



User's Guide

Version 2.0

CONTENTS

Danger

During normal operation of this device, hazardous voltages are present which can cause severe injury or death. These voltages are present on the terminal strips of the device and throughout the connected potential transformer (PT), current transformer (CT), status input, relay, and control power circuits. Installation and servicing should be performed only by qualified, properly trained personnel. See the 7700 ION *Installation & Basic Setup Instructions* for further details.

Warning

This equipment generates, uses, and can radiate radio frequency energy and if not installed and used in accordance with the instructions manual, may cause interference to radio communications. It has been tested and found to comply with the limits for a Class A computing device pursuant to Part 15 of FCC Rules, which are designed to provide reasonable protection against such interference when operated in a commercial environment. Operation of this equipment in a residential area may cause interference in which case the operator will be required to take whatever measures may be required to correct the interference.

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Basic communications settings (baud rate, protocol) and metering settings (volts mode, CT/PT ratios) must be configured before you can use the 7700 ION. If these settings have not been configured, follow the steps in the *7700 ION Installation & Basic Setup Instructions* before consulting this User's Guide.

You may only need to read certain sections of this User's Guide, depending on how you will use the 7700 ION.

Chapter 1 ♦ **Understanding the Basics of the 7700 ION**

Chapter 1 introduces the 7700 ION, and shows how it fits into power monitoring systems. The display and analysis software tools that compliment the 7700 ION are discussed, and some of the device's capabilities are presented.

Chapter 2 ♦ **Accessing Data and Interpreting Displays**

Chapter 2 shows you how to access the data that the factory-configured 7700 ION provides. Go directly to this chapter if you want to start viewing real-time and logged data without performing any additional configuration. Chapter 2 describes what data you can access using PEGASYS Vista software, PowerView software, and the MGT front panel display.

Chapter 3 ♦ **Making Minor Configuration Changes**

Chapter 3 describes how to use PEGASYS ION Designer to make minor changes to the meter's operation. Configuration functions provided by PowerView and the MGT are also described.

Chapter 4 ♦ **Customizing the 7700 ION / Using Advanced Functions**

Chapter 4 provides more details about the 7700 ION's operating software so that the advanced user can create custom functionality. Chapter 4 also describes advanced communications, time synchronization, and I/O available with the XPRESS CARD. Creating custom MGT displays is also discussed.

Chapter 5 ♦ **Technical Specifications**

The Technical Reference in Chapter 5 provides technical specifications, accuracy data, ordering options, and warranty/registration information.

Appendix A ♦ **Revenue Metering**

Details specific to the revenue-class 7700 ION -RMANSI and -RMICAN are provided in the Appendix.



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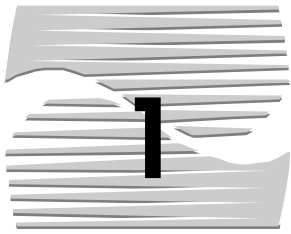
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Introduction

The 7700 ION is a highly advanced digital power meter, suited to virtually any power monitoring and control application. This Intelligent Electronic Device (IED) can take the place of numerous transducers, meters and control circuits in your power monitoring system. The 7700 ION provides true RMS measurements of voltage, current, power and energy, complemented by extensive I/O capabilities, comprehensive logging, and advanced power quality functions.



The 7700 ION with the Modular Graphics Terminal

The 7700 ION can be used effectively in numerous supply side and demand side operations. Some common applications of the 7700 ION are:

- ◆ Revenue Metering
- ◆ Substation Automation
- ◆ Commercial/Industrial Metering
- ◆ Power Quality Monitoring
- ◆ Capacitor Control
- ◆ SCADA

These are just a few of the many possibilities. Contact Power Measurement Customer Service if you would like assistance with your application.

The 7700 ION is Factory-Configured and Ready to Operate

Although the 7700 ION is fully customizable, it is shipped from the factory with many functions pre-configured. Once installation and basic setup are preformed, all of the basic measurements, energy calculations and recording functions are ready to operate, right out of the box. Many users will find that the factory configuration will serve their purposes without performing any additional configuration.

What's New in Firmware Version 7700V200

Firmware version 7700V200 offers many new and enhanced features, including new power quality functions, new communications and I/O options, and more ION module types for advanced applications. PEGASYS version 2.0 includes several enhancements that make the 7700 ION easier to set up and use.

Data Display and Device Configuration Improvements

The most significant change to the 7700 ION in the V200 release is found when you display data or perform configuration functions with PEGASYS Vista, ION Designer and the MGT.

The data measured by the 7700 ION is now easier to access and interpret in PEGASYS Vista. A new set of user diagrams, included on the PEGASYS 2.0 release CD, group most of the factory-configured functions onto five main screens for real-time measurements, power quality monitoring, energy and demand calculations, setpoints and digital input status.

Both ION Designer software and the MGT have been updated to provide easier access to setup functions.

Power Quality Features

7700V200 firmware provides enhanced power quality monitoring functions. The device now uses a nominal system voltage level to quantify power quality events such as sags, swells and transients. Both the Sag/Swell module and the Transient module have been improved, and the display of real-time and logged power quality events is incorporated into the standard PEGASYS Vista user diagrams.

New Communications and I/O Options

New or improved communications and I/O features include:

- ◆ The XPRESS CARD supports the DNP 3.0 protocol on either RS-485 port (only one port can be configured to use DNP 3.0 at any one time).
- ◆ New protocols and functions provide high-accuracy time synchronization using GPS receivers. PEGASYS time synchronization is also improved.
- ◆ The XPRESS CARD supports two independent EtherGate gateways.
- ◆ Support is added for various types of thermocouple inputs.
- ◆ The new Alert module provides automatic dial-out to PEGASYS and paging systems in response to user-specified conditions.

New ION Modules

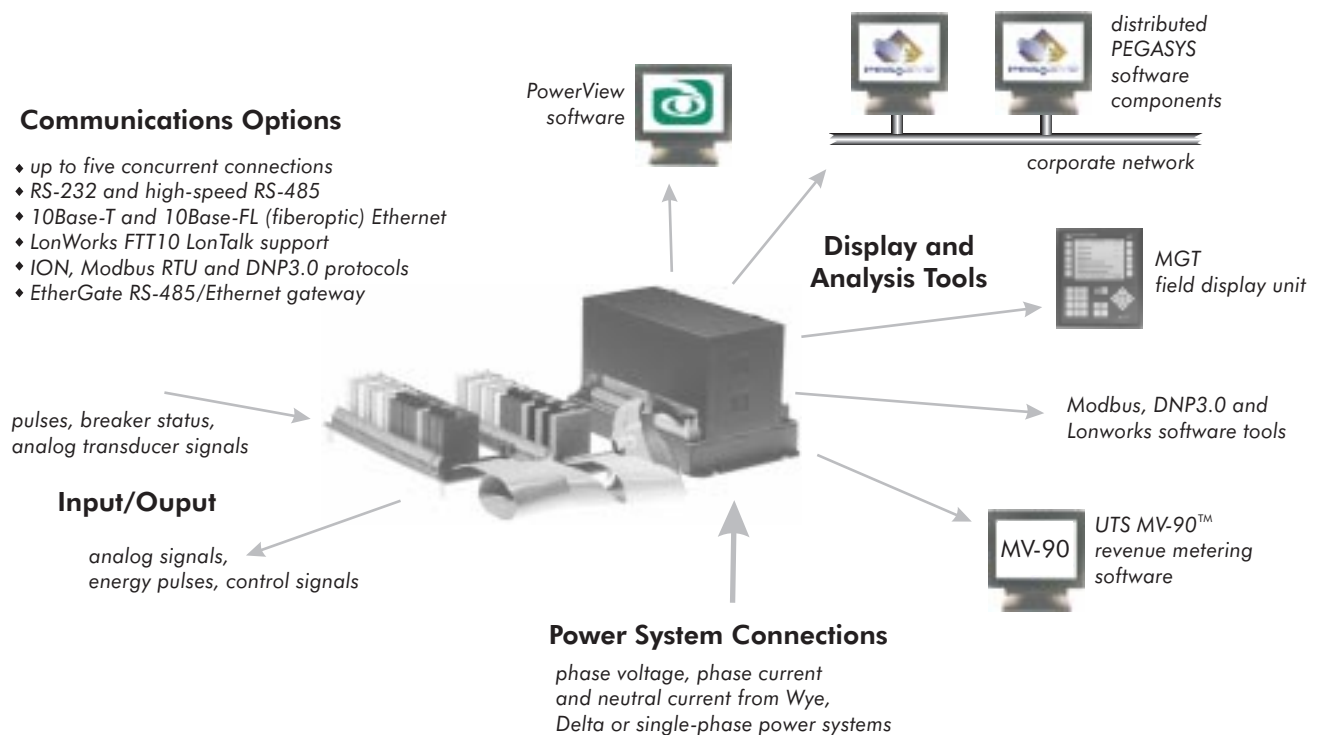
New ION modules are included that provide more options to the advanced user:

- ◆ DNP Import, Export and Options modules for DNP 3.0 communications.
- ◆ Relative Setpoint modules for monitoring a variable source input.
- ◆ Convert modules for converting different types of data.
- ◆ Feedback modules for creating circular linkages in ION frameworks.

The 7700 ION in a Power Monitoring System

Applications that include the 7700 ION, or any other IED, typically require additional equipment. Display and analysis software tools are almost always used to manage, interpret and distribute the data measured or logged by an IED. Usually there are a variety of tools used, and often these tools are connected using different communications standards and protocols. In many cases, an IED must also provide control capabilities and device-level data sharing.

The 7700 ION can adapt to almost any situation. Advanced communications allow data to be shared simultaneously across multiple networks, expandable I/O provides additional monitoring and control capabilities, and a variety of display and analysis tools can be used to monitor your power system. This User's Guide discusses the 7700 ION as it is most commonly used — as a part of a complete power monitoring system.



Data Display and Analysis Tools

The 7700 ION integrates seamlessly with the display and analysis software available from Power Measurement. The data acquired by the 7700 ION can be used in a variety of systems; however, Power Measurement software is designed to make use of the advanced capabilities the unit provides.

Power Measurement's PEGASYS Software



You will get the most out of the 7700 ION using Power Measurement's PEGASYS software suite. When PEGASYS is used, the 7700 ION becomes part of a fully networked information system, together with other Power Measurement IEDs and local and wide-area computer networks. PEGASYS provides tools for managing your power monitoring network, analyzing real-time and logged data, generating power system reports, and creating custom functionality at the IED level. PEGASYS is recommended for all power monitoring systems where advanced analysis and control capabilities are required.

Power Measurement's PowerView Software



The 7700 ION can be installed in power monitoring systems that use Power Measurement's PowerView software. PowerView provides real-time and available logged data display and analysis features, and complete device configuration capabilities. PowerView provides a low-cost solution for smaller power system where the advanced features of PEGASYS are not required.

The 7700 ION's Modular Graphics Terminal



Local monitoring and standalone applications are facilitated by the 7700 ION's front-panel interface, the Modular Graphics Terminal (the MGT). The MGT combines real-time display features with limited device configuration functions.

The MGT is often used in combination with a PEGASYS or PowerView system, providing an interface for field personnel.

Third-Party Tools

The 7700 ION can be integrated into various industry-standard networks. Data that is measured by the unit can be made available to other devices using Modbus RTU, DNP 3.0 and LonWorks protocols. Data from devices on these networks can also be imported into the 7700 ION. With these advanced communications functions, the power of the 7700 ION can be utilized in most existing power monitoring systems. Any data display and analysis software that works with Modbus RTU, DNP 3.0 or LonWorks devices will also work with the 7700 ION (specific communications options are required for LonWorks).

Communications Options



The standard 7700 ION has a single RS-232/RS-485 communications port capable of data rates up to 19,200 bps. The optional XPRESS CARD provides two additional high-speed RS-485 ports (data rates up to 115,200 bps) and a 10Base-T Ethernet port. A 10Base-FL fiberoptic Ethernet port and an FTT10 LonWorks port are available as options on the XPRESS CARD.

Depending on the hardware options purchased, up to five separate ports can communicate simultaneously. Power Measurement's ION Protocol, Modbus RTU, DNP 3.0, LonTalk and Power Measurement's EtherGate Protocol (an Ethernet/RS-485 gateway) are supported, depending on the communications port used. Refer to the section "Using Onboard and Expansion I/O" in Chapter 4 for details.



Input/Output

The standard 7700 ION has eight status inputs. Four optional analog inputs are available on the meter to monitor AC or DC signals. Additional I/O is available using one or two expansion boards — up to 15 input or output modules can be added (digital or analog inputs or outputs are available). Some restrictions apply to number of analog modules you can use, due to the power they require. Refer to the section "Using On-Board and Expansion I/O" in Chapter 4 for details.

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 user classifications are intended to make this guide easier to navigate.

◆ Typical User or Operator

Most users will simply want to display the data provided by the factory-configured 7700 ION. These users want fast access to data through the front panel, PEGASYS software, PowerView software or a third-party protocol such as Modbus RTU.

Chapter 2 addresses the needs of the typical user who wants to get data out of the 7700 ION. This chapter assumes that the reader is not concerned with how the device functions; instead the focus is on accessing and interpreting the data provided.

◆ System Administrator or Manager

Some users will 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 7700 ION's setup is complete. These users will use the front panel, PowerView software or PEGASYS software to change settings in the device's operating software. (PEGASYS is highly recommended for device configuration.)

Chapter 3 is directed at the user who wants to get more out of the 7700 ION by making adjustments to its factory-configured functionality. This chapter focuses on the different configuration changes that can be made with minimal effort, and what effects each type of setting will have. Very few details about the device's internal operation are provided.

◆ **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 device's operating software, the ION Architecture, and the PEGASYS tools used to customize the device's operation.

Chapter 4 is useful for the advanced user who wants to become familiar with the device's internal operation and its more sophisticated capabilities. This chapter is designed to facilitate different applications by providing background information and detailed functional descriptions — specific applications are only discussed to illustrate a particular function.

Configuration instructions for particular applications can be found in Power Measurement Application Notes, available from Power Measurement Customer Service.

Before You can Use this Guide

By the time you are ready to use this Guide, your 7700 ION 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 *7700 ION Installation & Basic Setup Instructions* shipped with the meter.

Getting More Information

Additional information is available from Power Measurement. Check our web site at www.pml.com, contact your local Power Measurement representative, or contact Power Measurement directly. (Contact information is provided on the first page of this document.) Documents related to the installation, operation and application of the 7700 ION:

7700 ION Installation & Basic Setup Instructions

This brief guide is shipped with each 7700 ION. It details the mounting, wiring and basic setup of the device.

ION Reference

This reference contains detailed descriptions of the ION architecture, ION Designer software, and all of the modules available in each ION device.

PEGASYS 2.0 Administrator's Guide

This guide explains the installation and configuration of the PEGASYS software suite. Advanced PEGASYS tools are described.

PEGASYS ION Designer On-line Help

This describes how to use PEGASYS ION Designer.

PEGASYS Vista User's Guide

This guide describes how to use PEGASYS Vista.

PowerView On-line Help

This describes how to use PowerView.



Displaying Data

The 7700 ION is shipped from the factory with a comprehensive configuration. Most users will find that the factory configuration suits their needs entirely. This chapter describes how to view the data that is measured and logged by the factory-configured 7700 ION using PEGASYS Vista software, PowerView software and the MGT front-panel interface.

The 7700 ION's factory configuration also includes some data that does not appear by default in PEGASYS Vista, PowerView or on the MGT. Further, the factory configuration makes several power, energy and demand parameters available through the Modbus RTU protocol. A list of available data that does not appear in PEGASYS Vista, PowerView or on the MGT is presented near the end of this chapter, and how to view it is briefly discussed.

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Displaying Data with PEGASYS Vista 2.0

PEGASYS Vista version 2.0 is the premiere display and analysis tool for the 7700 ION and other Power Measurement IEDs. A standard set of Vista User Diagrams displays real-time and logged data for various power system parameters. Interactive objects are provided on the diagrams that allow operators with appropriate PEGASYS authority to enable and disable logging functions and reset cumulative parameters.

Summary of Data Provided

The standard set of five Vista diagrams included with PEGASYS 2.0 display a variety of the data measured and logged by the factory-configured 7700 ION. Some of the diagrams include grouping windows that display additional data. The following list summarizes the data available from the standard diagrams; more detail is provided in the next few pages.

Real-Time Measurements

- ◆ Line-to-neutral voltages, line-to-line voltages, average L-N and L-L voltages and voltage unbalance level
- ◆ Phase currents and average current
- ◆ Phase kW, total kW, kVAR and kVA
- ◆ Frequency and signed power factor
- ◆ Min/max display of each of the above parameters
- ◆ All logged meter events
- ◆ Trend logs of voltage, current, power, frequency and power factor

Power Quality Data

- ◆ Running total of sag/swell and transient events
- ◆ CBEMA plot of power quality events
- ◆ Captured waveforms and sequence-of-events log
- ◆ Manual waveform capture control
- ◆ Phase voltage and current total harmonic distortion (THD)
- ◆ Min/max display of phase voltage and current THD
- ◆ Logged average and maximum THD and K factor

Energy & Demand Data

- ◆ Real-time and peak kW, kVAR and kVA sliding window demand
- ◆ Real-time net kWh, net kVARh and kVAh energy values
- ◆ Trend log of all of the above parameters, plus power factor lead and lag, imported, exported and net energy



NOTE

Many of the Vista diagrams also provide interactive control and parameter reset functions.

Setpoints

- ◆ Interactive monitoring of kW demand, phase current, and voltage unbalance conditions, with annunciation when user-specified upper limit is exceeded
- ◆ Real-time display of kW demand, phase current, and voltage unbalance

Digital Inputs

- ◆ Monitoring of the 7700 ION's eight on-board status inputs
- ◆ Status change counter for each input

Common Diagram Elements

Each diagram shows the name of the meter, the time on the meter's clock, and the type of meter. The five main diagrams also provide buttons that let you jump to other diagrams. Double-click any of the buttons near the top right-hand corner to jump to the associated diagram (this is illustrated in the Real-Time Measurements section below).



NOTE

Refer to the *PEGASYS Vista User's Guide* if you need help using Vista.

Displaying Data if PEGASYS is not Fully Configured

The *PEGASYS 2.0 Administrator's Guide*, shipped with PEGASYS 2.0, provides a set of guidelines that should be followed during commissioning. If PEGASYS 2.0 has been installed and configured using the recommended guidelines, the standard Vista user diagrams display real-time and logged data from your 7700 ION automatically.

If commissioning has not been completed (or if commissioning was performed without following the guidelines) some effort may be required to view 7700 ION data in Vista 2.0. If you are not able to run the PEGASYS Communications Server, Log Server or Vista, you will need to complete commissioning before you can display data from your 7700 ION. Contact your PEGASYS Administrator or refer to the *PEGASYS 2.0 Administrator's Guide* before continuing with this User's Guide.



NOTE

If you can't display data in PEGASYS Vista, and you don't have Level 5 authority, contact your PEGASYS administrator.

If you can run PEGASYS Vista and log on, you can probably access data from your 7700 ION. Try performing the following steps in Vista:

1. Log on to Vista with Supervisor authority (Level 5).
2. Select Generate Network Diagram from the File menu.
3. In the Network Diagram, double-click the Workstation icon corresponding to the computer that communicates with the 7700 ION. A new diagram with all available IEDs appears.
4. Double-click the icon for the 7700 ION. The Real-Time diagram appears, and live data should appear within moments.

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

Real-Time Measurements

The Real-Time diagram includes a simple power system illustration that shows various real-time parameters. 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.

The screenshot shows the 'Real-Time' interface for 'PML_SCADA switchgear7700'. It features a central power system diagram with phases A, B, C, and N. To the right, a table displays real-time parameters:

V avg [V]	600
Vln avg [V]	347
I avg [A]	100
P tot [kW]	177
Q tot [kVAR]	8.7
S tot [kVA]	186
Freq [Hz]	60.00
PF avg [%]	-0.4

Below the diagram, a 'Long-term Min/Max' button is visible. On the right side, there are sections for 'Meter Events', 'Trending' (with buttons for Voltage, Current, Power, FreqPF), and 'Enable/Disable Historic Data Logging'.

Callouts provide the following information:

- Double-click this button to return to the Network Diagram.
- Double-click any of these buttons to jump to the corresponding diagrams.
- This area represents your power system. A, B and C are the phases, and N is neutral. Voltage unbalance is shown below the line diagram.
- Line-to-line voltages.
- Phase current.
- Phase power.
- Line-to-neutral voltages.
- Double-click to see the min/max screen. Min/max reset is available here.
- Double-click this object to enable or disable data logging.
- Double-click to see the meter's Event log.
- Double-click any of these buttons to see data logs.

Long-term Min/Max

- ◆ Double-click the Long-term Min/Max object to see a Vista grouping window showing min/max values for line-to-line and line-to-neutral voltages, voltage unbalance, phase currents, power values (kVA, kVAR and kW), frequency and power factor.
- ◆ Level 3 PEGASYS authority is required to reset the min/max values.
- ◆ To return to the real-time diagram, use the File, Up One Level menu item.
- ◆ Min/max values are valid from the time the meter was powered up, or valid from the time the last reset was performed.

Historic Data Logging Enable

- ◆ The Log Server must be running to view historical data.
- ◆ Historic data logging is enabled by default.
- ◆ Level 3 PEGASYS authority is required to use the control object.
- ◆ 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.

Power Quality Data

The Power Quality diagram shows voltage disturbance and harmonics details. The voltage disturbance display counts sag/swell and transient events, and provides links to a sequence-of-events log and a CBEMA plot. The diagram includes a trigger for manual waveform recording, and control objects for enabling/disabling power quality event recording.

The harmonics measurement display shows total harmonic distortion for each phase of voltage and current. Links to harmonics min/max and harmonics trending displays are provided, and a control object is included for enabling/disabling harmonics logging.

The screenshot displays the PML SCADA interface for 'switchgear7700'. It features two main panels: 'Voltage Disturbances' and 'Harmonics Measurements'. The 'Voltage Disturbances' panel shows a 'Number of Events since: 21788 On 26 20:00 PM' and includes controls for 'Enable', 'Trigger Waveform recording (manually)', and 'Harmonics logging'. The 'Harmonics Measurements' panel shows 'Total Harmonic Distortion (%)' for voltage (V1, V2, V3) and current (I1, I2, I3) with bar charts, and includes controls for 'Longterm Min/Max', 'Harmonics Trending', and 'Enable Harmonics logging'. Callout boxes provide instructions for each control.

Check here to see how many sag/swell and transient events have occurred since power-up or the last reset.

Double-click these objects to see disturbance details in a CBEMA plot or sequence-of-events log.

Double-click this object to manually record a waveform.

Double-click these objects to enable or disable power quality event detection and waveform recording.

This area shows per phase voltage and current THD.

Double-click this object to view harmonics min/max data. Min/max reset is available here.

Double-click this object to view the harmonics data log.

Double-click this object to enable or disable harmonics logging.

Voltage Disturbance Counter Reset

- ◆ Level 3 PEGASYS authority is required to reset the power quality event counter, the manual waveform trigger, and the control objects.

Disturbance Details

- ◆ The Log Server must be running to view the CBEMA plot or sequence-of-events data.

Harmonics Measurements

- ◆ Total Harmonics Distortion (THD) is displayed as a percentage of phase measurements.

Long-term Min/Max

- ◆ Double-click the Long-term Min/Max object to see a Vista grouping window showing min/max values for phase voltage and current THD.
- ◆ Level 3 PEGASYS authority is required to reset the min/max values.

Harmonics Trending

- ◆ The Log Server must be running to view the logged harmonics data.
- ◆ Harmonics data logging is enabled by default.
- ◆ Level 3 PEGASYS authority is required to use the control object.
- ◆ 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.

Energy & Demand

The Energy & Demand diagram shows the real-time sliding window demand for kW, kVA, and kVAR, and the real-time energy values kWh net, kVARh net and kVAh. Peak demand is displayed for kW, kVAR and kVA, and a link to a demand profile trend is provided. Control objects for enabling/disabling demand logging and resetting energy and demand values are also included.

The screenshot shows the 'Energy & Demand' interface for 'PML_SCADA.switchgear7700'. It features several data tables and control elements:

- SW Demand (Sliding window demand):**

Real Time:	Value
kW Demand	172
kVAR Demand	74
kVA Demand	189
- Energy (Net energy values):**

Real Time:	Value
kWh net	2.878
kVARh net	835
kVAh	2.188
- Peak (Peak sliding window demand):**

Value	Time
kW Peak Demand	172 21/08/09 04:50:00 AM
kVAR Peak Demand	77 21/08/09 04:50:00 PM
kVA Peak Demand	189 21/08/09 04:50:00 AM
- Control Elements:** Includes 'Reset Demand', 'Reset Energy', 'Demand Profile' (with a link icon), and 'Enable Energy & Demand Logging' (with a switch icon).

Callouts from the image:

- 'Net energy values.' points to the Energy table.
- 'Sliding window demand.' points to the SW Demand table.
- 'Peak sliding window demand.' points to the Peak table.
- 'Double-click this object to see the energy & demand log.' points to the Demand Profile link.
- 'Double-click this object to enable or disable energy and demand logging.' points to the Enable Energy & Demand Logging switch.

Demand, Energy and Peak Demand Reset

- ◆ Level 3 PEGASYS authority is required to reset these values.

Demand Profile Trending

- ◆ The Log Server must be running to view the energy and demand log.
- ◆ Energy and demand logging is enabled by default.
- ◆ Level 3 PEGASYS authority is required to use the control object.
- ◆ 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.

Setpoints

The Setpoints diagram uses setpoints to monitor kW demand, over current and voltage unbalance levels. Vista announces warnings if any of the values exceed specified upper limits. (Users with Level 3 PEGASYS authority can define the setpoint limits.)

Over kW Sliding Window Demand Monitoring

- ◆ Over kW demand monitoring is disabled by default.
- ◆ Level 3 PEGASYS authority is required to enable over kW demand monitoring, and to set the kW demand upper limit.
- ◆ To set the upper kW demand limit, enter the total number of kW that should be considered as an over demand condition.
- ◆ The status will read “Not Available” when monitoring is disabled.

Per Phase Over Current Monitoring

- ◆ Over current monitoring is disabled by default.
- ◆ Level 3 PEGASYS authority is required to enable over current monitoring, and to set the phase current upper limit.
- ◆ To set the over current limits, enter the total number of Amps that should be considered as an over current condition.
- ◆ Each status will read “Not Available” when monitoring is disabled.

Voltage Unbalance Monitoring

- ◆ Over voltage unbalance monitoring is disabled by default.
- ◆ Level 3 PEGASYS authority is required to enable over voltage unbalance monitoring, and to set the voltage unbalance upper limit.
- ◆ 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.
- ◆ The status will read “Not Available” when monitoring is disabled.

Digital Inputs

The Digital Inputs diagram monitors the eight status inputs on the 7700 ION. The status of each input (ON or OFF), and the number of times the status has changed is displayed. The status change counter can be reset.

The screenshot shows the 'Digital Inputs' section of the PML_SCADA switchgear7700 interface. It features a table with the following data:

	Status	Count	Reset Counter
Digital Input 1	ON	0	[Reset Counter]
Digital Input 2	ON	0	
Digital Input 3	ON	0	
Digital Input 4	ON	0	
Digital Input 5	ON	0	
Digital Input 6	ON	0	
Digital Input 7	ON	0	
Digital Input 8	ON	0	

Callouts in the image provide the following information:

- A callout pointing to the 'Status' column: "The status of each input."
- A callout pointing to the 'Count' column: "The number of times each input has changed status."
- A callout pointing to the 'Reset Counter' button: "Double-click this object to reset the status change counter."

Status

- ◆ The 7700 ION's status inputs are de-energized when the meter is powered-up, so each status will initially be OFF.

Reset

- ◆ Level 3 PEGASYS authority is required to reset the status counter.

Displaying Additional Data in Vista

The factory-configured 7700 ION measures and calculates additional data that is not presented in the standard Vista diagrams. This data can be added to the standard diagrams, or new diagrams can be created. Any data that the 7700 ION measures or logs can be displayed on a Vista diagram.

PEGASYS Supervisor authority (Level 5) is required to create and configure new diagrams. Refer to the *PEGASYS Vista User's Guide* for details on creating Vista User Diagrams. If you don't have Level 5 authority, contact your PEGASYS administrator for assistance.

Refer to the section "Complete List of Factory-Configured Measurements and Functions" near the end of this chapter. This list indicates what data is not displayed on the standard Vista diagrams, but is available from the factory-configured 7700 ION.

Displaying Data with PowerView

PowerView for Windows 95/NT displays many of the parameters measured and logged by the 7700 ION.

The data displays in PowerView are considerably different than those in PEGASYS Vista. This section describes how to view data in PowerView, and which data screens are available.

Summary of Data Provided

PowerView includes a set of tables that display data from the 7700 ION version 7700V200. The available data is grouped into 27 data screens: 20 for data recorders and seven for other logs and measurements. Many of the data screens have multiple tabs that display additional data. The following list summarizes the data available from the standard data screens; see the “Complete List of Factory Configured Measurements and Functions” near the end of this chapter.

Data Recorders

- ◆ Any recorded data that is logged by the 7700 ION's 20 data recorders

Demand

- ◆ Sliding window demand, predicted demand and thermal demand for power and current parameters

Enables

- ◆ Logging enable switches for min/max values, energy, historic data, demand, harmonics, sag/swell, transients, and waveforms.

Event

- ◆ The meter's event log (all events logged by the meter)

Harmonics

- ◆ Phase voltage and current total harmonic distortion; phase voltage and current harmonic distortion values from the 1st to the 15th; K-factor

Maximum

- ◆ Maximum values and timestamps for all voltage, current, power, frequency and harmonic distortion parameters

Minimum

- ◆ Minimum values and timestamps for all voltage, current, power, frequency and harmonic distortion parameters

Real-Time

- ◆ Per-phase and total voltage, current, power, frequency and power factor; total, import and export energy

Status

- ◆ Monitoring of over kW, over phase currents, and over voltage unbalance; status of Digital Inputs.

Waveform

- ◆ All waveform records in tabular form, waveform plotting functions

PowerView's Data Screens Mode

In order to view data in PowerView, you must first set the view mode to Data Screens. This is done by selecting Data Screens from the View menu, or clicking the Data Screens button on the toolbar (see the graphic below).

Once in Data Screens mode, select a meter in the left pane, and the right pane displays the data display groups that are available for viewing.



NOTE

The PowerView network must be properly configured before you can display data. Refer to the PowerView User's Guide or on-line help for assistance.



Selecting Different Display Screens

PowerView can display different data screens for different versions of the 7700 ION. New data display screens, called tables, can be downloaded from Power Measurement's website at www.pml.com. Save these tables in PowerView's \Tables\Pml7700\Default folder. Contact Power Measurement Customer Service if you need assistance.

To change to a different set of display screens, expand the workstation tree and right-click the meter's icon. Select Properties from the pop-up menu. Under the Display tab of the Device Properties dialog box, select from the list of tables shown. Although all tables shown will allow you to display data, the Version 2.0 tables match the 7700 ION's factory-configuration, allowing PowerView to display a more comprehensive set of parameters.

The PowerView Data Filter

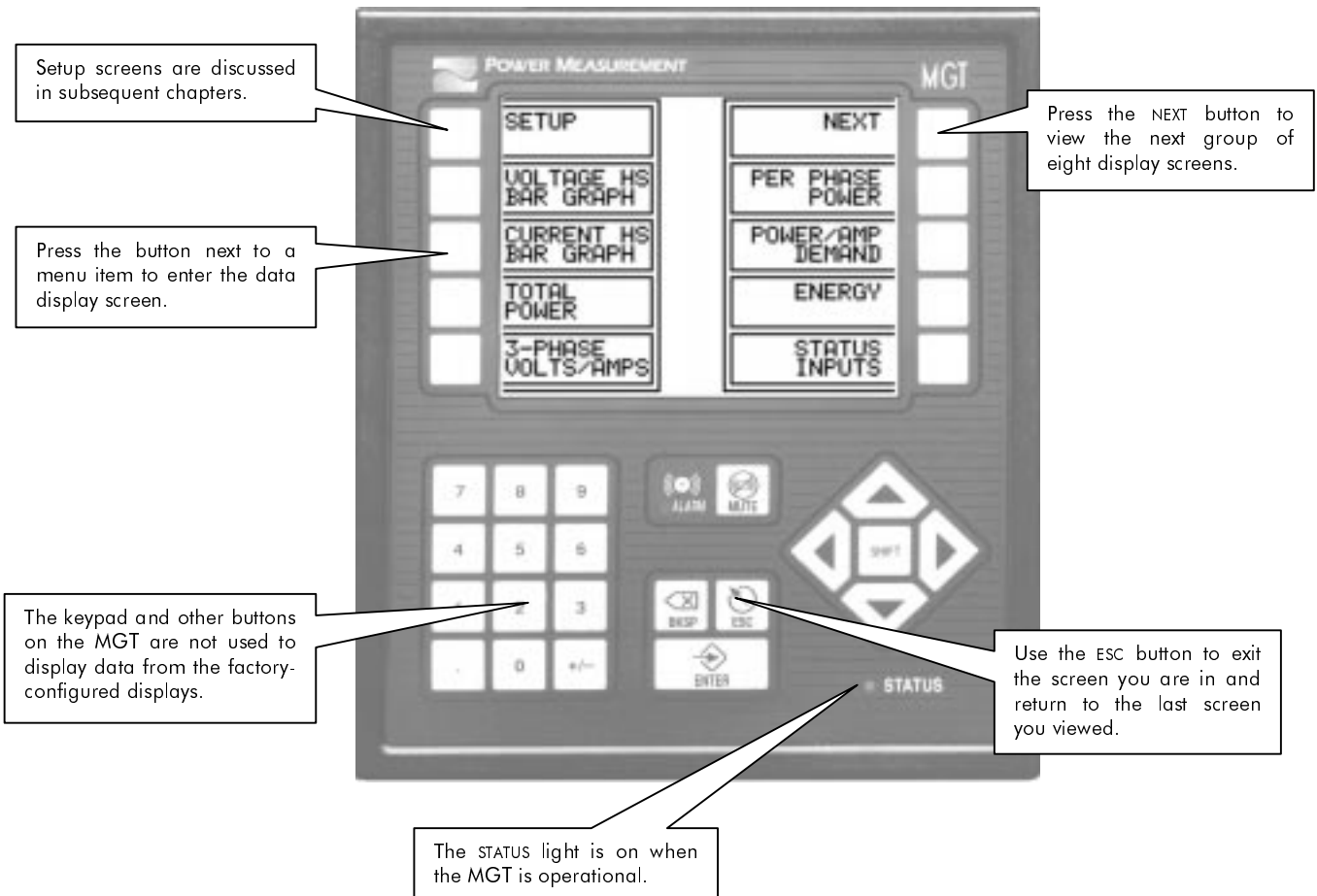
Each time you double-click a PowerView display screen icon that contains logged data, the data filter appears. Use the data filter to select the range of data you want to view, and press OK.

Displaying Data with the MGT

The MGT, or *Modular Graphics Terminal*, provides a detailed graphics and text display for the 7700 ION. The MGT has been configured at the factory with 24 displays showing most of the parameters measured by the meter. The factory-configured MGT displays numeric data screens, waveforms, trend graphs and harmonics histograms.

Data Display Screens

When the MGT is activated, it displays a menu of eight data display screens. Press the button adjacent to a menu item in the display area to access a particular display screen, or press NEXT move to the next menu of eight displays. The SETUP button provides access to configuration screens (discussed in the next chapter). Pressing the ESC key at any time returns you to the screen that was last displayed. The first screen looks like this:



The 24 screens provided display data in a number of different formats. The following paragraphs detail some of the important aspects of the various display formats.

Interpreting Numbers in Numeric Displays

Eleven of the 24 display screens show up to 15 parameters in a list, with the parameter name on the left, and the corresponding value on the right. One of the screens, Total Power, uses a large character display with four parameters on the screen. Both the 'standard' 15-parameter display and the large character display show numeric values.

When displaying numeric values, the MGT can display up to four digits of resolution. If more than four digits of resolution are required, use PEGASYS software to display data. If a value is too large or too small to be displayed with four digits, the MGT uses an abbreviated engineering notation that uses standard metric prefixes to indicate the magnitude of the reading. For example,

MGT Display	Value
12m40.....	0.0124
12K40.....	12, 400
12M40.....	12, 400, 000
1G240.....	1, 240, 000, 000

Numeric values are displayed in base units; voltages are displayed in volts, while current is displayed in amps. The following values, however, are displayed in kilo units rather than base units since kilo is the most frequently used measurement:

- ◆ kW
- ◆ kVA
- ◆ kVAR

When viewing these parameters with the MGT, remember that the values are already multiplied by 1000. For example, the reading below indicates 120, 000 kilowatts, *not* 120, 000 watts.

kW total120K0

INVLD and N/A Messages

If the MGT is unable to read a numeric or status value from the 7700 ION, it will display either INVLD or N/A in place of the value. INVLD indicates that the value received cannot be displayed because it is either too large or too small (it is below 1m000 or above 9G999). N/A appears if the register is not available.

Bar Graph Displays

Three display screens are provided for phase voltage and current:

- ◆ High-speed line-to-neutral and average voltage (100 ms update rate)
- ◆ High-speed phase and average current (100 ms update rate)
- ◆ Line-to-neutral voltage and phase current (1 second update) with minimum and maximum indicators.

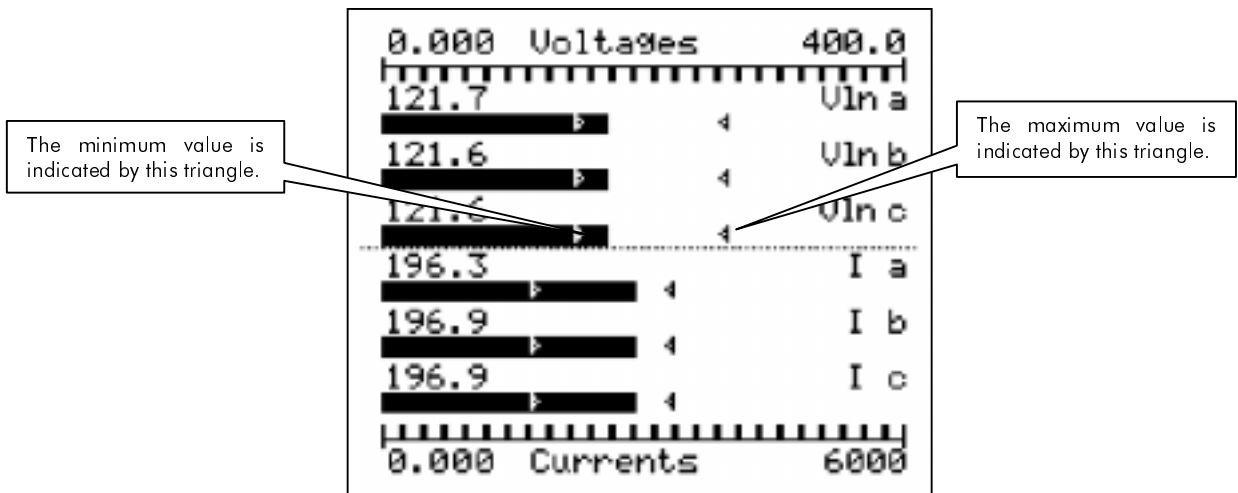
NOTE

Each of the MGT display screens can be adjusted to match your power system. Refer to "Creating Custom MGT Displays" in Chapter 4.

The two high-speed displays use a four-channel bar graph that shows the low limit, the parameter name (i.e. Vln a, meaning line-to-neutral voltage on phase A), and the upper limit above the bar for each measurement. The high-speed voltage display, called VOLTAGE HS BAR GRAPH, has fixed limits of 0 to 400 volts. The high-speed current display, called CURRENT HS BAR GRAPH, has fixed limits of 0 to 6000 Amps. If your voltage or current values are above the fixed upper limits, the MGT will display OFF SCALE in place of the bar. Similarly, the voltage bar graph displays OFF SCALE if you have a Delta power system, as there are no line-to-neutral voltage values available.

The phase voltage and current bar graph, called VOLTS/AMPS BAR GRAPH, displays line-to-neutral phase voltage and phase current values. As with the high-speed bar graphs, voltage limits of 0 to 400 Volts and current limits of 0 to 6000 Amps are fixed, and line-to-neutral voltages will read OFF SCALE if viewed in a Delta power system.

The VOLTS/AMPS BAR GRAPH also shows the minimum and maximum values measured (since power-up or the last min/max reset). Small triangles located on each parameter's bar indicate the min/max values:



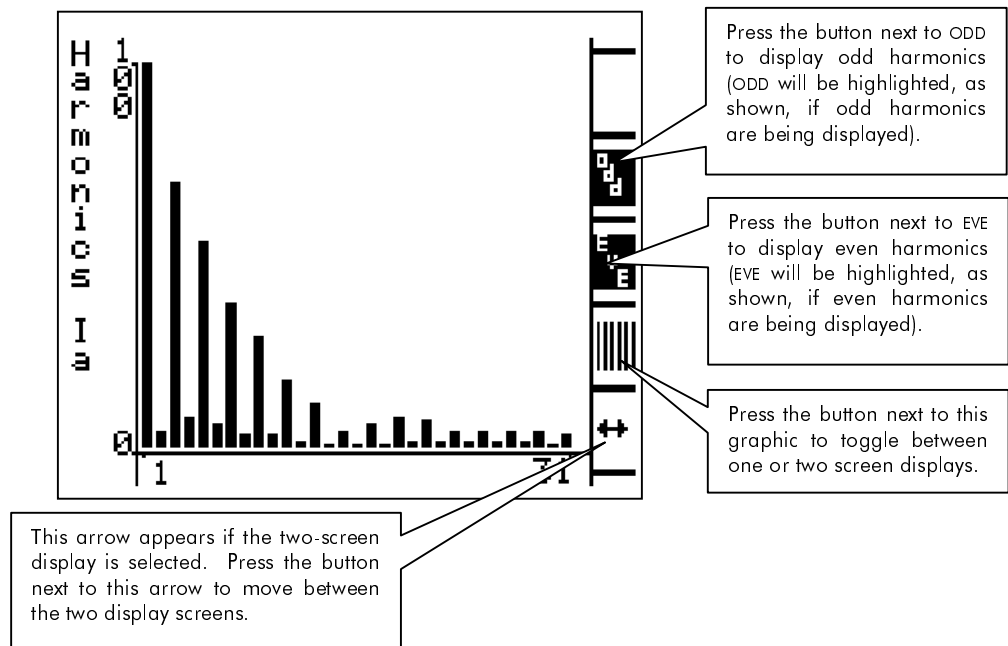
Trend Displays

Trend display screens are provided for total kW and total kVAR. Both screens show the values for each parameter over the last 150 seconds.

The limits set for total kW and total kVAR are 0 to 2400. If the total kW or total kVAR in your system are above this range, no trend graph will be displayed.

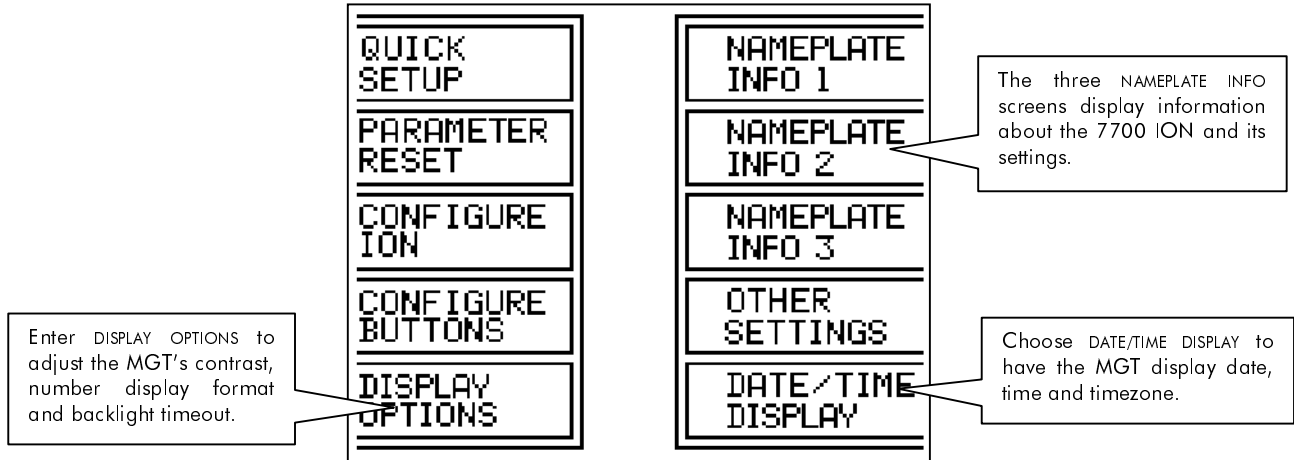
Harmonics Displays

Harmonics are displayed for each current phase. All harmonics from the fundamental to the 63rd can be displayed at once, or harmonics can be shown across two screens. The Harmonics display screens can be adjusted to show even harmonics, odd harmonics, or both.



Display Screens Available under SETUP

There are five display screens available under the SETUP menu item. You do not require password authorization to view these screens. The other eight items in the setup menu are used to configure the 7700 ION and the MGT, and require password authority (setup functions are described in the next chapter). Press SETUP on the main MGT screen to display these options:



Display Options

The DISPLAY OPTIONS menu includes three options: Adjust Contrast, Backlight Timeout and Numbers X.XXX.

Adjust Contrast allows you to change the contrast of the MGT's display. The MGT has a contrast scale of 0 to 15. Select Adjust Contrast, then use the right and left arrow buttons to lighten or darken the display screen.

Backlight Timeout allows you to set the amount of time the MGT's backlighting stays on when the MGT is idle. The bulb that provides the backlighting has a limited lifespan; to prolong the life of the bulb, you should only have backlighting on when you are actively using the MGT. Select Backlight Timeout, then enter the amount of time in seconds that the light should stay on after a button has been pressed.

Numbers X.XXX lets you change the numeric display format to use either a period or a comma character as the decimal delimiter when displaying numbers.

Nameplate Info 1

Nameplate Info 1 displays the 7700 ION's manufactured location, serial number, accuracy rating, and power system details.



NOTE

Additional information will be displayed in the Nameplate Info screens if the MGT is used with revenue-class 7700 ION meters.

Nameplate Info 2

Nameplate Info 2 displays the MGT's acceptable operating temperature, the amount of battery life left in the 7700 ION, and the configured demand settings.

Nameplate Info 3

Nameplate Info 3 displays the three lines of text that are written into the 7700 ION's Factory module. You can customize the text displayed by configuring the Factory module's Owner, Tag1 and Tag2 setup registers in ION Designer. Nameplate Info 3 also shows the firmware revisions of the 7700 ION, the MGT and the XPRESS CARD (if one exists), as well as the optional auxiliary I/O board's voltage level and the total amount of memory in the 7700 ION.

Date/Time Display

The MGT can be set to display the date, time and timezone. To display the data and time, press **SETUP**, then press **DATE/TIME DISPLAY**. You can exit the date/time screen at any time by holding the **ESC** button down for two seconds.

Complete List of Factory-Configured Measurements and Functions

NOTE

The ION modules and output registers used for each function are listed in this section to assist more advanced users. Typical users can ignore the three right-hand columns in the tables below.

The standard PEGASYS Vista diagrams, the PowerView Data Screens and the MGT display screens show much of the data that the factory-configured 7700 ION measures and calculates. There is additional data, however, that is available from the factory-configured meter but not presented by default in any of these display tools. This section lists all of the data provided by the factory-configured meter, and shows which parameters are displayed or accessible by default in each of the tools provided by Power Measurement.

Energy & Demand Framework

The energy and demand configuration calculates and logs energy values and both Thermal and Sliding Window demand. External triggers are included for operator reset of all values.

Description of Parameter or Function	Displayed/Accessible by Default			ION Module Name	ION Module Label	Output Register Label
	Vista	PowerView	MGT			
Imported kWh	●	●	●	Integrator #1	kWh imp	kWh imp
Exported kWh	●	●	●	Integrator #2	kWh exp	kWh exp
Total kWh		●	●	Integrator #3	kWh tot	kWh tot
Net kWh	●		●	Integrator #4	kWh net	kWh net
Imported kVARh	●	●	●	Integrator #5	kVARh imp	kVARh imp
Exported kVARh	●	●	●	Integrator #6	kVARh exp	kVARh exp
Total kVARh		●	●	Integrator #7	kVARh tot	kVARh tot
Net kVARh	●		●	Integrator #8	kVARh net	kVARh net
kVAh	●	●	●	Integrator #9	kVAh	kVAh
kW thermal demand (TD)		●	●	Thermal Demand #1	kW td	kW td
kVAR TD		●	●	Thermal Demand #2	kVAR td	kVAR td
kVA TD		●	●	Thermal Demand #3	kVA td	kVA td
Average current TD		●	●	Thermal Demand #4	I avg td	I avg td
Energy / Demand Logging trigger				Periodic Timer #1	EgyDmd Log Trg	EgyDmd Log Trg
Energy / Demand Recorder Enable	●	●		External Boolean #5	EgyDmd Log Enbl	EgyDmd Log Enbl
Energy Calc Enable		●		External Boolean #3	Energy Enble	Energy Enble
kW SW Demand	●	●	●	SW Demand #1*	kW swd	kW swd
kW Predicted Demand		●	●	SW Demand #1	kW swd	kW pred swd
kVAR SW Demand	●	●	●	SW Demand #2	kVAR swd	kVAR swd
kVAR Predicted Demand		●	●	SW Demand #2	kVAR swd	kVAR pred swd
kVA SW Demand	●	●	●	SW Demand #3	kVA swd	kVA swd

* SW Demand = Sliding Window Demand

Energy and Demand Framework, Continued

Description of Parameter or Function	Displayed/Accessible by Default			ION Module Name	ION Module Label	Output Register Label
	Vista	PowerView	MGT			
kVA Predicted Demand		●	●	SW Demand #3	kVA swd	kVA pred swd
Avg Current SW Demand		●	●	SW Demand #4	l avg swd	l avg swd
Avg Current SW Demand		●	●	SW Demand #4	l avg swd	l avg pred swd
Energy reset trigger	●	●		External Pulse #7	Energy Rset	Energy Rset
SWD reset trigger	●	●		External Pulse #3	SWDemand Rset	SWDemand Rset
TD reset trigger		●		External Pulse #4	Tdemand Rset	Tdemand Rset
Energy / Demand Recorder		●		Data Recorder #1	EgyDmd Log	EgyDmd Log

Min/Max Framework

This portion of the meter's configuration measures minimum and maximum values for various power, energy, demand and harmonics parameters. Separate reset triggers are provided for demand, harmonics and 'standard' power parameters.

Description of Parameter or Function	Displayed/Accessible by Default			ION Module Name	ION Module Label	Output Register Label
	Vista	PowerView	MGT			
Max Phase A L-N Volts	●	●	●	Maximum #1	Vln a mx	Vln a mx
Max Phase B L-N Volts	●	●	●	Maximum #2	Vln b mx	Vln b mx
Max Phase C L-N Volts	●	●	●	Maximum #3	Vln c mx	Vln c mx
Max Average L-N Volts		●	●	Maximum #4	Vln avg mx	Vln avg mx
Max L-L Volts AB	●	●	●	Maximum #5	Vll ab mx	Vll ab mx
Max L-L Volts BC	●	●	●	Maximum #6	Vll bc mx	Vll bc mx
Max L-L Volts CA	●	●	●	Maximum #7	Vll ca mx	Vll ca mx
Max Average L-L Volts		●	●	Maximum #8	Vll avg mx	Vll avg mx
Max Voltage Unbalance	●	●	●	Maximum #9	V unbal mx	V unbal mx
Max Phase A Current	●	●	●	Maximum #10	l a mx	l a mx
Max Phase B Current	●	●	●	Maximum #11	l b mx	l b mx
Max Phase C Current	●	●	●	Maximum #12	l c mx	l c mx
Max Average Current		●	●	Maximum #13	l avg mx	l avg mx
Max kW total	●	●	●	Maximum #14	kW tot mx	kW tot mx
Max kVAR total	●	●	●	Maximum #15	kVAR tot mx	kVAR tot mx

Min / Max Framework, Continued

Description of Parameter or Function	Displayed/Accessible by Default			ION Module Name	ION Module Label	Output Register Label
	Vista	PowerView	MGT			
Max kVA total	●	●		Maximum #16	kVA tot mx	kVA tot mx
Max Phase A Current THD	●	●	●	Maximum #17	I1 THD mx	I1 THD mx
Max Phase B Current THD	●	●	●	Maximum #18	I2 THD mx	I2 THD mx
Max Phase C Current THD	●	●	●	Maximum #19	I3 THD mx	I3 THD mx
Max Frequency	●	●		Maximum #21	Freq mx	Freq mx
Max Power Factor Lead		●		Maximum #22	PF lead mx	PF lead mx
Max Power Factor Lag	●	●		Maximum #23	PF lag mx	PF lag mx
Max Phase A Voltage THD	●	●	●	Maximum #24	V1 THD mx	V1 THD mx
Max Phase B Voltage THD	●	●	●	Maximum #25	V2 THD mx	V2 THD mx
Max Phase C Voltage THD	●	●	●	Maximum #26	V3 THD mx	V3 THD mx
Max kW SW Demand	●	●	●	Maximum #27	kW swd mx	kW swd mx
Max kVAR SW Demand	●	●	●	Maximum #28	kVAR swd mx	kVAR swd mx
Max kVA SW Demand	●	●	●	Maximum #29	kVA swd mx	kVA swd mx
Max kW Thermal Demand		●	●	Maximum #30	kW td mx	kW td mx
Max kVAR Therm. Demand		●	●	Maximum #31	kVAR td mx	kVAR td mx
Max kVA Thermal Demand		●	●	Maximum #32	kVA td mx	kVA td mx
Min Phase A L-N Volts	●	●	●	Minimum #1	Vln a mn	Vln a mn
Min Phase B L-N Volts	●	●	●	Minimum #2	Vln b mn	Vln b mn
Min Phase C L-N Volts	●	●	●	Minimum #3	Vln c mn	Vln c mn
Min Average L-N Volts		●	●	Minimum #4	Vln avg mn	Vln avg mn
Min L-L Volts AB	●	●	●	Minimum #5	Vll ab mn	Vll ab mn
Min L-L Volts BC	●	●	●	Minimum #6	Vll bc mn	Vll bc mn
Min L-L Volts CA	●	●	●	Minimum #7	Vll ca mn	Vll ca mn
Min Average L-L Volts		●	●	Minimum #8	Vll avg mn	Vll avg mn
Min Voltage Unbalance	●	●	●	Minimum #9	V unbal mn	V unbal mn
Min Phase A Current	●	●	●	Minimum #10	I a mn	I a mn
Min Phase B Current	●	●	●	Minimum #11	I b mn	I b mn
Min Phase C Current	●	●	●	Minimum #12	I c mn	I c mn
Min Average Current		●	●	Minimum #13	I avg mn	I avg mn
Min kW total	●	●	●	Minimum #14	kW tot mn	kW tot mn
Min kVAR total	●	●	●	Minimum #15	kVAR tot mn	kVAR tot mn

Min / Max Framework, Continued

Description of Parameter or Function	Displayed/Accessible by Default			ION Module Name	ION Module Label	Output Register Label
	Vista	PowerView	MGT			
Min kVA total	●	●		Minimum #16	kVA tot mn	kVA tot mn
Min Phase A Current THD	●	●	●	Minimum #17	I1 THD mn	I1 THD mn
Min Phase B Current THD	●	●	●	Minimum #18	I2 THD mn	I2 THD mn
Min Phase C Current THD	●	●	●	Minimum #19	I3 THD mn	I3 THD mn
Min Frequency	●	●		Minimum #21	Freq mn	Freq mn
Min Power Factor Lead		●		Minimum #22	PF lead mn	PF lead mn
Min Power Factor Lag	●	●		Minimum #23	PF lag mn	PF lag mn
Min Phase A Voltage THD	●	●	●	Minimum #24	V1 THD mn	V1 THD mn
Min Phase B Voltage THD	●	●	●	Minimum #25	V2 THD mn	V2 THD mn
Min Phase C Voltage THD	●	●	●	Minimum #26	V3 THD mn	V3 THD mn
Min kW SW Demand		●	●	Minimum #27	kW swd mn	kW swd mn
Min kVAR SW Demand		●	●	Minimum #28	kVAR swd mn	kVAR swd mn
Min Phase C Current THD		●	●	Minimum #29	kVA td mn	kVA td mn
Min kW Thermal Demand		●	●	Minimum #30	kW td mn	kW td mn
Min kVAR Therm. Demand		●	●	Minimum #31	kVAR td mn	kVAR td mn
Min kVA Thermal Demand		●	●	Minimum #32	kVA td mn	kVA td mn
Min / Max Enable		●		External Boolean #1	MnMx Enble	MnMx Enble
V/A/Power Min/Max Reset	●	●		External Pulse #5	MnMx Rset	MnMx Rset
Demand Min/Max Reset	●	●		External Pulse #1	Peak Dmd Rset	Peak Dmd Rset
Harmonics min/max Reset	●	●		External Pulse #10	Harm MnMx Rset	Harm MnMx Rset

Historic Data Logging Framework

This portion of the meter's configuration records 'standard' power system parameters such as voltage, current, power, frequency and power factor. Low, mean and high values are recorded for all parameters. Note that 'low' and 'high' are different from 'min' and 'max': low and high are reset every 15 minutes, whereas min and max are typically long-term measurements that are only reset by the operator. Similarly, 'mean' is reset every 15 minutes, unlike 'average' which is typically an instantaneous averaging of multiple real-time measurements.

Description of Parameter or Function	Displayed/Accessible by Default			ION Module Name	ION Module Label	Output Register Label
	Vista	PowerView	MGT			
Mean L-L Volts, AB	●	●		SW Demand #5	VII ab mean	VII ab mean
Mean L-L Volts, BC	●	●		SW Demand #6	VII bc mean	VII bc mean
Mean L-L Volts, CA	●	●		SW Demand #7	VII ca mean	VII ca mean
Mean L-L Volts, average	●	●		SW Demand #8	VII avg mean	VII avg mean
Mean Voltage Unbalance	●	●		SW Demand #9	V unbal mean	V unbal mean
Mean Phase A Current	●	●		SW Demand #10	I a mean	I a mean
Mean Phase B Current	●	●		SW Demand #11	I b mean	I b mean
Mean Phase C Current	●	●		SW Demand #12	I c mean	I c mean
Mean Average Current	●	●		SW Demand #13	I avg mean	I avg mean
Mean Neutral Current	●	●		SW Demand #14	I4 mean	I4 mean
Mean kW total	●	●		SW Demand #15	kW tot mean	kW tot mean
Mean kVAR total	●	●		SW Demand #16	kVAR tot mean	kVAR tot mean
Mean kVA total	●	●		SW Demand #17	kVA tot mean	kVA tot mean
Mean Power Factor lag	●	●		SW Demand #18	PF lag mean	PF lag mean
Mean Power Factor lead	●	●		SW Demand #19	PF lead mean	PF lead mean
Mean Frequency	●	●		SW Demand #20	Freq mean	Freq mean
High L-L Volts, AB	●	●		Maximum #20	VII ab high	VII ab high
High L-L Volts, BC	●	●		Maximum #55	VII bc high	VII bc high
High L-L Volts, CA	●	●		Maximum #56	VII ca high	VII ca high
High L-L Volts, average	●	●		Maximum #33	VII avg high	VII avg high
High Voltage Unbalance	●	●		Maximum #34	V unbal high	V unbal high
High Phase A Current	●	●		Maximum #35	I a high	I a high
High Phase B Current	●	●		Maximum #36	I b high	I b high
High Phase C Current	●	●		Maximum #37	I c high	I c high
High Average Current	●	●		Maximum #38	I avg high	I avg high
High Neutral Current	●	●		Maximum #39	I4 high	I4 high

Historic Data Logging Framework, Continued

Description of Parameter or Function	Displayed/Accessible by Default			ION Module Name	ION Module Label	Output Register Label
	Vista	PowerView	MGT			
High kW total	●	●		Maximum #40	kW tot high	kW tot high
High kVAR total	●	●		Maximum #41	kVAR tot high	kVAR tot high
High kVA total	●	●		Maximum #42	kVA tot high	kVA tot high
High Power Factor lag	●	●		Maximum #43	PF lag high	PF lag high
High Power Factor lead	●	●		Maximum #44	PF lead high	PF lead high
High Frequency	●	●		Maximum #45	Freq high	Freq high
Low L-L Volts, AB	●	●		Minimum #20	Vll ab low	Vll ab low
Low L-L Volts, BC	●	●		Minimum #46	Vll bc low	Vll bc low
Low L-L Volts, CA	●	●		Minimum #47	Vll ca low	Vll ca low
Low L-L Volts, average	●	●		Minimum #33	Vll avg low	Vll avg low
Low Voltage Unbalance	●	●		Minimum #34	V unbal low	V unbal low
Low Phase A Current	●	●		Minimum #35	I a low	I a low
Low Phase B Current	●	●		Minimum #36	I b low	I b low
Low Phase C Current	●	●		Minimum #37	I c low	I c low
Low Average Current	●	●		Minimum #38	I avg low	I avg low
Low Neutral Current	●	●		Minimum #39	I4 low	I4 low
Low kW total	●	●		Minimum #40	kW tot low	kW tot low
Low kVAR total	●	●		Minimum #41	kVAR tot low	kVAR tot low
Low kVA total	●	●		Minimum #42	kVA tot low	kVA tot low
Low Power Factor lag	●	●		Minimum #43	PF lag low	PF lag low
Low Power Factor lead	●	●		Minimum #44	PF lead low	PF lead low
Low Frequency	●	●		Minimum #45	Freq low	Freq low
Historic Logging Trigger		●		Periodic Timer #2	Hist Log Trg	Hist Log Trg
Historic Logging Enable	●	●		External Boolean #2	Hist Log Enble	Hist Log Enble
High value Reset		●		Feedback #1	Reset Hist high	Reset Hist high
Low value Reset		●		Feedback #2	Reset Hist low	Reset Hist low
Mean value recorder		●		Data Recorder #2	Hist mean Log	Hist mean Log
High value recorder		●		Data Recorder #3	Hist high Log	Hist high Log
Low value recorder		●		Data Recorder #4	Hist low Log	Hist low Log

Harmonics Logging Framework

This portion of the factory configuration records voltage and current harmonics measurements. Mean and average values are calculated, recorded and then reset every 60 minutes.

Description of Parameter or Function	Displayed/Accessible by Default			ION Module Name	ION Module Label	Output Register Label
	Vista	PowerView	MGT			
Mean Phase A Voltage THD*	●	●		S W Demand #21	V1 THD* mean	V1 THD* mean
Mean Phase B Voltage THD	●	●		S W Demand #22	V2 THD mean	V2 THD mean
Mean Phase C Voltage THD	●	●		S W Demand #23	V3 THD mean	V3 THD mean
Mean Phase A Current THD	●	●		S W Demand #24	I1 THD mean	I1 THD mean
Mean Phase B Current THD	●	●		S W Demand #25	I2 THD mean	I2 THD mean
Mean Phase C Current THD	●	●		S W Demand #26	I3 THD mean	I3 THD mean
Mean Phase A Current K Factor	●	●		S W Demand #27	I1 K Fac mean	I1 K Fac mean
Mean Phase B Current K Factor	●	●		S W Demand #28	I2 K Fac mean	I2 K Fac mean
Mean Phase C Current K Factor	●	●		S W Demand #29	I3 K Fac mean	I3 K Fac mean
High Phase A Voltage THD	●	●		Maximum #46	V1 THD* high	V1 THD* high
High Phase B Voltage THD	●	●		Maximum #47	V2 THD high	V2 THD high
High Phase C Voltage THD	●	●		Maximum #48	V3 THD high	V3 THD high
High Phase A Current THD	●	●		Maximum #49	I1 THD high	I1 THD high
High Phase B Current THD	●	●		Maximum #50	I2 THD high	I2 THD high
High Phase C Current THD	●	●		Maximum #51	I3 THD high	I3 THD high
High Phase A Current K Factor	●	●	●	Maximum #52	I1 K Fac high	I1 K Fac high
High Phase B Current K Factor	●	●	●	Maximum #53	I2 K Fac high	I2 K Fac high
High Phase C Current K Factor	●	●	●	Maximum #54	I3 K Fac high	I3 K Fac high
Harmonics Logging trigger		●		Periodic Timer #3	Harm Log Trg	Harm Log Trg
Harmonics Logging enable	●	●		External Boolean #6	Harm Log Enble	Harm Log Enble
High Harmonics reset		●		Feedback #3	Rset Harm high	Rset Harm high
Mean Harmonics Recorder		●		Data Recorder #7	Harm mean Log	Harm mean Log
High Harmonics Recorder		●		Data Recorder #8	Harm high Log	Harm high Log

* THD = Total Harmonic Distortion

Power Quality Monitoring Framework

This portion of the factory configuration monitors the phase voltage signals for sag/swell and transient events, and triggers waveform recordings when they occur (statistics are also recorded for each event). A trigger is provided for manual waveform recording, and counters are included to display the number of events that have occurred (an additional trigger provided to reset these counters).

Description of Parameter or Function	Displayed/Accessible by Default			ION Module Name	ION Module Label	Output Register Label
	Vista	PowerView	MGT			
Sag or Swell Duration	●	●		Sag/Swell #1	Sag/Swell 1	SS1 DistDur
Phase A min Voltage	●	●				SS1 DistV1Min
Phase A max Voltage	●	●				SS1 DistV1Max
Phase A average Voltage		●				SS1 DistV1Avg
Phase A Energy variance		●				SS1 DistV1Engy
Phase B min Voltage	●	●				SS1 DistV2Min
Phase B max Voltage	●	●				SS1 DistV2Max
Phase B average Voltage		●				SS1 DistV2Avg
Phase B Energy variance		●				SS1 DistV2Engy
Phase C min Voltage	●	●				SS1 DistV3Min
Phase C max Voltage	●	●				SS1 DistV3Max
Phase C average Voltage		●				SS1 DistV3Avg
Phase C Energy variance		●				SS1 DistV3Engy
Nominal Voltage at the beginning of Sag or Swell disturbance		●				SS1 DistNominal
Voltage level considered a Swell		●				SS1 Swell Lim *
Voltage level considered a Sag		●				SS1 Sag Lim *
Phase A Transient duration	●	●		Transient #1	Transient 1	TR1 TranV1Dur
Phase A Max Peak Transient	●	●				TR1 TranV1Max
Phase B Transient duration	●	●				TR1 TranV2Dur
Phase B Max Peak Transient	●	●				TR1 TranV2Max
Phase C Transient duration	●	●				TR1 TranV3Dur
Phase C Max Peak Transient	●	●				TR1 TranV3Max
Nominal Voltage at the beginning of Transient disturbance		●				TR1 TranNominal
Voltage fluctuation amount considered a Transient		●				TR1 Threshold *

* These are setup registers, not output registers.

Power Quality Framework, Continued

Description of Parameter or Function	Displayed/Accessible by Default			ION Module Name	ION Module Label	Output Register Label
	Vista	PowerView	MGT			
Sag/Swell Data Recorder		●		Data Recorder #5	Sag/Swell Log	Sag/Swell Log
Transient Data Recorder		●		Data Recorder #6	Transient Log	Transient Log
Phase A Voltage Waveform Rec.		●		Waveform Recorder #1	Wfm Rec V1	Wfm Rec V1
Phase B Voltage Waveform Rec.		●		Waveform Recorder #2	Wfm Rec V2	Wfm Rec V2
Phase C Voltage Waveform Rec.		●		Waveform Recorder #3	Wfm Rec V3	Wfm Rec V3
Phase A Current Waveform Rec.		●	●	Waveform Recorder #4	Wfm Rec I1	Wfm Rec I1
Phase B Current Waveform Rec.		●	●	Waveform Recorder #5	Wfm Rec I2	Wfm Rec I2
Phase C Current Waveform Rec.		●	●	Waveform Recorder #6	Wfm Rec I3	Wfm Rec I3
Sag/Swell monitoring Enable	●	●		External Boolean #4	Sag/Swell Enble	Sag/Swell Enble
Transient monitoring Enable	●	●		External Boolean #10	Transient Enble	Transient Enble
Waveform Recording Enable	●	●		External Boolean #11	Wfm Rec Enble	Wfm Rec Enble
Disturbance Counter reset	●	●		External Pulse #8	Dist Count Rset	Dist Count Rset
Manual Waveform Rec trigger	●	●		External Pulse #12	Man Wfm Trg	Man Wfm Trg
Sag/Swell Counter	●	●		Counter #9	Sag/Swell Count	Sag/Swell Count
Transient Counter	●	●		Counter #10	Transient Count	Transient Count
Disturbance timestamp reset		●		Counter #11	Rset timestamp	Rset timestamp
Waveform trigger merge		●		Pulse Merge #1	Wfm Trg Merge	Wfm Trg Merge

Setpoint Framework

This portion of the configuration provided setpoints to monitor phase current, voltage unbalance and kW sliding window demand. Using PEGASYS Vista, upper limits are input for each parameter. If the measured value goes above the specified limit for at least 30 seconds, Vista annunciates an alarm.

Description of Parameter or Function	Displayed/Accessible by Default			ION Module Name	ION Module Label	Output Register Label
	Vista	PowerView	MGT			
Over kW SW Demand	●	●		Relative Setpoint #1	Over kW swd	Over kW swd
Over Phase A Current	●	●		Relative Setpoint #2	Over I a	Over I a
Over Phase B Current	●	●		Relative Setpoint #3	Over I b	Over I b
Over Phase C Current	●	●		Relative Setpoint #4	Over I c	Over I c
Over Voltage Unbalance	●	●		Relative Setpoint #5	Over V unbal	Over V unbal
Nominal kW SW Demand	●	●		External Numeric #1	kW swd nominal	kW swd nominal
Nominal Phase A Current	●	●		External Numeric #2	I a nominal	I a nominal
Nominal Phase B Current	●	●		External Numeric #3	I b nominal	I b nominal
Nominal Phase C Current	●	●		External Numeric #4	I c nominal	I c nominal
Nominal Voltage unbalance	●	●		External Numeric #5	V unbal nominal	V unbal nominal
Over-demand monitoring enable	●	●		External Boolean #7	Over kW Enble	Over kW Enble
Over-current monitoring enable	●	●		External Boolean #8	Over Amp Enble	Over Amp Enble
Over-voltage unbalance monitoring enable	●	●		External Boolean #9	Over Vunb Enble	Over Vunb Enble

Digital Inputs Framework

This portion of the meter's configuration monitors the status of the 7700 ION's eight on-board digital inputs, and counts the number of times each input changes state.

Description of Parameter or Function	Displayed/Accessible by Default			ION Module Name	ION Module Label	Output Register Label
	Vista	PowerView	MGT			
Status of Digital Input 1	●	●	●	Digital Input #1	Digital In 1	S1
Status of Digital Input 2	●	●	●	Digital Input #2	Digital In 2	S2
Status of Digital Input 3	●	●	●	Digital Input #3	Digital In 3	S3
Status of Digital Input 4	●	●	●	Digital Input #4	Digital In 4	S4
Status of Digital Input 5	●	●	●	Digital Input #5	Digital In 5	S5
Status of Digital Input 6	●	●	●	Digital Input #6	Digital In 6	S6
Status of Digital Input 7	●	●	●	Digital Input #7	Digital In 7	S7
Status of Digital Input 8	●	●	●	Digital Input #8	Digital In 8	S8
Digital Input 1 status changes	●	●		Counter #1	S1 Counter	S1 Counter
Digital Input 2 status changes	●	●		Counter #2	S2 Counter	S2 Counter
Digital Input 3 status changes	●	●		Counter #3	S3 Counter	S3 Counter
Digital Input 4 status changes	●	●		Counter #4	S4 Counter	S4 Counter
Digital Input 5 status changes	●	●		Counter #5	S5 Counter	S5 Counter
Digital Input 6 status changes	●	●		Counter #6	S6 Counter	S6 Counter
Digital Input 7 status changes	●	●		Counter #7	S7 Counter	S7 Counter
Digital Input 8 status changes	●	●		Counter #8	S8 Counter	S8 Counter
Status change counter reset	●	●		External Pulse #6	S Count Rset	S Count Rset

Real Time Measurements (Core Modules)

This portion of the factory configuration contains the real-time phase voltage and current measurements, harmonics measurements, symmetrical components data, and output from the device's real-time clock.

Description of Parameter or Function	Displayed/Accessible by Default			ION Module Name	ION Module Label	Output Register Label
	Vista	PowerView	MGT			
Phase A L-N Volts	●	●	●	Power Meter Module	Power Meter *	VIn a *
Phase B L-N Volts	●	●	●			VIn b
Phase C L-N Volts	●	●	●			VIn c
Average L-N Volts	●	●	●			VIn avg
L-L Volts AB	●	●	●			Vll ab
L-L Volts BC	●	●	●			Vll bc
L-L Volts CA	●	●	●			Vll ca
Average L-L Volts	●	●	●			Vll avg
Phase A Current	●	●	●			I a
Phase B Current	●	●	●			I b
Phase C Current	●	●	●			I c
Average Current	●	●	●			I avg
Phase A kW	●	●	●			kW a
Phase B kW	●	●	●			kW b
Phase C kW	●	●	●			kW c
kW total	●	●	●			kW tot
Phase A kVAR		●	●			kVAR a
Phase B kVAR		●	●			kVAR b
Phase C kVAR		●	●			kVAR c
kVAR total	●	●	●			kVAR tot
Phase A kVA		●	●			kVA a
Phase B kVA		●	●			kVA b
Phase C kVA		●	●			kVA c
kVA total	●	●	●			kVA tot
PF in Quadrant 1 **						Quadrant 1

* In addition to the standard Power Meter module, the 7700 ION includes a HS (high-speed) Power Meter and a MU (meter units) Power Meter modules. Module and output register labels from the HS and MU Power Meter modules include an HS or MU prefix. Refer to the Power Meter module description in the *ION Reference* for details.

** Quadrant Boolean values indicate the quadrant where the Power Factor lies. Only one Quadrant Boolean will be on at any given time. Refer to the *ION Reference* for details on the Power Factor's quadrant.

Real-Time Measurements, Continued

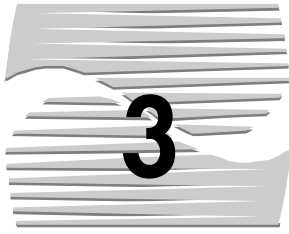
Description of Parameter or Function	Displayed/Accessible by Default			ION Module Name	ION Module Label	Output Register Label
	Vista	PowerView	MGT			
PF in Quadrant 2				Power Meter Module	Power Meter	Quadrant 2
PF in Quadrant 3						Quadrant 3
PF in Quadrant 4						Quadrant 4
Power Factor Phase A		●	●			PF sign a
Power Factor Phase B		●	●			PF sign b
Power Factor Phase C		●	●			PF sign c
Power Factor total	●	●	●			PF sign tot
Leading Power Factor Phase A						PF lead a
Leading Power Factor Phase B						PF lead b
Leading Power Factor Phase C						PF lead c
Leading Power Factor total						PF lead tot
Lagging Power Factor Phase A						PF lag a
Lagging Power Factor Phase B						PF lag b
Lagging Power Factor Phase C						PF lag c
Lagging Power Factor total						PF lag tot
Voltage Unbalance	●		●			V unbal
Current Unbalance			●			I unbal
Current Line 4			●			I 4
Phase Revolution						Phase Rev
Frequency Phase A	●	●				Freq
Meter Event						Event
Volts zero sequence magnitude			●			V ZeroSeqMag
Volts zero seq. phase angle			●			V ZeroSeqPhs
Volts positive seq. magnitude			●			V PosSeqMag
Volts positive seq. phase angle			●			V PosSeqPhs
Volts negative seq. Magnitude			●			V NegSeqMag
Volts negative seq. phase angle			●			V NegSeqPhs
Current zero seq. magnitude			●			I ZeroSeqMag
Current zero seq. phase angle			●	I ZeroSeqPhs		
Current positive seq. magnitude			●	I PosSeqMag		

Real-Time Measurements, Continued

Description of Parameter or Function	Displayed/Accessible by Default			ION Module Name	ION Module Label	Output Register Label
	Vista	PowerView	MGT			
Current positive seq. phase angle			●	Power Meter Module	Power Meter	I PosSeqPhs
Current negative seq. Magnitude			●			I NegSeqMag
Current negative seq. phase angle			●			I NegSeqPhs
Volts Phase A HDs		● (2 nd to 15 th)		Harmonics Analyzer Module #1	V1 Harmonics	V1 HD 1 <i>thru</i> V1 HD 63
Volts Phase A total HDs	●	●	●			V1 Total HD
Volts Phase A total even HDs		●				V1 Tot EvenHD
Volts Phase A total odd HDs		●				V1 Tot OddHD
Volts Phase B HDs		● (2 nd to 15 th)		Harmonics Analyzer Module #2	V2 Harmonics	V2 HD 1 <i>thru</i> V2 HD 63
Volts Phase B total HDs	●	●	●			V2 Total HD
Volts Phase B total even HDs		●				V2 Tot EvenHD
Volts Phase B total odd HDs		●				V2 Tot OddHD
Volts Phase C HDs		● (2 nd to 15 th)		Harmonics Analyzer Module #3	V3 Harmonics	V3 HD 1 <i>thru</i> V3 HD 63
Volts Phase C total HDs	●	●	●			V3 Total HD
Volts Phase C total even HDs		●				V3 Tot EvenHD
Volts Phase C total odd HDs		●				V3 Tot OddHD
Current Phase A HDs		● (2 nd to 15 th)	●	Harmonics Analyzer Module #4	I1 Harmonics	I1 HD 1 <i>thru</i> I1 HD 63
Current Phase A total HDs	●	●	●			I1 Total HD
Current Phase A total even HDs		●				I1 Tot EvenHD
Current Phase A total odd HDs		●				I1 Tot OddHD
Current Phase A K-Factor		●	●			I1 K Factor
Current Phase B HDs		● (2 nd to 15 th)	●	Harmonics Analyzer Module #5	I2 Harmonics	I2 HD 1 <i>thru</i> I2 HD 63
Current Phase B total HDs	●	●	●			I2 Total HD
Current Phase B total even HDs		●				I2 Tot EvenHD
Current Phase B total odd HDs		●				I2 Tot OddHD
Current Phase B K-Factor		●	●			I2 K Factor

Real-Time Measurements, Continued

Description of Parameter or Function	Displayed/Accessible by Default			ION Module Name	ION Module Label	Output Register Label
	Vista	PowerView	MGT			
Current Phase C HDs		● (2 nd to 15 th)	●	Harmonics Analyzer Module #6	I3 Harmonics	I3 HD 1 <i>thru</i> I3 HD 63
Current Phase C total HDs	●	●	●			I3 Total HD
Current Phase C total even HDs		●				I3 Tot EvenHD
Current Phase C total odd HDs		●				I3 Tot OddHD
Current Phase C K-Factor		●	●			I3 K Factor
Current 4 HDs		● (2 nd to 15 th)	●	Harmonics Analyzer Module #7	I4 Harmonics	I4 HD 1 <i>thru</i> I4 HD 63
Current 4 total HDs		●	●			I4 Total HD
Current 4 total even HDs		●				I4 Tot EvenHD
Current 4 total odd HDs		●				I4 Tot OddHD
Current 4 K-Factor		●	●			I4 K Factor
Universal Time (UTC)				Clock Module	Clock	UnivTime
Local Time	●					LocalTime
Daylight Savings Time (ON/OFF)						DSTFlag



Making Configuration Changes

Once basic setup is performed, most users will find that the 7700 ION’s factory configuration provides all of the monitoring, logging and control functionality they require. Depending on your application, you may need to make minor changes to the factory configuration to make the device “fit” your power system. This chapter explains how to make small changes to the factory configuration using PEGASYS software, PowerView software and the MGT.

The 7700 ION can be customized to perform virtually any power monitoring and control functions. Creating custom functionality involves dismantling the factory configuration and replacing it with your own module links and settings. If you want to make significant changes to the operation of the 7700 ION, refer to Chapter 4.

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Configuration Tools

Different types of configuration changes can be made using the different tools provided by Power Measurement. Each of the tools available has been designed to make basic configuration changes easy. The configuration tools available and the types of configuration changes you can make with them are as follows:



NOTE

Creating custom functionality in the 7700 ION is discussed in the next chapter.

- ◆ PEGASYS ION Designer software lets you change the settings for any function performed by the meter. Everything from basic setup to creating custom functionality can be performed using ION Designer. The different types of device functions are grouped together on the ION Designer screen, so you can quickly access the types of settings you want to change.

Refer to the PEGASYS ION Designer on-line help for assistance using the software.

- ◆ PowerView software (PowerView for Windows and PowerView Plus) provides basic and advanced setup modes, allowing you to change the settings for any meter function. Advanced users can create custom functionality with PowerView.

Refer to the PowerView on-line help for assistance using the software.

- ◆ The MGT also provides access to the settings of every meter function. Special screens are provided for quick access to basic setup functions. The MGT cannot be used to create custom functionality.

Any of the tools mentioned above are suitable for making minor changes to the device's configuration. If you plan to do more extensive changes later on, use PEGASYS ION Designer for device configuration — this software provides the most comprehensive view of the 7700 ION's internal operation. Once you have become comfortable with the ION Designer interface you will be better prepared to make major changes later.

Basics of the ION Architecture

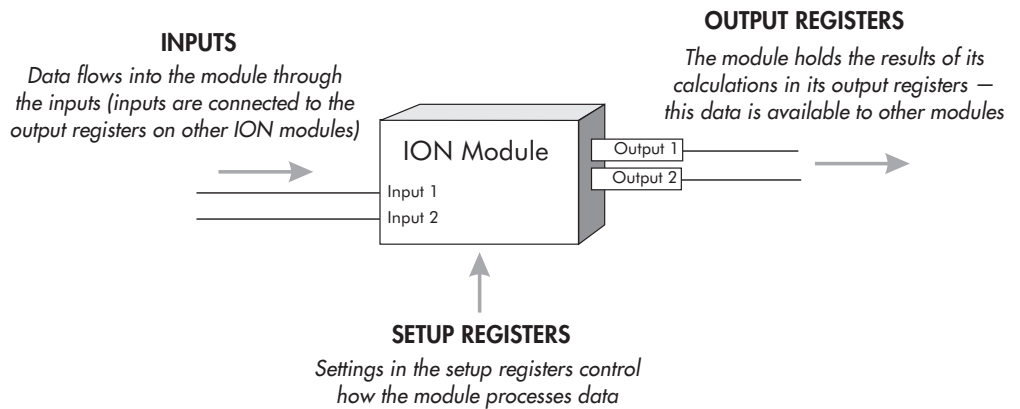
Before you begin altering the 7700 ION's operation, it is advisable to familiarize yourself with the basics of how the device operates. Understanding the basics of the ION architecture will help you understand how to make different types of configuration changes.

The 7700 ION and all other ION devices (including some PEGASYS software nodes, such as the VIP and the Log Server) use the Integrated Object Network, or ION, as their operating software. ION applies the principles of object-oriented software design to the creation of functionality inside your Power Measurement devices. The object-oriented structure of ION 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*, 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.

The ION Module

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.



There are approximately 50 types of modules in the ION architecture; the 7700 ION has 32 different module types. Most ION devices can support several instances of a certain module type (for example, the 7700 ION supports 16 Thermal Demand modules, 20 Periodic Timer modules and one Clock module).

NOTE

More detail on ION modules and registers is provided in Chapter 4.

ION Registers

Each module has one or more output registers, and most modules have Setup registers. (A module's inputs can be thought of as a link to the output registers on other modules.)

There are different types of registers, 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. All of the configuration tools discussed in this chapter prevent you from entering the wrong type of data into a register, but they do not prevent you from entering the wrong value. As any changes to a register's value alters the operation of the device, exercise caution when making configuration changes.

Making ION Configuration Changes

Regardless of the interface you use, when you make configuration changes to an ION device you are either changing a value in a module's setup register or you are changing the linkage between two or more modules. The types of configuration changes discussed in this chapter are changes to the settings held in ION module Setup registers.



The 7700 ION is factory-configured for optimal operation. Aside from basic setup, you do not need to make any modifications to the device's configuration for normal use.

Changing the settings in an ION module's setup registers changes the way the device operates. Carefully consider any change you intend to make before proceeding. Refer to the *ION Reference* for details on each ION module.

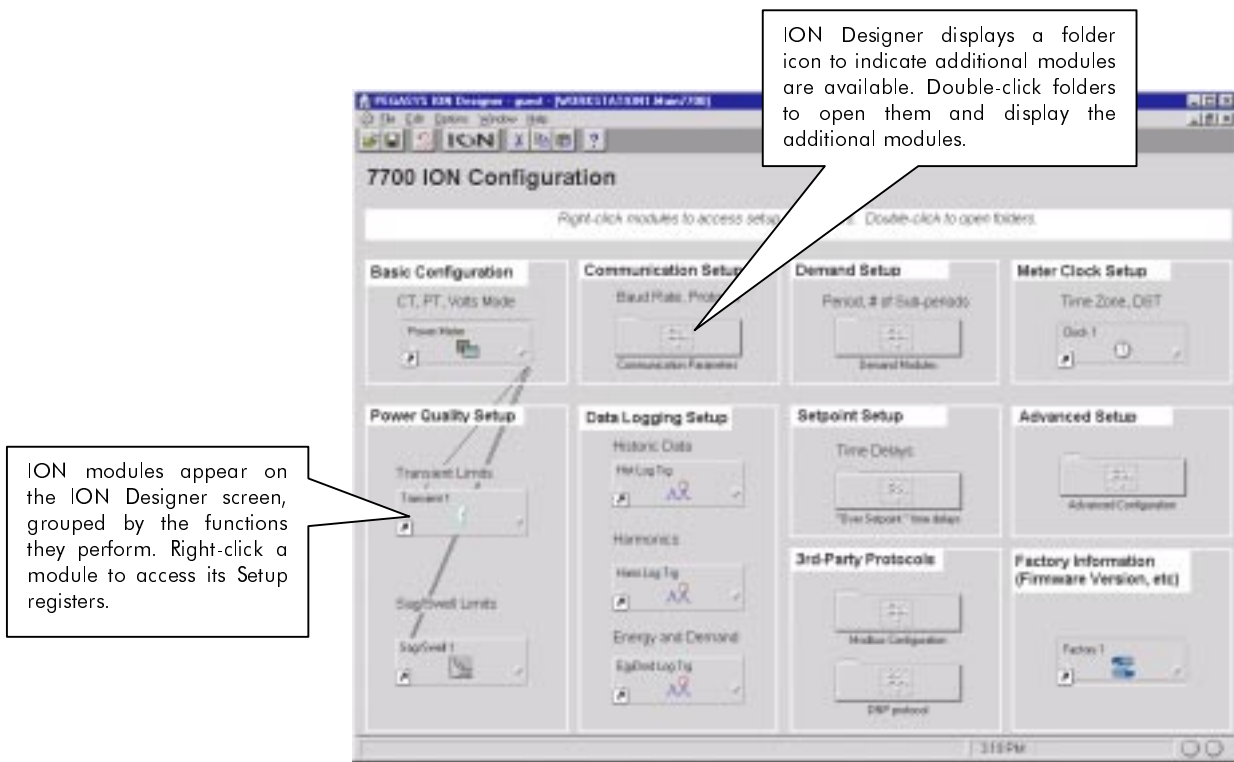
Adding or deleting links between ION modules significantly alters the operation of the device, and should only be performed by experienced personnel. Refer to "Creating Custom Functionality" in Chapter 4 for instructions on changing module links.

Configuring the 7700 ION with ION Designer

ION Designer software (part of Power Measurement’s PEGASYS suite) provides the most powerful interface to the 7700 ION’s operating software. All of the device’s ION modules can be accessed and configured using a standard technique and a unified interface.

The Main 7700 ION Configuration Screen

If PEGASYS 2.0 has been properly configured, the screen below will appear in each time that you open a 7700 ION in ION Designer. If PEGASYS has not yet been configured, refer to the *PEGASYS Administrator’s Guide*, or contact your PEGASYS network administrator.



Using ION Designer to Change Setup Registers

You require PEGASYS password level 5 to modify the settings in a module’s Setup register. If you do not have sufficient password authority, contact your PEGASYS administrator.

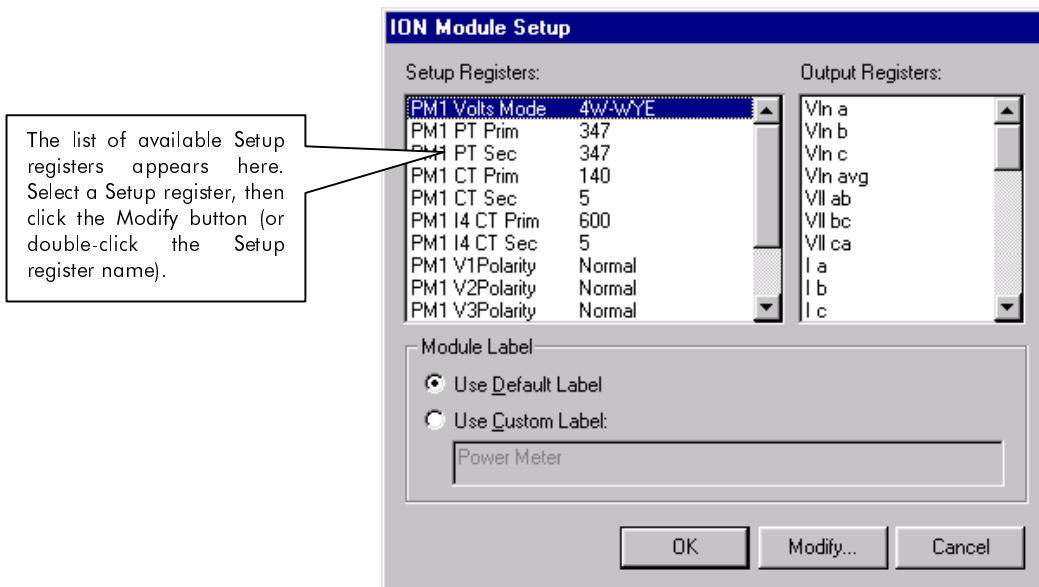
Once you have logged on to ION Designer and you have opened the 7700 ION’s node diagram, you can begin configuring ION modules. ION Designer displays two types of objects on the main configuration screen: ION modules and grouping objects (also called folders).

Grouping Windows (Folders)

The main 7700 ION configuration screen displays a number of folders. A folder in ION Designer indicates that additional modules are available. Double-click on a folder to access the modules that are contained inside it. In some cases a folder will contain additional folders — continue double-clicking on the folders until you reach the ION module you want to configure.

Accessing ION Module Setup Registers

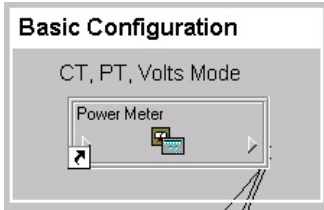
Once you have penetrated the folders to display the ION module you want to configure, right-click near the center of the module's icon. The ION Module Setup dialog box appears, showing a list of setup registers available for configuration:



Highlight the Setup register you want to configure, and click the Modify button. The Modify Register dialog box appears — this is where you make the change to the register's setting.

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. The details you need to perform basic configuration changes are provided in the following paragraphs. Complete details of each ION module Setup register are provided in the *ION Reference*.

Basic Configuration



The Basic Configuration area contains the Power Meter module. This module is the main connection between the power system measurements and all other ION modules in the device. The Power Meter reports the values for all of the voltage, current and power measurements. Right-click near the center of the module’s icon to configure its setup registers.

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 7700 ION is initially put into service (the device will not operate properly until Volts mode and PT and CT ratios are set), but some registers may need to be changed to refine the device’s operation.

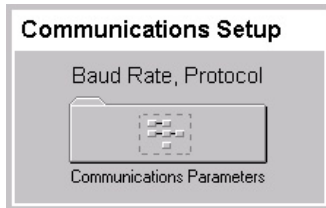
The functions of the setup registers in the Power Meter module are as follows:

Setup Register	Function
Volts Mode *	The power system’s configuration – WYE, DELTA, Single, etc
PT Prim *	The Potential Transformer’s primary winding rating for V1, V2 and V3
PT Sec *	The Potential Transformer’s secondary winding rating for V1, V2 and V3
CT Prim *	The Current Transformer’s primary winding rating for I1, I2 and I3
CT Sec *	The Current Transformer’s secondary winding rating for I1, I2 and I3
I4 CT Prim	The Current Transformer’s primary winding rating for I4
I4 CT Sec	The Current Transformer’s secondary winding rating for I4
V1 Polarity	The polarity of the Potential Transformer on V1
V2 Polarity	The polarity of the Potential Transformer on V2
V3 Polarity	The polarity of the Potential Transformer on V3
I1 Polarity	The polarity of the Current Transformer on I1
I2 Polarity	The polarity of the Current Transformer on I2
I3 Polarity	The polarity of the Current Transformer on I3
I4 Polarity	The polarity of the Current Transformer on I4
Phase Order	The expected rotation of the voltage phases (ABC or ACB)
Phase Lbls	The phase label format assigned to the outputs (ABC, RST, XYZ, RYB, RWB or 123)

* 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. PT/CT values, Volts Mode), the 7700 ION will operate properly. Typically there is no need to make further changes to the Power Meter module’s setup registers.

Communications Setup



The Communication Setup area contains a single folder called “Communications Parameters.” Double-click this folder to view the four Communications modules. The Communications modules control the links between the 7700 ION and the networks or workstations it communicates with. The Communications modules have the following functions:

Module Name	Settings
Comm 1	Comm 1 RS-232/RS-485 port
Comm 2	XPRESS CARD's high-speed Comm 2 RS-485 port
Comm 3	XPRESS CARD's high-speed Comm 3 RS-485 port
Ethernet	XPRESS CARD's 10Base-T and 10Base-FL Ethernet port

Communication settings are typically configured when the device is initially put into service. A communications channel must be configured before you can use PEGASYS; if you alter the settings for the channel that is in use you will lose your communications connection with the device.

NOTE

The XPRESS CARD is an optional component.

The standard 7700 ION has a single RS-232/RS-485 port (Comm 1).

The setup registers in the Communications and Ethernet modules define the parameters used for each communications port. The following parameters can be configured (different parameters are presented on different modules):

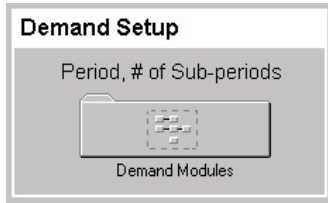
- ◆ communications standard (i.e. RS-485 or RS-232) and related settings
- ◆ communications protocol (i.e. ION, Modbus RTU, or DNP 3.0)
- ◆ communications link speed (i.e. 19, 200 bps)
- ◆ device unit ID (RS-485) or IP Address, gateway and subnet mask (Ethernet)

Communications Protocols

By default each communications port on the 7700 ION is configured to use the ION protocol. If you want to make use of the factory Modbus RTU or DNP 3.0 configurations, you need to configure the Communications module that controls the port you want to use.

Use the table above to determine which module controls the port you intend to use, and choose the appropriate protocol from the module's Protocol setup register. Note that DNP 3.0 is only available on the Comm 2 and Comm 3 XPRESS CARD ports, and only one port can communicate using DNP 3.0 at a time.

Demand Setup



The Demand Setup area contains a single folder called “Demand Modules.” Double-click this folder to view the eight demand modules that have been configured (four Thermal Demand modules and four Sliding Window Demand modules). The demand modules are configured to calculate the average current, and kW, kVAR and kVA demand.

The setup registers in the demand modules define time intervals for demand calculations and set the sensitivity of the module’s operation.

Setup Register (module)	Function
Sub Intvl (Sliding Window)	The time, in seconds, in the sliding window demand sub-interval
# SubIntvls (Sliding Window)	The number of sub-intervals in the sliding window
Pred Resp (Sliding Window)	The speed of Predicted Demand calculations; use higher values for faster prediction (values between 70 and 99 are recommended)
Interval (Thermal)	The time, in seconds, in the thermal demand interval
Time Const (Thermal)	The sensitivity to changes in the source signal; higher values provide faster response time (common values are 63 and 90)

Meter Clock Setup



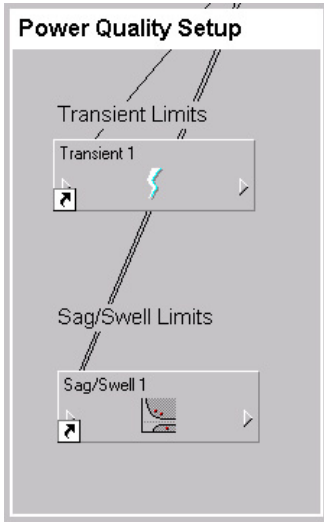
The Meter Clock Setup area contains the Clock module. Right-click near the center of the module’s icon to configure its setup registers. This module controls the 7700 ION’s internal clock, which provides timestamps for data logged by the device. The clock needs to be configured properly to ensure that logged data has accurate timestamp information. The Clock module also receives the time synchronization signals sent to it by PEGASYS workstations or GPS receivers, and updates the device’s clock when required.

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

Setup Register	Function
TZ Offset	The timezone the device is in, relative to Greenwich Mean Time
DST Start	Date and time when DST begins
DST End	Date and time when DST ends
DST Offset	The amount of time the clock is changed when DST begins or ends
Time Sync Source	The communications port that is responsible for receiving time sync signals
Time Sync Type	The type of time sync signal (Local or Universal time)

Refer to “Time Synchronization” in Chapter 4 for further details on using the 7700 ION’s time synchronization functions.

Power Quality Setup



The Power Quality Setup area contains the 7700 ION’s two power quality modules: the Transient module and the Sag/Swell module. Right-click near the center of either module’s icon to configure its setup registers.

Transient Module Settings

The Transient module monitors voltage waveforms for transient activity (i.e. CBEMA Type 1 disturbances) and reports each transient’s magnitude and duration.

The Transient module’s setup registers define what voltage disturbance magnitude should be considered as transient activity, and what priority these disturbances should be assigned.

Setup Register	Function
Threshold	The magnitude at which a voltage deviation is considered a transient
EvPriority	The priority assigned to a detected transient (0 to 255, 255 is highest)

The number entered into the Threshold setup register 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 in to the Threshold setup register.

Sag/Swell Module Settings

The Sag/Swell module monitors voltage waveforms for sags and swells (i.e. CBEMA Type 2 and Type 3 disturbances) and reports each disturbance’s magnitude and duration. The Sag/Swell module also breaks each disturbance into sub-disturbances for detailed analysis.

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

The only setup registers you may need to change are the Swell Lim and Sag Lim. Most applications will be served by the default values entered into these registers, but if you want to fine-tune Sag/Swell detection, try adjusting the Swell Lim and Sag Lim Values.

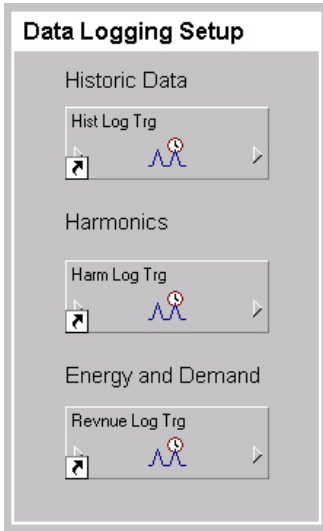
The Change Crit and EvPriority registers do not need to be changed for normal operation. Nom Volts must be set to enable Power Quality functions.

NOTE

If the Sag/Swell module’s Nom Volts setup register is set to zero, all Transient module and the 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.

Data Logging Setup



The Data Logging Setup area contains three Periodic Timer modules: one for Historic Data logging, one for Harmonics logging and one for Energy and Demand logging. These modules trigger logging on intervals specified in their setup registers. Right-click near the center of a module’s icon to configure its setup registers.

Historic Data Logging

The Periodic Timer module labeled “Hist Log Trig” controls the frequency of Historic Data logging. Change the value in the Period setup register to change the frequency of the logging (Period values are specified in seconds). Do not change the Sync Mode setup register.

Refer to “Historic Data Logging Framework” near the end of Chapter 2 for a complete list of the Historic Data parameters that are logged.

Harmonics Logging

The Periodic Timer module labeled “Harm Log Trig” controls the frequency of Harmonics logging. Change the value in the Period setup register to change the frequency of the logging (Period values are specified in seconds). Do not change the Sync Mode setup register.

Refer to “Harmonics Logging Framework” near the end of Chapter 2 for a complete list of the Harmonics parameters that are logged.

Energy & Demand Logging

The Periodic Timer module labeled “EgyDmd Log Trig” controls the frequency of Energy and Demand logging. Change the value in the Period setup register to change the frequency of the logging (Period values are specified in seconds). Do not change the Sync Mode setup register.

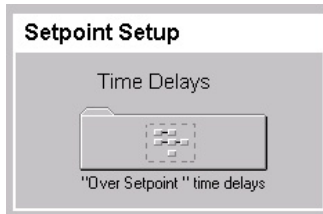
Refer to “Energy & Demand Framework” near the end of Chapter 2 for a complete list of the Energy and Demand parameters that are logged.

Changing the Parameters that are Logged

The 7700 ION’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.

Chapter 4 of this guide discusses adding and deleting links between modules. If you want to make changes to the preconfigured logging, familiarize yourself with the procedures described in “Creating Custom Functionality” in Chapter 4. Once you are comfortable editing module links, change logged parameters by linking the output registers you want logged to the inputs of an ION Data Recorder module.

Setpoint Setup



The Setpoint Setup area contains a single folder called “Over Setpoint Time Delays”. Double-click this folder to view the five Relative Setpoint modules that monitor phase current, kW demand and voltage unbalance for “over” conditions.

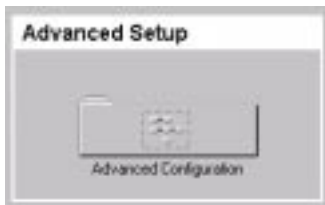
The Relative Setpoint modules have the following setup registers:

Setup Register	Function
Eval Mode	Determines how the Pickup and Dropoff setup register are interpreted
Over Pickup	The limit that a source input must exceed for an over condition to start
Over Dropoff	The limit that a source input must fall below for an over condition to end
Under Pickup	The limit that a source input must fall below for an under condition to start
Under Dropoff	The limit that a source input must exceed for an under condition to end
SusUntlON	Amount of time an input must be out of range for an over condition to start
SusUntlOFF	Amount of time an input must be back in range for an over condition to end
EvPriority	The priority assigned to a Relative Setpoint event (0 to 255, 255 is highest)

There is no need to change any of the Relative Setpoint module’s setup registers for normal operation of the 7700 ION. 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 will 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).

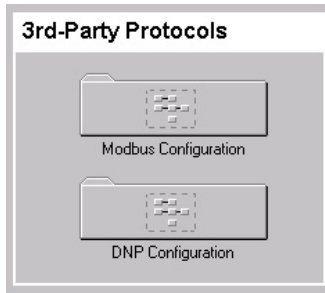
Advanced Setup



The Advanced Setup area contains a single folder called “Advanced Configuration.” Double-click this folder to view additional folders that contain device configuration information. The nine folders inside the Advanced Configuration folder provide access to the module frameworks that perform the various functions on the device.

As the name implies, “Advanced Configuration” should only be performed by experienced personnel who understand the internal operation of the 7700 ION — any changes you make in this area will affect the device’s operation. There are no adjustments required to any of the modules in the Advanced Setup area.

Third-Party Protocols



The Third-Party Protocols area contains two folders: “Modbus Configuration” and “DNP Configuration”. Double-click either of these folders to view the factory-configured Modbus and DNP 3.0 modules.

Modicon Modbus RTU Protocol

The 7700 ION supports the Modicon Modbus RTU protocol, making a comprehensive set of power, energy, demand and harmonics parameters available to Modbus Master devices. Refer to the section “Using the Modbus RTU Protocol” in Chapter 4 for a list of the parameters available through Modbus.

Advanced configuration can be performed on the 7700 ION to make any measured or calculated parameter available to connected Modbus Master devices. This requires relinking the Modbus Slave Read modules to the parameters you want to export via Modbus. Refer to Chapter 4 for details.

There are no basic configuration adjustments to make in the Modbus Configuration folder. Changing the factory Modbus configuration is an advanced setup procedure that requires an understanding of the Modbus protocol and an understanding of the 7700 ION’s internal operation.

DNP 3.0 Configuration

The 7700 ION uses the DNP 3.0 protocol to make various energy, power and demand parameters available to DNP 3.0 master devices. Refer to the section “Using the DNP 3.0 Protocol” for a list of the parameters available through DNP. The DNP 3.0 communications protocol is available only on the XPRESS CARD’s RS-485 ports, and only a single port can use the DNP 3.0 at any one time.

As with Modbus, any measured or calculated parameter can be made available through DNP 3.0. This requires relinking DNP Slave Export modules to the parameters you want to export via DNP.

There are no basic configuration adjustments to make in the DNP Configuration folder. Changing the factory DNP configuration is an advanced setup procedure that requires an understanding of the DNP 3.0 protocol and an understanding of the 7700 ION’s internal operation.

Configuring a Communications Protocol

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 either MODBUS RTU or DNP 3.0 from the list of available protocols in the Communications module’s Protocol setup register (refer to “Communications Setup” on page 3–8).

Modbus RTU is available on each of the 7700 ION’s communications ports, and multiple ports can communicate using Modbus simultaneously. DNP 3.0 is only available on the optional XPRESS CARD’s RS-485 ports, and only a single port can use the DNP 3.0 protocol at any one time.

NOTE

The 7700 ION can also be configured to receive data through Modbus or DNP 3.0. There is no factory-configured framework for receiving data through Modbus or DNP — refer to Chapter 4 for details on setting this up.

Factory Information



The Factory Information area has a single module called “Factory 1”. The Factory module contains information about the 7700 ION and the XPRESS CARD (if one is installed). Right-click near the center of the module’s icon to view its setup registers.

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). The device information provided is as follows:

Setup Register	Description
Device Type	A device type identifier (“7700” for the 7700 ION)
Compliance	A statement of whether the device is ION compliant or not
Options	Operating temperature and XPRESS CARD firmware version (if installed)
Revision	The 7700 ION’s firmware version
Serial Number	The 7700 ION’s serial number
Nom Freq	The expected frequency of the power system being monitored

Three editable setup registers are provided for you to enter your company’s name and other text information you want stored in the device. The editable registers are as follows:

Setup Register	Description
Owner	Text register for storing user information (i.e. company name)
Tag 1	Text register for storing user information (i.e. device location)
Tag 2	Text register for storing user information (i.e. device number or identifier)

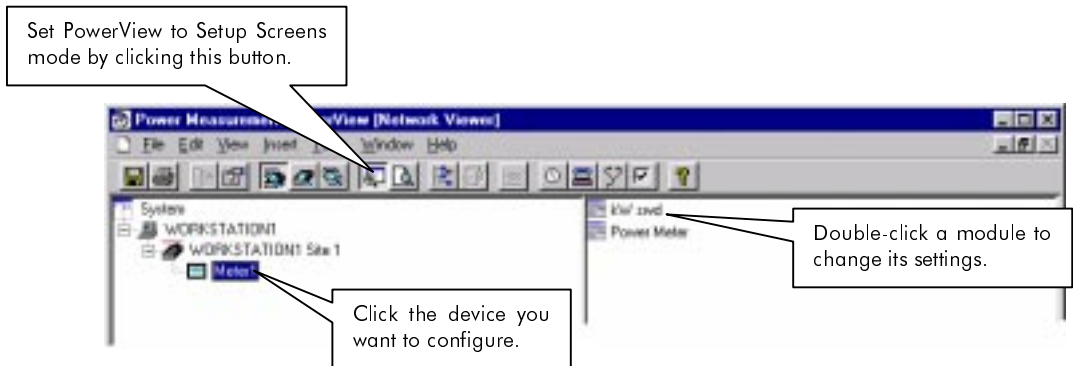
The Factory module also contains numerous read-only setup registers that hold the calibration constants used at the factory.

Configuring the 7700 ION with PowerView

PowerView provides complete device configuration capabilities. PowerView lets you link or unlink modules and configure setup register settings. The device setup functions discussed in this chapter are limited to setup register changes (module linking is an advanced operation — refer to Chapter 4).

Using the PowerView Interface

When you start PowerView and logon, a split screen appears showing your power monitoring network on the left and setup screens or data screens on the right. To configure an ION device in PowerView, set the display to Setup Screens mode, select the device in the left pane, then double-click the module you want to configure in the right pane.



PowerView's Setup Screens Mode

PowerView uses the same interface to provide device setup functions and to display measured data. To perform device configuration, make sure PowerView is set in Setup Screens mode.

Set PowerView to Setup Screens mode by selecting Setup Screens in the View menu or by clicking the Setup Screens button on the toolbar.

When PowerView is in Setup Screens mode, the right pane displays the ION modules in the selected device. To edit a module's setup registers, double-click the module's icon. Note that the number of ION modules that appear in the right pane depends on PowerView's setup mode (described on the next page).

PowerView's Basic and Advanced ION Setup Modes

PowerView has two setup modes: Basic ION Setup and Advanced ION Setup. By default PowerView is set to Basic ION Setup mode and only the ION modules that commonly require user configuration are displayed. In Advanced ION Setup mode PowerView displays all of the ION modules available in the device.

Using Basic ION Setup Mode

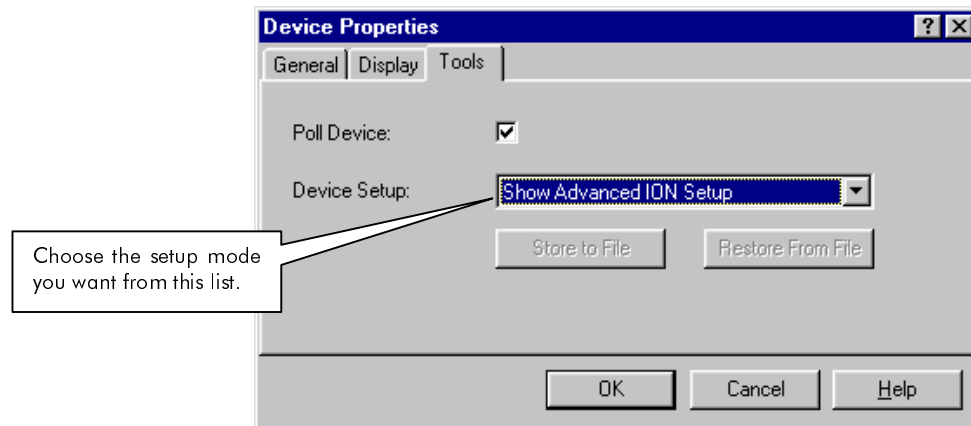
When you initially select Setup Screens mode in PowerView, the kW Sliding Window Demand module and the Power Meter module are displayed in the right pane.

- ◆ Double-click the kW Sliding Window Demand module to set the *Sub Intvl*, *#SubIntvls* and *Pred Resp* setup registers. Refer to page 3–9 for a description of each of these setup registers.
- ◆ Double-click the Power Meter module to configure various basic setup settings, such as PT/CT ratios and power system configuration. Refer to page 3–7 for a description of each of the Power Meter module's setup registers.

Changing to Advanced Setup Mode

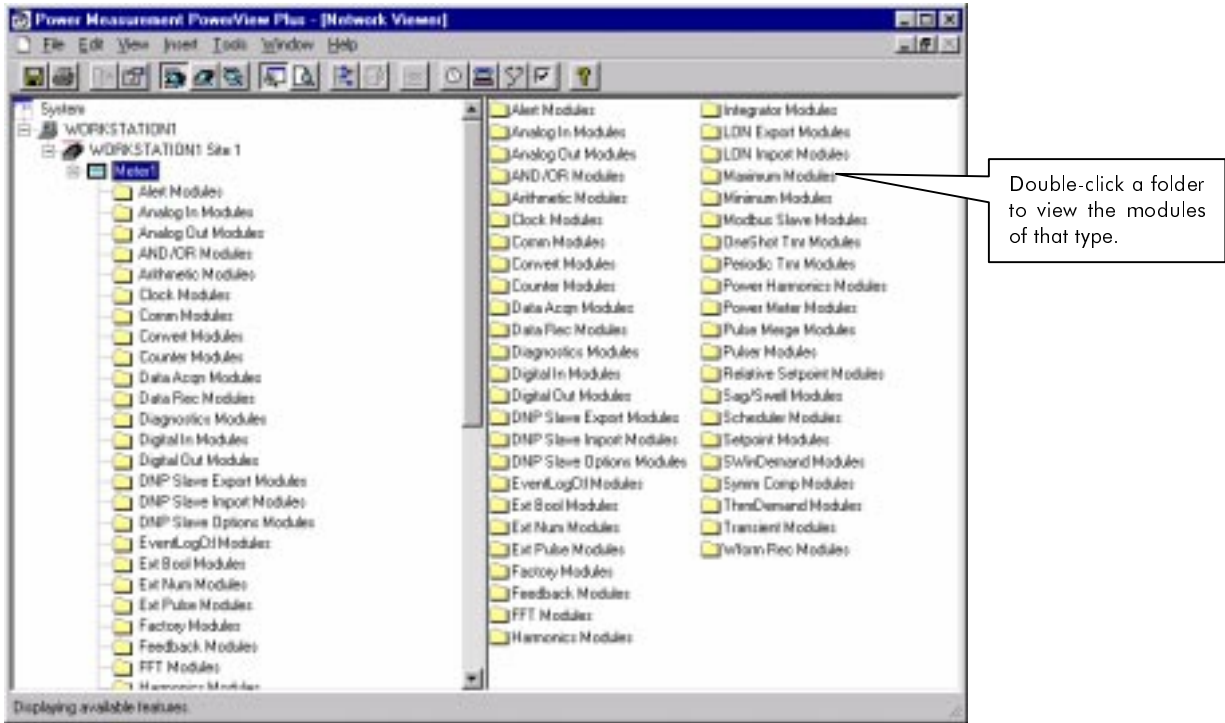
For a comprehensive view of all ION modules in the 7700 ION, set PowerView to Advanced ION Setup mode. Advanced ION Setup mode can be set for individual devices in the network.

Right-click on the device you want to configure and select Properties from the pop-up menu. The Device Properties dialog box appears. Click the Tools tab, and choose the setup mode you want to use.



Using Advanced Setup Mode

Once you choose Show Advanced ION Setup and click OK, PowerView uploads all ION modules from the device. Modules are grouped together by type in folders in the PowerView display. Double-click a folder to view the modules inside it.



If you double-click a folder and no modules appear in the right pane, there are no modules of that type created in the 7700 ION's factory configuration. If a module appears, double-click it to configure its setup registers.

Determining Which Modules to Configure

The 7700 ION is factory-configured to be fully operational. Unless you have a specific setting you want to change, you should not edit any of the device's modules. If you need to make a change to the device's operation, you have to determine which module you need to configure. This is usually a simple task, as all of the ION modules use names that indicate their function.

NOTE

If you are unable to determine which module you need to configure to achieve a specific type of operation, contact Power Measurement Customer Service.

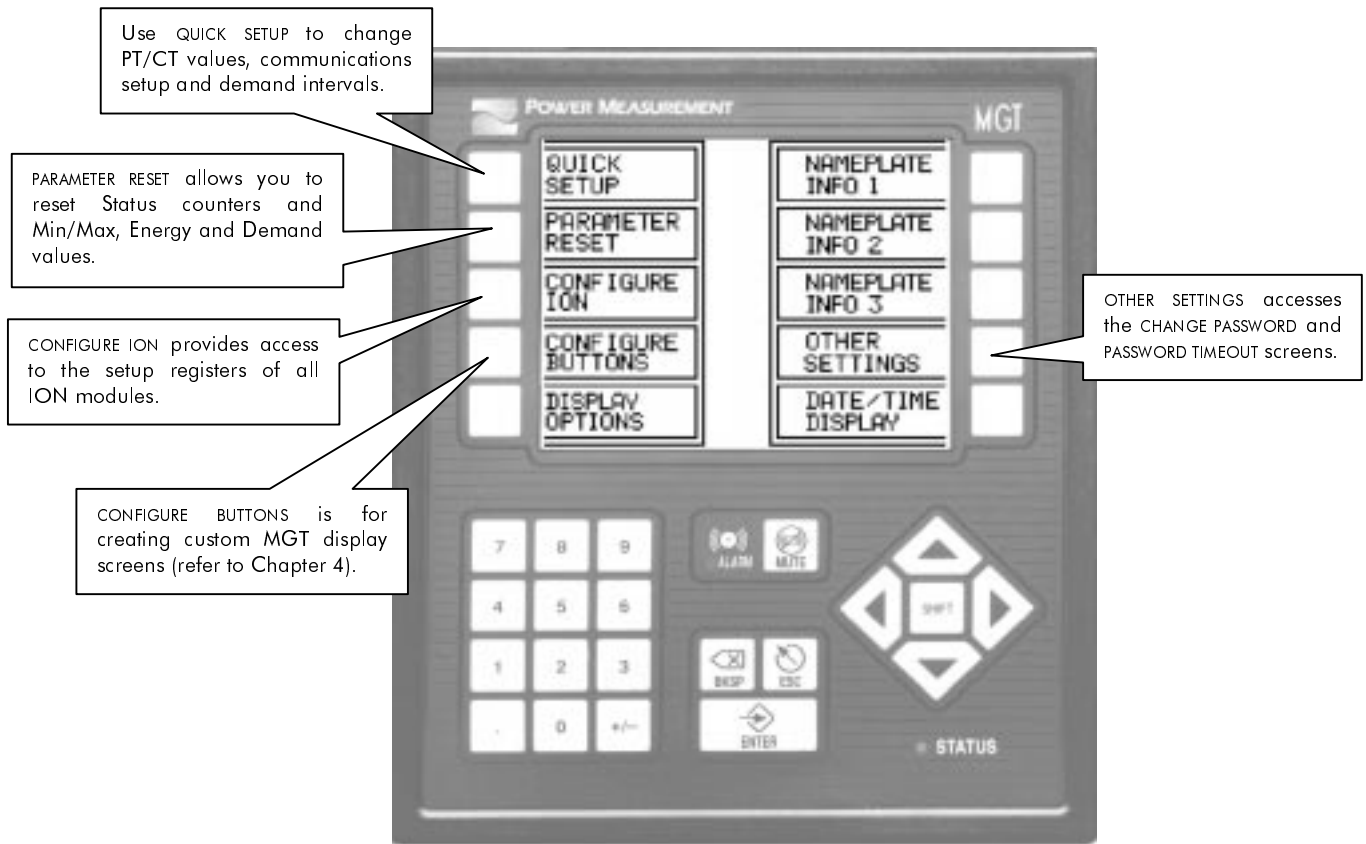
If you have a specific task you need to perform, but you don't know which module controls that task, first refer to "Configuring the 7700 ION with ION Designer" earlier in this chapter. ION Designer software organizes the modules into the types of functions they perform, such as Power Quality Setup, Demand Setup and Meter Clock Setup. If you can find the type of operation you need to perform in the headings under "Configuring the 7700 ION with ION Designer" you can see which modules are used for that operation. Also, refer to "Complete List of Factory-Configured Measurements and Functions" in Chapter 2. Measurements are described and correlated with module names in this table.

Configuring the 7700 ION with the MGT

The MGT provides device setup capability at the 7700 ION's installed location. All of the 7700 ION's setup registers can be configured moving through menus on the MGT's screen. (ION module links cannot be added or deleted using the MGT). The MGT also provides quick access to parameter reset for common cumulative parameters.

The MGT's Setup Menus

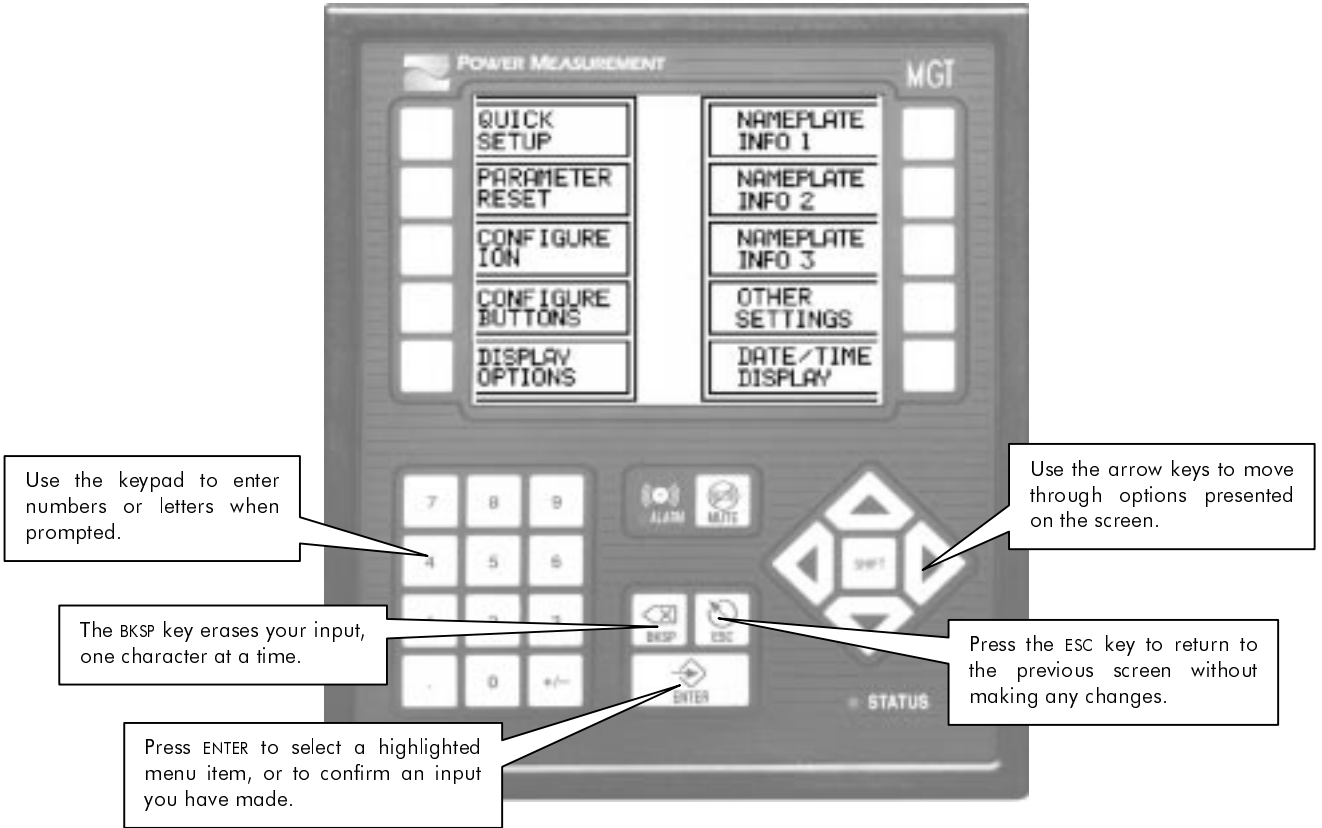
To access the MGT's device configuration functions, press the button next to the SETUP menu item (the top button on the left of the display screen). If the SETUP menu item does not appear on the MGT's display, press the button next to the PREVIOUS menu item until the SETUP option becomes available. Press SETUP to enter the MGT's main Setup Menu:



The DISPLAY OPTIONS, NAMEPLATE INFO and DATE/TIME DISPLAY menu items are described in "Displaying Data with the MGT" in Chapter 2.

Using the MGT's Buttons

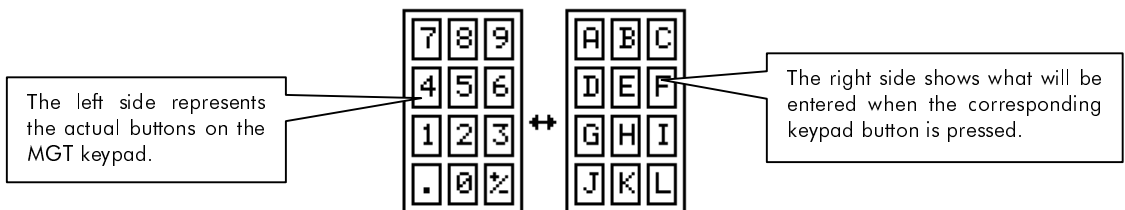
Move through the MGT's menu items by pressing the buttons adjacent to menu items on the screen. To enter data, use the numeric keypad and the arrow keys to make a selection or enter a value (detailed below). Once a selection is made or a value is entered, use the ENTER button to confirm the input and send the data to the 7700 ION. The BKSP button is used to delete the values you have entered, one character at a time. The ESC button moves you back to the previously viewed screen, discarding any changes you have made.



Making Selections and Entering Data

Many configuration changes are made by selecting options from a list. To make a selection, use the arrow keys to highlight the item you want, then press ENTER.

Some procedures require that you enter a number or a word. When the MGT wants input from you, it displays a representation of the keypad on the screen:



The left side of the button assignment screen represents the actual buttons on the MGT keypad. The right side of the display indicates which characters each of the keypad buttons represent. In the display above, to enter the character “G”, you would press “1” on the MGT keypad.

Press the right or left arrow buttons to scroll through all of the available keypad button assignments. When the character you want to enter is displayed on the right, press the corresponding keypad button on the left to enter that character. The SHIFT key offers a shortcut for accessing characters on other keypad screens: similar to the SHIFT key on a computer keyboard, pressing SHIFT on the MGT changes the case of the characters.

After you have entered the characters you want, press the ENTER button to send the command to the 7700 ION.

Passwords and Password Timeout

All device configuration functions are password protected. The password is factory set to zero (0). With the factory password you can penetrate the menus and change the password to a custom value.

The MGT also features a Password Timeout feature. This feature permits you to make multiple changes without having to repeatedly enter a password to authorize the change. Note that the timeout feature is applicable only within a particular SETUP menu (i.e. within CONFIGURE ION or PARAMETER RESET). You will be prompted for your password again if the timeout elapses or if you attempt to make changes from a different SETUP menu area.

To change the password or adjust the timeout value, choose the OTHER SETTINGS menu. When you are prompted for your password, press 0 (zero) on the keypad, then press the enter button. Choose either PASSWORD TIMEOUT or CHANGE PASSWORD. Follow the instructions on the MGT screen.



NOTE

If you forget your password, contact Power Measurement with your 7700 ION serial number.

Quick Setup

QUICK SETUP

The MGT's Quick Setup menu provides access to four basic setup functions: PT/CT, Serial COM, Ethernet COM and Demand. These settings are all made when the device is initially put into service — typically you will not need to change these settings once the device is operational. To access a Quick Setup menu, press SETUP, QUICK SETUP, and then the menu you want to use.

PT/CT

The PT/CT menu accesses the Power Meter and Sag/Swell module setup registers that are used for basic setup:

Setup Register	Function
Volts Mode	The power system's configuration – WYE, DELTA, Single, etc
PT Prim	The Potential Transformer's primary winding rating for V1, V2 and V3
PT Sec	The Potential Transformer's secondary winding rating for V1, V2 and V3
CT Prim	The Current Transformer's primary winding rating for I1, I2 and I3
CT Sec	The Current Transformer's secondary winding rating for I1, I2 and I3
I4 CT Prim	The Current Transformer's primary winding rating for I4
I4 CT Sec	The Current Transformer's secondary winding rating for I4
Nom Volts	The nominal power system voltage (used for power quality calculations)
Phase Lbls	The phase label format assigned to the outputs (ABC, RST, XYZ, RYB, RWB or 123)

Serial COM

The Serial COM menu accesses the Communications modules that control the 7700 ION's serial ports (Comm 1, and Comm 2/Comm 3 on the optional XPRESS CARD).

Setup Register	Function
Comm Mode	Sets the Comm 1 serial port's communications mode (RS-232 or RS-485)
Baud Rate *	Sets the communications speed, in bits/second) for the serial port
Unit ID *	Sets the 7700 ION's Unit ID — a unique Unit ID is required for each device
Protocol *	Sets the communications protocol for the serial port – refer to page 3–8.

* These setup registers are available for each installed serial port. The MGT displays CM1, CM2 or CM 3 to indicate communications ports 1, 2 or 3.

Ethernet COM

The Ethernet COM menu accesses the Ethernet module's setup registers. The Ethernet module controls the 10Base-T and 10Base-FL ports on the optional XPRESS CARD.

Setup Register	Function
Protocol	Sets the communications protocol for the Ethernet ports – refer to page 3–8.
IP Address	Sets the IP Address for the 7700 ION
Subnet Mask	Used if subnetting applies to your network – see your Network Administrator
Gateway	Used in multiple network configurations – see your Network Administrator

Typically your Network Administrator will provide you with the appropriate IP Address for the 7700 ION. The Subnet Mask and Gateway settings are only required if you have communications between multiple Ethernet networks, and if subnetting is implemented.

Demand

The Demand menu accesses some of the setup registers in the factory-configured Sliding Window Demand and Thermal Demand modules. These setup registers control the timing of demand calculations.

Setup Register (module)	Function
Sub Intvl (Sliding Window) *	The time, in seconds, in the sliding window demand sub-interval
# SubIntvls (Sliding Window) *	The number of sub-intervals in the sliding window
Interval (Thermal) *	The time, in seconds, in the thermal demand interval

* These setup registers are available for each demand module. The MGT displays SD1 to SD4 to indicate Sliding Window Demand modules 1 through 4, and TD1 through TD4 to indicate Thermal Demand modules 1 through 4.

Parameter Reset



The Parameter Reset menu allows you to reset various cumulative parameters. To access Parameter Reset, press **SETUP**, **PARAMETER RESET**, then use the up and down arrow keys to highlight the parameter you want to reset. When the parameter you want is highlighted, press **ENTER**.

The first time you reset a parameter, the password screen appears – enter 0 (zero) or the user password you previously configured. The MGT displays "...Done" next to the parameter name once it has been successfully reset. The parameters that are reset by each menu selection are detailed below.

Min/Max Reset

The minimum AND the maximum values for each the following parameters are reset when *Min/Max Rset* is used:

- ◆ Phase and average Current (I a, I b, I c, and I avg)
- ◆ Line-to-line voltages (Vll ab, bc and ca, and Vll avg)
- ◆ Line-to-neutral voltages (Vln a, b and c, and Vln avg)
- ◆ Frequency
- ◆ PF lead and PF lag
- ◆ Total kW, kVAR and kVA

Sliding Window Demand Reset

The following Sliding Window Demand parameters are reset when *SWDemand Rset* is used:

- ◆ Average Current SWD
- ◆ kVAR SWD
- ◆ kW SWD
- ◆ kVA SWD

Status Counter Reset

Each of the eight Status Counters that monitor the number of times each Status input changes are reset when *S Count Rset* is used.

Thermal Demand Reset

The following Thermal Demand parameters are reset when *TDemand Rset* is used:


- ◆ Average Current TD
- ◆ kVAR TD
- ◆ kW TD
- ◆ kVA TD

Energy Reset

The following energy parameters are reset when *Energy Rset* is used:

- ◆ kWh import, export, total and net
- ◆ kVARh import, export, total and net
- ◆ kVAh

Configure ION

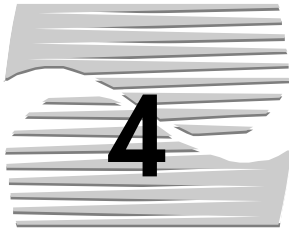


CONFIGURE
ION

The Configure ION menu provides access to the setup registers of every ION module in the 7700 ION. To edit a module's setup registers with the MGT, press SETUP then CONFIGURE ION. The Feature Manager appears, listing all of the module types available. Follow this procedure to access a setup register:

1. Use the arrow buttons to highlight the type of module you want to configure. The list of available modules occupies multiple MGT screens — when you get to the bottom of a screen, press ENTER when the word “more...” is highlighted to see the next group of module types. When the type of module you want to configure is highlighted, press ENTER to view the available modules of that type.
2. Use the arrow buttons to highlight the module you want to configure, then press ENTER. The module's setup registers appear, with their current settings displayed on the right.
3. Use the arrow buttons to move through the setup register listing until the register you want to configure is highlighted. Press ENTER, then enter your password to access the register's setting (use '0' if you have not configured a password). Press ENTER again after keying in your password.
4. Use the keypad to enter the new value, or use the arrow buttons to select the desired option from the list. Press ENTER to send the new setup register value to the 7700 ION. (Press ESC if you want to leave the screen without making any changes.)

Refer to the *ION Reference* for complete details on each setup register's function. Refer to Chapter 5 in this guide for a listing of the supported ranges or options for each module in the 7700 ION.



Using Advanced Features

The 7700 ION provides many advanced features, including comprehensive I/O, advanced interoperability support, and precision time synchronization. In addition, the 7700 ION's functionality can be customized to perform virtually any power monitoring and control functions. Using advanced features often requires considerable background knowledge — please be prepared to spend some time familiarizing yourself with the information in this chapter and the Technical Reference in Chapter 5.

This chapter discusses the creation of custom functionality, the use of I/O and advanced communications protocols, and the creation of custom MGT displays.

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 - Timing Considerations in the 7700 ION 4-6
 - ION Event Priority Groups 4-8
 - Dismantling the Factory Configuration..... 4-9
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- ◆ Using the Modbus RTU Protocol..... 4-20
- ◆ Using the DNP 3.0 Protocol 4-25
- ◆ Using Power Measurement's EtherGate Protocol 4-28
- ◆ Using the 7700 ION in LonWorks Networks..... 4-31
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Customizing the 7700 ION's Operation

The 7700 ION, and all other ION devices, can be completely customized to perform any functions you need. PEGASYS and PowerView software provide the tools to create specific functionality by altering the operating software inside the 7700 ION.



The 7700 ION is a sophisticated device. 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.

How Custom Functions are Created

To create custom functions, ION modules are linked together and then configured. Linking ION modules is a simple task: output registers on one module are linked to the inputs of subsequent modules. The data flows from the output register on the first module to the input on the second. Each module that receives data makes decisions and processes the data based on the settings in its setup registers. Once a module has processed the data it has received, it 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. It is the combination of modules linked together that creates powerful functionality. As the operation of the device can be separated into the specific, smaller functions performed by the modules, creating functionality is simple if you understand the functions of the component pieces.

Recommended Configuration Tools

Both PEGASYS and PowerView software provide the tools necessary to customize the 7700 ION's operation. Whenever possible, PEGASYS ION Designer should be used to create custom functionality as it provides a more powerful interface to the device's internal operation. ION Designer presents ION modules and module links graphically — you are able to view the flow of data on the screen. Many of the discussions in the chapter assume you are using ION Designer.

PowerView provides the functions required to link ION modules, but there is no graphic representation of how the data flows through the linked modules. Using PowerView to create custom functionality requires the ability to conceptualize module linkages without being able to view them on screen.

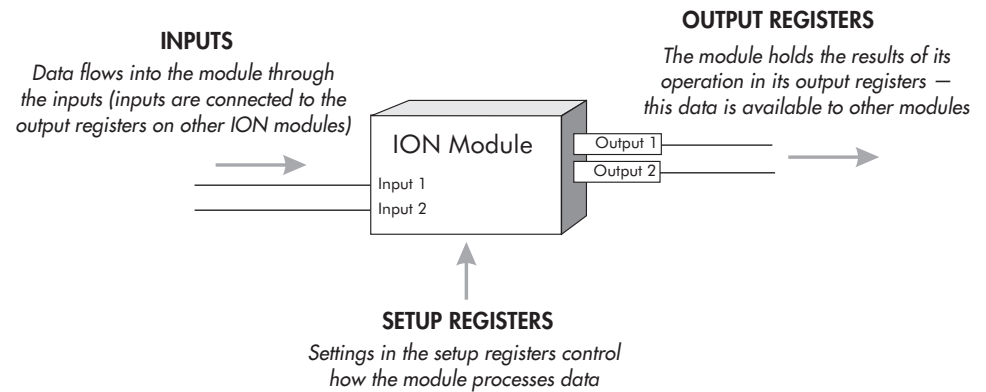
NOTE

Refer to the *ION Reference* for complete details on each ION module.

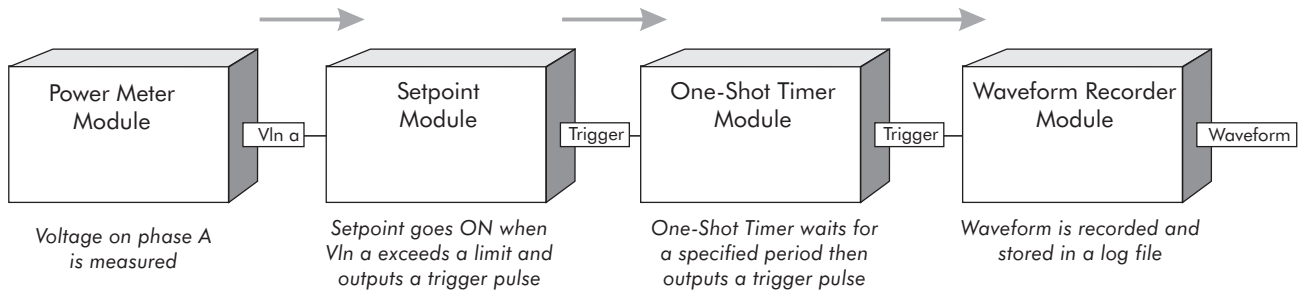
Adding modules using ION Designer software is discussed on page 4-11.

ION Details

In order to create custom functions in the 7700 ION it is necessary to understand some of the “rules” of ION. Read the following paragraphs for information on the component parts of an ION module and what restrictions apply to their use. To recall what was stated in Chapter 3, an ION module consists of inputs, setup registers and output registers.



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 8. 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. Some devices (including the 7700 ION) support the Feedback module, which makes circular linkages possible (refer to the *ION Reference*).

The Not Available Value

If a module is not linked to anything, its output registers will not contain any values and 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. This helps distinguish between cases where a register contains a value like 0 or OFF, and cases where there is actually no value stored.

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 *ION Reference*.)

Core Modules and Fixed Module Links

The 7700 ION includes several core modules. Core modules are integral to the basic operation of the device; they cannot be created or deleted. Core modules in the 7700 ION version 7700V200 include the Clock, Communications, Data Acquisition, Diagnostics, DNP Slave Options, Factory, FFT, Harmonics, Power Meter, and Symmetrical Components.

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 if desired.

ION Register Details

Not all output registers can serve as input registers for all modules. There are different *classes* of registers and each is capable of holding different types of information. To combine two ION modules together, the output registers of the first module must contain the kind of information that the next module can use.

To see if you can link ION modules, check the class of the module's inputs and output registers to ensure they are the same. The following list describes the various register classes available.

■ *Numeric*

These registers contain a single numeric value. It can be any value within the range capabilities of the device.

■ *Numeric Array*

These registers contain an array of numeric values.

● *Boolean*

These registers contain a logical ON or OFF (1 or 0).

∧ *Pulse*

These registers "contain" a pulse, or instantaneous signal. They are normally used for resetting, pulsing or triggering functions.



NOTE

ION Designer uses a double outline to indicate a core module.

Waveform

These registers contain formatted waveform data (an array of points that define a waveform). The information is formatted on the basis of:

#samples per cycle X #cycles

Enumerated

These registers are used for storing one value from a list of several options. For example, the Setpoint module has an Evaluate Mode setup register that can be set to either `LESSTHAN` or `GREATERTHAN`. Typically only setup registers are of the enumerated class.

Numeric Bounded

These registers contain a number bounded by a high and low limit. For example, in the Thermal Demand (TD) module, the setup register that specifies the period length is numeric bounded because the value must be a number higher than 1 but less than 100. Typically only setup registers are of the numeric bounded class.

Calendar

The Calendar register holds the setup information in the Scheduler module.

String

These registers contain text strings. Text strings can consist of any combination of numbers, letters and spaces, excluding double-quote characters ("). In addition, the text must not end with a backslash character (\). (Backslashes elsewhere in the text are permissible, as is a backslash at the end of the string if it is followed by a space character.)

String register applications include formulas (Arithmetic module) and device information (Factory module).

Event

Almost every ION module has an output called an event register that records all the *events* produced by the module. An event is simply any occurrence in the system that warrants logging (for example, changing a setup register or a Setpoint module going active). The contents of an event register include:

- ◆ A timestamp of when the event occurred
- ◆ The priority of the event
- ◆ The cause of the event
- ◆ Any values or conditions associated with the cause
- ◆ The effect of the event
- ◆ Any values or conditions associated with the effect

The Event Log Controller module takes all the event registers from all the modules in the device and assembles them to provide an Event Log.



Event Log

These registers contains the assembled contents of all the event registers of other modules. The Event Log Controller module uses this class of register to provide a log of all the events occurring on the device.



Log

These registers can contain a timestamped list of numeric, Boolean or waveform data. Typically, modules that record data (e.g. Data Recorder, Waveform Recorder) have Log output registers.

ION Register Names and Labels

Every register in the ION architecture has a name and a programmable label that identify what information the register contains. The default label for each register is typically the same as its name.

You can change the label via communications to be more descriptive for your application. For example, the name (and thus the default label) of the Maximum module's output register is *Maximum*. If you are using that particular module to record maximum values on Vunbal, you may want to change the "Maximum" label to "Max Vunbal" to make it more apparent what the contents of the register represent. The length of the label is limited to 15 characters.

Timing Considerations in the 7700 ION

The standard, high-accuracy update rate of the modules in the 7700 ION is 1 second. Many modules can also be configured to operate as high-speed, and as such are updated every cycle. When programming, or linking ION modules, it is important to keep in mind whether you want the framework you are creating to be a high-speed or high-accuracy framework. If you link three modules together to perform a function, the update rate of the first module in the framework defines the speed of the whole framework. For example, if you link:

Power Meter (high-speed) ⇒ Maximum ⇒ Recorder

the whole framework will operate at high-speed (1 cycle update rate), including the Maximum and Recorder modules. If you used an Analog input module (which all have a 1 second update rate) instead of the high-speed Power Meter module, the framework would operate as high-accuracy (1 second update rate).

In most cases, the number of high-speed-capable modules is limited so you should only use them when necessary.



NOTE

The modules that have time-sensitive setup registers include:

- Setpoint
- Relative Setpoint
- Periodic Timer
- One-shot Timer
- Digital Input
- Digital Output
- Pulse

In addition, both the Sliding Window Demand module and the Thermal Demand module have definable time intervals.

Time-Sensitive Modules

Many modules in the 7700 ION have setup registers requiring you to specify a time interval. Typically, these registers are specified in seconds and you can enter any value that is within the allowable range. Due to the update rate of the module however, the time that you specify cannot always be supported. If you specify a time that is shorter than the update rate of the module (or falls in-between update cycles), the module will round up to the shortest time possible.

For high-accuracy modules, it is advisable to specify time values in the various setup registers in multiples of the update rate.

For high-speed modules, it is still advisable to restrict your time values to multiples of the update rate (e.g. one cycle, two cycles, three cycles, etc.); however, because you are required to specify time in milliseconds, these modules should be addressed slightly differently.

Since the frequency of the system defines how many milliseconds there are in a cycle, and the frequency of the system can drift slightly, specifying an exact number of milliseconds may not always correspond with the number of cycles you expect. For example, if you specify a value in milliseconds that exactly corresponds to three cycles, your event may sometimes occur every three cycles and sometime every four if there has been any drift.

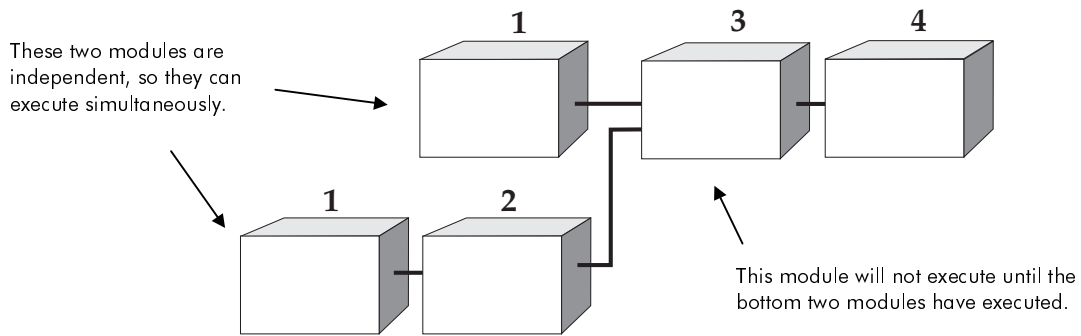
You can take advantage of the fact that some modules always round time values up to the closest update rate they can support to ensure that your time value results in the number of cycles you want. For example, in a 60 Hz system, if you specify 13 instead of 16.67 milliseconds, the module will automatically update every cycle, even if the frequency has drifted and the number of milliseconds in a cycle has changed to 15.

Sequence of Module Execution

ION modules are executed in the order in which they are logically linked, rather than the order in which you actually linked them. In other words, modules are executed in the same order in which the data flows from one module to the next.

This allows you to create a framework by linking modules in any order you want and maintain a logical execution order. For example, you can link the Data Recorder, the Maximum and the Thermal Demand modules together first, and then later link them to the Power Meter module. It does not affect the execution order; the Power Meter module will still execute first.

In more complex frameworks, the relationship between modules may not be as linear as in the previous examples. In these cases, modules are still executed in the order of information flow but some modules may be executed simultaneously if they do not depend on each other for data. For example:



Note that execution order and update rate are not the same thing. Update rate refers to how frequently a module performs its operation and updates its output registers (every second for high accuracy, every cycle for high speed). Execution order refers to the order in which modules execute *within* the update period. For example, if the framework above were high-speed, the entire process would execute within the 1 cycle update period; it would not take 4 cycles to execute.

ION Event Priority Groups

Events produced by the various ION modules are prioritized and grouped to facilitate custom logging. Each event has a priority group number assigned to it, based on its type and severity. There are 8 event priority groups in total, as shown in the table below.

Event Group	Description	Priority Number
Reset	Module reset or resynchronized	5
Setup Change	Module setup changes (setup register changes, label changes, input handle changes)	10
Input Register Change	Inputs of certain modules change value (i.e. input to And/Or module changes)	15
I/O State Change	I/O state changes (i.e. relay closes)	20
Information	Module produces important user information	25
Warning	Module produces a warning	30
Failure	A failure has occurred	255
Setpoint	Setpoint condition goes Active or Inactive (i.e. 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 Chapter 5 for more details.

External ION events

Some events are not produced by a specific module; they are generated internally by the 7700 ION. These events and their associated priority levels are shown in the table below.

Event Group	Description	Priority Number
Warning	Factory initialize performed	30
	Firmware upgrade performed	
	Memory upgrade performed	
	Device power-up	
	Device power-down	
Failure	Communications fail to allocate required memory	255

Dismantling the Factory Configuration

The 7700 ION's factory configuration uses approximately 90% of the available processing power. Any additions you make to the device's configuration will increase this number. (The processor power used cannot exceed 100%.)

You can add some functionality to the factory configuration without exceeding 100% processor power. By monitoring the impact each change has on the processor's capacity you can determine whether or not the change can be implemented without removing some existing functionality. If frameworks you are adding exceed 100% of available processor power, you will be prevented from saving them in the device (ION Designer or PowerView will report an error and you will not be able to download the framework).

If you want to make large additions, or additions that use high-speed modules, you will need to dismantle some of the factory configuration to free up processing power first.

Checking the Processor Power Level

The 7700 ION's Diagnostics module contains an output labeled Prc Pwr Used. The output reports the amount of processor power being used by the device's configuration.

To monitor processor power, add a numeric object to a Vista diagram, and link it to the Prc Pwr Used output register of the Diagnostics module. Each time you download a change you make in ION Designer, check the value of the Prc Pwr Used register in Vista. (Refer to the *ION Designer Online Help* for instructions on adding objects to Vista diagrams.)



NOTE

You can also view the value in an output register using ION Designer software. Hold down the Shift key and left-click on the module's output.

Deleting Factory-Configured Functions

If the additions you want to make exceed 100% processor power, you must delete some existing functionality before you can implement your custom framework. The simplest way to free processor resources is to delete the sections of the factory configuration that you are not using. The frameworks in the factory configuration and the amount of processing power each uses is shown in the following table.

Framework or Function	Processor Load (percent)
Minimum/Maximum	1.24
Historic Data Logging	5.05
Energy & Demand Logging	2.77 (7.44 for Revenue Meters)
Harmonics Logging	2.69
Power Quality Monitoring	43.61
Setpoints	0.35
Status Inputs	0.24
Modbus Configuration	3.12
<i>7700 ION Base Operating Load</i>	<i>30.00</i>
Total	89.07% (93.74% for Revenue Meters)

The table above shows that most of the frameworks in the factory configuration have a relatively small impact on the overall processor load (with the obvious exception of Power Quality Monitoring). If you do not make use of one of the factory-configured frameworks, consider deleting it to free up processor resource.

NOTE

Before deleting a framework, select it and choose Copy to Framework in ION Designer. Give it a unique name, and click OK to save it. This way you can restore the framework without having to reinitialize the factory configuration.

To delete a specific framework (other than the Modbus Configuration), double-click the Advanced Configuration folder on the main 7700 ION Configuration screen. Nine folders appear on the screen, covering eight of the nine frameworks shown in the table above. Select the folder containing the framework and press the Delete key on your keyboard. A dialog box appears showing you which modules will be deleted — click OK to remove the modules in the selected framework.

To delete the Modbus Configuration, select its folder on the main 7700 ION Configuration screen and press Delete on your keyboard. Press OK on the confirmation dialog box to remove the Modbus Configuration.

Restoring the Factory Configuration

The factory configuration can be reinitialized in the 7700 ION through ION Designer. The basic setup of the device can be retained, so the 7700 ION does not need to be taken out of service for a long period of time. Follow this procedure to restore the factory configuration (any custom features you created will be destroyed):

1. Display the main 7700 ION Configuration screen in ION 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). Press OK on the confirmation dialog box.

After a brief wait the modules are deleted, and the main 7700 ION Configuration screen is blank except for the Advanced Configuration folder (the Advanced folder contains the core modules which cannot be deleted).

3. Choose Select All from the Edit menu to select the Advanced Configuration folder (this also selects all folders and modules within the folder).
4. Choose Paste from Framework in the Edit menu, and select the file **7700_v20_default.fwn** from the `\PEGASYS\2.0\Config\fmwk\nd\` folder. Click OK. Click OK on the confirmation dialog box. A message appears indicating that ION Designer is pasting modules.
5. All modules are selected when the paste is complete. Click anywhere in the background of the node diagram to deselect all of the modules. Click the Power Meter shortcut in the Basic Configuration box to select it.
6. With the Power Meter module shortcut selected, click the Reset button in the ION 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). Choose Send & Save from the File menu. The factory configuration is now restored (any custom functionality you created is removed).

Adding and Linking Modules in ION Designer

In most cases you will only need to change the settings in an existing module's setup registers to achieve the functionality you want. Refer to "Configuring the 7700 ION with ION Designer" in Chapter 3 for information on this type of configuration change.

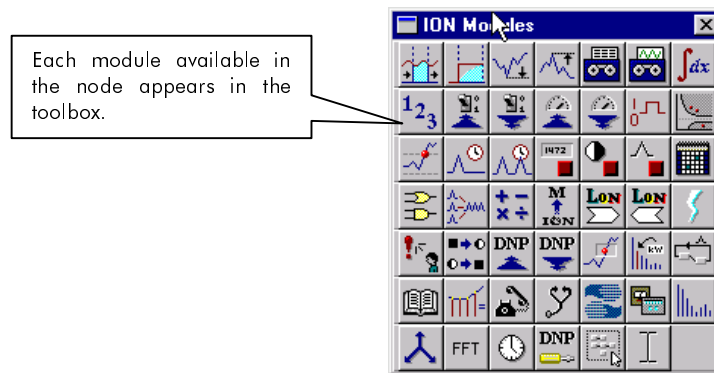
If you need to customize your meter's operation, you will need to create new ION modules, configure their settings, and in some cases link them to other modules. ION Designer provides a graphical view of your meter's internal operation, making these tasks simple. The basic functions of ION Designer are described in the next few paragraphs. Refer to the *ION Reference* for more information on ION Designer, or refer to the *ION Designer On-Line Help* for complete usage details.

Creating New Modules

To add a module, locate its icon in the ION 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 is added to the diagram and can be configured and linked.

Choosing the Module

The ION Designer toolbox displays icons for all of the modules available in the 7700 ION. If the toolbox is not displayed, choose Show Toolbox from the Options menu, and the toolbox appears:



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

Creating the Module

Follow these steps to create an ION module in the 7700 ION:

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, ION Designer places a *pending* module icon into the diagram (pending modules appear with a dashed outline).
3. Once you have configured the node as appropriate, choose Send & Save from the File menu to download the configuration to the node. Once the module has been saved in the node, the dashed outline is replaced with a solid outline, indicating that your changes have been saved.

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. ION Designer will inform you of dependant modules if they exist on the same node.

NOTE

Once you have created a module you may have to adjust its setup registers. Chapter 5 shows the setup register defaults a module will contain when it is initially created, as well as the ranges or options each setup register supports. If you have to change a setting, refer to “Configuring the 7700 ION with ION Designer” in Chapter 3 for instructions.



Linking Modules

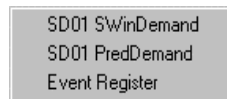
Module linking involves clicking on one module's output register symbol, choosing the output register you want to link, then clicking the input of a second module and selecting the input to link to. This operation can be performed in reverse – you can start with one module's input and link to another 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 a meter to a software node. You cannot link modules between meters. The paragraphs below describe how to link modules that reside on the same node. Refer to the *ION Reference* or the *ION Designer On-Line Help* for instructions if you want to link modules that reside on different nodes.

Follow the steps below to link modules on the 7700 ION:



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



or

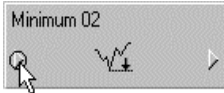



2. Click on the register you want to select. In the case of the dialog box, double-click on an output register, or choose the register and click Select.
3. Drag the cursor towards the module you want to link to; the cursor will change and a dotted line will follow it across the node diagram. This indicates 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.

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



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 will disappear, but the cursor will still indicate that a link is in progress.



4. Click on the  symbol on the **left** side of the module icon to display the module's inputs. In most cases, a pop-up menu will appear listing the module's inputs. (If there are a large number of inputs, a dialog box similar to the More Output Registers dialog will appear instead.) Inputs that are of 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 label of the register it is linked to is displayed beside the input. If you select the input, the existing link will be overwritten.

5. Choose the input you want from the pop-up or dialog box.
6. If the two modules are in the same window, the dotted line remains on the screen to show the link between the modules. When you save this change to the node, the line will change 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 ION and the 7700 ION's configuration, you can make changes to the existing frameworks to customize operation. Any edits you make to the existing frameworks will alter the device's operation — be sure you understand what effect your changes will have before proceeding.

Chapter 2 includes a table that lists all of the parameters and functions provided in the 7700 ION factory configuration. This table shows the module and output register that holds each parameter. If you want to delete or change a parameter, use this table to determine which module and which output register provides the data, then check which other modules the output register is linked to (described below).

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.

Checking an Output Register's "Owner"

Using ION 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.

Deleting the Link at a Module's Input

You can also check the links at a module's input. Using ION 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 will be overwritten.

Using Onboard and Expansion I/O

The 7700 ION is available with numerous I/O options. The standard configuration includes eight onboard status inputs. Four onboard analog inputs and two expansion boards, each with up to 15 I/O modules, are available as ordering options.

Onboard Status Inputs

The eight onboard status inputs 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. These inputs can be used for dry contact sensing, but not for voltage sensing.



NOTE

The onboard status inputs cannot be used for voltage sensing applications.

The function of each status input is controlled by the Digital Input modules 1 through 8. These modules are preconfigured at the factory, together with eight Counter modules for counting status changes, and an External Pulse module for resetting the Counter modules.

Once you have connected the status inputs to the field equipment that they monitor, check the 7700 ION's Digital Input modules to ensure they are configured appropriately. The eight Digital Input modules are factory configured as follows (refer to the *ION Reference* for complete details on module function):

Setup Register	Factory Setting
Input Mode	Pulse (complete pulse as opposed to KYZ transition pulse)
Event Log Mode	Log Off (status changes are not logged)
Polarity	Inverting (hardware signal is inverted)
Debounce	0.010 (mechanical contact bounce, in seconds)
Port	STATUS1 to STATUS8 (specifies which hardware port the module controls)

Auxiliary Analog Inputs

The 7700 ION can be ordered with an optional analog input board that provides four double-ended voltage or current inputs for direct interface with transducers. The configuration and maximum input range depends on the option ordered. The options are as follows:

Option	Input Impedance	Max Common Mode Voltage
0 – 1 mA	49.9 Ω	8 V
0 – 20 mA	100 Ω	20 V
0 – 1 V	≥ 50 k Ω	12 V
0 – 10 V	≥ 50 k Ω	25 V

Note that each of the four analog inputs can be configured to monitor AC or DC signals; however, all four inputs must be configured with the same input rating. In other words, if you ordered the AUX 20mA option, all four inputs must be configured as 0-20mA but some can be AC and some can be DC.

ION Analog Input modules control the function of each analog input. As the analog input board is optional, no Analog Input modules are included in the 7700 ION's factory configuration. Refer to page 4–11 for instructions on adding an ION module to the 7700 ION.

Analog Input modules are configured by selecting the port they monitor, and setting the scaling values used to normalize the incoming signal. Once configured, you can link the output of the Analog Input module to any other module that accepts numeric data.

I/O Expansion Boards



Do not use digital output modules on I/O Expansion Board B for control applications. False triggers may result when supply power to the board is lost.

Contact Power Measurement Customer Service for assistance if you want to use digital output modules on I/O Expansion Board B for control purposes.

The external input and output capabilities of the 7700 ION can be expanded using up to two plug-in I/O expansion boards. Each expansion board can provide multiple analog inputs, analog outputs, digital inputs, and/or digital outputs. A list of the I/O devices supported by the 7700 ION is available in Appendix A under the section "Ordering Options".

The functions of the I/O devices are controlled by Analog Input, Analog Output, Digital Input, Digital Output, and Pulser modules. Refer to page 4–11 for instructions on adding modules to the 7700 ION using ION Designer software.



NOTE

The Analog Input module's icon in the ION Designer toolbox looks like this:

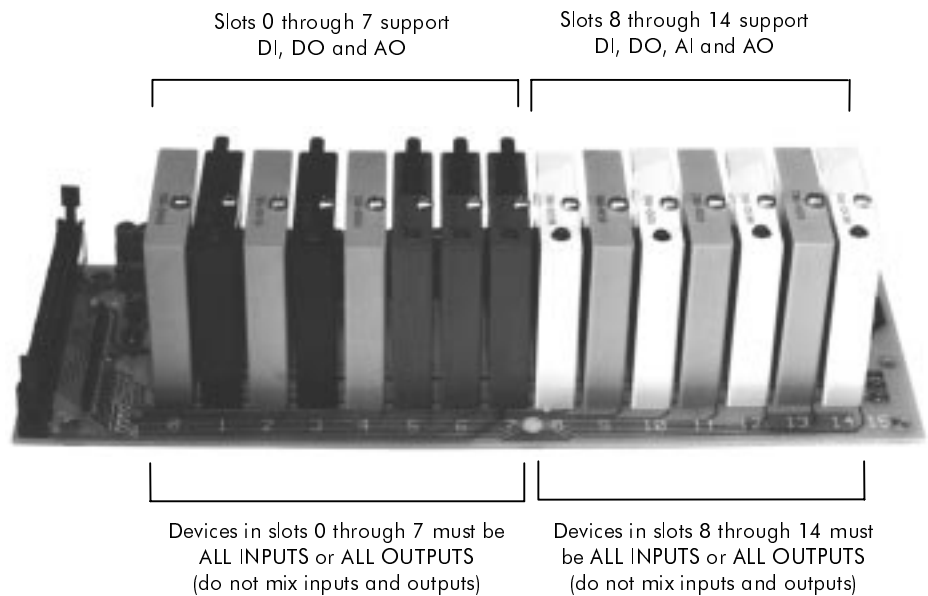


The Input and Output modules are configured by specifying the port they use to send or receive signals (see page 4–19), and configuring other settings specific to the type of operation they perform. Refer to the *ION Reference* for complete details on the function of each module type.

NOTE

Slots are numbered on the expansion boards. Note that slots 0–7 do not support analog input devices, and slot 15 is not used.

Each expansion board offers 15 slots you can plug I/O devices into. Slots 0 through 7 support digital input, digital output and analog output devices only (analog input devices are not supported). Slots 8 through 14 support digital input, digital output, analog input and analog output devices. Slot 15 is not supported. Other restrictions apply to the use of analog I/O devices, as discussed below.



Analog Device Restrictions — Power Supplies

Power requirements and hardware restrictions limit the number and placement of analog devices on I/O expansion boards.

The allowable number of analog devices the 7700 ION can support increases significantly when two external power supplies are used to power the expansion boards. The default configuration of Expansion Board A does not include a power supply; it has to be purchased separately. If Expansion Board A is powered directly from the 7700 ION, then a maximum of six analog devices can be installed on it. (A separate power supply is required for Expansion Board B in any configuration.)

To use the maximum number of analog I/O devices, two power supplies must be used (one for each expansion board). Note that if a separate power supply is used with Expansion Board A, then the jumper must be removed from the board. Failure to remove the jumper will void the 7700 ION's warranty. (Refer to the *7700 ION Installation & Basic Setup Instructions* for jumper location.)

Analog Device Restrictions – Direction (Input or Output)

The direction of all of the devices in slots 0 through 7 and slots 8 through 14 must be the same. You cannot mix inputs and outputs within these two groups of slots; however, you can have all inputs in slots 0 through 7, and all outputs in slots 8 through 14 (or vice versa).

As noted on the graphic above, only slots 8 through 14 support analog input devices, thereby limiting the maximum number of these devices to seven per board. Analog Output devices can populate both slot groups on the expansion board, so a maximum of 15 of these devices can be used per board.

If Expansion Board A is used without a separate power supply, only six analog devices can be used in total, regardless of direction restrictions.

The following table summarizes the restrictions on analog I/O devices.

	Max # of Analog Inputs	Max # of Analog Outputs	Max # of Analog Devices	Possible Maximum Configurations
Board A WITHOUT Optional Power Supply (default configuration)	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 (default configuration) + 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

Specifying a Port in an ION Module

The Analog Output, Digital Output and Pulser modules in the 7700 ION allow you to specify which port a signal is sent to. Similarly, the Analog Input and Digital Input modules allow you to specify which port to monitor for incoming signals.

When you access any of these module's Port setup register, all expansion board ports will be available selections, even if there is no expansion board connected to the 7700 ION. The AUX inputs will only appear in Port setup registers if the optional analog input card is installed. The following tables indicate what ports selections are available with the different 7700 ION I/O options.

Expansion Board A	Expansion Board B	Status Inputs	Aux Analog Inputs
Port A-0	Port B-0	STATUS1	AUX1/optionalDC
Port A-1	Port B-1	STATUS2	AUX1/optionalAC
Port A-2	Port B-2	STATUS3	AUX2/optionalDC
Port A-3	Port B-3	STATUS4	AUX2/optionalAC
Port A-4	Port B-4	STATUS5	AUX3/optionalDC
Port A-5	Port B-5	STATUS6	AUX3/optionalAC
Port A-6	Port B-6	STATUS7	AUX4/optionalDC
Port A-7	Port B-7	STATUS8	AUX4/optionalAC
Port A-8	Port B-8		
Port A-9	Port B-9		
Port A-10	Port B-10		
Port A-11	Port B-11		
Port A-12	Port B-12		
Port A-13	Port B-13		
Port A-14	Port B-14		

Auxiliary analog input options include 0-20mA, 0-1mA, 0-1V and 0-10V

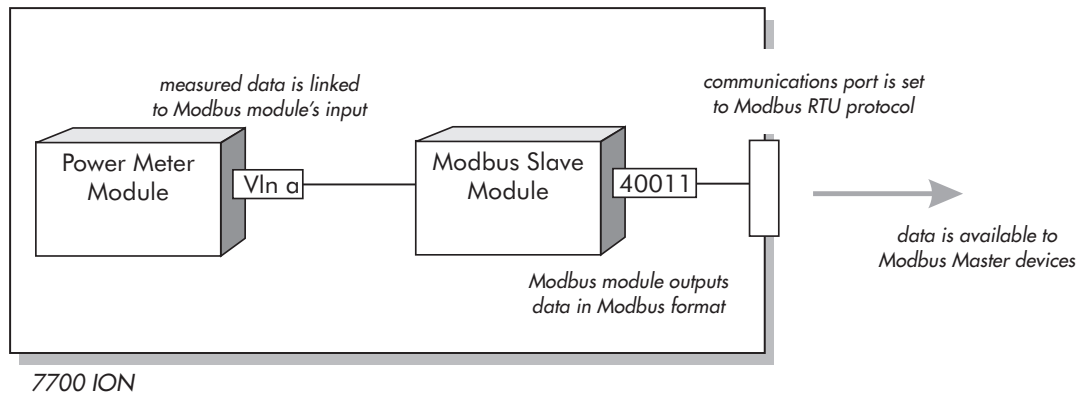
Note that ION module setup registers will only display the ports that are not yet assigned. As the 7700 ION's factory configuration makes use of all eight status inputs, STATUS1 through STATUS8 will not appear in new Digital Input modules you create. To make a STATUS port available, set the Port setup register to NOT USED in one of the factory-configured Digital Input modules.

Using the Modbus RTU Protocol

The 7700 ION can make any real-time data available through the Modicon Modbus RTU protocol. Modbus Master devices connected to the 7700 ION can access this data. Modbus Master devices can also write data into ION registers, making device configuration changes or initializing control actions.

The 7700 ION's Factory Modbus Configuration

The 7700 ION makes data available to Modbus Master devices using four Modbus Slave modules. These modules are linked to other modules in the 7700 ION that provide the energy, power and demand data. Once a communications channel is configured to use Modbus RTU protocol (refer to “Communications Setup” in Chapter 2), the data is available to Modbus Master devices.



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 7700 ION are required to interpret the data provided.

NOTE

Refer to the document:

7700 ION / Modicon Modbus
Serial Communications
Protocol and ION / Modbus
Register Map

for complete details on the
Modbus implementation in the
7700 ION.

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. There are only four Modbus Slave modules available in the 7700 ION, so you will have to delete some of the preconfigured links if you want to make other parameters available to Modbus Master devices.

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 *ION Reference* for complete details on Modbus Slave module function.

Modbus Slave Module Settings

The settings in the Modbus Slave module setup registers are shown in the tables below. Refer to the Modbus Slave module description in the ION Reference for complete details of each setup register's function and options.

Refer to 7700 ION/Modicon Modbus Serial Communications Protocol and ION/Modbus Register Map document for additional details on the Modbus implementation on the 7700 ION.

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 Module Parameter Mapping

The following tables show which measurements are provided by each of the four 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).

Modbus Slave Module #1 Links

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

Modbus Slave Module #2 Links

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	40027-40028
Phase B kW	kW b	Power Meter	Modbus Slave #2 – Source Input #2	40029-40030
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
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

Modbus Slave Module #3 Links

Measurement	Label	Source ION Module	Modbus Module and Input Number	Modbus Register
Maximum Avg L-L Voltage	Vll avg max	Maximum	Modbus Slave #3 – Source Input #1	40059-40060
Maximum Average Current	I avg max	Maximum	Modbus Slave #3 – Source Input #2	40061-40062
Maximum Total kW	kW tot max	Maximum	Modbus Slave #3 – Source Input #3	40063-40064
Maximum Total kVAR	kVAR tot max	Maximum	Modbus Slave #3 – Source Input #4	40065-40066
Maximum Total kVA	kVA tot max	Maximum	Modbus Slave #3 – Source Input #5	40067-40068
Maximum Line Frequency	Freq max	Maximum	Modbus Slave #3 – Source Input #6	40069-40070
Minimum Avg L-L Voltage	Vll avg min	Minimum	Modbus Slave #3 – Source Input #7	40071-40072
Minimum Average Current	I avg min	Minimum	Modbus Slave #3 – Source Input #8	40073-40074
Minimum Line Frequency	Freq min	Minimum	Modbus Slave #3 – Source Input #9	40075-40076
kW Sliding Window Demand	kW swd	Sliding Win Demand	Modbus Slave #3 – Source Input #10	40077-40078
kVA Sliding Window Demand	kVA swd	Sliding Win Demand	Modbus Slave #3 – Source Input #11	40079-40080
kVAR Sliding Window Demand	kVAR swd	Sliding Win Demand	Modbus Slave #3 – Source Input #12	40081-40082
Maximum kW SW Demand	kW swd max	Maximum	Modbus Slave #3 – Source Input #13	40083-40084
Maximum kVA SW Demand	kVA swd max	Maximum	Modbus Slave #3 – Source Input #14	40085-40086
Maximum kVAR SW Demand	kVAR td max	Maximum	Modbus Slave #3 – Source Input #15	40087-40088

Modbus Slave Module #4 Links

Measurement	Label	Source ION Module	Modbus Module and Input Number	Modbus Register
Imported kWh	kWh imp	Integrator	Modbus Slave #4 – Source Input #1	40089-40090
Exported kWh	kWh exp	Integrator	Modbus Slave #4 – Source Input #2	40091-40092
Total kWh	kWh tot	Integrator	Modbus Slave #4 – Source Input #3	40093-40094
Net kWh	kWh net	Integrator	Modbus Slave #4 – Source Input #4	40095-40096
Imported kVARh	kVARh imp	Integrator	Modbus Slave #4 – Source Input #5	40097-40098
Exported kVARh	kVARh exp	Integrator	Modbus Slave #4 – Source Input #6	40099-40100
Total kVARh	kVARh tot	Integrator	Modbus Slave #4 – Source Input #7	40101-40102
Net kVARh	kVARh net	Integrator	Modbus Slave #4 – Source Input #8	40103-40104
Total kVAh	kVAh	Integrator	Modbus Slave #4 – Source Input #9	40105-40106
Max Phase A Voltage THD	V1 THD max	Maximum	Modbus Slave #4 – Source Input #10	40107-40108
Max Phase B Voltage THD	V2 THD max	Maximum	Modbus Slave #4 – Source Input #11	40109-40110
Max Phase C Voltage THD	V3 THD max	Maximum	Modbus Slave #4 – Source Input #12	40111-40112
Max Phase A Current THD	I1 THD max	Maximum	Modbus Slave #4 – Source Input #13	40113-40114
Max Phase B Current THD	I2 THD max	Maximum	Modbus Slave #4 – Source Input #14	40115-40116
Max Phase C Current THD	I3 THD max	Maximum	Modbus Slave #4 – Source Input #15	40117-40118

Importing Data using Modbus RTU

It is possible to bring data into the 7700 ION 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 7700 ION.

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 7700 ION functions. You can also use the Modbus protocol to change setup register values in various ION modules to configure the 7700 ION's operation.

All of the information required to write to ION registers through Modbus is available in *7700 ION/Modicon Modbus Serial Communications Protocol and ION/Modbus Register Map*, available on the PEGASYS distribution CD, or by request from Power Measurement.

Using the DNP 3.0 Protocol

NOTE

Complete DNP documentation is available through the DNP User's Group (on the web at www.dnp.org).

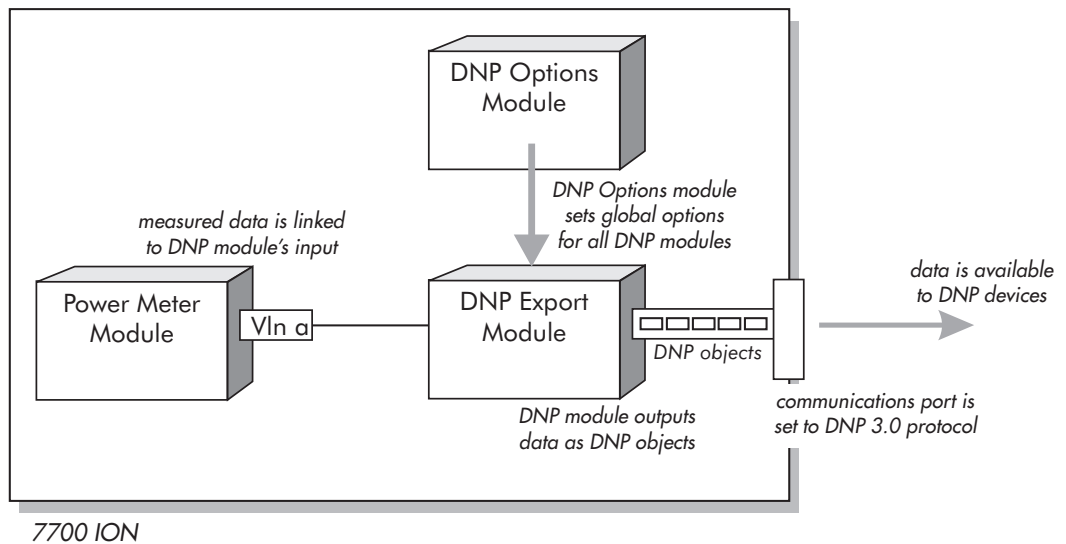
This documentation describes DNP 3.0 Transport Functions, the Application Layer Protocol, the Data Object Library, Subset Definitions, and the Data Link Layer Protocol Description.

The Distributed Network Protocol Version 3.0 (DNP 3.0) is an open protocol used in the electric utility industry for communications and interoperability among substation computers, RTUs, IEDs, and Master Stations. The 7700 ION can be integrated into a DNP network using the DNP Slave Import, Export and Options modules.

The 7700 ION's Factory DNP 3.0 Configuration

The 7700 ION's factory configuration makes various parameters available through DNP 3.0. There is no factory-configured functionality for importing DNP 3.0 data into the 7700 ION.

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 7700 ION communications port that is configured to use the DNP 3.0 protocol. The DNP Options module sets global options for all of the DNP Slave Export modules.



Changing the DNP Configuration

If the factory DNP configuration does not suit your needs, the existing DNP Slave Export modules can be relinked to other parameters that you want to access 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 7700 ION; of these, 14 are used by the factory configuration.



NOTE

DNP 3.0 can only be used on the XPRESS CARD's RS-485 ports (COM 1 and Ethernet ports are not supported).

Only one port per 7700 ION can be used with DNP 3.0.

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 *ION Reference* for complete details on DNP Slave Export and DNP Options module function.

As DNP 3.0 is a very complex protocol, an in-depth understanding of DNP 3.0 is required to interpret the settings in the DNP Options module and the DNP Slave Export modules. It is beyond the scope of this guide to describe DNP; consult the DNP User's Group or other resources to learn more about the protocol.

DNP Slave Export Module Settings

The 14 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 <i>Analog Input</i> ; three are <i>Binary Counter</i>
EventObj	Disable Event Objects
Deadband	0
FrozStaObj	Disable Frozen Static Objects
FrozEvtObj	Disable Frozen Event Objects
EventClass	Class 1
Scaling	OFF (excluding <i>Unbalx10</i> and <i>Freqx10</i> which are ON)
IONZero	0
IONFull	0 (1000 for <i>Unbalx10</i> and 100 for <i>Freqx10</i>)
DNPZero	0
DNPFull	0 (10000 for <i>Unbalx10</i> and 1000 for <i>Freqx10</i>)

As the table indicates, some of the setup register settings vary for different modules. Specifically, BasePoint will be different 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. (StatObj 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 3.0

Data can be imported into the 7700 ION 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 *ION Reference* for details.

Using Power Measurement's EtherGate Protocol

The EtherGate protocol can be used on one or more of the XPRESS CARD's RS-485 ports, in place of ION, Modbus RTU or DNP 3.0 protocols. The EtherGate protocol allows the 7700 ION to act as a gateway, transferring data directly between Ethernet and RS-485 networks.

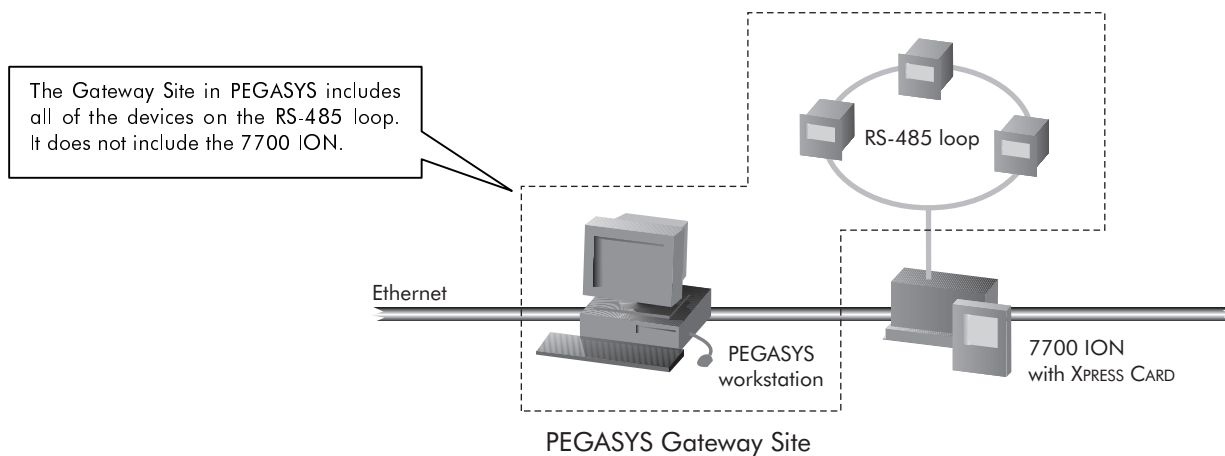
There are three ways EtherGate can be used to transfer data between networks. Using the IP Address of the 7700 ION, one of three IP Service Port numbers (sockets) can be used to direct the flow of data as follows:

- ◆ If the IP Service Port is set to 7800, Ethernet data is transferred to both XPRESS CARD RS-485 ports.
- ◆ If the IP Service Port is set to 7802, Ethernet data is transferred to the XPRESS CARD'S COM 2 RS-485 port only.
- ◆ If the IP Service Port is set to 7803, Ethernet data is transferred to the XPRESS CARD'S COM 3 RS-485 port only.

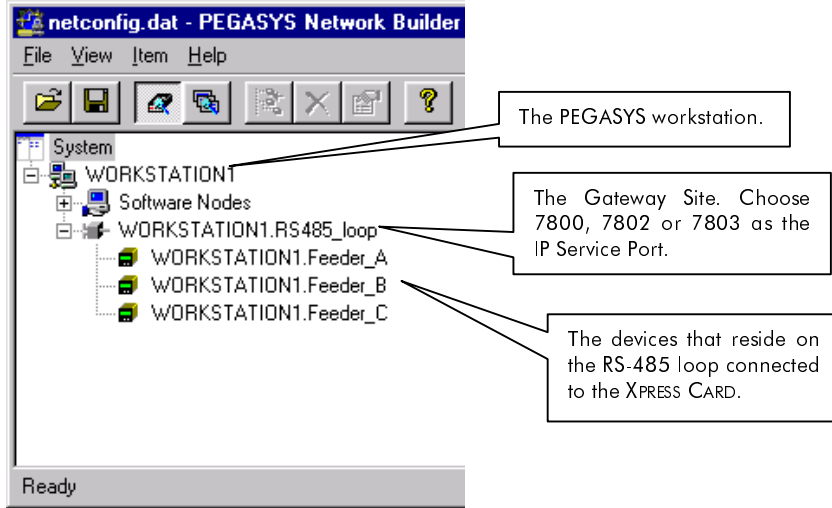
Communicating *Through* the 7700 ION

In the basic EtherGate configuration, your PEGASYS workstation connects to the XPRESS CARD's Ethernet port, and an RS-485 loop of devices connects to the XPRESS CARD's COM2 or COM3 RS-485 port (or both, if you have two RS-485 loops). You then add a Gateway Site in PEGASYS Network Builder, and add all of the devices on the RS-485 loop to this site.

In this configuration you communicate with the RS-485 loop *through* the 7700 ION (the 7700 ION acts as the gateway). You cannot communicate directly with the 7700 ION, unless you add an additional Ethernet Site, as discussed in the next section.

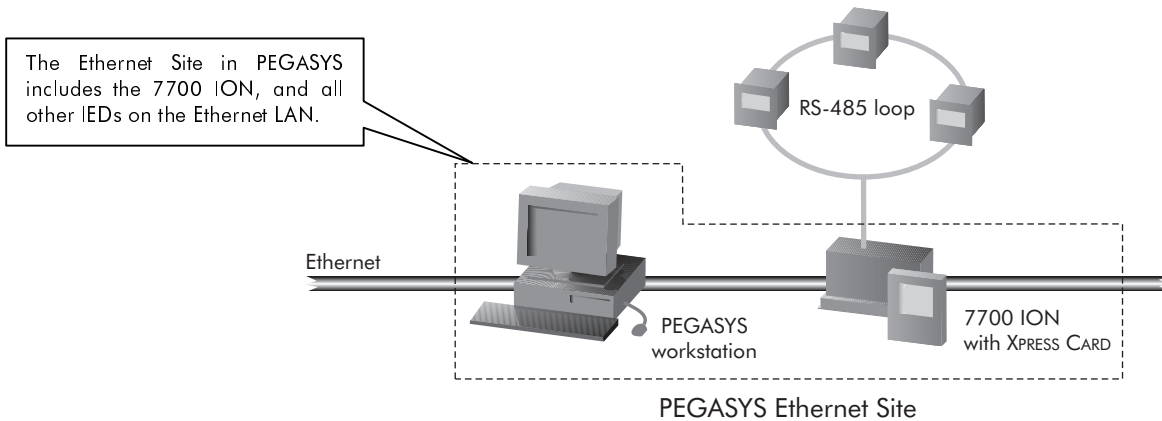


The Gateway Site in PEGASYS Network Builder is added under the PEGASYS workstation that resides on the Ethernet network. Each of the devices on the RS-485 loop is added to the Gateway Site, but the 7700 ION is not. The tree view in Network Builder looks like this:

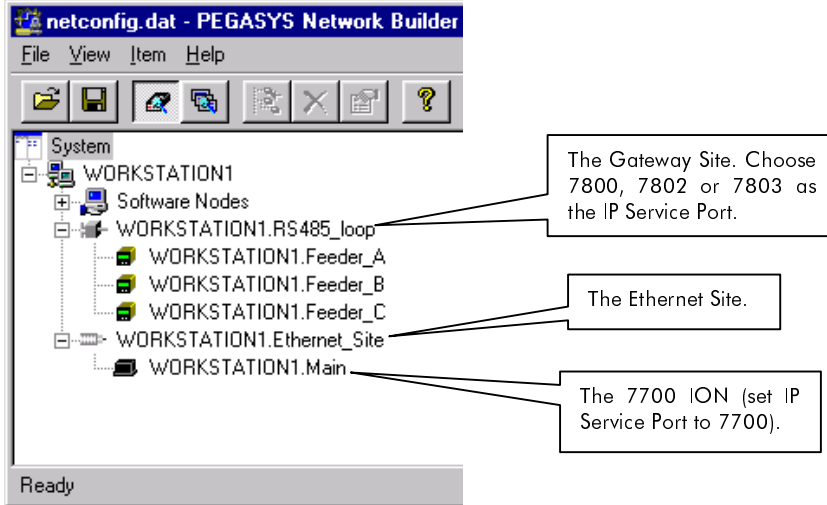


Communicating *To* the 7700 ION

You can also configure your system to communicate directly with the 7700 ION in addition to communicating with the attached RS-485 loop. This requires both a Gateway Site as described above, and an Ethernet Site configuration in Network Builder. The Ethernet Site includes the 7700 ION with the XPRESS CARD, and all other IEDs connected to the Ethernet network.



The Ethernet Site is added under the PEGASYS workstation that resides on the Ethernet network. The tree view in Network Builder, with both the Gateway Site and the Ethernet Site configured, looks like this:



You must enter an IP Address and an IP Service Port number (socket) when you add the 7700 ION to an Ethernet Site in Network Builder. The IP Service Port must always be '7700' for a 7700 ION in an Ethernet Site.

Specifying the Protocol and the IP Port Number

Each XPRESS CARD RS-485 port that you use as an Ethernet gateway must be configured to use the EtherGate protocol. The Ethernet network and the RS-485 loops on either side of the gateway may use ION or Modbus, but the RS-485 ports on the XPRESS CARD must be set to EtherGate for them to function as gateways. Edit the Protocol setup register in either of the 7700 ION's Comm 2 and Comm 3 modules (or both if you are using both RS-485 ports as gateways) and select ETHERGATE from the list of protocols.

You must enter an IP Service Port number when adding a Gateway Site. Use '7800' to transfer data to both COM 2 and COM 3; use '7802' to transfer data to COM 2 only; or use '7803' to transfer data to COM 3 only.

If you use EtherGate on both XPRESS CARD RS-485 ports, note that Unit ID values assigned to the IEDs must be unique across both networks.

Using the 7700 ION in LonWorks Networks

The 7700 ION offers an optional LonWorks port and supporting LonWorks Import and Export ION modules. As of 7700 ION version 7700V200, LonWorks support is released as a BETA product — technical support is limited.

Data can be imported into the 7700 ION or exported onto the LonWorks network using LonWorks Import and LonWorks Export modules. No LonWorks modules are included in the 7700 ION's factory configuration.

PEGASYS Configuration Updates are Not Required

You do not have to update your PEGASYS configuration in Network Builder to use the LonWorks port. The LonWorks port on the 7700 ION is part of a LonWorks network — it is not part of the PEGASYS network.

Configuring the LonWorks Port

There are three steps to configuring the XPRESS CARD's LonWorks port:

1. Physically connect the port to the network.
2. Configure LonWorks Import and LonWorks Export ION modules to map ION data into LonWorks data, and vice versa.
3. Configure the port as a node on the LonWorks network, using third-party network installation and management tools.



NOTE

Different LonWorks network installation and management tools are available, each with their own configuration procedures. Refer to the documentation for the network tools you are using.

Refer to the *ION Reference* for LonWorks Import module and LonWorks Export module functional descriptions.

The Service Pin

The XPRESS CARD has a push-button pin marked SERVICE, adjacent to the LonWorks port, which is used to advise the network installation tool which node is to be installed. A green LED located next to the LonWorks port will light when the SERVICE pin is pushed, and blink to indicate that the node is in an unconfigured state. The LED will stop blinking once the node's network configuration is complete. If the LED remains on after you have finished configuring the LonWorks network, network configuration was either not completed or not performed correctly.

Using Time Synchronization

Time synchronization allows you to synchronize the internal clocks of multiple networked Power Measurement devices. When your devices' clocks are synchronized, all data logs will have timestamps that are relative to a uniform time base. This allows you to perform accurate sequence-of-events and power quality analyses.

Time synchronization is achieved by broadcasting the time across the network of IEDs. When the source of the time broadcast (PEGASYS or a GPS receiver) initially connects to the devices, the time signal is interpreted as the absolute time, and the devices' clocks are reset. During normal operation time signals are sent out periodically, and each 7700 ION will continually assess its ability to remain synchronized with the incoming broadcasts. Over a brief period of time the 7700 ION learns how its internal timing differs from that of the broadcast source, and adjusts its timekeeping to compensate. Very accurate time synchronization can be achieved with this method.

NOTE

If the time on a device is out by one second or more when a time sync signal is received, the device's clock is reset to the broadcast time.

Devices that are not continuously connected to the time source (i.e. modem sites) will be synchronized each time they are connected. The longer the duration between connections, the larger the error in time synchronization can be. In the extreme case this can result in missing or duplicated logs. If this occurs, GPS receivers can be installed at the remote sites, a direct PEGASYS connection can be implemented, or the time between connections can be reduced. As a remote device's clock is reset upon connection if its clock is out of synchronization by one or more seconds, increasing the frequency of connections will typically ensure records are not duplicated or lost.

Time Synchronization Accuracy

Different time sync methods can be used to provide different levels of accuracy. PEGASYS can be used for systems where time synchronization is not critical. In this configuration, each device's clock is synchronized to the time broadcast by the PEGASYS Communications Server workstation. For applications where highly accurate synchronization is required, an additional serial network is installed at the site, and a GPS receiver is used to broadcast the time synchronization signal.

Using PEGASYS as the time source, the 7700 ION's clock can be synchronized to within $\pm 16\text{ms}$ (typical) of other 7700 ION meters in the network. Using a GPS receiver, the 7700 ION can be synchronized to within $\pm 1\text{ms}$ of Universal Time, or within $\pm 2\text{ms}$ (typical) of other 7700 ION devices on the network.

Communications Ports and Protocols Used

 **NOTE**

Time synchronization accuracy cannot be guaranteed on Ethernet networks.

Time synchronization signals from PEGASYS or a GPS receiver are received through the communications ports on the 7700 ION base unit and optional XPRESS CARD. Signals can be received on the device's COM 1 RS-232/RS-485 port, the XPRESS CARD's COM 2 or COM 3 RS-485 ports, or the XPRESS CARD's 10BaseT and 10BaseFL Ethernet ports.

An XPRESS CARD is required if time synchronization from a GPS receiver is implemented (two communications ports are required in this configuration), and COM1 should be used to receive time synchronization signals.

Time synchronization can be achieved using ION and DNP3.0 protocols (note that DNP 3.0 can be used on only one XPRESS CARD port per device). GPS time synchronization uses special protocols defined for the type of GPS receiver you are using.

Configuring the 7700 ION to Interpret Time Synchronization Signals

To implement PEGASYS or GPS time synchronization, use ION Designer or the MGT to configure the Clock module and the Communications or Ethernet module:

- ◆ Specify which port will receive time synchronization signals by setting the Time Sync Source setup register in the 7700 ION's Clock module. Only signals received on the port specified will be used for synchronization.
- ◆ Specify the protocol you want to use by setting the Protocol setup register in the 7700 ION's Communications module (or Ethernet module) for the port that receives the signals.

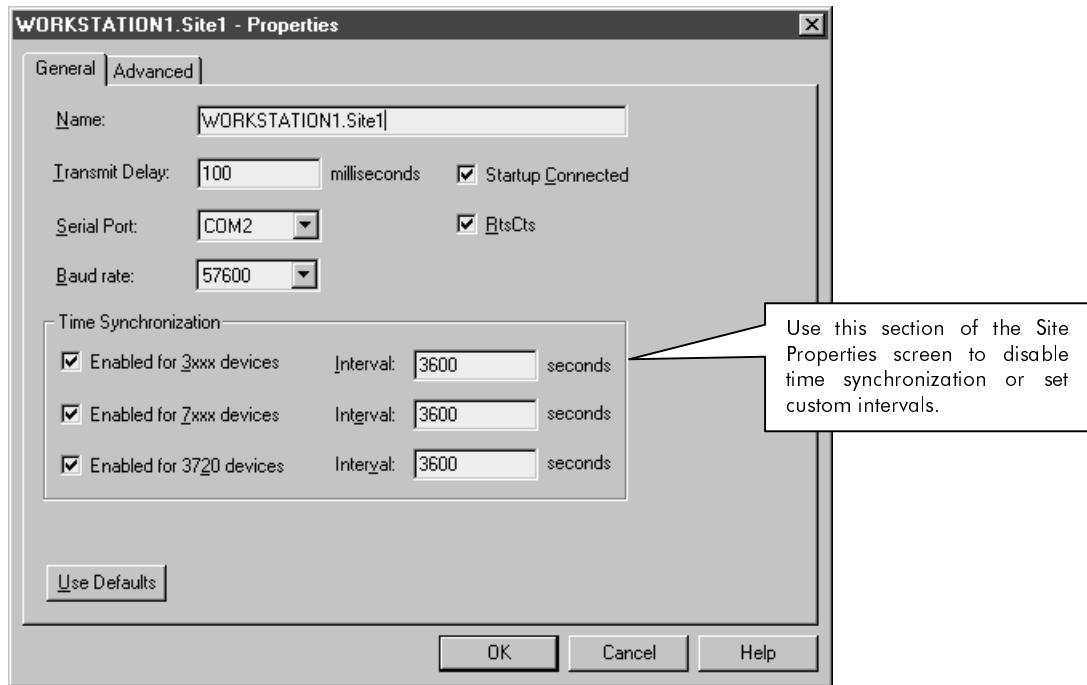
You may need to modify the "Time Sync Type" setup register if a DNP Master is sending time broadcasts in local time.

If you are using PEGASYS as the source for time synchronization signals, set the Communications or Ethernet module's Protocol setup register to ION. If you are using a GPS receiver as the time source, specify the receiver type in the Protocol setup register that matches your receiver. Various GPS receivers are supported by the 7700 ION.

Time Synchronization using PEGASYS

PEGASYS provides time synchronization by default. The communications port and protocol used for communications between PEGASYS and the networked devices is automatically used to send time synchronization signals to all connected Power Measurement devices.

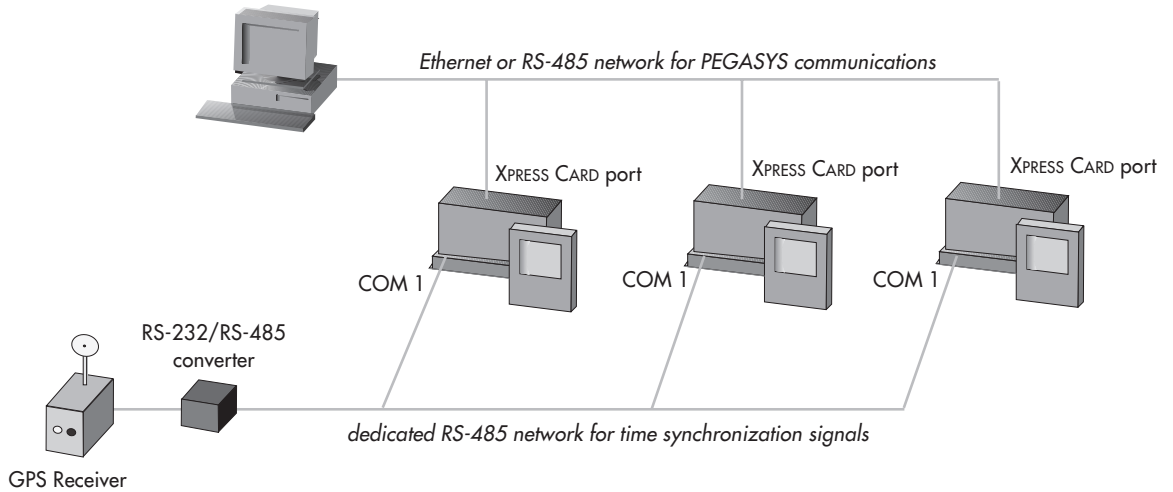
Time synchronization values are set for Power Measurement 3000-series, 7000-series and 3720 ACM power meters when Sites are defined in PEGASYS network. The Site Properties screen in Network Builder lets you disable time synchronization, or set custom intervals for any device type at any Site:



The default time synchronization interval of 3600 seconds is acceptable for most PEGASYS installations.

Time Synchronization using a GPS Receiver

Use GPS receivers at each Site if you require time synchronization of your 7700 ION devices to be within $\pm 1\text{ms}$ of Universal Time. To implement GPS time synchronization, each 7700 ION must be equipped with the optional XPRESS CARD, as two communications links are required at each device. The highest possible accuracy can be achieved using COM 1 to receive time signals; however, COM 2 and COM 3 can be used for time synchronization with slightly less accuracy than COM 1.



Either RS-232 or RS-485 networks can be used for time synchronization, however, RS-485 is recommended if more than two devices are being synchronized. (Ethernet cannot be used for GPS time synchronization.) If your GPS receiver's output is RS-232, use a Power Measurement COM32 or equivalent RS-232/RS-485 converter that does not buffer communications. (The Power Measurement COM128 is not recommended if used in Repeater Mode.)

Supported GPS Receivers

As of 7700 ION V200, the following GPS receivers are supported:

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
Clark and Associates GPS-200-ASCII	GPS:TRUETIME/DATUM

Time Synchronization Diagnostics and Event Logging

The 7700 ION's Diagnostics module includes five output registers that provide time synchronization diagnostics. Refer to the 7700 ION Diagnostics module description in the *ION Reference* for details.

Events are logged by the 7700 ION's Clock module, Communications modules and Diagnostics module in response to time synchronization events. The following events will appear in the PEGASYS 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 — 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 — generated when a time synchronization signal is interpreted as a time set, and the device'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.

Creating Custom MGT Displays

Custom MGT displays can be created showing any data the 7700 ION measures or calculates. To create a custom display, configure one of the buttons adjacent to the MGT's screen and specify the display format and parameters to show on the screen. As the MGT's buttons are factory-configured, an existing display is sacrificed when a custom display is created.

The MGT displays data in 11 different formats: standard character screens, large character screens, four and six-channel bar graphs, harmonics screens, trending screens, integrator screens, and three types of status screens. This section details the 11 different MGT display formats, and shows how each is set up to display specific parameters.

Overview of MGT Button Configuration

To create a custom display, one of the user-configurable buttons is reconfigured. All the user-configurable MGT buttons are set up as follows:

1. Press the SETUP button on the main menu, then press the button labeled CONFIGURE BUTTONS.
2. Using the keypad, enter your password.
3. Press the button that you want to configure.
4. You will be prompted to enter the first line of the new button label you want to define. Use the keypad to enter the first line of your new button label, then press ENTER. (The first line of the label can be up to 10 characters long.) Pressing ENTER will keep the current button label.
5. Use the keypad to enter the second line of your new button label (again, up to 10 characters) then press ENTER. The following screen appears:



NOTE

If the button you want to configure resides on a different screen, use the buttons labeled NEXT and PREVIOUS to scroll back and forth between the screens of configurable buttons. Press the ESC button to return to the main menu.



Use the arrow buttons to move up and down between the different screen selections.



6. Select the type of display screen you want to use, then press ENTER. Depending on the screen type you have chosen, you will be prompted for different information. Setting up each of the display screens is described in detail in the sections that follow. Refer to these sections for instructions about setting them up.
7. When you have specified all the necessary information for the display screen you selected, press ENTER. You will return to the main menu screens and the new button you have specified will appear in the main menu.

Any time you want to view the data in the screen you have setup, press its button in the main menu. To leave the screen and return to the main menu, press the ESC button.

Using the MGT Display Formats

The following paragraphs describe the various display formats that the MGT offers, and how each is configured. Refer to the register class symbol at the start of each format description to determine what register classes can be displayed in each screen (register classes are introduced on page 4-4).

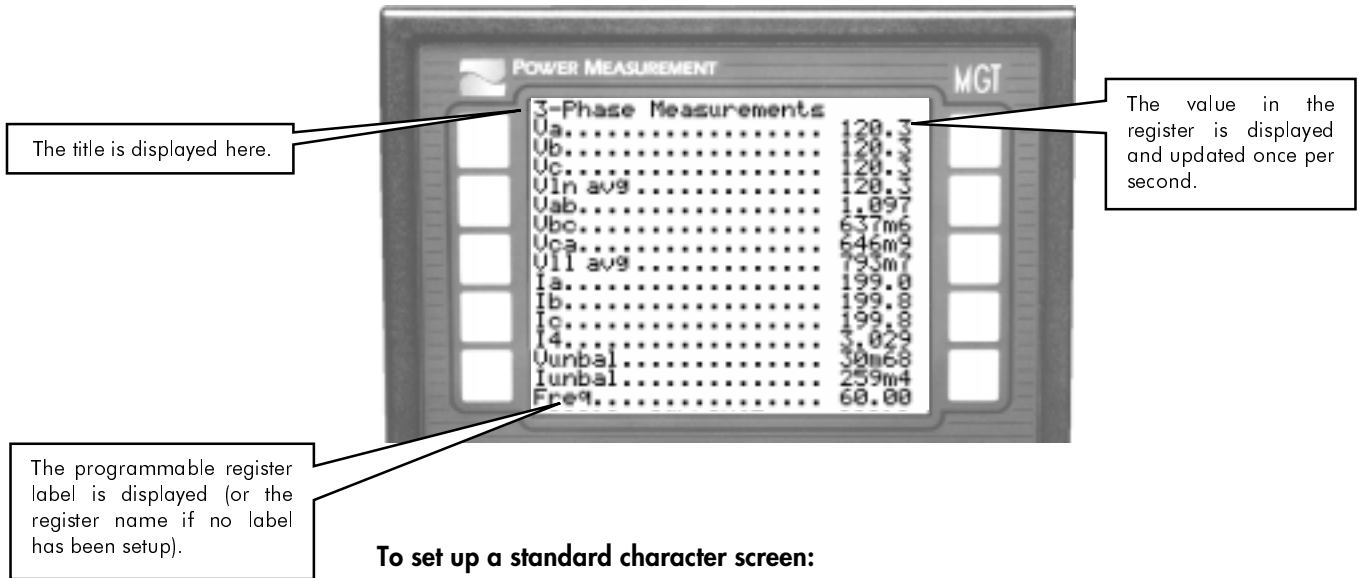
Specifying Parameter Handles

When you create a custom screen, the MGT requests a *parameter handle*. Parameter handles specify the memory location inside the 7700 ION where data is stored. Each ION register has a unique parameter handle.

Parameter handles are four-digit hexadecimal numbers, such as 71E4. To determine a particular parameter handle, refer to the help file *handles.pdf*, provided on all PEGASYS and PowerView release CDs. If you do not have a release CD from Power Measurement, contact Customer Service and request the parameter handles for the 7700 ION.

Standard Character Screens

Standard character screens are used for displaying numeric register values. They present data in small enough characters to include 15 different numeric registers on one screen. These screens are best suited for viewing close-up. Data in standard character screens are updated once per second, regardless of the update rate of the register on the connected device.



To set up a standard character screen:

1. Enter the parameter handle of the first register you want to display on the screen, then press ENTER. If you want to keep the register that is currently in use, press the button labeled KEEP PREVIOUS.
2. Repeat step 1 for the remaining 14 registers that you want to display. If at any point you want to return to the main menu and cancel your changes, press the ESC button. You do not have to specify a handle for every register if you do not want to use all 15 lines. Pressing ENTER will skip a line; in the display screen, that line will be left blank.
3. Once you have entered the parameter handles, you are prompted for a title for the display screen. Enter a title of up to 26 characters, then press the ENTER button. If you want to keep the title that is currently in use, press the button labeled KEEP PREVIOUS.



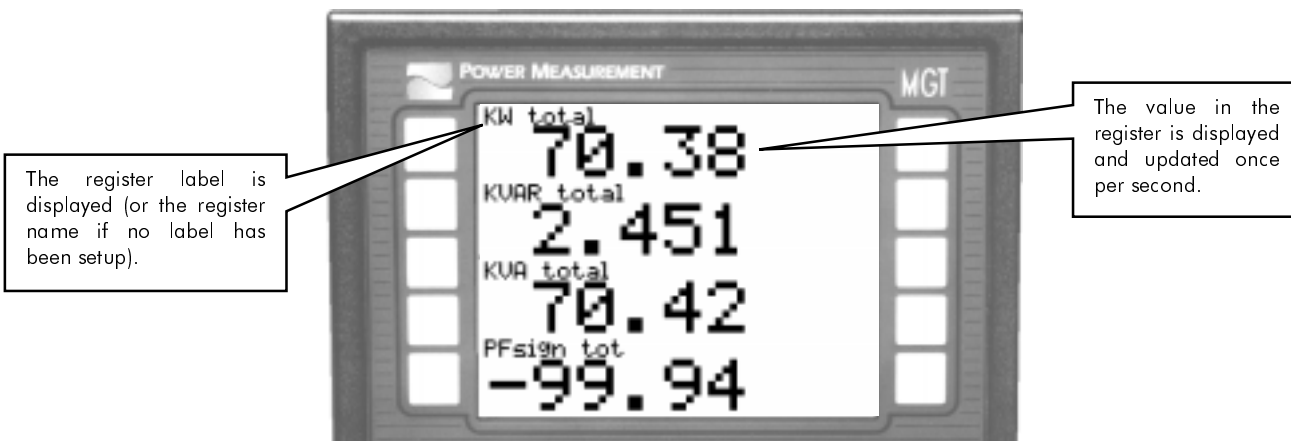
NOTE

If you have already set up a standard character screen and you want to change only some of the registers you are displaying, use the KEEP PREVIOUS button to keep the old registers.



Large Character Screens

Large character screens are also used for displaying numeric register values. They display up to four registers on one screen. The large character format is well suited for viewing from a distance. Data in large character screens are updated once per second, regardless of the update rate of the register on the connected device.



To set up a large character screen:

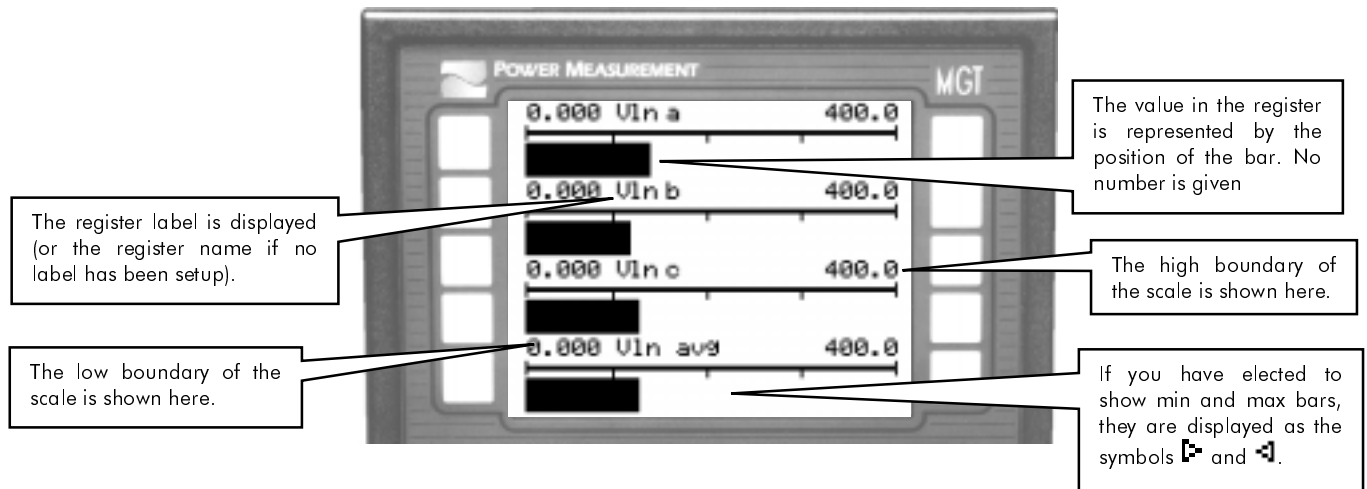
1. Enter the parameter handle of the first register you want to display on the screen, then press ENTER. If you want to keep the register that is currently in use, press the button labeled KEEP PREVIOUS.
2. Repeat step 1 for the remaining 3 registers that you want to display. If at any point you want to return to the main menu, press the ESC button. You do not have to specify a handle for every register if you do not want to use all 4 lines. Pressing ENTER will skip a line; in the display screen, that line will be left blank.

Bar Graph Screens

The MGT offers two different kinds of bar graph screens to display numeric registers on the connected device (a 4-channel and a 6-channel display). These displays offer a graphical representation of fluctuations in the register values and they are suitable for viewing from a distance. For both the 4- and 6-channel displays, you can define a minimum and a maximum boundary of the bar graph and hence control the scale of the graph. If you have linked any of the registers you are displaying to a Minimum or Maximum module, you can also display the minimum and maximum values attained by the register.

4-Channel Bar Graph

The 4-channel bar graph displays four numeric register values in bar graph form. If you are displaying high-accuracy registers, the graph is updated every second. If you are displaying high-speed registers without minimum and maximum values indicated, the graph is updated every 100 msec (with the minimum and maximum values displayed, the update rate is 1 second).



To set up a 4-channel bar graph screen:

1. Enter the parameter handle of the first register you want to display on the screen, then press ENTER. If you want to keep the register that is currently in use, press the button labeled KEEP PREVIOUS.
1. Enter the minimum boundary for the bar graph scale, then press ENTER. Note that this value should be the lowest value you expect the register to attain. For example, if your bar graph is to display the voltage on phase a, and you expect the voltage to be around 1200 V, you may want to enter 1000 as your minimum boundary. If you want to keep the value that is currently in use, press the button labeled KEEP PREVIOUS.
2. Enter the maximum boundary for the bar graph scale, then press ENTER. Note that this value should be the highest value you expect the register to attain. For example, if your bar graph is to display the voltage on phase a, and you expect the voltage to be around 1200 V, you may want to enter 1400 as your maximum boundary. If you want to keep the value that is currently in use, press the button labeled KEEP PREVIOUS.
3. Repeat steps 1 to 3 for the remaining 3 registers that you want to display. If at any point you want to return to the main menu, press the ESC button.

Parameter	Function
5	= min for parameter 1
6	= max for parameter 1
7	= min for parameter 2
8	= min for parameter 2
9	= min for parameter 3
10	= max for parameter 3
11	= min for parameter 4
12	= max for parameter 4

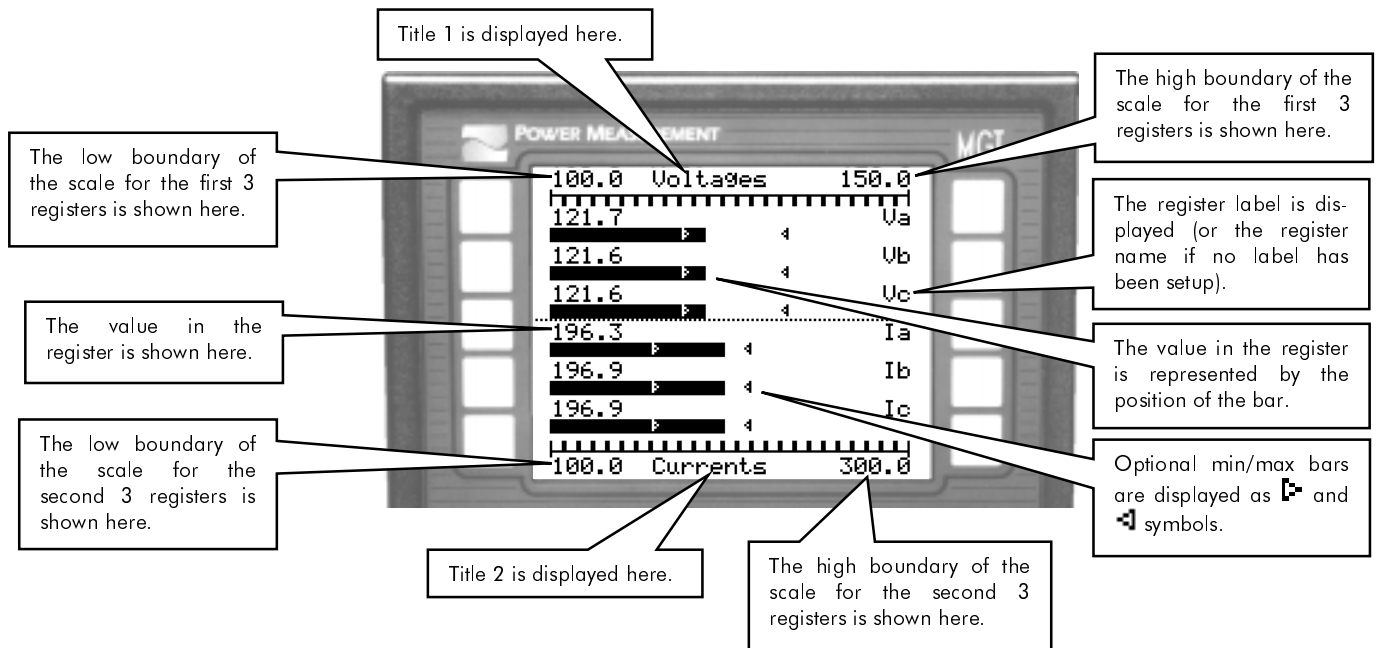
- The next value you are prompted for is the minimum value attained by the first register in the display. If you have linked the first register you are displaying to a Minimum module, you can display that minimum value on your bar graph. To do so, enter the handle of the appropriate Minimum module output register, then press ENTER. If you have not linked to a Minimum module, just press ENTER to continue.
- Next, you are prompted for the maximum value attained by the first register in the display. If you have linked the first register you are displaying to a Maximum module, you can display that maximum value on your bar graph. To do so, enter the handle of the appropriate Maximum module output register, then press ENTER. If you have not linked to a Maximum module, just press ENTER to continue.
- Steps 5 and 6 are repeated for the remaining three registers to be displayed in the bar graph.
- You are prompted to specify if you want to display min and max bars on the bar graph. If you specified parameter handles in steps 5 or 6 and you want to display these values, select 1, then press ENTER. If you have not linked to any Minimum or Maximum modules, or you do not want to display these values, select 0 and press ENTER.

NOTE

The minimum and maximum values attained by the register are not the same as the minimum and maximum boundaries of the scale.

6-Channel Bar Graph

The 6-channel bar graph displays six numeric register values in bar graph form, and in number form. If you are displaying high-accuracy registers, the graph is updated every second. If you are displaying high-speed registers without minimum and maximum values indicated, the graph is updated every 100 ms (with the minimum and maximum values displayed, the update rate is 1 second).



To set up a 6-channel bar graph screen:

Parameter	Function
7	= min for parameter 1
8	= max for parameter 1
9	= min for parameter 2
10	= min for parameter 2
11	= min for parameter 3
12	= max for parameter 3
13	= min for parameter 4
14	= max for parameter 4
15	= min for parameter 5
16	= max for parameter 5
17	= min for parameter 6
18	= max for parameter 6



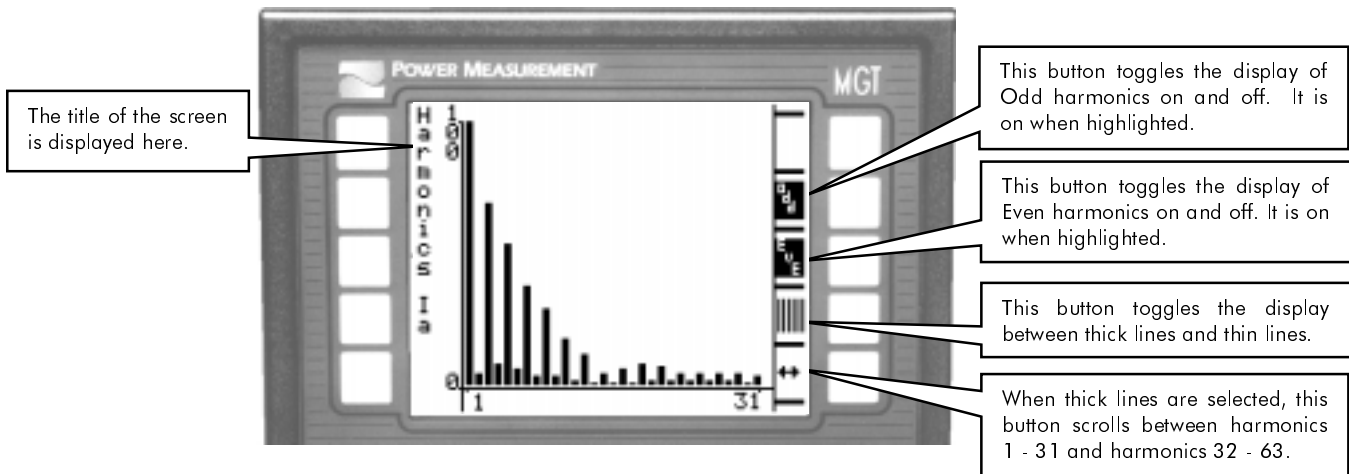
NOTE

The closer together your min and max values are, the more pronounced your graph's response will be to changes in the register value.

1. Enter the parameter handle of the first register you want to display on the screen, then press ENTER. If you want to keep the register that is currently in use, press the button labeled KEEP PREVIOUS. Repeat this step for the remaining 5 registers.
3. The next value you are prompted for is the minimum value attained by the first register in the display. If you have linked the first register you are displaying to a Minimum module, you can display that minimum value on your bar graph. To do so, enter the handle of the appropriate Minimum module output register, then press ENTER. If you have not linked to a Minimum module, just press ENTER to continue.
4. Next, you are prompted for the maximum value attained by the first register in the display. If you have linked the first register you are displaying to a Maximum module, you can display that maximum value on your bar graph. To do so, enter the handle of the appropriate Maximum module output register, then press ENTER. If you have not linked to a Maximum module, just press ENTER to continue.
5. Repeat steps 3 and 4 for the remaining 5 registers that you want to display. If at any point you want to return to the main menu, press the ESC button.
6. Enter the minimum boundary for the bar graph scale for the first three registers, then press ENTER. Note that this value should be the lowest value you expect any of these registers to attain.
7. Enter the maximum boundary for the bar graph scale for the first three registers, then press ENTER. Note that this value should be the highest value you expect any of these registers to attain. Enter the minimum boundary for the bar graph scale for the second three registers, then press ENTER.
8. Enter the maximum boundary for the bar graph scale for the second three registers, then press ENTER.
9. You are prompted to specify if you want to display min and max bars on the bar graph. If you specified parameter handles in steps 2 or 3 and you want to display these values, select 1, then press ENTER. If you have not linked to any Minimum or Maximum modules, or you do not want to display these values, select 0 and press ENTER.
10. Next, you are prompted for a title for the top three bar graphs (Title 1). Enter a title of up to 9 characters, then press the ENTER button.
11. Next, you are prompted for a title for the bottom three bar graphs (Title 2). Enter a title of up to 9 characters, then press the ENTER button.

Harmonics Screens

The harmonics screens allow you to display the values calculated by the Harmonics Analyzer module. They appear in a histogram form to show the harmonic spectrum of the input for which harmonics are being calculated. To maximize the resolution of the display, the harmonic with the highest amplitude is scaled to the top of the screen. The display is updated every second.



To set up a harmonics screen:

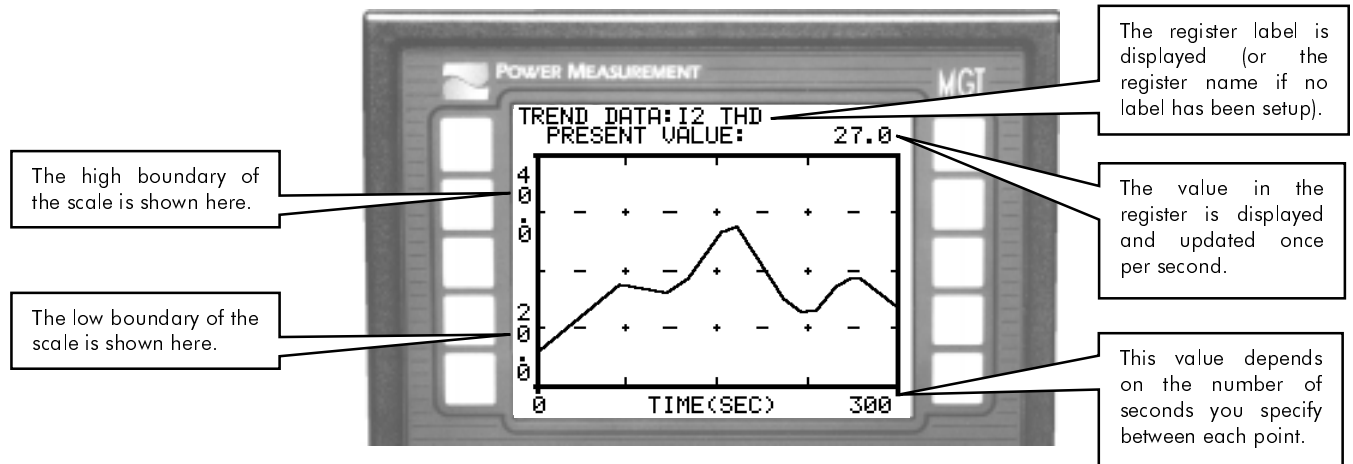
1. Enter the handle of the first output register of the Harmonics Analyzer module you want to view, then press ENTER. If you want to keep the register that is currently in use, press the button labeled KEEP PREVIOUS.
2. Enter a title of up to 15 characters, then press the ENTER button. If you want to keep the title that is currently in use, press the button labeled KEEP PREVIOUS.

IMPORTANT

You only need to enter the parameter handle for the first harmonic; the MGT automatically reads the remaining harmonic registers. If you enter an incorrect handle for the first output register, the rest of the readings will be unpredictable.

Parameter Trending Screens

The parameter trending screens plot the value of a register over time. These real-time displays allow you to view a register value graphically. You can specify the scale for the Y-axis of the graph (the register value) and the X-axis (time). The maximum update rate for a parameter trending screen is 1 second.



To set up a parameter trending screen:

1. Enter the handle of the register you want to plot on the screen, then press ENTER. If you want to keep the register that is currently in use, press the button labeled KEEP PREVIOUS.
2. Enter the minimum boundary value you expect the register to attain, then press ENTER. This value becomes the minimum boundary of the Y-axis of the trending graph. If you want to keep the value that is currently in use, press the button labeled KEEP PREVIOUS.
3. Enter the maximum boundary value you expect the register to attain, then press ENTER. This value becomes the maximum boundary of the Y-axis of the trending graph. If you want to keep the value that is currently in use, press the button labeled KEEP PREVIOUS.
4. Enter the number of seconds you want to elapse between each point on the graph. This determines the scale of the X-axis of the graph. For example, if you specify 1 second between each point, the X-axis will span 150 seconds. If you specify 2 seconds between each point, the X-axis will span 300 seconds. If you want to keep the value that is currently in use, press the button labeled KEEP PREVIOUS.

You do not need to specify a title for a parameter trending screen. It is pre-set to display the label of the selected register (or the register name if no label has been defined). The present value of the selected register is also displayed in numeric format at the top of the graph.

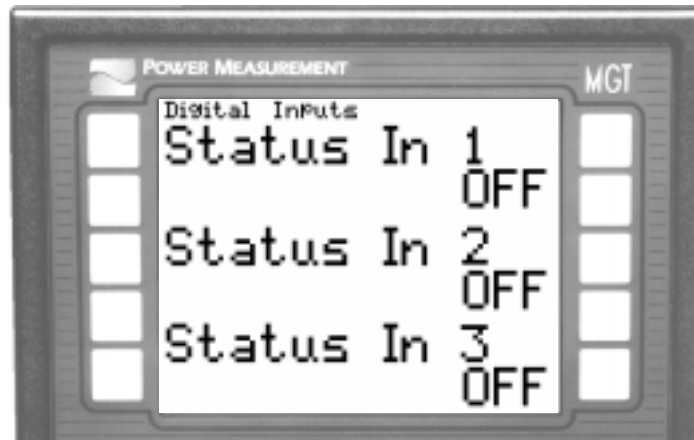


Status Display Screens

Status display screens are used for displaying Boolean register values. The data is presented using small enough characters to include 3, 7, or 14 different Boolean registers on one screen. Data in status display screens are updated once per second, regardless of the updated rate of the register on the connected device.

Large Status Display

The status display screens with three values use large characters and are suitable for viewing from a distance.



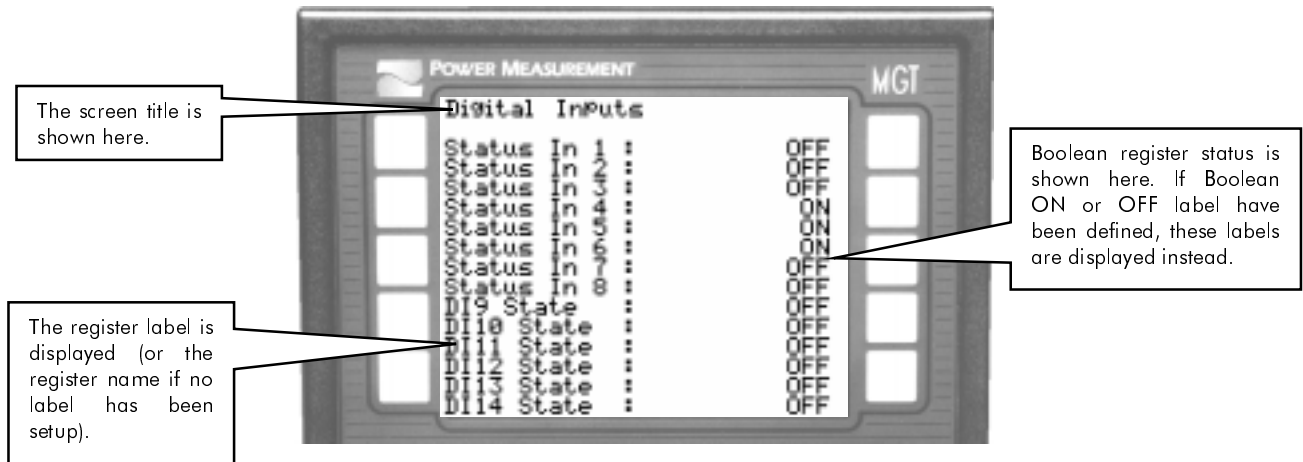
To set up a large status display screen:

1. Enter the parameter handle of the first register whose status you want to display on the screen, then press ENTER. If you want to keep the register that is currently in use, press the button labeled KEEP PREVIOUS.
2. Repeat step 1 for the remaining 2 registers whose status you want to display.
3. Once you have entered the parameter handles, you are prompted for a title for the display screen. Enter a title of up to 26 characters, then press the ENTER button. If you want to keep the title that is currently in use, press the button labeled KEEP PREVIOUS.

When you view your status display screen, the labels of the selected registers are displayed; if no labels have been defined, the default register names appear. To the right of each label, the state of the register is displayed. This can be either the associated Boolean ON or OFF label, or, if no Boolean ON/OFF labels have been defined, simply ON or OFF.

7 and 14 Status Display Screens

The screens displaying 7 and 14 values are best suited for viewing close-up.



To set up a 7 or 14 status display screen:

1. Enter the parameter handle of the first register whose status you want to display on the screen, then press ENTER. If you want to keep the register that is currently in use, press the button labeled KEEP PREVIOUS.
2. Repeat step 1 for the remaining 6 or 13 registers (depending on which display you selected) whose status you want to display.
3. Once you have entered the parameter handles, you are prompted for a title for the display screen. Enter a title of up to 26 characters, then press the ENTER button. If you want to keep the title that is currently in use, press the button labeled KEEP PREVIOUS.

When you view your status display screen, the labels of the selected registers are displayed; if no labels have been defined, the default register names appear. To the right of each label, the state of the register is displayed. This can be either the associated Boolean ON or OFF label, or, if no Boolean ON/OFF labels have been defined, simply ON or OFF.

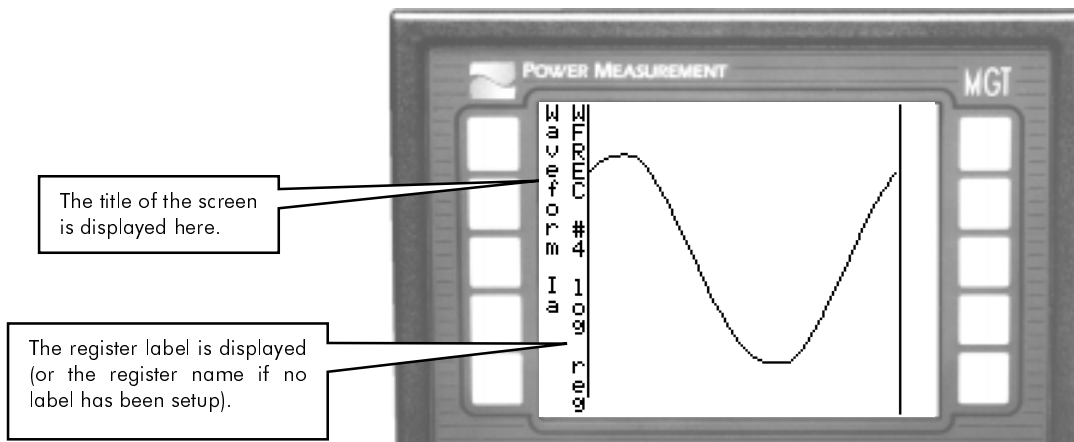


Waveform Display Screens

Waveform display screens allow you to display the output of a Waveform Recorder module. They read the data from this module's Wform Log output register and display it graphically based on the scale you define. Depending on how the waveform is formatted, your display may contain from 1 to 8 cycles of waveform data:

Waveform Format	Cycles Appearing on MGT	Resolution (samples/cycle)
128 x 14	1	128
64 x 14, 64 x 28	2	64
32 x 12, 32 x 26, 32 x 40, 32 x 54	4	32
16 x 22, 16 x 48, 16 x 72, 16 x 96	8	16

As the MGT can only display 128 points at a time, it takes the most recent set of waveforms in the Wform Log output register.



The title of the screen is displayed here.

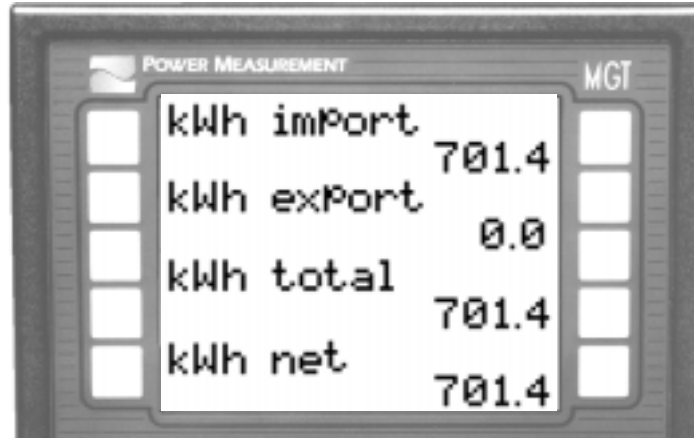
The register label is displayed (or the register name if no label has been setup).

To set up a waveform display screen:

1. Enter the handle of a Waveform Recorder's Wform Log output register, then press ENTER. If you want to keep the register that is currently in use, press the button labeled KEEP PREVIOUS.
2. Enter a title of up to 15 characters, then press the ENTER button. To keep the title that is currently in use, press the button labeled KEEP PREVIOUS.

Integrator Screens

Integrator screens allow you to display numeric outputs with greater resolution than other displays. They can display up to 4 output values on the MGT at one time, with up to 11 digits of resolution. By default, the MGT includes the ENERGY display; the outputs of Integrator modules #1 through #4.



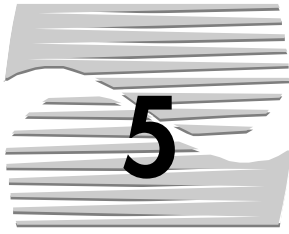
NOTE

Any ION numeric register can be displayed on an Integrator screen.

To set up an integrator display screen:

1. Enter the handle of an Integrator's Result output register (or other numeric register if desired), then press ENTER. If you want to keep the register that is currently in use, press the button labeled KEEP PREVIOUS.
2. Repeat step 1 for the remaining 3 registers whose Results you want to display. If you want to keep the register that is currently in use, press the button labeled KEEP PREVIOUS.

When you view your Integrator display screen, the labels of the selected registers are displayed; if no labels have been defined, the default register names appear. To the right of each label, the value of the register is displayed.



Technical Reference

The specifications that follow are subject to change without notice.

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ION Module Summary

The following table (pages 5–2 through 5–12) lists all of the ION modules available in the current version of the 7700 ION. The table shows how many of each ION module are available, how many of each are used in the factory configuration, and how many are high-speed capable (high-speed capable modules update every cycle; standard modules update every second).

 **NOTE**

Refer to the *ION Reference* for complete ION module details.

The ION Module Summary table also shows the ranges or options available for each module’s setup registers and the setting each register holds when a new module is created.


Setup Register Creation Defaults

It is important to note that the creation defaults shown in the table apply only to new modules when they are created in the device. The setup register settings shown do not apply to modules that are included in the factory configuration. Many of the modules in the factory configuration have been configured with custom settings.








Input and Output Register Descriptions

Complete descriptions of each module’s inputs and output registers can be found in the *ION Reference*. This document also includes operational descriptions for each module type. The *ION Reference* is shipped with PEGASYS software, and provided in digital format on Power Measurement distribution CD-ROMs.

ION Module Summary Table








ION Module Name	Total Available in 7700	Used in Factory Config.	High-Speed Capable	Setup Registers	Range or Options	Creation Default
Alert 	10	none	10	Message	Up to 120 characters	<i>default message</i>
				Priority	0 to 255	128
				Destination	Up to 50 characters	9,999-999-9999
				Type	PEGASYS, alphanumeric Pager, Numeric Pager or ASCII	PEGASYS
				Pager Num	Up to 16 characters	<i>empty</i>
				Com Port	Com 1, Com 2, Com 3 or Not a port	Not a port
				Attempts	1 to 20	3
				Retry Time	5 to 86400	15
				Lockout Time	0 to 86400	0
				Location	Up to 50 characters	<i>meter's network name</i>
Modem Init	Up to 50 characters	AT Q0V1E0				

ION Module Summary Table, Continued

ION Module Name	Total Available in 7700	Used in Factory Config.	High-Speed Capable	Setup Registers	Range or Options	Creation Default
Analog Input 	up to 18	none	none	Zero Scale	-1×10^9 to 1×10^9	0
				Full Scale	-1×10^9 to 1×10^9	1
				Port	<i>depends on I/O options</i>	NOT USED
Analog Output 	up to 30	none	none	Zero Scale	-1×10^9 to 1×10^9	0
				Full Scale	-1×10^9 to 1×10^9	1
				Port	<i>depends on I/O options</i>	NOT USED
AND/OR 	20	none	20	Mode	AND, OR, NAND or NOR	AND
				EvLogMode	LOG ON or LOG OFF	LOG OFF
Arithmetic 	4	none	N/A	Formula 1...8	Max 49 characters	<i>empty</i>
Clock * 	1	1	N/A	TZ Offset	-43,200 to 46,800	0
				DST Start	0 to 4.3×10^9	0
				DST End	86400 to 4.3×10^9	86400
				DST Offset	-10,800 to 10,800	0
				Time Sync Source*	COM1, COM2, COM3, ETHERNET	COM1
				Time Sync Type	UTC, Local	UTC
Comm *  <i>see also: Ethernet module</i>	4	4	<i>none</i>	Comm Mode	RS485 or RS232	RS485
				Baud Rate	1200, 2400, 4800, 9600 and 19200 (38400, 57600, 115200 for Comm2 and Comm3)	9600
				HshakeMode	RTS/CTS or RTS WITH DELAY	RTS WITH DELAY
				RTS Level	NORMAL or INVERTED	NORMAL
				CTS Level	NORMAL or INVERTED	NORMAL
				RTS Delay	0 to 1.00 second	0.01 seconds
				Unit ID	1 to 9999	<i>Factory set</i>
				Protocol	ION, MODBUS, DNP 3.0 GPS:TRUETIME/DATUM, GPS:ARBITER	ION
Convert 	20	none	20	<i>no setup registers</i>		



* denotes Core module (refer to Chapter 4)

ION Module Summary Table, Continued

ION Module Name	Total Available in 7700	Used in Factory Config.	High-Speed Capable	Setup Registers	Range or Options	Creation Default
Counter 	30	11	none	Multiplier	-1 x 10 ⁹ to 1 x 10 ⁹	1
				Count Mode	UP or DOWN	UP
				Preset	-1 x 10 ⁹ to 1 x 10 ⁹	0
				RollValue	-1 x 10 ⁹ to 1 x 10 ⁹	0
Data Acquisition* 	1	1	1	no setup registers		
Data Recorder 	20	8	20	Depth	0 to 2 x 10 ⁹	0
				Record Mode	CIRCULAR or STOP-WHEN-FULL	CIRCULAR
Diagnostics * 	1	1	N/A	no setup registers		
Digital Input 	up to 38	8	38	Input Mode	PULSE, KYZ	PULSE
				EvLog Mode	LOG ON or LOG OFF	LOG OFF
				Polarity	INVERTING or NON-INVERTING	INVERTING
				Debounce	0 to 65.525 seconds	0
				Port	<i>depends on I/O options</i>	NOT USED
Digital Output 	30	none	30	EvLog Mode	LOG ON or LOG OFF	LOG OFF
				Polarity	INVERTING or NON-INVERTING	INVERTING
				Debounce	0 to 65.525 seconds	0
				Port	<i>depends on I/O options</i>	NOT USED
DNP Slave Export 	16	14	16	DNPPoint	0 to 15	0
				DNPObjGrp	Analog Output or Binary Output	Binary Output


* denotes Core module (refer to Chapter 4)

ION Module Summary Table, Continued








ION Module Name	Total Available in 7700	Used in Factory Config.	High-Speed Capable	Setup Registers	Range or Options	Creation Default
DNP Slave Import  Note: DNP is only available on Com 2 or Com 3	16	none	16	BasePoint	0 to 60	0
				StaticObj	Binary Input, Binary Counter or Analog Input	Binary Input
				EventObj	Enable or Disable Event Objects	Disable Event Objects
				Deadband	0 to 4.3×10^9	0
				FrozStaObj	Enable or Disable Frozen Static Objects	Disable Frozen Static Object
				FrozEvtObj	Enable or Disable Frozen Event Objects	Disable Frozen Event Object
				EventClass	Class 1, 2 or 3	Class 1
				Scaling	ON or OFF	OFF
				IONZero	-1×10^{38} to 1×10^{38}	0
				IONFull	-1×10^{38} to 1×10^{38}	0
				DNPZero	-1×10^{38} to 1×10^{38}	0
DNPFull	-1×10^{38} to 1×10^{38}	0				
DNP Slave Options *  Note: DNP is only available on Com 2 or Com 3	1	1	1	BinInStatic	Single-Bit Binary Input or Binary input with status	Single-Bit Binary Input
				BinInEvents	<ul style="list-style-type: none"> Binary Input Change Without Time Binary Input Change With Time 	Binary Input Change Without Time
				BinInEvDepth	Fixed at 100	100
				BinCntStatic	<ul style="list-style-type: none"> 32-Bit Binary Counter 32-Bit Binary Counter Without Flag 16-Bit Binary Counter 16-Bit Binary Counter Without Flag 	16-Bit Binary Counter Without Flag
				FrzCntStatic	<ul style="list-style-type: none"> 32-Bit Frozen Counter 32-Bit Frozen Counter Without Flag 32-Bit Frozen Counter With Time of Freeze 16-Bit Frozen Counter 16-Bit Frozen Counter Without Flag 16-Bit Frozen Counter With Time of Freeze 	16-Bit Frozen Counter Without Flag

* denotes Core module (refer to Chapter 4)

ION Module Summary Table, Continued










ION Module Name	Total Available in 7700	Used in Factory Config.	High-Speed Capable	Setup Registers	Range or Options	Creation Default
DNP Slave Options * <i>continued</i>  Note: DNP is only available on Com 2 or Com 3	1	1	1	FrzCntEvents	<ul style="list-style-type: none"> • 32-Bit Frozen Counter Event Without Time • 32-Bit Frozen Counter Event With Time • 16-Bit Frozen Counter Event Without Time • 16-Bit Frozen Counter Event With Time 	16-Bit Frozen Counter Event Without Time
				FrzCntEvDepth	Fixed at 100	100
				CntChangeEvents	<ul style="list-style-type: none"> • 32-Bit Counter Change Event Without Time • 32-Bit Counter Change Event With Time • 16-Bit Counter Change Event Without Time • 16-Bit Counter Change Event With Time 	16-Bit Counter Change Event Without Time
				CntChangeEvDepth	Fixed at 100	100
				AIStatic	<ul style="list-style-type: none"> • 32-Bit Analog Input • 32-Bit Analog Input Without Flag • 16-Bit Analog Input • 16-Bit Analog Input Without Flag 	16-Bit Analog Input Without Flag
				FrzAIStatic	<ul style="list-style-type: none"> • 32-Bit Frozen Analog Input Without Flag • 32-Bit Frozen Analog Input With Time of Freeze • 16-Bit Frozen Analog Input Without Flag • 16-Bit Frozen Analog Input With Time of Freeze 	16-Bit Frozen Analog Input Without Flag
				FrzAIEvents	<ul style="list-style-type: none"> • 32-Bit Frozen Analog Event Without Time • 32-Bit Frozen Analog Event With Time • 16-Bit Frozen Analog Event Without Time • 16-Bit Frozen Analog Event With Time 	16-Bit Frozen Analog Event Without Time
				FrzAIEvDepth	Fixed at 100	100
				AIChangeEvents	<ul style="list-style-type: none"> • 32-Bit Analog Change Event Without Time • 32-Bit Analog Change Event With Time • 16-Bit Analog Change Event Without Time • 16-Bit Analog Change Event With Time 	16-Bit Analog Change Event Without Time

ION Module Summary Table, Continued

ION Module Name	Total Available in 7700	Used in Factory Config.	High-Speed Capable	Setup Registers	Range or Options	Creation Default
DNP Slave Options * <i>continued</i>  Note: DNP is only available on Com 2 or Com 3	1	1	1	AlChangeEvDepth	100 to 200	200
				AOStatic	32-bit Analog Output Status/ 16-bit Analog Output Status	16-bit Analog Output Status
				SelectTimeout	0-10 seconds	10 seconds
				TimeSynchPeriod	1- 86400 seconds (1 day)	86400
				ALFragSize	15 – 2048 bytes	2048
				DLAck	ALWAYS, MULTI-PACKET ONLY, NEVER	NEVER
				DLTimeout	100 msec to 10 seconds	2 seconds
				DLNumRetries	0-10	0
Ethernet * 	1	1	none	Gateway	<i>valid IP address</i>	None
				SubnetMask	<i>valid IP address</i>	None
				IP Address	<i>valid IP address</i>	None
				Protocol	ION or MODBUS RTU	ION
Event Log Controller * 	1	1	N/A	Depth	0 to 20 000	500
				Protection	The Protection register is factory-set to 128.	
				Cutoff	0 to 255	5
External Boolean 	32	11	0	EvPriority	0 to 127	0
External Numeric 	20	5	0	EvPriority	0 to 127	0
External Pulse 	128	17	0	EvPriority	0 to 127	0
Factory * 	1	1	N/A	Device Type (<i>read-only</i>)	N/A	7700 ION
				Compliance (<i>read-only</i>)	N/A	ION-Compliant
				Options (<i>read-only</i>)	N/A	<i>options purchased</i>
				Revision (<i>read-only</i>)	N/A	<i>firmware revision number</i>
				SerialNum (<i>read-only</i>)	N/A	<i>unit serial number</i>
				Owner	up to 255 characters	<i>empty</i>





* denotes Core module (refer to Chapter 4)

ION Module Summary Table, Continued





ION Module Name	Total Available in 7700	Used in Factory Config.	High-Speed Capable	Setup Registers	Range or Options	Creation Default
Factory * <i>continued</i> 	1	1	N/A	Tag 1	up to 255 characters	<i>empty</i>
				Tag 2	up to 255 characters	<i>empty</i>
				Nom Freq (<i>read-only</i>)	N/A	<i>factory set frequency</i>
				<i>Calibration Values: 39 additional read-only registers hold factory calibration values</i>		
Feedback 	10	3	10	<i>no setup registers</i>		
FFT * 	7	7	7	<i>no setup registers</i>		
Harmonics Analyzer * 	7	7	none	<i>no setup registers</i>		
Integrator 	30	9	none	Divisor	0 to 1×10^9 seconds	3600
				Int Mode	FORWARD, REVERSE, ABSOLUTE or NET	FORWARD
				Valu/Pulse	0 to 1×10^9	0
				RollValue	0 to 1×10^9	0 (no rollover)
LonWorks Export 	10	none	none	SNVT	<i>refer to ION Reference</i>	SNVT not used
				Send Delta	1×10^9	All
				Data Source	3.5×10^9	All
LonWorks Import 	90	none	none	SNVT	<i>refer to ION Reference</i>	SNVT not used
Maximum 	60	56	60	<i>no setup registers</i>		
Minimum 	60	47	60	<i>no setup registers</i>		

* denotes Core module (refer to Chapter 4)

ION Module Summary Table, Continued








ION Module Name	Total Available in 7700	Used in Factory Config.	High-Speed Capable	Setup Registers	Range or Options	Creation Default
Modbus Slave 	4	4	none	Format	<ul style="list-style-type: none"> • Unsigned 16B • Signed 16B • Unsigned 32B • Signed 32B • Unsigned 32B-M10K • Signed 32-M10K • Packed Boolean 	#1: Unsigned 16B #2 & #3: Signed 32 #4: Signed 32B-M10K
				Base Addr	400001 to 41800	#1: 40011 #2: 40027 #3: 40059 #4: 40089
				Scaling	Yes or No	#1, #2 and #3: Yes #4: No
				In Zero, In Full	-1×10^{38} to 1×10^{38} *	#1: 0, 6553 #2: -214748364, 214748364 #3: -214748364, 214748364 #4: No Scaling
				Out Zero, Out Full	-2147483647 to 2147483647 *	#1: 0, 65530 #2: -2147483640, 2147483640 #3: -2147483640, 2147483640 #4: No Scaling
One-Shot Timer 	12	none	12	Duration	0.010 to 2×10^6 seconds	1
Periodic Timer 	90	3	none	Period	0.010 to 2×10^6 seconds	900
				Sync Mode	NO TRIG ON SYNC or TRIGGER ON SYNC	NO TRIG ON SYNC
Power Harmonics 	1	none	none	Harmonic Number	1 to 63	1

ION Module Summary Table, Continued

ION Module Name	Total Available in 7700	Used in Factory Config.	High-Speed Capable	Setup Registers	Range or Options	Creation Default
Power Meter * 	3	3	1	Volts Mode	4W-WYE, 3W-WYE, DELTA, SINGLE or DEMO	4W-WYE
				PT Prim	1 to 999999	120/277/347 (depends on ordering option)
				PT Sec	1 to 999999	120/277/347 (depends on ordering option)
				CT Prim	1 to 999999	5
				CT Sec	1 to 999999	5
				I4 CT Prim	1 to 999999	5
				I4 CT Sec	1 to 999999	5
				V1Polarity	NORMAL or INVERTED	NORMAL
				V2Polarity	NORMAL or INVERTED	NORMAL
				V3Polarity	NORMAL or INVERTED	NORMAL
				I1Polarity	NORMAL or INVERTED	NORMAL
				I2Polarity	NORMAL or INVERTED	NORMAL
				I3Polarity	NORMAL or INVERTED	NORMAL
				I4Polarity	NORMAL or INVERTED	NORMAL
				PhaseOrder	ABC or ACB	ABC
				Nom Freq	not configurable - factory ordering option	
Phase Lbls	ABC, RST, XYZ, RYB or 123	ABC				
Pulse Merge 	8	1	8	EvLog Mode	LOG ON or LOG OFF	LOG OFF
				Pulser 	10	none
OutputMode	PULSE or KYZ	PULSE				
Polarity	INVERTING or NON-INVERTING	INVERTING				
Port	The Port option is variable, and depends on the options ordered with the 7700 ION. There is no default port; the available ports will be presented when you enter this setup register.					
Relative Setpoint 	10	5	none	Eval Mode	Value, Percentage	Value
				Over Pickup	0 to 1x10 ⁹ %	0
				Over Dropout	0 to 1x10 ⁹ %	0
				Under Pickup	0 to 1x10 ⁹ %	0



* denotes Core module (refer to Chapter 4)

ION Module Summary Table, Continued

ION Module Name	Total Available in 7700	Used in Factory Config.	High-Speed Capable	Setup Registers	Range or Options	Creation Default
Relative Setpoint <i>continued</i> 	10	5	1	Under Dropout	0 to 1×10^9 %	0
				SusUntION	0 to 3600 seconds	0
				SusUntIOFF	0 to 3600 seconds	0
				EvPriority	0 to 255	128
Sag/Swell 	1	1	1	Swell Limit	100 to 1000 %	106
				Sag Limit	0 to 100 %	88
				ChangeCrit	0 to 100 %	10
				NomVoltage	1 to 1×10^6 Volts	1200
				EvPriority	0 to 255	127
Scheduler 	1	none	none	Calendar	refer to <i>ION Reference</i>	
Setpoint 	24	none	24	High Limit	-1×10^9 to 1×10^9	0
				Low Limit	-1×10^9 to 1×10^9	0
				SusUntION	0 to 3600	0
				SusUntIOFF	0 to 3600	0
				Input Mode	Signed or Absolute	Signed
				Eval Mode	GreaterThan or LessThan	GreaterThan
				EvPriority	0 to 255	128
Sliding Window Demand 	40	29	none	Sub Intvl	60 to 5940 seconds	1800
				#SubIntvls	1 to 15	1
				Pred Resp	0 to 99	70
Symmetrical Components * 	2	2	none	Harmonic	<i>fixed at the fundamental harmonic</i>	
Thermal Demand 	16	4	16	Interval	60 to 5940 seconds	1800
				Time Const	1 to 99%.	90%

* denotes Core module (refer to Chapter 4)

ION Module Summary Table, Continued

ION Module Name	Total Available in 7700	Used in Factory Config.	High-Speed Capable	Setup Registers	Range or Options	Creation Default
Transient 	1	1	1	Threshold	100 to 1000 %	125
				EvPriority	0 to 255	128
Waveform Recorder 	14	6	14	Depth	0 to 2 x 10 ⁹	0
				RecordMode	CIRCULAR or STOP-WHEN-FULL	CIRCULAR
				Format	128x14, 64x14, 64x28, 32x12, 32x26, 32x40, 32x54, 16x22, 16x48, 16x72, 16x96	16x22
				Record Delay Cycles	0 to 2000	0

Measurements (@50 Hz/60 Hz @ 25°C) @ 1% to 125% Full Scale (FS) of input rating (50 mA to 6.25 A)

Parameter	Accuracy \pm (%reading + %FS)		MGT Resolution (%FS)*		Register Bounds	
	1 second	1 cycle	1 second	1 cycle	1 second	1 cycle
Voltage (L-N) in Wye; Vab, Vbc in Delta	0.1% + 0.01%	0.5%+0.05%	0.1%	0.1% + 1 LSD†	0 to 1×10^6	0 to 1×10^6
Voltage (L-N) in Wye; Vca in Delta	0.5% + 0.01%	1.0%+0.1%	0.1%	0.1% + 1 LSD	0 to 2×10^6	0 to 2×10^6
Frequency	0.01%	0.1%	0.01 Hz	0.01 Hz	20 Hz to 70 Hz	20 Hz to 70 Hz
Current (<5% FS)	1.0%	2.0%	0.1%	0.1% + 1 LSD	0 to 1×10^6	0 to 1×10^6
Current (5% to 125% FS)	0.1%+0.01%	0.5%+0.05%	0.1%	0.1% + 1 LSD	0 to 1×10^6	0 to 1×10^6
kVA (<5% FS)	1.0%	2.0%	0.1%	0.1% + 1 LSD	0 to 3.3×10^7	0 to 3.3×10^7
kVA (5% to 125% FS)	0.2%+0.02%	1.0%	0.1%	0.1% + 1 LSD	0 to 3.3×10^7	0 to 3.3×10^7
kVAh	0.2% reading	–	0.1% of reading	–	0 to 10^{38}	–
kW (<5% FS)	1.0%	2.5%+0.25%	0.1%	0.1% + 1 LSD	0 to $\pm 3.3 \times 10^7$	0 to $\pm 3.3 \times 10^7$
kW @ Unity PF (5% to 25% FS)	0.5%	2.5%+0.25%	0.1%	0.1% + 1 LSD	0 to $\pm 3.3 \times 10^7$	0 to $\pm 3.3 \times 10^7$
kW @ Unity PF (25% to 125% FS)	0.3%	2.5%+0.25%	0.1%	0.1% + 1 LSD	0 to $\pm 3.3 \times 10^7$	0 to $\pm 3.3 \times 10^7$
kW @ ± 0.5 PF (5% to 25% FS)	0.6%	5.0%+0.5%	0.1%	0.1% + 1 LSD	0 to $\pm 3.3 \times 10^7$	0 to $\pm 3.3 \times 10^7$
kW @ ± 0.5 PF (25% to 125% FS)	0.4%	5.0%+0.5%	0.1%	0.1% + 1 LSD	0 to $\pm 3.3 \times 10^7$	0 to $\pm 3.3 \times 10^7$
kVAR (<5% FS)	1.0%	2.5%+0.25%	0.1%	0.1% + 1 LSD	0 to $\pm 3.3 \times 10^7$	0 to $\pm 3.3 \times 10^7$
kVAR (5% to 125% FS)	0.55%+0.005%	2.5%+0.25%	0.1%	0.1% + 1 LSD	0 to $\pm 3.3 \times 10^7$	0 to $\pm 3.3 \times 10^7$
kWh, kVARh @ Unity PF ‡	IEC 0.5 Class @ 25°C	–	0.1% of reading	–	0 to $\pm 10^{38}$	–
kWh, kVARh @ ± 0.5 PF ‡	IEC 0.5 Class @ 25°C	–	0.1% of reading	–	0 to $\pm 10^{38}$	–
Harmonics (to 63rd)	1% Full Scale	–	0.1%	–	0.0001 to 100.00	–
K Factor	5% Full Scale	–	0.1%	–	0 to 1×10^6	–
Power Factor @ Unity PF	0.55%+0.025%	3.5%+0.35%	0.01%	1%	-0.01 to -100.00, 100.00 to 0.01	-0 to 100 to 0
Power Factor @ .5 Lag & .5 Lead	0.75%+0.025%	6.0%+0.6%	0.01%	1%	-0.01 to -100.00, 100.00 to 0.01	-0 to 100 to 0
Symmetrical Components	1% Full Scale	–	0.1%	–	Magnitude: 0 to 1×10^6 Phase: -180° to 180°	–

* Resolutions given are from the MGT. Higher resolution can be obtained via communications.

‡ kWh Accuracy Specification meets or exceeds IEC 687 Class 0.5

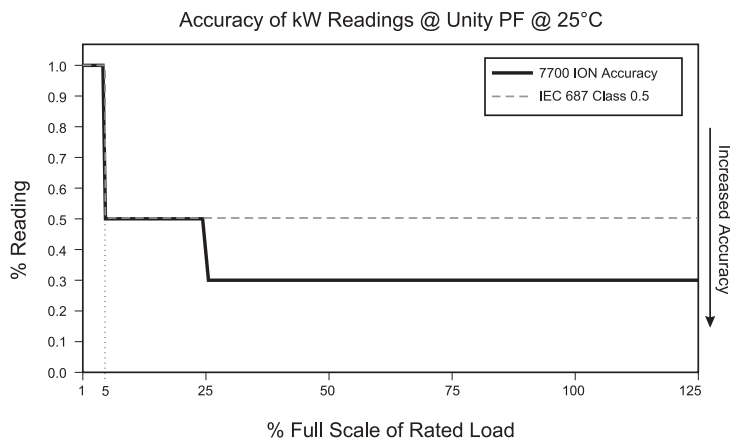
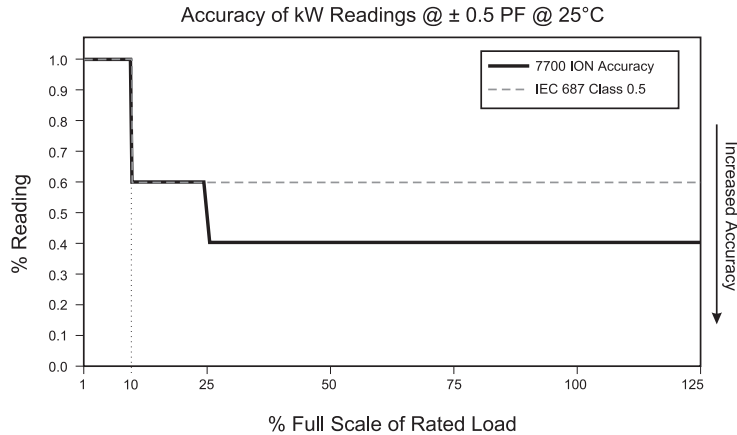
† LSD = least significant digit

kW Measurement Accuracy

The graphs below indicate the accuracy of the 7700 ION's kW measurements at 25°C at Power Factor values of 1.0, 0.5 lead and 0.5 lag. The graphs also compare 7700 ION accuracy with the IEC 687 Class 0.5 specification.

CAUTION

If the voltage on Phase A drops to 20% or lower of the rated nominal value, frequency detection will not function and measurement accuracy will be impaired.



High-Speed Measurements During Fault (@ 125% to 2000% of Rated Input, 6.25 A to 100 A)

Parameter	Accuracy ±(%reading)	MGT Resolution (%FS)	Range
Current (I1, I2 and I3 only)	5%	0.1%	0 to 10 ⁶
kVA	5%	0.1%	0 to 3.3x10 ⁷
kW, kVAR @ Unity PF	5%	0.1%	0 to ± 3.3x10 ⁷
kW, kVAR @ 50 Lag and 50 Lead	5%	0.1%	0 to ± 3.3x10 ⁷
Power Factor @ Unity PF	10%	0.01%	-0.01 to -100.00, 100.00 to 0.01
Power Factor @ 0.5 Lag and 0.5 Lead	10%	0.01%	-0.01 to -100.00, 100.00 to 0.01

Input Ratings

Input	Options	Specifications
Voltage Inputs	-120 option:	120 VAC nominal F.S. input, 25% overrange. Barrier strip connector rated to 600 Volts line-to-line.
	-277 option:	277 VAC nominal F.S. input, 25% overrange. Barrier strip connector rated to 600 Volts line-to-line.
	-347 option:	347 VAC nominal F.S. input, 25% overrange. Barrier strip connector rated to 600 Volts line-to-line.
		Overload withstand for all options: 1500 VAC continuous, 2500 VAC for 1 second, non-reoccurring
		Input impedance for all options: 2 MΩ
Current Inputs	Standard	5 Amp nominal F.S. input, 25% overrange
		20x fault capture capability
		Worst Case Burden (@ 6.25 Amps): 0.0625 VA
		Overload withstand for all options: 15 Amps continuous, 300 Amps for 1 second non-recurring
		Input Impedance: 2 mΩ
	1 Amp Option	1 Amp AC Nominal F.S. input, 25% overrange
Onboard Digital Inputs		Standard self-excited, dry contact sensing, no external voltage source required.
		+30 VDC differential SCOM output to S1 through S8 inputs.
		Minimum Pulse Width: 1 msec, Maximum Pulse Rate: 20 pulses / sec.
Optional Onboard Analog Inputs	0-1 mA Option	1 mA AC/DC nominal full scale input (1.25 mA AC/DC max.)
		Overload withstand: 50mA continuous, 100mA for 1 second non-recurring
		Input Impedance 49.9kΩ
		Accuracy: AC: ±0.25% F.S.; DC: ±(0.25% F.S. + 0.1% per Vcm*) total error
		Maximum Common Mode: 8 V
	0-20 mA Option	20 mA AC/DC nominal full scale input (25 mA AC/DC max.)
		Overload withstand: 35mA continuous, 70mA for 1 second non-recurring
		Input Impedance 100Ω
		Accuracy: AC: ±0.25% F.S.; DC: ±(0.25% F.S. + 0.1% per Vcm*) total error
		Maximum Common Mode: 20 V
	0-1 V Option	1.0 VAC/VDC nominal full scale input (1.25 VAC/VDC max.)
		Overload withstand: 20 VAC/VDC continuous, 40 VAC/VDC for 1 second non-recurring
		Input Impedance 49.9 kΩ
		Accuracy: AC: 60.25% F.S. DC: 6(0.25% F.S. + 0.13% per Vcm*) total error
		Maximum Common Mode: 12 V

* Vcm = Common mode voltage

Input Ratings, continued

Optional Onboard Analog Inputs <i>continued</i>	0-10 V Option	10.0 VAC/VDC nominal full scale input (12.5 VAC/VDC max.)
		Overload withstand: 20 VAC/VDC continuous, 40 VAC/VDC for 1 second non-recurring
		Input Impedance 49.9 kΩ
		Accuracy: AC: ±0.25% F.S.; DC: ±(0.25% F.S. + 0.025% per Vcm) total error
		Maximum Common Mode: 25 V
Power Supply*	Standard	85-240VAC (47-440 Hz) or 110-300VDC, 1 Amp worst case loading (56 W) @ 100 VAC @ 25°C
	-P24/ 48 option	20-60VDC @ 30 W worst case
		Power supply fuse current rating, type and rupturing speed: 3 A slow blow

* Power supply ratings apply to both 7700 ION and the external output boards.

Optional Input/Output Modules

Analog Input Modules

Part Number	Voltage Inputs					Current Inputs
	GAIVDC1	GAIVDC5	GAIVDC5B	GAIVDC10	GAIVDC10B	GAIIDC420
Range	0 to 1 VDC	0 to 5 VDC	-5 to 5 VDC	0 to 10 VDC	-10 to 10 VDC	4 to 20 mA
Resolution	244.1 μV	1.22 mV	2.44 mV	2.44 mV	4.88 mV	3.91 μA
Input Impedance	1 MΩ	1 MΩ	1 MΩ	1 MΩ	1 MΩ	133 Ω
Isolation (Input to Output):	2500 Vrms					
Accuracy @ 25°C:	± 0.2%					
Offset Drift:	± 50 ppm/°C					
Gain Drift:	± 55 ppm/°C					
Operating Temperature Range:	0°C to 60°C					
Storage Temperature Range:	-25°C to 85°C					

Analog Output Modules

	Voltage Outputs				Current Outputs
Part Number	GAOVDC5	GAOVDC5B	GAOVDC10	GAOVDC10B	GAOIDC420
Range	0 to 5 VDC	-5 to 5 VDC	0 to 10 VDC	-10 to 10 VDC	4 to 20 mA
Resolution	1.22 mV	2.44 mV	2.44 mV	4.88 mV	3.9 μ A
Sourcing Capability	20 mA max.@ 5 VDC	10 mA max.@ 5 VDC	10 mA max.@ 10 VDC	10 mA max.@ 10 VDC	20 mA max.@ 330 Ω max. loop resistance
Isolation (Input to Output):	2500 Vrms				
Accuracy @ 25°C:	\pm 0.6% range				
Offset Drift:	\pm 45 ppm/°C				
Gain Drift:	\pm 150 ppm/°C				
Short Circuit Protection:	Output signal can be shorted to ground without damaging the module				
Operating Temperature Range:	0°C to 60°C				
Storage Temperature Range:	-25°C to 85°C				

Digital Input Modules

	AC Inputs		DC Inputs	
Part Number	GDIAC120	GDIAC240	GDIDC32	GDIDC32H <i>(High Speed)</i>
Nominal Input Voltage:	120 VAC	240 VAC	32 VDC	32 VDC
Input Voltage Range:	90 to 140 VAC/VDC	180 to 280 VAC/VDC	3 to 32 VDC	3 to 32 VDC
Input Current @ Max Input Voltage:	8 mA rms	6 mA rms	18 mA	18 mA
Nominal Input Resistance:	22 k Ω	60 k Ω	1.8 k Ω	1.8 k Ω
Pick Up Voltage:	> 90 VAC	> 180 VAC	> 3 VDC	> 3 VDC
Drop Out Voltage:	< 25 VAC	< 50 VAC	< 1 VDC	< 1 VDC
Turn-on Time	20 msec max.	20 msec max.	0.20 msec max.	0.050 msec max.
Turn-off Time	20 msec max.	20 msec max.	0.40 msec max.	0.075 msec max.
Optical Isolation (Input to Output):	4000 VAC rms			
Operating Temperature Range:	-40°C to 100°C			
Storage Temperature Range:	-40°C to 125°C			
Standards & Certification:	UL File # E58632, CSA File # LR38763, TUV Certificate #R9474066			
Transient Protection:	Meets ANSI/IEEE C37.90-1989 Surge Withstand Capability Test			
7700 Scan Time:	1 msec maximum, 5 msec minimum, max pulse rate = 20 pps			

Digital Input Dry Contact Modules

Part Number	GDICC
Isolation, Input to Output	2500 VAC rms
Storage Temperature Range	-40°C to 125 °C
Operating Temperature Range	0°C to 60°C
Maximum Dry Contact Voltage Rating	25 VDC
Minimum Dry Contact Current Rating	5 mA
Maximum Turn-on Time	3.0 msec
Minimum Turn-off Time	3.0 msec
Standards and Certification:	UL File # E58632, CSA File # LR38763
Transient Protection:	Meets ANSI 37.90-1989 Surge Withstand Capability Test

Thermocouple Input Modules

Thermocouple Type	Type J	Type K	Type R	Type T
Part Number	GAITCJ	GAITCK	GAITCR	GAITCT
Input Range	0 to 700°C	-100 to 924°C	0 to 960°C	-200 to 224°C
Resolution	0.18°C	0.25°C	0.23°C	0.10°C
Isolation (Input to Output):	2500 Vrms			
Accuracy @ 25°C:	± 3°C			
Offset Drift:	± 100 ppm/°C			
Gain Drift:	± 55 ppm/°C			
Operating Temperature Range:	0°C to 60°C			
Storage Temperature Range:	-25°C to 85°C			

RTD Input Modules

Part Number	GAIRTD
Input Range:	-50°C to 350°C
Resolution:	0.10°C
Accuracy, Across Range @ 25°C:	± 0.8°C
Isolation:	2500 VRMS
Operating Temperature Range:	0°C to 60°C
Storage Temperature Range:	-25°C to 85°C

Digital Output Modules

Zero Voltage Turn-On, Normally Open, Manual Override Output Modules

Part Number	AC Outputs		DC Outputs
	GDOAC120MO	GDOAC240MO	GDODC60MO
Nominal Line Voltage:	120 VAC	240 VAC	N/A
Frequency Range:	25 Hz to 70 Hz	25 Hz to 70 Hz	N/A
Maximum Line Voltage:	N/A	N/A	60 VDC
Clamping Voltage:	N/A	N/A	80 VDC max.
Maximum Off-state Leakage	2 mA rms @ 60Hz	4 mA rms @ 60Hz	1.5 mA @ 60 VDC
Load Voltage Range:	24 to 140 VAC	24 to 280 VAC	3 to 60 VDC
Turn-on Time (60 Hz):	8.3 msec max.	8.3 msec max.	20 µsec max.
Turn-off Time (60 Hz):	8.3 msec max.	8.3 msec max.	50 µsec max.
Maximum Surge Current (peak):	80 Amps @ 60 Hz, 1 cycle; 25 Amps @ 60 Hz, 60 cycles	80 Amps @ 60 Hz, 1 cycle; 25 Amps @ 60 Hz, 60 cycles	5 Amp for 1 second
Load Current Range (rms):	0.03 to 3.5 Amps		
On-state Voltage Drop (peak):	1.5 Volts max.		
Power Dissipation:	1.0 Watt/Amp typical		
Optical Isolation(Input to Output):	4000 VAC rms		
Operating Temperature Range:	-40°C to +100°C		
Storage Temperature Range:	-40°C to +125°C		
Standards and Certification:	UL File # E58632, CSA File # LR38763		
Transient Protection:	Meets ANSI 37.90-1989 Surge Withstand Capability Test		

Normally Open, Solid State Relays

Part Number	AC Outputs (Zero Voltage Turn On)		DC Outputs		
	GDOAC120	GDOAC240	GDODC60	GDODC200	GDODC60L <i>(Low Leakage)</i>
Nominal Line Voltage:	120 VAC	240 VAC	N/A	N/A	N/A
Load Power Factor:	0.4 min.	0.4 min.	N/A	N/A	N/A
Frequency Range:	25 Hz to 70 Hz	25 Hz to 70 Hz	N/A	N/A	N/A
Maximum Line Voltage:	N/A	N/A	60 VDC	200 VDC	60 VDC
Maximum Off-state Leakage @ 60Hz (AC) or @ 60 VDC (DC):	2 mA rms	4 mA rms	1.5 mA	0.01 mA	0.01 mA
Load Voltage Range:	24 to 140 VAC	24 to 280 VAC	3 to 60 VDC	4 to 200 VDC	3 to 60 VDC
On-state Voltage Drop:	1.5 Volts max.	1.5 Volts max.	1.2 Volts max.	1.75 Volts max.	1.2 Volts max.
Clamping Voltage:	N/A	N/A	80 VDC max.	360 VDC max.	80 VDC max.
Power Dissipation:	1.0 Watt/Amp typ.	1.0 Watt/Amp typ.	1.0 Watt/Amp typ.	1.5 Watt/Amp typ.	1.0 Watt/Amp typ.
Load Current Range (RMS):	0.03 to 3.5 A	0.03 to 3.5 A	0.02 to 3.5 A	0.02 to 1.0 A	0.02 to 3.5 A
Turn-on Time:	8.3 msec max. @ 60Hz	8.3 msec max. @ 60Hz	20 µsec max.	75 µsec max.	75 µsec max.
Turn-off Time:	8.3 msec max. @ 60Hz	8.3 msec max. @ 60Hz	50 µsec max.	750 µsec max.	500 µsec max.
Surge Current (peak):	80 Amps @ 60 Hz, 1 cycle; 25 Amps @ 60 Hz, 60 cycles	80 Amps @ 60 Hz, 1 cycle; 25 Amps @ 60 Hz, 60 cycles	5 Amps maximum for 1 second	5 Amps maximum for 1 second	5 Amps maximum for 1 second
Transient Power Dissipation:	N/A	N/A	400 Watts @ 1 msec non-recurring		
Optical Isolation (Input to Output):	4000 VAC rms				
Operating Temperature Range:	-40°C to +100°C				
Storage Temperature Range:	-40°C to +125°C				
Standards and Certification:	UL File # E58632, CSA File # LR38763				
Transient Protection:	Meets ANSI 37.90-1989 Surge Withstand Capability Test				

Mechanical Relays

Part Number	GDODC100M
Maximum Line Voltage:	100 VDC/120 VAC maximum
Contact Rating:	10 Watts maximum
Switching Current:	0.5 A dc maximum. Inductive loads require diode suppression.
Carrying Current:	1.0 A maximum. Inductive loads require diode suppression.
Contact Resistance:	250 mΩ maximum
Turn-on Time:	1.0 msec maximum
Turn-off Time:	1.0 msec maximum
Off-state Leakage Current:	2 μA maximum @ 60Hz
Dielectric Isolation (Input to Output):	1500 VAC rms
Operating Temperature Range:	-20°C to +85°C
Storage Temperature Range:	-40°C to +125°C
Transient Protection:	Meets ANSI 37.90-1989 Surge Withstand Capability Test

Additional Specifications

Operating Temp:	0°C to +50°C (+32°F to +122°F) ambient air. (for TRAN model: -20°C to +50°C (-4°F to +122°F))
Storage Temp:	-30°C to +70°C (-22°F to +158°F)
Humidity:	5% to 95% non-condensing

Standards Compliance



UL: Certified to UL 3111

CSA: Certified to CAN/CSA C22.2 No.1010-1



International: IEC 1010-1
Registered under CB Scheme to EN61010-1
Measuring inputs comply with Installation Category III
Power supply inputs comply with Installation Category II



Surge Withstand: All inputs pass ANSI/IEEE C37.90-1989 surge withstand and fast transient tests

FCC: Part 15 of FCC Rules for a Class A Digital Device

CE: approved

Quality Assurance: ISO 9002 certified by QMI



Ordering Information

Basic Model

7700 ION With 85 - 240 VAC / 110 - 300 VDC power supply, MGT with 10 ft. (3.0 m) cable, a single optically isolated RS232C/RS485 - communications port and 512kB of on-board memory.

Revenue Metering Models

7700ION-RMICAN Meets Canadian revenue-metering standards (unsealed). Rated for 0.1 to 10 Amp AC. With universal power supply, MGT with 10 ft. (3.0 m) cable, 1024kB on-board memory, and single optically isolated RS232/RS485 communications card. Approval #AE-0688.

7700ION-RMANSI Accuracy meets ANSI C12.16 revenue-metering standard (unsealed). Rated for 0.1 to 10 Amp AC. With universal power supply, 1024kB on-board memory, MGT with 10 ft. (3.0 m) cable, and optically isolated RS232/RS485 communications card.

Meter Options (must be specified with 7700 ION when ordering)

-RM	Revenue security enabled, 5 Amp current inputs.
-120	For 69/120, 120/208, or 120/240 (single phase) Volts systems
-277	For 240/416, or 277/480 Volts systems
-347	For 347/600 Volts systems
-50Hz	For 50 Hz systems
-60Hz	For 60 Hz systems
-1Amp	1.0 Amp nominal full scale current inputs
-P24/48	20 to 60 VDC power supply (instead of 85 to 240 VAC / 110 to 300 VDC)
-TROP	Tropicalization (conformal coating) treatment
-TRAN	No Modular Graphics Terminal (MGT)
-XMEM	Additional 512kB of NVRAM
-XPRESS	Basic XPRESS card with two RS-485 ports and one 10BaseT Ethernet port
-RMSEAL	Factory-sealed meter (for RMICAN meters only). Contact factory for RMSEAL checklist.
-RMKEY	Hardware key for programming unsealed revenue metering units.

Xpress Card Options

-FIBER	10BaseFL Ethernet port
-LONFT	LonWorks with FTT10 Transceiver
-1MEG	Extra 1 MB of memory
-2MEG	Extra 2 MB of memory
-3MEG	Extra 3 MB of memory

Display

MGT	Modular Graphics Terminal with 10 ft. cable (for ordering MGT separately)
-50ft	50 ft. cable instead of 10 ft. cable
-200ft	200 ft. cable instead of 10 ft. cable

Internal Analog Input Options

(Use separate line item on Purchase Order)

Auxiliary Analog Inputs Board

AUX 1mA	0 to 1mA Auxiliary Analog Input
AUX 20mA	0 to 20mA Auxiliary Analog Input
AUX 1V	0 to 1VAC/VDC Auxiliary Analog Input
AUX 10V	0 to 10VAC/VDC Auxiliary Analog Input

Note: All four on-board Analog Inputs must have the same range.

External Input/Output Expansion Options

(Use separate line item on Purchase Order)

IOCA	I/O card for I/O Port A with ribbon cable (3 feet)
IOCB	I/O card for I/O Port B with ribbon cable (3 feet), and universal power supply (see power supply specifications). This option should be used for specifying a second I/O board or a board that will be populated with more than 6 analog devices.
-P24/48	Power Supply Option for IOCA or IOCB

Analog Input Devices

GAIVDC1	0 to 1 VDC Analog Input Device
GAIVDC5	0 to 5 VDC Analog Input Device
GAIVDC5B	-5 to 5 VDC Analog Input Device
GAIVDC10	0 to 10 VDC Analog Input Device
GAIVDC10B	-10 to 10 VDC Analog Input Device
GAIIDC420	4 to 20 mA Analog Input Device

Thermocouple Devices

GAITCR	Type R
GAITCT	Type T
GAITCJ	Type J
GAITCK	Type K
GAIRTD	RTD

Analog Output Devices

GAOVDC5	0 to 5 VDC Analog Output Device
GAOVDC5B	-5 to 5 VDC Analog Output Device
GAOVDC10	0 to 10 VDC Analog Output Device
GAOVDC10B	-10 to 10 VDC Analog Output Device
GAOIDC420	4 to 20 mA Analog Output Device

Digital Input Devices

GDIAC120	120 VAC Digital Input Device
GDIAC240	240 VAC Digital Input Device
GDIDC32	32 VDC Digital Input Device
GDIDC32H	32 VDC High Speed Digital Input Device
GDICC	Dry Contact Module

Digital Output Devices

GDOAC120	120 VAC, 3.5A, N.O. Solid State Relay
GDOAC120MO	120 VAC, 3.5A, Zero Voltage Turn On With Manual Override
GDOAC240	240 VAC, 3.5A, N.O. Solid State Relay
GDOAC240MO	240 VAC, 3.5A, Zero Voltage Turn On With Manual Override
GDODC60	60 VDC, 3.5A, N.O. Solid State Relay
GDODC60MO	60 VDC, 3.5A, Zero Voltage Turn On With Manual Override
GDODC200	200 VDC, 1.0A, N.O. Solid State Relay
GDODC60L	60 VDC, 3.5A, Low Leakage, N.O. Solid Relay
GDODC100M	100 VDC, 0.5A, N.O. Mechanical Relay

Ordering Example

This example specifies a 7700 ION for a 347/600 Volts, 60 Hz system. It includes an I/O card A with 60 VDC power supply, an I/O card B with 60 VDC power supply, six 0 to 1 VDC Analog Input Devices, six 4 to 20 mA Analog Output Devices, eight 120VAC Digital Input Devices, and four 120VAC Digital Output Devices:

```
1 7700ION -347 -60Hz
1 IOCA -P24/48
1 IOCB -P24/48
6 GAIVDC1
6 GAOIDC420
8 GDIAC120
4 GDOAC120
```

External Output Device Part Number Summary

The following table summarizes the manufacturer's part numbers for external devices used with the 7700 ION.

ORDERING OPTION	DESCRIPTION	MANF. PART #
Digital AC Outputs		
GDOAC120	120 VAC, 3.5A, N.O. Solid State Relay	70G-OAC5
GDOAC120MO	120 VAC, 3.5A, N.O. Zero Voltage Turn-on, Manual Override	70G-OAC5MA
GDOAC240	240 VAC, 3.5A, N.O. Solid State Relay	70G-OAC5A
GDOAC240MO	240 VAC, 3.5A, N.O. Zero Voltage Turn-on, Manual Override	70G-OAC5AMA
Digital DC Outputs		
GDODC60	60 VDC, 3.5 A, N.O. Solid State Relay	70G-ODC5
GDODC60L	60 VDC, 1.0 A, Low Leakage, N.O. Solid Relay	70G-ODC5B
GDODC60MO	60 VDC, 3.5 mA, Manual Override	70G-ODC5MA
GDODC200	200 VDC, 1.0A, N.O. Solid State Relay	70G-ODC5A
GDODC100M	100 VDC, 0.5A, N.O. Mechanical Relay	70G-ODC5R
Digital AC Inputs		
GDIAC120	120 VAC Digital Input Device	70G-IAC5
GDIAC240	240 VAC Digital Input Device	70G-IAC5A
Digital DC Inputs		
GDIDC32	32 VDC Digital Input Device	70G-IDC5
GDIDC32H	32 VDC High Speed Digital Input Device	70G-IDC5B
Dry Contact Inputs		
GDICC	Dry Contact Digital Input Device	70G-IDC5S
Analog Outputs		
GAOVDC5	0 to 5 VDC Analog Output Device	73G-OV5
GAOVDC5B	-.5 to 5 VDC Analog Output Device	73G-OV5B
GAOVDC10	0 to 10 VDC Analog Output Device	73G-OV10
GAOVDC10B	-10 to 10 VDC Analog Output Device	73G-OV10B
GAOIDC420	4 to 20 mA Analog Output Device	73G-OI420
Analog Inputs		
GAIVDC1	0 to 1 VDC Analog Input Device	73G-IV1
GAIVDC5	0 to 5 VDC Analog Input Device	73G-IV5
GAIVDC5B	-.5 to 5 VDC Analog Input Device	73G-IV5B
GAIVDC10	0 to 10 VDC Analog Input Device	73G-IV10
GAIVDC10B	-10 to 10 VDC Analog Input Device	73G-IV10B
GAIIDC420	4 to 20 mA Analog Input Device	73G-II420
Thermocouple Units		
GAITCJ	Type J Thermocouple Input Device	73G-ITCJ
GAITCK	Type K Thermocouple Input Device	73G-ITCK
GAITCR	Type R Thermocouple Input Device	73G-ITCR
GAITCT	Type T Thermocouple Input Device	73G-ITCT
GAIRTD	100 Ohm Platinum RTD Input Device	73G-ITR100

Warranty and Registration

This product is warranted against defects in materials and workmanship for three years. The Warranty is effective from date of purchase. Power Measurement Limited will repair or replace, at its option, any product found to be defective (F.O.B. point of manufacture) during the Warranty period, provided the equipment has been installed, wired, programmed, and operated in accordance with the manufacturer's instruction manual included with each unit, and the applicable sections of the Electrical Code.

The Warranty will be invalid if any unauthorized alterations are made to the product, or if the product has been abused or mishandled. Damage due to static discharges will void the Warranty, as will application of voltages or currents outside the specified ratings of the device inputs.

EXCEPT TO THE EXTENT PROHIBITED BY APPLICABLE LAW, NO OTHER WARRANTIES, WHETHER EXPRESSED OR IMPLIED, INCLUDING WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE, SHALL APPLY TO THIS PRODUCT; UNDER NO CIRCUMSTANCES SHALL POWER MEASUREMENT LIMITED BE LIABLE FOR CONSEQUENTIAL DAMAGES SUSTAINED IN CONNECTION WITH SAID PRODUCT AND POWER MEASUREMENT LIMITED NEITHER ASSUMES NOR AUTHORIZES ANY REPRESENTATIVE OR OTHER PERSON TO ASSUME FOR IT ANY OBLIGATION OR LIABILITY OTHER THAN SUCH AS IS EXPRESSLY SET FORTH HEREIN.

Product Return Procedure

The following procedure must be strictly adhered to when returning any Power Measurement product to the factory for the purpose of repair, replacement, credit, upgrade, recalibration, or for any other reason.



NOTE

Units received without prior authorization will not be accepted under any circumstances.

1. Contact Power Measurement or your local Power Measurement Sales Representative and obtain a *Return Merchandise Authorization (RMA)* number prior to shipment of any unit back to the manufacturer. Be prepared to provide the product's model number, serial number, and the reason for returning the unit.
2. If the unit is being returned for repair, replacement, or upgrade a *product return report* should be completed and included with the unit. The information provided should include:
 - ◆ A functional description of the unit defect or failure and the electrical/environmental conditions at the time of failure. This will significantly reduce repair/upgrade time (and cost, if warranty has expired). If the unit is being returned for an upgrade, recalibration or other modification, list the requirements.
 - ◆ The RMA number issued by Power Measurement, the serial number of the unit, the company name and address, the name of the person filling out the report, and the date.

- ◆ **IMPORTANT:** The return address to which the unit is to be shipped following servicing.
- 3. Pack the unit safely, preferably in the original shipping carton, and include the detailed report described above. **The RMA number must be clearly marked on the outside of the box.**
- 4. A packing slip must be attached to the outside of the box that includes the points of origin and destination, a description of contents, and the reason for return. Examples: *For Repair and Return*, or *Returned for Credit*. There should be no need to declare a value.
- 5. Ship PREPAID to the appropriate address below. Power Measurement will not accept C.O.D. shipments. If the unit is still under warranty, Power Measurement will pay the return shipping charges.

For Shipments Originating in the U.S.A.:

Power Measurement Ltd.
c/o VICTORIA CUSTOMS BROKERS
4131A Mitchell Way
Bellingham, WA 98226

For Shipments Originating Overseas:

Power Measurement Ltd.
2195 Keating Cross Road,
Saanichton, BC V8M 2A5

CUSTOMS CLEARANCE
Livingston International Inc. Ph(250)388-4435

For Shipments Originating in Canada:

Power Measurement Ltd.
2195 Keating Cross Road,
Saanichton, BC V8M 2A5

Registration

Please complete and mail the enclosed *Warranty Registration* card immediately. This will allow us to add you to our mailing list, to keep you up to date on the latest product firmware releases and new feature offerings.

Your comments and suggestions for product improvement and feature additions are welcome.



7700 ION Revenue Meters

This appendix provides an overview of the 7700 ION-RMxxxx Revenue Meters.

The fundamental functions of a revenue meter are to provide measurements that are within industry-accepted limits for accuracy over a defined range of operating conditions, and to provide adequate protection against unauthorized alteration of these measured quantities. International and national standards ensure industry-accepted accuracy limits. A combination of national and utility-based standards regulates protection against unauthorized quantity alteration.

7700 ION-RM Models

Two models of the 7700 ION-RM revenue meter are available; each model is designated by the certification it holds.



NOTE

All 7700 ION-RM devices are equipped with 1 MB of NVRAM.

Type	Certification Achievement	Current Inputs	Revenue Metering Security Systems
RMICAN (unsealed)	Canadian Revenue Metering Standards	Rated for 0.1 Amps to 10 Amps AC	Enabled
RMANSI (unsealed)	Accuracy complies with the ANSI C12.16 Revenue Metering Standard	Rated for 0.1 Amps to 10 Amps AC	Enabled

7700 ION-RM Options

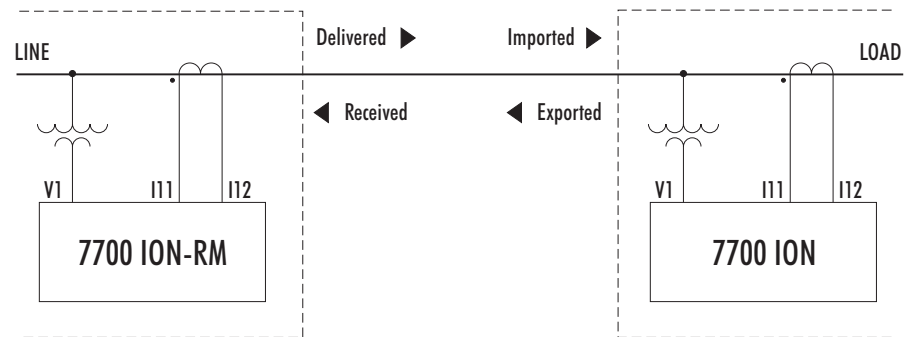
The RMSEAL option provides a factory installed anti-tamper mechanical seal on the base unit. This option is only available with the 7700 ION-RMICAN model. The Revenue Meter Programming Key (RMKEY) is a device which, when inserted into a 7700 ION-RM revenue meter, disables the meter's security systems to facilitate programming.

Differences between Standard and RM Models

The 7700 ION-RM differs from the standard (non-revenue) 7700 ION meter: additional modules for revenue calculations and new energy output register labels have been added to the 7700 ION-RM firmware.

Revenue Meter Energy Output Register Labels

The revenue and non-revenue meters differ in how they label energy flow: standard 7700 ION (non-revenue) meters use the terms “imported” and “exported” energy, 7700 ION-RM (revenue) meters use the terms “delivered” and “received” energy.



The energy output register labels of the 7700 ION-RM follow the revenue metering terminology; the energy labels for kVAh, kVARh and kWh are different from the non-revenue devices as follows:

- ◆ “imp” is “del”
- ◆ “tot” is “del+rec”
- ◆ “exp” is “rec”
- ◆ “net” is “del-rec”

For example, the 7700 ION’s output register “kVARh tot” will be “kVARh del+rec” in the 7700 ION-RM. A complete list of output registers is given in Chapter 2 for the non-revenue version of the 7700 ION.

Additional Revenue Metering Functions

There are 20 additional modules incorporated into the frameworks of the 7700 ION revenue meters. Some of these modules are used in the calculation and logging of both V^2h and I^2h (used for transformer and line loss compensation). The additional modules are as follows:

- ◆ 7 Integrator modules
- ◆ 4 AND/OR modules
- ◆ 2 External Pulse modules
- ◆ 1 Arithmetic module
- ◆ 1 Data Recorder
- ◆ 4 Pulser modules
- ◆ 1 External Boolean module

With the addition of these revenue-based modules, the overall processor power used by the device (Diagnostic module’s *Prc Pwr Used* output register) is approximately 94%.

Security Mechanisms

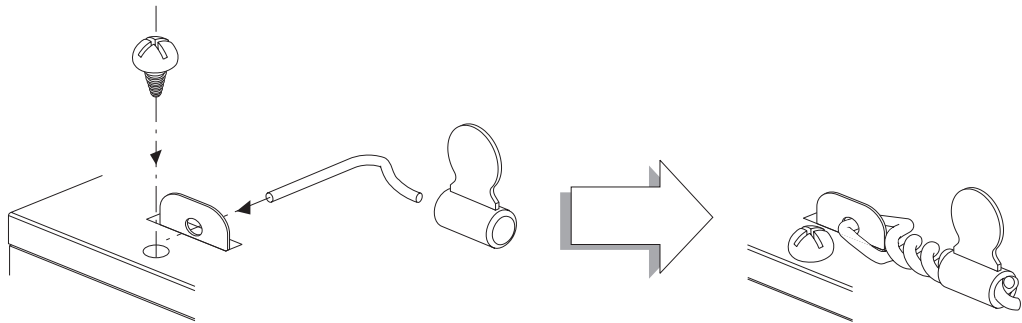
To meet Government regulations and Utility security requirements, the 7700 ION-RM revenue meter incorporates three types of security systems:

- ◆ a traditional “anti-tamper” mechanical seal on the 7700 ION base module
- ◆ a password-based security system that permits password protected minimum/maximum resets (for example, Sliding Window Demand reset)
- ◆ a hardware-based security system that uses the RMKEY programming key

Traditional “Anti-Tamper” Seals

The top panel of the 7700 ION-RM model has two tabs where you can apply a revenue seal. When utilized, these lead/wire seals effectively prevent unauthorized personnel from gaining access to meter internals. These seals are supplied by the meter owner, and are installed as follows:

1. Ensure that the top panel of the 7700 ION_RM device is in place and the four screws are fastened.
2. Insert the wire through the hole on one of the seal tabs protruding through the top panel.



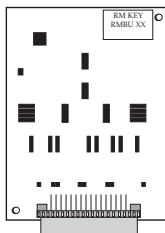
3. Twist the wire and crimp your lead sealing tab onto the wire.

Password Protected Min/Max Register Resets

The 7700ION meter front panel (MGT display panel) incorporates a password that must be entered in order to reset any of the minimum/maximum register values. The password must therefore be used to reset peak demand register values.

Hardware-based Security

The RMKEY



The 7700 ION-RM revenue meter is equipped with a comprehensive security system that provides protection against unauthorized alteration or tampering of “revenue-related” quantities. This security system “locks” all revenue-related ION modules, ION links and ION setup-registers. Of particular importance is the fact that basic meter configuration parameters including volts mode (service-type), PT ratio, and CT ratio are locked. These locks are automatically enabled (at the factory) for all 7700 ION-RM meters.

Revenue Meter Programming Key (RMKEY)

The Revenue Meter Programming Key (RMKEY) is a 3”x 4” (76mm x 102mm) circuit board. When the RMKEY is inserted into the 7700 ION-RM Revenue Meter, the key disables the meter security systems to facilitate programming prior to sealing (see “Configuring the 7700 ION-RM” below). Utility meter shop personnel who wish to program the meter in-house use this key. Each utility purchases one RMKEY (if desired users can purchase a spare key) which can be used in any 7700 ION-RM Revenue Meter.

Protected Quantities and Modules

Protected Quantities

- ◆ kWh (delivered, received, delivered + received, delivered – received)
- ◆ kVARh (delivered, received, delivered + received, delivered – received)
- ◆ kVAh (delivered, received)
- ◆ kW demand (predicted, TD, TD min, TD max, SW, SW min, SW max)
- ◆ kVAR demand (predicted, TD, TD min, TD max, SW, SW min, SW max)
- ◆ kVA demand (predicted, TD, TD min, TD max, SW, SW min, SW max)
- ◆ Digital Output #1 (kWh del pulse)
- ◆ Digital Output #2 (kWh rec pulse)
- ◆ Digital Output #3 (kVAh del pulse)
- ◆ Digital Output #4 (kVAh rec pulse)
- ◆ V²h and I²h

Protected or “Locked” Modules

- ◆ Power Meter Module.
- ◆ Integrator Modules #1 to #16 inclusive.
- ◆ Sliding Window Demand Module #1 to #3 inclusive.
- ◆ Thermal Demand Module #1 to #3 inclusive.
- ◆ Minimum Module #27 to #32 inclusive.
- ◆ Maximum Module #27 to #32 inclusive.
- ◆ External Pulse Modules #1, 3, 4, 7, 9, 19.
- ◆ External Boolean Modules #1, #3, and #5.
- ◆ Arithmetic Module #1.
- ◆ AND/ OR Modules #1 to #4 inclusive.
- ◆ Periodic Timer #1.
- ◆ Pulser Modules #1 to #4 inclusive.
- ◆ Data Recorder Module #1.



NOTE

Any of the locked modules cannot be deleted, even with the RMKEY inserted.

Configuring the 7700 ION-RM

When enabled, the 7700 ION-RM security system prevents unauthorized alteration of revenue-related quantities. Refer to the previous section, “Security Mechanisms” for details. By default, all 7700 ION-RM meters are shipped from the factory with the security system enabled. The following sections describe the steps required to configure a 7700 ION-RM meter.

Safety Precautions

Before attempting to remove the back plate of the 7700 ION-RM, ensure that the device is protected against static-electric discharge. To prevent damage to the unit, wear an anti-static wrist strap at all times.



During normal operation of the 7700 ION, hazardous voltages are present which can cause severe injury or death. These voltages are present on the terminal strips of the device and throughout the connected potential transformer (PT), current transformer (CT), status input, relay, and control power circuits. Installation and servicing should be performed only by qualified, properly trained personnel.



CAUTION

Failure to replace the XPRESS CARD before powering up the 7700 ION will result in loss of configuration data.

1. Open all PT fuses (or direct voltage input fuses) and close all CT shorting blocks. Turn off all power to the 7700 ION-RM and disconnect the Line and Neutral (or DC power) wires from the Supply Power inputs to the unit.
2. 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. Ensure that all cables still connected to the 7700 ION-RM are **NOT** live.

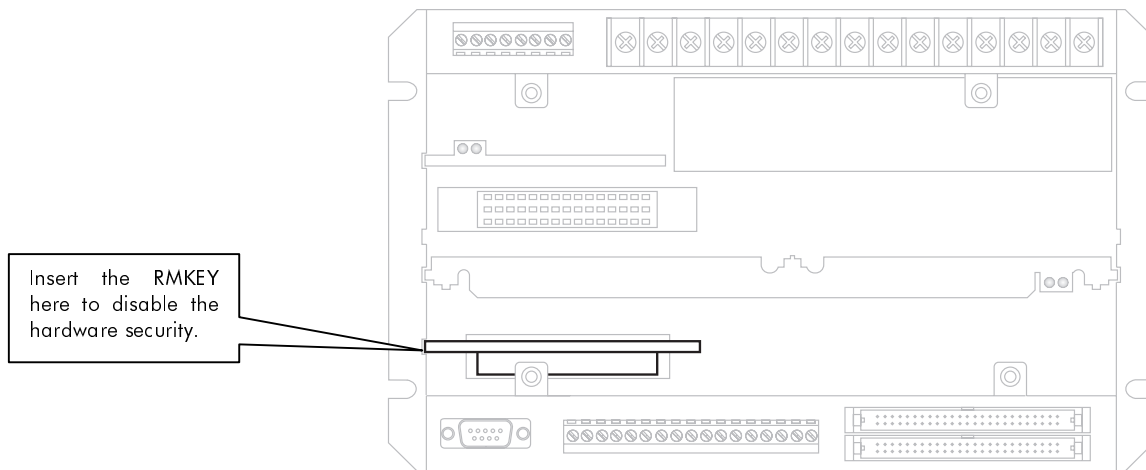
Configuration Procedure

Before configuring the 7700 ION-RM, ensure that adequate safety precautions have been exercised (see above).



The components inside the 7700 ION-RM are extremely sensitive to electro-static 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 7700 ION-RM warranty.

1. Remove the anti-tamper wire seals and four chassis screws on the top panel and set the top panel aside. If an Analog Input Card (AUX card) is presently installed, carefully remove it and set aside on a static-protected surface.
2. Hold the RMKEY by the sides and insert it into the VAUX slot as shown in the following diagram:



Insert the RMKEY here to disable the hardware security.

3. If your 7700 ION is equipped with an XPRESS CARD, you must re-insert the card (i.e., place the lid back on) or you will lose configuration data.
4. Power Up the 7700 ION, and configure the meter as required (Service type, PT and CT ratios, Pulse outputs, etc.). Remove control power from the 7700 ION-RM. Remove the RMKEY and replace the top panel and screws. Re-apply the anti-tamper seals.

CT & PT Selection

Consult your local Revenue Metering authorities to obtain standards for CT and PT selection for revenue metering applications.

Checklist for Factory-Sealed 7700 ION-RMICAN

COMPANY:	CONTACT NAME:
STREET:	PHONE:
CITY:	FAX:
PROVINCE:	P.O. NUMBER:
POSTAL CODE:	INDUSTRY CANADA REGISTRATION # * :

The following information **MUST** be supplied at time of order:

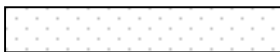
Service Type (select one)	<input type="checkbox"/> 2-Element 3-Wire DELTA (Volts Mode = DELTA)
	<input type="checkbox"/> 2 ½-Element 4-Wire WYE (Volts Mode = 3W-WYE)
	<input type="checkbox"/> 3-Element 4-Wire WYE (Volts Mode = 4W-WYE)
Voltage Transformer Ratio	<input type="text"/> : <input type="text"/> Primary/Secondary Rating (ex. 12000:120)
Current Transformer Ratio	<input type="text"/> : <input type="text"/> Primary/Secondary Rating (ex. 5000:5)
I4 Transformer Ratio	<input type="text"/> : <input type="text"/> Default = CT ratio
Voltage Input Rating (select one)	<input type="checkbox"/> 120 <input type="checkbox"/> 277
Current Input Rating	Industry Canada Class 10
Frequency	60 Hz
Auxiliary Power Input	<input type="checkbox"/> 85-240 VAC / 110-300 VDC <input type="checkbox"/> 20-60 VDC
Demand Parameter (select multiple)	<input type="checkbox"/> kW DEMAND <input type="checkbox"/> kVAR DEMAND <input type="checkbox"/> kVA DEMAND
Demand Method (select one)	<input type="checkbox"/> THERMAL DEMAND <input type="checkbox"/> SLIDING WINDOW DEMAND
Demand Period (select both)	<input type="text"/> MINUTES Length of Period TIMES (x) <input type="text"/> NUMBER of Sub-Periods (UPDATE)
Demand Synchronization Method	SYNC to Internal Clock
Mounting Type	Panel Mount
Energy Pulse Outputs (requires optional IOCA card and relay modules)	Output A0 = <input type="text"/> kWh/PULSE <input type="text"/> Specify Del, Rec, Del+Rec
	Output A1 = <input type="text"/> kVARh/PULSE <input type="text"/> Specify Del, Rec, Del+Rec
	Output A2 = <input type="text"/> kVAh/PULSE <input type="text"/> Specify Del, Rec, Del+Rec
	Output A3 = <input type="text"/> kVAh/PULSE <input type="text"/> Specify Del, Rec, Del+Rec
	Rollover <input type="text"/> Default = 1,000,000 <input type="text"/> Pulse Width (ms); Default = 20ms
Nameplate Information	OWNER INFO: <input type="text"/>
PLEASE PRINT CLEARLY	INFO 2: <input type="text"/>
	METER TAG #: <input type="text"/>

* Revenue Meters are factory-sealed for use in Canada only. All Revenue Meters must be registered with the regional *Industry Canada Legal Metrology Branch* office. This registration process is the responsibility of the end customer or main contractor, and results in an *Industry Canada* "E" number being issued for each energy/demand meter. Utility customers can use a meter tag number in place of an "E" number.

Data Recorder #1 (Sealed)

Fill in the parameters to be recorded by the Data Recorder module #1.

Channel 1 Parameter =	(DEFAULT = V_{LN} avg)
Channel 2 Parameter =	(DEFAULT = I_{LN} avg)
Channel 3 Parameter =	(DEFAULT = kW total)
Channel 4 Parameter =	(DEFAULT = kVAR total)
Channel 5 Parameter =	(DEFAULT = kVA total)
Channel 6 Parameter =	(DEFAULT = PF Signed total)
Channel 7 Parameter =	(DEFAULT = FREQ)
Channel 8 Parameter =	(DEFAULT = kWh import)
Channel 9 Parameter =	(DEFAULT = kWh export)
Channel 10 Parameter =	(DEFAULT = kVARh import)
Channel 11 Parameter =	(DEFAULT = kVARh export)
Channel 12 Parameter =	(DEFAULT = kVAh total)
Channel 13 Parameter =	User Selectable (CNT #1)
Channel 14 Parameter =	User Selectable (CNT #2)
Channel 15 Parameter =	User Selectable (CNT #3)
Channel 16 Parameter =	User Selectable (CNT #4)



Recorder Depth (Default = 100 records = 1 day)

Suggested Alternatives:

960 records = 10 days

1920 records = 20 days

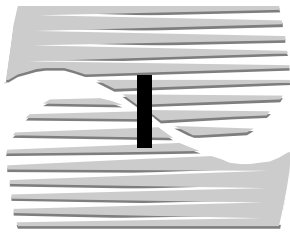
2880 records = 30 days



Recorder Interval (Default = 15 minutes)

Notes

1. For compatibility with the UTS MV-90 billing software, Data Recorder #1 must be configured as a 16-channel recorder.
2. Data Recorder #1 is locked when it is sealed. Channel assignments must therefore be specified **prior** to sealing.



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