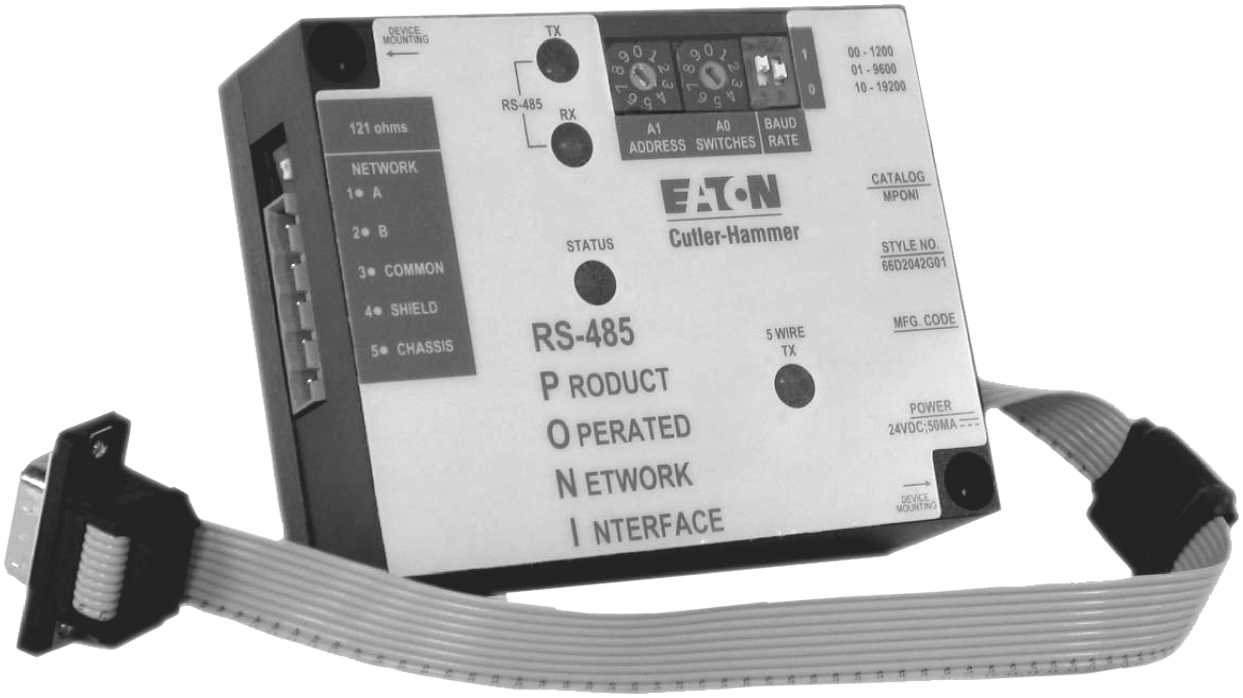
EATON | Cutler-Hammer

INSTRUCTIONS FOR THE RS-485 PONI

Instruction Leaflet 66A2070



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Introduction

The RS-485 **P**roduct **O**perated **N**etwork **I**nterface (RS-485 PONI) is a communications device that allows Eaton's Cutler-Hammer IQ Meters, IQ and MP Protective relays, and IQ Transfer switches to communicate over a Modbus RTU Network.

These host devices interface to the RS-485 PONI through their DB9 PONI interface connector. The host device provides a 24V DC voltage through the DB9 connector.

A 5-pin connector is provided for wiring to the RS-485 network. The RS-485 PONI mounts on the rear panel of the host product.

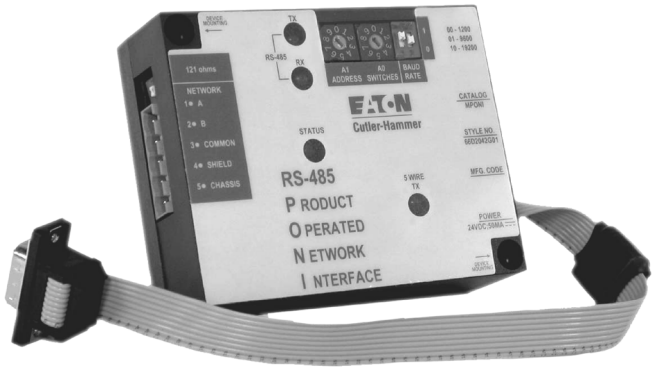


Figure 1: RS-485 PONI

Product Compatibility

The following products are supported by the RS-485 PONI. To ensure proper operation, the firmware of the host devices must be considered.

Table 1: Firmware Compatibility

IQ Host	RS-485 V1.00	RS-485 V1.01	RS-485 V1.02
IQ Analyzer	Ver. 2.02	Ver. 2.02	Ver 2.02
IQ DP-4000	Ver. 1.04	Ver. 1.04	Ver 1.04
IQ Data Plus II	Rev. 8B 6/26/95	Rev. 8B 6/26/95	Rev. 8B 6/26/95
MP-3000	Ver. 1.08	Ver. 1.08	Ver. 1.08
ATC-400	Ver. 1.40	Ver. 1.40	Ver. 1.40
IQ Transfer II	Ver. 4.5	Ver. 4.5	Ver. 4.5
MP4000	Not Supported	Not Supported	Ver. 1.06

Features

The RS-485 PONI provides the following features:

- A means of communicating using the standard Modbus RTU Protocol.
- Various baud rates are selectable for networking flexibility.
- Addresses 0-99 are selectable by way of two rotary switches.
- Status light provides indication of proper operation and also functions as an error indicator light.
- Data in IEEE Floating Point and fixed-point formats.
- Host interface communications indicator light.
- RS-485 TX/RX indicator lights.
- Termination resistor is DIP switch-selectable.

Hardware Installation

The RS-485 PONI is designed to be installed, operated and maintained by adequately trained personnel. These instructions do not cover all details, variations or combinations of the equipment, its storage, delivery, installation, checkout, safe operation or maintenance.

NOTE: De-energize the device to which the RS-485 PONI will be attached or wired; otherwise, erroneous operation or damage to equipment could occur.

The installer must comply with the National Electric Code and local codes or regulations, as well as safety practices, for this class of equipment.

1. Ensure that mounting screws and adapter bracket for the RS-485 PONI have been included.
2. Consult the Instruction Leaflet (IL) mounting instructions for each RS-485 PONI-compatible host device.

The following sections – 3a through 3f – explain common examples of mounting instructions.

3a. Mounting to an IQ Analyzer
Disconnect power to the IQ Device. Many applications will have a separately mounted power module. In this case, mount the RS-485 PONI to the IQ Device using the stacking screws provided.

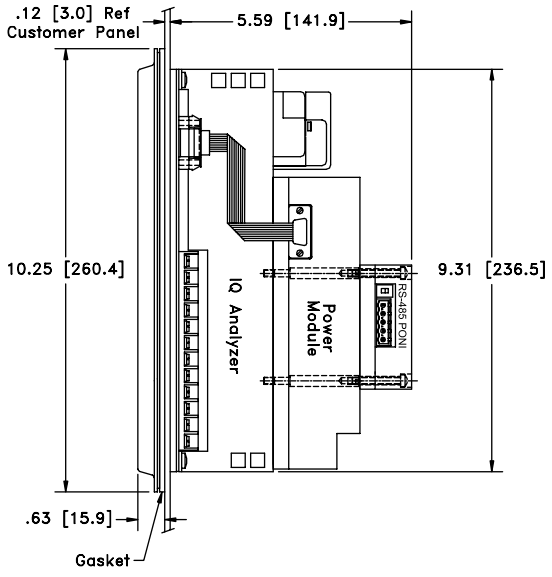


Figure2: Mounting to an IQ Analyzer

Mount the RS-485 PONI with the label facing up, the LEDs on the left, and the ribbon cable on the right.

Connect the ribbon cable from the RS-485 PONI to the receptacle of the IQ Device, shown in Figure 3 (below), and firmly tighten the screws on the plug lock assembly.

Refer to Figure 2 for dimensions.

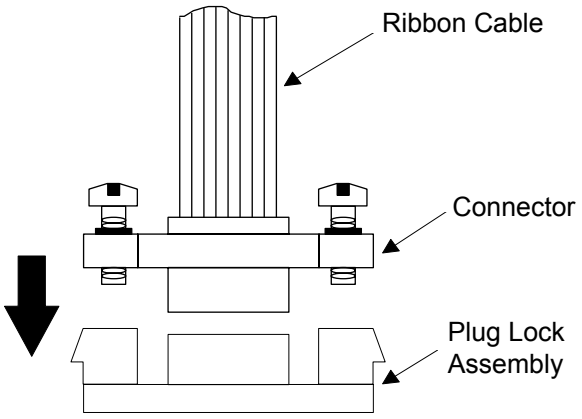


Figure 3: Attaching the Cable to the Plug Lock Assembly

A fuse change is needed on an IQ Analyzer 6000/6200 series, style style #'s 2D82302Gxx, and on IQ DP-4000's, style #'s 4D1311Gxx. While the power to the IQ device is disconnected, replace the ¼-Amp fuse with the ½-Amp fuse provided.

Restore power to the IQ device. New IQ Analyzer 6400/6600 series style #'s 66D2045Gxx, and IQ DP-4000's, style #'s 66D2040Gxx do not have external power supply fuses. These new style meters do not require the ½-Amp fuse included.

3b. Mounting to the IQ DP-4000 or IQ Data Plus II
Mounting to the IQ DP-4000 or to the IQ Data Plus II is the same as for the IQ Analyzer. Refer to IQ Analyzer instructions (in 3a) to complete the installation. Refer to Figure 4 below for dimensions.

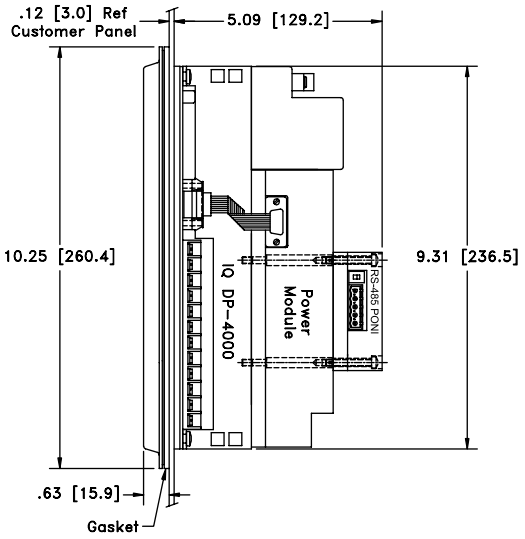


Figure 4: Mounting to a DP-4000

3c. Mounting to an MP-3000
To mount a RS-485 PONI onto the MP-3000, use the U-shaped mounting bracket and #6 32 x 1/4" pan head screws supplied with the MP-3000. Use this bracket only when a URTD is not mounted on the MP-3000. If a URTD is mounted on the back of the MP-3000, the RS-485 PONI can piggy-back directly onto the URTD. The machine screws supplied with the RS-485 PONI are then used to screw into the molded plastic mounting-holes of the URTD. Refer to the MP-3000 IL 17562x for additional information. To order this mounting bracket, use Part Number 7066C1 H01.

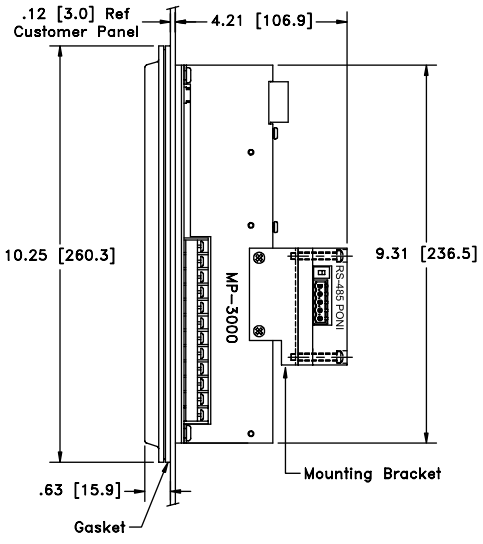


Figure 5: Mounting to an MP-3000

3d. Mounting to an MP-4000
To mount an RS-485 PONI onto the MP-4000, use the U-shaped mounting bracket and #6 32 x ¼" pan head screws supplied with the MP-4000. Use this bracket only when a URTD is not mounted to the MP-4000. If a URTD is mounted on the MP-4000, the RS-485 PONI can piggy back directly on the URTD. The machine screws supplied with the RS-485 PONI are then used to screw into the molded plastic mounting-holes of the URTD. Refer to the MP-4000 Instruction Book IB02602002E for additional information. To order this mounting bracket use part number 7066C1 H01.

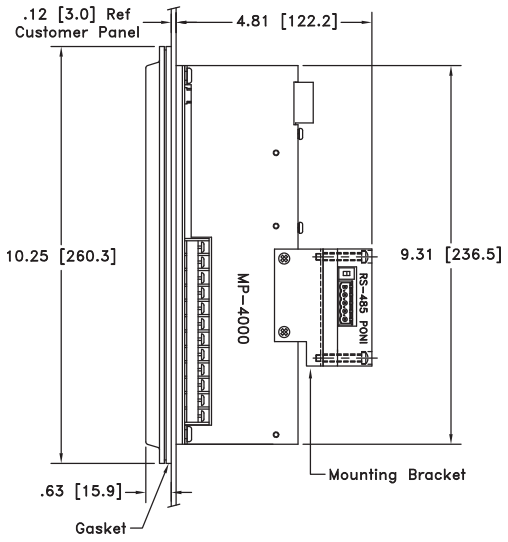


Figure 6: Mounting to an MP-4000

3e. Mounting to an ATC-400
To mount the RS-485 PONI to the rear of the ATC-400, use the stacking screws that are shipped with the RS-485 PONI. On the rear panel of the ATC-400, there are two treaded holes that are to be used for attaching PONI type devices. Refer to Figure 7.

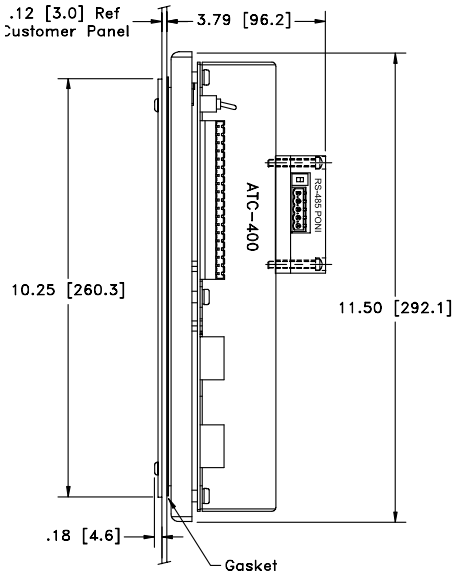


Figure 7: Mounting to an ATC-400

Mount the RS-485 PONI with the label facing up, the RS-485 connector on the left and the ribbon cable on the right, as you are facing the rear panel of the ATC-400.

Attach the ribbon cable from the RS-485 PONI to the receptacle of the IQ device, as shown in Figure 3 on Page 2, and firmly tighten the screws on the plug lock assembly.

3f. Mounting to an IQ Transfer II
To mount the RS-485 PONI to the rear of the IQ Transfer II use the stacking screws that are shipped with the RS-485 PONI. On the rear panel of the IQ Transfer II, there are two sets of threaded holes that are to be used for attaching PONI type devices.

Use either set for mounting the RS-485 PONI. Refer to Figure 8. Mount the RS-485 PONI with the label facing up, the RS-485 connector on the left and the ribbon cable on the right, as you are facing the rear panel of the IQ Transfer II.

Attach the ribbon cable from the RS-485 PONI to the receptacle of the IQ device, as shown in Figure 3 on Page 2, and firmly tighten the screws on the plug lock assembly.

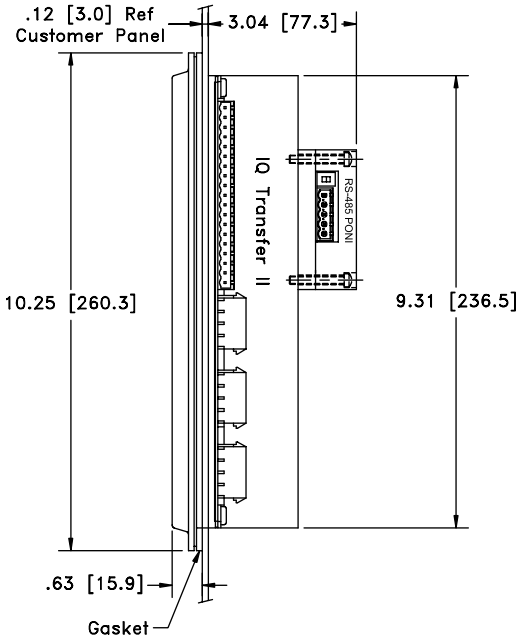


Figure 8: Mounting to an IQ Transfer II

Simplified Wiring Rules

The RS-485 PONI provides the user with a half-duplex EIA/RS-485 network connection. EIA/RS-485 is a multi-drop industrial-grade communications standard.

It is a "balanced differential" signal which uses a twisted-pair containing the "A" and "B" signals and a common. For this reason, it is very important to carry all three conductors to help ensure a high-quality communications network.

Signal Polarity
The data is considered a binary 1 when the voltage level of the “A” signal is less than the voltage level of the “B” channel. A binary 1 is considered a Mark or OFF, where as a binary 0 is a Space or ON.

Cabling
The recommended cable for maximum performance of the RS-485 network has a twisted-pair, 22-AWG stranded 7 x 30 conductors with PVC insulation under aluminum foil polyester tape, a single 24-AWG stranded 7 x 32 conductor with PVC insulation and aluminum foil polyester Tape, plus an all-over braided shield (Belden 3106A). Cables with similar shielding and smaller wire sizes (24 AWG) can be used for easier wiring. The cable characteristic impedance should be 120 ohms.

RS-485 Bus Termination
Assuming the characteristic impedance of the cable is 120 ohms, each segment of the RS-485 network should be terminated with an end-of-line terminating resistor. A resistor value of 120 ohm should be used at the Master end of the network as well at the end of the line.

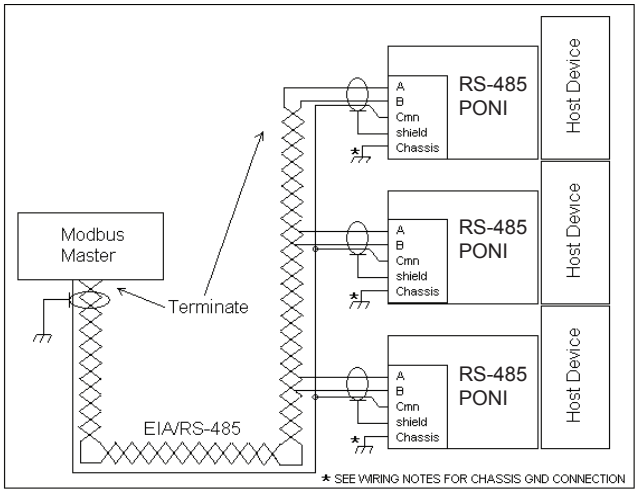


Figure 9. Typical RS-485 PONI Wiring Diagram

Connectors

RS-485 Connector
Figure 9 shows a typical Modbus network where the RS-485 PONI (Slave) and host devices are connected to the RS-485 Modbus master. A 5-pin connector pin-out assignment is as follows:

Pin	Signal
1	A
2	B
3	Common
4	Shield
5	Chassis

Wiring Notes:

1. A chassis ground connection is provided as part of the RS-485 connector. (Refer to the RS-485 Connector section on Page 4). It should be used only when mounting the RS-485 PONI to non-metallic surfaces.
2. When mounting the RS-485 PONI to host devices where the mounting surfaces are tied to the chassis ground, the “Chassis” ground connection on the RS-485 PONI should not be connected. Using the metal screws provided will ensure a proper chassis ground connection.
3. For maximum noise immunity, the chassis ground terminal should be wired to the closest system chassis ground with at least a 16AWG stranded copper wire. (See Wiring Notes 1 and 2.)
4. For maximum noise immunity, the shield of the RS-485 cable should be daisy-chained from one slave device to another and terminated to chassis ground at the Modbus master-end of the network (single-point ground).

System Capacity

The RS-485 PONI address can be set between 0 and 99 (decimal). The maximum number of RS-485 PONIs that can exist on a particular network is 99.

If Modbus slave devices other than RS-485 PONIs exist within the system, and if their address can be set above 99, the maximum number of slave devices on the network is 247.

LEDs, Rotary Switches, DIP Switches

As part of the initial setup, the baud rate, address, and termination resistor must be set to their correct settings. These switches and indicator LEDs are described as follows:

- **Status LED (µC) (Red)**
  The Status LED indicator lets the user know that the microprocessor inside of the RS-485 PONI is operating properly. It will alternate from ON for 1 second to OFF for 1 second.

  Other blinking patterns may be noticed in the event of an error detected by the RS-485 PONI. Refer to Error Detection in the Troubleshooting section on Page 6.

- **RS-485 Transmit LED (TX) (Red)**
  This LED will flash ON when the RS-485 PONI is responding to a request. The RS-485 PONI only responds to requests to its address.

- **RS-485 Receive LED (RX) (Red)**
  The RX LED will flash when the RS-485 PONI detects that a signal is being transmitted to its address.

- **121Ω Termination Dip Switch**
  The 121-ohm termination DIP switch, when switched to the ON position, places a 121-ohm resistor between the "A" and "B" terminals. This resistor should be used as an end-of-line terminator.
- **Address Selector Switches**
  There are two rotary switches that are used to set the Modbus address on the RS-485 PONI. An address from 0 (zero) to 99 decimal can be selected.
- **Baud Rate Selector Switch**
  The baud rate DIP switch is used to select the RS-485 PONI baud rate. It can be changed at any time and does not require the cycling of power.

RS-485 Baud Rate Switch		
Baud	A0	A1
1,200	Open	Open
9,600	Open	Closed
19,200	Closed	Open

Figure 10: RS-485 Baud Rate Switch

Modbus Network Communications Protocol

Function Codes

The RS-485 PONI responds to a limited number of Modbus functions codes: 03, 04, 08, and 16 (10_{16}).

Command/Data Pass-Through
The RS-485 PONI can pass host product commands/data directly through to any one of the attached host products. Thus, with access to IL 17384 – IMPACC System Communications, Parts A, B, D, and F, every INCOM product object and capability is available to the Modbus master.

IL 17384 is available at http://www.eaton.com.

When passing a command or data through to a host product, the RS-485 PONI acts as a dumb slave. Without modification, it passes the command or data through to the product.

In the event the product responds, the RS-485 PONI saves the response until the Modbus master queries for that response. The RS-485 PONI makes no modification to or interpretation of the product response data.

The Modbus master writes the INCOM product command/data using function code 16 (10_{16}) beginning at register 424577 (6000_{16}).

The data format for passing information through the RS-485 PONI to an host product is listed in Figure 11 on Page 6.

The Modbus master reads the INCOM product response to a pass-through query using either function code 03 or 04 beginning at register 424833 (6100_{16}).

The number of points (registers) of the read query is 2*nn, where nn is the number of INCOM messages in the response.

The format of the data acquired by the RS-485 PONI from the pass-through INCOM product query's response is displayed in Figure 12 on Page 7. Note that each INCOM response message contains a status byte which indicates its validity.

Control of Host Product

Since a control error could result in unwanted actions initiated by an host device, the RS-485 PONI requires a specific protocol by the Modbus master in order to perform control-related functions within the host product.

A set of registers is reserved for the control protocol. They begin at register 425089 (6200_{16}) and extend through 425091 (6202_{16}).

These three registers are written with a "slave action number" and its 1's complement using function code 16 (10_{16}). The format of the data is shown in Figure 13 on Page 8. These three registers exclusively must be written in one Modbus transaction.

If the slave action number and its 1's complement are valid, the RS-485 PONI issues the slave action control command onto the host product. If the slave action request is successfully acknowledged by the product, the RS-485 PONI returns a normal function code 16 (10_{16}) response to the Modbus master.

The Modbus master may further determine if the product completed the slave action function successfully by interrogating the product, for example, by reading its status.

If the host product does not acknowledge the slave action request, the RS-485 PONI returns an exception code 04.

If the slave action number and its 1's complement are invalid, the RS-485 PONI responds to the Modbus master with a data value illegal exception code 03. Refer to the Exception Codes section on Page 6 for more information.

Register Access Configurations

Any attempt to access a group of data objects which contain an invalid object will result in an illegal data object exception code 02.

See the *Exception Codes* section for more information. The floating point, fixed point and energy low order words are first in the Modbus register space.

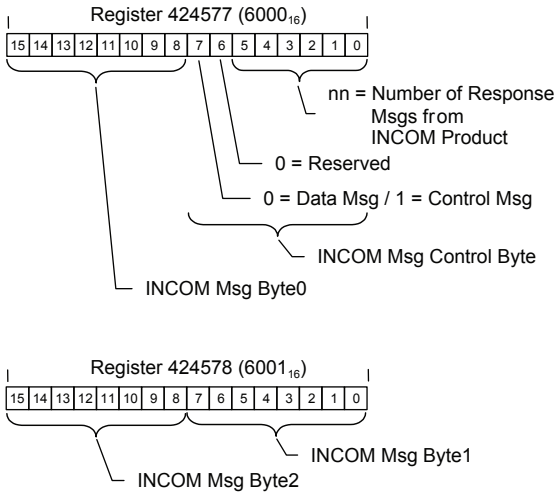


Figure 11. Pass-Through to INCOM Product Query Data Format

Energy Format

Energy objects occupy four (4) registers – register 3 through register 0. Register 3 is the high order register and register 0 is the low order register. These registers do not support IEEE floating point format.

Register 3 high byte contains a value corresponding to Engineering Units (power of 10 signed exponent). Register 3 low byte contains a Mantissa Multiplier value (power of 2 signed exponent). Register 2 through register 0 contain a 48-bit unsigned energy mantissa in units of watt-hours. The data format of these registers is provided in Figure 14 on Page 8.

Energy =

$2^{\text{Mantissa Multiplier}}$ x (48 bit unsigned energy value) x $10^{\text{Engineering Units}}$

Exception Codes

Under certain circumstances, the RS-485 PONI will return an exception code.

- If the function in the query is not supported by the RS-485 PONI, exception code 01 is returned in the response.
- If the data (object) register is illegal, exception code 02 is returned in the response.
- If the data value in the query is illegal, exception code 03 is returned.
- If the slave INCOM product fails (usually a timeout), exception code 04 is returned.
- In certain circumstances, an exception code 05 (ACK) is returned.
- If the RS-485 PONI cannot perform the requested function, exception code 07 (NACK) is returned.
- If only a partial register is used in the query, exception code 84 is returned.

INCOM Protocols

- **IL 17384 – Part A** *IMPACC Communications Standard*
- **IL 17384 – Part B** *Metering Products*
- **IL 17384 – Part D** *Motor Protection and Control*
- **IL 17384 – Part F** *Transfer Switches and //0 Devices*

Supported Diagnostic Sub-Functions

It is possible to obtain diagnostics from the RS-485 PONI or an attached INCOM product using function code 08. Refer to Table 2.

Troubleshooting

The most common issues experienced with the installation of an RS-485 PONI module are addressed as follows. If you have any questions or need further information or instructions, contact your local representative or the Power Quality Technial Support Center at 1-800-809-2772 or e-mail pqsupport@eaton.com.

- Status LED is not flashing.
  - o Verify that the 9-pin connector is plugged in.
- Modbus Rx LED is flashing, but the RS-485 PONI does not respond to master command requests.
  - o Verify that the data transfer rate is correctly set using baud rate switches (AO and AI).
  - o Verify that the communication cable is connected correctly from the master to the Modbus slave device.
  - o Verify that the Network is terminated properly.

- Five-wire Tx LED is flashing, but the module does not respond to master command requests.
  - o Verify that the communication cable is connected correctly from the RS-485 connector.
  - o Verify that the red, termination switch (SW1) is set to “ON” at the last Modbus slave device.
- Modbus Rx and TX LED are flashing, but the RS-485 PONI 5-wire LED does not flash.
  - o Most likely, the RS-485 PONI is returning an exception code to the master. See the Exception Codes section.

Table 2: Diagnostic Sub-Function Numbers

Sub-function No. # (decimal)	Name	In the query, use...
0	Echo Query	RS-485 PONI address
1	Restart Communications	RS-485 PONI address
4	Force Listen	RS-485 PONI address
10	Clear Slave Counters	RS-485 PONI address
11	UART Bus Message Count	RS-485 PONI address
12	UART Communication Error Count	RS-485 PONI address
13	Slave Exception Error Count	RS-485 PONI address
14	Slave Message Count	RS-485 PONI address
15	Slave No Response Count	RS-485 PONI address
16	Slave NACK Count	RS-485 PONI address
17	Slave Busy Count	RS-485 PONI address
18	UART Over Run Error Count	RS-485 PONI address
26	RS-485 PONI Firmware Version & Rev	RS-485 PONI address
27	RS-485 PONI Firmware Month and Day	RS-485 PONI address
28	RS-485 PONI Firmware Year	RS-485 PONI address

Error Detection Using Status LED

If the status light blinks twice in rapid ON/OFF cycles, followed by a 1.5-second OFF period, this is an indication that the product is not being recognized by the RS-485 PONI or that no product has been detected. This may result when a product firmware revision is older than that indicated in Table 1: Firmware Compatibility on Page 1.

If three blinks occur in rapid ON/OFF cycles, followed by a 1.5-second OFF period, an unsupported product has been detected. Contact Eaton’s Power Quality Technical Support Center at 1-800-809-2772 for further assistance.

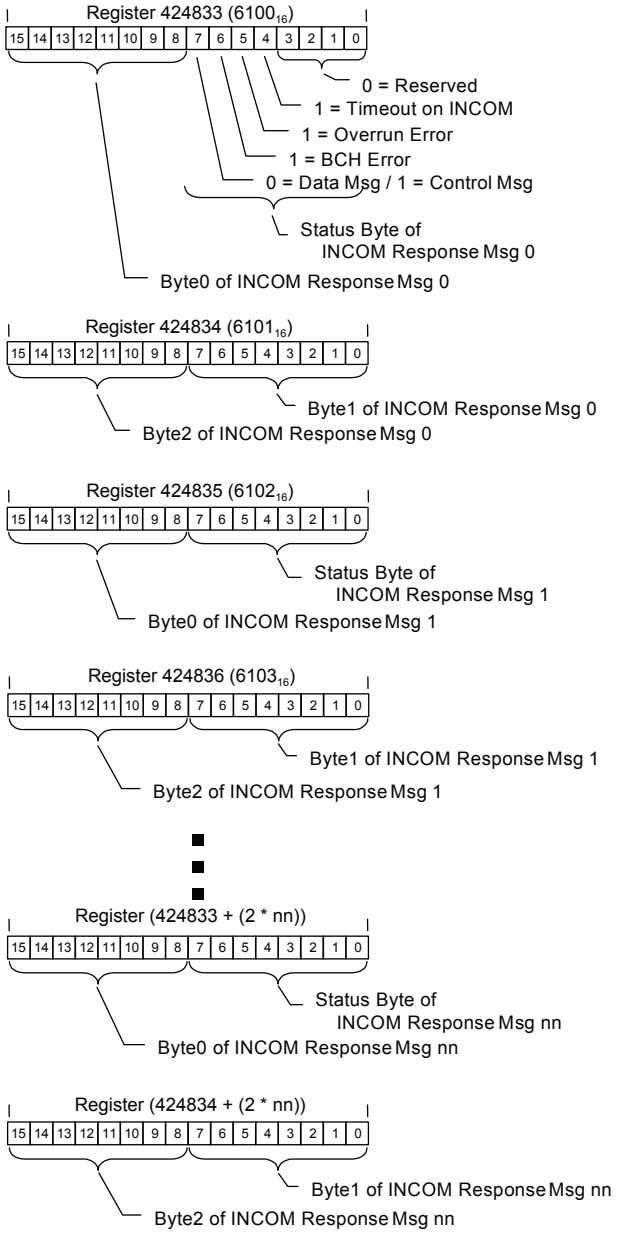


Figure 12: Pass-Through Response Data Format

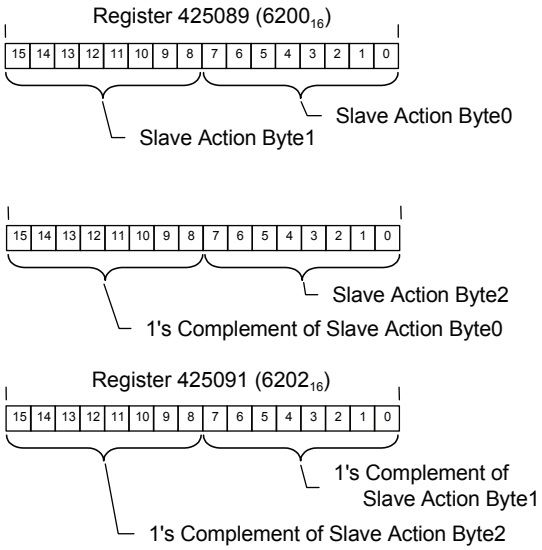


Figure 13: Control to INCOM Product Data Format

Shipping List

- RS-485 PONI 66D2042 (x1)
- Instruction Leaflet 66A2070H02 (x1)
- 5-pin Phoenix connector 9472A35H15 (x1)
- Mounting screws 70001BU25R (x2)

Safety and Compliance Standards

EMC/Safety Standards:
- UL 3111;CSA 1010.1
- CE Mark
- FCC Part 15, Class A
- EN 61000-6-2; 1999
- EN 55011; 1998

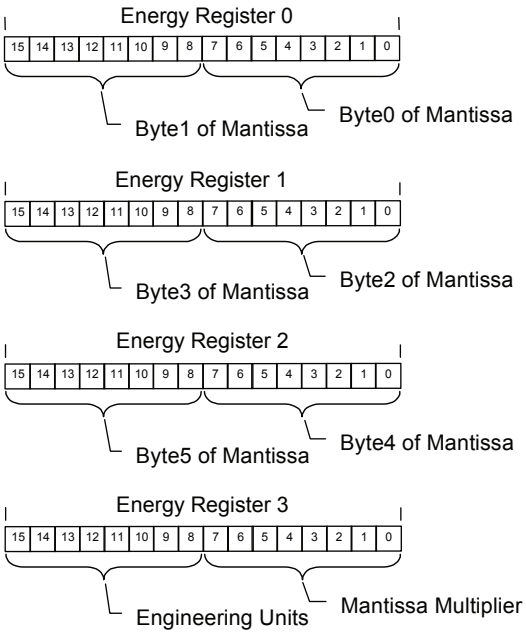
EMC Susceptibility Standards:
- EN 61000-4-2; 1995 Electro Static Discharge
- EN 61000-4-3; 1998 Radiated RF Immunity
- EN 61000-4-4; 1995 EFT and Burst
- EN 61000-4-5; 1995 Voltage Surge
- EN 61000-4-6; 1996 Conducted RF Immunity
- EN 61000-4-8; 1994 Power Frequency Magnetic Field
- ANSI C37.90.2; 1995 Radiated RF Immunity
- ANSI C37.90.1; 1989 Surge Withstand Capability

EMC Emissions Standards:
- FCC Part 15 Class A (10 meters)
- Radiated and Conducted Emissions
- EN 55011; 1998
- Radiated and Conducted Emissions

System Ratings

Operating Temperature	–20°C to 60°C
Storage Temperature	–20°C to 70°C
Altitude	3,048 m (10,000 ft.)
Operating Humidity	5% to 90% max. non-condensing
Environment	Indoor use only
Transient Overvoltage	Category 1
Pollution Degree	2
Equipment Class	3
Power Requirements	24V; 50 ma*

*The RS-458 PONI is powered by a limited source isolated from the mains by double insulation. This source must be an “SELV” voltage supply.



$$\text{Energy} = 2^{\text{Mantissa Multiplier}} * \text{Mantissa} * 10^{\text{Engineering Units}}$$

Figure 14: Energy Register Data Format

Maintenance and Care

The RS-485 PONI is designed to be self-contained and maintenance-free. The printed circuit board is calibrated and coated at the factory.

The RS-485 PONI is intended for servicing by factory-trained personnel only.

Never clean the RS-485 PONI while it is powered on. Clean the RS-485 PONI using a clean, dry cloth and ensure that the power is disconnected. Do not use water or solvents of any kind.

Appendix A – Register Maps and Code Definitions

Table 3: Modbus Register Maps

Name	Numeric	Units	IEEE-754 floating point	Fixed point	IEEE-754 floating (hex)	Fixed point (hex)	FP scale factor	DP-4000	IQ Analyzer	IQ Data Plus	IQ Transfer II	MP 3000	ATC-400	MP 4000
status (fixed point)	primary	n/a	404609 or 406145		1200 or 1800 hi		1	x	x	x	x	x	x	x
	secondary		404609 or 406145		1200 or 1800 lo			x	x	x	x	x	x	x
	cause		404610 or 406146		1201 or 1801			x	x	x	x	x	x	x
current	I_A	A	404611	406147	1202	1802	10	x	x	x		x		x
	I_B	A	404613	406149	1204	1804	10	x	x	x		x		x
	I_C	A	404615	406151	1206	1806	10	x	x	x		x		x
	I_G	A	404617	406153	1208	1808	10		x			x		
	I_N	A	404619	406155	120A	180A	10		x					x
	I_{Avg}	A	404621	406157	120C	180C	10		x			x		x
L-L voltage	V_{AB}	V	404623	406159	120E	180E	10	x	x	x	x			x
	V_{AC}	V	404625	406161	1210	1810	10	x	x	x	x			x
	V_{CA}	V	404627	406163	1212	1812	10	x	x	x	x			x
	V_{LLavg}	V	404629	406165	1214	1814	10		x					x
L-N voltage	V_{AN}	V	404631	406167	1216	1816	10	x	x	x				x
	V_{BN}	V	404633	406169	1218	1818	10	x	x	x				x
	V_{CN}	V	404635	406171	121A	181A	10	x	x	x				x
	V_{LN}	V	404637	406173	121C	181C	10		x					x
N-G voltage	V_{NG}	V	404639	406175	121E	181E	10		x					
current	peak I_A demand	A	404641	406177	1220	1820	10							
	peak I_B demand	A	404643	406179	1222	1822	10							
	peak I_C demand	A	404645	406181	1224	1824	10							
	peak I_G demand	A	404647	406183	1226	1826	10							
	peak I_N demand	A	404649	406185	1228	1828	10							
power	real 3 ph (power)	W	404651	406187	122A	182A	1	x	x					x
	reactive 3 ph	VAR	404653	406189	122C	182C	1	x	x					x
	apparent 3 ph	VA	404655	406191	122E	182E	1	x	x					x
power factor	displacement 3	n/a	404657	406193	1230	1830	100							
	apparent	n/a	404659	406195	1232	1832	100	x	x					x
frequency	freq	Hz	404661	406197	1234	1834	10	x	x	x				x
K-factor	K-factor	n/a	404663	406199	1236	1836	1		x					
THD factor	THD factor	n/a	404665	406201	1238	1838	1		x					
power	A ph	W	404667	406203	123A	183A	1		x					x
	B ph	W	404669	406205	123C	183C	1		x					x
	C ph	W	404671	406207	123E	183E	1		x					x
	reactive A ph	VAR	404673	406209	1240	1840	1		x					x
	reactive B ph	VAR	404675	406211	1242	1842	1		x					x
	reactive C ph	VAR	404677	406213	1244	1844	1		x					x
	apparent A ph	VA	404679	406215	1246	1846	1		x					x
	apparent B ph	VA	404681	406217	1248	1848	1		x					x
	apparent C ph	VA	404683	406219	124A	184A	1		x					x
power factor	displacement A	n/a	404685	406221	124C	184C	100		x					
	displacement B	n/a	404687	406223	124E	184E	100		x					
	displacement C	n/a	404689	406225	1250	1850	100		x					
	apparent A ph	n/a	404691	406227	1252	1852	100		x					x
	apparent B ph	n/a	404693	406229	1254	1854	100		x					x
	apparent C ph	n/a	404695	406231	1256	1856	100		x					x
power	peak demand	W	404697	406233	1258	1858	1	x	x					

Table 3: Modbus Register Maps (Continued)

Name	Numeric	Units	IEEE-754 floating point	Fixed point	IEEE-754 floating (hex)	Fixed point (hex)	FP scale factor	DP-4000	IQ Analyzer	IQ Data Plus	IQ Transfer II	MP 3000	ATC-400	MP 4000
source1	VAB	V	404699	406235	125A	185A	10				x		x	
	VBC	V	404701	406237	125C	185C	10				x		x	
	VCA	V	404703	406239	125E	185E	10				x		x	
	freq	Hz	404705	406241	1260	1860	10				x		x	
source 2	VAB	V	404707	406243	1262	1862	10				x		x	
	VBC	V	404709	406245	1264	1864	10				x		x	
	VCA	V	404711	406247	1266	1866	10				x		x	
	freq	Hz	404713	406249	1268	1868	10				x		x	x
power	power (real 3 ph)	W	404715	406251	126A	186A	1	x	x					x
power factor	pf	n/a	404717	406253	126C	186C	100	x	x					x
prod ID	prod ID	n/a	404719	406255	126E	186E	1	x	x	x	x	x	x	x
frequency	freq	Hz	404721	406257	1270	1870	100	x	x					x
real energy	forward	KWh	404723	406259	1272	1872	1	x	x					
	reverse	KWh	404725	406261	1274	1874	1	x	x					
reactive energy (32-bit)	net	KWh	404727	406263	1276	1876	1	x	x					
	lead	KVARh	404729	406265	1278	1878	1	x	x					
	lag	KVARh	404731	406267	127A	187A	1	x	x					
	net	KVARh	404733	406269	127C	187C	1	x	x					x
Energy (32-bit)	apparent	KVAh	404735	406271	127E	187E	1	x	x					x
Motor	phase unbalance	%	404737	406273	1280	1880	100					x		x
	thermal capacity	%	404739	406275	1282	1882	100					x		x
Temperature	winding 1	°C	404741	406277	1284	1884	1					x		x
	winding 2	°C	404743	406279	1286	1886	1					x		x
	winding 3	°C	404745	406281	1288	1888	1					x		x
	winding 4	°C	404747	406283	128A	188A	1					x		x
	winding 5	°C	404749	406285	128C	188C	1					x		x
	winding 6	°C	404751	406287	128E	188E	1					x		x
	motor bearing 1	°C	404753	406289	1290	1890	1					x		x
	motor bearing 2	°C	404755	406291	1292	1892	1					x		x
	load bearing 1	°C	404757	406293	1294	1894	1					x		x
	load bearing 2	°C	404759	406295	1296	1896	1					x		x
	auxiliary	°C	404761	406297	1298	1898	1					x		x
real energy (64-bit)	forward	Wh		406305		18A0	1	x	x					
	reverse	Wh		406309		18A4	1	x	x					
	net	Wh		406313		18A8	1	x	x					x
reactive energy (64-bit)	lead	VARh		406317		18AC	1	x	x					
	lag	VARh		406321		18B0	1	x	x					
	net	VARh		406325		18B4	1	x	x					x
Energy (64-bit)	apparent	VAh		406329		18B8	1	x	x					x

Table 4: Default Primary Status Code Definitions

Code	Default Definition	Code	Default Definition
0	Status Unknown	17	Neutral Trip
1	Device Open	18	Ground / Earth Trip
2	Device Closed	19	Phase A Alarm
3	Device Tripped	20	Phase B Alarm
4	Device Alarmed	21	Phase C Alarm
5	Device On	22	Neutral Alarm
6	Device Off	23	Ground / Earth Alarm
7	Device Ready	24	Phase AB Alarm
8	Device Starting	25	Phase BC Alarm
9	Device Running	26	Phase CA Alarm
10	Device Stopped	27	On Good Source
11	Device Locked-out		**Reserved 28...251**
12	Device Transferred		
13	Device Picked-up	252	Product-Specific Code 252
14	Phase A Trip	253	Product-Specific Code 253
15	Phase B Trip	254	Product-Specific Code 254
16	Phase C Trip	255	Product-Specific Code 255

Table 5: Default Secondary Status Code Definitions

Code	Default Definition	Code	Default Definition
0	Secondary status unknown		**Reserved 9...27**
1	Secondary status is not applicable		
2	Device in program mode		
3	Device in test mode		
4	Device disabled		
5	Device disarmed	28	Product-Specific Code 28
6	Controlled device failed to operate	29	Product-Specific Code 29
7	Device has powered up	30	Product-Specific Code 30
8	Device in alarm	31	Product-Specific Code 31

Table 6: Cause of Status

Code	Default Definition	Code	Default Definition
78	Over-temperature	117	Voltage Sag
79	Accessory Bus	118	Voltage Swell
80	Long Delay Neutral Overcurrent	119	Programming Error
81	External Condition #2	120	Fail to Sync On Phase
82	Historical Data	121	Fail to Sync On Frequency
83	External Condition #3	122	Fail to Sync On Voltage
84	Ground Fault (Instantaneous or Delay)	123	Anti-Backspin
85	Earth Fault (Instantaneous or Delay)	124	Zero Speed
86	External Condition #4	125	Time Between Starts
87	External Condition #5	126	Source 1
88	External Condition #6	127	Source 2
89	External Condition #7	128	Start
90	External Condition #8	129	Manual
91	External Condition #9	130	Synchronizing
92	Multiple External Conditions	131	Starts Per Hour
93	Motor Bearing Temperature	132	Preferred Source
94	Load Bearing Temperature	133	Plant Exerciser
95	Auxiliary Temperature	134	Neutral Ground Overvoltage
96	Winding Temperature	135	Safety Interlock
97	Local Temperature	136	Real Time Clock
98	External Temperature	137	High Floating Voltage
99	Rolled Phase	138	Trip Blocked
100	Per Unit Voltage	139	Incomplete Sequence
101	Sensitive	140	Cause N/A (none)
102	De-energized	141	Trip Position
103	Non-sensitive	142	Voltage Transient
104	Time-Delayed Sensitive	143	Tamper
105	Breaker Pumping	144	RTD
106	Sub-network Malfunction	145	Differential
107	Learning		**Reserved 146...2043**
108	Off-line		
109	Test		
110	Jam		
111	Under Load		
112	Delay Ground Overcurrent		
113	Calibration	2044	Product-Specific Code 2044
114	Emergency	2045	Product-Specific Code 2045
115	Torque Limit	2046	Product-Specific Code 2046
116	Deceleration	2047	Product-Specific Code 2047

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