ION® 7500 7600

User's Guide

POWER MEASUREMENT

Notices

For further assistance
please contact us at:

POWER MEASUREMENT

Worldwide Headquarters
2195 Keating Cross Road
Saanichton, BC
Canada V8M 2A5
Tel: 1-250-652-7100
Fax: 1-250-652-0411
Email: support@pwrm.com

www.pwrm.com

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Danger

This symbol indicates the presence of dangerous voltage within and outside the product enclosure that may constitute a risk of electric shock, serious injury or death to persons if proper precautions are not followed.

Caution

This symbol alerts the user to the presence of hazards that may cause minor or moderate injury to persons, damage to property or damage to the device itself, if proper precautions are not followed.

Note

This symbol directs the user's attention to important installation, operating and maintenance instructions.

Installation Considerations

Installation and maintenance of the ION 7500 / ION 7600 meter should only be performed by qualified, competent personnel that have appropriate training and experience with high voltage and current devices. The meter must be installed in accordance with all Local and National Electrical Codes.

DANGER

Failure to observe the following instructions may result in severe injury or death.

- During normal operation of the ION 7500 / ION 7600 meter, hazardous voltages are present on its terminal strips, and throughout the connected potential transformer (PT), current transformer (CT), digital (status) input, control power and external I/O circuits. PT and CT secondary circuits are capable of generating lethal voltages and currents with their primary circuit energized. Follow standard safety precautions while performing any installation or service work (i.e. removing PT fuses, shorting CT secondaries, etc).
- The terminal strips on the meter base should not be user-accessible after installation.
- Do not use digital output devices for primary protection functions. These include applications where the devices perform energy limiting functions or provide protection of people from injury. Do not use the ION 7500 / ION 7600 in situations where failure of the devices can cause injury or death, or cause sufficient energy to be released that can start a fire. The meter can be used for secondary protection functions.
- Do not HIPOT/Dielectric test the digital (status) inputs, digital outputs, or communications terminals. Refer to the label on the ION 7500 / ION 7600 meter for the maximum voltage level the device can withstand.

CAUTION

Observe the following instructions, or permanent damage to the meter may occur.

- The ION 7500 / ION 7600 meter offers a range of hardware options that affect input ratings. The ION 7500 / ION 7600 meter's serial number label lists all equipped options. Applying current levels incompatible with the current inputs will permanently damage the meter. This document provides installation instructions applicable to each hardware option.
- The ION 7500 / ION 7600 meter's chassis ground must be properly connected to the switchgear earth ground for the noise and surge protection circuitry to function correctly. Failure to do so will void the warranty.
- Terminal screw torque: Barrier-type (current, voltage, and relay terminal screws: 1.35 Nm (1.00 ft-lbf) max. Captured-wire type (digital inputs/outputs, communications, power supply: 0.90 Nm (0.66 ft.lbf) max.

FCC Notice

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense. The Ringer Equivalence Number (REN) for the ION 7500 / ION 7600 optional internal modem is 0.6. Connection to the ION 7500 / ION 7600 internal modem should be made via an FCC Part 68 compliant telephone cord (not supplied). The ION 7500 / ION 7600 cannot be used on a public coin phone service or party line services.

Network Compatibility Notice for the Internal Modem

The internal modem in meters equipped with this option is compatible with the telephone systems of most countries in the world, with the exception of Australia and New Zealand. Use in some countries may require modification of the internal modem's initialization strings. If problems using the modem on your phone system occur, please contact Power Measurement Technical Services

Standards Compliance

CSA: Certified to CAN/ CSA C22.2 No.1010-1	Certified to UL 3111	CE: approved

Limitation of Liability

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CHAPTER

1 Introduction

ION 7500™ and ION 7600™ intelligent metering and control devices provide revenue-accurate, true RMS measurements of voltage, current, power and energy, and are complemented by extensive I/O capabilities, comprehensive logging, and advanced power quality measurement and compliance verification functions. The meters come with an extensive selection of pre-configured data screens and measurements, so you can use the meters "out of the box" or customize them to fit your unique requirements.

ION 7500 and ION 7600 meters can replace numerous transducers, traditional meters, and control circuits. You can integrate the meters with ION® software or other energy management, SCADA, automation and billing systems, via multiple industry-standard communication channels and protocols.

In This Chapter

ION 7500 and ION 7600 Meters

The ION 7500™

The ION 7500 and ION 7600 are intelligent metering and control devices suited to a wide range of applications. The meters can be used as stand-alone devices, but their extensive capabilities are fully realized when used with ION software, as part of an enterprise energy management (EEM) system.

EEM systems give energy suppliers, service providers, and large industrial and commercial energy consumers the tools to meet all the challenges and opportunities of the new energy environment. EEM systems use real-time information and control to directly address a broad range of requirements throughout the power delivery chain and across an entire enterprise. These systems offer an integrated solution to managing new billing structures, distributed generation, energy purchasing, energy cost control, operational efficiency, and power quality and reliability.

ION technology uniquely delivers the benefits of enterprise energy management through an efficient, economical, and scalable architecture using web-enabled software and intelligent metering and control devices. ION systems place intelligence everywhere it's needed, delivering information and control to everyone that needs it, wherever they are. This gives all parties the necessary information to make the best energy decisions, and the control to act on them. Systems can span widely dispersed geographic locations and multiple points within each site. A single, shared system delivers a broad range of functionality that can satisfy the needs of many different groups within an enterprise, while integrating seamlessly with existing systems.

ION Enterprise™ is a powerful web-ready software suite that can process, analyze, store, and share information from across your entire organization. Its compatibility and flexibility means you can introduce individual components, at a pace you decide, while maintaining your original investments. You can access information and alarms from any workstation, pager, PDA, or cell phone locally or around the world, in the format you require. You can also perform coordinated load and equipment control functions, either manually or automatically. ION software collects data automatically from ION meters and third-party devices, so you can manage a single site or a global network of devices. ION software and hardware products reduce cost of installation and ownership by leverage existing corporate networks and popular networking technologies, including serial, wireless, modem, Ethernet and Internet links.

A wide selection of ION intelligent metering and control devices are available, with choices to meet the specific needs of various key points within an enterprise. Devices offer a range of high accuracy metering, power quality and reliability analysis, data and event logging, alarming, control and communications.

This manual discusses ION 7500 and ION 7600 meter default functionality, as well as features and applications. Throughout the manual, the term “meter” refers to both meter models. All differences between the models, such as a feature specific to one model, are indicated with the appropriate model number.

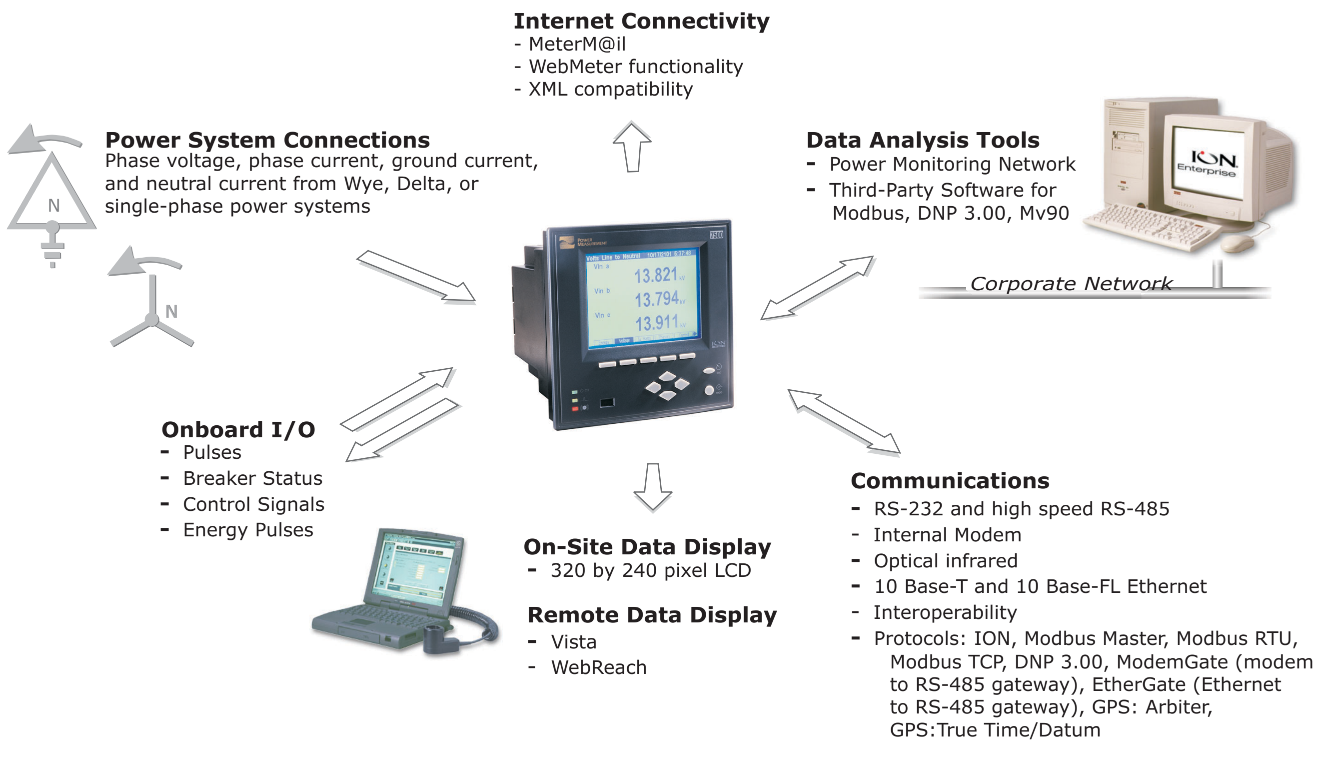
These meters can be used effectively in numerous energy supply-side (utility) and demand-side applications. Some common meter applications are:

- Revenue metering
- Substation automation
- Power quality monitoring (with Flicker)
- Commercial/industrial operations metering
- Demand and power factor control
- SCADA (supervisory control and data acquisition)
- Distributed generation (generator) monitoring and control

The ION meter in an Enterprise Energy Management System

Applications that include the meter typically require additional equipment. Display and analysis software tools are almost always used to manage, interpret and distribute the data measured or logged by a meter. There are usually a variety of tools used, and often these tools are connected using different communications standards and protocols. In many cases, a meter must also provide control capabilities and device-level data sharing.

The meter can adapt to many situations. Advanced communications allow data to be shared simultaneously across multiple networks, built-in I/O provides monitoring and control capabilities, and a variety of display and analysis tools can be used to monitor your power system.



Data Display and Analysis Tools

Not only does the meter's front panel allow meter configuration and data display, but the meter also integrates seamlessly with display and analysis software available from Power Measurement. ION Enterprise software is the network and device configuration software that also lets you analyze and monitor your system and produce reports for any department in an organization. Furthermore, you can use data acquired by the meter in a variety of third-party systems. ION software is designed to make use of all the available advanced capabilities.

The Front Panel

Local monitoring and standalone applications are facilitated by the meter's front panel interface. The front panel combines real-time display features with limited device configuration functions.

The front panel is often used in combination with an ION software system, providing an interface for field personnel.

WebMeter® Embedded Web Server Feature

An on-board web server combined with an Ethernet port provides quick and easy access to real-time energy and basic power quality information without special software: this is WebMeter functionality. The built-in web pages display a range of energy and basic power quality information through the web-enabled device; these pages even support basic meter configuration tasks.

MeterM@il® Internal E-Mail Server Feature

Configure the meter to automatically email high-priority alarm notifications or scheduled system-status update messages to anyone, anywhere within the facility or around the world. Specify the type of event that triggers an email alert, such as power quality disturbances or logged data at any pre-determined interval, and have your ION software administrator program the meter to respond with a MeterM@il message when these events occur. MeterM@il messages can be received like any email message over a workstation, cell phone, pager, or PDA.

XML Compatibility

The meters can exchange information using industry-standard XML format. This simple machine-readable format supports easy integration with custom reporting, spreadsheet, database, and other applications.

ION Enterprise™ Software

The complete ION Enterprise software package enables the meter to be part of a fully networked information system with other meters and local and wide-area computer networks. ION Enterprise is recommended for all power monitoring systems where advanced analysis and control capabilities are required.

ION Enterprise provides tools for managing your power monitoring network, logging data, analyzing real-time and logged data, generating power system reports, and creating custom functionality at the meter level.

ION Enterprise also offers two ways to remotely view information through a web browser: WebReach and Microsoft Terminal Services.

- WebReach only requires an URL to display a meter's real-time data and select views of historical and waveform data from a web browser; there is no client machine configuration. WebReach is a data display application; there is no control functionality available through it.
- Microsoft Terminal Services enable full ION Enterprise functionality, including control features. Some client machine configuration is required.

ION Setup™ Software

ION Setup is a meter configuration tool designed specifically to configure and test meters. ION Setup offers an intuitive graphical interface for performing basic meter setup, installing templates into meters, viewing real-time and reset accumulated values, verifying meter calibration and measurements, and setting up advanced security.

Communications Protocols

The meter can be integrated into various industry-standard networks. Data that is measured by the meter can be made available to other devices using the Modbus Master, Modbus RTU, Modbus TCP, and DNP 3.00 protocols, as well the MV-90 translation system. You can also configure the meter to import data from devices on these networks. With these advanced communications functions, the power of the meter can be utilized in most existing power monitoring systems. Any data display and analysis software that works with Modbus RTU or DNP 3.00 devices will also function with the meter.

The standard meter includes a selectable RS-232/RS-485 port (the factory default is RS-232), a high-speed RS-485 port, and an IrDA optical port for communications in the field. Order options include a 10Base-T Ethernet port or 10Base-FL fiber-optic port, and a 33.6 kbps internal modem (both FCC and CTR-21 compliant). Depending on the hardware options purchased, up to four separate ports can communicate simultaneously.

The communications card is retrofittable – it can be replaced while the meter is in the field.

Digital and Analog I/O Options

The meter has digital inputs and outputs that connect to the captured-wire terminals near the base of the unit. Additionally, a LED on the front panel is configured for energy pulsing. An optional analog I/O card can also be ordered with your meter. There are retrofit instructions for this I/O card, if you desire the card on a previously purchased meter.

Digital Inputs

The meter contains eight self-excited digital inputs capable of detecting a pulse rate of 20 pulses/second and timestamping transitions with 1ms resolution. They can be used for monitoring external contacts or pulse counting applications. These inputs use a current sensing technique to monitor contact status by providing an internal 30 VDC supply for self-excitation.

Relay Outputs

The meter contains four solid-state Form A outputs and three mechanical Form C relays. The solid-state outputs have a maximum voltage rating of 30 VDC and maximum current rating of 100 mA. The mechanical relays are rated at 250 VAC / 30 VDC and can switch up to 10A loads.

Analog Inputs and Analog Outputs

The meter offers an optional Analog I/O expansion card with numerous options:

- four 0 to 1 mA analog inputs
- four 0 to 20 mA analog inputs
- four -1 to 1 mA analog outputs
- four 0 to 20 mA analog outputs
- four 0 to 20 mA analog inputs & four 0 to 20 mA outputs
- four 0 to 1 analog inputs and four -1 to 1 mA analog outputs

NOTE

All options have an additional eight digital inputs on the card.

The Meter is Factory-Configured and Ready to Operate

Even though the meter is fully customizable, it is shipped from the factory with many pre-configured functions. Once you have performed the installation and basic setup, all of the basic measurements, energy calculations and recording functions are ready to operate right out of the box. You may find that the factory configuration aptly serves your purposes, allowing you to forego additional configuration.

Firmware Revision History

The table below lists the features related to a particular firmware release for your meter.

Firmware Version	Release Date	Firmware Enhancements	Template Improvements
v201	Aug. 10, 2000	◆ Initial release of the ION 7600 meter	
v203	Apr. 14, 2000	◆ Implemented the ModemGate protocol	
v206	Jan. 12, 2001	◆ Analog I/O ◆ WebMeter ◆ MeterM@il ◆ new and enhanced ION Modules ◆ Hardware improvements: 1 Amp current input option, Modicon Modbus TCP communications	◆ Revenue Log Module enhancements ◆ Sag/Swell Events on V4 ◆ Number of Nines display screen ◆ 9 additional DNP Slave modules ◆ 4 additional Calibration Pulser modules
v207	Feb. 22, 2001	◆ Trending Display feature	◆ New Trend Display Module
v210	May 16, 2001	◆ NICT and TRAN support added	
v222	Nov. 28, 2001	◆ Modbus Master capability ◆ DNP enhancements ◆ Hardware improvements: Option to order ION 7500 with 4 MB or 8 MB of Log Memory	◆ The maximum allowable number of the following ION Modules has been increased (see addendum for actual numbers): ◆ Integrator, Data Recorder, Sliding Window Demand, External Boolean, Minimum, Maximum, Display, Set Point
v231	Aug. 6, 2002	◆ Internet Phase 2 ◆ Stack replacement ◆ Hardware improvements	◆ Log Mail module replaced by the Log Export module ◆ New Web Page module

Using this Guide

This User's Guide is directed at three types of user: the typical user or operator, the system administrator, and the advanced user. You might not fit into any of these groups directly, or perhaps you are both an operator and an administrator. These classifications are intended to make this guide easier to navigate with respect to which information is appropriate to your needs.

Typical User or Operator

Most users simply want to display the data provided by the factory-configured meter. These users want fast access to data through the front panel, ION software, or a third-party protocol such as Modbus or DNP.

System Administrator or Manager

Some users need to make minor adjustments so that their meters "fit" their power systems: data recording intervals, demand sub-intervals and other parameters may need to be set before the meter's setup is complete. These users will use the front panel, or ION software to change settings in the device's operating software. (ION Enterprise is highly recommended.)

Advanced User or Systems Integrator

Advanced users may want to make use of the flexibility and power provided by the device's operating software. These users will need to become familiar with the ION architecture, and the ION software tools used to customize the device's operation.

Before You Can Use this Guide

By the time you are ready to use this guide, your meter should be installed, basic setup should have been performed, and communications/basic operation should have been verified. If the unit is not yet installed and operational, refer to the *Installation & Basic Setup Instructions* shipped with the meter.

Getting More Information

Additional information is available from Power Measurement. Check our web site at **www.pwrm.com**, contact your local Power Measurement representative, or contact Power Measurement directly (contact information is provided on the first page of this document). Documents that are related to the installation, operation and application of the meter are as follows:

Installation & Basic Setup Instructions

This brief guide is shipped with each meter. It details the mounting, wiring and basic setup of the device.

ION Programmer's Reference

This online reference contains detailed descriptions of all modules in an ION meter.

ION Enterprise Administrator Guide

This guide explains the installation and configuration of the ION Enterprise software suite.

Online ION Enterprise Help

Each ION Enterprise software component has an in-depth online help system.

Technical Notes

Appendix A contains technical notes that provide details for meter features and custom configurations. These technical notes are also available from our website which is regularly updated with new and revised technical notes.

Application Notes

Online application notes offer detailed, high-level descriptions of real-world situations, where Power Measurement's ION devices and ION software provide beneficial solutions.

CHAPTER

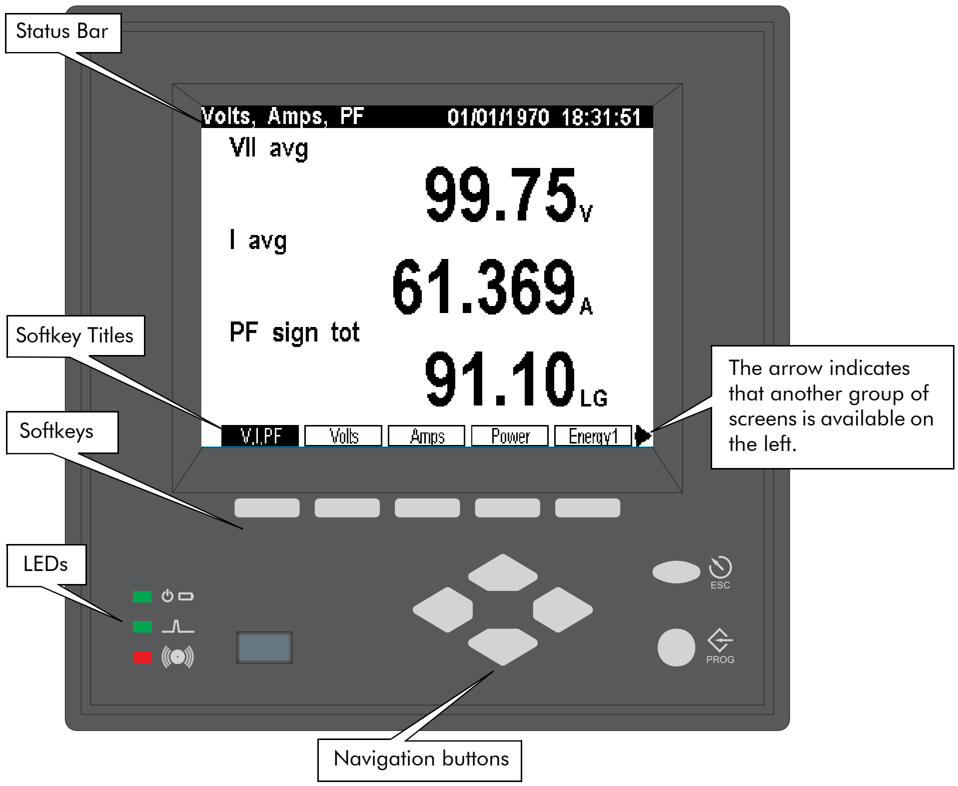
2 Using The Front Panel

The meter's front panel is used for both display and configuration purposes. The liquid crystal display (LCD) screen and the numerous selection, navigation, and configuration buttons allow quick access to basic meter configuration provided by special setup screens. The front panel also provides access to the settings of many other meter functions. Although you can customize the type of data you want displayed, this cannot be done through the meter's front panel.

In This Chapter

Displaying Data with the Front Panel

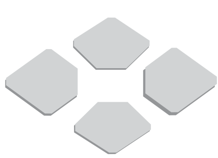
The front panel LCD (liquid crystal display) provides a detailed graphics and text display that has been factory configured to show many of the parameters measured by the meter.



The meter's display can show numeric data screens, event logs, phasor diagrams, bar graphs, and harmonics histograms.

Using the Front Panel Buttons to Display Data

The front panel has numerous buttons: softkeys, navigation buttons, program buttons. Program buttons are used when configuring the meter (see page 32). Use the following buttons to view data on the front panel display screens.



Navigation Buttons

The horizontal navigation buttons (Left/Right keys) select a different set of five Softkey titles to access different data screens. The vertical navigation buttons (Up/Down keys) are used to navigate within certain data display screens, such as within a Trend Display's graph and log screens or an Event Log screen, once one has been selected.

Softkeys

A Softkey button selects the data screen available in the corresponding Softkey title when pressed.

Front Panel LEDs

The front panel LEDs are as follows:

- The **green operation LED** (top) should always be on when the meter is in service. Contact Technical Services if this is not the case.
- The green LED in the middle is factory configured to be a Wh (del+rec) pulser. During the course of normal operation, this LED should blink intermittently as the meter measures power system energy.
- The red LED (bottom) on the front panel of the meter is provided for custom applications. Possible applications include sag/swell alarming, setpoint annunciation, and tariff notification. Like all the other outputs on the meter, this port can be controlled by a Digital Output, Pulser, or Calibration Pulser module.

Backlight Operation and Display Contrast

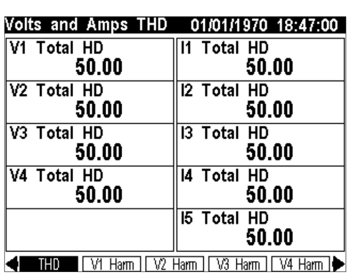
The front panel display is factory configured to dim five minutes after the last button press.If the front panel is dimmed, press any button to return the LCD to full brightness. The front panel display is adjusted at the factory to the optimal contrast level. If the contrast needs adjusting or want to change the backlight time-out period, you can do so from the Display Setup menu (see page 41).

Status Bar

The Status Bar of the meter is located along the top of all display screens. When in data display mode, the Status Bar shows: the date in MM/DD/YYYY format (configurable), the current local time in 24 hour format, and the data display screen title.

Display Screen Types

The meter's front panel displays measurements, configurable settings, and current configuration data in various forms. These data display screens are described below. Configuration (Setup menu) displays are described in the chapter "Default Functionality."



Numeric Displays

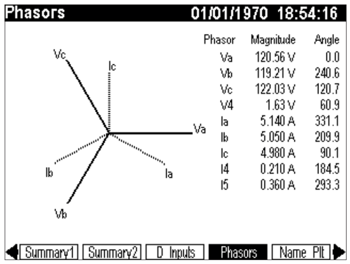
Numeric displays can show multiple parameters at a time: two, three, three with a timestamp, four, eight, ten (shown), or twenty. When displaying numeric values for current and power quantities, the front panel shows resolution to three decimal places by default. All other values are displayed to two decimals of accuracy. If you want to see finer resolutions, use Vista software to display the data.

If the front panel is unable to read a numeric value, or if the value is not available, it displays a dash (—).

Automatic Units

The front panel automatically scales the units for basic measurements, such as voltage, current and power parameters. For example, a measurement of 2,000 Watts is displayed as 2.000 kW. A measurement of 2,000,000 Watts is displayed as 2.000 MW. The meter makes these conversions using your PT and CT ratios.

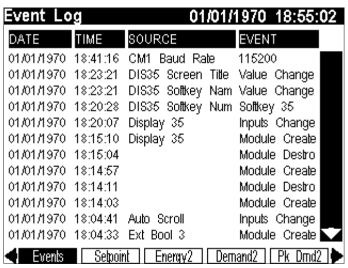
The meter only performs these automatic units if the measurement is derived solely from the Power Meter module's output.



Phasor Diagram Displays

Phase information can be displayed in phasor diagram format. Phasor diagrams are accompanied by tables that state the angle and magnitude of each phasor.

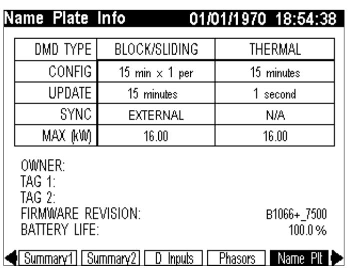
In cases where phasors are too small to be represented graphically, they are only shown as table entries.



Event Log Displays

Event Log displays alert you to recent events written to the meter's event log. The vertical (Up/Down) navigation buttons are used to move through the list.

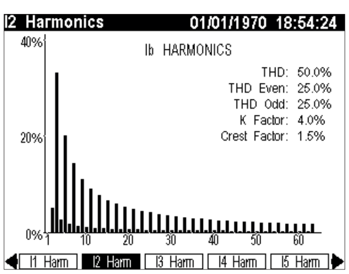
Details on altering the meter's Event Log characteristics, such as log depth and logging frequency, using Designer can be found in the "Default Functionality" chapter.



Nameplate Displays

Like Event Log displays, Nameplate displays show information in tabular format. Default nameplates show owner, meter, and power system details.

See the section "Time-Of-Use Configuration" in the Default Meter Functionality chapter for details on configuring the TAG strings.

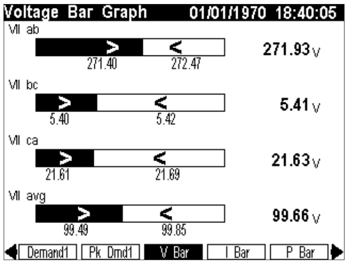


Histogram Displays

Harmonics content is displayed in histogram format. Harmonics are displayed from the 2^{nd} to the 63^{rd} harmonic, with Total Harmonic Distortion (THD) values displayed above the histogram (K Factor and Crest Factor only appear in current harmonic histograms).

Use the vertical navigation buttons on the meter front panel to select individual harmonics (from 2^{nd} to 40^{th}) in the histogram and view data specific to each of them (V_1, V_2, V_3, I_1, I_2, and I_3 only).

An arrow ▲ appears below the harmonic selected. Harmonic magnitude is displayed as an absolute value and as a percentage of the fundamental. The phase angle of each harmonic is also provided. To return to the THD values, position the arrow below the fundamental.

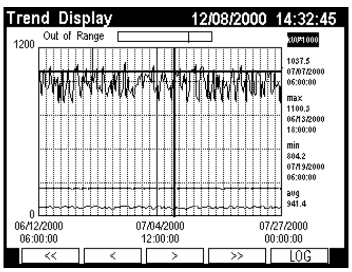


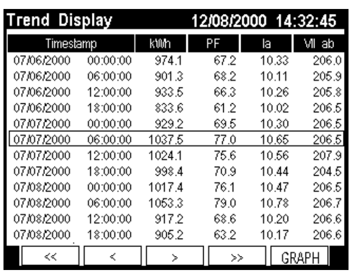
Trend Bar Graph Displays

Bar graph displays can show up to four real-time (numeric) parameters along with their upper and lower extremes.

Each bar graph automatically scales its output based on the magnitude of its extremes. The real-time value of each bar graph is displayed to the right of the graph. Note that scaling is applied separately to each bar graph in the display. *Do not* compare the magnitudes of two values based on the size of their bars.

In the trend bar graph shown on the left, the present value of Vll ab is 271.93 V. The bar graph also indicates that it has gone as low as 271.40 V and as high as 272.47 V.





Trend Display 12/08/2000 14:32:45

Timestamp		kWh	PF	Ia	Vll ab
07/06/2000	00:00:00	974.1	67.2	10.33	206.0
07/06/2000	06:00:00	901.3	68.2	10.11	205.9
07/06/2000	12:00:00	933.5	66.3	10.26	205.8
07/06/2000	18:00:00	833.6	61.2	10.02	206.5
07/07/2000	00:00:00	929.2	69.5	10.30	206.5
07/07/2000	06:00:00	1037.5	77.0	10.65	206.5
07/07/2000	12:00:00	1024.1	75.6	10.56	207.9
07/07/2000	18:00:00	998.4	70.9	10.44	204.5
07/08/2000	00:00:00	1017.4	76.1	10.47	206.5
07/08/2000	06:00:00	1053.3	79.0	10.78	206.7
07/08/2000	12:00:00	917.2	68.6	10.20	206.6
07/08/2000	18:00:00	905.2	63.2	10.17	206.6

<< < > >> GRAPH

Trend Displays

The Trend Display screen graphs the historical data of up to four different parameters simultaneously. A movable cursor that consists of the intersection of a vertical line and a horizontal line displays the value and timestamp of any plotted data within a parameter. The cursor displays the values of one parameter at one time only. With the Up and Down navigation keys, the cursor can move from one parameter to another.

In addition, a Trend Display log screen displays data logs for any graphed parameter – up to 3360 logs for each parameter. That is equivalent to 35 days worth of 15 minute data. The graph is updated when a new set of values is recorded. The highest supported update speed is once per second.

The ION 7500 front panel displays three preconfigured trending screens: V-Trend (voltage), I-Trend (current), and P-Trend (power). The ION 7600 must be configured using Designer in order to provide Trend Display. Contact Technical Services if you require your ION 7600 to be configured for Trend Display.

Default Front Panel Display Screens

The meter is factory configured to display a number of data screens on its front panel:

- 42 display screens for the ION 7500
- 48 display screens for the ION 7600

Each of these screens is accessible with a corresponding Softkey. See the "Button Functions" section for instructions on using the front panel buttons for data display.

NOTE

Each display screen is listed with the corresponding softkey name and the screen title.

Screens Shown in Display Cycle

Ten data display screens are included in the automatic display cycle. By default, the front panel scrolls repeatedly through the following screens in the order presented.

For details on screen type (e.g. three parameter, vector diagram, etc.) refer to the technical note *Custom Front Panel Displays.*

1. **V,I,PF (Volts, Amps, PF)**

   This numeric display screen contains the average line-to-line voltage, average current, and the total signed power factor.

2. **Volts (Volts)**

   This numeric display screen shows the line-to-line voltages Vll ab, Vll bc, and Vll ca.

3. **Amps (Amps)**

   This is a numeric screen containing currents I a, I b, and I c.

4. **Power (Total Power)**

   This numeric display screen contains total kW, kVAR, and kVA values.

5. **Energy1 (Energy Delivered)**

   This numeric display screen shows delivered (imported) energy values for kWh, kVARh, and kVAh.

6. **Demand1 (Demand Delivered)**

   This numeric display screen contains delivered values (kW, kVAR, and kVA) in the previous demand period. By default, these values come from a sliding window demand (rolling block) calculation.

7. Pk Dmd1 (Peak Demand Del)

This is a numeric display screen with timestamps that contains maximum delivered demand values for kW, kVAR, and kVA. The timestamps show the date and time at which the values were last updated. By default, these values come from a sliding window demand calculation.

8, 9, 10. V Bar, I Bar, P Bar (Voltage, Current, and Power Bar Graphs)

These three screens are trend bar graph displays. They show real time values for voltage (Vll ab, Vll bc, Vll ca, Vll avg), current (I a, I b, I c, I avg) and power (kW tot, kVAR tot, kVA tot, PF lag tot). The bar graphs also indicate the maximums and minimums recorded for these values.

Additional Data Display Screens

Most of the default data screens are not included in the default scrolling cycle. To view the other display screens, you must find the group of five Softkey titles that contains the data screen you want, and then press the corresponding Softkey.

NOTE

The numbers on the left correspond to the Display module's Softkey number in the ION 7600 meter's display framework. The Softkey numbering for an ION 7500 differs slightly due to V trend, I trend, and P trend taking the place of Softkeys 13, 14, and 15 respectively. The ION 7500 does not support display screens for EN50160 data and statistics.

11. Summary1 (Volts/Amps Summary)

This numeric display provides many important voltage, current, phase, and frequency measurements on a single screen.

12. Summary2 (Power Summary)

This numeric display provides real, reactive, and apparent power measurements for phase a, b and c (as well as their total). Signed Power Factor measurements are also provided on this screen.

13. D Inputs (Digital Inputs)

This numeric display screen shows the status of the eight on-board digital inputs. The present state of all inputs is shown (as Off or On) and the number (Cnt) of state changes since the last reset is recorded.

14. DI - I/O (DI on I/O Card)

This numeric display screen contains the status and counters for the digital inputs on the I/O card.

15. D Outputs (Digital Outputs)

This numeric display screen contains the mode and status for the relay and solid state outputs.

16. Anlg - I/O (Analog In and Out)

This numeric display screen contains scaled analog inputs (AI*n* scaled) and normalized analog outputs (AO*n* normalized), where *n* ranges from 1 to 4 for both inputs and outputs.

17. Phasors (Phasors)

This screen is a phasor diagram display that shows the magnitude and the relative angular difference between all phase voltage (V a, V b, V c, V 4) and current (I a, I b, I c, I 4, I 5) fundamental components.

18. Name Plt (Name Plate Info)

The Name Plate Info screen contains the following information: Owner, TAG 1 and TAG 2 from the Factory module, firmware revision of the ION meter, and a battery life indicator. TAG 1 and TAG 2 typically identify the meter's user and installed location. The Owner and TAG registers are configurable with the Designer software.

19. Events (Event Log)

The Event Log display alerts you to events written to the meter's event log. DATE, TIME, SOURCE, and EVENT information are provided. The up and down Navigation buttons allow you to move through the list.

20. Setpoint (Setpoint Status)

This numeric display screen displays the status of the setpoint parameters defined in the Vista Setpoints diagram.

21. Energy2 (Energy Received)

This numeric display screen shows received (exported) energy values for kWh, kVARh, and kVAh.

22. Demand2 (Demand Received)

This numeric display screen shows received power quantities (kW, kVAR, and kVA) in the present demand period. By default, these values are from a sliding window demand (rolling block) calculation.

23. Pk Dmd2 (Peak Demand Rec)

This is a numeric display screen with timestamps. It shows the maximum received demand quantities (kW, kVAR, and kVA) and the time at which they were recorded. By default, these values are from a sliding window demand (rolling block) calculation.

24. THD (Volts and Amps THD)

This numeric display screen contains the total harmonic distortion on all phase voltage and current inputs.

25, 26, 27, 28. V1 Harm, V2 Harm, V3 Harm, V4 Harm (Harmonics)

These four histogram display screens show the harmonic content on the phase voltage inputs.

29, 30, 31, 32, 33. I1 Harm, I2 Harm, I3 Harm, I4 Harm, I5 Harm (Harmonics)

These five histogram display screens show the harmonic content on the phase current inputs.

34. TOU (Active Rate / Season)

This eight parameter display screen shows kWh delivered values for each all four of the possible time of use (TOU) rates (rates A, B, C, and D).

35. TOU Egy (TOU Energy Del)

This numeric display screen shows the energy (in kWh) delivered for each time of use (TOU) rate (rates A, B, C, and D).

36, 37. TOU Dmd1 & TOU Dmd2 (TOU Peak Demand 1 and 2)

These two screens are numeric displays with timestamps. Together they show the maximum delivered kilowatts for each time of use (TOU) rate (rates A, B, C, and D). The timestamps show the date and time at which the values were last updated. By default, these values come from a sliding window demand (rolling block) calculation.

NOTE

The four TOU screens may only be important if you are using the meter in a billing application (i.e. you are a power provider). Typically, power consumers ignore the Time-Of-Use front panel displays.

EN50160 Data and Statistics Displays (ION 7600 only)

The remaining front panel screens display data to help you determine EN50160 voltage compliance. Unless compliance to this standard is of concern, you may ignore these displays. More details about EN50160 are provided in the technical note *Power Quality: ION Meters and EN50160*.

38. PQ Freq (PQ Power Frequency)

This numeric display shows the following EN50160 Power Frequency data: Nominal Frequency, period (10 second) Freq mean, minimum, and maximum. It also shows the EN50160 frequency compliance statistics: Freq N (the number of valid evaluation periods), Freq N_1 (a count of non-compliance), and Freq N_2 (the number of invalid evaluation periods).

39. PQ Vmag1 (PQ Supply Voltage 1)

This bar graph display shows the following EN50160 Voltage Magnitude data for all three voltage phases: period (10 minute) mean, minimum, and maximum.

40. PQ Vmag2 (PQ Supply Voltage 2)

This numeric display shows the following EN50160 Voltage Magnitude compliance statistics for all three voltage phases: mag N and mag N1.

41. PQ Flk1 (PQ Flicker 1)

This bar graph display shows the following EN50160 Flicker data for all three voltage phases: present Pst, minimum Pst, and maximum Pst.

42. PQ Flk2 (PQ Flicker 2)

This numeric display shows the following EN50160 Flicker data for all three voltage phases: present Pst, present Plt, and compliance statistics (Flck N and Flck N_1).

43. PQ Vdist (PQ Volt Disturbance)

This numeric display shows the following EN50160 Overvoltage and Dip data for all three voltage phases: expected nominal, minimum Dip, and maximum Overvoltage.

44. **PQ Vunb (PQ Volt Unbalance)**

    This numeric display contains the following EN50160 Voltage Unbalance data: V unbal mean, V unbal mean min, V unbal mean max, and compliance indicators (unbal N and unbal N_1).

45. **PQ Vhrm1 (PQ Volt Harmonics 1)**

    This bar graph display shows the following EN50160 Harmonics data: THD mean, THD mean mn, THD mean max for all three voltage phases (10-minute mean values, min and max values are updated every new observation period).

46. **PQ Vhrm2 (PQ Volt Harmonics 2)**

    This numeric display shows EN50160 Harmonics compliance statistics for all three voltage phases: Hrm N, Hrm N_1, Hrm N_2.

47. **Avblty (Power Availability)**

    This numeric display provides the following measurements: availability (with up-time in parts per million), number of nines, and evaluation time (in days).

48. **Pr - Avblty (Previous Availability)**

    This three parameter display with timestamp indicates the number of availability resets (including the most recent event's timestamp), the previous availability (with its timestamp), and the previous number of nines (with its timestamp).

Trending Display Screens in the ION 7500

The ION 7500 meter supports trending display in its framework. Each trending display has two views - graph and log - which are accessible via softkey once you are displaying the trend screen. As previously mentioned, the softkey numbering for an ION 7500 meter's display screens must be adjusted from the numbering presented for the ION 7600

V Trend (Voltage Trend Display)

The voltage trend display graphs the VII avg trend. This display is Softkey 13.

I Trend (Current Trend Display)

The current trend display graphs the I avg trend. This display is accessed with Softkey 14.

P Trend (Power Trend Display)

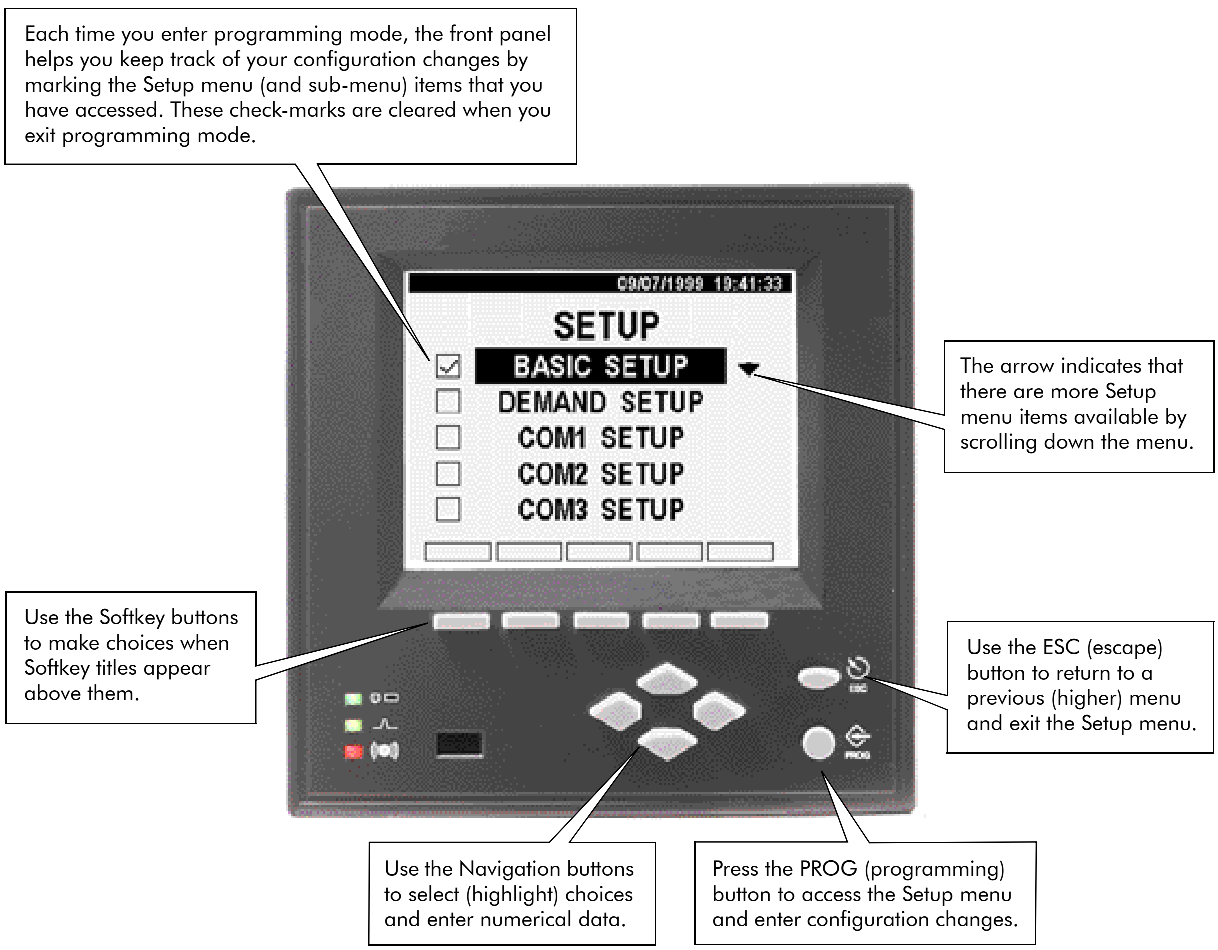
The power trend display graphs the KW tot trend. This display is accessed with Softkey 15.

Configuring the Meter with the Front Panel

The front panel allows you to setup and configure the meter at its installed location. When you change a setting in the front panel's Setup menu, you are actually altering the setup register value of an ION module. (ION module links cannot be added or deleted using the front panel.) The front panel's Setup menu also provides you with quick access to parameter resets for common cumulative parameters.

The Front Panel's Setup Menu

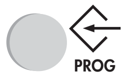
To access the Front Panel's Setup Menu, press that PROG (programming) button. Pressing the ESC (escape) button returns you to the data display screens.



Using the Front Panel Buttons for Configuration

Use the front panel buttons as follows to adjust the settings:

PROG

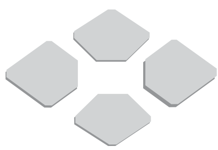


Press the PROG (programming) button to access the Setup Menu. Once in programming mode, the PROG button functions just like an Enter key on a computer keyboard. Press the PROG button to select a highlighted item or accept changes, passwords, and trigger resets.

ESC

Press the ESC (escape) button to return to a higher menu or abort a configuration change.

Navigation



Highlight menu items with the vertical (Up/Down) buttons.

Entering numbers: when a digit is highlighted, pressing the Up button increments the number by one, and pressing the Down button decreases it. Move the cursor to an adjacent digit with the horizontal (Left/Right) buttons.

Softkeys

Press a Softkey button when Softkey options become available (when titles appear in the Softkey title bar). Use Softkeys to select the parameters that you want to configure from the various sub-menus.

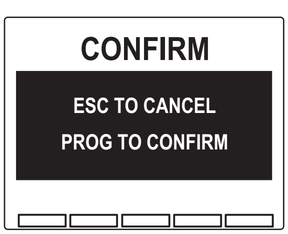
Passwords

All configuration functions in the front panel are password protected. The password is set to 0 (zero) in the factory. This password allows you to access the Security setup menu and to disable or change the password for a custom value. The front panel only prompts you for the meter password before you make your first configuration change.

Setup Mode Timeout

Once the meter has been configured, the front panel automatically exits the Setup menu five minutes after the last button press is detected. If the front panel returns to data display mode, you must re-enter the Setup menu and provide the valid meter password to resume making configuration changes.

Confirming Configuration Changes



The CONFIRM screen appears whenever you attempt to change the meter's settings through the front panel. This allows you to abort an unwanted configuration change. The front panel also informs you when an entry is out of range. In either case, you must press the PROG button to return to the setup screen.

WRITING ERROR Screen

If the CONFIRM screen does not appear for a valid entry, or the display reports a WRITING ERROR, repeat the configuration change. If the problem persists, contact Technical Services.

Basic Setup Menu

The Basic Setup menu contains values that typically do not need to be reconfigured once the meter is put into service. The Basic Setup menu item provides access to the following power monitoring system settings:

Sub-Menu	Register	Default	Description
PT/CT Setup	Volts Mode	4 Wire Wye	The power system's configuration
	PT Primary	120	The Potential Transformer's primary winding voltage rating for VA, VB, and VC
	PT Secondary	120	The Potential Transformer's secondary winding voltage rating for VA, VB, and VC
	CT Primary	5	The Current Transformer's primary winding current rating for IA, IB, and IC
	CT Secondary	5	The Current Transformer's secondary winding current rating for IA, IB, and IC
V4 Setup	V4 Primary	120	The potential transformer's primary winding rating on input V4
	V4 Secondary	120	The potential transformer's secondary winding rating on input V4
I4/I5 Setup	I4 Primary	5	The current transformer's primary winding rating on input I4
	I4 Secondary	5	The current transformer's secondary winding rating on input I4
	I5 Primary	5	The current transformer's primary winding rating on input I5
	I5 Secondary	5	The current transformer's secondary winding rating on input I5
V Polarity[1]	VA Polarity	Normal	The polarity of the potential transformer on VA
	VB Polarity	Normal	The polarity of the potential transformer on VB
	VC Polarity	Normal	The polarity of the potential transformer on VC
	V4 Polarity	Normal	The polarity of the potential transformer on V4
I Polarity[1]	IA Polarity	Normal	The polarity of the current transformer on IA
	IB Polarity	Normal	The polarity of the current transformer on IB
	IC Polarity	Normal	The polarity of the current transformer on IC
	I4 Polarity	Normal	The polarity of the current transformer on I4
	I5 Polarity	Normal	The polarity of the current transformer on I5
Current Probe[2]	Probe Type	Factory Default	Current Probe Input setting – selects phase angle correction method for I1, I2, I3

[1] Polarities can be normal or inverted.

[2] Applicable to meters ordered with the current probe input option.

All Basic Setup menu items are setup registers in the Power Meter module. See the online *ION Programmer's Reference* for details.

The Current Probe phase calibration registers are setup registers in the Factory module that can be configured in a Telnet or HyperTerminal session. Up to three separate groups of registers (*Factory Default, User Defined 1,* and *User Defined 2*) can be set up for three different Current Probes. In the Basic Setup menu, the *Probe Type* register is used to activate one of those register groups. Only the selected group is used in the meter's calculations.

Main Setup Menu

Press the PROG button to enter the main setup menu. The following table summarizes the front panel's Setup menu functions:

Setup Menu Item	Description
Basic Setup	Changes basic settings in the power measurement system configuration
Demand Setup	Sliding Window (Rolling Block) and Thermal Demand settings
COM1 Setup	RS-232 or RS-485 port setup
COM2 Setup	High-speed RS-485 port setup
COM3 Setup	Optical port (infrared) and optional internal modem setup
Network Setup	Ethernet Network addressing
PQ Setup	Sets the criteria (including nominal voltage) for disturbance detection
Format Setup	Customizes the style and values appearing on the display screens
Display Setup	Customizes display appearance and update rate
Time Setup	Clock and meter time settings
Security Setup	Modify and enable/disable password functions
Meter Resets	Reset functions for factory and user determined cumulative parameters

Highlight the Setup menu item that you want to access with the vertical navigation buttons. To select the item, press the PROG button. The content of each Setup menu item is described on the following pages.

Demand Setup Menu

Demand Setup provides access to all of the factory-configured parameters for sliding window demand (rolling block) and thermal demand.

The ION module setup register corresponding to each Demand Setup value is included for advanced users; these are found in the description for each Demand Setup value. Refer to the online *ION Programmer's Reference* for complete details about Sliding Window Demand modules and Thermal Demand modules.

Sliding Window Demand (Rolling Block) Settings

The Sliding Window sub-menu contains the following settings:

Sub Interval

This numeric value specifies the number of seconds in the sliding window demand sub-interval. Setting the SUB INTERVAL value changes the *Sub Intvl* setup register in all factory-configured Sliding Window Demand modules.

#Sub Intervals

This numeric value specifies the number of sub-intervals in the sliding window. Setting the #SUB INTERVALS value changes the *#Subintvls* setup register in all of the factory-configured Sliding Window Demand modules.

Predicted Response

This numeric value specifies the speed of the predicted demand output. It allows you to set the sensitivity of the demand prediction. Typically, this value does not need to be changed.

Specify 99 for the fastest prediction speed. The slowest prediction speed (0) causes the predicted demand output to follow the sliding window demand output. Setting the PRED RESPONSE value changes the *Pred Resp* setup register in all factory-configured Sliding Window Demand modules.

Thermal Demand Settings

The Thermal sub-menu contains the following settings:

Interval

This value specifies the number of seconds in the thermal demand interval. Setting the INTERVAL value changes the *Interval* setup register in all factory-configured Thermal Demand modules.

Time Constant

This value is a time constant that specifies the rate at which the thermal demand output responds to changes in the source input. Typically, this value does not need to be changed.

The higher you set the time constant value, the faster the response time will be. Values commonly used are 63 and 90. Setting the TIME CONSTANT value changes the *Time Const* setup register in all factory-configured Thermal Demand modules.

Demand Options

The Demand Options sub-menu contains the following setting:

Demand Lockout (days)

This value sets the minimum time allowed between consecutive demand resets *from the front panel only*; any attempts to reset the demand outside the bounds of the register will be ignored.

The default value for the Demand Lockout time is 25 days. The corresponding setup register, labeled *Demand Lockout Time*, is found in the Display Options module. This setting does not apply to demand resets initiated from software communications connections.

Network Setup

This menu item allows you to configure the Ethernet communications channel. The following settings can be configured in this option:

Setting	Description	Default
IP BootP Option	A BootP server automatically sets the IP Address, Subnet Mask, Gateway, and SMTP Mail Server IP Address – see your Network Administrator to determine if BootP is used If the IP BootP Option is set to BootP mode, then no network settings can be changed	BootP (Only meter's ordered with the Ethernet option are set to BootP by default; the default is otherwise set to Manual.)
IP Address	Sets the IP Address for the meter	If a BootP server has been correctly set up, the IP Address number appears. If no BootP server has been set up (e.g. you wish to configure settings through the front panel) then the default is None.
Subnet Mask	Used if subnetting applies to your network – see your Network Administrator to determine if Subnet Mask is used	If a BootP server has been correctly set up, and Subnet Mask is used, then the Subnet Mask address number appears. If Subnet Mask is not used, then the default is None. If no BootP server has been set up (e.g. you wish to configure through the front panel) then the default is None.
Gateway	Used in multiple network configurations – see your Network Administrator to determine if Gateway is used	If a BootP server has been correctly set up, and Gateway is used, then the Gateway address number appears. If Gateway is not used, then the default is None. If no BootP server has been set up (e.g. you wish to configure through the front panel) then the default is None.
SMTP Address	Sets the IP Address for the SMTP Mail Server that is configured to forward mail from the meter to the final destination – see your Network Administrator to determine if the SMTP Mail Server is used	If a BootP server has been correctly set up, and an SMTP Address is used, then the SMTP Address address number appears. If an SMTP Address is not used, then the default is None. If no BootP server has been set up (e.g. you wish to configure through the front panel) then the default is None.

Network settings can be configured automatically with BootP or manually through the front panel. (You can also configure network settings via Designer or ION Setup software — see "Using ION Software" on page 87 of this manual for more information.)

Configuring Network Settings with BootP

The BootP network setting is enabled by default. When a BootP server is set up with the correct information, the network settings (IP Address, Subnet Mask, Gateway, and SMTP Mail Server IP Address) automatically configure.

Ask your Network Administrator whether a BootP server has been set up on your network. If it has, and your Network Administrator has allocated the required network settings on the BootP server, then all of the network settings (that your facility requires) automatically appear on the Network Setup screen.

Configuring Network Settings Through the Front Panel

To configure network settings through the meter's front panel, you must change IP Boot Option from (the default) BootP to Manual.

Typically, your Network Administrator will provide you with the appropriate IP Address for the meter. The Subnet Mask and Gateway settings are only required if you have communications between multiple Ethernet networks and if subnetting is implemented.

⚠ CAUTION

Configuring the IP Address, Subnet Mask, and Gateway registers incorrectly can cause network disruptions. See your network administrator for more information.

Use the four Navigation buttons to edit the values of the network settings so that they match your system addresses.

As you configure the network addresses, the front panel automatically hides unnecessary leading zeroes from each three-digit grouping. The hidden leading zeroes appear (and disappear again) as you move the position of cursor across the network address.

89.123.40.056

In the example above, the highlighted zero is hidden as soon as you change the position of the cursor.

Serial Communications Setup

The current configuration of COM1 (RS-232 or RS-485), COM2 (RS-485), and COM3 (optical port or internal modem) are found in the COM Setup menu items. Ethernet settings are located under Network Setup. Depending on communications ports ordered with your meter, the parameters that you can setup for COM1, COM2, and COM3 are as follows:

COM Port Setting	Options	Default
Protocol	ION, Modbus RTU[1], Modbus Master, DNP 3.00, GPS Arbiter[2], GPS:Arbiter-Vorne[2], GPS:TrueTime/Datum[2], Factory, IEC870-102[3], EtherGate[3], and ModemGate[3].	all ports: ION
Baud Rate	300, 1200, 2400, 4800, 9600, 19200, 38400, 57600, and 115200 bps	9600 bps
Tran Delay	Transmit delay - the bounds are 0.0 to 1.0 s.	0.01s (10ms)
Unit ID	Sets the meter's Unit ID; a unique Unit ID is required for each device on a serial network.	COM1: Unit ID is based on the serial number.[5] COM2: 101 COM3: 102
Mode (COM1 and COM3)	The communications mode selected COM1:RS-232 or RS-485 COM3: IrDA or Modem (internal)	COM1: RS-232 COM3: Modem
Flow Control (COM1 only)	'RTS/CTS' or 'RTS with Delay'	'RTS with Delay'
Modem[4] (COM3 only)	Answer HR Rings– The number of rings during defined answer hours. Valid entries for this register are 0-255 rings; an entry of 0 rings will disable answering	1
	Non-Answer HR Rings– The number of rings during defined non-answer hours.	5

1 Connect to IP service port 7701 for Modbus RTU communications over Ethernet. The Modbus Unit ID of the meter over Ethernet is 100.

2 See the technical note *Time Synchronization and Timekeeping* for details about GPS.

3 IEC870-102, EtherGate and ModemGate are only available on COM1 and COM2.

4 This setting only applies if you have ordered the internal modem option (see below).

5 The factory set Unit ID for COM1 is based on the serial number of the meter, using the last four numbers before the dash. For example, if the serial number is PA-0009B263-01, the Unit ID is set in the factory to 9263. After a factory reset, the unit ID number will default to 100.

NOTE

The Factory Protocol is reserved for the use by Power Measurement Technical Services. Contact Technical Services if you require more information.

Internal Modem Setup

If you have the internal modem order option, you disable the IrDA optical port on COM3 by selecting MODEM for the *Mode* setting. The modem is factory configured to answer in the number of rings specified by Answer HR Rings (the Non-Answer HR Rings value is ignored by default).

A list of compatible AT commands is provided on the website and the technical note *Modem AT Commands for ION Meters*. Visit the web site for the latest modem configuration files.

PQ (Power Quality) Setup

The PQ Setup screen contains the following settings for the detection voltage sags and swells (i.e. ITI (CBEMA) Type 2 and Type 3 disturbances). The ION module setup register corresponding to each Sag/Swell Setup value is included for advanced users. Refer to the online *ION Programmer's Reference* for complete details about the Sag/Swell module.

Sag Limit

This item specifies the magnitude below which a power system input must fall for a sag to be recorded. This value must be expressed as a percentage of the nominal voltage (entered below in the NOMINAL VOLTAGE item). Setting the SAG LIMIT value changes the *Sag Lim* setup register in the factory-configured Sag/Swell module.

Swell Limit

This item specifies the magnitude above which a power system input must rise for a swell to be recorded. This value must be expressed as a percentage of the nominal voltage (entered below in the NOMINAL VOLTAGE item). Setting the SWELL LIMIT value changes the *Swell Lim* setup register in the factory-configured Sag/Swell module.

Change Criteria

You do not need to change this value for normal operation. This setting specifies the amount by which an input must change (either rise or fall) during a disturbance to be considered a new sub-disturbance. This value must be expressed as a percentage of the nominal voltage (entered below in the NOMINAL VOLTAGE item).

For example, if your Nominal Voltage is 120 V and your Change Criteria is 10%, any voltage change of 12 V or more during a disturbance will cause a new sub-disturbance to be recorded. Setting the CHANGE CRITERIA value changes the *ChangeCrit* setup register in the factory-configured Sag/Swell module.

Nominal Voltage

This item specifies the nominal voltage of the power system you are monitoring. By default, this value is set to 0 V. You should ensure that this item matches your power system's nominal voltage (i.e. 120, 277, or 347). All Sag/Swell functions are disabled when the nominal voltage setting is 0 (zero). Setting the NOMINAL VOLTAGE value changes the *Nom Volts* setup register in the factory-configured Sag/Swell module.

⚠ CAUTION

For the ION 7600 only, the value you enter will also be used by the Transient module and in all EN50160 compliance calculations. Therefore, all EN50160 and Transient functions are disabled when the NOMINAL VOLTAGE setting is 0 (zero). You should ensure that this item matches your power system's nominal voltage (i.e. 120, 277, or 347).

Event Priority

You do not need to change this value for normal operation. This setting allows you to assign a priority level to the Sag/Swell module events (from 0 to 255, 255 being the highest priority). Setting the EVENT PRIORITY value changes the *EvPriority* setup register in the factory-configured Sag/Swell module.

Format Setup Menu

Format Setup contains values that allow you to set labeling and formatting preferences for the front panel display.

Numeric Format

The Numeric Format sub-menu contains the following settings:

Digit Group

This specifies the symbols used to delimit thousands and the decimal place holder (i.e. 1000.0 or 1,000.0 or 1 000,0). The default is 1000.0 (no commas, no spaces).

Volts Decimal

You can display voltage measurements to one, two, or three decimal places. The default value is two decimal places.

Current Decimal

You can display current measurements to one, two, or three decimal places. The default value is three decimal places.

Power Decimal

You can display power measurements to one, two, or three decimal places. The default value is three decimal places.

General Format

The General Format sub-menu contains the following settings:

Phase Label

You can apply phase labels in any of the following six variations: ABC, RST, XYZ, RYB, RWB, and 123. The default label is ABC.

PF Symbol

You can choose Power Factor symbols to be: LD/LG (lead/lag), +/– (positive/negative), or CAP/IND (capacitive/inductive). The default symbols are LD/LG.

Date Format

You can have the front panel express the date in any of these formats: MM/DD/YYYY, DD/MM/YYYY, and YYYY/MM/DD. The default is MM/DD/YYYY.

Show DST

You can choose whether or not to display Daylight Savings Time (DST) on the front panel. The default is Display DST.

Display Setup Menu

You can configure the following display preferences within Display Setup.

Update Rate

You can set the front panel to update its data from every one to every six seconds. The default update time is one second.

Contrast

You can set the front panel display contrast level from level zero to level nine where higher numbers represent a sharper level of contrast.

NOTE

Press and hold both the "Up" navigation button and the PROG button at the same time. The contrast level will cycle through its range (0 to 9). Release the buttons at the contrast level you desire.

Backlight Timeout

This selection allows you to make the backlight dim automatically after zero to 7200 seconds (two hours). The default is 300 seconds (five minutes). If this value is set to 0 (zero), the backlight will always be at full brightness. Leaving the backlight at full brightness will reduce the back light's life expectancy.

Time Setup Menu

The Time Setup menu provides access to various time-related parameters in the meter, such as the synchronization sources and channels used, and the time offsets applicable to your location.

Clock Setup

The Clock Setup sub-menu contains settings for the meter's time keeping and time synchronization methods. Changing the settings under Clock Setup alters the setup register values of the Clock module — the module that provides timestamps for the data logged by the meter. Refer to the online *ION Programmer's Reference* for more information about the Clock module.

TZ Offset (hh:mm)

Set this value to the time zone of the meter's location, relative to Coordinated Universal Time (UTC). For example, an entry of -08:00 is the correct offset for Pacific Time in the USA, Canada, and Tijuana. Specify a positive (+) or negative (–) offset with the Navigation buttons. The value must be non-zero before you can change its sign.

DST Offset (hh:mm)

This setting determines the daylight savings time offset applicable to your location. The DST offset is the amount of time that the clock is moved when Daylight Savings time begins or ends. For example, an entry of +01:00 sets a daylight savings time offset of one hour. Setting DST offset to 0 (zero) disables daylight savings entirely. Specify a positive (+) or negative (–) offset with the Navigation buttons. The value must be non-zero before you can change its sign.

NOTE

The Clock Module's *DST Start* and *DST Stop* setup registers control the start and end times for Daylight Savings for up to twenty consecutive years. These registers are already configured in the factory. To change them, you must use Designer.

Sync Type

This setting specifies whether time synchronization signals are received in UTC (Coordinated Universal Time) or Local Time. The default is set to UTC for ION Enterprise. Some DNP masters use Local Time.

Sync Source

This setting determines the port responsible for receiving the time synchronization signals. Only signals received on the selected port are used to synchronize the meter's internal clock; time synchronization signals on all other ports are ignored. The choices are ETHERNET, COM1, COM2, and COM3. The default is COM1. Refer to the *Time Synchronization and Timekeeping* technical note for more details on synchronization sources.

Clock Source

This item determines the time synchronization source. The meter clock can be synchronized externally from the line frequency (Line Freq), or from an internal crystal (Internal), or through a communications port (COMM). The default is Line Freq. If you are using GPS time synchronization, change this setting to COMM.

Set Meter Time

The Set Meter Time sub-menu contains settings for the date and time displayed on the front panel. The Meter Time settings are dependent upon the configuration of the Clock Setup menu–-you must set the time zone offset (TZ Offset) prior to setting the Local Date and Time.

Local Date

Use this item to set the meter's display to the current date. The format of the date is defined in the General Format Setup menu.

Local Time

Use this item to set the meter's display to local time.

Meter Resets

The Meter Resets menu item allows you to clear the cumulative parameters stored by the meter. You are required to enter a valid meter password before executing any meter resets.

Factory Resets

This sub-menu contains the following default resets:

peak dmd rset

The Peak Demand Reset allows you to clear the peak demand values logged in the meter. When the meter is in test mode, the Demand Reset object clears the Revenue Test Mode demand parameters.

NOTE

See "Revenue Measurements" on page 97 for more information about TEST mode.

By default, there is a 25 day Demand Lockout Time. This is the minimum time allowed between consecutive demand resets. Any attempts to perform a demand reset before the lockout time has expired will be ignored. See "Demand Setup Menu" on page 34 for details about reconfiguring the default Demand Lockout.

MNMX RSET

The Minimum/Maximum Reset allows you to clear all accumulated minimum and maximum values stored in the meter.

HARM MNMX RSET

The Harmonics Minimum/Maximum Reset allows you to clear all accumulated minimum and maximum harmonics values stored in the meter.

MASTER RESET

The Master Reset control allows you to clear all the cumulative and derived quantities from the meter (including demand, peak demand, energy, revenue, and test mode parameters), clear the meter's event and waveform logs, and reset the meter's Data Recorder modules.

CAUTION

The Master Reset operation will clear all billable quantities from the meter, all logged data from the meter's event and waveform logs, and all data recorders. Carefully consider the implications of performing a Master Reset before proceeding.

DI COUNT RESET

The DI Count Reset allows you to clear the Digital Input Status Change counter. By default, the number of status changes of each digital input is shown in the *D Inputs* front panel display as well as in the Vista Digital Inputs/Outputs diagram.

User Resets

This sub-menu contains less critical and user-configurable controls.

DIST COUNT RESET

The meter contains a voltage disturbance display in its Power Quality Vista diagram, which counts the number of sag/swell events that have occurred since power-up or last reset. The Disturbance Count Reset allows you to clear this counter. See “PQ (Power Quality) Setup” on page 39.

MAN WFM TRG

The Manual Waveform Trigger forces the meter to perform a waveform capture. Waveform data is accessible in the Vista Power Quality diagram.

AVAILABILITY RESET

This item resets the Power Availability framework. Current values in the Availability display screen - availability (up-time in parts per million), number of nines, and evaluation time (in days). The previous statistics will appear in the Previous Availability display screen.

EN50160 RESET (ION 7600 only)

This item will reset all EN50160 parameters and statistics accumulated in the meter. Refer to Chapter 2 for a description of the EN50160 parameters displayed on the default front panel data screens and Vista diagrams. The technical note *Power Quality: ION Meters and EN50160* contains more information about EN50160.

CUSTOM 1 TRIG, CUSTOM 2 TRIG

These are resets that you may program yourself with Designer. The ION 7600 only has the CUSTOM 1 TRIG available, whereas the ION 7500 has both custom resets. Refer to “Creating a Front Panel Reset” on page 46 for more details.

Security Setup

The meter's eight-digit password allows you to configure the meter using the meter's front panel.

The settings in Security menu item allow you to:

- modify the existing meter password
- disable the password security check
- disable web browser configuration of the meter

You require the valid password to enter this menu. The default password is 0 (zero).

NOTE

The password enables users to change the configuration of the meter. It is recommended that you change your password from the default when you put the meter into service.

If have not yet entered your password, the meter front panel requires that you enter it before you can view the Security Setup menu. Refer to "Using the Front Panel Buttons for Configuration" on page 32 for instructions on the Navigation buttons to enter numerical data.

If you enter an incorrect password, the front panel will display an "invalid password" message and you must try again.

Password

Use this setting to change the current password to any eight digit number. As with all configuration changes, you are required to confirm the change. By default, the password is set to 0 (zero) in the factory. The password may be changed to any eight digit number.

Enabled

Use this setting to enable and disable password security on the meter. Disabling the password allows changes to all the meter's settings through the front panel without a security check.

⚠ **CAUTION**

Non-secure access to critical settings in the meter, such as PT and CT ratios, is not advisable. It is highly recommended that any meter in the field have the password security check enabled.

When you re-enable password security, the password is reset to the factory default of 0 (zero). You should re-enter a custom password at this point.

Disabling the Password Security Check is required to write to the meter via the Modbus RTU protocol. Refer to "Third Party Protocols" on page 68 for details about configuring your meter for third-party systems.

Web Config

Use this setting to disable web browser configuration of the meter.

Custom Front Panel Displays

ION meters ship with preconfigured display screens. Most users find that the data displayed by the front panel Liquid Crystal Display (LCD) screen suits their needs entirely. However, the data display screens can be customized to show virtually any parameter that is measured or calculated by the meter. For example, you could do one or all of the following with Designer software:

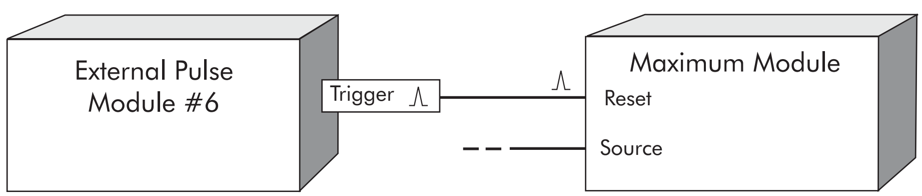
- change displayed parameters, such as from *Vll* to *Vln* or *Vllab* to *Vlna*
- aggregate displays from multiple meters, such as using a meter's front panel display to view data collected by one or more TRAN units
- adjust character size to be different on each screen
- change data display settings such as backlight timeout, automatic display scrolling, parameter update rate and display mode

Furthermore, the meter's Trend Display screen simultaneously graphs the historical data of up to four different parameters. A Trend Display log screen displays the data logs for any graphed parameter.

In order to customize your front panel display screens, you must make changes to ION modules that belong to the display framework. The technical note *Custom Front Panel Displays* has complete details on personalizing your meter's display screens.

Creating a Front Panel Reset

The meter's factory configuration allows some External Pulse modules to be triggered from the "User Resets" screen in the meter Setup menu. To define a custom reset, you must use ION software to link one of these External Pulse modules to the *Reset* input of the module that holds the value that you want to reset.



By default, the *Trigger* output of this module is linked to the User Resets item in the front panel Setup menu.

This ION module holds the value that you can reset from the front panel. You may also have to create and configure it.

These are the External Pulse modules that you can trigger from the front panel:

Meter Type	External Pulse Modules	User Resets Setup Menu Labels
ION 7500	#4 and #6	*Custom 1 Trg* and *Custom 2 Trg*
ION 7600	#6	Custom 1 Trg

Refer to "Meter Resets" on page 43 for more details about the User Resets screen in the meter's front panel Setup menu.

To access the External Pulse modules (#4 or #6) using Designer:

1. Double-click on the Advanced Setup folder in the main meter configuration screen. A number of framework folders appear.
2. Double-click on the folder labeled Custom Resets. The appropriate External Pulse module is now available for your customization.

CHAPTER

3 Default Meter Functionality

The information provided in this chapter corresponds to factory-configured ION devices. If you have a custom framework, some of the default settings may differ for your configuration.

In This Chapter

Default Meter Functionality

The following sections describe the default functionality defined by your meter's framework. With each advancement of firmware, there are changes to the framework, so your meter operation may differ slightly from what is presented.

The *ION Device Templates* documentation lists all the ION modules available in the current version of your meter, lists the total number of each ION module, and shows the ranges or options available for each module's setup registers. The *ION Devices Templates* documentation is available at www.pwrm.com.

Basic Setup

Basic configuration of the meter is provided by the Power Meter module. The Power Meter module is the main connection between the power system measurements and all other ION modules in the device. This module reports the values for all voltage, current and power measurements.

The Power Meter module's setup registers describe details of the power system being monitored. Many of the Power Meter module's setup registers are configured when the meter is initially put into service, although the device cannot operate properly until the Volts Mode and PT and CT ratios are set. Some registers may need to be changed to refine the device's operation.

Setup Register	Function	Default
Volts Mode [1]	The power system's configuration – WYE, DELTA, Single, etc	4W-WYE
PT Prim [1]	The Potential Transformer's primary winding rating for V1, V2 and V3	120
PT Sec [1]	The Potential Transformer's secondary winding rating for V1, V2 and V3	120
CT Prim [1]	The Current Transformer's primary winding rating for I1, I2 and I3	5
CT Sec [1]	The Current Transformer's secondary winding rating for I1, I2 and I3	5
V4 Prim [1]	The Potential Transformer's primary winding rating for V4	120
V4 Sec [1]	The Potential Transformer's secondary winding rating for V4	120
I4 CT Prim [1]	The Current Transformer's primary winding rating for I4	5
I4 CT Sec [1]	The Current Transformer's secondary winding rating for I4	5
I5 CT Prim [1]	The Current Transformer's primary winding rating for I5	5
I5 CT Sec [1]	The Current Transformer's secondary winding rating for I5	5
Vn Polarity	The polarity of the Potential Transformer on Vn	Normal
In Polarity	The polarity of the Current Transformer on In	Normal
Phase Order	The expected rotation of the voltage phases (ABC or ACB)	ABC
Phase Lbls	The phase label format assigned to the outputs (ABC, RST, XYZ, RYB, RWB or 123)	ABC

[1] The registers are typically set when the device is commissioned. Changing the values of these registers while the device is in service is not recommended.

Once basic setup is performed (i.e. the PT/CT and Volts Mode settings), the meter operates properly. Typically there is no need to make further changes to the Power Meter module's setup registers.

Communications Setup

Communication settings are typically configured when the ION meter is initially put into service. Each communications port on a meter is controlled by a single Communications module. The modules' setup registers define the parameters used for each port, so parameters do vary according to the type of communications channel selected (i.e. RS-232, RS-485, Modem, Infrared, Ethernet).

The Communications modules control the following channels:

Module Name	Settings
Comm 1	Selectable RS-232 or RS-485 port on COM1
Comm 2	High-speed RS-485 port on COM2
Comm 3	IrDA optical (infrared) RS-485 port or optional internal modem on COM3
Ethernet	Optional 10Base-T or 10Base-FL Ethernet port

A communications channel must be configured before you can use ION software (i.e. Vista or Designer). Altering the settings of a channel that is in use causes a loss of communications with the meter.

Communications Port	Setup Register	Function	Default
all Serial ports	Protocol	This sets the serial port's communications protocol	ION
all Serial ports	Baud Rate	This sets the communications speed in bits/second	9600 bps
all Serial ports	RTS Delay	This sets the RTS Delay for the serial communications port	0.01s (10ms)
all Serial ports	Unit ID	This sets the meter's Unit ID (A unique Unit ID is required for each device, including all the devices on a ModemGate or EtherGate serial loop.)	COM1: Unit ID is based on the serial number.[1] COM2: 101 COM3: 102
COM1 and COM3	Mode or Comm Mode	This sets the communications standard the hardware channel employs. COM1: RS-232 or RS-485 COM3: IRDA optical port or internal modem	COM1: RS-232 COM3: Modem
COM1 (RS-232) only	HshakeMode	Specifies the handshake mode the device is using when the Comm Mode is set to RS-232	RTS with Delay
COM3 (internal modem) only[2]	Answer Hours Rings	This specifies the number of rings during defined answer hours. Valid entries for this register are 0-255 rings; an entry of 0 rings will disable answering.	1
	Non-Answer Hours Rings	This specifies the number of rings during defined non-answer hours	5

Communications Port	Setup Register	Function	Default
Ethernet port	IP Boot Option	A BootP server automatically sets the IP Address, Subnet Mask, Gateway, and SMTP Mail Server IP Address. – see your Network Administrator to determine if BootP is used	BootP
	IP Address	This sets the IP Address of the meter	None (if BootP server is not used)
	Subnet Mask	This sets the Subnet Mask setting for the Ethernet Port	None (if BootP server is not used)
	Gateway	This sets the Ethernet Gateway setting for the Ethernet Port	None (if BootP server is not used)
	SMTP Server	This sets the IP Address for the SMTP Mail Server that is configured to forward mail from the meter to the final destination	None (if BootP server is not used)

[1] The factory set Unit ID for COM1 is based on the serial number of the meter, using the last four numbers before the dash. For example, if the serial number is PA-0009B263-01, the Unit ID is set in the factory to 9263. After a factory reset, the unit ID number will default to 100.

[2] If you have the internal modem order option, the modem shares COM3 with the IRDA optical port. The modem is factory configured to answer in the number of rings specified by Answer HR Rings (the Non-Answer HR Rings value is ignored by default). The modem initialization string (*Modem Init*) can only be altered via software communications.

Refer to the online *ION Programmer's Referenc*e for complete details about all the setup registers in the Communications module.

Modem Initialization String

The setup register labeled *ModemInit* is available for ION 7500 and ION 7600 meters with internal modems, and defines the initialization string for the internal modem (by default, the modem is factory configured to answer on one ring). You should not require changes to the *ModemInit* string for normal operation. If you require advanced modem functionality, you can customize the *ModemInit* register with a string up to 47 characters long.

Refer to the *Modem AT Commands* technical note for information regarding your internal modem, including details on customizing the modem's registers.

NOTE

The ModemInit string is automatically sent to the internal modem when the *ModemInit* setup register is changed, when the meter is powered up, and when the baud rate of the modem's Communications module is changed.

Communications Protocols

By default, all COM ports are configured to use the ION protocol. If you want to make use of Modbus RTU, DNP, or GPS system, you need to configure the *Protocol* setup register for the Communications module that controls the port you want to use. However, the FACTORY protocol is reserved for the use by Technical Service Engineers.

Data Logging Setup

The data recording frameworks contain Data Recorder modules, Waveform Recorder modules, and Periodic Timer modules. Data Recorder and Waveform Recorder modules are responsible for logging the power system data. The Periodic Timer modules control the recording frequency of the recorder modules to which they are linked.

Default Logging Capacity

The following table summarizes the default recording depths and recording intervals of the various Data recorders and Waveform recorders in the meter.

Log name	Depth	Interval
Revenue Log	3360	900 seconds (15 minutes)
Loss Log	3360	900 seconds (15 minutes)
TOU Data Logs (6 data recorders)	20 (ION 7500) 50 (ION 7600)	Triggered on demand
Historic Logs (3 data recorders)	760	900 seconds (15 minutes)
Harmonics Logs (2 data recorders)	190 (ION 7500) 840 (ION 7600)	3600
Waveform recording (waveform recorders: 6 for ION 7500, 14 for ION 7600)	5 ION 7500) 15 (ION 7600)	Triggered on demand
Report Generator Log (EgyDmd Log)	192 ION 7500) 3360 (ION 7600)	900 seconds (15 minutes)
Sag/Swell Log	100	Triggered on demand
Transient Log (ION 7600 only)	100	Triggered on demand
Event Log (Event Log Controller module)	500	Triggered on demand
EN50160 Logs (22 data recorders) (ION 7600 only)	10	Daily, weekly, 10 minutes, ...

Procedures for changing the logging depth and the frequency of logging are follow below.

Changing the Log Depths

Change the value in the Data Recorder's *Depth* setup register to increase the number of records stored in the recorder. The *RecordMode* setup register controls how the Data Recorder will overwrite old records; refer to the Data Recorder module description in the online *ION Programmer's Reference* before changing this setup register.

Changing the Frequency of Logging

The five Periodic Timer modules that control the frequency of different data recording are as follows:

- "Revenue Log Trg" controls the frequency of the logging of revenue values
- "Loss Log Trg" controls the frequency of Loss Compensation Data logging
- "EgyDmd Log Trg" controls the frequency of logging for the Energy and Demand Log (this log is used for generating reports using Reporter)
- "Hist Log Trg" controls the frequency of Historic Data logging
- "Harm Log Trg" controls the frequency of Harmonics logging

NOTE

The life of the flash memory is estimated at 40 to 50 years of read/writes under normal conditions. If the meter is programmed to write the data recorders in very short intervals, the life of the flash memory will be significantly reduced.

Change the value in the *Period* setup register to change the frequency of data logging (Period values are specified in seconds). Do not change the *Sync Mode* setup register.

For more information about the EN50160 data recorders, refer to "EN50160 Compliance Logging (ION 7600 only)" on page 57 as well as the technical note *Power Quality: ION Meters and EN50160* in Appendix A.

Default Logging Configuration

The following sections describe each Data Recorder and the parameters they log.

Revenue Log

The *Revenue Log* (Data Recorder #1) is configured for use with UTS MV-90 billing software. The default values logged by the Revenue Log are as follows:

Parameter	Description
kWh del int	Interval kWh delivered
kWh rec int	Interval kWh received
kVARh del int	Interval kVARh delivered
kVARh rec int	Interval kVARh received

Historic Data Logging

Three data recorders are used to record "standard" power system quantities, such as phase current, phase voltage and power factor. These recorders are labeled *Hist Mean Log*, *Hist High Log*, and *Hist Low Log*. By default, they log the following ION output register values:

Hist Mean Log	
Vll ab mean	I avg mean
Vll bc mean	I 4 mean
Vll ca mean	kW tot mean
Vll avg mean	kVAR tot mean
V unbal mean	kVA tot mean
Ia mean	PF lag mean
Ib mean	PF lead mean
Ic mean	Freq mean

Hist High Log	
Vll ab high	I avg high
Vll bc high	I 4 high
Vll ca high	kW tot high
Vll avg high	kVAR tot high
V unbal high	kVA tot high
Ia high	PF lag high
Ib high	PF lead high
Ic high	Freq high

Hist Low Log	
Vll ab low	I avg low
Vll bc low	I 4 low
Vll ca low	kW tot low
Vll avg low	kVAR tot low
V unbal low	kVA tot low
Ia low	PF lag low
Ib low	PF lead low
Ic low	Freq low

Loss Log

The *Loss Log* recorder is configured to record loss values. By default, it logs the following ION parameters:

Parameter	Description
MU Ia^2h int	Phase A interval current squared hours
MU Ib^2h int	Phase B interval current squared hours
MU Ic^2h int	Phase C interval current squared hours
MU Vll ab^2h int	Phase A interval voltage Line-to-Line squared hours
MU Vll bc^2h int	Phase B interval voltage Line-to-Line squared hours
MU Vll ca^2h int	Phase C interval voltage Line-to-Line squared hours

Harmonics Logging

Two recorders provide various harmonics logs, including K-factor and Total Harmonics Distortion (THD). These recorders are labeled *Harm Mean Log* and *Harm High Log*. By default, they log the following ION output register values:

Harm Mean Log	
V1 THD mean	I1 K Fac mean
V2 THD mean	I2 K Fac mean
V3 THD mean	I3 K Fac mean
I1 THD mean	
I2 THD mean	
I3 THD mean	

Harm High Log	
V1 THD high	I1 K Fac high
V2 THD high	I2 K Fac high
V3 THD high	I3 K Fac high
I1 THD high	
I2 THD high	
I3 THD high	

Time-of-Use Logging

Six data recorders are used to record energy and demand values based on the rates (A, B, C, D) set in the Time of Use (TOU) module. These recorders are labeled as follows: *TOU kWh Log*, *TOU kVA(R)h Log*, *TOU kW/VAR sd Log*, *TOU kW/VAR td Log*, *TOU kVA sd Log*, and *TOU kVA td Log*. By default, these data recorders log the following ION output register values:

TOU kWh Log
kWh del A
kWh rec A
kWh del B
kWh rec B
kWh del C
kWh rec C
kWh del D
kWh rec D

TOU kVA(R)h Log	
kVARh del A	kVAh del A
kVARh rec A	kVAh rec A
kVARh del B	kVAh del B
kVARh rec B	kVAh rec B
kVARh del C	kVAh del C
kVARh rec C	kVAh rec C
kVARh del D	kVAh del D
kVARh rec D	kVAh rec D

TOU kW/VAR sd Log	
kW sd mx del A	kVAR sd mx del A
kW sd mx rec A	kVAR sd mx rec A
kW sd mx del B	kVAR sd mx del B
kW sd mx rec B	kVAR sd mx rec B
kW sd mx del C	kVAR sd mx del C
kW sd mx rec C	kVAR sd mx rec C
kW sd mx del D	kVAR sd mx del D
kW sd mx rec D	kVAR sd mx rec D

TOU kW/VAR td Log	
kW td mx del A	kVAR td mx del A
kW td mx rec A	kVAR td mx rec A
kW td mx del B	kVAR td mx del B
kW td mx rec B	kVAR td mx rec B
kW td mx del C	kVAR td mx del C
kW td mx rec C	kVAR td mx rec C
kW td mx del D	kVAR td mx del D
kW td mx rec D	kVAR td mx rec D

TOU kVA sd Log	
kVA sd mx del A	kVA sd mx del A
kVA sd mx rec A	kVA sd mx rec A
kVA sd mx del B	kVA sd mx del B
kVA sd mx rec B	kVA sd mx rec B
kVA sd mx del C	kVA sd mx del C
kVA sd mx rec C	kVA sd mx rec C
kVA sd mx del D	kVA sd mx del D
kVA sd mx rec D	kVA sd mx rec D

TOU kVA td Log	
kVA td mx del A	kVA td mx del A
kVA td mx rec A	kVA td mx rec A
kVA td mx del B	kVA td mx del B
kVA td mx rec B	kVA td mx rec B
kVA td mx del C	kVA td mx del C
kVA td mx rec C	kVA td mx rec C
kVA td mx del D	kVA td mx del D
kVA td mx rec D	kVA td mx rec D

For more information refer to "Time of Use Configuration" on page 65 as well as the TOU module description in the online *ION Programmer's Reference*.

ION Enterprise Reporting

One recorder is configured to provide power system data for the Reporter software. This recorder is labeled *Egy Dmd Log*. If any input links to this module are changed, Reporter will not be able to create reports from the device's logs. If you use Reporter, do not change the parameters that are logged in the *Egy Dmd Log*.

Sag/Swell and Transient Logging

The meter logs the following ION output register values:

Sag/Swell Log			
DistDur	DistV2Engy	DistV1Engy	DistV3Engy
DistV1Min	DistV3Min	DistV2Min	DistNominal
DistV1Max	DistV3Max	DistV2Max	SwellLim
DistV1Avg	DistV3Avg	DistV2Avg	SagLim

Transient Log			
TranV1Dur	TranNominal	TranV2Max	PT Sec
TranV1Max	Threshold	TranV3Dur	CT Prim
TranV2Dur	PT Prim	TranV3Max	CT Sec

EN50160 Compliance Logging (ION 7600 only)

By default, 22 Data Recorders are used for logging EN50160 compliance parameters.

<table>
<tr><th>Data Recorder</th><th>EN50160 Component Logged</th></tr>
<tr><td>EN50160 Frq/Mg</td><td>Power Frequency and Supply Magnitude</td></tr>
<tr><td>EN50160 Flicker</td><td>Flicker</td></tr>
<tr><td>EN50160 Vlt Dp1</td><td rowspan="5">Supply Voltage Dips</td></tr>
<tr><td>EN50160 Vlt Dp2</td></tr>
<tr><td>EN50160 Vlt Dp3</td></tr>
<tr><td>EN50160 Vlt Dp4</td></tr>
<tr><td>EN50160 Vlt Dp5</td></tr>
<tr><td>EN50160 Intrp</td><td>Short/Long Interruptions</td></tr>
<tr><td>EN50160 Ovrvlt1</td><td rowspan="3">Temporary Overvoltages</td></tr>
<tr><td>EN50160 Ovrvlt2</td></tr>
<tr><td>EN50160 Ovrvlt3</td></tr>
</table>

<table>
<tr><th>Data Recorder</th><th>EN50160 Component Logged</th></tr>
<tr><td>EN50160 Vunbal</td><td>Voltage Unbalance</td></tr>
<tr><td>EN50160 Hrm Vlt</td><td rowspan="2">Harmonics (up to 40th)</td></tr>
<tr><td>EN50160 Ihm Vlt</td></tr>
<tr><td>EN50160 MSignal</td><td>Mains Signalling Voltage</td></tr>
<tr><td>EN50160 Prm-f/V</td><td rowspan="7">Parameter data

These data recorders are disabled by default (see below).</td></tr>
<tr><td>EN50160 Prm-Flk</td></tr>
<tr><td>EN50160 Prm-VDp</td></tr>
<tr><td>EN50160 Prm-Vlr</td></tr>
<tr><td>EN50160 Prm-OV</td></tr>
<tr><td>EN50160 PrmHrm1</td></tr>
<tr><td>EN50160 PrmHrm2</td></tr>
</table>

The ION 7600 logs EN50160 counter data for current and previous observation periods. EN50160 events are also logged. EN50160 parameter data logging (from seven "Prm" data recorders) is disabled by default. The EN50160 Parameter Logging enable is accessible in the default Power Quality Vista diagram. For more information about EN50160 data logging, refer to the technical note *Power Quality: ION Meters and EN50160.*

Energy Pulsing Setup

Each meter has both the Calibration Pulser module and the Pulser module.

Pulser Module Settings

The Pulser module serves as an intermediary between other modules' pulse output registers (accepting them as pulse inputs) and a hardware output channel on the device. These modules are capable of sending pulses or pulse transitions to any hardware output channel. The Pulser module contains the following setup registers:

Setup Register	Function	Default
Pulse Width	This numeric bounded register specifies the width, in seconds, of the output pulses.	1
OutputMode	This register defines whether the output is a complete pulse or a transition pulse (KYZ).	Pulse
Polarity	This register specifies the polarity of output. It has no effect if *OutputMode* is KYZ.	Non-inverting
Port	This register specifies which hardware port the output appears on. Only those hardware channels that are still available appear when you access this setting.	Not Used

Five common parameters (kWh del, kWh rec, kVARh del, kVARh rec, and kW sd del) are already linked to the Pulser modules for you.

NOTE

For safety reasons, no hardware channel has been selected. To make use of these links, you must configure the Pulser modules' *Port* setup registers to the appropriate hardware port that receives the output.

Calibration Pulser Module Settings

The Calibration Pulser module is a highly accurate energy pulser used for verifying calibration on meters employed in billing applications. This module type serves as an intermediary between the power (kW, kVAR or kVA) outputs of the Power Meter module and a device's hardware output channel.

The setup registers of the module labeled "kWh Pulser –D4," allow you to configure the solid-state output D4 for calibration pulsing. By default, the output on a standard meter generates a pulse for every 1.8Wh accumulated. This is the same pulsing rate as the middle front panel LED (controlled by a Calibration Pulser module labeled "kWh Pulser –LED"). You can modify the pulsing rate of either channel by changing the value of the *Kt* setup register of the controlling Calibration Pulser module (see below).

The following setup registers are available in the Calibration Pulser module:

Setup Register	Function	Default
Pulse Width	This numeric bounded register specifies the width, in seconds, of the pulses sent to the hardware channel. The Calibration Pulser module maintains a minimum duty cycle of 50% on the output pulse train.	0.05
Kt	The numeric bounded register defines how much energy the module accumulates before a pulse is sent to the hardware channel. An industry standard for energy pulsing is 1.8, or one pulse per 1.8 energy-hours.	1.80
Int Mode	Specifies the modes of integration that may be selected. [1]	Absolute
OutputMode	This register specifies whether the output is a complete pulse (Pulse) or a change of state transition (KYZ).	Pulse
Port	This register specifies which hardware port the output appears on. Only those hardware channels that are still available appear when you access this setting.	Not Used

[1] Refer to the Calibration Pulser module description in the online *ION Programmer's Reference* for more details.

Power Quality Configuration

Power quality configuration is provided by a number of modules, depending on your meter type: the Sag/Swell module, the Transient module, and numerous EN50160 frameworks, some of which include the Mains Signalling Evaluation modules.

Sag/Swell Module Settings

The Sag/Swell module monitors voltage waveforms for sags and swells (i.e. ITI (CBEMA) Type 2 and Type 3 disturbances); it then reports each disturbance's magnitude and duration. The Sag/Swell module can also detect sub-disturbances during a Sag/Swell event. Settings are as follows:

Setup Register	Function	Default
Swell Lim	This is the magnitude above which a voltage deviation is considered a swell.	106
Sag Lim	This is the magnitude below which a voltage deviation is considered a sag.	88
Change Crit	This is the amount a voltage signal must change during a disturbance to be considered a new sub-disturbance.	10
Nom Volts	This is the nominal power system voltage (used for all Power Quality functions).	0 [1]
EvPriority	The priority assigned to Sag/Swell and Transient module events (0 to 255, 255 is highest).	200

[1] The primary power system voltage is sometimes different than the PT Primary setup register value (i.e. when the PT Primary is used to indicate winding ratio rather than primary voltage).

Besides *NomVolts*, the only setup registers that you may need to change in the Sag/ Swell module are *Swell Lim* and *Sag Lim*. Most applications are served by the default values entered into these registers. The *Change Crit* and *EvPriority* setup registers do not need to be changed for normal operation.

NOTE

If the Sag/Swell module's *Nom Volts* setup register is set to zero, all Sag/Swell module functions are disabled. *Nom Volts* is typically set when the meter is put into service. If *Nom Volts* has not been set, enter a value for your system's nominal voltage (i.e. 120, 277, or 347). The value you enter will also be used by the Transient module and in all EN50160 compliance calculations with the ION 7600.

Transient Module Settings (ION 7600 only)

The Transient module monitors voltage waveforms for transient activity (i.e., ITI (CBEMA) Type 1 disturbances). The *Threshold* setup register defines what voltage disturbance magnitude should be considered as transient activity. *Threshold* is interpreted as a percentage of the nominal system voltage, plus 100. For example, if you want transients recorded when voltage deviates from nominal by 20%, enter 120 into the *Threshold* setup register.

Setup Register	Function	Default
Threshold	This is the magnitude at which a voltage deviation is considered a transient.	125
EvPriority	The priority assigned to Sag/Swell and Transient module events (0 to 255, 255 is highest).	200

EN50160 Settings (ION 7600 only)

The EN50160 framework is composed of numerous ION module types including: Mains Signaling Evaluation, Harmonics Evaluation, Voltage Harmonics, Flicker, and more. Refer to the technical note *Power Quality: ION Meters and EN50160* for details.

Setpoint Configuration

The Relative Setpoint module provides extensive control, secondary protection, and analysis capabilities by allowing you to initiate an action in response to a specific condition. It is particularly useful for performing actions based on differences between a value (e.g. kW on phase A) relative to a reference value (e.g. kW demand for all three phases). You can use this module's outputs for demand control of equipment or any other applications requiring setpoint activity relative to a varying value.

The Relative Setpoint modules monitor the following for "over" conditions: phase current, kW demand, and voltage unbalance.

Module	Label	Description
Relative Setpoint 1	Over KW sd	When active, this annunciates when the total kW SWDemand exceeds a specified amount.
Relative Setpoint 2	Over I a	When active, this annunciates when the current on phase A exceeds a specified amount.
Relative Setpoint 3	Over I b	When active, this annunciates when the current on phase B exceeds a specified amount.
Relative Setpoint 4	Over I c	When active, this annunciates when the current on phase C exceeds a specified amount.
Relative Setpoint 5	Over V unbal	When active, this annunciates if the voltage unbalance exceeds a specified percentage.
Relative Setpoint 6	Over I 4	When active, this annunciates when I 4 exceeds a specified amount.
Relative Setpoint 7	Over I 5	When active, this annunciates when I 5 exceeds a specified amount.

Relative Setpoint Module Settings

There is no need to change any of the Relative Setpoint modules' setup registers for normal operation of the meter.

Fine Tuning Over Condition Monitoring

If you want to fine-tune over condition monitoring, the only setup registers you should change are *SusUntlON* and *SusUntlOFF*.

SusUntlON determines how long the modules wait after an over condition is detected before reporting it. This gives the monitored value a short period to correct itself before the event is registered with the module so that very brief over conditions are ignored. Similarly, *SusUntlOFF* is the amount of time a normal value must be present before the module considers normal operation to be restored. Both *SusUntlON* and *SusUntlOFF* values are entered in seconds (the default value for both is 30 seconds).

Refer to the online *ION Programmer's Reference* for more information about the Relative Setpoint module.

Meter Clock Configuration

The Clock module controls the meter's internal clock, which provides timestamps for data logged by the device. The clock needs to be configured properly to ensure that logged data has accurate timestamp information. The Clock module also receives the time synchronization signals sent to it by the workstation running ION software, updating the device's clock when required.

The Clock module's *Clock Source* setup register defines how the meter's internal clock auto-corrects drift from its internally calculated time. A separate time source (such as a GPS receiver, or a DNP Master) can be used to synchronize the clock through a communications channel. By default, the clock is set to synchronize from the line frequency.

The setup registers in the Clock module specify timezone and Daylight Savings Time (DST) parameters and time synchronization functions.

Setup Register	Function	Default
TZ Offset	Sets the timezone the device is in, relative to Greenwich Mean Time.	0
DST Start 1 … DST Start 20	The date and time when DST begins for 20 separate years.	Refer to the *ION Device Templates* at www.pwrm.com for the DST Start and DST End defaults for the twenty separate years.
DST End … DST End 20	The date and time when DST ends for 20 separate years.	
DST Offset	The amount of time the clock is changed when DST begins or ends.	3, 600 seconds
Time Sync Source	Specifies the communications port that receives time sync signals.	COM1
Time Sync Type	Specifies the type of time sync signal (Local or Universal time).	UTC
Clock Source	Specifies the clock's time synchronization signal source (line frequency, communications signals, or internal crystal).	Line Frequency

TIP

When modifying setup registers of the Clock module in Designer, use the Format option to convert between UNIX and conventional time. Refer to the description of the Clock module in the online *ION Programmer's Reference* for more details.

Typically, the *DST Start* and *DST End* registers do not have to be reconfigured. The factory defaults are the DST start and end dates for 20 years, in UNIX time (the number of seconds since 00:00:00 UTC on Jan 1, 1970).

Refer to the technical note *Time Synchronization and Timekeeping* for further details on using the meter's time synchronization functions.

Display Setup

The meter's front panel display is controlled by three types of ION modules: the Display Options module, the Scroll module, and Display modules.

Display Options Module Settings

The Display Options module contains setup registers that hold data display settings such as contrast level, backlight timeout, daylight savings time, and update time. Settings in the Display Options modules are global, and affect the entire set of front panel display screens.

Setup Register	Function	Default
Contrast	Sets the global contrast setting for the meter display.	7
Backlight Timeout	Sets the time that the front panel's backlight stays on after the last press of a front panel button (in seconds).	300
Display Update Time	Sets the period between data display refreshes (in seconds).	1
Digital Grouping	Sets the numbering format by determining how groups of three digits are separated.	1,000
Demand Lockout Timeout	Sets the minimum time allowed between consecutive demand resets.	2,160,000

Scroll Module Settings

The Scroll module determines the sequence and rate of scrolling for multiple front panel display screens.

Setup Register	Function	Default
Scroll Delay	Sets the time that will elapse between successive pulses on the *Trigger* outputs when the scroll module is enabled.	6
Wraparound	Designates the last *Trigger* output (*Trigger* n) before returning to the first *Trigger* in he order.	10
Freeze Time	Sets the time (in seconds) that the Scroll module remains "frozen" when pulsed from the *Freeze*, *Up*, or *Down* inputs.	120

The *Trigger* outputs of Scroll module are linked to the inputs of Display modules. When a pulse is sent from the *Trigger* output of a Scroll module to a linked Display module, the Display module shows its information on the front panel.

Display Module Settings

Display modules determine the form and content of each display screen.

Setup Register	Function	Default
Screen Type	This specifies the way the linked parameters are displayed on the front panel screen.	Defaults vary among display screens. Refer to the *ION Device Templates* at www.pwrm.com.
Softkey Number	This assigns a softkey number to the display screen.	
Softkey Name	This assigns a softkey name to the display screen.	
Screen Title	This assigns a title to the display screen.	

Changing the Parameters that are Displayed

The meter's default display configuration shows a comprehensive set of parameters. Changing these parameters requires that you alter the links between various ION modules. Complete details on configuring the front panel displays are provided in the *Custom Front Panel Displays* technical note in the Appendix A.

Demand Setup

Demand is a measure of average power consumption over a fixed time interval. Peak (or maximum) demand is the highest demand level recorded over the billing period. Two methods of measuring demand are with Thermal Demand modules and Sliding Window Demand modules. These modules are configured to calculate the average current demand and kW, kVAR and kVA demand. The setup registers in the demand modules define time intervals for demand calculations, setting the sensitivity of the module's operation.

Sliding Window Demand Module Settings

Sliding Window Demand is often referred to as Rolling Block Demand. To compute sliding window demand values, the Sliding Window Demand module uses the sliding window averaging (or rolling interval) technique which divides the demand interval into sub-intervals. The demand is measured electronically based on the average load level over the most recent set of sub-intervals. This method offers better response time than fixed interval methods.

Setup Register	Function	Default
Sub Intvl	The time, in seconds, in the sliding window demand sub-interval.	900
#SubIntvls	The number of sub-intervals in the sliding window.	1
Pred Resp	The speed of Predicted Demand calculations; use higher values for faster prediction (70 to 99 recommended).	70

Thermal Demand Module Settings

The Thermal Demand module calculates thermal demand over a specified length of time. It uses a method which is equivalent to thermal averaging. For thermal averaging, the traditional demand indicator responds to heating of a thermal element in a Watt-Hour meter. You can adjust the Thermal Demand module's calculation to mimic this technique by changing the *Time Const* and I*nterval* setup parameters.

Setup Register	Function	Default
Interval	The time, in seconds, in the thermal demand interval.	900
Time Const	The sensitivity to changes in the source signal; higher values provide faster response time (common values are 63 and 90).	90

Time of Use Configuration

The Time of Use module may only be important if you are using the meter in a billing application (i.e. you are a power provider), as the module contains the meter's seasonal rate schedules. Typically, power consumers can ignore Time Of Use configuration.

Seasonal Settings

The Time of Use module supports up to four separate seasons. Each seasons' start and end dates are set into the appropriate *Season* setup register.

NOTE

Ensure that there is no date overlapping when defining seasons and that every day of the year is covered by your seasons. If there are gaps between seasons, the module returns an error and will not function.

If your rates do not change between seasons, you do not need to configure the *Season s*etup registers — Season 1 is the default, and all Season 1 rates are in effect all year.

If you have different seasons, enter their start and end dates into the appropriate setup registers. If your season is active on the same dates every year, you only need to enter a single range of dates in the appropriate *Season* setup register. If the active dates are different each year (for example, Season 3 becomes active every first Monday in August), the start dates must be individually specified for each year.

Time Of Use Module Settings

The Time of Use module's setup registers define your seasons' start and end dates, the day types where your rates may differ, and the rate schedules for each season's day types. The module compares the meter's internal clock with the season, day, and time of day settings in these registers, and changes its output registers to reflect the current state of these settings.

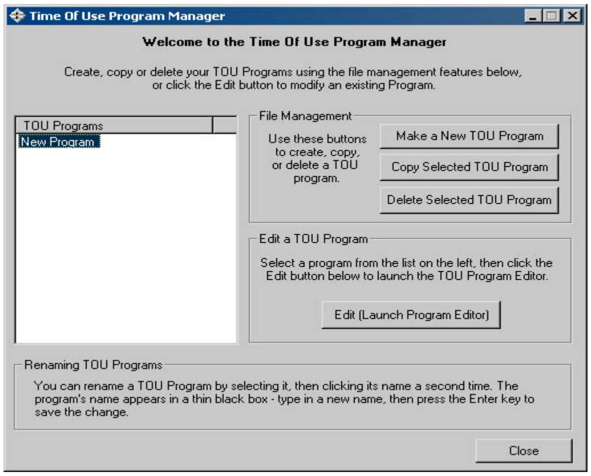
The Time of Use module is partially configured at the factory. Check the setup registers to ensure that the settings match your Time of Use schedules.

Setup Register	Function
Season 1- 4	These setup registers define the dates for each active season. When a season is active, the Time of Use module will use the applicable rate schedules.
Season 1 - 4 Weekday Rates	These setup registers specify seasonal weekday rates.
Season 1 - 4 Weekend Rates	These setup registers specify seasonal weekend rates.
Season 1 - 4 Alt 1 Rates	These setup registers specify a season's daily rates during the days specified in the Alt 1 Days setup register.
Season 1 - 4 Alt 2 Rates	These setup registers specify a season's daily rates during the days specified in the Alt 2 Days setup register.
Season 1 - 4 Holiday Rates	These setup registers specify a season's daily rates during the days specified in the Holidays setup register.
Weekdays	This register defines the days of the week for all seasons. The rates in the Season (1, 2, 3, or 4) Weekday Rates setup registers are used on these days.
Weekends	This register defines the weekend days for all seasons. The rates in the Season (1, 2, 3, or 4) Weekend Rates setup registers are used on these days.
Alt 1 Days	This register defines a set of alternative dates for all seasons. These dates generally have different rates from weekdays, weekends, or holidays.
Alt 2 Days	This register is similar in function to Alt 1 Days, but contains a different set of dates.
Holidays	This register defines the holidays for all seasons. The rates defined in the Season (1, 2, 3, or 4) Holiday Rates setup registers are used on these days.
Self Read Days	This setup register defines the dates and times that the Self Read output register will pulse. If no time is entered in this register, the Self Read output register will pulse on the date specified at 12:00 AM.

For more information, refer to the Time of Use module description in the online *ION Programmer’s Reference*.

Creating a New Time Of Use Schedule

You can create a new TOU schedule using the TOU Program Manager; the program is a self-documented, graphical wizard. You launch the TOU Program Manager in Designer from the Options menu.



Factory Information

The Factory module displays firmware version, serial number and other device information in read-only setup registers (read-only registers can be viewed but not changed).

Factory Module Settings

The device information provided is as follows:

Setup Register	Description
Device Type	A device type identifier (e.g. "7600" for the ION 7600)
Compliance	A statement of whether the device is ION compliant or not
Options	Shows model number of meter
Revision	The meter's firmware version
Serial Num	The meter's serial number
ION Version	The ION version supported by the device
Template	The name of the template (framework) installed on the device at the factory
Nom Freq	The expected frequency of the power system being monitored

The Factory module also contains numerous read-only setup registers that hold the calibration constants used at the factory.

How to TAG Your Meter

Three configurable setup registers are provided for you to enter your company name and other text information you want stored in the meter:

- *Owner* - This is a text register for storing user information (e.g. company name); it can be up to 255 characters in length.
- *Tag 1* - This is a text register for storing user information (e.g. device location); it can be up to 15 characters in length.
- *Tag 2* - This is a text register for storing user information (e.g. device number or identifier); it can be up to 15 characters in length.

Third Party Protocols

Modbus and DNP modules are factory configured and do not require basic configuration changes. Changing the factory configuration is an advanced setup procedure that requires an understanding of the protocol, as well as an understanding of the meter's internal operation.

Refer to the technical notes *DNP 3.0 and ION Technology,* and *Modbus and ION Technology* for the appropriate list of parameters available for each protocol.

NOTE

The meter can also be configured to receive data through Modbus or DNP 3.0, though there is no factory-configured framework for receiving data through these protocols. For details on configuring your network for receiving data via Modbus or DNP 3.0, refer to the DNP Slave Import module and Modbus Slave Import module descriptions in the online *ION Programmer's Reference*, as well as the technical notes *DNP 3.0 and ION Technology,* and *Modbus and ION Technology*.

Communications Protocol Configuration

In order to use the factory Modbus or DNP configuration you must first configure the communications channel you want to use. By default, all communications ports are configured to use the ION protocol. Choose the 3rd-party protocol you want from the list of available protocols in the Communications module's Protocol setup register.

NOTE

Modbus RTU is available on each of the meter's communications ports, and multiple ports can communicate using Modbus simultaneously. Only a single port can use the DNP 3.00 protocol at any one time.

Using the Modbus RTU Protocol

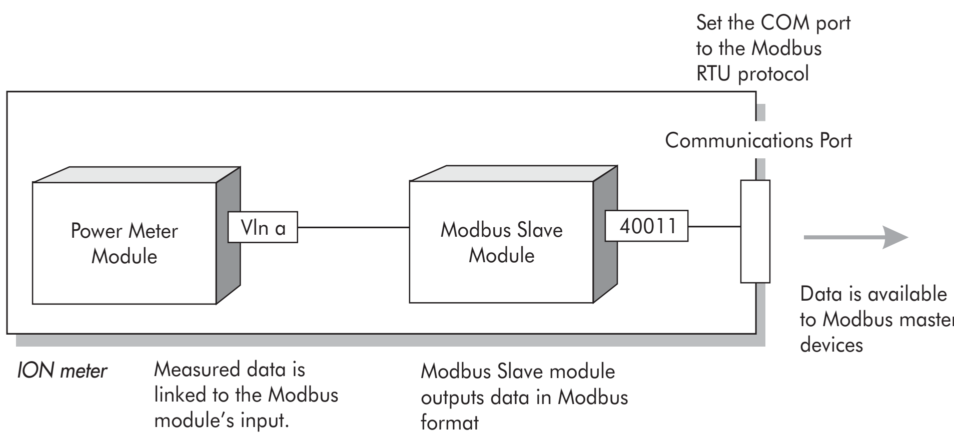
Both the ION 7500 and ION 7600 meters can make any real-time data available through the Modicon Modbus RTU protocol. Modbus Master devices connected to the meter can access this data. Modbus Master devices can also write data into ION registers, making device configuration changes or initiating control actions.

The Factory Modbus Configuration

The meter makes data available to Modbus Master devices using four Modbus Slave modules. These modules are linked to other modules in the meter that provide the energy, power and demand data. Once a communications channel is configured to use Modbus RTU protocol, the data is available to Modbus Master devices.

NOTE

Connect to IP Service Port 7701 for Modbus RTU communications over Ethernet. The Modbus Unit ID of the meter over Ethernet is 100.



As the data available through the Modbus Slave modules is in a specific format, knowledge of the Modbus protocol and an understanding of the settings used in the meter are required to interpret the data provided.

Changing the Modbus Configuration

If the factory Modbus configuration does not suit your needs, the existing Modbus Slave modules can be relinked to other parameters that you want to access through Modbus.

If your Modbus Master device requires data in a format different than that provided by the factory Modbus configuration, you can edit the setup registers in the Modbus Slave modules. These setup registers specify the Modbus format, scaling and base address settings.

Refer to the online *ION Programmer's Reference* for complete details on Modbus Slave module.

Modbus Slave Module Settings

The settings in the Modbus Slave module setup registers are shown in the tables below. Refer to *ION 7500 / ION 7600 Series meter Modicon Modbus Serial Communications Protocol and ION/Modbus Register Map* document for additional details on the Modbus implementation on the meter.

Modbus Slave Module #1

Setup Register	Setting
Format	unsigned 16-bit
Base Address	40011
Scaling	YES
In Zero	0
In Full	6553
Out Zero	0
Out Full	65530

Modbus Slave Module #2

Setup Register	Setting
Format	signed 32-bit
Base Address	40027
Scaling	YES
In Zero	-214748364
In Full	214748364
Out Zero	-2147483640
Out Full	2147483640

Modbus Slave Module #3

Setup Register	Setting
Format	signed 32-bit
Base Address	40059
Scaling	YES
In Zero	-214748364
In Full	214748364
Out Zero	-2147483640
Out Full	2147483640

Modbus Slave Module #4

Setup Register	Setting
Format	signed 32-bit MFP
Base Address	40089
Scaling	NO

Modbus Slave Modules #5 to #15 (EN50160 data)

Setup Register	Setting
Base Addresses	#5: 41000
	#6: 41016
	#7: 41032
	#8: 41048
	#9: 41064
	#10: 41080
	#11: 41096
	#12: 41112
	#13: 41128
	#14: 41144
	#15: 41160

Setup Register	Setting
Format	unsigned 16-bit
Scaling	NO
In Zero	-32767
In Full	32767
Out Zero	-32767
Out Full	32767

Modbus Slave Module Parameter Mapping

The following tables show which measurements are provided by each of the Modbus Slave modules. The source for each measurement is shown ("Source ION Module") so that you can easily delete parameters if you want to access different data. Note that the Modbus Register remains the same if you link a different parameter into one of the Modbus Slave module inputs (i.e. any value you link to Modbus Slave module #1, Source Input #1 will use Modbus Register 40011).

Measurement	Label	Source ION Module	Modbus Module and Input Number	Modbus Register
L-N Voltage Phase A	Vln a	Power Meter	Modbus Slave #1 – Source Input #1	40011
L-N Voltage Phase B	Vln b	Power Meter	Modbus Slave #1 – Source Input #2	40012
L-N Voltage Phase C	Vln c	Power Meter	Modbus Slave #1 – Source Input #3	40013
Average L-N Voltage	Vln avg	Power Meter	Modbus Slave #1 – Source Input #4	40014
L-L Voltage AB	Vll ab	Power Meter	Modbus Slave #1 – Source Input #5	40015
L-L Voltage BC	Vll bc	Power Meter	Modbus Slave #1 – Source Input #6	40016
L-L Voltage CA	Vll ca	Power Meter	Modbus Slave #1 – Source Input #7	40017
Average L-L Voltage	Vll avg	Power Meter	Modbus Slave #1 – Source Input #8	40018
Phase A Current	I a	Power Meter	Modbus Slave #1 – Source Input #9	40019
Phase B Current	I b	Power Meter	Modbus Slave #1 – Source Input #10	40020
Phase C Current	I c	Power Meter	Modbus Slave #1 – Source Input #11	40021
Average Current	I avg	Power Meter	Modbus Slave #1 – Source Input #12	40022
Voltage Unbalance	V unbal	Power Meter	Modbus Slave #1 – Source Input #13	40023
Current Unbalance	I unbal	Power Meter	Modbus Slave #1 – Source Input #14	40024
Line Frequency	Freq	Power Meter	Modbus Slave #1 – Source Input #15	40025
Neutral Current	I 4	Power Meter	Modbus Slave #1 – Source Input #16	40026

Measurement	Label	Source ION Module	Modbus Module and Input Number	Modbus Register
Phase A kW	kW a	Power Meter	Modbus Slave #2 – Source Input #1	40027
Phase B kW	kW b	Power Meter	Modbus Slave #2 – Source Input #2	40029
Phase C kW	kW c	Power Meter	Modbus Slave #2 – Source Input #3	40031-40032
Total kW	kW tot	Power Meter	Modbus Slave #2 – Source Input #4	40033-40034
Phase A kVAR	kVAR a	Power Meter	Modbus Slave #2 – Source Input #5	40035-40036
Phase B kVAR	kVAR b	Power Meter	Modbus Slave #2 – Source Input #6	40037-40038
Phase C kVAR	kVAR c	Power Meter	Modbus Slave #2 – Source Input #7	40039-40040
Total kVAR	kVAR tot	Power Meter	Modbus Slave #2 – Source Input #8	40041-40042
Phase A kVA	kVA a	Power Meter	Modbus Slave #2 – Source Input #9	40043-40044
Phase B kVA	kVA b	Power Meter	Modbus Slave #2 – Source Input #10	40045-40046

Measurement	Label	Source ION Module	Modbus Module and Input Number	Modbus Register
Phase V kVA	kVA c	Power Meter	Modbus Slave #2 – Source Input #11	40047-40048
Total kVA	kVA tot	Power Meter	Modbus Slave #2 – Source Input #12	40049-40050
Phase A signed PF	PF sign a	Power Meter	Modbus Slave #2 – Source Input #13	40051-40052
Phase B signed PF	PF sign b	Power Meter	Modbus Slave #2 – Source Input #14	40053-40054
Phase C signed PF	PF sign c	Power Meter	Modbus Slave #2 – Source Input #15	40055-40056
Average signed PF	PF signed tot	Power Meter	Modbus Slave #2 – Source Input #16	40057-40058

Measurement	Label	Source ION Module	Modbus Module and Input Number	Modbus Register
Maximum Avg L-L Voltage	Vll avg mx	Maximum	Modbus Slave #3 – Source Input #1	40059 to 40060
Maximum Average Current	I avg mx	Maximum	Modbus Slave #3 – Source Input #2	40061 to 40062
Maximum Total kW	kW tot mx	Maximum	Modbus Slave #3 – Source Input #3	40063 to 40064
Maximum Total kVAR	kVAR tot mx	Maximum	Modbus Slave #3 – Source Input #4	40065 to 40066
Maximum Total kVA	kVA tot mx	Maximum	Modbus Slave #3 – Source Input #5	40067 to 40068
Maximum Line Frequency	Freq mx	Maximum	Modbus Slave #3 – Source Input #6	40069 to 40070
Minimum Avg L-L Voltage	Vll avg mn	Minimum	Modbus Slave #3 – Source Input #7	40071 to 40072
Minimum Average Current	I avg mn	Minimum	Modbus Slave #3 – Source Input #8	40073 to 40074
Minimum Line Frequency	Freq mn	Minimum	Modbus Slave #3 – Source Input #9	40075 to 40076
kW Sliding Window Demand	kW sd del-rec	Sliding Win Demand	Modbus Slave #3 – Source Input #10	40077 to 40078
kVA Sliding Window Demand	KVA sd del+rec	Sliding Win Demand	Modbus Slave #3 – Source Input #11	40079 to 40080
kVAR Sliding Window Demand	kVAR sd del-rec	Sliding Win Demand	Modbus Slave #3 – Source Input #12	40081 to 40082
Maximum kW SW Demand	kW sd mx del-rec	Maximum	Modbus Slave #3 – Source Input #13	40083 to 40084
Maximum kVA SW Demand	kVA sd mx del+rec	Maximum	Modbus Slave #3 – Source Input #14	40085 to 40086
Maximum kVAR SW Demand	kVAR sd mx del-rec	Maximum	Modbus Slave #3 – Source Input #15	40087 to 40088
Phase reversal indicator (0=no reversal; 1=reversal)	Phase Rev	Power Meter	Modbus Slave #3 – Source Input #16	40089 to 40090

Measurement	Label	Source ION Module	Modbus Module and Input Number	Modbus Register
Imported kWh	kWh del	Integrator	Modbus Slave #4 – Source Input #1	40091 to 40092
Exported kWh	kWh rec	Integrator	Modbus Slave #4 – Source Input #2	40093 to 40094
Total kWh	kWh del+rec	Integrator	Modbus Slave #4 – Source Input #3	40095 to 40096
Net kWh	kWh del-rec	Integrator	Modbus Slave #4 – Source Input #4	40097 to 40098
Imported kVARh	kVARh del	Integrator	Modbus Slave #4 – Source Input #5	40099 to 40100

Measurement	Label	Source ION Module	Modbus Module and Input Number	Modbus Register
Exported kVARh	kVARh rec	Integrator	Modbus Slave #4 – Source Input #6	40101 to 40102
Total kVARh	kVARh del+rec	Integrator	Modbus Slave #4 – Source Input #7	40103 to 40104
Net kVARh	kVARh del-rec	Integrator	Modbus Slave #4 – Source Input #8	40105 to 40106
Total kVAh	kVAh del+rec	Integrator	Modbus Slave #4 – Source Input #9	40107 to 40108
Max Phase A Voltage THD	V1 THD mx	Maximum	Modbus Slave #4 – Source Input #10	40109 to 40110
Max Phase B Voltage THD	V2 THD mx	Maximum	Modbus Slave #4 – Source Input #11	40111 to 40112
Max Phase C Voltage THD	V3 THD mx	Maximum	Modbus Slave #4 – Source Input #12	40113 to 40114
Max Phase A Current THD	I1 THD mx	Maximum	Modbus Slave #4 – Source Input #13	40115 to 40116
Max Phase B Current THD	I2 THD mx	Maximum	Modbus Slave #4 – Source Input #14	40117 to 40118
Max Phase C Current THD	I3 THD mx	Maximum	Modbus Slave #4 – Source Input #15	40119 to 40120
(unused)	(unused)	(unused)	Modbus Slave #4 – Source Input #16	(unused)

Measurement	Label	Source ION Module	Modbus Module and Input Number	Modbus Register
EN50160 parameters – refer to Appendix A for more information about EN50160.	V1-Flck N	Signal Limit Evaluation	Modbus Slave #5 – Source Input #1	41000
	V1-Flck N1	Signal Limit Evaluation	Modbus Slave #5 – Source Input #2	41001
	V2-Flck N	Signal Limit Evaluation	Modbus Slave #5 – Source Input #3	41002
	V2-Flck N1	Signal Limit Evaluation	Modbus Slave #5 – Source Input #4	41003
	V3-Flck N	Signal Limit Evaluation	Modbus Slave #5 – Source Input #5	41004
	V3-Flck N1	Signal Limit Evaluation	Modbus Slave #5 – Source Input #6	41005
	Freq N	Signal Limit Evaluation	Modbus Slave #5 – Source Input #7	41006
	Freq N1	Signal Limit Evaluation	Modbus Slave #5 – Source Input #8	41007
	Freq N2	Signal Limit Evaluation	Modbus Slave #5 – Source Input #9	41008
	V1-Mag N	Signal Limit Evaluation	Modbus Slave #5 – Source Input #10	41009
	V1-Mag N1	Signal Limit Evaluation	Modbus Slave #5 – Source Input #11	41010
	V2-Mag N	Signal Limit Evaluation	Modbus Slave #5 – Source Input #12	41011
	V2-Mag N1	Signal Limit Evaluation	Modbus Slave #5 – Source Input #13	41012
	V3-Mag N	Signal Limit Evaluation	Modbus Slave #5 – Source Input #14	41013
	V3-Mag N1	Signal Limit Evaluation	Modbus Slave #5 – Source Input #15	41014
	Vunbal N	Signal Limit Evaluation	Modbus Slave #5 – Source Input #16	41015

Measurement	Label	Source ION Module	Modbus Module and Input Number	Modbus Register
EN50160 parameters – refer to Appendix A for more information about EN50160.	Vunbal N1	Signal Limit Evaluation	Modbus Slave #6 – Source Input #1	41016
	V1-Msignal N	Mains Signaling Evaluation	Modbus Slave #6 – Source Input #2	41017
	V1-Msignal N1	Mains Signaling Evaluation	Modbus Slave #6 – Source Input #3	41018
	V2-Msignal N	Mains Signaling Evaluation	Modbus Slave #6 – Source Input #4	41019
	V2-Msignal N1	Mains Signaling Evaluation	Modbus Slave #6 – Source Input #5	41020
	V3-Msignal N	Mains Signaling Evaluation	Modbus Slave #6 – Source Input #6	41021
	V3-Msignal N1	Mains Signaling Evaluation	Modbus Slave #6 – Source Input #7	41022
	V1-Hrm N	Harmonics Evaluation	Modbus Slave #6 – Source Input #8	41023
	V1-Hrm N1	Harmonics Evaluation	Modbus Slave #6 – Source Input #9	41024
	V1-Hrm N2	Harmonics Evaluation	Modbus Slave #6 – Source Input #10	41025
	V2-Hrm N	Harmonics Evaluation	Modbus Slave #6 – Source Input #11	41026
	V2-Hrm N1	Harmonics Evaluation	Modbus Slave #6 – Source Input #12	41027
	V2-Hrm N2	Harmonics Evaluation	Modbus Slave #6 – Source Input #13	41028
	V3-Hrm N	Harmonics Evaluation	Modbus Slave #6 – Source Input #14	41029
	V3-Hrm N1	Harmonics Evaluation	Modbus Slave #6 – Source Input #15	41030
	V3-Hrm N2	Harmonics Evaluation	Modbus Slave #6 – Source Input #16	41031

Measurement	Label	Source ION Module	Modbus Module and Input Number	Modbus Register
EN50160 parameters – refer to Appendix A for more information about EN50160.	V1-Inthrm N	Harmonics Evaluation	Modbus Slave #7 – Source Input #1	41032
	V1-Inthrm N1	Harmonics Evaluation	Modbus Slave #7 – Source Input #2	41033
	V2-Inthrm N	Harmonics Evaluation	Modbus Slave #7 – Source Input #3	41034
	V2-Inthrm N1	Harmonics Evaluation	Modbus Slave #7 – Source Input #4	41035
	V3-Inthrm N	Harmonics Evaluation	Modbus Slave #7 – Source Input #5	41036
	V3-Inthrm N1	Harmonics Evaluation	Modbus Slave #7 – Source Input #6	41037
	V1-Dip N11	Bin	Modbus Slave #7 – Source Input #7	41038
	V1-Dip N12	Bin	Modbus Slave #7 – Source Input #8	41039
	V1-Dip N13	Bin	Modbus Slave #7 – Source Input #9	41040
	V1-Dip N14	Bin	Modbus Slave #7 – Source Input #10	41041
	V1-Dip N21	Bin	Modbus Slave #7 – Source Input #11	41042
	V1-Dip N22	Bin	Modbus Slave #7 – Source Input #12	41043
	V1-Dip N23	Bin	Modbus Slave #7 – Source Input #13	41044
	V1-Dip N24	Bin	Modbus Slave #7 – Source Input #14	41045
	V1-Dip N31	Bin	Modbus Slave #7 – Source Input #15	41046
	V1-Dip N32	Bin	Modbus Slave #7 – Source Input #16	41047

Measurement	Label	Source ION Module	Modbus Module and Input Number	Modbus Register
EN50160 parameters – refer to Appendix A for more information about EN50160.	V1-Dip N33	Bin	Modbus Slave #8 – Source Input #1	41048
	V1-Dip N34	Bin	Modbus Slave #8 – Source Input #2	41049
	V1-Dip N41	Bin	Modbus Slave #8 – Source Input #3	41050
	V1-Dip N42	Bin	Modbus Slave #8 – Source Input #4	41051
	V1-Dip N43	Bin	Modbus Slave #8 – Source Input #5	41052
	V1-Dip N44	Bin	Modbus Slave #8 – Source Input #6	41053
	V1-Dip N51	Bin	Modbus Slave #8 – Source Input #7	41054
	V1-Dip N52	Bin	Modbus Slave #8 – Source Input #8	41055
	V1-Dip N53	Bin	Modbus Slave #8 – Source Input #9	41056
	V1-Dip N54	Bin	Modbus Slave #8 – Source Input #10	41057
	V1-Dip N61	Bin	Modbus Slave #8 – Source Input #11	41058
	V1-Dip N62	Bin	Modbus Slave #8 – Source Input #12	41059
	V1-Dip N63	Bin	Modbus Slave #8 – Source Input #13	41060
	V1-Dip N64	Bin	Modbus Slave #8 – Source Input #14	41061
	V2-Dip N11	Bin	Modbus Slave #8 – Source Input #15	41062
	V2-Dip N12	Bin	Modbus Slave #8 – Source Input #16	41063

Measurement	Label	Source ION Module	Modbus Module and Input Number	Modbus Register
EN50160 parameters – refer to Appendix A for more information about EN50160.	V2-Dip N13	Bin	Modbus Slave #9 – Source Input #1	41064
	V2-Dip N14	Bin	Modbus Slave #9 – Source Input #2	41065
	V2-Dip N21	Bin	Modbus Slave #9 – Source Input #3	41066
	V2-Dip N22	Bin	Modbus Slave #9 – Source Input #4	41067
	V2-Dip N23	Bin	Modbus Slave #9 – Source Input #5	41068
	V2-Dip N24	Bin	Modbus Slave #9 – Source Input #6	41069
	V2-Dip N31	Bin	Modbus Slave #9 – Source Input #7	41070
	V2-Dip N32	Bin	Modbus Slave #9 – Source Input #8	41071
	V2-Dip N33	Bin	Modbus Slave #9 – Source Input #9	41072
	V2-Dip N34	Bin	Modbus Slave #9 – Source Input #10	41073
	V2-Dip N41	Bin	Modbus Slave #9 – Source Input #11	41074
	V2-Dip N42	Bin	Modbus Slave #9 – Source Input #12	41075
	V2-Dip N43	Bin	Modbus Slave #9 – Source Input #13	41076
	V2-Dip N44	Bin	Modbus Slave #9 – Source Input #14	41077
	V2-Dip N51	Bin	Modbus Slave #9 – Source Input #15	41078
	V2-Dip N52	Bin	Modbus Slave #9 – Source Input #16	41079

Measurement	Label	Source ION Module	Modbus Module and Input Number	Modbus Register
EN50160 parameters – refer to Appendix A for more information about EN50160.	V2-Dip N53	Bin	Modbus Slave #10 – Source Input #1	41080
	V2-Dip N54	Bin	Modbus Slave #10 – Source Input #2	41081
	V2-Dip N61	Bin	Modbus Slave #10 – Source Input #3	41082
	V2-Dip N62	Bin	Modbus Slave #10 – Source Input #4	41083
	V2-Dip N63	Bin	Modbus Slave #10 – Source Input #5	41084
	V2-Dip N64	Bin	Modbus Slave #10 – Source Input #6	41085
	V3-Dip N11	Bin	Modbus Slave #10 – Source Input #7	41086
	V3-Dip N12	Bin	Modbus Slave #10 – Source Input #8	41087
	V3-Dip N13	Bin	Modbus Slave #10 – Source Input #9	41088
	V3-Dip N14	Bin	Modbus Slave #10 – Source Input #10	41089
	V3-Dip N21	Bin	Modbus Slave #10 – Source Input #11	41090
	V3-Dip N22	Bin	Modbus Slave #10 – Source Input #12	41091
	V3-Dip N23	Bin	Modbus Slave #10 – Source Input #13	41092
	V3-Dip N24	Bin	Modbus Slave #10 – Source Input #14	41093
	V3-Dip N31	Bin	Modbus Slave #10 – Source Input #15	41094
	V3-Dip N32	Bin	Modbus Slave #10 – Source Input #16	41095

Measurement	Label	Source ION Module	Modbus Module and Input Number	Modbus Register
EN50160 parameters – refer to Appendix A for more information about EN50160.	V3-Dip N33	Bin	Modbus Slave #11 – Source Input #1	41096
	V3-Dip N34	Bin	Modbus Slave #11 – Source Input #2	41097
	V3-Dip N41	Bin	Modbus Slave #11 – Source Input #3	41098
	V3-Dip N42	Bin	Modbus Slave #11 – Source Input #4	41099
	V3-Dip N43	Bin	Modbus Slave #11 – Source Input #5	41100
	V3-Dip N44	Bin	Modbus Slave #11 – Source Input #6	41101
	V3-Dip N51	Bin	Modbus Slave #11 – Source Input #7	41102
	V3-Dip N52	Bin	Modbus Slave #11 – Source Input #8	41103
	V3-Dip N53	Bin	Modbus Slave #11 – Source Input #9	41104
	V3-Dip N54	Bin	Modbus Slave #11 – Source Input #10	41105
	V3-Dip N61	Bin	Modbus Slave #11 – Source Input #11	41106
	V3-Dip N62	Bin	Modbus Slave #11 – Source Input #12	41107
	V3-Dip N63	Bin	Modbus Slave #11 – Source Input #13	41108
	V3-Dip N64	Bin	Modbus Slave #11 – Source Input #14	41109
	V1-Intrpt N1	Bin	Modbus Slave #11 – Source Input #15	41110
	V1-Intrpt N2	Bin	Modbus Slave #11 – Source Input #16	41111

Measurement	Label	Source ION Module	Modbus Module and Input Number	Modbus Register
EN50160 parameters – refer to Appendix A for more information about EN50160.	V1-Intrpt N3	Bin	Modbus Slave #12 – Source Input #1	41112
	V2-Intrpt N1	Bin	Modbus Slave #12 – Source Input #2	41113
	V2-Intrpt N2	Bin	Modbus Slave #12 – Source Input #3	41114
	V2-Intrpt N3	Bin	Modbus Slave #12 – Source Input #4	41115
	V3-Intrpt N1	Bin	Modbus Slave #12 – Source Input #5	41116
	V3-Intrpt N2	Bin	Modbus Slave #12 – Source Input #6	41117
	V3-Intrpt N3	Bin	Modbus Slave #12 – Source Input #7	41118
	V1-Ovlt N11	Bin	Modbus Slave #12 – Source Input #8	41119
	V1-Ovlt N12	Bin	Modbus Slave #12 – Source Input #9	41120
	V1-Ovlt N13	Bin	Modbus Slave #12 – Source Input #10	41121
	V1-Ovlt N14	Bin	Modbus Slave #12 – Source Input #11	41122
	V1-Ovlt N15	Bin	Modbus Slave #12 – Source Input #12	41123
	V1-Ovlt N21	Bin	Modbus Slave #12 – Source Input #13	41124
	V1-Ovlt N22	Bin	Modbus Slave #12 – Source Input #14	41125
	V1-Ovlt N23	Bin	Modbus Slave #12 – Source Input #15	41126
	V1-Ovlt N24	Bin	Modbus Slave #12 – Source Input #16	41127

Measurement	Label	Source ION Module	Modbus Module and Input Number	Modbus Register
EN50160 parameters – refer to Appendix A for more information about EN50160.	V1-Ovlt N25	Bin	Modbus Slave #13 – Source Input #1	41128
	V1-Ovlt N31	Bin	Modbus Slave #13 – Source Input #2	41129
	V1-Ovlt N32	Bin	Modbus Slave #13 – Source Input #3	41130
	V1-Ovlt N33	Bin	Modbus Slave #13 – Source Input #4	41131
	V1-Ovlt N34	Bin	Modbus Slave #13 – Source Input #5	41132
	V1-Ovlt N35	Bin	Modbus Slave #13 – Source Input #6	41133
	V2-Ovlt N11	Bin	Modbus Slave #13 – Source Input #7	41134
	V2-Ovlt N12	Bin	Modbus Slave #13 – Source Input #8	41135
	V2-Ovlt N13	Bin	Modbus Slave #13 – Source Input #9	41136
	V2-Ovlt N14	Bin	Modbus Slave #13 – Source Input #10	41137
	V2-Ovlt N15	Bin	Modbus Slave #13 – Source Input #11	41138
	V2-Ovlt N21	Bin	Modbus Slave #13 – Source Input #12	41139
	V2-Ovlt N22	Bin	Modbus Slave #13 – Source Input #13	41140
	V2-Ovlt N23	Bin	Modbus Slave #13 – Source Input #14	41141
	V2-Ovlt N24	Bin	Modbus Slave #13 – Source Input #15	41142
	V2-Ovlt N25	Bin	Modbus Slave #13 – Source Input #16	41143

Measurement	Label	Source ION Module	Modbus Module and Input Number	Modbus Register
EN50160 parameters – refer to Appendix A for more information about EN50160.	V2-Ovlt N31	Bin	Modbus Slave #14 – Source Input #1	41144
	V2-Ovlt N32	Bin	Modbus Slave #14 – Source Input #2	41145
	V2-Ovlt N33	Bin	Modbus Slave #14 – Source Input #3	41146
	V2-Ovlt N34	Bin	Modbus Slave #14 – Source Input #4	41147
	V2-Ovlt N35	Bin	Modbus Slave #14 – Source Input #5	41148
	V3-Ovlt N11	Bin	Modbus Slave #14 – Source Input #6	41149
	V3-Ovlt N12	Bin	Modbus Slave #14 – Source Input #7	41150
	V3-Ovlt N13	Bin	Modbus Slave #14 – Source Input #8	41151
	V3-Ovlt N14	Bin	Modbus Slave #14 – Source Input #9	41152
	V3-Ovlt N15	Bin	Modbus Slave #14 – Source Input #10	41153
	V3-Ovlt N21	Bin	Modbus Slave #14 – Source Input #11	41154
	V3-Ovlt N22	Bin	Modbus Slave #14 – Source Input #12	41155
	V3-Ovlt N23	Bin	Modbus Slave #14 – Source Input #13	41156
	V3-Ovlt N24	Bin	Modbus Slave #14 – Source Input #14	41157
	V3-Ovlt N25	Bin	Modbus Slave #14 – Source Input #15	41158
	V3-Ovlt-N31	Bin	Modbus Slave #14 – Source Input #16	41159

Measurement	Label	Source ION Module	Modbus Module and Input Number	Modbus Register
EN50160 parameters – refer to Appendix A for more information about EN50160.	V3-Ovlt-N32	Bin	Modbus Slave #15 – Source Input #1	41160
	V3-Ovlt-N33	Bin	Modbus Slave #15 – Source Input #2	41161
	V3-Ovlt-N34	Bin	Modbus Slave #15 – Source Input #3	41162
	V3-Ovlt-N35	Bin	Modbus Slave #15 – Source Input #4	41163
(unused)	(unused)	(unused)	Modbus Slave #15 – Source Input #5 to #16	(unused)

Importing Data using Modbus RTU

It is possible to bring data into the meter using Modbus. Various ION registers can be written by Modbus Master devices by correlating the Modbus register number with the address of the ION register you want to write. When a Modbus register is written with a value, the corresponding ION register will be written, provided the Modbus RTU protocol is active on the communications channel that connects the Modbus Master to the meter.

You can use the Modbus RTU protocol to write values into ION external numeric, pulse and Boolean registers, allowing you to enable, disable and reset meter functions. You can also use the Modbus protocol to change setup register values in various ION modules to configure the meter's operation.To bring data into the meter with Modbus RTU, you must disable the meter's password security. Information about writing ION registers through Modbus is available in the *ION 7500 / ION 7600 Series meter Modicon Modbus Serial Communications Protocol* document.

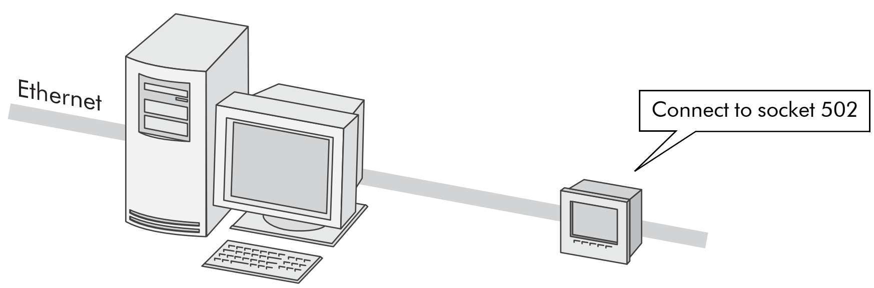
Using the Modbus/TCP Protocol

Modbus/TCP is the newest open Modbus protocol variant (formerly called MBAP). It defines the packet structure and connection port (port 502) for the industry standard TCP/IP protocol. The structure of Modbus/TCP is very similar to the Modbus RTU packet except that it has an extra six-byte header and does not use the cyclic redundancy check (CRC). Some of the newest ION firmware now supports Modbus/TCP for direct communications with the meter.

Modbus/TCP retains the Modbus RTU limit of 256 bytes to a packet. It is suggested that higher through-put is possible if this limitation is removed. This variant is called Enhanced Modbus/TCP but, so far, few devices have moved to support it.

Modbus TCP Communications

You can now communicate to the meter via Modbus TCP (formerly called MBAP). Your meter must have the optional Ethernet port. Connect to socket **502**.



Be aware that you cannot form an EtherGate to the Modbus TCP network.

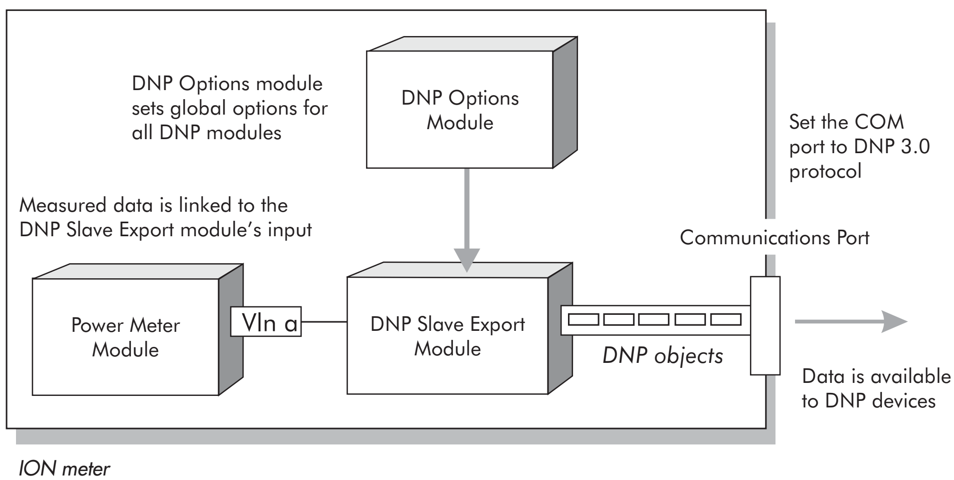
Using the DNP 3.00 Protocol

The Distributed Network Protocol Version 3.00 (DNP 3.00) is an open protocol used in the electric utility industry for communications and interoperability among substation computers, Remote Terminal Units (RTUs), Intelligent Electronic Devices (IEDs, e.g. meters), and Master Stations. The meter can be integrated into a DNP network using the DNP Slave Import, Export and Options modules.

The Factory DNP 3.00 Configuration

The meter's factory configuration makes various parameters available to export through DNP 3.00. There is no factory-configured functionality for importing DNP 3.00 data into the meter.

ION modules are linked to DNP Slave Export modules which convert the ION data into the appropriate DNP objects. These objects are available through the ION 7500 or ION 7600 meter's communications port that is configured to use the DNP 3.00 protocol. The DNP Options module sets global options for all of the DNP Slave Export modules.



The meter is shipped from the factory with the following DNP static objects defined. The following objects are returned in response to a Class 0 Poll. Note that the protocol of the desired communications port must set to "DNP 3.00" before the meter will respond to DNP master requests.

Analog Input Objects (16-Bit Analog Input without Flag) (Object 30, Variation 4)

Point	Label	Measurement	DNP Module and Input Number	Scaling
0	Vln a	L-N Voltage Phase A	DNP Slave Export #1 – Source Input #1	x1
1	Vln b	L-N Voltage Phase B	DNP Slave Export #1 – Source Input #2	x1
2	Vln c	L-N Voltage Phase C	DNP Slave Export #1 – Source Input #3	x1
3	Vln avg	Average L-N Voltage	DNP Slave Export #1 – Source Input #4	x1
4	Vll ab	L-L Voltage AB	DNP Slave Export #2 – Source Input #1	x1
5	Vll bc	L-L Voltage BC	DNP Slave Export #2 – Source Input #2	x1
6	Vll ca	L-L Voltage CA	DNP Slave Export #2 – Source Input #3	x1
7	Vll avg	Average L-L Voltage	DNP Slave Export #2 – Source Input #4	x1
8	I a	Phase A Current	DNP Slave Export #3 – Source Input #1	x1
9	I b	Phase B Current	DNP Slave Export #3 – Source Input #2	x1
10	I c	Phase B Current	DNP Slave Export #3 – Source Input #3	x1
11	I avg	Average Current	DNP Slave Export #3 – Source Input #4	x1
12	kW a	Phase A kW	DNP Slave Export #4 – Source Input #1	x1
13	kW b	Phase B kW	DNP Slave Export #4 – Source Input #2	x1
14	kW c	Phase C kW	DNP Slave Export #4 – Source Input #3	x1
15	kW tot	Total kW	DNP Slave Export #4 – Source Input #4	x1
16	kVAR a	Phase A kVAR	DNP Slave Export #5 – Source Input #1	x1
17	kVAR b	Phase B kVAR	DNP Slave Export #5 – Source Input #2	x1
18	kVAR c	Phase C kVAR	DNP Slave Export #5 – Source Input #3	x1
19	kVAR tot	Total kVAR	DNP Slave Export #5 – Source Input #4	x1
20	kVA a	Phase A kVA	DNP Slave Export #6 – Source Input #1	x1
21	kVA b	Phase B kVA	DNP Slave Export #6 – Source Input #2	x1
22	kVA c	Phase C kVA	DNP Slave Export #6 – Source Input #3	x1
23	kVA tot	Total kVA	DNP Slave Export #6 – Source Input #4	x1
24	PFsign a	Phase A signed PF	DNP Slave Export #7 – Source Input #1	x1
25	PFsign b	Phase B signed PF	DNP Slave Export #7 – Source Input #2	x1
26	PFsign c	Phase C signed PF	DNP Slave Export #7 – Source Input #3	x1
27	PF sign tot	Average signed PF	DNP Slave Export #7 – Source Input #4	x1
28	V unbal	Voltage Unbalance	DNP Slave Export #8 – Source Input #1	x10
29	I unbal	Current Unbalance	DNP Slave Export #8 – Source Input #2	x10
30	I4	Neutral Current	DNP Slave Export #9 – Source Input #1	x1
31	Freq	Line Frequency	DNP Slave Export #10 – Source Input #1	x10
32	kW sd del – rec	kW Sliding Window Demand	DNP Slave Export #11 – Source Input #1	x1
33	kVAR sd del – rec	kVAR Sliding Window Demand	DNP Slave Export #11 – Source Input #2	x1
34	kVA sd del - rec	kVA Sliding Window Demand	DNP Slave Export #11 – Source Input #3	x1

Binary Counter Objects (16-Bit Binary Counter without Flag) (Object 20, Variation 6)

Point	Label	Measurement	DNP Module and Input Number	Scaling
0	kWh del	kWh Delivered	DNP Slave Export #12 – Source Input #1	x1
1	kWh rec	kWh Received	DNP Slave Export #12 – Source Input #2	x1
2	kWh del+rec	kWh Total	DNP Slave Export #12 – Source Input #3	x1
3	kWh del-rec	kWh Net	DNP Slave Export #12 – Source Input #4	x1
4	kVARh del	kVARh Delivered	DNP Slave Export #13 – Source Input #1	x1
5	kVARh rec	kVARh Received)	DNP Slave Export #13 – Source Input #2	x1
6	kVARh del+rec	kVARh Total	DNP Slave Export #13 – Source Input #3	x1
7	kVARh del-rec	kVARh Net	DNP Slave Export #13 – Source Input #4	x1
8	kVAh del+rec	kVAh Total	DNP Slave Export #14 – Source Input #1	x1

Changing the DNP Configuration

If the factory DNP configuration does not suit your needs, you can relink the existing DNP Slave Export modules to access a different set of parameters through DNP. Alternately, you can add additional DNP Slave Export modules and link the desired ION parameters to them. There are 16 DNP Slave Export modules available on the meter; of these, 14 are used by the factory configuration.

NOTE

Only one meter port can be used to communicate via DNP 3.00 at a time. More details about using the DNP protocol is available in the *ION 7500 & ION 7600 DNP V3.00 Device Profile,* available from www.pwrm.com.

If your DNP network requires data in a format different than that provided by the factory DNP configuration, you can edit the setup registers in the DNP Slave Export modules and the DNP Options module. Do not make any changes to the DNP Options module's setup registers unless you understand the effects each change will cause. Refer to the online *ION Programmer's Reference* for complete details on DNP Slave Export and DNP Options module function.

Consult the DNP User's Group at http://www.dnp.org/ to learn more about the protocol.

DNP Slave Export Module Settings

The factory-configured DNP Slave Export modules are configured as shown in the following table.

Setup Register	Setting
BasePoint	Varies – each analog input or binary counter has a different BasePoint
StaticObj	11 modules are *Analog Input*; three are *Binary Counter*
EventObj	Disable Event Objects
Deadband	0
FrozStaObj	Disable Frozen Static Objects
FrozEvtObj	Disable Frozen Event Objects
EventClass	Class 1
Scaling	OFF (excluding *Unbalx10* and *Freqx10* which are ON)
IONZero	0
IONFull	0 (1000 for *Unbalx10* and 100 for *Freqx10*)
DNPZero	0
DNPFull	0 (10000 for *Unbalx10* and 1000 for *Freqx10*)

As the table indicates, some of the setup register settings vary for different modules. Specifically, *BasePoint* differs for each module within a group (Analog Input and Binary Counter are groups), and *StaticObj* is set to Analog Input for the 11 analog input points and Binary Counter for the three binary counter points. (*StaticObj* defines the type of DNP object the module provides when the Master polls it.)

In addition, *Scaling* is OFF for all but two modules. The only modules that apply scaling are the Analog Input points that provide Voltage and Current Unbalance data (labeled Unbalx10) and Frequency data (Labeled Freqx10). These modules apply x10 scaling.

DNP Options Module Settings

The DNP Options module provides global settings that affect all DNP Slave Export and DNP Slave Import modules. The default settings in this module are shown in the following table.

Setup Register	Setting	Function
BinInStatic	Single-bit Binary Input	variant for Binary Input Static objects
BinInEvents	Binary Input Change w/o time	variant for Binary Input Event objects
BinInEvDepth	100	maximum number of Binary Input Events that can be stored
BinCntStatic	16-bit Binary Counter w/o flag	variant for Binary Counter Static objects
FrzCntStatic	16-bit Frozen Counter w/o flag	variant for Frozen Counter Static objects
FrzCntEvents	16-bit Frozen Counter Event w/o time	variant for Frozen Counter Event objects
FrzCntEvDepth	100	maximum number of Frozen Counter Events that can be stored
CntChangeEvents	16-bit Counter Change Event w/o time	variant for Counter Change Event objects
CntChangeEvDepth	100	maximum number of Counter Change Events that can be stored
AIStatic	16-bit Analog Input w/o flag	variant for Analog Input Static objects
FrzAIStatic	16-bit Frozen Analog Input w/o flag	variant returned from Class 0 poll for Frozen Analog Input Static objects
FrzAIEvents	16-bit Frozen Analog Event w/o time	variant for Frozen Analog Input Event objects
FrzAIEvDepth	100	maximum number of Frozen Analog Input Events that can be stored
AIChangeEvents	16-bit Analog Input Change Event w/o time	variant for Analog Input Change Event objects
AIChangeEvDepth	200	maximum number of Analog Input Change Events that can be stored
AOStatic	16-bit Analog Output Status	variant for Analog Output Block objects
SelectTimeout	10	Select Before Operate timeout period (in seconds)
TimeSynchPeriod	86400	time (in seconds) between IED requests for time syncs
ALFragSize	2048	maximum application layer message size (in octets) that IED can send
DLAck	Never	when device will request data link layer acknowledgements
DLTimeout	2	how long data link layer waits for acknowledgement from Master
DLNumRetries	0	how many times a data link layer packet is re-sent after failing

Importing Data using DNP 3.00

Data can be imported into the meter from a DNP control relay or analog output device. DNP Slave Import modules are used to take a DNP Analog output or Binary output object and map them into ION registers. Refer to the DNP Slave Import module description in the online *ION Programmer's Reference* for details.

Restoring the Factory Configuration

If you have made changes to the default functionality and want to return to the factory configuration, you can re-initialize the factory configuration in the meter through Designer. The basic setup of the device can be retained, so the meter does not need to be taken out of service for a long period of time.

NOTE

If you restore the factory configuration, all custom features you created are lost.

To restore the factory configuration:

1. Display the meter's main Configuration screen in Designer.
2. Choose Select All from the Edit menu, then press Delete on your keyboard.

   The confirmation dialog box appears explaining that some modules will not be deleted (core modules cannot be deleted — scroll down in the dialog to see that various standard modules will be deleted).
3. Click OK on the confirmation dialog box.

   After a brief wait the modules are deleted, and the main meter Configuration screen is blank except for the Frameworks folder in the Advanced Setup area. (The Frameworks folder contains the folder of Core modules which cannot be deleted.)
4. Choose Select All from the Edit menu to select the Frameworks folder. This selects all subfolders and modules within the folder.
5. In the Edit menu, choose Paste from Framework, then select the appropriate .fwn file from the folder \ION Enterprise\config\fmwk\nd\. Click OK.

   The Factory module's *Default Template* register tells you the filename for the default factory framework. (For details about framework files, contact Technical Services or visit the Power Measurement web site's technical support area at http://www.pwrm.com/Support.)
6. Click Open. The Paste Summary window appears.
7. Click on the first module, scroll down to the last module, hold the Shift key and click on the last module. This selects all of the modules.
8. While holding the Shift key, click on the check box to the left of the module name so you see a lock icon with a green checkmark.

CAUTION

Persistent modules can be overwritten in Designer. When pasting a default framework onto a meter, use lock-paste on the Persistent modules, not free-paste. A list of Persistent modules is available on the Library page of Power Measurement's website, under "ION Device Templates".

9. Check "Maintain external inputs" and click OK on the confirmation dialog box.

   A message appears indicating that Designer is pasting modules. All modules are selected when the paste is complete. Click anywhere in the background of the node diagram to deselect all of the modules.

10. Click the Power Meter shortcut in the Basic Configuration area to select it. Once selected, click Reset in the Designer toolbar, or select Reset from the Edit menu. This reverts the Power Meter to the settings it had before you deleted any modules (retaining the basic setup you previously had).
11. Choose Send & Save from the File menu. The factory configuration is now restored (any custom functionality you created is removed).

NOTE

The time required to complete steps 3, 5, and 11 may vary depending on your connection and the meter configuration.

CHAPTER

4 Using ION Software

ION software encompasses a variety of programs that enhance the functionality and usability of your ION devices. ION software can collect data via serial, wireless, modem, or Ethernet links, so you can manage a single site or global network of devices. ION Enterprise is a software suite with applications for displaying data, configuring ION meters, performing system control, and much more. ION Setup is a stand-alone program that greatly simplifies meter configuration.

This chapter recognizes the various ION software programs available to you, and provides instructions on each program's use. Details on where to find more information on a program's operation are included in that program's introduction.

In This Chapter

ION Enterprise Software

ION Enterprise software offers control capabilities and comprehensive power quality and reliability analysis. It is a powerful software suite that can process, analyze, store, and share data across your entire enterprise. The fully networked client-server information system allows you to access data from any workstation, locally or around the world, in the formats you need. With ION Enterprise you can manage an intelligent ION metering network, monitoring and controlling individual devices, analyzing data, and deciding on new courses of action.

ION Enterprise software has four main components, each with their own user interfaces. These applications are the ION Management Console, Vista, Designer, and Reporter.

If you require more information on ION Enterprise software than is presented here, refer to the:

- online *ION Enterprise Help*
- *ION Enterprise Administrator Guide*
- *ION Enterprise Client User Guide*

Software Security

The software security system limits how you can use ION software to view meter data and send configuration changes to ION meters. A valid user account and password are required to log on to any ION software application. Each access level, or authority, that is specified for a user account defines the types of operations available in each application, so you may not necessarily be allowed to view or configure meter information if your authority does not permit it.

ION Enterprise provides two default software security settings: guest and supervisor. Both of these default security settings use 0 (zero) for the password, and enable the highest level of authority which allows complete control of the system.

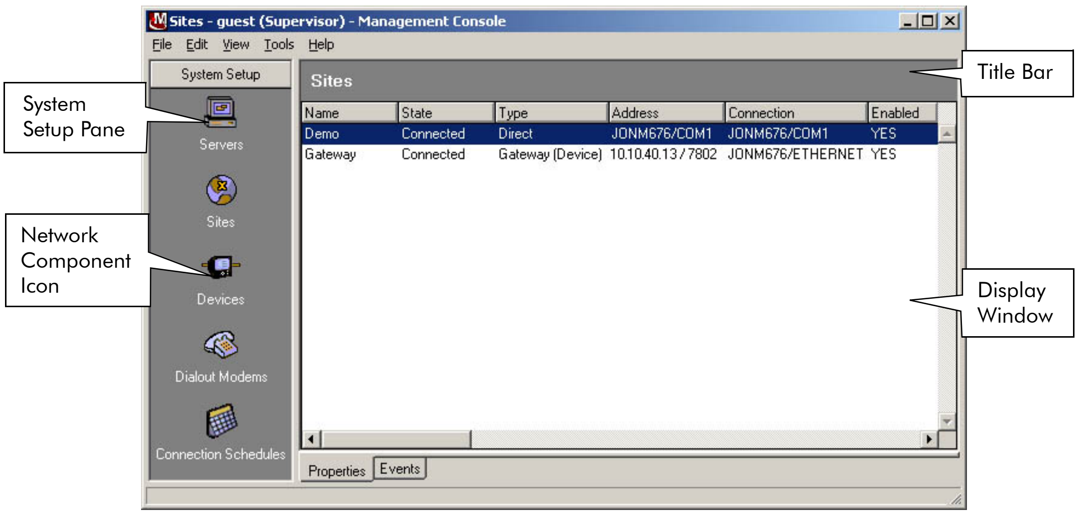
NOTE

Since both the software and the meter use password security, you may need to enter the software password, meter password, or both depending on the function you are performing.

For details on software security configuration, refer to the technical note *ION Security.*

ION Enterprise: ION Management Console

The ION Management Console is responsible for building your network. You build your power-monitoring network to reflect the way your physical communications network is wired so that ION Enterprise software can communicate with your devices. The network is created using servers, sites, devices, and modems. These network components must be configured in the ION Management Console before you can use the other ION Enterprise applications.



The following is a brief description of each network component. To learn how to configure these components, refer to the "Configuring Communications" on page 91.

Servers

A server is a computer in an ION Enterprise system running administrative software that controls access to the network and its resources, such as ION devices, and provides resources to computers functioning as workstations on the network. A server runs service components that create communication and software links between ION systems components, and it creates links into the ION database, too.

Computers with primary and secondary ION Enterprise installations are servers, as they have the communication software (services) installed. A primary server contains all software components and the database; a secondary server contains software but references the primary server for program files and database information. Both server types connect directly to ION devices via serial, Ethernet, or modem links, but there can be only one primary server on a network. When you install ION Enterprise, the Primary Server must be installed before any Secondary server or Client computers.

Sites

A site in an ION Enterprise system contains one or more intelligent devices that share a common communications link. There are three different types of sites, based on the type of communications medium each uses. The site types are as follows:

- Direct (Serial) Site - a direct-connected RS-232 or RS-485 network
- Modem Site - a remote serial site connected by a modem
- Ethernet Gateway Site - a gateway that transfers data between an Ethernet device and an RS-485 chain of connected devices

NOTE

You are not required to create a site for an Ethernet Device, unless you intend to use the device as an Ethernet Gateway Site.

Depending on the site type, devices belonging to a site may be at different physical locations.

Devices

Devices refer to intelligent devices (basic energy meters, multi-function monitoring/analysis/control devices, intelligent relays, etc.) that can be connected to an ION Enterprise network serially, via Ethernet, or through a gateway.

Serial Devices belong to Direct Sites or Modem Sites, so they communicate using modem, RS-232, or RS-485 connections. Before these types of devices can be added to the network, they require the prior configuration of a Direct Site or Modem Site.

Ethernet Devices are those that are directly connected to an Ethernet network. You are not required to create a site for an Ethernet Device, unless you intend to use the device as an Ethernet Gateway Site. Furthermore, you can manually connect and disconnect your Ethernet Devices from the ION Management Console.

Dialout Modems

A Dialout Modem is the modem that a server computer uses to communicate with a remote modem at a Modem Site.

Connection Schedules

Connection schedules are programmed routines for a server to regularly connect to and disconnect from Modem Sites and their associated ION (or other) devices. If so desired, you can also create connection schedules from Direct Sites and Ethernet Devices / Ethernet Gateway Sites.

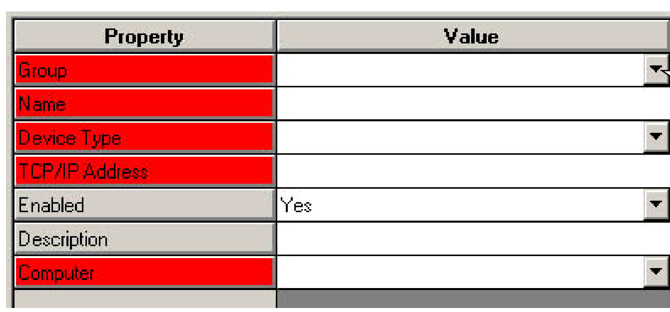
Configuring Communications

Before you can talk to the devices on your network, you need to configure communications within the ION Management Console. Essentially, this means adding one or more sites and then adding the devices associated with each site. If you create a modem site, then you also need to add and configure a dialout modem. There may be instances where you want to add a new server (either another computer or third-party gateway); the computer running the ION Enterprise software is considered a server and is listed in the Server section.

Adding a new Server, Site, Device or Dialout Modem:

1. Click the appropriate network component icon (Servers, Sites, Devices, Dialout Modems) in the System Setup pane. The title bar reflects your selection.
2. Right-click in the display window, select New and the type of Server, Site, Device. If you are configuring a modem you only have one New option.
3. Configure the item using the drop-down list boxes and manually entering values where required.
4. Right click in the Properties dialog box to access Advanced Properties. You can use the drop-down list boxes or manually enter new values as required.
5. Click OK when you are done.

The process of adding network components to the ION Management Console is the same for each component — the difference lies in how you configure the components. When the Properties dialog appears for the component you added, the fields for which you are required to provide information are highlighted in red. For example, the illustration below shows the required fields when adding a new Ethernet device:



Although Group has a drop down list box, you are not restricted to the values in the list. If you want to create a new group, simply type its name in the value field. Other drop down list boxes restrict you to the values in the list.

The Properties dialog has different required fields depending on which component you are adding:

- For a **Direct Site** you specify the serial port (COM1, COM 2, etc.) on the server computer where the serial device (or network of serial devices) is connected. You must specify the server computer that communicates with the direct site.
- For a **Modem Site** you provide information about the modem at the (remote) modem site: baud rate, modem telephone number, etc. You also specify the server computer that communicates with the modem site.

- For an **Ethernet Gateway Site**, you specify the Ethernet device acting as the gateway and the TCP/IP port to which the serial device, or network of serial devices, is connected. Before you can add an Ethernet Gateway Site, an Ethernet Device must be added and configured first.
- For a **Serial Device** you provide the device type, the unit ID, and the site to which the meter is connected. Before you can add serial devices, a Serial or Modem Site must be added and configured first.
- For an **Ethernet Device** you specify the type of meter, the meter's IP address, and the server computer that communicates with the Ethernet device.
- For a **Dialout Modem**, you provide the modem type, the computer that communicates over the modem channel, and the serial port used on the computer.
- For a **Computer** (Server) you specify the machine's computer name.
- For a **3rd-Party Gateway** (Server), you specify the name of the network host, the IP address of the gateway device, and the computer that communicates through the Ethernet gate

Complete details on working with the Management Console are available in the online *ION Enterprise Help*.

ION Enterprise: Vista

Vista is a display, analysis, and control application. It is the main user interface to the ION Enterprise system. Vista presents a graphical view of your power system, allowing you to view real-time data from power meters or historical data from the ION Enterprise database. It simplifies the tasks of managing your power system and transcends a number of physical device boundaries, so you can retrieve, store, and display data from any device in your system through a unified interface. Vista reports on the status of your power system components, informing you of alarm conditions and providing you with control capabilities for initiating intelligent device functions or actuating field machinery.

Displaying Data with Vista

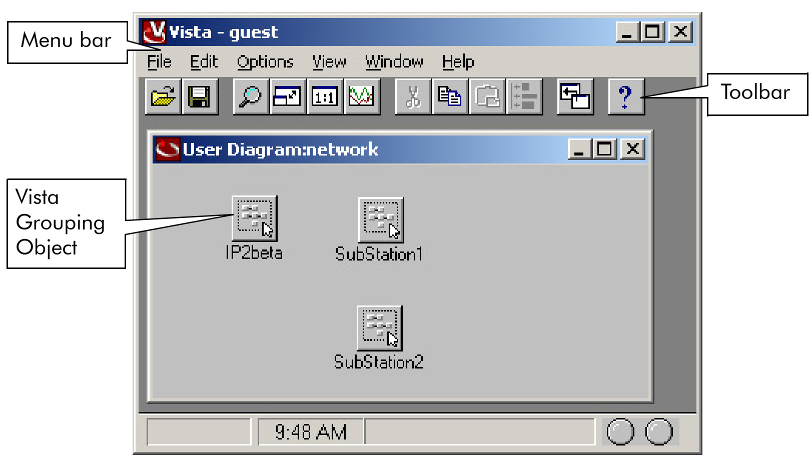
A standard set of Vista User Diagrams display real-time and logged data for various power system parameters. Interactive objects are provided on the diagrams that allow operators with appropriate authority to enable and disable logging functions and reset cumulative parameters.

A network diagram uses links to default user diagrams to display data from each device in your system. When you generate a network diagram, Vista automatically locates all devices in your system and displays them.

Generating a network diagram in Vista

1. Select Generate Network Diagram from the File menu.

   The Network Diagram initially looks like this:

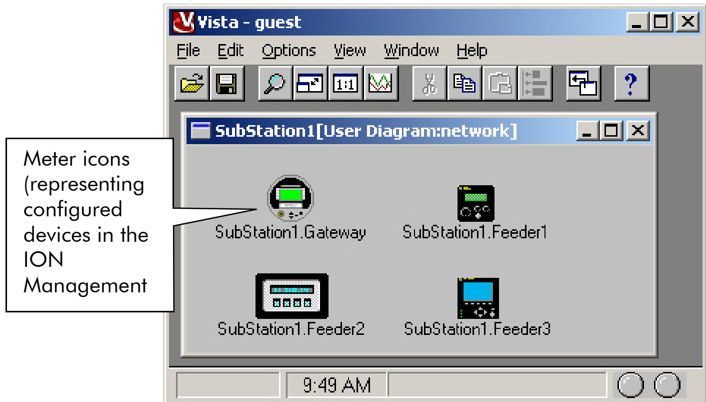


2. Click the appropriate grouping object. These are labelled according to the device's "Group" value in the ION Management Console.

NOTE

If you have Show Toolbox selected in the Options menu, you must double-click diagram objects and icons instead of single clicking them.

This opens a new window showing all of the installed meters. Each meter appears with an icon that represents its type and a label reflecting the name you configured in the ION Management Console.



3. Click a meter icon to open its main default diagram.

Each meter has a set of default diagrams that show the results of various real-time measurements and calculations that are being performed. Links to data, waveform, and event logs are also provided (if the meter supports logging).

You should now be able to navigate through the various diagrams and view real-time and logged data.

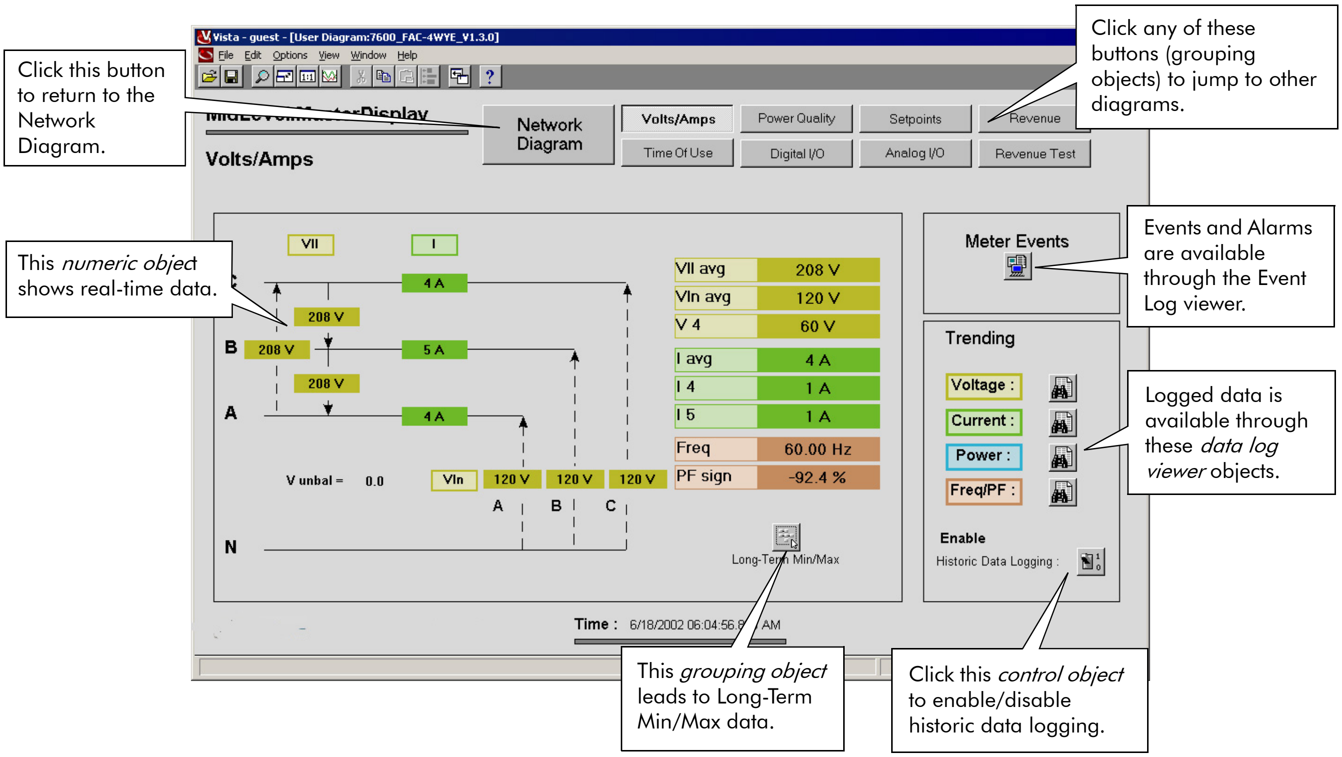
Displaying Data if the Software is Not Fully Configured

If ION Enterprise has been installed and configured using the recommended guidelines in the online *ION Enterprise Help*, the standard Vista user diagrams automatically display real-time data from your meter.

If you are unable to display data from your meter in Vista, contact your ION Enterprise software administrator, or refer to the online *ION Enterprise Help* before continuing with this User's Guide.

Vista Diagram Elements

Each Vista diagram shows the name of the meter, the time on the meter's clock, and the type of meter. The main diagrams also provide buttons that let you jump to other diagrams. Jump to another diagram by clicking any of the buttons near the top right-hand corner (as illustrated in the Volts/Amps diagram below).



- Most measurements appear on-screen in Vista *numeric objects*.
- Some ON/OFF quantities, such as the status of a setpoint, may appear as *status objects*.
- To view another screen or diagram, click on a *grouping object*. Grouping objects may be in the form of buttons, folders, meter icons, etc.

  To return to the previous diagram, use the button on the Vista toolbar, or use the File > Up One Level menu item.
- Level 3 ION Enterprise authority is required to use *control objects*.
- Logged data (such as snapshot, interval and waveform data) can be accessed by clicking the associated the *data log viewer* icon, which looks like this
- To view a record of events and alarms for the active user diagram, click — the *event log viewer* icon.
- To view records of high-priority events and alarms for your entire system, select the *global event log viewer* from the View pull-down menu.

Summary of Data Provided in Vista

The standard set of Vista diagrams included with ION Enterprise display a variety of data measured by the factory-configured meter. Some of the diagrams include grouping windows that display additional data. The following section summarizes the data, and interactive control functions provided.

Volts/Amps

The Volts/Amps diagram includes a simple power system illustration that shows various real-time parameters including: Line-to-neutral, line-to-line, average line-to-neutral, and line-to-line voltages, and voltage unbalance level.

The diagram also includes links to a min/max parameter display, the meter's event log, and various historical data logs. A control object is provided for disabling/enabling historic data.

Historic Data Logging Enable

- The Log Server must be running to view historical data.
- Historic data logging is enabled by default.
- The control object indicates the logging enable status: the switch is in the up position (1) when logging is enabled and down (0) when logging is disabled.

Long-Term Min/Max Measurements

Click the Long-Term Min/Max object in the Volts/Amps diagram to see the Long-Term Min/Max Measurements window. It displays min/max values for line-to-line and line-to-neutral voltages, power factor, and frequency. Min/max values can be reset with the Min/Max Reset Object. All min/max values are valid from the time the last reset was performed.

Power Quality

The Power Quality diagram shows voltage disturbance and harmonics details. For an ION 7600 meter, these details are on the Basic Overview tab of the Power Quality diagram. The details include:

- Running total of sag/swell events
- Running total of transient events (**ION 7600 only**)

NOTE

The ION 7600 features dual waveform capture: Sags are recorded at 32 samples x 54 cycles. Transients waveform capture at 256 samples x 7 cycles.

- ITI (CBEMA) plot of power quality events (Log Server must be running)
- Captured waveforms & sequence-of-events log (Log Server must be running)
- Phase voltage and current THD as a percentage of phase measurements
- Min/max display of phase voltage and current THD
- Trend logs of voltage THD, current THD, and current K-factor

- Real-time voltage flicker severity data for short term (Pst) and Long term (Plt) observation periods. Plt values > 0.65, or Pst values >= 1.0 indicate that the level of flicker is likely to be irritable (refer to the description of the Ficker module in the online *ION Programmer's Reference* for more details). (**ION 7600 only**)

This diagram also includes control objects for triggering manual waveform recording, enabling/disabling sag/swell and transient (if applicable) event recording, enabling/disabling harmonics logging, and resetting the Voltage Disturbance Counter.

Harmonics Trending

- The Log Server must be running to view the logged harmonics data.
- Harmonics data logging is enabled by default.
- The control object indicates the logging enable status: the switch is in the up position (1) when logging is enabled, and down (0) when logging is disabled.

Long-Term Harmonics Min/Max Measurements

Click the **Long-term Min/Max** object in the Power Quality Diagram to view the Long-Term Harmonics Min/Max Measurements window. It shows min/max values for phase voltage and current THD.

Min/max values can be reset with the Harmonics Min/Max Reset Object. All min/max values are valid from the time the last reset was performed.

EN50160 Measurements (ION 7600 only)

Click on the **EN50160** tab of the Power Quality diagram to view a comprehensive display of EN50160 statistics and parameters. Each tab in the EN50160 display corresponds to an EN50160 voltage measurement component (Frequency, Magnitude, Interruptions, Dips, Overvoltages, Flicker, Unbalance, Harmonics, Interharmonics, and Mains Signalling).

Refer to the technical note *Power Quality: ION Meters and EN50160* for more information.

Revenue Measurements

The Revenue Measurements diagram shows instantaneous power, energy and demand measurements. It also provides access to an Energy & Demand by Quadrant screen, and a number of interactive setups and controls.

Instantaneous Power

This section of the window depicts instantaneous active power, reactive power, and apparent power against a four-quadrant display.

Energy & Demand

This section shows Sliding window and thermal demand for the active, reactive, and apparent power (delivered and received). Accumulated values of active, reactive, and apparent energy (delivered and received) are also provided.

Energy & Demand by Quadrant

Click the **By Quadrant** button to see a Vista grouping window showing the following demand measurements by quadrant:

- Sliding window and thermal demand for active, reactive, and apparent power in all four quadrants
- Accumulated values of active, reactive, and apparent energy in all four quadrants

Demand Max and Demand Min

Click the **Demand MAX** and **Demand MIN** objects to see a Vista grouping window showing the maximum and minimum demand measurements.

Loss Compensation

The meter can perform loss compensation to the measurements it provides in one of two ways. Use this screen to do the following:

1. Enable loss compensation by double-clicking on the **Loss Compensation Mode** control object. You can ignore the remaining steps if you disable loss compensation.
2. Select a **Loss Compensation Method** (either the "Test Sheet" method or "%Loss Constants" method), and
3. Enter the power system specifications necessary for the line and transformer loss calculations to be performed.

Level 3 ION Enterprise authority is required to use control objects and enter system values.

Setup and Controls

Click the **Setup & Controls** object in the Revenue Measurements diagram to view the Setup & Controls grouping window. You may only use the Setup & Controls if you have Level 3 (or higher) permission.

- Meter Mode

  During regular service, you should not have to enable TEST mode. Placing the meter in TEST mode activates the parameters displayed in the Revenue Test Mode window. Typically, TEST mode should only be enabled for testing and calibration purposes (see Note). All TEST mode values are cleared when you exit TEST mode.

NOTE

All billing quantities recorded during normal operation cease to accumulate while the meter is in TEST mode. The data recorded by the ION 7600 in TEST mode is sent to special TEST mode registers instead.

- LED Pulser Mode

  This setting determines if front panel LED energy pulser will pulse in NORMAL and TEST mode, or just in TEST mode. Refer to "Displaying Data with the Front Panel" on page 22 for more information about the front panel LEDs.

- Revenue Measurements Scaling

  By clicking on Secondary Units ("1:1") this control object lets the meter display and record Secondary values for kW, kVAR, and kVA (values not scaled with PT and Ct ratios). By default, the meter displays Primary values (values that using Ct, and PT scaling) for these revenue quantities.

- Peak Demand Reset

  The Peak Demand Reset control object allows you to clear the peak demand values logged in the meter. When the meter is in TEST mode, this object clears Revenue Test Mode demand parameters.

- Master Reset

  The Master Reset control object allows you to clear all the cumulative and derived quantities from the meter (including demand, peak demand, energy, revenue, and Revenue Test Mode parameters). A master reset also clears the meter's Event log.

⚠ **CAUTION**

The Master Reset operation will clear all billable quantities from the meter. The Master Reset operation will also clear the logged data from the meter's Event log.

- Report Log Enable

  The Report Log Enable object allows you to disable the data recorder that is factory configured to work with Reporter. Disabling this recorder reduces the processing load on the meter and the network (and the Log Server in particular).

  You should only consider performing this action if the Reporter is not present with your version of ION Enterprise. For more information about Reporter, consult the online *ION Enterprise Help*.

Setpoints

The Setpoints diagram uses setpoints to monitor kW demand, over current and voltage unbalance levels. Vista annunciates warnings if any of the values match or exceed specified upper limits for 30 seconds or longer. Users with Level 3 authority can define the setpoint limits. All status indicators read "NOT AVAILABLE" when monitoring is disabled.

Over kW Sliding Window Demand Monitoring

- Over kW demand monitoring is disabled by default.
- To set the upper kW demand limit, enter the total number of kW that should be considered as an over demand condition.

Per Phase Over Current Monitoring

- Over current monitoring is disabled by default.
- To set the over current limits, enter the total number of Amps that should be considered as an over current condition.

Voltage Unbalance Monitoring

- Over voltage unbalance monitoring is disabled by default.
- To set the upper limit for voltage unbalance, enter the percentage of the average voltage measurement that will be considered as a voltage unbalance condition if it is exceeded by the voltage on any phase.

Time-of-Use

This diagram may only be important if you are using the meter in a billing application (i.e. you are a power provider). Typically, power consumers can ignore the Time-Of-Use Vista diagram.

The Time-of-Use (TOU) diagram displays TOU energy and demand information (from sliding window or thermal demand calculations) for four billing rates in the present and previous billing period, as well as the previous season. This diagram also provides a shortcut to grouping-window display showing peak demand details for all TOU parameters. Historic Data Logging is provided for all TOU parameters.

Time-of-Use Tables

- Tabs provide access to the different groups of parameters. TOU information is provided for demand, peak demand, and energy (real, reactive, and apparent components).
- Information is "NOT AVAILABLE" if TOU is not configured.
- Historic Data Logging is enabled by default. The Historic Data Logging enable object is located in the Volts/Amps diagram (refer to page 96).

TOU– Peak Demand Details

Double-click on the **Peak Demand Details** object in each parameter grouping to displays peak demand information about that parameter.

Digital Inputs/Outputs

The Digital I/O diagram monitors all eight status inputs and six of the seven relay outputs of the meter. The diagram displays the status (ON or OFF) of each port. It also keeps count of the number of input state changes. You can reset the status change counter with the Reset Counter control object. For more information on Digital I/O, refer to the technical note *Digital and Analog I/O*.

Inputs

The meter's status inputs are de-energized when the meter is powered-up, so each status will initially be OFF.

Outputs

The meter's status outputs remain NOT AVAILABLE until they are configured using ION Setup or Designer software (details for both applications are provided elsewhere). Digital Output D4 is not shown in the Digital I/O diagram. Port D4 is factory configured to output calibration pulses at a rate of 1.8Wh (del+rec)/pulse.

Analog Inputs/Outputs

The optional Analog I/O card must be installed on your meter for this diagram to function. Depending on which option you chose for your card, the Analog I/O diagram monitors either analog inputs or analog outputs, or it monitors both the inputs and outputs.

Inputs

The meter's analog inputs are monitored for the *ScaledValu* output register. This value is displayed next to the appropriate port.

Outputs

The meter's analog outputs are monitored for the *Normalized* output register. This value is displayed next to its port.

Refer to the technical note *Digital and Analog I/O* for more information on analog inputs and outputs and their associated output registers.

Revenue Test Mode

The Revenue Test Mode diagram shows TEST mode parameters. The energy and demand values displayed only accumulate when the meter is in TEST mode. See "Setup and Controls" on page 98 for instructions on placing the meter in TEST mode.

Revenue Test Mode Values

- Accumulated values of active, reactive, and apparent energy (delivered, received, and delivered + received)
- Sliding window and thermal demand for active power (delivered, received, delivered peak, and received peak)
- All TEST mode values are cleared once you exit TEST mode

A red, flashing TEST mode label appears above the Energy label when the meter is in Revenue TEST mode.

Customizing the Vista Interface

Standard Vista diagrams show much of the data that the factory-configured meter measures and calculates. However, the factory-configured meter can provide additional data that is not presented by default with these display tools. This data can be added to the standard Vista diagrams by placing addition diagram objects on them; or, you can create new user diagrams to display any additional data you want.

Vista cannot be used to customize data displays on the ION meters themselves.

NOTE

Level 5 ION software authority (Supervisor) is required to create and configure new Vista diagrams. If you do not have Level 5 password authority, contact your ION software administrator for assistance.

Diagram Objects in a User Diagram

Diagram objects provide the interface to ION registers in your network, and to DDE values from other applications. Each diagram object displays a single piece of information from somewhere in your power-monitoring network; for example, a single numeric object displays numeric data from a single source.

If your account has permission to edit user diagrams, the following diagram objects are represented by icons in a floating toolbox.

If this toolbox is not available in Vista, yet you have the proper permissions to edit user diagrams, you must select Options > Show Toolbox from the Vista menu. A check mark next to the option indicates that it has been selected.

To place a diagram object, simply click, drag and drop the object you want from the toolbox onto the current Vista display window. Once you have added the diagram object, right-click the icon to specify the actions you want it to perform.

Complete details on configuring diagram objects and creating Vista User Diagrams are in the online *ION Enterprise Help*.

Custom Appearance of a User Diagram

You can customize the appearance and configuration of any window within a user diagram. You can alter a window's font or background color, or configure window properties such as background image, real-time and logged data links, double-click action, and stale data settings.

To make one or more of these changes, right-click anywhere in the background of a user diagram. A menu appears with three selections:

Choosing Default Font or Background Color allows you to customize the area implied by the selection. Choosing Properties brings up the Window Properties Configuration box, which offers five groups of options: Image, Log Server, Node, Action and Stale Data. Complete details on these options are found in the online *ION Enterprise Help*.

ION Enterprise: Designer

Designer is an application for advanced users who know the nature of ION architecture, specifically the nature of frameworks. A framework is a number of ION modules arranged (linked) to perform a specific function or number of functions. Designer allows you to customize current frameworks by adding, deleting, or re-linking ION modules, and it allows you to create entirely new frameworks. Although it can be used to perform basic setup, such as changing an ION module's setup register, it is recommended that you only use Designer for framework customization and creation.

NOTE

In most cases, you will be able to achieve the functionality you want by changing the settings in an existing module's setup registers. For this operation it is recommended that you use ION Setup.

Basics of ION Architecture

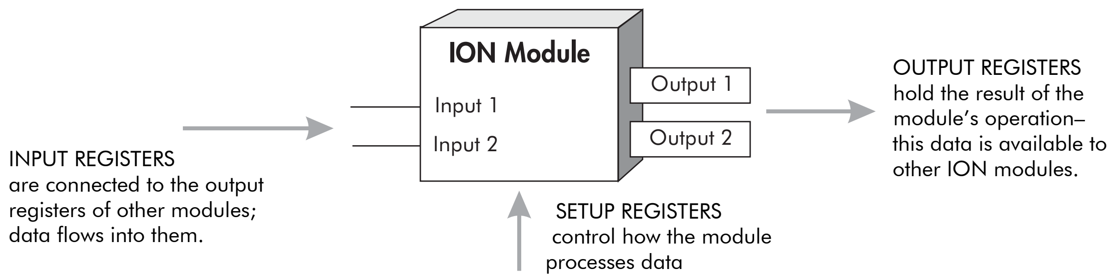
Before you begin altering the meter's operation, it is advisable to familiarize yourself with the basics of how the device operates. Understanding the basics of the ION architecture will help you understand how to make different types of configuration changes.

The ION architecture applies the principles of object-oriented software design to the creation of functionality inside your devices. The object-oriented structure allows you to connect different discrete objects (called ION modules) in different ways to define how information is accessed, transferred, and manipulated inside the device and across the power monitoring network.

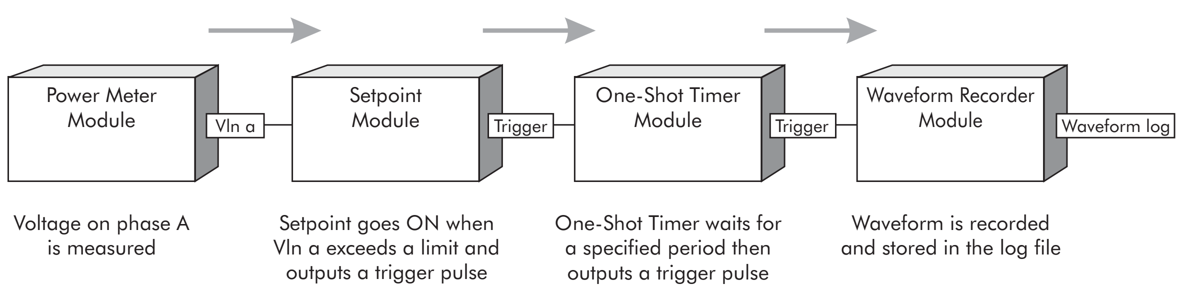
Each ION device contains a number of ION modules that perform specific functions. The ION modules are linked together to create frameworks or framework templates, defining multiple operations and logical pathways for power system information. The basic structure of an ION module is the same for each module type, making it easy to use new features once the basics are understood.

ION Modules

The ION module is the basic building block of the ION device's operating software. A module can be considered as a "function box": it receives data from its inputs, makes decisions based on the settings in its setup registers, and then makes data available at its output registers. All functionality provided by an ION device can be considered in terms of its modules and the linkages between them.



Modules are linked together to create powerful functions. For example, the framework below consists of four modules that, when combined, trigger a waveform recording in response to an over-voltage condition.



Module Linking Restrictions

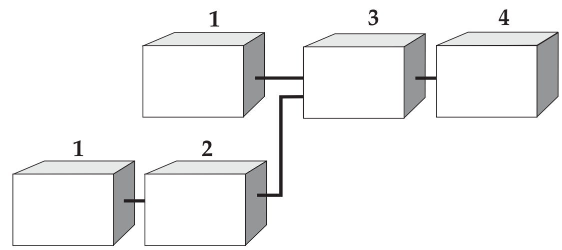
The maximum number of modules that can be linked in a row is 25. This is referred to as the framework's *depth*. Modules that branch off or branch into the chain do not affect the depth, and there is no restriction on the number of branches you can have in a framework.

Another restriction concerns "circular" linking of modules. You cannot link a module's output register to its own input or to the input of any module that precedes it in the chain. This protects you from creating infinite loops that can waste system resources.

The one exception to this rule is the Feedback module, which makes circular linkages possible (refer to the online *ION Programmer's Reference*).

Sequence of ION Module Execution

ION modules always execute in the order of the data flow (in the example below, from 1 to 4). This logical execution order is maintained even if you created the framework from back to front.



ION modules may execute simultaneously if they do not depend on each other for data (such as both ION modules labelled 1). Conversely, ION module 3 will not execute until both ION modules 1 and ION module 2 have executed.

ION Registers

Each module has one or more output registers, and most modules have Setup registers. (A module's inputs are links to the output registers on other modules.) There are different types of registers, each classified by the type of data they accept. When you want to change a module's configuration, you must supply the type of data that is appropriate for the register you are configuring. The configuration tools prevent you from entering the wrong type of data into a register, but they do not prevent you from entering the wrong value.

The 'NOT AVAILABLE' Value

An ION module that requires a link to one or more of its inputs, but has no such links created, does not contain any values in its output registers. Instead, its output registers are set to NOT AVAILABLE. In addition, if a module has an input that is invalid (for example, a line-to-neutral measurement for a 3-wire Delta system) its output register is also set to NOT AVAILABLE. The NOT AVAILABLE value helps to distinguish between cases where a register contains a value like 0 or OFF, and cases where there is actually no value stored.

NOTE

The NOT AVAILABLE value appears in Vista objects that are linked to ION modules with output registers that are NOT AVAILABLE. The front panel of the meter displays values that are NOT AVAILABLE as dashes (–).

If the inputs of a module are NOT AVAILABLE, its output registers are also NOT AVAILABLE. The NOT AVAILABLE value propagates through all linked modules. (The NOT AVAILABLE value propagates through linked Arithmetic modules differently - refer to the ION Arithmetic module description in the online *ION Programmer's Reference*.)

ION Configuration Changes and Module Security

When you make configuration changes to an ION device you are either changing a value in a module's setup register (basic configuration) or you are changing the linkage between two or more modules (advanced customization).

Certain parts of the meter's operating software are protected against deletion and tampering, specifically core ION modules, fixed module links, persistent ION modules, and locked ION modules. Visit Power Measurement's web site (www.pwrm.com) for a complete listing of these module types for your meter.

Core Modules

Core ION modules are fundamental to basic device or software node operation. You cannot create or delete core modules, and in some cases, you cannot configure them. Those ION modules classed as Core modules are the same in every device or software node, though not all devices and software nodes support all the Core modules. The following are examples of Core Modules: Power Meter module, Communications module, Display Options module, and the Factory Module.

Fixed Module Links

Several of the linkages between core modules are fixed; they are required for the basic operation of the device. A fixed link cannot be removed. A core module with fixed links can still be linked to other modules.

Persistent Modules

Persistent ION modules are similar to Core modules, as they are core to the operation of the device and cannot be created or deleted. These ION modules are protected, because they are factory-configured to provide important external control functions. Many External Pulse modules are Persistent ION modules. Do not reuse Persistent modules.

⚠ **CAUTION**

Persistent modules can be overwritten in Designer. When pasting a default framework onto a meter, use lock-paste on the Persistent modules, not free-paste. A list of Persistent modules is available on the Library page of Power Measurement's website, under "ION Device Templates".

Locked Modules

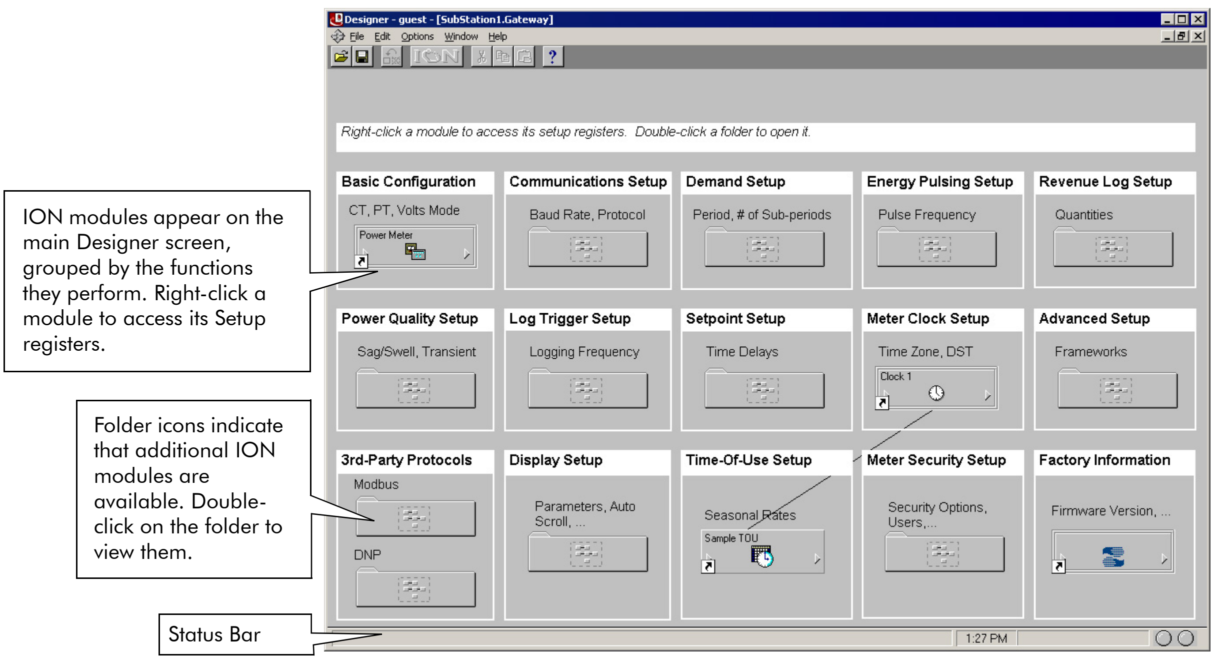
Locked modules provide security for revenue meters. This type of module security only applies to ION meters with the revenue-lock enabled (RM) order option. Furthermore, there are varying degrees to locked module security: Fully Locked, Writable Locked, and Front Panel Locked. Fully Locked security is designed to protect the revenue related functions within the meter; they cannot be modified in any way. (Fully Locked modules have their values written via internal meter methods, as the meter makes calculations based on its voltage and current inputs.) Writable Locked security allows you to trigger or change the state of the ION module, but you cannot delete it, link to it, or change its label. Front Panel Locked security prevents registers from being altered remotely via software; you must use the ION meter's front panel to make any modifications to these registers.

NOTE

Depending on the meter family, there may be different types of module security. *Rev_write_state_lookup* means the module cannot be modified in any way, and *Rev_destroy_lookup* means the module cannot be deleted.

Designer's Main Configuration Screen

If the software has been properly configured, the main screen of the meter's node diagram appears each time that you open a meter in Designer. If the ION software has not yet been configured, refer to the online *ION Enterprise Help*, or contact your network administrator. The different types of device functions are grouped together on the Designer screen, so you can quickly access the types of settings you want to change.



Once you have logged on to Designer and opened the meter's node diagram, you can begin configuring ION modules. Designer displays two types of objects on the main configuration screen: ION modules and grouping objects (also called folders).

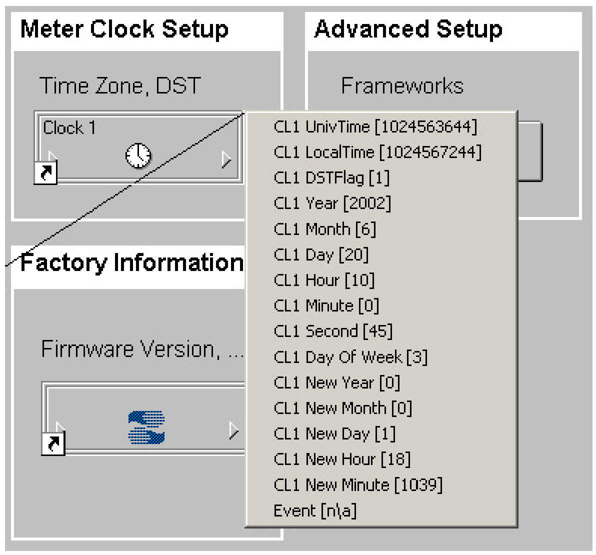
A folder in Designer indicates that additional modules are available. Double-click on a folder to access the modules contained inside it. In some cases a folder will contain additional folders — continue double-clicking on the folders until you reach the appropriate ION module.

Viewing Real-time Data in Designer

You can view the real-time values of output registers in Designer. This is useful when you are linking these outputs to other modules. It is recommended that you use Vista or ION Browser as your main data display application.

To view real-time data of output registers:

1. Click Options > Show Toolbox on the Designer menu.
2. Find the ION module you want, press the Shift key and click the output register. The following example shows the real-time data for the outputs of the Clock module in an ION 7600 meter:



Changing Setup Registers with Designer

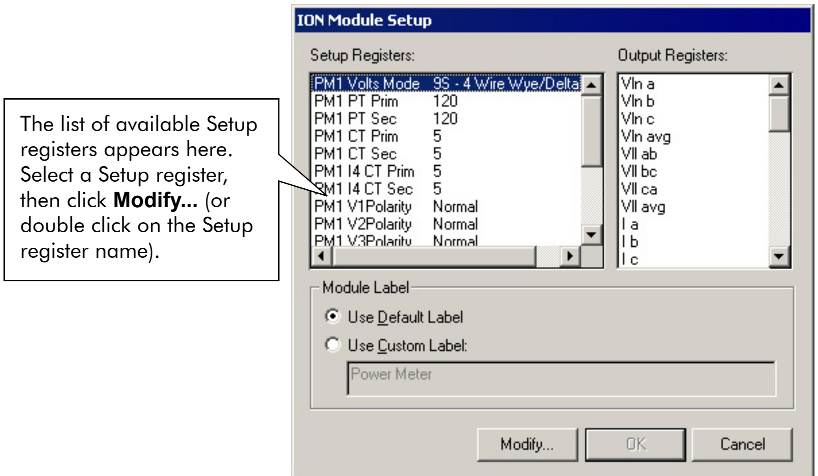
If you are familiar with the nature of ION architecture and comfortable using Designer, you can use the application to modify ION modules' setup registers.

NOTE

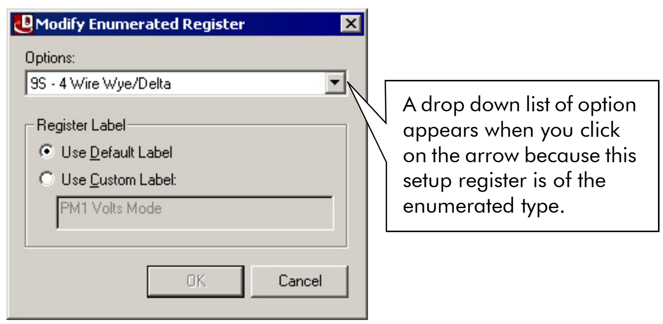
It is recommended that you use the Setup Assistant in the ION Setup software to configure an ION module's setup registers. The Setup Assistant is a user interface that provides access to the setup registers for a meter. (Refer to the ION Setup section for more details.)

To configure ION module setup registers with Designer

1. Right-click near the module's center. The ION Module Setup dialog box appears, showing a list of setup registers available for configuration.

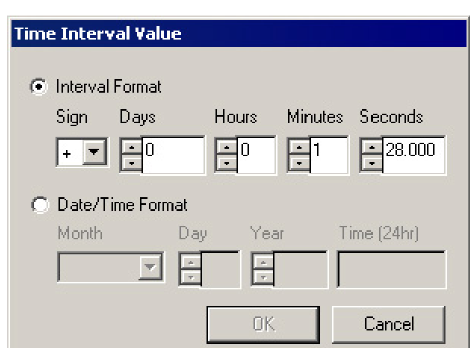


2. Highlight the Setup register you want to configure, and click **Modify...**. A Modify Register dialog box appears.



Make the change to the register's setting here. As there are different types of data held in setup registers, there are different Modify Register dialog boxes. The Modify Register dialog box may require that you choose an option from a list or enter a numeric value.

A format option is available when modifying Numeric Bounded setup registers. Clicking **Format** causes a "Formatted Numeric Value" window to appear:



Use the **Interval Format** area if the setting you are changing requires intervals. Use the **Date/Time Format** area if the setting you are changing requires specific dates (such as those needed used in the Clock module). Click OK when you have the desired setting for the time interval or date.

3. Click **OK** when you are satisfied with your configuration changes.

Complete details about the Setup registers of every ION module are provided in the online *ION Programmer's Reference*. Details about the Setup Areas on the main screen of the node diagram can be found in the Default Functionality chapter.

Customizing Frameworks in Designer

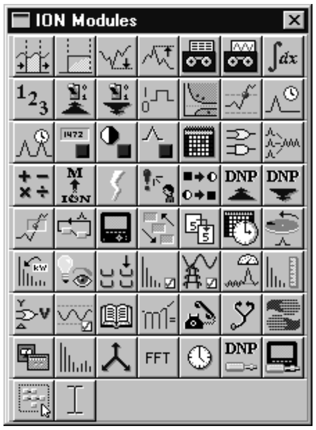
To create custom functions, ION modules are linked together and then configured. Linking ION modules is relatively straightforward: output registers on one module are linked to the input registers of subsequent modules. Data flows from the output register on the first module to the input registers on a second module. Each module that receives data makes decisions and processes the data based on its setup registers' settings. Once the data has been processed, a module makes the data available at its output registers. These output registers can then be linked to the inputs of other modules, and so on.

Most ION modules perform simple, discrete functions. The combination of modules linked together creates a more powerful functionality. Multiple modules linked together can be referred to as a framework. Since a device's operation can be separated into the specific, smaller functions performed by the modules, creating specialized functionality is simple if you understand the operation of the component pieces.

⚠ **CAUTION**

The meter is factory-configured for optimal operation. You should not make any changes to its operating software unless you are familiar with the ION architecture, you know specifically what you want to accomplish, and you understand the effects of the changes you intend to make.

If you need to customize your meter's operation, you will need to create new ION modules, configure their settings, and in some cases link them to other modules. Designer provides a graphical view of your meter's internal operation, making these tasks simple. If you require more information on Designer than is presented in these pages, refer to the online *ION Programmer's Reference* or online *ION Enterprise Help* for complete usage details.



Each ION module available to a meter appears in the toolbox.

Creating New Modules

To add a module, locate its icon in the Designer toolbox, press and hold the left mouse button over the icon, and drag it onto the node diagram. Once you release the mouse button, the module becomes part of the diagram and is ready to be configured and linked.

Choosing the Module

The Designer toolbox displays icons for all the meter's available module types. If the toolbox is not displayed, choose Show Toolbox from the Options menu.

As you drag the mouse over the icons in the toolbox, the status bar at the bottom of the Designer window displays the module type.

Creating the Module

Follow these steps to create an ION module in the meter:

1. On the ION Modules toolbox, press the mouse button down on top of the icon of the module you want to create, and drag it onto the node diagram. As you drag the icon, the cursor changes shape to indicate you are placing an object.
2. Release the mouse button to place the module in the diagram. When you release the mouse button, Designer places a *pending* module icon into the diagram (pending modules appear with a dashed outline).
3. Once you have configured the node to your liking, choose Send & Save from the File menu to download the configuration to the node. The dashed outline is replaced with a solid outline, indicating that your changes have been saved.

   After a Send & Save, ION modules that are offline (or inactive) appear with a red border. This can mean that the ION module's setup is incomplete. Refer to the online *ION Enterprise Help* for more details.

The web site has information about the setup register defaults a module has when it is initially created, as well as the ranges or options each setup register supports.

Deleting Modules

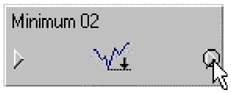
To delete a module, select it by clicking its icon, then press the Delete key. Use caution when deleting modules – any dependant modules will be affected. Designer informs you of dependant modules if they exist on the same node.

Linking Modules

Module linking involves clicking on one module's output register symbol, choosing the output register you want to link, then clicking the input of a second module and selecting the input to link to. This operation can be performed in reverse – you can start with one module's input and link to another module's output register if desired.

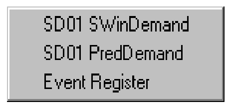
You can link modules that reside on different nodes, provided that you are linking between software nodes, or from meter to software node. You cannot link modules between meters. The following section describes how to link modules that reside on the same node. The online *ION Programmer's Reference* or the online *ION Enterprise Help* have instructions on linking modules that reside on different nodes.

Follow the steps below to link modules on the meter:

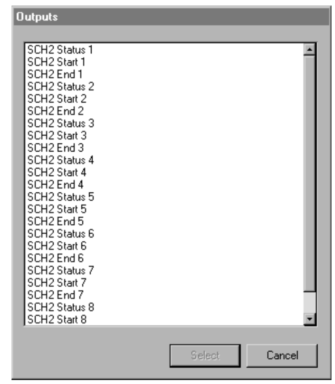


Accessing module outputs

1. Click on the symbol on the right side of the module icon to list a module's output registers. (To list the module's setup registers, hold the CTRL key while clicking on the symbol.) In most cases, a pop-up menu appears and lists the available registers. If the module has many registers, a dialog box appears instead.



or

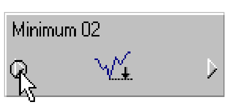


2. Click on the register you want to select. In the case of the dialog box, double-click on an output register, or choose the register and click Select.

The cursor looks like this when a linking operation is in progress: 

3. Drag the cursor towards the module to which you want to link; the cursor changes and a dotted line follows it across the node diagram. This indicates you are in the process of creating a link. The dotted line also shows where the connecting line will appear in the node diagram once the link is made.

   If you link to a module that is in a different window than the original module (either in a different node diagram or grouping window), the dotted line disappears, but the cursor still indicates that a link is in progress.



Accessing module inputs

4. Click on the module icon's left symbol to display the module's inputs. In most cases, a pop-up menu appears and lists the module's inputs. (If there are a large number of inputs, a dialog box similar to the More Output Registers dialog box appears instead.) Inputs that are a different class than the selected output register are grayed out to indicate that you cannot select them.

   If the input is already linked, the register label it is linked to is displayed beside the input. If you select the input, the existing link is overwritten.

5. Choose the input you want from the pop-up or dialog box.

   If the two modules are in the same window, the dotted line remains on the screen to show the link between the modules.

6. Save the changes you made to the node. When you save, the line changes from a dotted line to a thin black line to indicate that the link is now programmed on the node.

The procedure described above can also be performed in reverse order. You can select a module's input first and then link it to another module's output register.

Editing Existing Frameworks

If you are comfortable with the ION software and the meter's configuration, you can make changes to the existing frameworks to customize operation. Any edits you make to the existing frameworks alter the device's operation — be sure you understand what effect your changes will have before proceeding.

Checking an Output Register's "Owner"

Using Designer, right-click a module's output register to view its linkages, referred to as "owners". A dialog box appears showing all of the inputs that are linked to that output register. With this information you can determine what changes will result to the framework by deleting the links to the parameter. Note that links to inputs on other nodes are not shown in this dialog box.

⚠ **CAUTION**

Viewing owners by right-clicking a module's output register will only show you module linkages on the same node. Any links to modules on different nodes will not be shown. If links to modules on other nodes may exist, always check the links at a module's inputs.

Deleting the Link at a Module's Input

You can also check the links at a module's input. Using Designer, right-click on the input symbol on a module to view a dialog box listing each of the inputs and the output registers they are linked to. You can unlink inputs from within this dialog box as well.

Replacing a Link

You do not need to unlink a module's input before linking a different output register to it. If you link an output register to an input that is already linked, the existing link is overwritten.

ION Enterprise: Reporter

Reporter is a database reporting application. It lets you define, generate, and manage comprehensive reports based on the data in your database. Reporter retrieves data from the Relational Database Management System (RDBMS), and processes it into a finished report in Microsoft Excel format. There are a number of pre-configured reports available, including Power Quality, Load Profile, Energy and Demand, and EN50160 reports. You can also generate custom reports that incorporate virtually any data stored in the RDBMS and perform further analysis using Excel's advanced mathematical and graphical functions.

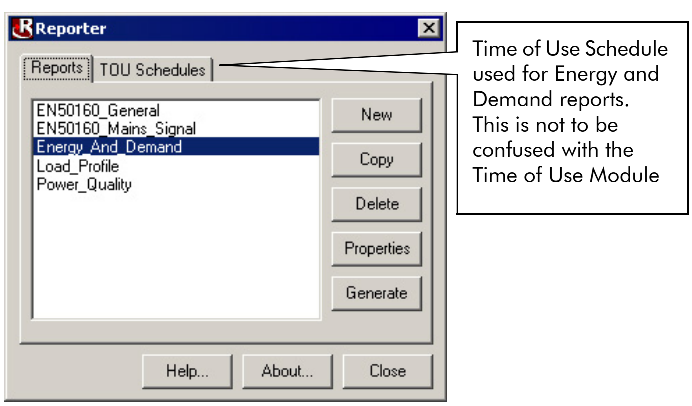
After you've designed custom reports and configured the Excel workbooks, reports are updated automatically, either in response to a power system event, or following a specified schedule. You can also configure reports to automatically email selected recipients after updating.

NOTE

The Report View Manager, a component of the Reporter, can be used on its own to create custom database views for use with other third party reporting packages. Advanced knowledge of database operation may be required to use the Report View Manager with third-party applications. Refer to the online *ION Enterprise Help* for details on the Report View Manager.

Pre-configured Reports

When you start Reporter, the main Reporter screen appears with a list of pre-configured reports. The most commonly accessed reports are the Energy and Demand report, the Load Profile report, and the Power Quality report. There are also 2 reports related to the European EN50160 power quality standards.



Energy and Demand

This report is designed to generate and display details about energy consumption and peak demand levels over a given time period. It uses a Time of Use Schedule (TOU) to reference the metered data against an energy provider's tariff schedule.

The first step in creating an Energy and Demand report is to preconfigure the TOU schedule that will be applied to the metered data. If you do not require a time of use schedule, you can create a mock schedule with only one time period defined. Use the EgyDmd Log as a query item.

Load Profile

This report generates a graphical representation of demand, or load levels, over a given time frame. The profile is a characterization of peak loads that can be used to determine and limit demand peaks which could lead to financial penalties for energy consumers, or could signal a need for additional generation or the introduction of load control programs for energy suppliers.

The Load Profile report also uses the EgyDmd Log as a query item, but it does not use a TOU schedule.

Power Quality

This report summarizes the number and severity of sags, swells, and transients over a given time range, and graphically represents the waveform captures of each individual event for further analysis.

The Power Quality report is slightly different than the other two report types, mainly in its requirements for different data log sources. The Power Quality report requires a combination of the Sag/Swell Log, Transient Log, and Waveform Log.

NOTE

You generate a Power Quality report with a combination of the Sag/Swell logs, Transient logs, and Waveform logs from the ION meters that have these as features. For example, the ION 7350 uses a Sag/Swell module and Waveform capture to generate a Power Quality report; however, the ION 7600 has the Sag/Swell Log, Transient Log, and Waveform Log, so all three sources are used for a Power Quality report.

EN50160

EN50160 is a general power quality standard used by energy suppliers and energy consumers in European countries. The report is a summary of the multiple pass/fail results of the evaluation methods outlined in the standard. All fourteen of the logs below must be added to each EN50160_General report:

- EN50160 Vlt Dp1 to EN50160 Vlt Dp5
- EN50160 Ovrvlt1 to EN50160 Ovrvlt3
- EN50160 Frq/Mg, EN50160 Flicker, EN50160 Intrp, EN50160 Hrm Vlt, EN50160 Ihm Vlt, and EN50160 Vunbal

EN50160 MSignal is the log used for the EN50160_Mains_Signal report.

Report Creation and Generation

These steps are used for creating all report types. Be sure to know which log(s) you use for the report you are creating.

NOTE

If you are creating an Energy and Demand report, complete the steps under "Creating a Time of Use Schedule" (following "Creating a Report") before you proceed with creating your report.

Creating a Report

1. Start Reporter.
2. Select the report type you want and click Copy.

   The pre-configured reports include some basic programing to simplify the customization process. It is recommended that you create a copy prior to making changes, leaving the default report unmodified.
3. Click the Properties button (while your copy is selected). The Report Properties dialog box appears.

   On the General tab, it is recommended that you change the default report name to distinguish it from other reports you may create.
4. Click New from within the Database Queries section. The Database Query Properties dialog box appears.
5. Select your DSN (Data Source Name). This is the name of your database file or archive.
6. Select the appropriate Log file(s) for the report. Click OK to close the Database Query Properties dialog box.
7. Click on the Distribution tab and select the appropriate check box.

   You may need to provide more information, such as a destination folder or email address, depending on your distribution method.
8. Make any changes you require on the Advanced tab and write any information you desire on the Notes tab.
9. Save your new report template.

Generating the Report

1. Select your report from the list.
2. Click Generate.

The Report Generator extracts the requested information from the database, applies the TOU (if required), and displays the report in Microsoft Excel. Larger reports with many queries may take a few minutes to complete.

NOTE

If you selected the check box for Interactive Date Range on the Advanced tab, you are prompted to select the date range within the Interactive Date Range screen.

Creating a Time of Use Schedule

1. Start Reporter and select the TOU tab.
2. Select the Sample file, then click copy to duplicate it.

   All of the pre-configured samples include some basic programing to simplify customization. It is generally best to create a copy of the samples before making changes, and leave the sample in its default state.

NOTE

Be aware that the NEW button creates a completely new report or TOU schedule with no default configuration. Use this option to create completely customized reports.

3. Select your new copy and click Properties to configure it.

   Examples of possible changes for the TOU schedule are as follows:

   - Rename the TOU Schedule using the appropriate field.
   - Modify On Peak and Off Peak charges using the appropriate field.
   - Add a 'Shoulder Period' which is often called a 'Partial Peak' (see below).
   - Change the Holidays to an appropriate country (see below).
4. Save the new TOU configuration when configuration is complete.

Adding a Shoulder Period

1. Highlight the Off Peak period by left clicking on it, select New.
2. Rename your new tariff period (i.e. Partial Peak).
3. Modify the time period by left clicking the plus sign, selecting the time period and changing the time within the left window.
4. You will also have to modify the time period within the On Peak and/or Off Peak intervals to ensure that there is no overlap (i.e. if your new 'Partial Peak' period is between 6:00 and 8:00 PM, then you will have to change your 'Off Peak' period to 8:00 PM to End Of Day).

Changing Which Days are Holidays

1. Select the Off Peak period.
2. Left-click 'All Day, Canada Holidays' and select a different country from the window on the left.
3. Add or remove holiday dates as required.

CAUTION

Double check to make certain that there are no gaps and no overlapping date or time ranges. The TOU schedule should not be confused with the Time of Use Module used by billing applications.

Once you have completed configuring the TOU schedule, you are ready to create the actual Energy and Demand report.

ION Setup Software

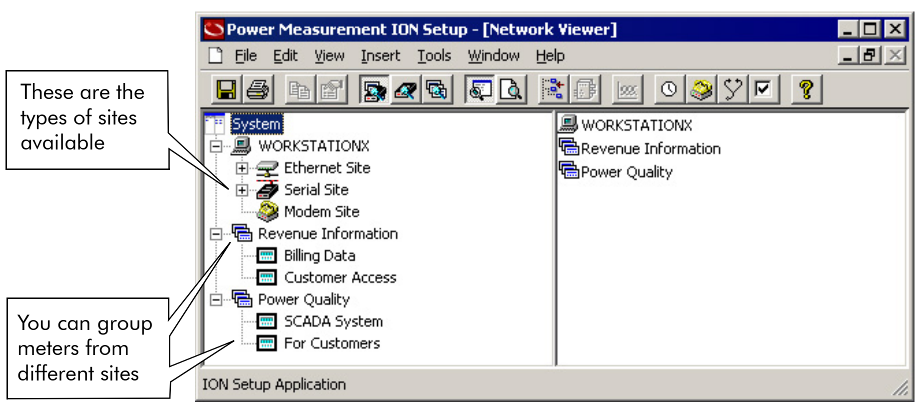
ION Setup is a software solution that allows basic configuration and control capabilities for your power monitoring devices. ION Setup can also display real-time and diagnostic data for your networked devices.

When starting ION Setup, you have the option to enter network mode or single device mode at the logon screen. Network mode allows you to add multiple sites and meters to your network, organize your meters into logical groups, and configure each site and meter individually. The single device mode, however, allows you to connect to only one meter and make changes to its configuration or view its data.

Refer to the documentation on you ION Setup CD or visit the Power Measurement web site for complete details on ION Setup.

Configuring Communications

With ION Setup, you first create one or more communication sites: the site defines the communication method. You then add devices to a site, followed by grouping the devices in a logical manner according to your needs (e.g. by common function or physical location).



NOTE

You must be logged on to ION Setup in network mode in order to add a site, group, or device.

Sites, Groups, and Meters

You can create a network of items within ION Setup so that the next time you want to upgrade a meter's firmware or make any configuration changes, the meter is easy to find and your communication setup is ready.

Sites refers to a communication method. For example, you need separate sites for Ethernet, Serial or Modem types of communication. A site can have many connected devices. You can also have one meter that is connected to two or more sites provided that the meter has the capability.

A group is an optional feature that lets you define a logical grouping of meters. For example, you can have a group of meters for power quality monitoring, or you can have a group of meters defined by location. Groups are always attached to the System icon. Devices within each group are attached to both the group and a communications site (sites are connected to the workstation).

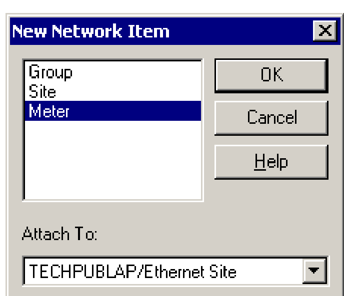
You can add a meter to a communication site or a group. When you add a meter to a group, it is automatically attached to the appropriate communication site. However, when you delete a meter from a group, the meter remains attached to the communication site.

Adding a Site, Group or Meter

1. Close any open windows to return to the Network Viewer screen. Do one of the following:
   - From the toolbar, click the Insert An Item button, or
   - From the Insert menu, choose Item, or
   - Right-click anywhere on the screen to display the shortcut menu, and then click Insert Item.

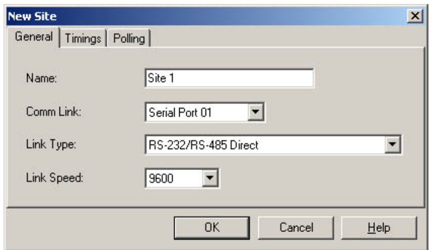
   The New Network Item dialog box appears (see illustration in step 2).

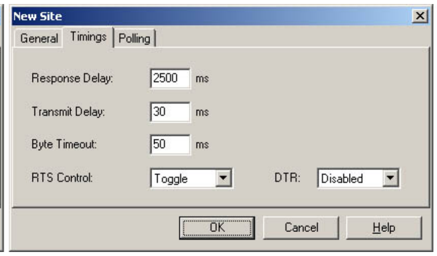
2. Click the item (Group, Site or Meter) that you want to add. In the **Attach To:** box, select where you want to attach the item.

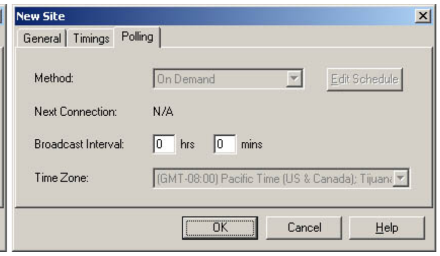


3. Click OK. A dialog box for the appropriate item appears. Depending on the item, there may be multiple tabs each with numerous options for configuration:

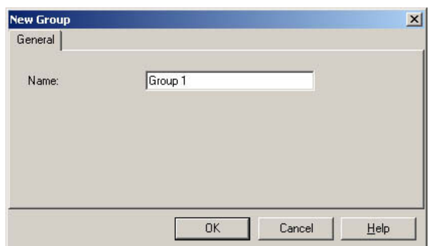
- When you add a new site, the dialog displays three tabs: General, Timings, and Polling. If you are adding a modem or gateway site, there is a fourth tab labelled Remote Info.



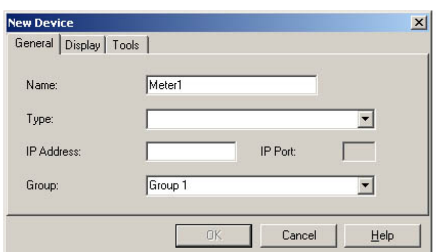


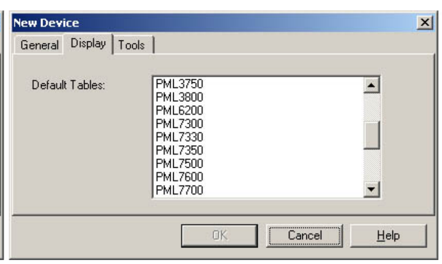


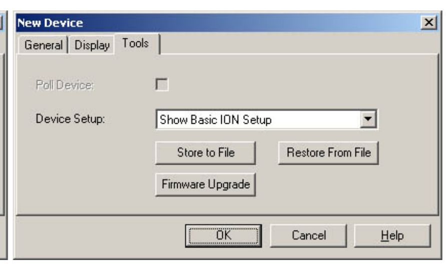
- When you add a new group, the dialog box has only one tab labelled General. On this tab, you can change the name of your newly created group.



- When you add a new meter, the dialog box displays three tabs: General, Display, and Tools.

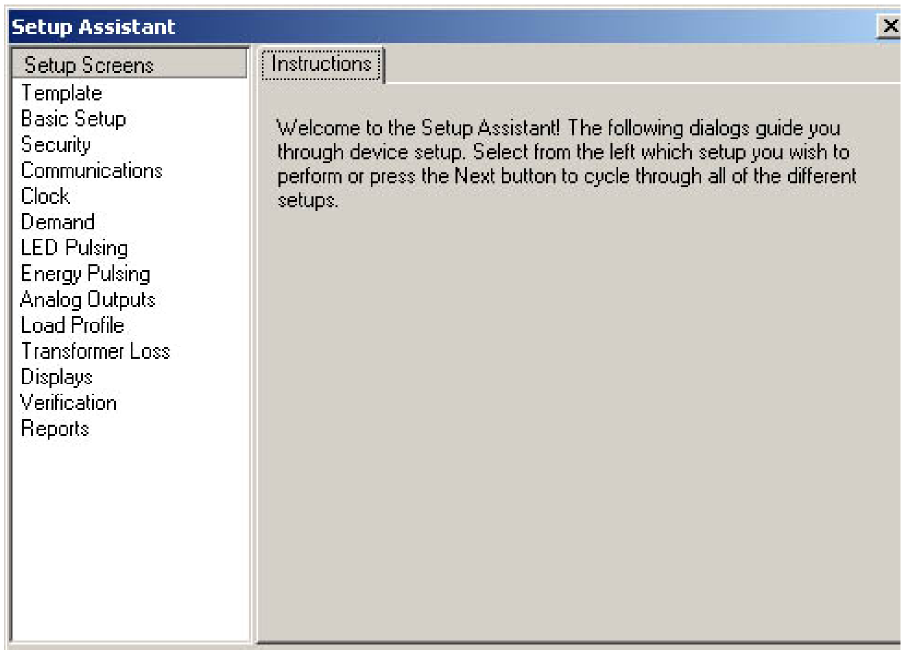






Basic Meter Configuration

The Setup Assistant is a user interface that contains relevant instructions to help guide you through common setup requirements for your ION meter. After you have added a device to ION Setup in network mode, or connected using single device mode, the Setup Assistant appears in the right pane. Double-click the Setup Assistant to access the setup dialog box.

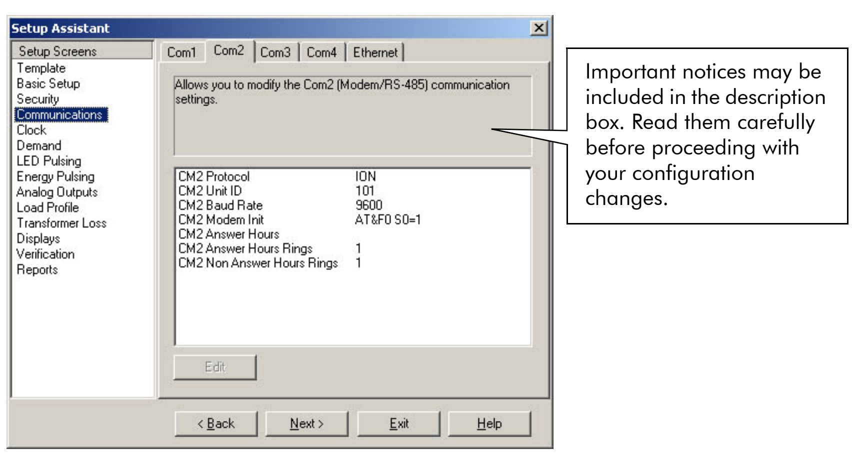


The Setup Assistant is accessible in both single device mode and network mode.

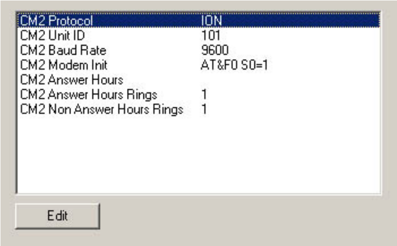
The Setup Screens on the left let you access different setup tabs on the right. It is from these setup tabs that you can configure a meter’s setup registers.

Changing a setup register

1. Highlight the Setup Screen you want and select the desired tab where applicable.



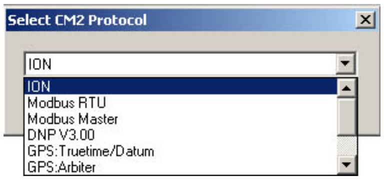
2. Highlight the setup register you want to edit in the register window.



3. Click the Edit button.

   (If advanced meter security is enabled, a window will appear asking for the meter's password. Type the meter's password and click OK.)

   A window appears where you can edit the register value.



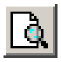
   Depending on the register class, you either select a value from a drop-down list or enter the new value manually in the field provided.

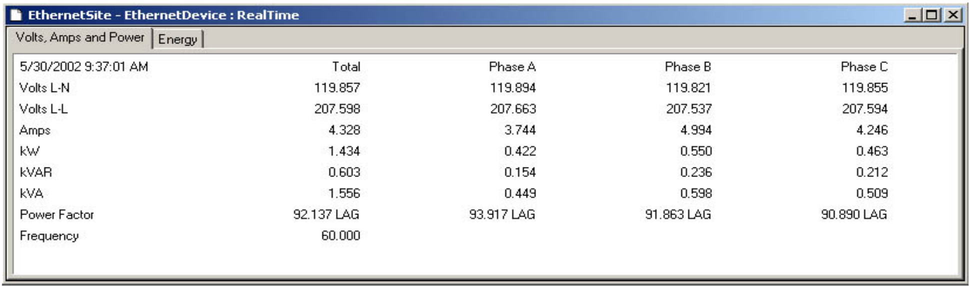
4. Make your selection from the drop-down list or enter a new value. Click OK. The setup register changes immediately.

Displaying Data with ION Setup

You can use ION Setup to display real-time or diagnostic data from any meter that you have added to the software.

Displaying real-time data

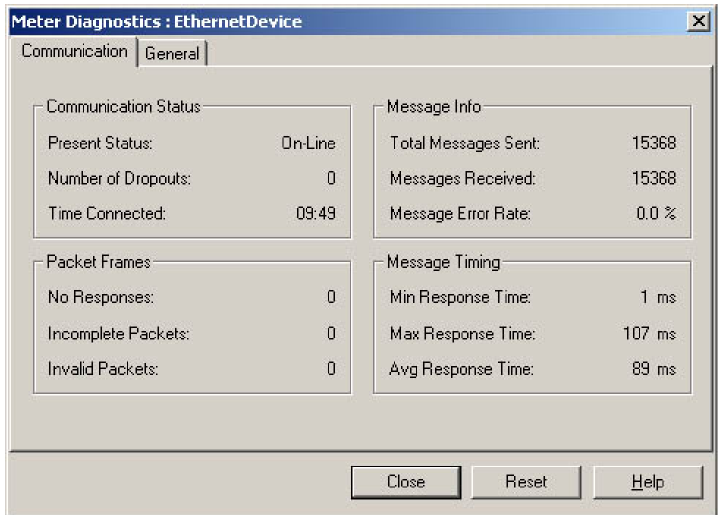
1. Select Data Screens from the View menu (or click  on the toolbar).
2. Click the device icon from which you want to view real-time data.
3. Double-click the icon for the screen you want to display (the screens in the right pane of the ION Setup window).
4. Click the desired tab to display its contents if there is more than one tab in the display screen.



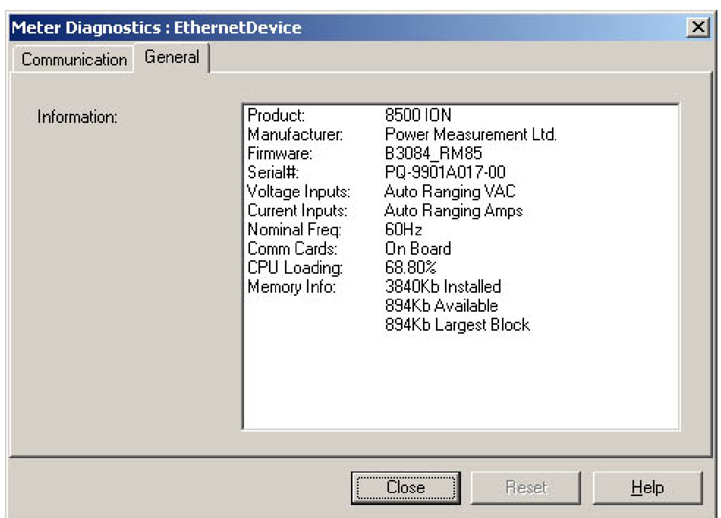
Displaying diagnostics data

1. Select a site or device icon from the left pane.
2. Select Diagnostics from the Tools menu (or click on the toolbar).

   The Communication tab displays information about the meter's communication status, message information, message timing, and packet frames. Clicking the Reset button sets all values to zero.



   The General tab display information about the meter, such as the meter type, the firmware version, serial number, communications, and available memory.



CHAPTER

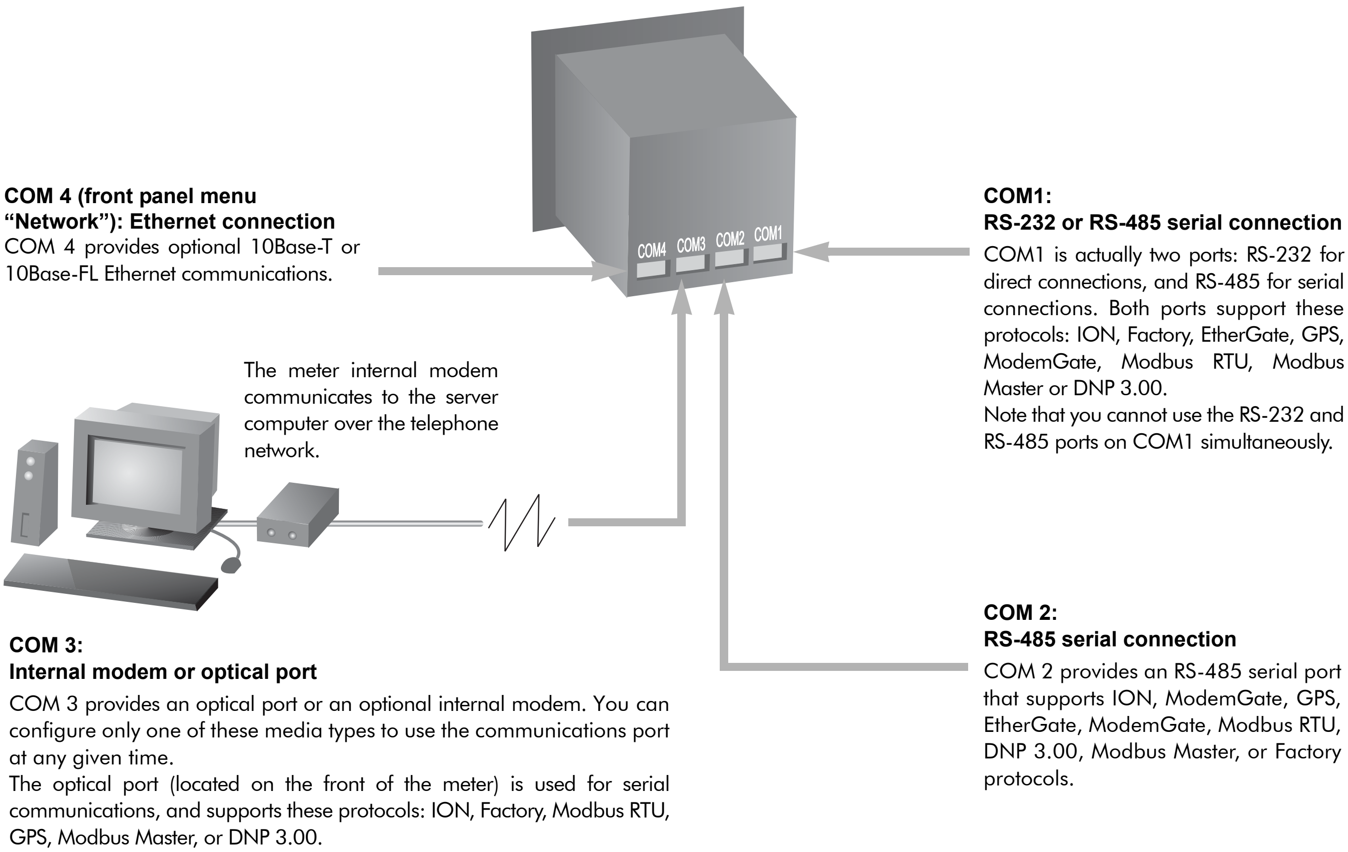
5 Features and Applications

The ION 7500 and ION 7600 meters offer unmatched value, functionality, and ease of use at key distribution points and sensitive loads. Comprehensive analog and digital I/O, multiple communication ports, industry-standard protocols, and precision time synchronization compliment the meters' ability to integrate with your energy management and SCADA systems.

In This Chapter

Communications

The following illustration shows all the possible connections to the communications card.



The ION 7500 and ION 7600 meters have numerous communication possibilities depending on your ordering preferences. Both models can have exactly the same communications options.

All of the communications ports can be used concurrently.

COM Port	Available Connections	Standard/Option
1	Selectable RS-232/RS-485 port	Standard
2	Dedicated RS-485 port	Standard
3	IrDA optical port	Standard
3	Internal modem	Option
4	10Base-T (or –FL) Ethernet [1]	Option

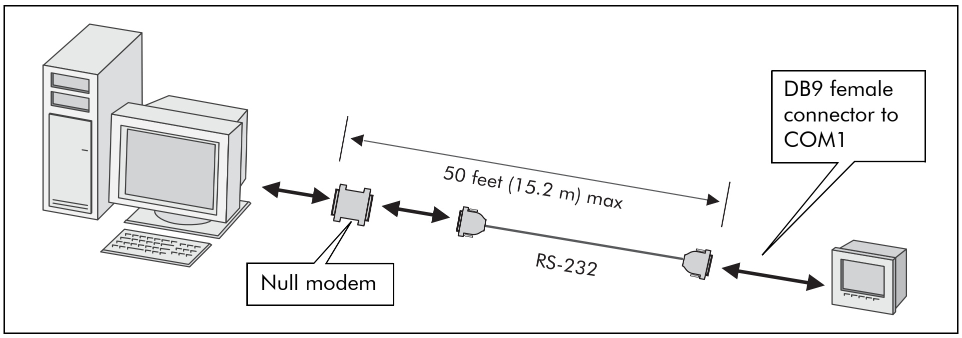
[1] 10Base-FL option will only be available if -FL was specified when the meter was ordered.

RS-232 Connections

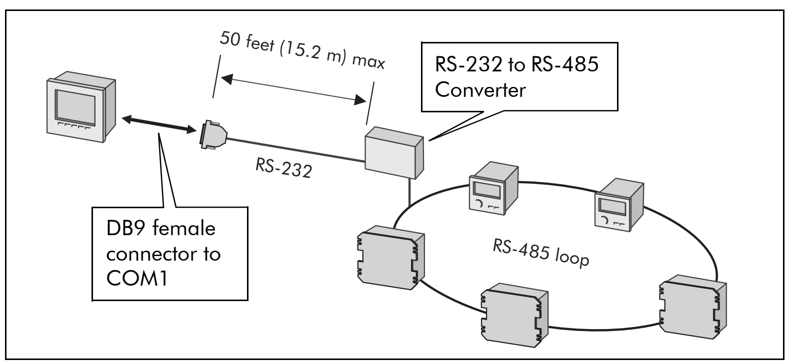
Refer to the "Hardware Reference" chapter for the ION 7500 and ION 7600 meters' RS-232 specifications.

An RS-232 connection is made at the male DB9 connector (COM1) at the back of the meter. The meter acts as a DTE device in all RS-232 connections. Use a null modem cable for connecting a meter to a workstation or use a standard straight-through RS-232 cable for connecting to an external modem. In either case, one end of the cable must be equipped with DB9 female connector for mating with the DB9 male connector on the meter. The maximum cable length is 50 feet (15.2 m).

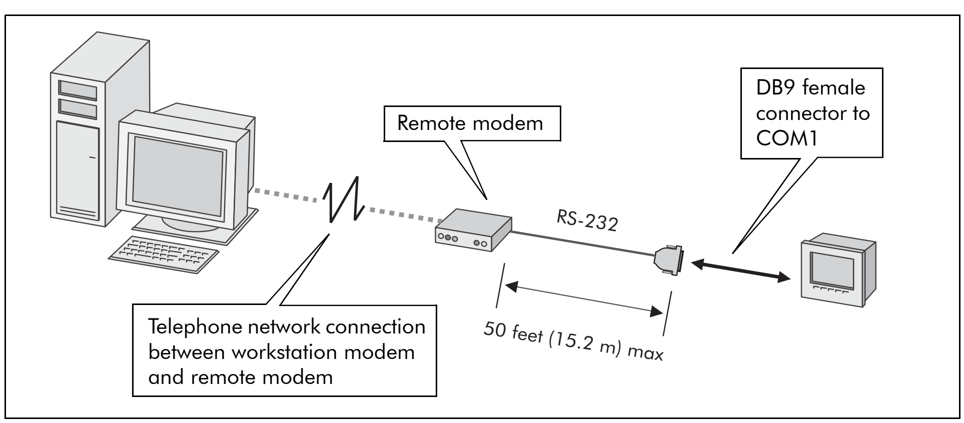
Computer Connections



Meter Connections



External Modem Connections

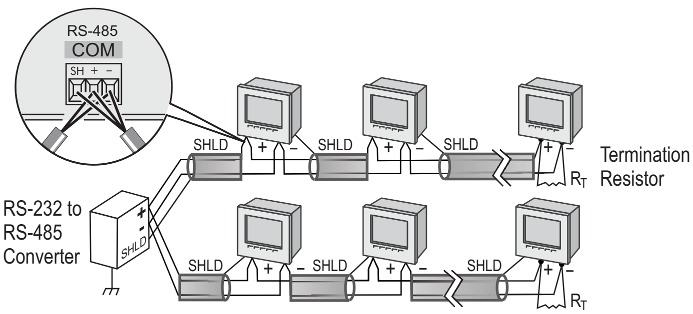


RS-485 Connections

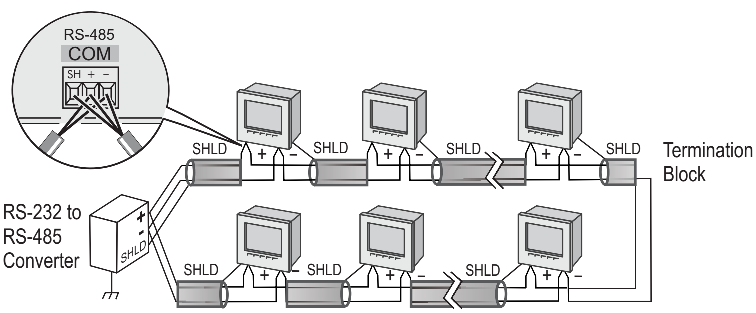
Refer to the "Hardware Reference" chapter for the ION 7500 and ION 7600 meters' RS-485 specifications.

RS-485 connections are made via the captured-wire connectors on the rear of the meter. Up to 32 devices can be connected on a single RS-485 bus. Use a good quality shielded twisted pair cable for each RS-485 bus, AWG 22 (0.5 mm^2) or larger. The overall length of the RS-485 cable connecting all devices cannot exceed 4000 ft. (1219 m). The RS-485 bus may be configured in straight-line or loop topologies.

Straight-Line Topology



Loop Topology



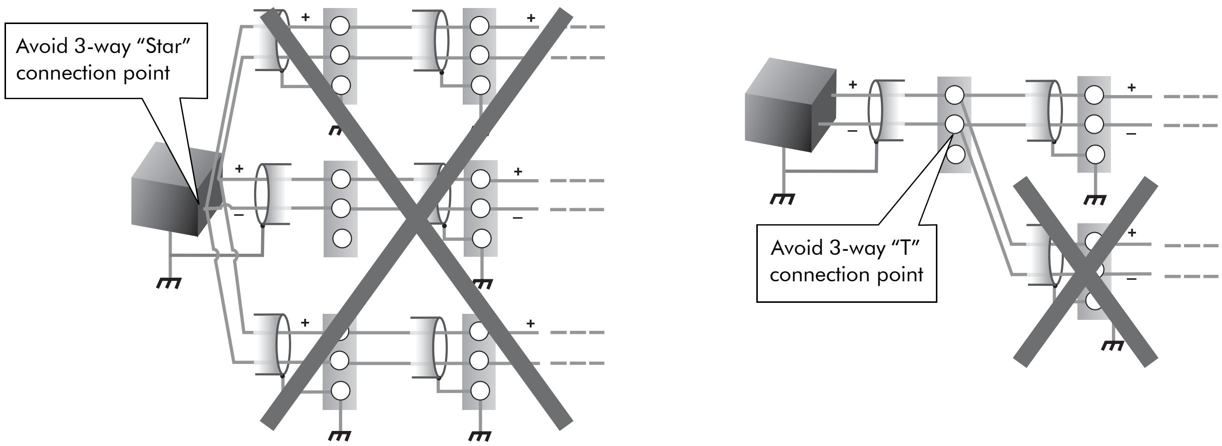
General Bus Wiring Considerations

Devices connected on the bus, including the meter, converter(s) and other instrumentation, must be wired as follows:

- Connect the shield of each segment of the cable to ground at *one end only*.
- Isolate cables as much as possible from sources of electrical noise.
- Use an intermediate terminal strip to connect each device to the bus. This allows for easy removal of a device for servicing if necessary.
- Install a ¼ Watt termination resistor (**RT**) between the (+) and (-) terminals of the device at each end point of a straight-line bus. The resistor should match the nominal impedance of the RS-485 cable (typically 120 ohms – consult the manufacturer's documentation for the cable's impedance value).

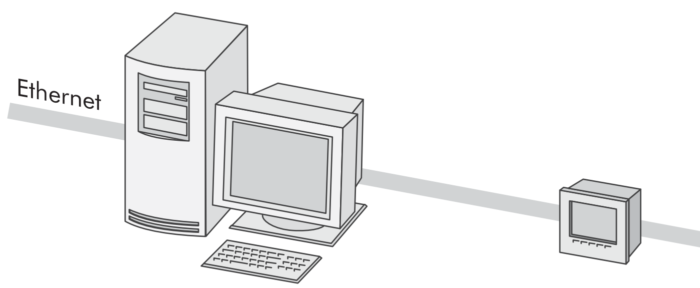
RS-485 Connection Methods to Avoid

Any device connection that causes a branch in the main RS-485 bus should be avoided. This includes *star* and *tee (T)* methods. These wiring methods cause signal reflections that may cause interference. At any connection point on the RS-485 bus, no more than two cables should be connected. This includes connection points on instruments, converters, and terminal strips. Following this guideline ensures that both star and tee connections are avoided.



Ethernet Connections

Refer to the "Hardware Reference" chapter for specifications on both Ethernet port options for the ION 7500 and ION 7600 meters.



This section only applies if your ION 7500 or ION 7600 meter has the Ethernet option. There are two port options available: a 10 Base-T Ethernet port with an RJ45 modular connector or a 10 Base-FL Ethernet port with an ST-type connector. Using the -FL option disables the standard RJ45 port. This optional Ethernet port is capable of data rates up to 10Mbps, and supports TCP/IP, ION, Telnet, and Modbus/TCP protocols. The Ethernet port is controlled by the ETH1 Communications module.

The EtherGate feature provides communications both to an Ethernet connected device and through that device to a connected serial network (See "The EtherGate Protocol" on page 131).

Meter Setup for Ethernet Communications

To enable communications through the meter’s Ethernet port, you must configure the Ethernet Communications module. The *IP Address*, *Subnet Mask*, *Gateway*, *SMTP Server* and *SMTP Connection Timeout* setup registers must properly match your system and can be set through the meter’s front panel or ION software.

Configuring the Ethernet Module through the Front Panel

1. Select Network Setup from the ION 7600 Setup menu.
2. Configure the Ethernet Communications module *IP Address*, *Subnet Mask*, *Gateway*, *SMTP Server* and *SMTP Connection Timeout* setup registers to match your communications system.

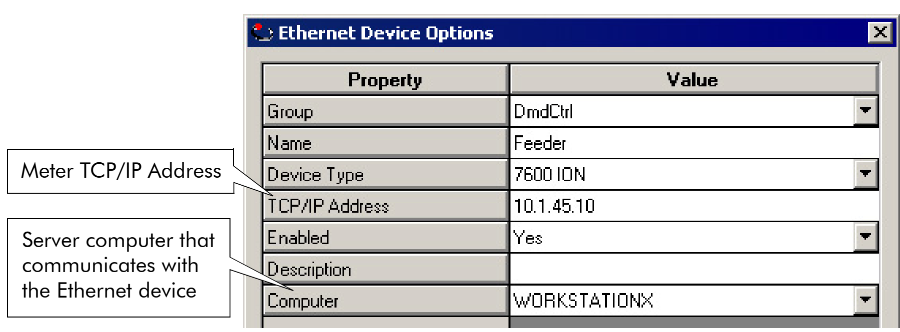
Configuring the Ethernet Module via Designer

After you have wired your meter to the Ethernet network and performed basic setup, add the meter to your ION Enterprise network using the Management Console. (It is not necessary/possible to add an Ethernet site.)

Adding an Ethernet Device to your ION Enterprise Network

In the Management Console, the Ethernet Device Options screen appears when you add an Ethernet device (meter). Use this screen to describe your meter Ethernet address and other communications information. Be sure to include:

- the server computer that will communicate with the Ethernet device
- the Ethernet device TCP/IP address.

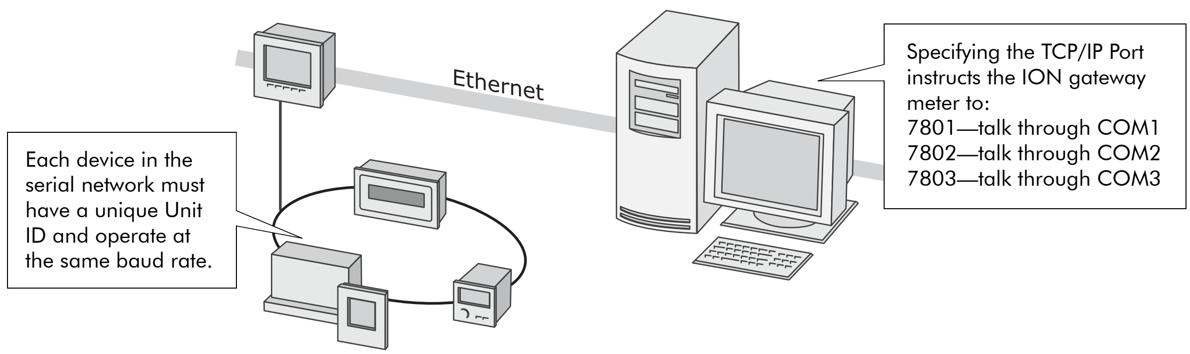


Configuring the Ethernet Module in Designer

To enable communications through the Ethernet port, you must configure the Ethernet (Communications) module. Launch Designer and configure the *IP Address*, *Subnet Mask*, *Gateway*, *SMTP Server* and *SMTP Connection Timeout* registers to match your system.

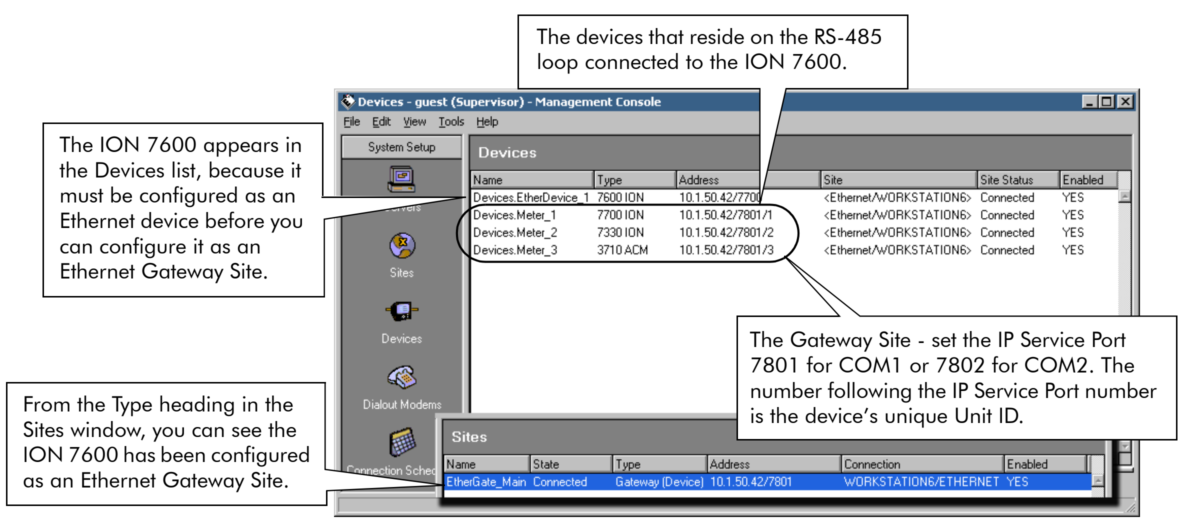
The EtherGate Protocol

The EtherGate protocol is a powerful communications tool that lets you communicate *to* a meter and *through* a meter simultaneously. When a meter installed on the Ethernet network has EtherGate enabled, a master device (such as a workstation running ION Enterprise software) can communicate *to* the meter, and *through* the meter to a serial network of devices wired to the meter's COM port. EtherGate is available on serial ports COM1 and COM 2 in place of the ION, Modbus Master, Modbus RTU, or DNP 3.00 protocols. The protocol permits the direct transfer of data from up to 62 devices (31 devices per COM port).



Once you have the chain of serial devices installed, use Designer or the meter's front panel to change the COM1 or COM 2 *Protocol* setting to **EtherGate**. The transfer of data between protocols is then handled automatically.

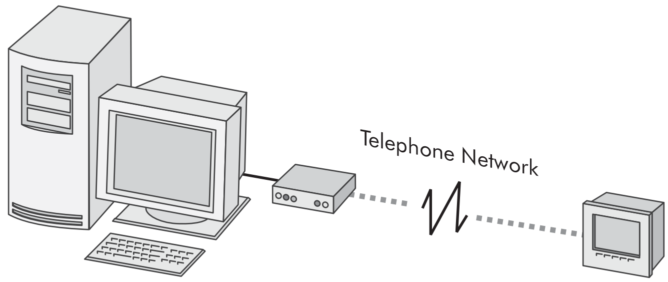
The Devices list in the ION Management Console appears as follows:



Refer to the *ION Meter as an Ethernet Gateway* technical note for complete details on configuring your meter for EtherGate.

Internal Modem Connections

Refer to the "Hardware Reference" chapter for internal modem specifications for the ION 7500 and ION 7600 meters.



This section only applies if your meter has an internal modem option. Depending on the ION meter and its date of manufacture, the installed optional internal modem could be one of two different brands. The Conexant modem is the older type modem, and is available in North American (FCC approved) or European (CTR-21 compliant) versions. The newer modem is manufactured by Multi-Tech and is a universal modem that can be readily used in most countries, and complies with FCC, Industry Canada and TBR-21 regulations — refer to the Notices at the start of this document for more details.

The internal modem shares the communications channel with the optical port. It is factory-configured to respond (and the optical port is disabled). To enable communications through the meter's internal modem, you must configure the Comm 3 Communications module. The *Baud Rate, Unit ID,* and *Protocol* setup registers must properly match your system, and the initialization string for the internal modem must be set up using the *ModemInit* register.

NOTE

The internal modem is multiplexed with the IrDA optical port on the meter's front panel, so only one channel can be in use at a time. To use the modem, the *Comm Mode* setup register of the Comm 3 Communications module must be set to Modem (the default value).

ModemInit Setup Register

The *ModemInit* string register defines the initialization string for the internal modem, with a maximum of 47 characters. Edit the *ModemInit* register and enter the initialization string desired. The string is sent to the modem as soon as you download the COM1 module. Note that the string is also sent to the modem whenever the meter is powered up, or whenever the baud rate in the Comm 1 Communications module is changed. Any changes to the *Modem Init* or *Baud Rate* setup registers while the modem is online will cause the modem to disconnect from the phone line.

CAUTION

Changing the *ModemInit* setup register while the internal modem is online causes the modem to disconnect from the phone line.

Modem Initialization Strings

Refer to the technical note *Modem AT Commands* for a complete list of AT commands for both Conexant and Multi-Tech modems.

NOTE

The technical note also contains instructions on how you can determine your meter’s modem type based on the meter’s serial number.

Adjusting the Modem Initialization String for CTR-21 Compliant modems

The table below shows the strings to add to the end of your modem configuration string setup register for each of three possible problems.

Problem	Add to Modem Initialization String
Does not answer (modem does not detect ring tone)	*NC70
Does not dial (modem does not detect dial tone)	In order of preference: `*NC70, *NC70X0, *NC8` (Italy only)
Does not detect busy signal	*NC70

CAUTION

A Conexant Modem does not support Pulse dialing. The Conexant Modem should be the only device on the telephone line. Attaching devices on the same line may cause one or more of these devices to operate incorrectly.

If your local modem (not the internal modem) is not already set up, configure it with the Remote Modem Configuration Utility according to the instructions in the online help. After the meter is installed and the internal modem is connected to the telephone network, the Comm 3 module can be configured using the meter’s front panel or ION software. To learn how to connect the internal modem to the telephone network, consult your meter’s *Basic Setup and Installation Instructions*.

NOTE

The online *ION Enterprise Help* contains details on: commissioning an ION network, managing modem connections, setting up periodic dial-out, and configuring remote site event notification.

Configuring the Comm 3 Module through the Front Panel

1. Select COM 3 Setup > COM 3 Hardware > Mode > Modem from the meter's setup menu. Press ESC to go back to the COM 3 Setup menu.
2. Select COM 3 Protocol to configure the Comm 3 communications module *Baud Rate, Unit ID,* and *Protocol* setup registers to match your communications system.

Configuring the Comm 3 Module via Designer

Before you can configure the Comm 3 module in Designer you must add the meter (with the internal modem) and a modem site to your ION Enterprise network.

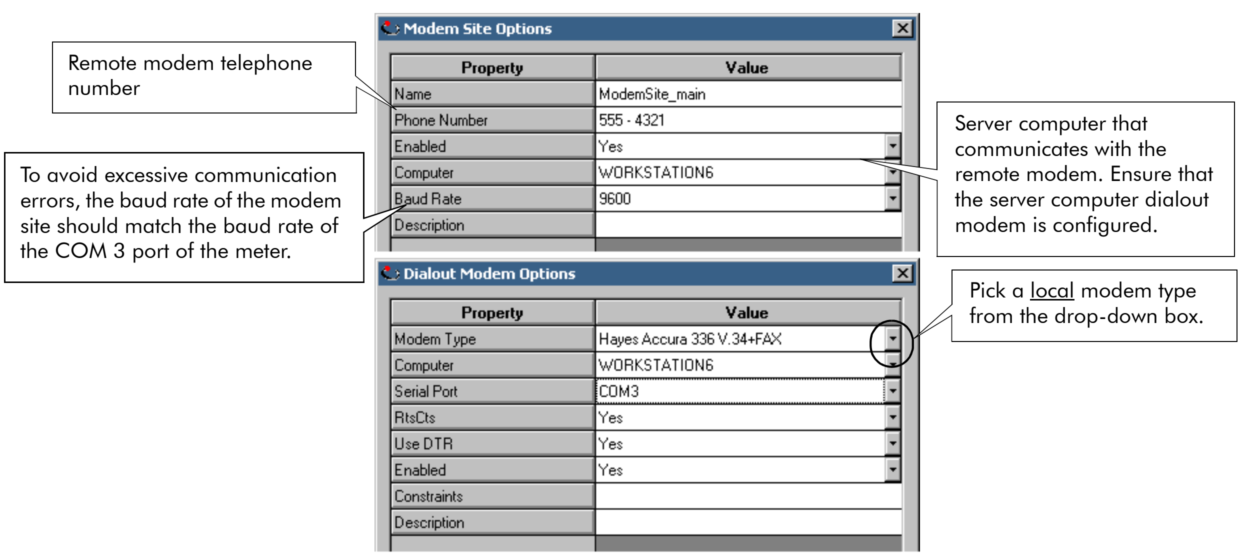
Adding a Meter and a Modem Site to your ION Enterprise Network

In the Management Console, add the meter with the internal modem, and a modem site to your ION Enterprise network. Describe how your remote modem is wired and other communications information on the options screens.

Either before or after adding the Modem Site, you must add a dialout modem to the server computer. The server computer dialout modem communicates to the modem at the modem site. Refer to the online *ION Enterprise Help* to learn how to add a dialout modem.

On the Modem Site Options screen, be sure to include:

- the server computer that will communicate with the remote modem
- the remote modem telephone number

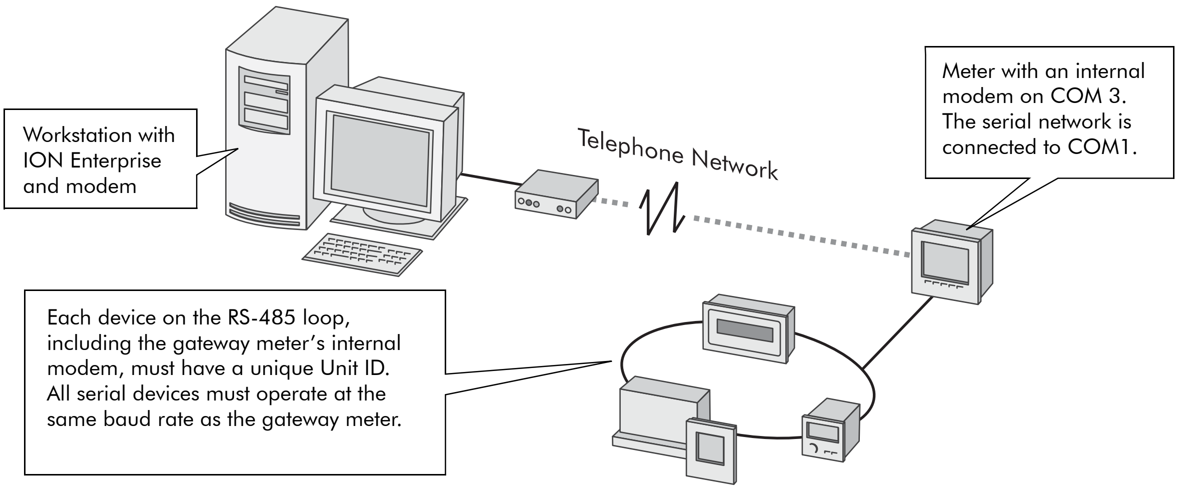


Configuring the Comm 3 Communications Module in Designer

Launch Designer, and configure the Comm 3 Communications module *Baud Rate, Unit ID,* and *Protocol* setup registers to match your communications system. Configure the initialization string for the internal modem using the *ModemInit* register. Refer to "ModemInit Setup Register" on page 132.

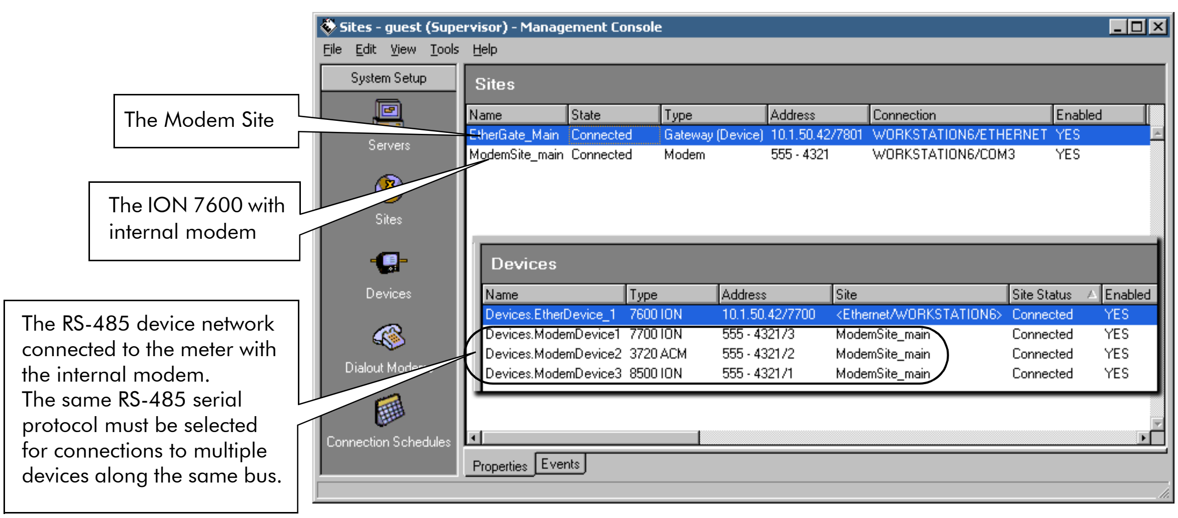
The ModemGate Protocol

The ModemGate feature creates a communications connection between the telephone network and an RS-485 serial network of devices. When you specify the protocol for a meter's COM port as MODEMGATE, all data received by the meter's internal modem is automatically transferred to the serial network. ModemGate is available on either COM1 and COM 2, but you cannot use the protocol on both ports simultaneously.



ModemGate connections do not connect a workstation with ION Enterprise (or other master device) to the gateway meter's COM1 or COM 2 port, but rather the gateway meter's internal modem port (COM 3).

The example below illustrates how the ION Management Console's Sites and Devices windows appear:



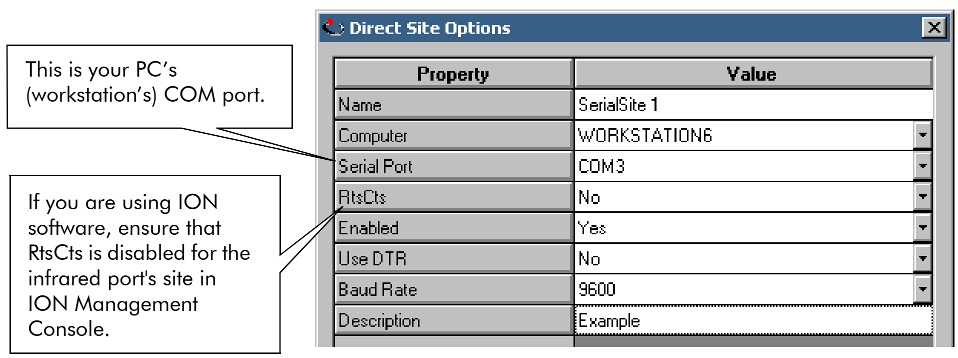
Refer to the *ION Meter as a ModemGate* technical note for complete details on configuring your meter for ModemGate.

Infrared Port Connections

Refer to the "Hardware Reference" chapter for the ION 7500 and ION 7600 meters' infrared port specifications.

The infrared port is IrDA compliant. It can be used to communicate real-time measurements to a portable PC via the ION, DNP 3.00, or Modbus RTU protocols. To enable communications from the infrared port, you must configure the COM 3 Communications module. The *Protocol*, the *Baud Rate* and *Unit ID* setup registers must properly match your system. If you have the internal modem option, you must ensure that the *Comm Mode* setup register is set to select the IrDA port. When creating an ION site, ensure that RtsCts is disabled (set to No) in the COM 3 serial site.

Refer to the ION Management Console online help for more details about adding serial sites.



Internet Connectivity

ION meters provide Internet connectivity so you can receive meter emails, view realtime data, and configure your system through a web browser from anywhere in the world. Your ION meter provides the following internet connectivity options:

- MeterM@il® feature (receive data logs and email alerts from the meter)
- WebMeter® feature (onboard web server allows you to view real-time data and configure the meter through a web browser)
- Microsoft Terminal Services for ION Enterprise (an ION Enterprise system that is located on a Terminal Server allows multiple users to view or configure an ION Enterprise system through a web browser)
- WebReach (view ION Enterprise system information through a web browser)

WebMeter and MeterMail

The WebMeter feature provides real-time data display and system configuration of a meter over the Internet. The MeterM@il feature lets meters automatically transmit data by email to anyone, anytime, anywhere.

Both the ION 7500 and ION 7600 meters provide WebMeter and MeterM@il capability. The following sections provide WebMeter and MeterM@il details.

ION WebMeter Feature

WebMeter-enabled meters have an on-board web server. Built-in web pages display certain energy and basic power quality information and also support basic meter configuration tasks. A meter with the WebMeter feature can be connected to your corporate Ethernet network like any other network device, and you can access it with a standard web browser like Internet Explorer.

Refer to the technical note *WebMeter Internal Web Server Feature* to learn how to:

- view your WebMeter data on the Internet
- configure your WebMeter-enabled meter
- set up your network for the WebMeter feature
- enable/disable web browser configuration of the meter

ION MeterM@il Feature

The MeterM@il feature allows your meter to send data logs as email attachments to a workstation, pager, cell phone, or PDA. In addition to the log export function, your meter can send email alerts.

Refer to the technical note *ION MeterM@il Internal Email Server Feature* to learn how to:

- view MeterM@il data
- set up your network for the MeterM@il feature

- configure your meter to use the MeterM@il feature
  - set up the meter for your SMTP Server
  - set up the MeterM@il feature to send alerts
  - set up the MeterM@il feature to send data logs

WebReach

WebReach allows you to remotely view ION Enterprise information through a web browser. WebReach requires a simple URL and no client machine configuration so you have the flexibility to view your data from a web browser anywhere in the world. With WebReach, you can view real-time data and select views of historical/waveform data. Currently, no configuration or control functions are available through WebReach. Refer to the online *ION Enterprise Help* for more details on WebReach.

Telnet and Hyperterminal

You can access certain Ethernet settings and statistics through a telnet application such as Microsoft Telnet. Similarly, you can use Windows HyperTerminal to access certain meter module settings. Use the following guidelines to determine which application you should use to access your meter:

- If your meter is connected to an Ethernet network, use a telnet application such as Microsoft Telnet.
- If your meter is connected serially or through a modem to your workstation, use a terminal application such as Windows HyperTerminal.

You can access certain Power Meter module and Factory module settings from both a Telnet session and HyperTerminal session. Both sessions also let you configure Factory module setup registers for Current Probe Input applications. Additionally, a Telnet session lets you view ethernet statistics and access certain Ethernet communications module settings.

Refer to the technical note *Telnet and HyperTerminal Access* for the appropriate application's menu options and connection instructions.

Digital and Analog I/O

The digital and analog I/O ports on ION meters let you bring a variety of data into a common system, thereby simplifying data gathering. The the ION 7500 and ION 7600 meters offers a variety of I/O combinations.

Standard in all meters are eight digital (status) inputs, four form A digital (solid-state) outputs, three form C relay outputs (electromechanical), and two front panel LED outputs. The digital inputs are ideal for monitoring status or counting pulses from external dry contacts. The four Form A outputs are suitable for performing end of interval pulsing, load control and alarm annunciation; the Form C relays are suitable for load switching applications. The LED outputs are used for energy pulsing and alarming.

There meter can be also be equipped with an optional I/O card which can include analog inputs and/or analog outputs or additional digital inputs. Analog inputs let you monitor a wide range of conditions, such as flow rates, RPM, fluid levels, oil pressures and transformer temperatures. Analog outputs let you output realtime power to an RTU or perform equipment control operations. Refer to the meter's datasheet for the ordering options available on the optional I/O card. This card does not need to be ordered with your meter; it can be retrofitted to meters already operating in the field.

The inputs are controlled by Digital Input modules. The outputs can be controlled by Digital Output modules, Pulser modules, or Calibration Pulser modules. All of these modules can act as intermediaries between the hardware port and the other modules in the meter. They define the characteristics of outgoing signals or tell the meter how to interpret incoming signals.

Refer to the technical note *Digital and Analog I/O* for more information regarding digital and analog inputs and outputs than is provided in this User's Guide.

Specifying a Port in an ION Module

The Digital Output, Digital Input, Analog Output, Analog Input, Pulser, and Calibration Pulser modules have *Port* setup registers that allow you to specify which port handles the outgoing or incoming signals. To assign a port to one of these modules, simply modify the *Port* setup register by picking a port from the enumerated list. This can be done with both Designer and ION Setup.

Be aware that the enumerated list only displays those ports that are not yet assigned to another module. For example, the meter's factory configuration makes use of Digital Output DO4 (it is already assigned to Calibration Pulser module "kWh Pulser –D4"). If you create a new Digital Output module and set its *Port* setup register, the port DO4 does not appear in the list of available ports.

To make a port available, you must locate the module controlling the port and set its *Port* setup register to NOT USED (or delete the module entirely). The port now appears in the enumerated list.

The following table describes the ports that can be configured (in the Digital Output, Pulser, Digital Input, Analog Input, Analog Output, and Calibration Pulser modules) to handle outgoing or incoming signals.

All ION 7500 and ION 7600 meters have these digital input/output ports. Optional analog input/output ports and optional digital inputs are also available on both meters.	
Standard Output Port Names	**Description**
Port R1	Digital (Form C Relay) Output port 1
Port R2	Digital Output port 2
Port R3	Digital Output port 3
Port D1	Digital (Form A Solid-State) Output port 4
Port D2	Digital Output port 5
Port D3	Digital Output port 6
Port D4	Digital Output port 7
kWh Pulse –LED	LED Output
Alarm LED	LED Output
Optional Output Port Names	**Description**
Port AO1	Analog Output port 1
Port AO2	Analog Output port 2
Port AO3	Analog Output port 3
Port AO4	Analog Output port 4
Standard Input Port Names	**Description**
Port S1	Digital (Status) Input port 1
Port S2	Digital Input port 2
Port S3	Digital Input port 3
Port S4	Digital Input port 4
Port S5	Digital Input port 5
Port S6	Digital Input port 6
Port S7	Digital Input port 7
Port S8	Digital Input port 8
Optional Input Port Names	**Description**
Port AI1	Analog Input port 1
Port AI2	Analog Input port 2
Port AI3	Analog Input port 3
Port AI4	Analog Input port 4
Port DI1	Digital (Status) Input port 9
Port DI2	Digital Input port 10
Port DI3	Digital Input port 11
Port DI4	Digital Input port 12
Port DI5	Digital Input port 13
Port DI6	Digital Input port 14
Port DI7	Digital Input port 15
Port DI8	Digital Input port 16

Using the Onboard Digital Outputs

Digital outputs are used for hardware relay control or pulse counting applications. For example, an ION meter's digital outputs can provide on/off control signals for capacitor banks, generators, and other equipment. The digital output ports can also send out status signals or kWh pulses, if the receiving device determines energy usage by counting pulses.

The meter provides three Form C mechanical relays and four Form A digital (solid-state) relays. The four Form A digital relays are suitable for performing end of interval pulsing, load control and alarm annunciation. All digital outputs can deliver a continuous signal or a pulse. (Contact Power Measurement for complete information regarding relay applications.)

⚠ **CAUTION**

The relay outputs of the meter should never be used for primary protection functions. Be sure that you are familiar with warnings at start of this document, as well as those presented your meter's *Installation & Basic Setup Instructions*.

These outputs can be controlled by Digital Output modules, Pulser modules, or Calibration Pulser modules, depending on the application. For relay and control, the Digital Output module is used. For pulsing applications, the Pulser and Calibration Pulser modules are generally used. All of these modules can act as intermediaries between the hardware port and the other modules in the meter. They define the characteristics of outgoing signals.

Output Modules

Both the Form A and Form C relays can be controlled with Digital Output modules, Pulser modules, or Calibration Pulser modules. By default, six Digital Output modules (labeled DO-D1 to DO-D3 and DO-R1 to DO-R3) are already created for this purpose. You can either use these modules, or create and configure other modules to control the output ports.

- **Calibration Pulser modules** allow you to generate high accuracy energy pulses for calibration testing purposes. They integrate instantaneous power inputs.
- **Digital Output modules** accept Boolean inputs, and output a continuous signal or pulses.
- **Pulser modules** convert instantaneous pulses to pulses or transitions.

Consult the online *ION Programmer's Reference* if you require more information about these ION modules.

Configure the settings of the controlling module to match your requirements. The settings in these modules are as follows:

ION Module	Setup Registers	Available Settings	Creation Default	Description
Digital Output	Port	Not Used Port DO1 Port DO2 Port DO3 Port DO4 [1] Port R1 Port R2 Port R3 kWh Pulse –LED Alarm LED	Not Used	The output hardware channel
	Pulse Width	0 to 2000000	0	Pulse Width, in seconds (0 for continuous pulse)
	Polarity	Inverting or Non-Inverting	Non-Inverting	Inverted or non-inverted output
	EvLog Mode	Log on or Log off	Log off	Whether or not to log status changes in the Event Log
Pulser	Port	As per Digital Output, above	Not Used	The output hardware channel
	PulseWidth	0.020 to 2000000	1	Pulse width, in seconds
	OutputMode	Pulse or KYZ	Pulse	Full pulse or KYZ (transition pulse)
	Polarity	Inverting or Non-Inverting	Non-Inverting	Inverted or non-inverted output
Calibration Pulser	Port	As per Digital Output, above	Not Used	The output hardware channel
	Pulse Width	0.010 to 1.000	0.05	Pulse Width, in seconds
	Kt	0.01 to 1000000000	1.8	Watts per pulse
	Int Mode	Forward, Reverse, Absolute, or Net	Absolute	Integration modes that may be selected
	OutputMode	Pulse or KYZ	Pulse	Full pulse or KYZ (transition pulse)

[1] See "Calibration Pulsing Relay DO4," below.

Ensure that the module's *Port* setup register matches the meter's output you want to control. If the port you want to use does not appear in the *Port* setup register's list, that port is in use by another module. Edit the port setup register of the module using that port and set it to NOT USED – the port will then be available to other modules.

Calibration Pulsing Relay DO4

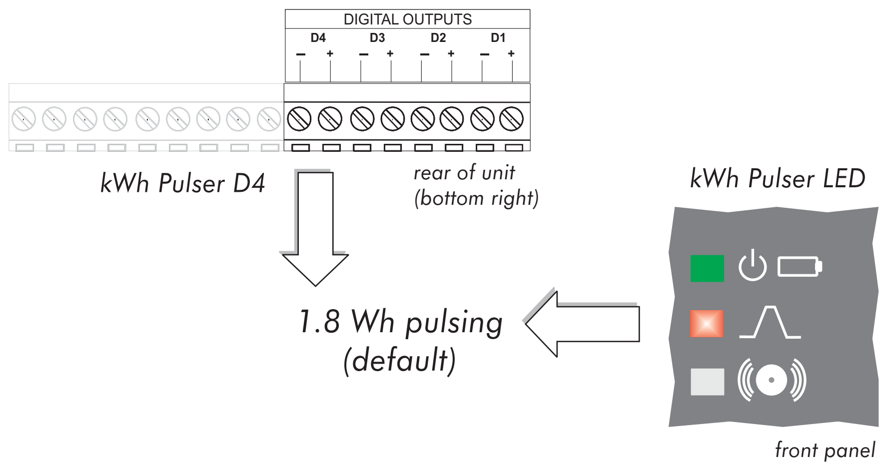
Solid-state relay DO4 is factory configured for calibration pulsing and requires no further setup. The Calibration Pulser module labeled *kWh Pulser –D4* controls this port. By default, the module is linked to the *kW del+rec* output of the Arithmetic module labeled "*del, rec*" (in the Demand Framework). (This Arithmetic module is linked to the MU Power Meter module's *MU kW tot* output.) The port will output a pulse for every 1.8 Wh accumulated (in NORMAL or TEST mode). This is the same pulsing rate as the middle LED on the front panel of the meter.

Energy Pulsing with LEDs

You can customize the operation of two LEDs on the meter's front panel: the kWh Pulse – LED and the Alarm LED.

kWh Pulse –LED

By default, the middle green LED on the meter's front panel is factory configured to be an energy pulser. Like solid-state relay output DO4, the kWh Pulser –LED is controlled by a Calibration Pulser module that has its *Source* input linked to the *kW del+rec* output of the Arithmetic module labeled "*del, rec.*" (This Arithmetic module is linked to the MU Power Meter module's *MU kW tot* output.). The LED port outputs a pulse for every 1.8 Wh accumulated (in both NORMAL and TEST mode).



Changing the value for the *Kt* setup register of the controlling Calibration Pulser module lets you modify the pulsing rate of either channel. If you want to configure the LED port for a different pulsing application, you must re-link the *Source* input to the output register of a different instantaneous power quantity in one of the Arithmetic modules in the Demand Framework. Ensure that the quantity you choose originates from the MU (meter units) Power Meter module.

Alarm LED

The red (bottom) LED on the front panel of the meter is provided for custom applications. It can be linked to a framework to provide notification to any event. Possible applications include sag/swell alarming, setpoint annunciation, and tariff notification. Like all the other outputs on the meter, this port can be controlled by a Digital Output, Pulser, or Calibration Pulser module.

Using the Onboard Digital Inputs

Digital inputs are necessary for status monitoring or pulse counting applications. Status monitoring can help you prevent equipment damage, improve maintenance, or track security breaches. Some common status monitoring applications are monitoring the closed/open positions of breakers, on/off status of generators, armed/unarmed conditions in a building alarm system, and over/under pressures of transformers.

The meter has eight status input ports. The function of each status input is controlled by a Digital Input module; this module tells the meter how to interpret incoming signals. Digital Input modules can be linked with other modules for counting status changes.

The function of each status input is controlled by the Digital Input modules DI-S1 to DI-S8. (Eight Counter modules for counting status changes and an External Pulse module for resetting them are included with the Digital Input framework.)

NOTE

The Digital Inputs on the Optional I/O card are controlled by the Digital Input modules I/O-S1 to I/O-S8. However, on the Optional I/O card itself, the inputs are labelled DI1 to DI8

The settings in the Digital Input modules are as follows:

Setup Register	Available Settings	Creation Default	Description
Input Mode	Pulse or KYZ	Pulse	Complete pulse or KYZ transition pulse
EvLog Mode	Log Off or Log On	Log Off	Whether or not to log status changes in the Event Log
Debounce	0 to 65.25	0.010	Mechanical contact bounce, in seconds
Polarity	Non-Inverting or Inverting	Non-Inverting	Non-inverted (or level) pulse
Port	Not Used Port DI1 Port DI2 Port DI3 Port DI4 Port DI5 Port DI6 Port DI7 Port DI8	Not Used	The input hardware channel controlled

Analog Inputs

Analog inputs can measure and store analog information such as electrical signals from transducers; transducers derive the electrical signals from flow rates, temperatures, pressures, rotations, and fluid levels. They are controlled by Analog Input modules.

Analog inputs require the installation of an optional circuit board inside the meter. The I/O card provides four analog inputs. By default, four Analog Input modules (labeled AI1 to AI4) are already created for this purpose. Configure the settings of the controlling module to match your requirements. The settings in these modules are as follows:

Setup Registers	Available Settings	Creation Default	Description
Port	Not Used or AI1 to AI4 inclusive	Not Used	The input hardware channel
Full Scale	-1×10^9 to 1×10^9	1	Defines what value appears in the ScaledValu output register when the highest possible value from the hardware is applied
Zero Scale [1]	-1×10^9 to 1×10^9	0	Defines what value appears in the ScaledValu output register when the lowest possible value from the hardware is applied

[1] An arbitrary input value can be treated as the Zero Scale (i.e., a 4-20mA input is capable of generating a 0 to X output).

Analog Outputs

An ION meter's analog outputs act as transducers. The meter measures power and energy, and then sends that information via the analog outputs to a remote terminal unit (RTU). The analog outputs issue industry standard 0 to 20 mA current signals. They are controlled by the Analog Output modules.

Analog inputs require the installation of an optional circuit board inside the meter. The I/O Card provides four analog outputs. By default, four Analog Output modules (labeled AO1 to AO4) are already created for this purpose. Configure the settings of the controlling module to match your requirements. The settings in these modules are as follows:

Setup Registers	Available Settings	Creation Default	Description
Port	Not Used AO1 to AO4 inclusive	Not Used	The output hardware channel
Full Scale	-1×10^9 to 1×10^9	1	Defines what value appears in the ScaledValu output register when the highest possible value from the hardware is applied
Zero Scale	-1×10^9 to 1×10^9	0	Defines what value appears in the ScaledValu output register when the lowest possible value from the hardware is applied

Time Synchronization

Time synchronization lets you synchronize the internal clocks of all networked meters and devices. Once synchronized, all data logs have timestamps that are relative to a uniform time base. This allows you to achieve precise sequence-of-events and power quality analyses. To synchronize clocks, use ION software to broadcast time signals across the network.

Refer to the technical note *Time Synchronization & Timekeeping* for more information on implementing time synchronization for your system.

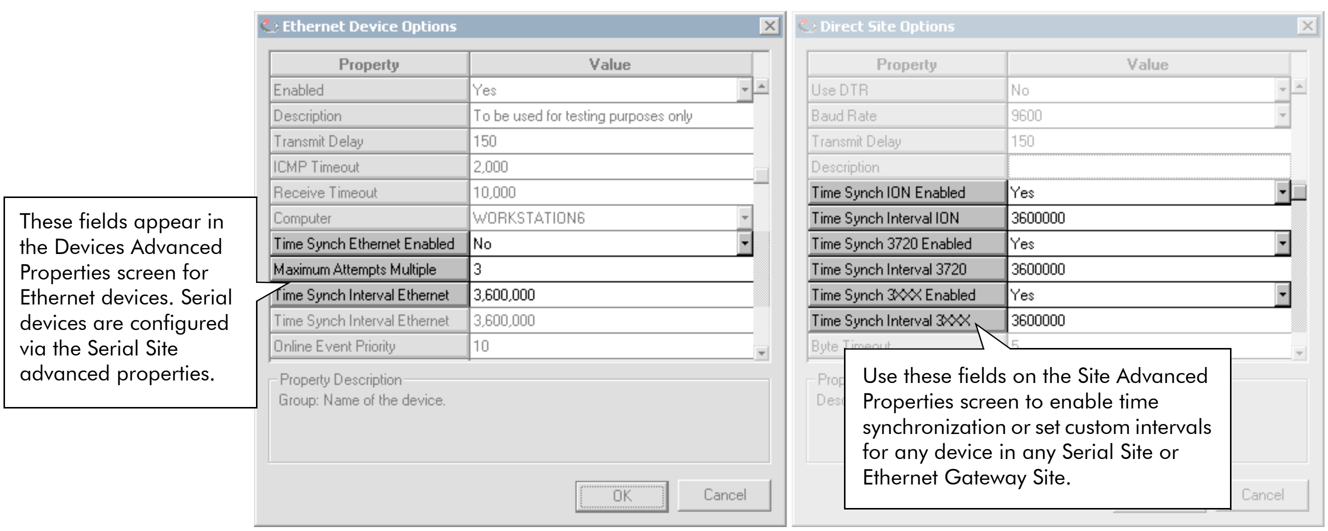
Enabling or Customizing Time Synchronization

1. Launch the ION Management Console.
2. From the System Setup Pane, select Sites or Devices.

   Select Sites if you want to customize a particular serial, modem, or Ethernet Gateway site.

   Select Devices if you want to customize an individual Ethernet device.
3. Right-click in the main window and select Properties.
4. Right-click inside the display window and select Advanced Properties.

The fields for enabling or customizing time synchronization are shown below.



The Property Description area explains the purpose for each field. The default time synchronization interval of 3,600 seconds (displayed in milliseconds) is acceptable for most ION installations.

NOTE

You need appropriate permissions to configure the meters on your network. Refer to the technical note *ION Security* for details on software and meter security.

Meter Security

The meter's security settings allow you to configure the meter through the front panel, with ION software, or with the optional embedded web server.

Standard meter security

Anytime you make configuration changes to your meter, either through the front panel or with ION software, you must enter a password.

Anti-tamper sealing

Your revenue meter can be protected by anti-tamper sealing.

Software security

ION software security brings access-level security to the meter. With ION software, you can configure multiple users with different passwords and specify access rights. For example, one user may have view-only rights, while another user may have meter configuration rights. ION software security only applies to users who are accessing the meter via ION software.

For more information on meter security, refer to the *ION Security* technical note in Appendix A.

Standard Meter Security

Standard meter security lets you configure the meter through the front panel or with communications software using a meter password.

This section describes password security options available from the front panel of the meter. Step-by-step instructions are given to help you enter, or change the meter password and disable (enable) the password security check on the front panel of the meter.

Entering the Password through the Front Panel

The first time you make a change to any setting you are presented with the Password display. The factory configured password is zero (0). The password prevents unauthorized tampering with your meter's configuration. Depending on site security, you may want to modify the user password from the default to protect your configuration. The default password is “0” and can be set to a maximum numeric value of 99999999.

Changing the Meter Password

1. Scroll down the Setup menu and select the Security Setup menu.
2. Press the PROG button to enter the Security Setup menu.
3. Press the MODIFY softkey. The menu selection Password becomes highlighted as well as the last zero.
4. Enter your new numeric password.
   - To change the value of the highlighted digit use the Up/Down arrow buttons.
   - To change the position of the cursor one space to the left or right, use the Left/Right arrow buttons.
5. Press PROG to accept the new password.
6. Press PROG to confirm your selection.

Disabling (and enabling) password security

Though it is not recommended, you can disable the meter password.

1. Scroll down the Setup menu and select the Security Setup menu.
2. Press the PROG button to enter the Security Setup menu.
3. Enter the current password and press PROG if you are presented with the Enter Password screen.
4. Press the softkey titled ENABLE, and select Yes to enable password security (if it has been disabled) or No to disable it.
5. Press PROG to make your selection. The Confirm screen appears.
6. Press PROG to confirm the change.

Data and Event Logging

The meter includes powerful data logging and event recording capabilities. Data and event logs recorded by the meter are prioritized and stored onboard. Data is retrieved periodically by the ION Enterprise software Log Server (or other third party application).

If you use ION Enterprise software, all retrieved data from your system is stored in an ODBC-compliant database. The information in the database can be viewed and analyzed using ION Enterprise software applications such as Vista (for viewing), or Reporter (for organizing and presenting data).

Data Logging

The meter ships with a comprehensive data-logging configuration. Information regarding the default logging capacity and default logging configuration can be found in "Data Logging Setup" on page 53.

To learn more about the data recorder modules in your meter, refer to *ION Device Templates* at www.pwrm.com. ION Device Templates lists all of the ION modules available in the current version of your meter, and the total number of each module. ION Device Templates also shows the ranges or options available for each module's setup registers.

Changing the Parameters that are Logged

The meter's factory configuration logs a comprehensive set of energy, power and harmonics parameters. You cannot change which parameters are logged by configuring a setup register. Adding or deleting a log's parameters is an advanced procedure, as it requires changes to the links between modules, so you must use Designer.

Refer to the Designer section of the chapter ION Software Tools. Once you are comfortable editing module links, you can change the logged parameters by linking the output registers you want logged to the inputs of an ION Data Recorder module.

Changing Waveform Recording

The Waveform Recorder modules do not require changes to their default settings. If you want to change the format of the recorded waveforms, refer to the Waveform Recorder module description in the online *ION Programmer's Reference*.

Event Logging

Events produced by a meter's various ION modules are prioritized and grouped to facilitate custom logging. Each event is assigned a priority group number based on its type and severity.

ION Event Priority Groups

Some event groups are preset with a Priority Number as shown in the table below. You can also define your own priority number for some modules. Priority numbers from 128-191 appear in the global even log viewer in ION Enterprise software. Priority numbers from 192-255 are logged, initiate a beep and cause the window to flash. You can customize these responses to display messages or perform *netsend* messages, for example.

Event Group	Description	Priority Number
Reset	Module reset or re synchronized	5
Setup Change	Module setup changes (setup register changes, label changes, input handle changes)	10
Input Register Change	Inputs of certain modules change value (ie, input to And/Or module changes)	15
I/O State Change	I/O state changes (ie, relay closes)	20
Information	Module produces important user information	25
Warning	Module produces a warning	30
EN50160 Event (ION 7600 only)	An EN50160 Counter (N_1 or N_2) increases	50
Failure	A failure has occurred	255
Setpoint	Setpoint condition goes Active or Inactive (ie, Sag/Swell module detects a disturbance)	programmable via module setup

The Event Log Controller module allows you to set a priority cutoff for event logging. Any events with a priority number greater than the cutoff value are logged, and events with lower priorities are discarded. Refer to the individual module descriptions and the Event Log Controller module description in the online *ION Programmer's Reference* for more details.

External ION Events

Some events are not produced by a specific module; they are generated internally by the meter. These events and their associated priority levels are shown in the table below.

Event Group	Description	Priority Number
Warning	Factory initialize performed	30
	Firmware or memory upgrade performed	
	Meter power-up or power-down	
	Internal modem not responding or modem recovered	
	Battery low	
	Telnet or serial terminal locked out	
	Security disabled or enabled	
Failure	Communications fail to allocate required memory	255

Logging and Recording Capacity

The meter provides both data and event logs, but the amount of memory required to store these logs depends on the number of parameters being logged and the frequency with which these parameters are logged. The following equation can help determine the amount of memory required to store data and event logs:

each record consumes (in Bytes) = ((number of parameters * 5) + 8)

The meter can also perform waveform recording. It can simultaneously capture events on all channels to a maximum of 96 cycles each. To calculate the waveform memory usage use the following formula:

waveform memory usage (in Bytes) = (2*(number of samples per cycle) + 10)*(number of cycles in waveform) + 30

NOTE

Round up to the next kilobyte after each of the above calculations.

Logging Configurations for ION 7500 Revenue Applications

You can alter the logging capacity of your ION 7500 meter, if it is being used for revenue applications. A suggested configuration is shown in the table below. To make use of the suggested revenue logging configuration, you must make all of the changes outlined below.

The following configuration does not apply to the ION 7600 meter, as it has a specific Revenue Log (see Chapter 2 for more details). This configuration is for an ION 7500 with standard 1Mb log memory.

Log	Depth	Interval	ION Modules Requiring Settings Changes
Revenue Log	760	35 days	Data Recorder module “Revenue Log” Periodic Timer module “Revenue Log Trg”
Loss Log	760	35 days	Data Recorder module “Loss Log” Periodic Timer module “Loss Log Trg”
Time Of Use Data Recorders	20	Triggered on demand	No changes required
Historic Logs	192	2	Data Recorder modules “Hist mean Log,” “Hist high Log,” and “Hist low Log” Periodic Timer module “Hist Log Trig”
Harmonics Logs	48	2	Data Recorder modules “Harm mean Log” and “Harm high Log” Periodic Timer module “Harm Log Trig”
Waveform recording	5	Triggered on demand	Data Recorder module “EgyDmd Log”
Report Generator Log	192	2	Data Recorder module “EgyDmd Log” Periodic Timer module “EgyDmd Log Trig”
Sag/Swell Log	100	Triggered on demand	No changes required
Event Log	500	Triggered on demand	No changes required

Alerting

The purpose of an ION alert system is to send an email or to contact a modem, fax, pager, or software in the event of a user-specified condition. These conditions can be changes in relays or power quality problems including surges, sags, swells and outages. With ION alarm notification, you can automatically advise key people of problems allowing quick remedial action, or notify ION software so logs can be uploaded from the site that initiated the alert.

The Alert module sends an alert whenever its *Trigger* input is pulsed. You can connect this input to any module that produces a pulse output. You can use modules that monitor alarm conditions such as changes in relay status and power quality problems. For example, you can connect the *Trigger* input to the output of a Setpoint module, thereby allowing the Alert module to send an alert when the setpoint condition is reached.

The Alert module delivers these types of alerts:

- Numeric Pager
- Alphanumeric Pager
- PEGASYS (for alerts to PEGASYS software)
- ION Alert (for alerts to ION Enterprise software)
- ASCII
- Email

Selection between modes is made with the Alert module *Alert Type* setup register.

The Alert module requires access to either a modem (a dedicated modem or a modem handling a loop of meters) or Ethernet (for the Alert module email capabilities).

Alerting is briefly described in the following section. For detailed information about alerting, including how to build a framework to send alerts, refer to the Alert module description in the online *ION Programmer's Reference.*

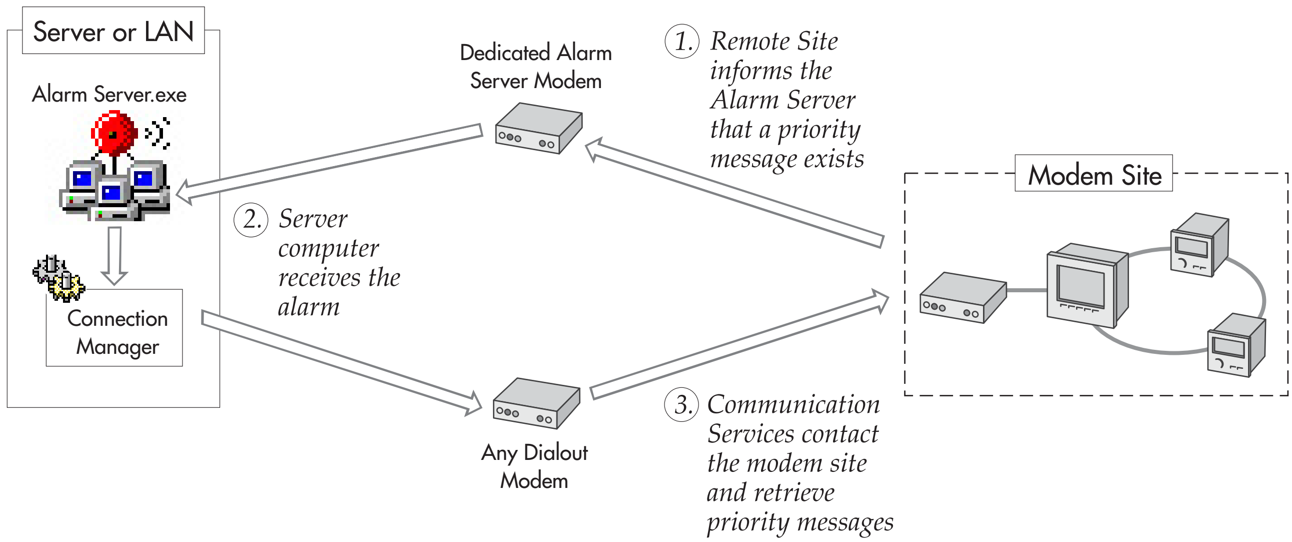
Alerting ION Software via the Alarm Server

NOTE

For detailed information about sending alerts to ION Enterprise/PEGASYS software via the Alarm Server, refer to the ION Enterprise online help.

The Alarm Server can run on any ION software Primary or Secondary server. The server computer should have a dedicated phone line and modem. Modems at remote sites are programmed to dial the server's phone number when a priority event occurs. The Alarm Server monitors the phone line and waits for the remote sites to annunciate events. The most common use of the Alarm Server is to handle Remote Site Event Notification.

Remote Site Event Notification



The Alarm Server uses a series of command line arguments to specify the actions it takes when a priority event is reported. These commands must be entered on the computer that is running the Alarm Server utility. Typically the Alarm Server is configured to launch the Connection Manager, which dials up the remote site and retrieves the logs from the devices. The Alarm Server can also be configured to launch other applications. A series of parameter switches are added to the command line to pass information about the event to the application that is launched.

Configuring the Alarm Server

The Alarm Server should have a dedicated phone line, modem, and COM port to avoid conflicts with other ION software components.

The modem used by the Alarm Server is **not** configured with the ION Management Console– only dialout modems are configured in the ION Management Console. The Alarm Server's executable, alarmsrv.exe, is typically located in \\Power Measurement\ION Enterprise\SYSTEM\bin. You can run the Alarm Server in a console window, or you can define a shortcut icon that includes all of the command line arguments required.

Alarm Server Command Line Arguments

Refer to the online *ION Enterprise Help* for a list of command lines that the Alarm Server supports.

Alerting via an Alphanumeric Pager

NOTE

For detailed information about building a framework for alerting via an alphanumeric pager, refer to the Alert module description in the online *ION Programmer's Reference.*

If an alphanumeric pager is specified as the destination address in the Alert module, then an alphanumeric paging service receives a message from the ION meter.

Once the modem at the paging service is contacted, the ION meter transmits the following information:

- Pager identification number
- Local time (year, month, date, hours, minutes, seconds)
- Remote site identification
- Priority of the alarm
- Alert message, with text strings and realtime measured values

To include a module's *Source* input in the message, reference the message string by using the form %Vn, where n is the *Source* input number. In the following *Message* register setting, the kWtot value is %V1. The string includes *Source* input 1 which would be the kWtot register from the Power Meter module.

The destination register contains your modem access number for the paging service provider and is what is dialed out first. The *Pager Num* register is the pager access number that is provided by your paging company.

Alerting via a Numeric Pager

NOTE

For detailed information about building a framework for alerting via a numeric pager, refer to the Alert module description in the online *ION Programmer's Reference.*

If a numeric pager is specified as the destination address in the Alert module, then a numeric paging service receives a message from the ION meter. Due to the inherent limitations in numeric paging, the ION meter can only send a string of digits to the paging service. The Alert module then waits a specified time, determined by the number of commas inserted after the phone number in the *Pager Num* setup register. Finally, the Alert module dials the message digital string.

There are two important factors to consider when setting up the Alert module for numeric paging. First, be sure to specify a string of digits that is meaningful to you, such as a coded message. Second, be aware that there is no way to assure that a message has been successfully transmitted. Instead, there may be a busy signal or an answering machine may take the call. The number of commas you add to your dial string is an estimate of how long the modem at the remote site waits before it transmits numbers.

NOTE

In the following destination-setting example: 1-250-555-666,,,,,999#, the pager number is 1-250-555-666 and the message string that displays on the pager is 999. You may need to insert 9,,, before the destination number if the line you are using is not a direct line. In this case the destination number is 9,,1-250-555-666,,999#

Alerting via Email

NOTE

For detailed information about setting up your network and building a framework for meter email (MeterM@il) alerts, refer to the technical note *ION MeterM@il Internal Email Server Feature.*

If email is specified as the destination address in the Alert module then an email message is sent to any address you specify. You can only set one email address per Alert module. If you want to send an alert to more than one email address you need to create a group — be sure your email server is configured to send email to groups via SMTP (Simple Message Transport Protocol).

Follow the steps below to send email alerts from your meter. Note that your meter must support emailing (with a correctly configured SMTP server):

1. Create an Alert module.
2. Configure these Alert module setup registers as indicated:
   - *Message* – type in the text of the alert to be emailed.
   - *Destination* – type in the destination email address.
   - *Type* – select Email.
   - *Com Port* – select Ethernet.
   - *Location* – type in a custom string; this is optional, and appears in the email.
   - *Email From* – type in an address that you want the email to appear from. This may be required as some SMTP servers only accept emails from valid addresses.
3. Create an ION module that will produce a pulse on its *Trigger* output when the exceptional event occurs (for example, a Setpoint module pulses its *Trigger* output when the setpoint condition is reached).
4. Link the Alert module's *Trigger* input to the *Trigger* output of the module created in step 3.
5. Send and save. When the *Trigger* input is pulsed, the Alert module establishes communications with the SMTP mail server, and emails the alert message.

Calculating Power Availability: Number of Nines

Power availability is becoming an increasingly important topic in today's electronic world. As the use of electronic equipment increases in industry and the home, the degree of tolerance for power outages has decreased. In some cases, a very short loss or reduction of supply voltage can have a large economic impact.

The purpose of calculating the "Number of Nines" is to provide a measurement of the time that power was available at the point the meter is monitoring. This value can be used alone or incorporated into other reliability calculations. Availability can be calculated as a percentage of total time (since the last reset).

A typical utility distribution system provides an availability of approximately 99.9%. Many applications require better availability than this: up to 99.9999% or better. It has become common to refer to high availability using the "Number of Nines": 99.9% corresponds to 3 nines; 99.9999% is 6 nines.

Once the meter is installed, the availability calculations must be reset to ensure valid time counts. You can reset the availability calculations with Vista software, ION Setup software, or through the meter's front panel.

For more information on the power availability, refer to the technical note *Power Availability*.

CHAPTER

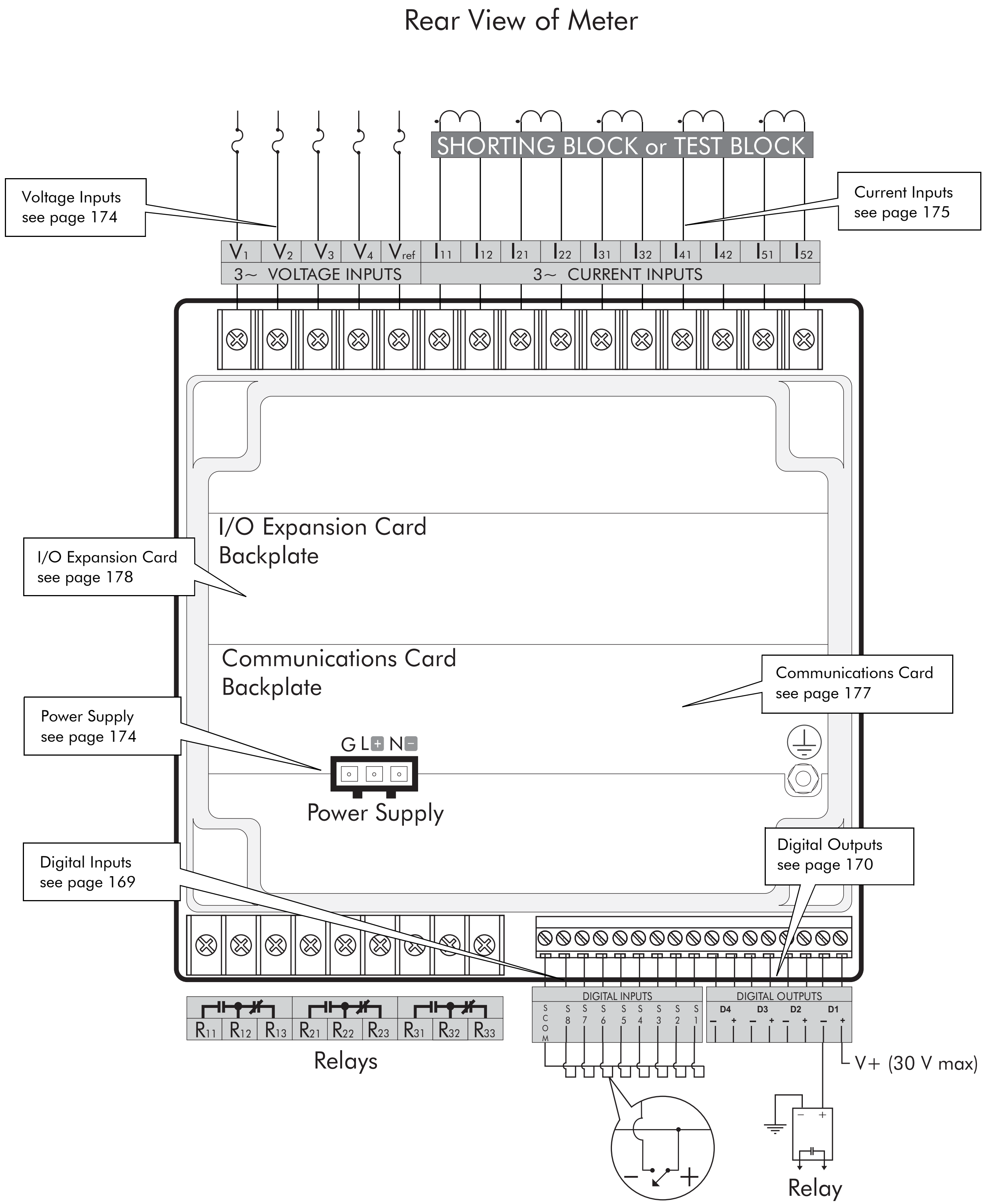
6 Hardware Reference

This chapter is intended to provide quick, at-a-glance, technical specifications for the more common hardware features of the ION 7500 and ION 7600 meters. Not all specifications are included.

All specifications are subject to change without notice. For the most recent information see the meter's *Datasheet*.

In This Chapter

Standard Model



General Specifications

Environmental Conditions

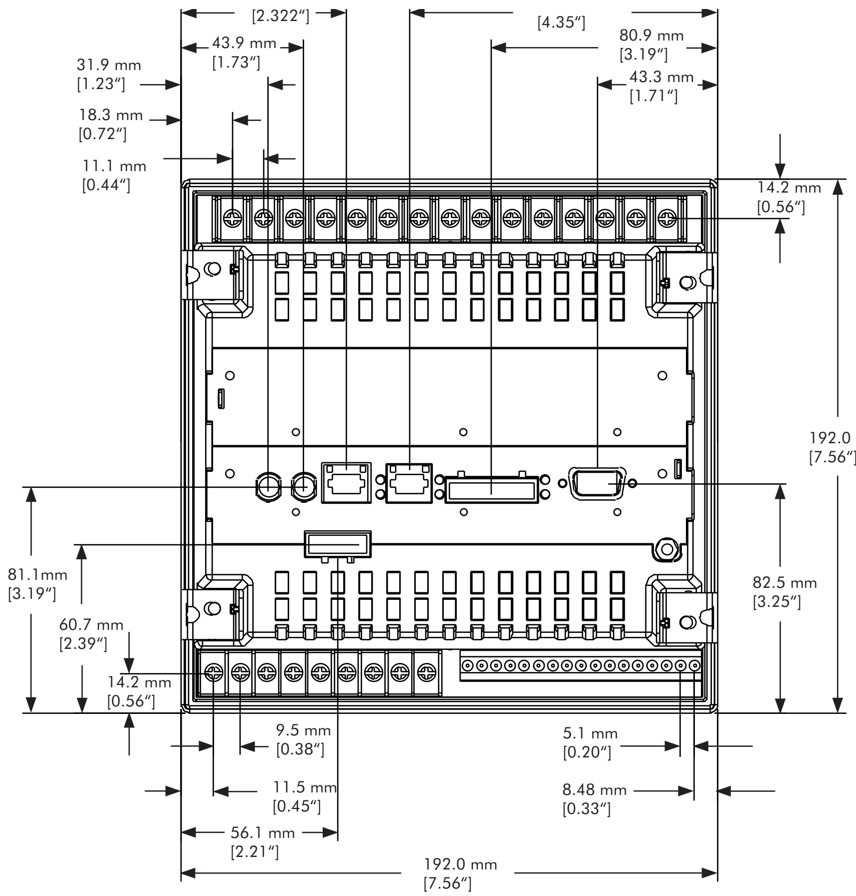
To operate properly and effectively, environmental conditions should fall within the guidelines listed below.

Environmental Condition	Acceptable Range
Location	Indoor use
Operating Range	-20°C to +70°C (-4°F to +158°F) with no formation of ice.
Display Operating Range	-20°C to +60°C (-4°F to +140°F)[1]
Storage	-40°C to +85°C (-40°F to +185°F)
Humidity	5 to 95% non-condensing

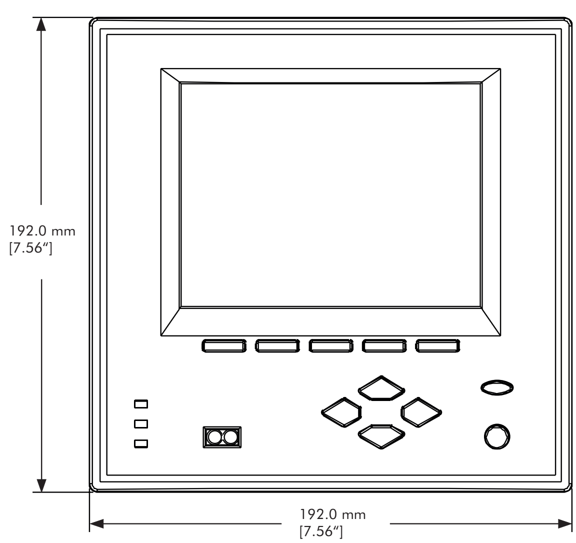
[1] Display visibility may be adversely affected below 0°C.

Unit Dimensions

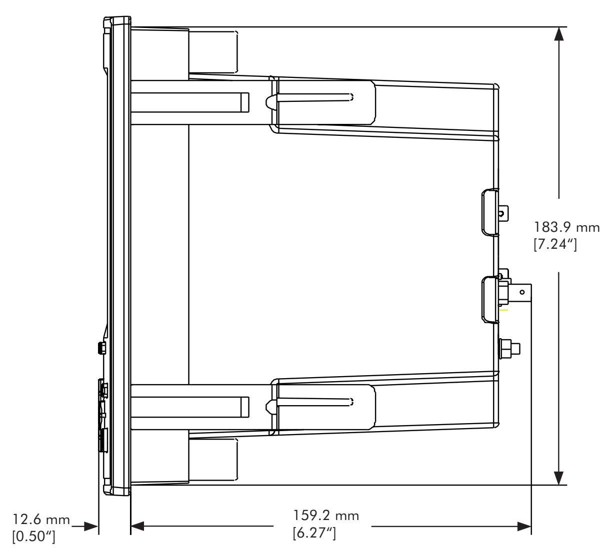
Basic Model — Rear View



Basic Model — Front View

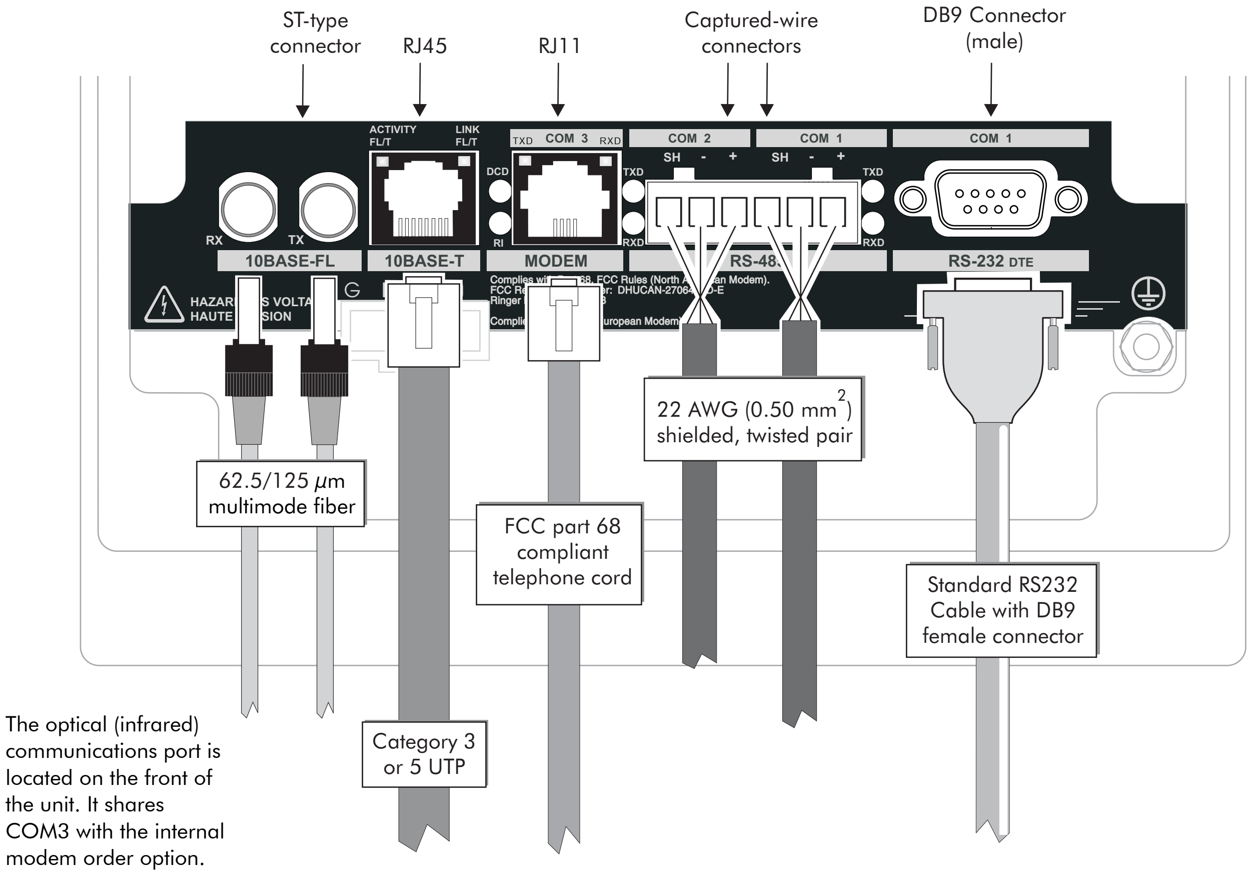


Basic Model — Side View



Communications Specifications

The following illustration shows all the possible connections to the communications card.



COM Port	Available Connections	Standard/Option
1	Selectable RS-232/RS-485 port	Standard
2	Dedicated RS-485 port	Standard
3	IrDA optical port	Standard
3	Internal modem	Option
4	10Base-T (or –FL) Ethernet [1]	Option

[1] 10Base-FL option will only be available if -FL was specified when the meter was ordered.

LEDs

LED	Color	Function
Ethernet ACTIVITY	Red[1]	Flashes as signals are transmitted and received for both Ethernet 10 Base-T and 10 Base-FL ports
Ethernet LINK	Green[1]	On as long as there is an active connection to either the 10 Base-T or 10 Base-FL ports
Internal Modem DCD	Green	Carrier Detect– Indicates the presence of a carrier signal (active connection to the modem)
Internal Modem RI	Green	Flashes to when the modem detects rings (Ring Indicator)
COM3 TRANSMIT	Red	Flashes as signals are transmitted from the COM3 internal modem
COM3 RECEIVE	Red	Flashes as signals are received on COM3 internal modem
COM2 TRANSMIT	Red	Flashes as signals are transmitted from the COM2 RS-485 loop
COM2 RECEIVE	Red	Flashes as signals are received on COM2 RS-485 loop
COM1 TRANSMIT	Red	Flashes as signals are transmitted from the COM1 RS-232 connection or the COM1 RS-485 loop
COM1 RECEIVE	Red	Flashes as signals are received on COM1 RS-232 connection or the COM1 RS-485 loop

[1] One or both of the Ethernet LED colors may differ from the standard red and green.

COM1 Port

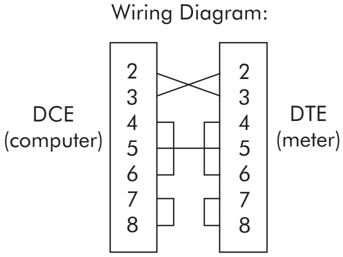
RS-232 Connections

RS-232 connection is made at the male DB9 connector. The meter acts as a DTE device in all RS-232 connections. Specifications are as follows:

Specification	Value
Baud Rates	300 to 115,200 bps (default is 9,600 bps)
Duplex	Full
Supported Protocols	ION, Modbus RTU, DNP 3.0, FACTORY, Iec870-102, GPS: Arbiter, GPS: TRUE TIME DATUM, EtherGate, ModemGate (default is ION)
Isolation	Optical isolation from all other inputs and outputs (excluding the COM1 RS-485 port); isolation voltage is 750 V peak for 10 seconds @ 60 Hz.

Computer Connections

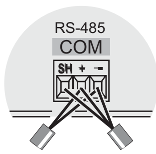
DB9 Null Modem Wiring Diagram:



Specification	Description
Cable Type	Null modem RS-232 cable
Cable Ends	DB9 female end for mating with the DB9 male connector on the meter
Max. Cable Length	50 feet (15.2 m)

External Modem Connections

Specification	Description
Cable Type	Standard straight-through RS-232 cable
Cable Ends	DB9 female end for mating with the DB9 male connector on the meter
Max. Cable Length	50 feet (15.2 m)



RS-485 Connections

RS-485 connections are made via the captured-wire connectors on the rear of the meter. Devices can be connected in series using RS-485 (see diagram to the left). Be sure not to ground the wires at both ends.

Specifications are as follows:

Specification	Value
Baud Rates	300 to 57,600 bps (default is 9,600 bps)
Duplex	Half
Supported Protocols	ION, Modbus RTU, DNP 3.0, FACTORY, Iec870-102, GPS: Arbiter, GPS: TRUE TIME DATUM, EtherGate, ModemGate (default is ION)
Isolation	Optical isolation from all other inputs and outputs (the COM1 RS-485 port is not isolated from the COM1 RS-232 port); isolation voltage is 750 V peak for 10 seconds @ 60 Hz.

Connections

Specification	Description
Cable Type	Good quality shielded twisted pair cable, AWG 22 or larger.
Max. Cable Length	4,000 ft. (1219 m) [1]
Max. number of devices per bus	32

[1] The lengths of all (+ and –) cable segments must be counted including those that connect devices to terminal blocks.

Terminal connections on the meter are marked as follows:

Marking	Terminal Function
SHLD	RS-485 Shield
–	RS-485 Data Minus
+	RS-485 Data Plus

COM2 Port

Same as for COM Port 1 except there is no RS-232 connection available, only RS-485.

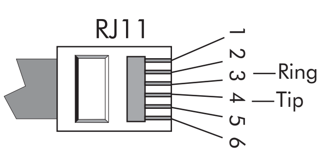
COM3 Port

Internal Modem

- The internal modem is multiplexed with the optical port.
- By default, the modem is enabled and the optical port is disabled.

Specification	Value
Baud Rate	300 to 33,600 bps [1]
Error Correction	V.42 LAPM, MNP 2-4, MNP 10
Data Compression	V.42 bis/MNP 5
Interface	RJ11 (Tip & Ring)
Government Approvals	FCC Modem: FCC P68 (USA), Industry Canada CS-03 (CAN) CE Modem: CTR-21 (Austria, Belgium, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxemburg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, UK)

[1] The baud rate used between connected modems is independent of the baud rate used for communication between the internal modem and the meter.
Higher data rates can be achieved if data compression is enabled in the modem.



Connection

Connect to the internal modem via the female RJ-11 jack located on the back of the meter. For FCC compliant modems, use an FCC Part 68 compliant telephone cord.

If your meter has the CTR21 Compliant internal modem option, you may also require an adapter to interface with your particular European telephone line connection. The adapter type will depend on the telephone line standards in your country or region (several standards may be in use in the same country).

Optical (Infrared)

Specifications for the optical port are as follows:

Specification	Value
Baud Rate	9,600 to 115,200 bps (default is 9,600 bps)
Duplex	Half
Operating Distance	less than 1 meter (3 feet) [1]
Optical Range	±15° (minimum), ±30° (maximum)
Supported Protocols	ION, Modbus RTU, DNP 3.0, FACTORY (default is ION)

[1] No physical connection is required to use the infrared port. Any device with an IRDA-compliant port that is positioned within the operating distance and optical range specified above can receive data.

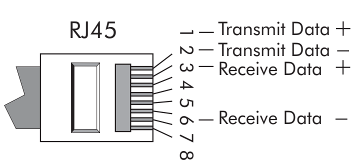
Ethernet Port

Specifications for the Ethernet ports are as follows:

Specification	Value
Data Rate	10 Mbps, half duplex
Supported Protocols	ION, Telnet, Modbus RTU [1], Modbus TCP [1], FACTORY

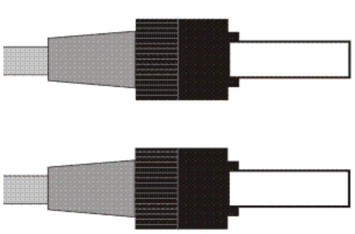
[1] The unit ID for Modbus RTU and Modbus TCP over Ethernet is 100.

Ethernet Connections



10Base-T

Specification	Description
Isolation	Transformer isolated Min. isolation voltage: 1,500VAC/2,250VDC
Wire Type	High quality Category 3 or 5 UTP (CAT 5 unshielded twisted pair recommended) cable Max. length: 100 meters
Connector Type	Male RJ45 modular



10Base-FL

Specification	Description
Isolation	Optical
Wire Type	62.5/125 micrometer multimode fiber cable Max. length: 2,000 meters
Connector Type	ST-type

NOTE

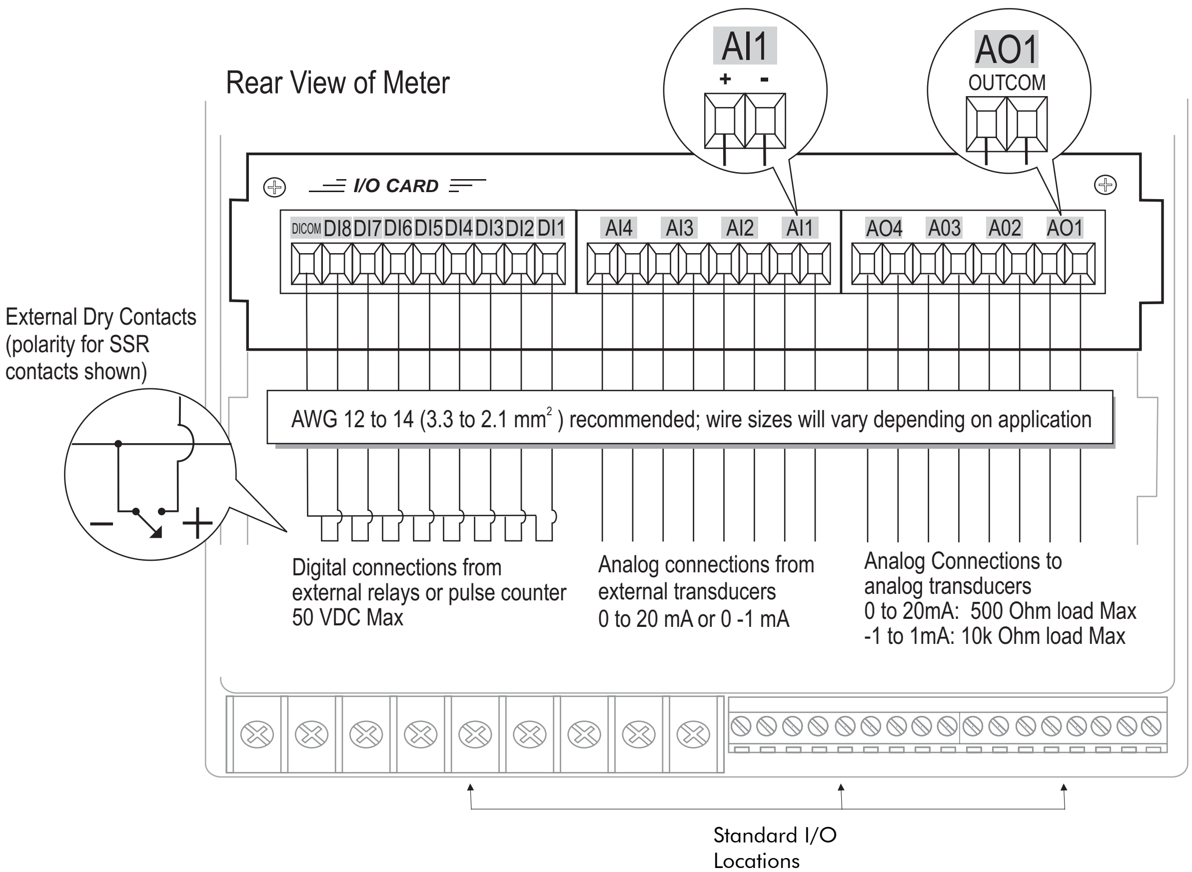
Using the fiber port disables the standard RJ45 port.

IP Service Ports

Connect to the following IP Service Ports for communications over the Ethernet.

Protocol	TCP/IP Port
ION	7700
Modbus RTU	7701
Modbus TCP	502
EtherGate COM1	7801
EtherGate COM2	7802

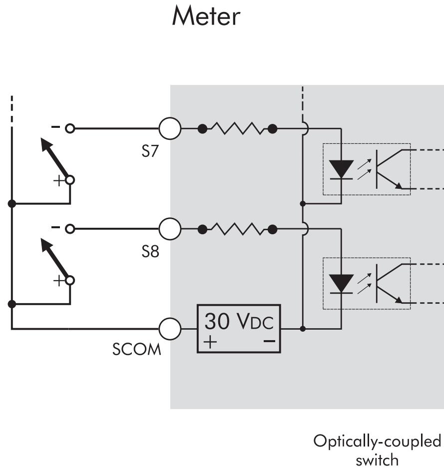
I/O Specifications



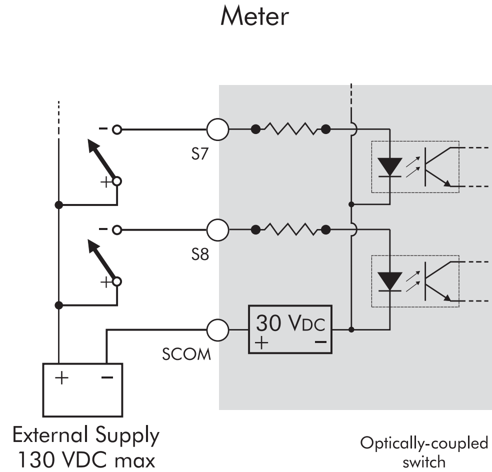
Digital Inputs

Specification	Standard I/O (S1 to S8)	Expansion Card I/O (D11 to D18)
Min Pulse Width	1 millisecond	20 milliseconds
Max Pulse Rate	20 Hz	25 Hz
Scan Time	1 millisecond for all inputs (min)	20 milliseconds for all inputs (min)
Isolation to Ground	300 VDC for 10 seconds, 60 Hz	300 VDC for 10 seconds, 60 Hz
Max Voltage	130 VDC (continuous)	50 VDC (continuous)
Timestamp Accuracy	1 millisecond	2 milliseconds
Connection Type	Captured-wire	
Wire Type	AWG 14 to AWG 12	

Internal Excitation

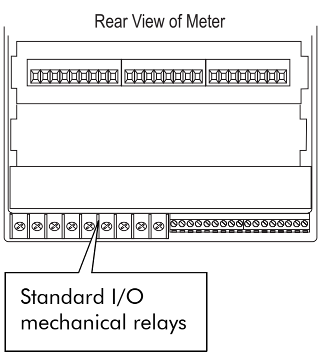


Additional External Excitation (Optional)



Mechanical Relay Outputs

Specifications for the three Form C relays (R1, R2 and R3) are as follows:



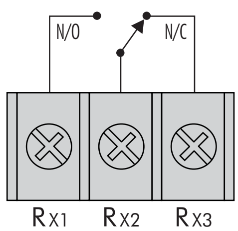
Specification	Standard I/0
Rated Voltage	250 VAC / 30 VDC
Rated Load @ Rated Voltage	10 A resistive 7.5 A (AC) / 5 A (DC) Inductive (p.f. = 0.4)
Max. Voltage	380 VAC, 125 VDC, Installation category III (Distribution), Pollution degree 2
Max Load @ Max Voltage	0.2A (DC) / 3A (AC)
Max. Switching Load	2,500 VA resistive 1,875 VA inductive (p.f. = 0.4)
Isolation	5,000 VAC for 1 minute
Lifetime	no load: 10,000,000 operations rated voltage and load: 100,000 operations
Turn-On Time	8.3 ms Max (60 Hz)
Turn-Off Time	AC: 8.3 ms Max (60 Hz) DC: 5 ms Max
Update Time	½ cycle or 1-second
Connector Type	Ring or spade
Wire Type	Use the appropriate gauge wire for the amount of current that could be drawn by the connected device [1]

[1] Consult the device's operating instructions or manufacturer for assistance if required.

NOTE

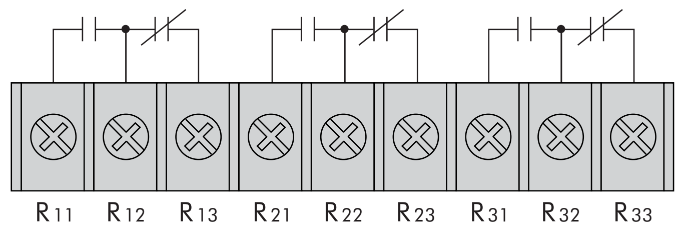
Because mechanical relays have limited lifetimes, mechanical KYZ relays are typically not suitable for energy pulsing applications. For energy pulsing applications, consider using Form A outputs in KYZ mode.

A typical connection and operational details are illustrated below..



Operational Block Diagram

STATE	RX1 – RX2	RX2 – RX3
Inactive	Open	Closed
Active	Closed	Open
Pulse	Closed for duration of pulse	Open for duration of pulse

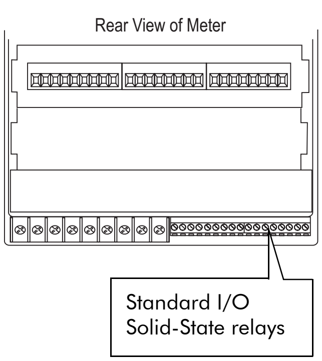


NOTE

The mechanical relays should be protected by external fuses.

Solid-State Relay Outputs

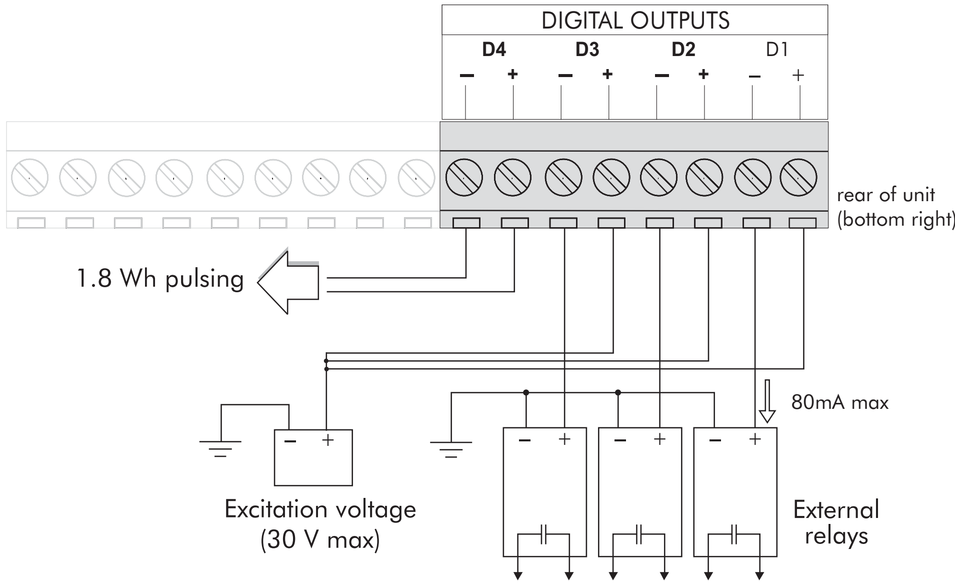
Specifications for the four digital relay (Form A) outputs (D1 through D4) are as follows:



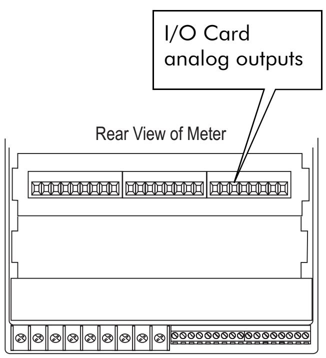
Specification	Value
Signal Type	Continuous or pulse [1]
Maximum Load Voltage	30V
Maximum Load Current	80 mA
Isolation	5,000 Vrms
Scan Time	½ cycle
Connection Type	Captured-wire
Wire Type	AWG 28 to AWG 16

[1] Digital output D4 is configured at the factory to emit pulses for calibration testing purposes.

Connections to the terminal strip are made as shown in the following diagram.



Analog Outputs

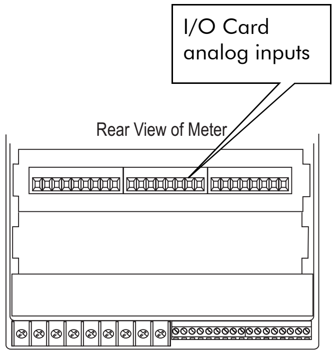


The I/O expansion card can be ordered with 4 analog outputs.

Specification	0 to 20 mA Analog Outputs	-1 to 1 mA Analog Outputs
Scalable	To 4-20 mA	To 0-1 mA
Signal Type	Continuous DC	Continuous DC
Driving Capability	500 Ω	10 kΩ
Accuracy	+/– 0.30% of full scale	
Connection Type	Captured-wire	
Wire Type	AWG 14 to AWG 12	

⚠ **CAUTION**

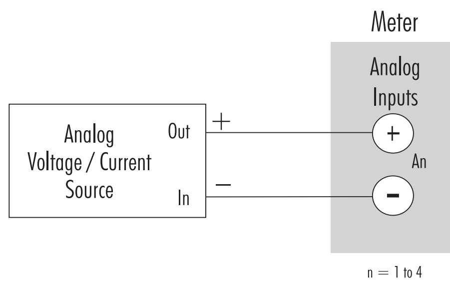
Due to internal circuit design, it is recommended that the analog inputs of the I/O Card NOT be driven with the outputs on the same card.



Analog Inputs

The I/O expansion card can be ordered with 4 unidirectional analog inputs.

Specification	0-20 mA Analog Inputs	0-1 mA Analog Inputs
Scalable	To 4-20 mA	To 0-1 mA
Signal Type	Continuous DC	Continuous DC
Input Impedance	25 Ω	475 Ω
Isolation Impedance	(channel/channel) > 400 kΩ	
Accuracy	+/– 0.30% of full scale	
Connector Type	Captured-wire	
Wire Type	AWG 14 to AWG 12	



Electrical Specifications

Power Supply

Specification	Description
Rated Inputs	AC: 85 – 240 VAC, 47-63 Hz DC:110 – 330 VDC Installation category II (local), Pollution degree 2
Dielectric Withstand	2,000 VAC RMS, 60Hz for 1 minute
Burden	Typical: 12 VA
	Max: 20 VA
Ride-through	Min: 100ms (6 cycles @ 60 Hz)
Connector Type	Captured wire
Wire Type	AWG 14 to AWG 12

Voltage Inputs

Specification	Value
Operating Range	0 to 347 Volts RMS (L-N) and 0 to 600 RMS (L-L)
Steady-State Rating	0 to 347 Volts RMS
Overload Rating	1,500 VAC RMS (continuous) and 3,250 VAC RMS (one minute)
Input Impedance	5 MΩ
Phase Voltage Connector Type	Ring or spade
Phase Voltage Wire Type	AWG 12 to AWG 10
Phase Voltage Sense Lead Protection	Use breakers or fuses at their source

Potential Transformers (PTs)

System Mode	Voltage Range	Requires PTs
Wye	120 VAC line-to-neutral or 208 VAC L-L	no
	277 VAC line-to-neutral or 480 VAC L-L	no
	347 VAC line-to-neutral or 600 VAC L-L	no
	over 347 VAC L-N or 600 VAC L-L	yes
Single Phase	120 VAC line-to-neutral or 240 VAC L-L	no
	277 VAC line-to-neutral or 554 VAC L-L	no
	over 277 VAC L-N or 554 VAC L-L	yes
Delta	up to 480 VAC L-L	recommended [1]
	over 480 VAC L-L	yes

[1] To maximize accuracy, the use of PTs is recommended for all delta connections, however, direct connect delta up to 480 V is supported.

Current Inputs

Specification	5A Option	1A Option
Input Rating	5A, 10A, or 20A	1A, 2A, 5A, or 10A
Fault Capture	70A peak	17.5A peak
Maximum Voltage	600V RMS (CAT III IEC61010-1)	600V RMS (CAT III IEC61010-1)
Impedance	2 mΩ	15 mΩ
Burden	0.05 VA per phase (at 5A)	0.015 VA per phase (at 1A)
Dielectric Withstand	3250 VAC, 60Hz for 1 minute	3250 VAC, 60Hz for 1 minute
Overload	500A RMS for 1 second, non-recurring	50A RMS for 1 second, non-recurring

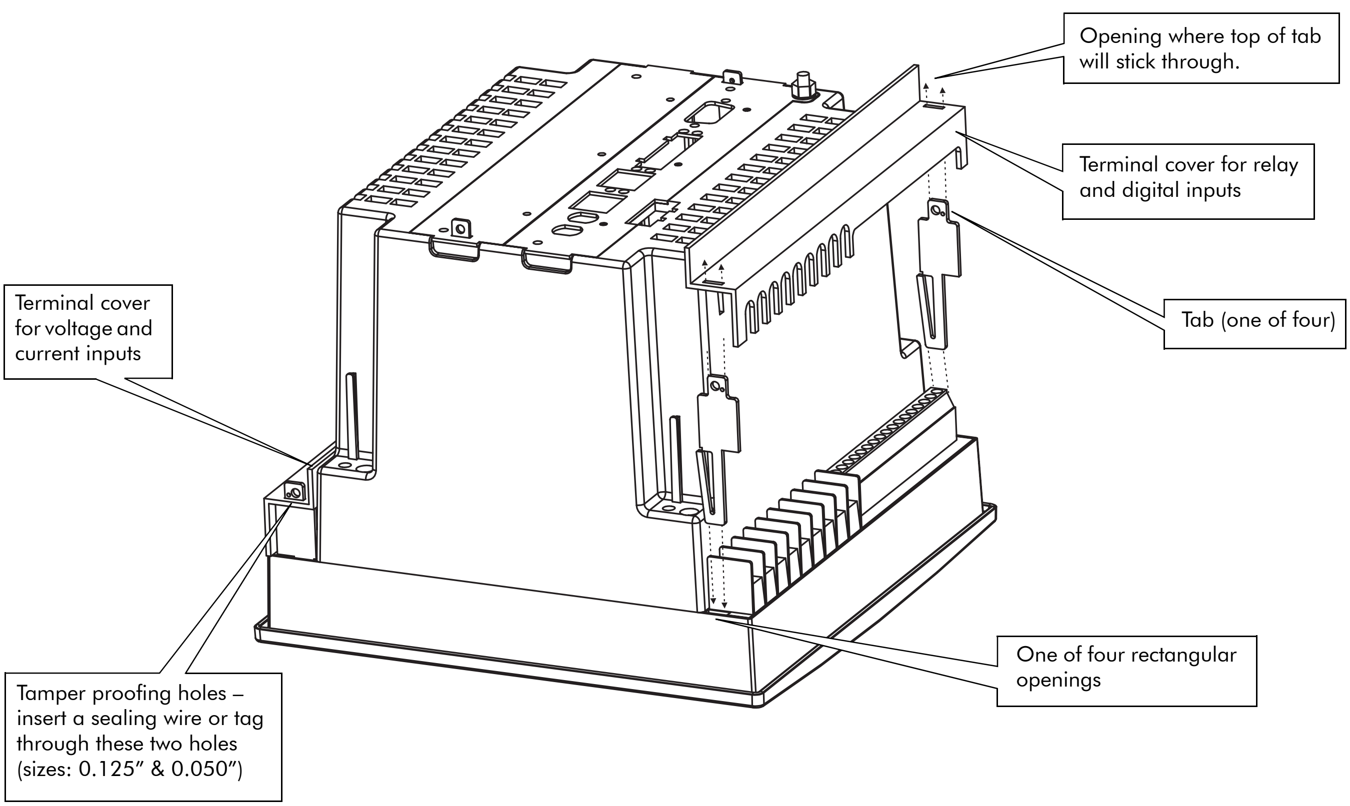
Retrofit Options

Terminal Cover

Installation Instructions

1. Turn off all power to the meter.
2. Open all PT fuses (or direct voltage input fuses). Close all CT shorting blocks.
3. Ensure that all cables connected to the meter (including those at to the I/O terminals) are **NOT** live.
4. For each cover, insert two tabs into the small rectangular openings at either end of the strip (refer to the diagram below).
5. Optional: you can tamper-proof each terminal strip by inserting a sealing wire or tag through the holes at the end of the tabs.
6. Close the PT fuses (or direct voltage input fuses), and open the CT shorting blocks.
7. Turn on power to the meter and verify the correct operation of the unit.

Installation Diagram



Communications Card

Installation Instructions

DANGER

The components inside the meter are extremely sensitive to electrostatic discharge. To prevent damage to the unit, wear an anti-static wrist strap at all times when working inside the unit. Failure to use proper equipment during servicing will void the meter's warranty.

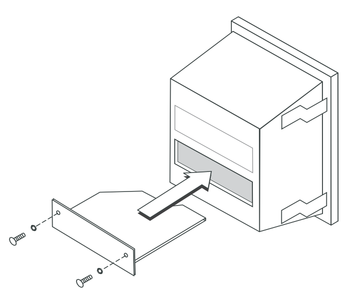
The following steps should be taken before inserting a Comm Card into the meter:

1. Turn off all power to the meter.
2. Open all PT fuses (or direct voltage input fuses). Close all CT shorting blocks.
3. Disconnect the Line and Neutral (or DC power) wires from the Control Power inputs of the unit.
4. Disconnect all other wiring (or power off all other circuits) which may present potentially hazardous voltage levels to the unit, such as connections to the relay outputs, status inputs, etc.
5. Ensure that all cables still connected to the meter are **NOT** live.

Removing the Existing Communications Card

The meter's Comm Card can be removed while the unit is still mounted in its switchgear panel (or other mounting location).

1. Remove the two screws and lockwashers on the Comm Card's backplate (refer to the diagram).
2. Remove the nut from the chassis ground lug.
3. Grasp the Comm Card by the sides of its backplate and pull it out of the socket, away from the chassis.
4. Place the Comm Card in an anti-static wrapping.



Installing the New Card

The Comm Card consists of a circuit board with an attached polarized CHAMP connector on the component side. Install the communications card as follows:

1. Hold the communications card by the sides and slide it into the base unit with the component side facing up.
2. Slide the edge of the circuit board down the slots along each side of the chassis.
3. Align the CHAMP connector with the socket and press the Comm Card firmly into place. The socket and the connector are polarized, so the pins in the connector will not fit into the socket if the card is not oriented correctly. The communications card is securely inserted into the socket when the backplate of the Comm Card meets the chassis of the meter.

Final Steps

4. Ensure the cover meets the chassis of the base unit.
5. Use the Phillips screwdriver to replace the two backplate screws, as well as the nut on the chassis ground lug, with their lock-washers. They must be installed firmly to preserve transient immunity.
6. Reinstall the Line and Neutral (or DC power) wiring to the Control Power inputs of the unit.
7. Reconnect all other wiring (or re-enable all other circuits). Close the PT fuses (or direct voltage input fuses), and open the CT shorting blocks.
8. Turn on power to the meter and verify the correct operation of the unit.

I/O Expansion Card

The standard I/O expansion card has 8 digital (status) inputs labelled DI1 to DI8. Depending on what you ordered, the I/O expansion card will also contain either 4 analog inputs, or 4 analog outputs, or both. Check the label on the I/O Card for your I/O specifications.

Installation Instructions

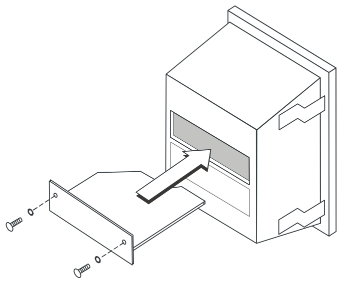
The following steps should be taken before inserting an I/O Card into the meter:

1. Turn off all power to the meter.
2. Open all PT fuses (or direct voltage input fuses). Close all CT shorting blocks.
3. Disconnect the Line and Neutral (or DC power) wires from the Control Power inputs of the unit.
4. Disconnect all other wiring (or power off all other circuits) which may present potentially hazardous voltage levels to the unit, such as connections to the relay outputs, status inputs, etc.
5. Ensure that all cables still connected to the meter are **NOT** live.

Installing the I/O Card

The I/O Card consists of a circuit board with an attached polarized CHAMP connector on the component side. Follow these steps to install the I/O Card:

1. If present, remove the plastic tab that seals the I/O Card's cover plate to the meter. Use the Phillips screwdriver to remove the plate's two screws, then remove the plate.
2. Hold the I/O card by the sides and slide it into the base unit with the component side facing up. Slide the edge of the circuit board down the slots along each side of the chassis.
3. Align the CHAMP connector with the socket and press the I/O Card firmly into place. The socket and the connector are polarized, so the pins in the connector will not fit into the socket if the card is not oriented correctly. The I/O card is securely inserted into the socket when the backplate of the I/O Card meets the chassis of the meter.



4. Ensure the cover meets the chassis of the base unit. Use the Phillips screwdriver to replace the two backplate screws with their lock-washers. They must be installed firmly to preserve transient immunity.
5. Reinstall the Line and Neutral (or DC power) wiring to the Control Power inputs of the unit.
6. Reconnect all other wiring (or re-enable all other circuits). Close the PT fuses (or direct voltage input fuses), and open the CT shorting blocks.
7. Turn on power to the meter and verify the correct operation of the unit.

Refer to "Digital and Analog I/O" on page 139 for the settings in these modules.

TRAN Model

A TRAN is a meter with no display. All specifications are the same as for a standard meter, except the following.

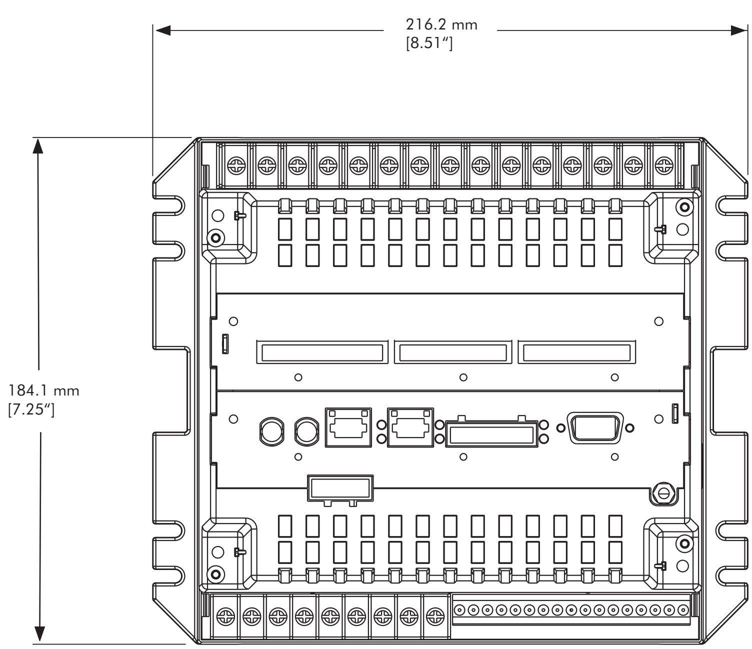
Environmental Conditions

The TRAN meter can operate at a lower temperature than the standard meter.

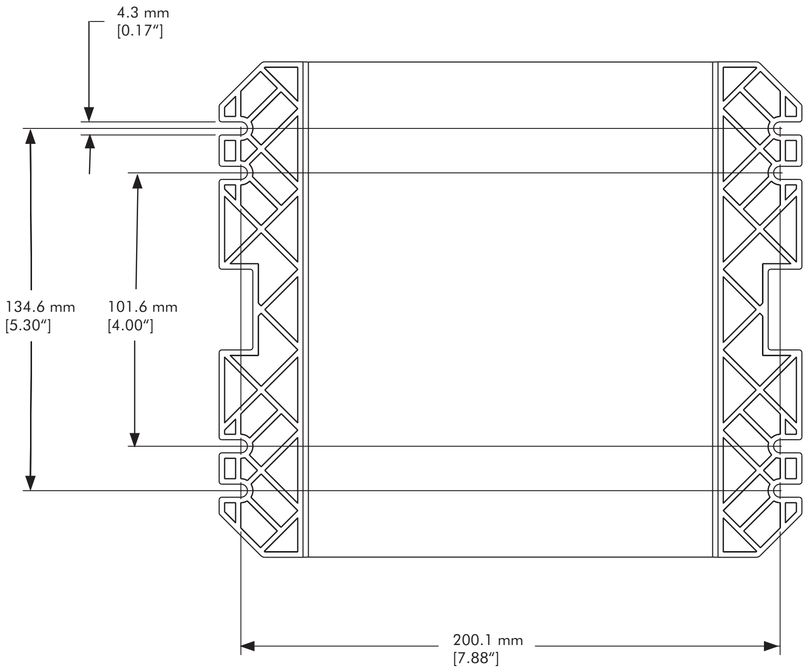
Environmental Condition	Acceptable Range
Location	Indoor use
Operating	-40°C to +70°C (-40°F to +158°F) no formation of ice
Storage	-40°C to +85°C (-40°F to +185°F)
Humidity	5 to 95% non-condensing

Unit Dimensions

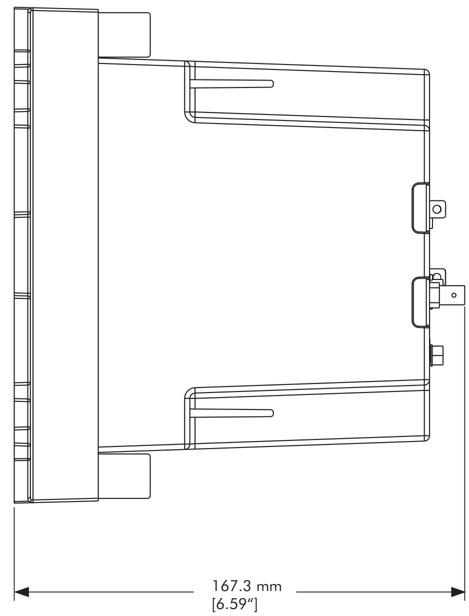
TRAN Model — Front View



TRAN Model — Front View



TRAN Model — Side View



APPENDIX

A Technical Notes

Power Measurement technical notes provide ION feature details including custom configurations for your meter.

In This Appendix

Current Probe Inputs Basic Setup

Meters with the Current Probes Input Option are compatible with clamp-on current probes. All current inputs on these meters are modified to accept 0-5 Vrms AC signals from a variety of clamp-on current probes. This option reduces the downtime required to install a meter. There are two Current Probe Input Option configurations:

A. Meters calibrated and shipped with probes: the meter is pre-configured and calibrated at the factory with three Universal Technic 10A current probes, meeting IEC 1036 Class 1 accuracy levels which includes the meter and the current probes accuracy. The current probes can be used for monitoring 1A or 5A secondaries. Probe cable is 22 AWG (0.3 mm^2) and two meters in length.

B. Meters calibrated, but not with probes: this option allows you to order a meter that is calibrated for use with current probes. You then supply your own probes (as long as they match the input specifications of the meter) or select one of the several compatible models available from PML as accessories. Probes and probe cables must be compliant with IEC 61010-1 CATIII protection requirements and not require more than 220k Ohm of load impedance.

Whether basic setup is necessary depends on your Current Probe Input Option.

Basic Setup is NOT required:

If your ordering option includes PML supplied current probes and a meter factory-calibrated to match the current probe specifications (option “A” above).
If you have this ordering option, then this document does not apply to you.

Basic Setup IS required:

If your meter ordering option does **not** include current probes that have been factory-calibrated with the meter (option “B” above). In this case, you need to set up the transformation ratio for the current probes you will be using. If energy readings *accuracy* is important, then you need to set up the phase angle specified by the current probe manufacturer. To learn how to do this setup, read the following instructions.

In This Document

Telnet and HyperTerminal Access

To perform current probe basic setup, you need to access the meter Calibration menu in a Telnet or HyperTerminal session:

- Telnet: select Debug Parser > KAL? (Display Calibration Help Screen).
- HyperTerminal: select the KAL? (Display Calibration Help Screen).

Refer to the technical note titled *Telnet and HyperTerminal Access* for instructions on how to run a Telnet or HyperTerminal session.

To learn more about the Calibration menu, help, and commands refer to the section "Calibration Menu and the KCTSTP/KCTRD Commands" on page 188.

Current Probe Basic Setup

Basic setup for current probes involves programming the meter with the current probe transformation ratio, and if necessary, the phase angle provided by the current probe manufacturer (phase angle correction is necessary if energy readings *accuracy* is required). These parameters are saved to the meter as *User Defined 1* or *User Defined 2* and are activated on the meter with the meter front panel or software.

In the following example, we will set up a ION 7500 meter to match current probes that have a 300A primary rating, a 0.333V output, and a phase shift of 2° (as specified by the current probe manufacturer).

In a Telnet or HyperTerminal session, we will set up the parameters using the KCTSTP write command, and save this to the meter as ***User Defined 1***. (Refer to the KCTSTP command in the "The Calibration menu contains the following calibration commands:" section).

Next, we will verify our setup with the KCTRD read command. Finally, with the meter front panel or software, we will access the Power Meter module ***Current Probe*** setup register, and select ***User Defined 1***. This activates the meter with the parameters we have set in this example.

⚠ CAUTION

Before changing meter parameters, use the Calibration menu KCTRD read command to display the meter default settings. Print out the default settings, and store the printout so you can refer to the default settings later if required.

To perform current probe basic setup:

1. Connect the current probes to the meter (in this example we are using a ION 7500 meter). Refer to the meter *Installation and Basic Setup Instructions* for current probe installation instructions.

2. In a Telnet or HyperTerminal session, access the Calibration menu. Refer to the technical note titled *Telnet and HyperTerminal Access* for instructions on how to run a Telnet or HyperTerminal session.

3. Set up the current probe transformation ratio and the phase angle.

   In this example, we will set up a split core CT with AC voltage output. The model is CT-300A-0.333V (Nominal Primary current 300A, Nominal secondary voltage 0.333V). The phase angle is < 2.0 degrees. This is saved to register group "User Defined 1" (1) and is the same for all phase current channels (44). Refer to the KCTSTP command in the section "The Calibration menu contains the following calibration commands:" on page 188.

   To write these parameters to the meter, type in:

   7500ION:\PORT_1>kctstp CT-300A-0.333V 300 0.333 2.0 1 44

   Press Enter.

4. To read that the new parameters have been written to the meter, type in:

   7500ION:\PORT_1>kctrd

   Press Enter.

5. With the meter front panel or software, activate the current probe parameters set in step 3:

   - Meter front panel: select *Basic Setup* > *Current Probe* > *User Defined 1*.
   - Designer software: access the Power Meter module *Current Probe* setup register and set it to *User Defined 1*.

Calibration Menu and the KCTSTP/KCTRD Commands

The Calibration menu lets you access setup registers in the meter Factory module. With the read/write commands KCTRD and KCTSTP, you can program the meter with parameters appropriate for your current probes.

Calibration Menu and Help

The Calibration menu contains the following calibration commands:

TERMINAL COMMANDS	
KRD	Read All RMS Calibration Constants
KFRD	Read All Force Levels
KFSRD	Read All Full Scale Values
KCTSTP <tag> <I> <V> <phase angle> <u> <ch>	Write Setup for External CT
KCTRD	Read Setup of External CTs
KD	Read Power Meter Module Diagnostics

Description of KCTSTP and KCTRD Calibration Commands

The command KCTSTP writes all current probe setup registers. The command KCTRD reads all current probe setup registers.

KCTSTP <tag> <I> <V> <phase angle> <u> <ch>

Write the external current probe setup registers

Description:

This command writes to non-volatile registers containing the external current probe parameters

Arguments:

<tag> the current probe model or name tag, maximum of 15 characters; **do not leave spaces** between characters

<I> the RMS value of the nominal primary current of the current probe

<V> the nominal RMS value of the secondary nominal voltage of the current probe

<phase angle> current probe's phase angle in degrees for constant phase compensation

<u> selected register group: 1-User Defined 1, 2-User Defined 2

<ch> selected current channel(s): 4-6 (4=I1;5=I2;6=I3), 44 (44 = ALL PHASE CURRENT CHANNELS: I1,I2,I3)

Example:

Set up a split core CT with AC voltage output model CT-300A-0.333V (Nominal Primary current 300A, Nominal secondary voltage 0.333V, phase angle < 2.5deg, constant phase compensation (2)), saved to register group "User Defined 1" (1) same for all phase current channels (44)

```
7500ION:\PORT_1>kctstp CT-300A-0.333V 300 0.333 2.5 1 44
executing CAL command

FACTORY PARAMETERS SET FOR EXTERNAL CT(s).
Factory Default:
------------------------------------------------------------------------------------------
Phase|Probe| Inom | Vnom |    Pha(I) curve coefficients        | Probe Name Tag
      |comp |  [A]  |  [V]  |      a      |       b      |       c      |
------------------------------------------------------------------------------------------
 PH A  01   0010.0  1.000  000.00000  000.00000   000.00000   CT-10A-1V
 PH B  01   0010.0  1.000  000.00000  000.00000   000.00000   CT-10A-1V
 PH C  01   0010.0  1.000  000.00000  000.00000   000.00000   CT-10A-1V
------------------------------------------------------------------------------------------
User Defined 1:
------------------------------------------------------------------------------------------
Phase|Probe| Inom | Vnom |    Pha(I) curve coefficients        | Probe Name Tag
      |comp |  [A]  |  [V]  |      a      |       b      |       c      |
------------------------------------------------------------------------------------------
 PH A  02   0300.0  0.333  002.50000  000.00000   000.00000   CT-300A-0.333V
 PH B  02   0300.0  0.333  002.50000  000.00000   000.00000   CT-300A-0.333V
 PH C  02   0300.0  0.333  002.50000  000.00000   000.00000   CT-300A-0.333V
----------------------------------------------------------------------------------------
User Defined 2:
------------------------------------------------------------------------------------------
Phase|Probe| Inom | Vnom |    Pha(I) curve coefficients        | Probe Name Tag
      |comp |  [A]  |  [V]  |      a      |       b      |       c      |
------------------------------------------------------------------------------------------
 PH A  00   0001.0  1.000  000.00000  000.00000   000.00000   none
 PH B  00   0001.0  1.000  000.00000  000.00000   000.00000   none
 PH C  00   0001.0  1.000  000.00000  000.00000   000.00000   none
------------------------------------------------------------------------------------------
```

KCTRD

Read all current probe setup registers

Description:

This command lists the content of all current probe setup registers. There are three identical groups of registers: Factory Default (configured in the factory), User Defined 1, User Defined 2 (both for user configuration).

Each group contains the following probe parameters:

Primary Nominal Current, Secondary Nominal Voltage, Probe Name Tag (character string). Additionally, if the meter was ordered with factory calibrated current probes, then the Factory Default register group contains probe phase compensation coefficients.

For meters equipped with Current Probe Input Option, but not ordered with factory calibrated current probes, all register groups should contain zero values, except for Nominal Current and Voltage, which are set to 1.0 by default.

For meters **NOT** equipped with Current Probe Input Option, all register groups should contain zero values, except for Nominal Current and Voltage, which are set to 1.0 by default.

Arguments:

None

Custom Front Panel Displays

This document explains how to customize your meter's front panel display screens using Designer software. Instructions are also included for customizing the ION 7300 Series meter's display screens through the meter front panel.

In This Document

Introduction

ION meters ship with preconfigured display screens. Most users find that the data displayed by the front panel LCD (Liquid Crystal Display) suits their needs entirely. However, front panel displays may be customized on most ION meters.

ION meters' display screens can be customized to show virtually any measurement or calculation of which the meter is capable. For example, you could do one or all of the following:

- change displayed parameters, such as from *Vll* to *Vln* or *Vllab* to *Vlna*
- aggregate displays from multiple meters, such as using a meter's front panel display to view data collected by one or more TRAN units (see the section titled "Displaying Data from Other Meters" on page 206)
- adjust character size to be different on each screen
- change data display settings such as backlight timeout, automatic display scrolling, parameter update rate and display mode*

* The display mode setting is not available for ION 7300 meters.

In order to customize your front panel display screens, you must make changes to ION modules that belong to the display framework. After briefly summarizing the functions of these ION modules, this document explains how you customize your meter using Designer software.

ION Modules in the Display Framework

There are three particular ION modules that control the front panel display:

- the Display module
- the Display Options module
- the Scroll module

Refer to the online *ION Programmer's Reference* for complete details on these modules, including descriptions of their inputs, setup registers, and output registers.

NOTE

The online *ION Programmer's Reference* details all of the registers belonging to a particular ION module, but not every register is employed in the various series of meters. Only those registers applicable to the meter's module configuration appear in Designer.

Display Modules

A Display module controls which values are displayed on a display screen, and how these values are presented. Depending on your meter model, the Display modules vary slightly according to the inputs utilized and the setup register settings. Each Display module corresponds to one meter display screen.

Display Modules for ION 8000 Series, ION 7500 / ION 7600 Meters

The Display module's *Source* inputs are linked to the numeric parameters you want to display. These parameters are sent to the front panel when the Display module's *Show* input is pulsed.

The Display module's setup registers determine screen type (e.g. numeric, event log, trend bar etc.), softkey name and number (if applicable), and screen title (if applicable) of each display. Many Display modules available in the meter are used in the factory configuration. You can alter some characteristics of the factory-configured displays by modifying the setup register of the Display modules.

The Display module's setup registers determine how the *Source* data is presented on the front panel display. Depending on the display screen type, which is specified by the *Screen Type* setup register, you can use up to twenty *Source* links to a single Display module. This means you can show the values of up to twenty different sources on one front panel display screen. In addition, you can display harmonics, trending, and event logs (see the Screen Types column in the table below). For additional information about screen types, consult the section *Display Screen Types* in your meter's user guide.

Screen Types	Max. # of Source Inputs	Display Description
Two, three, four, eight, ten, and twenty parameter numeric[1,3]	2, 3, 4, 8, 10, and 20	Displays one to twenty values (the fewer the values, the larger the values appear on the display screen)
Two/three parameter numeric display; each parameter has a timestamp (ION 8000 Series)	3	Displays three numeric values with their timestamps
4 parameter trend bar graph[2]	12	Displays 4 real time parameters with minimum and maximum values
Harmonics V1-V4 (ION 7500 / ION 7600 only)	0	Displays phase voltage harmonics histogram
Harmonics I1 – I5 (ION 7500 / ION 7600 only)	0	Displays phase current harmonics histogram
Vector diagram	0	Data is displayed in phasor format
Event Log (ION 7500 / ION 7600 only; ION 8500 only shows critical)	0	Displays Event Log data
Name plate	0	Displays Nameplate Information
All segments	0	Activates all of the display screen's pixels
Data Log Trend - log source 1 to 4 (ION 7500 / ION 7600 only)	4	Configures a Display module for Trend Display
Date and/or time, and/or time remaining in the current interval (ION 8000 Series)	?	Support for time and date formats in the display modules, enabling displays with nothing but date and/or time and/or time remaining in the current interval

1 If you alter the *Screen Type* setting to a display type that accommodates more numeric parameters, you may have to create additional *Source* links.

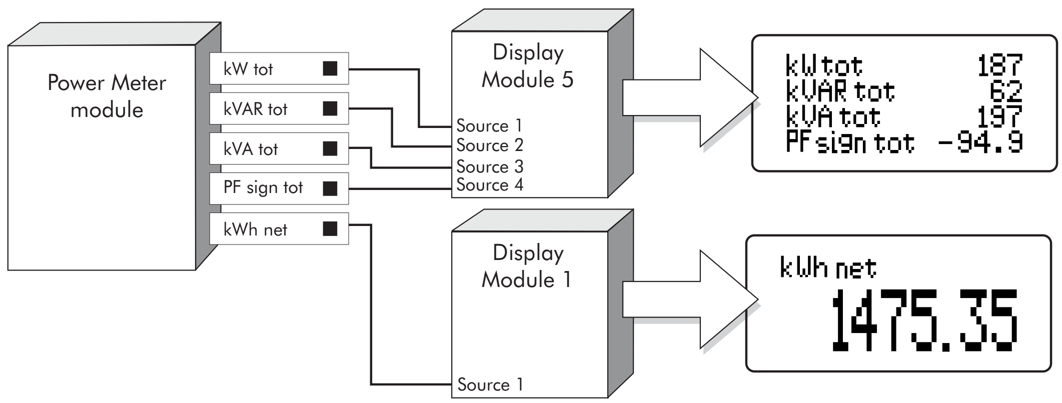
2 See "Creating Custom Trend Bar Graphs (ION 7500 / ION 7600 only)" on page 200.

3 The ION 7500 / ION 7600 meters displays all of these parameter groupings; the ION 8000 Series displays parameter groupings of two, three, or four.

Display Modules for ION 7300 Series Meters

The ION 7300 Series meters display screens are available in a numeric format only (parameter values are displayed numerically rather than in graphs or trends etc.). Up to four parameters can be linked to a Display module — these parameters appear on the display screen when the module is activated.

Links to a Display module can be made using Designer or the front panel. Each Display module has one setup register, *Screen Type*, which sets the number of parameters that the display screen will show.



Screen Types

The *Screen Type* setup register has five options: ONE PARAMETER, TWO PARAMETER, THREE PARAMETER, FOUR PARAMETER, AND DISABLED. The number of inputs for the Display module should match the *Screen Type* setup register.

If you select a *Screen Type* with more parameters than are currently linked to the Display module, the display screen will show any unavailable inputs as N/A. If a *Screen* Type is selected which has fewer parameters than are linked to the module, the Display module will only display the *Display Type* number, and will break any links to parameters that it cannot display.

For example, if you have a display screen with four parameters, and you select a *Screen Type* of ONE PARAMETER, the first parameter is displayed and the other three links to the ION Display module are severed.

Changing ION 7300 Series Display Module Default Settings

There are eight numeric display screens available for customization. Because all eight front panel screen displays are factory-configured, an existing display must be changed if you want a custom display. Refer to the section "Changing Displayed Parameters in an Existing Screen" on page 199 to learn how to customize a display screen for a ION 7300 Series meter.

Display Options Module

The Display Options module is a core module that cannot be deleted, copied, or linked. You configure it by altering the setup registers that hold settings such as display mode, decimal accuracy, parameter labels, update time, date format, and daylight savings time. Other setup registers control screen functions, such as contrast level and backlight timeout. Settings in the Display Options modules are global and affect the entire set of front panel display screens.

NOTE

For the ION 7300 Series meters, configure the Display Options module *AutoScroll* setup register to specify the time between automatic display scrolling. Refer to "Module Behavior in the ION 7300 Series Meters" on page 196.

Scroll Modules

These modules are designed to control the scrolling rate of the display screens, and the order in which the screens appear. The *Trigger* outputs of a Scroll module pulse in succession. When linked to the *Show* inputs of a number of Display modules, the front panel scrolls through the data linked to the *Source* inputs of the Display modules.

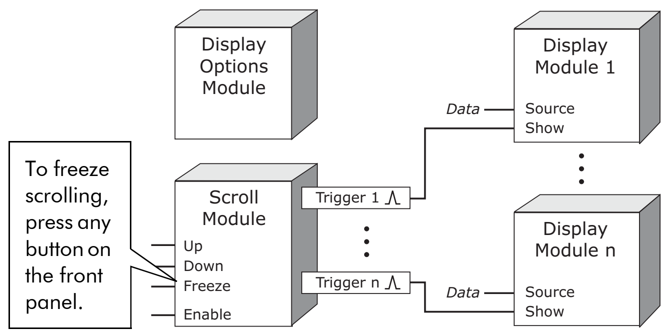
NOTE

The ION 7300 Series meters do not utilize the ION Scroll module; instead scrolling is configured in the Display Options module *AutoScroll* setup register. Refer to the proceeding section "Display Options Module" on page 195, and the following section "Display Framework Overview" on page 196.

Display Framework Overview

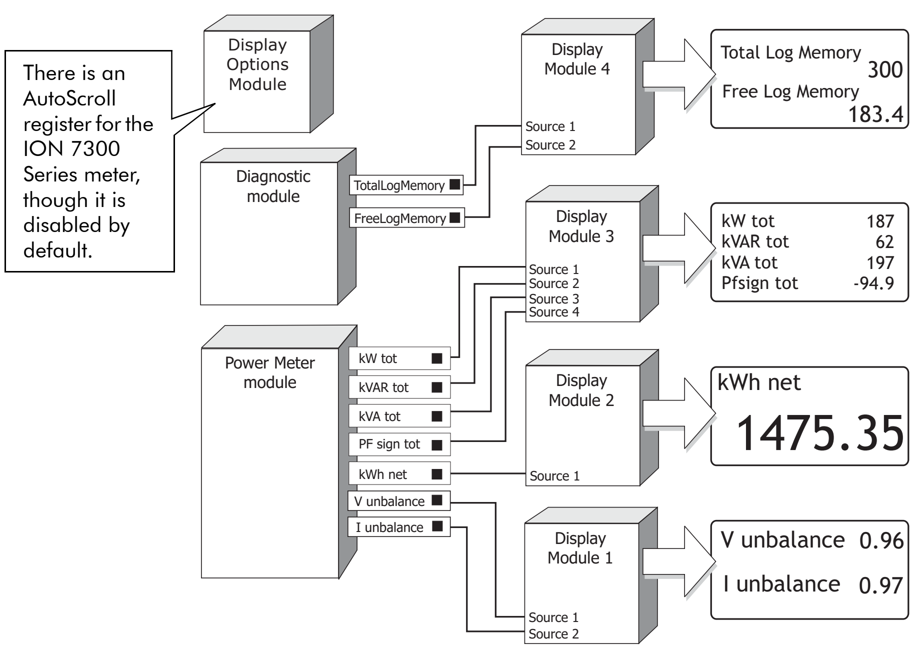
The following diagrams illustrate how the Display Options module, Display module, and Scrolling module (if applicable) work together to provide your meter's front panel with the appropriate display screens.

Module Behavior in ION 8000 Series and ION 7500 / ION 7600 Meters



Note that the first Display module's *Show* input is linked to the Scroll module's first *Trigger* output register: this is your first display screen on the meter. Accordingly, the second Display module's *Show* input is linked to the Scroll module's second *Trigger* output in order to setup the second display screen, and so on.

Module Behavior in the ION 7300 Series Meters



The order in which data displays depends on the numbering of the Display modules. Therefore, the data linked to Display module 1 is displayed on the first front panel screen and so on. Scrolling between the display screens is done with the up/down arrow buttons on the front of the meter.

To view all Display, Display Options, and Scroll modules at once:

Launch Designer and continue with the instructions which follow below your particular meter type.

For the ION 8000 Series and ION 7500 / ION 7600 meters:

6. Double-click on the Advanced Setup folder in the main meter configuration screen. The label above the folder reads "Frameworks."
7. Double-click on the folder labeled "Display Framework."

For the ION 7300 Series:

1. Double-click the Meter Display Setup folder in the main meter configuration screen. The label below the folder reads "Display Modules."

   All Display modules and a shortcut to the Display Options module appear.

Changing Default Display Frameworks

The factory-configured Display framework uses many of the Display modules available in the meter. Only a few of the default screens have room for extra data. To make a significant modification to the existing display framework, you either have to create new display modules and configure them, or change the links and settings of the modules in the existing Display framework (or both).

Four common customizations are discussed in the following sections:

- removing a display screen
- adding a new display screen
- replacing the parameters in an existing display screen
- creating custom trend bar graphs (ION 7500 and ION 7600 only)

Making a Framework Backup

Before you reconfigure or delete a framework, you should make a copy. This ensures that you can restore the framework without having to reinitialize the factory configuration.

To make a framework copy:

1. Select the desired framework.
2. Choose **Copy to Framework** from the Edit menu.

   Give the framework a unique name. Select a different location in which to save the framework, if you so desire.
3. Click **Ok**.

You can find instructions on reinitializing factory configurations in your *User's Guide*.

Removing a Display Screen

Use caution when deleting modules, as any dependant modules are also affected. Designer informs you of dependant modules if they exist on the same node.

To remove a data display screen:

1. Launch Designer.
2. Select the Display module responsible for the screen.
3. Press delete. This also deletes all links to that particular Display module.

If the display screen you are deleting is part of the automatic scrolling cycle, you should reconfigure the links from the Scroll module's *Trigger* outputs to the remaining Display modules so that the following considerations hold true:

- The first Display module in the scrolling cycle is linked to the *Trigger 1* output of the Scroll module.
- The last Display module in the scrolling cycle (module *n*) is linked to the *Trigger n* output of the Scroll module. For example, if your scrolling cycle consists of 5 screens, then *Trigger 5* should be linked to the fifth module in the cycle.
- The *Wraparound* setup register of the Scroll module designates the last trigger output (*Trigger n*). Expanding on the previous example, since *Trigger 5* is the last trigger, the Scroll module's *Wraparound* setup register would have a value of 5.

Adding a New Display Screen

For the ION 8000 Series, ION 7500, and ION 7600 meters, you can create a new front panel display without dismantling any of the existing displays.

NOTE

You cannot add a new display screen for the ION 7300 Series meters; there are no available Display modules that you can create. Instead, you must re-configure one of the existing factory-configured display screens. See the following section "Changing Displayed Parameters in an Existing Screen" on page 199.

To add a new display screen in Designer:

1. Create a Display module.
2. Define the modules characteristics (display format) by adjusting its setup registers.
3. Link any required data to the *Source* inputs of the Display module.

If you want your new screen to appear in the automatic scrolling cycle, then you must link the *Show* input of the Display module to a *Trigger* output of a Scroll module. See "Removing a Display Screen" on page 198 for considerations on re-linking Scroll module *Trigger* outputs.

Changing Displayed Parameters in an Existing Screen

For the ION 7500, ION 7600, ION 8000 Series, and ION 7300 Series meters, you can change displayed parameters in existing screens using Designer software.

NOTE

For the ION 7300 Series meter, you must set the Display Options module's *Display Mode* setup register to PROGRAMMABLE before changing displayed parameters in an existing screen.

To change parameters shown in a display screen, link the output register containing the numeric data you want to display to the *Source* inputs of the Display module. If there is not a free *Source* input, you will have to first delete (i.e., "unlink") an existing link to a *Source* input.

Changing Displayed Parameters using the Meter's Front Panel (ION 7300 Series)

With the ION 7300 Series meters, you can change the displayed parameters in an existing screen using the meter's front panel.

Before changing displayed parameters in an existing screen:

For customized screens to display on the front panel, you must set the Display Options module's *Display Mode* setup register to PROGRAMMABLE before changing displayed parameters in an existing screen.

On the meter's front panel, go to DISPLAY SETUP > DISPLAY MODE and select PROGRAMMABLE.

Changing displayed parameters in an existing screen:

The SCREEN SETUP menu screen allows you to change the data displayed on the eight display screens.

1. From the SELECT SETUP menu, select SCREEN SETUP. The list of display titles appears that correspond to each of the eight display screens. The screen number with an asterix (*) beside it indicates the active display (the screen displayed before you entered SELECT SETUP).
2. Select the screen you want to change, and press the round button. Two settings appear, VALUES and STYLE, that allow you to specify which measurements to display.
3. Select STYLE if you need to change the number of displayed parameters in the selected screen.

   This setting has five options for each display screen: ONE PARAMETER, TWO PARAMETER, THREE PARAMETER, FOUR PARAMETER, and DISABLED. Select the number of values you want to display (the fewer the values you select for display, the larger the measurement will appear on the display screen).

   If you select a large style (for example, one value) for a display screen that is set to display more than one value, the front panel will warn you with a message, and will display only the first value — the links to the undisplayable values are severed and will have to be reprogrammed.

4. Select VALUES to change the displayed parameter in the selected screen.

   When you change the value displayed on a screen, you are presented with a complete list of the meter's measurements. Using the lists of modules provided, select the values you want to have displayed on that display screen.

   The number of VALUES you can select is a function of the STYLE setting. You cannot select more values than the STYLE is set to display.

Creating Custom Trend Bar Graphs (ION 7500 / ION 7600 only)

Bar Graph displays are configured differently than other numeric parameter displays. Each bar in the display is associated with three specific *Source* inputs as follows:

Bar Graph	Input	Function	Attributes
First (top)	Source 1	Real-Time value for Bar Graph #1	Bar graph #1 will not appear if you do not link this input
	Source 2	Minimum value for Bar Graph #1	Link to the output of a Minimum module
	Source 3	Maximum for Bar Graph #1	Link to the output of a Maximum module
Second	Source 4	Real-Time value for Bar Graph #2	Bar graph #2 will not appear if this input is not linked
	Source 5	Minimum for Bar Graph #2	Link to the output of a Minimum module
	Source 6	Maximum for Bar Graph #2	Link to the output of a Maximum module
Third	Source 7	Real-Time value for Bar Graph #3	Bar graph #3will not appear if this input is not linked
	Source 8	Minimum for Bar Graph #3	Link to the output of a Minimum module
	Source 9	Maximum for Bar Graph #3	Link to the output of a Maximum module
Fourth (bottom)	Source 10	Real-Time value for Bar Graph #4	Bar graph #4 will not appear if this input is not linked
	Source 11	Minimum for Bar Graph #4	Link to the output of a Minimum module
	Source 12	Maximum for Bar Graph #4	Link to the output of a Maximum module

Typically, the minimum and maximum values for each bar graph come from links to the outputs of Minimum and Maximum ION modules that are themselves linked to the real-time parameter shown in the bar graph.

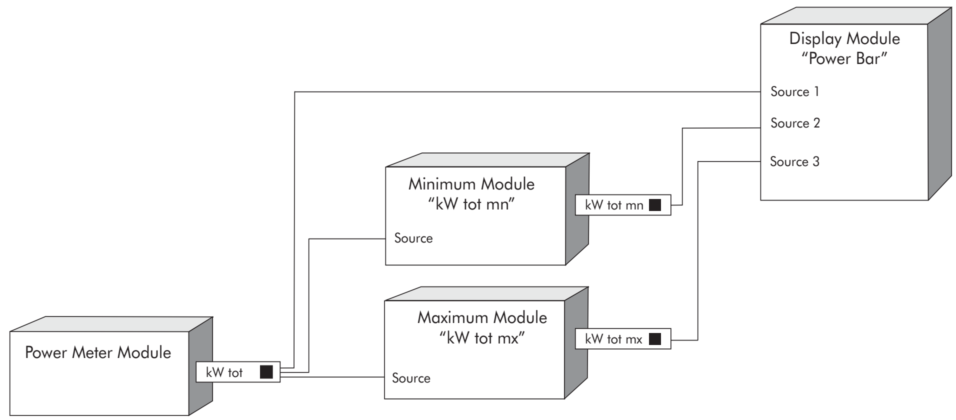
NOTE

This feature works only if the meter's Volts Mode is NOT set to Demo. When the meter is in Demo mode, a default trending log showing Vll ab, Ia, PF and KW will be displayed rather than the actual log that has been linked to the Display module.

The diagram below shows an example of the links necessary for one bar graph (in the top position).

A bar graph reports a "Mn/Mx Display Error" in the following cases:

- ◆ Minimum input not linked
- ◆ Maximum input not linked
- ◆ Max input < Min input
- ◆ Min input > Max input



Trend Display (ION 7500 preconfigured / ION 7600 unconfigured)

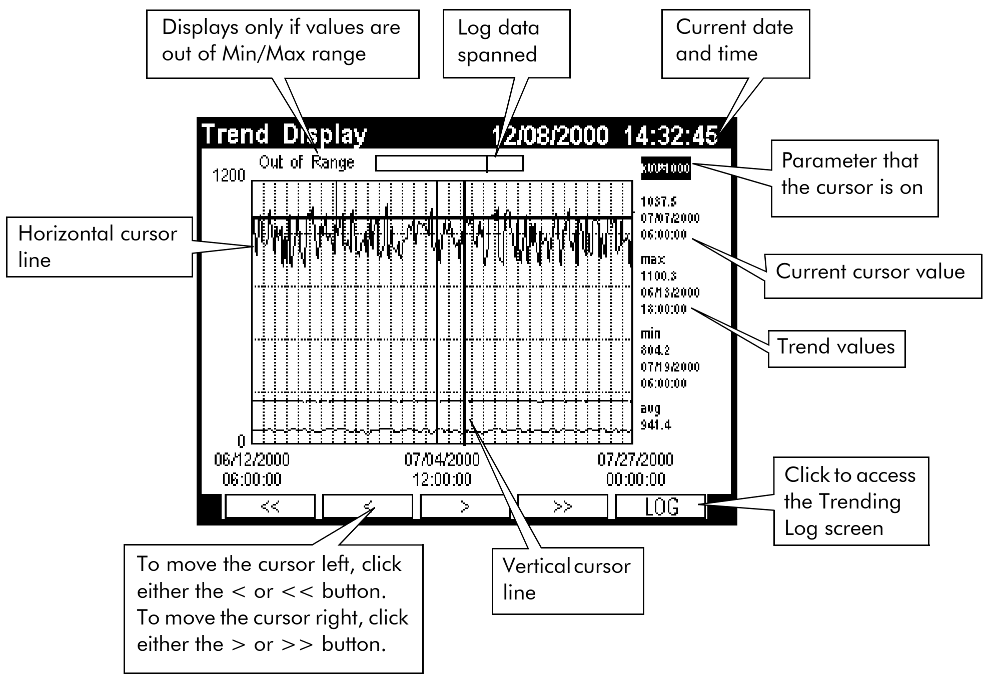
ION 7500 / ION 7600 meters have an additional Trend Display customization option available to them. The meter's Trend Display screen simultaneously graphs the historical data of up to four different parameters. Furthermore, a Trend Display log screen displays the data logs for any graphed parameter.

The ION 7500 front panel displays three preconfigured trending screens: V-Trend (voltage), I-Trend (current), and P-Trend (power). The ION 7600 must be configured using Designer in order to provide Trend Display. Contact Technical Services if you require your ION 7600 to be configured for Trend Display.

NOTE

It is possible to change the Trending parameters with Designer software. Contact Technical Services for information.

Trend Display Screen



Selecting and navigating the Trend Display screen:

- Use the appropriate softkey to view the Trend Display screen from the front panel.
- Once the trend is selected, the softkeys and Up/Down keys only navigate within the Trend Display graph and log screens.

  A moveable cursor, composed from the intersection of a vertical line and a horizontal line, displays the value and timestamp of any plotted data within a parameter. The cursor only displays the values of one parameter at one time. You move the cursor from one parameter to another with the Up and Down navigation keys.

- Use the ESC key to exit the Trend Display.

NOTE

On the ION 7500 the default Trending parameters displayed are kW sd d-r, Vll, and Iavg. The minimum and maximum values of the graph automatically scale based on the Ct primary and Pt primary values.

Statistical values such as Minimum, Maximum, and Average also display for the data at the cursor location. The Minimum and Maximum values display with timestamps. Statistical values are calculated for all the historical data available in the associate data log, including the data that does not fit into the current screen view.

It is possible to display up to 3360 logs for each parameter: that is 35 days worth of 15 minute data. The graph is updated when a new set of values is recorded. The highest supported update speed is once per second.

By default, the data is logged for Trend Display every 15 minutes. This logging interval can be changed by configuring the Periodic Timer module's setup register with the help of Designer software.

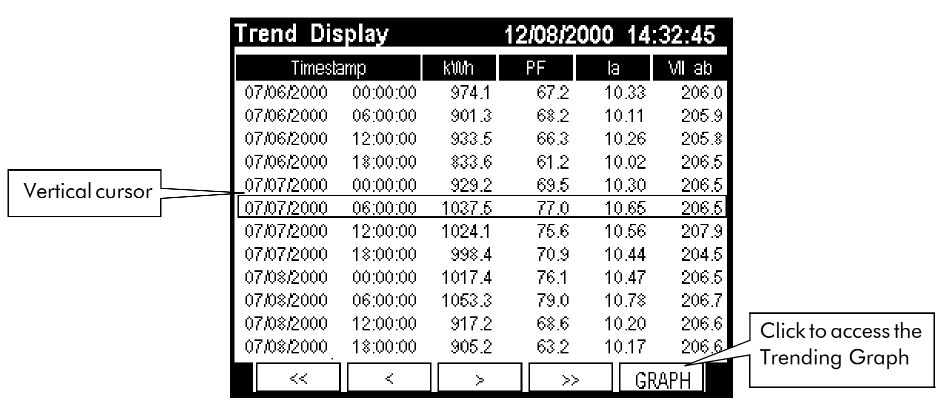
To change the logging interval for Trend Display data:

1. Launch Designer, and open the meter.
2. Double-click the grouping folder in the Display Setup area. The shortcut to the periodic timer module is labeled "Dsp Trnd Log Trg."
3. Right-click the Dsp Trnd Log Trg module setup register.
4. Double-click on the PT7 Period, and change the value.
5. Send & Save. The Trend Display screen now logs and plots data at the interval you specified.

NOTE

Currently, the Trending Display screen only accepts synchronous data triggered by a periodic timer. If a setpoint module asynchronously triggers a data recorder which is set for the trending purposes, then it is possible that the records drawn in the screen will be unevenly distributed over time.

Trending Data Log Screen



Timestamp		kWh	PF	Ia	Vll ab
07/06/2000	00:00:00	974.1	67.2	10.33	206.0
07/06/2000	06:00:00	901.3	68.2	10.11	205.9
07/06/2000	12:00:00	933.5	66.3	10.26	205.8
07/06/2000	18:00:00	833.6	61.2	10.02	206.5
07/07/2000	00:00:00	929.2	69.5	10.30	206.5
07/07/2000	06:00:00	1037.5	77.0	10.65	206.5
07/07/2000	12:00:00	1024.1	75.6	10.56	207.9
07/07/2000	18:00:00	998.4	70.9	10.44	204.5
07/08/2000	00:00:00	1017.4	76.1	10.47	206.5
07/08/2000	06:00:00	1053.3	79.0	10.78	206.7
07/08/2000	12:00:00	917.2	68.6	10.20	206.6
07/08/2000	18:00:00	905.2	63.2	10.17	206.6

For any value on the graph, you can access a data log screen. Simply press the softkey corresponding to the Log button to view the graphed value in a data log format. The log screen also lists the twelve parameter values that surround the current cursor position, each with a corresponding timestamp.

Screen Messages

Messages that may appear on the Trending Display screen are explained below.

Screen Message	Description
Start of Logged Data	This message displays when you have navigated to the extreme left of the Trending Display Graph where the plotted data starts.
End of Logged Data	When you have navigated to the extreme right of the Trending Display Graph where the plotted data ends, this message appears.
Out of Range	This displays when a logged data value is not within the minimum or maximum range. You can view the "out of range" values on the Data Log screen.
Setup Error	This never displays if you use the default Trending Display screens. This message will display if the default Trending Display framework has been modified so that a minimum value is larger than a maximum value. It also displays when a Display module configured for Trending has not been linked to a Data Recorder module, so there are no values to plot.
Invalid Log	This message displays whenever an invalid log value is recorded. In addition, trend graphs cannot be viewed.

Adding New Trend Display Modules

Users who are familiar with the ION Architecture, Designer software, and Vista software can link additional Display modules for trending. Here are some guidelines:

- You can configure any Display module as Trend Display by setting the *Screen Type* setup register to *Data Log Trend - Log Source 1 to 4*.
- The maximum number of Trend Display modules permitted is 10.
- Any Data Recorder module output log can be connected to a Trend Display module.
  - The Data Recorder module output log must be connected to the first input of the associated Trend Display module.
  - Even though a Data Recorder module has up to sixteen Source inputs, only the first four Source inputs can be viewed in Trend Display.
- With External Numeric modules, min/max can be set in Vista.
  - The External Numeric module that sets up the minimum value for the displayed data must be connected to the second input of the associated Trend Display module.
  - The External Numeric module that sets up the maximum value for the displayed data must be connected to the third input of the associated Trend Display module.

Disk Simulator (ION 8000 Series)

This ION 8000 Series meter Disk Simulator display simulates the behavior of a mechanical watt-hour meter indicating power received or delivered by the direction of the pulse.

Beginning with the ION 8000 Series' v221 firmware, the meter's Calibration Pulser modules support the Disk Simulator feature. The Calibration Pulser module has a new output register, labeled *Disk Position*. When pulsed, *Disk Position* outputs the accumulated quantity (kWh, kVAh, etc.) associated with its parent module. The *Disk Position* outputs accumulated quantities only if the Calibration Pulser module *Port* setup register specifies a physical hardware port that is connected to the meter. If the port is not specified, then the *Disk Position* output is zero even if there is a non-zero accumulated quantity.

If the input accumulates positively (i.e. delivered power or energy), and the Calibration module *Int Mode* register is set to FORWARD, TOTAL or NET, then the Disk Simulator revolves from left to right. If the input accumulates negatively (i.e. received power or energy) and the *Int Mode* register is set to REVERSE, then the Disk Simulator revolves from right to left.

The Calibration module *Disk Position* output is always a positive numeric value regardless of the module's *Int Mode* setting (FORWARD, REVERSE, etc.). Refer to the online *ION Programmer's Reference* for ION module details.

To create a Disk Simulator screen:

1. Create a new Display module, and choose the type as *Disk Simulator*.
2. Connect the new Display module's first input to the Calibration Pulser module's *Disk Position* output that you want to monitor for its pulsing interval.
3. To include the newly added screen to the ALT screen list, connect the Display module's *Show1* and *Show2* inputs to the Scroll module's last available *Trigger* outputs in ALT SCROLL UP and ALT SCROLL DOWN (respectively).

   You can determine the last available *Trigger* by right-clicking on the output to discover the *Triggers'* owners.
4. Increase the Scroll module's *Wraparound* setup register by 1 to include the new screen.
5. Configure the remaining display settings according to your needs.

Although the Disk Simulator display is intended to show the disk behavior of mechanical watt-hour meters, this feature can be used to monitor any accumulated meter quantity over the time. To do this, connect the Display module's first input to the meter quantity, and connect the second input to the maximum value that you expect the displayed quantity to be bounded by (this could be any ION output register or an *External Numeric* module register). In this case, (i.e. the Display module is *not* connected to a Calibration Pulser module) the Disk Simulator revolves from left to right.

NOTE

The inputs to the Disk Simulator display are always positive. If the value exceeds the maximum scale value assigned in the second input, then nothing is displayed except labels and the disk rectangle.

Displaying Data from Other Meters

Data can be read at a workstation using ION Enterprise software, but there may be situations which require the data to be read at the source. With just one Power PC meter, such as an ION 8500 or ION 7500, you can view the data collected by numerous TRANs and other devices over a serial network. This is done using the Modicon Modbus protocol. The ION meter with the front panel display acts as the Modbus Master, and the other meters are the Modbus Slaves. Thus, the display meter has its protocol set to MODBUS MASTER, and each TRAN meter is configured to use the MODBUS protocol.

NOTE

TRAN is short for "transducer." A TRAN meter is a basic meter model without a front panel display; a TRAN can be used with a remote display.

Refer to the *Modbus and ION Technology* technical note for more information on how to configure the Modbus Master.

NOTE

An ION 7500 / ION 7600 meter must be configured with the v2.2 or later firmware, and an ION 8000 Series meter must have v218 or later. These particular firmware versions provide the ION meter with Modbus Master functionality.

Customized Display Framework

The ION 7500 with front panel display is the Modbus Master that is showing data from the other meters (the Modbus Slaves) on the serial connection.

If this were the complete display framework, then there would be a total of four screens showing data on the ION 7500 with front panel display: one screen from each TRAN (the ION 7500 and the ION 7300) and two screens from the ION 6200. Notice how the ION 6200 has had its data displayed on different screens.

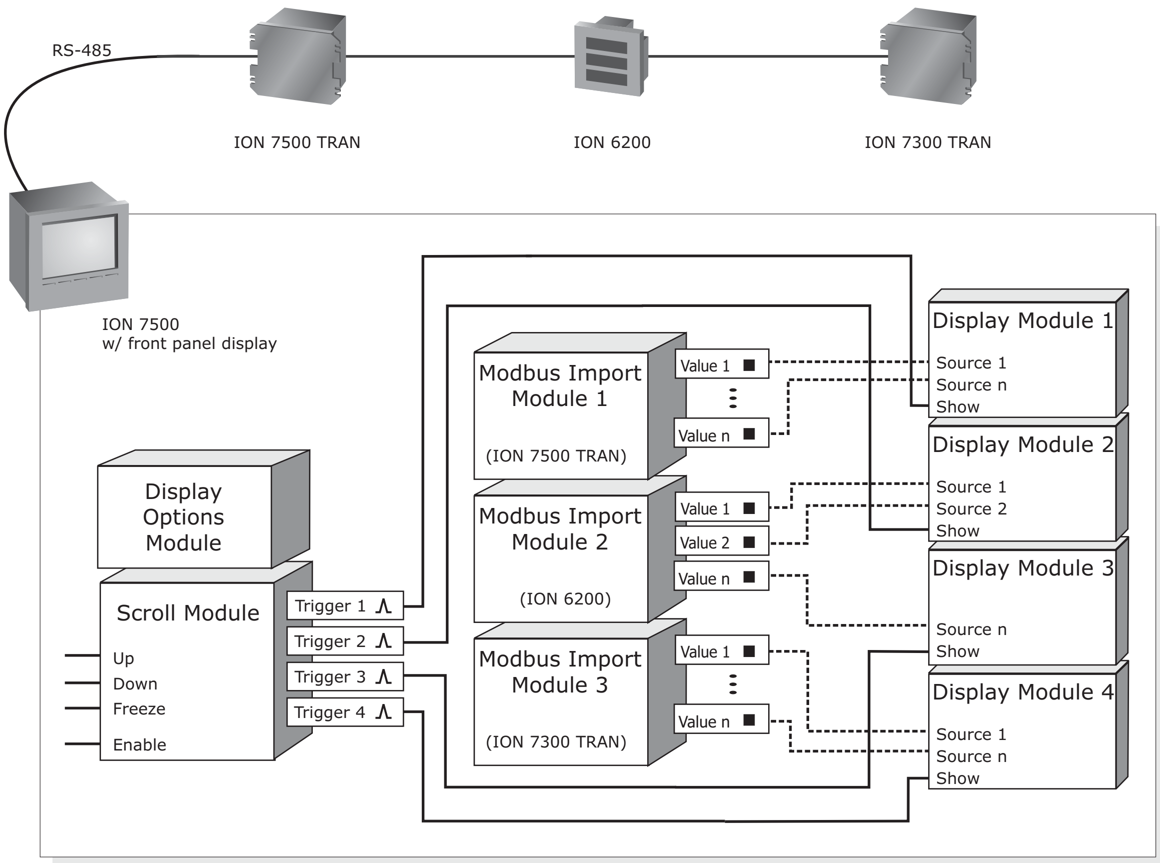
To configure your custom display framework:

To aggregate data from multiple devices on a network and display it on an ION 8000 Series meter or ION 7500 / ION 7600 meter, follow the steps below. The framework changes are made to the meter displaying the data.

1. Launch Designer, ensuring that Options > Show Toolbox is checked.

   If you want a blank work space, where you can keep your master configuration, simply drag out a new grouping object from the toolbox, name it appropriately and double-click on your new grouping object.

2. Drag out a Modbus Import module and right-click on the Modbus Import module to access the setup registers.
3. Use the *ReadNow* input of the Modbus Import module if you want to setup a trigger source that activates a read (i.e. a pulse). If you do not link *ReadNow* the module polls Modbus devices continuously.
4. Right-click the Modbus Import module to configure register settings.



Configure the following setup registers as needed: *Slave Address*, *Register Address*, Number of Registers read by the module, Format and scaling requirements. The supported *Slave Address* range (Unit ID on ION meters) for a Modbus device is from 1 to 247.

5. Repeat steps 2 - 4 for every meter or TRAN in the serial network whose data you wish to display on the meter with the front panel.

   The meter with the front panel requires a separate Modbus Import module for each meter whose data it displays, because all meters in the network have unique Unit IDs. This is how the Modbus Master distinguishes which meter (*Slave Address*) is providing what data (*Register Address*).

6. Link each Modbus Import module's output registers to the appropriate Display module's *Source* inputs.

7. Define each Display module's characteristics (display format) by adjusting its setup registers. Do the same to the Display Options module if so desired.

8. See "Removing a Display Screen" on page 198 for considerations on re-linking Scroll module *Trigger* outputs.

   This step is important if you want to have your new screens appear in an automatic scrolling cycle, or if your custom framework has fewer display screens than the factory configuration, and you need to adjust the Scroll module's settings.

9. Send & Save changes.

Digital and Analog I/O

This document discusses the application and configuration of digital inputs/outputs (I/O), and analog I/O. Details are provided for both onboard I/O and external I/O boards.

In This Document

Introduction

Analog and digital I/O ports on ION meters let you bring in a variety of data into a common system. This simplifies data gathering and provides the following capabilities. Meter analog and digital I/O ports let you:

- Interface the I/O ports with relays as well as transducers for gas, steam, air, and water metering.
- Use the inputs to count transducer pulses and breaker trips, or measure flow rates, rotations, fuel levels, oil pressures, and transformer temperatures.
- Use the outputs for equipment control to transfer any value (e.g. energy) to remote terminal units (RTUs).
- Monitor equipment status.

There is a range of I/O solutions available depending on your application. Onboard I/O provides fast and robust performance for time-critical applications. Configuration is simple and integration is seamless.

For extensive I/O requirements with the ION 8000 Series meter, you can use the I/O Expander — this device was designed and tested with the ION 8000 Series meter, and provides reliable performance.

You can use meters with Modbus master capability (ION 8000 Series, ION 7500, and ION 7600 meters) for extensive I/O requirements; when communication speed is not required, you can use the Grayhill OpenDAC I/O system (see the *Grayhill OpenDAC and ION Technology* technical note for more information). Other ION meters also use Grayhill I/O products, such as the ION 7300 relay extension board and the ION 7700 expansion boards.

I/O Solutions

ION meters offer you a range of onboard I/O. For expanded I/O applications, you can use Grayhill products (see the *Grayhill OpenDAC and ION Technology* technical note for further information). Configuring onboard and expanded I/O is the same with ION software.

Every ION meter has a set of software modules that control its analog and digital onboard I/O ports. There is one ION software module that corresponds to each hardware input or output port, for example, one Digital Input software module corresponds to one hardware input port.

Onboard I/O requires minimal setup with Designer software. The I/O Expander for the ION 8000 Series meters and expansion boards for the ION 7700, ION 7300 Series, ION 7500, and ION 7600 require similar setup to the onboard I/O with Designer software.

Refer to your meter *User's Guide* or technical documentation, or the online *ION Programmer's Reference* for complete details on how to link and configure these ION modules using Designer software.

Onboard I/O for ION Meters

The number of digital and analog inputs and outputs on each ION meter is listed below.

Meter	Digital Inputs*	Digital Outputs*	Analog Inputs*	Analog Outputs	Modbus Master
ION 6200	0	2	0	0	
ION 7300	0	4	4	4	
ION 7330	4	4	4	4	
ION 7350	4	4	4	4	
ION 7500	16	7	4	4	yes
ION 7600	16	7	4	4	yes
ION 7700	8	0	4	0	
ION 8300	3	4	0	0	
ION 8400	3	4	0	0	yes
ION 8500	3	4	0	0	yes

* Some digital inputs/outputs and all analog inputs require the installation of an optional circuit board inside the meter. See the meter's data sheet for complete details.

I/O Expander for ION 8000 Series Meters

To get enhanced analog or digital I/O with the ION 8000 Series meters, you can use an external I/O Expander. Complete information for the I/O Expander is available in the *I/O Expander Installation and Basic Setup Instructions*.

The I/O Expander equips an ION meter with eight digital inputs, four Form A digital outputs, and four Form C digital outputs, or four analog outputs (0 to 20 mA, –20 to 20 mA, or –1 to +1 mA) in place of the four Form A digital outputs. The I/O Expander also provides a convenient location for the ION meter's RS-232 and RS-485 communications wiring.

The I/O Expander is mounted separately, no more than 15 feet away from the meter. It connects to the meter via a standard Molex Micro-Fit 3.0 connector. RS-232 and RS-485 links are made via standard DB9 and captured-wire connectors located on the I/O Expander. The analog output version of the I/O Expander must be powered by an external source, a standard AC/DC supply.

As the I/O Expander board is external, you can install and configure I/O points without affecting the meter's operation. Terminal strips simplify connections to external equipment. Furthermore, the low-profile connectors between the meter and the I/O board let you easily remove the meter without disconnecting all the attached I/O wiring.

External I/O with Grayhill Products

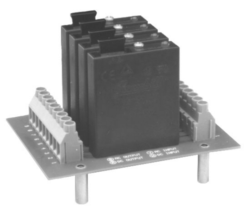
You can change the number of inputs and outputs available for ION meters, or extend the functionality of the standard digital outputs through external I/O boards. Just plug Grayhill analog or digital I/O hardware modules into the boards. For more information, see the Grayhill OpenDAC and ION Technology technical note, or visit the Grayhill website at www.grayhill.com.

Meter	Digital Inputs	Digital Outputs	Analog Inputs	Analog Outputs
ION 7300	0	4†	0	0
ION 7330	0	4†	0	0
ION 7350	0	4†	0	0
ION 7700	30	30	14	30
ION 8300	8	8	0	4
ION 8400	8	8	0	4
ION 8500	8	8	0	4

† The ION 7300 Series meter relay expansion board is used to extend the functionality of the standard onboard digital outputs.

As with onboard I/O, the functionality of these external Grayhill hardware modules are controlled by ION software modules inside the meter. ION Digital Output, Analog Output, Pulser, and Calibration Pulser modules specify output signal characteristics, while the Digital Input or Analog Input modules define incoming signals.

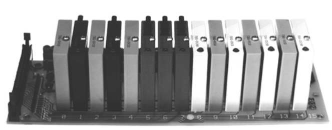
Digital Output Boards for ION 7300 Series Meters

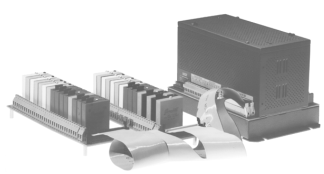


You can extend the capability on the ION 7300, ION 7330 and ION 7350 with an optional relay extension board (REB). The relay extension board provides four slots where you can plug Grayhill digital output hardware modules. There are nine Grayhill hardware modules of varying functionality available.

You can use ION Digital Output, Pulser, or Calibration Pulser modules to control the functions of the Grayhill relay. Set the module's *Port* setup register to the digital output port (D1 to D4) that the Grayhill relay is connected to. Refer to "Configuring ION Modules for Digital and Analog I/O" on page 230. For wiring instructions, see your *ION 7300 Series* meter's *Installation and Basic Setup Instructions* for more information.

Expansion Boards for the ION 7700





The ION 7700 expansion boards provide multiple analog and digital inputs, analog outputs, digital inputs, and/or digital outputs. Up to two expansion boards can be connected to the ION 7700 meter, though the second board requires its own power supply. (The first expansion board connected to the meter is powered by the meter itself.) Each expansion board offers 15 slots where you can plug Grayhill I/O hardware modules. Some restrictions to the use of analog I/O Grayhill hardware modules are listed below.

Grayhill analog hardware module restrictions—power supplies

Power requirements and hardware restrictions limit the number and placement of Grayhill analog hardware modules on I/O expansion boards. To install the maximum number of Grayhill analog I/O hardware modules, you must have two power supplies (one for each expansion board). These power supplies are purchased separately.

If you only need to install a maximum of six Grayhill analog hardware modules, you can power Expansion Board A directly from the ION 7700. Note that if you have a separate power supply for Expansion Board A, then you must remove the associated jumper from the board. Failure to remove the jumper voids the ION 7700's warranty. See the *ION 7700 Installation and Basic Setup Instructions* for jumper location. Expansion Board B always requires a separate power supply, no matter what the configuration.

Grayhill analog hardware module restrictions—direction of installation

The direction of all modules in slots 0 through 7 and slots 8 through 14 must be the same. Slots 0 through 7 support digital input, digital output and analog output Grayhill hardware modules only (not analog input modules). Slots 8 through 14 support digital input, digital output, analog input and Grayhill analog output hardware modules. Slot 15 is not supported.

As noted above, only slots 8 through 14 support analog input hardware modules, so you can have a maximum of 7 per board. Analog output hardware modules can populate both slot groups on the expansion board, so you can install a maximum of 15 analog output hardware modules per board. The following table summarizes the restrictions on analog I/O devices.

Description	Maximum # of Analog Inputs	Maximum # of Analog Outputs	Maximum # of Analog Devices	Possible Maximum Configurations
Board A WITHOUT Optional Power Supply	6	6	6	Any combination up to 6 total
Board A WITH Optional Power Supply	7	15	15	Board full
Board A WITHOUT Optional Power Supply + Board B	13	21	21	A: 6 AI; B: 7 AI, 8 AO A: 6 AO; B: 7 AI, 8 AO A: 6 AO; B: 15 AO A: 6 AI; B: 15 AO
Board A WITH Optional Power Supply + Board B	14	30	30	Both boards full

Expansion Boards for Meters with Modbus Master Capability

For ION meters that have Modbus master capability, the Grayhill OpenDAC I/O system provides extended functionality. The Grayhill OpenDAC system provides serial Modbus RTU connections to the ION meter. Extended analog and digital I/O capability are provided by the Grayhill OpenDAC rack.

OpenDAC controllers provide network connections but do not perform local control, and are used most often with ION meters that have Modbus master capability. OpenLine hardware modules fit into an OpenDAC rack to make up the system. OpenLine hardware modules are dual-point modules, for example, one digital input module has two input channels. The Series 73L modules are analog, and measure or control voltage, current, or temperature. The Series 70L modules are digital and are discrete — either on or off.

Grayhill OpenDAC controllers and hardware modules let you stack up two racks for a total of 32 I/O points. You can also mix analog and digital inputs and outputs on the same rack. You must have a power supply for each expansion board. These power supplies are purchased separately.

In general, you require the following to use the OpenDAC system with an ION meter that has Modbus master capability:

- ION Meter with Modbus master capability
- OpenDAC controller
- One or two OpenDAC racks
- Up to eight OpenLine hardware modules (per rack) up to 16 I/O points per rack
- Five-volt, 5-Amp DC power supply (you may need more amperage if you using current output modules)
- OpenDAC Modbus Configuration Installation and Troubleshooting Guide, Bulletin #812

Power Requirements

The Modbus controller requires 1 Amp at 5Vdc. The I/O modules require between 10-150mA depending on module type.

Description	Maximum draw per channel for I/O
Controller	1A
Rack	40mA
Digital Inputs	20mA
Digital Outputs	20mA
Analog Voltage Input	75mA
Analog Current Input	75mA
Analog Voltage/Current Outputs	200mA
Thermocouple Modules	75mA

The 5-Amp power supply can support the Modbus controller (1 Amp) plus two full racks of digital I/O that fit on a DIN rail rack.

Communications Considerations

The OpenDAC controller provides four wire RS-485 with the Modbus RTU protocol. To get two additional RS-485, connect a jumper wire between the two negative and positive terminals.

The Unit ID is set with two dial switches. One switch sets the low word of the ID (0x0 to 0xF) and the other sets the high word. Protocol and baud rate are set with the third dial switch, common settings are as follows:

Switch Setting	Parameters
0	9600 baud Modbus RTU
1	19 200 baud Modbus RTU
Remaining settings are for higher baud rates or ASCII protocol	

NOTE

Detailed setup information for the Grayhill OpenDAC system is available at www.grayhill.com and in Bulletin #812, OpenDAC Modbus Configuration, Installation and Troubleshooting manual. Part numbers are available on the Power Measurement order form.

Configuring Digital and Analog I/O

With the exception of Modbus master control of I/O, ION meters require the setup of ION modules for digital and analog I/O capabilities.

Digital Input: Digital (status) inputs can be used for monitoring external contacts or pulse counting applications, and are controlled by Digital Input modules. This module tells the meter how to interpret incoming signals.

Digital Output: Digital outputs are used for hardware relay control or pulse counting applications. The outputs can be controlled by Digital Output modules, Pulser modules, or Calibration Pulser modules, depending on the application (relay switching or energy pulsing). An example of a commonly used application for each module is listed below.

- Digital Output module: monitors a change of state to control relay operation via a hardware output device.
- Pulser module: transfers high-speed pulses to a hardware pulse counting device that is used to track energy usage.
- Calibration Pulser module: integrates instantaneous power inputs, then outputs high-speed pulses to an LED that can be monitored to verify ION revenue meter calibration.

All of these modules can act as intermediaries between the hardware port and the other modules in the meter. They define the characteristics of outgoing signals.

Analog Input: Analog inputs can measure DC signals from transducers. They are controlled by Analog Input modules.

Analog Output: Analog outputs can deliver a continuous DC signal, and are controlled by the Analog Output modules.

The following sections describe how the modules provide digital and analog data exchange among ION meters and devices that measure and collect various types of information.

Configuring Digital Input

Digital inputs are necessary for status monitoring or pulse counting applications. Status monitoring can help you prevent equipment damage, improve maintenance, or track security breaches. Some common status monitoring applications are monitoring the closed/open positions of breakers, on/off status of generators, armed/unarmed conditions in a building alarm system, and over/under pressures of transformers.

NOTE

If you want to confirm the status of a breaker, it should have an auxiliary circuit that indicates whether it is open or closed. If you want to check for the over/under conditions of a transformer, you have to interface the meter's digital input to a transducer that monitors the transformer and turns on if such a condition exists.

You can also have the digital inputs count transducer pulses to indicate, for example, the number of times a breaker has tripped, or the number of rotations completed by a device. Another option is to have the inputs read pulses from gas, water, steam, or other electricity meters.

Digital Input Module

Digital inputs are used to monitor the status of a sensor such as limit, pressure or temperature switches, and to monitor the status of loads. The source connected to the Digital Input module provides a logic-level signal that describes the state of device that is monitored. The device state is interpreted as either a complete pulse or a KYZ transition (half of a pulse) and is made available as an output. Each state change is determined by the amount of time (debounce time) that the external signal remains in a state.

Digital Input Module Setup Registers

Setup Register	Description
Input Mode	Specifies if the external signal is pulse or KYZ
Event Log Mode	Specifies whether events are logged or not (LOG ON, LOG OFF)
Polarity	Determines if the signal from the hardware is inverting or non-inverting
Debounce	Specifies how long the external signal must remain in a state to be considered a valid state change
Port	Defines which hardware port provides the signal

Specifying a Debounce Time

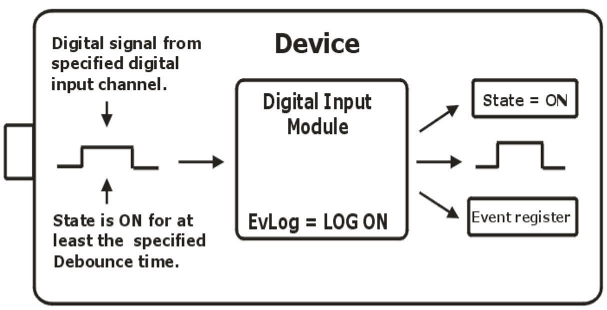
The value specified for the Debounce setup register depends on the kind of signal and the input devices being monitored. A typical value for solid state, dry contacts is 0 to 5 milliseconds. For mechanical dry contacts, a value between 1 and 80 milliseconds is typical. Some input devices may already have a built-in debounce time, often referred to as a *Turn On* or *Turn Off* time.

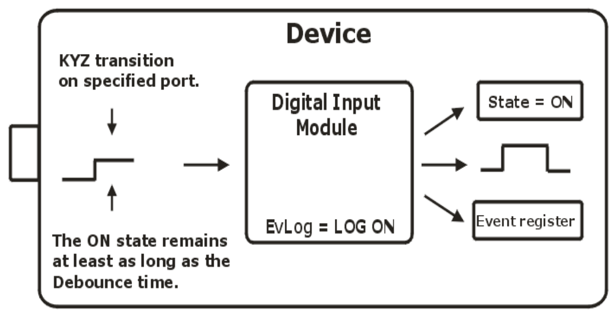
NOTE

ION 7300 Series, ION 7500, ION 7600 and ION 7700 meters have factory preconfigured Digital Input modules, as well as Counter modules for counting status changes, and External Pulse modules for resetting counter modules.

Detailed Operation: Pulse or KYZ Input Mode

Digital inputs can be set in either a pulse or KYZ configuration. In pulse applications you specify the module registers to change (on or off) when a signal occurs for the specified debounce time (usually between 0-5ms for solid state dry contact, and 1-80ms for mechanical dry contacts). In KYZ applications a transition occurs when a signal is received, the transition remains at least as long as the debounce time. When the next transition occurs, the input module state changes again. This type of redundancy is important in utility applications where the pulses correspond to energy consumption.





Configuring Digital Output

Digital output ports provide access to external relays and control capabilities. For example, an ION meter's digital outputs can provide on/off control signals for capacitor banks, generators, and other equipment.

ION meter digital output ports can also send out status signals or kWh pulses if the receiving device determines energy usage by counting pulses.

Different ION modules are used to control the hardware digital output ports in different ways. For relay and control, the Digital Output module is used. For pulsing applications, the Pulser and Calibration Pulser modules are generally used.

Each hardware digital output consists of a dry contact relay (switch) that is either open or closed. An external power supply may be required to sense whether the relay is open (no current) or closed (flowing current).

⚠ **CAUTION**

The digital relay outputs should never be used for primary protection functions.

For additional information regarding using the digital output ports for energy pulsing, refer to "Energy Pulsing from ION Meters" on page 232.

Digital Output Module

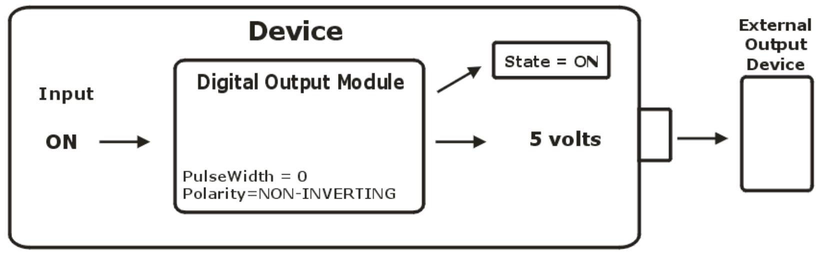
The Digital Output module acts as an intermediary between another module in the device and the hardware port. It takes a Boolean input and sends that out a hardware channel as a constant level or pulse. With the module setup registers, you must specify what kind of output that the module produces, and on what hardware port.

Digital Output Module Setup Registers

Setup Register	Description
Event Log Mode	Specifies whether events are logged or not (LOG ON, LOG OFF)
Polarity	Determines if the signal from the hardware is inverting or non-inverting
Pulse Width	Specifies the width of the output pulse
Ports	Defines the hardware port where the pulse or (continuous) output is sent

Detailed Operation

The following example illustrates the basic operation of a Digital Output module. The input in the figure could be any of the *Source*, *Force ON*, *Force OFF*, or *Normal* inputs. The *EvLog Mode* and the *Port* setup registers could be set to whatever is appropriate (they do not affect the output values of the module). Similarly, the *Mode* and *Event* output registers contain whatever is appropriate.



When specifying the *Polarity* setup register, you must consider the characteristics of the external output device. If you have defined different ON or OFF labels for the *State* output register, you should consider the characteristics of the output device and the *Polarity* setting.

Calibration Pulser Module

The Calibration Pulser module is a highly accurate energy pulser often used for verifying calibration on ION revenue meters. This module can serve as an intermediary between the power (kW, kVAR or kVA) outputs of the Meter Units Power Meter module and an ION meter's hardware output channel.

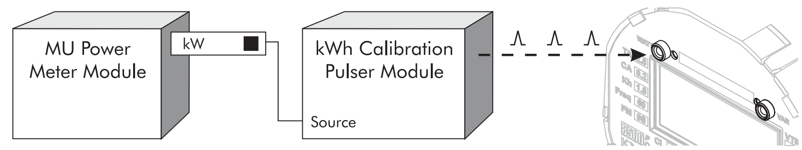
The module integrates the instantaneous power inputs and then outputs complete pulses or KYZ transitions to a hardware channel. Using the Calibration Pulser module setup registers, you must specify the output mode, output rate (Kt), the output pulse width or minimum duration between KYZ transitions, and the hardware port where the pulses appear.

Calibration Pulser Module Setup Registers

Setup Register	Description
Output Mode	Specifies whether the output is a complete pulse (PULSE) or a change of state transition (KYZ)
Pulse Width	Specifies the width (on-time) of the output pulse (e.g. how long an LED is lit or relay is open)
Kt	Defines how much energy is accumulated by the module before an output is sent to the hardware channel
Integration Mode	Defines the mode of integration
Ports	Defines the hardware port where the output appears

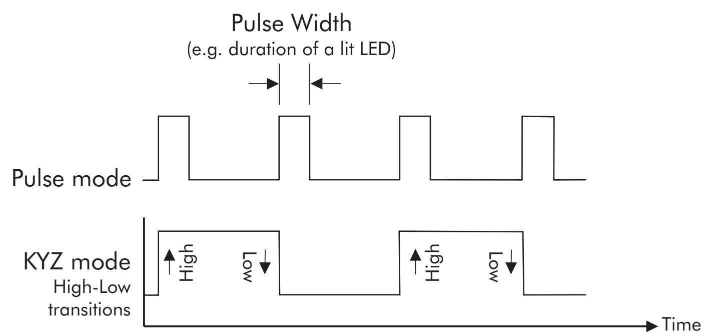
Detailed Module Operation

The Calibration Pulser module integrates the *Source* input, determines how many KYZ transitions or complete pulses it must generate from the *Kt* setup register, and sends the output to the hardware channel specified in the *Port* setup register.



Depending on the number of KYZ transitions or complete pulses output, the Calibration Pulser module operates in a normal, maximum, or an overload state.

Normal State

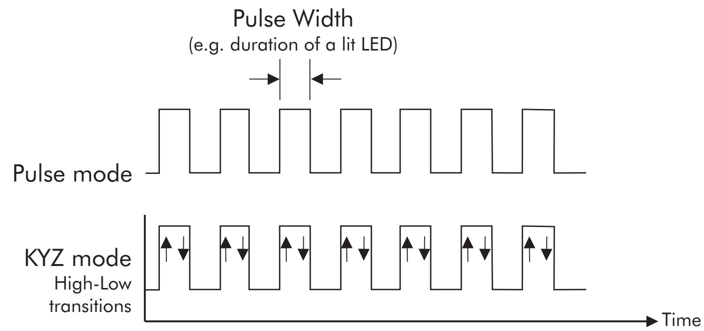


A value entered into the *Pulse Width* register describes the on-time of the pulse (i.e. the time period that an LED is lit or relay is closed). In normal operation, the on-time of the pulse is significantly shorter than the off-time.

KYZ mode indicates a transition (from high to low or vice versa), so Pulse Width typically has no effect, except in an overload state. The on-time and off-time of a KYZ transition is equal in normal and maximum states.

The diagram above shows four complete pulses for the Calibration Pulser module in PULSE mode, and four transitions for the Calibration Pulser module in KYZ mode. If the *Kt* register was set up to send a pulse or KYZ transition for 1.8 energy-hours on each module respectively, then both modules have equal energy-hours output.

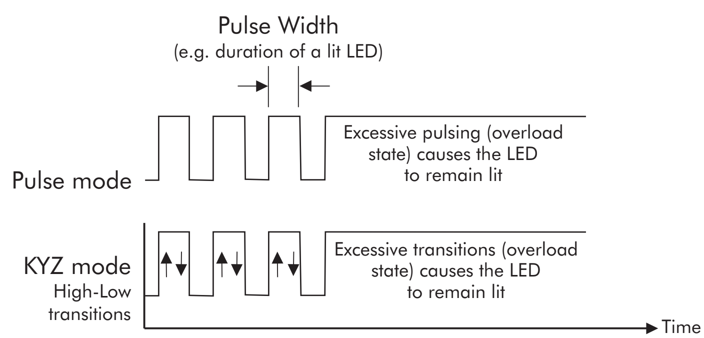
Maximum State



In PULSE mode during maximum operation, the *Source* input increases so the on-time and off-time of the pulses are equal.

The diagram above shows seven complete pulses for the Calibration Pulser module in PULSE mode, and fourteen transitions for the Calibration Pulser module in KYZ mode. If the *Kt* register was set up to send a pulse or KYZ transition for 1.8 energy-hours on each module respectively, then the module in KYZ mode has output twice as much energy-hours than the module in PULSE mode.

Overload State



If the *Source* input increases so that an excessive number of state changes appear at the hardware channel, the *Overload* Boolean output is turned ON, and pulsing stops (i.e. the LED or digital output will remain on) until the energy values return to a nominal level. The *Overload* Boolean output is available for Calibration Pulser modules in PULSE or KYZ mode.

The diagram above shows three complete pulses for the Calibration Pulser module in PULSE mode, and six transitions for the Calibration Pulser module in KYZ mode. For both modules, the *Overload* output has turned on, causing the LED to remain lit.

Pulser Module

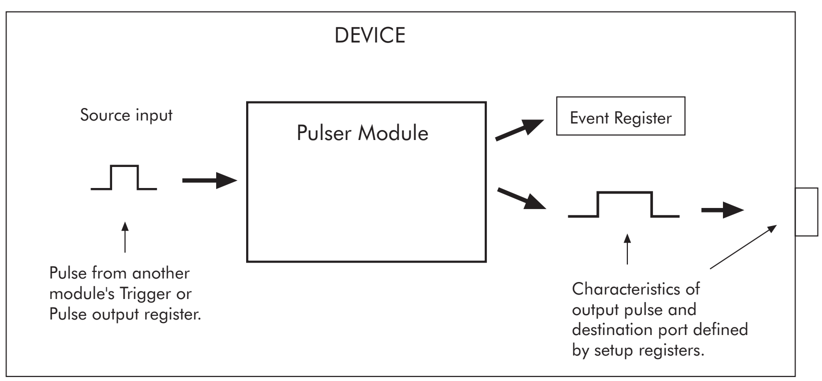
The Pulser module serves as a intermediary between other module's pulse output registers and a hardware output channel on the device. It converts the instantaneous pulses to pulses or transitions on a hardware output channel. With the module setup registers, you must specify whether the output is a transition or complete pulse, if it will pulse high or low, and the hardware port where the pulses will appear. For each pulse received at the *Source* input, a single pulse is sent to the specified hardware output channel.

Pulser Module Setup Registers

Setup Register	Description
Output Mode	Specifies whether the output is a complete pulse (PULSE) or a change of state transition (KYZ)
Pulse Width	Specifies the width (on-time) of the output pulse (e.g. how long an LED is lit or relay is open)
Polarity	Defines the output polarity of the pulses if you have selected a complete pulse as the Output Mode. It has no effect if you selected transition mode
Ports	Defines the hardware port where the output appears

Detailed Operation

The figure below illustrates the operation of the Pulser module.



Each second, the Pulser module determines how many pulses it has received on its *Source* input and outputs a like number of pulses to the specified hardware output channel. Because the *PulseWidth* setup register limits the output pulse to a minimum width, the Pulser module may not always be able to output a pulse for every pulse it receives on its *Source* input. In these cases, the extra pulses are sent to the hardware output channel in the next second. In cases where the Pulser module can output the correct number of pulses, these pulses are spread evenly throughout the second.

Configuring Analog Input

Analog inputs can measure and store analog information such as electrical signals from transducers; transducers derive the electrical signals from flow rates, temperatures, pressures, rotations, and fluid levels. Analog inputs require the installation of an optional circuit board inside the meter.

Analog Input Module

The Analog Input module takes an analog signal from a hardware port, scales it, and makes the scaled result available in its output register.

ION meters with analog input connections have two types of analog input ports available when you order a meter (refer to your meter's label to determine what type you ordered):

Analog Input Option	Input Impedance	Max Common Mode Voltage
0 to 1 mA	475 Ω	8 V
0 to 20 mA (scalable to 4 - 20 mA)	25 Ω	20 V

The accuracy of these analog inputs is ±0.3% of full-scale.

Connecting Auxiliary Analog Inputs (ION 7700 Meters)
The optional internal analog input boards for ION 7700 meters provide four double-ended current or voltage inputs for direct interface with transducers or thermocouples. The option ordered determines the configuration and maximum input range for all four analog input pairs (refer to the label on the ION 7700 for the AUX rating). All four must have the same input rating (e.g. 0 - 20 mA). Analog inputs receive DC signals only. Options include:

ION 7700 Analog Input Option	Input Impedance	Max Common Mode Voltage
0 to 1 mA	49.9 Ω	8 V
0 to 20 mA	100 Ω	20 V
0 to 1 V	>= 50 kΩ	12 V
0 to 10 V	>= 50 kΩ	25 V

Analog Input Module Setup Registers

An ION Analog Input software module corresponds to each hardware input port. This module takes signals from an input port, scales it, and makes the result available to the meter. The register settings let you determine the value that appears in the output register when the lowest and highest possible values from the hardware are applied, and determine the hardware port that the module will control.

To learn more about the Analog Input module scaling, refer to the section "Setting Analog Zero and Full Scale Values" on page 227.

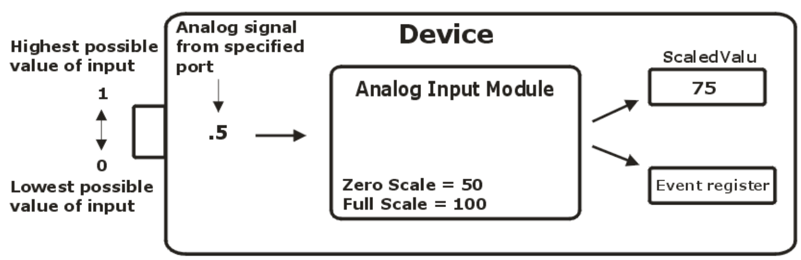
Setup Register	Description
Zero Scale	Defines the value that appears in the *ScaledValu* output register when the lowest value from the hardware port is applied
Full Scale	Defines the value that appears in the *ScaledValu* output register when the highest value from the hardware port is applied
Port	Defines the hardware port that provides the signal

NOTE

Once you have set the *Port* setup register to the appropriate analog input port on the meter, link the *ScaledValu* output register to another software module or framework for analysis.

Detailed Operation

The following example illustrates the Analog Input module with an input coming from 50% of the highest possible input value. The Analog Input module takes the input value and calculates what it corresponds to on the new scale, which is defined by the *Zero Scale* and *Full Scale* registers. In this case, 50% on the new scale is a value of 75. This value is written into the *ScaledValu* output register.



Configuring Analog Output

An ION meter's analog outputs act as transducers. The meter measures power and energy, and then sends that information via the analog outputs to a remote terminal unit (RTU). The analog outputs issue industry standard 0 to 20 mA current signals.

Analog Output Module

Analog outputs allow you to control external devices by delivering a specific current or voltage that is proportional to your source point. The Analog Output module takes an input value and scales it to the appropriate values for output to an analog hardware port. It also provides the scaled value as an output register that can be accessed by other modules.

Ordering options on some ION meters provide analog outputs that can deliver a continuous dc signal. The accuracy of analog outputs for ION meters is ±0.3% of full scale. The following varieties are available—be sure to check the device label to determine your option:

Analog Output Option	Maximum Load
-1 to 1 mA (scalable to 0 to 1 mA)	10 Ω
0 to 1 mA	10 Ω
0 to 20 mA (scalable to 4 - 20 mA)	500 Ω
-20 mA to 20 mA	500 Ω

An ION 7300 Series TRAN meter with an analog output card cannot be ordered with a remote display (RMD).

Analog Output Module Setup Registers

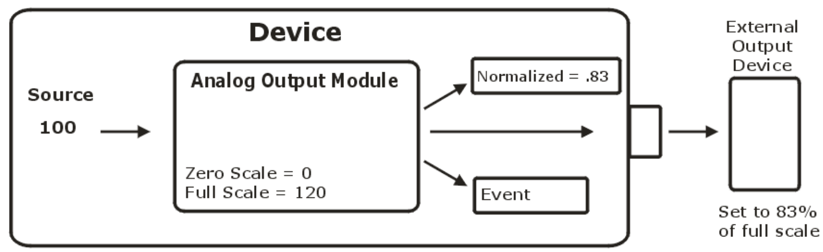
An ION Analog Output software module corresponds to each hardware output port. This module takes a numeric value and scales it for output to an analog hardware port, allowing you to control external devices by delivering a specific current or voltage. The register settings let you determine the value that appears in the output register when the lowest and highest possible values from the hardware are applied, and determine the hardware port that the module will control.

To learn more about the Analog Output module scaling, refer to the section "Setting Analog Zero and Full Scale Values" on page 227.

Setup Register	Description
Zero Scale	Should be set to the value on the *Source* input that will create the minimum possible output on the analog hardware port
Full Scale	Should be set to the value on the *Source* input that will create the highest possible output on the analog hardware port
Port	Defines the hardware port where the output appears

Detailed Operation

The following illustration shows the operation of a Analog Output module. The *Source* input falls between the *Zero Scale* and *Full Scale* values. It is scaled and the result is then sent to the specified hardware port. (The port is specified in the *Port* setup register.) The *Normalized* output register provides information about the state of the hardware: the output on the hardware port in this instance is at 83%.



If at any point the input rises above the value specified in the *Full Scale* setup register, the output remains at the *Full Scale* value and the maximum possible value is sent to the hardware port. Likewise, if the input falls below the value specified in the *Zero Scale* register, the output remains at the *Zero Scale* value and the lowest possible value is sent to the hardware port. If the input becomes NOT AVAILABLE, the *Normalized* output register is also NOT AVAILABLE and the lowest possible value is sent to the hardware port.

Setting Analog Zero and Full Scale Values

You control or monitor external analog devices by delivering or receiving a specific current or voltage that is proportional to a source. This is done by setting the *Full Scale* and *Zero Scale* setup registers and defining the hardware port that receives (Input) or delivers (Output) current. Use Designer software to configure the setup registers in the Analog Input or Output modules.

When scaling values to current, the *Full Scale* value is always set to the highest value you expect. The *Zero Scale* value depends on the actual current that drives the input/output and the type of information that the current represents. The following information steps through scaling an Analog Output module that receives kW as a source and passes the kW value to an analog device whose range is different than the range for the ION analog output.

NOTE

The general behavior of *Full Scale* and *Zero Scale* is such that: if the input rises above the *Full Scale* value, the output remains at the *Full Scale* value and the maximum possible value is sent to the hardware port. Likewise, if the input falls below the *Zero Scale* value, the output remains at the *Zero Scale* value and the lowest possible value is sent to the hardware port.

Considerations when scaling

1. Set the *Full Scale* value that you expect. For example, consider scaling an Analog Output module whose *Source* input is linked to kW values; if the highest Watt value that you expect is 10 kW enter 10,000 as the *Full Scale* value.
2. Consider the output type you have, (-1 to 1 mA, -20 to 20 mA, 0 to 20 mA) and then consider the output range you want (0 to 1 mA, 0 to 20 mA or 4 to 20 mA). For example, the Analog output on an I/O Expander may be 0 to 20 mA, and the analog device connected to the I/O Expander may support a range of 4 to 20 mA.
3. Calculate the *Zero Scale* setting according to the table below. The table assumes the *Source* input varies between *Zero Scale* and the *Full Scale* settings.

Output Type	Desired Range	Zero Scale Setting*	Full Scale Setting
-1 to 1 mA	0 to 1 mA	negative value of Full Scale (e.g. -1000)	e.g. 1000
-20 to 20 mA	0 to 20 mA	negative value of Full Scale (e.g. -1000)	e.g. 1000
	4 to 20 mA	-1.5 times value of Full Scale (e.g. -1500)	e.g. 1000
0 to 20 mA	4 to 20 mA	-0.25 times value of Full Scale (e.g. -250)	e.g. 1000

* To determine the *Zero Scale* multiplier, calculate the ratio of minimum desired output to the desired range:

$$\mathrm{ZeroScaleMultiplier} = \frac{\mathrm{MinimumDesiredOutput}}{\mathrm{MaximumDesiredOutput} - \mathrm{MinimumDesiredOutput}}$$

For example, assume output type is 0 to 20 mA and desired range is 4 to 20 mA:

$$0.25 = \frac{4\mathrm{mA}}{20\mathrm{mA} - 4\mathrm{mA}}$$

NOTE

The Zero Scale setting is *minus* 0.25 times the Full Scale value as explained in the following section "Determining the Zero Scale setting for output ranges below zero". Although the section describes setting for ranges below zero, the calculation proves the multiplier is negative for output ranges starting at zero.

Determining the Zero Scale setting for output ranges below zero

To determine the *Zero Scale* setting for any range of output (e.g. -1000 W to 1000 W) use the *Zero Scale* multiplier to calculate the portion of the entire range that falls below the lowest expected value. When you subtract this portion of the range from the lowest expected value the result is entered as the *Zero Scale* setting:

$$\mathrm{ZeroScaleValue} = \mathrm{MinimumValue} - \mathrm{ZeroScaleMultiplier}(\mathrm{Maximum} - \mathrm{Minimum})$$

For example, assume the output type is 0 to 20 mA, the desired range is 4 to 20 mA, and the minimum and maximum expected values are -1000 W and 1000 W:

$$-1500 = -1000\mathrm{W} - 0.25(1000\mathrm{W} - (-1000\mathrm{W}))$$

Enter -1500 in the *Zero Scale* register. When the value drops to its lowest expected value of -1000 W the current output is 4 mA as illustrated below:

Configuring ION Modules for Digital and Analog I/O

Designer software lets you change the configuration of existing modules or create new modules. Below are general considerations for using Designer software:

- When using Designer software for configuration, ensure **Show Toolbox** is selected from the Tools menu.
- From the toolbox you can search for the module you want to create or modify and click on the icon.
- Right-click on the module to display existing modules. If you want to edit an existing module, click on that module to jump to its location.
- To create a new module, left-click its icon and drag it onto the workspace.
- Right-click on the module icon to access setup registers. You can read the input or output register owners by Shift Left-clicking on the either side of the module.

Configuring modules for digital or analog I/O

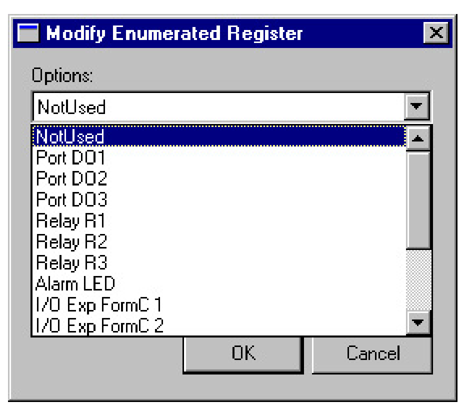
1. Once you have connected the external I/O field equipment to the appropriate input or output ports, run Designer software, and open the meter template.
2. If required, create the appropriate module for each input or output port you are going to use.
3. Link the *Source* input of these modules to a value you want to reflect through the desired outputs, **or** configure the input *Port* setup register to match the input port you want to monitor.
4. Configure the settings of the controlling module to match your requirements. The various module settings for each module are found under the appropriate Module Settings heading.

These software modules have *Port* registers that allow you to specify which port handles the incoming or outgoing signals.

Assigning a port to a module

1. Locate the appropriate module in Designer.
2. Right-click the module to open the ION Module Setup.
3. Modify the *Port* setup register by picking from the enumerated list.

The enumerated list only shows those ports which have not already been assigned to another module.
Port DO4 has already been assigned to another module, so it is absent from the list.



Making a port available

1. Locate the module controlling the port in Designer.
2. Right-click that module to open ION Module Setup.
3. Set that *Port* setup register to NOT USED (or delete the module entirely). The port now appears in the enumerated list.

Energy Pulsing from ION Meters

If you wish to use one of the digital outputs on an ION 7300 Series, ION 7500, ION 7600, or ION 8000 meter for energy pulsing applications (Wh, kVAh, kVARh), assign it any Pulser, Digital Output, or Calibration Pulser module.

NOTE

In the ION 7300 Series, ION 7500, and ION 7600 meters,ION 7600, one of the solid-state relays (DO4) is preconfigured for calibration pulsing. It outputs a pulse for every 1.8 Wh measured and is controlled by the Calibration Pulser module. This default configuration can be disabled. Refer to the meter's User's Guide to learn how to disable this default configuration.

On all these meters, an energy pulsing LED is preconfigured to pulse every 1.8 Wh (1.2 Wh on 35S socket meters). A Calibration Pulser module controls it. You can configure the LED for other energy pulsing applications (kVAh, kVARh) by disabling the default configuration and then assigning it any Pulser, Digital Output, or Calibration Pulsar module.

On the ION 6200, two Pulser software modules are pre-set to send pulses every 1 kWh and every 1 kVARh to the solid state relays on the meter.

The infrared port on the ION 7300 Series meters can also be used for energy pulsing. To do this, you must set the communications protocol to INFRARED I/O. Then choose one of the Pulser modules and specify the infrared port in its setup register.

One Digital Output, Calibration Pulser, or Pulser ION module corresponds to each physical output port.

Digital Output module: A Digital Output module takes a Boolean input and sends it out a hardware channel as a constant level or a complete pulse.

Calibration Pulser module: All ION meters have Calibration Pulser modules that allow you to generate high accuracy energy pulses for calibration testing. They integrate instantaneous power inputs. A Calibration Pulser module takes numeric input and sends a pulse out a hardware channel based on the calibration constant (Kt). This value defines how much energy accumulates before a pulse is sent to the hardware channel.

Pulser module: A Pulser module takes a pulse input from any other ION module's output register and sends a pulse to a specific hardware channel based on the pulse width. A Pulser module takes an instantaneous pulse and converts it to either a complete pulse or a transition pulse for a hardware channel.

NOTE

By default, the Form C digital outputs are normally open in the KY position upon power up. If a Form C output is used for Watt-Hour pulsing and the meter is powered down when the output is closed in the KY position, then a false transition occurs as the output returns to its default (KY) position. To compensate for the extra pulse generated on power down, the first pulse after power up is ignored, i.e., there is no transition on the Form C output until the second Watt-Hour pulse is generated by the meter. This mechanism ensures that the correct number of Watt-Hour pulses are provided, regardless of the state the Form C outputs are in when the meter is powered down.

MeterM@il® Internal Email Server Feature

The MeterM@il internal email server feature allows meters to automatically send high-priority alarm notifications or scheduled system status updates as email messages to anyone, anywhere within the facility or around the world. Messages sent via the MeterM@il feature can be received like any email message over a workstation, cell phone, pager, or PDA.

Contact your Power Measurement representative to determine whether your meter supports email alerts, log export or both.

In This Document

Introduction

This document addresses three audiences: the recipient of the MeterM@il message, the network administrator, and the ION Enterprise™ software administrator.

Recipient of the MeterM@il Message

The first section is geared towards the user who receives the MeterM@il message, and discusses how to view and interpret email sent by the meter. This section is titled:

- Viewing the MeterM@il Message

Network Administrator

The second section is geared towards the network administrator, and discusses how meters are added to the corporate network so that the recipient of the MeterM@il message is able to receive the emails that the meter is sending. This section is titled:

- Setting Up the Network for the MeterM@il Feature

ION Software Administrator

The third section is geared towards the ION software administrator who uses Designer to program the meter to email alerts and data logs. This section is titled:

- Configuring the Meter for MeterM@il Technology

Viewing the MeterM@il Message

The meter can be configured to email alerts regarding specified events (e.g. power quality disturbances), and email periodic data logs (e.g. kWh del).

Email Alerts

You can specify the type of event that triggers an email alert and have these events programmed on the meter by your ION software administrator.

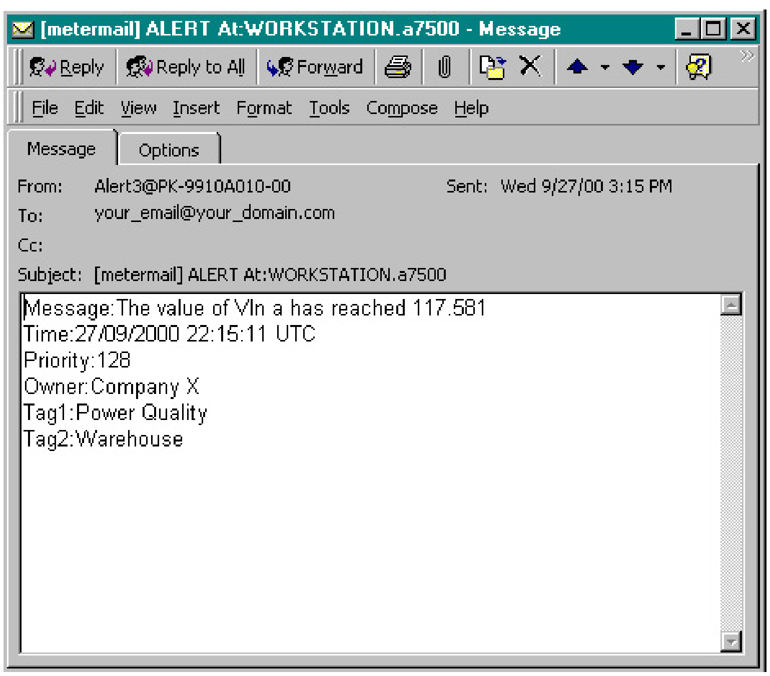
The alert email shows the following:

- the alert message details
- the event's date and time
- the event priority level
- the meter's owner
- additional user-defined meter identification information labelled "Tag1" and "Tag2"

NOTE

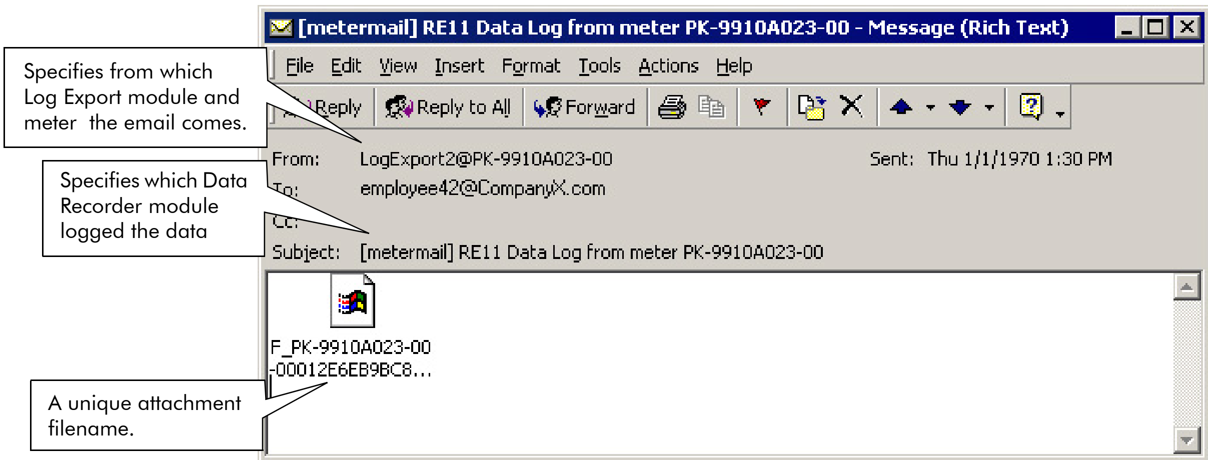
Tag1 and Tag2 are meter settings for information of your choice.

Here is an example of an email alert:



Email Data Logs

The meter can email logged data daily, hourly, or at any interval your ION software administrator configures. The logged data does not appear in the body of an email; the information is contained in an email attachment instead. The following illustration shows how an email sent by the Log Export module appears in your inbox:



You can gather some information from the email without opening the attachment. The From column displays which Log Export module and meter sent the email (the meter is identified by its serial number). The Subject column tells you which Data Recorder is responsible for logging the data. The attachment has a unique filename which incorporates the meter's serial number.

The email attachment is an eXtensible Markup Language (XML) document. Even though XML is a machine readable format meant to be processed by another program, you can still interpret the information contained within an attachment (see the illustration on page 237). This information can be taken from the XML attachment:

- the name of the data log
- the device (meter) type
- the meter's serial number
- the meter's owner
- additional user-defined meter identification information labelled "Tag1" and "Tag2"
- the record number
- the UTC (Universal Coordinated Time) that the data was recorded
- the names of the logged data fields (e.g. Vln a, Vln b, Vln c)
- the numeric values of the logged data

The XML Attachment

When you open the XML attachment in a browser, you see the following:

Links to the Resource Directory Description Language (RDDL) and XML Schema documents.

Device which generated the email

The generating device’s template, owner, Tag1, and Tag2 information.

Meter information

The meter’s template, owner, Tag1, and Tag2 information.

The Data Recorder module that logs the data.

Logged data fields

The record number, timestamp, and logged data values (respectively).


```
<?xml version="1.0" encoding="utf-8" ?>
  <soap:Envelope
xmlns="http://rddl.xmlinside.net/PowerMeasurement/data/ion/historical/pushmessaging/1/"
xmlns:soap="http://schemas.xmlsoap.org/soap/envelope/">
  <soap:Header />
  <soap:Body>
    <Data id="PK-9910A023-00-3D2358555AD26-6FA8"
     xmlns:ident="http://rddl.xmlinside.net/PowerMeasurement/data/ion/identity/1/">
      <ident:GeneratedBy ident:name="MainMeter" ident:namespace="Miami.CompanyX"
       ident:type="7500" ident:signature=" PK-9910A023-00"
       ident:dateTime="2002-07-03T20:02:29.373Z" />
      <ident:Configuration ident:revision="B3352_7500"
        ident:template="7500_FAC-4WYE_V1.2.0.0.0" ident:owner="CompanyX"
        ident:tag1="Main" ident:tag2="Headquarters">
        <ident:Timezone>
          <ident:Bias>480</ident:Bias>
          <ident:DSTBias>-60</ident:DSTBias>
          <ident:DSTStart>1999-04-04T02:00:00.000-08:00</ident:DSTStart>
          <ident:DSTEnd>2018-10-28T02:00:00.000-08:00</ident:DSTEnd>
          </ident:Timezone>
          </ident:Configuration>
        <Device ident:name="MainMeter" ident:namespace="Miami.CompanyX"
          ident:signature=" PK-9910A023-00" ident:type="7500">
          <ident:Configuration ident:revision="B3352_7500"
            ident:template="7500_FAC-4WYE_V1.2.0.0.0" ident:owner="CompanyX"
            ident:tag1="Main" ident:tag2="Headquarters">
             <ident:Timezone>
             <ident:Bias>480</ident:Bias>
             <ident:DSTBias>-60</ident:DSTBias>
             <ident:DSTStart>1999-04-04T02:00:00.000-08:00</ident:DSTStart>
             <ident:DSTEnd>2018-10-28T02:00:00.000-08:00</ident:DSTEnd>
             </ident:Timezone>
          </ident:Configuration>
          <Recorder id="Data Rec 39" label="RE39 Data Log">
            <Channels>
             <Channel id="c1" label="Vll avg" />
             <Channel id="c2" label="I avg" />
             <Channel id="c3" label="PF sign tot" />
            </Channels>
           <Records>
           <R pos="52400" ts="2002-07-03T20:02:20.000Z"
            c1="207.6390" c2="4.3291" c3="-92.1563" />
           </Records>
          </Recorder>
        </Device>
    </Data>
  </soap:Body>
 </soap:Envelope>
```


Refer to the Resource Directory Description Language (RDDL) documents at the following location if you require more information:

- http://rddl.xmlinside.net/PowerMeasurement/data/ion/historical/pushmessaging/1/

Setting Up the Network for the MeterM@il Feature

The information contained in this section is geared towards the network administrator who sets up the corporate network for meter email transmission. The required network components for using MeterM@il technology are described here.

Automatically Configuring Meter Network Settings

Meters that are equipped with the MeterM@il feature reside on an Ethernet network. Each meter requires an IP Address and other network settings to define its location on the network, and to interact properly with other network devices. These network settings can be set manually with the meter's front panel, or automatically with a BootP Server.

To learn how to configure meter network settings manually with the meter's front panel, refer to Network Settings in your meter's *Installation and Basic Setup Instructions*. To learn how to configure meter network settings automatically with a BootP Server, follow the instructions below.

NOTE

BootP is not available for ION 8000 Series meters.

BootP Server

BootP (Bootstrap Protocol) is a protocol that automatically configures a device's (e.g. meter's) network settings without user involvement.

The BootP server is managed by the network administrator, who allocates the meter IP address and other network settings to the BootP server. When this is completed, and the meter is booted up, the BootP server automatically assigns the IP address and other network settings to the meter.

When the meter is in BootP mode, it does not need to be manually re-booted for an IP address change. Since most power meters cannot be easily rebooted on demand, the meter has been set up to poll the BootP server every eight hours for an IP address. If the IP address is changed on the BootP server, then the meter obtains the new address at the next polling interval.

NOTE

Depending on your meter and meter firmware version, BootP may be enabled by default; check your meter's *Basic Setup and Installation Instructions*. You can enable BootP through the meter's front panel or with Designer software.

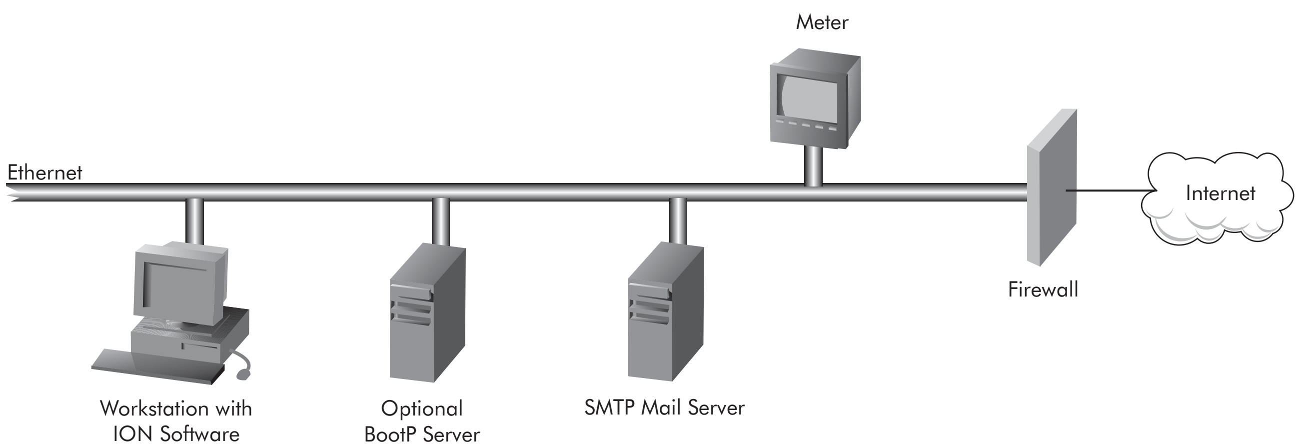
Preparing the BootP Server to automatically configure network settings:

1. Set up the BootP server on the same Ethernet network as the meter you wish to access using a web browser. Follow the documentation packaged with the BootP software for the correct installation.
2. Enter the meter Ethernet MAC address in the BootP database.
3. Allocate these settings to the meter Ethernet MAC address:
   - IP Address of the meter
   - Subnet Mask (if the network is subnetted)
   - Gateway (if the network has a default gateway)
   - SMTP Mail Server Address (mandatory for using the MeterM@il feature)

NOTE

When the meter is in BootP mode, you must configure the network settings in the BootP server. Otherwise, those settings will NOT be updated on the meter. In BootP mode, you are prevented from changing network settings through the meter's front panel, or with ION software.

Setting Up the Network for the MeterM@il Feature



The above illustration shows a network that is set up to take advantage of the MeterM@il feature on the meter. Both the meter and the SMTP mail server reside on the same Ethernet LAN. When the meter has an email to send, the connection between the meter and the SMTP mail server is quickly made over the LAN. The SMTP mail server forwards the MeterM@il message to its final destination.

To see an example of a network where MeterM@il technology accesses the SMTP mail server via a dial-up connection, see "SMTP Connection Timeout" on page 240.

The network components for using MeterM@il technology are described below.

- **Ethernet network**: Ethernet is the connection medium for the delivery of email from a meter to an SMTP server.
- **Workstation with ION software**: A computer with ION software is required to set up a meter equipped with the MeterM@il feature. Refer to "Configuring the Meter for MeterM@il Technology" on page 242.
- **Meter**: The meter can be connected to your LAN like any other network device.
- **SMTP mail server**: The MeterM@il feature requires an SMTP mail server to be configured to forward email from the meter to the final destination of the email message. The SMTP server may be located on your Ethernet network or accessed via a dial-up modem connection.
- **BootP server**: A BootP server can be set up to automatically configure meter network settings. See "Automatically Configuring Meter Network Settings" on page 238. (BootP is not available for ION 8000 Series meters.)
- **Firewall**: If the SMTP server that the meter uses is beyond the corporate network, you must configure the firewall to allow outgoing connections on TCP/IP port 25 from the meter to the SMTP server. If the SMTP server is within the network, no additional configuration is required.

SMTP Connection Timeout

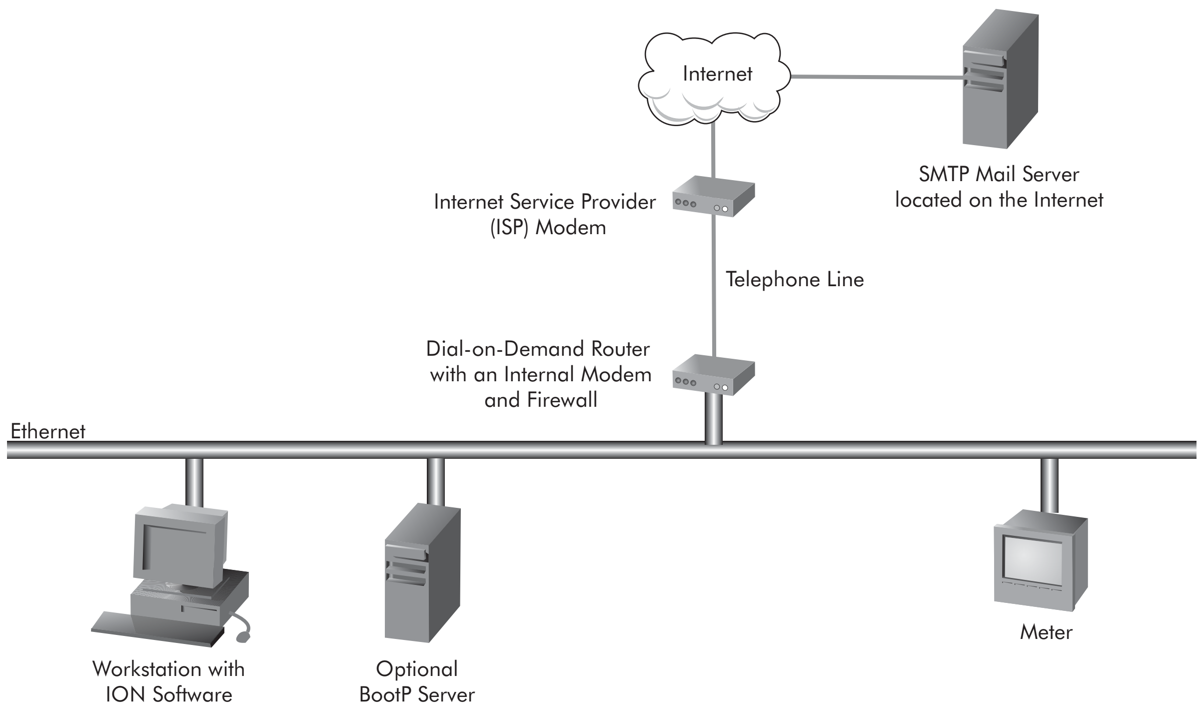
For meter email transmission, an SMTP mail server which is configured to forward email from that meter to the final destination is required. The SMTP mail server may be located on your Ethernet network (as illustrated above), or accessed via a dial-up modem connection (as illustrated below). If the SMTP mail server is located on your Ethernet network, the connection between the meter and the SMTP server is usually made quickly. If the SMTP mail server is accessed via a dial-up modem the connection can take longer, and can cause the meter to terminate the attempted connection to the SMTP server because the server takes too long to respond.

You can extend the SMTP Connection Timeout interval on your meter using the *SMTP Connection Timeout* setup register in the Ethernet Communications module:

- If the SMTP server is on your local network, you can most likely leave the *SMTP Connection Timeout* setting to its default of 60 seconds.
- If the SMTP server is accessed via a dial-up connection, the *SMTP Connection Timeout* should be extended to allow for extra time to establish a connection. The exact time setting depends on the speed of your dial-up process.

The *SMTP Connection Timeout* register can be set through the meter's front panel or with Designer software. See "'Setting Up the Meter for the SMTP Server" on page 242.

In the illustration below, the SMTP mail server does not reside on the same local network as the meter, so an SMTP mail server connection may not always be made quickly. When the meter has an email to send, the following process occurs. First, the meter contacts the dial-on-demand router that contains an internal modem. Second, the router modem contacts the Internet Service Provider (ISP) modem to connect to the Internet and initiate a connection to the specified SMTP mail server. Connecting to the SMTP mail server can take longer than the *SMTP Connection Timeout* register default of 60 seconds. In such a case, the interval should be extended.



Configuring the Meter for MeterM@il Technology

This section presents information geared to the ION software administrator who, using Designer software, creates frameworks which program the meter to email alerts and data logs. For assistance using Designer, refer to the online help.

Setting Up the Meter for the SMTP Server

Before you program the meter to email alerts and data logs, you must set up the meter with your SMTP mail server address and, if required, extend the SMTP connection timeout.

The SMTP mail server settings can be set manually with ION software or the meter's front panel, or automatically with a BootP Server.

To learn how to program SMTP mail server settings to the meter with:

- BootP, see "Automatically Configuring Meter Network Settings" on page 238
- the meter's front panel, see Network Settings in your meter's *Installation and Basic Setup Instructions*
- Designer software, see the instructions below

Setting Up the Meter for your SMTP Server:

1. Open the meter in Designer and double-click on the **Communications Setup** folder.
2. Right-click on the icon in the center of the Ethernet module. The ION Module Setup screen appears.
3. Double-click the **SMTP Server** setup register and type in the IP address of your SMTP server.
4. If required, double-click the **SMTP Connection Timeout** setup register and increase the timeout period.

NOTE

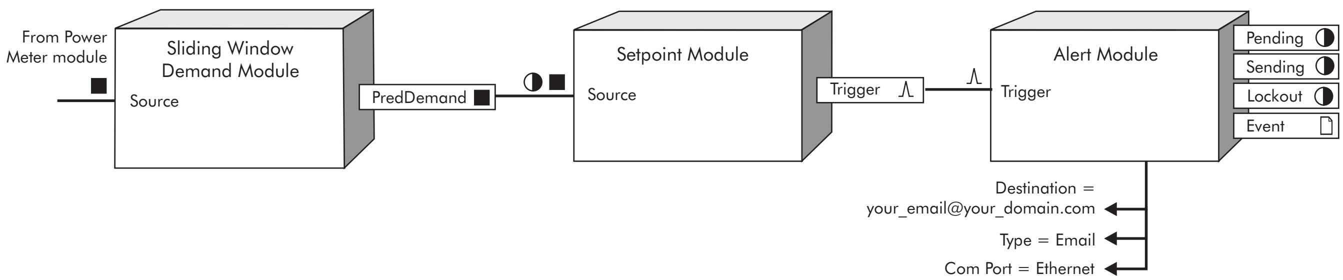
The SMTP Connection Timeout sets the amount of time the meter waits when establishing a connection to an SMTP mail server. This setting is intended to compensate for situations where it takes some time to negotiate a connection, such as dial-up access. See the previous section "SMTP Connection Timeout" on page 240 for more information.

5. Click **Send and save**.

Configuring the MeterM@il Feature to Send Alerts

The Alert module can be configured to send an email alert message to your workstation – this keeps you informed about certain alarm conditions so you can act on them.

The Alert module sends an alert whenever its *Trigger* input is pulsed. You can connect this input to any module that produces a pulse output. You can use modules that monitor alarm conditions such as changes in relay status and power quality problems (surges, sags, swells, outages).



In the example framework above, a Sliding Window Demand module's output is monitored so that an alert is sent when the predicted demand value goes above a certain limit. A Setpoint module is required to determine when the high limit condition is met, and to send a pulse to trigger the Alert module. When the pulse is received, the message is sent according to the Alert module's setup register values. The example above shows the setup registers that must be configured in the Alert module for email alerts (see step 4 below for additional setup register configuration).

NOTE

The SMTP Server address must be configured correctly before the MeterM@il feature can operate. In addition, the SMTP Connection Timeout period may need to be extended (e.g. if the SMTP mail server does not reside on the Ethernet network).

Setting up the meter to send alerts:

1. Create an Alert module.
2. Create an ION module that produces a pulse on one of its output registers when the exceptional event occurs (in the example above, a Setpoint module pulses its *Trigger* output when the setpoint condition is reached).
3. Link the Alert module's *Trigger* input register to a pulse output register on the module created in step 2.
4. Configure the following Alert module setup registers as follows:
   - ***Message*** – this string register contains the text of the alert to be emailed. You can use up to 120 alphanumeric characters in your message string. Values and names from registers linked to the module's *Source* inputs can be included in the message by referencing them in the message string.

- ***Destination*** – this string register identifies the alert's destination email address. You can use a maximum of 50 characters.
- ***Type*** – this register specifies the type of destination you wish to alert; select "Email."
- ***Com Port*** – this register allows you to specify the communications port that is used to email the alert; select "Ethernet."
- ***Location*** – this string register identifies the meter that is sending the alert, and defaults to the network meter name. You can change the default; use 60 characters maximum.
- ***Email From*** – this string register specifies the email address that will appear in the "From" field on the email. The default value of this register is ALERT<ALERT MODULE NUMBER> @ <METER SERIAL NUMBER> — for example, Alert3@PK-9910A010-00. This register will have to be altered in cases where the receiving SMTP server only accepts emails from valid Internet domains (i.e. SomeName.COM). This string may be up to 80 characters long.

5. Click **Send and save**. When the *Trigger* input is pulsed, the Alert module establishes communications with the SMTP mail server, and emails the alert message.

Configuring the MeterM@il Feature to Send Data Logs

The Log Export module can send data logs in different ways, though only email is currently implemented. This section discusses the ION modules involved in a "data push" framework, plus the corresponding setup registers that you need to configure in order to utilize the MeterM@il feature in the framework. The term "data push" refers to the action of the Log Export module sending data logs. A complete description of the Log Export module and the other ION modules involved in the framework can be found in the online *ION Programmer's Reference* at www.pwrm.com.

The MeterM@il feature requires that an additional framework be created in Designer before you can configure your meter to use the Log Export feature. Each "data push" framework includes the following:

- A Data Recorder module that records the values in its *Source* inputs each time it is pulsed and stores these values in its *Data Log* output register.
- A Log Export module that retrieves information from the Data Recorder module's *Data Log* register and sends the data to a specified destination.
- A module that sends values to the Data Recorder module (e.g. Power Meter module or a Modbus Import module).
- A Periodic Timer module that triggers the Data Recorder module to record the values it is sent.
- A module that triggers the Log Export module to send the logged data (e.g. a Clock or Periodic Timer module). This module is optional, because the Data Recorder module's *Record Complete* output register can be configured to trigger the Log Export module to send data logs. When this is the case, the data logs are emailed at the same interval that the Data Recorder module records new data.

Additional ION Module Configurations

In addition to the "data push" framework, you need to configure certain setup registers in the Factory module and the Ethernet (Communications) module. If these registers are not configured, the Log Export module cannot go online.

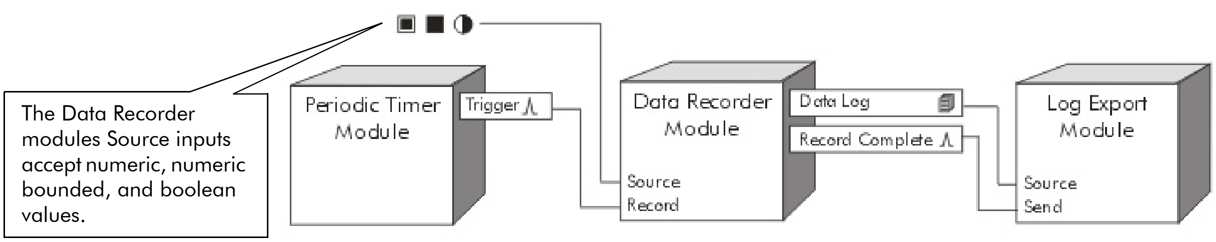
Device Namespace (Factory module)
The value in this register is used as the namespace attribute in the Device element of XML messages generated by the Log Export module. The value range for this string value is up to 80 characters; these characters must be alphanumeric but can also include a dash (hyphen) or a dot (period). If this register is not configured, the Log Export module cannot go online.

NOTE

A namespace uniquely identifies a set of names so that there is no ambiguity when objects with different origins but the same names are mixed together. A namespace is commonly given the name of a Uniform Resource Identifier (URI) - such as a web site address - both because the namespace may be associated with the site or page of that URI (for example, a company name) and because a URI is likely to be a unique name.

Device Name (Factory module)
The value in this register is used as the name attribute in the Device element of XML messages generated by the Log Export module. The value range for this string is up to 80 characters; these characters must be alphanumeric but can also include a dash (hyphen) or a dot (period). If this register is not configured, the Log Export module cannot go online.

SMTP Server (Ethernet module)
This setup register contains the IP Address of the email server to which the meter sends outgoing email. If this register is not configured correctly, the Log Export module fails to send any emails.



Configuring the meter to send data logs:

1. Configure the Factory module's *Device Namespace* and *Device Name* setup registers with appropriate values.
2. Configure the Ethernet (Communications) module's *SMTP Server* setup register with the correct IP address.
3. Link the Data Recorder module's *Source* inputs to the values you want to log. For example, you could use the Power Meter module's outputs Vln a, Vln b, and Vln c as the *Source* inputs.
4. Link the Data Recorder module's *Record* input to the Periodic Timer module's *Trigger* output. (Adjust the *Period* setup register in the Periodic Timer module.)

5. Link the Log Export module's *Source* input to the Data Recorder module's *Data Log* output.
6. Link the Log Export module's *Send* input to the Data Recorder module's *Record Complete* output.
7. Configure these Log Export module setup registers appropriately:
   - *Destination* – This is the destination's Uniform Resource Identifier (URI). Current support is limited to email URIs (e.g. mailto:john.doe@anywhere.com). You must include **mailto:** as a prefix to the email address string in order to send records via email. The default value is "Enter Destination Address," which means you must specify a destination in order for the module to go online. The destination string can be anywhere between 0 and 80 characters.
   - *Maximum Send Records* – This register determines the maximum number of records that are emailed at once. The default value is set to 0, essentially disabling the module. This register must be changed to a non-zero value for the Log Export module to go online.
   - *Email From* - This register contains the address that appears in the From: field of the email sent by the Log Export module. This register only applies to messages sent via email. The default value depends on which Log Export module you are using and the meter's serial number. Email arriving from a meter have a default format like LogExport<module number>@<serial number>.

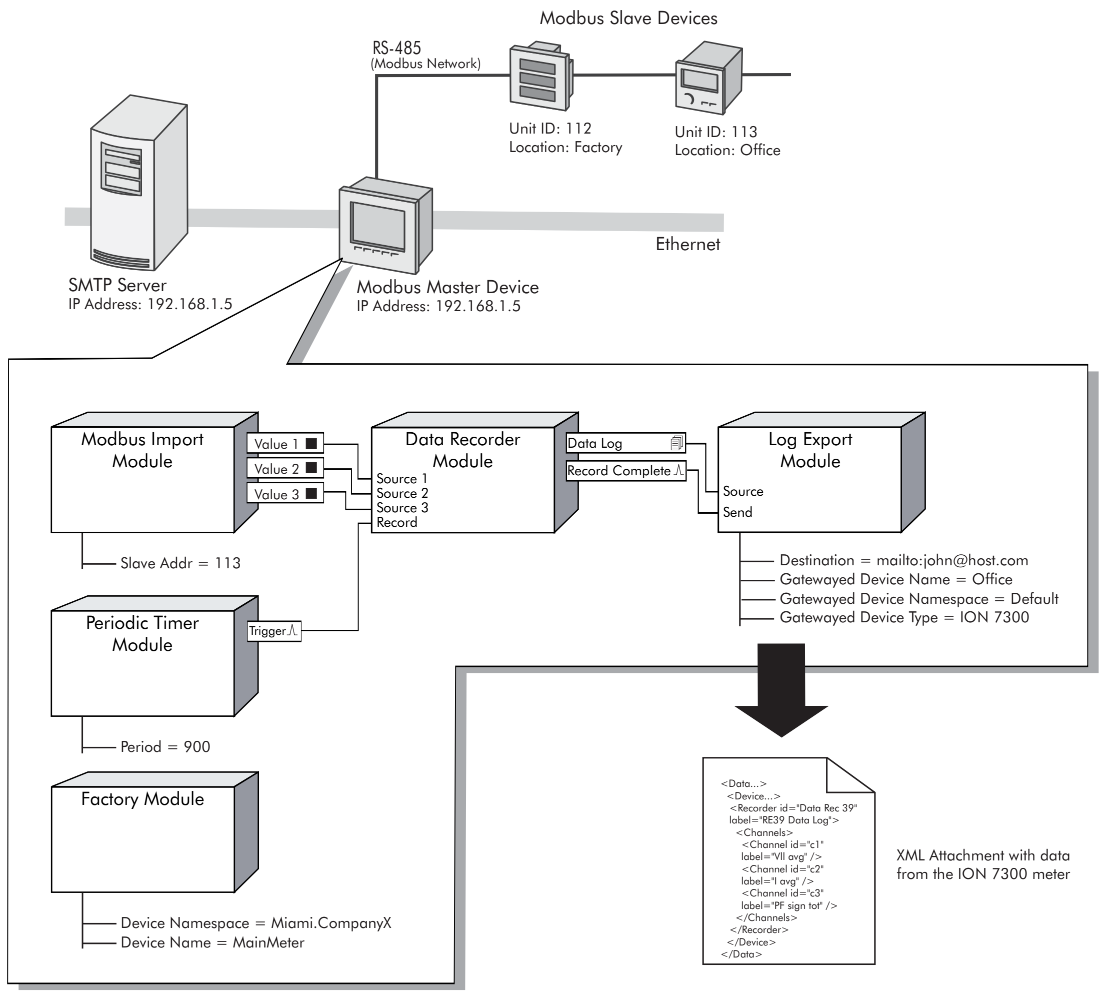
   Configure the following Log Export module setup registers when using the MeterM@il feature in a gateway scenario. These registers differentiate the gatewayed device (which logs the data) from the gateway meter (which sends the data).

   - Gatewayed Device Namespace - The string value in this register is used as the namespace attribute in the Device element of XML messages generated by the module. The default value is Default. When it is set to Default, the namespace attribute of the Device element inherits the value from the Factory module's Device Namespace setup register.
   - *Gatewayed Device Name* - The string value in this register is used as the name attribute in the Device element of XML messages generated by the module. The default value is Default. When it is set to Default, the name attribute of the Device element inherits the value from the Factory module's Device Name setup register.
   - *Gatewayed Device Type* - This value is used as the type attribute in the Device element of XML messages generated by the module. The default value is Default. When set to Default, the type attribute of the Device element inherits the value from the Factory module's *DeviceType* register.

Click **Send and save**. When the *Send* input is pulsed, the Log Export module establishes communications with the SMTP mail server and sends the data log via email.

MeterM@il Technology in a Modbus Network

The following example illustrates just one of the many uses for the Log Export module. This Modbus network includes the ION 7500 as the Modbus Master and the ION 6200 and ION 7300 meters as Modbus slave devices. Configuration is performed on the framework where the Modbus Master is located for systems that utilize MeterM@il technology.



Notice that the Modbus Import module supplies values to the Data Recorder module’s *Source* inputs. The Modbus Import module’s *Slave Addr* (slave address) is set to 113, indicating that the values come from the ION 7300. The Periodic Timer module’s *Period* register is set to 900, so the Data Recorder module is pulsed every fifteen minutes (900 seconds). When it is pulsed the Data Recorder module records the values in its *Source 1-3* inputs. Once the values are successfully recorded, the Data Recorder module's *Record Complete* output pulses the Log Export module’s *Send* input. The Log Export module then sends all its *Source* data records that have not previously been sent to the email specified in the *Destination* setup register (john@host.com).

The *Gatewayed Device Name* register in the Log Export module is configured with a value other than Default. This identifies the data as belonging to the meter known as "Office," which in this case is the ION 7300. If this register were to remain as Default, the data would appear to come from the ION 7500, because the value for the *Gatewayed Device Name* would come from the Factory module's *Device Name* setup register.

ION® Security

ION Security consists of ION software security and ION meter security. ION software security requires you to log on to its components (such as Vista™, Designer™ and Device Upgrader) with a user name and password. The ION software user account restricts the use of ION software to view or setup configuration changes on the meter.

ION meter security requests a password when you attempt to save a change on to the meter either through the front panel of the meter or using software (ION or third party software).

Some ION meters support Advanced security where you can configure the meter to recognize multiple users each with different levels of access to the meter components and functionality.

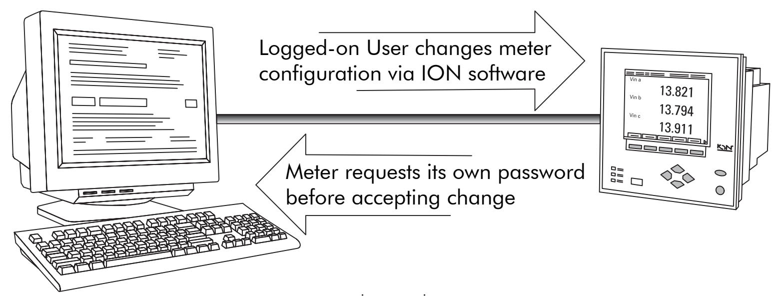
In This Document

Overview of Security

Two separate layers of ION security protect your power monitoring system from unsolicited changes or tampering: ION software security and ION meter security. Each type of security has its own password protection scheme. An optional hardware lock security is also available for revenue meters.

ION Software Security

ION Meter Security



ION Software Security

- ◆ Requires valid user name and password when starting any ION software component
- ◆ Logon provides your security access level, which in turn determines the manner of configuration changes you can make
- ◆ Password-enabled access is separate from meter security
- ◆ You must still provide the meter's password to make any configuration changes

ION Meter Security

- ◆ Requires a password separate from ION software password
- ◆ Capable of Standard and Advanced Security

Standard

- ◆ Requires single password with no username
- ◆ Enabled by default on all ION meters
- ◆ Meter password still required for changes made using software

Advanced

- ◆ Available on ION 8000 Series meters only
- ◆ Up to 16 different users allowed, each user has unique access rights
- ◆ Requires both username and password

Optional: Hardware Lock Security

- ◆ Meter is physically locked
- ◆ Denies any changes to revenue-related parameters
- ◆ Must break the lock and place the meter in TEST mode to change revenue related modules

Icon Descriptions

You will encounter the following security-related icons within ION meters and ION software.

This icon refers to **ION software security**. See "ION Enterprise Software Security" on page 251 and "ION Setup Software Security" on page 253.

This icon refers to **ION meter security**. See "Standard Meter Security" on page 255 and "Advanced Meter Security (ION 8000 Series)" on page 258.

ION Enterprise Software Security

The ION software security system limits how you can view meter data and send configuration changes to ION meters. You must have a valid user account to log on to any ION software application. Your access level determines the type of operations you can perform.

Security Access Levels

Security access levels define how you can use the software to view and acknowledge meter data or set up configuration changes that are sent to a meter. The table below summarizes the user accounts and their permissions.

	Supervisor (5)	Operator (4)	Controller (3)	User (2)	View Only (1)
View Vista or Designer diagrams	YES	YES	YES	YES	YES
Connect/disconnect sites or devices	YES	YES	YES	-	-
Modify network configuration (using Management Console)	YES	YES	-	-	-
Change Vista or Designer diagrams	YES	-	-	-	-
Administer software security	YES	-	-	-	-

NOTE

Vista control objects have a default "may operate" setting of Controller(3). If you want individuals with "User" security access to be able to perform a control object's double-click action, you must change the "may operate" level to User(2).

Note that ION software access will not necessarily give you access rights to view or configure meter information.

For example, you've logged on to Designer at the supervisor access level (Standard security is enabled). If you change one of the ION module settings and then send this change to the meter, the meter requests its own password before executing the change. In other words, supervisor-level access grants you the authority to modify settings in ION software, but the meter provides its own, second layer of security.

If Advanced security is enabled on the meter you must supply a user name and password to connect to the meter and view data.

Entering the software user name and password

1. Enter your valid user account information when prompted with this window:

The default password is zero (0) and the default user has Supervisor access.

Creating or modifying ION Enterprise user accounts

1. Launch the Management Console and log on with Supervisor access.
2. Choose User Administrator... from the Tool menu.
3. Use the buttons to Add or Remove accounts or Change passwords on existing accounts.

ION Setup Software Security

ION Setup provides a four-level security access system. Supervisor-level personnel can control access and define which functions are available to each user by grouping the user according to security level, as follows:

Supervisor: This level is for management or supervisory personnel. This permits access to all device configuration functions, including the security list, system/ network configuration, and data display functions.

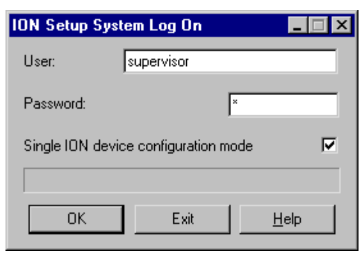
Operator: This level is for high level system operators. This permits access to system configuration and data display functions. Operators should be well trained in operating ION Setup.

Controller: This level allows a controller to display data but not to change ION Setup or meter configuration. This level also allows a controller to operate triggers.

User Security level 1: This is suitable for personnel that use ION Setup on a regular basis and who inform Supervisors or Operators of alarm conditions.

Entering the software user name and password

1. Enter your valid user account information when prompted with this window:

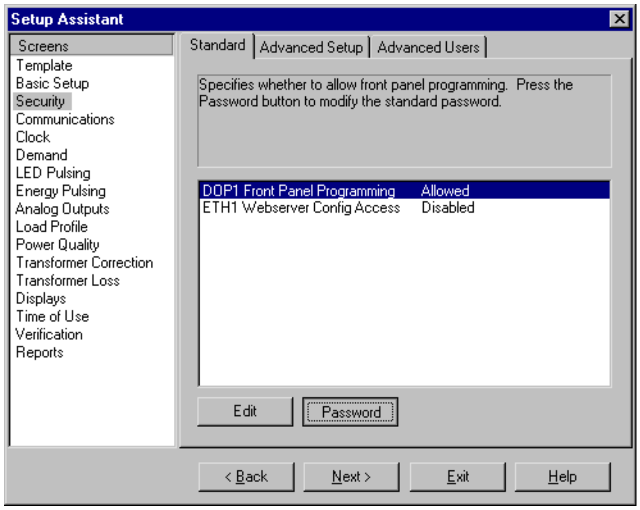


The default password is zero (0) and the default user has Supervisor access.

Creating or modifying ION Setup user accounts

1. Launch ION Setup and log on with Supervisor access.
2. Connect to the appropriate meter and double-click the Setup Assistant.

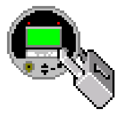
3. Click the Security heading in the Setup Assistant.



4. Use the available tabs to Add or Remove accounts or Change passwords on existing accounts.

ION Setup supports a maximum of 50 users.

ION Meter Security



Any configuration changes sent to the meter through its communications ports or its front panel must be validated with the meter’s password (in addition to your ION software password) before the change is set on the meter.

The Meter Password

The meter password is a numeric string of up to eight digits. If Standard security is enabled, the meter password is required when you attempt to make a change to the meter configuration through the front panel or using software such as Vista, Designer, Device Upgrader or ION Setup.

NOTE

The *Front Panel Programming* setup register in the Display Options module lets you lock out any changes through the front panel. You can set this register using Designer or ION Setup software.

Standard Meter Security

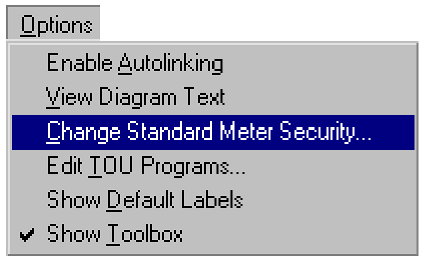
Standard meter security is enabled by default on all ION meters; all configuration functions in the front panel are password-protected. The password is factory-set to 0 (zero).

If you make configuration changes to the meter via the front panel, the meter prompts you for its password before accepting any configuration changes. Similarly, if you make any configuration changes via ION software you are prompted by the meter for its password (in addition to the password used to access ION software). Once you enter the correct meter password and confirm the new configuration, the change is set on the meter.

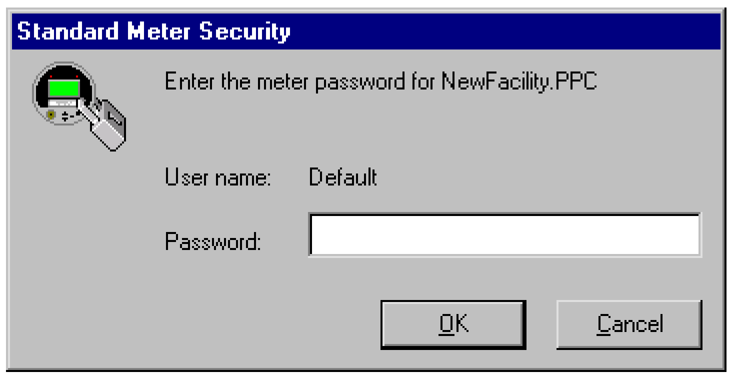
Note that the front panel will prompt you for the meter password before you make your first configuration change. You will not need to re-enter the password for each subsequent change. However, if you perform no additional configuration changes for five minutes, you will need to re-enter the Setup menu and provide the valid meter password to resume making changes. This is because the meter returns from setup mode to data display mode after five minutes of inactivity.

Configuring standard meter security in Designer

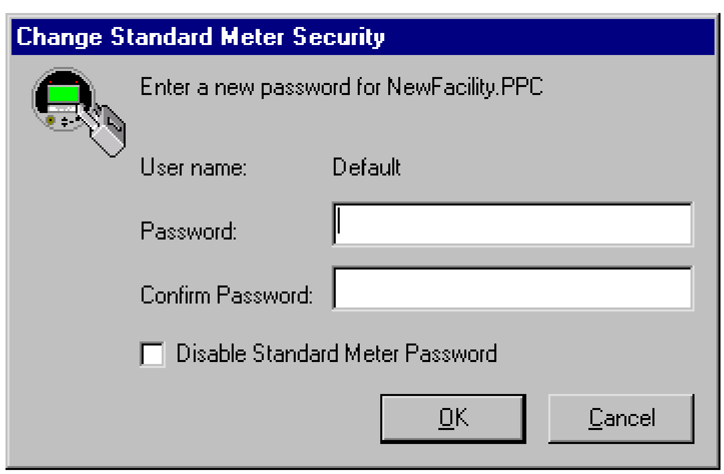
1. Launch Designer software with Supervisor access.
2. Select Options > Show Toolbox if the toolbox is not displayed.
3. From the Options menu, select Change Standard Meter Security...



4. Enter the meter password when prompted. You must enter the existing meter password before you can change security settings (the default is zero).



5. Type a new numeric password and confirm by re-typing the password in the fields (see image below). If you are sure you want to disable Standard security, click the Disable Standard Meter Security check box.

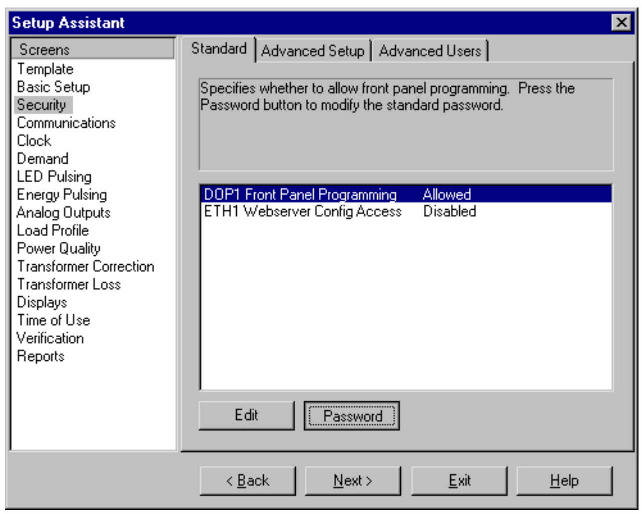


⚠ CAUTION

Do not disable security unless it is absolutely necessary. Disabling Standard security leaves your meter configuration open to tampering (intentional or unintentional) through communications and the front panel.

Configuring standard meter security in ION Setup

1. Launch ION Setup with Supervisor authority.
2. Connect to the appropriate meter.
3. Once connected, double-click the Setup Assistant and select the Security heading.
4. Make sure the Standard tab is selected



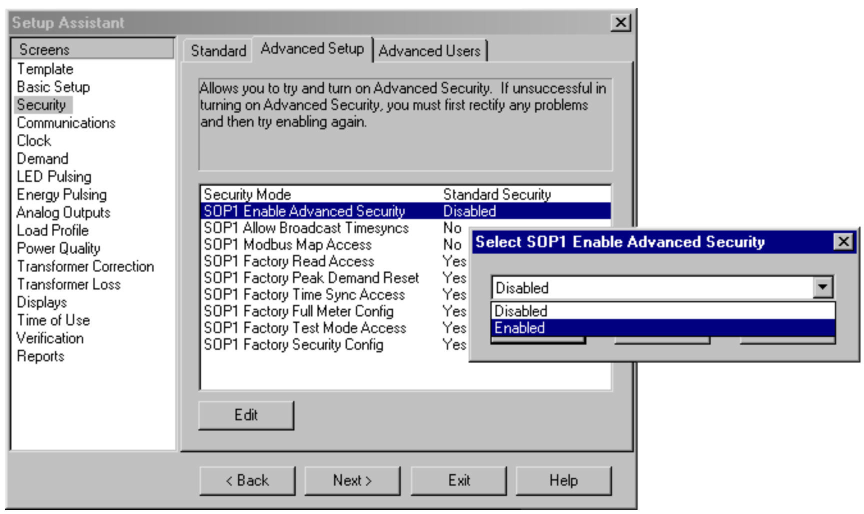
5. Click Password. The following dialog box appears:

6. Type a new numeric password and confirm by re-typing the password in the fields.

Advanced Meter Security (ION 8000 Series)

Available on ION 8000 Series meters, this level of security allows you to configure up to 16 users, each with unique access rights to the meter. Access rights consist of the following levels where you can:

- **Read:** view any parameter except the security configuration.
- **Peak Demand Reset:** perform a reset of peak demand values (for example, sliding window demand for kW, kVAR, kVA etc.).
- **Timesync:** set the time on the meter.
- **Full Meter Configuration:** configure any programmable register on the meter except for registers related to the security setup, registers that result in a demand reset, or actions that place the meter in test mode.
- **Test Mode:** put the meter into test mode.
- **Advanced Security Configuration:** configure Advanced security for the meter, full meter configuration must also be set to YES.



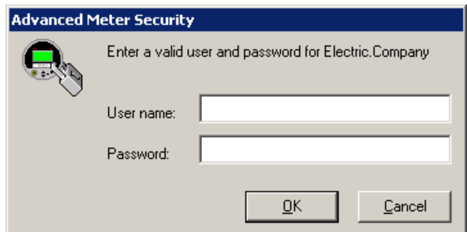
When configuring users, in most cases you must set Read access to YES. However, you can set up a user without read access; for example, you may want to create a user who can only timesync the meter. In some cases (such as Advanced security configuration access) you must set multiple access options to YES. When you are configuring Advanced security, the software rejects unacceptable or unsafe user configurations.

NOTE

Use only ION Enterprise or ION Setup v1.1 to configure Advanced security. ION Setup has a Setup Assistant that guides you through Advanced security setup.

Entering an advanced security user name and password

When you attempt to view data or make a change to a meter that has advanced security enabled, you are prompted for a user name and password.



1. Enter the valid Advanced security user name.

NOTE

User names are fixed as USER1 through to USER16.

2. Enter the appropriate password and click OK.

Configuring advanced security using ION Enterprise

If you are using Designer software follow the instructions below.

1. Launch Designer software with Supervisor access. From the File menu choose Open... and select the meter you want to configure with Advanced security.
2. If the toolbox is not displayed, choose Options from the main menu and select Show Toolbox.
3. If you do not want to allow front panel programming using the Standard security meter password then double-click on the Display Options module and change the Front Panel Programming register to disallow.

NOTE

If you allow front panel programming when you set up Advanced security, the meter password (used in Standard security) is still active through the front panel. You may need to allow front panel programming if someone installs the meter in the field and needs to make setup modifications. Once the meter is installed, you can disallow front panel programming so that Advanced security user names and passwords must be used to view or change meter information.

4. Double-click on the Meter Security Setup folder.

   For each user you want to configure, drag out a Security User module from the Toolbox, and modify the appropriate access level setup registers.
5. Click the Change Password button at the bottom left of the module setup screen to configure a password. The default password is zero (0).

   Click OK when you have configured the users.
6. Right-click on the Security Options module.
7. Double-click on any setup register and use the drop-down menu to change the register setting or label.

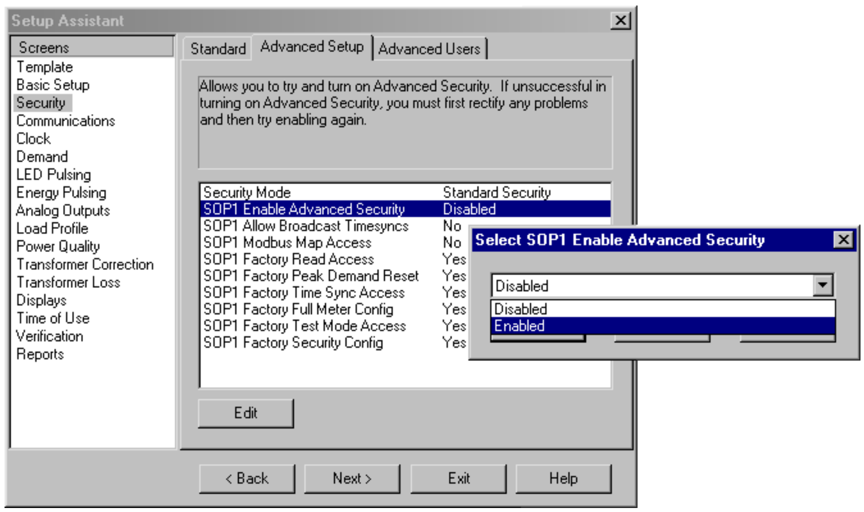
You must set the 'Enable Advanced Security' register to Enabled. Refer to the Security Options module description in the ION software online help for more details.

8. From the File menu choose Send & Save. Advanced security is now enabled on the meter.

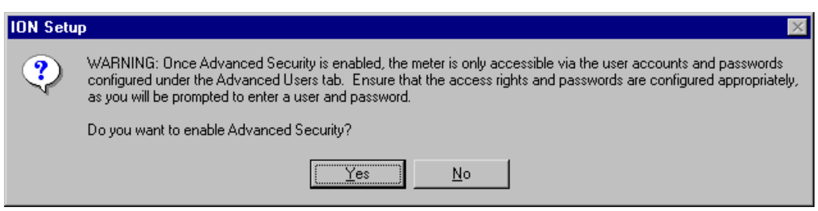
Configuring advanced security using ION Setup

If you are using ION Setup software follow the instructions below.

1. Launch ION Setup with Supervisor access.
2. Connect to the meter you want to configure with Advanced security.
3. Once connected, double-click the Setup Assistant in the right-hand column of the Network Viewer.
4. Select the Security heading in the left-hand column of the Setup Assistant. Click the Advanced Setup tab.
5. Click the SOP1 Enable Advanced Security listing. Click Edit.



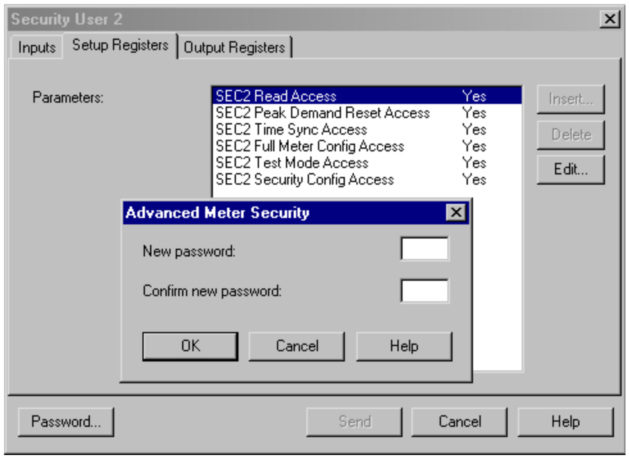
6. Select the Enabled setting. You will be prompted with the following warning screen. Click Yes.



Configuring advanced users with ION Setup

1. Click the Advanced Users tab in the Security setup screen.
2. Click the Add User button. ION Setup automatically adds a new user.

3. Select the new user listing and click Edit. The following dialog box appears:



Use the available settings to configure access levels for the new user. Passwords can also be changed from this screen.

4. Click Send to send the changes to the meter.

Device Security Access for ION Services

Many ION services need constant access to your network's ION devices. These services include the ION Log Server, the VIP and Site Server that perform the following type of functions:

Service	Function
ION Log Server	Reads the ION meter Data Recorder or waveform modules
VIP	Can be configured to read from a meter or perform control action using Distributed Control
Site Server	Broadcasts time signals to the meter

When Advanced meter security is enabled, these services may not have sufficient access rights to perform their operations. You must specify a user with sufficient access rights for these services.

NOTE

You may want to configure a separate user for accessing services. If you observe trouble with ION software accessing the meter, it is likely that these services either do not have access rights or the original user name and password have changed.

Allowing ION services access to advanced security enabled meters (ION Enterprise)

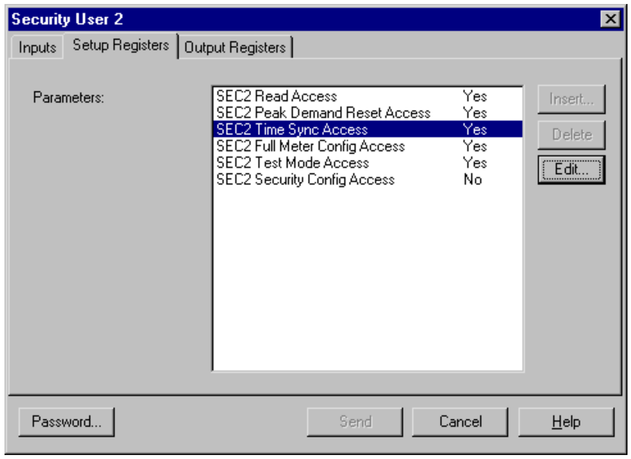
1. Launch the Management Console and click Devices on the Management Console's System Setup Pane.
2. Highlight an ION device (or select multiple devices) with Advanced security enabled, right-click and select Security... The following window displays.

3. Select the user name you want from the drop down menu. Once you select a user the Change Password button is active. Click the check box if you want to allow this user to send time synchronization signals to the meter. Click OK.
4. Enter the valid password, re-type the password to confirm and click OK.

Allowing ION services access to advanced security enabled meters (ION Setup)

1. Launch ION Setup and connect to the appropriate meter.
2. Once connected, open the Setup Assistant and select Security from the left-hand column. Make sure Advanced Security is enabled in the Setup Assistant.

3. Select the user name you want from the available list. Click the Edit button. The following window appears:



4. Click Time Sync Access from the available settings list. If you want to allow this user to send time synchronization signals to the meter, ensure the setting reads Yes. To change the setting, click the Edit button and make the appropriate changes.

Additional Revenue Metering Security

To meet government regulations and utility security requirements, the revenue meter incorporates additional security systems:

- a hardware-locked security system that prevents modification of revenue quantities after the meter is sealed.
- a traditional anti-tamper mechanical seal on the meter base unit.

Hardware Lock Security

The hardware-locked security feature is an ordering option for some ION meters. This hardware lock is factory set; to make configuration changes to billing parameters on a hardware-locked meter, you must first place the meter in TEST mode. Refer to your meter's User's Guide for the location of the test mode button. In all cases, the TEST mode button is located under the anti-tamper sealed outer cover.

In certain countries the meter is no longer revenue certified if the hardware lock is broken.

Typical values that are protected include:

- kWh, kVARh, kVAh delivered, received, del-rec, del+rec.
- kW, kVAR, kVA Thermal and Sliding Window demand min and max values.
- Digital Outputs controlling the energy pulsing applications.
- All Power system settings, including PT an CT ratios.

Anti-Tamper Seals

Revenue meters incorporate one or two sealing cans through which traditional lead/ wire seals are inserted. These seals effectively prevent unauthorized personnel from gaining access to meter internals, and are provided with the meter.

ION® TECHNOLOGY

TECHNICAL NOTE

WebMeter® Internal Web Server Feature

Several ION® meters offer WebMeter capability, which allows you to view meter data and perform basic meter configuration using a web browser. The meter can be connected to your corporate Ethernet network like any other network device, and you can access it with a standard web browser like Internet Explorer.

In This Document

Introduction

This document addresses three audiences: the web browser user, the network administrator, and the ION Enterprise™ software administrator.

Web Browser User

The first two sections are geared to the web browser user and discuss how to view meter data, and perform basic meter configuration. These sections are titled:

- Viewing WebMeter Data on the Internet
- Configuring your Meter

Network Administrator

The third section is geared to the network administrator and discusses how to incorporate the meter into the corporate network so a user can access the meter with a web browser. This section is titled:

- Setting Up your WebMeter Network

ION Software Administrator

The fourth and fifth sections are geared to the ION software administrator who uses Designer to enable or disable configuration of the meter with a web browser. These sections are titled:

- Enabling/Disabling Meter Web Browser Configuration
- Enabling/Disabling Meter Web Server Functionality

Viewing WebMeter Data on the Internet

With WebMeter, you can view various power measurements over the web, in both HTML and XML formats. For example:

- real-time voltages, currents, power (kW, kVAR, kVA), power factor and frequency
- accumulated energy
- peak demand

There are two types of web pages you can use to view meter data: default and custom. The default pages display pre-determined sets of values while the custom pages can be created to display any values the user requires.

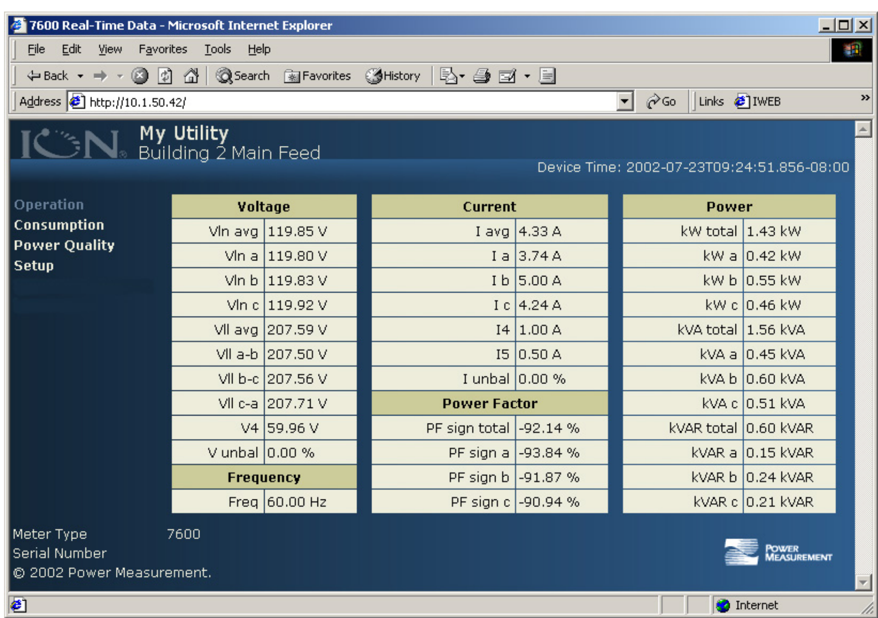
Default Web Pages

Your meter comes with five default web pages. Although you cannot create more default pages, you can make minor alterations to the existing ones. Default web pages are slightly different for each meter.

Viewing default web pages:

1. Start your web browser.
2. Type the meter’s IP address into the browser’s address field. (If necessary, contact your network administrator for the IP address). The default page will appear, and will be different for each meter family.

   Below is the default page for the ION 7600 meter, the **Operation** screen. (If Advanced Security is enabled on your ION 8000 Series meter, you must enter a user name and password before the Operation screen appears).



3. To view consumption measurements, click the **Consumption** link at the left side of the screen.
4. To view power quality measurements, click the **Power Quality** link at the left side of the screen.

The Setup and Network Setup pages are covered in the section, "Configuring your Meter".

Custom Web Pages

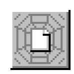
The Web Page module is used to create custom pages with parameters you specify. These pages can be created as either HTML or XML. The XML pages will display only XML code in the browser unless they are linked to an XSLT stylesheet.

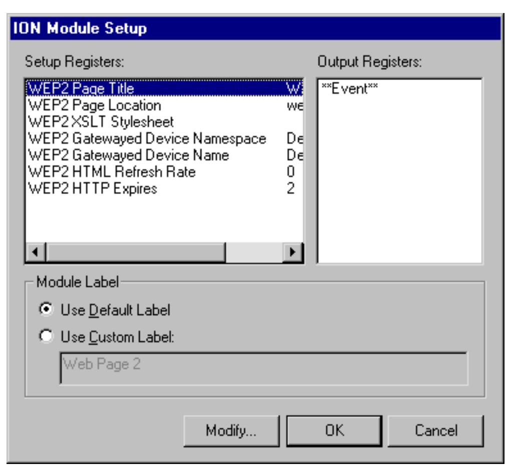
NOTE

For comprehensive information on the XML schemas provided by the Web Page module, you can view the Resource Directory Description Language (RDDL) documents at:
http://rddl.xmlinside.net/PowerMeasurement/data/ion/presentvalue/1

Refer to the following instructions to learn how to create custom web pages with Designer software.

Creating custom web pages:

1. Open the meter in Designer.
2. Drag a Web Page module from the Toolbox. 
3. Right-click the module to enter setup.



The following setup registers are used with the Web Page module:

- **Page Title:** This register determines the title for the customized web page.
- **Page Location:** This register specifies the location (or address) of the web page.

- **XSLT Stylesheet*:** This optional register specifies the URL where the XSLT stylesheet is located.
- **Gatewayed Device Namespace*:** The string value in this register is used as the namespace attribute in the Device element of XML messages generated by the module.
- **Gatewayed Device Name*:** The string value in this register is used as the name attribute in the Device element of XML messages generated by the module.
- **HTML Refresh Rate:** This register's value, which is inserted into an HTML META tag on the web pages, indicates how often to update the web page when viewed in a browser.
- **HTTP Expires:** This register specifies when the web page expires.

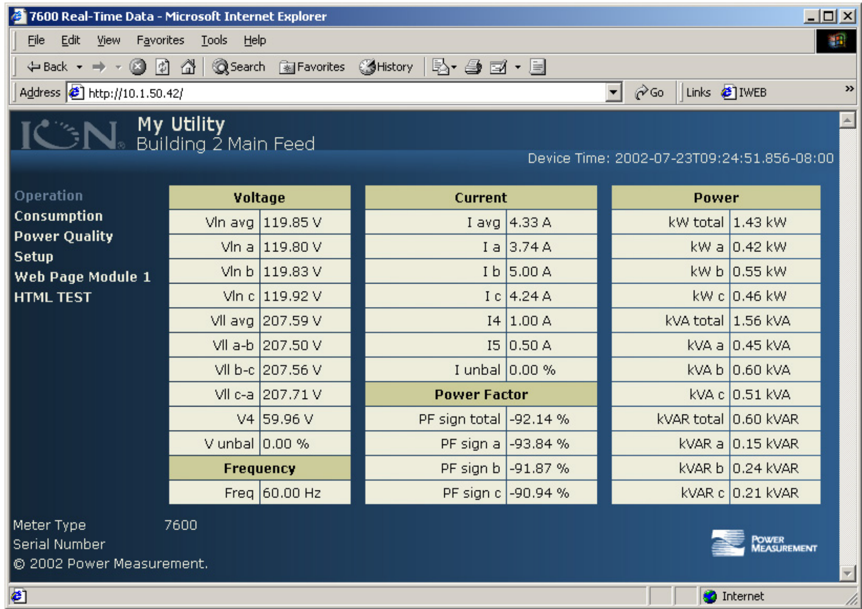
* These registers only apply to XML web pages

4. To change the module Label (name) from its default setting, check "Use Custom Label" and enter the new name.
5. To change a Register Label (name) from its default setting, double-click on the register, check "Use Custom Label" and enter the new name.
6. To change a Register Value from its default setting, double-click on the register, then enter the new value.
7. Link other module outputs to the Web Page module inputs for the values you require. You can have up to 50 sources per Web Page module.
8. Click **Send and save**.

Viewing custom web pages:

1. Start your web browser.
2. Type the meter's IP Address into the browser's Address field. (If necessary, contact your network administrator for the IP Address). The default page will appear and will be different for each meter family.

   Below is the default page for the ION 7600 meter. Notice the link under the Setup screen link: Web Page Module 1. This is a custom page created for this particular meter.



3. To view a custom page in HTML, click its link at the left side of the screen, or enter the address of the page and use the .html extension.

   For example:

   http://10.1.50.42/webpage1.html

4. To view a custom page in XML, enter the address of the page and use the .xml extension.

   For example:

   http://10.1.50.42/webpage1.xml

5. To view the meter's catalog XML web page, enter the following address:

   http://<enter meter IP address here>/catalog.xml

NOTE

For comprehensive information on the XML schemas provided by the Web Page module (specific to the catalog web page), you can view the Resource Directory Description Language (RDDL) documents at: http://rddl.xmlinside.net/PowerMeasurement/data/ion/presentvalue/catalog/1

See the online *ION Programmer's Reference* for more information on using the Web Page module.

Configuring your Meter

Use the Setup page to configure your meter's WebMeter feature.

If security is enabled, as a security measure, you must enter a user name and the meter password when you change a parameter. Note that security is enabled by default. Contact your ION software administrator for a user name and the meter password.

NOTE

If meter configuration via a web browser is disabled, and you attempt to configure the meter, an error message displays. To enable meter configuration via a web browser, see "Enabling/Disabling Meter Web Browser Configuration" on page 277.

Since every meter family will have different default web pages, the following instructions may not be exactly accurate for your meter.

Using the Setup Page

Use this page to change your default web page's power meter measurement parameters.

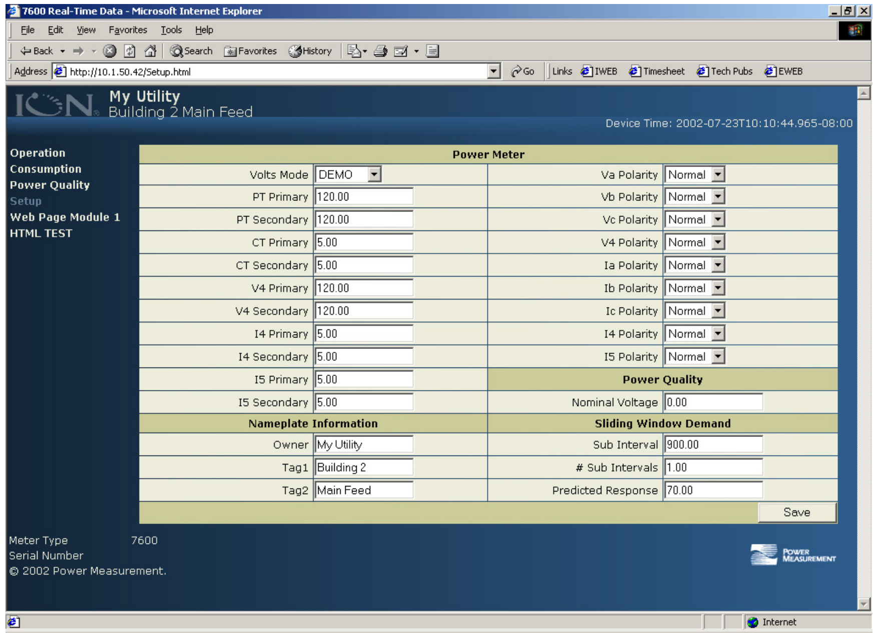
Configuring your meter with the Setup page:

1. Start your web browser.
2. Type the meter's IP Address into the browser Address field. The Operation screen appears.

NOTE

If Advanced Security is enabled on your ION 8000 Series meter, you must enter a user name and password before the Operations screen appears. To configure your meter with a web browser, your user name and password must have "Full Config Access" on the meter.

3. At the left side of the screen, click on the **Setup** link.



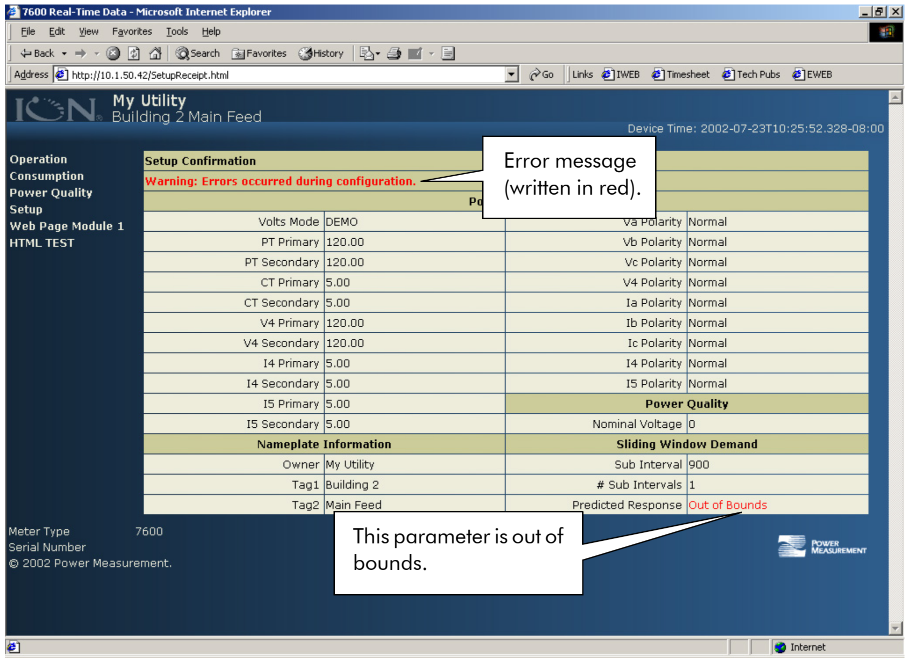
4. Edit the parameters you wish to modify. If you are satisfied with your changes, proceed to step 5.
5. **Undo Changes**
   If you are not satisfied with your changes, you can revert to the previous settings by clicking another link on the left and then returning to the Setup page. Using your browser's **Back** button will not work.
6. Click the **Save** button. A pop-up window appears asking for your user name and the meter password. If you have Advanced Security enabled on your ION 8000 Series meter, you are prompted for a password before the connection is made.
7. Type in your user name and the meter password. (If necessary, contact your ION software administrator for the user name and meter password). The Setup Confirmation screen appears. This screen shows all the parameters, including your changes.

NOTE

Configuration changes made to the Sliding Window Demand parameters on an ION 7300 Series meter can take up to two minutes to complete.

Setup Errors

If any errors occur when you attempt to save the new settings, an error message displays on the confirmation page. Any parameters which are not successfully set are highlighted in red and remain unchanged on the meter.



If you still wish to change the parameter values, you should determine the cause of each error (e.g. incorrect parameter value). Then, using your browser's Back button, return to the Setup page and attempt the changes again.

For more information regarding error messages, contact Technical Services.

Setting Up your WebMeter Network

This section presents information geared to the network administrator who sets up the corporate network for web browser access to the meter. The required network components for using WebMeter are described, as well as the configuration of network settings.

Configuring Meter Network Settings

A WebMeter-enabled device resides on an Ethernet network and requires an IP Address and other network settings to define its location on the network, and to interact properly with other network devices. These network settings can be set manually with the meter's front panel, or automatically with a BootP Server.

To learn how to configure meter network settings manually with the meter's front panel, refer to Network Settings in your meter's *Installation and Basic Setup Instructions*.

Automatic Configuration via a BootP Server

BootP (Bootstrap Protocol) is a protocol that automatically configures a device's (e.g. meter's) network settings without user involvement.

The BootP server is managed by the network administrator, who allocates the meter IP address and other network settings to the BootP server. When this is completed, and the meter is booted up, the BootP server automatically assigns the IP address and other network settings to the meter.

When the meter is in BootP mode, it does not need to be manually re-booted for an IP address change. Since most power meters cannot be easily rebooted on demand, the meter has been set up to poll the BootP server every eight hours for an IP address. If the IP address is changed on the BootP server, then the meter obtains the new address at the next polling interval.

NOTE

Depending on your meter and meter firmware version, BootP may be enabled by default; check your meter's *Basic Setup and Installation Instructions*. You can enable BootP with the meter's front panel or with ION software.

Preparing the BootP Server to automatically configure network settings:

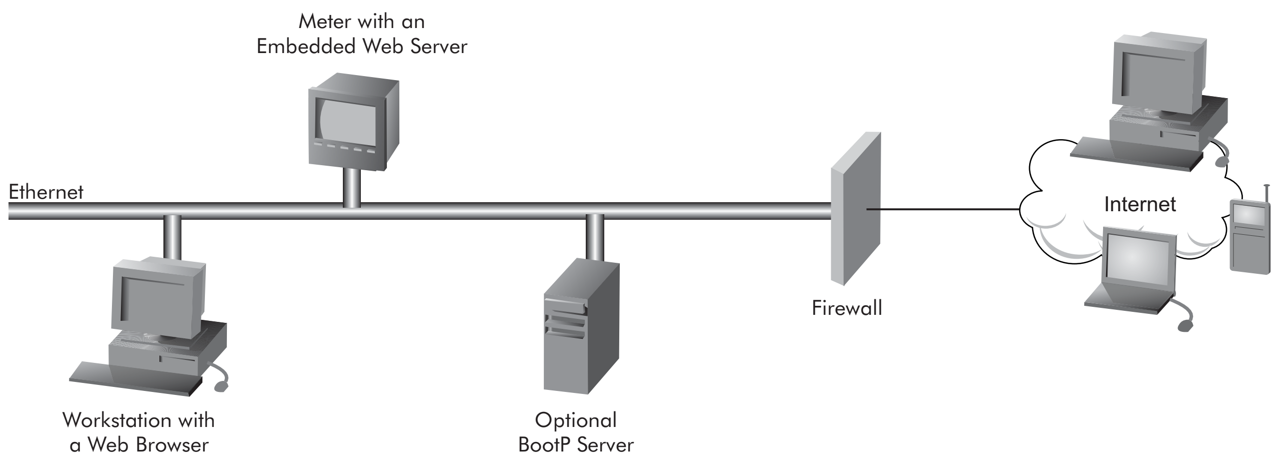
1. Set up the BootP server on the same Ethernet network as the meter you wish to access using a web browser. Follow the documentation packaged with the BootP software for the correct installation.
2. Enter the meter Ethernet MAC address in the BootP database.

3. Allocate these settings to the meter Ethernet MAC address:
   - meter IP Address
   - Subnet Mask (if the network is subnetted)
   - Gateway (if the network has a default gateway)
   - SMTP Mail Server Address (mandatory for MeterM@il)

NOTE

When the meter is in BootP mode, you must configure the network settings in the BootP server. Otherwise, those settings will NOT be updated on the meter. In BootP mode, you are prevented from changing network settings through the meter's front panel, or with ION software.

A WebMeter Network



The above illustration shows a network set up for WebMeter use. The meter can be accessed by the web browser of a workstation on the same Local Area Network (LAN) as the meter. Alternatively, any device with a web browser can access the meter over the Internet, providing that a valid TCP/IP path exists between the meter and that device. This may require changes to existing firewalls or other security mechanisms.

The WebMeter network components are described below.

- **Ethernet network**: Ethernet is the connection medium for web access to a meter.
- **Workstation with a web browser**: any computer that is connected to the same network as the meter can access the embedded web server via that computer's web browser. Alternatively, any computer with a web browser can access the WebMeter-enabled meter over the Internet providing that a valid TCP/IP path exists between the meter and that device. Firewall restrictions may apply.
- **Meter with an embedded web server**: the meter can be connected to your LAN like any other network device.

- **BootP server**: a server can be set up to automatically configure meter network settings. See "Configuring Meter Network Settings" on page 274.
- **Firewall**: to access the meter from beyond the corporate network, a firewall configured for your meter is recommended. For WebMeter equipped devices, HTTP uses TCP/IP port 80; you must configure the firewall to allow incoming connections on TCP/IP port 80 to read the meter.

Enabling/Disabling Meter Web Browser Configuration

You can enable/disable web browser configuration of the meter with Designer software or the meter's front panel. Refer to your meter's *Installation and Basic Setup* manual to learn how to enable/disable web browser configuration of the meter with the front panel. Refer to the following instructions to learn how to enable/disable web browser configuration with Designer software.

NOTE

Depending on the meter, web browser configuration of the meter may be enabled by default.

Enabling/disabling web browser configuration of the meter:

The steps are the same for enabling or disabling web browser configuration of the meter; in step 3 you select either option.

1. Open the meter in Designer and double-click on the **Communications Setup** folder. The screen that appears contains shortcuts to several Communications modules and one Ethernet module.
2. Right-click on the icon in the center of the Ethernet module. The ION Module Setup screen appears.
3. Double-click the **Webserver Config Access** setup register and change the value to "Enabled" or "Disabled."
4. Click **Send and save**.

Enabling/Disabling Meter Web Server Functionality

You can enable/disable the web server functionality of the meter with Designer software. Refer to the following instructions to learn how to enable/disable web server functionality with Designer software.

NOTE

Depending on the meter, web server functionality of the meter may be enabled by default.

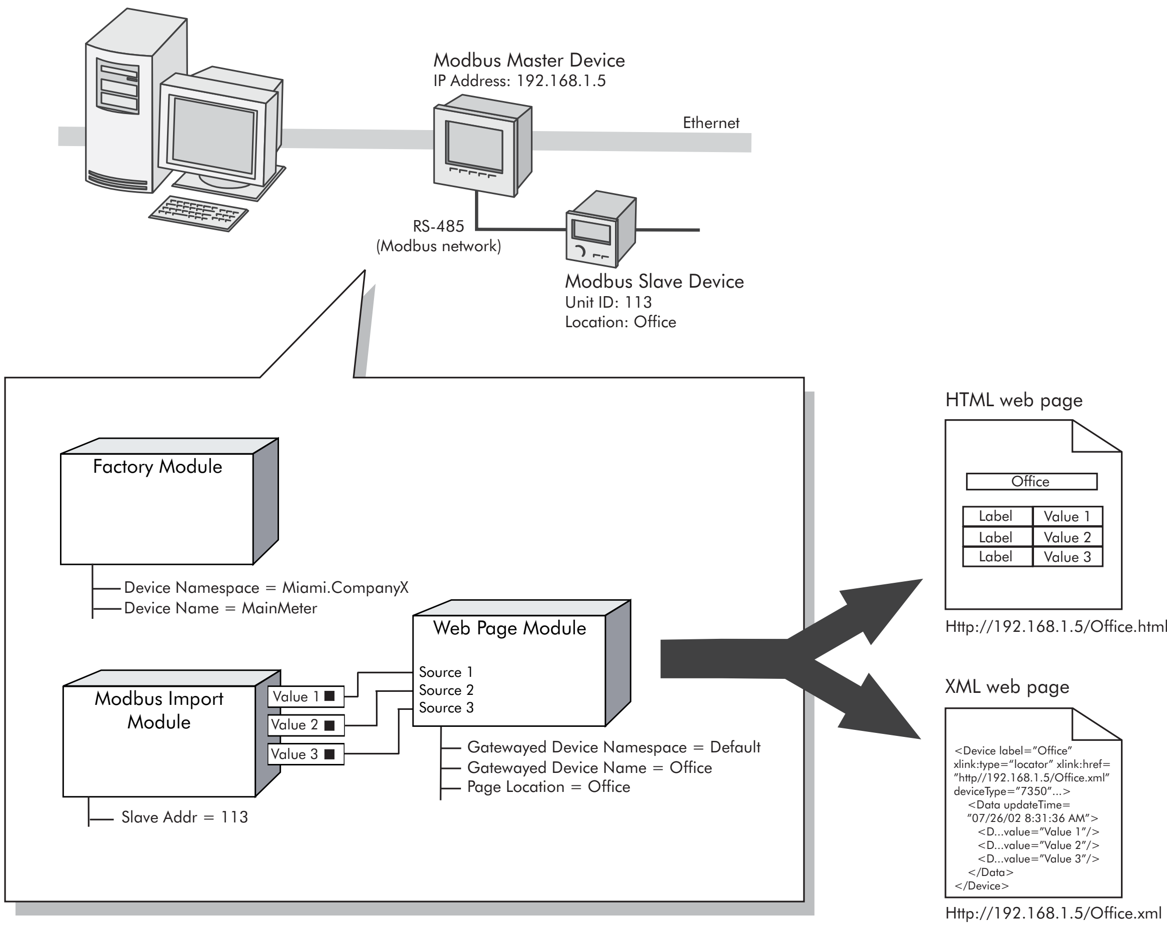
Enabling/disabling web server functionality of the meter:

The steps are the same for enabling or disabling web server functionality of the meter; in step 3 you select either option.

1. Open the meter in Designer and double-click on the **Communications Setup** folder. The screen that appears contains shortcuts to several Communications modules and one Ethernet module.
2. Right-click on the icon in the center of the Ethernet module. The ION Module Setup screen appears.
3. Double-click the **Enable Webserver** setup register and change the value to "Yes" or "No."
4. Click **Send and save**.

Using WebMeter in a Modbus Network

Below is a typical application of the WebMeter feature.



Hardware

In this example, the ION 7500 meter is WebMeter enabled, and is acting as Modbus master to the ION 6200 meter (acting as Modbus slave). The IP Address of the ION 7500 meter is 192.168.1.5 and it is also connected to the workstation PC via the Ethernet.

The ION 6200 meter's Unit ID is 113 and its location is the office. It is serially connected to the ION 7500 meter using RS-485 cable.

Framework

The framework for the ION 7500 meter shows how the different modules are configured to produce a custom web page for the ION 6200 meter.

Factory Module

The Factory module has been configured so that the setup register *Device Namespace* value is "Miami.CompanyX" and the setup register *Device Name* value is "MainMeter".

Modbus Import Module

Three values (Value 1, 2 and 3) are imported from the ION 6200 meter via the Modbus Import module. These values are then linked to the Web Page module for the web page to display. The *Slave Addr* setup register's value is "113" which corresponds to the Unit ID of the Slave meter.

Web Page Module

The Web Page module has Values 1, 2 and 3 for its sources. Setup register *Gatewayed Device Namespace* has a default value which means the register inherits the value from the Factory module's *Device Namespace* setup register. In this example, the value is "Miami.CompanyX".

Setup register *Gatewayed Device Name* value is "Office". This value is important if more than one gatewayed device is sending XML data to the Web Page module. Otherwise, it can be left as default in which case the register inherits the value from the Factory module's *Device Name* setup register. In this example, the value would be "MainMeter".

The value of the *Page Location* setup register is "Office". Since the ION 7500 meter's IP Address is 192.168.1.5, the web page for the ION 6200 meter will be found at: http://192.168.1.5/Office.html (or.xml)

Modem AT Commands

This technical note outlines compatible AT commands that may be used with ION meters equipped with the internal modem option. AT commands control a modem's operation and are useful for setting up the modem (for example, if you want to turn off the modem's autoanswer feature). All AT commands begin with the characters **AT**, which is short for "attention code". This is what alerts the modem that a command is following immediately.

⚠ CAUTION

Adding, removing or changing AT commands should only be performed by qualified individuals. Putting improper code in the modem configuration string could cause the modem to become inoperable.

Depending on the ION meter and its date of manufacture, the installed optional internal modem could be one of two different brands. The Conexant modem is the older type modem, and is available in North American (FCC approved) or European (CTR-21 compliant) versions. The newer modem is manufactured by Multi-Tech and is a universal modem that can be readily used in most countries, and complies with FCC, Industry Canada and TBR-21 regulations.

Contained in this document is a section explaining how you can determine which type of modem is installed on your ION meter, a section that lists AT command sets for the new (Multi-Tech) modem, and a section that lists AT command sets for the older (Conexant) modems.

In This Document

ION Meter Internal Modem Types

The change to the internal modem installed in ION meters began during mid-third quarter of 2001. This switchover is traceable to the meter and its serial number.

The serial number follows the format xx-YYMMxNNN-xx, where YY is the year of manufacture, MM is the month of manufacture, and NNN is the unit number (i.e. the nth unit manufactured during the YYMM period). YY=01 indicates the year 2001, MM=01 indicates January and MM=12 indicates December.

ION meter	Starting serial number for units equipped with new Multi-Tech modem
ION 7500	PK-0111A184-01
ION 7600	PL-0111A176-01
ION 7700	PM-0111B005-06
ION 8300	PS-0108A012-01
ION 8400	PR-0108A156-02
ION 8500	PQ-0108A003-03

Use the above table to determine which internal modem is equipped in your ION meter. If YYMM on your meter's serial number is lower than what is listed in the table, then your meter is equipped with the older (Conexant) modem. If YYMM on your meter's serial number is higher than what is listed in the table, then your meter is equipped with the newer (Multi-Tech) modem.

If YYMM on your meter's serial number is the same as what is listed in the table, then use NNN to compare — if NNN on your meter's serial number is lower than what is listed in the table, then your meter is equipped with the older (Conexant) modem; if it is higher, then your meter is equipped with the newer (Multi-Tech) modem.

Multi-Tech Modems in ION Meters

The Multi-Tech ModemModule™ is the newer-type modem equipped in ION meters that are ordered with the internal modem option. The Multi-Tech modem is compatible with most telephone systems in the world, with the exception of Australia and New Zealand.

Multi-Tech Internal Modem Settings

Since the Multi-Tech modem are universally compatible with most telephone systems, no further reconfiguration of the default settings should be necessary.

International support

In some cases, the default initialization string for the internal (Multi-Tech) modem may need to be changed depending on the country it is used in. Countries not listed below are compatible with the default (North American) settings:

- Hong Kong, Hungary, India, Indonesia, Israel, Korea, Malaysia, Philippines, Poland, Singapore, Slovenia and Vietnam
  AT%T19,0,30
- Czech Republic
  AT%T19,0,25
- Japan
  AT%T19,0,10

AT Commands for the Multi-Tech Modem

The following table summarizes the compatible AT commands for ION meters equipped with the Multi-Tech internal modems:

Command		Values	Default	Description
AT	Attention Code	n/a		The attention code precedes all command lines except A/, A:, and escape sequences.
A/	Repeat Last Command	n/a		Repeat the last command string. Do not precede this command with AT. Do not press ENTER to execute.
Bn	Communication Standard Setting	n = 0–3, 15, 16	1 and 16	B0 Select ITU-T V.22 mode when modem is at 1200 bps. B1 Select Bell 212A when modem is at 1200 bps. B2 Deselect V.23 reverse channel (same as B3). B3 Deselect V.23 reverse channel (same as B2). B15 Select V.21 when the modem is at 300 bps. B16 Select Bell 103J when the modem is at 300 bps.
Nn	Modulation Handshake	n = 0 or 1	1	N0 Modem performs handshake only at communication standard specified by S37 and the B command. N1 Modem begins handshake at communication standard specified by S37 and the B command. During handshake, fallback to a lower speed can occur.

Command		Values	Default	Description
P	Pulse Dialing	P, T	T	Configures the modem for pulse (non-touch-tone) dialing. Dialed digits are pulsed until a T command or dial modifier is received.
Sr=n	Set Register Value	r = S-register number; n varies	None	Set value of register Sr to value of n, where n is entered in decimal format. E.g., S0=1.
T	Tone Dialing	P, T	T	Configures the modem for DTMF (touch-tone) dialing. Dialed digits are tone dialed until a P command or dial modifier is received.
&Gn	V.22bis Guard Tone Control	n = 0, 1, or 2	0	&G0 Disable guard tone. &G1 Set guard tone to 550 Hz. &G2 Set guard tone to 1800 Hz. Note: The &G command is not used in North America.
&Pn	Pulse Dial Make-to-Break Ratio Selection	n = 0, 1, or 2	0	&P0 60/40 make-to-break ratio &P1 67/33 make-to-break ratio &P2 20 pulses per second Note: The &P2 command is available only if the country code is set to Japan.
&Qn	Asynchronous Communications Mode	n = 0, 5, 6, 8, or 9	5	&Q0 Asynchronous with data buffering. Same as \N0. &Q5 Error control with data buffering. Same as \N3. &Q6 Asynchronous with data buffering. Same as \N0. &Q8 MNP error control mode. If MNP error control is not established, the modem falls back according to the setting in S36. &Q9 V.42 or MNP error control mode. If neither error control is established, the modem falls back according to the setting in S36.
\An	Select Maximum MNP Block Size	n = 0, 1, 2, or 3	3	\A0 64-character maximum. \A1 128-character maximum. \A2 192-character maximum. \A3 256-character maximum.
\Nn	Error Correction Mode Selection	n = 0–5, or 7	3	\N0 Non-error correction mode with data buffering (buffer mode; same as &Q6). \N1 Direct mode. \N2 MNP reliable mode. If the modem cannot make an MNP connection, it disconnects. \N3 V.42/MNP auto-reliable mode. The modem attempts first to connect in V.42 error correction mode, then in MNP mode, and finally in non-error correction (buffer) mode with continued operation. \N4 V.42 reliable mode. If the modem cannot make a V.42 connection, it disconnects. \ N5 V.42, MNP, or non-error correction (same as \N3). \ N7 V.42, MNP, or non-error correction (same as \N3).
\Tn	Inactivity Timer	n = 0, 1–255	0	Sets the time (in minutes) after the last character is sent or received that the modem waits before disconnecting. A value of zero disables the timer. Applies only in buffer mode. Note: You can also set the inactivity timer by changing the value of S30.
-Cn	Data Calling Tone	n = 0 or 1	0	-C0 Disable V.25 data calling tone to deny remote data/fax/voice discrimination. -C1 Enable V.25 data calling tone to allow remote data/fax/voice discrimination.
%Cn	Data Compression Control	n = 0 or 1	1	%C0 Disable V.42bis/MNP 5 data compression. %C1 Enable V.42bis/MNP 5 data compression.

Command		Values	Default	Description
%En	Fallback and Fall Forward Control	n = 0, 1, or 2	2	%E0 Disable fallback and fall forward. %E1 Enable fallback, disable fall forward. %E2 Enable fallback and fall forward.
$MBn	Online BPS Speed	n = speed in bits per second	28,800	$MB75 Selects CCITT V.23 mode $MB300 Selects 300 bps on-line $MB1200 Selects 1200 bps on-line $MB2400 Selects 2400 bps on-line $MB4800 Selects 4800 bps on-line $MB9600 Selects 9600 bps on-line $MB14400 Selects 14,400 bps on-line $MB19200 Selects 19,200 bps on-line $MB28800 Selects 28,800 bps on-line $MB33600 Selects 33,600 bps on-line
$SBn	Serial Port Baud Rate	n= speed in bits per second	115200	$SB300 Selects 300 bps at serial port $SB1200 Selects 1200 bps at serial port $SB2400 Selects 2400 bps at serial port $SB4800 Selects 4800 bps at serial port $SB9600 Selects 9600 bps at serial port $SB19200 Selects 19,200 bps at serial port $SB38400 Selects 38,400 bps at serial port $SB57600 Selects 57,600 bps at serial port $SB115200 Selects 115,200 bps at serial port $SB230400 Selects 230,400 bps at serial port

S-Registers

S-registers are memory locations that store certain modem values or parameters. **S commands** are used to read or alter the contents of S-registers.

Register	Unit	Range	Default	Description
S6	seconds	2-65*	2*	Sets the time the modem waits after it goes off-hook before it begins to dial the telephone number.
S7	seconds	1-255*	50*	Sets the time the modem waits for a carrier signal before aborting a call. Also sets the wait for silence time for the @ dial modifier.
S8	seconds	0-65	2	Sets the length of a pause caused by a comma character in a dialing command.
S10	100 ms	1-254	20	Sets how long a carrier signal must be lost before the modem disconnects.
S11	1ms	50-150*	95*	Sets spacing and duration of dialing tones.
S28	decimal	0, 1-255	1	0 disables, 1.255 enables V.34 modulation.
S30	1 minute	0, 1-255	0	Sets the length of time that the modem waits before disconnecting when no data is sent or received. A value of zero disables the timer. See also the \T command
S35	decimal	0-1	0	0 disables, 1 enables the V.25 calling tone, which allows remote data/fax/voice discrimination.
S36	decimal	0-7	7	Specifies the action to take in the event of a negotiation failure when error control is selected. (See S48.)

Register	Unit	Range	Default	Description
S37	decimal	0-19	0	Sets the maximum V.34 ¡°upstream¡± speed at which the modem attempts to connect. 0 = maximum speed 1 = reserved 2 = 1200/75 bps 3 = 300 bps 4 = reserved 5 = 1200 bps 6 = 2400 bps 7 = 4800 bps 8 = 7200 bps 9 = 9600 bps 10 = 12000 bps 11 = 14400 bps 12 = 16800 bps 13 = 19200 bps 14 = 21600 bps 15 = 24000 bps 16 = 26400 bps 17 = 28800 bps 18 = 31200 bps 19 = 33600 bps
S43	decimal	0-1	1	For testing and debugging only. Enables/disables V.32bis start-up auto mode operation. 0 = disable; 1 = enable.
S48	decimal	7 or 128	7	Enables (7) or disables (128) LAPM negotiation. The following lists the S36 and S48 configuration settings for certain types of connections. S48=7 S36=0, 2 LAPM or hang up S36=1, 3 LAPM or async S36=4, 6 LAPM, MNP, or hang up S36=5, 7 LAPM, MNP, or async S48=128 S36=0, 2 Do not use S36=1, 3 Async S36=4, 6 MNP or hang up S36=5, 7 MNP or async

Conexant Modems in ION Meters

Some ION meters that are ordered with the internal modem option are equipped with the older type Conexant modem. To find out what type of modem your meter has, refer to the section, "ION Meter Internal Modem Types" on page 282.

AT Commands for the Conexant Modem

The following lists the AT commands that are compatible with ION meters equipped with the Conexant internal modem.

Command Group		Members	Description
Bn	Select CCITT or BELL Mode	ATB0	CCITT Mode
		ATB1	BELL Mode (default)
Sn	Read/Write S-Register	ATSn=v	Sets S-Register n to the value v
&Fn	Restore Factory Configuration (Profile)	AT&F0	Restore factory configuration 0
		AT&F1	Restore factory configuration 1
&Gn	Select Guard Tone	AT&G0	Disables guard tone (default)
		AT&G1	Disables guard tone
		AT&G2	Selects 1800 Hz guard tone
%Cn	Enable/DisableData Compression	AT%C0	Disables data decompression
		AT%C1	Enables MNP 5 data compression negotiation
		AT%C2	Enables V.42 bis data compression
		AT%C3	Enables both V.42 bis and MNp 5 data compression
%En	Enable/Disable Line Quality Monitor & Auto-Retrain or Fallback/Fall Fwd	AT%E0	Disable line quality
		AT%E1	Enable line quality monitor and auto-retrain
		AT%E2	Enable line quality monitor and fallback/fall forward
\An	Select Maximum MNP Block Size	AT\A0	64 characters
		AT\A1	128 characters (Default)
		AT\A2	192 characters
		AT\A3	256 characters

Command Group		Members	Description
\Nn	Operating Mode	AT\N0	Normal speed buffered mode
		AT\N1	Serial interface
		AT\N2	Reliable (error-correction) mode
		AT\N3	Auto reliable mode
		AT\N4	LAPM error-correction mode
		AT\N5	MNP error-correction mode

AT+MS Commands Select Modulation

Selects the modulation; enables or disables auto-mode; specifies the lowest and highest connection rates; selects m-Law or A-Law codec type, and enables or disables robbed bit signaling generation (server modem) or detection (client modem).

`+MS=` <Mod> [,[<Automode>] [,[<Min_Rate>] [,[<Max_Rate>] [,[<X_Law>] [,[< Rb_Signaling>]]]]]] <CR>

`AT+MS=?` Send a string of information to the DTE consisting of supported options

<mod>	Modulation	Possible Rates (bps)
0	V.21	300
1	V.22	1200
2	V.22 bis	2400, 1200
3	V.23	1200
9	V.32	9600, 4800
10	V.32 bis	14400, 12000, 9600, 7200, 4800
11	V.34	33600, 31200, 28800, 26400, 24000, 21600, 19200, 16800, 14400, 12000, 9600, 7200, 4800, 2400
64	Bell103	300
69	Bell212	1200

Changing the Internal Modem Settings

To reconfigure the ION meter's internal modem, access its setup register:

- **Using PEGASYS™ or ION Enterprise™:**
  In Designer, right-click the internal modem's Comm module (inside the Communications Setup group).
- **Using ION Setup™:**
  Double-click the Comm module icon for the meter's internal modem. If you cannot see the module, right-click the meter icon. In the Device Properties dialog box, click the Tools tab, then select "Show Advanced ION Setup" in the Device Setup box. Click OK.

Changing the Local Modem Settings

Using PEGASYS or ION Setup

PEGASYS and ION Setup use the modem.ini file to define how the local modem should behave whenever modem communication is initiated. The modem.ini file contains information that sets the local modem to the specified baud rate and turns compression and error correction off. This particular setting is useful only if there are 3700 Series meters connected to the ION meter's internal modem communications loop (through ModemGate™). If only ION meters are used, we recommend that only the minimum required modem.ini settings be used (i.e. **Q0 E0 V1 &K0**).

Use a standard text editing software like Notepad™ to make changes to the modem.ini file.

Using ION Enterprise

ION Enterprise™ uses database queries to configure the local modem settings. Database queries are beyond the scope of this technical note. If you want to learn how to configure the local modem using ION Enterprise, please contact Power Measurement Technical Services.

Cellular Phone Compatibility

Using analog cellular phones to communicate with a meter equipped with a modem is not recommended due to the inherent unreliability of cellular phone communication. However, if cellular phone-to-meter communication is necessary, we recommend the following setup:

For compatibility with the (newer) Multi-Tech internal modem:

- **Local modem**: Multi-Tech 5600ZDX or GVC 56K (also possible with other Conexant chipset based modems)
- **Necessary AT commands**: `+MS=11,1,1200,4800\N2`

- **Description**: This setup forces v.34 at maximum 4800 baud and forces error correction. This also ensures other AT commands do not turn off error correction and compression. The 4800 setting may be increased to 7200/9600, but in most cases, using 4800 results in better throughput due to less errors for the modems to deal with.

For the above application, the following are recommended modem initialization string changes for the Multi-Tech modem (inside the ION meter):

AT command: `S10=100`
Description: Increases disconnect time on loss of carrier

AT command: `B1`
Description: If rate drops to 1200, use Bell protocol

For compatibility with the (older) Conexant internal modem:

- **Local modem**: Black Box MiniModem 56k Data/Faxmodem, model MD1620A, or Multi-Tech MultiModem, model MT5600ZDX
- **Necessary AT commands**: `%E0-K1-SEC+1+MS=10,1,1200,9600`
- **Description**: This setup allows the modem to negotiate any baud rate between 1200 and 9600 bps. This setup also prevents v.34 connections by not allowing the modem to negotiate anything higher than V32bis.

For the above application, the following are recommended modem initialization string changes for the Conexant modem (inside the ION meter):

AT command: `%E0-K1-SEC+1+MS=10,1,120,9600`

In addition, the modem site needs to be set up as follows, regardless of the actual connection baud rate:

- Modem Type: Black Box MiniModem 56k Data/Fax
- Transmit Delay: 10 ms
- Baud Rate: 9600 bps
- RTS/CTS: unchecked
- Receive Timeout: 5000 ms
- Byte Timeout: 20 byte-time

Power Availability

Power availability is becoming an increasingly important topic in today's electronic world. As the use of electronic equipment increases in industry and the home, the degree of tolerance for power outages has decreased. In many cases, a very short loss or reduction of supply voltage can have a large economic impact.

The ION 8400™, ION 8500™ as well as the ION 7500™ and ION 7600™ meters come pre-configured with a power availability framework that provides reliability measurements using "number of nines" calculations.

NOTE

While the Availability Framework is pre-configured, the operation of this framework requires the correct configuration of the Sag/Swell module according to your meter's power supply and operating ranges. See "Sag/Swell Module Configuration" on page 294. See also the *ION Programmer's Reference* for detailed descriptions of this module.

In This Document

Introduction

Power availability predicts, based on historical data, the probability that a specific power system will be functioning in its correct state at some point in the future. The availability calculation measures the time that power was available at the meter's monitoring point. This value can be used alone or incorporated with other reliability calculations.

Typically, a utility distribution system provides an availability of approximately 99.9%. Many applications require better availability than this: up to 99.9999% or better. At this level, the number of consecutive nines becomes difficult to determine at a glance. High levels of availability are commonly referred to as "Number of Nines": 99.9% corresponds to 3 nines; 99.9999% is 6 nines.

Once the meter is installed, the availability calculations must be reset to ensure valid time counts. You can reset availability calculations using ION® software. In the case of ION 7500 and ION 7600 meters, availability can be reset via the meter's front panel. You can also pause availability calculations for meter maintenance or decommissioning purposes (refer to "Resetting and Pausing Power Availability" on page 295).

Availability Framework - Release History

Firmware Versions	Release Dates	Availability Features	Comments
V209 - V231	November, 00 to March, 03	◆ Arithmetic modules compare the last-stored time before the meter went down with the time the meter regained power. ◆ Uptime calculates using a seconds counter and the down-time is added to provide the total uptime. ◆ Disturbance time taken from the Sag/Swell module and downtime is added separately. ◆ 'Include meter downtime' allows users to ignore planned outages.	Availability implementation requires no user setup - if the meter loses power this is reflected in the Availability calculation.*
V240	March, 03	◆ Sag/Swell module in ION 8000 Series meter modified to record an outage when the blade-powered meter is unpowered. ◆ Diagnostics module records meter outage duration.	Availability implementation requires no user setup.*

* Requires proper configuration of the Sag/swell module to record system disturbances.

Availability on the Meter Front Panel

The following power availability values display on the meter's front panel, and are viewable in the Vista™ component of ION Enterprise™ or ION Setup™ software:

- **Number of Nines**: the number of consecutive nines that appear in the most-significant digits of the availability value (e.g. "10" on the front panel indicates 10 nines: 99.99999999).
- **Availability-ppm**: the fraction of time that the power is available, in parts per million (ppm).
- **Evaluation Time (days)**: the number of days that have elapsed since the calculation was last reset. This gives an indication of the time interval over which the availability calculation is made.
- The availability framework is found at this location within Designer: Advanced Setup\Power Quality Framework\Power Availability Framework.

Sample Availability Framework Behaviors

Scenario 1: blade powered meter + power system outage

The Sag/Swell total disturbance time includes the outage. The meter downtime from the diagnostics module is added to the meter uptime to account for the total time of observation.

Scenario 2: blade powered meter + meter decommissioned

The Sag/Swell module logs the downtime as disturbance time. When the meter powers back up, the meter downtime from the diagnostics module is added to the meter uptime.

Scenario 3: auxiliary powered meter + power system outage

The Sag/Swell total disturbance time includes the outage. The meter never loses power, which means that there is no meter downtime and the meter uptime is equivalent to the total time of observation.

Scenario 4: auxiliary powered meter + meter decommissioned

The Sag/Swell module does not log a disturbance time. When the meter powers back up, the meter downtime from the diagnostics module is added to the meter uptime.

Assumptions

The above scenarios assume that:

1. The auxiliary powered meter assumed the power system was within specs during a meter down time if it didn't detect a disturbance prior to powering down.
2. The Sag/Swell module is configured correctly to monitor voltage disturbances.
3. The Sag limit is set above the voltage level at which the meter starts powering down.

4. An auxiliary powered meter is used for applications that require a highly accurate measurement of power system downtime.

Sag/Swell Module Configuration

Your meter's power availability framework requires that the Sag/Swell module be configured to the limits of your meter's power supply specification. See the online *ION Programmer's Reference* for detailed information on the operation of the Sag/Swell module.

Operating ranges of the ION 8000 Series meter are listed below:

Power Supply		**Operating Range**		
		9S	**36S**	**35S**
3-Phase blade powered meter	Option E	(120 – 277) ± 15% (102 – 318.5) VLN rms)	(120 – 277) ± 15% (102 – 318.5) VLN rms	120 – 480 ± 15% (102V – 552) VLL rms
	Option G	57.7 – 70VLN ± 15% (49 – 80.5) VLN rms)	57 – 70VLN ± 15% (49 – 80.5) VLN rms	N/A
Auxiliary powered meter	Option H (High V)	(160 – 277) ± 20% (128 – 332.4) VLN rms		
	Option J (Low V)	65 – 120 ± 20% (52 – 144) VLN rms		

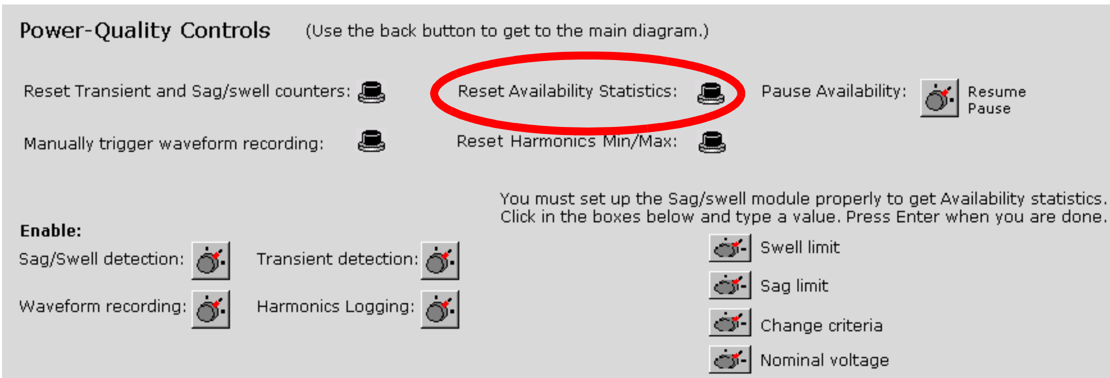
The ANSI C84.1 1989 standard recommends a Swell limit of 106% for Range B voltage levels, as well as a Sag limit of 88% for load voltages and 92% for the service entrance.

Resetting and Pausing Power Availability

The power availability framework allows the user to pause or reset its operation. The framework can be paused with ION software; resetting the framework can be performed via ION software or, in the case of the ION 7500 and ION 7600 meters, via the front panel settings.

Resetting Availability with Vista

With Vista software, you can manually reset availability calculations. A meter is typically reset after installation to ensure valid time counts.



Availability calculations are reset with the *Rst Avlty Stats* (Reset Availability Statistics) External Pulse module, which can be accessed through the meter's front panel or with Vista software.

To ensure correct availability calculations, do not reset during a Sag or Swell.

NOTE

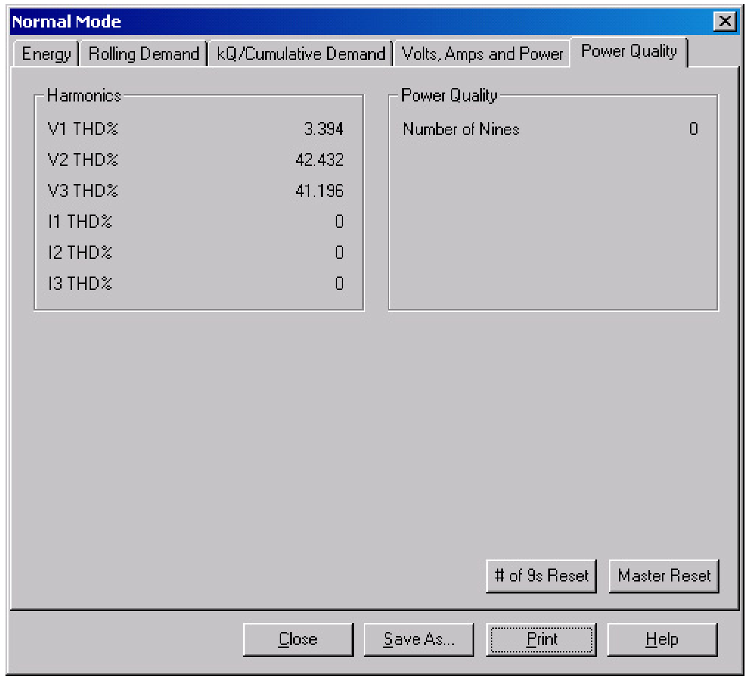
The "Rst Avlty Stats" module exists in the ION 7500 / ION 7600 meter firmware v206 or later, or the ION 8000 Series meter firmware v209 or later.

Resetting Availability with ION Setup Software

With ION Setup software, you can reset availability calculations by clicking on the button labeled "# of 9s Reset" in the Verification > Normal Mode > Power Quality tab.

1. Launch ION Setup software and double-click the Setup Assistant.
2. Click on the Verification setup screen, and from that screen, double-click Normal Mode.
3. In the Normal Mode screen, click the Power Quality tab.

4. In the Power Quality screen, click the button labeled "# of 9s Reset" to reset availability calculations. Provide a password (if requested), and click OK.



Resetting Availability through the Meter Front Panel

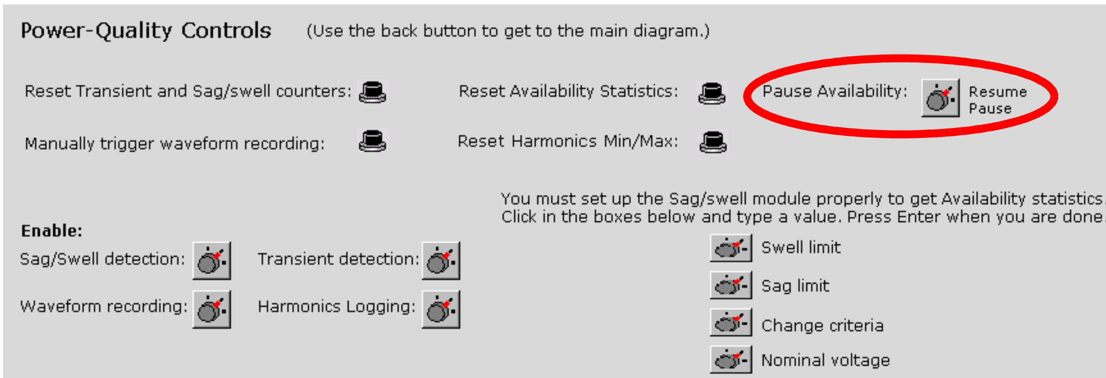
(ION 7500 / ION 7600 meters only)

Through the meter's front panel, you can easily reset availability calculations.

1. Access the Setup screen on your meter's front panel.
2. Scroll to the Meter Resets setting and select it.
3. Select User Resets.
4. Select Availability Reset. The Enter Password window appears.
5. Enter your password.
6. Select Confirm. A window with "Reset Successful" appears. Also, on the User Resets screen, the word "Pulsed" appears beside the Availability Reset setting.

Pausing Availability

The availability framework allows a user to temporarily pause the meter uptime counter and ignore any meter downtime and disturbance time. This allows a user to decommission the meter without affecting the availability statistics. Availability statistics are also paused when the Availability framework is "turned off." Note the "Pause Availability" switch on the graphic below.



Detailed Behavior

The Availability framework measures Disturbance time from the Sag/Swell module, Uptime from a counter module and meter Downtime from the Diagnostics module. Meter Downtime is added to the Uptime count to provide the total time of observation.

The meter uses three measurements when calculating the availability:

1. **Meter Uptime**: the time the meter is powered and actively monitoring. The time is measured by counting 1-second pulses from a periodic timer module.
2. **Meter Downtime**: this time is measured by the meter's internal clock and made available through the diagnostics module. The diagnostics module downtime register is updated on each power up. This calculation is accurate across a single month boundary: any additional month boundaries are assumed to have 30 days. You must set the Sag limit above the minimum voltage level specific to the power supply and wiring configuration of the meter (see "Sag/Swell Module Configuration" on page 294 for specifications). If there is no control power then it is assumed there is no power anywhere, and this time counts against availability.

   When the meter powers up, it takes about 15 seconds before the ION modules are operational again. This power up time counts against the availability (a single power up per year limits total availability to 6 nines). If the application requires better resolution than this, then a UPS or other auxiliary power supply for the meter should be considered.

   If the meter or control power circuit is taken out of service for maintenance, you can disable the measurement of meter downtime with ION software; see "Pausing Availability" on page 297.

Number of Nines	ppm (% x 10,000)	Downtime (seconds/year)	Downtime per year
1	90%	3153600	36.5 days
2	99%	315360	3.7 days
3	99.9%	31536	8.8 hours
4	99.99%	3153.6	52.6 minutes
5	99.999%	315.36	5.3 minutes
6	99.9999%	31.536	31.5 seconds
7	99.99999%	3.153599998	3.2 seconds
8	99.999999%	.3153599998	.32 seconds
9	99.9999999%	.03153599998	.032 seconds
10	99.99999999%	.003153599998	.0032 seconds

3. **Voltage Disturbance Duration**: the total number of seconds that the voltage was outside the envelope determined by the Sag/Swell module. If several sags or swells occur during one second, only the last one counts toward the total. The Sag/Swell module settings may be used to control the voltage tolerance. If the Sag/Swell module is not enabled, no voltage disturbances are counted.

Terminology

For a better understanding of the Availability framework in ION meters, it is necessary to know the following terms:

- **Blade-powered meter:** the power to run the meter is derived from the Voltage input terminals that are connected to the monitored system. The meter loses power if the monitored system is down.
- **Auxiliary-powered meter:** The power to run the meter is derived from an independent power source. The meter remains powered when the monitored system is down.
- **Meter uptime:** the time the meter is powered and actively monitoring. The time is measured by counting 1-second pulses from a periodic timer module.
- **Meter downtime:** the time the meter is not powered. This time is measured by the meter's internal clock and made available through the diagnostics module. The diagnostics module downtime register is reset at the beginning of each outage.
- **Availability:** the probability of finding a system in the operating state at some time into the future. Availability is calculated as:

$$\text{Availability} = \frac{\text{Time the power system is operating within specifications}}{\text{Total time of operation*}}$$

$$= \frac{\text{Meter uptime - disturbance time}}{\text{Meter uptime + meter downtime}}$$

* Where total time of observation = uptime + meter downtime

- **Unavailability:** calculated in the framework and then converted to number of nines, and Availability in percent and parts per million (ppm):

$$\text{Unavailability} = \frac{\text{Time the power system is operating outside specifications}}{\text{Total time of operation*}}$$

$$= \frac{\text{Disturbance time}}{\text{Meter uptime + meter downtime}}$$

* Where total time of observation = uptime + meter downtime

Power Quality: ION® Meters and EN50160

EN50160 is a European standard that defines the voltage characteristics of the electricity supplied by public distribution systems. It provides the limits within which any customer can expect voltage characteristics to remain. Some ION meters have a default configuration that measures the supply voltage and presents EN50160 statistics according to a set of guidelines defined by Eurelectric (UNIPEDE).

(Visit http://unipede.eurelectric.org for a copy of the Measurement Guide for Voltage Characteristics– reference 23002Ren9531.)

These factory configured meters already provide data to aid in EN50160 compliance determinations. The meter's front panel and the Vista diagrams display a range of EN50160 statistical information by default. Certain ION meters are also provided with many EN50160 parameters for Modbus systems. Refer to the meter's *User's Guide* for more information on these parameters and their Modbus addresses.

This technical note summarizes the EN50160 data and statistics measured by the ION meters that comply with the EN50160 standard. A description of the EN50160 counters and external controls is also provided.

In This Document

Default EN50160 Measurements

The EN50160 standard divides voltage characteristics into 10 distinct components. Each component has operating conditions and requirements for "valid" samples (such as a measured voltage between ±15% of nominal).

The factory configured meter uses a counter-based (N, N_1, N_2...) scheme to evaluate the compliance of each component within a defined observation period. Counter statistics are provided for current and previous observation periods; a brief description of each counter is also provided. The Data Logging section for each component provides a number of data log viewers for counter and parameter data. The following sections describe the data and statistics provided for each EN50160 measurement.

NOTE

Refer to "EN50160 External Controls" on page 323 for details on enabling EN50160 parameter data logging.

Power Frequency

The frequency measurement is a mean value over fixed 10-second intervals. The nominal value for frequency is 50 Hz (or 60 Hz, depending on model number).

- Observation period of one week with fixed steps of 10 seconds.
- **N** = number of 10-second intervals in which the supply voltage is within ±15% of nominal.
- **N_1** = number of intervals in which the frequency differs more than 0.5 Hz from nominal and the supply voltage is within ±15% of nominal.
- **N_2** = number of intervals in which the frequency is +2 Hz or -3 Hz from nominal and the supply voltage is within ±15% of nominal.

Power frequency complies with the standard if $N_1/N <= 5\%$ and $N_2 = 0$ during the observation period (1 week by default).

EN 50160 data (current observation period): The meter generates the N, N_1 and N_2 counts described above. These counters reset at the beginning of the next observation period.

EN 50160 data (previous observation period): The meter stores the N, N_1 and N_2 counter values at the end of each observation period before these counters are reset. These three registers are also stored in a data recorder for each observation period.

Events: The meter creates a message in the Event log every time the N_1 and N_2 counters increase.

Parameter data: The meter can be enabled to record the 10-minute mean, ½ cycle minimum and ½ cycle maximum values of frequency into a data recorder every 10 minutes.

Power Frequency Default Measurements

Register Label	Source Module Type	Description
Freq N*	Signal Limit Evaluation	number of valid intervals (voltage on all phases within +/- 15% of nominal)
Freq N invld*		number of invalid intervals
Freq N1*		number of valid intervals in which the freq deviates from the nominal by more than +/-1%
Freq N2*		num of valid intervals in which the freq deviates from the nominal by more than +4% or -6%
PO Freq N	Store	Freq N of the previous Observation Period
PO Freq N1		Freq N1 of the previous Observation Period
PO Freq N2		Freq N2 of the previous Observation Period
Freq mean-ep	Sliding Window Demand	average Frequency over 10s (used for display purposes)
Freq mn-op	Minimum	minimum mean Frequency (Freq mean-ep) over 1week (used for display purposes)
Freq mx-op	Maximum	maximum mean Frequency (Freq mean-ep) over 1week (used for display purpose)
Freq N1/N	Arithmetic	N1/N ratio
Freq N2/N		N2/N ratio
PO Freq N1/N		N1/N ratio of the previous Observation Period
PO Freq N2/N		N2/N ratio of the previous Observation Period

* This data is recorded once a week by Data Recorder module 17.

Optionally, the data below can be recorded every 10 minutes by Data Recorder 32.

Register Label	Description
PQ Freq mean	average Frequency over 10minutes
PQ Freq low	minimum Frequency over 10 minutes (HS measurement)
PQ Freq high	maximum Frequency over 10 minutes (HS measurement)

Magnitude of Voltage Supply

Each measurement is the mean of RMS voltage for each phase over fixed 10-minute intervals. The nominal value is defined by the Sag/Swell module's *Nom Volts* setup register.

NOTE

Nom Volts is typically setup when the meter is placed into service; if *Nom Volts* has not been set, enter a value for your system's nominal voltage. This value will be used in all EN50160 compliance calculations.

- Observation period of one week with fixed steps of 10 minutes.
- **N** = number of 10-minute intervals in which the supply voltage is within ±15% of nominal.
- $\mathbf{N_1}$ = number of intervals in which the supply voltage differs more than 10% from nominal and supply voltage is within ±15% of nominal.

Supply voltage complies with the standard if $N_1/N <= 5\%$ during the observation period (1 week by default).

EN 50160 data (current observation period): The meter generates the N and N_1 counts for each phase as described above. These counters are reset at the beginning of the next observation period.

EN 50160 data (previous observation period): The meter stores the N and N_1 counter values at the end of each observation period before these counters are reset. These 6 registers are also stored in a data recorder for each observation period.

Events: The meter creates a message in the Event log every time the N_1 counter for each phase increases.

Parameter data: The meter can be enabled to record the 10-minute mean, ½ cycle minimum and ½ cycle maximum values of supply voltage for each phase into a data recorder every 10 minutes.

Voltage Magnitude Default Measurements

Register	Source Module Type	Description
V1-Mag N*	Signal Limit Evaluation	number of valid intervals (voltage on phase 1 within +/- 15% of nominal)
V1-Mag N invld*		number of invalid intervals
V1-Mag N1*		number of valid intervals in which the voltage deviates from nominal by more than +/-10%
V2-Mag N*		number of valid intervals (voltage on phase 2 within +/- 15% of nominal)
V2-Mag N invld*		number of invalid intervals
V2-Mag N1*		number of valid intervals in which the voltage deviates from nominal by more than +/- 10%
V3-Mag N*		number of valid intervals (voltage on phase 3 within +/- 15% of nominal)
V3-Mag N invld*		number of invalid intervals
V3-Mag N1*		number of valid intervals in which the voltage deviates from nominal by more than +/- 10%
PO V1-Mag N	Store	V1-Mag N of the previous Observation Period
PO V1-Mag N1		V1-Mag N1 of the previous Observation Period
PO V2-Mag N		V2-Mag N of the previous Observation Period
PO V2-Mag N1		V2-Mag N1 of the previous Observation Period
PO V3-Mag N		V3-Mag N of the previous Observation Period
PO V3-Mag N1		V3-Mag N1 of the previous Observation Period
V1 mean	Sliding Window Demand	average voltage on phase 1 over 10m (used for display purposes)
V1 mean mn	Minimum	minimum of average voltage V1 (V1 mean) over 1 week (used for display purposes)
V1 mean mx	Maximum	maximum of average voltage V1 (V1 mean) over 1 week (used for display purposes)
V2 mean	Sliding Window Demand	average voltage on phase 2 over 10m (used for display purposes)
V2 mean mn	Minimum	minimum of average voltage V2 (V2 mean) over 1 week (used for display purposes)
V2 mean mx	Maximum	maximum of average voltage V2 (V2 mean) over 1 week (used for display purposes)
V3 mean	Sliding Window Demand	average voltage on phase 3 over 10m (used for display purposes)
V3 mean mn	Minimum	minimum of average voltage V3 (V3 mean) over 1 week (used for display purposes)
V3 mean mx	Maximum	maximum of average voltage V3 (V3 mean) over 1 week (used for display purposes)
V1-Mag N1/N	Arithmetic	N1/N ratio
V2-Mag N1/N		N1/N ratio
V3-Mag N1/N		N1/N ratio
PO V1-Mag N1/N		N1/N ratio of the previous Observation Period
PO V2-Mag N1/N		N1/N ratio of the previous Observation Period
PO V3-Mag N1/N		N1/N ratio of the previous Observation Period

* This data is recorded once a week by Data Recorder module 17.

Optionally, the data below can be recorded every 10 minutes by Data Recorder 32:

Parameter	**Description**
PQ V1 mean	average voltage on phase 1 over 10 minutes
PQ V1 low	minimum voltage on phase 1 over 10 minutes (HS measurement)
PQ V1 high	maximum voltage on phase 1 over 10 minutes (HS measurement)
PQ V2 mean	average voltage on phase 2 over 10 minutes
PQ V2 low	minimum voltage on phase 2 over 10 minutes (HS measurement)
PQ V2 high	maximum voltage on phase 2 over 10 minutes (HS measurement)
PQ V3 mean	average voltage on phase 3 over 10 minutes
PQ V3 low	minimum voltage on phase 3 over 10 minutes (HS measurement)
PQ V3 high	maximum voltage on phase 3 over 10 minutes (HS measurement)

Flicker

The flicker values Pst (short-term) and Plt (long-term) are generated according to IEC 61000-4-15.

- Observation period of one week with fixed Pst intervals of 10 minutes. A Pst value is considered valid only if the supply voltage is within ±15% of nominal and/or there is no voltage dip >= 15%.
- **N** = number of Plt values collected during the observation period (based on 12 valid consecutive Pst values).
- **N_1** = number of intervals in which Plt > 1.

Flicker complies with the standard if N_1/N <= 5% during the observation period (1 week by default).

NOTE

Flicker is typically caused by rapid repeated application of large loads. This causes a series of small voltage dips which can affect the performance of nearby devices that are voltage sensitive. A voltage flicker problem can often be observed by the naked eye by noticing flickering lights.

EN 50160 data (current observation period): The meter generates the N and N_1 counts for each phase as described above. These counters are reset at the beginning of the next observation period.

EN 50160 data (previous observation period): The meter stores the N and N_1 counter values at the end of each observation period before these counters are reset. These 6 registers are also stored in a data recorder for each observation period.

Events: The meter creates a message in the Event log every time the N_1 counter for each phase increases.

Parameter data: The meter can be enabled to record Pst and Plt values in a data recorder at the interval used to generate these values (10 minutes and 10 x 12 = 2 hours, respectively).

Flicker Default Measurements

Register Label	Source Module Type	Description
V1-Flck Pst	Flicker	Pst value for voltage on phase 1
V2-Flck Pst	Flicker	Pst value for voltage on phase 2
V3-Flck Pst	Flicker	Pst value for voltage on phase 3
V1-Flck Plt	Flicker	Plt value for voltage on phase 1
V2-Flck Plt	Flicker	Plt value for voltage on phase 2
V3-Flck Plt	Flicker	Plt value for voltage on phase 3
V1-Flck N*	Signal Limit Evaluation	number of valid intervals (voltage on phase 1 within +/- 15% of nominal and no dip >= 15%)
V1-Flck N invd*	Signal Limit Evaluation	number of invalid intervals
V1-Flck N1*	Signal Limit Evaluation	number of valid intervals in which Plt on phase 1 is greater than 1
V2-Flck N*	Signal Limit Evaluation	number of valid intervals (voltage on phase 2 within +/- 15% of nominal and no dip >= 15%)
V2-Flck N invd*	Signal Limit Evaluation	number of invalid intervals
V2-Flck N1*	Signal Limit Evaluation	number of valid intervals in which Plt on phase 2 is greater than 1
V3-Flck N*	Signal Limit Evaluation	number of valid intervals (voltage on phase 3 within +/- 15% of nominal and no dip >= 15%)
V3-Flck N invd*	Signal Limit Evaluation	number of invalid intervals
V3-Flck N1*	Signal Limit Evaluation	number of valid intervals in which Plt on phase 3 is greater than 1
PO V1-Flck N	Store	V1-Flck N of the previous Observation Period
PO V1 Flck N1	Store	V1-Flck N1 of the previous Observation Period
PO V2-Flck N	Store	V2-Flck N of the previous Observation Period
PO V2 Flck N1	Store	V2-Flck N1 of the previous Observation Period
PO V3-Flck N	Store	V3-Flck N of the previous Observation Period
PO V3 Flck N1	Store	V3-Flck N1 of the previous Observation Period
V1 Pst mn	Minimum	minimum Pst value for phase 1 over 1week (used for display purposes)
V1 Pst mx	Maximum	maximum Pst value for phase 1 over 1 week (used for display purposes)
V2 Pst mn	Minimum	minimum Pst value for phase 2 over 1week (used for display purposes)
V2 Pst mx	Maximum	maximum Pst value for phase 2 over 1 week (used for display purposes)
V3 Pst mn	Minimum	minimum Pst value for phase 3 over 1week (used for display purposes)
V3 Pst mx	Maximum	maximum Pst value for phase 3 over 1 week (used for display purposes)
V1-Flck N1/N	Arithmetic	N1/N ratio
V2-Flck N1/N	Arithmetic	N1/N ratio
V3-Flck N1/N	Arithmetic	N1/N ratio
PO V1-Flck N1/N	Arithmetic	N1/N ratio of the previous Observation Period
PO V2-Flck N1/N	Arithmetic	N1/N ratio of the previous Observation Period
PO V3-Flck N1/N	Arithmetic	N1/N ratio of the previous Observation Period

* This data is recorded once a week by Data Recorder module 18.

Optionally, the data below can be recorded every 10 minutes by Data Recorder 33.

Register Label	Description
V1-Flck Pst	Pst value for voltage on phase 1
V2-Flck Pst	Pst value for voltage on phase 2
V3-Flck Pst	Pst value for voltage on phase 3
V1-Flck Plt	Plt value for voltage on phase 1
V2-Flck Plt	Plt value for voltage on phase 2
V3-Flck Plt	Plt value for voltage on phase 3

Supply Voltage Dips

The voltage dip is based on half-cycle RMS measurements. The duration of the dip corresponds to the period during which the RMS value remains less than 90% of the nominal voltage. The depth of the dip is defined as the difference (expressed in % of nominal voltage) between the minimum RMS voltage over the course of the dip and the nominal voltage.

The observation period is 1 week. No evaluation criteria are suggested by either the EN 501060 standard or the UNIPEDE *Measurement Guide for Voltage Characteristics*; you should apply your own criteria to the data captured by the meter. The table below defines the classification scheme for counters Nij:

Depth (d%) Duration (t)	**10ms <= t <100ms**	**100ms <= t < 500ms**	**500ms <= t < 1s**	**1s < t < 3s**	**3s <= t < 20s**	**20s <= t < 1min**
10 < d < 15	N_{11}	N_{21}	N_{31}	N_{41}	N_{51}	N_{61}
15 <= d < 30	N_{12}	N_{22}	N_{32}	N_{42}	N_{52}	N_{62}
30 <= d < 60	N_{13}	N_{23}	N_{33}	N_{43}	N_{53}	N_{63}
60 < d <99	N_{14}	N_{24}	N_{34}	N_{44}	N_{54}	N_{64}

EN 50160 data (current observation period): The meter maintains the counters listed in the table above for each phase. These counters are reset on a weekly basis.

EN 50160 data (previous observation period): The meter stores the counter values listed in the table above for each phase on a weekly basis before these counters are reset. These registers are also stored in a data recorder on a weekly basis.

Events: The meter creates a message in the Event log every time one of the counters increases.

Parameter data: The meter can be enabled to record the minimum RMS voltage for each phase during a dip, the duration of the dip and the timestamp for when the dip occurred.

Voltage Dips Default Measurements

Values from the current observation period (in the first four columns) are found in Bin modules. They are also logged weekly by Data Recorder modules 19 – 23. Values from previous observation (PO) period are found in Store modules.

Register Labels							
V1-Dip N11	V1-Dip N12	V1-Dip N13	V1-Dip N14	PO V1-Dip N11	PO V1-Dip N12	PO V1-Dip N13	PO V1-Dip N14
V1-Dip N21	V1-Dip N22	V1-Dip N23	V1-Dip N24	PO V1-Dip N21	PO V1-Dip N22	PO V1-Dip N23	PO V1-Dip N24
V1-Dip N31	V1-Dip N32	V1-Dip N33	V1-Dip N34	PO V1-Dip N31	PO V1-Dip N32	PO V1-Dip N33	PO V1-Dip N34
V1-Dip N41	V1-Dip N42	V1-Dip N43	V1-Dip N44	PO V1-Dip N41	PO V1-Dip N42	PO V1-Dip N43	PO V1-Dip N44
V1-Dip N51	V1-Dip N52	V1-Dip N53	V1-Dip N54	PO V1-Dip N51	PO V1-Dip N52	PO V1-Dip N53	PO V1-Dip N54

Register Labels							
V1-Dip N61	V1-Dip N62	V1-Dip N63	V1-Dip N64	PO V1-Dip N61	PO V1-Dip N62	PO V1-Dip N63	PO V1-Dip N64
V2-Dip N11	V2-Dip N12	V2-Dip N13	V2-Dip N14	PO V2-Dip N11	PO V2-Dip N12	PO V2-Dip N13	PO V2-Dip N14
V2-Dip N21	V2-Dip N22	V2-Dip N23	V2-Dip N24	PO V2-Dip N21	PO V2-Dip N22	PO V2-Dip N23	PO V2-Dip N24
V2-Dip N31	V2-Dip N32	V2-Dip N33	V2-Dip N34	PO V2-Dip N31	PO V2-Dip N32	PO V2-Dip N33	PO V2-Dip N34
V2-Dip N41	V2-Dip N42	V2-Dip N43	V2-Dip N44	PO V2-Dip N41	PO V2-Dip N42	PO V2-Dip N43	PO V2-Dip N44
V2-Dip N51	V2-Dip N52	V2-Dip N53	V2-Dip N54	PO V2-Dip N51	PO V2-Dip N52	PO V2-Dip N53	PO V2-Dip N54
V2-Dip N61	V2-Dip N62	V2-Dip N63	V2-Dip N64	PO V2-Dip N61	PO V2-Dip N62	PO V2-Dip N63	PO V2-Dip N64
V3-Dip N11	V3-Dip N12	V3-Dip N13	V3-Dip N14	PO V3-Dip N11	PO V3-Dip N12	PO V3-Dip N13	PO V3-Dip N14
V3-Dip N21	V3-Dip N22	V3-Dip N23	V3-Dip N24	PO V3-Dip N21	PO V3-Dip N22	PO V3-Dip N23	PO V3-Dip N24
V3-Dip N31	V3-Dip N32	V3-Dip N33	V3-Dip N34	PO V3-Dip N31	PO V3-Dip N32	PO V3-Dip N33	PO V3-Dip N34
V3-Dip N41	V3-Dip N42	V3-Dip N43	V3-Dip N44	PO V3-Dip N41	PO V3-Dip N42	PO V3-Dip N43	PO V3-Dip N44
V3-Dip N51	V3-Dip N52	V3-Dip N53	V3-Dip N54	PO V3-Dip N51	PO V3-Dip N52	PO V3-Dip N53	PO V3-Dip N54
V3-Dip N61	V3-Dip N62	V3-Dip N63	V3-Dip N64	PO V3-Dip N61	PO V3-Dip N62	PO V3-Dip N63	PO V3-Dip N64

The following Minimum module output registers are used for display purposes:

Register Label	Description
V1-Dip mn	greatest voltage dip on phase 1 (=lowest voltage) over 1 week)
V2-Dip mn	greatest voltage dip on phase 2 (=lowest voltage) over 1 week)
V3-Dip mn	greatest voltage dip on phase 3 (=lowest voltage) over 1 week)

Optionally, the following data can be recorded at every Dip event by Data Recorder 34.

Register Label	Description
V1-Dip [%]	voltage dip on phase 1
V2-Dip [%]	voltage dip on phase 2
V3-Dip [%]	voltage dip on phase 3
V1-Dip duration	dip duration on phase 1
V2-Dip duration	dip duration on phase 2
V3-Dip duration	dip duration on phase 3

Short and Long Interruptions

Interruption detection is based on half-cycle RMS measurements. The duration of the interruption corresponds to the period during which the RMS value remains less than 1% of the nominal voltage.

The observation period is 1 week. No evaluation criteria are suggested by either the EN 501060 standard or the UNIPEDE *Measurement Guide for Voltage Characteristics*; you should apply your own criteria to the data captured by the meter.

The table below defines the classification scheme for counters Ni:

Duration of Interruptions	duration < 1s	1s <= duration < 3 min	duration >= 3 min
Number of Interruptions	N_1	N_2	N_3

EN 50160 data (current observation period): The meter maintains the counters listed in the table above for each phase. These counters are reset on a weekly basis.

EN 50160 data (previous observation period): The meter stores the counter values listed in the table above for each phase on a weekly basis before these counters are reset. These registers are also stored in a data recorder on a weekly basis.

Events: The meter creates a message in the Event log every time one of the counters increases.

Parameter data: The meter can be enabled to record the duration of the interruption and the timestamp for when the interruption occurred.

Interruptions Default Measurements

Counters from the present observation period are located in BIN modules. They also recorded weekly by Data Recorder modules 24, 25. Counters are from the previous observation (PO) Period are located in Store modules.

Register Label (Current Observation Period)		
V1-Intrpt N1	V1-Intrpt N2	V1-Intrpt N3
V2-Intrpt N1	V2-Intrpt N2	V2-Intrpt N3
V3-Intrpt N1	V3-Intrpt N2	V3-Intrpt N3

Register Label (Previous Observation Period)		
PO V1-Intrpt N1	PO V1-Intrpt N2	PO V1-Intrpt N3
PO V2-Intrpt N1	PO V2-Intrpt N2	PO V2-Intrpt N3
PO V3-Intrpt N1	PO V3-Intrpt N2	PO V3-Intrpt N3

Optionally, the data below can be recorded at every Interruption event by Data Recorder 35:

Register Label	Description
V1-Irpt durtn	interruption duration on phase 1
V2-Irpt durtn	interruption duration on phase 2
V3-Irpt durtn	interruption duration on phase 3

Temporary Overvoltages

Overvoltage detection is based on half-cycle RMS measurements.The duration of the overvoltage corresponds to the period during which the RMS value remains more than 110% of the nominal voltage. The magnitude of the overvoltage is defined as the ratio (expressed in %) between the maximum RMS voltage during the overvoltage and the nominal voltage.

The observation period is 1 week. No evaluation criteria are suggested by either the EN 501060 standard or the UNIPEDE *Measurement Guide for Voltage Characteristics*; you should apply your own criteria to the data captured by the meter. The table below defines the classification scheme for counters Nij:

Overvoltages / Duration "t"	**t < 1s**	**1s <= t < 1 min**	**t >= 1 min**
110 < magnitude <= 120 %	N_{11}	N_{21}	N_{31}
120 < magnitude <= 140 %	N_{12}	N_{21}	N_{32}
140 < magnitude <= 160 %	N_{13}	N_{23}	N_{33}
160 < magnitude <= 200 %	N_{14}	N_{24}	N_{34}
magnitude > 200 %	N_{15}	N_{25}	N_{35}

EN 50160 data (current observation period): The meter maintains the counters listed in the table above for each phase. These counters are reset on a weekly basis.

EN 50160 data (previous observation period): The meter stores the counter values listed in the table above for each phase on a weekly basis before these counters are reset. These registers are also stored in a data recorder on a weekly basis.

Events: the meter creates a message in the Event log every time one of the counters increases.

Parameter data: The meter can be enabled to record the maximum RMS voltage for each phase during an overvoltage, the duration of the overvoltage and the timestamp for when the overvoltage occurred.

Overvoltages Default Measurements

The data below is from the present observation period; values are all located in Bin modules. They are also recorded weekly by Data Recorders 25, 26, and 27.

Register Labels				
V1-Ovrvlt N11	V1-Ovrvlt N12	V1-Ovrvlt N13	V1-Ovrvlt N14	V1-Ovrvlt N15
V1-Ovrvlt N21	V1-Ovrvlt N22	V1-Ovrvlt N23	V1-Ovrvlt N24	V1-Ovrvlt N25
V1-Ovrvlt N31	V1-Ovrvlt N32	V1-Ovrvlt N33	V1-Ovrvlt N34	V1-Ovrvlt N35
V2-Ovrvlt N11	V2-Ovrvlt N12	V2-Ovrvlt N13	V2-Ovrvlt N14	V2-Ovrvlt N15
V2-Ovrvlt N21	V2-Ovrvlt N22	V2-Ovrvlt N23	V2-Ovrvlt N24	V2-Ovrvlt N25
V2-Ovrvlt N31	V2-Ovrvlt N32	V2-Ovrvlt N33	V2-Ovrvlt N34	V2-Ovrvlt N35

Register Labels				
V3-Ovrvlt N11	V3-Ovrvlt N12	V3-Ovrvlt N13	V3-Ovrvlt N14	V3-Ovrvlt N15
V3-Ovrvlt N21	V3-Ovrvlt N22	V3-Ovrvlt N23	V3-Ovrvlt N24	V3-Ovrvlt N25
V3-Ovrvlt N31	V3-Ovrvlt N32	V3-Ovrvlt N33	V3-Ovrvlt N34	V3-Ovrvlt N35

The following counters are from the Previous Observation period (PO). These values are all located in Store modules.

Register Labels				
PO V1-Ovrvlt N11	PO V1-Ovrvlt N12	PO V1-Ovrvlt N13	PO V1-Ovrvlt N14	PO V1-Ovrvlt N15
PO V1-Ovrvlt N21	PO V1-Ovrvlt N22	PO V1-Ovrvlt N23	PO V1-Ovrvlt N24	PO V1-Ovrvlt N25
PO V1-Ovrvlt N31	PO V1-Ovrvlt N32	PO V1-Ovrvlt N33	PO V1-Ovrvlt N34	PO V1-Ovrvlt N35
PO V2-Ovrvlt N11	PO V2-Ovrvlt N12	PO V2-Ovrvlt N13	PO V2-Ovrvlt N14	PO V2-Ovrvlt N15
PO V2-Ovrvlt N21	PO V2-Ovrvlt N22	PO V2-Ovrvlt N23	PO V2-Ovrvlt N24	PO V2-Ovrvlt N25
PO V2-Ovrvlt N31	PO V2-Ovrvlt N32	PO V2-Ovrvlt N33	PO V2-Ovrvlt N34	PO V2-Ovrvlt N35
PO V3-Ovrvlt N11	PO V3-Ovrvlt N12	PO V3-Ovrvlt N13	PO V3-Ovrvlt N14	PO V3-Ovrvlt N15
PO V3-Ovrvlt N21	PO V3-Ovrvlt N22	PO V3-Ovrvlt N23	PO V3-Ovrvlt N24	PO V3-Ovrvlt N25
PO V3-Ovrvlt N31	PO V3-Ovrvlt N32	PO V3-Ovrvlt N33	PO V3-Ovrvlt N34	PO V3-Ovrvlt N35

The Maximum module output registers are used for display purposes:

Register Label	Description
V1-Ovrvlt mx	greatest over-voltage on phase 1 over 1 week
V2-Ovrvlt mx	greatest over-voltage on phase 2 over 1 week
V3-Ovrvlt mx	greatest over-voltage on phase 3 over 1 week

Optionally, the data below can be recorded at the end of every Overvoltage event by Data Recorder 36.

Register Label	Description
V1-Ovrvlt [%]	over-voltage on phase 1
V2-Ovrvlt [%]	over-voltage on phase 2
V3-Ovrvlt [%]	over-voltage on phase 3
V1-Ovrvlt durtn	over-voltage duration on phase 1
V2-Ovrvlt durtn	over-voltage duration on phase 2
V3-Ovrvlt durtn	over-voltage duration on phase 3

Supply Voltage Unbalance

Each basic measurement is the true RMS value over a fixed 10-minute period (see the UNIPEDE *Measurement Guide for Voltage Characteristic* for more details).

- Observation period of one week with fixed steps of 10 minutes.
- **N** = number of 10-minute intervals in which the supply voltage is within ±15% of nominal.
- $\mathbf{N_1}$ = number of intervals in which the voltage unbalance exceeds 2% (3% in some areas) and the supply voltage is within ±15% of nominal.

Voltage unbalance complies with the standard if $N_1/N <= 5\%$ during the observation period (1 week by default).

Each measurement is the RMS unbalance voltage:

$$V_{UNBAL\%} = \frac{\text{negative sequence voltage}}{\text{positive sequence voltage}}$$

EN 50160 data (current observation period): The meter generates the N and N_1 counts as described above. These counters are reset at the beginning of the next observation period.

EN 50160 data (previous observation period): The meter stores the N and N_1 counter values at the end of each observation period before these counters are reset. These 2 registers are also stored in a data recorder for each observation period.

Events: A message is created in the Event log every time the N_1 counter increases.

Unbalance Default Measurements

Register Label	Module Type	Description
Vubal N*	Signal Limit Evaluation	Number of valid intervals (voltage on all phases within +/- 15% of nominal)
Vunbal N invld*		Number of invalid intervals
Vunbal N1*		Number of valid intervals in which the voltage unbalance exceeds 2%
PO Vunbal N	Store	Vunbal N of the previous Observation Period
PO Vunbal N1		Vunbal N1 of the previous Observation Period
Vunbal mean	Sliding Window Demand	Average voltage unbalance over 10 minutes (used for display purposes)
Vunbl mean mn	Minimum	Minimum average voltage unbalance over 1 week (used for display purposes)
Vunbl mean mx	Maximum	Maximum average voltage unbalance over 1 week (used for display purposes)
Vunbal N1/N	Arithmetic	N1/N ratio
PO Vunbal N1/N		N1/N ratio of the previous Observation Period

* This data is recorded once every week by Data Recorder 28.

Harmonic Voltage

All harmonic measurements are performed as defined by IEC 61000-4-7.

- Observation period of one week with fixed steps of 10 minutes.
- **N** = number of 10-minute intervals in which the supply voltage is within ±15% of nominal.
- $\mathbf{N_1}$ = number of intervals in which one or more of the individual harmonic levels defined in the table below are exceeded and the supply voltage is within ±15% of nominal. Levels for individual harmonics (for each phase) up to the 25th are defined in the table below.
- $\mathbf{N_2}$ = number of intervals in which the THD value for one or more of the voltage phases exceeds 8% and the supply voltage is within ±15% of nominal. The THD calculation will include all harmonics up to the 40thd).

Harmonic voltage complies with the standard if $N_1/N <= 5\%$ and $N_2/N <= 5\%$ during the observation period (1 week by default).

Odd Harmonics					
Not Multiples of 3				Multiples of 3	
Order	Threshold	Order	Threshold	Order	Threshold
5	6%	17	2%	3	5%
7	5%	19	1.5%	9	1.5%
11	3.5%	23	1.5%	15	0.5%
13	3%	25	1.5%	21	0.5%

Even Harmonics	
Order	Threshold
2	2%
4	1%
6…24	0.5%

EN 50160 data (current observation period): The meter generates the N, N_1 and N_2 counts described above for each phase. These counters are reset at the beginning of the next observation period.

EN 50160 data (previous observation period): The meter stores the N, N_1 and N_2 counter values at the end of each observation period before these counters are reset. These 9 registers are also stored in a data recorder for each observation period.

Events: The meter creates a message in the Event log every time the N_1 and N_2 counters increase.

Parameter data: The meter can be enabled to record the 10-minute mean, minimum and maximum values of THD, TO(odd)HD and TE(even)HD for each voltage phase into a data recorder every 10 minutes.

Harmonics Default Measurements

Register Label	Source Module	Description
V1-Hrm N*	Harmonics Evaluation	number of valid intervals (voltage on phase 1 within +/- 15% of nominal)
V1-Hrm N invld*		number of invalid intervals
V1-Hrm N1*		number of intervals in which one or more individual harmonics on phase 1 exceed their limits
V1-Hrm N2*		number of intervals in which the THD value on phase 1 exceeds the limit
V2-Hrm N*		number of valid intervals (voltage on phase 2 within +/- 15% of nominal)
V2-Hrm N invld*		number of invalid intervals
V2-Hrm N1*		number of intervals in which one or more individual harmonics on phase 2 exceed their limits
V2-Hrm N2*		number of intervals in which the THD value on phase 2 exceeds the limit
V3-Hrm N*		number of valid intervals (voltage on phase 3 within +/- 15% of nominal)
V3-Hrm N invld*		number of invalid intervals
V3-Hrm N1*		number of intervals in which one or more individual harmonics on phase 3 exceed their limits
V3-Hrm N2*		number of intervals in which the THD value on phase 3 exceeds the limit
PO V1-Hrm N	Store	V1-Hrm N of the previous Observation Period
PO V1-Hrm N1		V1-Hrm N1 of the previous Observation Period
PO V1-Hrm N2		V1-Hrm N2 of the previous Observation Period
PO V2-Hrm N		V2-Hrm N of the previous Observation Period
PO V2-Hrm N1		V2-Hrm N1 of the previous Observation Period
PO V2-Hrm N2		V2-Hrm N2 of the previous Observation Period
PO V3-Hrm N		V3-Hrm N of the previous Observation Period
PO V3-Hrm N1		V3-Hrm N1 of the previous Observation Period
PO V3-Hrm N2		V3-Hrm N2 of the previous Observation Period
V1 THD mean	Sliding Window Demand	average THD on phase 1 over 10 minutes (used for display purposes)
V2 THD mean		average THD on phase 2 over 10 minutes (used for display purposes)
V3 THD mean		average THD on phase 3 over 10 minutes (used for display purposes)
V1 THD mean mn	Minimum	minimum average THD on phase 1 over 1 week (used for display purposes)
V2 THD mean mn		minimum average THD on phase 2 over 1 week (used for display purposes)
V3 THD mean mn		minimum average THD on phase 3 over 1 week (used for display purposes)
V1 THD mean mx	Maximum	maximum average THD on phase 1 over 10 minutes (used for display purposes)
V2 THD mean mx		maximum average THD on phase 2 over 1 week (used for display purposes)
V3 THD mean mx		maximum average THD on phase 3 over 1 week (used for display purposes)

Register Label	Source Module	Description
V1-Hrm N1/N	Arithmetic	N1/N ratio
V1-Hrm N2/N		N2/N ratio
V2-Hrm N1/N		N1/N ratio
V2-Hrm N2/N		N2/N ratio
V3-Hrm N1/N		N1/N ratio
V3-Hrm N2/N		N2/N ratio
PO V1-Hrm N1/N		N1/N ratio of previous Observation Period
PO V1-Hrm N2/N		N2/N ratio of previous Observation Period
PO V2-Hrm N1/N		N1/N ratio of previous Observation Period
PO V2-Hrm N2/N		N2/N ratio of previous Observation Period
PO V3-Hrm N1/N		N1/N ratio of previous Observation Period
PO V3-Hrm N2/N		N2/N ratio of previous Observation Period

* This data is recorded by Data Recorder module 29 once a week.

Optionally, the following data is recorded once every 10 minutes by Data Recorder modules 37 and 38.

Register Label	Description		Register Label	Description
PQ V1 THD mean	average THD on phase 1 over 10 minutes		PQ V2 TOHD mx	maximum TOHD on phase 1 over 10 minutes
PQ V1 THD mn	minimum THD on phase 1 over 10 minutes		PQ V2 TEHD mean	average TEHD on phase 1 over 10 minutes
PQ V1 THD mx	maximum THD on phase 1 over 10 minutes		PQ V2 TEHD mn	minimum TEHD on phase 1 over 10 minutes
PQ V1 TOHD mean	average TOHD on phase 1 over 10 minutes		PQ V2 TEHD mx	maximum TEHD on phase 1 over 10 minutes
PQ V1 TOHD mn	minimum TOHD on phase 1 over 10 minutes		PQ V3 THD mean	average THD on phase 3 over 10 minutes
PQ V1 TOHD mx	maximum TOHD on phase 1 over 10 minutes		PQ V3 THD mn	minimum THD on phase 3 over 10 minutes
PQ V1 TEHD mean	average TEHD on phase 1 over 10 minutes		PQ V3 THD mx	maximum THD on phase 3 over 10 minutes
PQ V1 TEHD mn	minimum TEHD on phase 1 over 10 minutes		PQ V3 TOHD mean	average TOHD on phase 1 over 10 minutes
PQ V1 TEHD mx	maximum TEHD on phase 1 over 10 minutes		PQ V3 TOHD mn	minimum TOHD on phase 1 over 10 minutes
PQ V2 THD mean	average THD on phase 2 over 10 minutes		PQ V3 TOHD mx	maximum TOHD on phase 1 over 10 minutes
PQ V2 THD mn	minimum THD on phase 2 over 10 minutes		PQ V3 TEHD mean	average TEHD on phase 1 over 10 minutes
PQ V2 THD mx	maximum THD on phase 2 over 10 minutes		PQ V3 TEHD mn	minimum TEHD on phase 1 over 10 minutes
PQ V2 TOHD mean	average TOHD on phase 1 over 10 minutes		PQ V3 TEHD mx	maximum TEHD on phase 1 over 10 minutes
PQ V2 TOHD mn	minimum TOHD on phase 1 over 10 minutes			

Interharmonic Voltage

Interharmonics are the entire *band* of frequencies between two successive integer multiples of the fundamental. All harmonic measurements are performed as defined in IEC 61000-4-7.

- Observation period of one week with fixed steps of 10 minutes.
- **N** = number of 10-minute intervals in which the supply voltage is within ±15% of nominal.
- $\mathbf{N_1}$ = number of intervals in which one or more of the interharmonic levels defined in the table below are exceeded and the supply voltage is within ±15% of nominal. Levels for interharmonic bands up to the 25th harmonic are defined in the table below.

Apply your own compliance evaluation criteria to the interharmonic statistics provided by the meter.

In the table below, order 2 specifies all frequencies between the fundamental and the 2^{nd} harmonic; order 3 specifies all frequencies between the 2^{nd} harmonic and the 3^{rd}; etc.

Odd Harmonics					
Not Multiples of 3				Multiples of 3	
Order	Threshold	Order	Threshold	Order	Threshold
5	6%	17	2%	3	5%
7	5%	19	1.5%	9	1.5%
11	3.5%	23	1.5%	15	0.5%
13	3%	25	1.5%	21	0.5%

Even Harmonics	
Order	Threshold
2	2%
4	1%
6…24	0.5%

EN 50160 data (current observation period): The meter generates the N and N1counts described above for each phase. These counters are reset at the beginning of the next observation period.

EN 50160 data (previous observation period): The meter stores the N and N_1 counter values at the end of each observation period before these counters are reset. These registers are also stored in a data recorder for each observation period.

Events: The meter creates a message in the Event log every time the N_1 counter increases.

Interharmonics Default Measurements

Register Label	Source Module	Description
V1-Inthrm N*	Harmonics Evaluation	number of valid intervals (voltage on phase 1 within +/- 15% of nominal)
V1-Inthrm N ivd*		number of invalid intervals
V1-Inthrm N1*		number of intervals in which one or more individual harmonics on phase 1 exceed their limits
V2-Inthrm N*		number of valid intervals (voltage on phase 2 within +/- 15% of nominal)
V2-Inthrm N ivd*		number of invalid intervals
V2-Inthrm N1*		number of intervals in which one or more individual harmonics on phase 2 exceed their limits
V3-Inthrm N*		number of valid intervals (voltage on phase 3 within +/- 15% of nominal)
V3-Inthrm N ivd*		number of invalid intervals
V3-Inthrm N1*		number of intervals in which one or more individual harmonics on phase 3 exceed their limits
PO V1-Inthrm N	Store	V1-Inthrm N of the previous Observation Period
PO V1-Inthrm N1		V1-Inthrm N1 of the previous Observation Period
PO V2-Inthrm N		V2-Inthrm N of the previous Observation Period
PO V2-Inthrm N1		V2-Inthrm N1 of the previous Observation Period
PO V3-Inthrm N		V3-Inthrm N of the previous Observation Period
PO V3-Inthrm N1		V3-Inthrm N1 of the previous Observation Period
V1-Inthrm N1/N	Arithmetic	N1/N ratio
V2-Inthrm N1/N		N1/N ratio
V3-Inthrm N1/N		N1/N ratio
PO V1-Ihrm N1/N		N1/N ratio of previous Observation Period
PO V2-Ihrm N1/N		N1/N ratio of previous Observation Period
PO V3-Ihrm N1/N		N1/N ratio of previous Observation Period

* This data is recorded weekly by Data Recorder 30.

Mains Signaling Voltage

In some countries, power transmission and distribution systems are also used to carry communication signals. If the magnitude of these signals becomes too large, they have the potential to interfere with the operation of electrical equipment in much the same way that excessive harmonic and interharmonic voltages do. The purpose of this measurement component is to ensure that these signals do not exceed defined levels. EN 50160 defines three types of mains signals:

1. **Ripple control**: frequencies between 110 to 3000 Hz
2. **Power line carrier**: frequencies between 3 to 148.5 kHz
3. **Marking signals**: short transients superimposed at select points on the voltage waveform

The meter can monitor ripple control signals between 110 Hz and 3000 Hz. The meter performs signaling voltage measurements using interharmonic voltages near the user-defined signaling frequencies. You can specify three frequencies to be monitored; the default is 1060Hz.

NOTE

Some common ripple control frequencies in Europe include 183 Hz, 191 Hz, 425 Hz and 1060 Hz.

The signaling voltage measurement is the mean voltage (not RMS) over a fixed interval of 3 seconds.

- Observation period of one day with fixed steps of 3 seconds.
- **N** = number of 3-second intervals in which the supply voltage is within ±15% of nominal.
- **N_1** = number of intervals in which the mean value of the signalling voltage exceeds the curve defined in the EN 50160 standard and the supply voltage is within ±15% of nominal.

Mains signaling voltage complies with the standard if $N_1/N <= 1\%$ during the observation period (1 day by default).

EN 50160 data (current observation period): the meter generates the N and N_1 counts for each phase as described above. These counters are reset at the beginning of the next observation period.

EN 50160 data (previous observation period): the meter stores the N and N_1 counter values at the end of each observation period before these counters are reset. These 6 registers are also stored in a data recorder for each observation period.

Events: the meter creates a message in the Event log every time the N_1 counter for each phase increases.

Mains Signaling Evaluation Module Settings

To enable EN50160 mains signal voltage monitoring, you must specify the signal frequency of interest and the allowable signal voltage threshold for each of the three voltage phases. These parameters are held in the *Frequency* and *Limit* setup registers of their respective Mains Signaling Evaluation modules.

The allowable *Frequency* range is 5 Hz to 2500 Hz (default is 1060 Hz). If this register is set to 0Hz, then no evaluation will be performed. The voltage threshold defined by the *Limit* setup register must be expressed as a percentage of the fundamental (default is 100%). Refer to the online *ION Programmer's Reference* for more details about this module.

Mains Signaling Default Measurements

Register Label	Source Module	Description
V1-MSignal N*	Mains Signalling Evaluation	number of valid intervals (voltage on phase 1 within +/- 15% of nominal)
V1-MSignl N ivd*		number of invalid intervals
V1-MSignal N1*		number of valid intervals in which the signaling voltage on phase 1 exceeds a user defined limit
V2-MSignal N*		number of valid intervals (voltage on phase 2 within +/- 15% of nominal)
V2-MSignl N ivd*		number of invalid intervals
V2-MSignal N1*		number of valid intervals in which the signaling voltage on phase 2 exceeds a user defined limit
V3-MSignal N*		number of valid intervals (voltage on phase 3 within +/- 15% of nominal)
V3-MSignl N ivd*		number of invalid intervals
V3-MSignal N1*		number of valid intervals in which the signaling voltage on phase 3 exceeds a user defined limit
PO V1-MSignal N	Store	PO V1-MSignal N of the previous Observation Period
PO V1-MSgnal N1		PO V1-MSgnal N1 of the previous Observation Period
PO V2-MSignal N		PO V2-MSignal N of the previous Observation Period
PO V2-MSgnal N1		PO V2 MSgnal N1 of the previous Observation Period
PO V3-MSignal N		PO V3-MSignal N of the previous Observation Period
PO V3-MSgnal N1		PO V3-MSgnal N1 of the previous Observation Period
V1-MSig N1/N	Arithmetic	N1/N ratio
V2-MSig N1/N		N1/N ratio
V3-MSig N1/N		N1/N ratio
PO V1-MSig N1/N		N1/N ratio of previous Observation Period
PO V2-MSig N1/N		N1/N ratio of previous Observation Period
PO V3-MSig N1/N		N1/N ratio of previous Observation Period

* This data is recorded weekly by Data Recorder 31.

EN50160 External Controls

To access these controls, double-click the Controls grouping object on the EN50160 tab in a default Power Quality Vista diagram.

Enabling the EN50160 Calculations

EN50160 statistics (counters N, N_1, etc.) monitoring and logging are enabled when:

- External Boolean module "EN50160 Enable" is ON (=1) (the default).
- Sag/Swell module's "Nominal Voltage" setup register has a value > 0. By default, this register is set to 0. You can set this value from the meter's front panel as well as in Designer.

In addition to the above, **EN50160 parameter logging** (logging of the EN50160 voltage measurements themselves) is enabled when:

- External Boolean module "PQ Prm Rc Enbl" is also ON (=1). To conserve memory, parameter data logging is disabled (OFF) by default.
- Double-click this control object to enable EN50160 parameters to be logged.

EN50160 Reset

EN50160 statistics (counters) and parameter data are cleared from the meter when the External Pulse module "EN50160 Reset" is triggered:

- Double-click this control object to clear the External Pulse module, or use the Setup Menu in the meter's front panel.

The logged EN50160 quantities (data logs) are preserved.

EN50160 Synchronization Mode & Synchronization Timing

These control objects allow you to choose a **Free** or **Scheduled** synchronization mode for the EN50160 data acquisition. If you select Scheduled, then you can opt for Synchronization Timing to start at midnight of the present day, or at midnight of the coming Saturday. If you select Free, then EN50160 statistics and data start accumulating after the first EN50160 Reset (see above).

By default, all cumulative EN50160 parameters are scheduled to synchronize every Saturday at midnight. You can alter these settings through links to two External Boolean modules:

- PQ Sync Mode (External Boolean 23)
- PQ Sync Tdy/Sat (External Boolean 24)

ION TECHNOLOGY®

TECHNICAL NOTE

Sub-Metering with a Modbus Master

Sub-metering is typically used for two applications: energy cost allocation or operations information. Sub-metering can be used for billing purposes in any situation where multiple businesses use a common electrical infrastructure. Sub-metering systems can also be used for maintenance planning, and to optimize energy consumption through data collection and analysis. The information discussed in this technical note pertains to a sub-metering application where a Modbus master device collects data from several Modbus slave devices.

Modicon® Modbus is a widely used protocol in process control industries. ION meters can operate in Modbus networks as both slaves and masters, and can communicate easily with ION software or other third-party software. For more information about Modbus, refer to the technical note *Modbus and ION Technology.*

This document describes the procedure to configure a Modbus master device to control several Modbus slave devices. The following is a list of possible Modbus master and Modbus slave devices.

Modbus Master Devices	Siemens 9500	ION 8500	ION 8400	ION 7500
Modbus Slave Devices	Siemens 9200	ION 6200		

The default frameworks included in ION 7600 and Siemens 9600 meters do not support this Modbus Master framework. For more information, contact Technical Services.

In This Document

Configuring the Modbus Network

Each meter on the Modbus network must be configured correctly before it will communicate successfully. Configuring the Modbus network has three main stages:

1. Connecting the devices physically
2. Configuring the Modbus Slave devices
3. Configuring the Modbus Master device

Connecting the Modbus Slave Devices

The Modbus Slave devices must be connected to a COM port on the Modbus Master through an RS485 loop. (See the *ION 6200 Installation & Basic Setup Instructions* for help configuring an RS485 network.)

Configuring the Modbus Slave Devices

Each slave device on the Modbus network must have a unique Unit ID. The custom framework you will be pasting into the Modbus Master uses Unit IDs 100 through 111. For simplicity, you may want to use these Unit IDs when configuring your Modbus network, otherwise you will have to modify the framework. Further, all devices on the network must be communicating with the Modbus protocol and with the same Baud rate.

Programming an ION 6200 Modbus Slave Device

1. Hold down both arrow buttons on the front panel to enter setup mode. The default password for ION devices is zero.
2. Use the arrow buttons to find the Unit ID setting, the display will show **unid**.
3. Give the device a unique Unit ID.
4. Verify that the communication protocol (**Prot**) is set to **Mod**.
5. Verify that the Baud rate (**bAud**) is **9600**.

Configuring the Modbus Master Device

1. Press the **Prog** button on the Modbus Master device to enter setup mode.
2. Select the COM port that is connected to the Modbus network.
3. Set the communication protocol to **Modbus Master**.
4. Set the Baud rate to **9600**.

Pasting the Modbus Master Framework into the Meter

This section describes how to paste the Modbus Master framework into the meter.

CAUTION

The Modbus Master framework is designed to work with meters that use their factory default framework. If you paste the Modbus Master framework into a meter that is not using its default configuration, the custom configuration on your meter can be destroyed.

1. Ensure that the Modbus Master framework (Modbus_Master.fwn) is located in your frameworks directory (C:\ION Enterprise\config\fmwk\nd).
2. Connect to your Modbus Master device in Designer.
3. Open the Options menu and verify that the **Show Toolbox** menu item is checked.
4. Double-click on the **Frameworks** folder to access the Advanced Configuration folder.

NOTE

Before you paste in the new framework, click on an empty area of the screen. This ensures that no modules are selected.

5. Click on the Edit menu and select **Paste From Framework.**
6. Select the Modbus Master framework and click Open.
7. In the **Paste Summary** dialog box, click OK. This will "free paste" the Modbus Master framework into the meter. When the pasting is completed, a new folder called **Modbus Master Framework** appears.

NOTE

Refer to the section, "Multiple Modbus Master Devices" if you plan to use this framework in several Modbus Master devices.

8. Once you have returned to the main window in Designer, click **Send and Save** to save your changes.

Customizing the Modbus Master Framework

The Modbus Master framework is designed to handle 12 Modbus Slave devices. This is limited by the number of Modbus Import Modules supported by ION meters. Each Modbus Slave device uses five Modbus Import Modules, two Arithmetic Modules, and two Data Recorder Modules. If you do not require all 12 Modbus Slaves, you may want to remove some the extra **Sub Meter** folders from your framework. Deleting unused **Sub Meter** folders will free unused resources on your meter.

Once all unused Sub Meter folders have been deleted, verify that the Unit IDs in each **Sub Meter** folder of your framework corresponds to the Unit IDs of the meters on your Modbus Network. To verify Unit IDs, right-click on each **Modbus Import Module** in a **Sub Meter** folder and verify the value in the **Device Name** setup register corresponds to the Unit ID of your meter.

Multiple Modbus Master Devices

After you have pasted and customized the Modbus Master framework into one of your meters, you can then use this framework to paste into the other Modbus Master meters in your site. The following procedure describe how to copy the Modbus Master framework into several Modbus Master meters. Follow the steps outlined below to ensure framework consistency across each meter in your site.

1. After you have customized your Modbus Master framework (see previous section), select the **Modbus Master Framework** folder from the **Advanced Configuration** folder
2. Select **Edit**>**Copy to framework**.
3. Type a descriptive name for your custom framework. Click **Save**.
4. Connect to the next meter you would like to paste your custom framework into.
5. Double-click the Frameworks folder to access the meter's **Advanced Configuration** folder.
6. Select **Edit**>**Paste from Framework**.
7. In the **Paste Summary** dialog box, click the green checkmark to the left of the first module in the list. Hold down your keyboard's **Shift** key and click the last module in the list. The checkmark changes to a checkmark and a lock icon. This lets you "lock paste" the modules into your meter.

NOTE

When pasting your customized Modbus Master framework, it is important to "lock paste" the modules into the meter so that all the Modbus Master meters have identical frameworks. This is particularly important when creating Vista diagrams that are compatible across the different Modbus Master meters.

8. Click OK. When the pasting is completed, a new folder called **Modbus Master Framework** appears.

Customizing the Modbus Master Front Panel Display

You can create custom front panel displays for your Modbus master device. Use Designer software to add a new Display module to your meter's Display framework. Refer to the online *ION Programmer's Reference,* and the technical note *Custom Front Panel Displays.*

Controlling the Data Logging Capabilities

There are two Data Recording Modules included in each **Sub Meter** folder that log several important parameters from each meter. A folder within the framework called **Data Recording Control** contains a **Periodic Timer Module** (named 15 Minute Timer), and an **External Boolean Module** (named Modbus Log). The Periodic Timer will trigger the Data Recorders every 15 minutes. The External Boolean is used to turn data logging on or off and must be controlled using the Vista application. Data logging is OFF by default.

Customizing your Vista Diagram

1. Run the Vista application.
2. Open the File menu and select the Open option.
3. Give your new diagram a descriptive name (e.g. Modbus Master Control) and click OK.
4. Open the **Options** menu and verify that the **Show Toolbox** option is checked.
5. Click and drag a **Control Object** from the toolbox onto the Vista diagram.
6. Right-click on the object to view its configuration.
7. Click the **Link** tab. Select **Custom** and click the **Edit Link** button.
8. Double-click on the Modbus master device to display its list of **Managers**.
9. Double-click the **Ext Bool Modules** in the **Managers** field.
10. Double-click **Modbus Log** in the **Modules** field.
11. Double-click **Sub Log Enable** in the Output Registers field to link the Control Object.

Modbus Import Module Configurations

The following table outlines the Modbus Import module default configuration for the Modbus Master framework. Refer to Appendix B of the *ION 6200 Installation & Basic Setup Instructions* for a complete Modbus address table.

Output Register	Module 1	Module 2	Module 3	Module 4	Module 5
1	Vln a	Frequency	kW total	kW demand	* kWh del
2	Vln b	PF sign total	kVAR total	kW peak demand	* kWh rec
3	Vln c	PF sign a	kVA total	kVAR demand	* kVARh del
4	Vln ave	PF sign b	kW a	kVA demand	* kVARh rec
5	Vll ab	PF sign c	kW b	kVAR peak demand	* kVA del+rec
6	Vll bc		kW c	kVA peak demand	V1 THD
7	Vll ca		kVAR a		V2 THD
8	Vll ave		kVAR b		V3 THD
9	I a		kVAR c		I1 THD
10	I b		kVA a		I2 THD
11	I c		kVA b		I3 THD
12	I ave		kVA c		
13	I demand				
14	I peak demand				
15	I4				

* Values are accessible from Arithmetic modules included with the Modbus master framework.

Telnet and HyperTerminal Access

This document describes how to access certain meter settings with Microsoft Telnet or Windows HyperTerminal applications:

- If your meter is connected to an Ethernet network, use a telnet application such as Microsoft Telnet.
- If your meter is connected serially or through a modem to your workstation, use a terminal application such as Windows HyperTerminal.

In This Document

Using Telnet

NOTE

Use Telnet if your meter has Ethernet capabilities. Use HyperTerminal if your meter is connected serially or through a modem to your workstation.

A Telnet session lets you:

- access certain Ethernet communications module settings
- view Ethernet statistics
- access certain Power Meter module settings
- access certain Factory module settings
- clear the front panel event log display on the ION 8000 Series meters
- configure Factory module setup registers for Current Probe Input applications

To connect to the meter:

1. Choose **Run...** from the Windows **Start** menu and type the word ***telnet.*** Press Enter.
2. To connect to the meter choose **Connect** from the main menu and select **Remote System...**
3. Type in the meter IP address in the *Host Name* box.

NOTE

The IP address must match the IP address setup register in the meter Ethernet communications module.

4. Leave the *Port* value and the *TermType* setting as the defaults. Press Enter. The *Login* screen appears.
5. Type the meter type (such as 7500) as the *Login* depending on the type of meter you have. Press Enter.
6. Type the meter password ("0" by default). Press Enter.

NOTE

If ten incorrect passwords are entered in succession the Telnet access locks-out for 24 hours or until the security features are disabled with the front panel of the meter.

7. Type "?" for meter Help screen. Press Enter. A list of menu options appears.

Telnet Menu

The Telnet menu options are:

0)	Logout
1)	Ethernet Settings
2)	Ethernet Stats
3)	Meter Clear Functions
4)	Factory Login
9)	Switch to Debug Parser (and route msgs to telnet)
?)	Displays this menu

Logout – select this option to logout of the meter, and end the Telnet session.

Ethernet Settings – there are two options in this menu: one for viewing your current communications settings and one for configuring your IP Boot option, IP address, Subnet mask, Gateway address and SMTP address.

Ethernet Stats – there are three options available in this menu: one for viewing various Ethernet statistics, one for viewing an Ethernet collision histogram, and a third option for resetting these statistics.

Meter Clear Functions – there are two options available in this menu: one returns you to the Main Menu, and one clears the meter Event Log Display.*

* The Meter Clear Functions option is only available for the ION 8000 Series meters.

Switch to Debug Parser (and route msgs to telnet) – there are eight screens with options available in this menu: Help; All Commands; Display Comm Help; Miscellaneous Help: Reset Help; Security Help; Time Help; and Calibration Help. In addition, the Factory Login and Logout menus are available.

Factory Login – this menu is reserved for Technical Services use.

To access menus:

1. You can view the list of menus at any time by typing a question mark (?) and pressing Enter.
2. To access a menu, press the corresponding number on your keyboard, then press Enter.

Using HyperTerminal

NOTE

Ensure that the meter COM port you are using has its Protocol register set to "Factory."

Use Windows HyperTerminal to access certain meter module settings if your meter is connected serially or through a modem to your workstation.

A HyperTerminal session lets you:

- access certain Factory module settings
- access certain Power Meter module settings
- clear the front panel event log display on the ION 8000 Series meter
- configure Factory module setup registers for Current Probe Input applications

To connect to the meter:

1. Launch HyperTerminal from the **Start > Programs > Accessories > HyperTerminal** menu.
2. A window requesting a modem install appears. If you wish to install a modem, click Yes and follow the steps. If you do not need to install a modem, click No. The *Connection Description* window appears.

   Type in the name for this HyperTerminal session in the *Name* box. Press Enter. The *Connect To* window appears.
3. In the *Connect Using* box, select your PC COM port (e.g. **COM1**). Press Enter. The *COM 1 Properties* window appears.
4. In the *Bits Per Second* box, select **9600**.
5. In the *Flow Control* box, select **None**.
6. For the other settings, use the defaults. Press Enter. A HyperTerminal session window appears.
7. Press Enter. A response indicating an "invalid command" appears. Below this there is a prompt that indicates the meter type and the PC port where the meter is connected. For example:

   ION 7500:\PORT_1>
8. Type "?" and press Enter for the Factory Terminal menu.

As you toggle between the different Factory Terminal menu options you are required to type in a Login and Password:

Login: the number of the ION 7500 (e.g. 7500)

Password: the default meter password is "0"

Factory Terminal Menu

The Factory Terminal menu options are:

```
?          Display Help Screen
ALL?       Display All Commands
COMM?      Display Comm Help Screen
MISC?      Display Misc Help Commands
RESET      Display Reset Help Commands
SEC?       Display Security Help Screen
TIME?      Display Time Help Screen
KAL?       Display Calibration Help Screen
LOGIN      Factory login
LOGOUT     Logout
```

Display Help Screen – select this option to display the Factory Terminal menu (menu displayed above).

Display All Commands – select this option to display every Terminal Command that can be used in HyperTerminal.

Display Comm Help Screen – this option is not used if your meter is connected serially to your workstation.

Display Misc Help Screen – this option lists commands that allow you to repeat the last command, and display the battery statistics, meter release version, and meter firmware version.

Display Reset Help Screen – if your security level allows you to perform resets then this screen lists the following options: full or partial factory initialization; restore the factory framework; read power-up style; and reset fatal error.

Display Security Help Screen – select this option to enable/disable password or hardware security, or read the meter lock state.

Display Time Help Screen – select this option to set or display the meter time, and human meter time:

- meter time: Unix time (seconds since January 1, 1970)
- human meter time: day/month/year and hour:minute:second

Display Calibration Help Screen – select this option to display or configure meter calibration parameters.

Factory Login – this menu is reserved for Technical Services use.

Logout – select this option to logout of the meter, and end the HyperTerminal session.

The ION® Meter as an Ethernet Gateway

You can use your meter to let ION or other supported protocol data pass through the meter to other networks including third party systems. This technical note describes how to use your ION meter as a gateway.

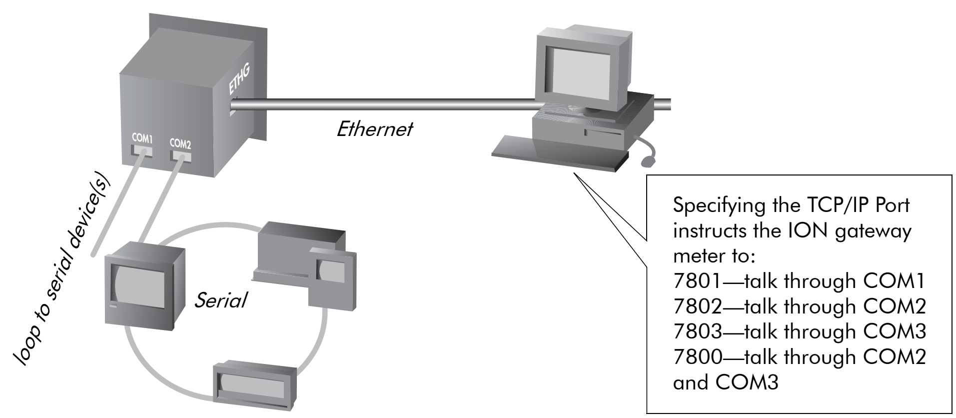
In This Document

EtherGate

A gateway is a network point that acts as an entrance (or gate) to another network. Gateways enable communication between networks, for example Ethernet and RS-485. This technical note describes how to use your ION meter's Ethernet connection as an EtherGate to transfer data between Ethernet and serial networks.

EtherGate is a powerful communications tool that lets you communicate *to* a meter and *through* a meter simultaneously. When a meter installed on the Ethernet network has EtherGate enabled, a master device (such as a workstation running ION Enterprise software) can communicate to the meter, and through the meter to a serial network of devices wired to the meter's COM port.

Ethernet uses 'virtual' ports to create many-port capability for devices on the Ethernet network. Each virtual TCP/IP port specifies which COM port on the gateway meter data is sent, as illustrated below.



To set up EtherGate, take the following steps:

1. Connect the gateway meter to the Ethernet, and wire the serial network of devices to the meter's COM port. Perform basic setup on each meter.

Then, using ION Enterprise software:

2. Add an Ethernet device that defines the meter that you have installed on the Ethernet network.
3. Add an Ethernet gateway site to enable Ethergate on the Ethernet device you added in step 2.
4. Add each device on the serial loop to the Ethernet gateway site you added in step 3.

These steps are described in more detail below.

Step 1: Install the Gateway Meter and Serial Network Devices

1. Install the ION gateway meter on the Ethernet network and perform basic setup — to properly configure an ION meter to communicate using TCP/IP you need a unique IP Address for your meter, and a Subnet Mask address (this address distinguishes among devices on the same LAN). Refer to the meter's documentation for setup instructions.
2. On the gateway meter's serial COM port, set the protocol to **EtherGate** using the meter front panel or ION Setup software. You do not need to configure a Unit ID for the gateway meter.
3. Wire serial devices on the bus to the gateway meter's appropriate communications port, and perform basic setup on each of these (set baud rate, Unit ID and protocol).

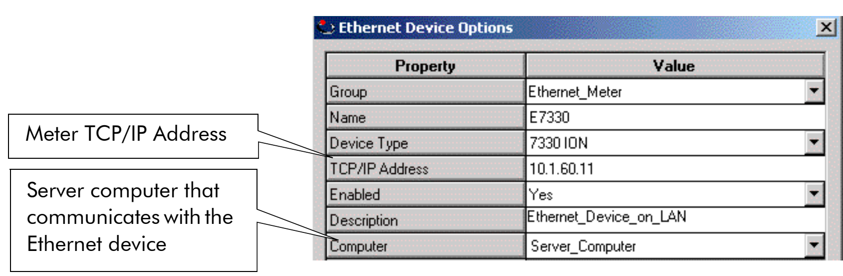
NOTE

Each device connected on the serial network must have a unique Unit ID.

Step 2: Add the ION Gateway Meter to Your ION Enterprise Network

After installation and basic setup is complete, set up your ION Enterprise network to mirror your communications network. Start by adding an Ethernet device that defines the meter that you have installed on the Ethernet network.

1. Launch the Management Console, and click the Devices button. Right-click in the Display Window and choose **New > Ethernet Device...**
2. Enter the information by typing in the appropriate fields or using the drop-down menus.

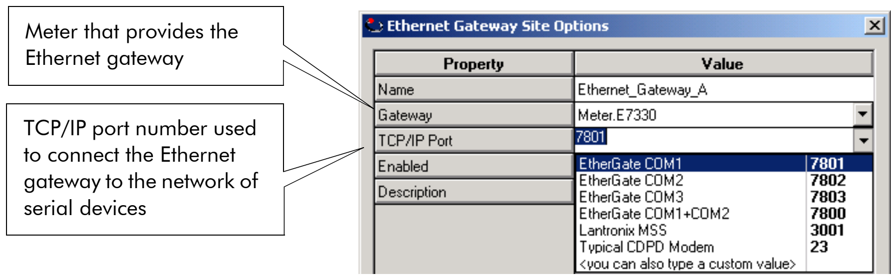


Step 3: Add an EtherGate Site to Your ION Enterprise Network

Step 1 lets you communicate *to* the ION gateway meter. To communicate *through* the ION meter using EtherGate, you need to create an Ethernet gateway site.

1. In the Management Console, click the **Sites** button. Right-click and choose **New > Ethernet Gateway...**

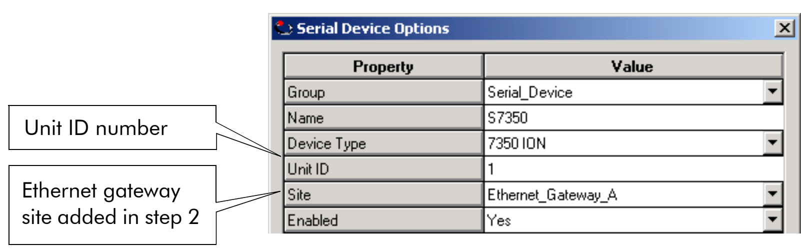
2. Enter the information by typing in the appropriate fields or using the drop-down menus.



Step 4: Add Serial Devices to the ION Enterprise Ethernet Gateway Site

Once you have an Ethernet device and gateway site configured, you can add the serial devices to the Ethernet gateway site.

1. In the ION Management Console and click the **Devices** button. Right-click in the Display Window and choose **New > Serial Device...**
2. Enter the information by typing in the appropriate fields or using the drop-down menus.



EtherGate Checklist

✓	Confirm that the gateway meter's IP Address and Subnet Mask Address are correct.
✓	Confirm that the gateway meter's appropriate COM port is used for the gateway. Ensure that the protocol is set to ETHERGATE.
✓	Confirm the baud rate and unit ID settings for each serial device.

The ION® Meter as a ModemGate

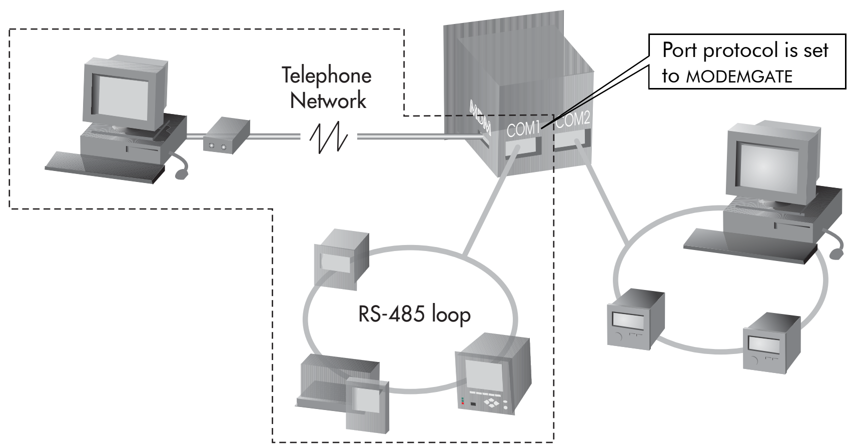
You can use your meter to let ION or other supported protocol data pass through the meter to other networks including third party systems. This technical note describes how to use your ION meter's internal modem as a gateway.

In This Document

ModemGate

A gateway is a network point that acts as an entrance (or gate) to another network. Gateways enable communication between networks. This technical note describes how to use your ION meter's internal modem as a ModemGate to collect data from serial networks.

The ModemGate feature creates a communications connection between the telephone network and a serial network (RS-232 or RS-485) of devices. When you specify the protocol for a meter's COM port as MODEMGATE, all data received by the meter's internal modem is automatically transferred to the serial network. You can only ModemGate out of one COM port on the meter.



NOTE

On ION 7330 and ION 7350 meters, the internal modem option is hardwired to COM1. If you are using ModemGate, then an ION 7330 or ION 7350 meter with an internal modem that will reside on the serial loop must connect to the serial loop using COM2. If COM1 is used, then the two modems (gated meter internal modem and serially looped meter internal modem) conflict during communication.

General network installation and basic setup:

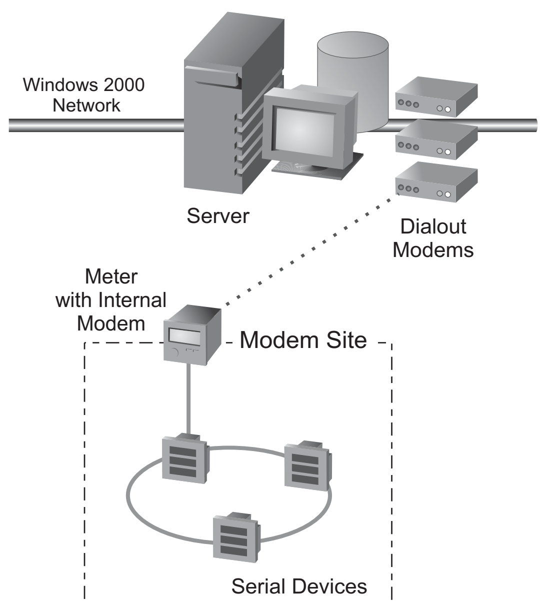
1. Install the ION gateway meter with the internal modem and connect the internal modem to the telephone network.
2. Follow the instructions in your ION meter's documentation to perform basic setup.
3. Wire the serial devices to the appropriate COM port on the meter and perform basic setup on each of these devices. After wiring and basic setup is complete, you must set up the software to reflect how you have wired the communications network.

ModemGate Checklist.

✓	All connected devices, including the modem of the PC, use the same baud rate
✓	Each device connected on the RS-485 network has a unique Unit ID
✓	Each device Unit ID and common baud rate are recorded for future reference
✓	The protocol on the ION gateway meter is set to MODEMGATE (ION on the ION 7300 Series meter)
✓	COM port hardware is set to RS-485 on the ModemGate meter (ION 8000 Series and ION 7500/ION 7600 meters)

NOTE

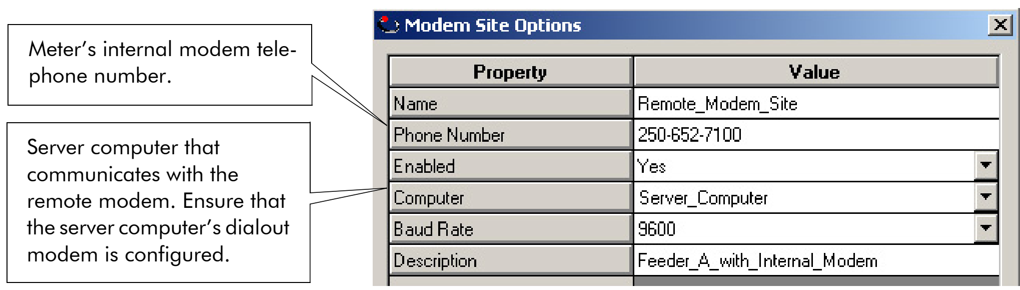
Each device connected on the RS-485 network must have a unique Unit ID number and the same baud rate as the internal modem.



Step 1: Add a Modem Site to an ION Enterprise Network

Once the hardware is installed, you can use ION Enterprise software to configure communications among devices.

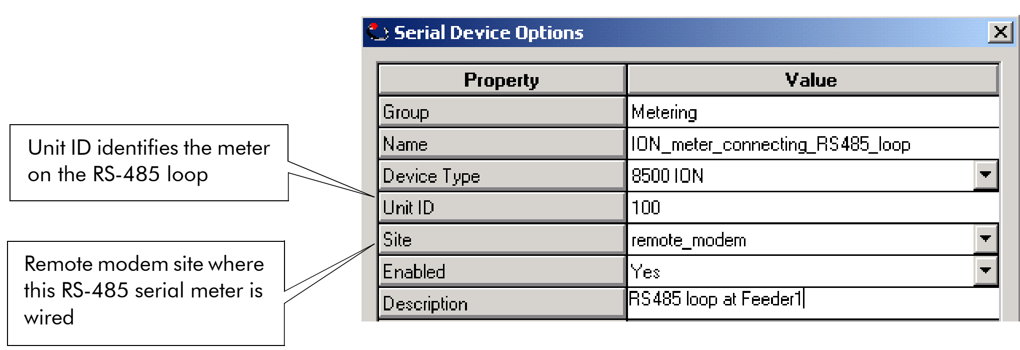
1. Launch the Management Console and click the Sites button on the System Setup Pane. Right-click in the display window and choose **New > Modem Site...**
2. Enter the information by typing in the appropriate fields or using the drop-down menus. Refer to the *ION Enterprise Getting Started* guide to learn how to add a dialout modem.



Step 2: Add Meters to the Modem Site

After you have added and configured the ION Enterprise modem site using the Management Console, you can add each serial meter on the RS-485 loop to the modem site.

1. Launch the Management Console and click the **Devices** button. Right-click in the Display Window and choose **New > Serial Device...**
2. Enter the information by typing in the appropriate fields or using the drop-down menus.



Step 3: Configure the ION Gateway Meter for ModemGate

You need to configure the communications settings on the ION meter that serves as a gateway.

1. Once the gateway meter is installed and the internal modem is connected, use the front panel of the meter to configure the internal modem and the serial communications port.
2. Set the internal modem baud rate, Unit ID and protocol (for most applications the default settings are appropriate). The baud rate must be the same for the port hosting the gateway and all connected devices.
3. Set the protocol (on the meter) for the port hosting the gateway to MODEMGATE. If you have an ION 7300 Series meter select ION as the protocol. The baud rate for this port must be the same as all other communicating ports.

NOTE

You cannot have MODEMGATE (ION on the ION 7300 Series meter) protocol enabled on two ports simultaneously.

Time Synchronization & Timekeeping

Time synchronization lets you synchronize the internal clocks of all networked meters and devices. Once synchronized, all data logs have timestamps that are relative to a uniform time base. This allows you to achieve precise sequence-of-events and power quality analyses. To synchronize clocks, use ION® software or a Global Positioning System (GPS) receiver to broadcast time signals across the network.

In This Document

Introduction

Time synchronization signals are broadcast periodically over the network; each meter continually assesses its ability to remain synchronized with the incoming broadcasts. Over a brief period, each meter learns how its internal timing differs from that of the broadcast source and adjusts its timekeeping to compensate. Very accurate time synchronization is achieved with this method.

Meters at modem sites are synchronized each time they are connected. The longer the duration between connections, the larger the error in time synchronization. In the extreme case, this can result in missing or duplicated logs. If this occurs, you can increase the frequency of connections: install GPS receivers at the remote sites, or arrange for a direct ION software connection.

It is important that only one method of time synchronization be used on each network. If multiple methods are used, the timestamps will differ for the sites and devices using separate time synchronizing methods.

Before you configure time synchronization on your network, you should familiarize yourself with the Clock module settings. Once you have done this, you can decide which synchronization method you want to use.

NOTE

Time Synchronization is disabled by default with ION Enterprise. In order to use time synchronization with an ION device, the feature must be enabled from the ION Management Console for that device. Refer to "Enabling or Customizing Time Synchronization" on page 351 for instructions.

Clock Module Settings

The Clock module controls an ION meter's internal clock. In order to correctly set up time synchronization with your single meter or network, you need to be familiar with certain features of the Clock module. Essentially, you need to configure the Clock module's Setup registers to correspond to the type of time synchronization you desire. You use Designer software or the front panel's Setup menu to configure the Clock module.

Clock Source Used for Synchronization:

The *Clock Source* setup register has three settings from which to choose, depending on the method of time synchronization. The ION 7500 / ION 7600 and ION 8000 Series of meters have all three settings available as options. The ION 7700 and ION 7300 Series only have the INTERNAL setting.

- **LINE FREQUENCY:**

  When the *Clock Source* is set to monitor the ISO Grid Operation line frequency, each meter auto-corrects the internal clock based on the measured line frequency. Over a long period of time, this form of time keeping is highly accurate. If a power outage occurs, the clock automatically synchronizes with the meter's internal crystal until power is restored. Once the power is restored, the clock once again synchronizes with the line frequency. Meters synchronize with the line frequency by default.

- **INTERNAL:**

  If you prefer having the meter itself provide timekeeping, set the *Clock Source* setup register to INTERNAL. The clock then synchronizes to the meter's internal crystal.

- **COMM:**

  Use this for the *Clock Source* if you set the *Sync Source* setup register (see below) to a COM port to receive GPS time synchronization signals.

Type of Time Used for Synchronization:

The *Time Sync Type* setup register specifies whether time synchronization signals are received in Coordinated Universal Time (UTC) or Local Time.

- **UTC:**

  Coordinated Universal Time is the standard time common to every place in the world. Formerly and still widely called Greenwich Mean Time (GMT), UTC nominally reflects the mean solar time along the Earth's prime meridian. It is expressed using a 24-hour clock but can be converted into a 12-hour clock (AM and PM). The time kept on the ION meter is always UTC (24-hour clock). When using UTC, the *TZ Offset* and *DST Offset* setup registers (see below) are not required. The *Time Sync Type* setup register is set to UTC by default.

- **LOCAL:**

  This setting requires that the time zone offset and DST offset are filled in correctly. Thus, Local time is basically the UTC adjusted for time zone and daylight savings time. There are some DNP masters and GPS receivers that use Local time; for these only, change the *Time Sync Type* from its default setting to LOCAL.

Time Zone Adjustment:

The *TZ Offset* register specifies the time zone applicable to the area in which the meter resides. It is obtained by adding or subtracting the appropriate number of hours and minutes (hh:mm) from UTC time.

Daylight Savings Time Adjustment:

The *DST Offset* register holds the Daylight Savings Time offset applicable to the meter's location. The *DST Offset* is the amount of time in hours and minutes (hh:mm) that the clock is adjusted when Daylight Savings Time begins.

NOTE

The setup registers, DST Offset and TZ Offset have no affect on the information recorded by a meter's data and event recorders. These recorders always use UTC as their timestamped reference.

Communications Port Used for Synchronization:

The *Time Sync Source* setup register specifies which communications port receives time synchronization signals. Only signals received on the selected port are used for time synchronization; all other time synchronization signals are ignored. Signals can be received on the following ports:

- COM1 RS-232/RS-485 port
- COM2 RS-485 port or optional internal modem
- COM3 optical port
- 10Base-T Ethernet port

NOTE

GPS Time Synchronization cannot be used with the Ethernet port, since time synchronization accuracy cannot be guaranteed--there is no way to determine when a packet will arrive over the Ethernet.

Time synchronization can be achieved using ION and DNP 3.0 protocols. GPS time synchronization uses special protocols defined for the type of GPS receiver you are using. The following table summarizes the time synchronization sources:

Source of Synchronization used for the *Time Sync Source* Register	*Protocol* Register in the Communications Module	*Time Sync Type* Register in the Clock Module	*Clock Source* Register in the Clock Module
ION	ION	UTC[1]	LINEFREQ, INTERNAL
DNP	DNP	UTC/LOCAL	LINEFREQ, INTERNAL
Arbiter 1092	GPS:ARBITER GPS:ARBITER-VORNE	UTC/LOCAL	COMM
True Time XL-DC	GPS:TRUETIME/DATUM	UTC/LOCAL	COMM
Datum Exac Time	GPS:TRUETIME/DATUM	UTC/LOCAL	COMM
Clark GPS-200-ASCII	GPS:TRUETIME/DATUM	UTC/LOCAL	COMM

[1] Note that ION time synchronization only uses the UTC setting; the LOCAL setting cannot be used.

Time Synchronization: ION or GPS

Use ION software for systems where time synchronization is not critical. ION software can synchronize a meter's clock to within ± 16ms (typical) of other meters in a serial network.

Use a GPS receiver if you require time synchronization to within ± 1ms of Coordinated Universal Time (UTC), or within ± 2ms (typical) of other meters in the network. If you install a GPS receiver, you'll need an additional serial network.

ION Time Synchronization

ION software provides time synchronization by default. (It is disabled by default.) The communications port and protocol used for communications between ION software and the networked devices is automatically used to send time synchronization signals to all connected ION devices. ION software sends out a time sync packet and the time is set once the packet is received.

Time synchronization values are set when sites or Ethernet devices are defined in an ION Enterprise network. You enable time synchronization or set custom intervals for any device in any site through the ION Management Console.

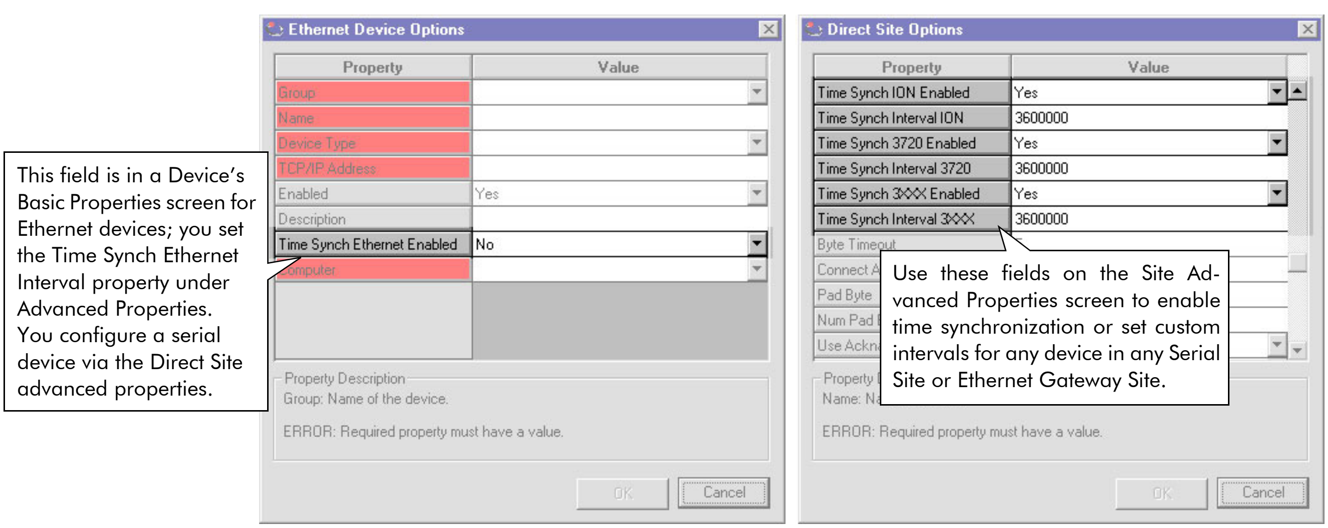
Enabling or Customizing Time Synchronization

1. Launch the ION Management Console.
2. From the System Setup Pane, select Sites or Devices.

   Select Sites if you want to customize a particular serial, modem, or Ethernet Gateway site.

   Select Devices if you want to customize an individual Ethernet device.
3. Right-click in the main window and select Properties.
4. Right-click inside the display window and select Advanced Properties.

The fields for enabling or customizing time synchronization are shown below.



The Property Description area explains the purpose for each field.

The default time synchronization interval of 3,600 seconds (displayed in milliseconds) is acceptable for most ION installations.

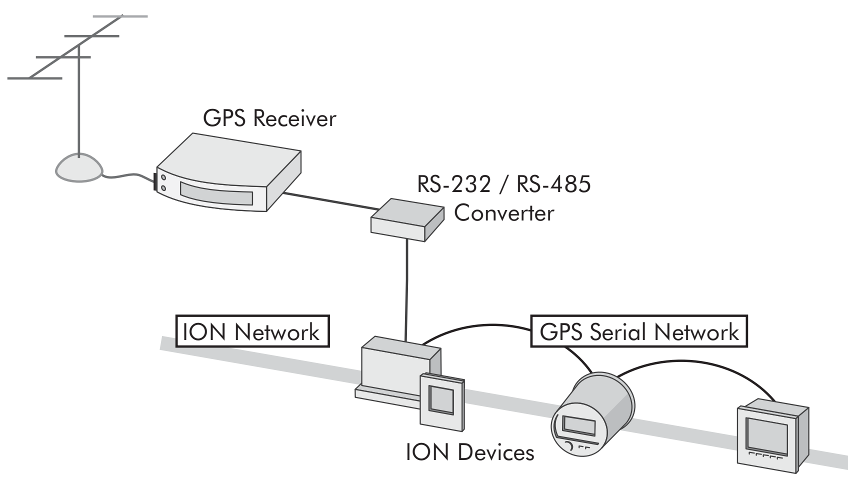
NOTE

You need appropriate permissions to configure the meters on your network. Refer to the technical note *ION Security* for details on software and meter security.

GPS Time Synchronization

To implement a GPS scheme, you need a dedicated serial network. If you are already using a serial link for communications with ION software, you need a second serial network to transport GPS signals.

Either RS-232 or RS-485 networks can be used for GPS time synchronization, though RS-485 is recommended if more than two meters are being synchronized. If your GPS receiver output is RS-232 use the COM32 or equivalent RS-232/RS-485 converter that does not buffer communications. The COM128 is not recommended if used in Repeater Mode.



NOTE

The ION 7700 has the highest possible synchronization accuracy using communications port 1 (COM1) on the meter; however, COM2 and COM3 (via the Xpress Card) are still acceptable for time synchronization.

Configuring for GPS Time Synchronization

To implement GPS time synchronization, use Designer software to configure the Clock module and the Communications module:

1. Launch Designer and choose Show Toolbox from the Options menu if it is not already displayed. Double-click the Clock module.
2. Set the Clock module's *Clock Source* setup register to COMM.

3. Specify which COM port will receive time synchronization signals by setting the *Time Sync Source* setup register in the meter's Clock module; Ethernet is not be used with GPS time synchronization. Only signals received on the port specified are used for synchronization.
4. Specify the receiver you want to use by selecting it from the *Protocol* setup register in the receiving port's Communications module (see table below).

You may need to modify the *Time Sync Type* setup register, if a DNP Master is sending time broadcasts in local time.

Supported GPS Receivers

GPS Receiver	Comm Module Protocol Register Setting
True Time XL-DC series	GPS:TRUETIME/DATUM
Datum ExacTime Series	GPS:TRUETIME/DATUM
Arbiter 1092	GPS:ARBITER GPS:ARBITER-VORNE[1]
Clark and Associates GPS-200-ASCII	GPS:TRUETIME/DATUM

[1] GPS:ARBITER-VORNE is only supported in the ION 8000 Series and ION 7500 / ION 7600 meters.

GPS Time Synchronization Format

Any GPS receiver may be used as a time synchronization source, as long as the receiver outputs the ASCII time string (shown below) every second and has On Time Mark (OTM). Use the table below to select the appropriate 'protocol' register for each OTM type.

On Time Mark (OTM)	'Protocol' Register
Start bit of <SOH>	GPS:ARBITER
Start bit of <CR>	GPS:TRUETIME/DATUM
Start bit of <BEL>	GPS:ARBITER-VORNE

During normal operation of a GPS timesynching system, time signals are sent out once per second as an ASCII string containing the time.

The ASCII time string for GPS:ARBITER and GPS:TRUETIME/DATUM is the following:
<SOH>DDD:HH:MM:SSQ<CR><LF>

The ASCII time string for GPS:ARBITER-VORNE is the following:
44HHMMSS<CR><LF>
55DDD<CR><LF>
11NN<CR><LF>
<BEL>

Explanation of GPS:ARBITER & GPS:TRUETIME/DATUM ASCII Time String

ASCII Time String: <SOH>DDD:HH:MM:SSQ<CR><LF>	
<SOH>	start of header (ASCII 01_{hex})
DDD	day of the year
HH	hours
MM	minutes
SS	seconds
Q	quality flag
<CR>	carriage return (ASCII $0D_{hex}$)
<LF>	line feed (ASCII $0A_{hex}$)

Explanation of GPS:ARBITER-VORNE ASCII Time String

ASCII Time String (below left)[1]	
44HHMMSS<CR><LF>	UTC/local time
55DDD<CR><LF>	day of the year
11NN<CR><LF>	out-of-lock time in minutes
<BEL>	<BEL> = hex 07

[1] Explanation of <CR> and <LF> is the same as in the previous table.

The bytes in the time string must transmit continuously for the time synchronization signals to be received correctly. When using a GPS receiver for time synchronization, it is best to use it at 9600 baud rather than a higher baud rate. This reduces the chance of bytes being interrupted and provides the best accuracy, since the accuracy of the OTM depends on the baud rate.

Diagnostics and Event Logging

The meter's Diagnostics module includes output registers that provide time synchronization diagnostics. Events are logged by the meter's Clock module, Communications modules, and Diagnostics module in response to time synchronization events.

Diagnostics Module Output Registers

- *Time Sync Source*

  This register is ON if the internal clock synchronizes with the line frequency or GPS, and it is OFF if the internal clock synchronizes with its own internal crystal.

- *GPS Receiver Status*

  This register is ON if the GPS receiver is locked onto a time source and OFF if the lock is lost. This information is received directly from the GPS receiver; the register is NOT AVAILABLE if the GPS time synchronization is not used.

- *Time Sync Count*

  This register indicates how many time synchronization signals have been received. The value increases with each signal received.

- *Time Since Last Time Sync*

  This register displays the amount of time, in seconds, since the last time synchronization signal was received.

- *Time Sync Diag* (*time sync diagnostics*)

  This register displays the difference, in microseconds, between the timestamp in a synchronization signal and the time in the device's clock when the signal is received. The displayed value is a sliding window average over the last five time synchronization signals received.

- *Time Sync Status*

  This register is ON if a time synchronization signal is acquired, and OFF if the signal has been lost. The Diagnostics module calculates the average interval for the last five signals received, considering the signal lost if no signals are received in two times the average interval.

Event Logging

The following events appear in the Event Log:

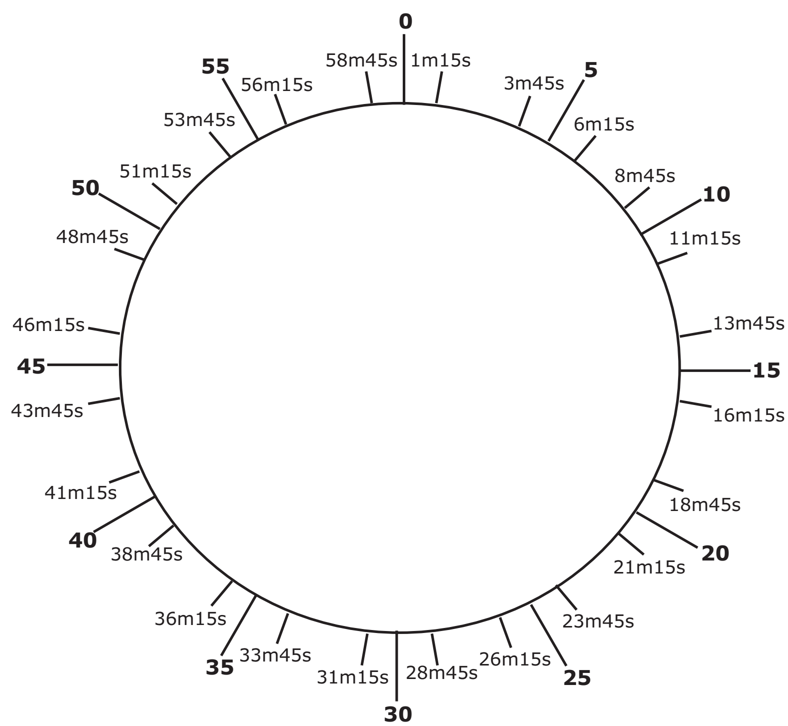
- Time sync acquired — generated when the first time sync signal is received (Diagnostics module's Time Sync Status register goes ON).
- Time sync lost event — generated if no time sync signals are received in two times the average interval of the last five signals (Diagnostics module's Time Sync Status register goes OFF).
- GPS locked — generated when the GPS receiver locks onto a time source (Diagnostics module's GPS Status register goes ON).

- GPS unlocked — generated when the GPS receiver loses its lock on a time source (Diagnostics module's GPS Status register goes OFF).
- Time set event — generated when a time synchronization signal is interpreted as a time set, and the meter's clock is reset. Two events are recorded: one with the timestamp before the clock was set, and one with the timestamp after the clock was set.

Time-Synchronization Blackout

Time-synchronization blackout is defined as a duration when time synchronization cannot occur. Utilities often record power usage at regular, predetermined intervals. For example, the utility may schedule a recording every five minutes during an hour period (i.e. 5, 10, 15, 20,..., 55, 60). If a time synch moves the meter clock forward, the meter may miss one of the recording intervals. If a time synch moves the meter clock backwards, the meter may get two records with the same timestamp. The time synchronization blackout feature seeks to protect the time before and after these recording intervals by not sending out any time synch signals at those times.

ION Enterprise has time-synchronization blackouts enabled automatically. The blackout intervals are every five minutes as follows: 0, 5, 10, 15, 20, 25, 30, 35, 40, 45, 50, 55. Each blackout is 2 minutes and 30 seconds in duration. This duration is distributed evenly before and after the interval. The diagram below illustrates the time synchronization blackout feature in ION Enterprise.



If a regularly scheduled time synch is not sent due to a blackout interval, the software continues trying to send the time synchronization signal every 15 seconds until the blackout period expires and the time synch is sent.

Changing Default Blackout Settings

In order to change the default settings for the interval or the blackout duration, you must edit the registry.

CAUTION

Only edit the registry information detailed here. Making changes to other registry settings can have undesirable, possibly detrimental, effects on your system.

There are two registry entries that control the time-synchronization blackout behavior. These registry settings are both of type REG_DWORD and can be found in the same directory as the other ION Enterprise registry entries.

TimesyncBlackoutInterval_mins

Default value: 5

This entry is specified in minutes. It must have a value greater than 1 in order for time-synchronization blackouts to occur. A value of 60 or greater configures blackouts to occur once an hour.

TimesyncBlackoutDuration_secs

Default value: 150 (2 minutes 30 seconds in seconds)

This entry is specified in seconds. A value of 0 (zero) disables the blackout feature. This entry cannot have a value greater than or equal to 3600 (one hour).

NOTE

If you want to disable the blackout feature but keep time synchronization enabled, set the TimesyncBlackoutDuration_secs register to 0.

There are certain settings for these registry entries that can disable time synchronization in general (not just the blackout feature). These are as follows:

- TimecyncBlackoutInterval_mins < 1
- TimesyncBlackoutDuration_secs >= 3600 (1 hour)
- TimesyncBlackoutDuration_secs (the value converted to minutes) >= TimecyncBlackoutInterval_mins

Do not use any of these settings to disable time synchronization. If you want to disable time synchronization for a particular device, use the ION Management Console to do so.

Time-Synchronization Blackout Considerations

- Remeber to specify TimesyncBlackoutInterval_mins in minutes and TimesyncBlackoutDuration_secs in seconds.
- When your values are bad, an error is sent to the system log database. If time synchronization signals are not occurring, check the system log to see if there's an error message about your blackout values.
- When reviewing time synchronization messages in the system log, remember that the time in the message is not the time to which the meter was time synched, but rather it is the time the message was posted to the system log. The message is posted after the meter is time synched.

Upgrading ION® Device Firmware

Each ION meter and certain meter components (such as the ION 7330 Ethernet card, ION 7700 Xpress™ card, or MGT) use *firmware* to store operating software. You can upgrade your ION device to a newer version of operating software by simply upgrading its firmware.

In This Document

The Device Upgrader

ION Enterprise™ software includes a device upgrade utility named Device Upgrader, which you can use to upgrade each ION device in your system. With the Device Upgrade utility you can upgrade the firmware on a single ION device, or upgrade multiple ION devices of the same type in a single session. You access the Device Upgrader utility from the ION Management Console.

NOTE

A Supervisor password authority (level 5) is required to upgrade ION devices.

The following instructions detail how to upgrade one or more devices of the *same type*. If you need to upgrade devices that are *different* types, then you have to perform the following instructions for *each* device. For example, if you need to upgrade an ION 7330 meter and an ION 7330 Ethernet card, then you have to perform the following instructions once for the meter, and then again for the Ethernet card (or vice versa).

Before You Upgrade

Please read this section before you begin your upgrade. The recommendations presented here can help your device upgrading procedure.

Checking the Log Server before upgrading

Data stored in the meter's memory is lost during the firmware upgrade. This includes waveforms, Min/Max values, and information stored in Data Recorder and Integrator modules. It is recommended that you ensure the Log Server is caught up (i.e. up to date) before you commence upgrading.

Ensuring the Log Server is caught up

1. Launch Vista and open a user diagram.
2. Click the Data Log Viewer for voltage or other parameter that updates quickly (e.g. every fifteen minutes).
3. Look at the timestamp column.

	timestamp	Vll avg
1	04/23/2003 02:45:00.000 PM	207.842
2	04/23/2003 02:30:00.000 PM	207.854
3	04/23/2003 02:15:00.000 PM	207.842
4	04/23/2003 02:00:00.000 PM	207.852
5	04/23/2003 01:45:00.000 PM	207.84

If the timestamp is current — the date is correct and the time is within the update period — then the Log Server is caught up.

Modifying the transmit delay for Ethernet devices

For Ethernet devices belonging to the ION 8000 series or ION 7500 and ION 7600 series, you can set the Transmit Delay parameter to 0 for faster firmware upgrades. Note that you should also set the Use Ack/Nacks parameter to No when you modify the transmit delay for these devices.

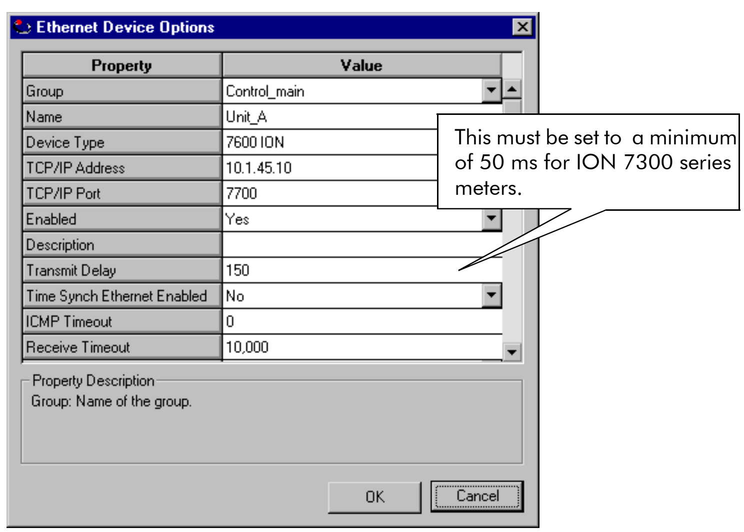
Upgrading firmware for ION 7300 series meters, however, require a minimum transmit delay of 50 ms. Although the default transmit delay for these devices is 150 ms, you may want to check this setting before you attempt to upgrade your device. Failure to have a minimum of 50 ms transmit delay for ION 7300 series devices may result in upgrade failure.

NOTE

It is recommended that the default transmit delay of 150 ms be used for ION 7300 series meters whenever possible. Only advanced users should change this setting.

Configuring device transmit delay

1. In the ION Management Console menu, click the Devices icon in the left-hand pane.
2. Right-click the device you wish to upgrade in the list of devices and select Properties.
3. Right-click in the dialog box and select Advanced Properties.



4. Set Transmit Delay to at least 50 ms (150 ms is recommended) for ION 7300 series meters, or set Transmit Delay to 0 for ION 7500, ION 7600, and ION 8000 series meters (set Use Ack/Nacks to No for this group of devices too.)
5. Click OK.

NOTE

When upgrading the firmware for devices in serial and modem sites, it is recommended that you keep the transmit delay at the site's default (i.e. 150 ms for both serial and modem sites).

Laptop computer considerations

Laptop computers generally have different default power option properties than desktop computers. Incorrect power options can adversely affect the Device Upgrader's performance, because the connection between the laptop and the device must be maintained in order for the Device Upgrader to complete its task. If the laptop's hard disk shuts down or the laptop enters system standby mode, this connection is broken and the Device Upgrader must be restarted.

When using the Device Upgrader utility from a laptop computer, it is recommended that you follow these guidelines:

- Plug the laptop computer into a wall outlet. Do not run the laptop on its battery pack.
- Configure the hard disks so that they do not shut down after a certain period of time (i.e. set to "never").
- Turn off power suspension (e.g. system stand-by) and hibernate options.
- Disable options that power down the laptop when it is closed. This prevents a shut down if the laptop is accidentally closed.
- Disable the screen saver; screen savers can burden the CPU.

Upgrading Your ION Device(s)

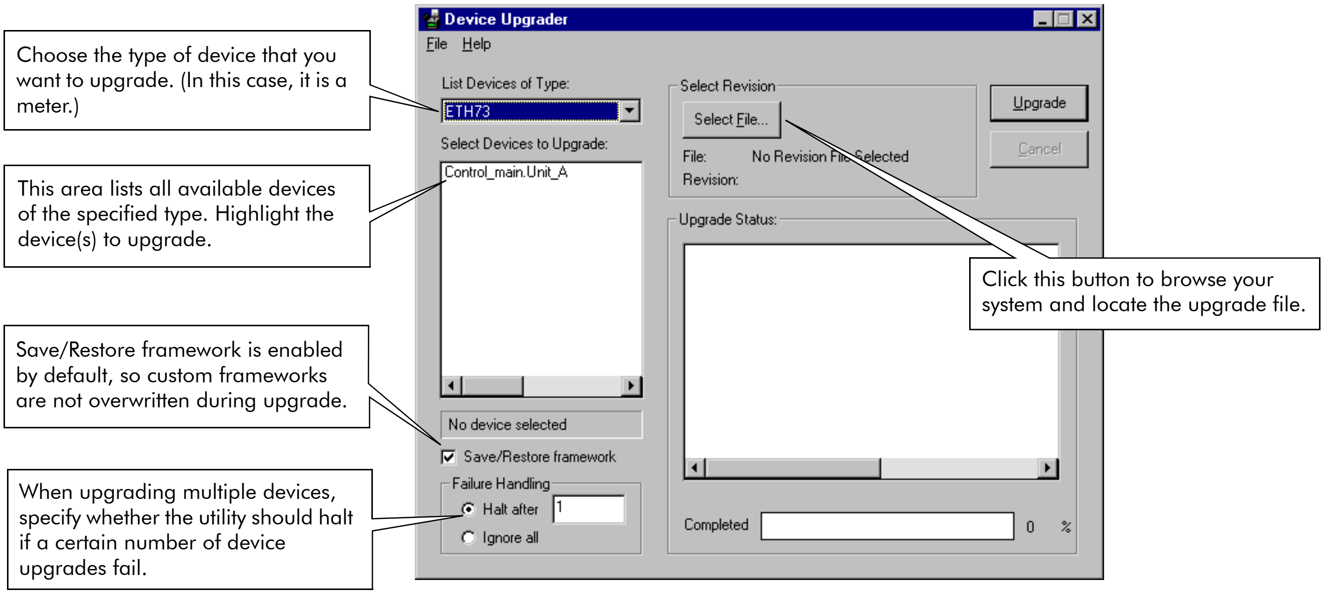
1. In the ION Management Console menu, select Tools > System > Device Upgrader.
2. Type your username and password, and click OK. (Use "guest" and "0" if ION Enterprise security has not been configured.)

   An information window appears with recommendations and warnings:

NOTE

To shut down the Log Server: click Start > Settings > Control Panel. Double-click Administrative Tools > Services > ION Log Server. Click Stop and OK. After you have finished your device upgrade, restart the Log Server.

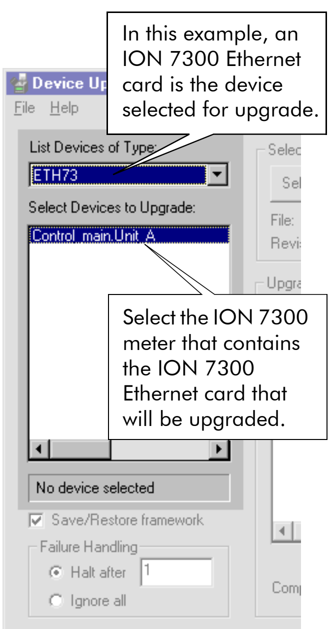
When you have read the information and you are ready to upgrade your devices, click OK. The Device Upgrade window displays:



3. Select the appropriate ION device in the List Devices of Type box. The Device Upgrade utility searches your system and lists all the supported devices in the Select Devices to Upgrade box.
4. Select the device(s) you want to upgrade from the Select Devices to Upgrade list. To make multiple selections, hold down the Ctrl key.

   The **Save/Restore Framework** check box is selected by default so that you do not lose your current framework template during the upgrade, including any custom frameworks you may have configured. Clearing the Save/Restore Framework check box deletes the current framework template for each selected device when the firmware upgrade is complete; there is no framework configuration in the upgraded devices. It is recommended that you leave this check box selected.

   If you intend to replace the meter's framework template with the newest default template after you upgrade the firmware, then you can clear the check box. Remember to download the ION software updates to support the latest firmware version (these can be found at HTTP://WWW.PWRM.COM/SUPPORT/DOWNLOADS).



5. If you are upgrading multiple devices, specify in the Failure Handling area how the Device Upgrader utility responds to an unsuccessful upgrade:
   - Select **Halt After** and specify the number of devices with failed upgrades that can occur before the utility stops.

By default, the utility is set to stop after the first failed upgrade. If, for example, you increase this number to 5, the Device Upgrade utility will continue upgrading devices until the entire selection has been upgraded, or a total of five devices have failed the upgrade process.

- Select **Ignore All** to attempt to upgrade all of the selected devices regardless of any failures.

Failure handling is useful when upgrading large numbers of devices. Because the upgrade process is time-consuming, you may choose to leave the Device Upgrade utility to operate on its own (e.g. overnight). By setting the failure handling accordingly, you can instruct the Device Upgrade utility to continue the upgrade even after encountering problems with one or more devices.

6. In the Select Revision section, click the Select File button. In the Revision File Selection box, locate the revision file that you want to use, and click Open.

   The selected file and revision number are displayed below the Select File button. This file will be downloaded to all the devices that are highlighted in the Select Devices to Upgrade list.

7. Click Upgrade to upgrade the selected device(s).

   The Upgrade Status box describes each step in the upgrade process, and the Percent Completed bar indicates the progress of each upgrade. Each completed upgrade is noted in the Upgrade Status box.

NOTE

If connection to the device is lost, or if power to the device is interrupted during an upgrade, restart the Device Upgrade utility procedure.

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