
ION® 7700

# *Intelligent Metering and Control Devices*

For use by industrial sites, commercial facilities, utilities, power marketers, and energy service companies, the ION 7700™ meter offers incredible flexibility and functionality by combining high-accuracy, revenue certified power and energy measurements, plus an extensive variety of I/O combinations for universal metering. Detailed power quality analysis features keep you informed about your power distribution system.

Integrate the meter with our ION Enterprise™ software or other energy management and SCADA systems through multiple communication channels and protocols.

Patented ION® technology lets you customize metering or analysis functions at your workstation, without any hard-wiring. Just graphically link a few drag-and-drop icons, or select default setups, and you're ready to go.

## *Applications Summary*

### Power Quality Analysis
Discover the sources of power quality events, harmonics, and voltage sags/swells. Analyze problems and avoid repeat interruptions.

### Cost Allocation and Billing
Determine cost centers, identify opportunities for demand control and check energy consumption patterns. Use comprehensive multi-year scheduling and time-of-use activity profiles.

### Demand and Power Factor Control
Avoid penalties with automated load shedding, scheduling, peak shaving or capacitor bank control.

### Load Studies and Circuit Optimization
Determine the capacity of your electric network and run at peak efficiency. Perform load trending.

### Equipment Monitoring and Control
Improve process yields and extend equipment life. Meter all your utilities including gas, steam, water and more.

### Preventative Maintenance
Set up alarms to warn of pending problems. Log events and alarms for all critical conditions.

## *Features Summary*

### Measurements
- Revenue certified
- Instantaneous voltage, current, frequency, power factor
- Energy: bi-directional, absolute, net
- Demand: rolling block, predicted, thermal
- Harmonics: individual and total harmonic distortion up to the 63rd
- Sag/swell recording

### Communications
- Optional built-in modem with ModemGate™ to allow modem access for 31 other devices
- Optional 10Base-T or 10Base-FL Ethernet port with EtherGate™ for direct data transfer from Ethernet to RS-485
- Modbus™ RTU and DNP 3.0 protocol support

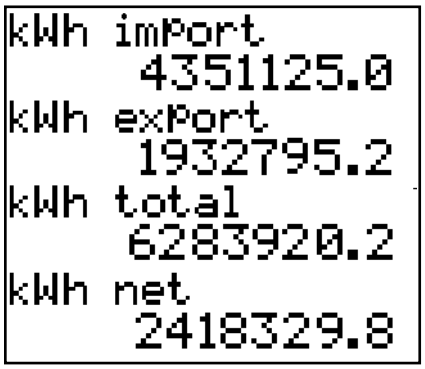
### On-Board Data Logging
- Scheduled or event-driven logging of up to 320 parameters
- Sequence-of-events and min/max logging

### Setpoints for Control and Alarms
- Setpoint on any parameter or condition
- 1 second or 1 cycle operation

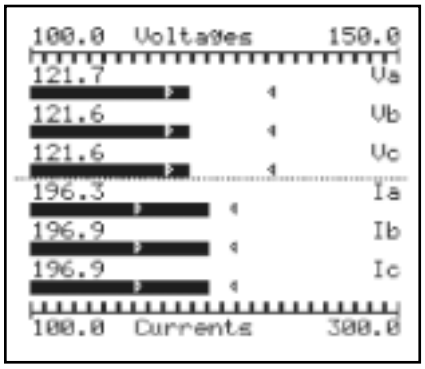
### Digital Inputs and Outputs
- 4 optional analog inputs
- 8 digital inputs
- Up to 30 addition I/O points can be ordered

POWER MEASUREMENT

Energy Display




Multiple display formats are available, including bar graphs with min/max indicators




View Time-Of-Use data via the front panel


## Front Panel Display

The ION 7700 meter can be enhanced with an optional MGT, (Modular Graphics Terminal). The MGT features bright back lighting and adjustable contrast.

A wide selection of character sizes enhance visibility under difficult lighting conditions or at long distances. It provides a choice of 24 customizable screens (you choose the parameters and the format) and offers password protection.

## Metering

The ION 7700 meter offers a comprehensive set of high-accuracy metering and recording functions.

### Energy

The unit is fully bi-directional and meters energy in four quadrants. It provides active, reactive and apparent energy parameters and can integrate any instantaneous power parameter to supply measurements like:

- kWh delivered
- kWh received
- kWh net (delivered - received)
- kWh total (delivered + received)
- kVARh, kVAh delivered
- kVARh, kVAh received
- kVARh, kVAh net (delivered - received)
- kVARh, kVAh total (delivered + received)
- Volt-hours
- Amp-hours
- Integration of any instantaneous measurement

Energy registers can be logged automatically on a programmed schedule.

### Demand

The ION 7700 meter supports all standard demand calculation methods, including rolling block, thermal (exponential), and predicted demand. It can be configured to measure demand on any instantaneous value and can record peak (maximum) and minimum demand with accurate date and time stamps to the second. Peak demand registers can be reset manually (password protected) or logged and reset automatically on a programmed schedule. Measurements include:

- kW demand, min/max
- kVAR demand, min/max
- kVA demand, min/max
- Amps demand, min/max
- Volts demand, min/max
- Demand on any instantaneous measurement

### Time-Of-Use

- 2 year internal calendar
- Up to 15 daily tariff profiles
- Programmable triggers
- Separate energy and demand accumulators

### Instantaneous

The ION 7700 meter offers a comprehensive array of instantaneous (real-time) measurements, including a choice of high accuracy, 1 second or high-speed, 1 cycle measurements, including true RMS, per phase and total/average for:

- Voltage
- Current
- Active power (kW)
- Reactive power (kVAR)
- Apparent power (kVA)
- Power factor
- Frequency
- Voltage and current unbalance
- Phase reversal

### Universal Metering

Accepts input pulses from gas, water, steam, or other metering equipment. Converts pulses into actual consumption values.

## Power Quality Metering

### Waveform Recording

It can simultaneously capture all voltage and current channels, including:

- Sub-cycle disturbance capture
- Up to 14 cycles at 128 samples/cycle
- Up to 96 cycles at 16 samples/cycle
- Record back-to-back waveforms for up to several seconds
- Display and compare multiple waveforms in ION Enterprise software

### Outage Detection

Advanced setpoint capabilities permit the detection, recording, and real-time reporting of outages, including duration, date, time, and relation to other system conditions.

### Out-of-Limit Detection

The meter offers accurate and reliable setpoint capabilities for the detection, recording, and real-time reporting of frequency variations, voltage or current phase imbalances, loss of voltage or current phase, power factor variations, overvoltages or undervoltages, etc.

### Performance Indicators

The unit can be configured to meter a wide range of utility performance indicators, including:

- Total outage time (in seconds)
- Out-of-tolerance duration for total harmonic distortion, voltage, frequency, power factor and hundreds of other definable indices

### Harmonic Distortion Metering

Complete harmonic distortion metering, recording and real-time reporting, up to the 63rd harmonic, for all voltage and current inputs.

- Individual harmonics
- Total even harmonics
- Total odd harmonics
- Total harmonics (even + odd)
- K-factor on current inputs

### Disturbance Detection

High-speed setpoint capabilities allow reliable detection and recording of events, sequence-of-events, and alarm conditions, including magnitude, duration and equipment status. Internal waveform recorders are completely configurable and can record all voltage and current inputs simultaneously. Control the number of pre-event and post-event cycles recorded. Trigger waveform recording with events, external inputs, or manual control.

### Sag/Swell Detection

Monitor and record disturbances caused by poor power quality.

- Magnitude and duration data suitable for plotting on voltage tolerance curves
- Determine the amount of excess or deficient energy during the disturbance
- Per phase triggers for waveform recording or control operations

### Symmetrical Components

Zero, negative and positive sequences including phase and magnitude for voltage and current inputs. Identify harmful voltage and current unbalances in equipment before they cause damage.

### Transient Capture

- Detect and record sub-cycle transients as short as 130µs at 60Hz (156µs at 50Hz)
- Analyze transients by plotting them on a voltage tolerance (e.g. CBEMA) curve using PC-based ION Enterprise software

## *Data and Event Recording*

The meter can be equipped with up to 4 MB of meter-based nonvolatile memory, ensuring important data is never lost, even in the event of communication or power loss.

### Load Profiling

The ION 7700 meter incorporates 320 channels via 20 data recorders. Channel assignments are configurable for historical trend recording of energy, demand, voltage, current, power quality, or any other measured parameter. Trigger recorders on a time interval basis, a calendar schedule, by alarm/event condition, or manually.

### High-Speed Data Recording

Use high-speed "burst" recording (as fast as 1-cycle intervals) to store detailed characteristics of disturbances or outages. Trigger recording by a user-defined setpoint, or from external equipment. Gated recording logs data only during the critical event so that memory is conserved.

### Coincident Min/Max Recording

Log the values of key parameters or equipment conditions coincident with an extreme condition, complete with date/time stamping. For example, record all feeder voltages and currents at the moment a peak demand condition occurs.

### Power Quality Recording

Use ION Enterprise software to automatically upload disturbance waveforms, sag/swell data, and harmonic distortion measurements from the meter to the secure database for detailed visual analysis at your workstation.

### Time Synchronization and GPS

A real-time clock allows internal events and data records to be date-stamped and time-stamped to millisecond resolution. The clock can be synchronized to either of two sources:

- The meter's internal crystal (+/- 50ppm)
- An external GPS receiver with an accuracy of +/- 1 millisecond

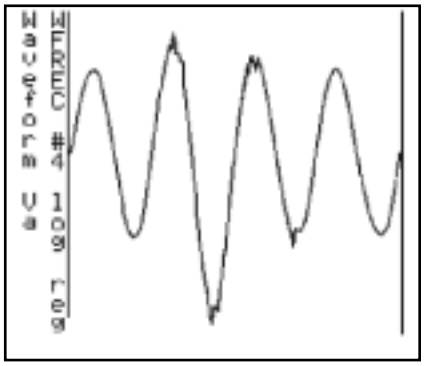
When using GPS time synchronization, either pre-selected serial port is dedicated exclusively as a GPS synchronization input.

## *The Power of ION*

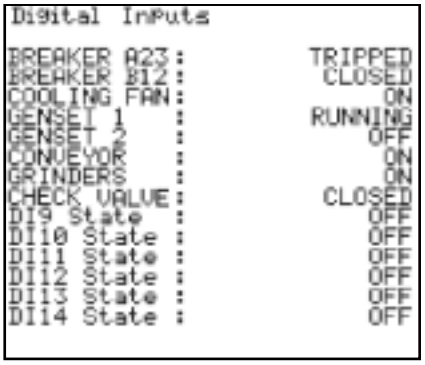
The ION 7700 meter is based on our patented object-oriented ION® technology, which ensures the longevity of your metering solution because it can adapt as your needs change and lets you take advantage of our ongoing advances in technology.

The measurements and other functions of the ION 7700 meter are provided by ION modules. You can quickly add or rearrange functions with drag-and-drop icons and a few clicks of a mouse. Imagine new features and build them with ION.

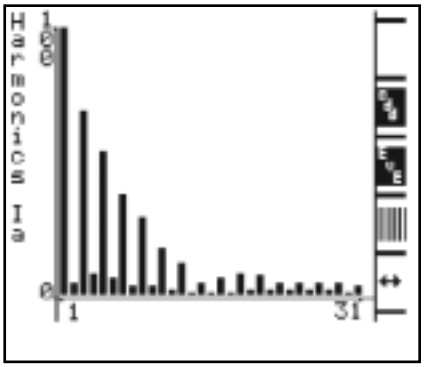
View waveforms right at the front panel



Define custom labels for digital input status like "Breaker 5 open"




Odd, even or total harmonics, up to the 31st or 63rd.



## Logic, Math and Control

Sophisticated logic and mathematical functions let you perform on-board calculations on any measured value. Calculate true quantities from pulse inputs (e.g. BTU calculations) and transformer loss compensation values. You can also implement real-time billing schemes.

### Mathematical Functions

Define formulas using the following operators:

- Arithmetic (+, x, -, ÷)
- Comparison (>, <, =, ≥, ≤, ≠)
- Logical (AND, OR, NOT, TRUE, FALSE, IF)
- Trigonometric (SIN, COS, TAN, ASIN, ACOS, ATAN)
- Math (PI, SQRT, POWER, SUM, SUMSQ, AVG, RMS, LOG10, LN, MAX, MIN)
- Thermocouple linearization

### Programmable Logic and Setpoint Control

24 setpoints can be configured for 1-second or 1-cycle operation. Setpoint can be triggered by any over or under condition you specify.

Use setpoints to trigger:

- Audible (through software) and visible alarms
- Modem/pager dial-back
- Data logging
- Waveform recording with control over pre-event and post-event capture
- Relay control
- Clearing and reset functions
- Relative setpoints

## Inputs/Outputs

The analog and digital I/O capabilities of the ION 7700 meter allow you to monitor a wide range of conditions, such as flow rates, device cycles (RPM), fuel levels, oil pressures and transformer temperatures. You can output energy pulses to an RTU or perform equipment control operations.

### Internal Analog Inputs

Four optional analog inputs accept 0–1mA, 0–20 mA, 0–1V, or 0–10V signals.

### Status Inputs

Eight optically isolated digital inputs can monitor status or count pulses from any external "volts free" dry contact. Count transducer pulses or breaker trips.

### Expandable I/O Options

- 1 or 2 optional I/O expansion boards
- Each board supports up to 15 I/O devices
- Contact Power Measurement for I/O combinations supported

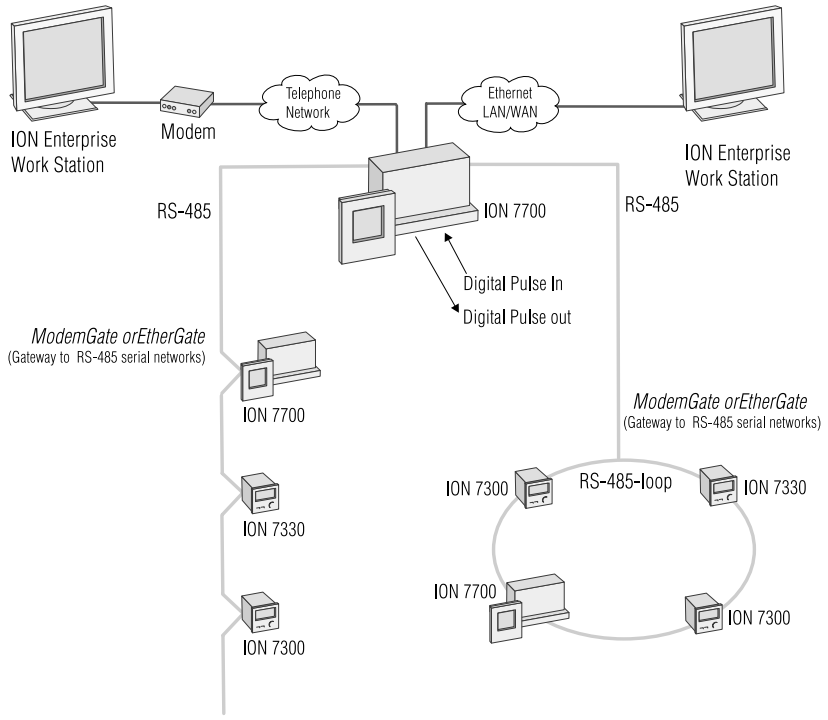
## Software Integration

With its extensive communication capabilities, the ION 7700 can be integrated into energy management or distribution control systems.

### ION Enterprise

The meter is compatible with our Windows 2000 based ION Enterprise power monitoring software. The software displays real-time and logged data and offers manual control/configuration capabilities. ION Enterprise software provides enterprise-wide data sharing in a secure networked environment.

Multiport Communications




## Communications

### Standard Communication Card

Optically isolated, transient protected RS-232C or RS-485port

- Protocols: ION, Modbus RTU, GPS
- Baud rate: Up to 19,200 bps

### Internal Modem

- Optional internal telephone modem features fast connect time, and ModemGate, a gateway letting up to 31 additional devices share a meter's internal modem via the Com 1 port. Supports ION and Modbus RTU protocols up to 19.2 kbps.

### Xpress Card™ for Multi-Port, Multi-Protocol Access

The optional Xpress card offers up to 3 additional communications ports for secure, simultaneous data sharing with utility systems and customers directly at the hardware level using a choice of communication standards and protocols.

In addition, the Xpress Card supports up to 3 MB of expansion memory for data, waveform and event logs.

### Port 1: RS-485

- Protocols: ION, DNP 3.0, Modbus RTU, GPS or Ethergate 1*
- Baud rate: Up to 115.2 kbps

### Port 2: RS-485

- Protocols: ION, DNP 3.0, Modbus RTU, GPS or Ethergate 2*
- Baud rate: Up to 115.2 kbps

### Port 3: Ethernet (10Base-T or 10Base-FL)

- Protocol: ION or Modbus RTU over TCP/IP
- Data rate: 10 Mbps

** EtherGate provides a gateway between Ethernet and RS-485 serial networks.*

### Alarm Dialing

When equipped with the internal modem, Alarm Dialing allows the meter to contact the ION Enterprise monitoring station when an Event occurs. The ION 7700 meter can also send an alphanumeric message to a pager without ION Enterprise. Contact us for external modem requirements.

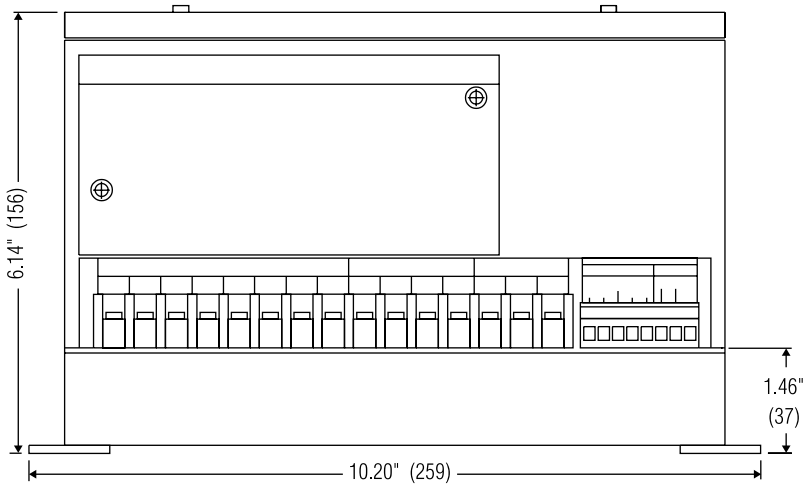
### Flash-Based Firmware

- Perform upgrades via communications without removing the unit from the site

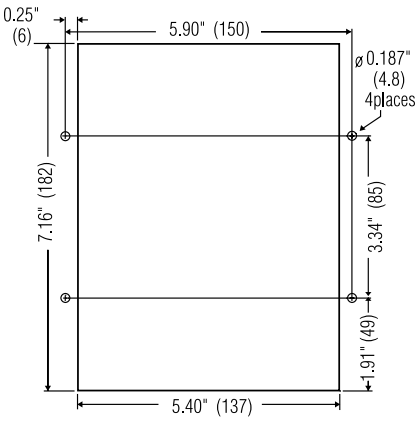
## Mounting and Dimensions

- The ION 7700 meter can be flush-mounted.
- The MGT can be panel-mounted up to 200 ft. (61 m) from the unit. A single cutout is required with 4 inches (10 cm) of clearance behind the panel.
- I/O expansion boards can be flush-mounted up to 3 ft. (1 m) from the ION 7700; no cutouts are required.

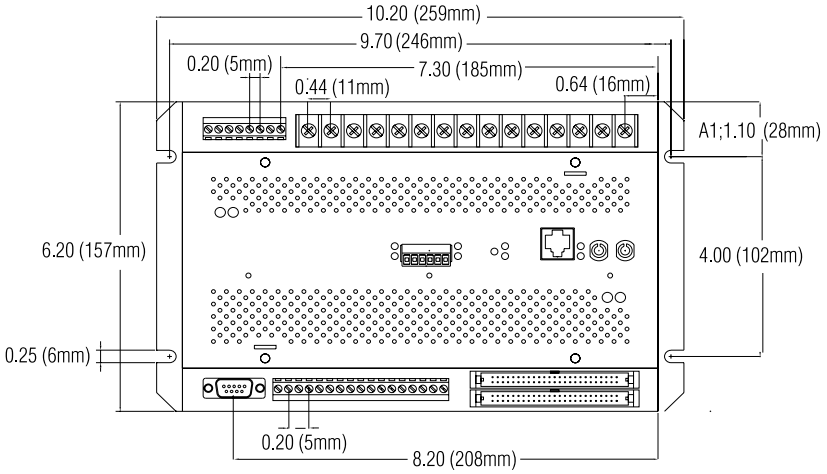
Side View



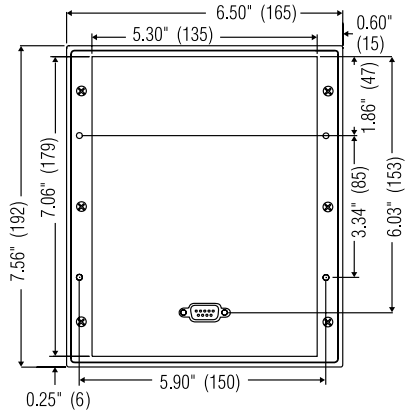

MGT Panel Cutout



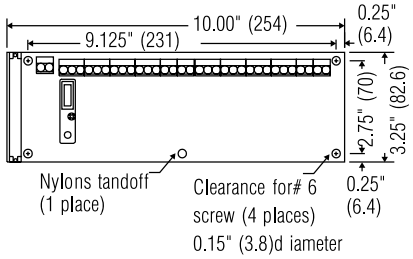

Top view with optional Xpress card installed



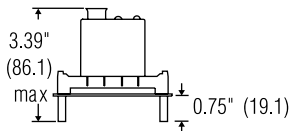

MGT Back View



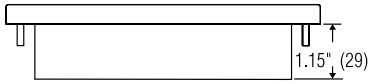

Optional External I/O, top view




Optional External I/O, end view

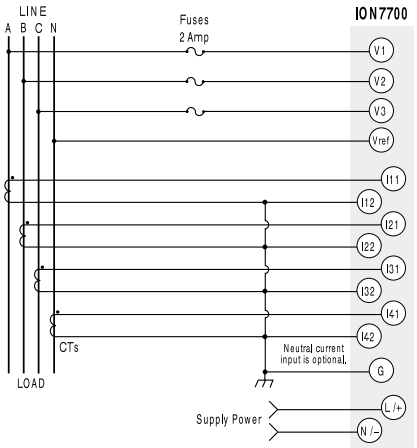



MGT Top View

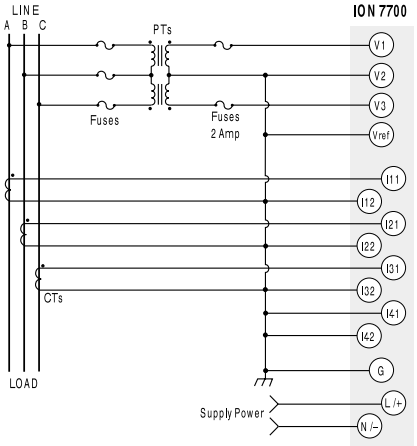


## Example Connections

4-Wire Wye (Direct Connection)




3-Wire Delta (2 PTs and 3 CTs)




## Connections

### Installation

- 4-wire Wye, 3-wire Wye, 3-wire Delta, and Single Phase systems
- 3 voltage and 4 current inputs
- Fourth current input for neutral or ground current monitoring
- All inputs pass ANSI/IEEE C37.90-1989 surge withstand and fast transient tests

### Voltage and Current Inputs

- No PTs required for Wye (Star) systems up to 347/600 VAC
- For higher voltage systems, PTs with 120 VAC secondaries may be used
- 5 Amp nominal full scale current inputs (or optional 1 Amp current inputs)

### Control Power

The ION 7700 meter can be powered from a dedicated fused feed, or from the voltage source it is monitoring (dependent on the power supply).

## Measurement Specifications

| Parameter | Accuracy ± (%reading +% FS*) 1 second |
|---|---|
| Voltage (I-n) | 0.1% + 0.01% |
| Voltage (I-I) | 0.5% + 0.01% |
| Frequency | 0.01% |
| Current† | 0.1% + 0.01% |
| kVA† | 0.2% + 0.02% |
| kVAR† | 0.55% + 0.005% |
| kVAh | 0.2% of reading |
| Power Factor at Unity PF | 0.55% + 0.025% |
| Harmonics (to 63rd) | 1% Full Scale |
| K Factor | 5% Full Scale |
| Symmetrical Components | 1% Full Scale |

** %Full scale voltage and current.* † *Reading from 5% to 125% FS.*

Display resolution meets or exceeds accuracy.

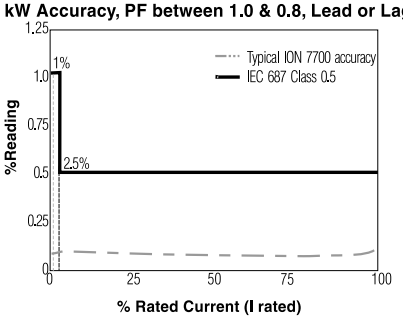
## kW and kWh Measurements

| | Accuracy* | Register Bounds kW | kWh |
|---|---|---|---|
| ANSI 12.20 Class 0.5 | 0.5% reading | 0 to ± $3.3 \times 10^7$ | 0 to ± $10^{38}$ |
| IEC 687 Class 0.5 | 0.5% reading | 0 to ± $3.3 \times 10^7$ | 0 to ± $10^{38}$ |

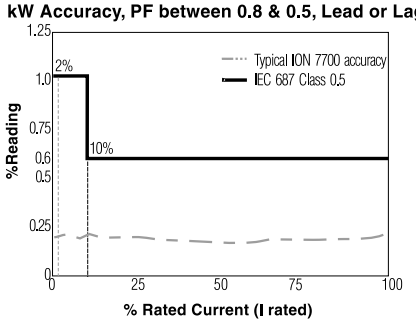
** Refer to Compliance section on page 7.*

## User Programmable Log Capacity

**kW Accuracy, PF between 1.0 & 0.8, Lead or Lag**




**kW Accuracy, PF between 0.8 & 0.5, Lead or Lag**




Example Configurations:

| | Standard Memory | | XMEM Option (extra 512K) | | Xpress - 3MEG Option | |
|---|---|---|---|---|---|---|
| Event Log | 500 Events | 500 Events | 500 Events | 500 Events | 500 Events | 500 Events |
| Data Log | 25 days A | 99 days B | 67 days A | 270 days B | 99 days A | 395 days B |
| Waveform Log | 2 C | 8 D | 6 C | 24 D | 100 C | 400 D |

A *16 parameters recorded every 15 minutes*

B *16 parameters recorded hourly*

C on each of *6 channels at 128 samples per cycle for 14 cycles*

D on each of *6 channels at 16 samples per cycle for 22 cycles*

# Specifications

## Voltage Inputs

- 120 Option: 120 VAC nominal F.S. input
- 277 Option: 277 VAC nominal F.S. input
- 347 Option: 347 VAC nominal F.S. input
- All Options: 25% overrange, overload withstand for 1500 VAC continuous, 2500 VAC for 1 second non-recurring, Input Impedance: 2 MΩ

## Current Inputs

- Basic Option: 5 Amps AC nominal F.S. input, 25% overrange
- 1AMP Option: 1.0 Amp AC nominal F.S. input, 25% overrange
- Starting current: 5mA
- 20x fault capture capability
- RMICAN and RMANSI Options (revenue metering options): 5 Amps AC nominal F.S. input, 100% overrange, 10x fault capture capability, 10mA starting current
- Overload withstand: 15 Amps continuous, 300 Amps for 1 second non-recurring Input Impedance: 2 mΩ
- Worst Case Burden at 6.25 Amps: 0.0625 VA

## Waveform Recording

- Sampling Resolution: 16, 32, 64 or 128 samples per cycle for frequencies from 20 to 70 Hz
- Resolution: 13 bits (0.0125%)

## Internal Digital Inputs

- Self-excited, dry contact, no external voltage source required
- +30 VDC differential SCOM output to S1 through S8 inputs
- Minimum Pulse Width: 1 ms
- Maximum Pulse Rate: 20 pulses/second

## Internal Analog Inputs (optional)

**0–1mA Option:**

- 1 mA DC nominal full scale input (1.25 mA DC max.)
- Overload withstand: 50 mA continuous, 100 mA for 1 second non-recurring
- Input Impedance: 49.9 Ω
- Accuracy: DC: ± (0.25% F.S. + 0.25% per Vcm) total error
- Maximum Common Mode: 8 V

**0–20mA Option:**

- 20 mA DC nominal full scale input (25 mA DC max.)
- Overload withstand: 35 mA continuous, 70 mA for 1 second non-recurring
- Input Impedance: 100 Ω
- Accuracy: DC: ± (0.25% F.S. + 0.1% per Vcm) total error
- Maximum Common Mode: 20 V

**0–1V 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: 0.25% F.S., DC: ± (0.25% F.S. + 0.13% per Vcm) total error
- Maximum Common Mode: 12 V

**0–10V 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

## External I/O Device Specifications

For detailed specifications of all supported external I/O devices, please contact Power Measurement.

## Power Supply for ION 7700

- Basic: 85 to 240 VAC/ 47 to 440 Hz or 110 to 300 VDC, 1 Amp worst case loading (56 W) at 100 VAC at 25°C (77°F)
- P24/48 option: 20 to 60 VDC at 30 W worst case

## Power Consumption for ION 7700

Typical 150 mA at 120 VAC (with no I/O Expansion boards)

## Power Supply for External I/O Board

(Required for second board. Required for first board if more than 6 analog devices are used.)

- Basic: 85 to 240 VAC / 47 to 440 Hz or 110 to 300 VDC, 0.5 Amp worst case loading (28 W) at 100 VAC at 25°C (77°F)
- P24/48 Option: 20 to 60 VDC at 30 W worst case

## Environmental Conditions

- Operating Temp: -20°C to 50°C (-4°F to 122°F) (with MGT): 0°C to 50°C (32°F to 122°F)
- Storage Temp: -30°C to 70°C (-22°F to 158°F) (with MGT): -20°C to 70°C (-4°F to 158°F)
- Humidity: 5% to 95% non-condensing

## Revenue Metering

Revenue metering options of the ION 7700 meter include:

**Protected Values**

The following values are protected from alteration:

- kWh and kVARh (import, export, net, total)
- kVAh (delivered and received)
- kW, kVAR and kVA demand (TD and SWD min and max)
- kWh, kVARh and kVAh pulse outputs
- Contents of Data Recorder #1

**Security Mechanisms**

- Anti-tamper mechanical seal on base unit
- Password protection for min/max resetting
- Hardware key required for programming revenue certified modules

## Shipping

- 15 lbs / 7 kg (includes ION 7700 meter, MGT, standard cabling, two I/O boards, one I/O board power supply)
- 17 x 10 x 10 inches (0.98 cu. ft.) 40.8 x 24 x 24 cm (0.0235 cu. m)

## Standards Compliance

- Industry Canada: Revenue metering approval #AE-0688
- Certification to ANSI C12.16-1991 standard, by an independent NRTL laboratory (Met Labs)
- Meets or exceeds IEC 687 Accuracy Class 0.5 at 25°C (77°F)
- Meets or exceeds ANSI C12.20 Accuracy Class 0.5 at 25°C (77°F)
- UL: CSA certified to UL 508 and UL 3111-1
- CSA: CAN/CSA-C22.2 No.142-M1987 and CAN/CSA-C22.2 No.1010.1
- Europe: Registered under CB Scheme to EN61010-1, certified to EN50081-2 and EN50082-2 by MET Laboratories, Inc.
- Surge Withstand: Voltage, Current, Power, Internal Digital and Analog inputs, and RS-485 ports all pass ANSI/IEEE C37.90-1989 surge withstand and fast transient tests
- FCC: Part 15 of FCC Rules for a Class A Digital Device
- Quality Assurance Certification: ISO 9002 certified by QMI

Certificate No. 002188

## Some features are optional.

To identify standard and optional features, please see the 'Product Order Forms' at www.pwrm.com.

| Features and Options List | ION 7700 |
|---|---|
| **Power Quality** | |
| Sag/Swell Monitoring | ■ |
| Symmetrical Components: zero, positive, negative | ■ |
| Transient detection, microseconds | 130 |
| Harmonics: individual, even, odd, total up to | 63rd |
| Sampling rate, maximum samples per cycle | 128 |
| Flicker, (harmonics to EN50160, IEC 6100-4-7/4-15) | |
| Configurable for IEEE 519 - 1992, IEEE159, SEMI | |
| Uptime in number of nines | |
| **Logging and Recording** | |
| Standard memory capacity | 512kB |
| Maximum optional memory capacity | 4MB |
| Min/max logging for any parameter | ■ |
| Historical logs, maximum # of channels | 320 |
| Waveform logs, maximum # of cycles | 96 |
| Timestamp resolution in seconds | 0.001 |
| GPS time synchronization | ■ |
| **Communications and I/O** | |
| RS-232/485 ports | 1 |
| RS-485 ports | 2 |
| Ethernet ports | 1 |
| Internal Modem | 1 |
| DNP 3.0 through serial and modem | ■ |
| Modbus RTU slave on serial and modem | ■ |
| EtherGate, data transfer between Ethernet and RS-485 | ■ |
| ModemGate, data transfer between internal modem and RS-485 | ■ |
| Analog Inputs | 18 |
| Analog Outputs | 30 |
| Digital status inputs/counter | 38 |
| Digital relay outputs | 30 |
| **Setpoints, Alarming, and Control** | |
| Setpoints, minimum response time | 1 cycle |
| Setpoints, number of | 24 |
| Math, logic, trig, log, linearization formulas | ■ |
| Single and multi-condition alarms | ■ |
| Call-out on alarms | ■ |
| **Revenue Metering and Standards** | |
| ANSI C12.16 accuracy compliant | ■ |
| IEC 60687 accuracy class 0.5S compliant | ■ |
| Measurement Canada Approved | ■ |
| ANSI class 10 (5A nominal, 10A max) | ■ |
| MV-90 on serial, Ethernet ports | ■ |
| Multi-year scheduling: hourly activity profiles | ■ |
| Transformer/line loss compensation | ■ |

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