IQ 150S/250S

Electronic Self-Enclosed Submeters with Wifi Ethernet Capability

User & Installation Manual

Powering Business Worldwide

IM02601006E Rev 1.0

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1 Introduction

About This Manual

This document is the user manual for the installation, operation, and maintenance of the Eaton IQ 150S/250S Meter. It is intended for authorized and qualified personnel who use the IQ 150S/250S Meter. Please refer to the specific WARNINGS and CAUTIONS in this section before proceeding.

For Technical Support and after hour emergencies, contact our Power Quality Technical Support team at 1-800-809-2772, option 4 / sub-option 1 or by email at PQSUPPORT@EATON.COM.

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Safety Precautions

All safety codes, safety standards, and/or regulations must be strictly observed in the installation, operation, and maintenance of this device.

WARNINGS refer to instructions that, if not followed, can result in death or injury.

CAUTIONS refer to instructions that, if not followed, can result in equipment damage.

WARNINGS

SHOCK HAZARDS:

IMPROPER INSTALLATION CAN CAUSE DEATH, INJURY, AND/OR EQUIPMENT DAMAGE.

Follow all Warnings and Cautions. Completely read and understood the information in this document before attempting to install or operate the equipment. Improper wiring could cause death, injury, or equipment damage. Only qualified personnel are to service the IQ 150S/250S Meter.

TROUBLESHOOTING PROCEDURES MAY REQUIRE PROXIMITY TO EXPOSED ENERGIZED(LIVE) ELECTRICAL WIRING AND/OR PARTS WHERE THE HAZARD OF FATAL ELECTRIC SHOCK IS PRESENT. Exercise extreme care to avoid injury or death. Always disconnect, lock-out, and tag the current and voltage sources and the control power supply circuit before touching the connections or components on the rear face of the meter base unit.

FAILURE TO GROUND THE IQ 150S/250S METER MAY RESULT IN INJURY, DEATH, OR EQUIPMENT DAMAGE. Properly ground the IQ 150S/250S Meter during installation.

FCC Information

Regarding the wireless module:

- This device complies with Part 15 of the FCC rules. Operation is subject to the following two conditions: 1) this device may not cause harmful interference, and 2) this device must accept any interference received, including interference that may cause undesired operation.

- The antenna provided must not be replaced with an different type. Attaching a different antenna will void the FCC approval and the FCC ID can no longer be considered.

Covered by one or more of the following patents:

US Patent Numbers D526920, D525893, 6751563, 6735535, 6636030.

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2: IQ 150S/250S Submeter Overview and Specifications

2.1: Hardware Overview

Eaton's IQ 150S/250S submeter is designed to measure revenue grade electrical energy usage and communicate that information via various communication media. The unit supports RS485, RJ45 wired Ethernet or IEEE 802.11 WiFi Ethernet connections. This allows the submeter to be placed anywhere within an industrial or commercial facility and still communicate quickly and easily back to central software.

The unit is designed with advanced measurement capabilities, allowing it to achieve high performance accuracy. The IQ 150S meter is specified as a 0.2% class energy meter for billing applications (the IQ 250S is so specified for Class 10 only). To verify the submeter's performance and calibration, power providers use field test standards to verify that the unit's energy measurements are correct. The IQ 150S/250S meter is a traceable revenue meter and contains a utility grade test pulse to verify rated accuracy.

The IQ 250S meter has up to 2 MegaBytes* for datalogging. It offers three historical logs, a Limits (Alarm) log, and a System Events log.
***NOTE**: Because the memory is flash-based rather than NVRAM (non-volatile random-access memory), some sectors are reserved for overhead, erase procedures, and spare sectors for long-term wear reduction.

IQ 150S/250S meter features detailed in this manual are:

- 0.2% Class Revenue Certifiable Energy and Demand Submeter (IQ 250S Class 10 only)
- Meets ANSI C12.20 (0.2%) and IEC 62053-22 (0.2%) Classes (IQ 250S Class 10 only)
- Multifunction Measurement including Voltage, Current, Power, Frequency, Energy, etc.
- Three line 0.56" bright red LED display
- 2 MegaBytes Memory for Datalogging (IQ 250S)

- Real Time Clock for Time-Stamping of Logs (Logs are available only with the IQ 250S)
- Percentage of Load bar for Analog meter perception
- Modbus RTU (over Serial) and Modbus TCP (over Ethernet)
- Serial RS485 communication
- Ethernet and wireless Ethernet (WiFi)
- Easy to use faceplate programming
- Direct interface with most Building Management systems

The IQ 150S/250S submeter uses standard 5 or 1 Amp CTs (either split or donut). It surface mounts to any wall and is easily programmed. The unit is designed specifically for easy installation and advanced communication.

2.1.1: Ordering Information

IQ - 150 - S - A - 6 - 5 - 1 - 1

1 2 3 4 5 6

1. Model:

150 = Energy

250 = Energy Plus

2. Meter Type

S = Self-enclosed Submeter

3. Frequency:

5 = 50 Hz System

6 = 60 Hz System

4. Current Input:

5 = 5 Amp Secondary

1 = 1 Amp Secondary

5. Power Supply:

1 = Universal, (90 - 400) VAC @50/60Hz or (100-370) VDC

6. Communication

1 = RS485 with Modbus RTU and KYZ Pulse Output

2 = RJ45 Ethernet Connection or Wireless (802.11b) with Modbus TCP and KYZ Pulse Output (also configurable for RS485)

Example: IQ 150-S-A-6-5-1-1

(IQ 150 Self-enclosed Energy submeter with 60Hz System, 5 Amp Secondary, 90-400 VAC/100-370 VDC Power Supply, RS485 Modbus and KYZ Pulse Output)

2.1.2: Measured Values

The IQ 150S/250S meter provides the following measured values all in real time and some additionally as average, maximum and minimum values.

IQ150S/250S Meter Measured Values				
Measured Values	Real Time	Average	Maximum	Minimum
Voltage L-N	X		X	X
Voltage L-L	X		X	X
Current per Phase	X	X	X	X
Current Neutral	X			
Watts	X	X	X	X
VAR	X	X	X	X
VA	X	X	X	X
PF	X	X	X	X
+Watt-hr	X			
-Watt-hr	X			
Watt-hr Net	X			
+VAR-hr	X			
-VAR-hr	X			
VAR-hr Net	X			
VA-hr	X			
Frequency	X		X	X
Voltage Angles	X			
Current Angles	X			
% of Load Bar	X			

2.1.3: Utility Peak Demand

The IQ150S/250S meter provides user-configured Block (Fixed) window or Rolling window Demand. This feature allows you to set up a customized Demand profile. Block window Demand is Demand used over a user-configured Demand period (usually 5, 15 or 30 minutes). Rolling window Demand is a fixed window Demand that moves for a user-specified subinterval period.

For example, a 15-minute Demand using 3 subintervals and providing a new Demand reading every 5 minutes, based on the last 15 minutes.

Utility Demand features can be used to calculate kW, kVAR, kVA and PF readings. All other parameters offer Max and Min capability over the user-selectable averaging period. Voltage provides an Instantaneous Max and Min reading which displays the highest surge and lowest sag seen by the meter

2.2: Specifications

Power Supply

Range:	Universal, (90 to 400)VAC @50/60Hz or (100 to 370)VDC
Power Consumption:	16 VA Maximum

Voltage Inputs (Measurement Category III)

Range:	IQ 150S: Universal, Auto-ranging up to 416VAC L-N, 721VAC L-L IQ 250S: Universal, Auto-ranging up to 576VAC L-N, 721VAC L-L
Supported hookups:	3 Element Wye, 2.5 Element Wye, 2 Element Delta, 4 Wire Delta
Input Impedance:	1M Ohm/Phase
Burden:	0.36VA/Phase Max at 600V, 0.0144VA/Phase at 120V
Pickup Voltage:	10VAC

Connection:	Screw terminal - #6 - 32 screws See Figure 3.1
Input Wire Gauge:	AWG#16 - 26
Fault Withstand:	Meets IEEE C37.90.1 (Surge Withstand Capability)
Reading:	Programmable Full Scale to any PT Ratio

Current Inputs

Class 10:	5A Nominal, 10 Amp Maximum
Class 2:	1A Nominal, 2 Amp Secondary
Burden:	0.005VA Per Phase Max at 11 Amps
Pickup Current:	0.1% of Nominal
Connections:	Screw terminal - #6-32 screws (Diagram 3.1)
Current Surge Withstand:	100A/10 seconds at 23^{o} C
Reading:	Programmable Full Scale to any CT Ratio

Isolation

All Inputs and Outputs are galvanically isolated and tested to 2500VAC

Environmental Rating

Storage:	(-20 to +70)^{o} C
Operating:	(-20 to +70)^{o} C
Humidity:	to 95% RH Non-condensing
Faceplate Rating:	NEMA12 (Water Resistant)

Measurement Methods

Voltage, Current:	True RMS
Power:	Sampling at 400+ Samples per Cycle on All Channels Measured Readings Simultaneously
A/D Conversion:	6 Simultaneous 24 bit Analog to Digital Converters

Update Rate

Watts, VAR and VA:	Every 6 cycles, e.g., 100 milliseconds (Ten times per second) @60Hz
All other parameters:	Every 60 cycles, e.g, 1 second @60Hz

Communication Format

RS485

Protocols:	Modbus RTU, Modbus ASCII, DNP 3.0, Modbus TCP (for Ethernet-enabled)
Com Port Baud Rate:	9600 to 57600 b/s
Com Port Address:	001-247
Data Format:	8 Bit, No Parity

Wireless Ethernet (Optional)

802.11b Wireless or 10/100BaseT Ethernet	WiFi or RJ45 Connection
128 bit WEP Encryption	128 bit Wireless Security

Modbus TCP Protocol

Mechanical Parameters

Dimensions:	(H7.9 x W7.6 x D3.2) inches, (H200.7 x W193.0 x D81.3) mm
Weight:	4 pounds

KYZ/RS485 Port Specifications

RS485 Transceiver; meets or exceeds EIA/TIA-485 Standard:

Type:	Two-wire, half duplex
Min. Input Impedance:	96kΩ
Max. Output Current:	±60mA

Wh Pulse

KYZ output contacts (and infrared LED light pulses through face plate; see Section 6.4 for Kh values):

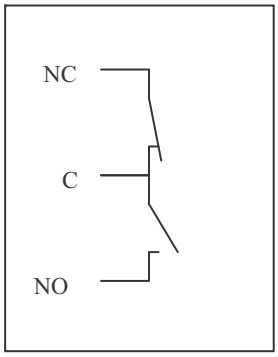
Pulse Width:	40ms for IQ 150S; 90ms for IQ 250S
Full Scale Frequency:	~6Hz for IQ 150S; ~3Hz for IQ 250S
Contact type:	Solid State – SPDT (NO – C – NC)
Relay type:	Solid state
Peak switching voltage:	DC ±350V
Continuous load current:	120mA
Peak load current:	350mA for 10ms
On resistance, max.:	35Ω
Leakage current:	1µA@350V
Isolation:	AC 3750V
Reset State:	(NC - C) Closed; (NO - C) Open

Infrared LED:

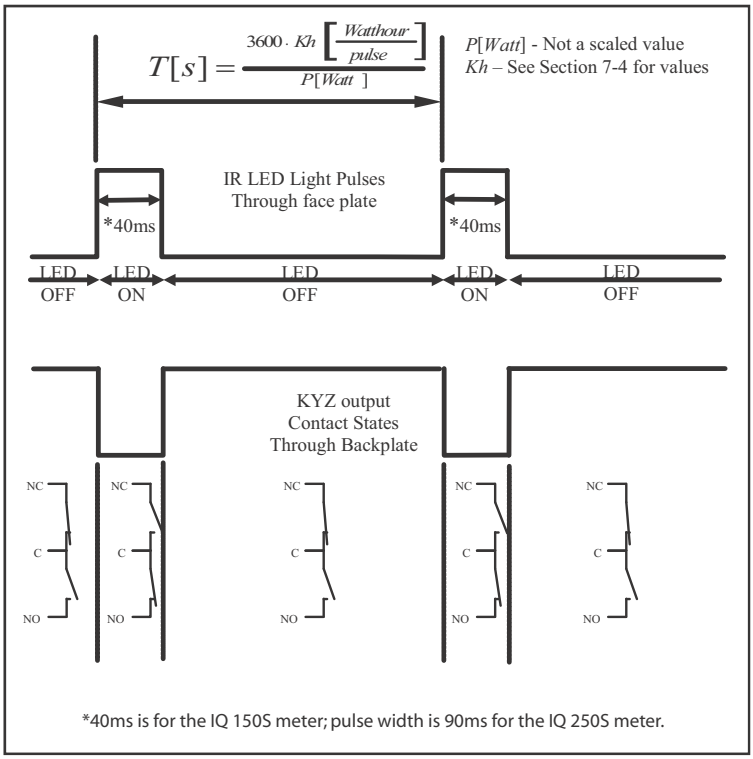
Peak Spectral Wavelength: 940nm

Reset State: Off

Internal Schematic:



Output Timing:



2.3: Compliance

- IEC 62053-22 (0.2% Accuracy), IQ 250S - Class 10 only
- ANSI C12.20 (0.2% Accuracy), IQ 250S - Class 10 only
- ANSI (IEEE) C37.90.1 Surge Withstand
- ANSI C62.41 (Burst)
- IEC1000-4-2: ESD
- IEC1000-4-3: Radiated Immunity
- IEC1000-4-4: Fast Transient
- IEC1000-4-5: Surge Immunity
- UL Listed
- CE Compliant

2.4: Accuracy

For 23ºC, 3 Phase balanced Wye or Delta load, at 50 or 60 Hz (as per order), 5A (Class 10) nominal unit:

Parameter	Accuracy	Accuracy Input Range
Voltage L-N [V]	0.1% of reading[2]	(69 to 480)V
Voltage L-L [V]	0.1% of reading	(120 to 600)V
Current Phase [A]	0.1% of reading[1]	(0.15 to 5)A
Current Neutral (calculated) [A]	2.0% of Full Scale[1]	(0.15 to 5)A @ (45 to 65)Hz
Active Power Total [W]	0.2% of reading[1,2]	(0.15 to 5)A @ (69 to 480)V @ +/- (0.5 to 1) lag/lead PF
Active Energy Total [Wh]	0.2% of reading[1,2]	(0.15 to 5)A @ (69 to 480)V @ +/- (0.5 to 1) lag/lead PF
Reactive Power Total [VAR]	0.2% of reading[1,2]	(0.15 to 5)A @ (69 to 480)V @ +/- (0 to 0.8) lag/lead PF
Reactive Energy Total [VARh]	0.2% of reading[1,2]	(0.15 to 5)A @ (69 to 480)V @ +/- (0 to 0.8) lag/lead PF
Apparent Power Total [VA]	0.2% of reading[1,2]	(0.15 to 5)A @ (69 to 480)V @ +/- (0.5 to 1) lag/lead PF

Apparent Energy Total [VAh]	0.2% of reading[1,2]	(0.15 to 5)A @ (69 to 480)V @ +/- (0.5 to 1) lag/lead PF
Power Factor	0.2% of reading[1,2]	(0.15 to 5)A @ (69 to 480)V @ +/- (0.5 to 1) lag/lead PF
Frequency	+/- 0.01Hz	(45 to 65)Hz
Load Bar	+/- 1 segment	(0.005 to 6)A

1 For 2.5 element programmed units, degrade accuracy by an additional 0.5% of reading.

- For 1A (Class 2) Nominal, degrade accuracy by an additional 0.5% of reading.
- For 1A (Class 2) Nominal, the input current range for Accuracy specification is 20% of the values listed in the table.

2 For unbalanced voltage inputs where at least one crosses the 150V auto-scale threshold (for example, 120V/120V/208V system), degrade accuracy by additional 0.4%.

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3: Mechanical Installation

3.1: Overview

The IQ 150S/250S meter can be installed on any wall See Chapter 4 for wiring diagrams.

Mount the meter in a dry location, which is free from dirt and corrosive substances.

Recommended Installation Tools

- #2 Phillips screwdriver
- Wire cutters

3.2: Install the Base

1. Determine where you want to install the submeter.
2. With the submeter power off, open the top of the submeter. Use the front cover support to keep the cover open as you perform the installation (see Figure 3.1).

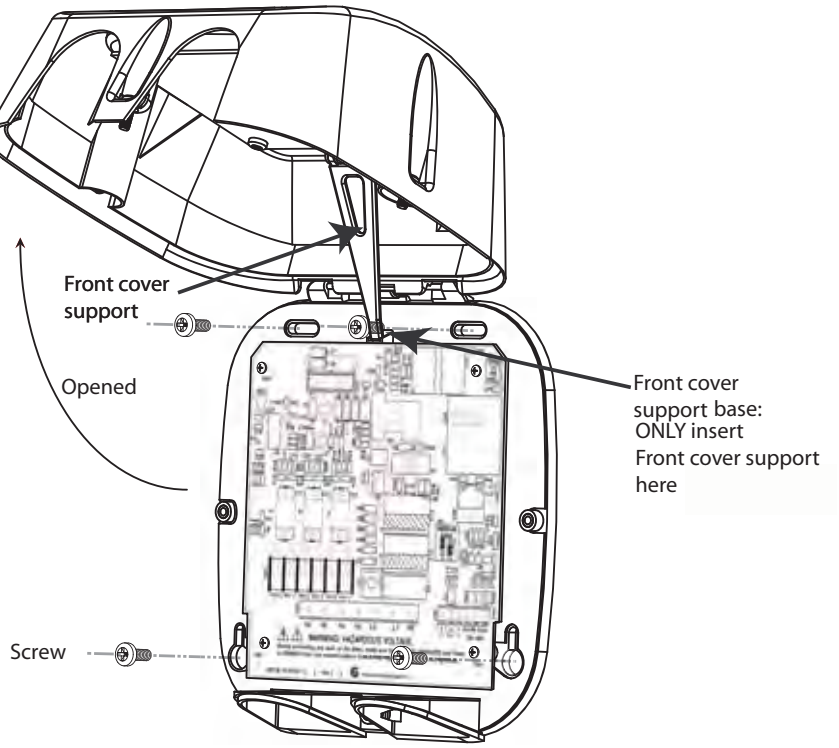


Figure 3.1: Submeter with Cover Open

CAUTIONS!

- Remove the antenna before opening the unit.
- Only use the front cover support if you are able to open the front cover to the extent that you can fit the front cover support into its base. **DO NOT** rest the front cover support on the inside of the meter, even for a short time - by doing so, you may damage components on the board assembly. Always insert the front cover support into its base.

3. Find the 4 Installation Slots and insert screws through each slot into the wall or panel.

4. Fasten securely - DO NOT overtighten. Maximum recommended torque is 0.5/0.6 Nm (4.42/5.31 lbF in).

3.2.1:Mounting Diagrams

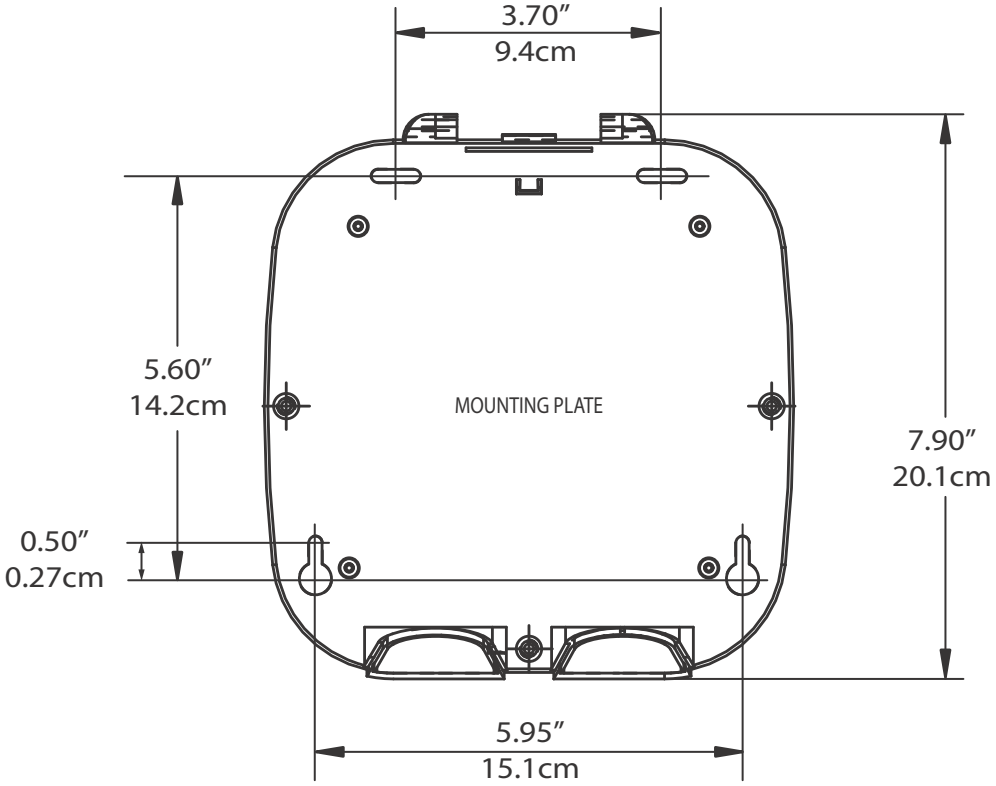


Figure 3.2: Mounting Plate Dimensions

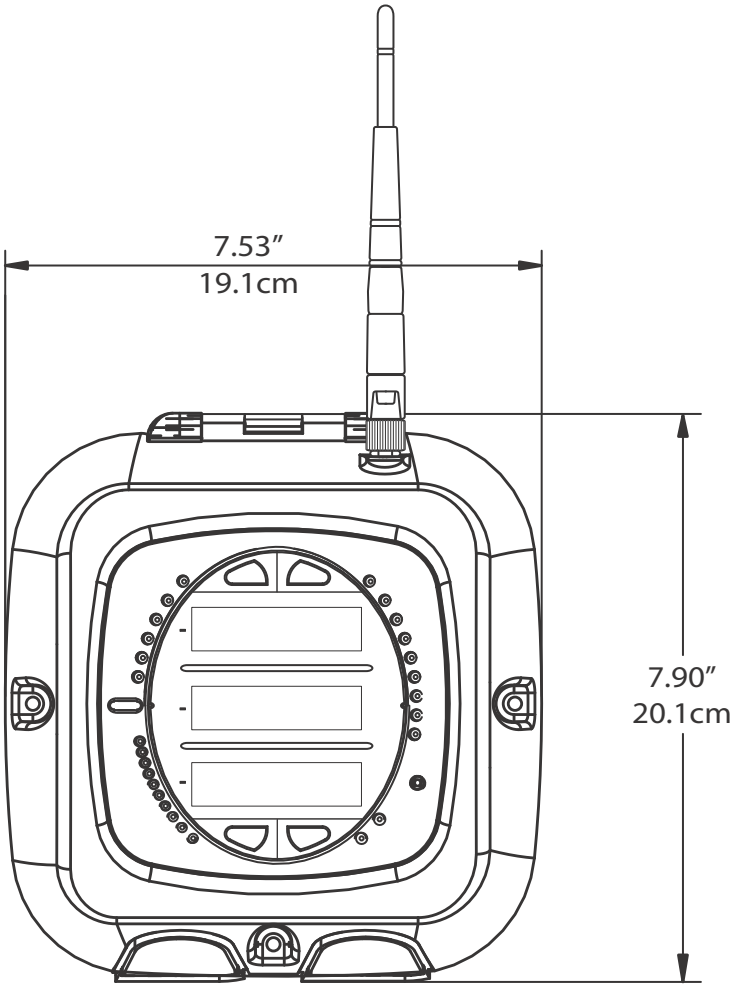


Figure 3.3: Front Dimensions

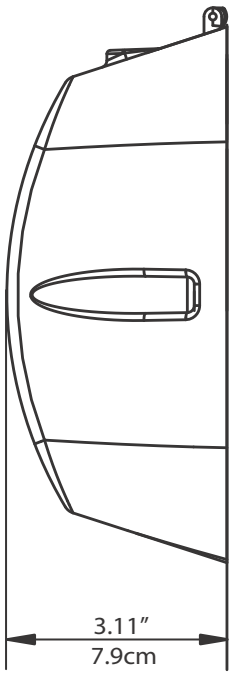


Figure 3.4: Side Dimensions

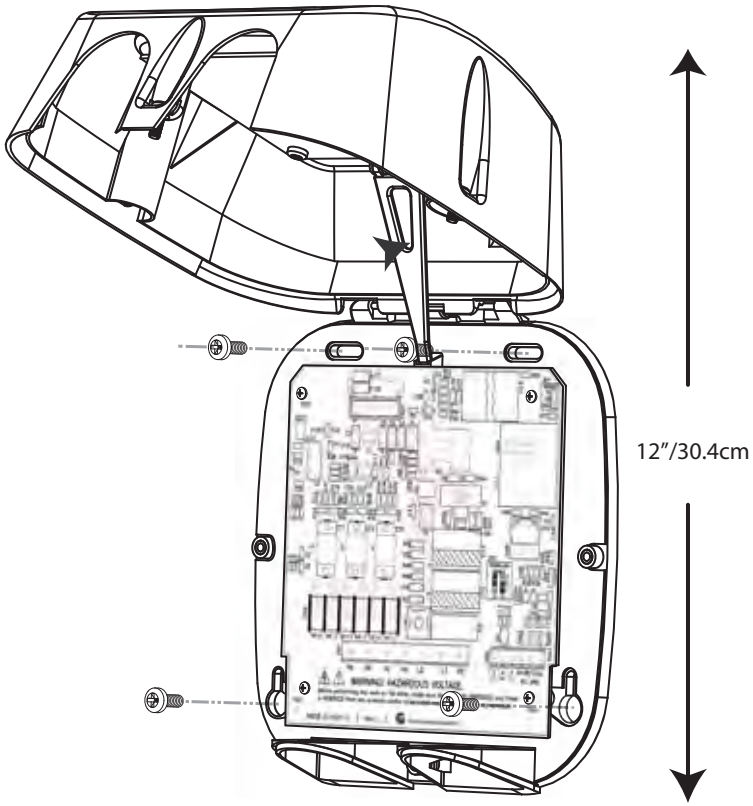


Figure 3.5: Open Cover Dimensions

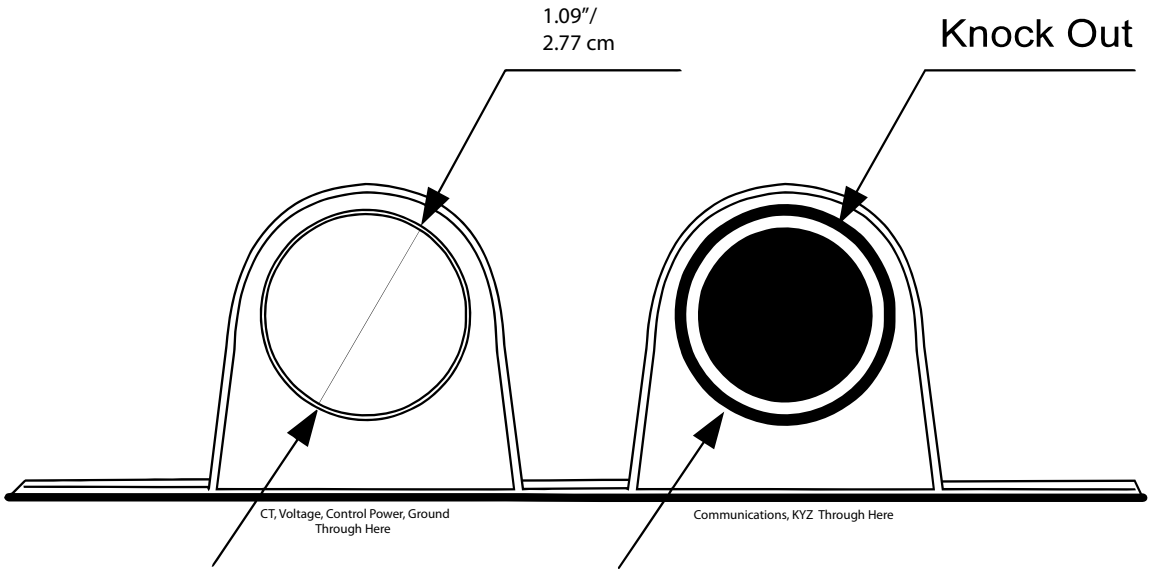


Figure 3.6: Bottom View with Access Holes

3.3: Secure the Cover

1. Close the cover, making sure that power and communications wires exit the submeter through the openings at the base (see Figure 3.6).

CAUTION! To avoid damaging components on the board assembly, make sure the front cover support is in the upright position before closing the front cover.

2. Using the 3 enclosed screws, secure the cover to the base in three places - DO NOT over-tighten (you may damage the cover). Maximum recommended torque is 0.5/0.6 Nm (4.42/5.31 lbF in).

3. The unit can be sealed after the front cover is closed. To seal the unit, thread a seal tag (not supplied by Eaton) through the housing located between the bottom access holes (see figures 3.6 and 3.7).

4. Reattach the antenna, if applicable.

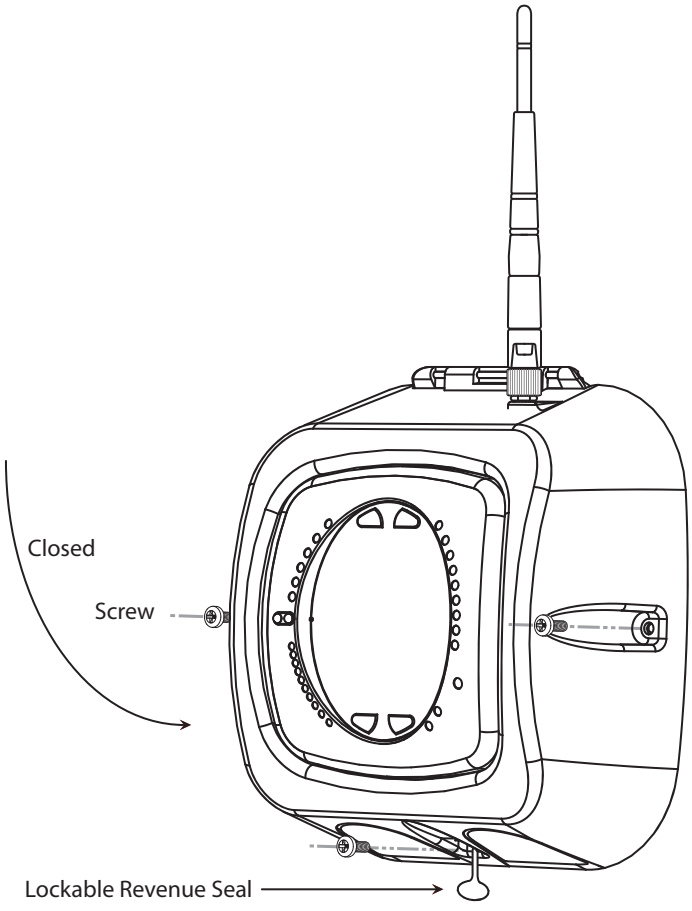


Figure 3.7: Submeter with Closed Cover

4: Electrical Installation

4.1: Considerations When Installing Meters

Installation of the IQ 150S/250S meter must be performed only by qualified personnel who follow standard safety precautions during all procedures. Those personnel should have appropriate training and experience with high voltage devices. Appropriate safety gloves, safety glasses and protective clothing is recommended.

During normal operation of the IQ 150S/250S meter, dangerous voltages flow through many parts of the meter, including: Terminals and any connected CTs (Current Transformers) and PTs (Potential Transformers), all I/O Modules (Inputs and Outputs) and their circuits. All Primary and Secondary circuits can, at times, produce lethal voltages and currents. Avoid contact with any current-carrying surfaces.

Do not use the meter or any I/O Output Device for primary protection or in an energy-limiting capacity. The meter can only be used as secondary protection.

Do not use the meter for applications where failure of the meter may cause harm or death.

Do not use the meter for any application where there may be a risk of fire.

All meter terminals should be inaccessible after installation.

Do not apply more than the maximum voltage the meter or any attached device can withstand. Refer to meter and/or device labels and to the Specifications for all devices before applying voltages.

Do not HIPOT/Dielectric test any Outputs, Inputs or Communications terminals.

Eaton recommends the use of Shorting Blocks and Fuses for voltage leads and power supply to prevent hazardous voltage conditions or damage to CTs, if the meter needs to be removed from service. CT grounding is optional.

IMPORTANT!

- IF THE EQUIPMENT IS USED IN A MANNER NOT SPECIFIED BY THE MANUFACTURER, THE PROTECTION PROVIDED BY THE EQUIPMENT MAY BE IMPAIRED.

- THERE IS NO REQUIRED PREVENTIVE MAINTENANCE OR INSPECTION NECESSARY FOR SAFETY. HOWEVER, ANY REPAIR OR MAINTENANCE SHOULD BE PERFORMED BY THE FACTORY.

DISCONNECT DEVICE: The following part is considered the equipment disconnect device. A SWITCH OR CIRCUIT-BREAKER SHALL BE INCLUDED IN THE END-USE EQUIPMENT OR BUILDING INSTALLATION. THE SWITCH SHALL BE IN CLOSE PROXIMITY TO THE EQUIPMENT AND WITHIN EASY REACH OF THE OPERATOR. THE SWITCH SHALL BE MARKED AS THE DISCONNECTING DEVICE FOR THE EQUIPMENT.

4.2: Electrical Connections

All wiring for the IQ 150S/250S is done through the front of the unit (lifting the cover with the power to the unit OFF) so that the unit can be surface mounted. Connecting cables exit the unit via two openings in the base plate (see figures 3.6 and 4.1).

DO NOT over-torque screws. Maximum recommended torque is 0.5/0.6 Nm (4.42/5.31 lbF in).

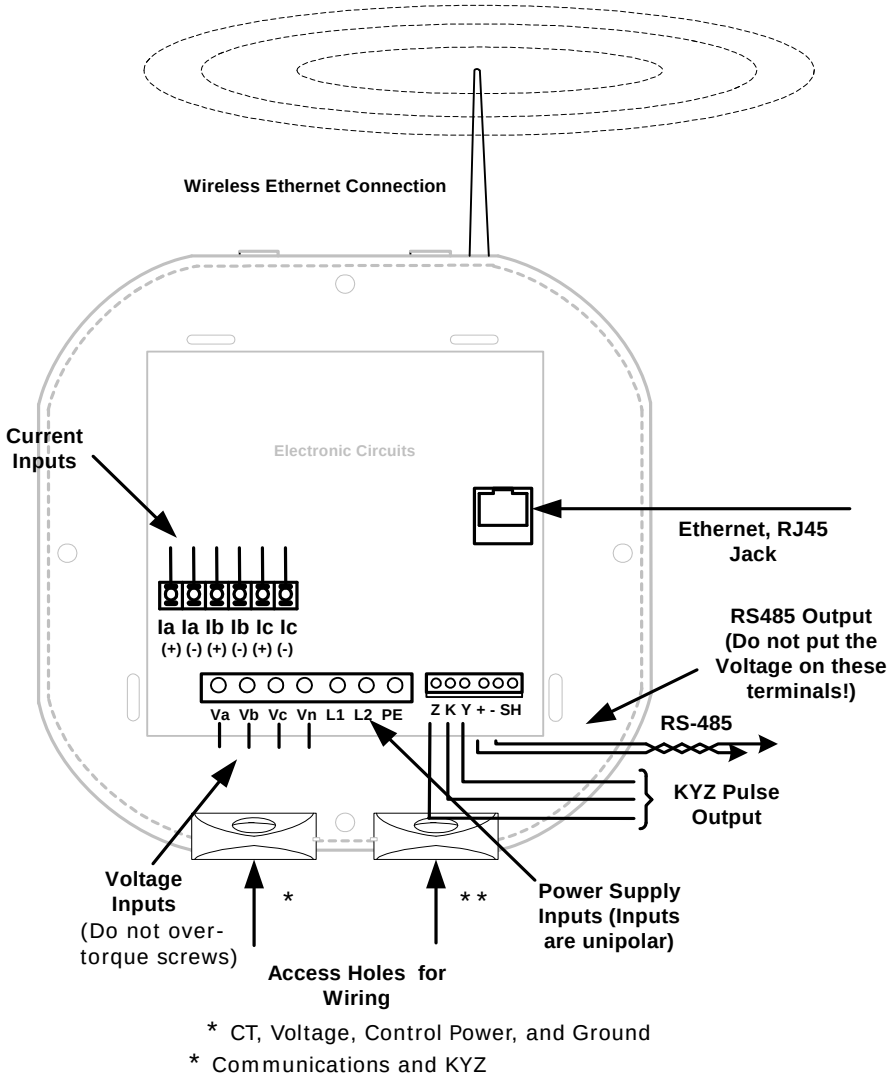


Figure 4.1: Submeter Connections

4.3: Ground Connections

The meter's Ground Terminal (PE) should be connected directly to the installation's protective earth ground.

4.4: Voltage Fuses

Eaton recommends the use of fuses on each of the sense voltages and on the control power, even though the wiring diagrams in this chapter do not show them.

- Use a 0.1 Amp fuse on each Voltage input.
- Use a 3 Amp fuse on the power supply.

4.5: Electrical Connection Diagrams

Choose the diagram that best suits your application. Make sure the CT polarity is correct.

1. Three Phase, Four-Wire System Wye with Direct Voltage, 3 Element

   a. Dual Phase Hookup

   b. Single Phase Hookup

3. Three Phase, Four-Wire System Wye with Direct Voltage, 2.5 Element

4. Three-Phase, Four-Wire Wye with PTs, 3 Element

5. Three-Phase, Four-Wire Wye with PTs, 2.5 Element

6. Three-Phase, Three-Wire Delta with Direct Voltage (No PTs, 2 CTs)

7. Three-Phase, Three-Wire Delta with Direct Voltage (No PTs, 3 CTs)

8. Three-Phase, Three-Wire Delta with 2 PTs, 2 CTs

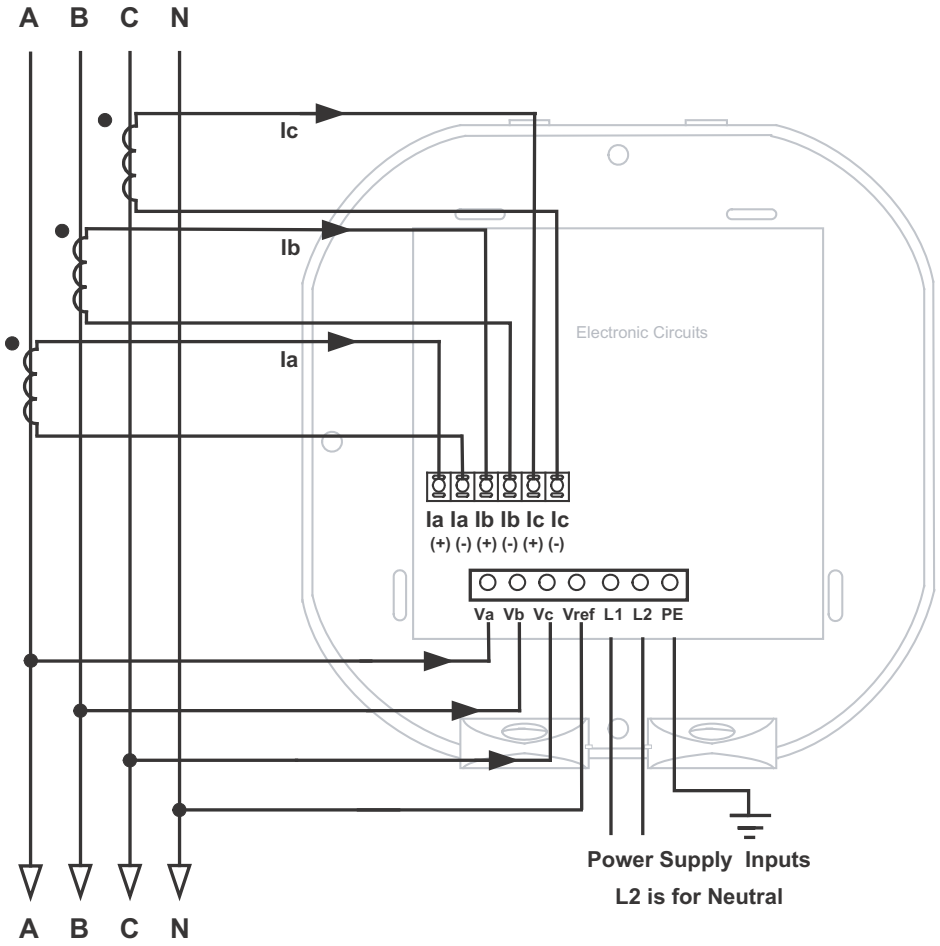
9. Three-Phase, Three-Wire Delta with 2 PTs, 3 CTs

10. Current Only Measurement (Three Phase)

11. Current Only Measurement (Dual Phase)

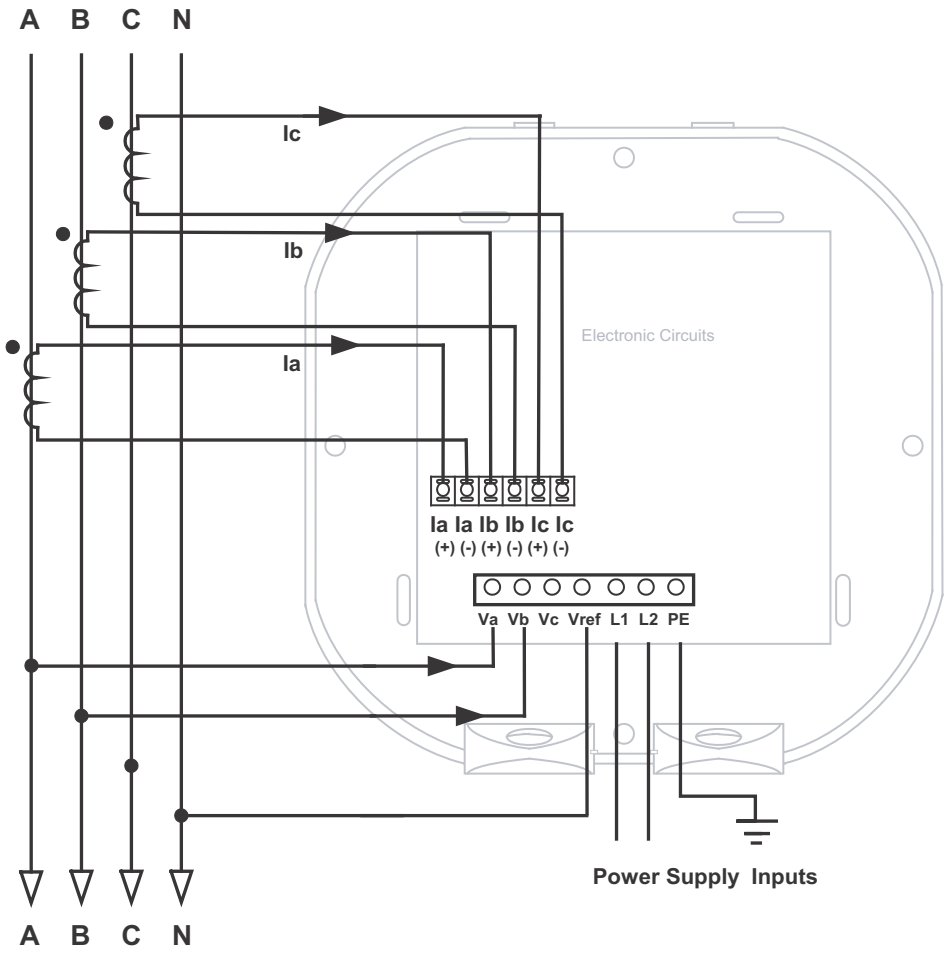
12. Current Only Measurement (Single Phase)

1. Service: WYE, 4-Wire with No PTs, 3 CTs

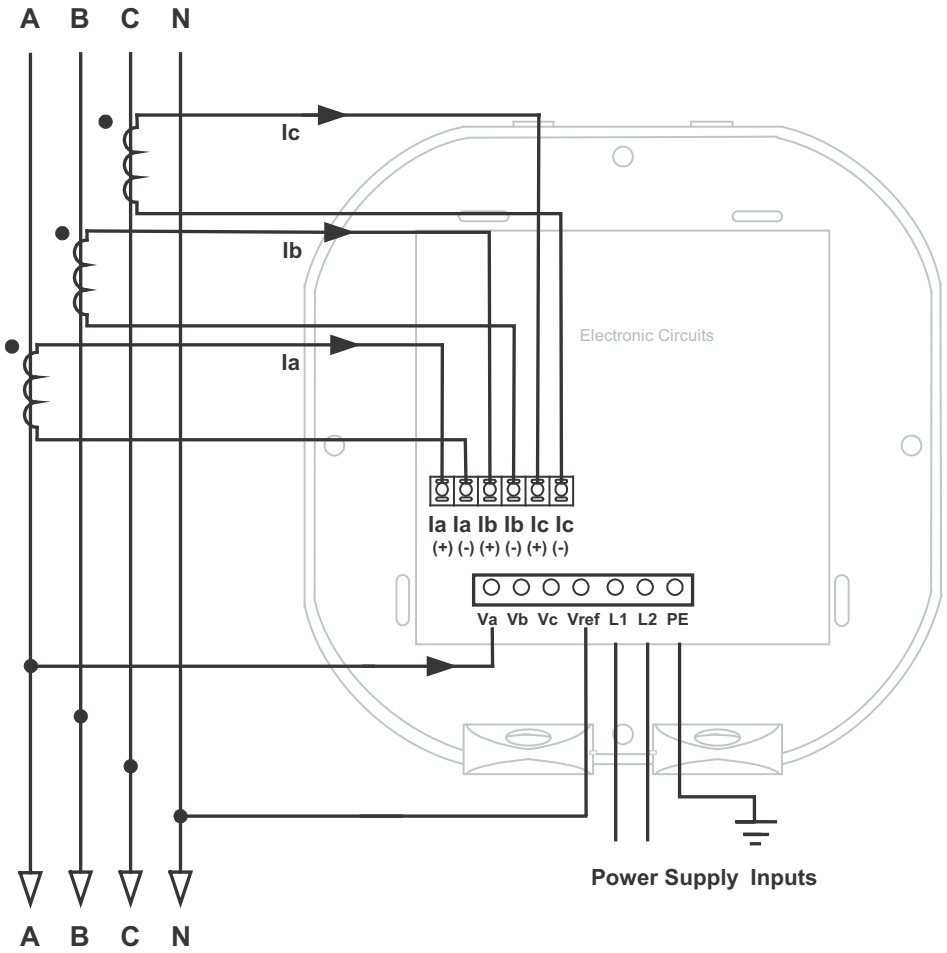


Select: "3 EL WYE" (3 Element Wye) in Meter Programming setup.

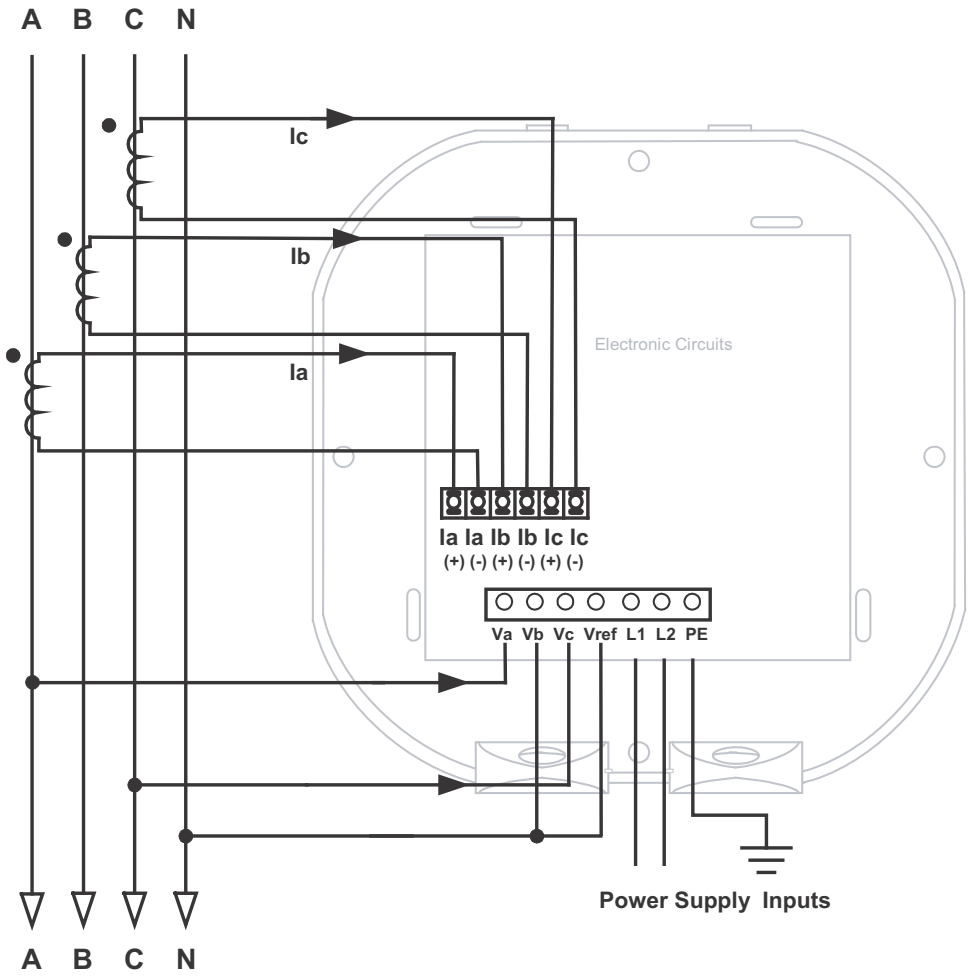
1a. Dual Phase Hookup



1b. Single Phase Hookup

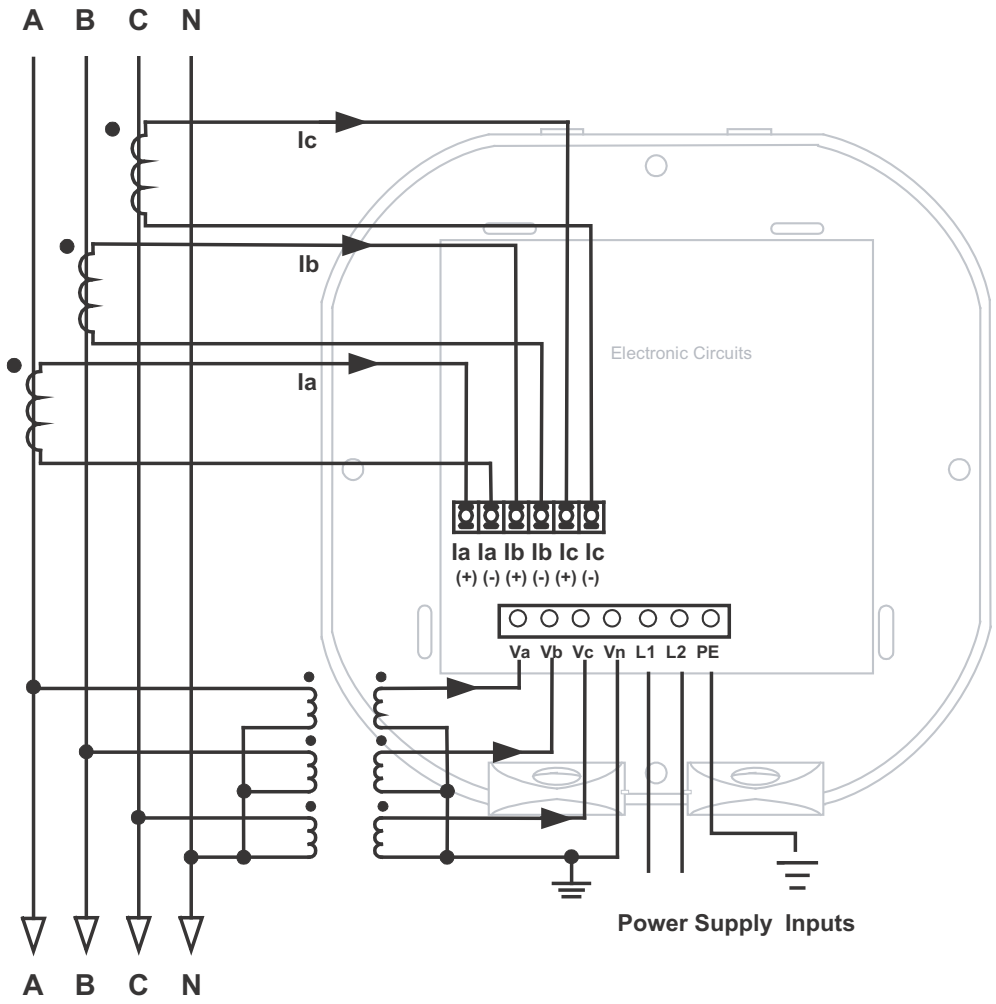


2. Service: 2.5 Element WYE, 4-Wire with No PTs, 3 CTs



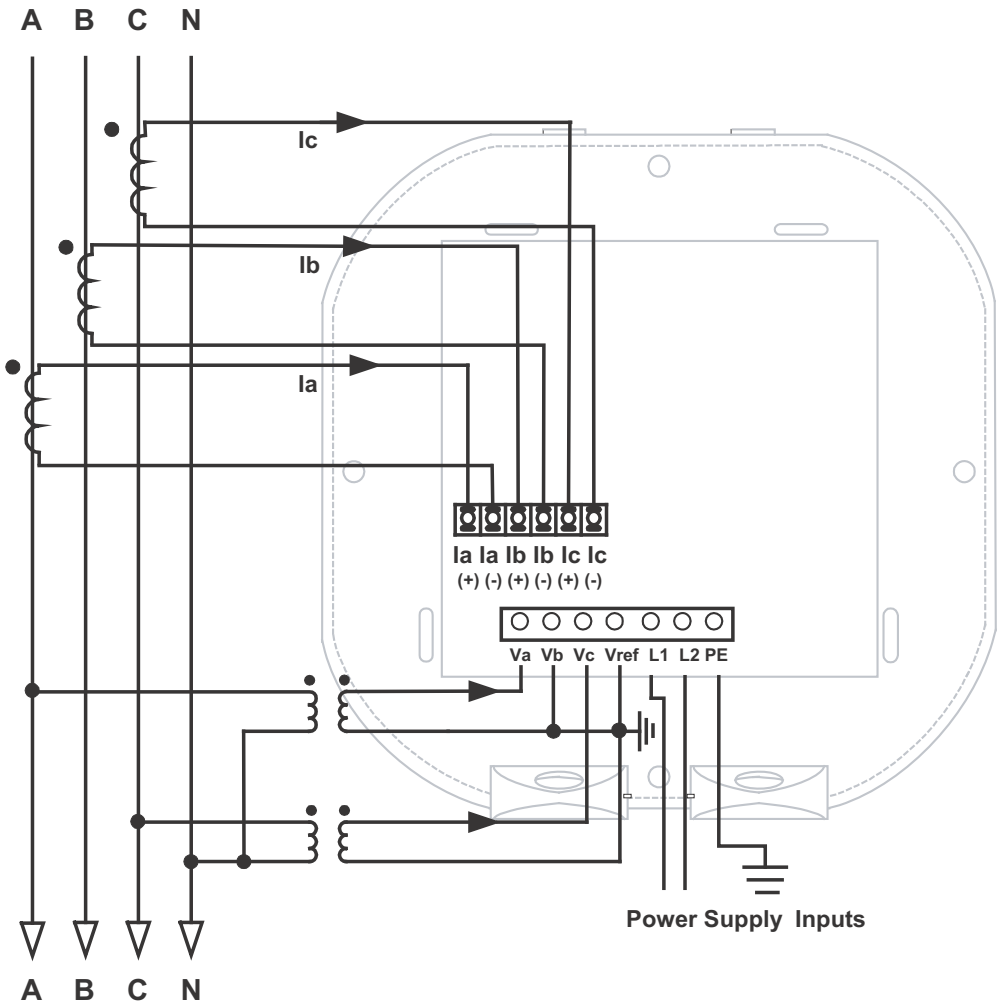
Select: "2.5 EL WYE" (2.5 Element Wye) in Meter Programming setup.

3. Service: WYE, 4-Wire with 3 PTs, 3 CTs



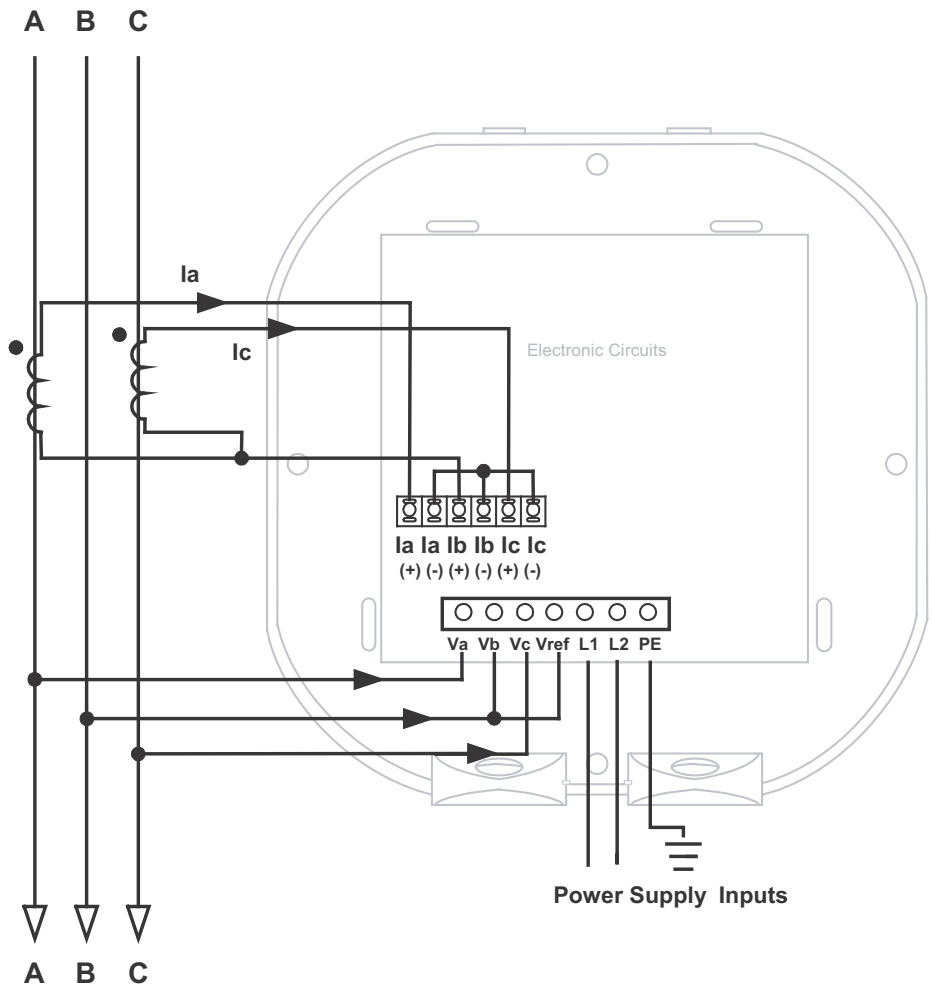
Select: "3 EL WYE" (3 Element Wye) in Meter Programming setup.

4. Service: 2.5 Element WYE, 4-Wire with 2 PTs, 3 CTs



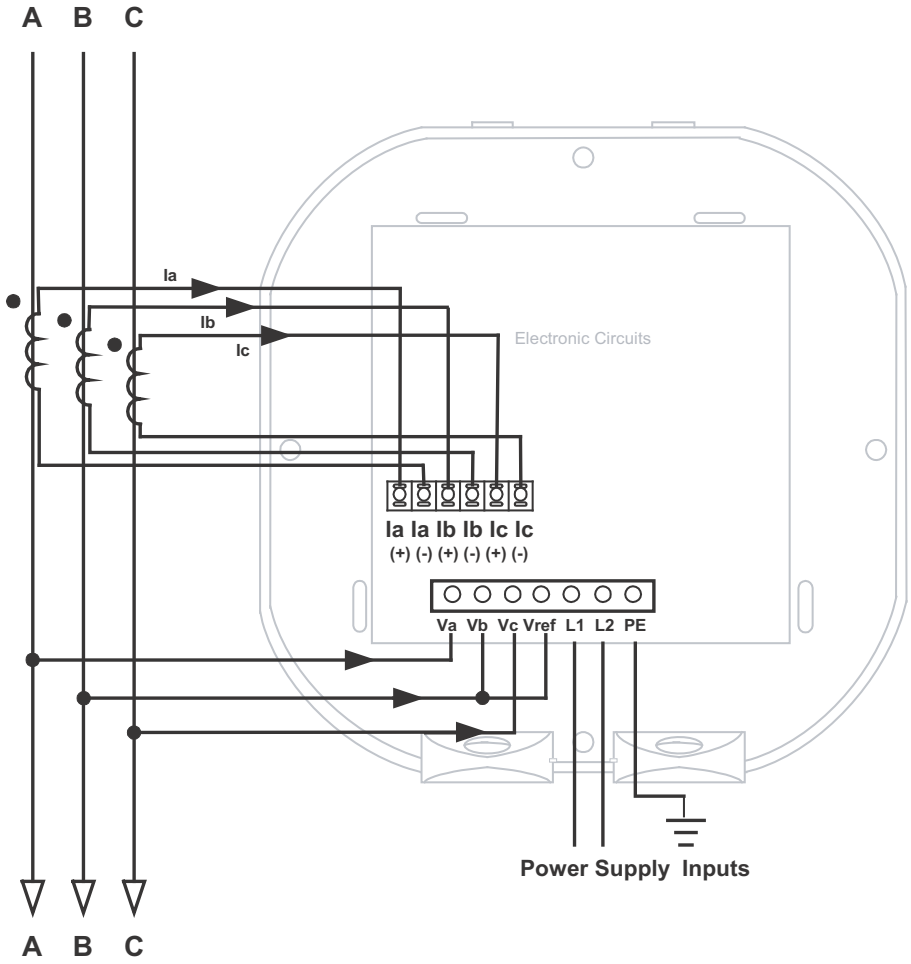
Select: "2.5 EL WYE" (2.5 Element Wye) in Meter Programming setup.

5. Service: Delta, 3-Wire with No PTs, 2 CTs



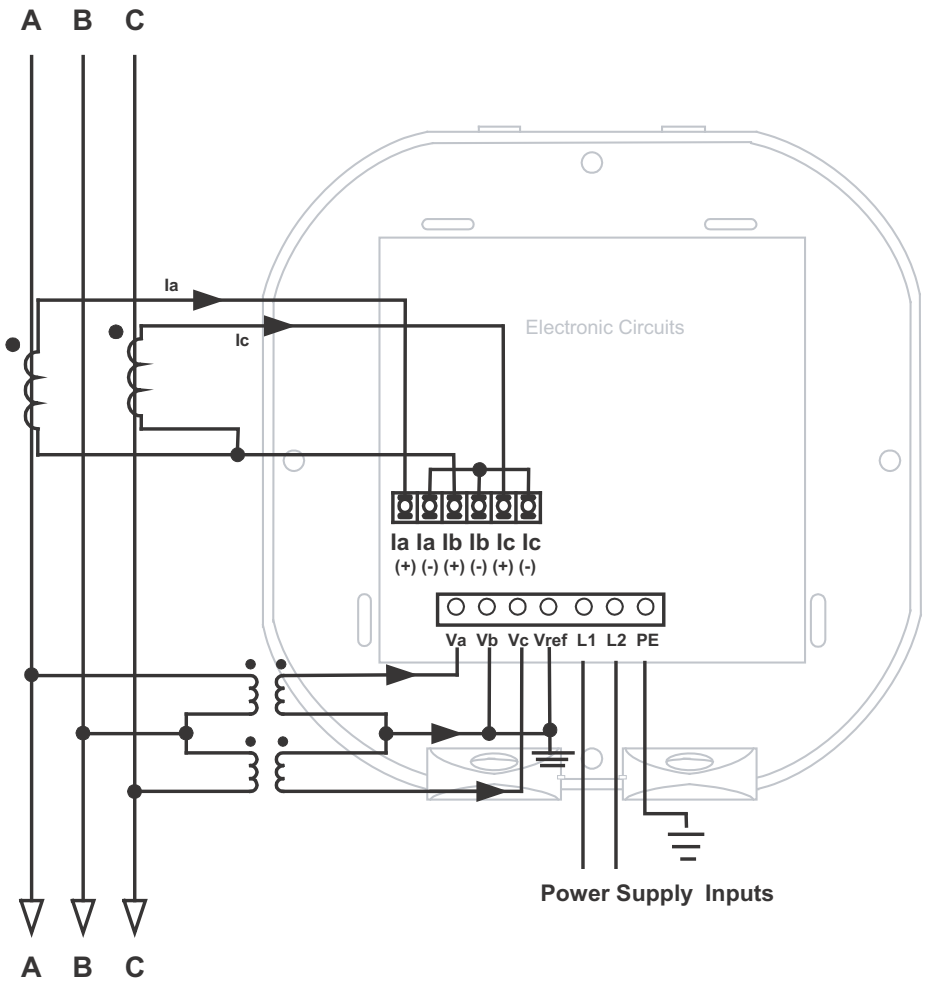
Select: "2 Ct dEL" (2 CT Delta) in Meter Programming setup.

6. Service: Delta, 3-Wire with No PTs, 3 CTs



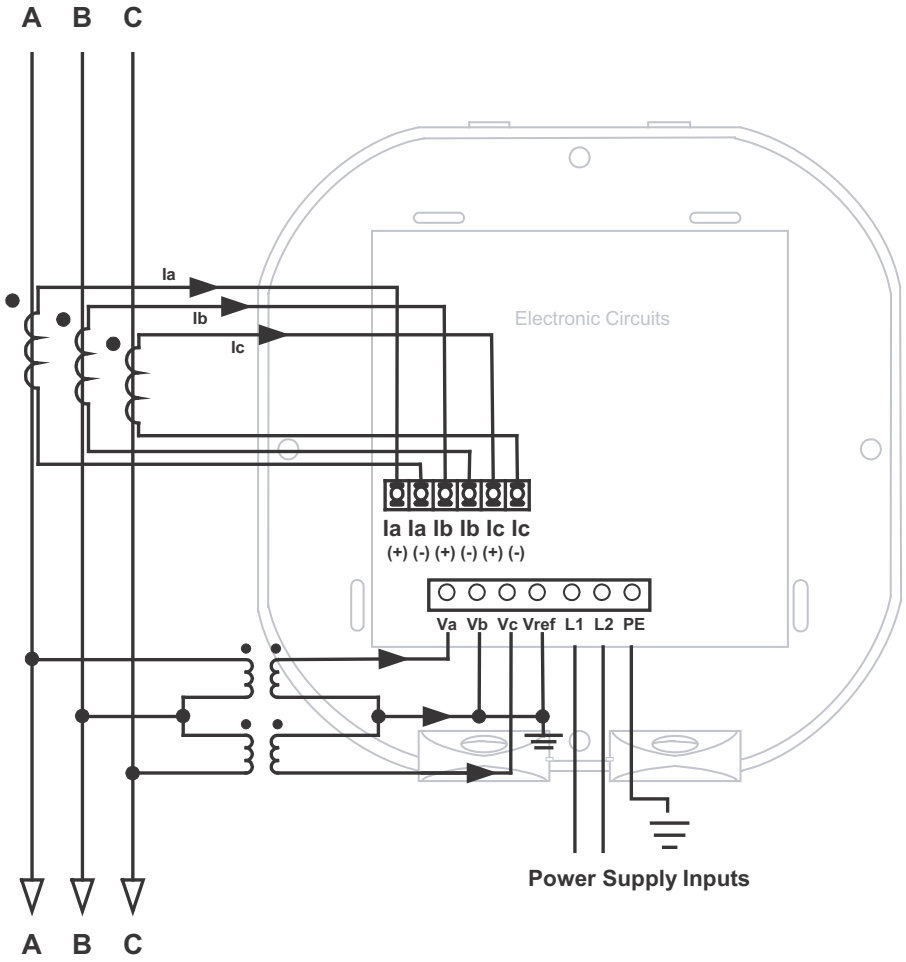
Select: "2 Ct dEL" (2 CT Delta) in Meter Programming setup.

7. Service: Delta, 3-Wire with 2 PTs, 2 CTs



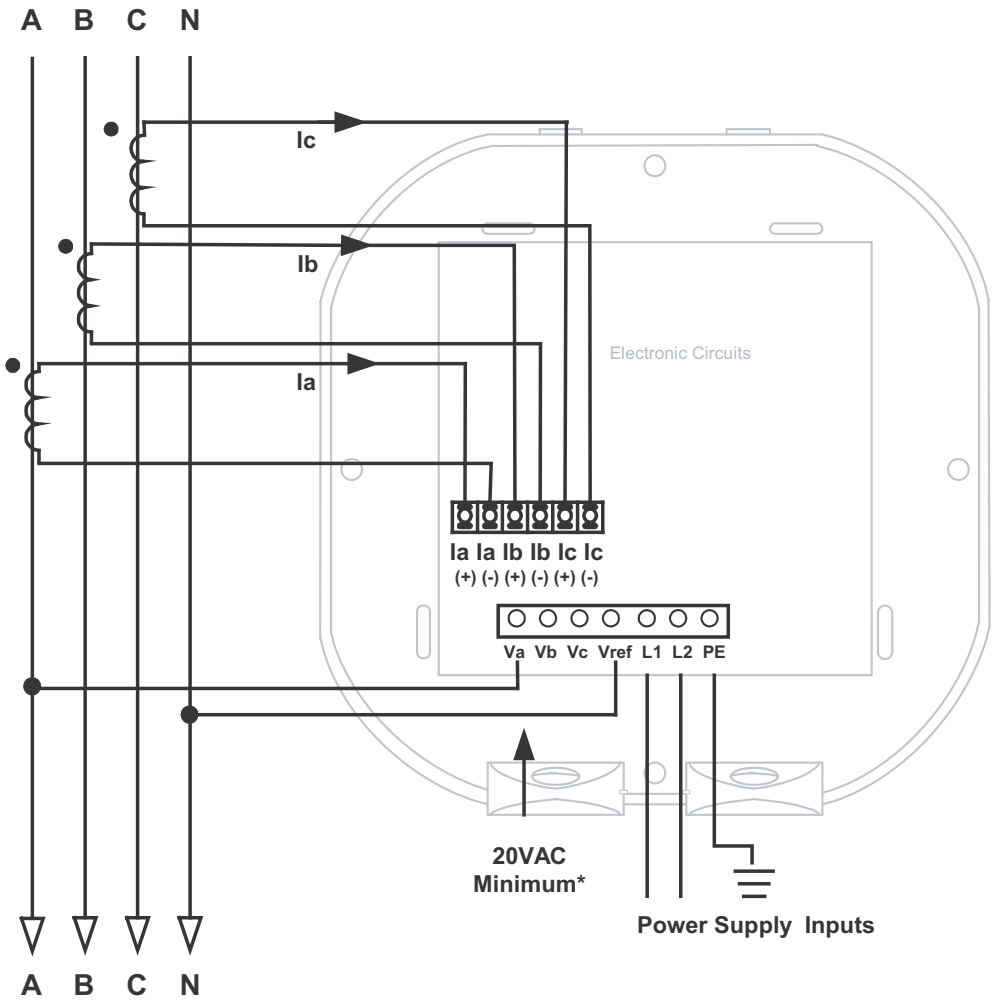
Select: "2 Ct dEL" (2 CT Delta) in Meter Programming setup.

8. Service: Delta, 3-Wire with 2 PTs, 3 CTs



Select: "2 Ct dEL" (2 CT Delta) in Meter Programming setup.

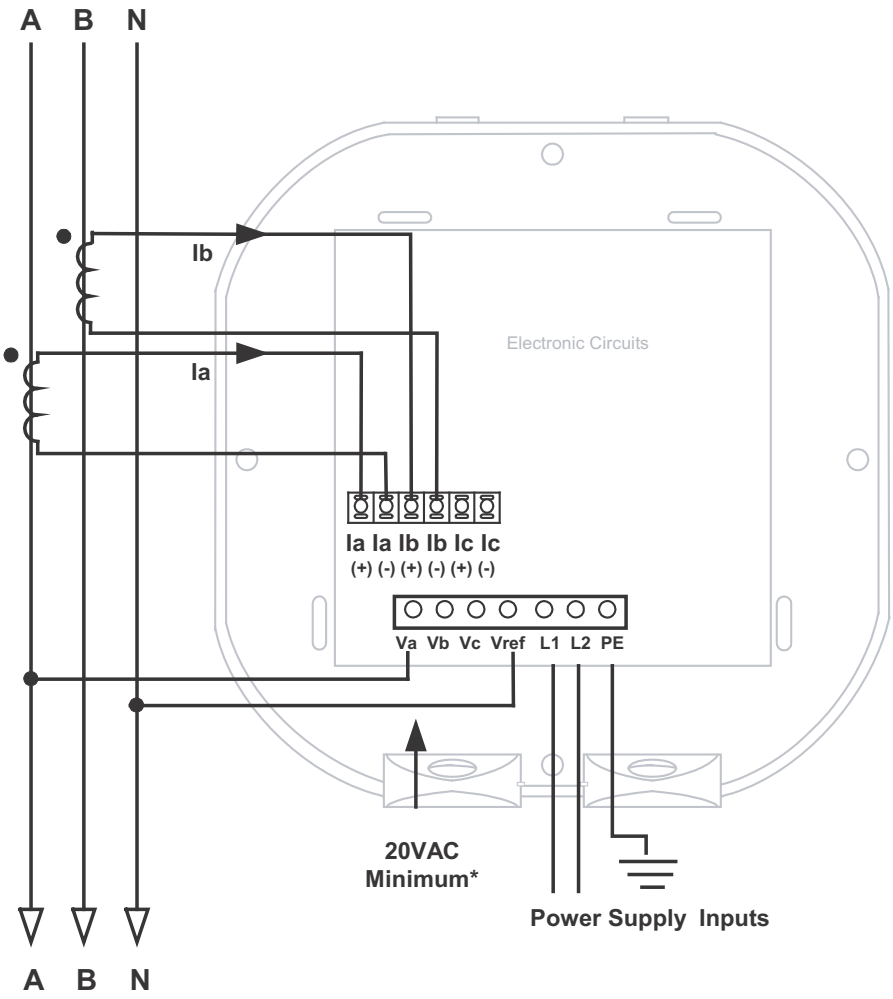
9. Service: Current Only Measurement (Three Phase)



Select: "3 EL WYE" (3 Element Wye) in Meter Programming setup.

NOTE: Even if the meter is used for only Amp readings, the unit requires a Volts AN reference. Please make sure that the Voltage input is attached to the meter. AC Control Power can be used to provide the reference signal.

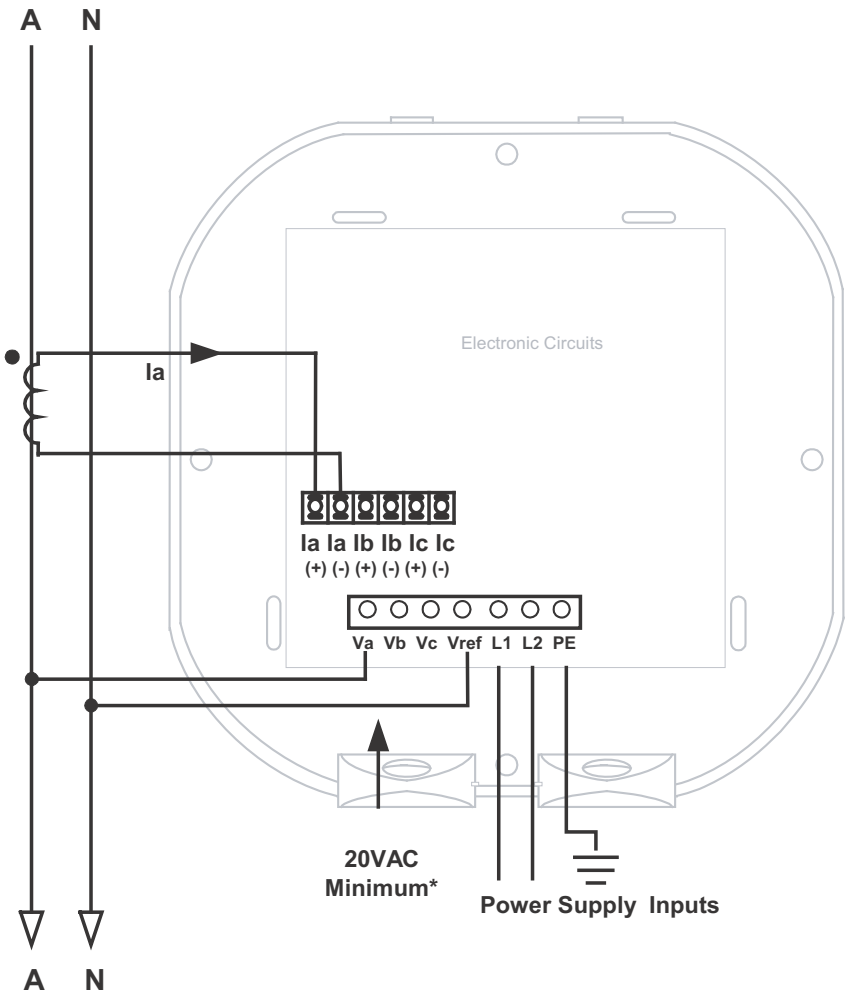
10. Service: Current Only Measurement (Dual Phase)



Select: "3 EL WYE" (3 Element Wye) in Meter Programming setup.

NOTE: Even if the meter is used for only Amp readings, the unit requires a Volts AN reference. Please make sure that the Voltage input is attached to the meter. AC Control Power can be used to provide the reference signal.

11. Service: Current Only Measurement (Single Phase)



Select: "3 EL WYE" (3 Element Wye) in Meter Programming setup.

NOTE: Even if the meter is used for only Amp readings, the unit requires a Volts AN reference. Please make sure that the Voltage input is attached to the meter. AC Control Power can be used to provide the reference signal.

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5: Communication Installation

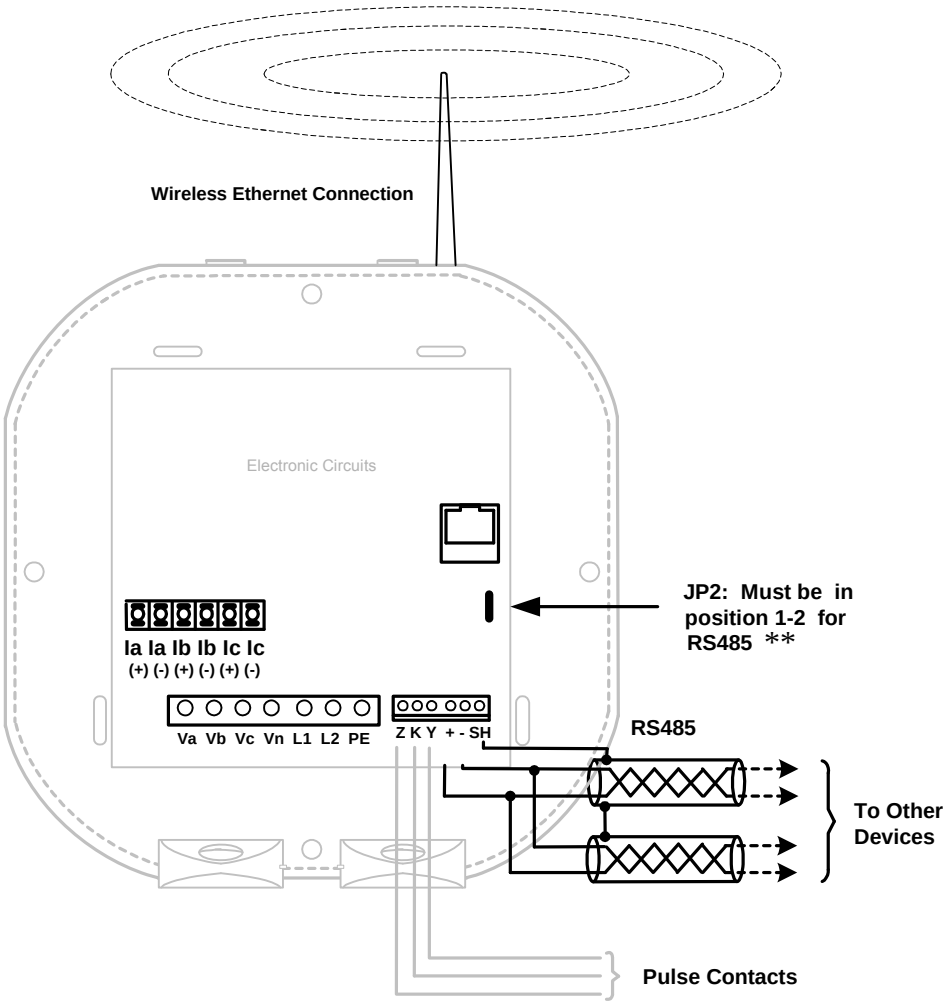
5.1: IQ 150S/250S Communication

The IQ 150S/250S submeter provides a communication port plus a KYZ pulse output. The communication port, Com 2, provides RS485 or RJ45 Ethernet or WiFi Ethernet communication (see Chapter 6 for Ethernet communication).

5.1.1: RS485 Communication Com 2 (485 Option)

The IQ 150S/250S submeter's RS485 port uses standard 2-Wire, half duplex architecture. The RS485 connector is located on the front of the meter, under the cover. A connection can easily be made to a Master device or to other slave devices, as shown below.

NOTE: Care should be taken to connect + to + and - to - connections.



The IQ150S/250S submeter's RS485 connection can be programmed with the buttons on the face of the meter or by using Eaton Meter Configuration software.

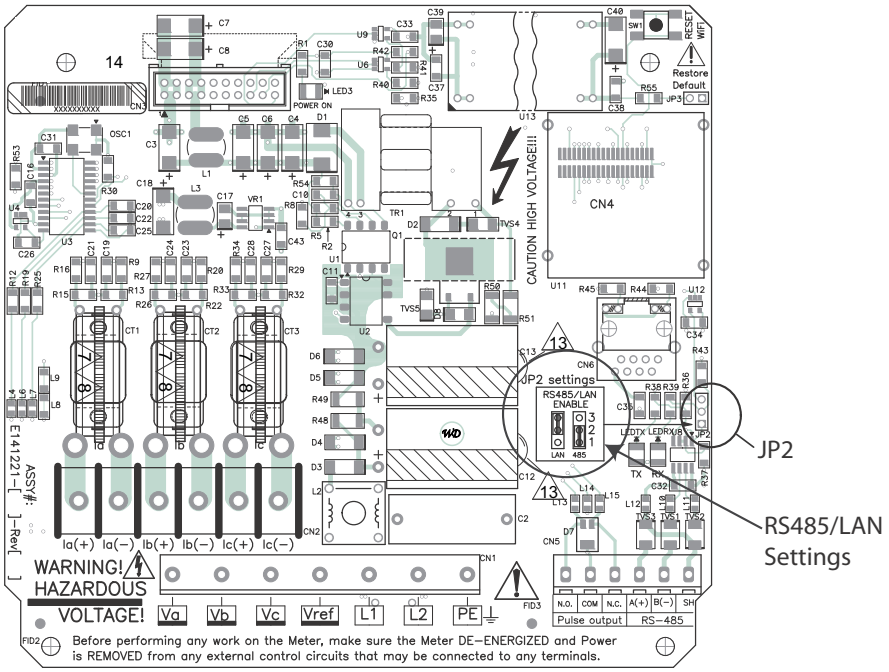
Standard RS485 Port Settings

Address: 001 to 247

Baud Rate: 9600, 19200, 38400 or 57600 Baud

Protocol: Modbus RTU, Modbus ASCII, or DNP 3.0

** The position of Jumper 2 (JP2) must be set for either RS485 or Ethernet communication. See the figure below. You put the jumper on positions 2 and 3 for LAN (Ethernet) communication, and on 1 and 2 for RS485 communication.

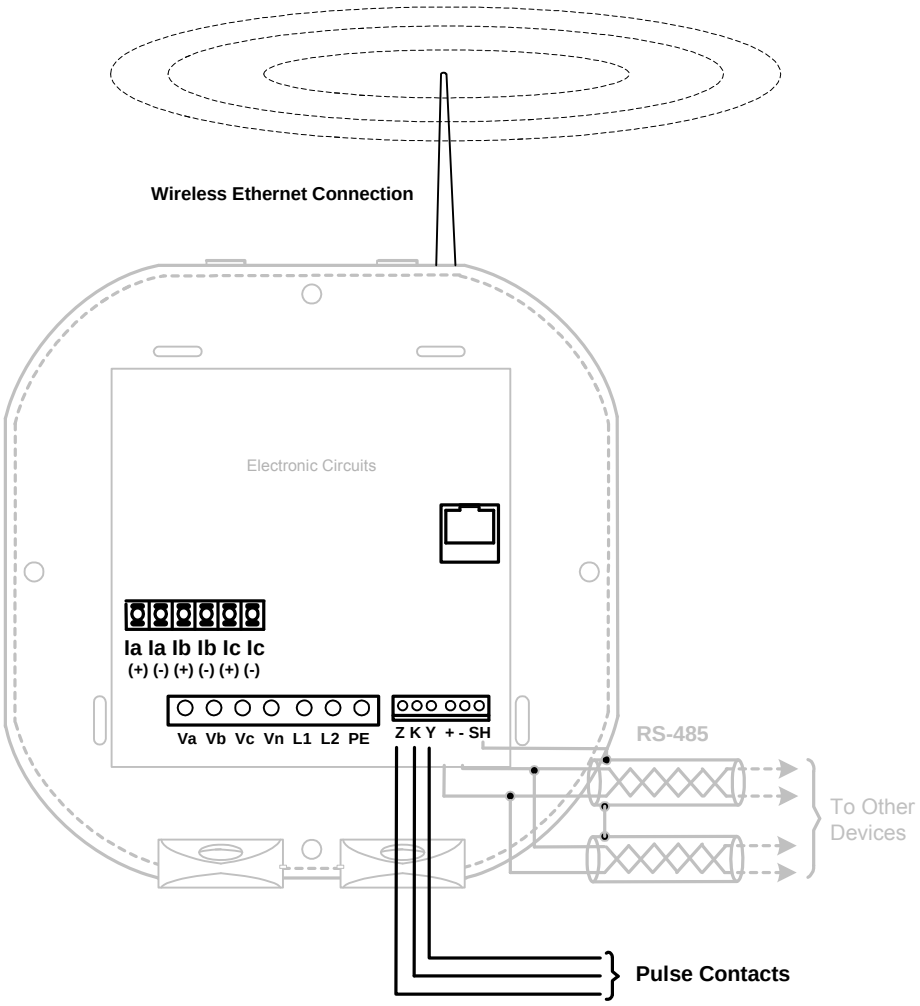


5.1.2: KYZ Output

The KYZ pulse output provides pulsing energy values that verify the submeter's readings and accuracy.

The KYZ Pulse Output is located on the face of the meter, under the cover and just below the RS485 connection.

See Section 2.2 for the KYZ output specifications; see Section 7.4 for pulse constants.

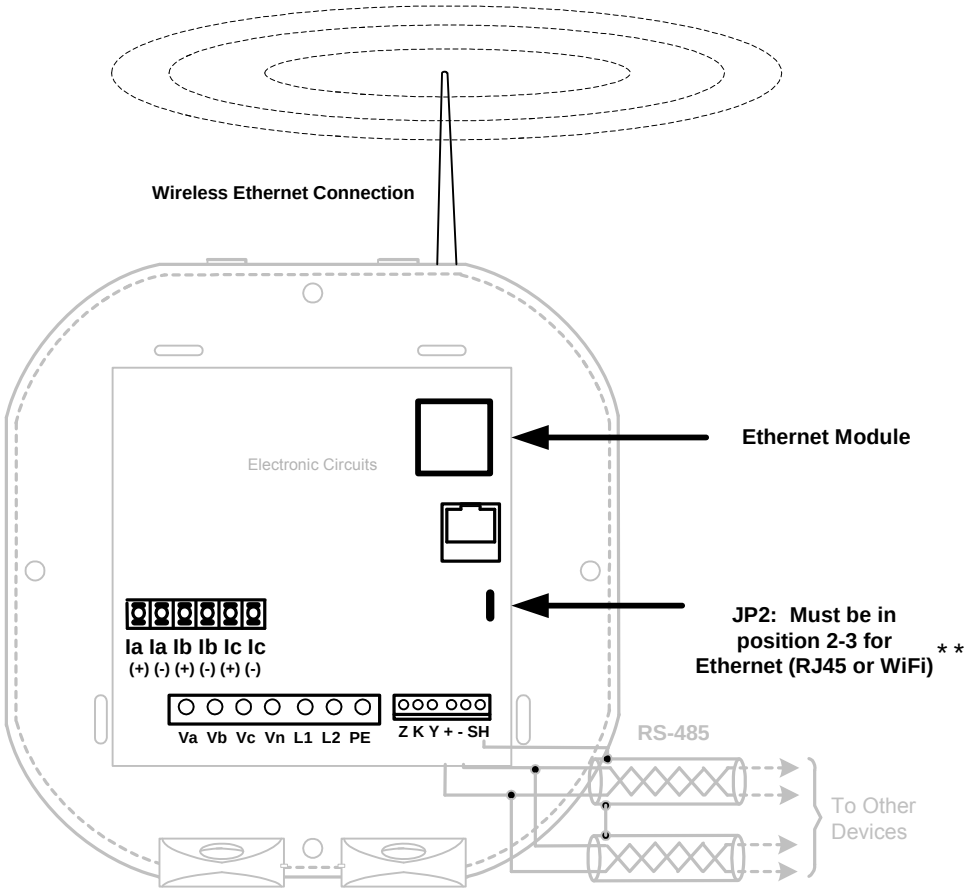


5.1.3: Ethernet Connection

In order to use the IQ 150S/250S submeter's Ethernet capability, the Ethernet Module must be installed in your meter, and the JP2 must be set to positions 2-3. You can use either wired Ethernet, or WiFi.

For wired Ethernet, use Standard RJ45 10/100BaseT cable to connect to the IQ 150S/250S submeter. The RJ45 line is inserted into the RJ45 port of the meter.

For WiFi connections, make sure you have the correct antenna attached to the meter.



Refer to Chapter 6 for instructions on how to set up the Network Module.

** See the JP2 figure and instructions on page 5-2.

5.2: Meter Communication and Programming Overview

Programming and communication can utilize the RS485 connection shown in Section 5.1.1 or the RJ45/WiFi connection shown in Section 5.1.3. Once a connection is established, Eaton Meter Configuration software can be used to program the meter and communicate to other devices.

Meter Connection

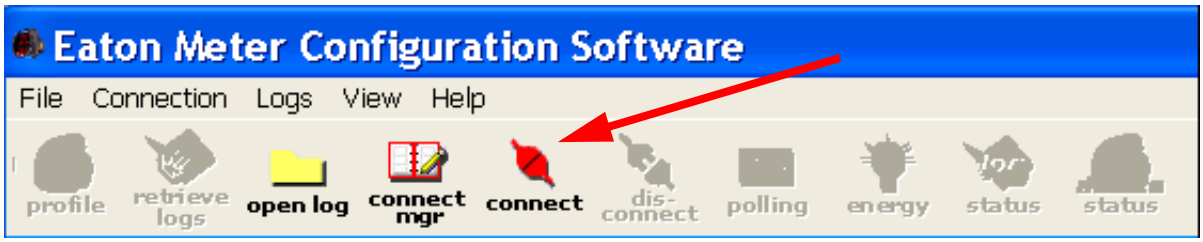
To provide power to the meter, use one of the wiring diagrams in Chapter 4 or attach an Aux cable to GND, L(+) and N(-).

The RS485 cable attaches to SH, - and + as shown in Section 5.1.1.

5.2.1: How to Connect to the Submeter

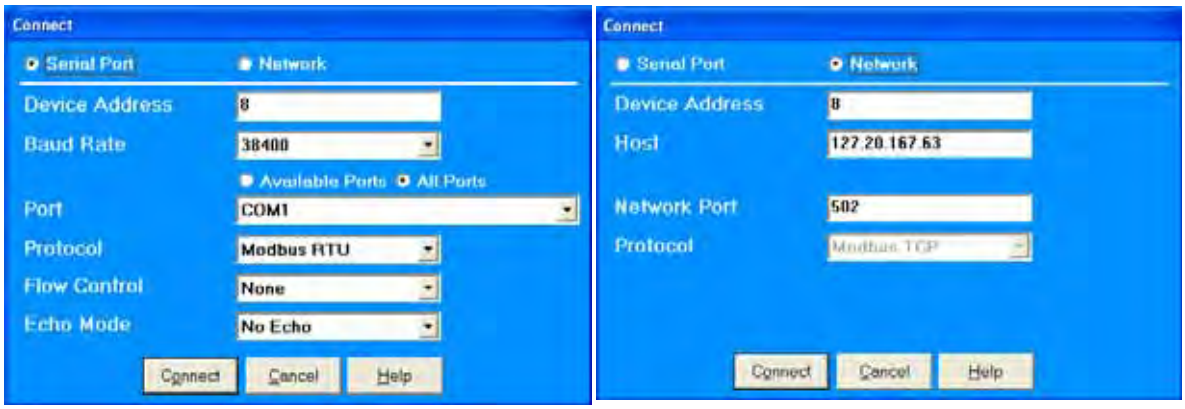
1. Open Eaton Meter Configuration software.

2. Click the **Connect** icon on the Icon bar.



The Connect screen opens, showing the Initial settings. Make sure your settings are the same as those shown here, except for the IP Address field, which must be your device's IP address. The address shown here is the default Ethernet option address.

NOTE: The settings you make will depend on whether you are connecting to the meter via Serial Port (screen on the left) or Network (screen on the right). Use the pull-down menus to make any necessary changes.



3. Click the **Connect** button on the screen.

   NOTE: You may have to disconnect power, reconnect power and then click **Connect**.

   The Device Status screen appears, confirming a connection.

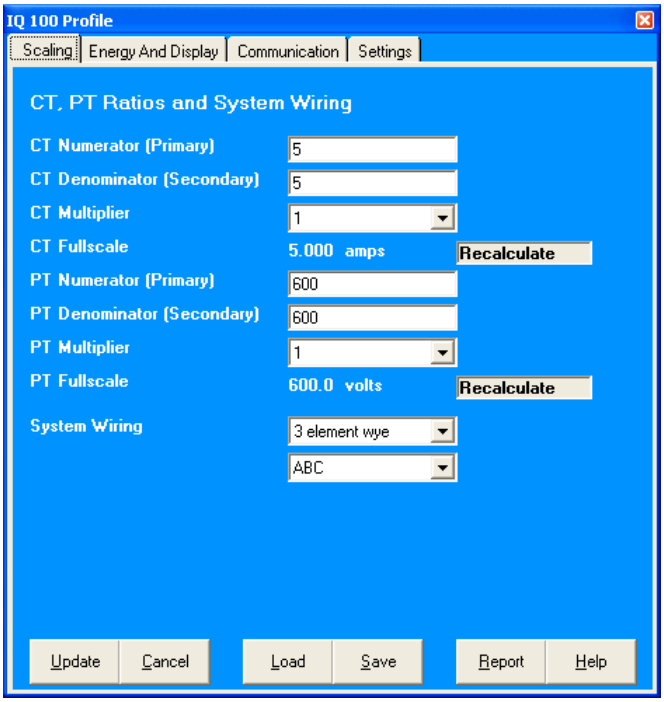
4. Click **OK**.

5. The Eaton Meter Configuration software Main screen appears. Click the **Profile** icon in the Title Bar.

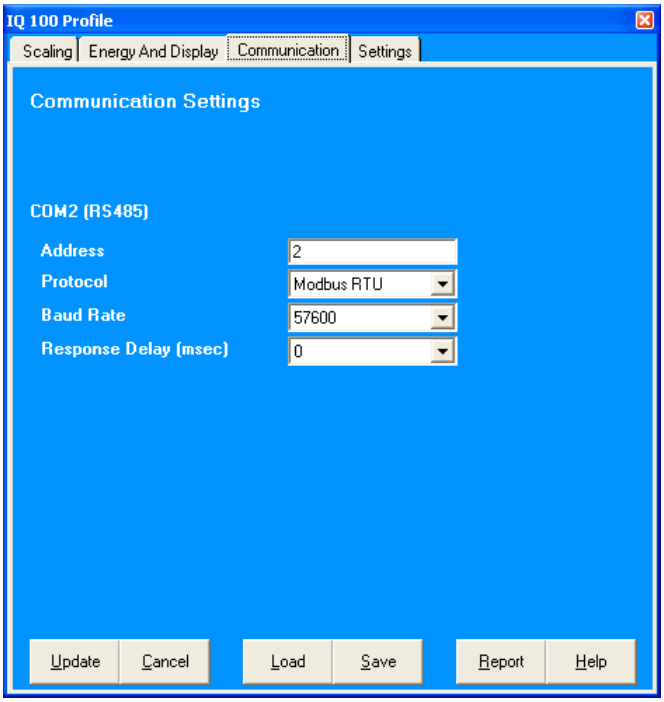
6. You will see the IQ 150S/250S meter's Device Profile screen.

   NOTE: The following screens are for the IQ 150S. If you are connected to an IQ 250S, see Section 5.2.3.

   The tabs at the top of the screen allow you to navigate between settings screens (see below).



7. Click the **Communications** tab. You will see the following screen. Use this screen to enter communication settings for the meter's RS485 port (COM 2) Make any necessary changes to settings.



8. Valid Communication Settings are as follows:

COM2	(RS485)
Address	(1-247)
Protocol	(Modbus RTU, Modbus ASCII or DNP)
Baud Rate	(9600 to 57600)
Response Delay	(0-750 msec)

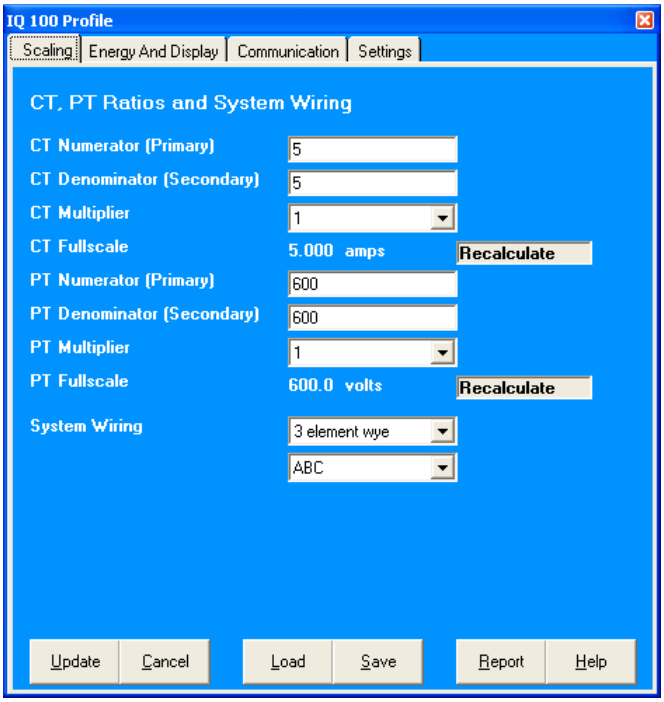
9. When changes are complete, click the **Update** button to send the new profile to the meter.

10. Click **Exit** to leave the Device Profile or click other menu items to change other aspects of the Device Profile (see following section for instructions).

5.2.2: IQ 150S Submeter Device Profile Settings

NOTE: You can view this manual online by clicking **Help>Contents** from the Eaton Meter Configuration Software's Main screen.

CT, PT Ratios and System Wiring (Scaling tab)



The screen fields and acceptable entries are as follows:

CT Ratios

CT Numerator (Primary): 1 - 9999

CT Denominator (Secondary): 5 or 1 Amp

NOTE: This field is display only.

CT Multiplier: 1, 10 or 100

Current Full Scale: Calculations based on selections. Click **Recalculate** to see the result of changes.

PT Ratios

PT Numerator (Primary): 1 - 9999

PT Denominator (Secondary): 40 - 600

PT Multiplier: 1, 10, 100, or 1000

Voltage Full Scale: Calculations based on selections. Click **Recalculate** to see the result of changes.

System Wiring

3 Element Wye; 2.5 Element Wye; 2 CT Delta

Phases Displayed

A, AB, or ABC

NOTE: Voltage Full Scale = PT Numerator x PT Multiplier

Example:

A 14400/120 PT would be entered as:

PT Numerator: 1440

PT Denominator: 120

Multiplier: 10

This example would display a 14.40kV.

Example CT Settings:

200/5 Amps: Set the Ct-n value for 200, Ct-Multiplier value for 1

800/5 Amps: Set the Ct-n value for 800, Ct-Multiplier value for 1

2,000/5 Amps: Set the Ct-n value for 2000, Ct-Multiplier value for 1

10,000/5 Amps: Set the Ct-n value for 1000, Ct-Multiplier value for 10

Example PT Settings:

277/277 Volts: Pt-n value is 277, Pt-d value is 277, Pt-Multiplier is 1

14,400/120 Volts: Pt-n value is 1440, Pt-d value is 120, Pt-Multiplier value is 10

138,000/69 Volts: Pt-n value is 1380, Pt-d value is 69, Pt-Multiplier value is 100

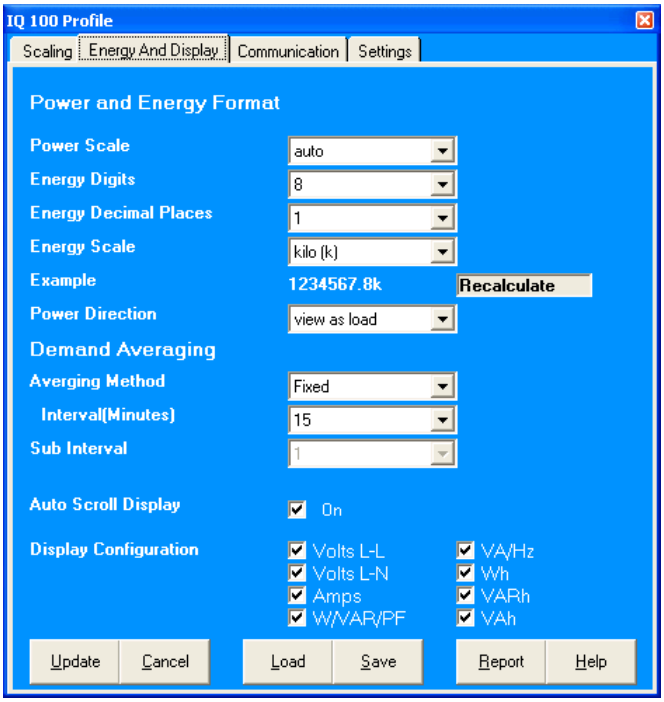
345,000/115 Volts: Pt-n value is 3450, Pt-d value is 115, Pt-Multiplier value is 100

345,000/69 Volts: Pt-n value is 345, Pt-d value is 69, Pt-Multiplier value is 1000

NOTE: Settings are the same for Wye and Delta configurations.

Energy and Display

The settings on this screen determine the display configuration of the meter's faceplate.



The screen fields and acceptable entries are as follows:

Power and Energy Format

Power Scale: Unit, kilo (k), Mega (M), or auto.

Energy Digits: 5, 6, 7, or 8

Energy Decimal Places: 0-6

Energy Scale: Unit, kilo (k), or Mega (M)

For Example: a reading for Digits: 8; Decimals: 3; Scale: k would be formatted:

00123.456k

Power Direction: View as Load or View as Generator

Demand Averaging

Averaging Method: Block or Rolling

Interval (Minutes): 5, 15, 30, or 60

Sub Interval (if Rolling is selected): 1-4

Auto Scroll

Click to set On or Off.

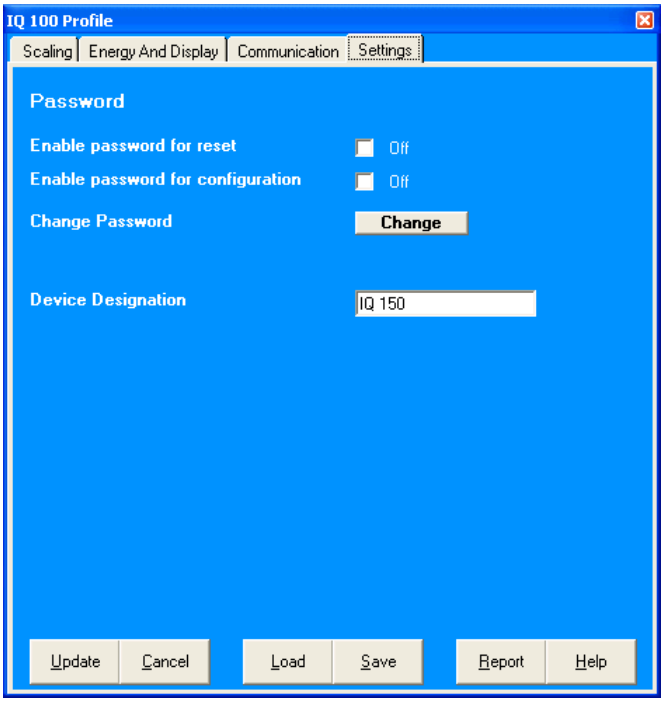
Display Configuration:

Click Values to be displayed.

NOTE: You MUST select at least ONE.

NOTE: If incorrect values are entered on this screen the following message appears:WARNING: Current, CT, PT and Energy Settings will cause invalid energy accumulator values.
Change the settings until the message disappears.

Settings



The screen fields are as follows:

Password

NOTE: The meter is shipped with Password Disabled. There is NO DEFAULT PASSWORD.

Enable Password for Reset: click to Enable.

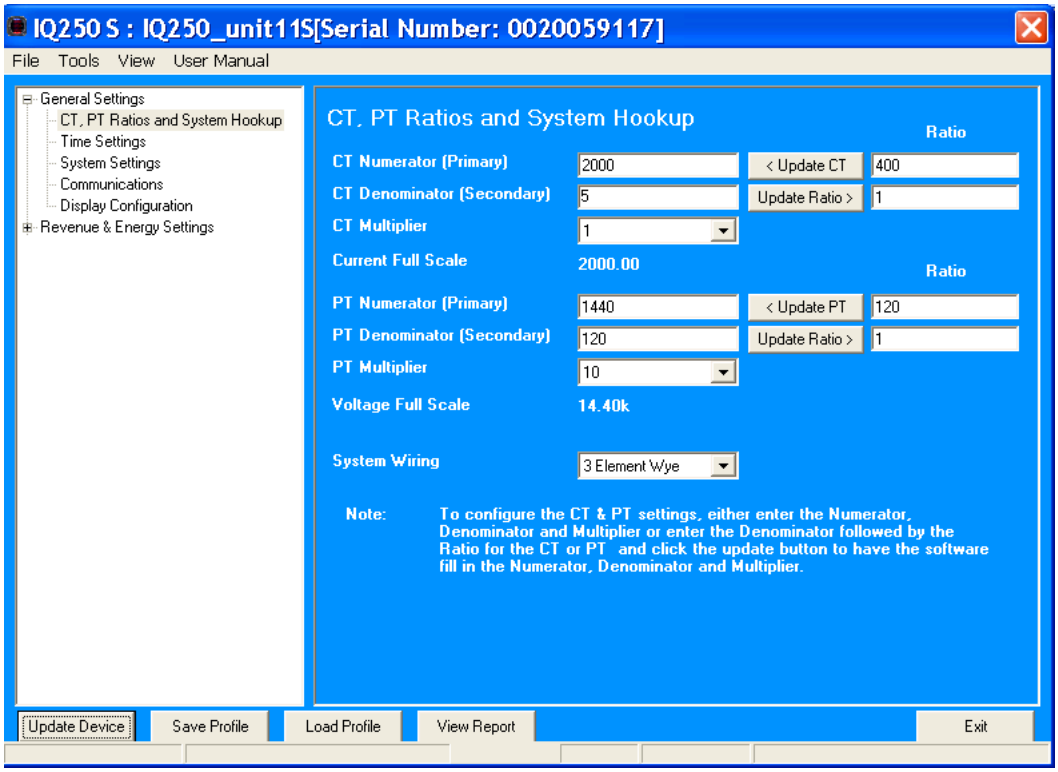
Enable Password for Configuration: click to Enable.

Change Password: click to Change.

Device Designation: optional user-assigned label.

5.2.3: IQ 250S Submeter Device Profile Settings

1. When you are connected to an IQ 250S meter and click **Profile**, you see the following screen.



The IQ 250S meter's Profile screen features a Tree Menu on the left for Settings navigation, and Buttons and a Title Bar that allow you to perform tasks, for example, updating the Device Profile.

Selecting Settings

- The Tree Menu on the left side of the screen allows you to navigate between Settings. The example screen pictured above shows the Tree Menu you see when you first open the screen. Click on the + next to a Setting (for example, Revenue & Energy Settings) to see additional Setting options.

- From the Tree Menu, click on the Setting you want to configure (for example, System Settings) to display its screen in the right side of the Device Profile screen.

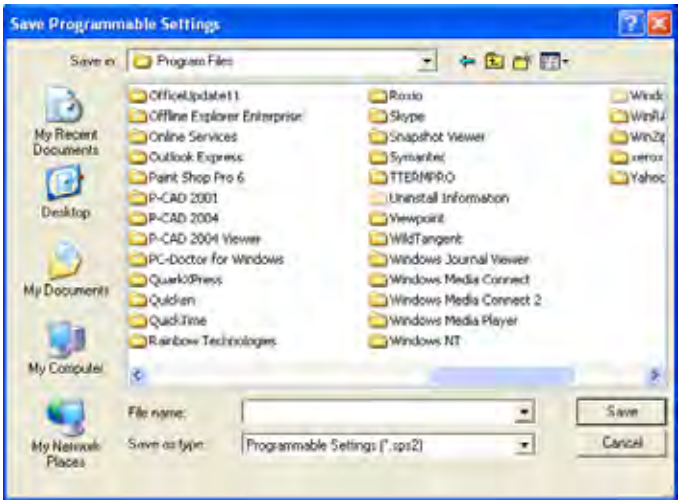
Performing Tasks

You can perform tasks from either the Device Profile screen Buttons or from the Title Bar. The screen Buttons and their functions are as follows:

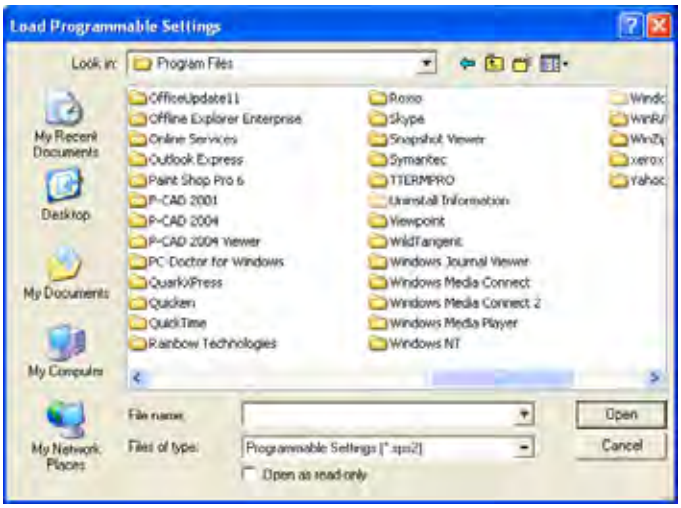
- ·Update Device: Click to send the current settings to the meter.

  NOTE: You must click the Update Device button after making changes to the Settings screens, if you want to update the connected meter's settings.

- Save Profile: Click to save the Device Profile settings to a file. You will see the Save Programmable Settings window, shown below. Give a name to the Device Profile and click Save.



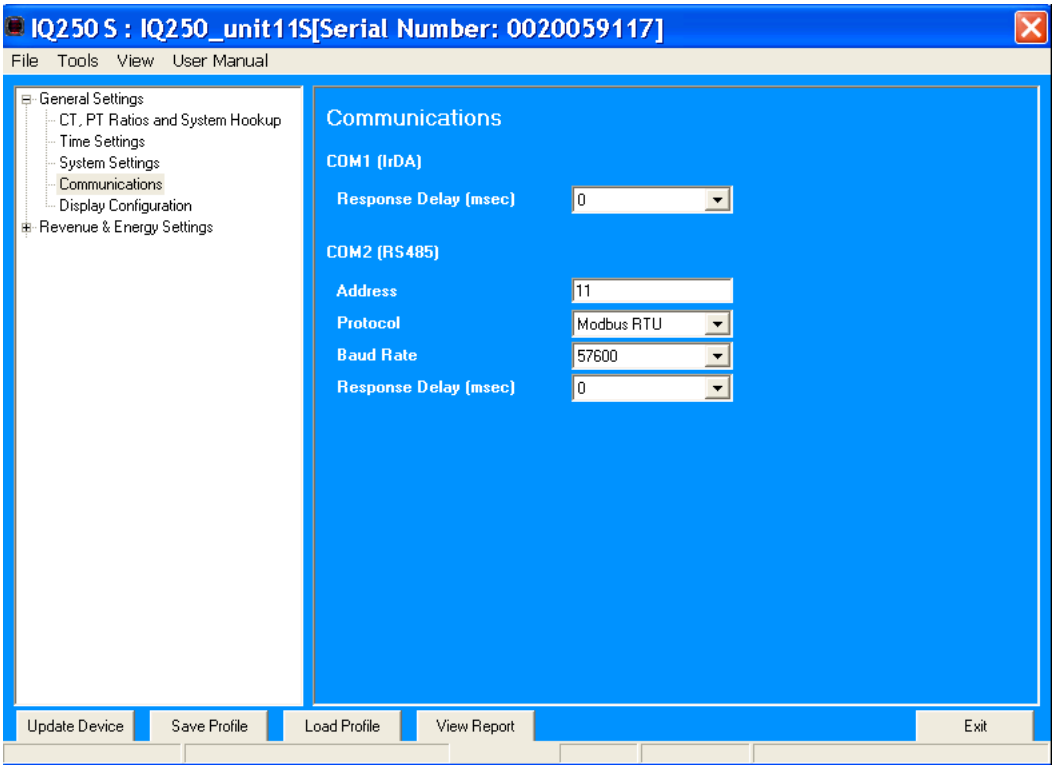
• ·Load Profile: Click to load a previously saved Device Profile Settings file. You will see the Load Programmable Settings window, shown below. Select the saved Device Profile you want and click Open. The settings from that file will now appear in the Settings screens; for example, the CT and PT Ratios will be those from the saved Device Profile, rather than from the currently connected meter.



• View Report: Click to open a Notepad window containing the Device Profile settings in a text file.
- Print the text file by selecting File>Print from the Notepad Title Bar.
- Save the text file by selecting File>Save from the Notepad Title Bar.

• Exit: Click to leave the Device Profile Editor.

2. Click the **Communications** tab. You will see the following screen. Use this screen to enter communication settings for the meter's RS485 port (COM 2) Make any necessary changes to settings.



3. Valid Communication Settings are as follows:

   COM2 (RS485)

   Address (1-247)

   Protocol (Modbus RTU, Modbus ASCII or DNP)

   Baud Rate (9600 to 57600)

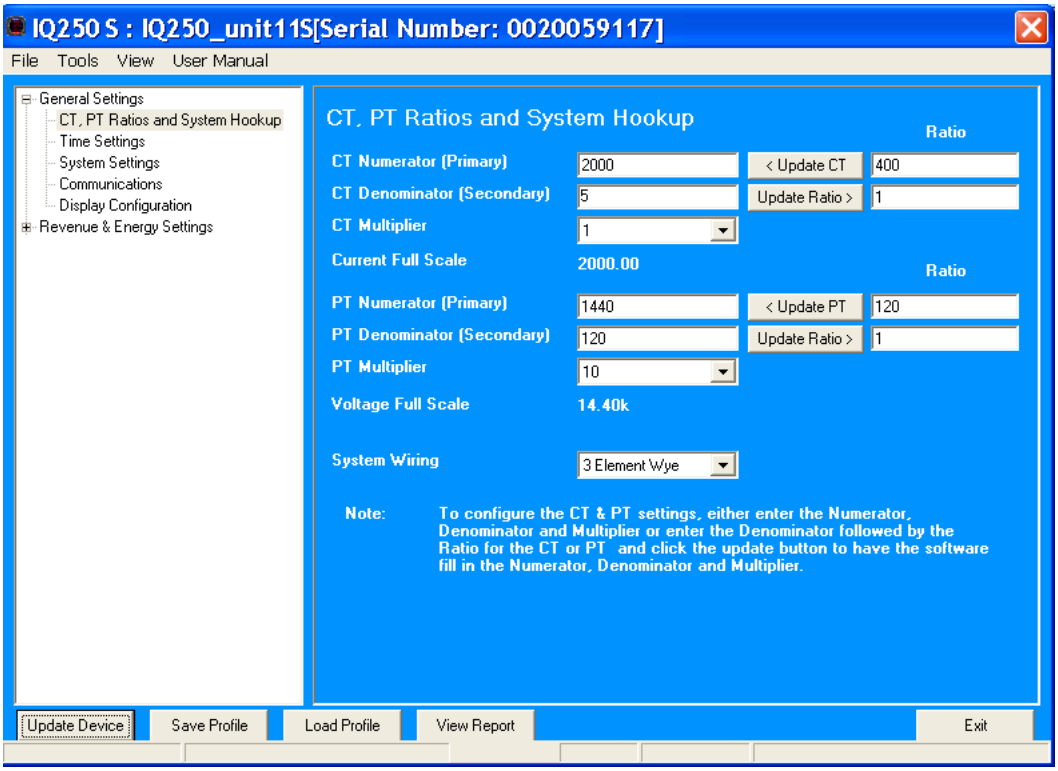
   Response Delay (0-750 msec)

4. When changes are complete, click the **Update Device** button to send the new profile to the meter.

5. Click **Exit** to leave the Device Profile or click other menu items to change other aspects of the Device Profile (see following section for instructions).

Additional Settings for the IQ250S

CT, PT Ratios and System Hookup



The screen fields and acceptable entries are as follows:

CT Ratios

CT Numerator (Primary): 1 - 9999

CT Denominator (Secondary): 5 or 1 Amp

NOTE: This field is display only.

CT Multiplier: 1, 10 or 100

Current Full Scale: Calculations based on selections. Click **Recalculate** to see the result of changes.

PT Ratios

PT Numerator (Primary): 1 - 9999

PT Denominator (Secondary): 40 - 600

PT Multiplier: 1, 10, 100, or 1000

Voltage Full Scale: Calculations based on selections. Click **Recalculate** to see the result of changes.

System Wiring

3 Element Wye; 2.5 Element Wye; 2 CT Delta

Phases Displayed

A, AB, or ABC

NOTE: Voltage Full Scale = PT Numerator x PT Multiplier

Example:

A 14400/120 PT would be entered as:

PT Numerator: 1440

PT Denominator: 120

Multiplier: 10

This example would display a 14.40kV.

Example CT Settings:

200/5 Amps: Set the Ct-n value for 200, Ct-Multiplier value for 1

800/5 Amps: Set the Ct-n value for 800, Ct-Multiplier value for 1

2,000/5 Amps: Set the Ct-n value for 2000, Ct-Multiplier value for 1

10,000/5 Amps: Set the Ct-n value for 1000, Ct-Multiplier value for 10

Example PT Settings:

277/277 Volts: Pt-n value is 277, Pt-d value is 277, Pt-Multiplier is 1

14,400/120 Volts: Pt-n value is 1440, Pt-d value is 120, Pt-Multiplier value is 10

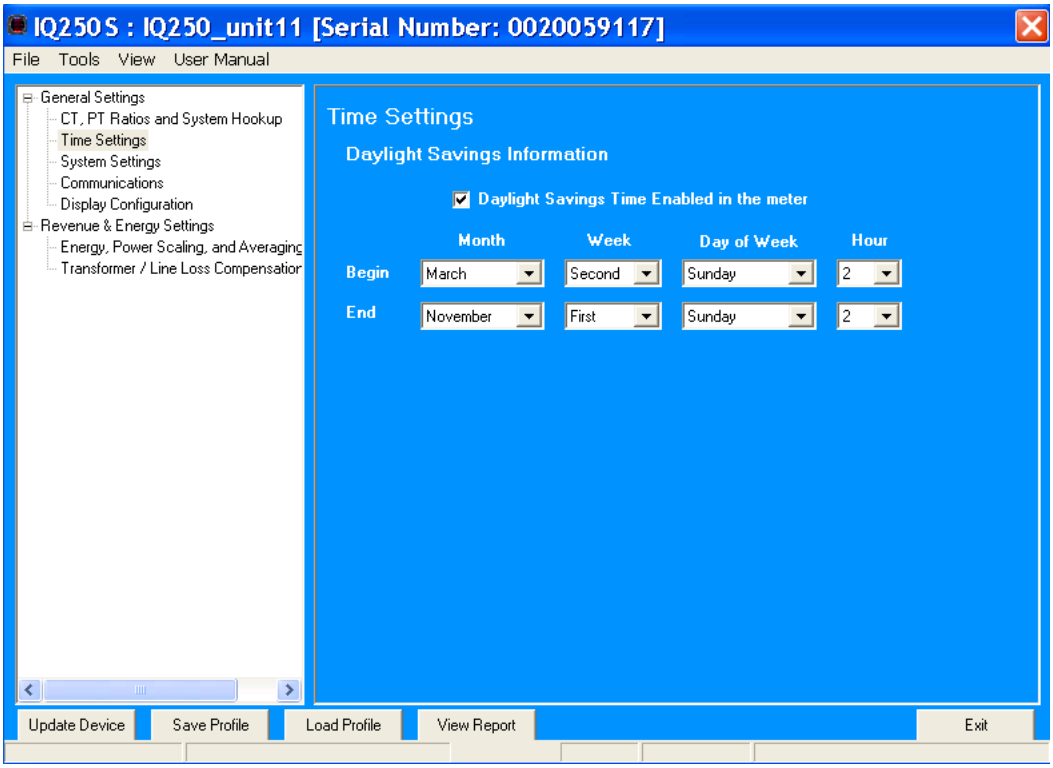
138,000/69 Volts: Pt-n value is 1380, Pt-d value is 69, Pt-Multiplier value is 100

345,000/115 Volts: Pt-n value is 3450, Pt-d value is 115, Pt-Multiplier value is 100

345,000/69 Volts: Pt-n value is 345, Pt-d value is 69, Pt-Multiplier value is 1000

NOTE: Settings are the same for Wye and Delta configurations.

Time Settings



Use this setting to enable or disable Daylight Savings Time for the IQ 250S, and to set the beginning and ending times for Daylight Savings Time. You can also set the Time Zone and enable Clock Sync if supported by your meter.

1. From the Tree Menu, click General Settings>Time Settings.

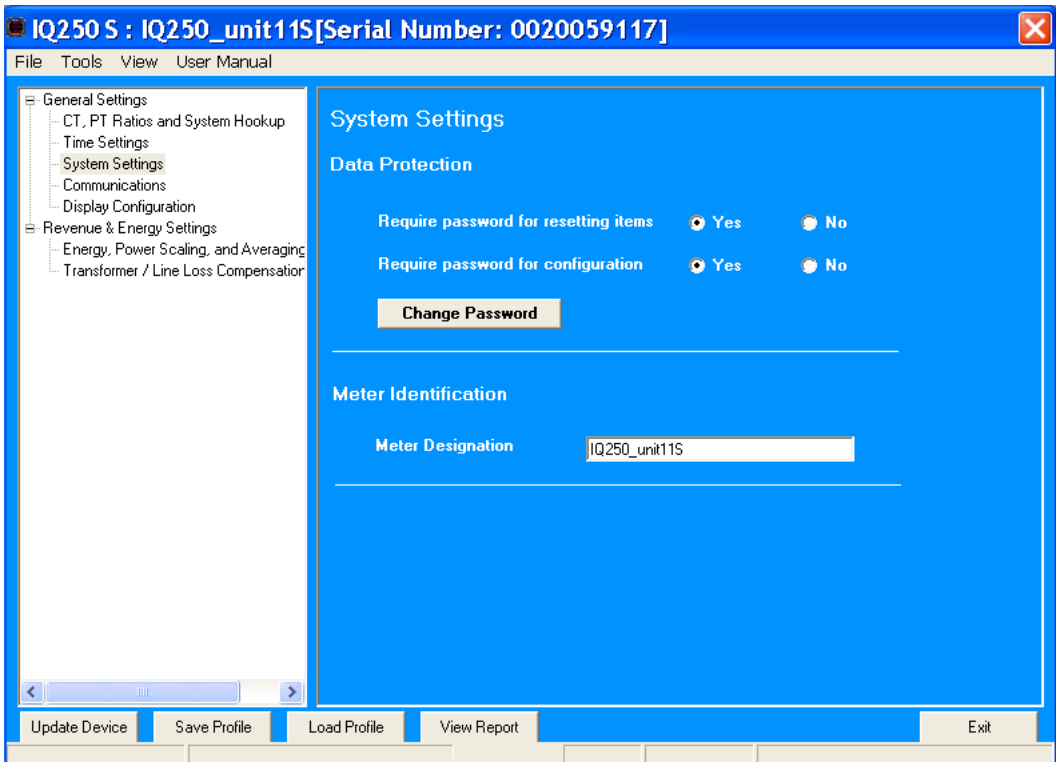
2. Check or uncheck the box to Enable or Disable Daylight Savings time.

3. Use the entry fields to set the start and end times for the Daylight Savings Time feature, if enabled. Select the values you want from the Month, Week, Day of the Week, and Hour fields.

4. Select the time Zone and Clock Sync options from the pull-down menus.

NOTE: The Hour field uses a 24-Hour clock.

System Settings



From the Tree Menu, click General Settings>System Settings. From this screen, you can do the following:

- Enable or Disable Password for Resetting and/or Configuration: click the radio button next to Yes or No. Enabling Password protection prevents unauthorized tampering with devices.

IMPORTANT! You must set up a password before enabling Password Protection. Click the Change button next to Change Password if you have not already set up a password.

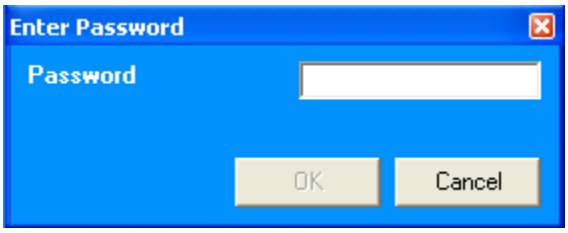
When you click the Change button next to Change Password in the Settings screen, you will see the Enter the New Password screen.

1. Type in the new password (0 - 9999).

2. Retype the password.

3. Click Change. The new password is saved and the meter restarts.

NOTE: If Password Protection has already been enabled for configuration and you attempt to change the password, you will see the Enter Password screen (shown below) after you click Change. Enter the old password and click OK to proceed with the password change.



You can enable or disable a Password for Resetting (Reset Max/Min Energy Settings) and Configuration (Device Profile) in the Systems Settings screen (see previous page).

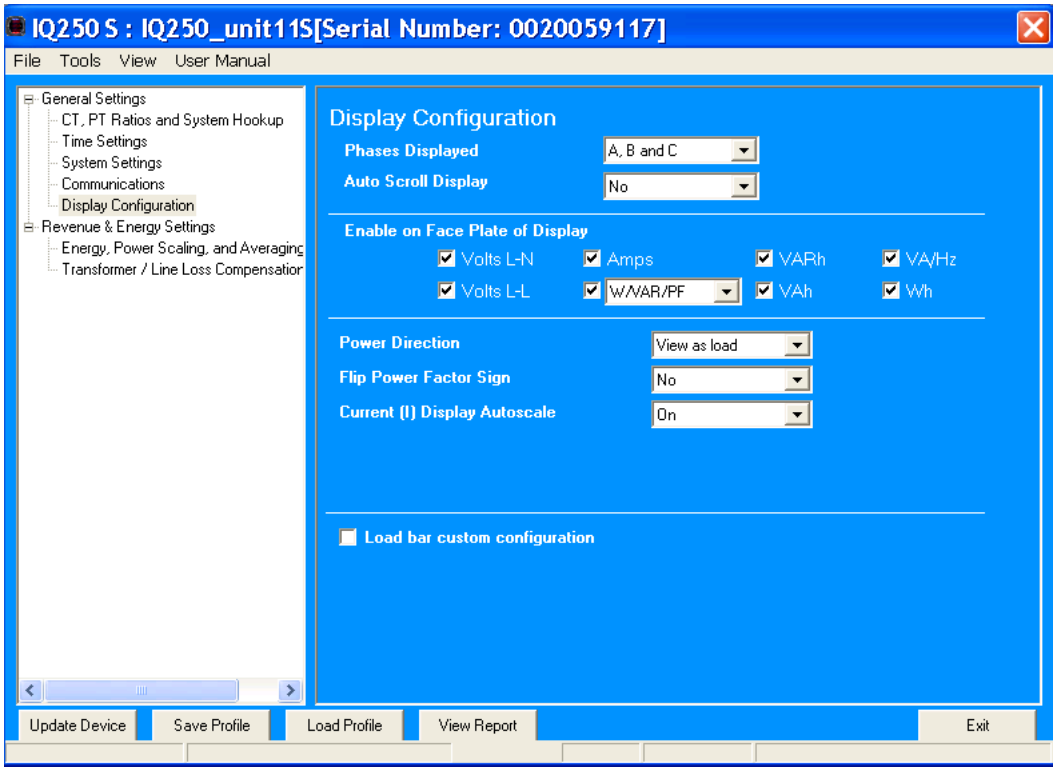
NOTE: If you enable a Password for Resetting, you must also enable it for Configuration.

IMPORTANT! You must set up a password before enabling Password Protection. Click the Change button next to Change Password if you have not already set up a password and follow the above instructions.

When anyone attempts to make a change that is under Password protection, the Enter Password screen opens. (See the example screen above.) If the correct Password is not entered, the change does not take place.

Display Configuration

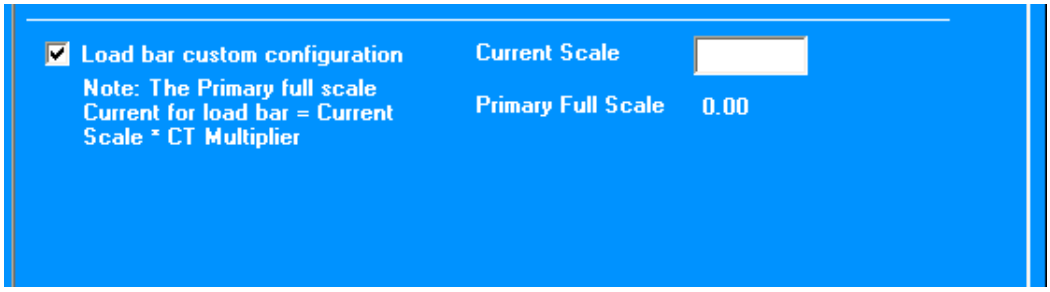
The settings on this screen determine the display configuration of the meter's faceplate.



The screen fields and acceptable entries are as follows:

- Phases Displayed: A; A and B; A, B, and C. This field determines which phases display on the faceplate. For example, if you select A and B, only those two phases will be displayed on the faceplate.
- Auto Scroll Display: Yes or No. This field enables or disables the scrolling of selected readings on the faceplate. If enabled, the readings scroll every 5 seconds.
- Enable on Face Plate of Display: Check the boxes of the Readings you want displayed on the faceplate of the meter. You must select at least one reading.
- Power Direction: View as Load or View as Generator
- Flip Power Factor Sign: Yes or No.
- Current Display Auto-Scale: On or Off (no decimal places)

- Load Bar Custom Configuration: Click this bar to add Current scaling. Additional fields open on the screen - see the figure below.



Enter the Current scale you want to use, The Primary Full Scale field will reflect your entry (as it says on the screen, Primary Full Scale Current for the Load Bar is equal to the Current scale multiplied by the CT multiplier.

Energy, Power Scaling, and Averaging

Use this setting to configure:

- The display of Power in the meter
- The display and storage of Energy in the meter
- The interval over which Average values are computed.

Functional Overview of Energy Settings and Averaging

Energy Scaling

Energy Setting includes:

- Digits (the number of digits in the reading)
- Decimals (the number of decimal places in the reading)
- Energy Scale: the scale of the reading – unit; kilo (number times 1000); Mega (number times 1 million).

Energy settings allow you to balance the resolution (or accuracy) of the energy stored, with the interval over which energy rollover occurs. For example, the maximum resolution for a k scale reading is: 99999.999k.

To calculate the speed at which the energy will rollover, you must know the Energy Full Scale, which is computed from the CT and PT Full Scale values (see Section 9.2.4.1). The formula for calculating Energy Full Scale is:

Wye system: CT Full Scale x PT Full Scale x 3

Delta system: CT Full Scale x PT Full Scale x 3 x 3

For example, for a CT Full Scale of 2000, PT Full Scale of 14400, Wye system:

2000 x 14400 x 3=86400000

In this example, the energy will increment at 86400000 Watts per hour, or 24000 Watts per second.

This value allows you to determine the number of digits, decimal places, and energy scale you want to configure for the Energy settings, when you take into account the rollover time. To determine the number of hours before rollover, use this formula:

[Max Resolution]/[Full Scale] = #Hours, where Max Resolution = maximum digits and decimals for the Energy scale in use.

Using the example from above, with an energy scale of Mega, the formula would be:

99999.999 M/86.4 M = 1157.4074 hours or about 48 days until rollover.

NOTE: To increase the number of days until rollover, you can:

- Increase the number of digits (to 8)
- Decrease the number of decimal places (to 0)
- Increase the Energy Scale (to M).

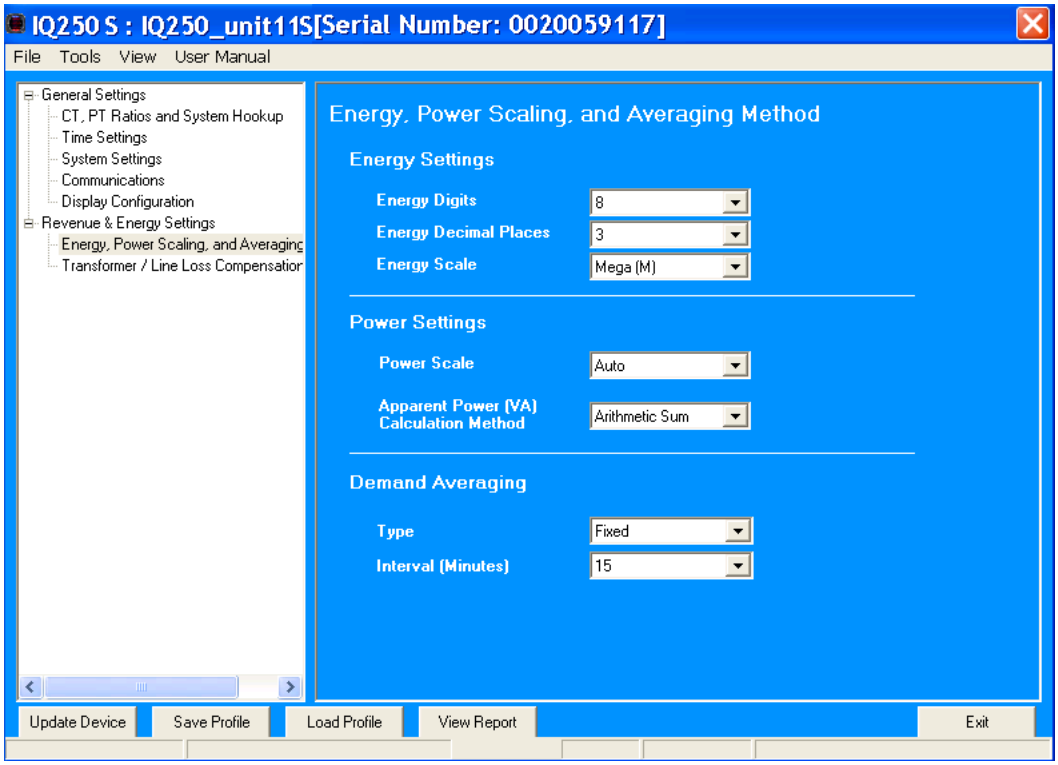
Demand Averaging

Demand is the average rate of energy use over time. The IQ 250S supports two types of demand averaging: Fixed demand and Sliding demand:

- Fixed demand records the average demand for time intervals that you define (usually 5, 15 or 30 minutes).

- Sliding demand functions like multiple, overlapping Fixed demand. You define the subintervals at which an average of demand is calculated. An example of Sliding demand would be a 15-minute Demand block using 5-minute subintervals, thus providing a new demand reading every 5 minutes, based on the last 15 minutes.

From the Tree Menu, click Energy Settings> Energy, Power Scaling, and Averaging.



The screen fields and acceptable entries are as follows:

- Energy Settings

  Energy Digits: 5; 6; 7; 8

  Energy Decimal Places: 0 - 6

  Energy Scale: unit; kilo (K); Mega (M)

  For example: a reading for Digits: 8; Decimals: 3; Scale: K would be formatted: 00123.456k

NOTE: Your selection in the Energy Settings fields determines the precision of energy stored for display and polling. Refer to the Functional Overview at the beginning of this section for more information.

- Power Settings:

  Power Scale: Auto; unit; kilo (K); Mega (M)

  Apparent Power (VA) Calculation Method: Arithmetic Sum or Vector Sum

- Demand Averaging:

  Type: Fixed or Sliding

  Interval (Fixed demand) or Sub-Interval (Sliding demand) in minutes: 5; 15; 30; 60

  Number of Subintervals: 1; 2; 3; 4

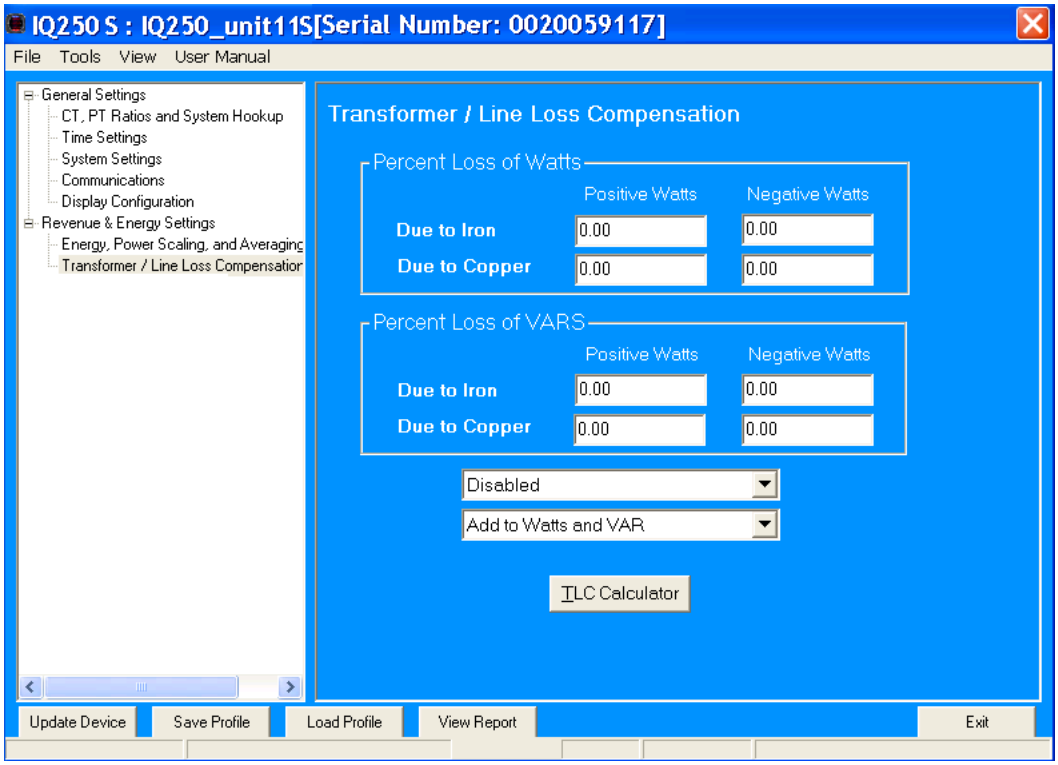
  Interval Window: This field is display only. It is the product of the values entered in the Sub-Interval and Number of Subintervals fields.

  NOTE: You will only see the Number of Subintervals and Interval Window fields if you select Sliding Demand.

Transformer/Line Loss Compensation

Transformer/Line Loss Compensation allows you to add or subtract losses to meter registration.

From the Tree Menu, click Revenue & Energy Settings>Transformer/Line Loss Compensation.



This screen displays the current values for the meter's Transformer Loss Compensation. The screen fields and acceptable entries are as follows

- Percent Loss of Watts due to Iron and Copper/Positive Watts and Negative Watts
- Percent Loss of VARS due to Iron and Copper/Positive and Negative Watts
- Drop-down menu #1. Choose from: Disabled, Fe Only, Cu Only, Both Fe and Cu.
- Drop-down menu #2. Choose from: Add to Watts and VAR; Add to Watts and Subtract from VAR; Subtract from Watts and Add to VAR; Add to Watts and VAR; Subtract from Watts and VAR.

1. Click **TLC Calculator** to find the values to enter into the Percent Loss fields. The TLC Calculator button launches an Excel Spreadsheet that makes the calculations for you once you enter the required data.

   WARNING! Eaton Meter Configuration Software automatically launches the Excel Spreadsheet

when you click the TLC Calculator button. If you do not have Excel software installed on your computer, a Warning message is displayed instead of the worksheet.

EXCEL NOTE: For most Excel users, the spreadsheet does run until you give the application permission to run the Macros contained in the sheet. You give permission by changing the Excel Security Setting from High to Medium, as follows:

a. From the Excel toolbar, click Tools>Security>Options.

b. On the Security Tab page, click the Macro Security button.

c. Select Medium Security.

4. Enter the percent Loss of Watts and VARS for copper and iron in the appropriate fields.

Configuring Limits (IQ 250S)

Use this screen to assign Limits for the meter.

Functional Overview for Limits:

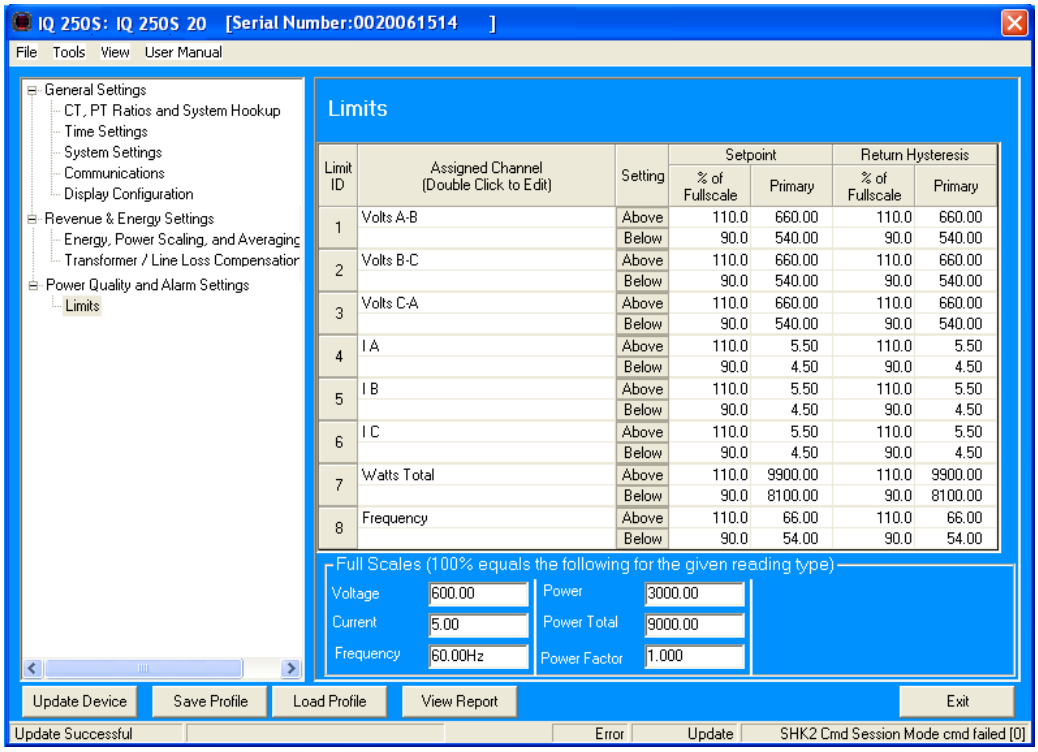
Limits are transition points used to divide acceptable and unacceptable measurements. When a value goes above or below the limit, an out-of-limit condition occurs. You can set and configure up to eight Limits for the IQ 250S meter.

Once they are configured, you can view the out-of-Limits (or Alarm) conditions in the Limits Polling screen.

You can assign the eight limits to readings from three groups of parameters:

- Readings (Instantaneous Voltage; Instantaneous Current; Total and Per Phase Power and Power Factor; Frequency; and Neutral Current)
- Demand (Current; Per Phase, Total Power and Power Factor)

From the Tree Menu, click Power Quality and Alarm Settings>Limits.



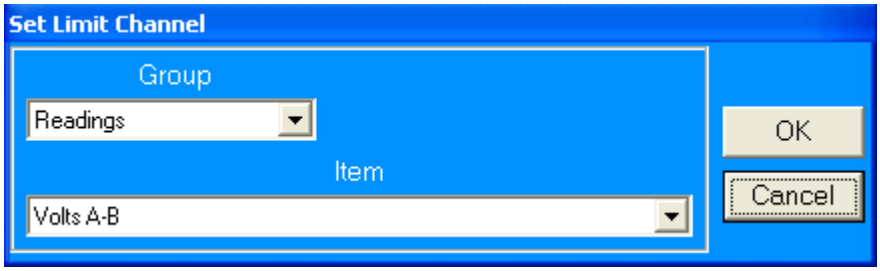
The current settings for Limits are shown in the screen.

The bottom of the screen shows the Full Scale values for:

- Voltage
- Current
- Frequency
- Power
- Power Total
- Power Factor
- Phase Angles

1. Select a limit by double-clicking on the Assigned Channel field.

2. You will see the screen shown below.



Select a Group and an Item for the Limit.

3. Click OK.

4. To Configure a Limit, double-click on the Field to set the following values:

- Above and Below Setpoint:% of Full Scale (the point at which the reading goes out of limit)

  Examples:

  100% of 120V Full Scale = 120V

  90% of 120V Full Scale = 108V

- Above and Below Return Hysteresis: the point at which the reading goes back within limit (see figure below)

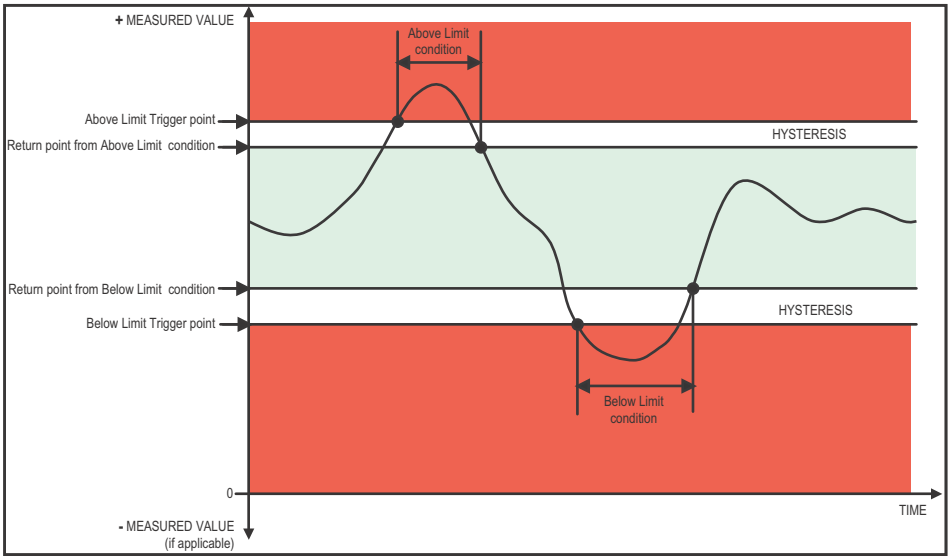
Examples:

Above Setpoint = 110%; Below Setpoint = 90%

(Out of Limit above 132V);(Out of Limit below 108V)

Above Return Hysteresis = 105%; Below Return Hysteresis = 95%

(Stay out of Limit until below 126V)(Stay out of Limit until above 114V)



NOTES:

- The Primary fields are display only. They show what the set point and return Hysteresis value are for each limit.
- If the Above Return Hysteresis is greater than the Above Set Point, the Above Limit is Disabled; if the Below Return Hysteresis is less than the Below Set Point, the Below Limit is Disabled. You may want to use this feature to disable either the Above Limit or Below Limit condition for a reading.
- If you are entering negative limits, be aware that the negative value affects the way the above and below limits function, since negative numbers are processed as signed values.

Configuring Historical Logs (IQ250S)

Use this setting to select the parameters to be stored in each of the IQ 250S meter's three Historical Logs.

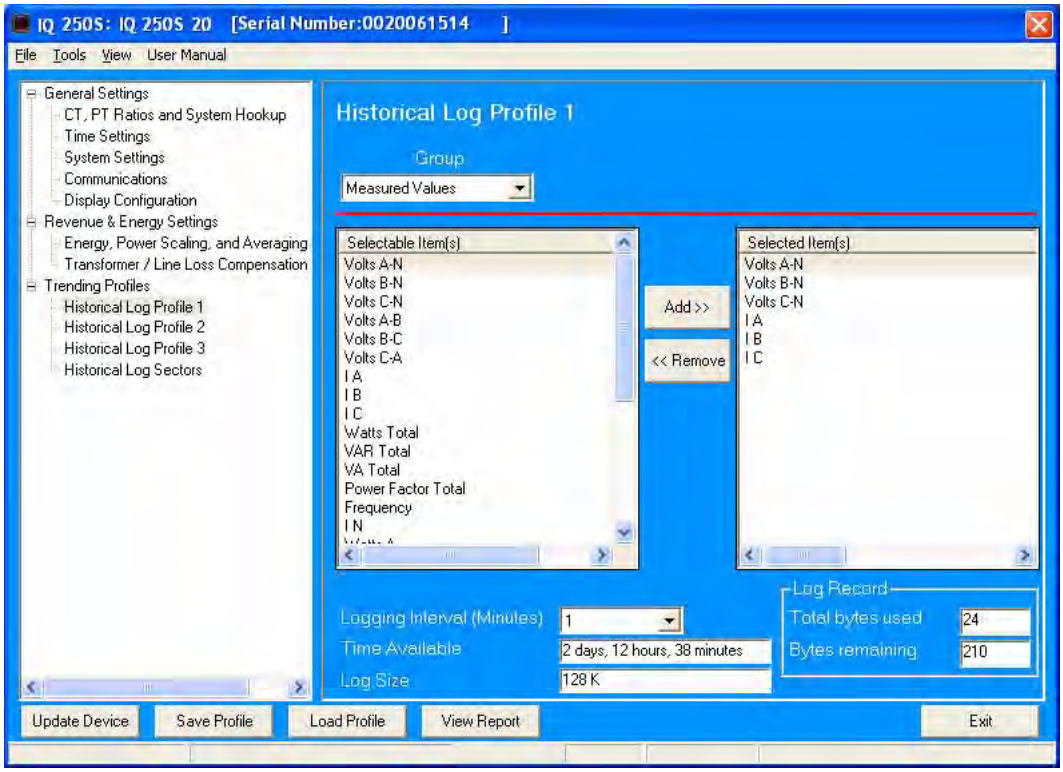
Functional Overview of Historical Logs:

Having three historical logs affords you the flexibility of programming each log with unique parameters. For example, you might program Historical Log 1 to record Power Quality parameters (for example, Limits/Alarms), Log 2 to record Demand parameters, and Log 3 to record Energy parameters.

Historical Log parameters can be selected from eight groups:

- Measured Values (Instantaneous Voltage; Instantaneous Current; Total and Per Phase Power and Power Factor; Frequency; Neutral Current; Symmetrical Components and Voltage Unbalances)
- Demand (Current; Per Phase, Total Power and Power Factor)
- Maximums (Maximum values for all of the readings listed above)
- Minimums (Minimum values for all of the readings listed above)
- Energy (Watt-hours, VA-hours, VAR-hours)
- Short Term Min (Min value within the Demand Interval)
- Short Term Max (Max value within the Demand Interval)
- Uncompensated ((Watt-hours, VA-hours, VAR-hours)

From the Tree Menu, click Trending Profiles>Historical Log Profile (1-3**)**.



This screen lets you select items to be stored in the historical log you selected. The Group field determines the items that are available for selection.

1. Select a Group. The possible selections are: Measured Values, Demand, Maximums, Minimums, Energy, Short Term Min, Short Term Max, and Uncompensated.

2. Select items for your log:

   a. Highlight the item(s) you want in the Selectable Items box.

   b. Click Add. The item(s) are added to the Selected Items box.

   c. To remove item(s), highlight them in the Selected Items box and click Remove.

4. Set the Logging Interval (Minutes). The available choices are: 1, 3, 5, 10, 15, 30, 60. The Logging Interval determines when the meter takes a snapshot.

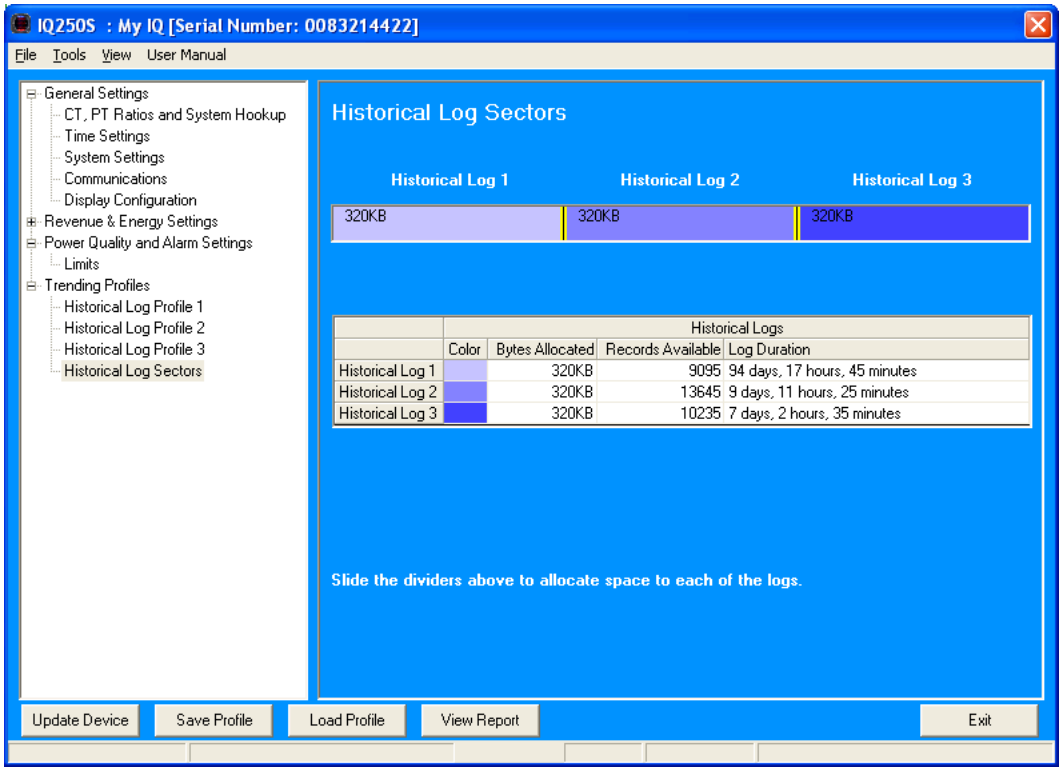
NOTE: There are two display fields at the bottom of the Historical Log Profile screen. They show the Total Bytes Used and the Bytes Remaining for this historical log. These fields are updated as

you make selections on the screen. The total number of bytes available per log record is approximately 234.

Configuring Historical Log Sectors (IQ250S)

Use this setting to increase or decrease the amount of records each of the IQ 250S meter's three Historical logs can store, and the duration each log can run, before becoming filled.

From the Tree Menu, click Trending Profiles>Historical Log Sectors.



The screen shows the current space allocation for the meter's Historical logs, including:

- The number of bytes allocated to each log
- The number of records available for each log
- The duration of each log

To change the current allocation for a log:

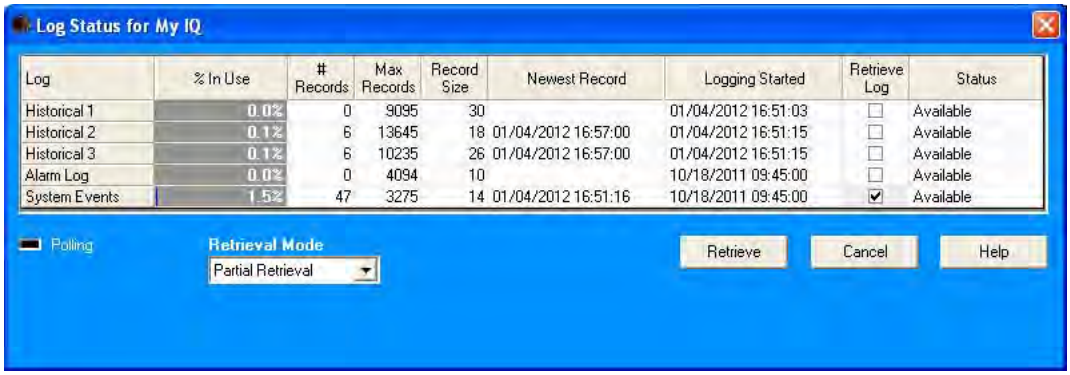
1. Click on one of the double yellow lines dividing the individual logs.

2. You will see a line with arrows on each side. Drag the line in either direction to increase or decrease the log allocation. The display fields for the logs will reflect any changes you make to the allocation.

Viewing Log Status/Retrieving Logs (IQ 250S)

Follow these steps to view Log status and/or retrieve logs.

1. Click Logs>Statistics or Logs>Retrieve Log(s) from Device from the Title bar (or click the Log Status or Retrieve Logs icons). You will see the screen shown below.



2. This screen shows the following information for all of the IQ 250S meter's logs:

- % in Use - the amount of the log that is currently being used
- # of Records - the number of records currently in the log
- Max Records - the maximum number of records the log can hold
- Record Size - the current record size in Bytes
- Newest Record - the date and time stamp of the most recent record in the log
- Logging Started - the date and time that logging began
- Retrieve Log - a checkbox that lets you select log retrieval
- Status - whether the log is Available or Not Available for retrieval

3. To retrieve a log, click its Retrieve Log checkbox.

NOTE: The System Events log is always retrieved when a log is retrieved: its box is always checked.

4. Use the pull-down menu for Retrieval Mode to select one of two options:

   • Partial Retrieval (this is the default Retrieval mode)

   • Time Range Retrieval

   NOTES:

   • In Partial Retrieval mode, only the newest records are retrieved. This increases retrieval speed, since records that have previously been retrieved are ignored. When the log is full, it will roll over. Partial Retrieval mode should be used for Billing and continuous logging.

   • The Time Range Retrieval mode is useful if you want to retrieve specific events. If you select Use Time Range from the pull-down menu, date range fields will display, allowing you to select the time range for data retrieval. Only records (within the specified time range) that are newer than the latest records in the log database can be retrieved for any selected logs. For this reason, Time Range Retrieval should not be used for Billing or continuous logging purposes. The only way to retrieve earlier records using Time Range Retrieval is to delete the existing log database(s) before retrieving the log(s).

5. Click Retrieve.

   a. You will see a screen that shows the percent retrieved for each log, the time elapsed since retrieval began, and any messages.

   b. After the logs have been retrieved, you will see a screen which shows you the Mode, Start time, and Status of Log Conversion.

   c. The Log Viewer opens.

NOTES:

• Only one person at a time can download a log. If someone else is downloading a log, it will be unavailable until the download is complete.

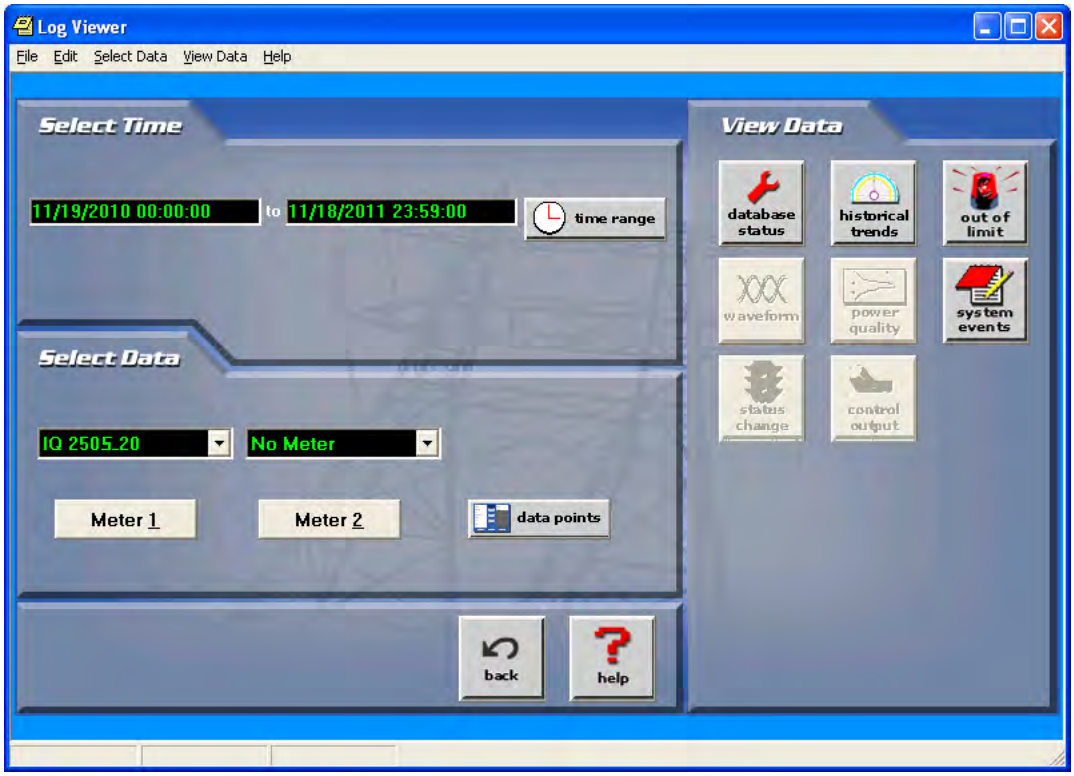
• Retrieve logs as often as you want. Each time you retrieve a log file, Eaton Meter Configuration Software appends only the newest records and captures to the existing database.

Using the Log Viewer (IQ 250S)

To access Log Viewer, either:

- Retrieve logs from a connected meter, as shown in the previous section.
- Click the Open Log icon from the Eaton Meter Configuration Software's Main screen. The Retrieved Logs directory opens, allowing you to pick a previously stored log file.
- Run Log Viewer from the Windows® Start menu.

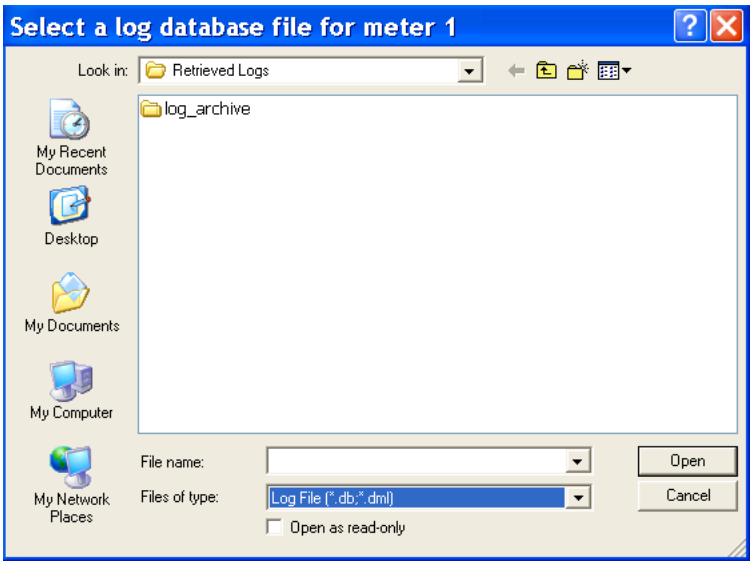
You will see the Log Viewer's main screen, shown below.



1. Choose the log data file(s) you want to view in either of the following ways:

   - If you have retrieved logs through Eaton Meter Configuration Software, the meter's designated label is shown in the field above the Meter 1 button. Click the Log's button on the right side of the screen to view a log. (The buttons of unavailable logs are grayed out and unselectable.)

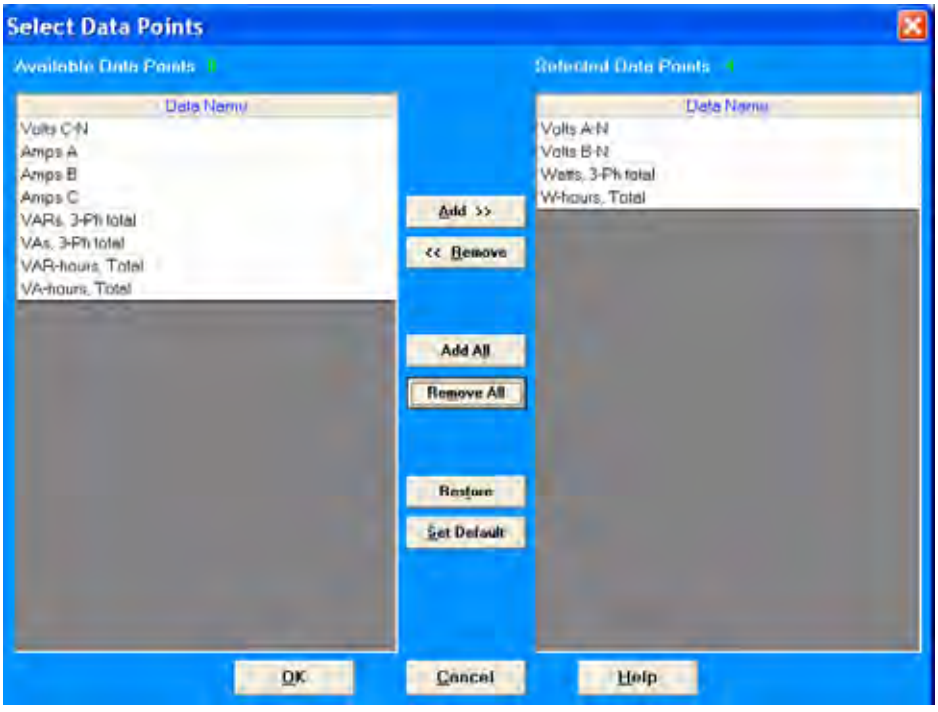
- If you want to view a previously retrieved log, click either Meter button (1 or 2). Log Viewer opens a window prompting you to select a log database (.db). See the example screen below.



2. Select the file you want and click Open.

   NOTE: You can choose a different log file (.db) for Meter 1 and for Meter 2.

3. Select the data points you want to view by clicking the Data Points button in Log Viewer's Main screen. You will see the screen shown below. Note that the number of data points you see reflects the number of parameters in the log.

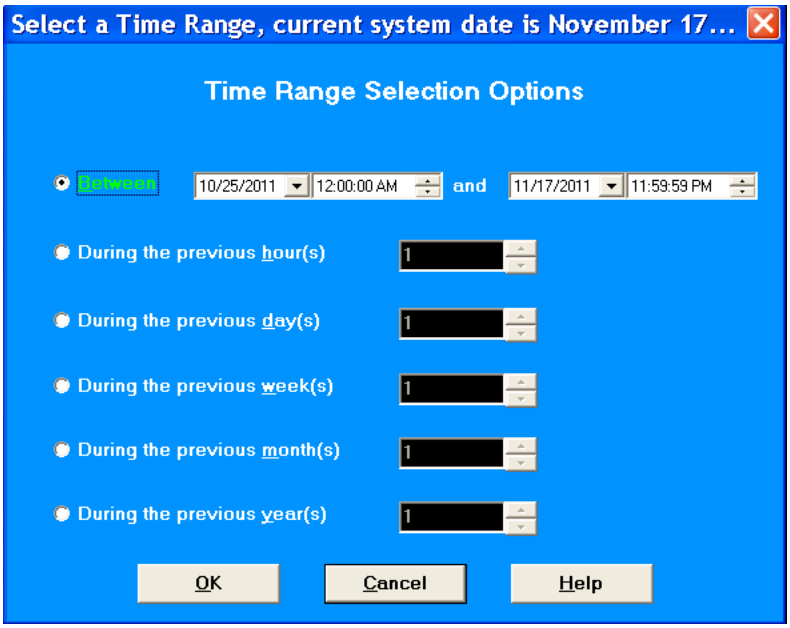


4. From the Available Data Points column, click on the data points you want to include when viewing the log file.

   - To select multiple points, hold down the Ctrl key while clicking.
   - To select points in sequence, hold down the Shift key while clicking.
   - Click the Add button to move the Data Points to the Selected Data Points column.
   - Click the Restore button to return the selection to its previous setting.

5. When you finish your selection, click OK to return to Log Viewer's main screen.

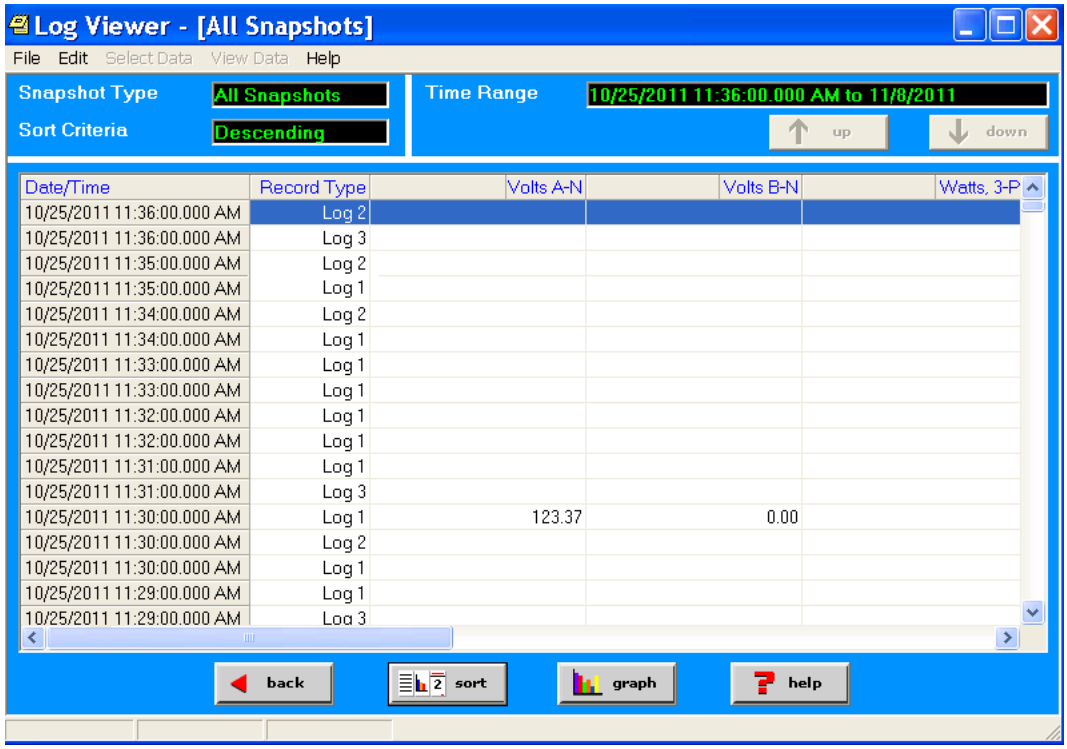
6. Select the portion of the log you want to view by specifying a time range. Log Viewer bases its time/date format on your computer's Regional Settings (Windows® Control Panel). Click the Time Range button. You will see the following screen.



   - To select a specific time range, click the Between radio button and enter a date and time in each field. You can also the arrows to open a calendar for the date and to increment the time field.
   - To select a range of hours, days, months or years only, click the appropriate radio button and use the arrows to select the range.

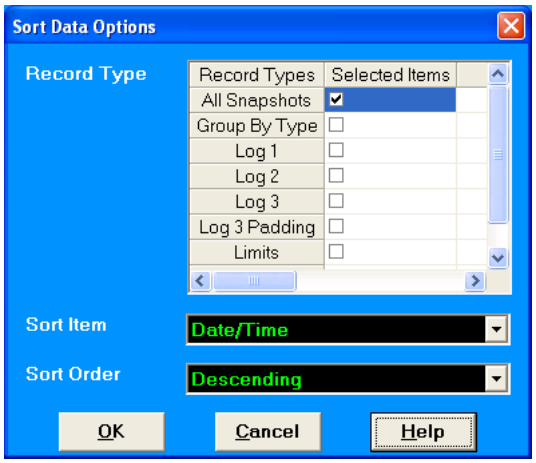
7. Click OK. The time range you selected is displayed in the Log Viewer's main screen.

8. Click on the Historical Trends button or View Data>Snapshots. Log Viewer displays trending data for the selected log file based on the time range and data points you chose. See the example screen shown below.

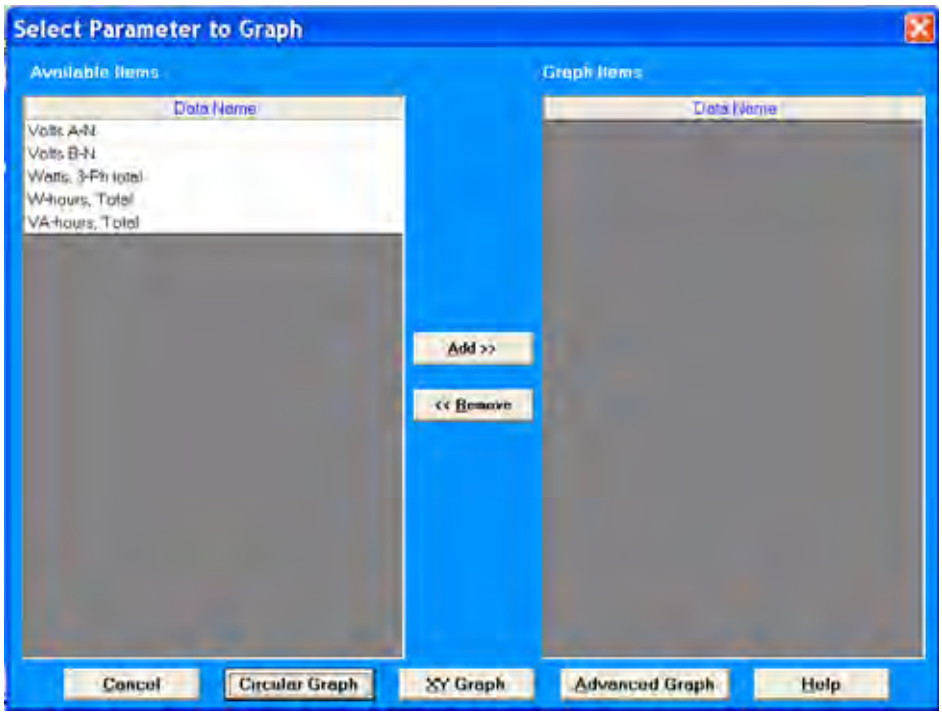


- The name of the log file and the type of data point are listed in the top row.
- You can move the columns, so that the most important data is most accessible. Right-click on the column title and drag it to the desired location on the table.
- To save the data to your clipboard, right-click with the cursor positioned anywhere in the table.

- To sort the data by Date/Time or data point, in either ascending or descending order, click the Sort button and use the pull-down menus to make your selection. See the screen shown below.



9. To display Trending data as either an XY, Circular, or Advanced graph, click the Graph button. You will see the following screen.



The Available Items column lists the log's data points. (To add a new data point, return to Log Viewer's main screen and click the Data Points button.)

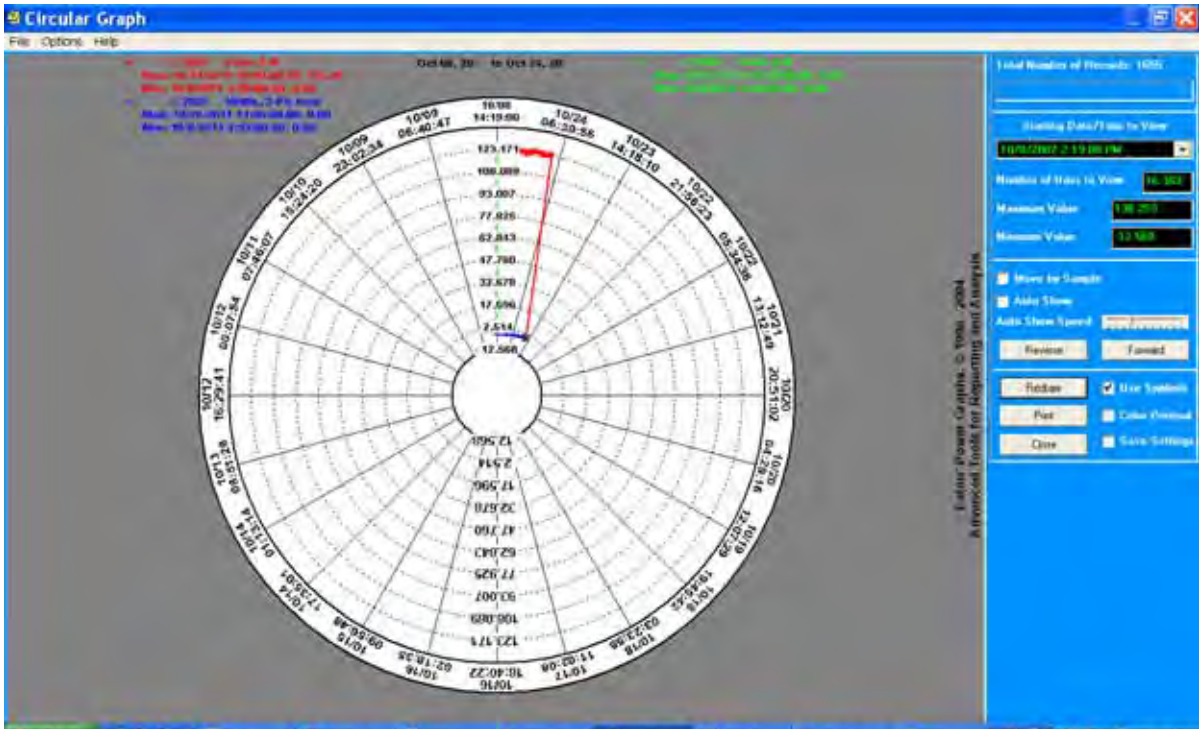
a. Click on the data points you want to graph.

b. Click the Add button. The items appear in the Graph Items column.

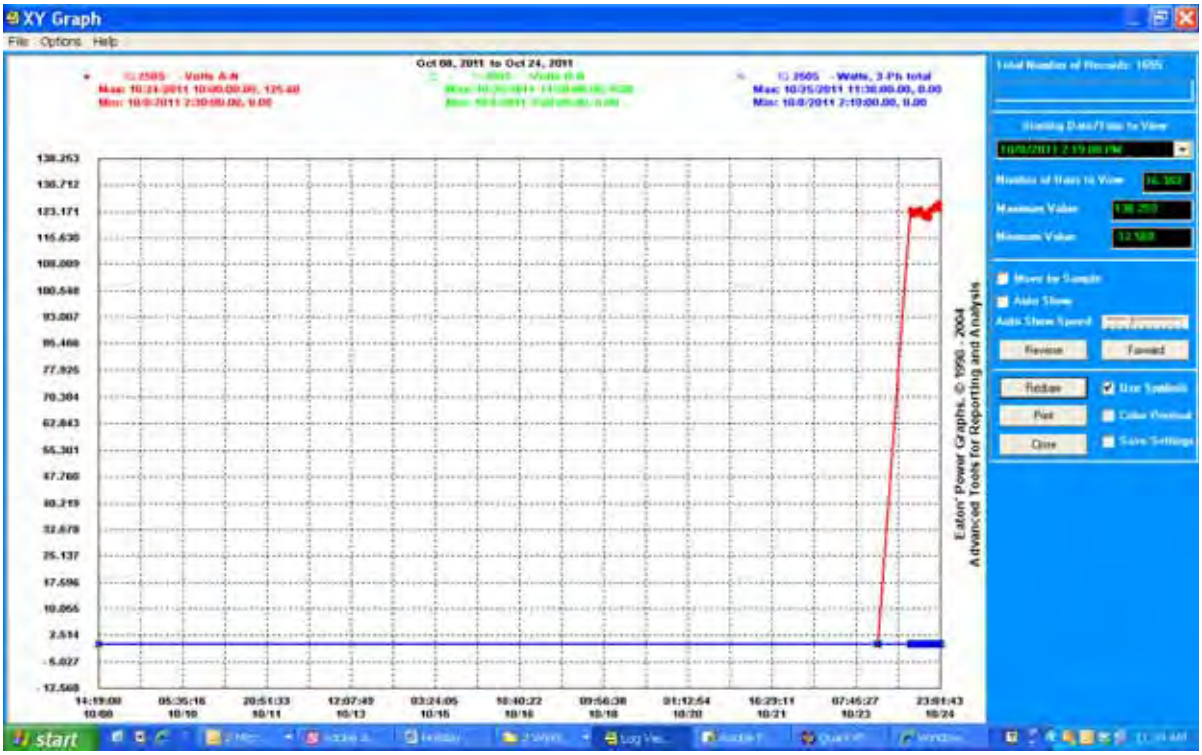
- To select multiple data points, hold down the Ctrl key while clicking.
- To select data points in sequence, hold down the Shift key while clicking.

NOTE: Only six data points in total can be graphed at one time. If there are two open log files, you can only select three data points per file.

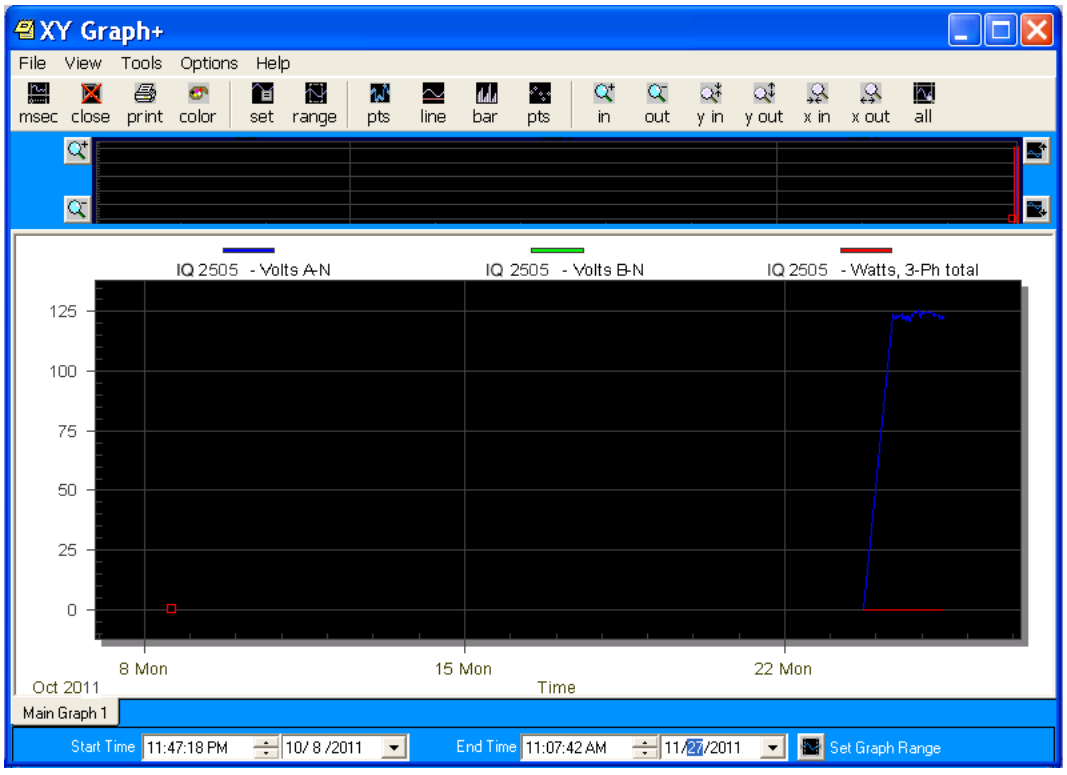
c. To view the graph, click either the Circular, XY, or Advanced Graph buttons. See the example graphs below and on the next page.



Circular Graph



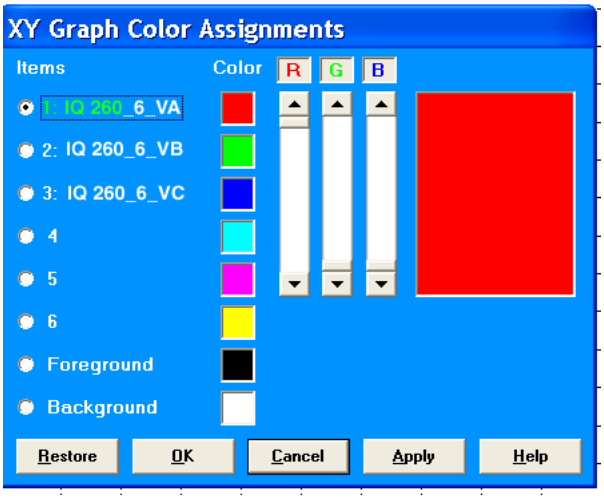
XY Graph



Advanced Graph

The following instructions pertain to all of the graphs:

- To change the starting point of the graph, choose a new date/time segment from the Starting Date/Time to View pull-down menu.
- To change the amount of time represented on the graph, enter a value in the Number of Days to View field and press Enter or click on the Redraw button.
- To change the scale of the graph, enter a value in the Minimum Value and Maximum Value fields and press Enter or the Redraw button.
- To view one sample at a time, click in the Move by Sample box; then click on the Forward or Reverse buttons each time you would like to view the next (or previous) sample.
- To view a continuous, sample-by-sample rendering of the graph, click the Move by Sample box and the Auto Show box. Select a speed by sliding the Auto Show Speed bar left or right; click on the Forward or Reverse buttons to determine the direction of the Auto Show. To stop Auto Show, deselect the Auto Show box.
- To print the graph on a color printer, check the Color Printout box and click Print.
- To print the graph on a black-and-white printer, click the Use Symbols box and click Print.
- To copy the graph data to the computer's clipboard, select Copy from the File menu. Paste the data into a spreadsheet, such as Excel®.
- To export the graph's data, select Export Data from the File menu.
- To change the graph's color assignments, select Select Colors from the Options menu. You will see the screen shown on the next page.



NOTES:

- The Advanced Graph also has a Color button which opens the Color Assignments screen.
- The Color Assignments screen is slightly different for the Advanced Graph.
- The small squares under the Color heading represent the color currently assigned to each component of the graph.
- To make adjustments to an Item's color, click the radio button beside it and create a new color by moving the red, green and blue sliders. Create black by moving all sliders down, white by moving all sliders up. The large square on the right shows the color you have created.
- Click OK to return to the graph; Log Viewer redraws the graph using the new color scheme.
- Click the Restore button to return all color schemes to their default values.

10. When you are finished using the Log Viewer, click the X button or File>Exit to close the screen.

NOTE: You can also view the Limits log (listing any alarms) and System Events log (listing firmware changes, logging start and stop times, Runtime start, stop, and end times, resets, change of meter's programmable settings and other system events.) From the Log Viewer's Main screen:

- Click the Out of Limit button to view the Limits log (you need to download this log or select an already downloaded log first. See the instructions beginning on page 5-35).
- Click the System Events button to view the System Events log.

5.2.4: Polling the IQ 150S/250S Submeter

The Real Time Poll features of Eaton Meter Configuration software are used to continuously view instantaneous values within an IQ 150S/250S meter. The software provides tabular views of metered values, circuit measurements, interval data, and pulse data.

The Real Time Poll features are divided into three groups, accessed by clicking Real-Time Poll in the Title Bar:

- Real Time Readings
- Revenue, Energy and Demand Readings
- Power Quality

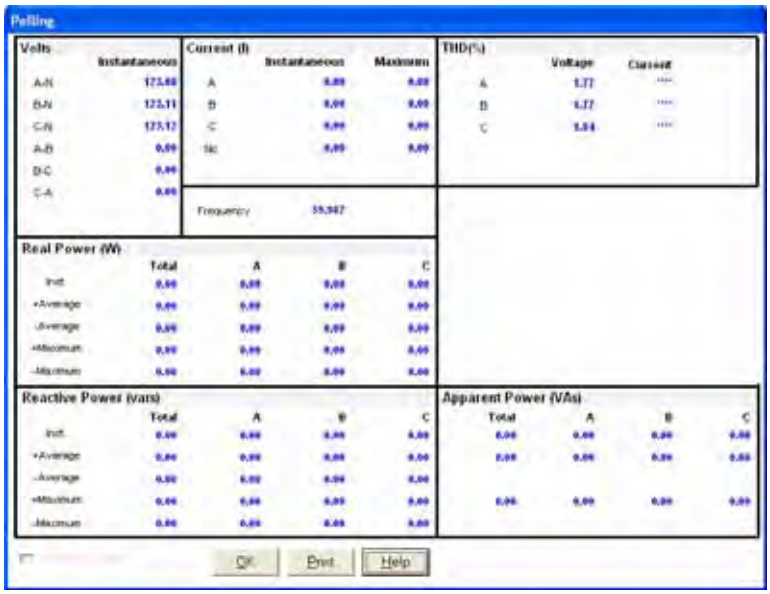
When you click Real Time Readings; Revenue, Energy and Demand Readings; and Power Quality, you will see a sub-menu that allows you to select individual polling screens.

NOTE: Clicking the Polling icon on the Title Bar is the same as selecting Instantaneous Polling from the Real-Time Poll>Real Time Readings menu; clicking the Phasors icon on the Title Bar is the same as selecting Phasors from the Real-Time Poll>Power Quality menu.

Instantaneous Polling

Click Real-Time Poll>Real Time Readings>Instantaneous Polling. You will see the screen shown below.

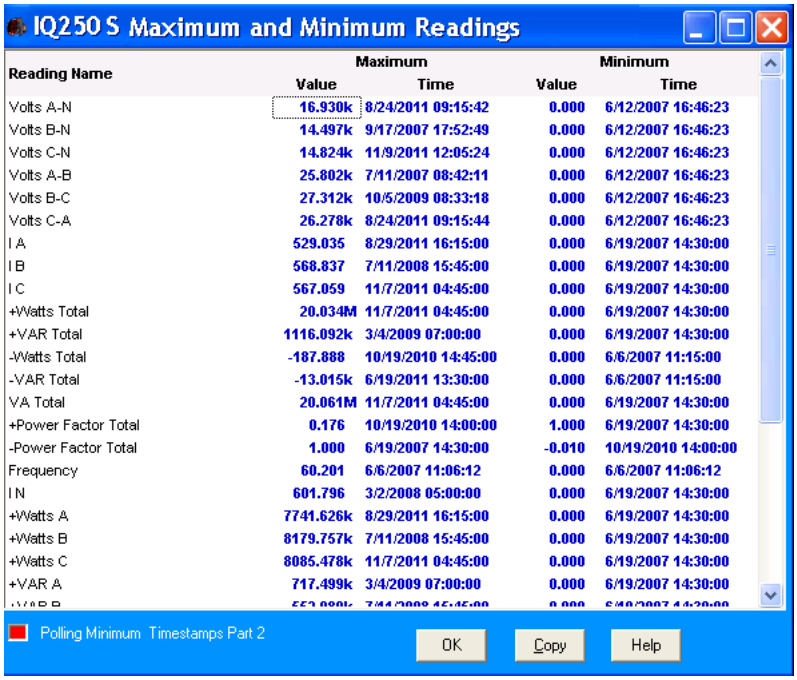
NOTE: This screen capture is for an IQ 150S meter. If you are connected to an IQ 250S meter you won't see the THD% section of the screen.



- Click Print to print a copy of the screen.
- Click Help to view instructions for this screen.
- Click OK to return to the main screen.

Poll Max and Min Readings

Click Real-Time Poll>Real Time Readings>Poll Max and Min Readings. You will see the screen shown below.



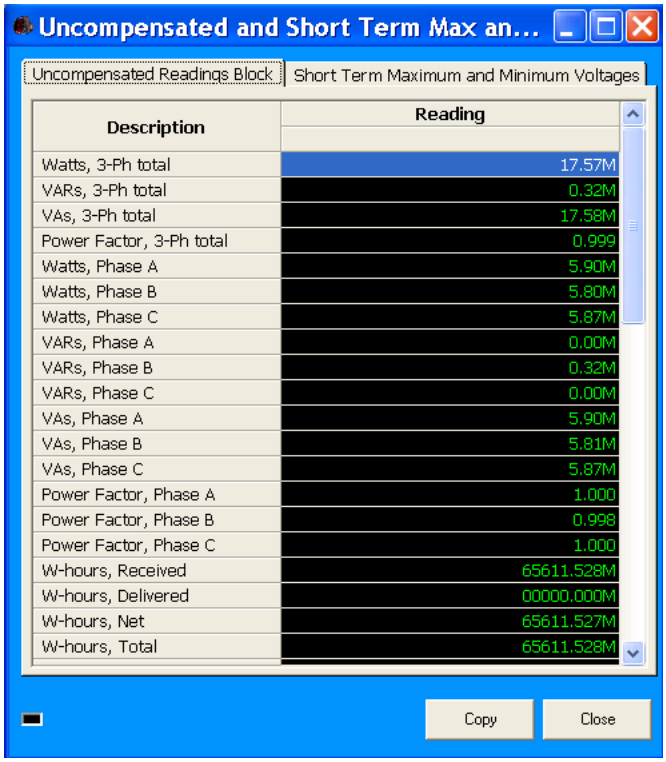
This screen displays the maximum and minimum values and the time of their occurrence for all of the IQ 150S/250S Real-Time readings. Use the scroll bar to view readings not displayed on the screen.

- Click Copy to copy the readings to the clipboard. You can then paste them into another document, for example, an Excel file.

- Click OK to close the screen.

Uncompensated and Short Term Max and Min Readings

Click Real-Time Poll>Real Time Readings>Uncompensated and Short Term Max and Min Readings. You will see the screen shown below.



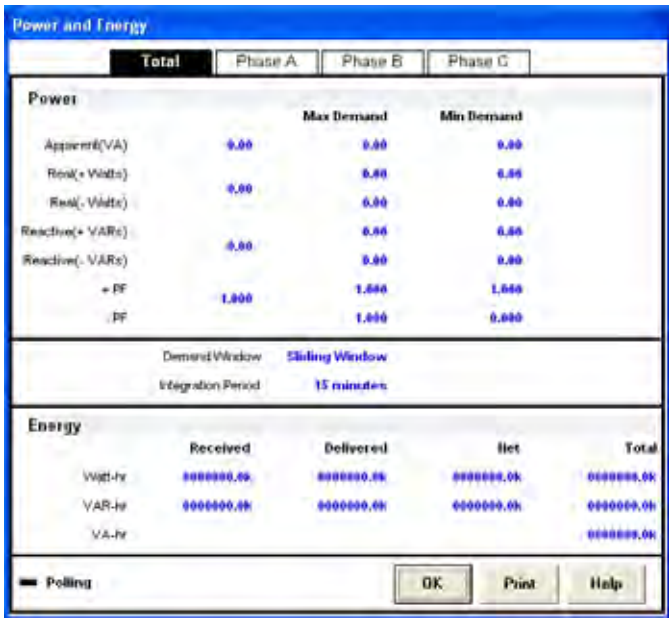
The initial display shows the uncompensated readings for the meter. Click the Short Term Maximum and Minimum Voltages to see those readings.

- Click Copy to copy the readings to the clipboard. You can then paste them into another document, for example, an Excel file.

- Click Close to close the screen.

Power and Energy

Click Real-Time Poll>Revenue, Energy and Demand Readings>Power and Energy. You will see the screen shown below.



This screen displays the power and energy for Total power and all three phases.

1. Click the tabs at the top of the screen to select the view you want:

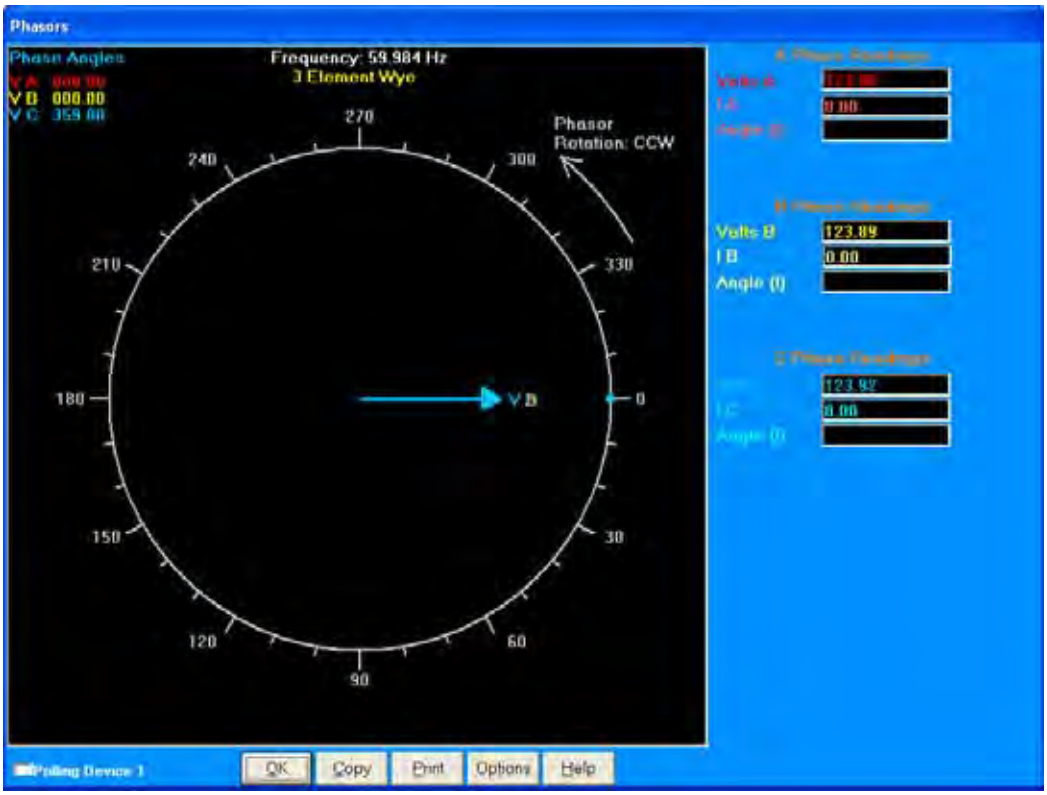
- Total
- Phase A
- Phase B
- Phase C

2. Click Print to print the readings.

3. Click OK to close the screen.

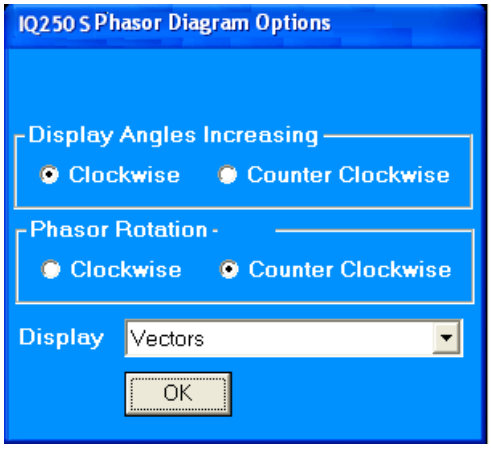
Poll Phasors

Click Real Time Poll>Power Quality>Phasors. You will see the screen shown below.



The Phasors screen displays the Phase relationships of the currently connected meter.

1. To adjust the Phasor display, click Options at the bottom of the screen.You will see the screen shown below.



a. In the Display Angles Increasing and Phasor Rotation boxes, select either Clockwise or Counter Clockwise.

b. From the pull-down menu at the bottom of the screen, select Vectors, Triangles, or Vectors and Triangles to change the graphic representation of the data.

2. Click OK to save your selections and return to the Phasors screen.

3. From the Phasors screen:

- Click Copy to save a copy of the screen to the clipboard.
- Click Print to send a copy of the graph to a printer.
- Click Help to view instructions for this screen.

4. Click OK to return to the main screen.

Poll Limits (IQ 250S)

Click Real-Time Poll>Power Quality and Alarms>Limits. You will see the screen shown below.

This screen shows the current status of any Limits programmed in the Device Profile.

NOTE: See instructions for configuring Limits, earlier in this chapter.

1. The displayed fields are:

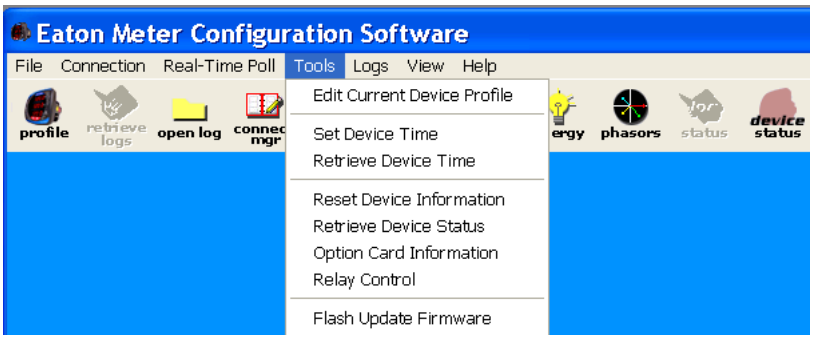
   - Limit ID – the identification of the limit
   - Label - the item the Limit is set for
   - Value – the current reading for this item
   - Status/Limit1/Limit2 – whether the current reading is “In” or “Out” for the Above (Limit 1) and Below (Limit 2) Setpoints
   - Limit 1/Setting/Point/Hysteresis – Above: the point above which the reading goes out of limit (Setpoint) and the point at which it returns to within limit (Hysteresis)
   - Limit 2/Setting/Point/Hysteresis – Below: the point below which the reading goes out of limit (Setpoint) and the point at which it returns to within limit (Hysteresis).

2. Click Print to print the screen.

3. Click OK to close the screen.

5.2.5: Using the IQ 150S/250S Tools Menu

The Tools Menu allows you to access specific functions for the IQ 150S/250S meter. Click Tools from the Title Bar to display the Tools Menu.

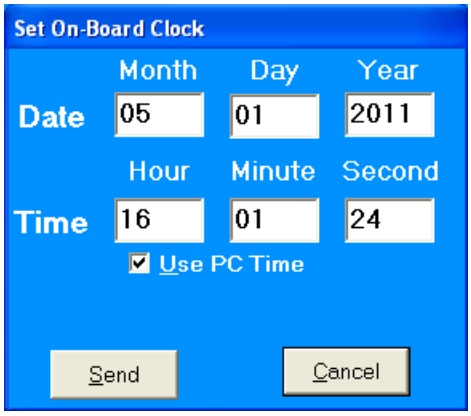


Accessing the Device Profile Screen

Click the first option, Edit Current Device Profile, to open the Device Profile screen. This menu option performs the same function as clicking the Profile icon in the Title Bar.

Setting Device Time

Click Tools>Set Device Time. You will see the screen shown below.



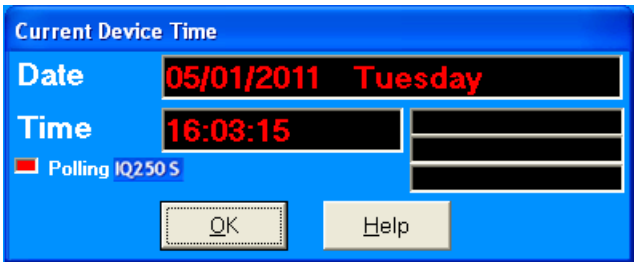
This screen allows you to set the meter's internal clock and/or synchronize it to your PC's time. The meter's clock is used for logging and other time retrieval purposes.

- You can enter a new Month, Day, and Year in the Date fields.
- Check the box next to Use PC Time to synchronize the meter to your PC; uncheck the box if you want to reset the time manually. You can then enter the Hour, Minute, and Seconds you want in the Time fields.

• Click Send to send the new date and/or time to the meter; click Cancel to close the screen.

Retrieving Device Time

Click Tools>Retrieve Device Time. You will see the screen shown below.



This screen displays the meter's internal time. If Daylight Savings Time is enabled, 'DST' displays in one of the fields to the right of the Time field.

Click OK to close the screen.

Reset Device Information

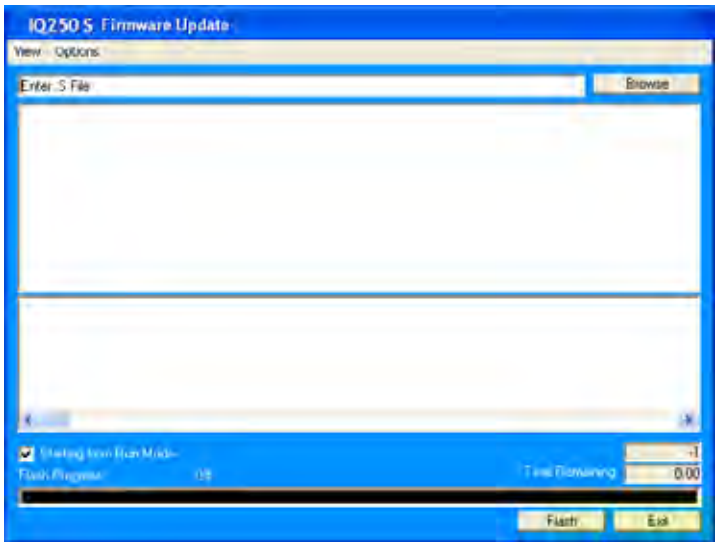
Click this option to reset Max/Min values. You will see the screen shown below. Click the checkbox and click Reset to reset max/min values; click Cancel to close the screen without resetting.

Retrieve Device Status

Click this option to see the Device status screen for the meter. this is the same screen that displays when you first connect to the meter.

Flash Update Firmware

Click this option to upgrade the meter's firmware. You will see the screen shown below.



1. Click Browse to locate the flash file.

2. Click OK to update the firmware with the flash file.

3. When flashing is complete, click Exit to close the screen.

NOTE: Flash updating of firmware can only be done at a Baud Rate of 57600.

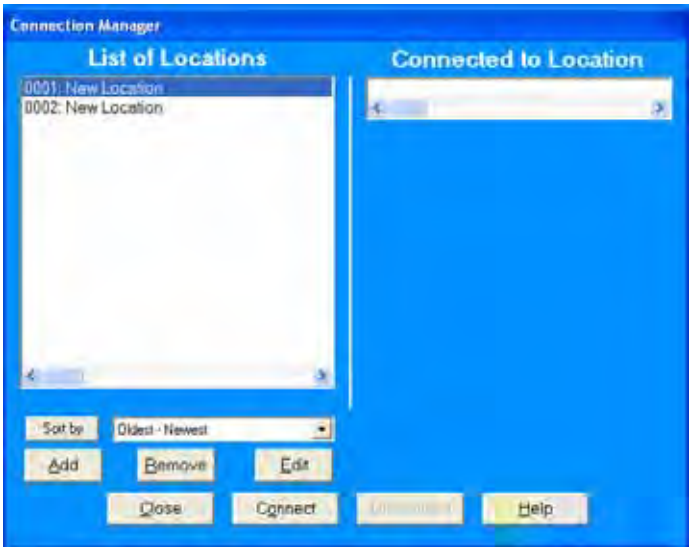
5.2.6: Performing Other Tasks with Eaton Meter Configuration Software

The following sections contain instructions for other tasks you can perform using the Eaton Meter Configuration software.

Connection Manager

Use Connection Manager to add or remove connection locations and/or devices at locations.

1. Click Connection>Connection Manager or click on the Connect Mgr icon. You will see the screen shown below.

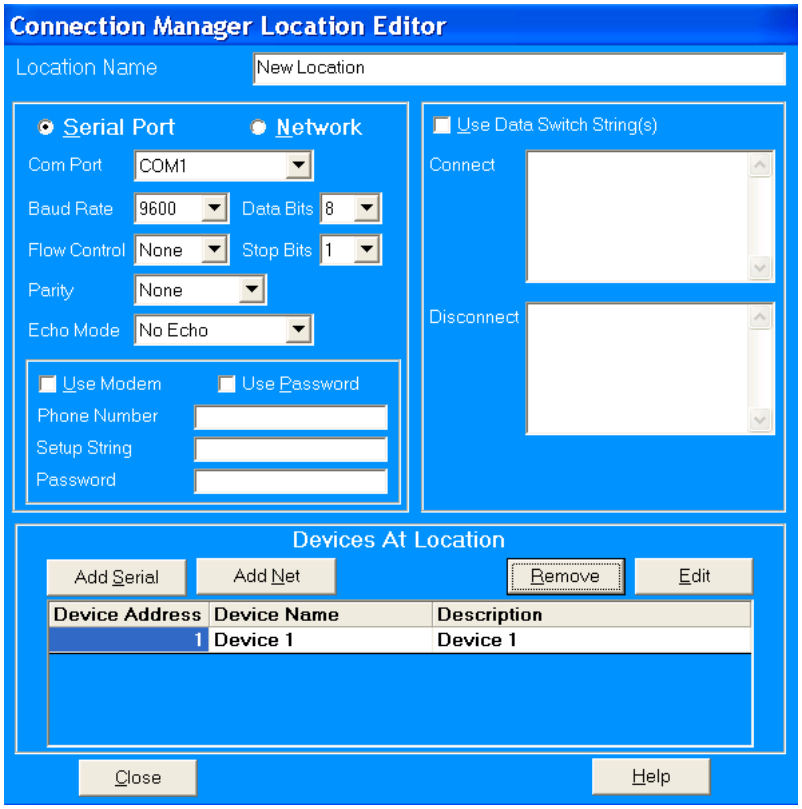


List of Locations:

On the left side of the Connection Manager screen is a List of Locations. These are the locations of one or more meters to which you can connect. You can add a location and/or a device; edit a location and/or device; or remove a location and/or device.

- To add a location:

a. Click the Add button. You will see the Connection Manager Location Editor screen. On this screen, you program the Communication settings for each new location.



b. Type a name for the new location.

c. Click Serial Port or Network.

d. Enter Communication settings:

- Com Port: COM 1 - 99
- Baud Rate: 1200 - 115200
- Flow Control: None or Hardware
- Data Bits: 8 (or 7)
- Parity: None (Even, Odd)

e. To add a device:

- Click Add Serial (to add a Serial Port connected device) or Add Net (to add a Network connected device) in the Devices at Location box. You can add up to 255 devices (Serial Port and/or Network connected) at one location.

NOTES:

- All devices must have the same connection parameters: Baud, Parity and Flow Control.
- Multiple devices slow down polling.
- If you are connecting to a device through the Power Xpert® Gateway, the protocol must be Modbus TCP.

f. To edit a device:

- Select the device from the Devices at Location box. (Scroll down to find all devices.)
- Click Edit. You will see the Connection Manager Location Device Editor screen, shown below.

- Use this screen to program the device properties for each device at a location. If the device has a Serial Port device connection, you will see the example screen on the left; if the device has a Network device connection, you will see the example screen on the right.

  NOTE: Click the Network or Serial button at the top of the screen to switch connection screens.

- Enter Device Properties:

- Address: 1 - 247 (Unique Address)
- Name: Device Name
- Description: (Type and Number, for example)
- Protocol: Modbus RTU, ASCII, or Modbus TCP
- Device Type: IQ Meter
- Comm Port: 1 or 2 (Serial Port Only)
- IP Address:100.10.10.10 (for example) (Network Only)
- Port Number:502 (Default) (Network Only)

- Click Close to save settings and return to the Connection Manager Location Editor screen.

g. To remove a device, select the device from the Devices at Location box and click Remove.

h. Click Close to return to the Connection Manager screen.

• To edit a location:

a. Select a location from the List of Locations box.

b. Click the Edit button. The Connection Manager Location Editor screen appears, displaying the current settings for the location.

c. Make any changes to settings and/or devices at the location.

d. Click Close to exit the screen.

• To remove a location:

a. Select a location from the List of Locations box.

b. Click Remove.

c. Click Yes in the Confirmation window.

• To sort the list of locations:

a. Select a sort method (A-Z, Z-A, Newest-Oldest or Oldest-Newest) from the pull-down menu.

b. Click Sort By.

• To connect to a location:

a. Select the location you want to connect to from the List of Locations box. **NOTE:** You may only connect to one location at a time. To change to a different location, you must disconnect from the current location by selecting it and clicking Disconnect.

b. Click Connect. When the connection is made, the selected location appears in the Connected To Locations section of the screen.

c. Click Close. The Device Status screen opens, confirming the connection. The computer Status bar at the bottom of the screen also confirms the computer's connection parameters.

NOTE: If the connection fails, a popup screen alerts you. Check that all cables are secure, that the RS232 cable is connected to the correct Com Port on the computer, and that the computer is set to use the same baud rate and protocol as the meter to which the computer is connected.

Disconnecting from an IQ 150S/250S meter

To disconnect from a meter or from a location, do one of the following:

• Click on the Disconnect icon in the Title Bar.

• Select Connection>Disconnect from the Title Bar.

• From the Connection Manager screen, select the location from the Connected to Location field and click the Disconnect button.

Changing the Primary Device/Address

Use this feature to select another meter as the primary device.

1. Click Connect>Change Primary Device/Address. You will see the screen shown below.

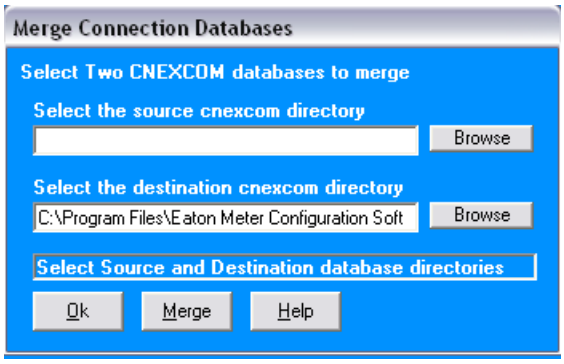
2. Enter the address of the device you want to designate as the new Primary Device.

3. Click OK.

Merging Connection Databases

Use this feature to combine two sets of cnexcom databases.

1. Click Connection>Merge Connection Databases. You will see the screen shown below. It allows you to select the two databases to merge.



2. Click the Browse button next to each field to pick the databases. The Source cnexcom database will be merged into the Destination cnexcom database.

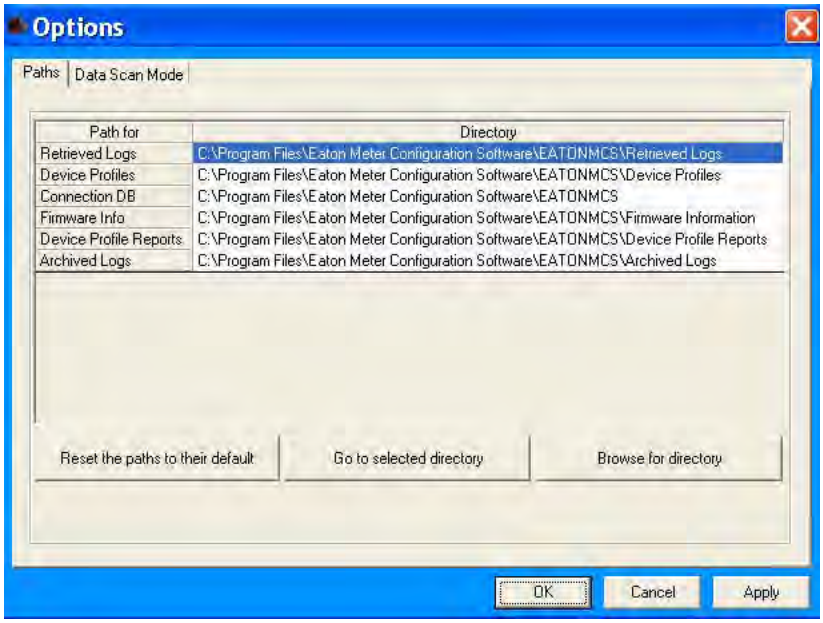
3. Click the Merge button to proceed with the merge; click OK to exit the screen.

Using the Options Screen

1. Click View>Options. You will see the screen shown below. Use this screen to access the following features:

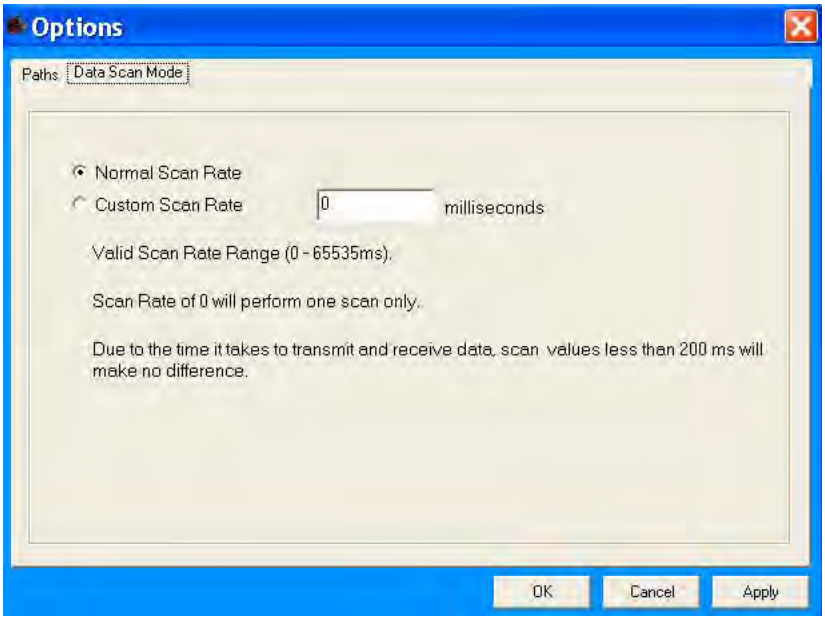
- Paths for Eaton Meter Configuration software files
- Data Scan mode

Use the tabs at the top of the screen to access these features.



2. The first display is the Paths screen, shown above. Use this screen to view or change the paths the Eaton Meter Configuration software uses for data.

3. Click the Data Scan Mode tab to see the screen shown below. Use this screen to select normal scan rate or to enter a custom scan rate.



4. Click:

- Apply to apply your selection(s) and keep the Options screen open
- OK to apply your selection and close the Options screen
- Cancel to close the Options screen without saving any selections that have not been applied

Using the Help Menu

The Help menu, accessed by clicking Help in the Title Bar, allows you to:

- View this manual online: click Help>this User Manual.
- View information about the Eaton Meter Configuration software, including version number: click Help>About Eaton Meter Configuration Software.

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6: Ethernet Configuration

6.1: Introduction

The IQ 150S/250S submeter has an option for a WiFi (Wireless) or RJ45 Ethernet connection. This option allows the submeter to be set up for use in a LAN (Local Area Network), using standard WiFi base stations. Configuration for these connections is easily accomplished through your PC using Telnet connections. Then you can access the submeter to perform meter functions directly through any computer on your LAN: the IQ 150S/250S meter does not need to be directly connected (wired) to these computers for it to be accessed.

This chapter outlines the procedures you use to set up the IQ 150S/250S submeter to function via its Ethernet configuration.

6.2: Factory Default Settings

The settings shown in Section 6.2.1 are the default settings for the IQ 150S/250S submeter: they are the settings programmed into your meter when it is shipped to you. You may need to modify some of these settings when you set up your Ethernet configuration.

NOTES:

- Change Settings 1 and 6 ONLY. Settings 2, 3, and 4 must be the same as shown in Section 6.2.1. If they are not, reset them to the values shown in Section 6.2.1.
- If setting 3 is not CP0..! Defaults (In), the procedure for Network Module Hardware Initialization (Section 6.3.4) will not work.

6.2.1: Modbus/TCP to RTU Bridge Setup

1) Network/IP Settings:

Network Mode……Wired Only

IP Address 10.0.0.1

Default Gateway .....--- not set ---

Netmask 255.255.255.0

2) Serial & Mode Settings:

Protocol .....Modbus/RTU,Slave(s) attached

Serial Interface 57600,8,N,1,RS232,CH1

3) Modem/Configurable Pin Settings:

CP0..! Defaults (In) CP1..! GPIO (In) CP2..! GPIO (In)

CP3..! GPIO (In) CP4..! GPIO (In) CP5..! GPIO (In)

CP6..! GPIO (In) CP7..! GPIO (In) CP8..! GPIO (In)

CP9..! GPIO (In) CP10.! GPIO (In)

RTS Output ..... Fixed High/Active

4) Advanced Modbus Protocol settings:

Slave Addr/Unit Id Source .. Modbus/TCP header

Modbus Serial Broadcasts ...Disabled (Id=0 auto-mapped to 1)

MB/TCP Exception Codes ....Yes (return 00AH and 00BH)

Char, Message Timeout 00050msec, 05000msec

6) WLAN Settings:

WLAN ..... Disabled, network:LTRX_IBSS

Topology……. AdHoc, Country: US, Channel: 11

Security…… none

TX Data rate…….. 11 Mbps auto fallback

Power management….. not supported in ad hoc mode

D)efault settings, S)ave, Q)uit without save

Select Command or parameter set (1..6) to change:

6.3: Configure Network Module

These procedures detail how to set up the IQ 150S/250S meter on the Network Module.

Only one person at a time can be logged into the network port. This eliminates the possibility of several people trying to configure the Ethernet interface simultaneously.

6.3.1: Configuration Requirements

- You may want to consult your Network Administrator before performing these procedures, since some functions may be restricted to the Network Administrator.

- If you have only one Ethernet adapter (network card), the screen displays only that configuration. You will use this Ethernet adapter to access the IQ 150S/250S meter's Network Module. You may have to configure the Ethernet adapter in order to use it with the IQ 150S/250S meter's Network Module, using the instructions in Section 6.4.2.

- If you have multiple Ethernet adapters (network cards) installed on your computer, you must choose, configure and use the correct one to access the Network Module.

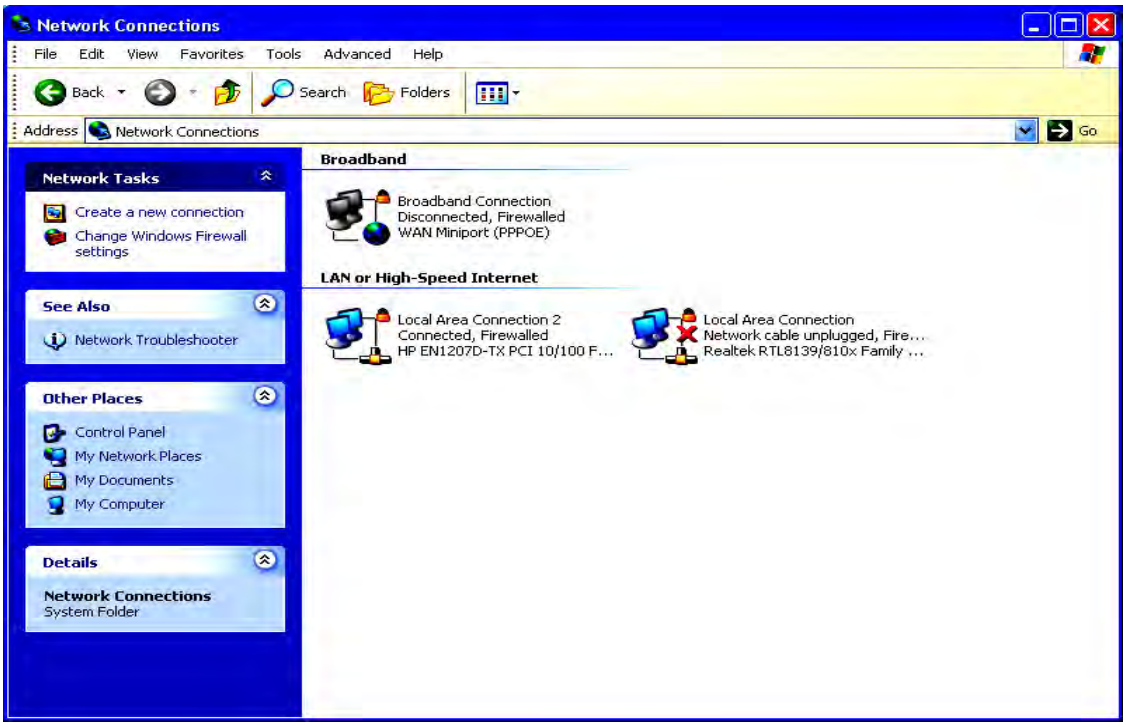
- The Ethernet Adapter must be set up for point-to-point connection in order for it to connect to the IQ 150S/250S meter's Network module, as follows:

  IP Address should be 10.0.0.2
  Subnet Mask should be 255.255.255.0

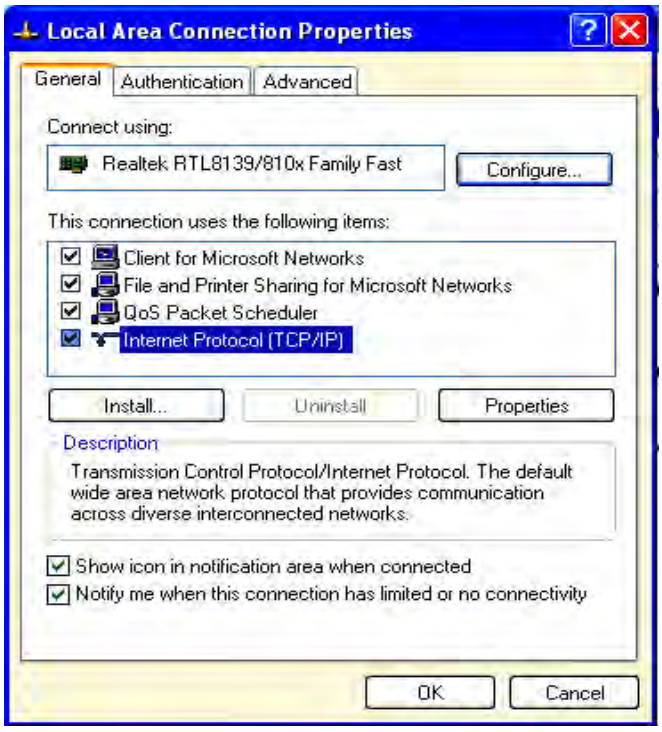
  These settings can be made in the Ethernet Adapter. Follow the procedure in Section 6.3.2.

6.3.2: Configuring the Ethernet Adapter

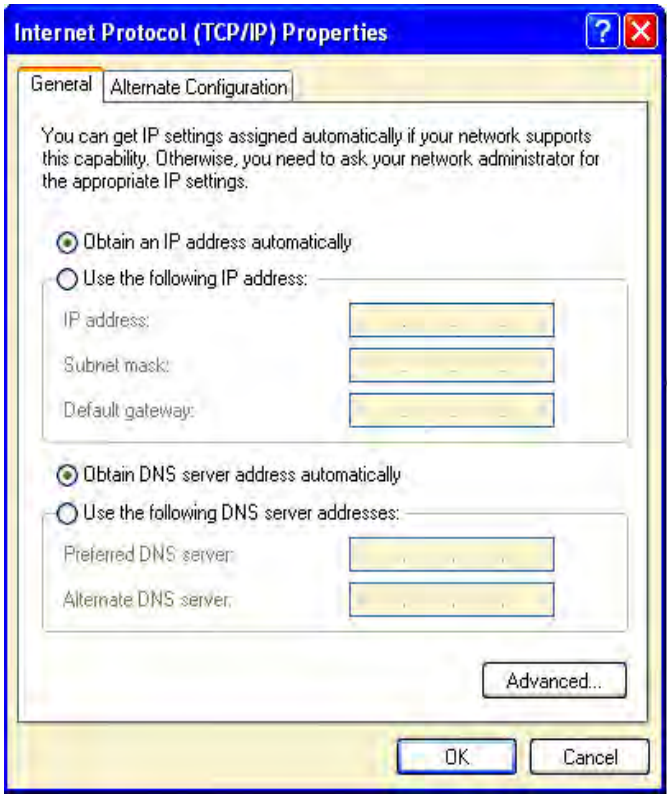
1. From the PC's Start Menu, select **Settings>Network Connections** or **Control Panel>Network Connections**. You will see a screen like the one shown below.



2. Right click on the Local Area Network connection you will be using to connect to the IQ 150S/250S submeter, and select Properties from the pull-down menu. You will see the screen shown on the next page.



3. Select Internet Protocol [TCP/IP] from the middle of the screen and click the Properties button. You will see the screen shown below.



4. Click the Use the Following IP Address radio button. The screen changes to allow you to enter the IP Address and Subnet Mask.

   a. Enter 10.0.0.2 in the IP Address field.

   b. Enter 255.255.255.0 in the Subnet Mask field.

3. Click the **OK** button.

4. You can now close the Local Area Connection Properties and Network Connection windows.

6.3.3: Detailed Configuration Parameters

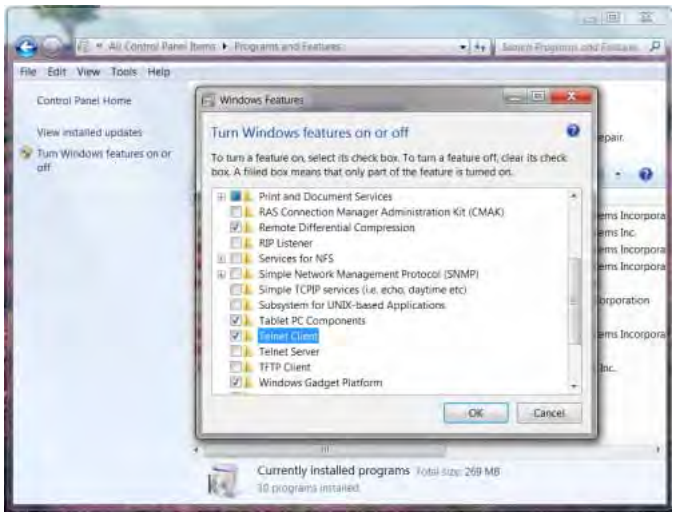
Certain parameters must be configured before the Ethernet interface can function on a network. The following procedure can be locally or remotely configured.

Use a Telnet connection to configure the unit over the network. The Ethernet interface's configuration is stored in meter memory and is retained without power. The configuration can be changed at any time. The Ethernet interface performs a reset after the configuration has been changed and stored.

Establish a Telnet connection to port 9999:

NOTE: If your PC is running Windows 7, you need to enable Telnet before using it.

1. Open the Control Panel.
2. Select Programs and Features.
3. Select Turn Windows features on or off.
4. Check the box for Telnet Client.
5. Click OK. The Telnet client is now available.



1. From the Windows Start menu, click **Run** and type 'cmd'.

2. Click the **OK** button to bring up Windows's Command Prompt window.

3. In the Command Prompt window, type:

   telnet 10.0.0.1 9999 and press the **Enter** key.

   NOTE: Be sure to include a space between the IP address and 9999.

```
Microsoft Windows XP [Version 5.1.2600]
(C) Copyright 1985-2001 Microsoft Corp.

C:\Documents and Settings\Administrator>telnet 10.0.0.1 9999
```

The following parameters appear, for example:

```
Serial Number 5415404  MAC Address  00:20:4A:54:3C:2C
Software Version V01.2 (000719)
Press Enter to go into Setup Mode
```

4. Press **Enter** again, quickly.

5. After entering Setup Mode (confirm by pressing Enter), you can configure the parameters for the software you are using by entering one of the numbers on the Change Setup Menu, or you can confirm default values by pressing **Enter**. Be sure to store new configurations when you are finished. The Ethernet Interface will then perform a power reset and the Factory Default Settings will display again (refer to Section 6.2.1).

6.3.4: Setup Details

This section illustrates how each section of settings appears on the screen, if you press Y (Yes) to change one or more of the settings.

CAUTION! Change Settings 1 and 6 ONLY. Settings 2, 3, and 4 must be the same as shown in Section 6.2.1. If they are not, reset them to the values shown in Section 6.2.1.

Network IP Settings Detail (1) (Set device with static IP Address.)

Network Mode: 0=Wired only, 1=Wireless Only <0> ? 1

IP Address <010> 192.<000> 168.<000> .<000> .<001>

Set Gateway IP Address <N> ? Y

Gateway IP Address : <192> .<168> .<000> .<001>

Set Netmask <N for default> <Y> ? Y

<255> .<255> .<255> .<000>

Change telnet config password <N> ? N

Serial & Mode Settings (2) (Make sure these settings match those shown in Section 6.2.1.)

Attached Device (1=Slave 2=Master) (1) ? 1

Serial Protocol (1=Modbus/RTU 2=Modbus/ASCII) (1) ? 1

Use serial connector (1=CH1 2=CH2) (1) ? 1

Interface Type (1=RS232 2=RS422/RS485+4-wire 3=RS485+2-wire) (1) ? 1

Enter serial parameters (57600,8,N,1) 57600, 8, N, 1

Modem/Configurable Pin Settings (3) (Make sure these settings match those shown in Section 6.2.1.)

CAUTION! You must configure this setting correctly in order to be able to use the Network Module Hardware Initialization procedure (Section 6.4).

Press 3. The following appears on the screen:

CP0 Function (hit space to toggle) GPIO (In)

Press the Space bar until the following appears on the screen:

CP0 Function (hit space to toggle) Defaults(In)

Press **Enter**. The following appears on the screen:

Invert (active low) (Y) ?

Press **Y**.

Ignore other settings (press **Enter** through the rest of Setting 3).

Advanced Modbus Protocol settings (4) (Make sure these settings match those shown in Section 6.2.1.)

Slave address (0 for auto, or 1..255 fixed otherwise) (0) ? 0

Allow Modbus Broadcasts (1=Yes 2=No) (2) ? 2

Use MB/TCP 00BH/00AH Exception Responses (1=No 2=Yes) (2) ? 2

Disable Modbus/TCP pipeline (1=No 2=Yes) (1) ? 1

Character Timeout (0 for auto, or 10-6950 msec) (50) 50

Message Timeout (200-65000 msec) (5000) 5000

Serial TX delay after RX (0-1275 msec) (0) 0

Swap 4x/0H to get 3x/1x (N) ? N

Local slave address for GPIO (0 to disable, or 1..255) (0) ? 0

WLAN Settings Detail (6) (The settings shown are recommended by Eaton for use with IQ 150S/250S submeter.)

Topology: 0=Infrastructure, 1=Ad-Hoc <1> ? 0

Network name <SSID> <LTRX_IBSS> ? Eaton_IQ150S_250S

Security suite: 0=none, 1=WEP, 2=WPA, 3=WPA2/802.11i <0> ? 0

TX Data rate: 0=fixed, 1=auto fallback <1> ? 1

TX Data rate: 0=1, 1=2, 2=5.5, 3=11, 4=18, 5=24, 6=36, 7=54 Mbps <3> ? 7

Enable power management <N> ? Y

IMPORTANT NOTES:

- The settings for the Wireless Access Point should be IDENTICAL to the settings for LWAN, shown above. For programming, see the User's Manual for the Wireless Access Point in use.
- See Section 6.3.4.1 for information on using an Encryption key.

Exiting the screen

CAUTION! DO NOT PRESS 'D.'

Press 'S' to Save the settings you've entered.

6.3.4.1: Encryption Key

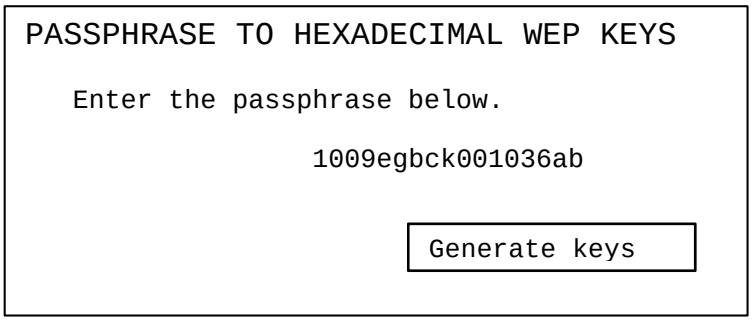
Eaton recommends that you use 128-bit encryption when setting up your Ethernet configuration.

In the WLAN Settings (6), set Security WEP (1), Authentication shared (1), WEP128 (1) and Change Key (Y).

When Change Key (Y) is entered, you are required to enter an Encryption Key. You can manually enter 26 hexadecimal characters (required for 128-bit encryption) or you can use a WEP Key provider online (example: www.powerdog.com/wepkey.cgi). WEP Key providers should note on their website that their encryption algorithm is for the Wired Equivalent Privacy portion of IEEE 802.11b/g.

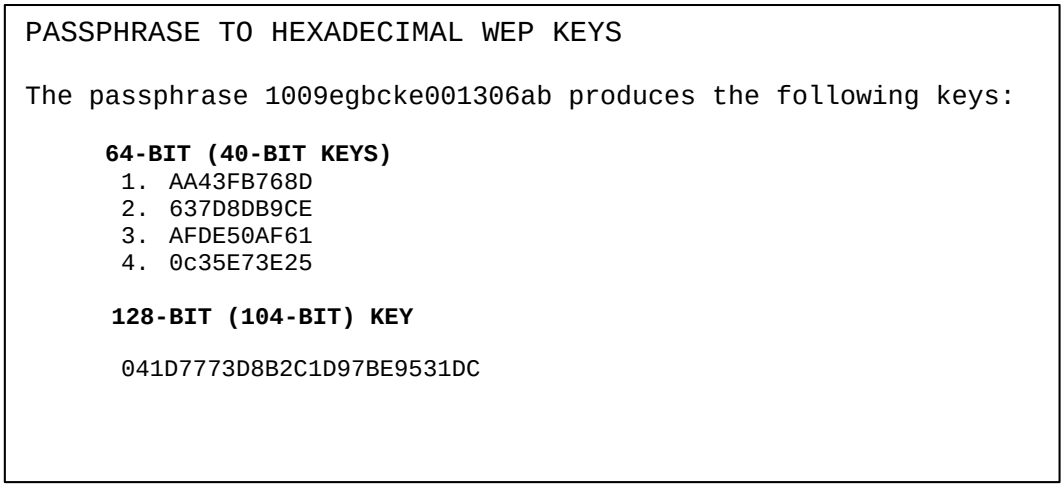
WEP Key Provider Steps

1. Input 26 alphanumeric characters as your Passphrase.



IMPORTANT! Remember your Passphrase.

2. Click the **Generate Keys** button. Your Hexadecimal WEP Keys appear.



3. Input the 128-bit Key in the Change Key section of the WLAN Settings (6).

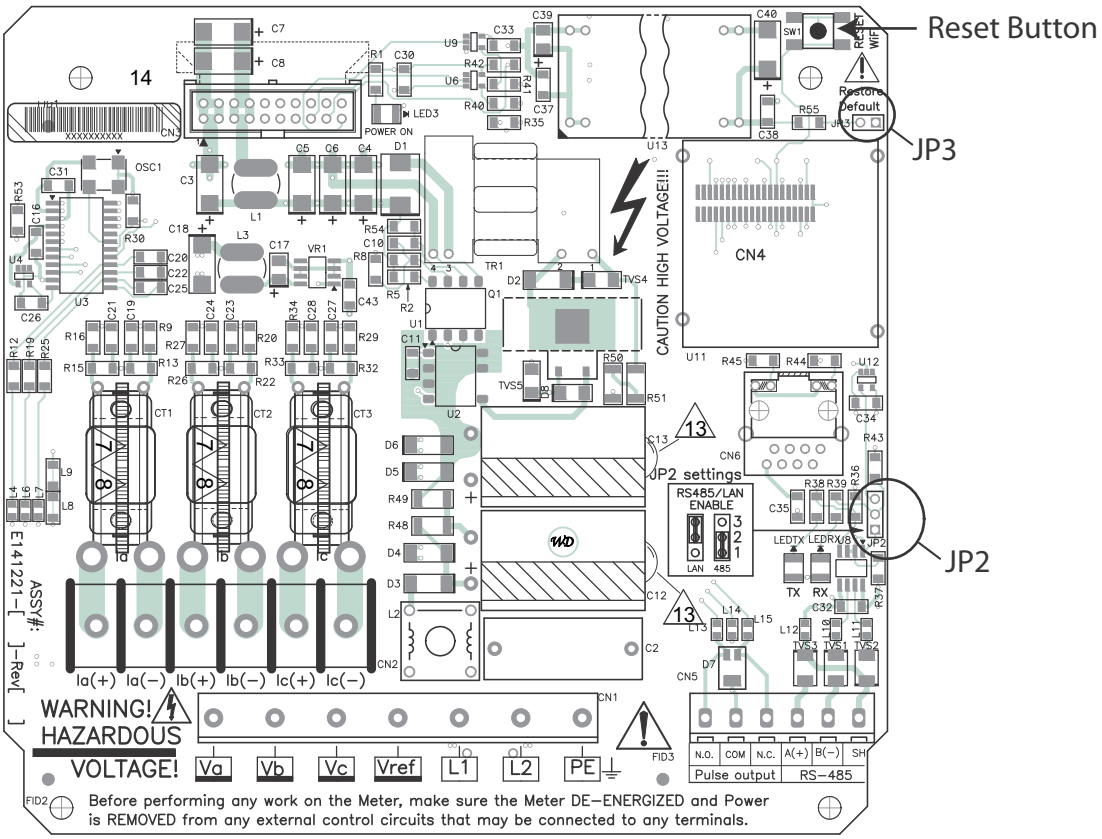
4. Continue inputting settings.

5. Press 'S' to Save your settings.

6.4: Network Module Hardware Initialization

If you don't know your current Network Module settings, or if the settings are lost, you can use this method to initialize the hardware with known settings you can then work with.

Main Board



1. Place a shorting block on JP3 and press the **Reset** button on the main board.

   NOTE: JP3 is located on the right hand side, upper corner of the main board. The shorting block can be "borrowed" from JP2, located at the middle, right hand side. See the figure shown above.

2. After you press the **Reset** button, move the jumper back to JP2.

3. Make sure your settings are the same as those in Section 6.2.1. Follow the steps in Section 6.3 to configure the Network Module.

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7: Using the Submeter

7.1: Introduction

The IQ 150S/250S submeter can be configured and a variety of functions can be accomplished by using the Elements and the Buttons on the submeter face. This chapter reviews front panel navigation. See Appendix A for complete Navigation maps.

7.1.A: Understanding Submeter Face Elements

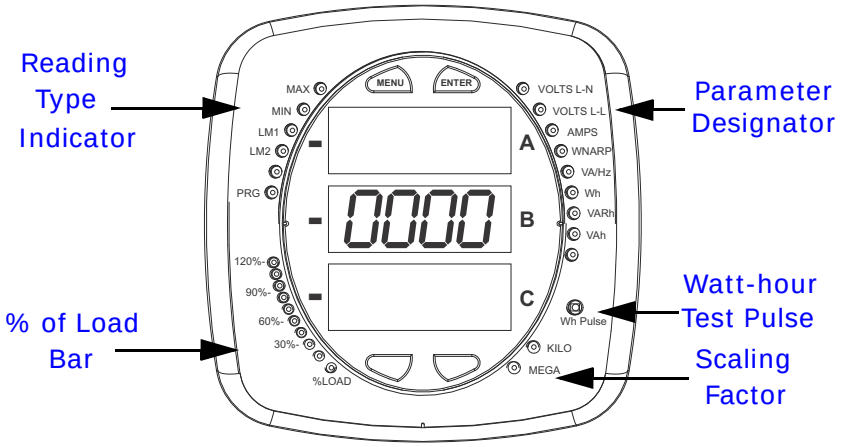


Figure 7.1: Faceplate with Elements

The meter face features the following elements:

- Reading Type Indicator: e.g., Max (The meter shown above is an IQ 250S - the LM1 and LM2 indicators are not one the IQ 150S meter.)
- Parameter Designator: e.g., Volts L-N
- Watt-Hour Test Pulse: Energy pulse output to test accuracy
- Scaling Factor: Kilo or Mega multiplier of displayed readings
- % of Load Bar: Graphic Display of Amps as % of the Load (Refer to Section 7.3 for additional information.)

7.1.B: Understanding Submeter Face Buttons

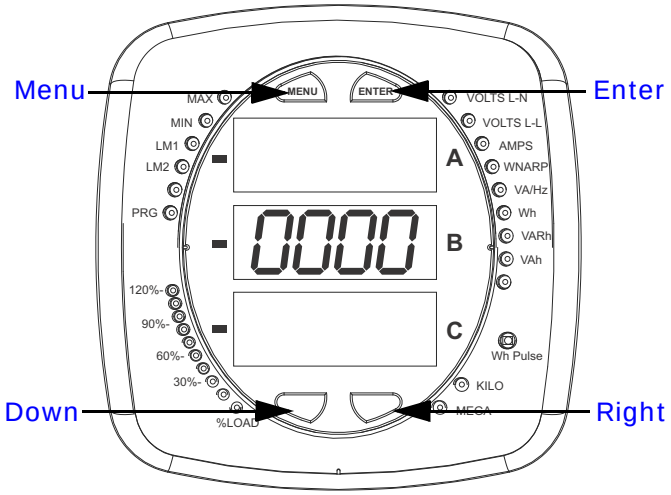


Figure 7.2: Faceplate with Buttons

The meter face has **Menu**, **Enter**, **Down** and **Right** buttons, which let you perform the following functions:

- View Meter Information
- Enter Display Modes
- Configure Parameters (may be Password Protected)
- Perform Resets (may be Password Protected)
- Perform LED Checks
- Change Settings
- View Parameter Values
- Scroll Parameter Values
- View Limit States (IQ 250S)

7.2: Using the Front Panel

You can access four modes using the IQ 150S/250S submeter's front panel buttons:

- Operating mode (Default)
- Reset mode
- Configuration mode
- Information mode - Information mode displays a sequence of screens that show model information, such as Frequency, Amps, etc.

Use the **Menu**, **Enter**, **Down** and **Right** buttons to navigate through each mode and its related screens.

NOTES:

- See Appendix A for the complete display mode Navigation maps.
- The meter can also be configured using software; see Chapter 5 for instructions.

7.2.1: Understanding Startup and Default Displays

Upon Power Up, the meter displays a sequence of screens:

- Lamp Test screen where all LEDs are lit
- Lamp Test screen where all digits are lit
- Firmware screen showing build number
- Error screen (if an error exists)

After startup, if auto-scrolling is enabled, the IQ 150S/250S meter scrolls the parameter readings on the right side of the front panel. The Kilo or Mega LED lights, showing the scale for the Wh, VARh and VAh readings. Figure 7.3 shows an example of a Wh reading.

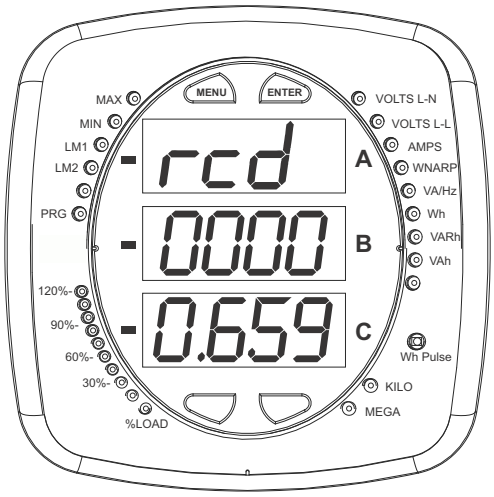


Figure 7.3: Display Showing Watt-hr Reading

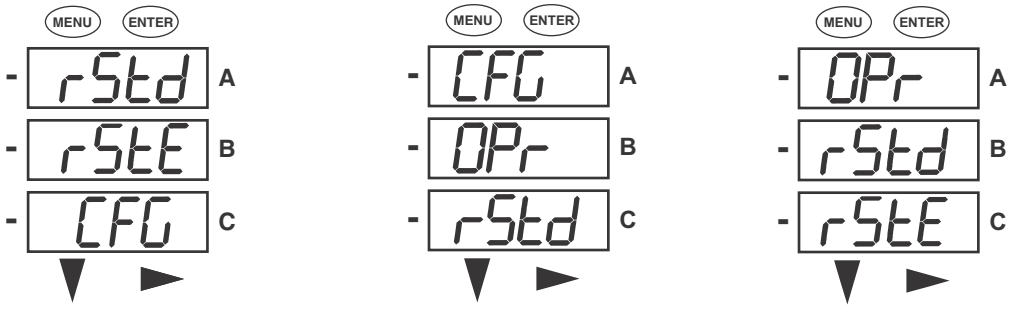
The IQ 150S/250S meter continues to provide scrolling readings until one of the buttons on the front panel is pressed, causing the meter to enter one of the other Modes.

7.2.2: Using the Main Menu

1. Press the **Menu** button. The Main Menu screen appears.

- The Reset: Demand mode (rStd) appears in the A window. Use the Down button to scroll, causing the Reset: Energy (rStE), Configuration (CFG), Operating (OPr), and Information (InFo) modes to move to the A window.

- The mode that is currently flashing in the A window is the “Active” mode, which means it is the mode that can be configured.



For example: Press Down Twice - CFG moves to A window. Press Down Twice - OPr moves to A window.

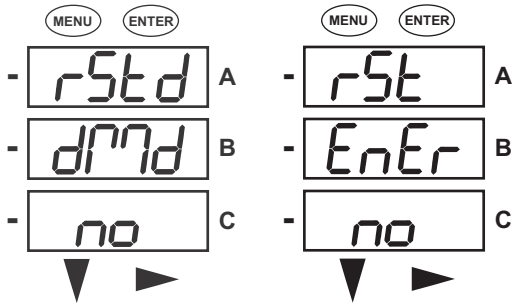
2. Press the **Enter** button from the Main Menu to view the Parameters screen for the mode that is currently active.

7.2.3: Using Reset Mode

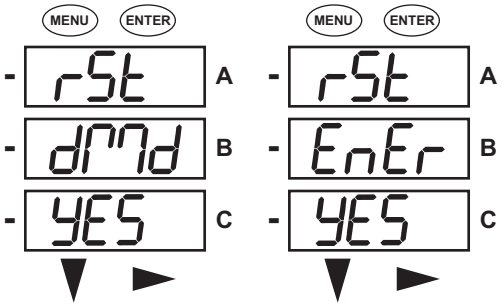
Reset mode has two options:

- Reset: Demand (rStd): resets the Max and Min values.
- Reset: Energy (rStE): resets the energy accumulator fields.

1. Press the Enter button while either rStd or rStE is in the A window. The Reset Demand No or Reset Energy No screen appears.



   - If you press the **Enter** button again, the Main Menu appears, with the next mode in the A window. (The **Down** button does not affect this screen.)
   - If you press the **Right** button, the Reset Demand YES or Reset Energy YES screen appears. Press **Enter** to perform a reset.



NOTE: If Password protection is enabled for reset, you must enter the four digit password before you can reset the meter (see Chapter 5 for information on Password protection). To enter a password, follow the instructions in Section 7.2.4.

CAUTION! Reset Demand YES resets **all** Max and Min values.

2. Once you have performed a reset, the screen displays either “rSt dMd donE” or “rSt EnEr donE”and then resumes auto-scrolling parameters.

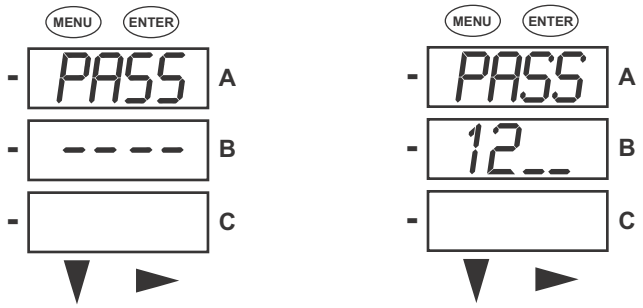
7.2.4: Entering a Password

If Password protection has been enabled in the software for reset and/or configuration (see Chapter 5 for more information), a screen appears requesting a password when you try to reset the meter and/or configure settings through the front panel.

- PASS appears in the A window and 4 dashes appear in the B window. The leftmost dash is flashing.

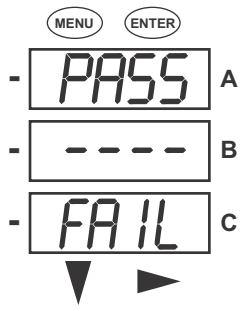
1. Press the **Down** button to scroll numbers from 0 to 9 for the flashing dash. When the correct number appears for that dash, use the **Right** button to move to the next dash.

Example: The left screen, below, shows four dashes. The right screen shows the display after the first two digits of the password have been entered.



2. When all 4 digits of the password have been selected, press the **Enter** button.

- If you are in Reset Mode and you enter the correct password, “rSt dMd donE” or “rSt EnEr donE”appears and the screen resumes auto-scrolling parameters.
- If you are in Configuration Mode and you enter the correct password, the display returns to the screen that required a password.
- If you enter an incorrect password, “PASS ---- FAIL” appears and:
  - The previous screen is re-displayed, if you are in Reset Mode.
  - The previous Operating mode screen is re-displayed, if you are in Configuration mode.



7.2.5: Using Configuration Mode

Configuration mode follows Reset: Energy on the Main Menu.

To access Configuration mode

1. Press the **Menu** button while the meter is auto-scrolling parameters.

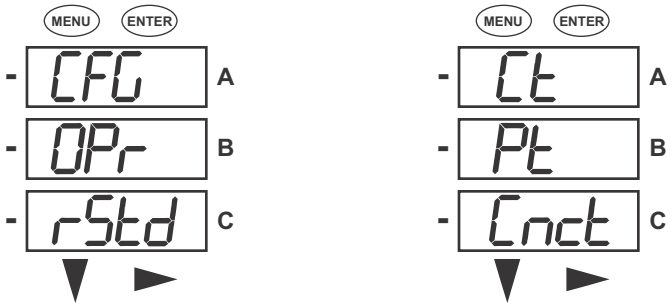
2. Press the **Down** button until the Configuration Mode option (CFG) is in the A window.

3. Press the **Enter** button. The Configuration Parameters screen appears.

4. Press the **Down** button to scroll through the configuration parameters: Scroll (SCrL), CT, PT, Connection (Cnct) and Port. The parameter currently 'Active," i.e., configurable, flashes in the A window.

5. Press the **Enter** button to access the Setting screen for the currently active parameter.

NOTE: You can use the **Enter** button to scroll through all of the Configuration parameters and their Setting screens, in order.



Press **Enter** when CFG is in A window - Parameter screen appears -

Press **Down**- Press **Enter** when

Parameter you want is in A window

6. The parameter screen appears, showing the current settings. To change the settings:

   - Use either the **Down** button or the **Right** button to select an option.

   - To enter a number value, use the **Down** button to select the number value for a digit and the **Right** button to move to the next digit.

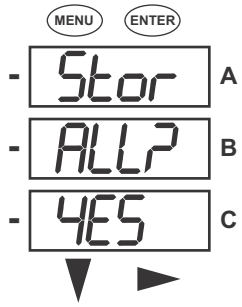
NOTE: When you try to change the current setting and Password protection is enabled for the meter, the Password screen appears. See Section 7.2.4 for instructions on entering a password.

7. Once you have entered the new setting, press the **Menu** button twice.

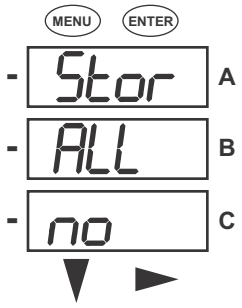
8. The Store ALL YES screen appears. You can either:

- Press the **Enter** button to save the new setting.
- Press the **Right** button to access the Store ALL no screen; then press the **Enter** button to cancel the Save.

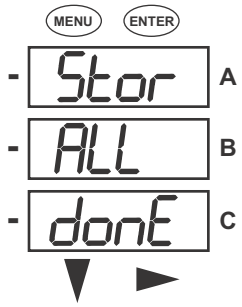
9. If you have saved the settings, the Store ALL done screen appears and the meter resets.



Press the **Enter** button to save the settings. Press the **Right** button for Stor All no screen.



Press the **Enter** button to Cancel the Save.



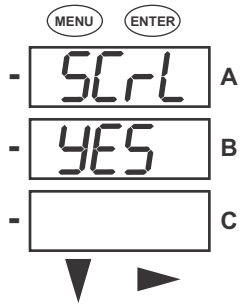
The settings have been saved.

7.2.5.1: Configuring the Scroll Feature

When in Auto Scroll mode, the meter performs a scrolling display, showing each parameter for 7 seconds, with a 1 second pause between parameters. The parameters that the meter displays have been selected through Eaton Meter Configuration software (refer to Chapter 5 for instructions).

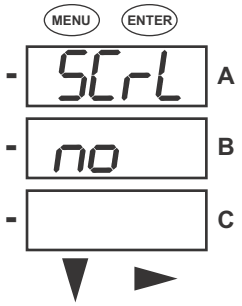
To enable or disable Auto-scrolling:

1. Press the **Enter** button when SCrl is in the A window. The Scroll YES screen appears.



2. Press either the **Right** or **Down** button if you want to access the Scroll no screen. To return to the Scroll YES screen, press either button.

3. Press the **Enter** button on either the Scroll YES screen (to enable auto-scrolling) or the Scroll no screen (to disable auto-scrolling).



4. The CT- n screen appears (this is the next Configuration mode parameter).

NOTES:

- To exit the screen without changing scrolling options, press the **Menu** button.
- To return to the Main Menu screen, press the **Menu** button twice.
- To return to the scrolling (or non-scrolling) parameters display, press the **Menu** button three times.

7.2.5.2: Configuring CT Setting

The CT Setting has three parts: Ct-n (numerator), Ct-d (denominator), and Ct-S (scaling).

1. Press the **Enter** button when Ct is in the A window. The Ct-n screen appears. You can either:

- Change the value for the CT numerator.
- Access one of the other CT screens by pressing the **Enter** button: press **Enter** once to access the Ct-d screen, twice to access the Ct-S screen.

  NOTE: The Ct-d screen is preset to a 5 amp or 1 amp value at the factory and cannot be changed.

a. To change the value for the CT numerator:

From the Ct-n screen:

- Use the Down button to select the number value for a digit.
- Use the Right button to move to the next digit.

b. To change the value for CT scaling

From the Ct-S screen:

Use the **Right** button or the **Down** button to choose the scaling you want. The Ct-S setting can be 1, 10, or 100.

NOTE: If you are prompted to enter a password, refer to Section 7.2.4 for instructions on doing so.

2. When the new setting is entered, press the **Menu** button twice.

3. The Store ALL YES screen appears. Press **Enter** to save the new CT setting.

Example CT Settings:

200/5 Amps: Set the Ct-n value for 200 and the Ct-S value for 1.

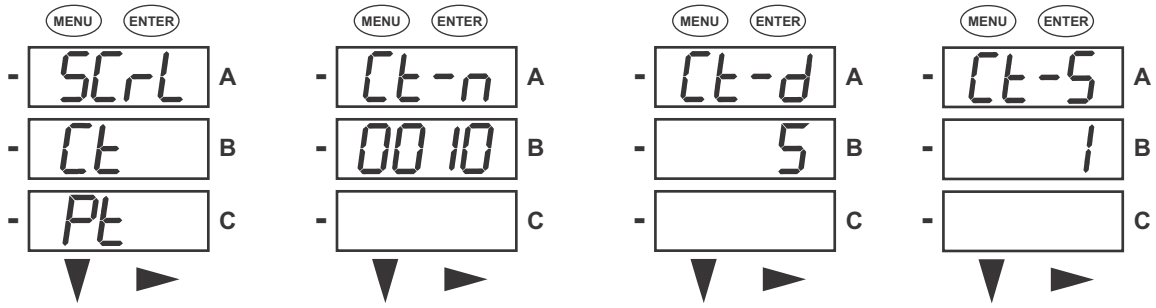
800/5 Amps: Set the Ct-n value for 800 and the Ct-S value for 1.

2,000/5 Amps: Set the Ct-n value for 2000 and the Ct-S value for 1.

10,000/5 Amps: Set the Ct-n value for 1000 and the Ct-S value for 10.

NOTES:

- The value for Amps is a product of the Ct-n value and the Ct-S value.
- Ct-n and Ct-S are dictated by primary current; Ct-d is secondary current.



Press **Enter** | Use buttons to set Ct-n | Ct-d cannot be changed | Use buttons to select scaling

7.2.5.3: Configuring PT Setting

The PT Setting has three parts: Pt-n (numerator), Pt-d (denominator), and Pt-S (scaling).

1. Press the **Enter** button when Pt is in the A window. The PT-n screen appears. You can either:
   - Change the value for the PT numerator.
   - Access one of the other PT screens by pressing the **Enter** button: press **Enter** once to access the Pt-d screen, twice to access the Pt-S screen.

a. To change the value for the PT numerator or denominator:

From the Pt-n or Pt-d screen:

- Use the **Down** button to select the number value for a digit.
- Use the **Right** button to move to the next digit.

b. To change the value for the PT scaling:

From the Pt-S screen:

Use the **Right** button or the **Down** button to choose the scaling you want. The Pt-S setting can be 1, 10, 100, or 1000.

NOTE: If you are prompted to enter a password, refer to Section 7.2.4 for instructions on doing so.

2. When the new setting is entered, press the **Menu** button twice.

3. The STOR ALL YES screen appears. Press **Enter** to save the new PT setting.

Example PT Settings:

277/277 Volts: Pt-n value is 277, Pt-d value is 277, Pt-S value is 1.

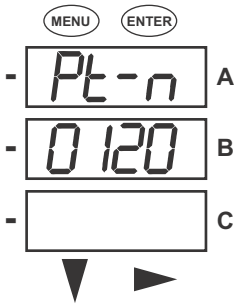
14,400/120 Volts: Pt-n value is 1440, Pt-d value is 120, Pt-S value is 10.

138,000/69 Volts: Pt-n value is 1380, Pt-d value is 69, Pt-S value is 100.

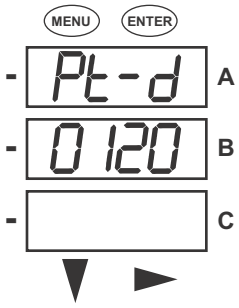
345,000/115 Volts: Pt-n value is 3450, Pt-d value is 115, Pt-S value is 100.

345,000/69 Volts: Pt-n value is 345, Pt-d value is 69, Pt-S value is 1000.

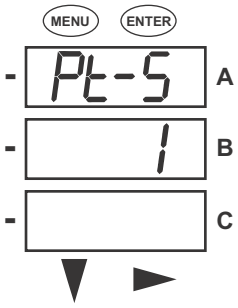
NOTE: Pt-n and Pt-S are dictated by primary voltage; Pt-d is secondary voltage.



Use buttons to set Pt-n



Use buttons to set Pt-d



Use buttons to select scaling

7.2.5.4: Configuring Connection Setting

1. Press the **Enter** button when Cnct is in the A window. The Cnct screen appears.

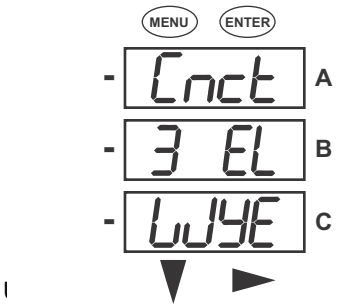
2. Press the **Right** button or **Down** button to select a configuration. The choices are:

   - 3 Element Wye (3 EL WYE)
   - 2.5 Element Wye (2.5EL WYE)
   - 2 CT Delta (2 Ct dEL)

NOTE: If you are prompted to enter a password, refer to Section 7.2.4 for instructions on doing so.

3. When you have made your selection, press the **Menu** button twice.

4. The STOR ALL YES screen appears. Press **Enter** to save the setting.



7.2.5.5: Configuring Communication Port Setting

Port configuration consists of: Address (a three digit number), Baud Rate (9600; 19200; 38400; or 57600), and Protocol (DNP 3.0; Modbus RTU; or Modbus ASCII).

1. Press the **Enter** button when POrt is in the A window. The Adr (address) screen appears. You can either:

   - Enter the address.
   - Access one of the other Port screens by pressing the **Enter** button: press **Enter** once to access the bAUd screen (Baud Rate), twice to access the Prot screen (Protocol).

a. To enter the Address

From the Adr screen:

- Use the **Down** button to select the number value for a digit.
- Use the **Right** button to move to the next digit.

b. To select the Baud Rate:

From the bAUd screen:

Use the **Right** button or the **Down** button to select the setting you want.

c. To select the Protocol:

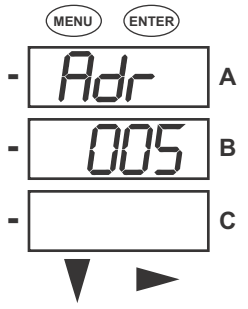
From the Prot screen:

Press the **Right** button or the **Down** button to select the setting you want.

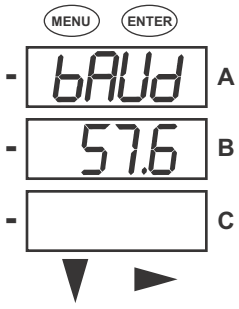
NOTE: If you are prompted to enter a password, refer to Section 7.2.4 for instructions on doing so.

2. When you have finished making your selections, press the **Menu** button twice.

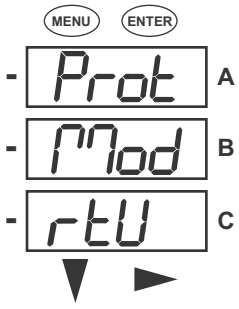
3. The STOR ALL YES screen appears. Press **Enter** to save the settings.



Use buttons to enter Address



Use buttons to select Baud Rate



Use buttons to select Protocol

7.2.6: Using Operating Mode

Operating mode is the IQ150S/250S submeter's default mode, that is, the standard front panel display. After starting up, the meter automatically scrolls through the parameter screens, if scrolling is enabled. Each parameter is shown for 7 seconds, with a 1 second pause between parameters. Scrolling is suspended for 3 minutes after any button is pressed.

1. Press the **Down** button to scroll all the parameters in Operating mode. The currently "Active," i.e., displayed, parameter has the Indicator light next to it, on the right face of the meter.

2. Press the **Right** button to view additional readings for that parameter. The table below shows possible readings for Operating mode. Sheet 2 in Appendix A shows the Operating mode Navigation map.

NOTE: Readings or groups of readings are skipped if not applicable to the meter type or hookup, or if they are disabled in the programmable settings.

OPERATING MODE PARAMETER READINGS

POSSIBLE READINGS

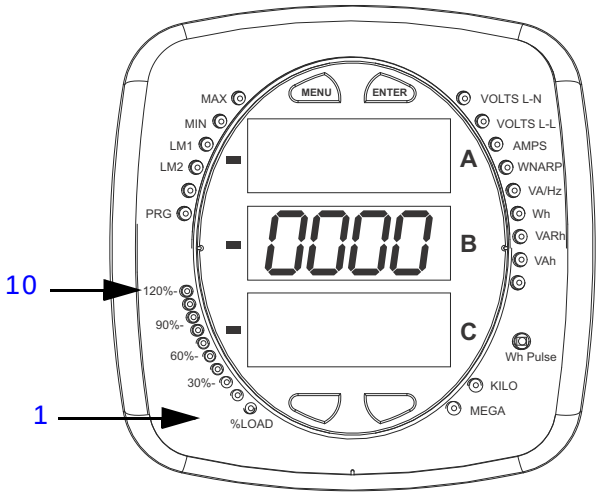
VOLTS L-N	VOLTS_LN	VOLTS_LN_MAX	VOLTS_LN_MIN		VOLTS_LN_THD
VOLTS L-L	VOLTS_LL	VOLTS_LL_MAX	VOLTS_LL_MIN		
AMPS	AMPS	AMPS_NEUTRAL	AMPS_MAX	AMPS_MIN	AMPS_THD
W/VAR/PF	W_VAR_PF	W_VAR_PF_MAX_POS	W_VAR_PF_MIN_POS	W_VAR_PF_MIN_NEG	
VA/Hz	VA_FREQ	VA_FREQ_MAX	VA_FREQ_MIN		
Wh	KWH_REC	KWH_DEL	KWH_NET	KWH_TOT	
VARh	KVARH_POS	KVARH_NEG	KVARH_NET	KVARH_TOT	
VAh	KVAH				

7.3: Understanding the % of Load Bar

The 10-segment LED bar graph at the bottom left of the IQ 150S/250S meter's front panel provides a graphic representation of Amps. The segments light according to the load, as shown in the table below.

When the Load is over 120% of Full Load, all segments flash "On" (1.5 secs) and "Off" (0.5 secs).

Segments	Load >= % Full Load
none	no load
1	1%
1-2	15%
1-3	30%
1-4	45%
1-5	60%
1-6	72%
1-7	84%
1-8	96%
1-9	108%
1-10	120%
All Blink	>120%



7.4: Performing Watt-Hour Accuracy Testing (Verification)

To be certified for revenue metering, power providers and utility companies must verify that the billing energy meter performs to the stated accuracy. To confirm the meter's performance and calibration, power providers use field test standards to ensure that the unit's energy measurements are correct. Since the IQ 150S/250S submeter is a traceable revenue meter, it contains a utility grade test pulse that can be used to gate an accuracy standard. This is an essential feature required of all billing grade meters.

- Refer to Figure 7.5 for an example of how this process works.
- Refer to Table 7.1 for the Wh/Pulse constants for accuracy testing.

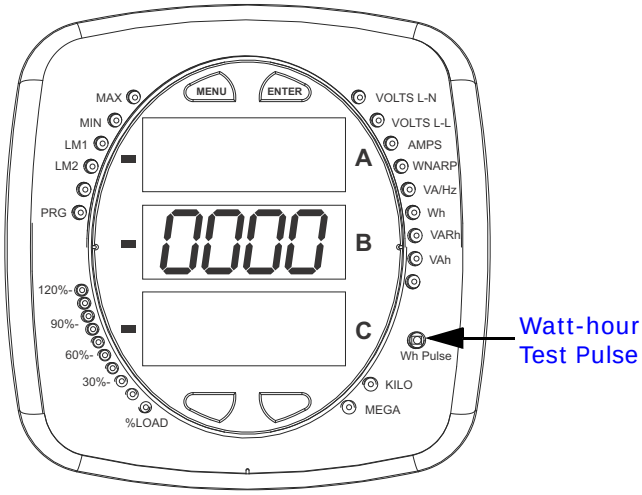


Figure 7.4: Watt-hour Test Pulse

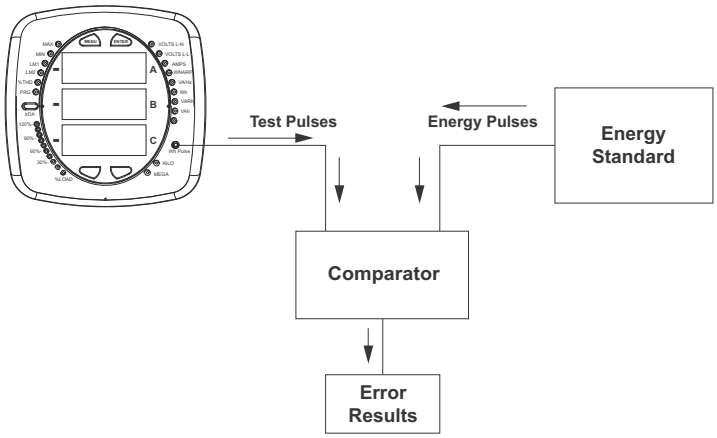


Figure 7.5: Using the Watt-hour Test Pulse

Meter	Input Voltage Level	Class 10 Models	Class 2 Models
IQ 150S	Below 150V	0.2505759630	0.0501151926
	Above 150V	1.0023038521	0.2004607704
IQ 250S	Below 150V	0.500017776	0.1000035555
	Above 150V	2.000071103	0.400014221

Table 7.1: Infrared & KYZ Pulse Constants for Accuracy Testing - Kh Watt-hour per pulse

NOTES:

- Minimum pulse width for the IQ 150S is 40 milliseconds; minimum pulse width for the IQ 250S is 90 milliseconds.
- Refer to Chapter 2, Section 2.2, for Wh Pulse specifications.

A: IQ 150S/250S Meter Navigation Maps

A.1: Introduction

You can configure the IQ 150S/250S meter and perform related tasks using the buttons on the meter face. Chapter 7 contains a description of the buttons on the meter face and instructions for programming the meter using them. The meter can also be programmed using software (see Chapter 5).

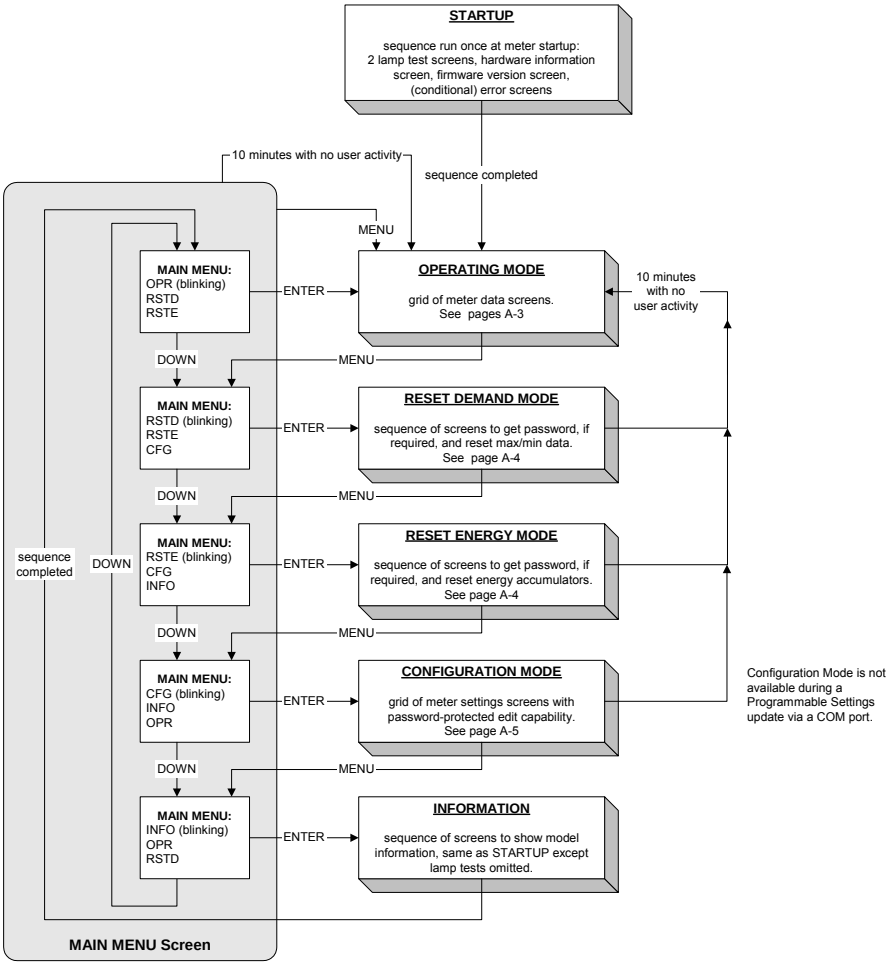
A.2: Navigation Maps (Sheets 1 to 4)

The IQ 150S/250S meter's Navigation maps begin on the next page. The maps show in detail how to move from one screen to another and from one display mode to another using the buttons on the face of the meter. All display modes automatically return to Operating mode after 10 minutes with no user activity.

IQ 150S/250S meter Navigation map titles

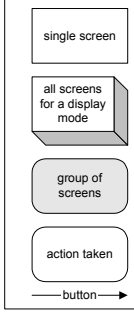
- Main Menu Screens (Sheet 1)
- Operating mode screens (Sheet 2)
- Reset mode screens (Sheet 3)
- Configuration mode screens (Sheet 4)

Main Menu Screens (Sheet 1)



MAIN MENU screen scrolls through 4 choices, showing 3 at a time. The top choice is always the "active" one, which is indicated by blinking the legend.

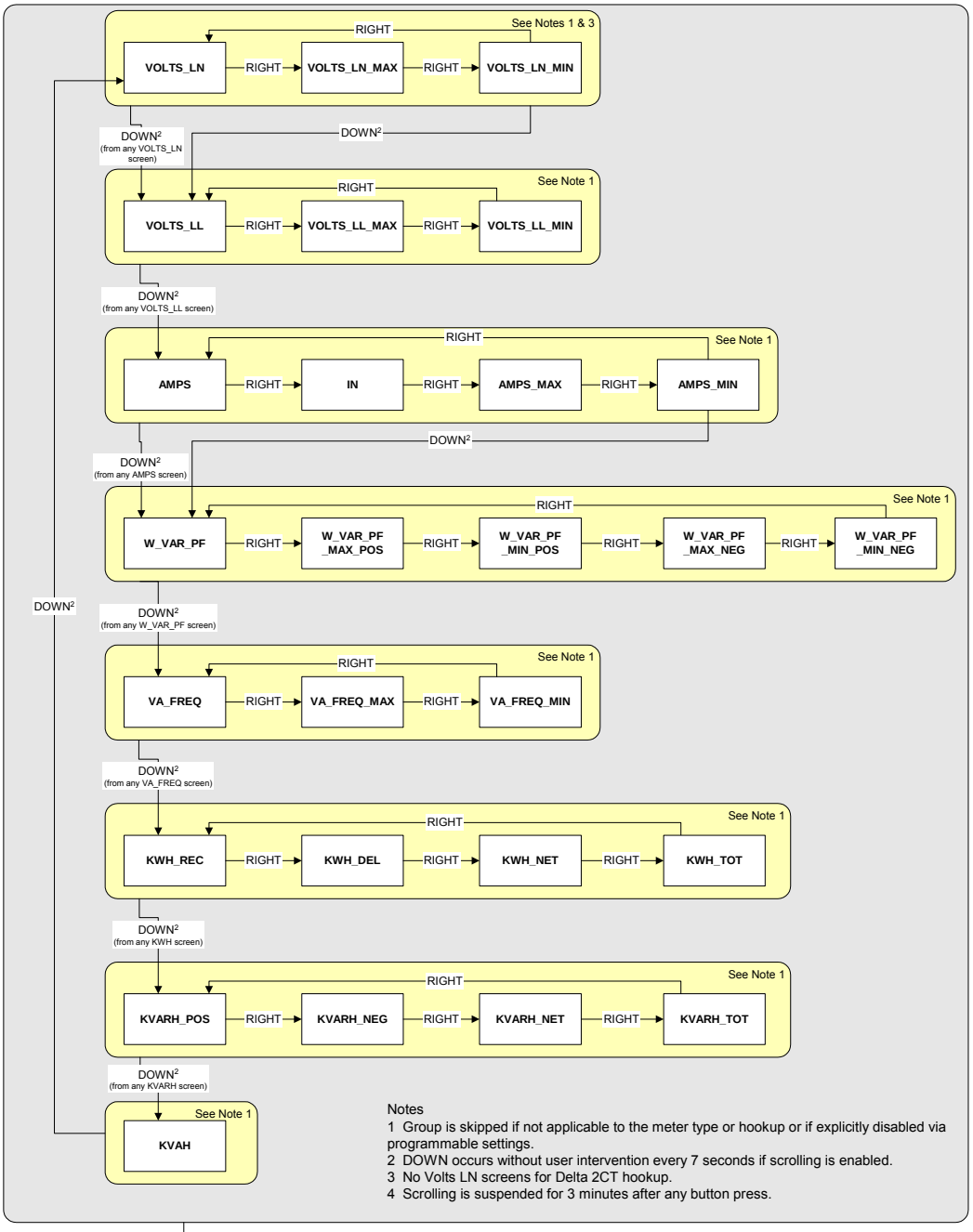
SYMBOLS



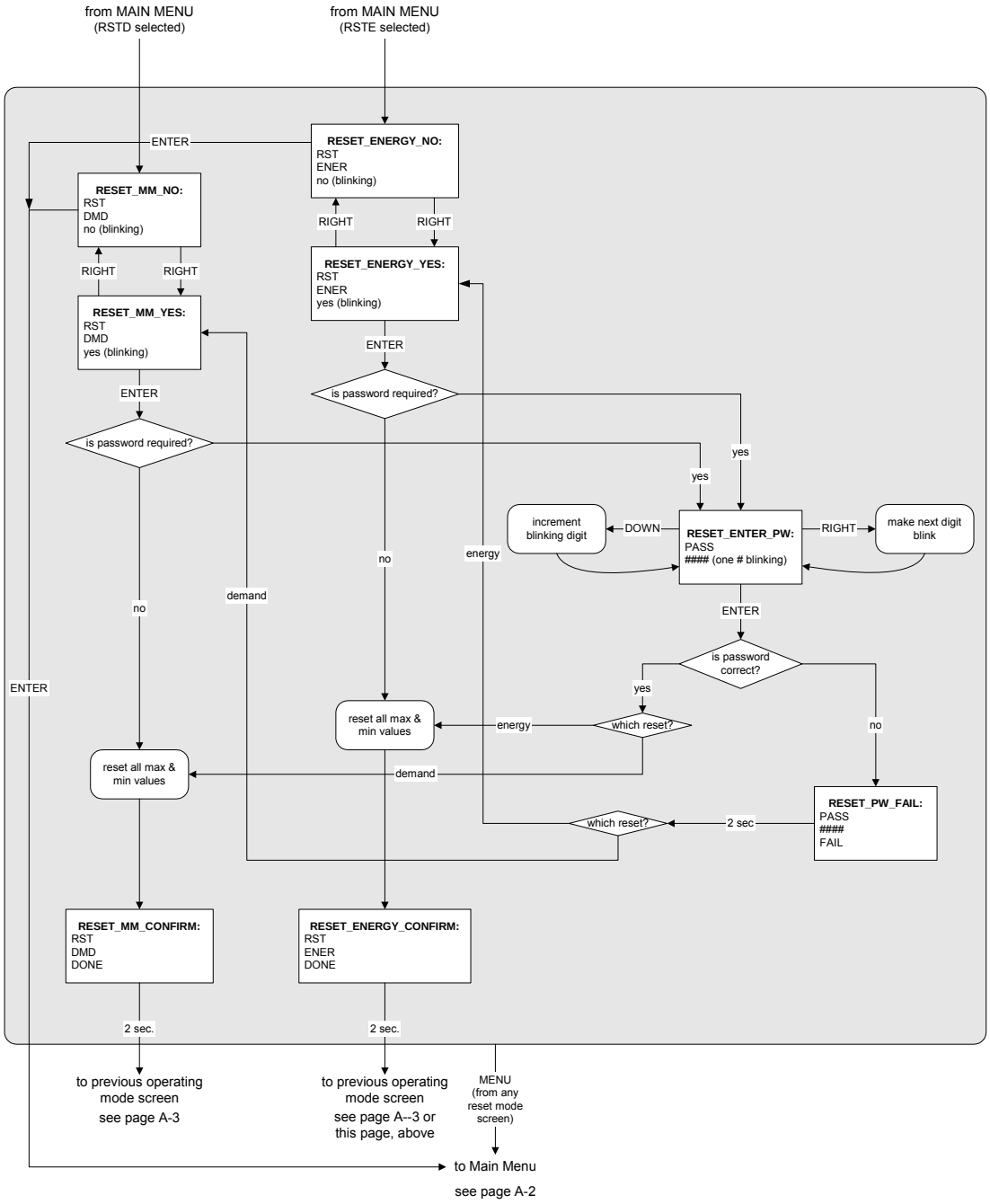
BUTTONS

MENU	Returns to previous menu from any screen in any mode
ENTER	Indicates acceptance of the current screen and advances to the next one
DOWN, RIGHT	Navigation and edit buttons
Navigation:	No digits or legends are blinking. On a menu, down advances to the next menu selection, right does nothing. In a grid of screens, down advances to the next row, right advances to the next column. Rows, columns, and menus all navigate circularly.
Editing:	A digit or legend is blinking to indicate that it is eligible for change. When a digit is blinking, down increases the digit value, right moves to the next digit. When a legend is blinking, either button advances to the next choice legend.

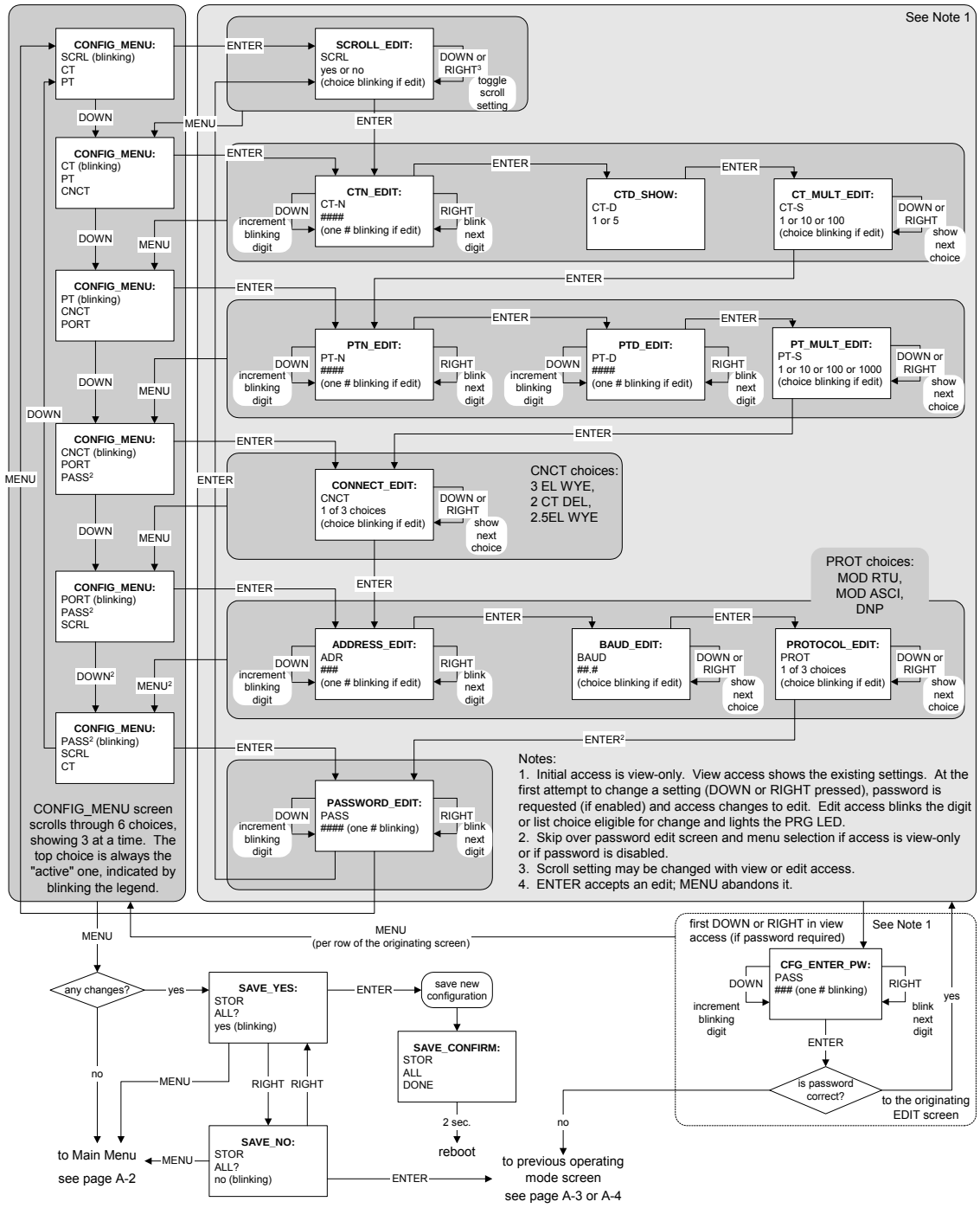
Operating Mode Screens (Sheet 2)



Reset Mode Screens (Sheet 3)



Configuration Mode Screens (Sheet 4)



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B: IQ 150S/250S Meter Modbus Map

B.1: Introduction

The Modbus Map for the IQ 150S/250S Meter gives details and information about the possible readings of the meter and about the programming of the meter. The IQ 150S/250S can be programmed using the buttons on the face plate of the meter (Chapter 7). The meter can also be programmed using software. For programming instructions, see Section 5.2.

B.2: Modbus Register Map Sections

The IQ 150S/250S Modbus Register Map includes the following sections:

Fixed Data Section, Registers 1- 47, details the Meter's Fixed Information described in Section 7.2.

Meter Data Section, Registers 1000 - 5003, details the Meter's Readings, including Primary Readings, Energy Block, Demand Block, Maximum and Minimum Blocks, Phase Angle Block and Status Block. Operating Mode readings are described in Section 7.2.6.

Commands Section, Registers 20000 - 26011, details the Meter's Resets Block, Programming Block, Other Commands Block and Encryption Block.

Programmable Settings Section, Registers 30000 - 30067, details the Meter's Basic Setups.

Secondary Readings Section, Registers 40001 - 40100, details the Meter's Secondary Readings Setups.

IQ 250S Only - Log Retrieval Section, Registers 49997 - 51127, details log and retrieval. See Section B.5 for instructions on retrieving logs.

B.3: Data Formats

ASCII:	ASCII characters packed 2 per register in high, low order and without any termination characters.
SINT16/UINT16:	16-bit signed/unsigned integer.
SINT32/UINT32:	32-bit signed/unsigned integer spanning 2 registers. The lower-addressed register is the high order half.

FLOAT: 32-bit IEEE floating point number spanning 2 registers. The lower-addressed register is the high order half (i.e., contains the exponent).

B.4: Floating Point Values

Floating Point Values are represented in the following format:

Register	0								1							
Byte	0								1							
Bit	7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
Meaning	s	e	e	e	e	e	e	e	e	m	m	m	m	m	m	m
sign	exponent								mantissa							

Register	0								1							
Byte	0								1							
Bit	7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
Meaning	s	e	e	e	e	e	e	e	e	m	m	m	m	m	m	m
sign	exponent								mantissa							

The formula to interpret a Floating Point Value is:

$-1^{sign} \times 2^{exponent-127} \times 1.mantissa = 0x0C4E11DB9$

$-1^{sign} \times 2^{137-127} \times 1 \cdot 10000100001110110111001$

$-1 \times 2^{10} \times 1.75871956$

-1800.929

Register	0x0C4E1								0x01DB9							
Byte	0x0C4								0x0E1							
Bit	7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
	1	1	0	0	0	1	0	0	1	1	1	0	0	0	0	1
Meaning	s	e	e	e	e	e	e	e	e	m	m	m	m	m	m	m
	m	m	m	m	m	m	m	m	m	m	m	m	m	m	m	m
sign	exponent								mantissa							
1	0x089 + 137								0b01100001000111010111001							

Register	0x01DB9								0x0B9v							
Byte	0x01D								0x0B9v							
Bit	7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
	0	0	0	1	1	1	0	1	1	0	1	1	1	0	0	1
Meaning																

Formula Explanation:

C4E11DB9 (hex) 11000100 11100001 00011101 10111001 (binary)

The sign of the mantissa (and therefore the number) is 1, which represents a negative value.

The Exponent is 10001001 (binary) or 137 decimal.

The Exponent is a value in excess 127. So, the Exponent value is 10.

The Mantissa is 11000010001110110111001 binary.

With the implied leading 1, the Mantissa is (1).611DB9 (hex).

The Floating Point Representation is therefore -1.75871956 times 2 to the 10.

Decimal equivalent: -1800.929

NOTES:

- Exponent = the whole number before the decimal point.
- Mantissa = the positive fraction after the decimal point.

B.5: Retrieving Logs Using the IQ 250S Meter's Modbus Map

This section describes the log interface system of the IQ 250S meter from a programming point of view. It is intended for programmers implementing independent drivers for log retrieval from the meter. It describes the meaning of the meter's Modbus Registers related to log retrieval and conversion, and details the procedure for retrieving a log's records.

NOTES:

- All references assume the use of Modbus function codes 0x03, 0x06, and 0x10, where each register is a 2 byte MSB (Most Significant Byte) word, except where otherwise noted.
- The carat symbol (^) notation is used to indicate mathematical "power." For example, 2^8 means 28; which is 2 x 2 x 2 x 2 x 2 x 2 x 2 x 2, which equals 256.

B.5.1: Data Formats

Time stamp: Stores a date from 2000 to 2099. Time stamp has a Minimum resolution of 1 second.

Byte	0	1	2	3	4	5
Value	Year	Month	Day	Hour	Minute	Second
Range	0-99 (+2000)	1-12	1-31	0-23	0-59	0-59
Mask	0x7F	0x0F	0x1F	0x1F	0x3F	0x3F

The high bits of each time stamp byte are used as flags to record meter state information at the time of the time stamp. These bits should be masked out, unless needed.

B.5.2: IQ 250S Meter Logs

The IQ 2500S meter has 5 logs: System Event, Alarm (Limits), and 3 Historical logs. Each log is described below.

1. **System Event (0)**: The System Event log is used to store events which happen in, and to, the meter. Events include Startup, Reset Commands, Log Retrievals, etc. The System Event Log Record takes 20 bytes, 14 bytes of which are available when the log is retrieved.

Byte	0	1	2	3	4	5	6	7	8	9	10	11	12	13
Value	timestamp						Group	Event	Mod	Chan	Param1	Param2	Param3	Param4

NOTE: The complete Systems Events table is shown in Section B.5.5, step 1, on page B-19.

2. **Alarm Log (1):** The Alarm Log records the states of the 8 Limits programmed in the meter.

   - Whenever a limit goes out (above or below), a record is stored with the value that caused the limit to go out.
   - Whenever a limit returns within limit, a record is stored with the "most out of limit" value for that limit while it was out of limit.

The Alarm Log Record uses 16 bytes, 10 bytes of which are available when the log is retrieved.

Byte	0	1	2	3	4	5	6	7	8	9
Value	timestamp						direction	limit#	Value%	

The limit # byte is broken into a type and an ID.

Bit	0	1	2	3	4	5	6	7
Value	type	0	0	0	0	Limit ID		

3. **Historical Log 1 (2)**: The Historical Log records the values of its assigned registers at the programmed interval.

NOTE: See Section B.5.3, Number 1, for details on programming and interpreting the log.

Byte	0	1	2	3	4	5	6	-	-	N
Value	timestamp						values . . .			

4. **Historical Log 2 (3)**: Same as Historical Log 1.

5. **Historical Log 3 (4)**: Same as Historical Log 1.

B.5.3: Block Definitions

This section describes the Modbus Registers involved in retrieving and interpreting an IQ 250S meter's Log. Other sections refer to certain 'values' contained in this section. See the corresponding value in this section for details.

NOTES:

- "Register" is the Modbus Register Address in 0-based Hexadecimal notation. To convert it to 1-based decimal notation, convert from hex16 to decimal10 and add 1. For example: 0x03E7 = 1000.
- "Size" is the number of Modbus Registers (2 byte) in a block of data.

Historical Log Programmable Settings:

The Historical Logs are programmed using a list of Modbus Registers that will be copied into the Historical Log record. In other words, Historical Log uses a direct copy of the Modbus Registers to control what is recorded at the time of record capture.

To supplement this, the programmable settings for the Historical Logs contain a list of descriptors, which group registers into items. Each item descriptor lists the data type of the item, and the num-

ber of bytes for that item. By combining these two lists, the Historical Log record can be interpreted.

For example: Registers 0x03E7 and 0x03E8 are programmed to be recorded by the historical log. The matching descriptor gives the data type as float, and the size as 4 bytes. These registers program the log to record "Primary Readings Volts A-N."

Historical Log Blocks:

Start Register: 0x7917 (Historical Log 1)

0x79D7 (Historical Log 2)

0x7A97 (Historical Log 3)

Block Size: 192 registers per log (384 bytes)

The Historical Log programmable settings are comprised of 3 blocks, one for each log. Each is identical to the others, so only Historical Log 1 is described here. All register addresses in this section are given as the Historical Log 1 address (0x7917).

Each Historical Log Block is composed of 3 sections: The header, the list of registers to log, and the list of item descriptors.

Header:

Registers: 0x7917 - 0x7918

Size: 2 registers

Byte	0	1	2	3
Value	# Registers	# Sectors		Interval

- # Registers: The number of registers to log in the record. The size of the record in memory is [12 + (# Registers x 2)]. The size during normal log retrieval is [6 + (# Registers x 2)]. If this value is 0, the log is disabled. Valid values are {0-117}.

- # Sectors: The number of Flash Sectors allocated to this log. Each sector is 64kb, minus a sector header of 20 bytes. 15 sectors are available for allocation between Historical Logs 1, 2, and 3. The sum of all Historical Logs may be less than 15. If this value is 0, the log is disabled. Valid values are {0-15}.

- Interval: The interval at which the Historical Log's Records are captured. This value is an enumeration:

0x01	1 minute
0x02	3 minute
0x04	5 minute
0x08	10 minute
0x10	15 minute
0x20	30 minute
0x40	60 minute

Register List:

Registers:	0x7919 - 0x798D
Size:	1 register per list item, 117 list items

The Register List controls what Modbus Registers are recorded in each record of the Historical Log. Since many items, such as Voltage, Energy, etc., take up more than 1 register, multiple registers need to be listed to record those items.

For example: Registers 0x03E7 and 0x03E8 are programmed to be recorded by the historical log. These registers program the log to record "Primary Readings Volts A-N."

- Each unused register item should be set to 0x0000 or 0xFFFF to indicate that it should be ignored.
- The actual size of the record, and the number of items in the register list which are used, is determined by the # registers in the header.
- Each register item is the Modbus Address in the range of 0x0000 to 0xFFFF.

Item Descriptor List:

Registers:	0x798E - 0x79C8
Size:	1 byte per item, 117 bytes (59 registers)

While the Register List describes what to log, the Item Descriptor List describes how to interpret that information. Each descriptor describes a group of register items, and what they mean.

Each descriptor is composed of 2 parts:

- Type: The data type of this descriptor, such as signed integer, IEEE floating point, etc. This is the high nibble of the descriptor byte, with a value in the range of 0-14. If this value is 0xFF, the descriptor should be ignored.

0	ASCII: An ASCII string, or byte array
1	Bitmap: A collection of bit flags
2	Signed Integer: A 2's Complement integer
3	Float: An IEEE floating point
4	Energy: Special Signed Integer, where the value is adjusted by the energy settings in the meter's Programmable Settings.
5	Unsigned Integer
6	Signed Integer 0.1 scale: Special Signed Integer, where the value is divided by 10 to give a 0.1 scale.
7-14	Unused
15	Disabled: used as end list marker.

- Size: The size in bytes of the item described. This number is used to determine the pairing of descriptors with register items.

  For example: If the first descriptor is 4 bytes, and the second descriptor is 2 bytes, then the first 2 register items belong to the 1st descriptor, and the 3rd register item belongs to the 2nd descriptor.

  NOTE: As can be seen from the example, above, there is not a 1-to-1 relation between the register list and the descriptor list. A single descriptor may refer to multiple register items.

Register Items	**Descriptors**
0x03C7/	Float, 4 byte

0x03C8
0x1234 Signed Int, 2 byte

NOTE: The sum of all descriptor sizes must equal the number of bytes in the data portion of the Historical Log record.

Log Status Block:

The Log Status Block describes the current status of the log in question. There is one header block for each of the logs. Each log's header has the following base address:

Log	**Base Address**
Alarms:	0xC737
System:	0xC747
Historical 1:	0xC757
Historical 2:	0xC767
Historical 3:	0xC777

Bytes	Value	Type	Range	# Bytes
0-3	Max Records	UINT32	0 to 4,294,967,294	4
4-7	Number of Records Used	UINT32	1 to 4,294,967,294	4
8-9	Record Size in Bytes	UINT16	4 to 250	2
10-11	Log Availability	UINT16		2
12-17	Timestamp, First Record	TSTAMP	1Jan2000 - 31Dec2099	6
18-23	Timestamp, Last Record	TSTAMP	1Jan2000 - 31Dec2099	6
24-31	Reserved			8

- Max Records: The maximum number of records the log can hold given the record size, and sector allocation. The data type is an unsigned integer from 0 - 2^32.

- Records Used: The number of records stored in the log. This number will equal the Max Records when the log has filled. This value will be set to 1 when the log is reset. The data type is an unsigned integer from 1 - 2^32.

  NOTE: The first record in every log before it has rolled over is a "dummy" record, filled with all 0xFF's. When the log is filled and rolls over, this record is overwritten.

- Record Size: The number of bytes in this record, including the timestamp. The data type is an unsigned integer in the range of 14 - 242.

- Log Availability: A flag indicating if the log is available for retrieval, or if it is in use by another port.

0	Log Available for retrieval
1	Not used
2	In use by COM2 (RS485)
0xFFFF	Log Not Available - the log cannot be retrieved. This indicates that the log is disabled.

  NOTE: To query the port by which you are currently connected, use the Port ID register:

Register:	0x1193
Size:	1 register

  Description: A value from 1-4, which enumerates the port that the requestor is currently connected on.

  NOTES:

  - When Log Retrieval is engaged, the Log Availability value will be set to the port that engaged the log. The Log Availability value will stay the same until either the log has been disengaged, or 5 minutes have passed with no activity. It will then reset to 0 (available).
  - Each log can only be retrieved by one port at a time.
  - Only one log at a time can be retrieved.

- First Timestamp: Timestamp of the oldest record.

- Last Timestamp: Timestamp of the newest record.

Log Retrieval Block:

The Log Retrieval Block is the main interface for retrieving logs. It is comprised of 2 parts: the header and the window. The header is used to program the particular data the meter presents when a log window is requested. The window is a sliding block of data that can be used to access any record in the specified log.

Session Com Port: The IQ 250S meter's Com Port which is currently retrieving logs. Only one Com Port can retrieve logs at any one time.

Registers:	0xC34E - 0xC34E
Size:	1 register
0	No Session Active
1	(Not used by the IQ 250S)
2	COM2 (RS485)

To get the current Com Port, see the NOTE on querying the port, on the previous page.

Log Retrieval Header:

The Log Retrieval Header is used to program the log to be retrieved, the record(s) of that log to be accessed, and other settings concerning the log retrieval.

Registers: 0xC34F - 0xC350

Size: 2 registers

Bytes	Value	Type	Format	Description	# Bytes
0-1	Log Number, Enable, Scope	UINT16	nnnnnnnn esssssss	nnnnnnnn - log to retrieve, e - retrieval session enable ssssss - retrieval mode	2
2-3	Records per Window, Number of Repeats	UINT16	wwwwwwww nnnnnnnn	wwwww-www - records per window, nnnnnnnn - repeat count	2

- Log Number: The log to be retrieved. Write this value to set which log is being retrieved.

0	System Events
1	Alarms
2	Historical Log 1
3	Historical Log 2
4	Historical Log 3

- Enable: This value sets if a log retrieval session is engaged (locked for retrieval) or disengaged (unlocked, read for another to engage). Write this value with 1(enable) to begin log retrieval. Write this value with 0(disable) to end log retrieval.

0	Disable
1	Enable

- Scope: Sets the amount of data to be retrieved for each record. The default should be 0 (normal).

0	Normal
1	Timestamp Only
2	Image

  - Normal [0]: The default record. Contains a 6-byte timestamp at the beginning, then N data bytes for the record data.
  - Timestamp [1]: The record only contains the 6-byte timestamp. This is most useful to determine a range of available data for non-interval based logs, such as Alarms and System Events.
  - Image [2]: The full record, as it is stored in memory. Contains a 2-byte checksum, 4-byte sequence number, 6-byte timestamp, and then N data bytes for the record data.

- Records Per Window: The number of records that fit evenly into a window. This value is set-able, as less than a full window may be used. This number tells the retrieving program how many records to expect to find in the window.

  (RecPerWindow x RecSize) = #bytes used in the window.
  This value should be ((123 x 2) \ recSize), rounded down.
  For example, with a record size of 30, the RecPerWindow = ((123 x 2) \ 30) = 8.2 ~= 8

- Number of Repeats: Specifies the number of repeats to use for the Modbus Function Code 0x23 (35). Since the meter must pre-build the response to each log window request, this value must be set once, and each request must use the same repeat count. Upon reading the last register in the specified window, the record index will increment by the number of repeats, if auto-increment is enabled. Section B.5.4.2 has additional information on Function Code 0x23.

0	Disables auto-increment
1	No Repeat count, each request will only get 1 window.
2-8	2-8 windows returned for each Function Code 0x23 request.

Bytes	Value	Type	Format	Description	# Bytes
0-3	Offset of First Record in Window	UINT32	ssssssss nnnnnnnn nnnnnnnn nnnnnnnn	ssssssss - window status nn…nn - 24-bit record index number.	4
4-249	Log Retrieve Window	UINT16			246

Log Retrieval Window Block:

The Log Retrieval Window block is used to program the data you want to retrieve from the log. It also provides the interface used to retrieve that data.

Registers: 0xC351 - 0xC3CD

Size: 125 registers

- Window Status: The status of the current window. Since the time to prepare a window may exceed an acceptable modbus delay (1 second), this acts as a state flag, signifying when the window is ready for retrieval. When this value indicates that the window is not ready, the data in the window should be ignored. Window Status is Read-only, any writes are ignored.

0	Window is Ready
0xFF	Window is Not Ready

- Record Number: The record number of the first record in the data window. Setting this value controls which records will be available in the data window.

  - When the log is engaged, the first (oldest) record is "latched." This means that record number 0 will always point to the oldest record at the time of latching, until the log is disengaged (unlocked).

  - To retrieve the entire log using auto-increment, set this value to 0, and retrieve the window repeatedly, until all records have been retrieved.

    NOTES:

    - When auto-increment is enabled, this value will automatically increment so that the window will "page" through the records, increasing by RecordsPerWindow each time that the last register in the window is read.

    - When auto-increment is not enabled, this value must be written-to manually, for each window to be retrieved.

- Log Retrieval Data Window: The actual data of the records, arranged according to the above settings.

B.5.4: Log Retrieval

Log Retrieval is accomplished in 3 basic steps:

1. Engage the log.

2. Retrieve each of the records.

3. Disengage the log.

B.5.4.1: Auto-Increment

In Eaton's traditional Modbus retrieval system, you write the index of the block of data to retrieve, then read that data from a buffer (window). To improve the speed of retrieval, the index can be automatically incremented each time the buffer is read.

In the IQ 250S meter, when the last register in the data window is read, the record index is incremented by the Records per Window.

B.5.4.2: Modbus Function Code 0x23

QUERY

Field Name	Example (Hex)
Slave Address	01
Function	23
Starting Address Hi	C3
Starting Address Lo	51
# Points Hi	00
# Points Lo	7D
Repeat Count	04

RESPONSE

Field Name	Example (Hex)
Slave Address	01
Function	23
# Bytes Hi	03
# Bytes Lo	E0
Data	...

Function Code 0x23 is a user defined Modbus function code, which has a format similar to Function Code 0x03, except for the inclusion of a "repeat count." The repeat count (RC) is used to indicate that the same N registers should be read RC number of times. (See the Number of Repeats bullet on page B-14.)

NOTES:

- By itself this feature would not provide any advantage, as the same data will be returned RC times. However, when used with auto-incrementing, this function condenses up to 8 requests into 1 request, which decreases communication time, as fewer transactions are being made.

- Keep in mind that the contents of the response data is the block of data you requested, repeated N times. For example, when retrieving log windows, you normally request both the window index, and the window data. This means that the first couple of bytes of every repeated block will contain the index of that window.

- In the IQ 250S meter repeat counts are limited to 8 times for Modbus RTU, and 4 times for Modbus ASCII.

The response for Function Code 0x23 is the same as for Function Code 0x03, with the data blocks in sequence.

IMPORTANT! Before using Function Code 0x23, always check to see if the current connection supports it. Some relay devices do not support user defined function codes; if that is the case, the message will stall. Other devices don't support 8 repeat counts.

B.5.4.3: Log Retrieval Procedure

The following procedure documents how to retrieve a single log from the oldest record to the newest record, using the "normal" record type (see **Scope**). All logs are retrieved using the same method. See Section B.5.4.4 for a Log Retrieval example.

NOTES:

- This example uses auto-increment.

- In this example, Function Code 0x23 is not used.

- You will find referenced topics in Section B.5.3. Block Definitions.

- Modbus Register numbers are listed in brackets.

1. Engage the Log:

   a. Read the Log Status Block.

i. Read the contents of the specific logs' status block [0xC737+, 16 reg] (see Log Headers).

ii. Store the # of Records Used, the Record Size, and the Log Availability.

iii. If the Log Availability is not 0, stop Log Retrieval; this log is not available at this time. If Log Availability is 0, proceed to step 1b (Engage the log).

This step is done to ensure that the log is available for retrieval, as well as retrieving information for later use.

b. Engage the log: write log to engage to Log Number, 1 to Enable, and the desired mode to Scope (default 0 (Normal)) [0xC34F, 1 reg]. This is best done as a single-register write.

This step will latch the first (oldest) record to index 0, and lock the log so that only this port can retrieve the log, until it is disengaged.

c. Verify the log is engaged: read the contents of the specific logs' status block [0xC737+, 16 reg] again to see if the log is engaged for the current port (see Log Availability). If the Log is not engaged for the current port, repeat step 1b (Engage the log).

d. Write the retrieval information.

i. Compute the number of records per window, as follows:

RecordsPerWindow = (246 \ RecordSize)

- If using 0x23, set the repeat count to 2-8. Otherwise, set it to 1.
- Since we are starting from the beginning for retrieval, the first record index is 0.

ii. Write the Records per window, the Number of repeats (1), and Record Index (0) [0xC350, 3 reg].

This step tells the IQ 250S meter what data to return in the window.

2. Retrieve the records:

a. Read the record index and window: read the record index, and the data window [0xC351, 125 reg].

- If the meter Returns a Slave Busy Exception, repeat the request.
- If the Window Status is 0xFF, repeat the request.
- If the Window Status is 0, go to step 2b (Verify record index).

NOTES:

- We read the index and window in 1 request to minimize communication time, and to ensure that the record index matches the data in the data window returned.
- Space in the window after the last specified record (RecordSize x RecordPerWindow) is padded with 0xFF, and can be safely discarded.

b. Verify that the record index incremented by Records Per Window. The record index of the retrieved window is the index of the first record in the window. This value will increase by Records Per Window each time the window is read, so it should be 0, N, N x 2, N x 3 . . . for each window retrieved.

- If the record index matches the expected record index, go to step 2c (Compute next expected record index).
- If the record index does not match the expected record index, then go to step 1d (Write the retrieval information), where the record index will be the same as the expected record index. This will tell the IQ 250S meter to repeat the records you were expecting.

c. Compute next Expected Record Index.

- If there are no remaining records after the current record window, go to step 3 (Disengage the log).
- Compute the next expected record index by adding Records Per Window, to the current expected record index. If this value is greater than the number of records, resize the window so it only contains the remaining records and go to step 1d (Write the retrieval information), where the Records Per Window will be the same as the remaining records.

3. Disengage the log: write the Log Number (of log being disengaged) to the Log Index and 0 to the Enable bit [0xC34F, 1 reg].

B.5.4.4: Log Retrieval Example

The following example illustrates a log retrieval session. The example makes the following assumptions:

- Log Retrieved is Historical Log 1 (Log Index 2).
- Auto-Incrementing is used.
- Function Code 0x23 is not used (Repeat Count of 1).
- The Log contains Volts-AN, Volts-BN, Volts-CN (12 bytes).
- 100 Records are available (0-99).
- COM Port 2 (RS485) is being used (see Log Availability).
- There are no Errors.
- Retrieval is starting at Record Index 0 (oldest record).
- Protocol used is Modbus RTU. The checksum is left off for simplicity.
- The IQ 250S meter is at device address 1.
- No new records are recorded to the log during the log retrieval process.

1. Read [0xC757, 16 reg], Historical Log 1 Header Block.

Send:	0103 C757 0010
Command:	
Register Address:	0xC757
# Registers:	16

Receive:	010320 00000100 00000064 0012 0000 060717101511 060718101511 0000000000000000
Data:	
Max Records:	0x100 = 256 records maximum.
Num Records:	0x64 = 100 records currently logged.
Record Size:	0x12 = 18 bytes per record.
Log Availability:	0x00 = 0, not in use, available for retrieval.
First Timestamp:	0x060717101511 = July 23, 2006, 16:21:17
Last Timestamp:	0x060717101511 = July 24, 2006, 16:21:17

NOTE: This indicates that Historical Log 1 is available for retrieval.

2. Write 0x0280 -> [0xC34F, 1 reg], Log Enable.

Send:	0106 C34F 0280
Command:	
Register Address:	0xC34F
# Registers:	1 (Write Single Register Command)
Data:	
Log Number:	2 (Historical Log 1)

Enable:	1 (Engage log)
Scope:	0 (Normal Mode)

Receive:	0106C34F0280 (echo)

NOTE: This engages the log for use on this COM Port, and latches the oldest record as record index 0.

3. Read [0xC757, 16 reg], Availability is 0.

Send:	0103 C757 0010
Command:	
Register Address:	0xC757
# Registers:	16

Receive:	010320 00000100 00000064 0012 0002 060717101511 060718101511 0000000000000000
Data:	
Max Records:	0x100 = 256 records maximum.
Num Records:	0x64 = 100 records currently logged.
Record Size:	0x12 = 18 bytes per record.
Log Availability:	0x02 = 2, In use by COM2, RS485 (the current port)
First Timestamp:	0x060717101511 = July 23, 2006, 16:21:17
Last Timestamp:	0x060717101511 = July 24, 2006, 16:21:17

NOTE: This indicates that the log has been engaged properly in step 2. Proceed to retrieve the log.

4. Compute #RecPerWin as (246\18)=13. Write 0x0D01 0000 0000 -> [0xC350, 3 reg] Write Retrieval Info. Set Current Index as 0.

Send:	0110 C350 0003 06 0D01 00 000000
Command:	
Register Address:	0xC350
# Registers:	3, 6 bytes
Data:	
Records per Window:	13. Since the window is 246 bytes, and the record is 18 bytes, 246\18 = 13.66, which means that 13 records evenly fit into a single window. This is 234 bytes, which means later on, we only need to read 234 bytes (117 registers) of the window to retrieve the records.
# of Repeats:	1. We are using auto-increment (so not 0), but not function code 0x23.
Window Status:	0 (ignore)
Record Index:	0, start at the first record.

Receive:	0110C3500003 (command ok)

NOTES:

- This sets up the window for retrieval; now we can start retrieving the records.
- As noted above, we compute the records per window as 246\18 = 13.66, which is rounded to 13 records per window. This allows the minimum number of requests to be made to the meter, which increases retrieval speed.

5. Read [0xC351, 125 reg], first 2 reg is status/index, last 123 reg is window data. Status OK.

Send:	0103 C351 007D
Command:	
Register Address:	0xC351
# Registers:	0x7D, 125 registers

Receive:	0103FA 00000000 060717101511FFFFFFFFFFFFFFFFFFFFFF 06071710160042FAAACF42FAAD1842FAA9A8 . . .
Data:	
Window Status:	0x00 = the window is ready.
Index:	0x00 = 0, The window starts with the 0'th record, which is the oldest record.
Record 0:	The next 18 bytes is the 0'th record (filler).
Timestamp:	0x060717101511, = July 23, 2006, 16:21:17
Data:	This record is the "filler" record. It is used by the meter so that there is never 0 records. It should be ignored. It can be identified by the data being all 0xFF. **NOTE:** Once a log has rolled over, the 0'th record will be a valid record, and the filler record will disappear.
Record 1:	The next 18 bytes is the 1'st record.
Timestamp:	0x060717101600 July 23, 2006, 16:22:00
Data:	
Volts AN:	0x42FAAACF, float = 125.33~
Volts BN:	0x42FAAD18, float = 125.33~

Volts CN: 0x42FAA9A8, float = 125.33~

. . . 13 records

NOTES:

- This retrieves the actual window. Repeat this command as many times as necessary to retrieve all of the records when auto-increment is enabled.
- Note the filler record. When a log is reset (cleared) in the meter, the meter always adds a first "filler" record, so that there is always at least 1 record in the log. This "filler" record can be identified by the data being all 0xFF, and it being index 0. If a record has all 0xFF for data, the timestamp is valid, and the index is NOT 0, then the record is legitimate.
- When the "filler" record is logged, its timestamp may not be "on the interval." The next record taken will be on the next "proper interval," adjusted to the hour. For example, if the interval is 1 minute, the first "real" record will be taken on the next minute (no seconds). If the interval is 15 minutes, the next record will be taken at :15, :30, :45, or :00 - whichever of those values is next in sequence.

6. Compare the index with Current Index.

NOTES:

- The Current Index is 0 at this point, and the record index retrieved in step 5 is 0: thus we go to step 8.
- If the Current Index and the record index do not match, go to step 7. The data that was received in the window may be invalid, and should be discarded.

7. Write the Current Index to [0xC351, 2 reg].

Send: 0110 C351 0002 04 00 00000D

Command:

Register Address: 0xC351

Registers: 2, 4 bytes

Data:

Window Status: 0 (ignore)

Record Index: 0x0D = 13, start at the 14th record.

Receive: 0110C3510002 (command ok)

NOTES:

- This step manually sets the record index, and is primarily used when an out-of-order record index is returned on a read (step 6).
- The example assumes that the second window retrieval failed somehow, and we need to recover by requesting the records starting at index 13 again.

8. For each record in the retrieved window, copy and save the data for later interpretation.

9. Increment Current Index by RecordsPerWindow.

NOTES:

- This is the step that determines how much more of the log we need to retrieve.
- On the first N passes, Records Per Window should be 13 (as computed in step 4), and the current index should be a multiple of that (0, 13, 26, . . .). This amount will decrease when we reach the end (see step 10).
- If the current index is greater than or equal to the number of records (in this case 100), then all records have been retrieved; go to step 12. Otherwise, go to step 10 to check if we are nearing the end of the records.

10. If number records - current index < RecordsPerWindow, decrease to match.

NOTES:

- Here we bounds-check the current index, so we don't exceed the records available.
- If the number of remaining records (#records - current index) is less than the Records per Window, then the next window is the last, and contains less than a full window of records. Make records per window equal to remaining records (#records-current index). In this example, this

occurs when current index is 91 (the 8'th window). There are now 9 records available (100-91), so make Records per Window equal 9.

11. Repeat steps 5 through 10.

NOTES:

- Go back to step 5, where a couple of values have changed.

Pass	CurIndex	FirstRecIndex	RecPerWindow
0	0	0	13
1	13	13	13
2	26	26	13
3	39	39	13
4	52	52	13
5	65	65	13
6	78	78	13
7	91	91	9
8	100	------	-------

- At pass 8, since Current Index is equal to the number of records (100), log retrieval should stop; go to step 12 (see step 9 Notes).

12. No more records available, clean up.

13. Write 0x0000 -> [0xC34F, 1 reg], disengage the log.

Send: 0106 C34F 0000

Command:

Register Address: 0xC34F

Registers: 1 (Write Single Register Command)

Data:

Log Number: 0 (ignore)

Enable: 0 (Disengage log)

Scope: 0 (ignore)

Receive: 0106C34F0000 (echo)

NOTES:

- This disengages the log, allowing it to be retrieved by other COM ports.
- The log will automatically disengage if no log retrieval action is taken for 5 minutes.

B.6: Modbus Register Map

The IQ 150S and 250S meters' Modbus register maps begin on the following page. The first map is for the IQ 150S, and the second is for the IQ 250S.

Modbus Address Hex	Modbus Address Decimal	Description[1]	Format	Range[6]	Units or Resolution	Comments	# Reg
Fixed Data Section							
Identification Block						read-only	
0000 - 0007	1 - 8	Reserved			none		8
0008 - 000F	9 - 16	Meter Serial Number	ASCII	16 char	none		8
0010 - 0010	17 - 17	Meter Type	UINT16	bit-mapped	-------t --------	t = transducer model (1=yes, 0=no)	1
0011 - 0012	18 - 19	Firmware Version	ASCII	4 char	none		2
0013 - 0013	20 - 20	Map Version	UINT16	0 to 65535	none		1
0014 - 0014	21 - 21	Meter Configuration	UINT16	bit-mapped	-------- --ffffff	ffffff = calibration frequency (50 or 60)	1
0015 - 0015	22 - 22	ASIC Version	UINT16	0-65535	none		1
0016 - 0026	23 - 39	Reserved					17
0027 - 002E	40 - 47	Reserved					8
						Block Size:	47
Meter Data Section [2]							
Primary Readings Block, 6 cycles (IEEE Floating Point)						read-only	
0383 - 0384	900 - 901	Watts, 3-Ph total	FLOAT	-9999 M to +9999 M	watts		2
0385 - 0386	902 - 903	VARs, 3-Ph total	FLOAT	-9999 M to +9999 M	VARs		2
0387 - 0388	904 - 905	VAs, 3-Ph total	FLOAT	-9999 M to +9999 M	VAs		2
						Block Size:	6
Primary Readings Block, 60 cycles (IEEE Floating Point)						read-only	
03E7 - 03E8	1000 - 1001	Volts A-N	FLOAT	0 to 9999 M	volts		2
03E9 - 03EA	1002 - 1003	Volts B-N	FLOAT	0 to 9999 M	volts		2
03EB - 03EC	1004 - 1005	Volts C-N	FLOAT	0 to 9999 M	volts		2
03ED - 03EE	1006 - 1007	Volts A-B	FLOAT	0 to 9999 M	volts		2
03EF - 03F0	1008 - 1009	Volts B-C	FLOAT	0 to 9999 M	volts		2
03F1 - 03F2	1010 - 1011	Volts C-A	FLOAT	0 to 9999 M	volts		2
03F3 - 03F4	1012 - 1013	Amps A	FLOAT	0 to 9999 M	amps		2
03F5 - 03F6	1014 - 1015	Amps B	FLOAT	0 to 9999 M	amps		2
03F7 - 03F8	1016 - 1017	Amps C	FLOAT	0 to 9999 M	amps		2
03F9 - 03FA	1018 - 1019	Watts, 3-Ph total	FLOAT	-9999 M to +9999 M	watts		2
03FB - 03FC	1020 - 1021	VARs, 3-Ph total	FLOAT	-9999 M to +9999 M	VARs		2
03FD - 03FE	1022 - 1023	VAs, 3-Ph total	FLOAT	-9999 M to +9999 M	VAs		2
03FF - 0400	1024 - 1025	Power Factor, 3-Ph total	FLOAT	-1.00 to +1.00	none		2
0401 - 0402	1026 - 1027	Frequency	FLOAT	0 to 65.00	Hz		2

Modbus Address Hex	Modbus Address Decimal	Description[1]	Format	Range[6]	Units or Resolution	Comments	# Reg
0403 - 0404	1028 - 1029	Neutral Current	FLOAT	0 to 9999 M	amps		2
						Block Size:	30
Primary Energy Block						read-only	
044B - 044C	1100 - 1101	W-hours, Received	SINT32	0 to 99999999 or 0 to -99999999	Wh per energy format	* Wh received & delivered always have opposite signs	2
044D - 044E	1102 - 1103	W-hours, Delivered	SINT32	0 to 99999999 or 0 to -99999999	Wh per energy format	* Wh received is positive for "view as load", delivered is positive for "view as generator"	2
044F - 0450	1104 - 1105	W-hours, Net	SINT32	-99999999 to 99999999	Wh per energy format		2
0451 - 0452	1106 - 1107	W-hours, Total	SINT32	0 to 99999999	Wh per energy format	* 5 to 8 digits	2
0453 - 0454	1108 - 1109	VAR-hours, Positive	SINT32	0 to 99999999	VARh per energy format	* decimal point implied, per energy format	2
0455 - 0456	1110 - 1111	VAR-hours, Negative	SINT32	0 to -99999999	VARh per energy format	* resolution of digit before decimal point = units, kilo, or mega, per energy format	2
0457 - 0458	1112 - 1113	VAR-hours, Net	SINT32	-99999999 to 99999999	VARh per energy format		2
0459 - 045A	1114 - 1115	VAR-hours, Total	SINT32	0 to 99999999	VARh per energy format		2
045B - 045C	1116 - 1117	VA-hours, Total	SINT32	0 to 99999999	VAh per energy format	* see note 10	2
						Block Size:	18
Primary Demand Block (IEEE Floating Point)						read-only	
07CF - 07D0	2000 - 2001	Amps A, Average	FLOAT	0 to 9999 M	amps		2
07D1 - 07D2	2002 - 2003	Amps B, Average	FLOAT	0 to 9999 M	amps		2
07D3 - 07D4	2004 - 2005	Amps C, Average	FLOAT	0 to 9999 M	amps		2
07D5 - 07D6	2006 - 2007	Positive Watts, 3-Ph, Average	FLOAT	-9999 M to +9999 M	watts		2
07D7 - 07D8	2008 - 2009	Positive VARs, 3-Ph, Average	FLOAT	-9999 M to +9999 M	VARs		2
07D9 - 07DA	2010 - 2011	Negative Watts, 3-Ph, Average	FLOAT	-9999 M to +9999 M	watts		2
07DB - 07DC	2012 - 2013	Negative VARs, 3-Ph, Average	FLOAT	-9999 M to +9999 M	VARs		2
07DD - 07DE	2014 - 2015	VAs, 3-Ph, Average	FLOAT	-9999 M to +9999 M	VAs		2
07DF - 07E0	2016 - 2017	Positive PF, 3-Ph, Average	FLOAT	-1.00 to +1.00	none		2
07E1 - 07E2	2018 - 2019	Negative PF, 3-PF, Average	FLOAT	-1.00 to +1.00	none		2
						Block Size:	20
Primary Minimum Block (IEEE Floating Point)						read-only	
0BB7 - 0BB8	3000 - 3001	Volts A-N, Minimum	FLOAT	0 to 9999 M	volts		2
0BB9 - 0BBA	3002 - 3003	Volts B-N, Minimum	FLOAT	0 to 9999 M	volts		2
0BBB - 0BBC	3004 - 3005	Volts C-N, Minimum	FLOAT	0 to 9999 M	volts		2
0BBD - 0BBE	3006 - 3007	Volts A-B, Minimum	FLOAT	0 to 9999 M	volts		2
0BBF - 0BC0	3008 - 3009	Volts B-C, Minimum	FLOAT	0 to 9999 M	volts		2

Modbus Address		Description[1]	Format	Range[6]	Units or Resolution	Comments	# Reg
Hex	Decimal						
0BC1 - 0BC2	3010 - 3011	Volts C-A, Minimum	FLOAT	0 to 9999 M	volts		2
0BC3 - 0BC4	3012 - 3013	Amps A, Minimum Avg Demand	FLOAT	0 to 9999 M	amps		2
0BC5 - 0BC6	3014 - 3015	Amps B, Minimum Avg Demand	FLOAT	0 to 9999 M	amps		2
0BC7 - 0BC8	3016 - 3017	Amps C, Minimum Avg Demand	FLOAT	0 to 9999 M	amps		2
0BC9 - 0BCA	3018 - 3019	Positive Watts, 3-Ph, Minimum Avg Demand	FLOAT	0 to +9999 M	watts		2
0BCB - 0BCC	3020 - 3021	Positive VARs, 3-Ph, Minimum Avg Demand	FLOAT	0 to +9999 M	VARs		2
0BCD - 0BCE	3022 - 3023	Negative Watts, 3-Ph, Minimum Avg Demand	FLOAT	0 to +9999 M	watts		2
0BCF - 0BD0	3024 - 3025	Negative VARs, 3-Ph, Minimum Avg Demand	FLOAT	0 to +9999 M	VARs		2
0BD1 - 0BD2	3026 - 3027	VAs, 3-Ph, Minimum Avg Demand	FLOAT	-9999 M to +9999 M	VAs		2
0BD3 - 0BD4	3028 - 3029	Positive Power Factor, 3-Ph, Minimum Avg Demand	FLOAT	-1.00 to +1.00	none		2
0BD5 - 0BD6	3030 - 3031	Negative Power Factor, 3-Ph, Minimum Avg Demand	FLOAT	-1.00 to +1.00	none		2
0BD7 - 0BD8	3032 - 3033	Frequency, Minimum	FLOAT	0 to 65.00	Hz		2
						Block Size:	34
Primary Maximum Block (IEEE Floating Point)						read-only	
0C1B - 0C1C	3100 - 3101	Volts A-N, Maximum	FLOAT	0 to 9999 M	volts		2
0C1D - 0C1E	3102 - 3103	Volts B-N, Maximum	FLOAT	0 to 9999 M	volts		2
0C1F - 0C20	3104 - 3105	Volts C-N, Maximum	FLOAT	0 to 9999 M	volts		2
0C21 - 0C22	3106 - 3107	Volts A-B, Maximum	FLOAT	0 to 9999 M	volts		2
0C23 - 0C24	3108 - 3109	Volts B-C, Maximum	FLOAT	0 to 9999 M	volts		2
0C25 - 0C26	3110 - 3111	Volts C-A, Maximum	FLOAT	0 to 9999 M	volts		2
0C27 - 0C28	3112 - 3113	Amps A, Maximum Avg Demand	FLOAT	0 to 9999 M	amps		2
0C29 - 0C2A	3114 - 3115	Amps B, Maximum Avg Demand	FLOAT	0 to 9999 M	amps		2
0C2B - 0C2C	3116 - 3117	Amps C, Maximum Avg Demand	FLOAT	0 to 9999 M	amps		2
0C2D - 0C2E	3118 - 3119	Positive Watts, 3-Ph, Maximum Avg Demand	FLOAT	0 to +9999 M	watts		2
0C2F - 0C30	3120 - 3121	Positive VARs, 3-Ph, Maximum Avg Demand	FLOAT	0 to +9999 M	VARs		2
0C31 - 0C32	3122 - 3123	Negative Watts, 3-Ph, Maximum Avg Demand	FLOAT	0 to +9999 M	watts		2
0C33 - 0C34	3124 - 3125	Negative VARs, 3-Ph, Maximum Avg Demand	FLOAT	0 to +9999 M	VARs		2
0C35 - 0C36	3126 - 3127	VAs, 3-Ph, Maximum Avg Demand	FLOAT	-9999 M to +9999 M	VAs		2
0C37 - 0C38	3128 - 3129	Positive Power Factor, 3-Ph, Maximum Avg Demand	FLOAT	-1.00 to +1.00	none		2
0C39 - 0C3A	3130 - 3131	Negative Power Factor, 3-Ph, Maximum Avg Demand	FLOAT	-1.00 to +1.00	none		2
0C3B - 0C3C	3132 - 3133	Frequency, Maximum	FLOAT	0 to 65.00	Hz		2
						Block Size:	34
Reserved Block[7, 13]						read-only	
0F9F - 0F9F	4000 - 4000	Reserved	UINT16	0 to 9999, or 65535	0.1%		1
0FA0 - 0FA0	4001 - 4001	Reserved	UINT16	0 to 9999, or 65535	0.1%		1
0FA1 - 0FA1	4002 - 4002	Reserved	UINT16	0 to 9999, or 65535	0.1%		1
0FA2 - 0FA2	4003 - 4003	Reserved	UINT16	0 to 9999, or 65535	0.1%		1

Modbus Address Hex	Modbus Address Decimal	Description[1]	Format	Range[6]	Units or Resolution	Comments	# Reg
0FA3 - 0FA3	4004 - 4004	Reserved					1
0FA4 - 0FA4	4005 - 4005	Reserved					1
0FA5 - 0FA5	4006 - 4006	Reserved					1
0FA6 - 0FA6	4007 - 4007	Reserved					1
0FA7 - 0FA7	4008 - 4008	Reserved					1
0FA8 - 0FA8	4009 - 4009	Reserved					1
0FA9 - 0FA9	4010 - 4010	Reserved					1
0FAA - 0FAA	4011 - 4011	Reserved					1
0FAB - 0FAB	4012 - 4012	Reserved					1
0FAC - 0FAC	4013 - 4013	Reserved					1
0FAD - 0FAD	4014 - 4014	Reserved					1
0FAE - 0FAE	4015 - 4015	Reserved					1
0FAF - 0FAF	4016 - 4016	Reserved					1
0FB0 - 0FB0	4017 - 4017	Reserved					1
0FB1 - 0FB8	4018 - 4025	Reserved					8
0FB9 - 0FBC	4026 - 4029	Reserved					4
0FBD - 0FC4	4030 - 4037	Reserved					8
0FC5 - 0FC8	4038 - 4041	Reserved					4
						Block Size:	42
Phase Angle Block[10]						read-only	
1003 - 1003	4100 - 4100	Phase A Current	SINT16	-1800 to +1800	0.1 degree		1
1004 - 1004	4101 - 4101	Phase B Current	SINT16	-1800 to +1800	0.1 degree		1
1005 - 1005	4102 - 4102	Phase C Current	SINT16	-1800 to +1800	0.1 degree		1
1006 - 1006	4103 - 4103	Angle, Volts A-B	SINT16	-1800 to +1800	0.1 degree		1
1007 - 1007	4104 - 4104	Angle, Volts B-C	SINT16	-1800 to +1800	0.1 degree		1
1008 - 1008	4105 - 4105	Angle, Volts C-A	SINT16	-1800 to +1800	0.1 degree		1
						Block Size:	6
Status Block						read-only	
1387 - 1387	5000 - 5000	Meter Status	UINT16	bit-mapped	--exnpch ssssssss	exnpch = EEPROM block OK flags (e=energy, x=max, n=min, p=programmabl settings, c=calibration, h=header), ssssssss = state (1=Run, 2=Limp, 10=Prog Set Update via buttons, 12=Prog Set Update via COM2)	1
1388 - 1388	5001 - 5001	Reserved					1
1389 - 138A	5002 - 5003	Time Since Reset	UINT32	0 to 4294967294	4 msec	wraps around after max coun	2
						Block Size:	4

Modbus Address Hex	Modbus Address Decimal	Description[1]	Format	Range[6]	Units or Resolution	Comments	# Reg
Commands Section [4]							
Resets Block[4]						write-only	
4E1F - 4E1F	20000 - 20000	Reset Max/Min Blocks	UINT16	password[5]			1
4E20 - 4E20	20001 - 20001	Reset Energy Accumulators	UINT16	password[5]			1
						Block Size:	2
Meter Programming Block						read/conditional write	
55EF - 55EF	22000 - 22000	Initiate Programmable Settings Update	UINT16	password[5]		meter enters PS update mod	1
55F0 - 55F0	22001 - 22001	Terminate Programmable Settings Update[3]	UINT16	any value		meter leaves PS update mode via reset	1
55F1 - 55F1	22002 - 22002	Calculate Programmable Settings Checksum[3]	UINT16			meter calculates checksum on RAM copy of PS block	1
55F2 - 55F2	22003 - 22003	Programmable Settings Checksum[3]	UINT16			read/write checksum register; PS block saved in EEPROM on write[3]	1
55F3 - 55F3	22004 - 22004	Write New Password[3]	UINT16	0000 to 9999		write-only register; always reads zero	1
59D7 - 59D7	23000 - 23000	Initiate Meter Firmware Reprogramming	UINT16	password[5]			1
						Block Size:	6
Other Commands Block						read/write	
61A7 - 61A7	25000 - 25000	Force Meter Restart	UINT16	password[5]		causes a watchdog reset, always reads 0	1
						Block Size:	1
Encryption Block						read/write	
658F - 659A	26000 - 26011	Perform a Secure Operation	UINT16			encrypted command to read password or change meter type	12
						Block Size:	12
Programmable Settings Section							
Basic Setups Block						write only in PS update mode	
752F - 752F	30000 - 30000	CT multiplier & denominator	UINT16	bit-mapped	dddddddd mmmmmmmm	high byte is denominator (1 or 5, read-only), low byte is multiplier (1, 10, or 100)	1
7530 - 7530	30001 - 30001	CT numerator	UINT16	1 to 9999	none		1
7531 - 7531	30002 - 30002	PT numerator	UINT16	1 to 9999	none		1
7532 - 7532	30003 - 30003	PT denominator	UINT16	1 to 9999	none		1

Modbus Address		Description[1]	Format	Range[6]	Units or Resolution	Comments	# Reg
Hex	Decimal						
7533 - 7533	30004 - 30004	PT multiplier & hookup	UINT16	bit-mapped	mmmmmmmm MMMMhhhh	MMMMmmmmmmmm is PT multiplier (1, 10, 100, 1000), hhhh is hookup enumeration (0 = 3 element wye[9S], 1 = delta 2 CTs[5S], 3 = 2.5 element wye[6S])	1
7534 - 7534	30005 - 30005	Averaging Method	UINT16	bit-mapped	--iiiiii b----sss	iiiiii = interval (5,15,30,60) b = 0-block or 1-rolling sss = # subintervals (1,2,3,4)	1
7535 - 7535	30006 - 30006	Power & Energy Format	UINT16	bit-mapped	pppp--nn -eee-ddd	pppp = power scale (0-unit, 3-kilo, 6-mega, 8-auto) nn = number of energy digits (5-8 --> 0-3) eee = energy scale (0-unit, 3-kilo, 6-mega) ddd = energy digits after decimal point (0-6) See note 10.	1
7536 - 7536	30007 - 30007	Operating Mode Screen Enables	UINT16	bit-mapped	00000000 eeeeeeee	eeeeeeee = op mode screen rows on(1) or off(0), rows top to bottom are bits low order to high order	1
7537 - 753D	30008 - 30014	Reserved					7
753E - 753E	30015 - 30015	User Settings Flags	UINT16	bit-mapped	---g--nn srp--wf-	g = enable alternate full scale bargraph current (1=on, 0=off) nn = number of phases for voltage & current screens (3=ABC, 2=AB, 1=A, 0=ABC) s = scroll (1=on, 0=off) r = password for reset in use (1=on, 0=off) p = password for configuration in use (1=on, 0=off) w = pwr dir (0-view as load, 1-view as generator) f = flip power factor sign (1=yes, 0=no)	1
753F - 753F	30016 - 30016	Full Scale Current (for load % bargraph)	UINT16	0 to 9999	none	If non-zero and user settings bit g is set, this value replaces CT numerator in the full scale current calculation.	1
7540 - 7547	30017 - 30024	Meter Designation	ASCII	16 char	none		8

Modbus Address Hex	Modbus Address Decimal	Description[1]	Format	Range[6]	Units or Resolution	Comments	# Reg
7548 - 7548	30025 - 30025	Reserved				dddd = reply delay (* 50 msec)	1
7549 - 7549	30026 - 30026	COM2 setup	UINT16	bit-mapped	----dddd -ppp-bbb	ppp = protocol (1-Modbus RTU, 2-Modbus ASCII, 3-DNP)	1
754A - 754A	30027 - 30027	COM2 address	UINT16	1 to 247	none		1
754B - 754B	30028 - 30028	Reserved					1
754C - 754C	30029 - 30029	Reserved					1
754D - 754D	30030 - 30030	Reserved					1
754E - 754E	30031 - 30031	Reserved					1
754F - 754F	30032 - 30032	Reserved					1
7550 - 7554	30033 - 30037						5
7555 - 7559	30038 - 30042						5
755A - 755E	30043 - 30047						5
755F - 7563	30048 - 30052						5
7564 - 7568	30053 - 30057						5
7569 - 756D	30058 - 30062						5
756E - 7572	30063 - 30067						5
						Block Size:	68
12-Bit RTU Readings Section							
12-Bit RTU Block						read-only except as noted	
9C40 - 9C40	40001 - 40001	System Sanity Indicator	UINT16	0 or 1	none	0 indicates proper meter operatio	1
9C41 - 9C41	40002 - 40002	Volts A-N	UINT16	2047 to 4095	volts	2047= 0, 4095= +150	1
9C42 - 9C42	40003 - 40003	Volts B-N	UINT16	2047 to 4095	volts	volts = 150 * (register - 2047) / 2047	1
9C43 - 9C43	40004 - 40004	Volts C-N	UINT16	2047 to 4095	volts		1
9C44 - 9C44	40005 - 40005	Amps A	UINT16	0 to 4095	amps	0= -10, 2047= 0, 4095= +10	1
9C45 - 9C45	40006 - 40006	Amps B	UINT16	0 to 4095	amps	amps = 10 * (register - 2047) / 2047	1
9C46 - 9C46	40007 - 40007	Amps C	UINT16	0 to 4095	amps		1
9C47 - 9C47	40008 - 40008	Watts, 3-Ph total	UINT16	0 to 4095	watts	0= -3000, 2047= 0, 4095= +3000	1
9C48 - 9C48	40009 - 40009	VARs, 3-Ph total	UINT16	0 to 4095	VARs	watts, VARs, VAs =	1
9C49 - 9C49	40010 - 40010	VAs, 3-Ph total	UINT16	2047 to 4095	VAs	3000 * (register - 2047) / 2047	1
9C4A - 9C4A	40011 - 40011	Power Factor, 3-Ph total	UINT16	1047 to 3047	none	1047= -1, 2047= 0, 3047= +1 pf = (register - 2047) / 1000	1
9C4B - 9C4B	40012 - 40012	Frequency	UINT16	0 to 2730	Hz	0= 45 or less, 2047= 60, 2730= 65 or more freq = 45 + ((register / 4095) * 30)	1
9C4C - 9C4C	40013 - 40013	Volts A-B	UINT16	2047 to 4095	volts	2047= 0, 4095= +300	1
9C4D - 9C4D	40014 - 40014	Volts B-C	UINT16	2047 to 4095	volts	volts = 300 * (register - 2047) / 2047	1
9C4E - 9C4E	40015 - 40015	Volts C-A	UINT16	2047 to 4095	volts		1

Modbus Address Hex	Modbus Address Decimal	Description[1]	Format	Range[6]	Units or Resolution	Comments	# Reg
9C4F - 9C4F	40016 - 40016	CT numerator	UINT16	1 to 9999	none		1
9C50 - 9C50	40017 - 40017	CT multiplier	UINT16	1, 10, 100	none	CT = numerator * multiplier / denominator	1
9C51 - 9C51	40018 - 40018	CT denominator	UINT16	1 or 5	none		1
9C52 - 9C52	40019 - 40019	PT numerator	UINT16	1 to 9999	none		1
9C53 - 9C53	40020 - 40020	PT multiplier	UINT16	1, 10, 100	none	PT = numerator * multiplier / denominator	1
9C54 - 9C54	40021 - 40021	PT denominator	UINT16	1 to 9999	none		1
9C55 - 9C56	40022 - 40023	W-hours, Positive	UINT32	0 to 99999999	Wh per energy format	* 5 to 8 digits	2
9C57 - 9C58	40024 - 40025	W-hours, Negative	UINT32	0 to 99999999	Wh per energy format	* decimal point implied, per energy format	2
9C59 - 9C5A	40026 - 40027	VAR-hours, Positive	UINT32	0 to 99999999	VARh per energy format	* resolution of digit before decimal point = units, kilo, or mega, per energy format	2
9C5B - 9C5C	40028 - 40029	VAR-hours, Negative	UINT32	0 to 99999999	VARh per energy format		2
9C5D - 9C5E	40030 - 40031	VA-hours	UINT32	0 to 99999999	VAh per energy format	* see note 10	2
9C5F - 9C5F	40032 - 40032	Neutral Current	UINT16	0 to 4095	amps	see Amps A/B/C above	1
9C60 - 9CA2	40033 - 40099	Reserved	N/A	N/A	none		67
9CA3 - 9CA3	40100 - 40100	Reset Energy Accumulators	UINT16	password[5]		write-only register; always reads as 0	1
						Block Size:	100
End of Map							

Data Formats

ASCII	ASCII characters packed 2 per register in high, low order and without any termination characters.
SINT16 / UINT16	16-bit signed / unsigned integer.
SINT32 / UINT32	32-bit signed / unsigned integer spanning 2 registers. The lower-addressed register is the high order half.
FLOAT	32-bit IEEE floating point number spanning 2 registers. The lower-addressed register is the high order half (i.e., contains the exponent).

Notes

1 All registers not explicitly listed in the table read as 0. Writes to these registers will be accepted but won't actually change the register (since it doesn't exist).

2 Meter Data Section items read as 0 until first readings are available or if the meter is not in operating mode. Writes to these registers will be accepted but won't actually change the register.

3 Register valid only in programmable settings update mode. In other modes these registers read as 0 and return an illegal data address exception if a write is attempted.

4 Meter command registers always read as 0. They may be written only when the meter is in a suitable mode. The registers return an illegal data address exception if a write is attempted in an incorrect mode.

5 If the password is incorrect, a valid response is returned but the command is not executed. Use 5555 for the password if passwords are disabled in the programmable settings.

(continued)

6 M denotes a 1,000,000 multiplier.

7 Not used.

8 Writing this register causes data to be saved permanently in EEPROM. If there is an error while saving, a slave device failure exception is returned and programmable settings mode automatically terminates via reset.

9 Reset commands make no sense if the meter state is LIMP. An illegal function exception will be returned.

10 Energy registers should be reset after a format change.

11 Not used.

12 Not used.

13 Not used.

14 All 3 voltage angles are measured for Wye and Delta hookups. For 2.5 Element, Vac is measured and Vab & Vbc are calculated. If a voltage phase is missing, the two voltage angles in which it participates are set to zero. A and C phase current angles are measured for all hookups. B phase current angle is measured for Wye and is zero for other hookups. If a voltage phase is missing, its cu angle is zero.

15 If any register in the programmable settings section is set to a value other than the acceptable value then the meter will stay in LIMP mode. Please read the comments section or the range for each register in programmable settings section for acceptable values.

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Modbus Address

Fixed Data Section									
Identification Block								read-only	
Hex			Decimal			Description (Note 1)	Format	Range (Note 6)	Units or Resolution	Comments	# Reg
0000	-	0007	1	-	8	Meter Name	ASCII	16 char	none		8
0008	-	000F	9	-	16	Meter Serial Number	ASCII	16 char	none		8
0010	-	0010	17	-	17	Meter Type	UINT16	bit-mapped	------st -----vvv	t = 0 s= 1 vvv = V-switch: V33 = standard 200S	1
0011	-	0012	18	-	19	Firmware Version	ASCII	4 char	none		2
0013	-	0013	20	-	20	Map Version	UINT16	0 to 65535	none		1
0014	-	0014	21	-	21	Meter Configuration	UINT16	bit-mapped	-----ccc --ffffff	ccc = CT denominator (1 or 5), ffffff = calibration frequency (50 or 60)	1
0015	-	0015	22	-	22	ASIC Version	UINT16	0-65535	none		1
0016	-	0017	23	-	24	Boot Firmware Version	ASCII	4 char	none		2
0018	-	0018	25	-	25	Reserved					1
0019	-	0019	26	-	26	Reserved					1
001A	-	001D	27	-	30	Meter Type Name	ASCII	8 char	none		4
001E	-	0026	31	-	39	Reserved				Reserved	9
0027	-	002E	40	-	47	Reserved				Reserved	8
										Block Size:	47

Meter Data Section (Note 2)									
Primary Readings Block								read-only	
Hex			Decimal			Description (Note 1)	Format	Range (Note 6)	Units or Resolution	Comments	# Reg
03E7	-	03E8	1000	-	1001	Volts A-N	FLOAT	0 to 9999 M	volts		2
03E9	-	03EA	1002	-	1003	Volts B-N	FLOAT	0 to 9999 M	volts		2
03EB	-	03EC	1004	-	1005	Volts C-N	FLOAT	0 to 9999 M	volts		2
03ED	-	03EE	1006	-	1007	Volts A-B	FLOAT	0 to 9999 M	volts		2
03EF	-	03F0	1008	-	1009	Volts B-C	FLOAT	0 to 9999 M	volts		2
03F1	-	03F2	1010	-	1011	Volts C-A	FLOAT	0 to 9999 M	volts		2
03F3	-	03F4	1012	-	1013	Amps A	FLOAT	0 to 9999 M	amps		2
03F5	-	03F6	1014	-	1015	Amps B	FLOAT	0 to 9999 M	amps		2
03F7	-	03F8	1016	-	1017	Amps C	FLOAT	0 to 9999 M	amps		2
03F9	-	03FA	1018	-	1019	Watts, 3-Ph total	FLOAT	-9999 M to +9999 M	watts		2
03FB	-	03FC	1020	-	1021	VARs, 3-Ph total	FLOAT	-9999 M to +9999 M	VARs		2
03FD	-	03FE	1022	-	1023	VAs, 3-Ph total	FLOAT	-9999 M to +9999 M	VAs		2
03FF	-	0400	1024	-	1025	Power Factor, 3-Ph total	FLOAT	-1.00 to +1.00	none		2
0401	-	0402	1026	-	1027	Frequency	FLOAT	0 to 65.00	Hz		2
0403	-	0404	1028	-	1029	Neutral Current	FLOAT	0 to 9999 M	amps		2
0405	-	0406	1030	-	1031	Watts, Phase A	FLOAT	-9999 M to +9999 M	watts		2
0407	-	0408	1032	-	1033	Watts, Phase B	FLOAT	-9999 M to +9999 M	watts		2
0409	-	040A	1034	-	1035	Watts, Phase C	FLOAT	-9999 M to +9999 M	watts		2
040B	-	040C	1036	-	1037	VARs, Phase A	FLOAT	-9999 M to +9999 M	VARs		2
040D	-	040E	1038	-	1039	VARs, Phase B	FLOAT	-9999 M to +9999 M	VARs		2
040F	-	0410	1040	-	1041	VARs, Phase C	FLOAT	-9999 M to +9999 M	VARs		2
0411	-	0412	1042	-	1043	VAs, Phase A	FLOAT	-9999 M to +9999 M	VAs		2
0413	-	0414	1044	-	1045	VAs, Phase B	FLOAT	-9999 M to +9999 M	VAs		2
0415	-	0416	1046	-	1047	VAs, Phase C	FLOAT	-9999 M to +9999 M	VAs		2
0417	-	0418	1048	-	1049	Power Factor, Phase A	FLOAT	-1.00 to +1.00	none		2
0419	-	041A	1050	-	1051	Power Factor, Phase B	FLOAT	-1.00 to +1.00	none		2
041B	-	041C	1052	-	1053	Power Factor, Phase C	FLOAT	-1.00 to +1.00	none		2
041D	-	0425	1054	-	1062	Reserved				Reserved	9
										Block Size:	63

Per phase power and PF have values only for WYE hookup and will be zero for all other hookups.

Primary Energy Block										read-only	
Hex			Decimal			Description (Note 1)	Format	Range (Note 6)	Units or Resolution	Comments	# Reg
05DB	-	05DC	1500	-	1501	W-hours, Received	SINT32	0 to 99999999 or 0 to -99999999	Wh per energy format	* Wh received & delivered always have opposite signs	2
05DD	-	05DE	1502	-	1503	W-hours, Delivered	SINT32	0 to 99999999 or 0 to -99999999	Wh per energy format	* Wh received is positive for "view as load", delivered is positive for "view as generator"	2
05DF	-	05E0	1504	-	1505	W-hours, Net	SINT32	-99999999 to 99999999	Wh per energy format	* 5 to 8 digits	2
05E1	-	05E2	1506	-	1507	W-hours, Total	SINT32	0 to 99999999	Wh per energy format		2
05E3	-	05E4	1508	-	1509	VAR-hours, Positive	SINT32	0 to 99999999	VARh per energy format	* decimal point implied, per energy format	2
05E5	-	05E6	1510	-	1511	VAR-hours, Negative	SINT32	0 to -99999999	VARh per energy format		2
05E7	-	05E8	1512	-	1513	VAR-hours, Net	SINT32	-99999999 to 99999999	VARh per energy format	* resolution of digit before decimal point = units, kilo, or mega, per energy format	2
05E9	-	05EA	1514	-	1515	VAR-hours, Total	SINT32	0 to 99999999	VARh per energy format		2
05EB	-	05EC	1516	-	1517	VA-hours, Total	SINT32	0 to 99999999	VAh per energy format	* see note 10	2
05ED	-	05EE	1518	-	1519	W-hours, Received, Phase A	SINT32	0 to 99999999 or 0 to -99999999	Wh per energy format		2
05EF	-	05F0	1520	-	1521	W-hours, Received, Phase B	SINT32	0 to 99999999 or 0 to -99999999	Wh per energy format		2
05F1	-	05F2	1522	-	1523	W-hours, Received, Phase C	SINT32	0 to 99999999 or 0 to -99999999	Wh per energy format		2
05F3	-	05F4	1524	-	1525	W-hours, Delivered, Phase A	SINT32	0 to 99999999 or 0 to -99999999	Wh per energy format		2
05F5	-	05F6	1526	-	1527	W-hours, Delivered, Phase B	SINT32	0 to 99999999 or 0 to -99999999	Wh per energy format		2
05F7	-	05F8	1528	-	1529	W-hours, Delivered, Phase C	SINT32	0 to 99999999 or 0 to -99999999	Wh per energy format		2
05F9	-	05FA	1530	-	1531	W-hours, Net, Phase A	SINT32	-99999999 to 99999999	Wh per energy format		2
05FB	-	05FC	1532	-	1533	W-hours, Net, Phase B	SINT32	-99999999 to 99999999	Wh per energy format		2
05FD	-	05FE	1534	-	1535	W-hours, Net, Phase C	SINT32	-99999999 to 99999999	Wh per energy format		2
05FF	-	0600	1536	-	1537	W-hours, Total, Phase A	SINT32	0 to 99999999	Wh per energy format		2
0601	-	0602	1538	-	1539	W-hours, Total, Phase B	SINT32	0 to 99999999	Wh per energy format		2
0603	-	0604	1540	-	1541	W-hours, Total, Phase C	SINT32	0 to 99999999	Wh per energy format		2
0605	-	0606	1542	-	1543	VAR-hours, Positive, Phase A	SINT32	0 to 99999999	VARh per energy format		2
0607	-	0608	1544	-	1545	VAR-hours, Positive, Phase B	SINT32	0 to 99999999	VARh per energy format		2
0609	-	060A	1546	-	1547	VAR-hours, Positive, Phase C	SINT32	0 to 99999999	VARh per energy format		2
060B	-	060C	1548	-	1549	VAR-hours, Negative, Phase A	SINT32	0 to -99999999	VARh per energy format		2
060D	-	060E	1550	-	1551	VAR-hours, Negative, Phase B	SINT32	0 to -99999999	VARh per energy format		2
060F	-	0610	1552	-	1553	VAR-hours, Negative, Phase C	SINT32	0 to -99999999	VARh per energy format		2
0611	-	0612	1554	-	1555	VAR-hours, Net, Phase A	SINT32	-99999999 to 99999999	VARh per energy format		2
0613	-	0614	1556	-	1557	VAR-hours, Net, Phase B	SINT32	-99999999 to 99999999	VARh per energy format		2
0615	-	0616	1558	-	1559	VAR-hours, Net, Phase C	SINT32	-99999999 to 99999999	VARh per energy format		2
0617	-	0618	1560	-	1561	VAR-hours, Total, Phase A	SINT32	0 to 99999999	VARh per energy format		2
0619	-	061A	1562	-	1563	VAR-hours, Total, Phase B	SINT32	0 to 99999999	VARh per energy format		2
061B	-	061C	1564	-	1565	VAR-hours, Total, Phase C	SINT32	0 to 99999999	VARh per energy format		2
061D	-	061E	1566	-	1567	VA-hours, Phase A	SINT32	0 to 99999999	VAh per energy format		2
061F	-	0620	1568	-	1569	VA-hours, Phase B	SINT32	0 to 99999999	VAh per energy format		2
0621	-	0622	1570	-	1571	VA-hours, Phase C	SINT32	0 to 99999999	VAh per energy format		2
										Block Size:	72

Primary Demand Block									read-only	
Hex			Decimal			Description (Note 1)	Format	Range (Note 6)	Units or Resolution	Comments	# Reg
07CF	-	07D0	2000	-	2001	Amps A, Average	FLOAT	0 to 9999 M	amps		2
07D1	-	07D2	2002	-	2003	Amps B, Average	FLOAT	0 to 9999 M	amps		2
07D3	-	07D4	2004	-	2005	Amps C, Average	FLOAT	0 to 9999 M	amps		2
07D5	-	07D6	2006	-	2007	Positive Watts, 3-Ph, Average	FLOAT	-9999 M to +9999 M	watts		2
07D7	-	07D8	2008	-	2009	Positive VARs, 3-Ph, Average	FLOAT	-9999 M to +9999 M	VARs		2
07D9	-	07DA	2010	-	2011	Negative Watts, 3-Ph, Average	FLOAT	-9999 M to +9999 M	watts		2
07DB	-	07DC	2012	-	2013	Negative VARs, 3-Ph, Average	FLOAT	-9999 M to +9999 M	VARs		2
07DD	-	07DE	2014	-	2015	VAs, 3-Ph, Average	FLOAT	-9999 M to +9999 M	VAs		2
07DF	-	07E0	2016	-	2017	Positive PF, 3-Ph, Average	FLOAT	-1.00 to +1.00	none		2
07E1	-	07E2	2018	-	2019	Negative PF, 3-PF, Average	FLOAT	-1.00 to +1.00	none		2
07E3	-	07E4	2020	-	2021	Neutral Current, Average	FLOAT	0 to 9999 M	amps		2
07E5	-	07E6	2022	-	2023	Positive Watts, Phase A, Average	FLOAT	-9999 M to +9999 M	watts		2
07E7	-	07E8	2024	-	2025	Positive Watts, Phase B, Average	FLOAT	-9999 M to +9999 M	watts		2
07E9	-	07EA	2026	-	2027	Positive Watts, Phase C, Average	FLOAT	-9999 M to +9999 M	watts		2
07EB	-	07EC	2028	-	2029	Positive VARs, Phase A, Average	FLOAT	-9999 M to +9999 M	VARs		2
07ED	-	07EE	2030	-	2031	Positive VARs, Phase B, Average	FLOAT	-9999 M to +9999 M	VARs		2
07EF	-	07F0	2032	-	2033	Positive VARs, Phase C, Average	FLOAT	-9999 M to +9999 M	VARs		2
07F1	-	07F2	2034	-	2035	Negative Watts, Phase A, Average	FLOAT	-9999 M to +9999 M	watts		2
07F3	-	07F4	2036	-	2037	Negative Watts, Phase B, Average	FLOAT	-9999 M to +9999 M	watts		2
07F5	-	07F6	2038	-	2039	Negative Watts, Phase C, Average	FLOAT	-9999 M to +9999 M	watts		2
07F7	-	07F8	2040	-	2041	Negative VARs, Phase A, Average	FLOAT	-9999 M to +9999 M	VARs		2
07F9	-	07FA	2042	-	2043	Negative VARs, Phase B, Average	FLOAT	-9999 M to +9999 M	VARs		2
07FB	-	07FC	2044	-	2045	Negative VARs, Phase C, Average	FLOAT	-9999 M to +9999 M	VARs		2
07FD	-	07FE	2046	-	2047	VAs, Phase A, Average	FLOAT	-9999 M to +9999 M	VAs		2
07FF	-	0800	2048	-	2049	VAs, Phase B, Average	FLOAT	-9999 M to +9999 M	VAs		2
0801	-	0802	2050	-	2051	VAs, Phase C, Average	FLOAT	-9999 M to +9999 M	VAs		2
0803	-	0804	2052	-	2053	Positive PF, Phase A, Average	FLOAT	-1.00 to +1.00	none		2
0805	-	0806	2054	-	2055	Positive PF, Phase B, Average	FLOAT	-1.00 to +1.00	none		2
0807	-	0808	2056	-	2057	Positive PF, Phase C, Average	FLOAT	-1.00 to +1.00	none		2
0809	-	080A	2058	-	2059	Negative PF, Phase A, Average	FLOAT	-1.00 to +1.00	none		2
080B	-	080C	2060	-	2061	Negative PF, Phase B, Average	FLOAT	-1.00 to +1.00	none		2
080D	-	080E	2062	-	2063	Negative PF, Phase C, Average	FLOAT	-1.00 to +1.00	none		2
										Block Size:	64

Uncompensated Readings Block									read-only	
Hex		Decimal			Description (Note 1)	Format	Range (Note 6)	Units or Resolution	Comments	# Reg
0BB7	- 0BB8	3000	-	3001	Watts, 3-Ph total	FLOAT	-9999 M to +9999 M	watts		2
0BB9	- 0BBA	3002	-	3003	VARs, 3-Ph total	FLOAT	-9999 M to +9999 M	VARs		2
0BBB	- 0BBC	3004	-	3005	VAs, 3-Ph total	FLOAT	-9999 M to +9999 M	VAs		2
0BBD	- 0BBE	3006	-	3007	Power Factor, 3-Ph total	FLOAT	-1.00 to +1.00	none		2
0BBF	- 0BC0	3008	-	3009	Watts, Phase A	FLOAT	-9999 M to +9999 M	watts		2
0BC1	- 0BC2	3010	-	3011	Watts, Phase B	FLOAT	-9999 M to +9999 M	watts		2
0BC3	- 0BC4	3012	-	3013	Watts, Phase C	FLOAT	-9999 M to +9999 M	watts		2
0BC5	- 0BC6	3014	-	3015	VARs, Phase A	FLOAT	-9999 M to +9999 M	VARs		2
OBC7	- 0BC8	3016	-	3017	VARs, Phase B	FLOAT	-9999 M to +9999 M	VARs		2
0BC9	- 0BCA	3018	-	3019	VARs, Phase C	FLOAT	-9999 M to +9999 M	VARs	Per phase power and PF have values only for WYE hookup and will be zero for all other hookups.	2
0BCB	- 0BCC	3020	-	3021	VAs, Phase A	FLOAT	-9999 M to +9999 M	VAs		2
0BCD	- 0BCE	3022	-	3023	VAs, Phase B	FLOAT	-9999 M to +9999 M	VAs		2
0BCF	- 0BD0	3024	-	3025	VAs, Phase C	FLOAT	-9999 M to +9999 M	VAs		2
0BD1	- 0BD2	3026	-	3027	Power Factor, Phase A	FLOAT	-1.00 to +1.00	none		2
0BD3	- 0BD4	3028	-	3029	Power Factor, Phase B	FLOAT	-1.00 to +1.00	none		2
0BD5	- 0BD6	3030	-	3031	Power Factor, Phase C	FLOAT	-1.00 to +1.00	none		2
0BD7	- 0BD8	3032	-	3033	W-hours, Received	SINT32	0 to 99999999 or 0 to -99999999	Wh per energy format	* Wh received & delivered always have opposite signs	2
0BD9	- 0BDA	3034	-	3035	W-hours, Delivered	SINT32	0 to 99999999 or 0 to -99999999	Wh per energy format	* Wh received is positive for "view as load", delivered is positive for "view as generator"	2
0BDB	- 0BDC	3036	-	3037	W-hours, Net	SINT32	-99999999 to 99999999	Wh per energy format	* 5 to 8 digits	2
0BDD	- 0BDE	3038	-	3039	W-hours, Total	SINT32	0 to 99999999	Wh per energy format		2
0BDF	- 0BE0	3040	-	3041	VAR-hours, Positive	SINT32	0 to 99999999	VARh per energy format	* decimal point implied, per energy format	2
0BE1	- 0BE2	3042	-	3043	VAR-hours, Negative	SINT32	0 to -99999999	VARh per energy format		2
0BE3	- 0BE4	3044	-	3045	VAR-hours, Net	SINT32	-99999999 to 99999999	VARh per energy format	* resolution of digit before decimal point = units, kilo, or mega, per energy format	2
0BE5	- 0BE6	3046	-	3047	VAR-hours, Total	SINT32	0 to 99999999	VARh per energy format		2
0BE7	- 0BE8	3048	-	3049	VA-hours, Total	SINT32	0 to 99999999	VAh per energy format	* see note 10	2
0BE9	- 0BEA	3050	-	3051	W-hours, Received, Phase A	SINT32	0 to 99999999 or 0 to -99999999	Wh per energy format		2
0BEB	- 0BEC	3052	-	3053	W-hours, Received, Phase B	SINT32	0 to 99999999 or 0 to -99999999	Wh per energy format		2
0BED	- 0BEE	3054	-	3055	W-hours, Received, Phase C	SINT32	0 to 99999999 or 0 to -99999999	Wh per energy format		2
0BEF	- 0BF0	3056	-	3057	W-hours, Delivered, Phase A	SINT32	0 to 99999999 or 0 to -99999999	Wh per energy format		2
0BF1	- 0BF2	3058	-	3059	W-hours, Delivered, Phase B	SINT32	0 to 99999999 or 0 to -99999999	Wh per energy format		2
0BF3	- 0BF4	3060	-	3061	W-hours, Delivered, Phase C	SINT32	0 to 99999999 or 0 to -99999999	Wh per energy format		2
0BF5	- 0BF6	3062	-	3063	W-hours, Net, Phase A	SINT32	-99999999 to 99999999	Wh per energy format		2
0BF7	- 0BF8	3064	-	3065	W-hours, Net, Phase B	SINT32	-99999999 to 99999999	Wh per energy format		2
0BF9	- 0BFA	3066	-	3067	W-hours, Net, Phase C	SINT32	-99999999 to 99999999	Wh per energy format		2
0BFB	- 0BFC	3068	-	3069	W-hours, Total, Phase A	SINT32	0 to 99999999	Wh per energy format		2
0BFD	- 0BFE	3070	-	3071	W-hours, Total, Phase B	SINT32	0 to 99999999	Wh per energy format		2
0BFF	- 0C00	3072	-	3073	W-hours, Total, Phase C	SINT32	0 to 99999999	Wh per energy format		2
0C01	- 0C02	3074	-	3075	VAR-hours, Positive, Phase A	SINT32	0 to 99999999	VARh per energy format		2
0C03	- 0C04	3076	-	3077	VAR-hours, Positive, Phase B	SINT32	0 to 99999999	VARh per energy format		2
0C05	- 0C06	3078	-	3079	VAR-hours, Positive, Phase C	SINT32	0 to 99999999	VARh per energy format		2
0C07	- 0C08	3080	-	3081	VAR-hours, Negative, Phase A	SINT32	0 to -99999999	VARh per energy format		2
0C09	- 0C0A	3082	-	3083	VAR-hours, Negative, Phase B	SINT32	0 to -99999999	VARh per energy format		2
0C0B	- 0C0C	3084	-	3085	VAR-hours, Negative, Phase C	SINT32	0 to -99999999	VARh per energy format		2
0C0D	- 0C0E	3086	-	3087	VAR-hours, Net, Phase A	SINT32	-99999999 to 99999999	VARh per energy format		2
0C0F	- 0C10	3088	-	3089	VAR-hours, Net, Phase B	SINT32	-99999999 to 99999999	VARh per energy format		2
0C11	- 0C12	3090	-	3091	VAR-hours, Net, Phase C	SINT32	-99999999 to 99999999	VARh per energy format		2
0C13	- 0C14	3092	-	3093	VAR-hours, Total, Phase A	SINT32	0 to 99999999	VARh per energy format		2
0C15	- 0C16	3094	-	3095	VAR-hours, Total, Phase B	SINT32	0 to 99999999	VARh per energy format		2
0C17	- 0C18	3096	-	3097	VAR-hours, Total, Phase C	SINT32	0 to 99999999	VARh per energy format		2
0C19	- 0C1A	3098	-	3099	VA-hours, Phase A	SINT32	0 to 99999999	VAh per energy format		2
0C1B	- 0C1C	3100	-	3101	VA-hours, Phase B	SINT32	0 to 99999999	VAh per energy format		2
0C1D	- 0C1E	3102	-	3103	VA-hours, Phase C	SINT32	0 to 99999999	VAh per energy format		2
									Block Size:	104

Phase Angle Block									read-only	
Hex			Decimal			Description (Note 1)	Format	Range (Note 6)	Units or Resolution	Comments	# Reg
1003	-	1003	4100	-	4100	Phase A Current	SINT16	-1800 to +1800	0.1 degree		1
1004	-	1004	4101	-	4101	Phase B Current	SINT16	-1800 to +1800	0.1 degree		1
1005	-	1005	4102	-	4102	Phase C Current	SINT16	-1800 to +1800	0.1 degree		1
1006	-	1006	4103	-	4103	Angle, Volts A-B	SINT16	-1800 to +1800	0.1 degree		1
1007	-	1007	4104	-	4104	Angle, Volts B-C	SINT16	-1800 to +1800	0.1 degree		1
1008	-	1008	4105	-	4105	Angle, Volts C-A	SINT16	-1800 to +1800	0.1 degree		1
										Block Size:	6

Status Block									read-only	
Hex			Decimal			Description (Note 1)	Format	Range (Note 6)	Units or Resolution	Comments	# Reg
1193	-	1193	4500	-	4500	Port ID	UINT16	1 to 4	none	Identifies which Shark COM port a master is connected to; 1 for COM1, 2 for COM2, etc.	1
1194	-	1194	4501	-	4501	Meter Status	UINT16	bit-mapped	mmmpch-- -ffeeccc	mmm = measurement state (0=off, 1=running normally, 2=limp mode, 3=warmup, 6&7=boot, others unused) See note 16. pch = NVMEM block OK flags (p=profile, c=calibration, h=header), flag is 1 if OK ff = flash state (0=initializing, 1=logging disabled by Vswitch, 3=logging) ee = edit state (0=startup, 1=normal, 2=privileged command session, 3=profile update mode) ccc = port enabled for edit(0=none, 1-4=COM1-COM4, 7=front panel)	1
1195	-	1195	4502	-	4502	Limits Status	UINT16	bit-mapped	87654321 87654321	high byte is setpt 1, 0=in, 1=out low byte is setpt 2, 0=in, 1=out see notes 11, 12, 17	1
1196	-	1197	4503	-	4504	Time Since Reset	UINT32	0 to 4294967294	4 msec	wraps around after max count	2
1198	-	119A	4505	-	4507	Meter On Time	TSTAMP	1Jan2000 - 31Dec2099	1 sec		3
119B	-	119D	4508	-	4510	Current Date and Time	TSTAMP	1Jan2000 - 31Dec2099	1 sec		3
119E	-	119E	4511	-	4511	Reserved				Reserved	1
119F	-	119F	4512	-	4512	Current Day of Week	UINT16	1 to 7	1 day	1=Sun, 2=Mon, etc.	1
										Block Size:	13
										Block Size:	876

Short term Primary Minimum Block									read-only	
Hex			Decimal			Description (Note 1)	Format	Range (Note 6)	Units or Resolution	Comments	# Reg
1F27	-	1F28	7976	-	7977	Volts A-N, previous Demand interval Short Term Minimum	FLOAT	0 to 9999 M	volts	Minimum instantaneous value measured during the demand interval before the one most recently completed.	2
1F29	-	1F2A	7978	-	7979	Volts B-N, previous Demand interval Short Term Minimum	FLOAT	0 to 9999 M	volts		2
1F2B	-	1F2C	7980	-	7981	Volts C-N, previous Demand interval Short Term Minimum	FLOAT	0 to 9999 M	volts		2
1F2D	-	1F2E	7982	-	7983	Volts A-B, previous Demand interval Short Term Minimum	FLOAT	0 to 9999 M	volts		2
1F2F	-	1F30	7984	-	7985	Volts B-C, previous Demand interval Short Term Minimum	FLOAT	0 to 9999 M	volts		2
1F31	-	1F32	7986	-	7987	Volts C-A, previous Demand interval Short Term Minimum	FLOAT	0 to 9999 M	volts		2
1F33	-	1F34	7988	-	7989	Volts A-N, Short Term Minimum	FLOAT	0 to 9999 M	volts	Minimum instantaneous value measured during the most recently completed demand interval.	2
1F35	-	1F36	7990	-	7991	Volts B-N, Short Term Minimum	FLOAT	0 to 9999 M	volts		2
1F37	-	1F38	7992	-	7993	Volts C-N, Short Term Minimum	FLOAT	0 to 9999 M	volts		2
1F39	-	1F3A	7994	-	7995	Volts A-B, Short Term Minimum	FLOAT	0 to 9999 M	volts		2
1F3B	-	1F3C	7996	-	7997	Volts B-C, Short Term Minimum	FLOAT	0 to 9999 M	volts		2
1F3D	-	1F3E	7998	-	7999	Volts C-A, Short Term Minimum	FLOAT	0 to 9999 M	volts		2
										Block Size:	24

Primary Minimum Block									read-only	
Hex			Decimal			Description (Note 1)	Format	Range (Note 6)	Units or Resolution	Comments	# Reg
1F3F	-	1F40	8000	-	8001	Volts A-N, Minimum	FLOAT	0 to 9999 M	volts		2
1F41	-	1F42	8002	-	8003	Volts B-N, Minimum	FLOAT	0 to 9999 M	volts		2
1F43	-	1F44	8004	-	8005	Volts C-N, Minimum	FLOAT	0 to 9999 M	volts		2
1F45	-	1F46	8006	-	8007	Volts A-B, Minimum	FLOAT	0 to 9999 M	volts		2
1F47	-	1F48	8008	-	8009	Volts B-C, Minimum	FLOAT	0 to 9999 M	volts		2
1F49	-	1F4A	8010	-	8011	Volts C-A, Minimum	FLOAT	0 to 9999 M	volts		2
1F4B	-	1F4C	8012	-	8013	Amps A, Minimum Avg Demand	FLOAT	0 to 9999 M	amps		2
1F4D	-	1F4E	8014	-	8015	Amps B, Minimum Avg Demand	FLOAT	0 to 9999 M	amps		2
1F4F	-	1F50	8016	-	8017	Amps C, Minimum Avg Demand	FLOAT	0 to 9999 M	amps		2
1F51	-	1F52	8018	-	8019	Positive Watts, 3-Ph, Minimum Avg Demand	FLOAT	0 to +9999 M	watts		2
1F53	-	1F54	8020	-	8021	Positive VARs, 3-Ph, Minimum Avg Demand	FLOAT	0 to +9999 M	VARs		2
1F55	-	1F56	8022	-	8023	Negative Watts, 3-Ph, Minimum Avg Demand	FLOAT	0 to +9999 M	watts		2
1F57	-	1F58	8024	-	8025	Negative VARs, 3-Ph, Minimum Avg Demand	FLOAT	0 to +9999 M	VARs		2
1F59	-	1F5A	8026	-	8027	VAs, 3-Ph, Minimum Avg Demand	FLOAT	-9999 M to +9999 M	VAs		2
1F5B	-	1F5C	8028	-	8029	Positive Power Factor, 3-Ph, Minimum Avg Demand	FLOAT	-1.00 to +1.00	none		2
1F5D	-	1F5E	8030	-	8031	Negative Power Factor, 3-Ph, Minimum Avg Demand	FLOAT	-1.00 to +1.00	none		2
1F5F	-	1F60	8032	-	8033	Frequency, Minimum	FLOAT	0 to 65.00	Hz		2
1F61	-	1F62	8034	-	8035	Neutral Current, Minimum Avg Demand	FLOAT	0 to 9999 M	amps		2
1F63	-	1F64	8036	-	8037	Positive Watts, Phase A, Minimum Avg Demand	FLOAT	-9999 M to +9999 M	watts		2
1F65	-	1F66	8038	-	8039	Positive Watts, Phase B, Minimum Avg Demand	FLOAT	-9999 M to +9999 M	watts		2
1F67	-	1F68	8040	-	8041	Positive Watts, Phase C, Minimum Avg Demand	FLOAT	-9999 M to +9999 M	watts		2
1F69	-	1F6A	8042	-	8043	Positive VARs, Phase A, Minimum Avg Demand	FLOAT	-9999 M to +9999 M	VARs		2
1F6B	-	1F6C	8044	-	8045	Positive VARs, Phase B, Minimum Avg Demand	FLOAT	-9999 M to +9999 M	VARs		2
1F6D	-	1F6E	8046	-	8047	Positive VARs, Phase C, Minimum Avg Demand	FLOAT	-9999 M to +9999 M	VARs		2
1F6F	-	1F70	8048	-	8049	Negative Watts, Phase A, Minimum Avg Demand	FLOAT	-9999 M to +9999 M	watts		2
1F71	-	1F72	8050	-	8051	Negative Watts, Phase B, Minimum Avg Demand	FLOAT	-9999 M to +9999 M	watts		2
1F73	-	1F74	8052	-	8053	Negative Watts, Phase C, Minimum Avg Demand	FLOAT	-9999 M to +9999 M	watts		2
1F75	-	1F76	8054	-	8055	Negative VARs, Phase A, Minimum Avg Demand	FLOAT	-9999 M to +9999 M	VARs		2
1F77	-	1F78	8056	-	8057	Negative VARs, Phase B, Minimum Avg Demand	FLOAT	-9999 M to +9999 M	VARs		2
1F79	-	1F7A	8058	-	8059	Negative VARs, Phase C, Minimum Avg Demand	FLOAT	-9999 M to +9999 M	VARs		2
1F7B	-	1F7C	8060	-	8061	VAs, Phase A, Minimum Avg Demand	FLOAT	-9999 M to +9999 M	VAs		2
1F7D	-	1F7E	8062	-	8063	VAs, Phase B, Minimum Avg Demand	FLOAT	-9999 M to +9999 M	VAs		2
1F7F	-	1F80	8064	-	8065	VAs, Phase C, Minimum Avg Demand	FLOAT	-9999 M to +9999 M	VAs		2
1F81	-	1F82	8066	-	8067	Positive PF, Phase A, Minimum Avg Demand	FLOAT	-1.00 to +1.00	none		2
1F83	-	1F84	8068	-	8069	Positive PF, Phase B, Minimum Avg Demand	FLOAT	-1.00 to +1.00	none		2
1F85	-	1F86	8070	-	8071	Positive PF, Phase C, Minimum Avg Demand	FLOAT	-1.00 to +1.00	none		2
1F87	-	1F88	8072	-	8073	Negative PF, Phase A, Minimum Avg Demand	FLOAT	-1.00 to +1.00	none		2
1F89	-	1F8A	8074	-	8075	Negative PF, Phase B, Minimum Avg Demand	FLOAT	-1.00 to +1.00	none		2
1F8B	-	1F8C	8076	-	8077	Negative PF, Phase C, Minimum Avg Demand	FLOAT	-1.00 to +1.00	none		2
1F8D	-	1F8D	8078	-	8078	Reserved					1
1F8E	-	1F8E	8079	-	8079	Reserved					1
1F8F	-	1F8F	8080	-	8080	Reserved					1
1F90	-	1F90	8081	-	8081	Reserved					1
1F91	-	1F91	8082	-	8082	Reserved					1
1F92	-	1F92	8083	-	8083	Reserved					1
1F93	-	1F9B	8084	-	8092	Reserved				Reserved	9
										Block Size:	93

Primary Minimum Timestamp Block									read-only	
Hex			Decimal			Description (Note 1)	Format	Range (Note 6)	Units or Resolution	Comments	# Reg
20CF	-	20D1	8400	-	8402	Volts A-N, Min Timestamp	TSTAMP	1Jan2000 - 31Dec2099	1 sec		3
20D2	-	20D4	8403	-	8405	Volts B-N, Min Timestamp	TSTAMP	1Jan2000 - 31Dec2099	1 sec		3
20D5	-	20D7	8406	-	8408	Volts C-N, Min Timestamp	TSTAMP	1Jan2000 - 31Dec2099	1 sec		3
20D8	-	20DA	8409	-	8411	Volts A-B, Min Timestamp	TSTAMP	1Jan2000 - 31Dec2099	1 sec		3
20DB	-	20DD	8412	-	8414	Volts B-C, Min Timestamp	TSTAMP	1Jan2000 - 31Dec2099	1 sec		3
20DE	-	20E0	8415	-	8417	Volts C-A, Min Timestamp	TSTAMP	1Jan2000 - 31Dec2099	1 sec		3
20E1	-	20E3	8418	-	8420	Amps A, Min Avg Dmd Timestamp	TSTAMP	1Jan2000 - 31Dec2099	1 sec		3
20E4	-	20E6	8421	-	8423	Amps B, Min Avg Dmd Timestamp	TSTAMP	1Jan2000 - 31Dec2099	1 sec		3
20E7	-	20E9	8424	-	8426	Amps C, Min Avg Dmd Timestamp	TSTAMP	1Jan2000 - 31Dec2099	1 sec		3
20EA	-	20EC	8427	-	8429	Positive Watts, 3-Ph, Min Avg Dmd Timestamp	TSTAMP	1Jan2000 - 31Dec2099	1 sec		3
20ED	-	20EF	8430	-	8432	Positive VARs, 3-Ph, Min Avg Dmd Timestamp	TSTAMP	1Jan2000 - 31Dec2099	1 sec		3
20F0	-	20F2	8433	-	8435	Negative Watts, 3-Ph, Min Avg Dmd Timestamp	TSTAMP	1Jan2000 - 31Dec2099	1 sec		3
20F3	-	20F5	8436	-	8438	Negative VARs, 3-Ph, Min Avg Dmd Timestamp	TSTAMP	1Jan2000 - 31Dec2099	1 sec		3
20F6	-	20F8	8439	-	8441	VAs, 3-Ph, Min Avg Dmd Timestamp	TSTAMP	1Jan2000 - 31Dec2099	1 sec		3
20F9	-	20FB	8442	-	8444	Positive Power Factor, 3-Ph, Min Avg Dmd Timestamp	TSTAMP	1Jan2000 - 31Dec2099	1 sec		3
20FC	-	20FE	8445	-	8447	Negative Power Factor, 3-Ph, Min Avg Dmd Timestamp	TSTAMP	1Jan2000 - 31Dec2099	1 sec		3
20FF	-	2101	8448	-	8450	Frequency, Min Timestamp	TSTAMP	1Jan2000 - 31Dec2099	1 sec		3
2102	-	2104	8451	-	8453	Neutral Current, Min Avg Dmd Timestamp	TSTAMP	1Jan2000 - 31Dec2100	1 sec		3
2105	-	2107	8454	-	8456	Positive Watts, Phase A, Min Avg Dmd Timestamp	TSTAMP	1Jan2000 - 31Dec2099	1 sec		3
2108	-	210A	8457	-	8459	Positive Watts, Phase B, Min Avg Dmd Timestamp	TSTAMP	1Jan2000 - 31Dec2099	1 sec		3
210B	-	210D	8460	-	8462	Positive Watts, Phase C, Min Avg Dmd Timestamp	TSTAMP	1Jan2000 - 31Dec2099	1 sec		3
210E	-	2110	8463	-	8465	Positive VARs, Phase A, Min Avg Dmd Timestamp	TSTAMP	1Jan2000 - 31Dec2099	1 sec		3
2111	-	2113	8466	-	8468	Positive VARs, Phase B, Min Avg Dmd Timestamp	TSTAMP	1Jan2000 - 31Dec2099	1 sec		3
2114	-	2116	8469	-	8471	Positive VARs, Phase C, Min Avg Dmd Timestamp	TSTAMP	1Jan2000 - 31Dec2099	1 sec		3
2117	-	2119	8472	-	8474	Negative Watts, Phase A, Min Avg Dmd Timestamp	TSTAMP	1Jan2000 - 31Dec2099	1 sec		3
211A	-	211C	8475	-	8477	Negative Watts, Phase B, Min Avg Dmd Timestamp	TSTAMP	1Jan2000 - 31Dec2099	1 sec		3
211D	-	211F	8478	-	8480	Negative Watts, Phase C, Min Avg Dmd Timestamp	TSTAMP	1Jan2000 - 31Dec2099	1 sec		3
2120	-	2122	8481	-	8483	Negative VARs, Phase A, Min Avg Dmd Timestamp	TSTAMP	1Jan2000 - 31Dec2099	1 sec		3
2123	-	2125	8484	-	8486	Negative VARs, Phase B, Min Avg Dmd Timestamp	TSTAMP	1Jan2000 - 31Dec2099	1 sec		3
2126	-	2128	8487	-	8489	Negative VARs, Phase C, Min Avg Dmd Timestamp	TSTAMP	1Jan2000 - 31Dec2099	1 sec		3
2129	-	212B	8490	-	8492	VAs, Phase A, Min Avg Dmd Timestamp	TSTAMP	1Jan2000 - 31Dec2099	1 sec		3
212C	-	212E	8493	-	8495	VAs, Phase B, Min Avg Dmd Timestamp	TSTAMP	1Jan2000 - 31Dec2099	1 sec		3
212F	-	2131	8496	-	8498	VAs, Phase C, Min Avg Dmd Timestamp	TSTAMP	1Jan2000 - 31Dec2099	1 sec		3
2132	-	2134	8499	-	8501	Positive PF, Phase A, Min Avg Dmd Timestamp	TSTAMP	1Jan2000 - 31Dec2099	1 sec		3
2135	-	2137	8502	-	8504	Positive PF, Phase B, Min Avg Dmd Timestamp	TSTAMP	1Jan2000 - 31Dec2099	1 sec		3
2138	-	213A	8505	-	8507	Positive PF, Phase C, Min Avg Dmd Timestamp	TSTAMP	1Jan2000 - 31Dec2099	1 sec		3
213B	-	213D	8508	-	8510	Negative PF, Phase A, Min Avg Dmd Timestamp	TSTAMP	1Jan2000 - 31Dec2099	1 sec		3
213E	-	2140	8511	-	8513	Negative PF, Phase B, Min Avg Dmd Timestamp	TSTAMP	1Jan2000 - 31Dec2099	1 sec		3
2141	-	2143	8514	-	8516	Negative PF, Phase C, Min Avg Dmd Timestamp	TSTAMP	1Jan2000 - 31Dec2099	1 sec		3
2144	-	2146	8517	-	8519	Reserved					3
2147	-	2149	8520	-	8522	Reserved					3
214A	-	214C	8523	-	8525	Reserved					3
214D	-	214F	8526	-	8528	Reserved					3
2150	-	2152	8529	-	8531	Reserved					3
2153	-	2155	8532	-	8534	Reserved					3
2156	-	2167	8535	-	8552	Reserved				Reserved	18
										Block Size:	153

Short term Primary Maximum Block									read-only	
Hex			Decimal			Description (Note 1)	Format	Range (Note 6)	Units or Resolution	Comments	# Reg
230F	-	2310	8976	-	8977	Volts A-N, previous Demand interval Short Term Maximum	FLOAT	0 to 9999 M	volts		
2311	-	2312	8978	-	8979	Volts B-N, previous Demand interval Short Term Maximum	FLOAT	0 to 9999 M	volts		
2313	-	2314	8980	-	8981	Volts C-N, previous Demand interval Short Term Maximum	FLOAT	0 to 9999 M	volts	Maximum instantaneous value measured during the demand interval before the one most recently completed.	
2315	-	2316	8982	-	8983	Volts A-B, previous Demand interval Short Term Maximum	FLOAT	0 to 9999 M	volts		
2317	-	2318	8984	-	8985	Volts B-C, previous Demand interval Short Term Maximum	FLOAT	0 to 9999 M	volts		
2319	-	231A	8986	-	8987	Volts C-A, previous Demand interval Short Term Maximum	FLOAT	0 to 9999 M	volts		
231B	-	231C	8988	-	8989	Volts A-N, Maximum	FLOAT	0 to 9999 M	volts		2
231D	-	231E	8990	-	8991	Volts B-N, Maximum	FLOAT	0 to 9999 M	volts		2
232F	-	2320	8992	-	8993	Volts C-N, Maximum	FLOAT	0 to 9999 M	volts	Maximum instantaneous value measured during the most recently completed demand interval.	2
2321	-	2322	8994	-	8995	Volts A-B, Maximum	FLOAT	0 to 9999 M	volts		2
2323	-	2324	8996	-	8997	Volts B-C, Maximum	FLOAT	0 to 9999 M	volts		2
2325	-	2326	8998	-	8999	Volts C-A, Maximum	FLOAT	0 to 9999 M	volts		2
										Block Size:	12

Primary Maximum Block									read-only	
Hex			Decimal			Description (Note 1)	Format	Range (Note 6)	Units or Resolution	Comments	# Reg
2327	-	2328	9000	-	9001	Volts A-N, Maximum	FLOAT	0 to 9999 M	volts		2
2329	-	232A	9002	-	9003	Volts B-N, Maximum	FLOAT	0 to 9999 M	volts		2
232B	-	232C	9004	-	9005	Volts C-N, Maximum	FLOAT	0 to 9999 M	volts		2
232D	-	232E	9006	-	9007	Volts A-B, Maximum	FLOAT	0 to 9999 M	volts		2
232F	-	2330	9008	-	9009	Volts B-C, Maximum	FLOAT	0 to 9999 M	volts		2
2331	-	2332	9010	-	9011	Volts C-A, Maximum	FLOAT	0 to 9999 M	volts		2
2333	-	2334	9012	-	9013	Amps A, Maximum Avg Demand	FLOAT	0 to 9999 M	amps		2
2335	-	2336	9014	-	9015	Amps B, Maximum Avg Demand	FLOAT	0 to 9999 M	amps		2
2337	-	2338	9016	-	9017	Amps C, Maximum Avg Demand	FLOAT	0 to 9999 M	amps		2
2339	-	233A	9018	-	9019	Positive Watts, 3-Ph, Maximum Avg Demand	FLOAT	0 to +9999 M	watts		2
233B	-	233C	9020	-	9021	Positive VARs, 3-Ph, Maximum Avg Demand	FLOAT	0 to +9999 M	VARs		2
233D	-	233E	9022	-	9023	Negative Watts, 3-Ph, Maximum Avg Demand	FLOAT	0 to +9999 M	watts		2
233F	-	2340	9024	-	9025	Negative VARs, 3-Ph, Maximum Avg Demand	FLOAT	0 to +9999 M	VARs		2
2341	-	2342	9026	-	9027	VAs, 3-Ph, Maximum Avg Demand	FLOAT	-9999 M to +9999 M	VAs		2
2343	-	2344	9028	-	9029	Positive Power Factor, 3-Ph, Maximum Avg Demand	FLOAT	-1.00 to +1.00	none		2
2345	-	2346	9030	-	9031	Negative Power Factor, 3-Ph, Maximum Avg Demand	FLOAT	-1.00 to +1.00	none		2
2347	-	2348	9032	-	9033	Frequency, Maximum	FLOAT	0 to 65.00	Hz		2
2349	-	234A	9034	-	9035	Neutral Current, Maximum Avg Demand	FLOAT	0 to 9999 M	amps		2
234B	-	234C	9036	-	9037	Positive Watts, Phase A, Maximum Avg Demand	FLOAT	-9999 M to +9999 M	watts		2
234D	-	234E	9038	-	9039	Positive Watts, Phase B, Maximum Avg Demand	FLOAT	-9999 M to +9999 M	watts		2
234F	-	2350	9040	-	9041	Positive Watts, Phase C, Maximum Avg Demand	FLOAT	-9999 M to +9999 M	watts		2
2351	-	2352	9042	-	9043	Positive VARs, Phase A, Maximum Avg Demand	FLOAT	-9999 M to +9999 M	VARs		2
2353	-	2354	9044	-	9045	Positive VARs, Phase B, Maximum Avg Demand	FLOAT	-9999 M to +9999 M	VARs		2
2355	-	2356	9046	-	9047	Positive VARs, Phase C, Maximum Avg Demand	FLOAT	-9999 M to +9999 M	VARs		2
2357	-	2358	9048	-	9049	Negative Watts, Phase A, Maximum Avg Demand	FLOAT	-9999 M to +9999 M	watts		2
2359	-	235A	9050	-	9051	Negative Watts, Phase B, Maximum Avg Demand	FLOAT	-9999 M to +9999 M	watts		2
235B	-	235C	9052	-	9053	Negative Watts, Phase C, Maximum Avg Demand	FLOAT	-9999 M to +9999 M	watts		2
235D	-	235E	9054	-	9055	Negative VARs, Phase A, Maximum Avg Demand	FLOAT	-9999 M to +9999 M	VARs		2
235F	-	2360	9056	-	9057	Negative VARs, Phase B, Maximum Avg Demand	FLOAT	-9999 M to +9999 M	VARs		2
2361	-	2362	9058	-	9059	Negative VARs, Phase C, Maximum Avg Demand	FLOAT	-9999 M to +9999 M	VARs		2
2363	-	2364	9060	-	9061	VAs, Phase A, Maximum Avg Demand	FLOAT	-9999 M to +9999 M	VAs		2
2365	-	2366	9062	-	9063	VAs, Phase B, Maximum Avg Demand	FLOAT	-9999 M to +9999 M	VAs		2
2367	-	2368	9064	-	9065	VAs, Phase C, Maximum Avg Demand	FLOAT	-9999 M to +9999 M	VAs		2
2369	-	236A	9066	-	9067	Positive PF, Phase A, Maximum Avg Demand	FLOAT	-1.00 to +1.00	none		2
236B	-	236C	9068	-	9069	Positive PF, Phase B, Maximum Avg Demand	FLOAT	-1.00 to +1.00	none		2
236D	-	236E	9070	-	9071	Positive PF, Phase C, Maximum Avg Demand	FLOAT	-1.00 to +1.00	none		2
236F	-	2370	9072	-	9073	Negative PF, Phase A, Maximum Avg Demand	FLOAT	-1.00 to +1.00	none		2
2371	-	2372	9074	-	9075	Negative PF, Phase B, Maximum Avg Demand	FLOAT	-1.00 to +1.00	none		2
2373	-	2374	9076	-	9077	Negative PF, Phase C, Maximum Avg Demand	FLOAT	-1.00 to +1.00	none		2
2375	-	2375	9078	-	9078	Reserved					1
2376	-	2376	9079	-	9079	Reserved					1
2377	-	2377	9080	-	9080	Reserved					1
2378	-	2378	9081	-	9081	Reserved					1
2379	-	2379	9082	-	9082	Reserved					1
237A	-	237A	9083	-	9083	Reserved					1
237B	-	2383	9084	-	9092	Reserved				Reserved	9
										Block Size:	93

Primary Maximum Timestamp Block										read-only	
Hex			Decimal			Description (Note 1)	Format	Range (Note 6)	Units or Resolution	Comments	# Reg
24B7	-	24B9	9400	-	9402	Volts A-N, Max Timestamp	TSTAMP	1Jan2000 - 31Dec2099	1 sec		3
24BA	-	24BC	9403	-	9405	Volts B-N, Max Timestamp	TSTAMP	1Jan2000 - 31Dec2099	1 sec		3
24BD	-	24BF	9406	-	9408	Volts C-N, Max Timestamp	TSTAMP	1Jan2000 - 31Dec2099	1 sec		3
24C0	-	24C2	9409	-	9411	Volts A-B, Max Timestamp	TSTAMP	1Jan2000 - 31Dec2099	1 sec		3
24C3	-	24C5	9412	-	9414	Volts B-C, Max Timestamp	TSTAMP	1Jan2000 - 31Dec2099	1 sec		3
24C6	-	24C8	9415	-	9417	Volts C-A, Max Timestamp	TSTAMP	1Jan2000 - 31Dec2099	1 sec		3
24C9	-	24CB	9418	-	9420	Amps A, Max Avg Dmd Timestamp	TSTAMP	1Jan2000 - 31Dec2099	1 sec		3
24CC	-	24CE	9421	-	9423	Amps B, Max Avg Dmd Timestamp	TSTAMP	1Jan2000 - 31Dec2099	1 sec		3
24CF	-	24D1	9424	-	9426	Amps C, Max Avg Dmd Timestamp	TSTAMP	1Jan2000 - 31Dec2099	1 sec		3
24D2	-	24D4	9427	-	9429	Positive Watts, 3-Ph, Max Avg Dmd Timestamp	TSTAMP	1Jan2000 - 31Dec2099	1 sec		3
24D5	-	24D7	9430	-	9432	Positive VARs, 3-Ph, Max Avg Dmd Timestamp	TSTAMP	1Jan2000 - 31Dec2099	1 sec		3
24D8	-	24DA	9433	-	9435	Negative Watts, 3-Ph, Max Avg Dmd Timestamp	TSTAMP	1Jan2000 - 31Dec2099	1 sec		3
24DB	-	24DD	9436	-	9438	Negative VARs, 3-Ph, Max Avg Dmd Timestamp	TSTAMP	1Jan2000 - 31Dec2099	1 sec		3
24DE	-	24E0	9439	-	9441	VAs, 3-Ph, Max Avg Dmd Timestamp	TSTAMP	1Jan2000 - 31Dec2099	1 sec		3
24E1	-	24E3	9442	-	9444	Positive Power Factor, 3-Ph, Max Avg Dmd Timestamp	TSTAMP	1Jan2000 - 31Dec2099	1 sec		3
24E4	-	24E6	9445	-	9447	Negative Power Factor, 3-Ph, Max Avg Dmd Timestamp	TSTAMP	1Jan2000 - 31Dec2099	1 sec		3
24E7	-	24E9	9448	-	9450	Frequency, Max Timestamp	TSTAMP	1Jan2000 - 31Dec2099	1 sec		3
24EA	-	24EC	9451	-	9453	Neutral Current, Max Avg Dmd Timestamp	TSTAMP	1Jan2000 - 31Dec2100	1 sec		3
24ED	-	24EF	9454	-	9456	Positive Watts, Phase A, Max Avg Dmd Timestamp	TSTAMP	1Jan2000 - 31Dec2099	1 sec		3
24F0	-	24F2	9457	-	9459	Positive Watts, Phase B, Max Avg Dmd Timestamp	TSTAMP	1Jan2000 - 31Dec2099	1 sec		3
24F3	-	24F5	9460	-	9462	Positive Watts, Phase C, Max Avg Dmd Timestamp	TSTAMP	1Jan2000 - 31Dec2099	1 sec		3
24F6	-	24F8	9463	-	9465	Positive VARs, Phase A, Max Avg Dmd Timestamp	TSTAMP	1Jan2000 - 31Dec2099	1 sec		3
24F9	-	24FB	9466	-	9468	Positive VARs, Phase B, Max Avg Dmd Timestamp	TSTAMP	1Jan2000 - 31Dec2099	1 sec		3
24FC	-	24FE	9469	-	9471	Positive VARs, Phase C, Max Avg Dmd Timestamp	TSTAMP	1Jan2000 - 31Dec2099	1 sec		3
24FF	-	2501	9472	-	9474	Negative Watts, Phase A, Max Avg Dmd Timestamp	TSTAMP	1Jan2000 - 31Dec2099	1 sec		3
2502	-	2504	9475	-	9477	Negative Watts, Phase B, Max Avg Dmd Timestamp	TSTAMP	1Jan2000 - 31Dec2099	1 sec		3
2505	-	2507	9478	-	9480	Negative Watts, Phase C, Max Avg Dmd Timestamp	TSTAMP	1Jan2000 - 31Dec2099	1 sec		3
2508	-	250A	9481	-	9483	Negative VARs, Phase A, Max Avg Dmd Timestamp	TSTAMP	1Jan2000 - 31Dec2099	1 sec		3
250B	-	250D	9484	-	9486	Negative VARs, Phase B, Max Avg Dmd Timestamp	TSTAMP	1Jan2000 - 31Dec2099	1 sec		3
250E	-	2510	9487	-	9489	Negative VARs, Phase C, Max Avg Dmd Timestamp	TSTAMP	1Jan2000 - 31Dec2099	1 sec		3
2511	-	2513	9490	-	9492	VAs, Phase A, Max Avg Dmd Timestamp	TSTAMP	1Jan2000 - 31Dec2099	1 sec		3
2514	-	2516	9493	-	9495	VAs, Phase B, Max Avg Dmd Timestamp	TSTAMP	1Jan2000 - 31Dec2099	1 sec		3
2517	-	2519	9496	-	9498	VAs, Phase C, Max Avg Dmd Timestamp	TSTAMP	1Jan2000 - 31Dec2099	1 sec		3
251A	-	251C	9499	-	9501	Positive PF, Phase A, Max Avg Dmd Timestamp	TSTAMP	1Jan2000 - 31Dec2099	1 sec		3
251D	-	251F	9502	-	9504	Positive PF, Phase B, Max Avg Dmd Timestamp	TSTAMP	1Jan2000 - 31Dec2099	1 sec		3
2520	-	2522	9505	-	9507	Positive PF, Phase C, Max Avg Dmd Timestamp	TSTAMP	1Jan2000 - 31Dec2099	1 sec		3
2523	-	2525	9508	-	9510	Negative PF, Phase A, Max Avg Dmd Timestamp	TSTAMP	1Jan2000 - 31Dec2099	1 sec		3
2526	-	2528	9511	-	9513	Negative PF, Phase B, Max Avg Dmd Timestamp	TSTAMP	1Jan2000 - 31Dec2099	1 sec		3
2529	-	252B	9514	-	9516	Negative PF, Phase C, Max Avg Dmd Timestamp	TSTAMP	1Jan2000 - 31Dec2099	1 sec		3
252C	-	252E	9517	-	9519	Reserved					3
252F	-	2531	9520	-	9522	Reserved					3
2532	-	2534	9523	-	9525	Reserved					3
2535	-	2537	9526	-	9528	Reserved					3
2538	-	253A	9529	-	9531	Reserved					3
253B	-	253D	9532	-	9534	Reserved					3
253E	-	254F	9535	-	9552	Reserved				Reserved	18
										Block Size:	153

Commands Section (Note 4)

Hex			Decimal			Description (Note 1)	Format	Range (Note 6)	Units or Resolution	Comments	# Reg
Resets Block (Note 9)										**write-only**	
4E1F	-	4E1F	20000	-	20000	Reset Max/Min Blocks	UINT16	password (Note 5)			1
4E20	-	4E20	20001	-	20001	Reset Energy Accumulators	UINT16	password (Note 5)			1
4E21	-	4E21	20002	-	20002	Reset Alarm Log (Note 21)	UINT16	password (Note 5)		Reply to a reset log command indicates that the command was accepted but not necessarily that the reset is finished. Poll log status block to determine this.	1
4E22	-	4E22	20003	-	20003	Reset System Log (Note 21)	UINT16	password (Note 5)			1
4E23	-	4E23	20004	-	20004	Reset Historical Log 1 (Note 21)	UINT16	password (Note 5)			1
4E24	-	4E24	20005	-	20005	Reset Historical Log 2 (Note 21)	UINT16	password (Note 5)			1
4E25	-	4E25	20006	-	20006	Reset Historical Log 3 (Note 21)	UINT16	password (Note 5)			1
4E26	-	4E26	20007	-	20007	Reserved					1
4E27	-	4E2E	20008	-	20015	Reserved				Set to 0.	2
4E29	-	4E2A	20010	-	20011	Reserved				Reserved	2
4E2B	-	4E2B	20012	-	20012	Reserved					1
4E2C	-	4E2C	20013	-	20013	Reserved					1
4E2D	-	4E2D	20014	-	20014	Reserved					1
4E2E	-	4E2E	20015	-	20015	Reserved					1
										Block Size:	16
Privileged Commands Block										**conditional write**	
5207	-	5207	21000	-	21000	Initiate Meter Firmware Reprogramming	UINT16	password (Note 5)			1
5208	-	5208	21001	-	21001	Force Meter Restart	UINT16	password (Note 5)		causes a watchdog reset, always reads 0	1
5209	-	5209	21002	-	21002	Open Privileged Command Session	UINT16	password (Note 5)		meter will process command registers (this register through 'Close Privileged Command Session' register below) for 5 minutes or until the session is closed, whichever comes first.	1
520A	-	520A	21003	-	21003	Initiate Programmable Settings Update	UINT16	password (Note 5)		meter enters PS update mode	1
520B	-	520B	21004	-	21004	Calculate Programmable Settings Checksum (Note 3)	UINT16	0000 to 9999		meter calculates checksum on RAM copy of PS block	1
520C	-	520C	21005	-	21005	Programmable Settings Checksum (Note 3)	UINT16	0000 to 9999		read/write checksum register; PS block saved in nonvolatile memory on write (Note 8)	1
520D	-	520D	21006	-	21006	Write New Password (Note 3)	UINT16	0000 to 9999		write-only register; always reads zero	1
520E	-	520E	21007	-	21007	Terminate Programmable Settings Update (Note 3)	UINT16	any value		meter leaves PS update mode via reset	1
520F	-	5211	21008	-	21010	Set Meter Clock	TSTAMP	1Jan2000 - 31Dec2099	1 sec	saved only when 3rd register is written	3
5212	-	5212	21011	-	21011	Reserved				Reserved	1
5213	-	5219	21012	-	21018	Reserved				Reserved	7
521A	-	521A	21019	-	21019	Close Privileged Command Session	UINT16	any value		ends an open command session	1
										Block Size:	20
Encryption Block										**read/write**	
658F	-	659A	26000	-	26011	Perform a Secure Operation	UINT16			encrypted command to read password or change meter type	12
										Block Size:	12

Programmable Settings Section										
Basic Setups Block									write only in PS update mode	
Hex			Decimal			Description (Note 1)	Format	Range (Note 6)	Units or Resolution	Comments	# Reg
752F	-	752F	30000	-	30000	CT multiplier & denominator	UINT16	bit-mapped	ddddddddmmmmmmmm	high byte is denominator (1 or 5, read-only), low byte is multiplier (1, 10, or 100)	1
7530	-	7530	30001	-	30001	CT numerator	UINT16	1 to 9999	none		1
7531	-	7531	30002	-	30002	PT numerator	UINT16	1 to 9999	none		1
7532	-	7532	30003	-	30003	PT denominator	UINT16	1 to 9999	none		1
7533	-	7533	30004	-	30004	PT multiplier & hookup	UINT16	bit-mapped	mmmmmmmm mmmmhhhh	mm…mm = PT multiplier (1, 10, 100, or 1000) hhhh = hookup enumeration (0 = 3 element wye[9S], 1 = delta 2 CTs[5S], 3 = 2.5 element wye[6S])	1
7534	-	7534	30005	-	30005	Averaging Method	UINT16	bit-mapped	--iiiiii b----sss	iiiiii = interval (5,15,30,60) b = 0-block or 1-rolling sss = # subintervals (1,2,3,4)	1
7535	-	7535	30006	-	30006	Power & Energy Format	UINT16	bit-mapped	ppppiinn feee-ddd	pppp = power scale (0-unit, 3-kilo, 6-mega, 8-auto) ii = power digits after decimal point (0-3), applies only if f=1 and pppp is not auto nn = number of energy digits (5-8 --> 0-3) eee = energy scale (0-unit, 3-kilo, 6-mega) f = decimal point for power (0=data-dependant placement, 1=fixed placement per ii value) ddd = energy digits after decimal point (0-6) See note 10.	1
7536	-	7536	30007	-	30007	Operating Mode Screen Enables	UINT16	bit-mapped	-------x eeeeeeee	eeeeeeee = op mode screen rows on/off, rows top to bottom are bits low order to high order x = set to suppress PF on W/VAR/PF screens	1
7537	-	7537	30008	-	30008	Daylight Saving On Rule	UINT16	bit-mapped	hhhhhwww -dddmmmm	applies only if daylight savings in User Settings Flags = on; specifies when to make changeover hhhhh = hour, 0-23 www = week, 1-4 for 1st - 4th, 5 for last ddd = day of week, 1-7 for Sun - Sat mmmm = month, 1-12 Example: 2AM on the 4th Sunday of March hhhhh=2, www=4, ddd=1, mmmm=3	1
7538	-	7538	30009	-	30009	Daylight Saving Off Rule	UINT16	bit-mapped	hhhhhwww -dddmmmm		1
7539	-	753D	30010	-	30014	Reserved				Reserved	5
753E	-	753E	30015	-	30015	User Settings Flags	UINT16	bit-mapped	---g-inn srpdywfa	g = enable alternate full scale bar graph current (1=on, 0=off) i = fixed scale and format current display 0=normal autoscaled current display 1=always show amps with no decimal places nn = number of phases for voltage & current screen (3=ABC, 2=AB, 1=A, 0=ABC) s = scroll (1=on, 0=off) r = password for reset in use (1=on, 0=off) p = password for configuration in use (1=on, 0=off) d = daylight saving time changes (0=off, 1=on) y = diagnostic events in system log (1=yes, 0=no) w = power direction (0=view as load, 1=view as generator) f = flip power factor sign (1=yes, 0=no) a = apparent power computation method (0=arithmetic sum, 1=vector sum)	1
753F	-	753F	30016	-	30016	Full Scale Current (for load % bar graph)	UINT16	0 to 9999	none	If non-zero and user settings bit g is set, this value replaces CT numerator in the full scale current calculation. (See Note 12)	1

Basic Setups Block - continued									write only in PS update mode	1
Hex		Decimal			Description (Note 1)	Format	Range (Note 6)	Units or Resolution	Comments	# Reg
7540	-	7547	30017	-	30024	Meter Designation	ASCII	16 char	none		8
7548	-	7548	30025	-	30025	COM1 setup	UINT16	bit-mapped	----dddd -0100110	dddd = reply delay (* 50 msec) ppp = protocol (1-Modbus RTU, 2-Modbus ASCII, 3-DNP) bbb = baud rate (1-9600, 2-19200, 4-38400, 6-57600)	1
7549	-	7549	30026	-	30026	COM2 setup	UINT16	bit-mapped	----dddd -ppp-bbb		1
754A	-	754A	30027	-	30027	COM2 address	UINT16	1 to 247	none		1
754B	-	754B	30028	-	30028	Limit #1 Identifier	UINT16	0 to 65535		use Modbus address as the identifier (see notes 7, 11, 12)	1
754C	-	754C	30029	-	30029	Limit #1 Out High Setpoint	SINT16	-200.0 to +200.0	0.1% of full scale	Setpoint for the "above" limit (LM1), see notes 11-12.	1
754D	-	754D	30030	-	30030	Limit #1 In High Threshold	SINT16	-200.0 to +200.0	0.1% of full scale	Threshold at which "above" limit clears; normally less than or equal to the "above" setpoint; see notes 11-12.	1
754E	-	754E	30031	-	30031	Limit #1 Out Low Setpoint	SINT16	-200.0 to +200.0	0.1% of full scale	Setpoint for the "below" limit (LM2), see notes 11-12.	1
754F	-	754F	30032	-	30032	Limit #1 In Low Threshold	SINT16	-200.0 to +200.0	0.1% of full scale	Threshold at which "below" limit clears; normally greater than or equal to the "below" setpoint; see notes 11-12.	1
7550	-	7554	30033	-	30037	Limit #2	SINT16	same as Limit #1	same as Limit #1	same as Limit #1	5
7555	-	7559	30038	-	30042	Limit #3	SINT16				5
755A	-	755E	30043	-	30047	Limit #4	SINT16				5
755F	-	7563	30048	-	30052	Limit #5	SINT16				5
7564	-	7568	30053	-	30057	Limit #6	SINT16				5
7569	-	756D	30058	-	30062	Limit #7	SINT16				5
756E	-	7572	30063	-	30067	Limit #8	SINT16				5
7573	-	7582	30068	-	30083	Reserved				Reserved	16
7583	-	75C2	30084	-	30147	Reserved				Reserved	64
75C3	-	75C3	30148	-	30148	watts loss due to iron when watts positive	UINT16	0 to 99.99	0.0001		1
75C4	-	75C4	30149	-	30149	watts loss due to copper when watts positive	UINT16	0 to 99.99	0.0001		1
75C5	-	75C5	30150	-	30150	var loss due to iron when watts positive	UINT16	0 to 99.99	0.0001		1
75C6	-	75C6	30151	-	30151	var loss due to copper when watts positive	UINT16	0 to 99.99	0.0001		1
75C7	-	75C3	30152	-	30152	watts loss due to iron when watts negative	UINT16	0 to 99.99	0.0001		1
75C8	-	75C48	30153	-	30153	watts loss due to copper when watts negative	UINT16	0 to 99.99	0.0001		1
75C9	-	75C9	30154	-	30154	var loss due to iron when watts negative	UINT16	0 to 99.99	0.0001		1
75CA	-	75CA	30155	-	30155	var loss due to copper when watts negative	UINT16	0 to 99.99	0.0001		1
75CB	-	75CB	30156	-	30156	transformer loss compensation user settings flag	UINT16	bit-mapped	-------- ----cfwv	c - 0 disable compensation for losses due to copper, 1 enable compensaion for losses due to copper f - 0 disable compensation for losses due to iron, 1 enable compensaion for losses due to iron w - 0 add watt compensation, 1 subtract watt compensation v - 0 add var compensation, 1 subtract var compensation	1
75CC	-	75E5	30157	-	30182	Reserved				Reserved	26
75E6	-	75E6	30183	-	30183	Programmable Settings Update Counter	UINT16	0-65535		Increments each time programmable settings are changed; occurs when new checksum is calculated.	1
75E7	-	7626	30184	-	30247	Reserved for Software Use				Reserved	64
										Block Size:	248
Log Setups Block									**write only in PS update mode**	
Hex		Decimal			Description (Note 1)	Format	Range (Note 6)	Units or Resolution	Comments	# Reg
7917	-	7917	31000	-	31000	Historical Log #1 Sizes	UINT16	bit-mapped	eeeeeeee sssssss	high byte is number of registers to log in each record (0-117), low byte is number of flash sectors for the log (see note 19) 0 in either byte disables the log	1
7918	-	7918	31001	-	31001	Historical Log #1 Interval	UINT16	bit-mapped	00000000 hgfedcba	only 1 bit set: a=1 min, b=3 min, c=5 min, d=10 min, e=15 min, f=30 min, g=60 min, h=EOI pulse	1
7919	-	7919	31002	-	31002	Historical Log #1, Register #1 Identifier	UINT16	0 to 65535		use Modbus address as the identifier (see note 7)	1
791A	-	798D	31003	-	31118	Historical Log #1, Register #2 - #117 Identifiers	UINT16	0 to 65535		same as Register #1 Identifier	116
798E	-	79D6	31119	-	31191	Historical Log #1 Software Buffer				Reserved for software use.	73
79D7	-	7A96	31192	-	31383	Historical Log #2 Sizes, Interval, Registers & Software Buffer	same as Historical Log #1				192
7A97	-	7B56	31384	-	31575	Historical Log #3 Sizes, Interval, Registers & Software Buffer	same as Historical Log #1				192
7B57	-	7B76	31576	-	31607	Reserved				Reserved	31
										Block Size:	608
7CFF	-	7F3E	32000	-	32575	Reserved					576
80E7	-	8326	33000	-	33064	Reserved					576

12-Bit Readings Section												
12-Bit Block											read-only except as noted	
Hex			Decimal			Description (Note 1)	Format	Range (Note 6)	Units or Resolution		Comments	# Reg
9C40	-	9C40	40001	-	40001	System Sanity Indicator	UINT16	0 or 1	none		0 indicates proper meter operation	1
9C41	-	9C41	40002	-	40002	Volts A-N	UINT16	2047 to 4095	volts		2047= 0, 4095= +150	1
9C42	-	9C42	40003	-	40003	Volts B-N	UINT16	2047 to 4095	volts		volts = 150 * (register - 2047) / 2047	1
9C43	-	9C43	40004	-	40004	Volts C-N	UINT16	2047 to 4095	volts			1
9C44	-	9C44	40005	-	40005	Amps A	UINT16	0 to 4095	amps		0= -10, 2047= 0, 4095= +10	1
9C45	-	9C45	40006	-	40006	Amps B	UINT16	0 to 4095	amps		amps = 10 * (register - 2047) / 2047	1
9C46	-	9C46	40007	-	40007	Amps C	UINT16	0 to 4095	amps			1
9C47	-	9C47	40008	-	40008	Watts, 3-Ph total	UINT16	0 to 4095	watts		0= -3000, 2047= 0, 4095= +3000	1
9C48	-	9C48	40009	-	40009	VARs, 3-Ph total	UINT16	0 to 4095	VARs		watts, VARs, VAs =	1
9C49	-	9C49	40010	-	40010	VAs, 3-Ph total	UINT16	2047 to 4095	VAs		3000 * (register - 2047) / 2047	1
9C4A	-	9C4A	40011	-	40011	Power Factor, 3-Ph total	UINT16	1047 to 3047	none		1047= -1, 2047= 0, 3047= +1 pf = (register - 2047) / 1000	1
9C4B	-	9C4B	40012	-	40012	Frequency	UINT16	0 to 2730	Hz		0= 45 or less, 2047= 60, 2730= 65 or more freq = 45 + ((register / 4095) * 30)	1
9C4C	-	9C4C	40013	-	40013	Volts A-B	UINT16	2047 to 4095	volts		2047= 0, 4095= +300	1
9C4D	-	9C4D	40014	-	40014	Volts B-C	UINT16	2047 to 4095	volts		volts = 300 * (register - 2047) / 2047	1
9C4E	-	9C4E	40015	-	40015	Volts C-A	UINT16	2047 to 4095	volts			1
9C4F	-	9C4F	40016	-	40016	CT numerator	UINT16	1 to 9999	none		CT = numerator * multiplier / denominator	1
9C50	-	9C50	40017	-	40017	CT multiplier	UINT16	1, 10, 100	none			1
9C51	-	9C51	40018	-	40018	CT denominator	UINT16	1 or 5	none			1
9C52	-	9C52	40019	-	40019	PT numerator	UINT16	1 to 9999	none		PT = numerator * multiplier / denominator	1
9C53	-	9C53	40020	-	40020	PT multiplier	UINT16	1, 10, 100, 1000	none			1
9C54	-	9C54	40021	-	40021	PT denominator	UINT16	1 to 9999	none			1
9C55	-	9C56	40022	-	40023	W-hours, Positive	UINT32	0 to 99999999	Wh per energy format		* 5 to 8 digits	2
9C57	-	9C58	40024	-	40025	W-hours, Negative	UINT32	0 to 99999999	Wh per energy format		* decimal point implied, per energy format	2
9C59	-	9C5A	40026	-	40027	VAR-hours, Positive	UINT32	0 to 99999999	VARh per energy format		* resolution of digit before decimal point = units, kilo, or mega, per energy format	2
9C5B	-	9C5C	40028	-	40029	VAR-hours, Negative	UINT32	0 to 99999999	VARh per energy format			2
9C5D	-	9C5E	40030	-	40031	VA-hours	UINT32	0 to 99999999	VAh per energy format		* see note 10	2
9C5F	-	9C60	40032	-	40033	W-hours, Positive, Phase A	UINT32	0 to 99999999	Wh per energy format			2
9C61	-	9C62	40034	-	40035	W-hours, Positive, Phase B	UINT32	0 to 99999999	Wh per energy format			2
9C63	-	9C64	40036	-	40037	W-hours, Positive, Phase C	UINT32	0 to 99999999	Wh per energy format			2
9C65	-	9C66	40038	-	40039	W-hours, Negative, Phase A	UINT32	0 to 99999999	Wh per energy format			2
9C67	-	9C68	40040	-	40041	W-hours, Negative, Phase B	UINT32	0 to 99999999	Wh per energy format			2
9C69	-	9C6A	40042	-	40043	W-hours, Negative, Phase C	UINT32	0 to 99999999	Wh per energy format			2
9C6B	-	9C6C	40044	-	40045	VAR-hours, Positive, Phase A	UINT32	0 to 99999999	VARh per energy format			2
9C6D	-	9C6E	40046	-	40047	VAR-hours, Positive, Phase B	UINT32	0 to 99999999	VARh per energy format			2
9C6F	-	9C70	40048	-	40049	VAR-hours, Positive, Phase C	UINT32	0 to 99999999	VARh per energy format			2
9C71	-	9C72	40050	-	40051	VAR-hours, Negative, Phase A	UINT32	0 to 99999999	VARh per energy format			2
9C73	-	9C74	40052	-	40053	VAR-hours, Negative, Phase B	UINT32	0 to 99999999	VARh per energy format			2
9C75	-	9C76	40054	-	40055	VAR-hours, Negative, Phase C	UINT32	0 to 99999999	VARh per energy format			2
9C77	-	9C78	40056	-	40057	VA-hours, Phase A	UINT32	0 to 99999999	VAh per energy format			2
9C79	-	9C7A	40058	-	40059	VA-hours, Phase B	UINT32	0 to 99999999	VAh per energy format			2
9C7B	-	9C7C	40060	-	40061	VA-hours, Phase C	UINT32	0 to 99999999	VAh per energy format			2
9C7D	-	9C7D	40062	-	40062	Watts, Phase A	UINT16	0 to 4095	watts			1
9C7E	-	9C7E	40063	-	40063	Watts, Phase B	UINT16	0 to 4095	watts			1
9C7F	-	9C7F	40064	-	40064	Watts, Phase C	UINT16	0 to 4095	watts			1
9C80	-	9C80	40065	-	40065	VARs, Phase A	UINT16	0 to 4095	VARs		0= -3000, 2047= 0, 4095= +3000	1
9C81	-	9C81	40066	-	40066	VARs, Phase B	UINT16	0 to 4095	VARs		watts, VARs, VAs =	1
9C82	-	9C82	40067	-	40067	VARs, Phase C	UINT16	0 to 4095	VARs		3000 * (register - 2047) / 2047	1
9C83	-	9C83	40068	-	40068	VAs, Phase A	UINT16	2047 to 4095	VAs			1
9C84	-	9C84	40069	-	40069	VAs, Phase B	UINT16	2047 to 4095	VAs			1
9C85	-	9C85	40070	-	40070	VAs, Phase C	UINT16	2047 to 4095	VAs			1
9C86	-	9C86	40071	-	40071	Power Factor, Phase A	UINT16	1047 to 3047	none		1047= -1, 2047= 0, 3047= +1 pf = (register - 2047) / 1000	1
9C87	-	9C87	40072	-	40072	Power Factor, Phase B	UINT16	1047 to 3047	none			1
9C88	-	9C88	40073	-	40073	Power Factor, Phase C	UINT16	1047 to 3047	none			1
9C89	-	9CA2	40074	-	40099	Reserved	N/A	N/A	none		Reserved	26
9CA3	-	9CA3	40100	-	40100	Reset Energy Accumulators	UINT16	password (Note 5)			write-only register; always reads as 0	1
											Block Size:	100

Log Retrieval Section

Log Retrieval Block									read/write except as noted	
Hex			Decimal			Description (Note 1)	Format	Range (Note 6)	Units or Resolution	Comments	# Reg
C34C	-	C34D	49997	-	49998	Log Retrieval Session Duration	UINT32	0 to 4294967294	4 msec	0 if no session active; wraps around after max count	2
C34E	-	C34E	49999	-	49999	Log Retrieval Session Com Port	UINT16	0 to 4		0 if no session active, 1-4 for session active on COM1 - COM4	1
C34F	-	C34F	50000	-	50000	Log Number, Enable, Scope	UINT16	bit-mapped	nnnnnnnn esssssss	high byte is the log number (0-system, 1-alarm, 2-history1, 3-history2, 4-history3, 5-I/O changes, 11-waveform, (11 reserved for future use) e is retrieval session enable(1) or disable(0) sssssss is what to retrieve (0-normal record, 1-timestamps only, 2-complete memory image (no data validation if image)	1
C350	-	C350	50001	-	50001	Records per Window or Batch, Record Scope Selector, Number of Repeats	UINT16	bit-mapped	wwwwwwww snnnnnnn	high byte is records per window if s=0 or records per batch if s=1, low byte is number of repeats for function 35 or 0 to suppress auto-incrementing; max number of repeats is 8 (RTU) or 4 (ASCII) total windows, a batch is all the windows	1
C351	-	C352	50002	-	50003	Offset of First Record in Window	UINT32	bit-mapped	ssssssss nnnnnnnn nnnnnnnn nnnnnnnn	ssssssss is window status (0 to 7-window number, 0xFF-not ready); this byte is read-only. nn…nn is a 24-bit record number. The log's first record is latched as a reference point when the session is enabled. This offset is a record index relative to that point. Value provided is the relative index of the whole or partial record that begins the window.	2
C353	-	C3CD	50004	-	50126	Log Retrieve Window	UINT16	see comments	none	mapped per record layout and retrieval scope, read-only	123
										Block Size:	130
Log Status Block										read only	
Hex			Decimal			Description (Note 1)	Format	Range (Note 6)	Units or Resolution	Comments	# Reg
						Alarm Log Status Block					
C737	-	C738	51000	-	51001	Log Size in Records	UINT32	0 to 4,294,967,294	record		2
C739	-	C73A	51002	-	51003	Number of Records Used	UINT32	1 to 4,294,967,294	record		2
C73B	-	C73B	51004	-	51004	Record Size in Bytes	UINT16	14 to 242	byte		1
C73C	-	C73C	51005	-	51005	Log Availability	UINT16		none	0=available, 1-4=in use by COM1-4, 0xFFFF=not available (log size=0)	1
C73D	-	C73F	51006	-	51008	Timestamp, First Record	TSTAMP	1Jan2000 - 31Dec2099	1 sec		3
C740	-	C742	51009	-	51011	Timestamp, Last Record	TSTAMP	1Jan2000 - 31Dec2099	1 sec		3
C743	-	C746	51012	-	51015	Reserved				Reserved	4
										Individual Log Status Block Size:	16
C747	-	C756	51016	-	51031	System Log Status Block		same as alarm log status block			16
C757	-	C766	51032	-	51047	Historical Log 1 Status Block		same as alarm log status block			16
C767	-	C776	51048	-	51063	Historical Log 2 Status Block		same as alarm log status block			16
C777	-	C786	51064	-	51079	Historical Log 3 Status Block		same as alarm log status block			16
C787	-	C796	51080	-	51095	Reserved					16
C797	-	C7B6	51096	-	51127	Reserved					32
										Block Size:	128

End of Map

Data Formats	
ASCII	ASCII characters packed 2 per register in high, low order and without any termination characters.
SINT16 / UINT16	16-bit signed / unsigned integer.
SINT32 / UINT32	32-bit signed / unsigned integer spanning 2 registers. The lower-addressed register is the high order half.
FLOAT	32-bit IEEE floating point number spanning 2 registers. The lower-addressed register is the high order half (i.e., contains the exponent).
TSTAM	3 adjacent registers, 2 bytes each. First (lowest-addressed) register high byte is year (0-99), low byte is month (1-12). Middle register high byte is day(1-31), low byte is hour (0-23 plus DST bit).
P	DST (daylight saving time) bit is bit 6 (0x40). Third register high byte is minutes (0-59), low byte is seconds (0-59). For example, 9:35:07AM on October 12, 2049 would be 0x310A, 0x0C49, 0x2307, assuming DST is in effect.

Notes	
1	All registers not explicitly listed in the table read as 0. Writes to these registers will be accepted but won't actually change the register (since it doesn't exist).
2	Meter Data Section items read as 0 until first readings are available or if the meter is not in operating mode. Writes to these registers will be accepted but won't actually change the register.
3	Register valid only in programmable settings update mode. In other modes these registers read as 0 and return an illegal data address exception if a write is attempted.
4	Meter command registers always read as 0. They may be written only when the meter is in a suitable mode. The registers return an illegal data address exception if a write is attempted in an incorrect mode.
5	If the password is incorrect, a valid response is returned but the command is not executed. Use 5555 for the password if passwords are disabled in the programmable settings.
6	M denotes a 1,000,000 multiplier.
7	Each identifier is a Modbus register. For entities that occupy multiple registers (FLOAT, SINT32, etc.) all registers making up the entity must be listed, in ascending order. For example, to log phase A volts, VAs, and VA hours, the register list would be 0x3E7, 0x3E8, 0x411, 0x412, 0x61D, 0x61E and the number of registers (0x7917 high byte) would be 7.
8	Writing this register causes data to be saved permanently in nonvolatile memory. Reply to the command indicates that it was accepted but not whether or not the save was successful. This can only be determined after the meter has restarted.
9	Reset commands make no sense if the meter state is LIMP. An illegal function exception will be returned.
10	Energy registers should be reset after a format change.
11	Entities to be monitored against limits are identified by Modbus address. Entities occupying multiple Modbus registers, such as floating point values, are identified by the lower register address. If any of the 8 limits is unused, set its identifier to zero. If the indicated Modbus register is not used or is a nonsensical entity for limits, it will behave as an unused limit.
12	There are 2 setpoints per limit, one above and one below the expected range of values. LM1 is the "too high" limit, LM2 is "too low". The entity goes "out of limit" on LM1 when its value is greater than the setpoint. It remains "out of limit" until the value drops below the in threshold. LM2 works similarly, in the opposite direction. If limits in only one direction are of interest, set the in threshold on the "wrong" side of the setpoint. Limits are specified as % of full scale, where full scale is automatically set appropriately for the entity being monitored: current — FS = CT numerator * CT multiplier voltage — FS = PT numerator * PT multiplier 3 phase power — FS = CT numerator * CT multiplier * PT numerator * PT multiplier * 3 [* SQRT(3) for delta hookup] single phase — FS = CT numerator * CT multiplier * PT numerator * PT multiplier [* SQRT(3) for delta hookup] frequency — FS = 60 (or 50) power factor — FS = 1.0 percentage — FS = 100.0 angle — FS = 180.0
13	n/a
14	n/a
15	A block of data and control registers is allocated for each option slot. Interpretation of the register data depends on what card is in the slot.
16	Measurement states: Off occurs during programmable settings updates; Run is the normal measuring state; Limp indicates that an essentail non-volatile memory block is corrupted; and Warmup occurs briefly (approximately 4 seconds) at startup while the readings stabilize. Run state is required for measurement, historical logging, demand interval processing, limit alarm evaluation, and min/max comparisonss. Resetting min/max or energy is allowed only in run and off states; warmup will return a busy exception. In limp state, the meter reboots at 5 minute intervals in an effort to clear the problem.
17	Limits evaluation for all entites except demand averages commences immediately after the warmup period. Evaluation for demand averages, maximum demands, and minimum demands commences at the end of the first demand interval after startup.
18	n/a
19	There are 15, 29, or 45 flash sectors available in a common pool for distribution among the 3 historical logs. The pool size, number of sectors for each log, and the number of registers per record together determine the maximum number of records a log can hold. S = number of sectors assigned to the log,
20	n/a
21	Logs cannot be reset during log retrieval. Busy exception will be returned.

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C: IQ 150S Meter DNP Map

C.1: Introduction

The IQ 150S meter's DNP map shows the client-server relationship in the meter's use of DNP Protocol.

C.2: DNP Implementation

PHYSICAL LAYER

The IQ 150S meter can use RS485 as the physical layer. This is accomplished by connecting a PC to the meter using the meter's RS485 connection (see Chapter 5).

RS485

RS485 provides multi-drop network communication capabilities. Multiple meters can be placed on the same bus, allowing for a Master device to communicate with any of the other devices. Appropriate network configuration and termination should be evaluated for each installation to insure optimal performance (see Chapter 5).

Communication Parameters

IQ 150S meters communicate in DNP 3.0 using the following communication settings:

- 8 Data Bits
- No Parity
- 1 Stop Bit
- Baud Rates: 9600, 19200, 38400, 57600

C.3: Data Link Layer

The Data Link Layer for IQ 150S meters is subject to the following considerations:

Control Field

The Control Byte contains several bits and a Function Code.

Control Bits

Communication directed to the meter should be Primary Master messages (DIR = 1, PRM = 1). Response will be primary Non-Master messages (DIR = 0, PRM = 1). Acknowledgment will be Secondary Non-Master messages (DIR = 0, PRM = 0).

Function Codes

IQ 150S meters support all of the Function Codes for DNP 3.0.

Reset of Data Link (Function 0)

Before confirmed communication with a master device, the Data Link Layer must be reset. This is necessary after a meter has been restarted, either by applying power to the meter or reprogramming the meter. The meter must receive a RESET command before confirmed communication can take place. Unconfirmed communication is always possible and does not require a RESET.

User Data (Function 3)

After receiving a request for USER DATA, the meter generates a Data Link CONFIRMATION, signaling the reception of the request, before the actual request is processed. If a response is required, it is also sent as UNCONFIRMED USER DATA.

Unconfirmed User Data (Function 4)

After receiving a request for UNCONFIRMED USER DATA, if a response is required, it is sent as UNCONFIRMED USER DATA.

Address

DNP 3.0 allows for addresses from 0 - 65534 (0x0000 - 0xFFFE) for individual device identification, with the address 65535 (0xFFFF) defined as an all stations address. IQ 150S/250S meters' addresses are programmable from 0 - 247 (0x0000 - 0x00F7), and address 65535 (0xFFFF) is recognized as the all stations address.

C.4: Transport Layer

The Transport Layer as implemented on IQ 150S meters is subject to the following considerations:

Transport Header

Multiple-frame messages are not allowed for IQ 150S meters. Each Transport Header should indicate it is both the first frame (FIR = 1) as well as the final frame (FIN = 1).

C.5: Application Layer

The Application Layer contains a header (Request or Response Header, depending on direction) and data.

Application Headers

Application Headers contain the Application Control Field and the Function Code.

Application Control Field

Multiple-fragment messages are not allowed for IQ 150S meters. Each Application Header should indicate it is both the first fragment (FIR = 1) as well as the final fragment (FIN = 1). Application-Level confirmation is not used by IQ 150S meters.

Function Codes

The following Function codes are implemented on IQ 150S meters.

Read (Function 1)

Objects supporting the READ function are:

- Binary Outputs (Object 10)
- Counters (Object 20)
- Analog Inputs (Object 30)
- Class (Object 60)

These Objects can be read either by requesting a specific Variation available as listed in this appendix, or by requesting Variation 0. READ requests for Variation 0 of an Object is fulfilled with the Variation listed in this appendix.

Write (Function 2)

Objects supporting the WRITE function are:

- Internal Indications (Object 80)

Direct Operate (Function 5)

Objects supporting the DIRECT OPERATE function are:

- Control Relay Output Block (Object 12)

Direct Operate - No Acknowledgment (Function 6)

Objects supporting the DIRECT OPERATE - NO ACKNOWLEDGMENT function are:

- Change to MODBUS RTU Protocol

Response (Function 129)

Application responses from IQ 150S meters use the RESPONSE function.

Application Data

Application Data contains information about the Object and Variation, as well as the Qualifier and Range.

C.5.1: Object and Variation

The following Objects (Obj.) and Variations (Var.) are supported by IQ 150S meters:

- Binary Output Status (Object 10, Variation 2) †
- Control Relay Output Block (Object 12, Variation 1)
- 32-Bit Binary Counter Without Flag (Object 20, Variation 5) †
- 16-Bit Analog Input Without Flag (Object 30, Variation 4) †
- Class 0 Data (Object 60, Variation 1) †

- Internal Indications (Object 80, Variation 1)

† READ requests for Variation 0 are honored with the above Variations.

C.5.1.1: Binary Output Status (Obj. 10, Var. 2)

Binary Output Status supports the following function:

Read (Function 1)

A READ request for Variation 0 is responded to with Variation 2.

Binary Output Status is used to communicate the following data measured by IQ 150S meter:

Energy Reset State

Change to MODBUS RTU Protocol State

Energy Reset State (Point 0)

IQ 150S meters accumulate power generated or consumed over time as Hour Readings, which measure positive VA Hours and positive and negative W Hours and VAR Hours. These readings can be reset using a Control Relay Output Block object (Object 12). The Binary Output Status point reports whether the Energy Readings are in the process of being reset, or are accumulating. Normally, readings are being accumulated - the state of this point reads as '0'. If readings are in the process of being reset, the state of this point reads as '1'.

Change to Modbus RTU Protocol State (Point 1)

IQ 150S meters can of change from DNP Protocol to Modbus RTU Protocol. This enables the user to update the Device Profile of the meter (this does not change the meter’s Protocol setting). A meter reset brings communication back to DNP. A status reading of "1" equals Open, or de-energized. A reading of "0" equals Closed, or energized.

C.5.1.2: Control Relay Output Block (Obj. 12, Var. 1)

Control Relay Output Block supports the following functions:

Direct Operate (Function 5)

Direct Operate - No Acknowledgment (Function 6)

Control Relay Output Blocks are used for the following purposes:

Energy Reset

Change to MODBUS RTU Protocol

Energy Reset (Point 0)

As stated previously, IQ 150S meters accumulate power generated or consumed over time as Hour Readings, which measure positive VA Hours and positive and negative W Hours and VAR Hours. These readings may be reset using Point 0.

Change to Modbus RTU Protocol (Point 1)

Refer to Section C.5.1.1 on the previous page for the Change to Modbus Protocol information.

Use of the DIRECT OPERATE (Function 5) function will operate only with the settings of Pulsed ON (Code = 1 of Control Code Field) once (Count = 0x01) for ON 1 millisecond and OFF 0 milliseconds.

C.5.1.3: 32-Bit Binary Counter Without Flag (Obj. 20, Var. 5)

Counters support the following functions:

Read (Function 1)

A READ request for Variation 0 is responded to with Variation 5.

Counters are used to communicate the following data measured by IQ 150S/250S meters:

Hour Readings

Hour Readings (Points 0 - 4)

Point	Readings	Unit
0	+W hour	Wh
1	-W hour	Wh
2	+VAR hour	VARh
3	-VAR hour	VARh
4	+VA hour	VAh

NOTE: These readings may be cleared by using the Control Relay Output Block (see previous Section C.5.1.2).

C.5.1.4: 16-Bit Analog Input Without Flag (Obj. 30, Var. 4)

Analog Inputs support the following functions:

Read (Function 1)

A READ request for Variation 0 is responded to with Variation 4.

Analog Inputs are used to communicate the following data measured by IQ 150S meters:

- Health Check
- Phase-to-Neutral Voltage
- Phase-to-Phase Voltage
- Phase Current

- Total Power
- Three Phase Total VAs
- Three Phase Power Factor Total
- Frequency
- Three Phase +Watts Max Avg Demand
- Three Phase +VARs Max Avg Demand
- Three Phase -Watts Max Avg Demand
- Three Phase -VARs Max Avg Demand
- Three Phase VAs Max Avg Demand
- Angle, Phase Power
- Angle, Phase-to-Phase Voltage
- CT Numerator, Multiplier, Denominator
- PT Numerator, Multiplier, Denominator

Health Check (Point 0)

The Health Check point is used to indicate problems detected by the IQ 150S meter. A value of zero (0x0000) indicates the meter does not detect a problem. Non-zero values indicate a detected anomaly.

Phase-to-Neutral Voltage (Points 1 - 3)

Point	Reading
1	Phase AN Voltage
2	Phase BN Voltage
3	Phase CN Voltage

These points are formatted as 2's complement fractions. They represent a fraction of a 150V Secondary input. Inputs of above 150V Secondary are pinned at 150V
Secondary.

Phase-to-Phase Voltage (Points 4 - 6)

Point	Reading
4	Phase AB Voltage
5	Phase BC Voltage
6	Phase CA Voltage

These points are formatted as 2's complement fractions. They represent a fraction of a 300V Secondary input. Inputs of above 30 V Secondary are pinned at 300V
Secondary.

Phase Current (Points 7 - 9)

Point	Reading
7	Phase A Current
8	Phase B Current
9	Phase C Current

These points are formatted as 2's complement fractions. They represent a fraction of a 10A Secondary input. Inputs of above 10A Secondary are pinned at 10A Secondary.

Total Power (Points 10 - 11)

Point	Reading
10	Total Watt

Point	Reading
11	Total VAR

These points are formatted as 2's complement fractions. They represent a fraction of 4500W Secondary in normal operation, or 3000W Secondary in Open Delta operation. Inputs above/below +/-4500 or +/-3000W Secondary are pinned at +/-4500 or +/-3000W Secondary, respectively.

Total VA (Point 12)

Point	Reading
12	Total VA

This point is formatted as a 2's complement fraction. It represents a fraction of 4500W Secondary in normal operation, or 3000W Secondary in Open Delta operation. Inputs above/below +/-4500 or +/-3000W Secondary are pinned at +/-4500 or +/-3000W Secondary, respectively.

Power Factor (Point 13)

Point	Reading
13	Power Factor Total

This point is formatted as a 2's complement integer. It represents Power Factors from -1.000 (0x0FC18) to +1.000 (0x003E8). In Open Delta operation, Total Power Factor (Point 13) is always zero.

Frequency (Point 14)

Point	Reading
14	Frequency

This point is formatted as a 2's complement fraction. It represents the Frequency as measured on Phase A Voltage in units of cHz (centiHertz, 1/100 Hz). Inputs below 45.00 Hz are pinned at 0 (0x0000); inputs above 75.00 Hz are pinned at 9999 (0x270F).

Maximum Demands of Total Power (Points 15 - 19)

Point	Reading
15	Maximum Positive Demand Total Watts
16	Maximum Positive Demand Total VARs
17	Maximum Negative Demand Total Watts
18	Maximum Negative Demand Total VARs
19	Maximum Average Demand VAs

These points are formatted as 2's complement fractions. They represent a fraction of 4500W Secondary in normal operation, or 3000W Secondary in Open Delta operation. Inputs above/below +/-4500 or +/-3000W Secondary are pinned at +/-4500 or +/-3000W Secondary, respectively.

Phase Angle (Points 20 - 25)

Point	Reading
20	Phase A Current Angle
21	Phase B Current Angle
22	Phase C Current Angle
23	Volts A-B Angle
24	Volts B-C Angle
25	Volts C-A Angle

These points are formatted as 2's complement integers. They represent angles from -180.00 (0x0F8F8) to +180.00 (0x00708).

CT & PT Ratios (Points 26 - 31)

Point	Reading
26	CT Ratio Numerator
27	CT Ratio Multiplier
28	CT Ratio Denominator
29	PT Ratio Numerator
30	PT Ratio Multiplier

Point	Reading
31	PT Ratio Denominator

These points are formatted as 2's complement integers. They can be used to convert from units in terms of the Secondary of a CT or PT into units in terms of the Primary of a CT or PT. The ratio of Numerator divided by Denominator is the ratio of Primary to Secondary.

IQ 150S meters typically use Full Scales relating Primary Current to 5A and Primary Voltage to 120V. However, these Full scales can range from mAs to thousands of kAs, and from mVs, to thousands of kVs. Following are example settings:

CT Example Settings

200 Amps: Set the Ct-n value for 200 and the Ct-S value for 1.

800 Amps: Set the Ct-n value for 800 and the Ct-S value for 1.

2,000 Amps: Set the Ct-n value for 2000 and the Ct-S value for 1.

10,000 Amps:Set the Ct-n value for 1000 and the Ct-S value for 10.

NOTE: CT Denominator is fixed at 5 for 5A units; CT Denominator is fixed at 1 for 1A units.

PT Example Settings

277 Volts (Reads 277 Volts): Pt-n value is 277, Pt-d value is 277, Pt-S value is 1.

120 Volts (Reads 14,400 Volts): Pt-n value is 1440, Pt-d value is 120, Pt-S value is 10.

69 Volts (Reads 138,000 Volts): Pt-n value is 1380, Pt-d value is 69, Pt-S value is 100.

115 Volts (Reads 347,000 Volts): Pt-n value is 3470, Pt-d value is 115, Pt-S value is 100.

69 Volts (Reads 347,000 Volts): Pt-n value is 347, Pt-d value is 69, Pt-S value is 1000.

C.5.1.5: Class 0 Data (Obj. 60, Var. 1)

Class 0 Data supports the following functions:

Read (Function 1)

A request for Class 0 Data from a IQ 150S meter returns three Object Headers. Specifically, it returns 16-Bit Analog Input Without Flags (Object 30, Variation 4), Points 0 - 31, followed by 32-Bit Counters Without Flags (Object 20, Variation 5), Points 0 - 4, followed by Binary Output Status (Object 10, Variation 2), Points 0 - 1. (There is NO Object 1.)

A request for Object 60, Variation 0 is treated as a request for Class 0 Data.

C.5.1.6: Internal Indications (Obj. 80, Var. 1)

Internal Indications support the following functions:

Write (Function 2)

Internal Indications may be indexed by Qualifier Code 0.

Device Restart (Point 0)

This bit is set whenever the meter resets. The polling device may clear this bit by Writing (Function 2) to Object 80, Point 0.

C.6: IQ 150S Meter DNP Mapping (DNP-1 to DNP-2)

The IQ 150S DNP Point Map follows.

Binary Output States, Control Relay Outputs, Binary Counters (Primary) and Analog Inputs are described on Page 1.

Internal Indication is described on Page 2.

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Object	Point	Var	Description	Format	Range	Multiplier	Units	Comments
Binary Output States								Read via Class 0 only
10	0	2	Reset Energy Counters	BYTE	Always 1	N/A	none	
10	1	2	Change to Modbus RTU Protocol	BYTE	Always 1	N/A	none	
Control Relay Outputs								
12	0	1	Reset Energy Counters	N/A	N/A	N/A	none	Responds to Function 5 (Direct Operate), Qualifier Code 17x or 28x, Control Code 3, Count 0, On 0 msec, Off 1 msec ONLY.
12	1	1	Change to Modbus RTU Protocol	N/A	N/A	N/A	none	Responds to Function 6 (Direct Operate - No Ack), Qualifier Code 17x, Control Code 3, Count 0, On 0 msec, Off 1 msec ONLY.
Binary Counters (Primary)								Read via Class 0 only
20	0	4	W-hours, Positive	UINT32	0 to 99999999	multiplier = $10^{(n-d)}$, where n and d are derived from the energy format. n = 0, 3, or 6 per energy format scale and d = number of decimal places.	W hr	example:
20	1	4	W-hours, Negative	UINT32	0 to 99999999		W hr	energy format = 7.2K and W-hours counter = 1234567
20	2	4	VAR-hours, Positive	UINT32	0 to 99999999		VAR hr	n=3 (K scale), d=2 (2 digits after decimal point), multiplier = $10^{(3-2)} = 10^{1} = 10$, so energy is 1234567 * 10 Whrs, or 12345.67 KWhrs
20	3	4	VAR-hours, Negative	UINT32	0 to 99999999		VAR hr	
20	4	4	VA-hours, Total	UINT32	0 to 99999999		VA hr	
Analog Inputs (Secondary)								Read via Class 0 only
30	0	5	Meter Health	SINT16	0 or 1	N/A	none	0 = OK
30	1	5	Volts A-N	SINT16	0 to 32767	(150 / 32768)	V	Values above 150V secondary read 32767.
30	2	5	Volts B-N	SINT16	0 to 32767	(150 / 32768)	V	
30	3	5	Volts C-N	SINT16	0 to 32767	(150 / 32768)	V	
30	4	5	Volts A-B	SINT16	0 to 32767	(300 / 32768)	V	Values above 300V secondary read 32767.
30	5	5	Volts B-C	SINT16	0 to 32767	(300 / 32768)	V	
30	6	5	Volts C-A	SINT16	0 to 32767	(300 / 32768)	V	
30	7	5	Amps A	SINT16	0 to 32767	(10 / 32768)	A	Values above 10A secondary read 32767.
30	8	5	Amps B	SINT16	0 to 32767	(10 / 32768)	A	
30	9	5	Amps C	SINT16	0 to 32767	(10 / 32768)	A	

Object	Point	Var	Description	Format	Range	Multiplier	Units	Comments
30	10	5	Watts, 3-Ph total	SINT16	-32768 to +32767	(4500 / 32768)	W	
30	11	5	VARs, 3-Ph total	SINT16	-32768 to +32767	(4500 / 32768)	VAR	
30	12	5	VAs, 3-Ph total	SINT16	0 to +32767	(4500 / 32768)	VA	
30	13	5	Power Factor, 3-Ph total	SINT16	-1000 to +1000	0.001	none	
30	14	5	Frequency	SINT16	0 to 9999	0.01	Hz	
30	15	5	Positive Watts, 3-Ph, Maximum Avg Demand	SINT16	-32768 to +32767	(4500 / 32768)	W	
30	16	5	Positive VARs, 3-Ph, Maximum Avg Demand	SINT16	-32768 to +32767	(4500 / 32768)	VAR	
30	17	5	Negative Watts, 3-Ph, Maximum Avg Demand	SINT16	-32768 to +32767	(4500 / 32768)	W	
30	18	5	Negative VARs, 3-Ph, Maximum Avg Demand	SINT16	-32768 to +32767	(4500 / 32768)	VAR	
30	19	5	VAs, 3-Ph, Maximum Avg Demand	SINT16	-32768 to +32767	(4500 / 32768)	VA	
30	20	5	Angle, Phase A Current	SINT16	-1800 to +1800	0.1	degree	
30	21	5	Angle, Phase B Current	SINT16	-1800 to +1800	0.1	degree	
30	22	5	Angle, Phase C Current	SINT16	-1800 to +1800	0.1	degree	
30	23	5	Angle, Volts A-B	SINT16	-1800 to +1800	0.1	degree	
30	24	5	Angle, Volts B-C	SINT16	-1800 to +1800	0.1	degree	
30	25	5	Angle, Volts C-A	SINT16	-1800 to +1800	0.1	degree	
30	26	5	CT numerator	SINT16	1 to 9999	N/A	none	CT ratio = (numerator * multiplier) / denominator
30	27	5	CT multiplier	SINT16	1, 10, or 100	N/A	none	
30	28	5	CT denominator	SINT16	1 or 5	N/A	none	
30	29	5	PT numerator	SINT16	1 to 9999	N/A	none	PT ratio = (numerator * multiplier) / denominator
30	30	5	PT multiplier	SINT16	1, 10, or 100	N/A	none	
30	31	5	PT denominator	SINT16	1 to 9999	N/A	none	
30	32	5	Neutral Current	SINT16	0 to 32767	(10 / 32768)	A	For 1A model, multiplier is (2 / 32768) and values above 2A secondary read 32767.
Internal Indication								
80	0	1	Device Restart Bit	N/A	N/A	N/A	none	Clear via Function 2 (Write), Qualifier Code 0.

D: IQ 250S Meter DNP Map

D.1: Overview

This Appendix describes the functionality of the IQ250S meter's version of the DNP protocol. A DNP programmer needs this information to retrieve data from the IQ 250S meter. The DNP version used by the IQ 250S is a reduced set of the Distributed Network Protocol Version 3.0 subset 2; it gives enough functionality to get critical measurements from the IQ 250S meter.

The IQ 250S meter's DNP version supports Class 0 object/qualifiers 0,1,2,6, only. No event generation is supported. The IQ 250S meter always acts as a secondary device (slave) in DNP communication.

D.2: Physical Layer

The IQ250S meter's DNP version uses serial communication. Port 2 (RS485 compliant port) is used. Speed and data format is transparent for the IQ250S meter's DNP version: they can be set to any supported value.

D.3: Data Link Layer

The IQ 250S meter can be assigned a value from 1 to 65534 as the target device address. The data link layer follows the standard frame FT3 used by DNP Version 3.0 protocol, but only 4 functions are implemented: Reset Link, Reset User, Unconfirmed User Data, and Link Status, as depicted in the following table.

Function	Function Code
Reset Link	0
Reset User	1
Unconfirmed User Data	4
Link Status	9

Table D.1: Supported Link Functions

[dst] and [src] are the device address of the IQ 250S meter and Master device, respectively. Refer to Section D.7 for more detail on supported frames for the data link layer.

In order to establish optimal communication with the IQ 250S meter, we recommend that you perform the Reset Link and Reset User functions. The Link Status is not mandatory, but can be performed as well. The inter-character time-out for DNP is 1 second. If this amount of time, or more, elapses between two consecutive characters within a FT3 frame, the frame will be dropped.

D.4: Application Layer

The IQ 250S meter's DNP version supports the Read, Write, Direct Operate and Direct Operate Unconfirmed functions.

- The Read function (code 01) provides a means for reading the critical measurement data from the meter. This function should be posted to read object 60 variation 1, which will read all the available Class 0 objects from the DNP register map. See the register map in Section C.6. In order to retrieve all objects with their respective variations, the qualifier must be set to ALL (0x06). See Section D.7 for an example showing a read Class 0 request data from the meter.

- The Write function (code 02) provides a means for clearing the Device restart bit in the Internal Indicator register only. This is mapped to Object 80, point 0 with variation 1. When clearing the restart device indicator use qualifier 0. Section D.7 shows the supported frames for this function.

- The Direct Operate function (code 05) is intended for resetting the energy counters and the Demand counters (minimum and maximum energy registers). These actions are mapped to Object 12, points 0 and 2, which act as control relays. The relays must be operated (On) in 0 msec and released (Off) in 1 msec only. Qualifiers 0x17 or x28 are supported for writing the energy reset. Sample frames are shown in Section D.7.

- The Direct Operate Unconfirmed (or Unacknowledged) function (code 06) is intended for asking the communication port to switch to Modbus RTU protocol from DNP. This switching acts as a control relay mapped into Object 12, point 1 in the meter. The relay must be operated with qualifier 0x17, code 3 count 0, with 0 milliseconds on and 1 millisecond off, only. After sending this request the current communication port will accept Modbus RTU frames only. To make this port go back to DNP protocol, the unit must be powered down and up. Section D.7 shows the constructed frame to perform DNP to Modbus RTU protocol change.

D.5: Error Reply

In the case of an unsupported function, or any other recognizable error, an error reply is generated from the IQ 250S meter to the Primary station (the requester). The Internal Indicator field will report the type of error: unsupported function or bad parameter.

The broadcast acknowledge and restart bit are also signaled in the Internal Indicator field, but they do not indicate an error condition.

D.6: IQ 250S Meter's DNP Register Map

Object 10 - Binary Output States

Object	Point	Var	Description	Format	Range	Multiplier	Units	Comments
10	0	2	Reset Energy Counters	BYTE	Always 1	N/A	None	Read by Class 0 or with qualifier 0, 1, 2, or 6
10	1	2	Change to Modbus RTU Protocol	BYTE	Always 1	N/A	None	Read by Class 0 or with qualifier 0, 1, 2, or 6
10	2	2	Reset Demand Cntrs (Max / Min)	BYTE	Always 1	N/A	None	Read by Class 0 or with qualifier 0, 1, 2, or 6

Object 12 - Control Relay Outputs

Object	Point	Var	Description	Format	Range	Multiplier	Units	Comments
12	0	1	Reset Energy Counters	N/A	N/A	N/A	none	Responds to Function 5 (Direct Operate), Qualifier Code 17x or 28x, Control Code 3, Count 0, On 0 msec, Off 1 msec ONLY.
12	1	1	Change to Modbus RTU Protocol	N/A	N/A	N/A	none	Responds to Function 6 (Direct Operate - No Ack), Qualifier Code 17x, Control Code 3, Count 0, On 0 msec, Off 1 msec ONLY.
12	2	1	Reset Demand Counters (Max / Min)	N/A	N/A	N/A	none	Responds to Function 5 (Direct Operate), Qualifier Code 17x or 28x, Control Code 3, Count 0, On 0 msec, Off 1 msec ONLY.

Object 20 - Binary Counters (Primary Readings) - Read via Class 0 or with qualifier 0, 1, 2, or 6

Object	Point	Var	Description	Format	Range	Multiplier	Units	Comments
20	0	5	W-hours, Positive	UINT32	0 to 99999999	Multiplier = 10(n-d), where n and d are derived from the energy format. n = 0, 3, or 6 per energy format scale and d = number of decimal places.	Whr	example: energy format = 7.2K and W-hours counter = 1234567 n=3 (K scale), d=2 (2 digits after decimal point), multiplier = 10(3-2) = 101 = 10, so energy is 1234567 * 10 Whrs, or 12345.67 KWhrs
20	1	5	W-hours, Negative	UINT32	0 to 99999999		Whr	
20	2	5	VAR-hours, Positive	UINT32	0 to 99999999		VARhr	
20	3	5	VAR-hours, Negative	UINT32	0 to 99999999		VARhr	
20	4	5	VA-hours, Total	UINT32	0 to 99999999		VAhr	

Object 30 - Analog Inputs (Secondary Readings) - Read via Class 0 or with qualifier 0, 1, 2, or 6

Object	Point	Var	Description	Format	Range	Multiplier	Units	Comments
30	0	4	Meter Health	sint16	0 or 1	N/A	None	0 = OK
30	1	4	Volts A-N	sint16	0 to 32767	(150 / 32768)	V	Values above 150V secondary read 32767.
30	2	4	Volts B-N	sint16	0 to 32767	(150 / 32768)	V	
30	3	4	Volts C-N	sint16	0 to 32767	(150 / 32768)	V	
30	4	4	Volts A-B	sint16	0 to 32767	(300 / 32768)	V	Values above 300V secondary read 32767.
30	5	4	Volts B-C	sint16	0 to 32767	(300 / 32768)	V	
30	6	4	Volts C-A	sint16	0 to 32767	(300 / 32768)	V	
30	7	4	Amps A	sint16	0 to 32767	(10 / 32768)	A	Values above 10A secondary read 32767.

Object	Point	Var	Description	Format	Range	Multiplier	Units	Comments
30	8	4	Amps B	sint16	0 to 32767	(10 / 32768)	A	
30	9	4	Amps C	sint16	0 to 32767	(10 / 32768)	A	
30	10	4	Watts, 3-Ph total	sint16	-32768 to +32767	(4500 / 32768)	W	
30	11	4	VARs, 3-Ph total	sint16	-32768 to +32767	(4500 / 32768)	VAR	
30	12	4	VAs, 3-Ph total	sint16	0 to +32767	(4500 / 32768)	VA	
30	13	4	Power Factor, 3-Ph total	sint16	-1000 to +1000	0.001	None	
30	14	4	Frequency	sint16	0 to 9999	0.01	Hz	
30	15	4	Positive Watts, 3-Ph, Maximum Avg Demand	sint16	-32768 to +32767	(4500 / 32768)	W	
30	16	4	Positive VARs, 3-Ph, Maximum Avg Demand	sint16	-32768 to +32767	(4500 / 32768)	VAR	
30	17	4	Negative Watts, 3-Ph, Maximum Avg Demand	sint16	-32768 to +32767	(4500 / 32768)	W	
30	18	4	Negative VARs, 3-Ph, Maximum Avg Demand	sint16	-32768 to +32767	(4500 / 32768)	VAR	
30	19	4	VAs, 3-Ph, Maximum Avg Demand	sint16	-32768 to +32767	(4500 / 32768)	VA	
30	20	4	Angle, Phase A Current	sint16	-1800 to +1800	0.1	degree	
30	21	4	Angle, Phase B Current	sint16	-1800 to +1800	0.1	degree	
30	22	4	Angle, Phase C Current	sint16	-1800 to +1800	0.1	degree	
30	23	4	Angle, Volts A-B	sint16	-1800 to +1800	0.1	degree	
30	24	4	Angle, Volts B-C	sint16	-1800 to +1800	0.1	degree	
30	25	4	Angle, Volts C-A	sint16	-1800 to +1800	0.1	degree	

Object	Point	Var	Description	Format	Range	Multiplier	Units	Comments
30	26	4	CT numerator	sint16	1 to 9999	N/A	none	CT ratio = (numerator * multiplier) / denomina-tor
30	27	4	CT multiplier	sint16	1, 10, or 100	N/A	none	
30	28	4	CT denominator	sint16	1 or 5	N/A	none	
30	29	4	PT numerator	SINT16	1 to 9999	N/A	none	PT ratio = (numerator * multiplier) / denomina-tor
30	30	4	PT multiplier	SINT16	1, 10, or 100	N/A	none	
30	31	4	PT denominator	SINT16	1 to 9999	N/A	none	
30	32	4	Neutral Current	SINT16	0 to 32767	(10 / 32768)	A	For 1A model, mul-tiplier is (2 / 32768) and values above 2A secondary read 32767

Object 80 - Internal Indicator

Object	Point	Var	Description	Format	Range	Multiplier	Units	Comments
80	7	1	Device Restart Bit	N/A	N/A	N/A	none	Clear via Function 2 (Write), Qualifier Code 0.

D.7: DNP Message Layouts

Legend

All numbers are in hexadecimal base. In addition the following symbols are used.

dst	16 bit frame destination address
src	16 bit frame source address
crc	DNP Cyclic redundant checksum (polynomial $x^{16}+x^{13}+x^{12}+x^{11}+x^{10}+x^{7}+x^{6}+x^{5}+x^{2}+1$)
x	transport layer data sequence number
y	application layer data sequence number

Link Layer related frames

Reset Link

Request	05	64	05	C0	dst	src	crc
Reply	05	64	05	00	src	dst	crc

Reset User

Request	05	64	05	C1	dst	src	crc
Reply	05	64	05	00	src	dst	crc

Link Status

Request	05	64	05	C9	dst	src	crc
Reply	05	64	05	0B	src	dst	crc

Application Layer related frames

Clear Restart

Request	05	64	0E	C4	dst		src		crc	
	Cx	Cy	02	50	01	00	07	07	00	crc
Reply	05	64	0A	44	src		dst		crc	
	Cx	Cy	81	int. ind.			crc			

Class 0 Data

Request	05	64	0B	C4	dst		src		crc							
	Cx	Cy	01	3C	01	06	crc									
Request (alternate)	05	64	14	C4	dst		src		crc							
	Cx	Cy	01	3C	02	06	3C	03	06	3C	04	06	3C	01	06	crc
Reply (same for either request)	05	64	72	44	src		dst		crc							
	Cx	Cy	81	int. ind.		14	05	00	00	04	pt 0				pt 1	crc
	pt 1		pt 2				pt 3				pt 4			1E	04	crc
	00	00	20	pt 0		pt 1		pt 2		pt 3		pt 4	pt 5		pt6	crc
	pt6	pt 7		pt 8		pt 9		pt 10		pt 11		pt 12	pt 13			crc
		pt 15		pt 16		pt 17		pt 18		pt 19		pt 20	pt 21			crc
		pt 23		pt 24		pt 25		pt 26		pt 27		pt 28	pt 29			crc
		pt 31		pt 32		0A	02	00	00	02	pt0	pt1	pt2	crc		

Reset Energy

Request	05	64	18	C4	dst		src		crc								
	Cx	Cy	05	0C	01	17	01	00	03	00	00	00	00	00	01	00	crc
	00	00	00	crc													
Reply	05	64	1A	44	src		dst		crc								
	Cx	Cy	81	int. ind.	0C	01	17	01	00	03	00	00	00	00	00	00	crc
	01	00	00	00	00	crc											

Request (alternate)	05	64	1A	C4	dst		src		crc								
	Cx	Cy	05	0C	01	28	01	00	00	00	03	00	00	00	00	00	crc
	01	00	00	00	00	crc											
Reply	05	64	1C	44	src		dst		crc								
	Cx	Cy	81	int. ind.	0C	01	28	01	00	00	00	03	00	00	00	00	crc
	00	00	01	00	00	00	00	crc									

Switch to Modbus

Request	05	64	18	C4	dst		src		crc								
	Cx	Cy	06	0C	01	17	01	01	03	00	00	00	00	00	01	00	crc
	00	00	00	crc													
No Reply																	

Reset Demand (Maximums & Minimums)

Request	05	64	18	C4	dst		src		crc								
	Cx	Cy	05	0C	01	17	01	02	03	00	00	00	00	00	01	00	crc
	00	00	00	crc													
Reply	05	64	1A	44	src		dst		crc								
	Cx	Cy	81	int. ind.	0C	01	17	01	02	03	00	00	00	00	00	00	crc
	01	00	00	00	00	crc											

Request (alternate)	05	64	1A	C4	dst		src		crc								
	Cx	Cy	05	0C	01	28	01	02	00	00	03	00	00	00	00	00	crc
	01	00	00	00	00	crc											
Reply	05	64	1C	44	src		dst		crc								
	Cx	Cy	81	int. ind.	0C	01	28	01	02	00	00	03	00	00	00	00	crc
	00	00	01	00	00	00	00	crc									

Error Reply

Reply	05	64	0A	44	src	dst	crc
	Cx	Cy	81	int. ind.	crc		

D.8: Internal Indication Bits

Bits implemented in the IQ 250S meter are listed below. All others are always reported as zeroes.

Bad Function

Occurs if the function code in a User Data request is not Read (0x01), Write (0x02), Direct Operate (0x05), or Direct Operate, No Ack (0x06).

Object Unknown

Occurs if an unsupported object is specified for the Read function. Only objects 10, 20, 30, and 60 are supported.

Out of Range

Occurs for most other errors in a request, such as requesting points that don't exist or direct operate requests in unsupported formats.

Buffer Overflow

Occurs if a read request or a read response is too large for its respective buffer. In general, if the request overflows, there will be no data in the response while if the response overflows at least the first object will be returned. The largest acceptable request has a length field of 26, i.e. link header plus 21 bytes more, not counting checksums. The largest possible response has 7 blocks plus the link header.

Restart

All Stations

These 2 bits are reported in accordance with standard practice.

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