAT III up to 480 V L-L CAT II up to 600 V L-L
Overvoltage category (Control power)	CAT III up to 300 V L-N
Dielectric	As per IEC / UL 61010-1 Ed-3
Protective Class	II, Double insulated for user accessible parts
Other certification	RCM

Communications

RS485 port	2-Wire, 4800, 9600, 19200 or 38400 baud Parity - Even, Odd, None Firmware update available through communication port using DLF3000 software.
Pulse Output (POP)	Max 40 V DC, 20 mA 20 ms ON time Configurable pulse weight from 1 to 9999000 (pulse/ k_h)
Isolation	2.5 kV RMS, double insulated
Protection features	Password protected for set-up parameters
Display language	English

Real-time clock

Battery backup time	3 years NOTE: When meter is in off state.
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As standards, specifications, and design change from time to time,
please ask for confirmation of the information given in this publication.

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