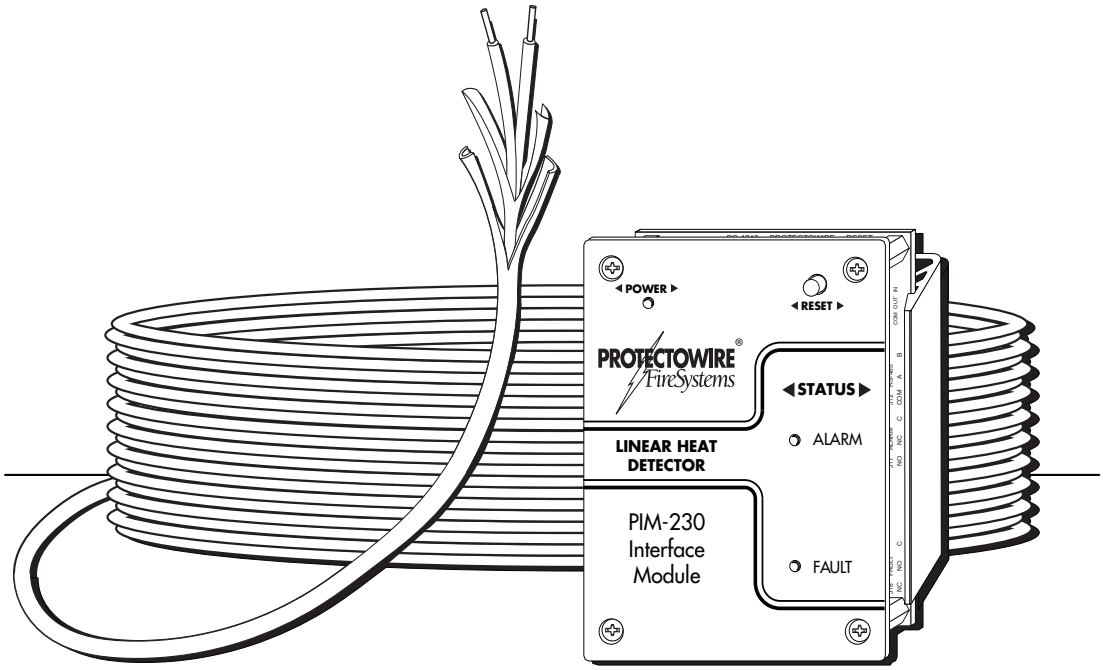
PROTECTOWIRE®
FireSystems



PIM-230 Interface Module with Modbus Over RS-485 & Ground Fault Detection

Installation and Operation Guide

An ISO 9001 Registered Company

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PIM-230
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PIM-230 Interface Module
Installation and Operation Guide

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Modbus Over RS-485 Operation Guide

Introduction to Digital Linear Heat Detection Technology

Protectowire Linear Heat Detector is a sensor cable that detects heat anywhere along its length. The sensor cable is comprised of two steel conductors individually insulated with a heat sensitive polymer. The insulated conductors are twisted together to impose a spring pressure between them, then wrapped with a protective tape and finished with an outer jacket suitable for the environment in which the detector will be installed.

Invented and Patented by The Protectowire Co., Inc. in 1938, Digital Linear Heat Detectors have been utilized in the fire protection industry for over 80 years.

Ideally suited to industrial high risk hazards as well as many types of commercial applications, Protectowire Linear Heat Detector has unique advantages over other types of detectors, especially when difficult installation factors or severe environmental conditions are present.

How Digital Linear Heat Detection Works

To understand how Digital Linear Heat Detectors work it is important to have an understanding of how they are constructed.

Figure 1 - Digital linear heat detectors are constructed of a twisted pair of spring conductors coated with a thermoplastic coating designed to soften at a specific temperature. An initiating device circuit monitors a length of this detector installed in an area to be protected.

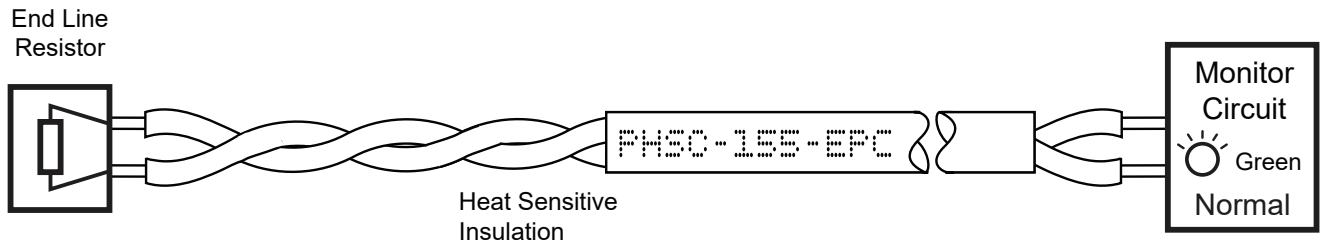


Figure - 1

Figure 2 - When the detector is exposed to heat at any point along its length the thermoplastic coating at that point softens and the spring pressure between conductors causes them to contact each other creating a short circuit. The short circuit is sensed by the initiation device circuit.

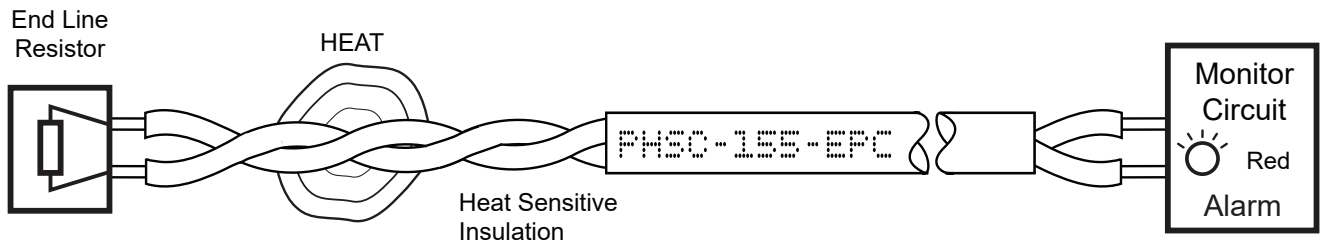
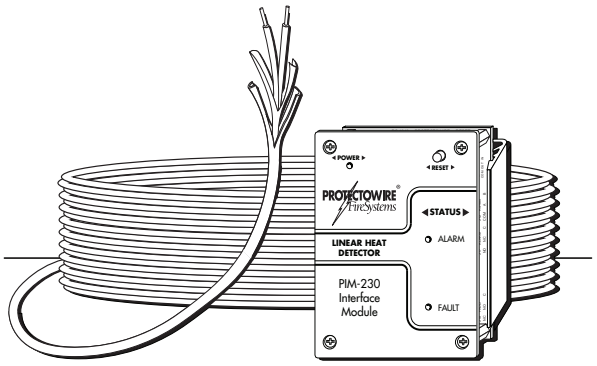


Figure - 2

The PIM-230 Series Interface Module



General Information

The Protectowire PIM-230 is a detection control module that provides an interface between a main fire alarm control panel detection circuit or addressable node and Protectowire Digital Linear Heat Detector. The module provides one (1) supervised detection circuit that may be field wired for either Class A (Style D) or Class B (Style B) service. The alarm initiation circuit is capable of operating up to 6,560 feet (2000 meters) of Protectowire Digital Linear Heat Detector. The PIM-230 initiating circuit is designed to monitor Protectowire Digital Linear Heat Detector and also supports other types of normally open contact alarm initiation devices. Two wire smoke detectors which require initiating device circuit power to operate are **NOT** supported.

Description

The PIM-230 operates using standard initiating device circuit technology. When paired with Protectowire Digital Linear Heat Detectors, the module provides full supervision and alarm condition monitoring of the detector loop.

The PIM-230 is designed for easy installation and integration within existing or new fire detection and suppression control equipment. Optionally the PIM-230 is available pre-mounted in a NEMA-4X (IP66) rated enclosure for field installation. In order to ensure proper operation, each PIM-230 module requires clean, regulated & filtered resettable external power which is normally provided by the host fire alarm panel. Each module contains a green “Power-On” LED indicator, one (1) red “Alarm” LED indicator and one (1) yellow “Fault” indicator. One (1) set of Form C alarm contacts and one (1) set of Form C general fault contacts are provided to connect the unit to the host fire alarm panel. The module also provides an RS-485 serial communication port which allows monitoring of the module status, including alarm point location information.

Specifications

Electrical
- Power input - Regulated 12 to 24 VDC (+10% / -15%) @ 0.87 Watts Standby, 1.1 Watts Alarm
- Power Limited, on board surge and EMI protection device
- End of Line Resistor, 10K Ohm 1/2W

Inputs
- One initiating device circuit capable of monitoring up to 6,560 Feet (2000 Meters) of Protectowire PHSC and PLR Digital Linear Heat Detectors. Minimum conductor size is 20AWG (0.812mm), or as require by local code.

Ground Fault Detector
- Ground fault detection circuit capable of detecting high resistance faults from any IDC input leg to the PIM-230 power supply ground reference.

Environmental
- Ambient temperature range: -40° to 140°F (-40° to 60°C)
- Humidity: Max. 95% non-condensing

Visual Annunciation
- One green “Power” indicator
- One red “Alarm” indicator
- One yellow “Fault” indicator

Status Relay Contacts (Rated 1 amp @ 24VDC Resistive Load)
- One (1) set of Form C (SPDT) Alarm Contacts
- One (1) set of Form C (SPDT) Fault Contacts

Programming & Operation
- One 8 Point DIP switch for function selection
- One reset pushbutton

RS-485 Serial Port
- One RS-485 Serial Port
- Half duplex (2-wire with common) 1/8th load
- Supports Modbus RTU V1.1b

Board Assembly Dimensions
- 2.75” W x 3.75” H x 1.25” D (69.85mm x 95.25mm x 31.75mm)
- Mounting via provided 2.75”W snap track

Enclosure Option: Model # PIM-230E
- 4.72” H x 4.72” W x 2.38” D (120mm x 120mm x 60.5mm)
- Clear full view cover
- *NEMA 4X Rated
  (Closest IEC equivalent - IP66)

  ** Additional enclosures and sizes available. Consult factory.*

Installation and Wiring

Mounting and Location - The PIM-230 can be provided as a complete module assembly for installation within existing or new fire detection and suppression control equipment or mounted in a factory supplied enclosure. Please refer to the specification section for enclosure information. When mounting the PIM-230 be sure to follow the installation guidelines below.

The PIM-230 interface module shall be located in a clean, dry, vibration free environment and shall not be subjected to temperatures or humidity that exceeds the module's specifications.

The PIM-230 should be mounted in an accessible location where the status display can be viewed without obstruction.

The enclosure rating should meet or exceed that which is required for the installation environment. All enclosure penetrations should be via connectors and/or conduit hardware that meet or exceed the rating of the enclosure.

To utilize the maximum detector length capacity of the PIM-230, feed cable lengths should be kept to a minimum by locating the PIM-230 as close to the area of detection as possible.

Wiring Diagram

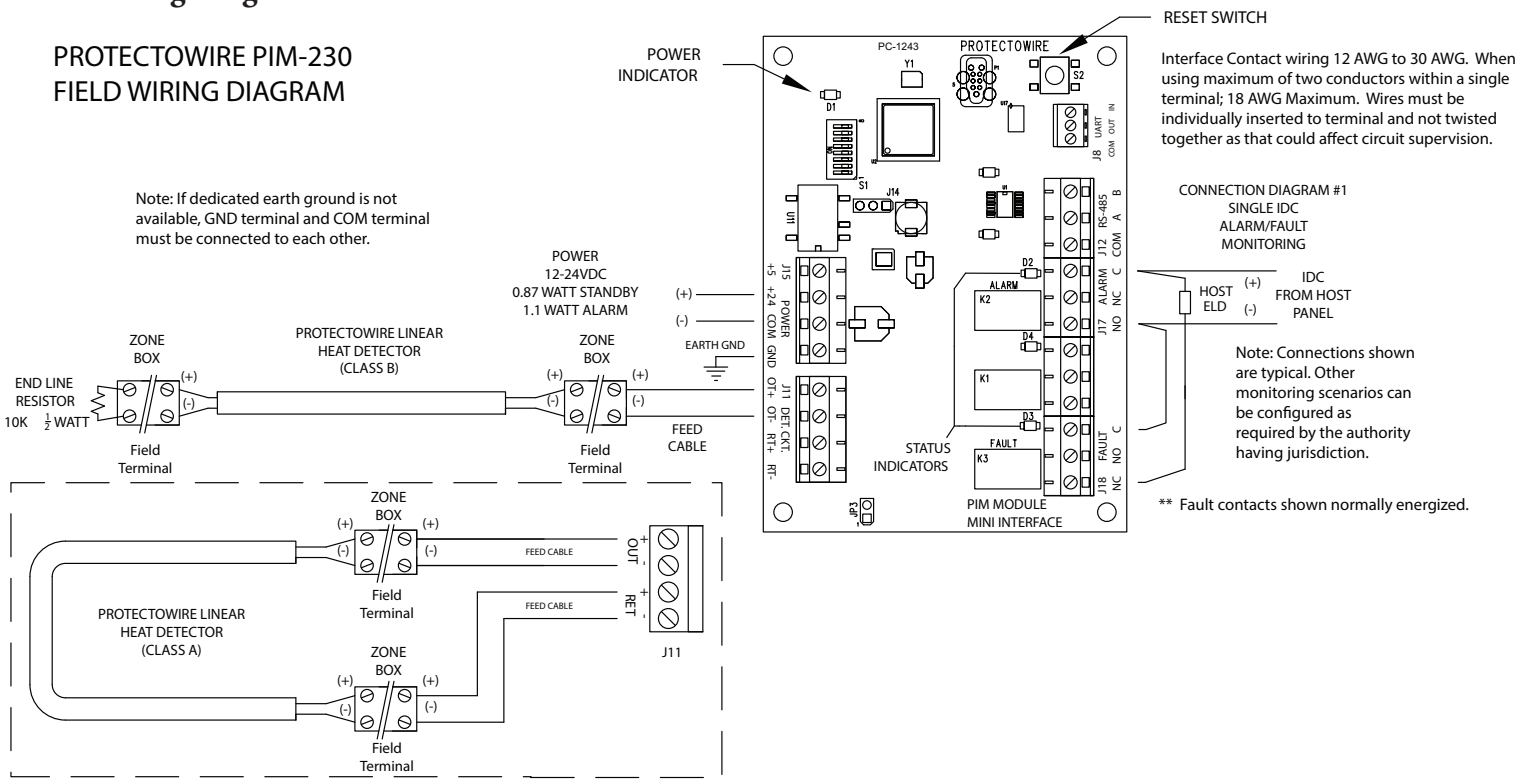


Figure - 6

Note: See last page of manual for full size view of this wiring diagram

Installation and Wiring - (continued)

Wire the system according to this manual using Figure 6 as reference. Wiring must be in accordance with applicable National and/or Local Electrical Fire Alarm Codes.

Detector Wiring - The PIM-230 provides one (1) supervised detection circuit that may be field wired for either Class A (Style D) or Class B (Style B)service. The alarm initiating circuit is capable of operating up to 6,560 feet (2000 meters) of Protectowire Digital Linear Heat Detector. The PIM-230 initiation circuit is designed to monitor Protectowire Digital Linear Heat Detector and also supports other types of normally open contact alarm initiating devices. Two wire smoke detectors which require initiating device circuit power to operate are **NOT** supported.

Step 1 - Remove the factory supplied 10K 1/2w end-of-line resistor (ELR) from terminal J11 Out (+) and (-). Retain this resistor for installation at the end of the detector run as shown in the Class "B" field wiring diagram (Figure 6). For Class "A" configuration the ELR shall be removed and retained for future troubleshooting.

Step 2 - Connect the Protectowire Linear Heat Detector to the PIM-230 interface module at terminal J11 as shown in the field wiring diagram (Figure 6) in either a Class "B" or Class "A" configuration

Wiring Terminations - All termination and splices in the detector loop must be made utilizing Protectowire recommended terminals. Only zone boxes and splicing connectors specifically recommended by The Protectowire Co., Inc. shall be utilized.

Interface Wiring - The PIM-230 is a detection control module that provides an interface between a main fire alarm control panel detection circuit or addressable node and Protectowire Digital Linear Heat Detector. The most common interface connections utilize the three form "C" contacts provided for Fault and Alarm conditions.

Step 3 - Connect the hosts panel's initiation device circuit(s) to terminals J17 as shown on the field wiring diagram (Figure 6). Reference the host panel wiring specifications for correct wiring configuration and requirements.

Power Wiring - The PIM-230 requires external, clean regulated and filtered uninterruptible DC power. The module provides an internal switch regulator which supports input voltages between 12 to 24 VDC (+10% - 15%) @ 1.1 Watts. To implement remote resetting of the module from the host panel, the supplied power may be interrupted during the host panels reset sequence.

Step 4 - Connect a regulated 12-24VDC resettable power supply to terminal J15 as shown in the field wiring diagram (Figure 6). See the "Specification" section for power requirements.

Important! - The PIM-230 must be connected to earth ground via the J15 GND terminal as depict ed in the field wiring diagram. If earth ground is unavailable, for example in vehicle applications, the GND and COM terminals must be connected to each other with a jumper wire.

Configuration and Feature Selection

Configuration Prerequisites - The PIM-230 must be configured and tested before service. Configuration and testing of detection equipment shall be performed by competent, qualified personnel having jurisdiction over this detection equipment. Monitoring equipment connected to the PIM-230 should be bypassed or disabled prior to setup to avoid unintended activation of the monitoring equipment.

Indicators, Configuration & Controls - The PIM-230 has an integrated set of status indicators, DIP switches for configuration and a reset switch for restoring the status to normal after an event has been cleared.

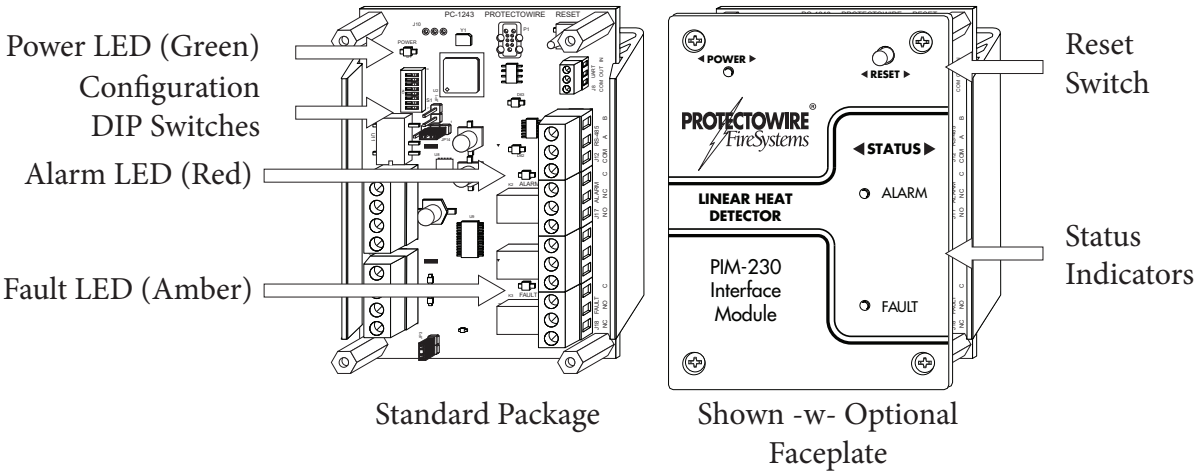


Figure -7

Initial Power Up - When power is applied, the PIM-230 green power on LED will illuminate. The module has a short initialization sequence and will begin actively monitoring within 1-2 seconds. The PIM-230 will display the current linear heat detector status via the two status indicators. If either of the status indicators is illuminated the field connections should be verified before proceeding to module configuration.

Resetting the Module - When an alarm event is detected on the interface module initiating device circuit the condition must be cleared before the module will return to a normal status.

Alarms can be cleared once the field detection loop has been restored to normal by depressing the Reset switch located at the top right corner of the module. See Figure 7.

Open conditions do not require the detector be reset. Once the open condition is repaired in the field detection loop the module will return to a normal standby automatically.

Factory Restore - When servicing a module with unknown settings such as RS-485 communication parameters it may be beneficial to restore the module to factory settings. A factory restore can be performed by following these steps.

1. With the module powered on, depress and hold the Reset switch.
2. Remove power from the module and continue to depress the Reset switch.
3. Restore power to the module while continuing to hold the reset switch.
4. Release the reset switch

After following these steps the PIM-230 settings will be restored to the factory defaults.

Operation and Testing

Testing Notes - The PIM-230 must be configured and tested before service. Configuration and testing of detection equipment shall be performed by competent, qualified personnel having jurisdiction over this detection equipment. Any monitoring equipment connected to the PIM-230 should be bypassed or disabled during testing to avoid unintended activation of the monitoring equipment. Remote monitoring should then be verified under controlled conditions as the final phase of testing.

It is recommended all linear heat detection installations be tested and inspected for proper operation a minimum of once per year.

Inspection of the Installation - Before performing any operational testing of the detection system it is recommended that the following inspections be performed:

Visually inspect the linear heat detector installation and confirm conformance with the Installation, Operation and Maintenance Manual for Protectowire Linear Heat Detectors. Check for any signs of physical damage or wear to the detector and associated installation hardware.

Confirm that the Installation and Setup Configuration of the PIM-230 conforms to the applicable installation and configuration sections of this manual.

During the inspection process make note of the location and quantity of all field connections including zone boxes, end of line boxes, and field splices. All terminations should be inspected for proper connection and polarity. Confirm all connections are suitable for the environment in which they are located, i.e. properly sealed or contained within a properly rated enclosure.

Detection Operation and Testing - The module provides one (1) supervised detection circuit that may be field wired for either Class A (Style D) or Class B (Style B) service. This initiating device circuit is capable of operating up to 6,560 feet (2000 meters) of Protectowire Digital Linear Heat Detector or equivalent combination of detector and feed cable. See Figure 8 for an example of a typical field wiring for Class A and B configuration.

Class B wiring configurations consist of a single length of detector connected to the outgoing “OUT” field terminals of the PIM-230 directly or through a length of extensions cable. The detector is then terminated with an End Line Resistor (ELR) which is monitored by the PIM-230 to confirm continuity.

Class A wiring configurations consists of a single length of detector connected to the outgoing “OUT” field terminals of the PIM-230 directly or through a length of extension cable. The detector is then connected to the return “RTN” field terminals of the PIM-230 directly or through a length of extension cable. No End Line Resistor is required in this configuration. Continuity is confirmed through the return connection.

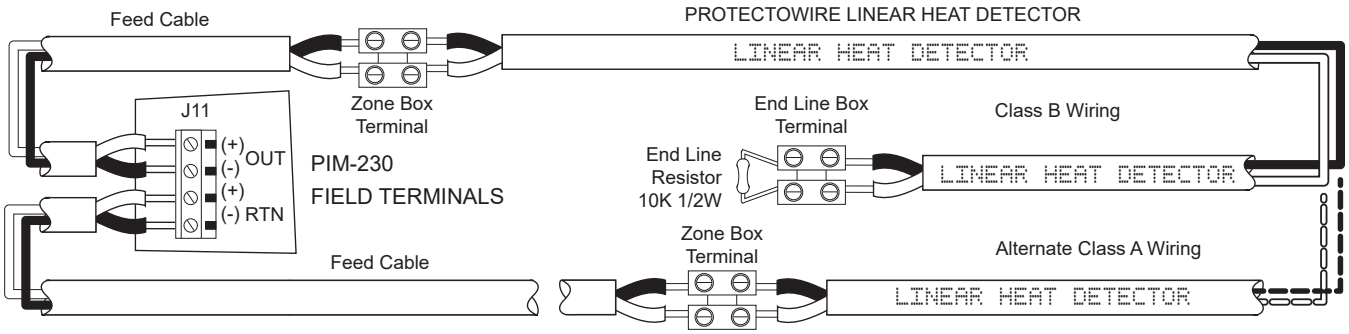


Figure - 8

Step 1 - **Test Open Circuit Monitoring** - At the end of the Protectowire Linear Heat Detector, open the circuit by disconnecting one leg of the detector from the ELR, see Figure 9, or return field terminals, see Figure 10.

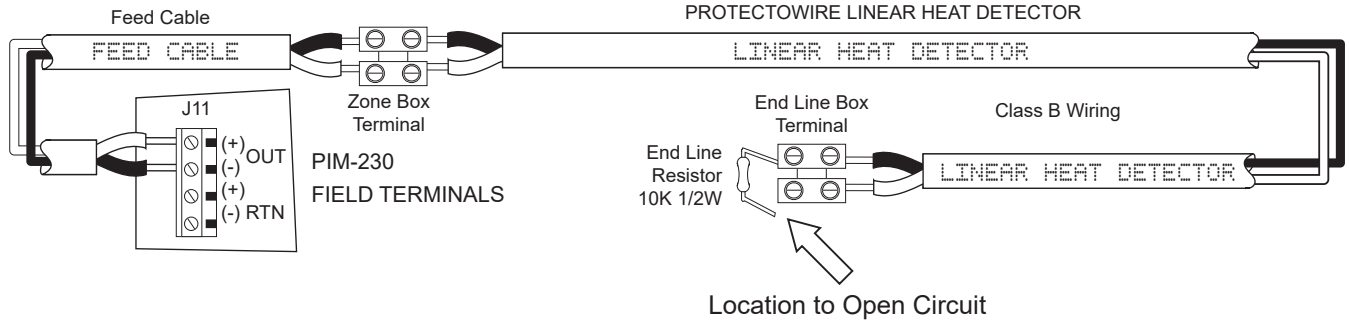


Figure - 9

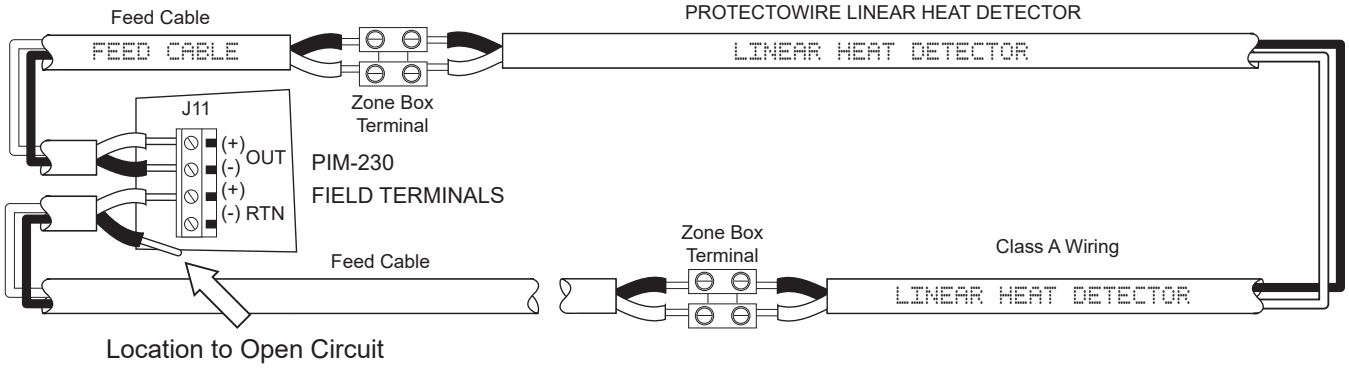
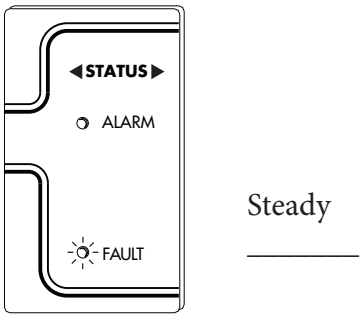


Figure - 10

The PIM-230 "Fault" LED will turn ON steady. Any remote device monitoring the PIM-230 status should indicate an open/fault condition. Re-connect the detector to the ELR or return "RTN" terminals. The PIM-230 fault indicator will turn off and the module will return to a "NORMAL" standby condition.

PIM-230 Fault Status Indicator



Step 2 - **Test Alarm Monitoring** - At the end of the Protectowire Linear Heat Detector, connect a jumper lead across both legs of the detector at the ELR, see Figure 11 or return field terminals, see Figure 12.

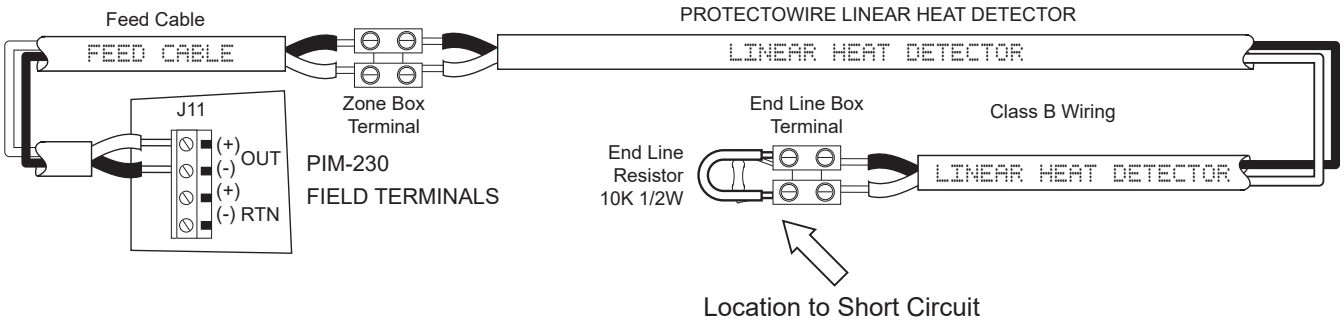


Figure - 11

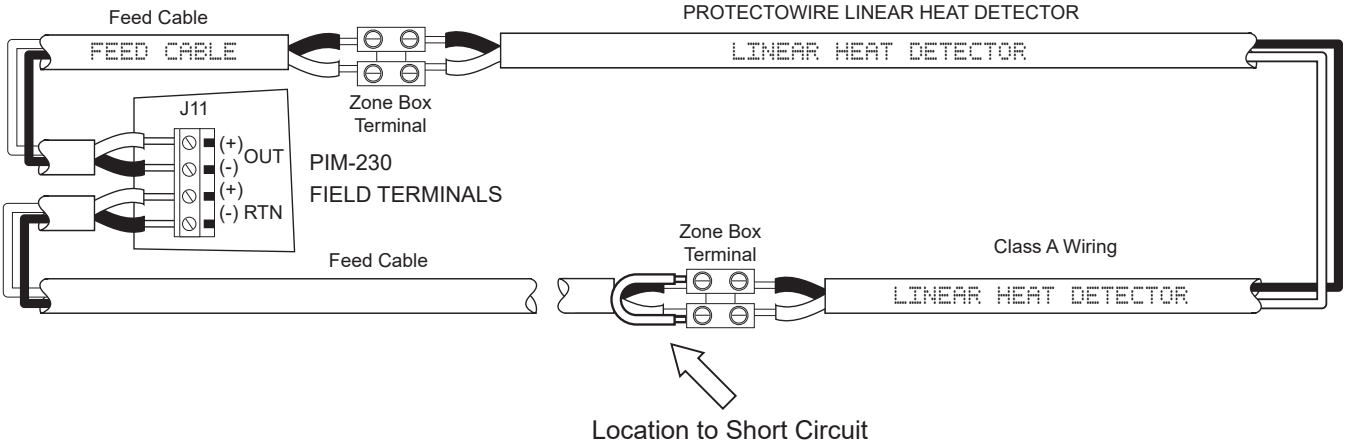
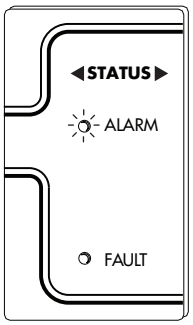


Figure - 12

After approximately 10 seconds the PIM-230 "ALARM" turn ON steady indicating an alarm condition. Any remote device monitoring the PIM-230 status should indicate an alarm condition. Remove the short and reset the interface module to return to a normal standby condition.

PIM-230 Alarm Status Indicator

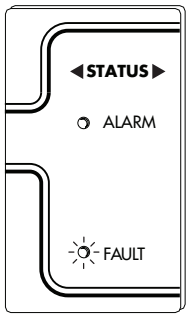


Steady

Ground Fault Detector - The PIM-230 includes a ground fault detector capable of detecting current leakage between the IDC field connections and the modules earth ground reference. Operation of the ground fault detector can be verified by connecting a low resistance jumper lead from the PIM-230 earth ground terminal J15 GND to any of the IDC terminations, J11 - (+) OUT, (-) OUT, (+) RTN or (-) RTN terminals. The detector will respond to a fault presence in approximately 10 seconds. The PIM-230 will report a "FAULT" condition. The "FAULT" indicator will flash on and off to identify the existing ground fault condition and the fault relay contact will change state.

A ground fault can only be restored by locating and removing the ground fault path from the IDC connections to earth ground. The PIM-230 will continue to detect overheat conditions with a single ground fault present but all ground faults should be addressed as soon as possible to prevent potential adverse effects on detector operation.

PIM-230 Ground Fault Status Indicator



Blinking
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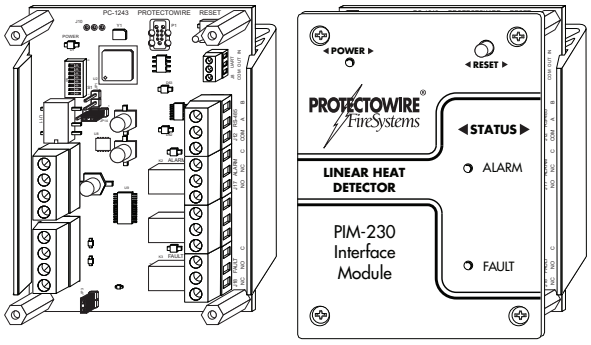
Modbus Over RS-485 Operation Guide



RS-485 Description

RS-485 is a standard which describes a physical layer utilized in serial communication. RS-485 allows for installation of inexpensive local network systems and supports multi-drop communication links. Due to its use of differential balanced line signaling over twisted pair wiring, RS-485 can span distances of up to 4,000 feet (1,220 meters) without repeaters. RS-485 has been widely adopted in many industries as the underlying physical layer of industrial automation networks.

Modbus Description

Modbus Protocol - MODBUS is an application-layer messaging protocol, positioned at level 7 of the OSI model. Developed and published by Modicon in 1979 it is now a *de facto* - standard protocol utilized in a wide array of communication applications. The standard is openly published and a royalty-free protocol. It provides client/server communication between devices connected on different types of buses or networks. Documentation of the Modbus Protocol and its implementation is beyond the scope of this manual.

To gain a better understanding of MODBUS Protocol and it's implementation it is recommended you visit http:///www.modbus.org/ where the full MODBUS Protocol specification can be obtained along with implementation guides and many other resources.

PIM-230 Modbus over RS-485 Description

The PIM-230 interface module provides integrated Modbus over RS-485 communications. Each module can be configured as a Modbus slave device on an RS-485 network. Once configured to communicate on a network, each module can be polled by a master device for a variety of module specific data. A master device, such as a PLC (Programmable Logic Controller) can monitor the status of one or more modules and take actions based on their status. Modbus over RS-485 communication is a convenient method for utilizing detector status information to implement equipment shutdown or other automation events.

Specifications

Port Specifications

- RS-485 Serial Port compatible with TIA/EIA-485 specifications
- Supports Half Duplex Mode (2 wire)
- Baud Rates Supported, 9.6K, 19.2K, 57.6K, 115.2K
- Network Bus Load, 1/8th Load
- Biasing, None
- Wiring method, Two wire with common

Protocol Information

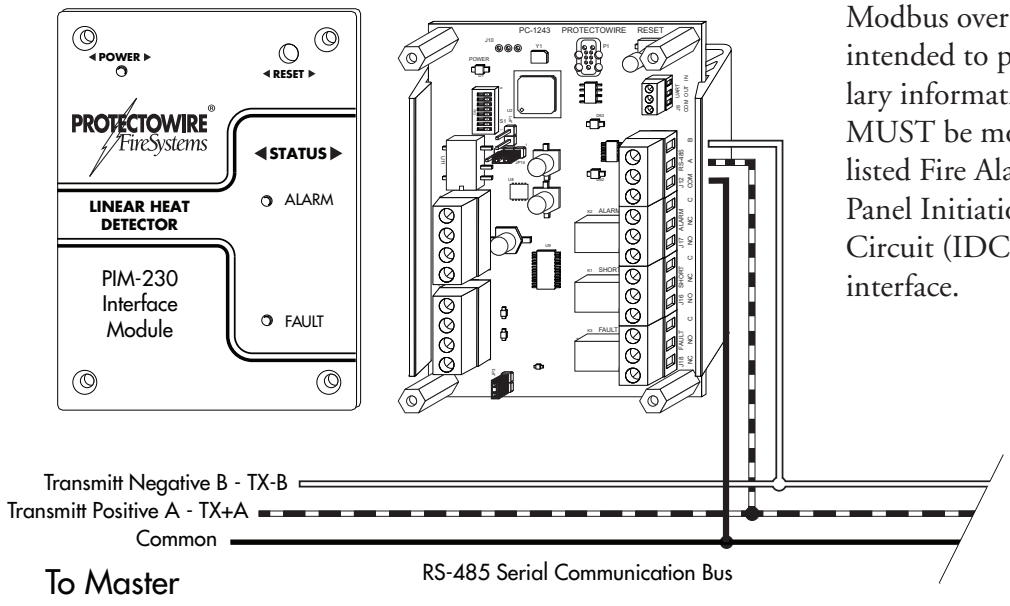
- Modbus RTU
- Modbus Application Protocol Specification, V1.1b, Modbus - IDA, 12/28/2006
- Cyclic redundancy check, CRC-16

RS-485 Wiring

Wiring connection for the RS-485 port are made via Terminal J12 on the upper right corner of the module. Wiring should be made using communications cable suitable for the environment and rated for the intended purpose.

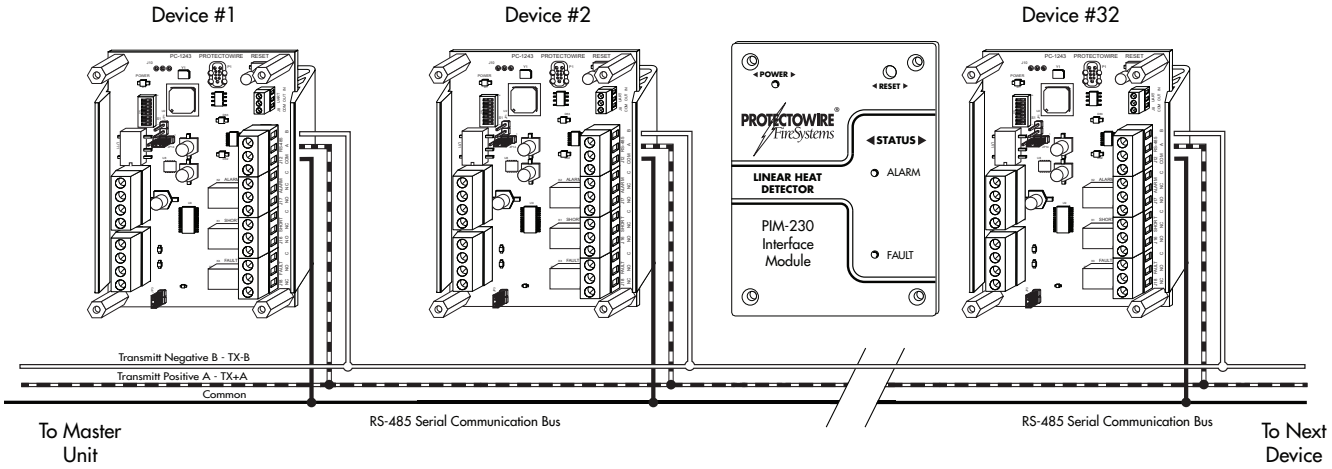
Each module requires three connection to the communication bus. Transmit A (+), Transmit B (-) and common (COM). The module operates in half duplex mode. To operate in this mode the Transmit (+) and (-) terminals are internally connected to the receive (+) and receive (-) terminals respectively. The module does not support full duplex operation.

Wiring Diagram - Figure 1



Modbus over RS-485 is intended to provide ancillary information. Each unit MUST be monitored by a listed Fire Alarm Control Panel Initiation Device Circuit (IDC) via contact interface.

Bus Example - Figure 2



Configuration Settings

Once properly wired to the communication bus each module must be configured to communicate on the network. The following network settings must be known before configuring the module.

Slave Address - Each device is assigned a unique slave address to identify it on the network. The Modbus protocol specification allows for addresses in the range from 1 to 247.

Parity - Each device must be configured to use the same parity as the network. Each module can be configured for the following.

8-E-1 - 8 Data bits, Even Parity Bit, 1 stop bit (Default Setting)
8-O-1 - 8 Data bits, Odd Parity Bit, 1 stop bit
8-N-2 - 8 Data bits, No Parity Bit, 2 stop bits

Baud Rate - Each device must be configured to use the same baud rate in bits per second as the network. Each module can be configured for the following baud rates.

9.6K Baud, 19.2K Baud, 57.6K Baud & 115.2K Baud (Default Setting 19.2K Baud)

Modifying the RS-485/Modbus Configuration

Communication Configuration - The PIM-230 communication settings are set via serial communication. Each setting is modified by writing a specific value to a Modbus holding register assigned to each of the three configurable communication parameters.

Before the communications settings can be changed communication with the PIM-230 must first be established using the default settings. The following communication settings are the factory defaults.

Slave Address = 1, Baud Rate = 8-E-1 - 8 Data bits, Even Parity, 1 Stop Bit, Baud rate = 19.2K Baud

Factory Restore - If the communications settings are not known they can be reset to the above noted defaults by performing a factory restore. Note that factory restore will affect additional configuration settings.

Setting the Slave Address - The PIM-230 slave address can be read and written at holding register 40053. Writing a value from 1 to 247 will set the PIM-230 slave address to the written value. Be aware that changing the slave address will break communications until the master device is updated with the new slave address value.

Table 1.

Register			Name	Access	Range	Type	Function Code
Modbus Address	Decimal	Hex					
40053	52	34	Status	Read/Write	1 = Active	Word/Bits	03 or 06

Setting the Parity - The PIM-230 parity setting can be read and written at holding register 40054. Writing a value from 0 to 2 will set the PIM-230 slave address to the written value. Be aware that changing the parity will break communications until the master device is updated with the new parity value.

Table 2.

Register			Name	Access	Range	Type	Function Code
Modbus Address	Decimal	Hex					
40054	53	35	Status	Read/Write	1 = Active	Word/Bits	03 or 06

Register value of 0 = 8-E-1 - 8 Data bits, Even Parity Bit, 1 stop Bit
Register value of 1= 8-O-1 - 8 Data bits, Odd Parity Bit, 1 stop Bit.
Register value of 2 = 8-N-2 - 8 Data bits, No Parity Bit, 2 stop Bits.

Setting the Baud Rate - The PIM-230 Baud Rate setting can be read and written at holding register 40055. Writing a value from 0 to 3 will set the PIM-230 baud rate to the corresponding value in the list below. Be aware that changing the baud rate will break communications until the master device is updated with the new baud rate value.

Table 3.

Register			Name	Access	Range	Type	Function Code
Modbus Address	Decimal	Hex					
40055	54	36	Status	Read/Write	1 = Active	Word/Bits	03 or 06

Register Value List
Register value of 0 = 9.6K Baud
Register value of 1= 19.2K Baud
Register value of 2 = 57.6K Baud
Register value of 3 = 115.2K Baud

Module Status - The PIM-230 Status is available from a single 16 bit Modbus holding register at protocol address 40001. Each bit of the holding register represents a function status of the module. The status bits are arranged so monitoring only the 3 least significant bits provides the priority status of the module. The priority status bit states are Normal (All bits zero), Fault (Bit zero active), Short (Bit 1 active) and Alarm (Bit 2 Active). Each additional bit (3 through 8) provides additional non-essential status information. Bits 10 through 15 are reserved for future use.

Table 4.

Register			Name	Access	Range	Type	Function Code
Modbus Address	Decimal	Hex					
40001	0	0	Status	Read Only	1 = Active	Word/Bits	03

Table 5.

Status Bits Assignments															
15	**14**	**13**	**12**	**11**	**10**	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
Reserved						Ground Fault	Menu Accessed	Alarm Return	Alarm Out	None	None	Open	General Alarm	None	General Fault

Table 6.

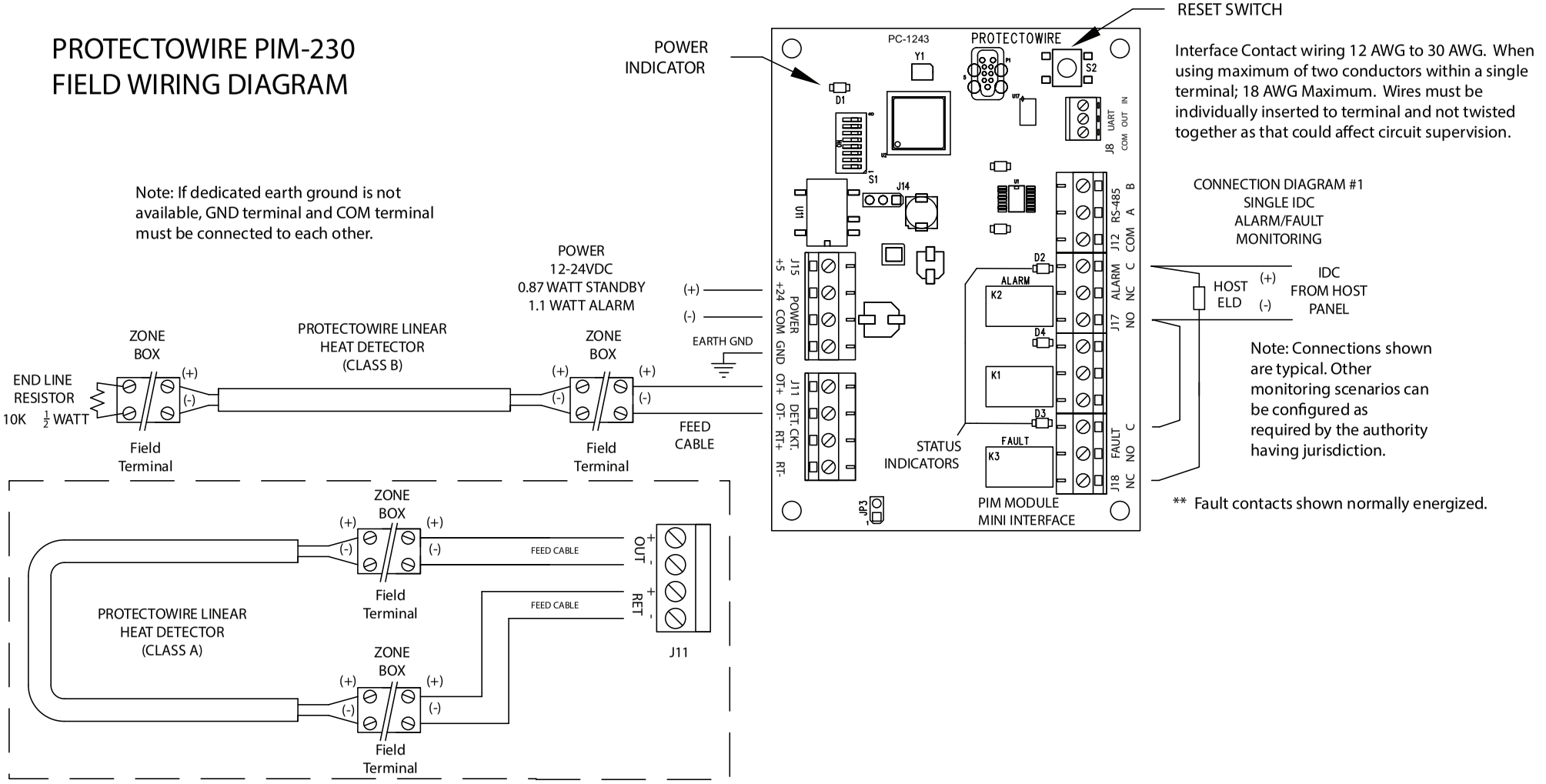
	Status Bits Event Grid									
Ground Fault	**Menu Access**	**Alarm Return**	**Alarm Out**	**Short Return**	**Short Out**	**Open**	**Alarm**	**Short**	**Fault**	
9	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**	< Bit
0	0	0	0	-	-	0	0	-	0	Normal
0	1	0	0	-	-	0	0	-	1	Normal then > Menu Access
										Class B Status Events
0	0	0	0	-	-	0	0	0	1	Normal then > Open
0	0	0	1	-	-	0	1	-	0	Class B Alarm
										Class A Status Events
0	0	0	1	-	-	1	0	-	1	Alarm present on Out, Return Open
0	0	1	0	-	-	1	1	-	1	Alarm present on Return, Out Open
0	0	1	1	-	-	0	1	-	0	Alarm present on Out & Return
1	0	0	0	-	-	0	0	-	0	Ground Fault present on IDC Wiring

Initialize / Reset - The PIM-230 interface module can be re-initialized or reset remotely by wiring an integer value of 65280 (0xFF00) to Modbus holding register 40101. Writing this value will re-initialize the module with an identical function of pressing the reset button. Writing any other value to this register will have no effect. There is no read function for this register.

Table 10.

Register			Name	Access	Range	Type	Function Code
Modbus Address	**Decimal**	**Hex**					
40101	100	64	Initialize	Read Only	65280 (0xFF00)	Integer	06

PROTECTOWIRE PIM-230
FIELD WIRING DIAGRAM



Interface Contact wiring 12 AWG to 30 AWG. When using maximum of two conductors within a single terminal; 18 AWG Maximum. Wires must be individually inserted to terminal and not twisted together as that could affect circuit supervision.

PIM-230 Field Wiring Diagram

Installation Notes

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