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HazardPRO™
Wireless Hazard Monitoring

ELECTRO-SENSORS

System Manager Installation Manual

Volume One

Introduction

This document will provide guidance for your HazardPRO System Manager operation. This document includes an Operation Manual, System Wiring Information, Modbus Options, and optional mounting information. Additional information regarding HazardPRO sensors and nodes can be found in the HazardPRO node and sensor Installation document Volume 2. For any additional questions please contact our Technical Department via Tech@electro-sensors.com or by telephone at (800)328-6170.

Table of Contents

Section A

System Manager Configuration Options

	XL	XM	XS	Comments
Pieces of Equipment (Max)	32	16	4	XL/XM Enclosure Dimensions: 30” x 30” x 11” (21” display) XS Enclosure Dimensions: 24” x 24” x 11” (15” display)
Nodes	96	48	12	9.52” x 7.7” x 6.1” (Box Dimensions)
Sensors per Node	10	10	10	2 are dedicated to ambient temperature monitoring
Sensors (Max)	960	480	120	All sensor types including ambient sensors
Temperature/Vibration Sensors	576	288	72	6 sensors per node
Contact Inputs	96	48	12	1 Contact Sensor per node
Speed Sensors	96	48	12	Generally one piece per equipment
Gateway Pairs	10	10	2	
Relay I/O Boards	2	1	0	Each I/O board has 16 equipment relays and 1 warning alarm relay

Section B

System Manager Electrical Requirements

These are the electrical requirements for the System Manager. It explains the proper conditions and configuration options. The system Manager should be installed, powered, and have the proper configuration completed prior to installing the Nodes or the Sensors.

For the best commissioning results follow the recommended installation sequence.

1. Install the System Manager: connect power to it.
2. Install the receiving antennas.
3. Install the sending antennas.
4. Power up the Nodes and install in position.
5. Install the Sensors, verifying proper operation as they are installed.

Electrical Power Requirements and System Control

1. Power requirement: 115 Vac, 15 AMP, clean power, dedicated.
2. Interface to Plant Control System (this is set up in the HazardPRO system manager under the PCSI icon).

To ensure the proper operation of the System there are two required elements.

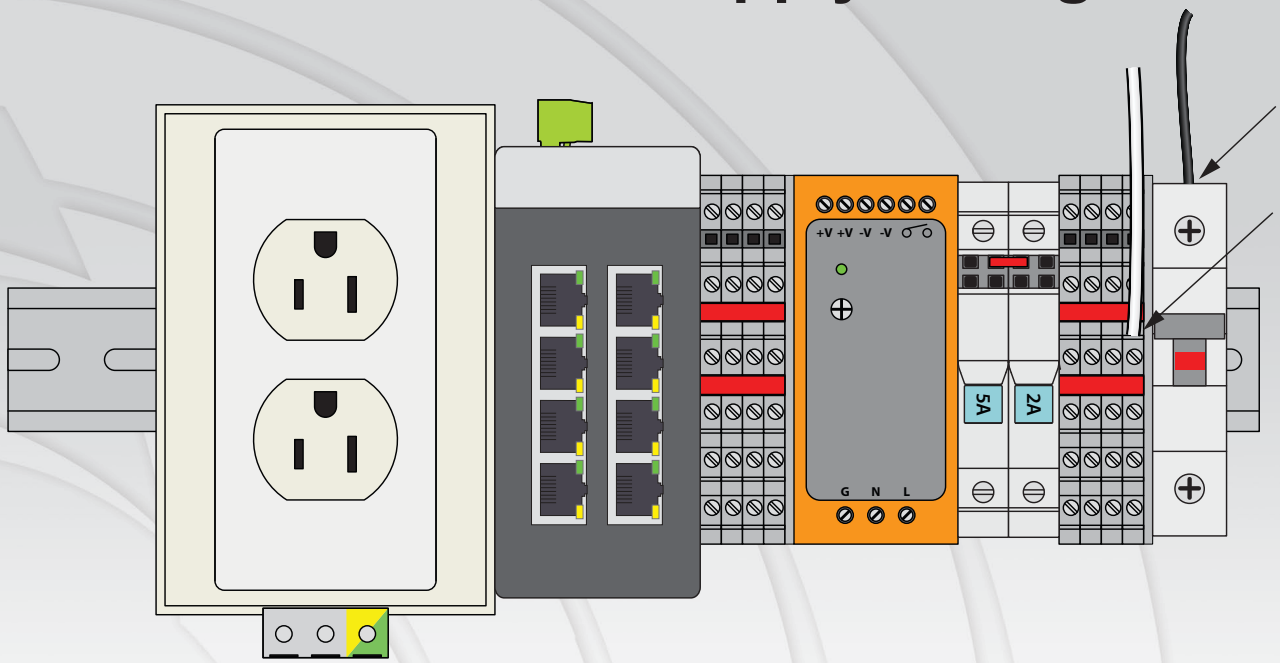
1. A Run signal that is “ON” whenever a piece of equipment is running. This Run signal must turn “OFF” when the equipment is stopping or stopped. The system needs to be able to identify when the equipment is running. This Run signal is supplied to the Run relay and the associated Run/Stop logic.
2. The System Manager will keep the N.O. contacts of the run relay closed when the equipment is running and there is not a shutdown alarm. If there is a shutdown alarm condition or the equipment is stopped, the relay will be de-energized and the N.O. contacts will open.

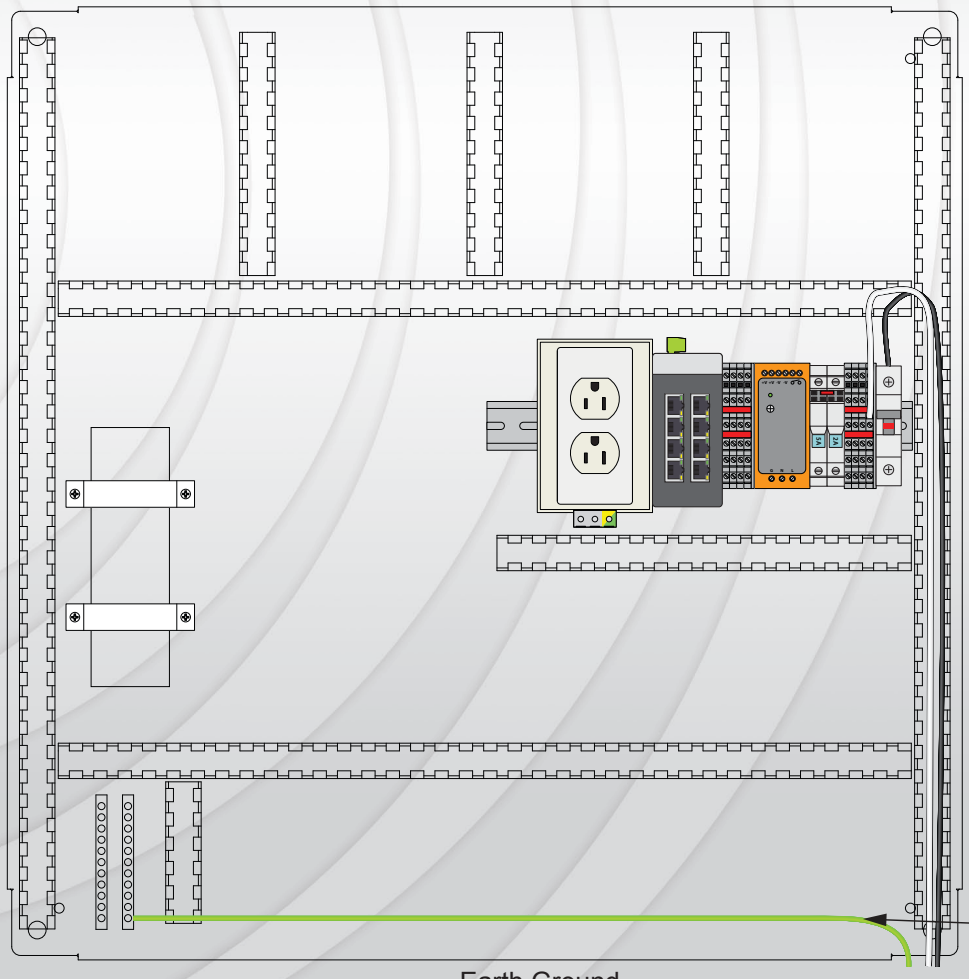
There are two options for supplying this run signal to the HazardPRO system. One utilizes the Run relays in the HazardPRO enclosure; the second option utilizes a Modbus TCP/IP connection directly to the HazardPRO touch screen without using relays.

____ Option A: The Run signal is supplied from the run/stop circuit for the equipment; this connects directly to a run relay on the Relay I/O board. A neutral/common is also required for a reference to the Run/Stop logic.

____ Option B: The Run signal is communicated by the PLC to the HazardPRO touch screen. A Modbus TCP/IP interface communicates with a bank of Modbus registers that are read/written by both the PLC and the HazardPRO touchscreen. There is a register for each piece of equipment and by setting various values in the register, both the PLC and the HazardPRO touch screen know if a piece of equipment is running, stopped, or in an alarmed condition. An Ethernet cable is used to connect the PLC to the HazardPRO touch screen.

Power Supply Wiring

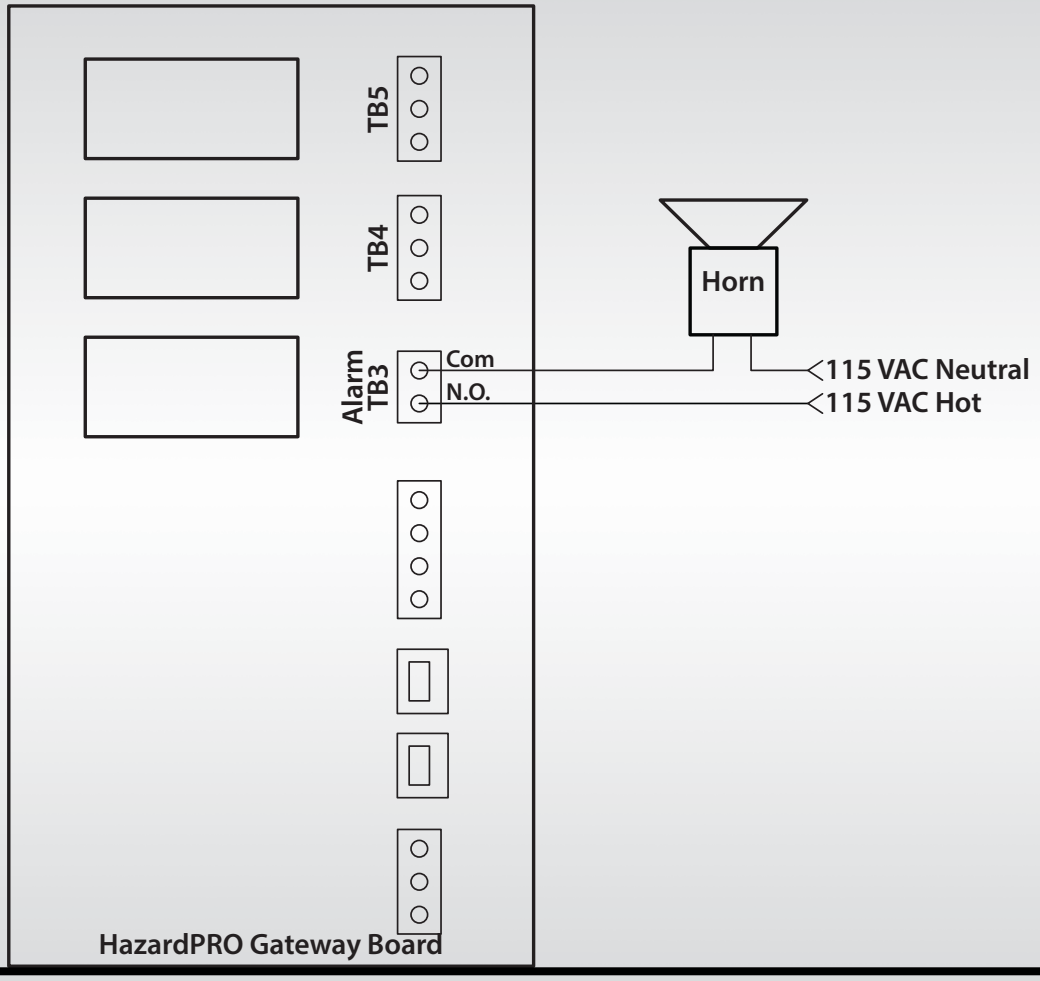




Horn Relay Options

Model XS ONLY

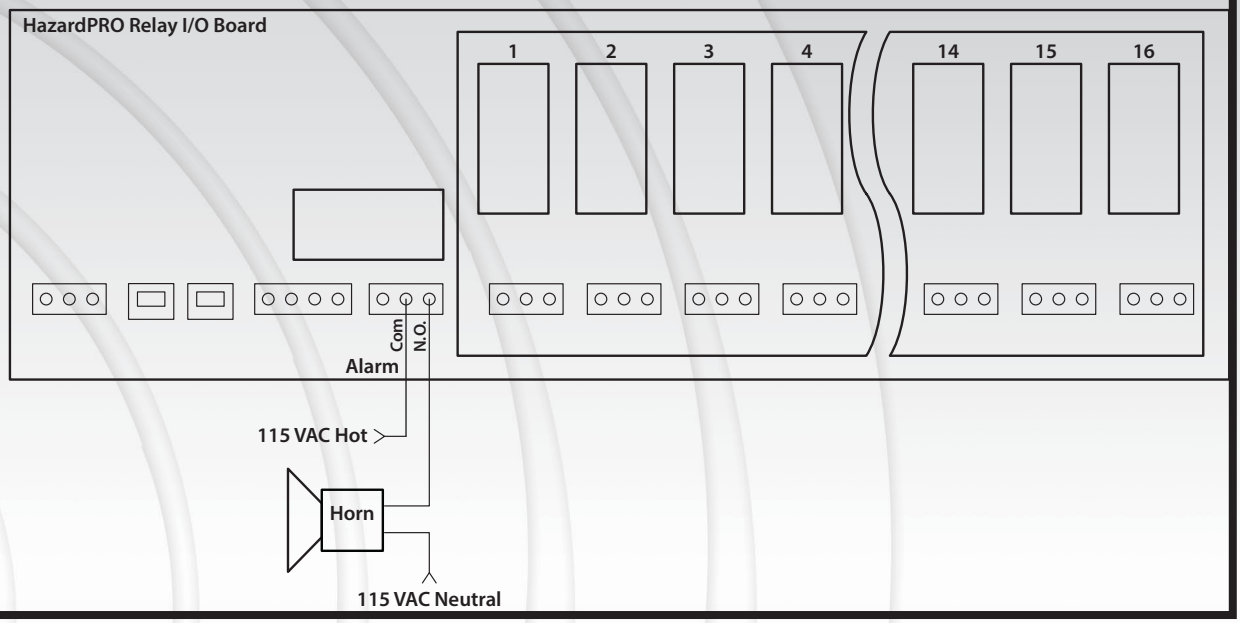
Horn connection to Gateway Board



Horn Relay Options

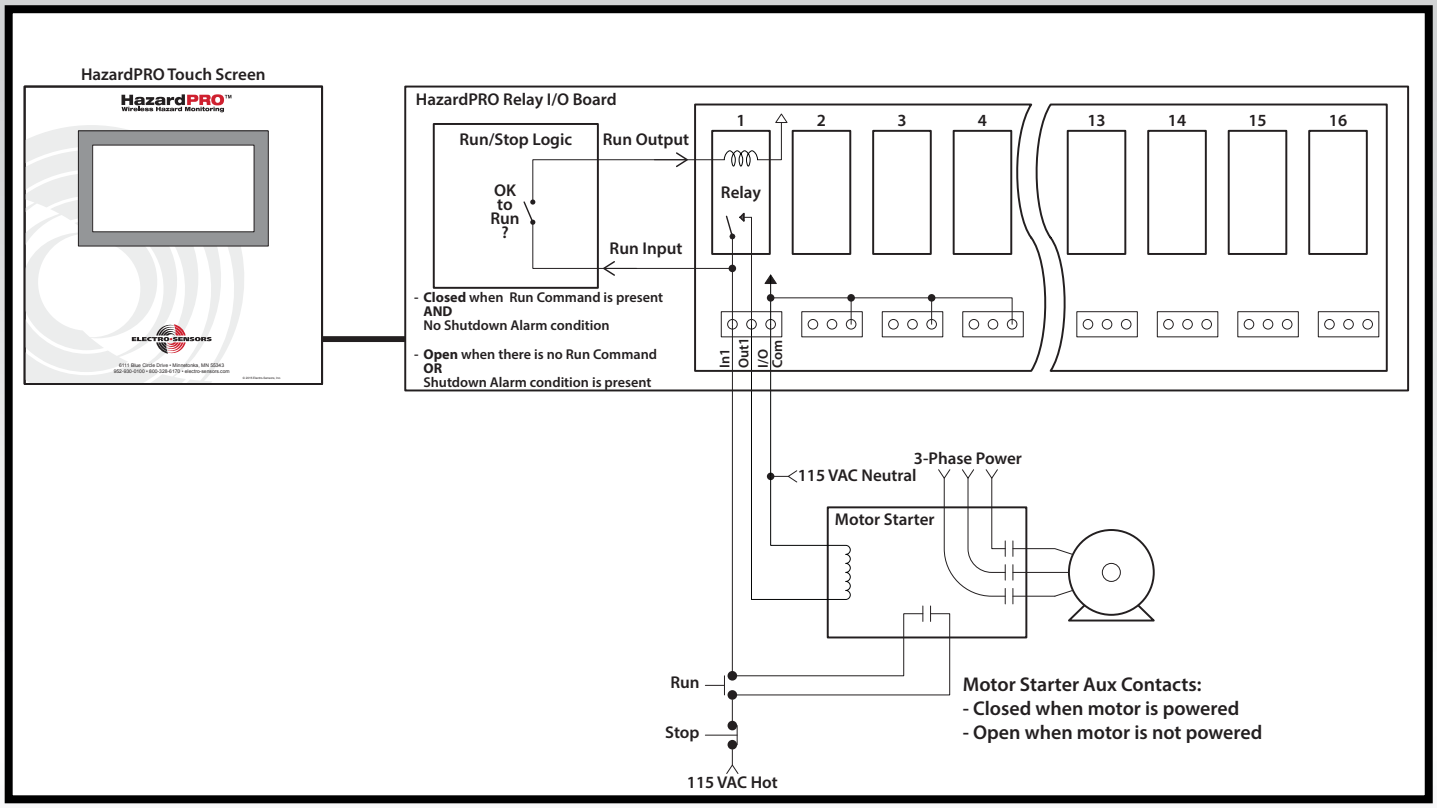
For HazardPRO XM & XL System Managers

Horn connection to Relay I/O Board

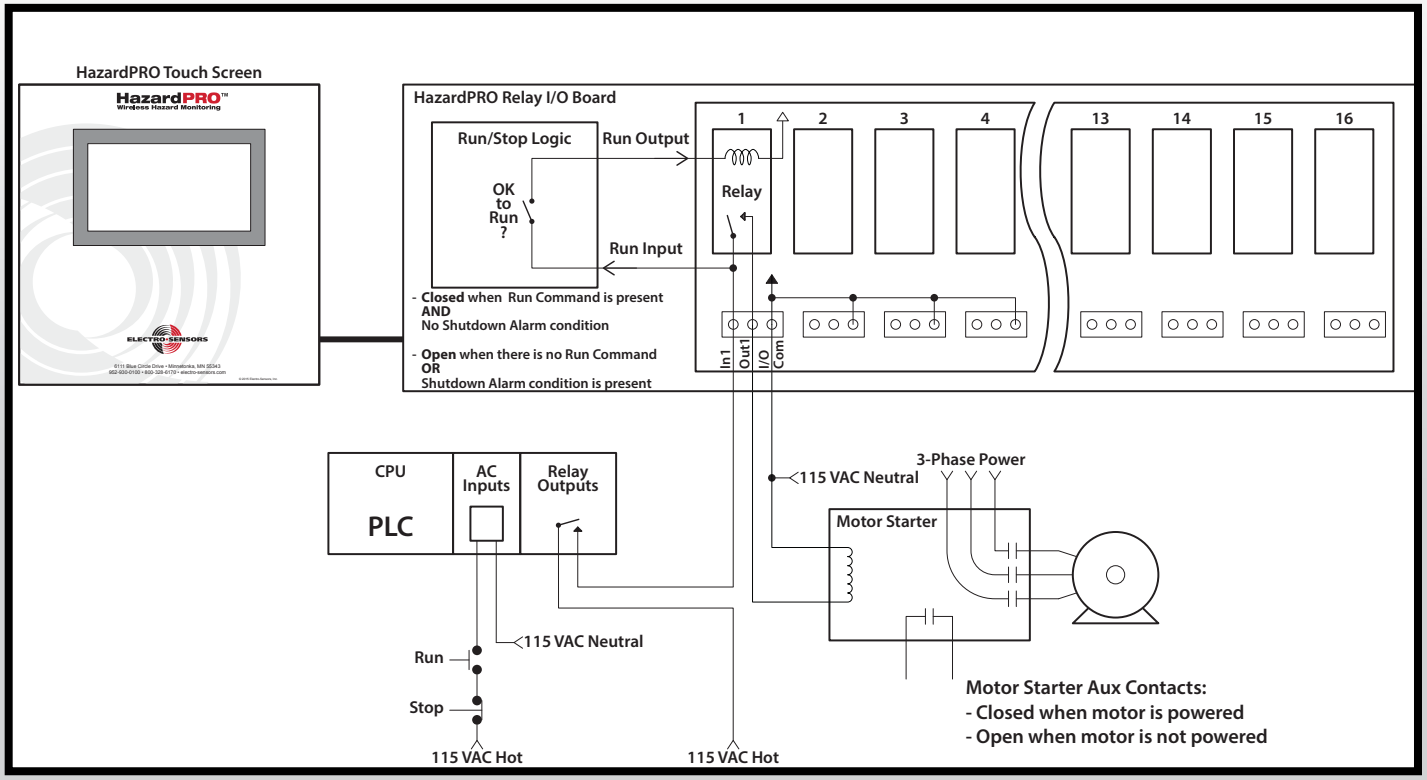


Run/Stop Connections

Run/Stop Connections - Using Run and Stop Push button Switches

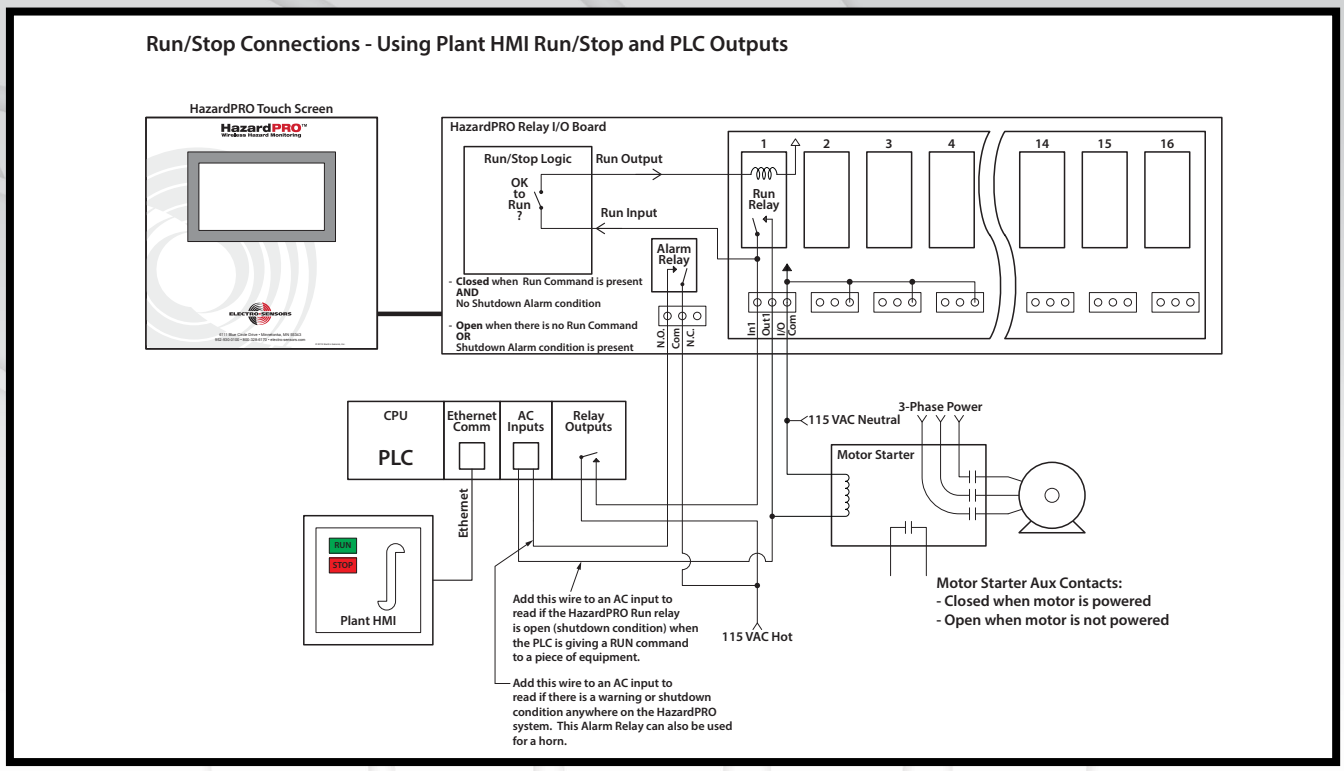


Run/Stop Connections - Using PLC Inputs/Outputs to the Relay I/O Board

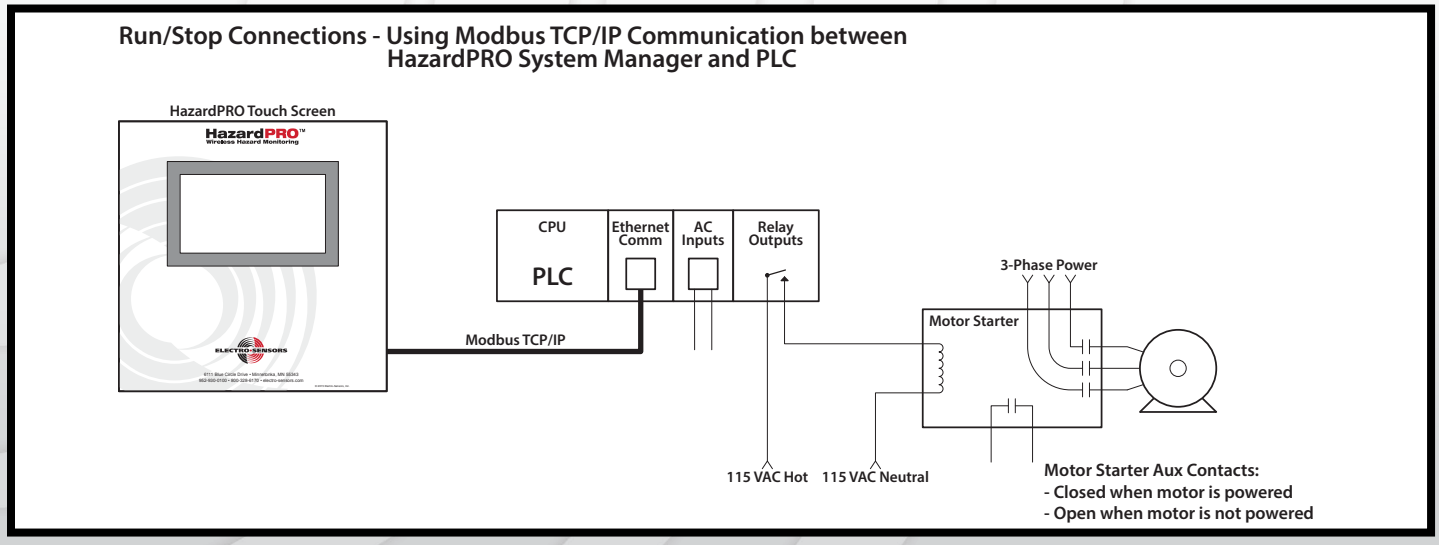


Run/Stop Connections

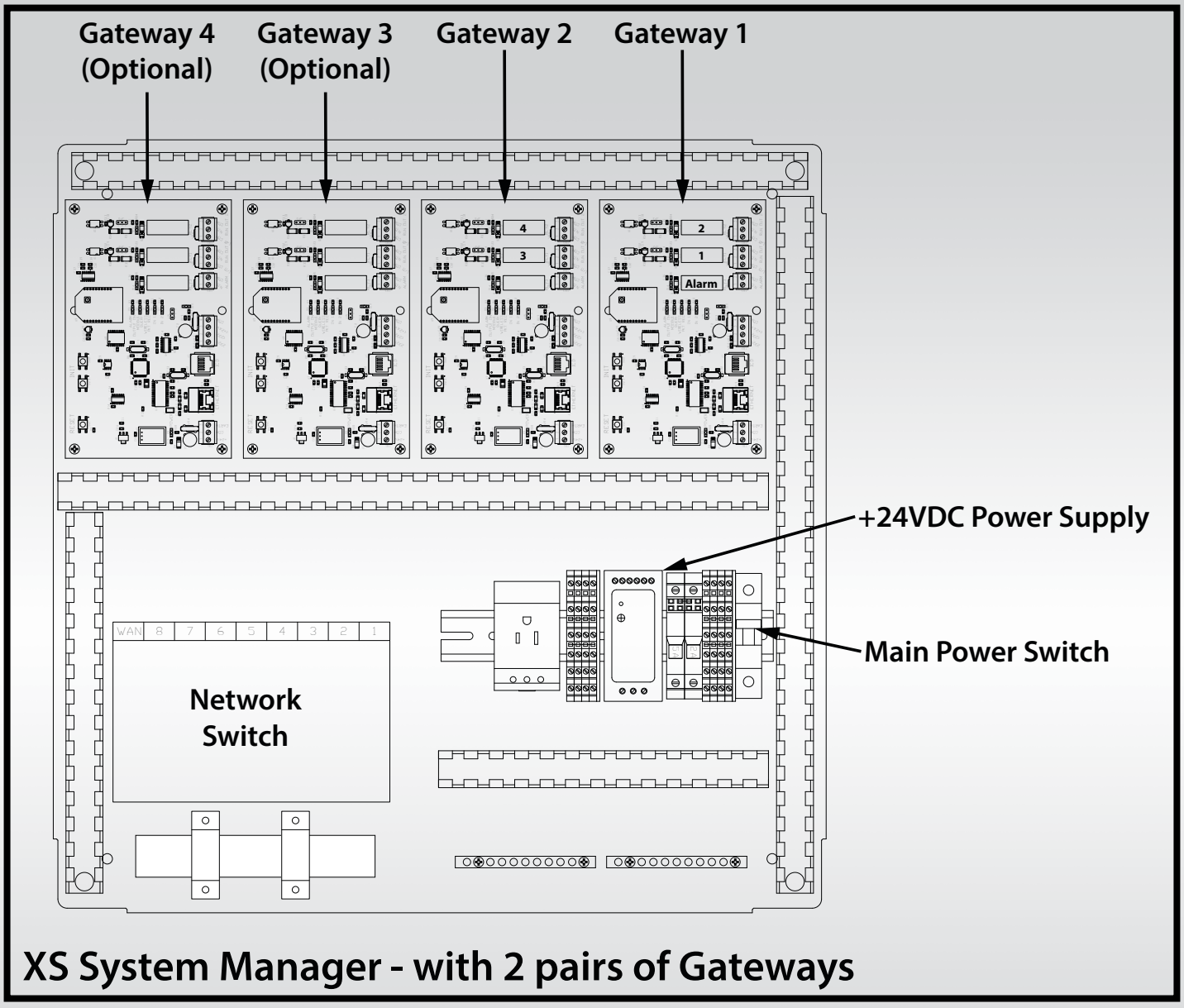
Run/Stop Connections - Using Plant HMI Run/Stop and PLC Outputs



Run/Stop Connections - Using Modbus TCP/IP Communication between HazardPRO System Manager and PLC



Section C
System Manager Configuration
Model XS ONLY

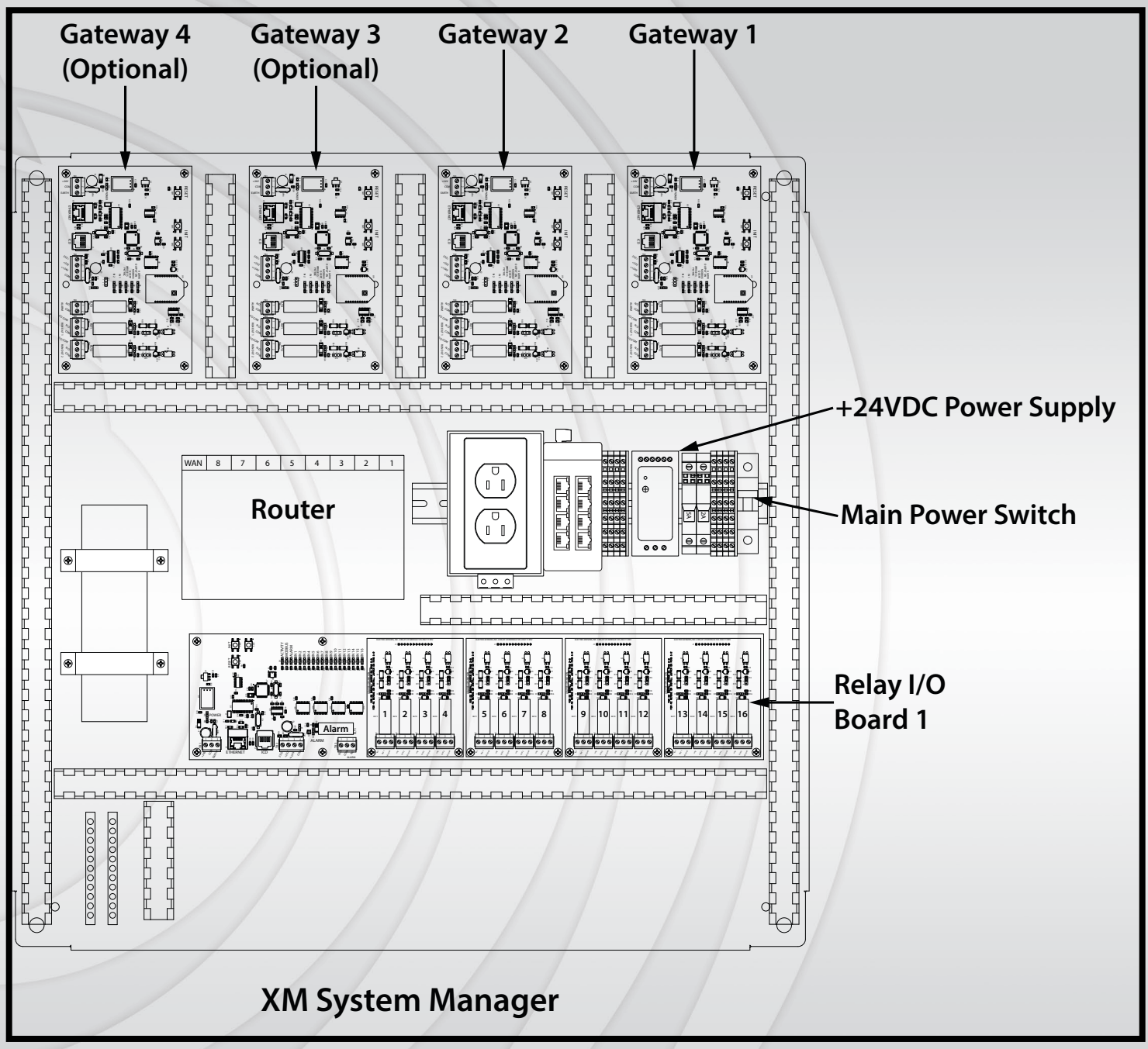


XS System Manager - with 2 pairs of Gateways

XS System Manager - With Two Pairs of Gateways

System Manager Configuration

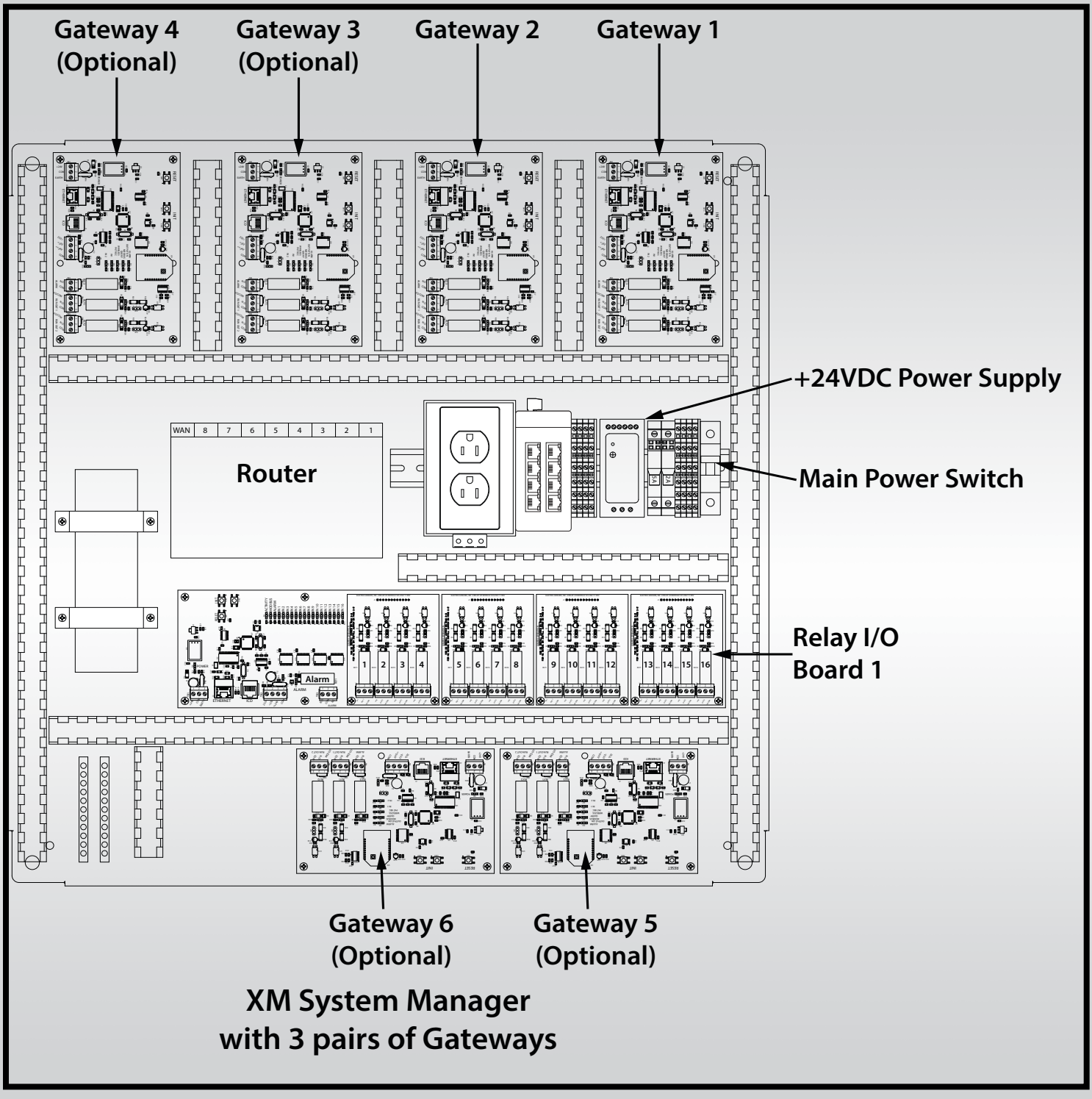
Model XM ONLY



XM System Manager - With Two Pairs of Gateways

System Manager Configuration

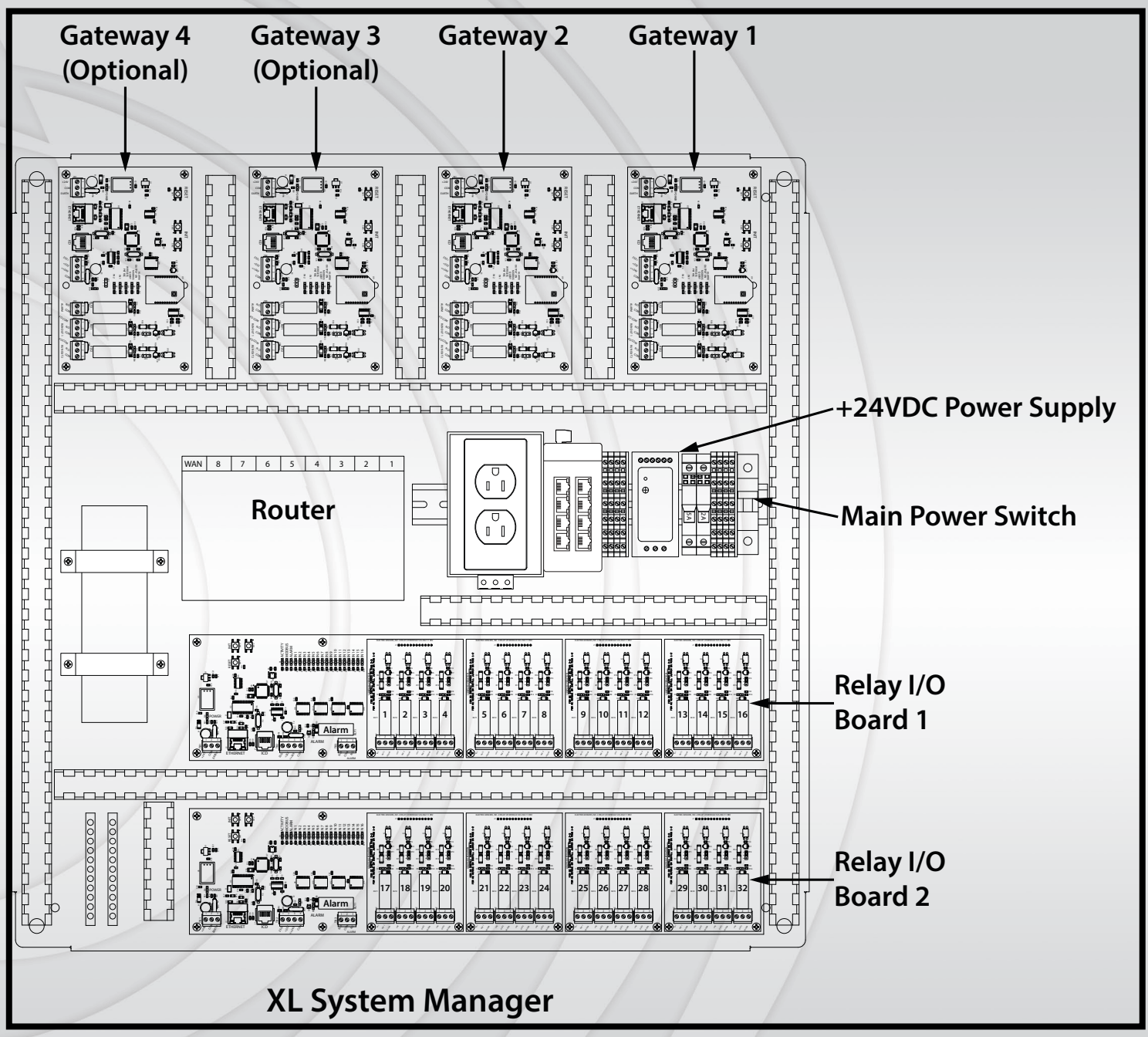
Model XM ONLY



XM System Manager - With Three Pairs of Gateways

System Manager Configuration

Model XL ONLY



XL System Manager - With Two Pairs of Gateways

Section D

ELECTRO•SENSORS

HazardPRO™
Wireless Hazard Monitoring

Operation Manual

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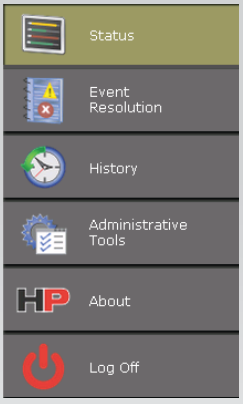


CHAPTER 1

Status

This menu selection displays the equipment being monitored and the available space for equipment expansion. The menu will allow you to select any piece of equipment. Once selected (highlighted) the equipment Name, Status and Section areas will be visible.

Status View:

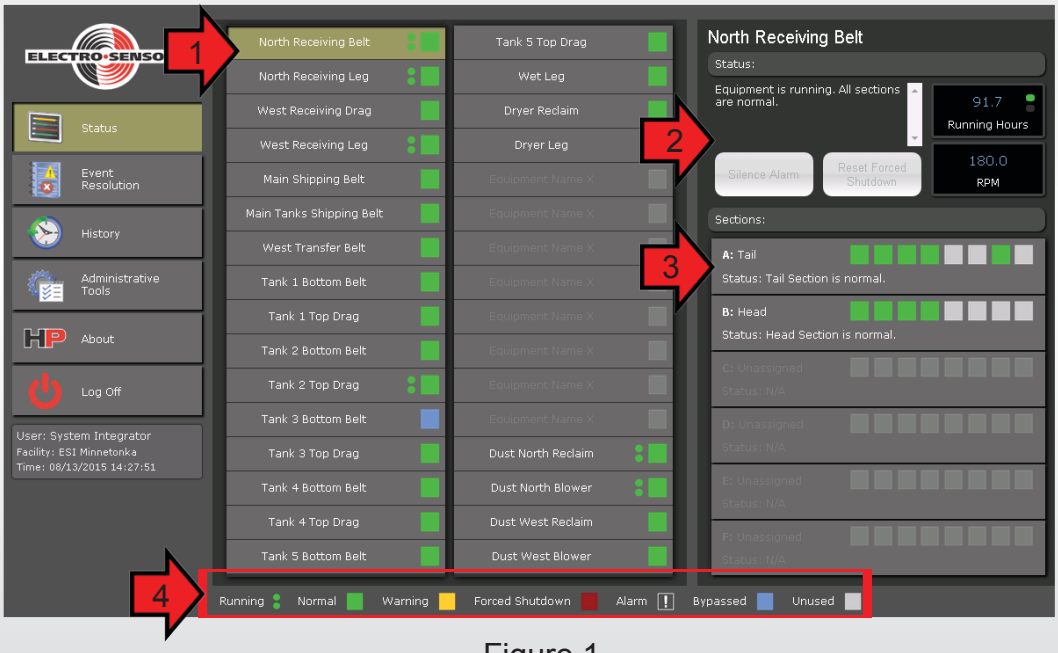


Figure 1

1. Displays all the equipment and the corresponding status.
2. Displays the status of the equipment selected, including: Running Hours, RPM, alarms and shutdown conditions.
3. This area displays all of the sections and the sensors. Clicking a specific section would display the individual information for that section.
4. The key shows what each colored symbol represents on the status page.

To view sensor details, select the desired Section (Figure 2). The equipment section will then display each sensor being monitored. Each sensor input will be in numeric sequence. Selecting Details will open a detailed view of each input, and will allow a graph to be displayed.

Detail View:

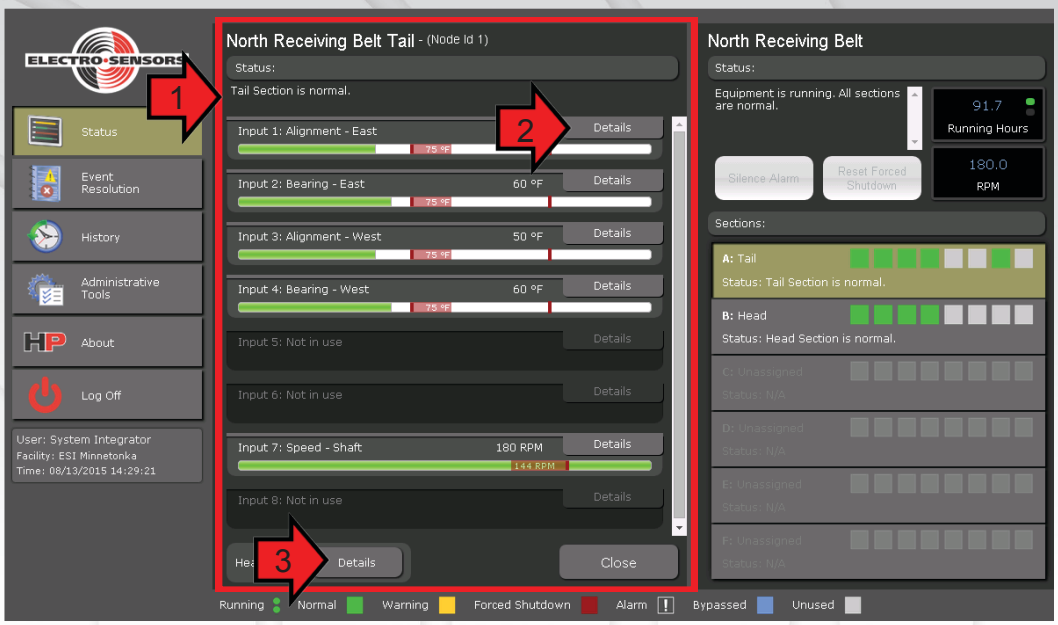


Figure 2

Temperature:

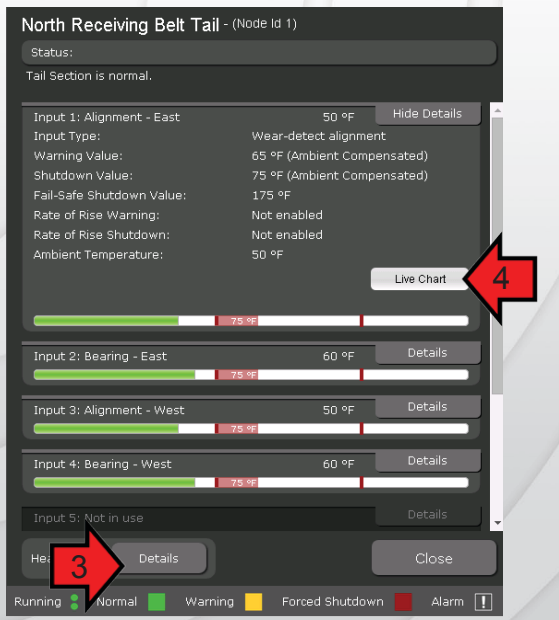


Figure 3

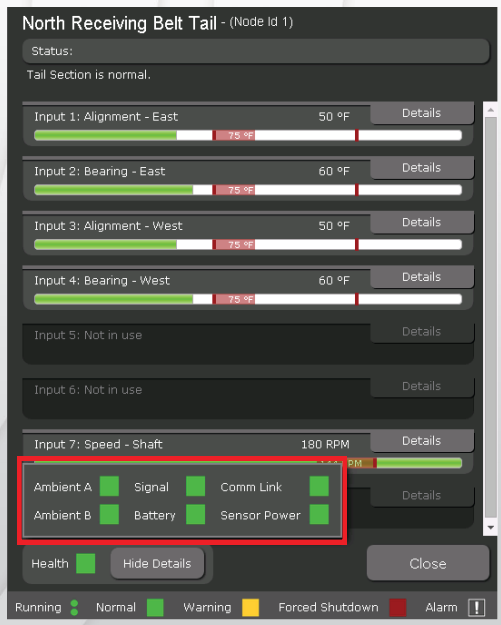


Figure 4

1. Section status, monitor readings for each of the inputs for the section.
2. This will expand to view details of each sensor (Figure 3 is expanded).
3. Selecting Details will expand to show overall health of the Section (figure 4).
4. Selecting Live Chart will open a graphical representation of sensor data (Next Page).

Live Charts:

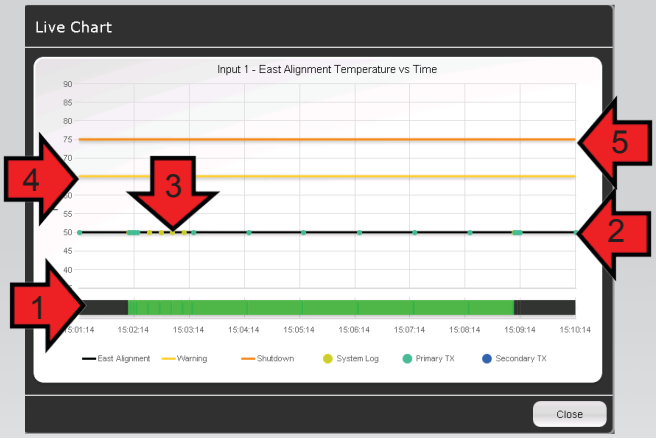


Figure 5

Displays the name of the Input, type of measurement, and the following details (Figure 5):

1. Green signifies equipment is running (green bar).
2. The measured value (black line).
3. Heartbeat (dots on the black line) displays either the primary or the secondary transmission.
4. Warning value (yellow line).
5. Shutdown value (orange line).

Speed Calibration:

The initial speed calibration occurs automatically after the equipment is attached and a run command is given for the very first time. To recalibrate or reset the set-point, hold a magnet up to the calibration target on the bottom of the Node for three seconds while the equipment is running.

Set Points:

- Speed Warning: 90% of the calibrated speed (not adjustable).
- Speed Shutdown: 80% of the calibrated speed (not adjustable).

Note: Warning and Shutdown values will only be visible if the equipment has received a run command (As shown in figure 6 & 7).

Run Signal:

When the system receives a run signal, for the first 60 seconds the System Manager will display the warning and shutdown values while ramping up to 80% and 90% of the calibrated speed. The system will then monitor for speed slowdowns. If a fault occurs the alarm will sound until silenced.

No Run Command

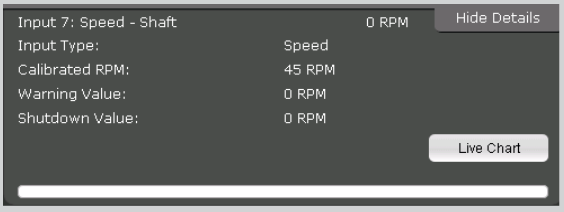
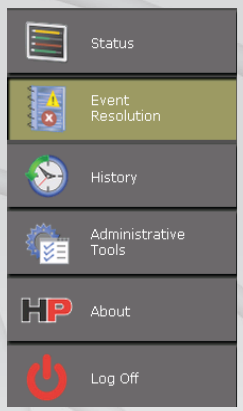


Figure 6

Run Command

Figure 7



CHAPTER 2

Event Resolution

This menu displays any event when a condition is detected outside the normal or preset parameters. This section will display: the event, cause, time, and will provide a graph. It will then allow the user to add comments about the event and the resolution. Also, it will allow full documentation of the event including closing, saving, and printing.

Event Resolution:

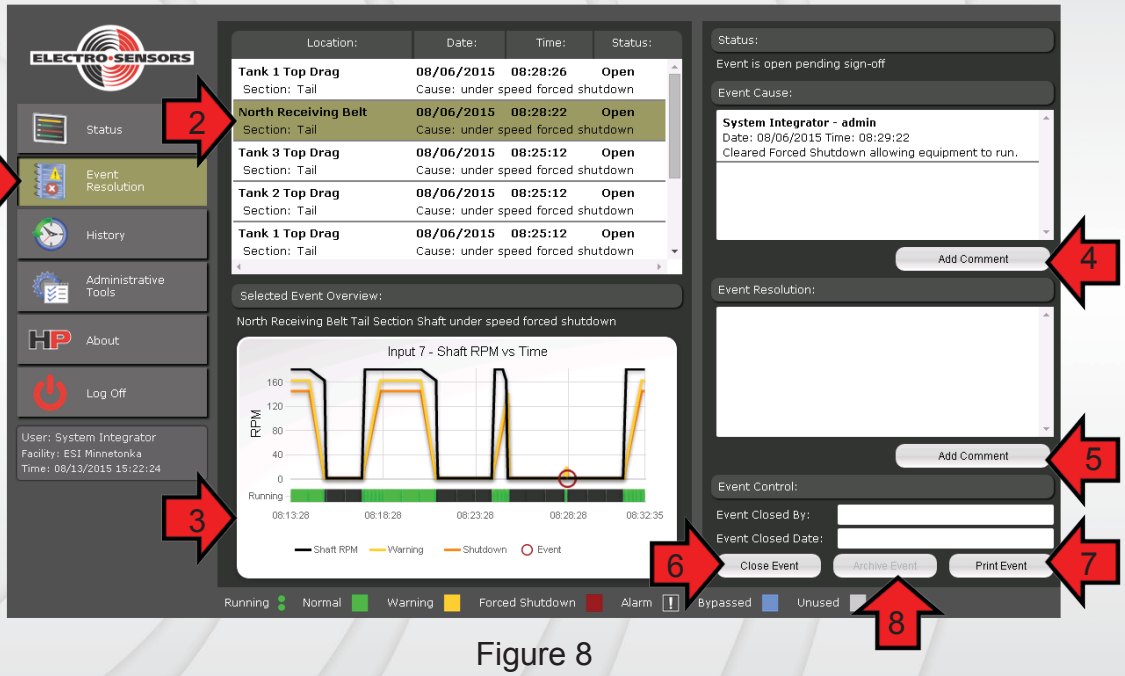
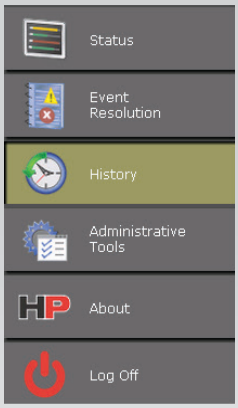


Figure 8

1. Select Event Resolution from the main side menu (Figure 8).
2. Selecting an event will highlight the event.
3. Graph will display data from the moment the event was triggered.
4. Enter any comments regarding the selected event.
5. Enter comments regarding the resolution to the event.
6. Close the event.
7. Print the event for a hard copy.
8. After an event has been closed it can be archived.



CHAPTER 3

History

This menu displays the historical information for each piece of equipment: Section (Node) and Input. Data is available for a selected date and time range.

History:

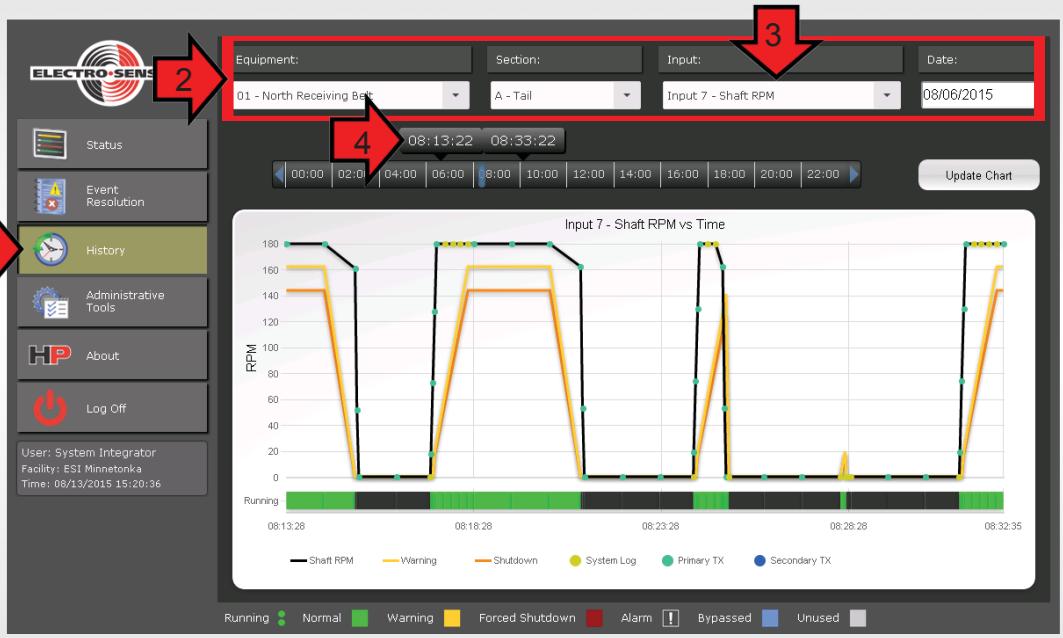


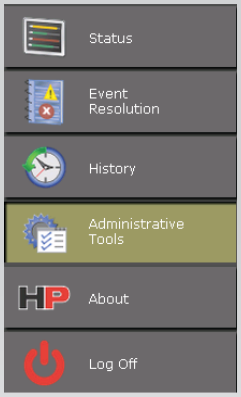
Figure 10

1. Select History tab from the main side menu.
2. Select options from the drop-down menus.
3. Select Input, this will include all sensors and items referenced on page 19.
4. The time bar can be adjusted by clicking on and sliding the bars to define specific time ranges.

Input description table:

Input	Description
Battery Voltage	Reads the battery voltage.
Sensor Power Voltage	Reads the sensor voltage.
Signal Strength	Reports the node signal strength in Decibels.
Elapsed Time	Reports the time between transmissions.
Packet Difference	Reports the number of data packets transmitted over time.
Transmission Reason	Why the data packet was transmitted. Examples are: heartbeat, inputs changed, retries, etc.
Attempt Number	Reports the number of retries the Node has sent before the system manager sent an acknowledgment.
XBee Boot Duration	The time it takes the radio to boot or wake up.
XBee Transmission Duration	The length of time the radio was awake to complete the last transmission.
XBee Status Code	The status success rate. If a failed transmission occurs this will provide a reason for the failure.
XBee Update Settings	This will increment whenever the wireless communication settings are updated.
XBee Reload AT Cmds	If the Processor has difficulty communicating with the transceiver or detects a new transceiver, the graph will increment by one.
XBee Bad Frames	If the transmission packet does not comply with the expected command structure, this variable will increment by one.
XBee No Processor Comm	If the processor communication fails it is incremented by one.
Communication Init Fail	If the node processor cannot successfully initialize the communication section of the program at boot.
Node Boots	The number of times the node reboots in a given amount of time.

Reference Table A



CHAPTER 4

Administrative Tools

This section has many administrative functions. Only Administrator, Corporate Manager, and Facility Manager accounts can access Administrative Tools. Subsections include: Equipment Configuration, Event Archive, Facility Information, Gateways, Interval Mode, Plant Control System Interface, Remote Notification, Slow-Down Testing, Slow-Down Testing Reports, System Wide Hazard Monitoring Settings, and Users.

Administrative Tools Subsections:

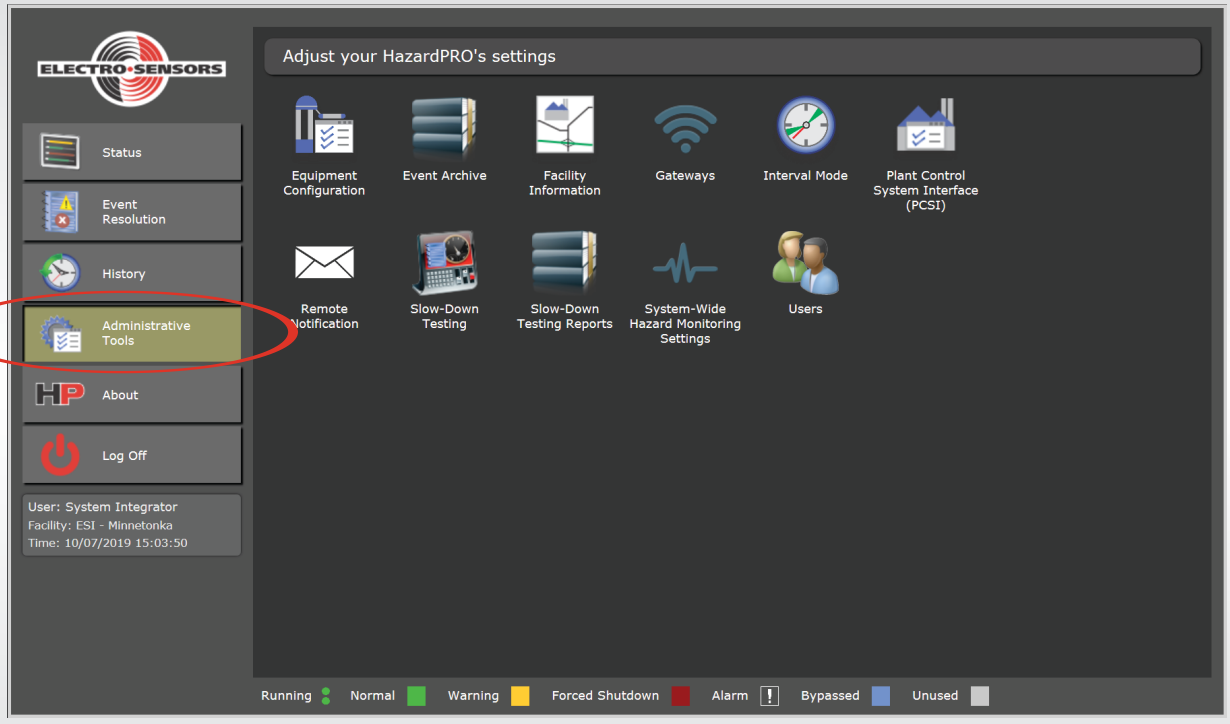


Figure 11

Equipment Configuration:

This tool allows the user to add, edit, and delete equipment from the system. This includes the identification of each Section and the connected Sensors.

Administrative Tools Subsections:

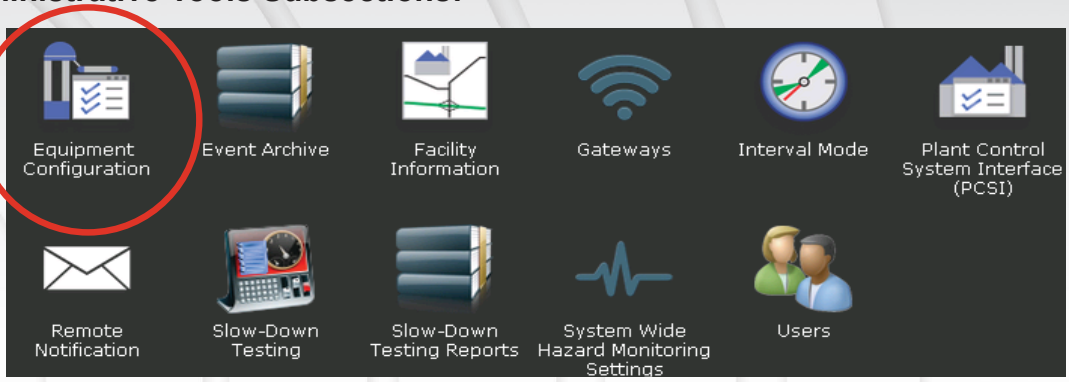


Figure 12

Managing Equipment:

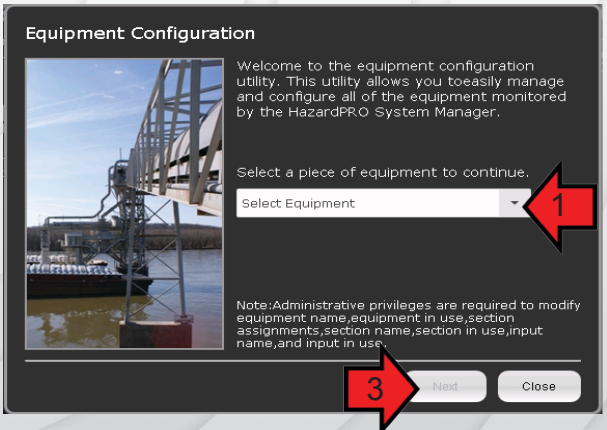


Figure 13

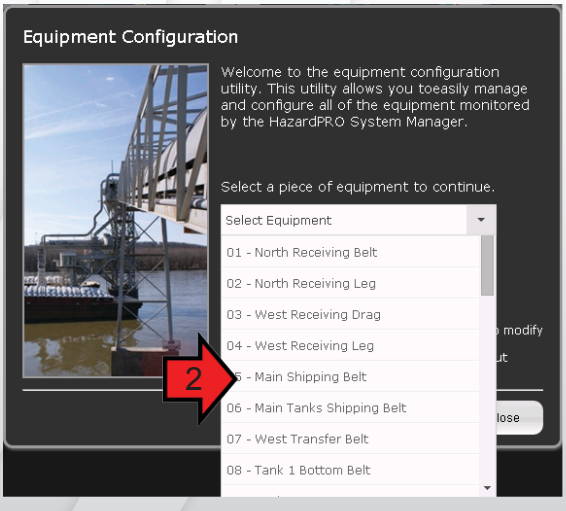


Figure 14

1. Select a piece of equipment using the drop-down arrow.
2. Select one of the drop-down menu options.
3. Click on the Next button to continue.

Equipment Configuration: Equipment General

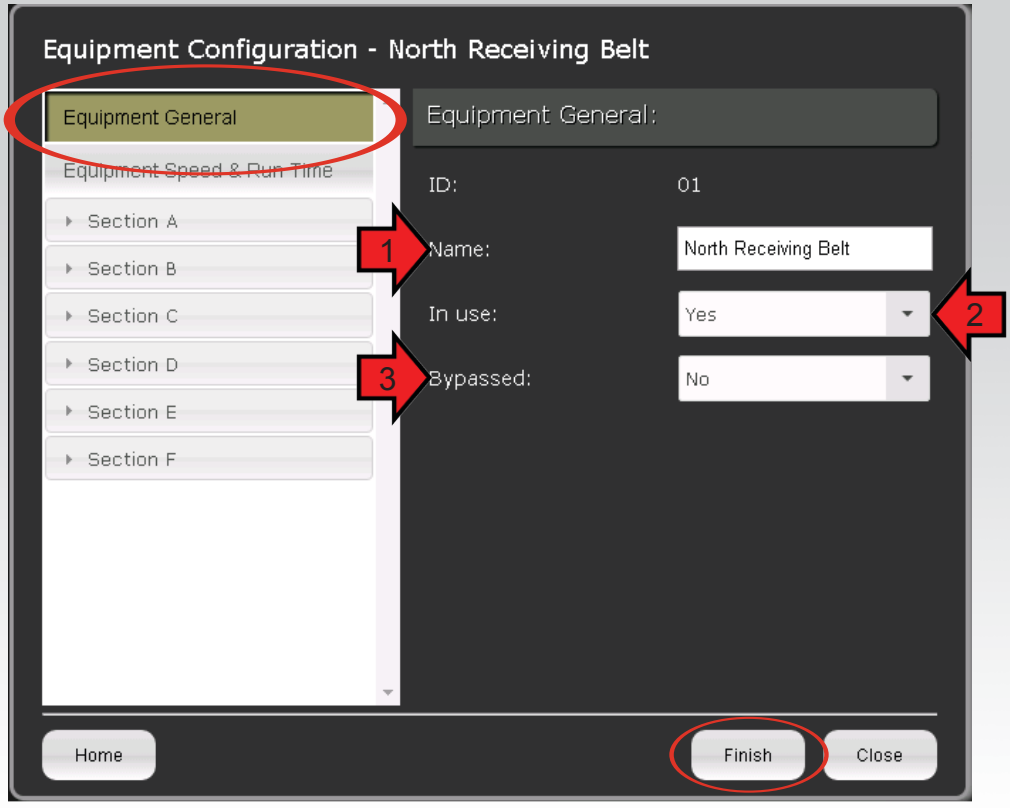


Figure 15

Select the Equipment General. The equipment can be named, put In Use, and Bypassed.

1. This will become the name on the System Manager Status screen (Only the Administrator can change this.)
2. Select whether the equipment is being actively monitored.
3. When equipment is Bypassed, Nodes will continue to transmit sensor data and the system manager will still monitor the equipment. It will not save information from bypassed equipment in the history file, nor will it alarm when a fault condition is detected. Only use this mode when working on equipment.

Note: To save, you must select Finish and confirm by selecting Save Changes, if you select Home or Close, your changes will not be saved or recorded.

Equipment Speed and Run Time:

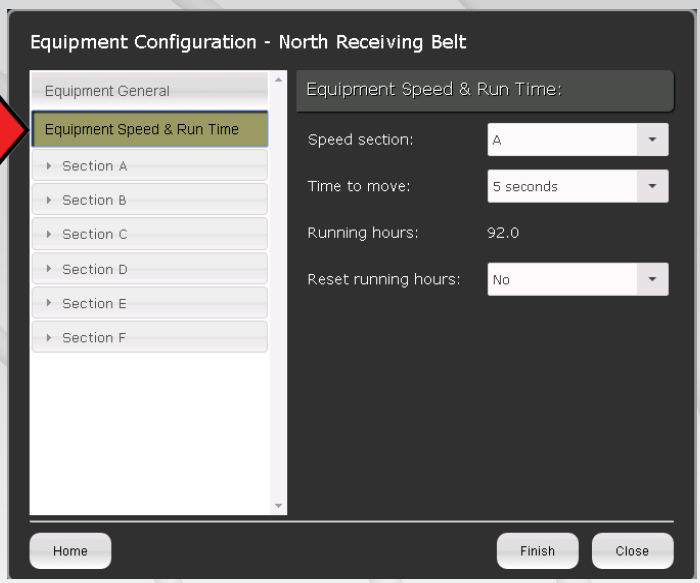


Figure 16

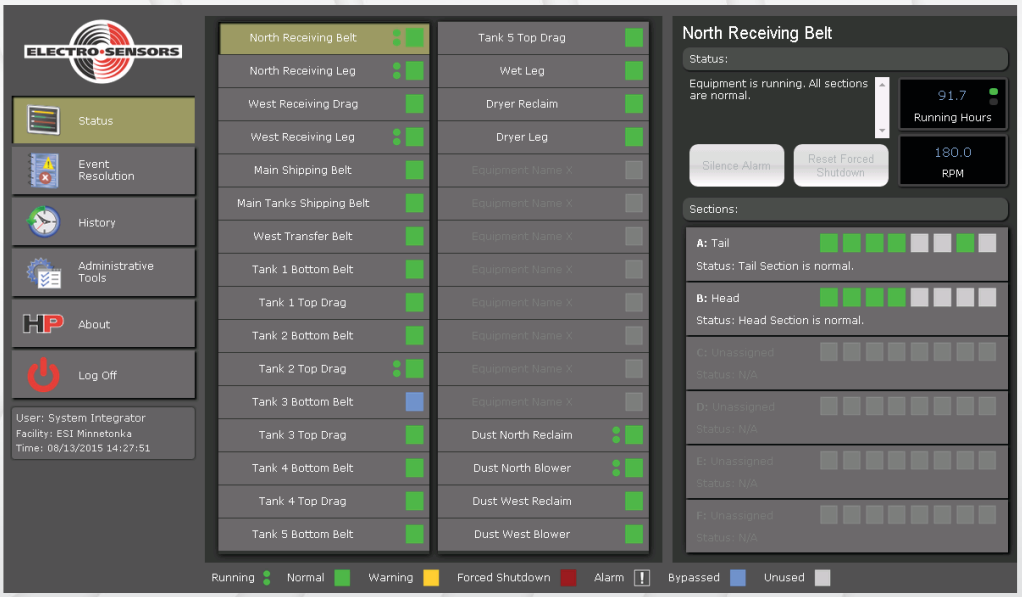


Figure 17

1. This allows you to select a primary speed display in the Status section of the main display.

Sections A through F

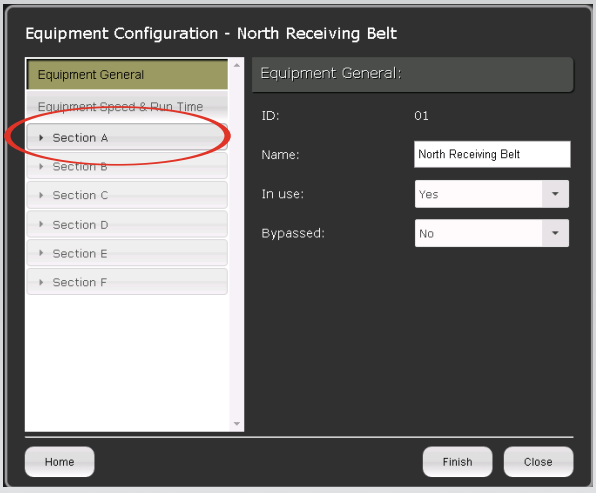


Figure 18

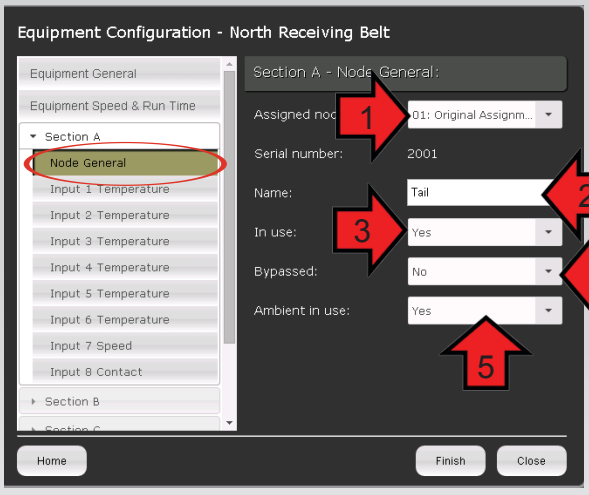


Figure 19

When you select a Section the Node General will highlight and allow the user to define or change the Node Parameters.

1. If the Node ID is unassigned, Select the appropriate available ID (Serial Number should match the ID on the Node's side label).
2. This name will display on the System Manager.
3. Select if, Section should be put In Use.
4. Select if, Section should be Bypassed.
5. Yes-activates the ambient sensors, No-uses set points.
    - Ambient in use will allow you to set a warning and a shutdown conditions based upon the ambient temperature readings.
    - If set to No, a warning and a shutdown condition is based upon a fixed value.

See Reference Document A for setting ranges (Page: 46).

Note: To save you must select Finish, if you select Home or Close, your changes will not be saved.

Reminder: Selecting Yes, for ambient In Use will change the options for setting sensor set-points.

Inputs 1 Through 6: Temperature

There are six inputs identified specifically for temperatures.

Ambient Temperature Control

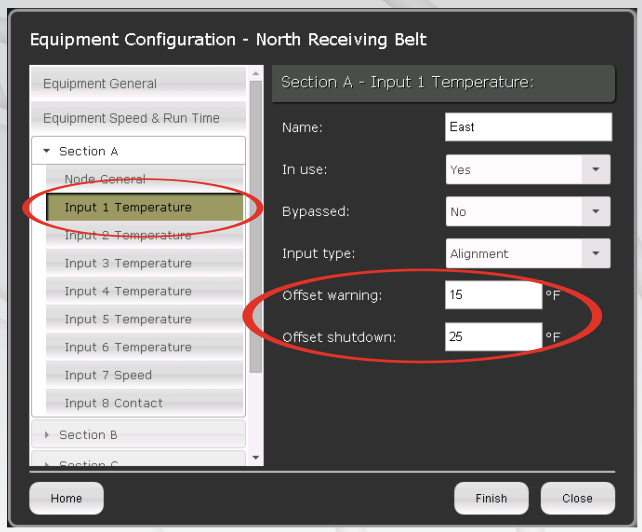


Figure 20

Fixed Temperature Control

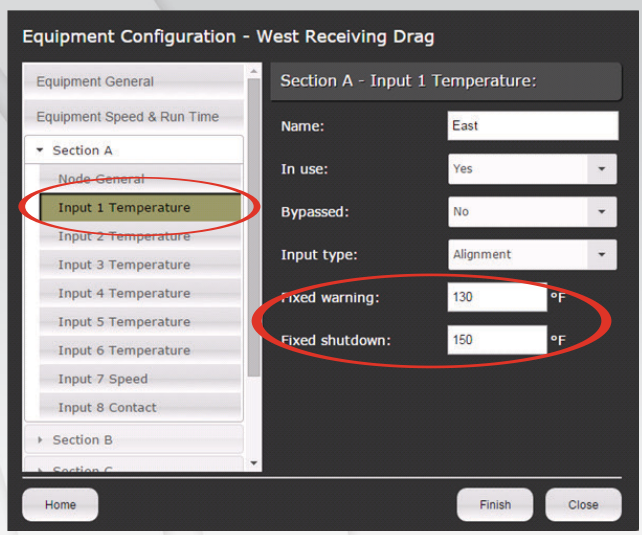


Figure 21

1. Record the name for the sensor as you want it displayed on the System Manager.
2. Select whether or not you would like the sensor to be placed In Use.
3. Select whether or not you want to Bypass sensor.
4. This allows the user to designate the type of temperature sensor.
5. If Ambient in use was set to Yes, then the warning and shutdown values will be off-set from the ambient temperature reading. If Ambient in use was set to No, then the warning and shutdown values will be fixed numbers.

Note: To save you must select Finish and confirm by selecting Save Changes, if you select Home or Close, your changes will not be saved or recorded.

Input 7 Speed: One input per Section is reserved for sensing speed.

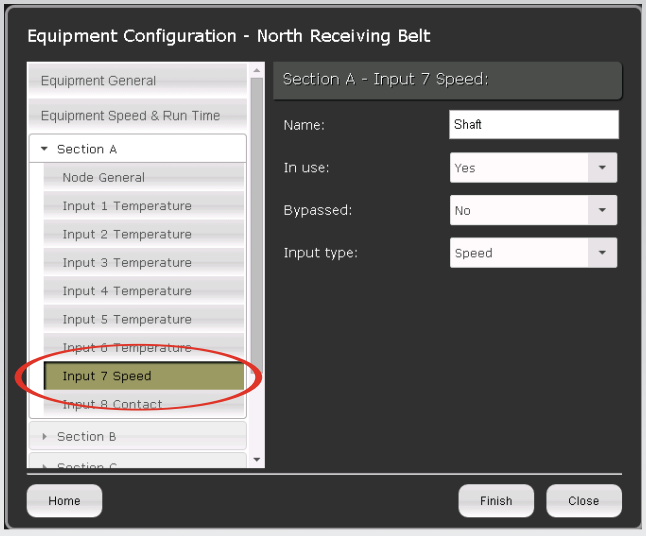


Figure 22

Input 8 Contact:

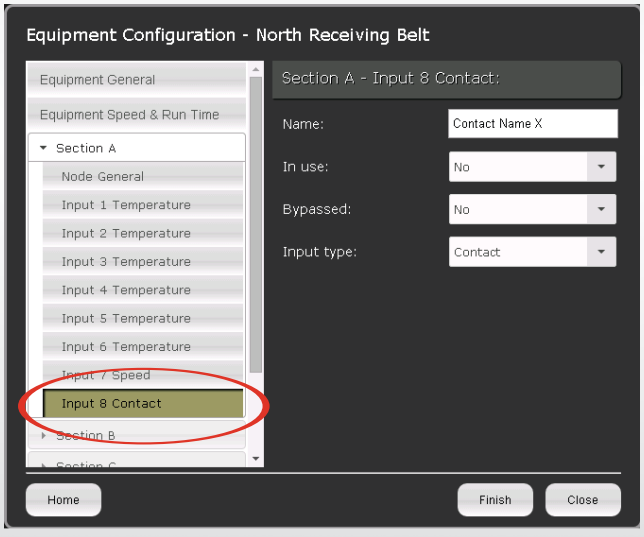
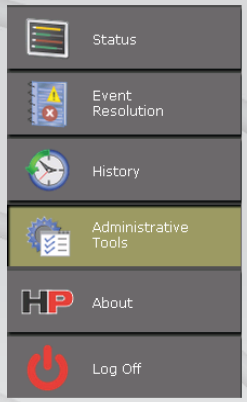


Figure 23

1. Record the name for the sensor as you want it displayed on the System Manager.
2. Select whether or not you want to have the sensor put In Use.
3. Select whether or not you want to Bypass the “alarming” of the sensor.
4. Input 7 is reserved for Speed, while Input 8 is reserved for Contact.

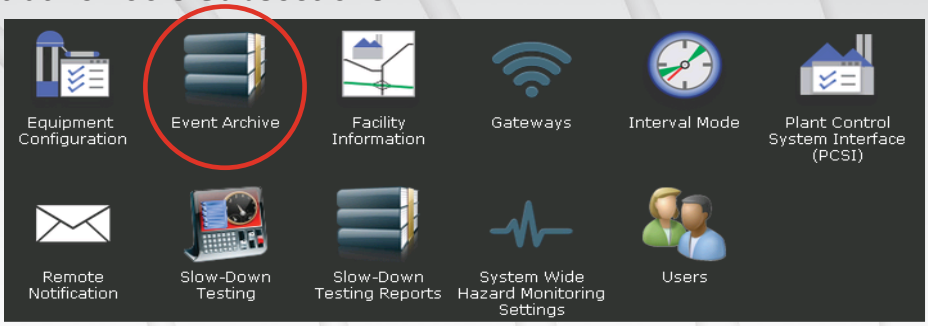
Note: To save you must select Finish and confirm by selecting Save Changes, if you select Home or Close, your changes will not be saved or recorded.



Event Archive:

View archived (historical) events that have been logged within the System Manager. These events identify why the record was created and which steps were taken to resolve the situation. They reference the date and time in which the event was logged.

Administrative Tools Subsections:



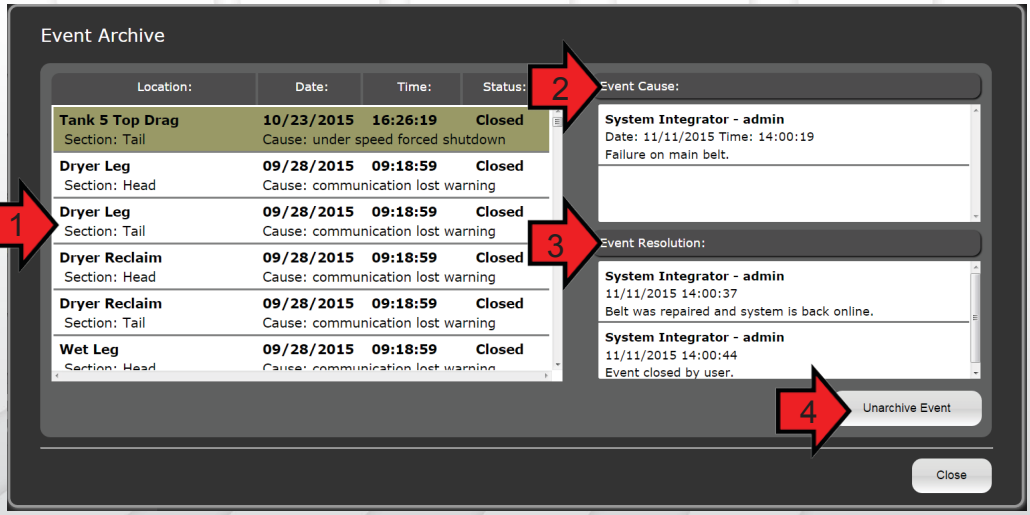
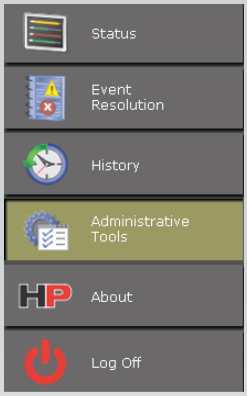


Figure 24

1. Archives show location, time, date, and cause of the event.
2. The user can view the Event Cause.
3. The user can view the resolution, including who entered the resolution along with the date, time, and a description.
4. Unarchive Event allows you to return a selected event to the Event Resolution section.



Facility Information:

This section manages information about the physical location of the System Manager

Administrative Tools Subsections:

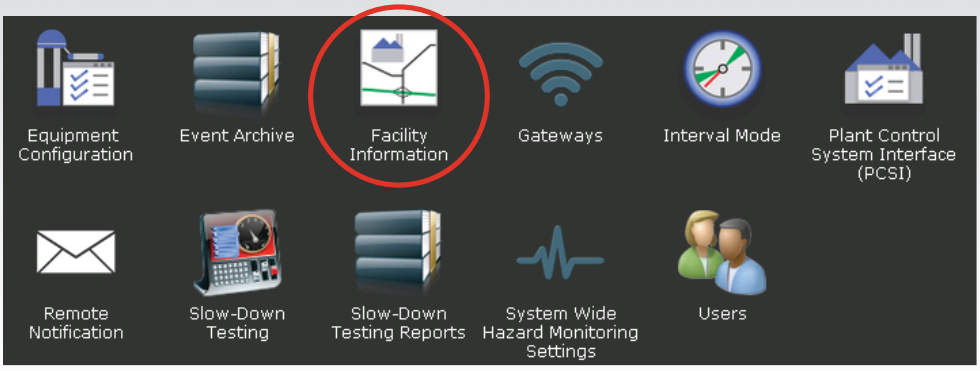
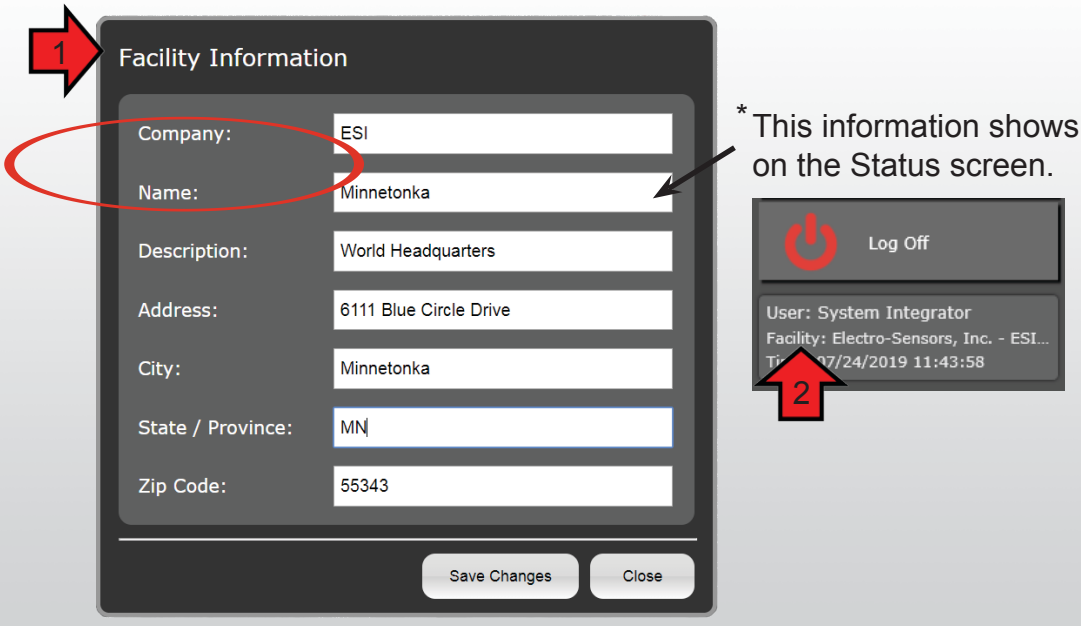
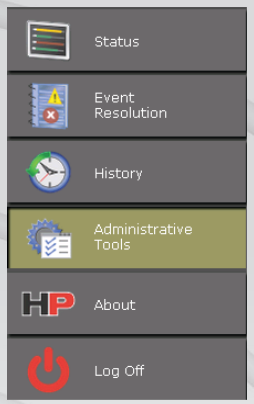


Figure 23



1. Facility Information should be filled out in this section.
2. To change the facility name on the home page you must change the company and name fields in the Facility Information settings.

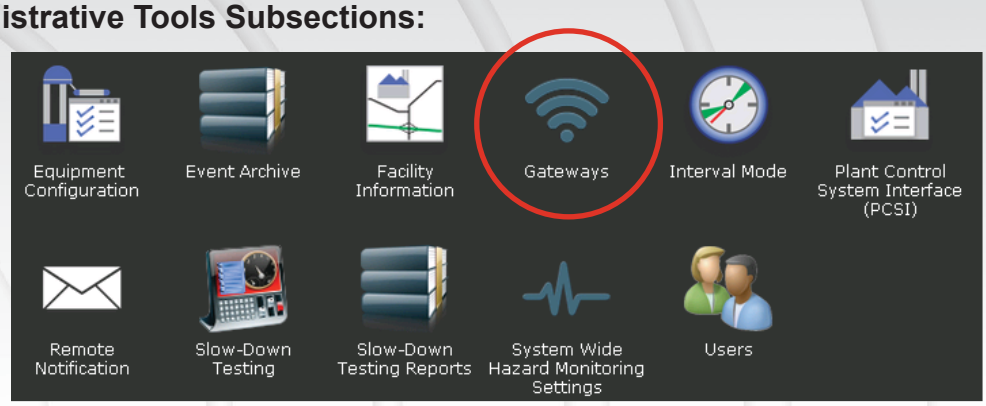
Note: To save you must select Save Changes, if you select Close, nothing will be saved or recorded.



Gateways: Administrator Access Only

This utility manages the gateway connection settings. **Caution**: these settings can only be changed by a System Administrator, and will affect communication with nodes if altered.

Administrative Tools Subsections:



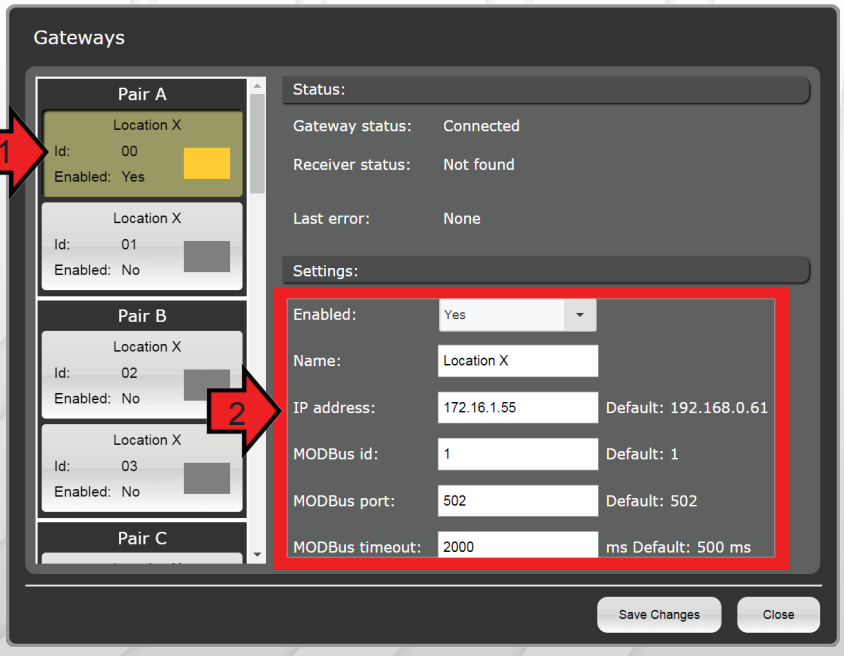


Figure 26

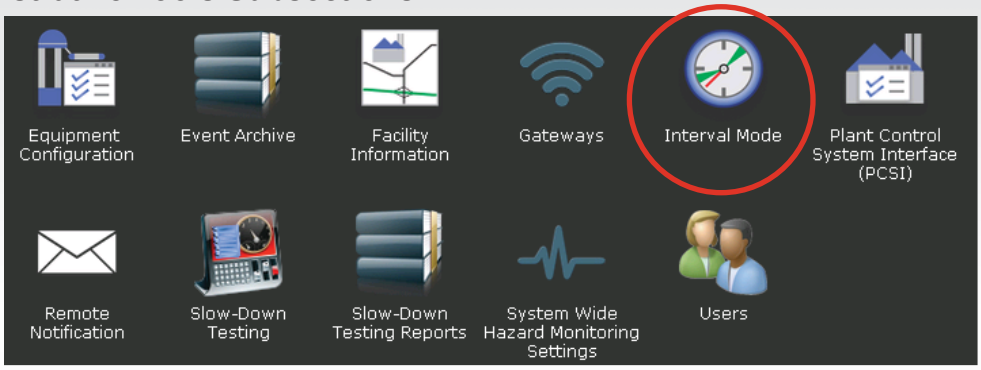
1. Gateways always come in pairs.
2. Gateway IP settings must match the Gateway.

Note: To save you must select Save Changes, if you select Close, your changes will not be saved or recorded.

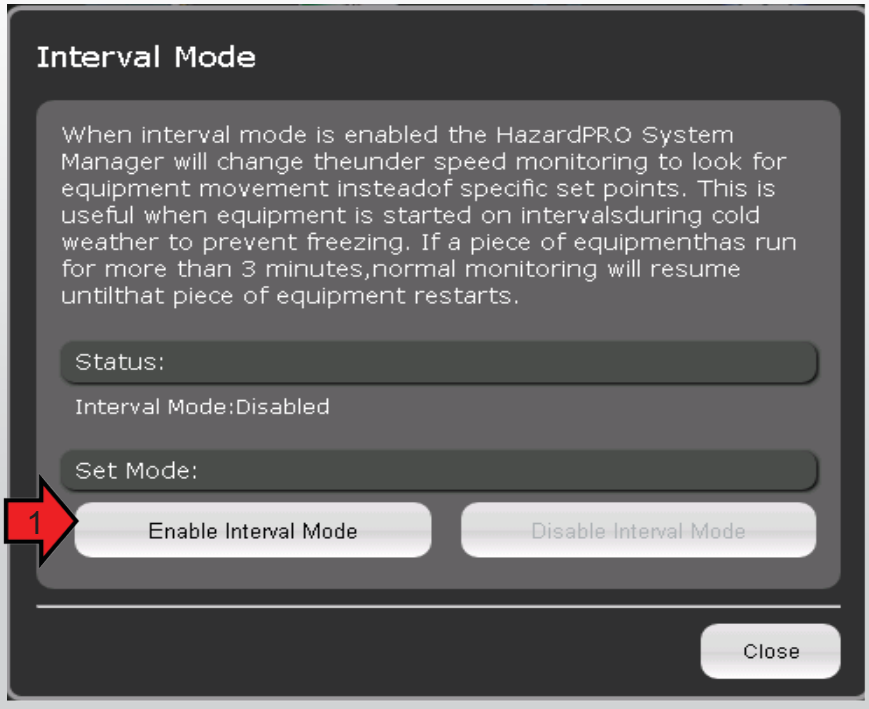
Interval Mode:

Interval Mode allows the user to enable systems to run on intervals. This can be utilized for applications such as cold weather operations.

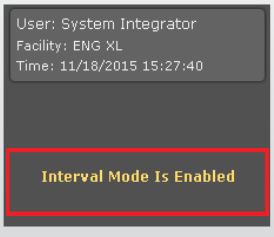
Administrative Tools Subsections:



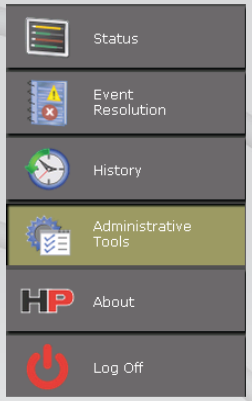
Interval Mode Options:



* When Interval Mode is enabled a notification will appear on the status screen.



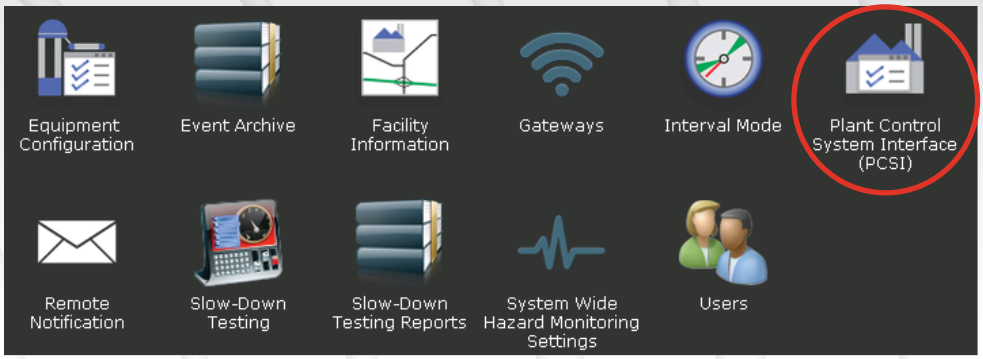
1. To enable interval mode select “Enable Interval Mode”.



Plant Control System Interface (PCSI): Authorized Access Only

The Plant Control System Interface (PCSI) page allows the System Administrator to change the communication settings for use with PLC I/O, Relay I/O, or Gateway I/O.

Administrative Tools Subsections:



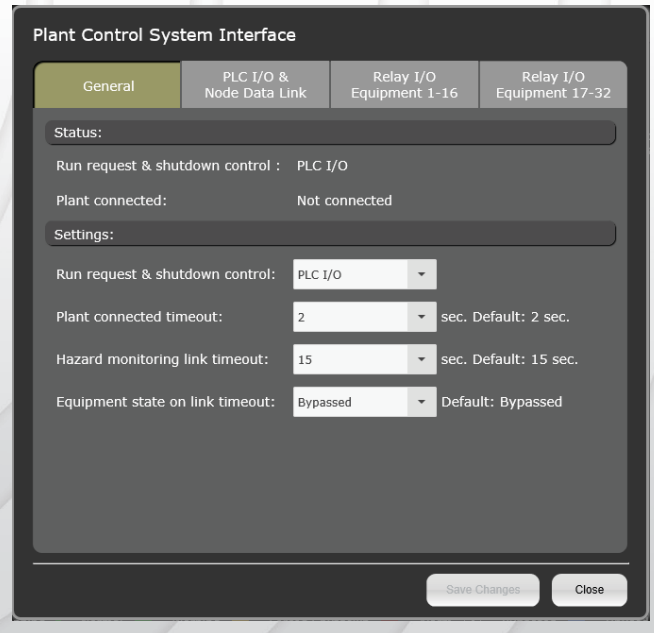


Figure 28

Note:

- These settings will affect the operation of your HazardPRO System Manager. An Administrator account is required to change these settings.

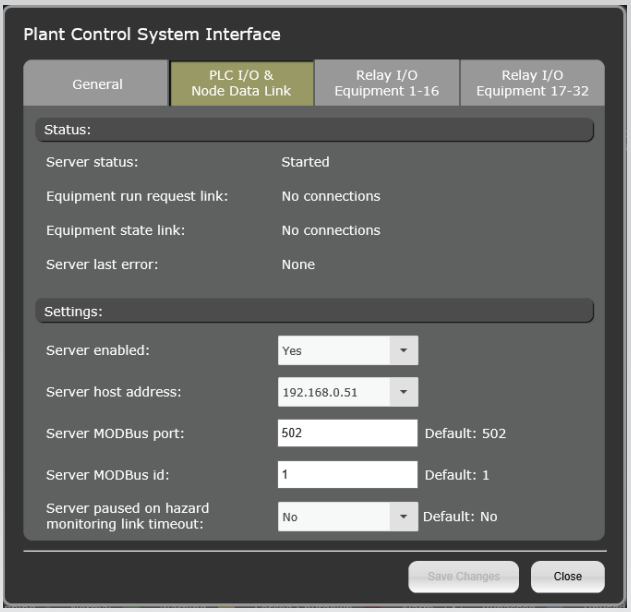


Figure 29

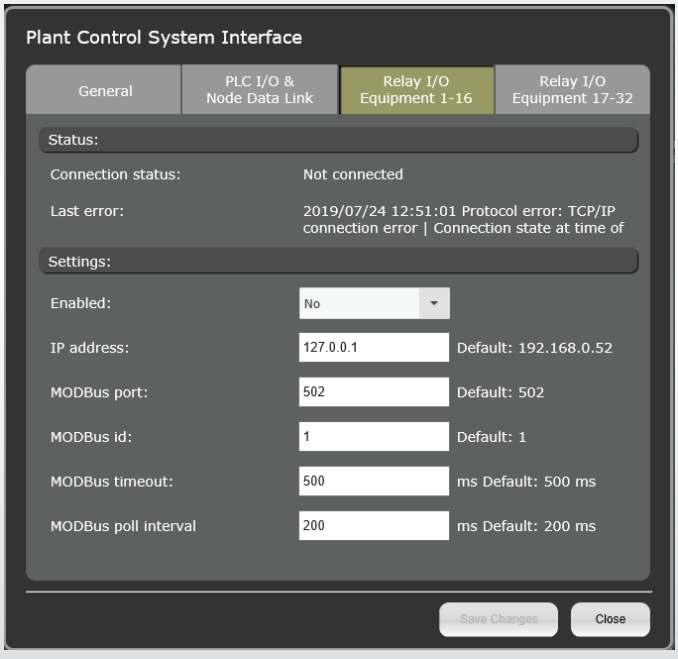


Figure 30

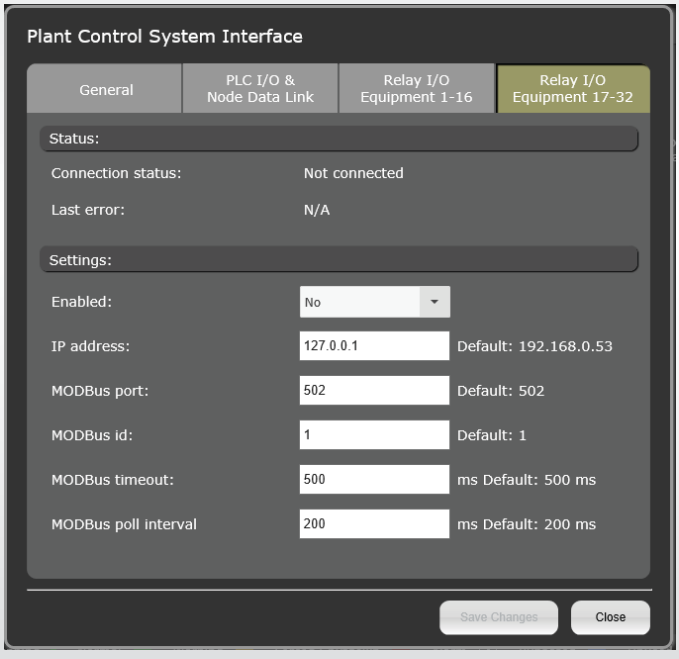
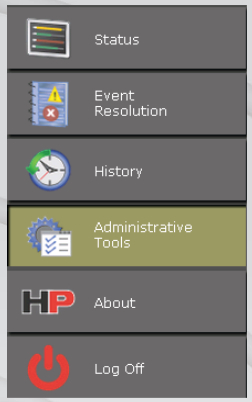


Figure 31

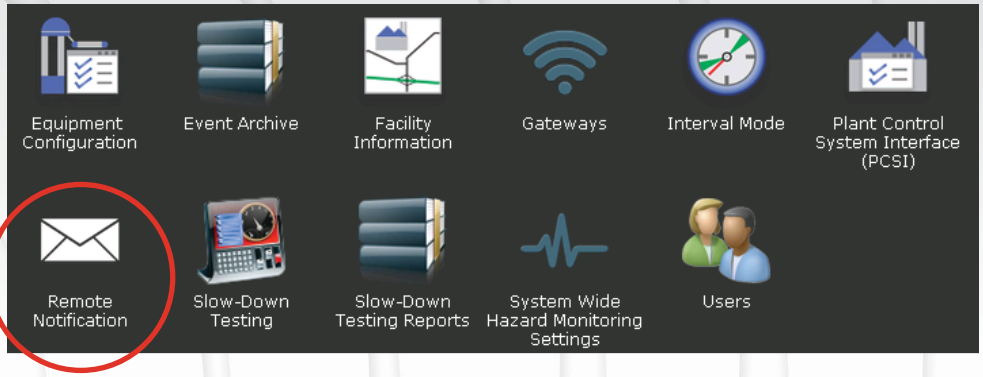
PLC I/O - Server host address should match network of the PLC. (Figure 29)
Relay I/O - IP address must match Relay I/O board IP for proper operation (Figure 30, 31)



Remote Notification

This section is used to set which events trigger remote notification to the listed users.

Administrative Tools Subsections:



Remote Notification, General Settings:

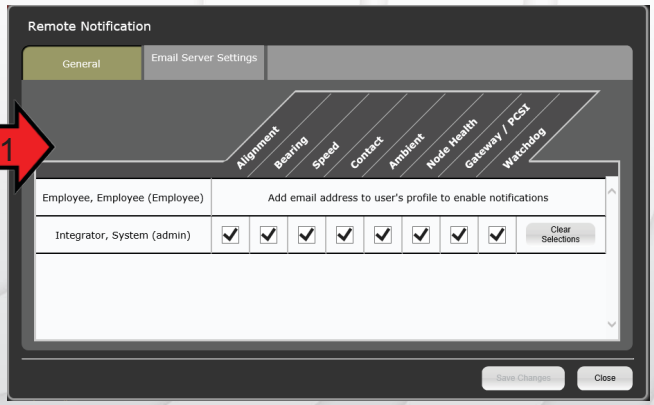


Figure 30

Remote Notification, E-mail Server Settings:

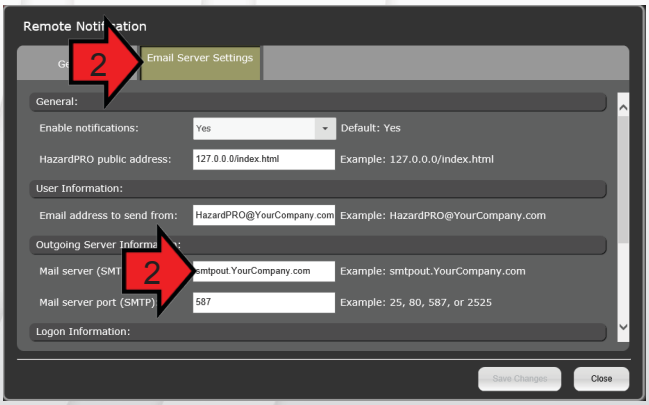


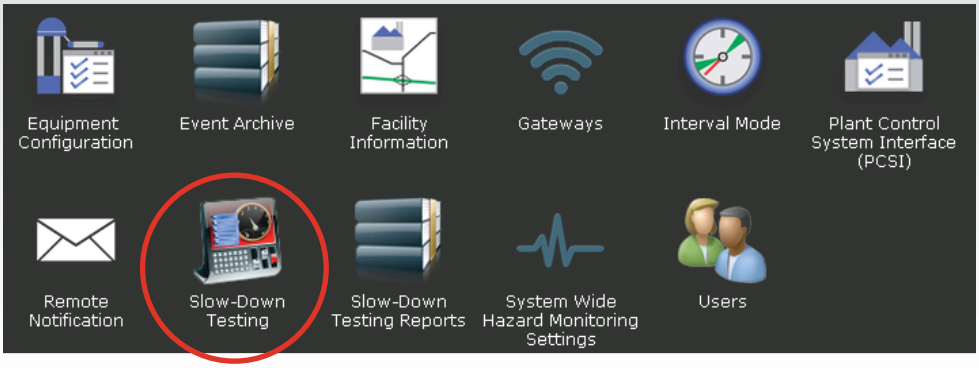
Figure 31

1. Notifications can be enabled for each failure type. (Fig 30) by user
2. Custom SMTP server may be used. Enter relevant information into E-mail Server Settings.

Slow-Down Testing: Caution

Slow-Down testing is a tool that can be used to ensure that the hazard monitoring system is working properly. Slow-Down Testing **Will** stop your machinery so take the necessary precautions. Slow-Down Testing will simulate a slow down to confirm warnings and shutdowns operate properly. Once the emergency threshold is reached the equipment will be shut down.

Administrative Tools Subsections:



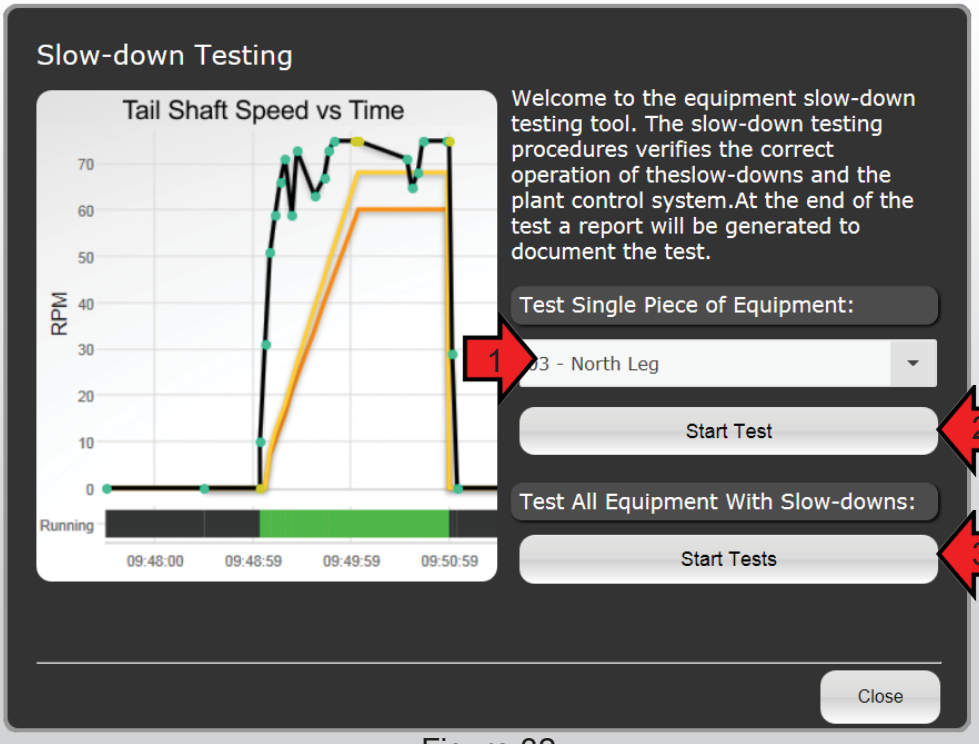


Figure 32

1. Use this selection to identify the piece of equipment you wish to test.
2. Select Start Test to initiate the test of the single piece of equipment.
3. This option will initiate a system wide test to verify correct operation.

Slow-Down Testing: Visual and Audible Testing

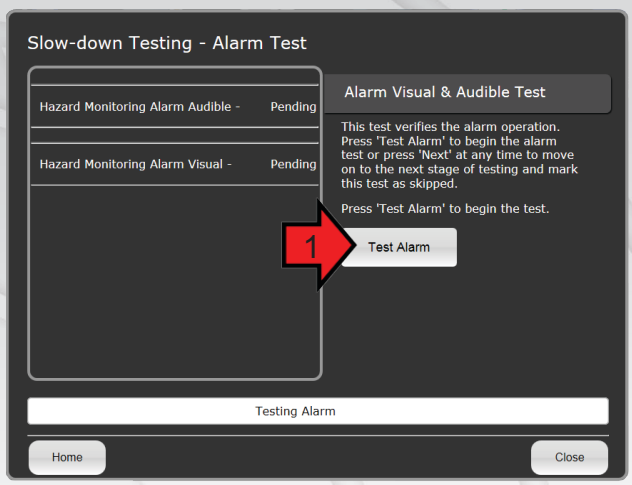


Figure 33

Slow-Down Testing: Visual and Audible Testing

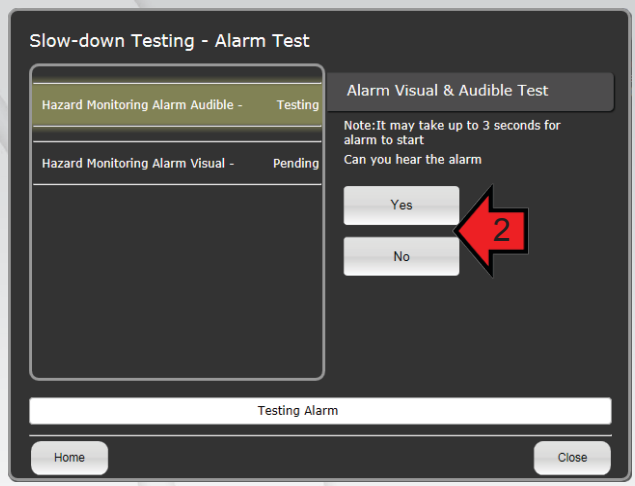


Figure 34

Slow-Down Testing: Visual and Audible Testing Results

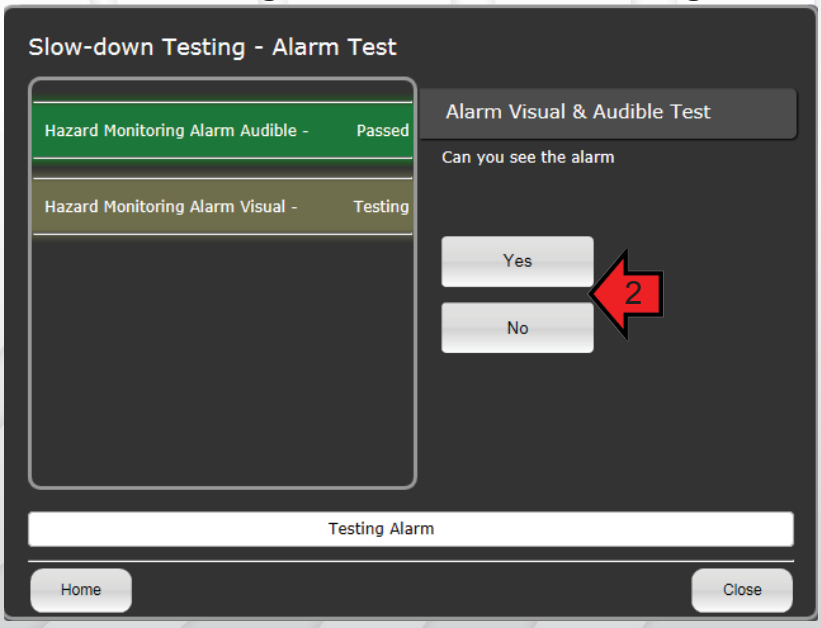


Figure 35

1. Begin the alarm test.
2. Answer the following questions based on the results of your test.

Slow-Down Testing: Equipment Testing

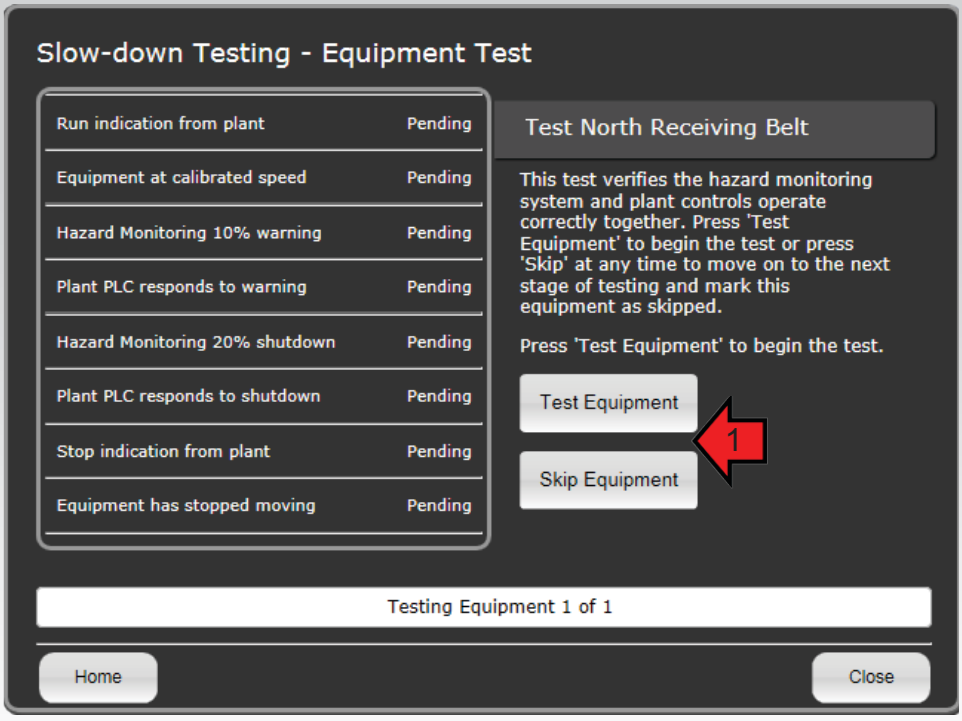


Figure 36

Slow-Down Testing: Equipment Testing Results

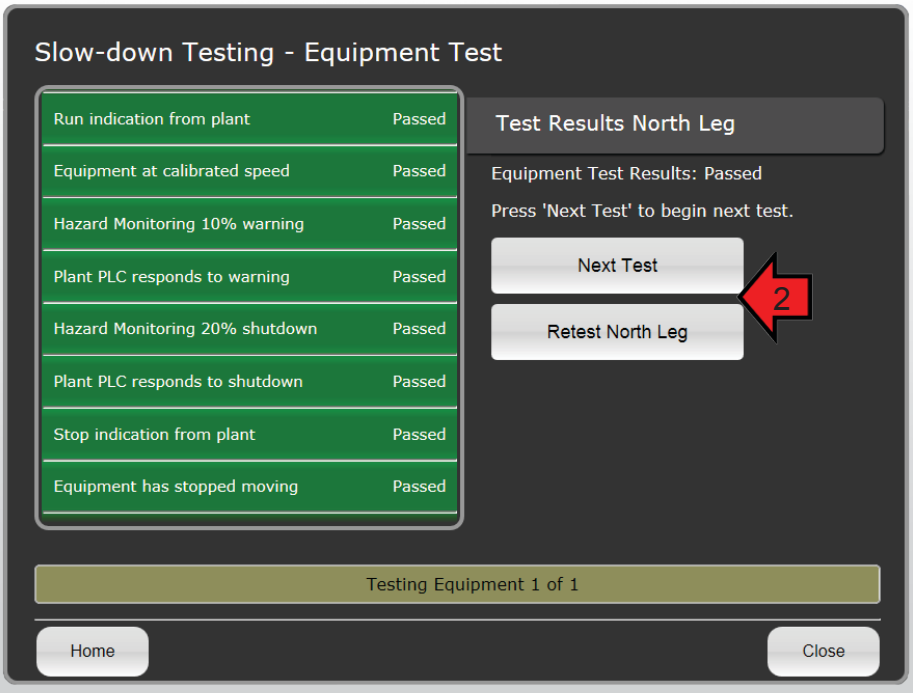


Figure 37

1. This portion of the test confirms that all of the components of your hazard monitoring system are working correctly. You can either initiate a test or choose to skip.
2. On this screen it will show you which equipment passed or failed the test, you can either choose to retest or continue with the testing process.

Slow-Down Testing: Alarm Re-Enableing

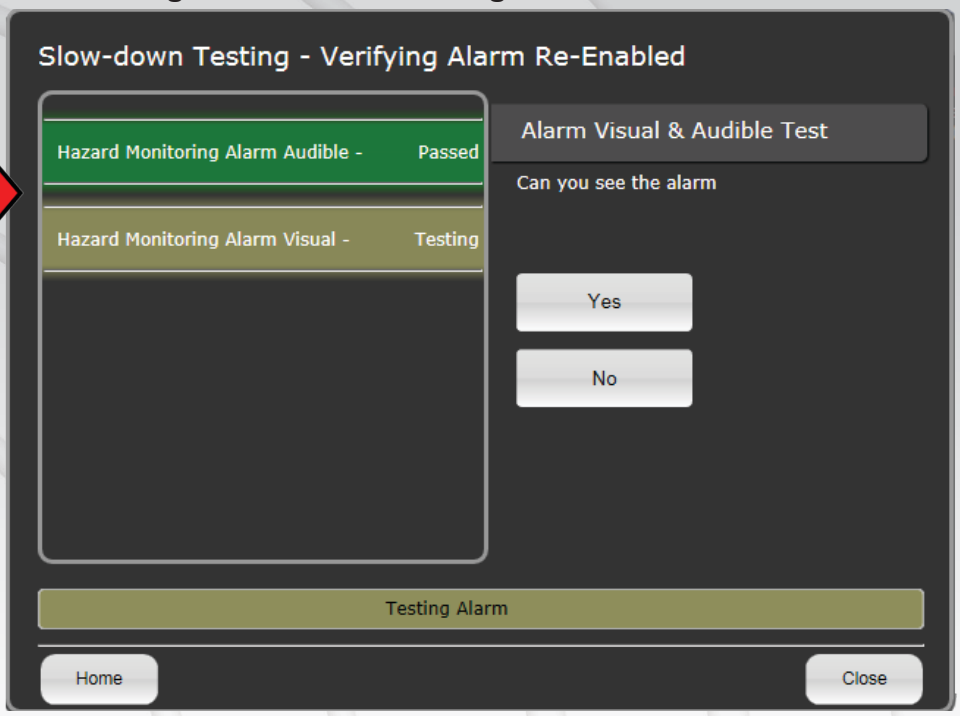


Figure 38

Slow-Down Testing Completion Screen

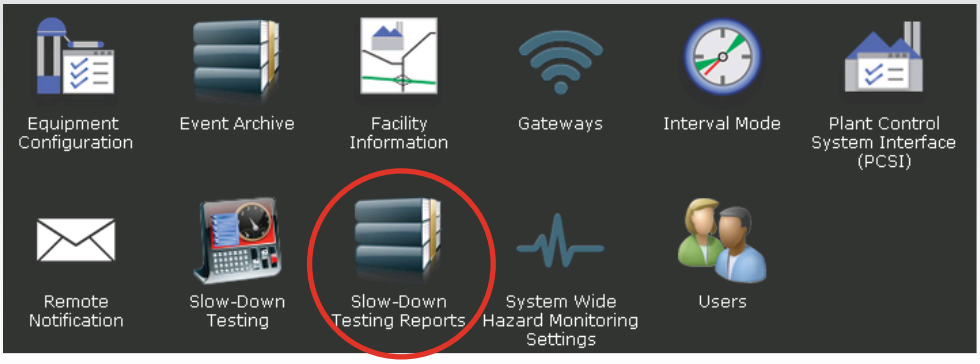
Figure 39

1. This screen shows a second alarm condition to confirm correct operation.
2. When you see the page showing the speed plotted on the graph it means that your test is complete. A Testing Report will automatically be generated showing the results of your Slow-Down Test. To view your Testing Report click the “View Report” button. **Note:** To view an example refer to (Page 39).

Slow-Down Testing Reports

After running slow down testing, it will generate a report. This report will show the user which components of the overall system passed or failed the slow-down testing. These reports can be viewed at any time through the Slow Down Testing Reports menu.

Administrative Tools Subsections:



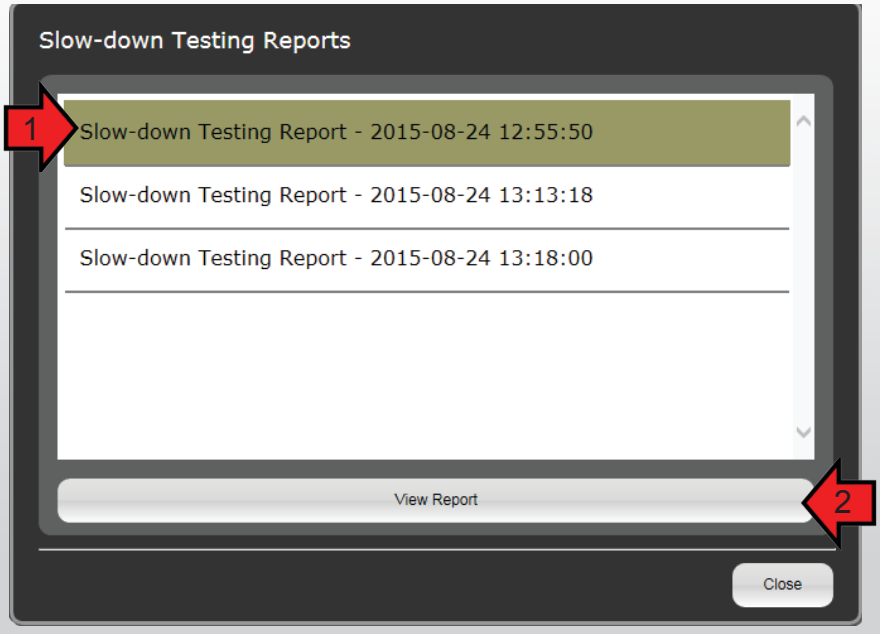


Figure 40

1. Select which Slow-Down Testing Report you wish to view.
2. Click View Report to open a Slow-Down Testing Report.

Slow-Down Testing Report:

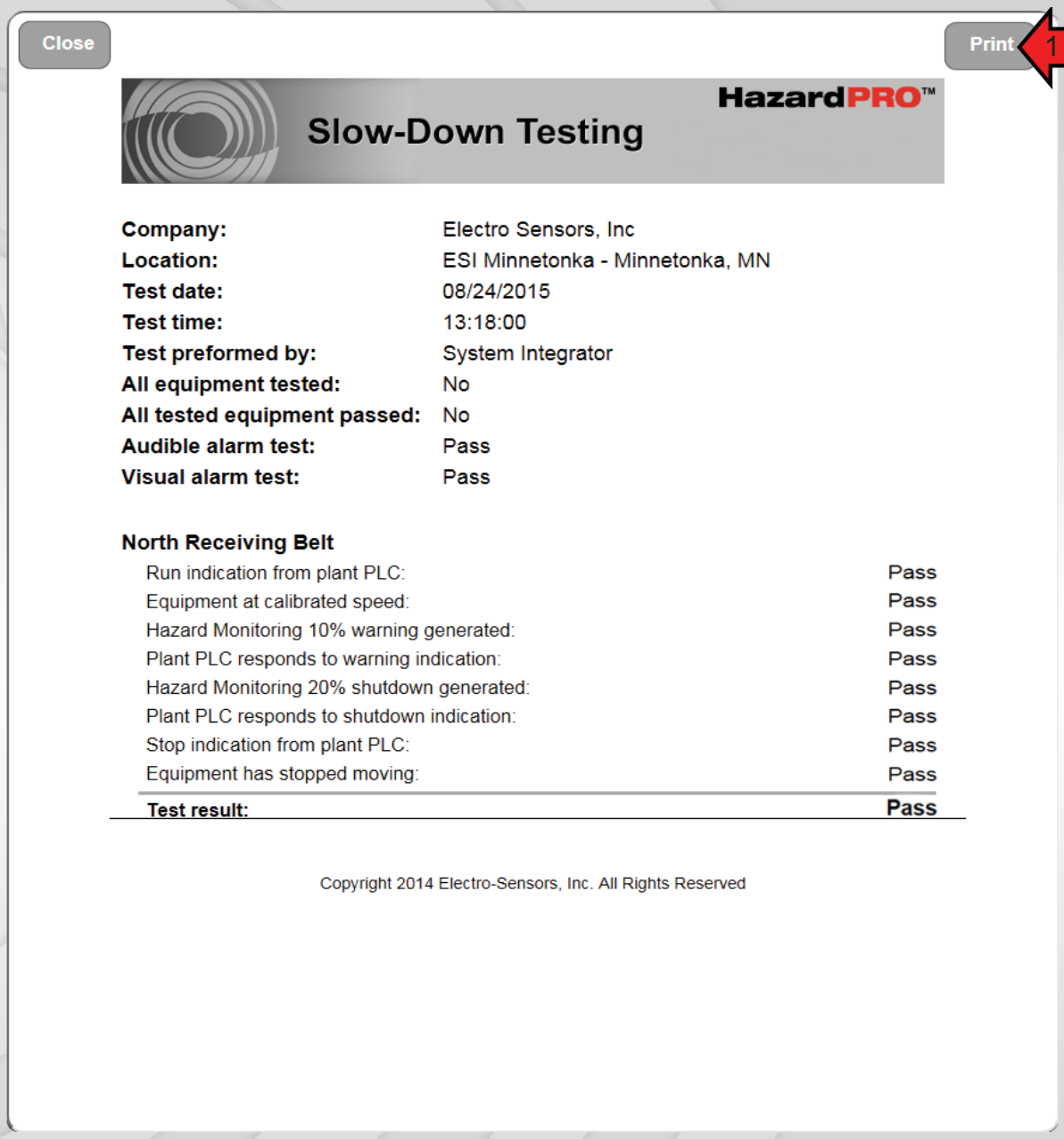


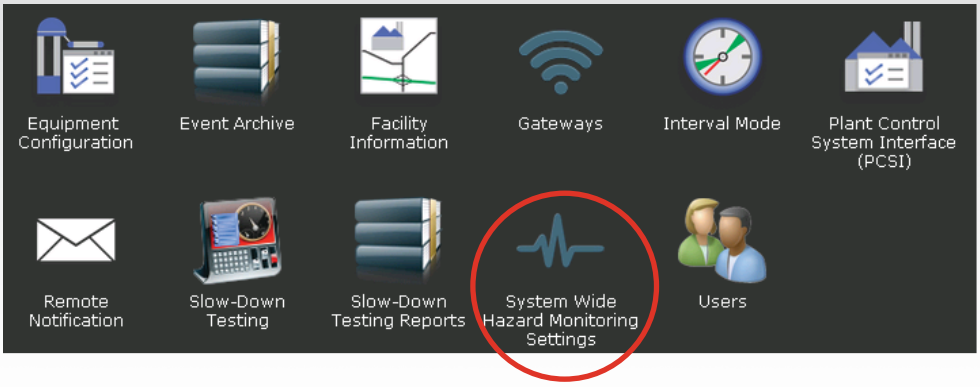
Figure 41

1. To print the Slow-Down Testing Report, Click the Print button in the upper right corner of the report.

System Wide Hazard Monitoring Settings

This area is where global settings can be set for the System Manager. These settings can be overridden by higher priority settings in other areas of the System Manager (System Manager always uses lower temperature set-points if there are contradicting values).

Administrative Tools Subsections:



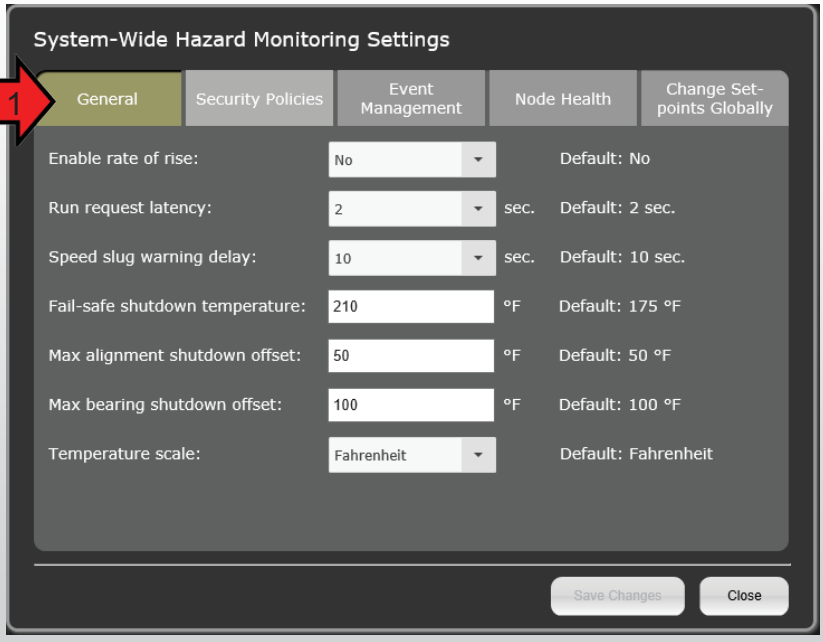


Figure 42

1. The General tab contains settings that affect all pieces of equipment.

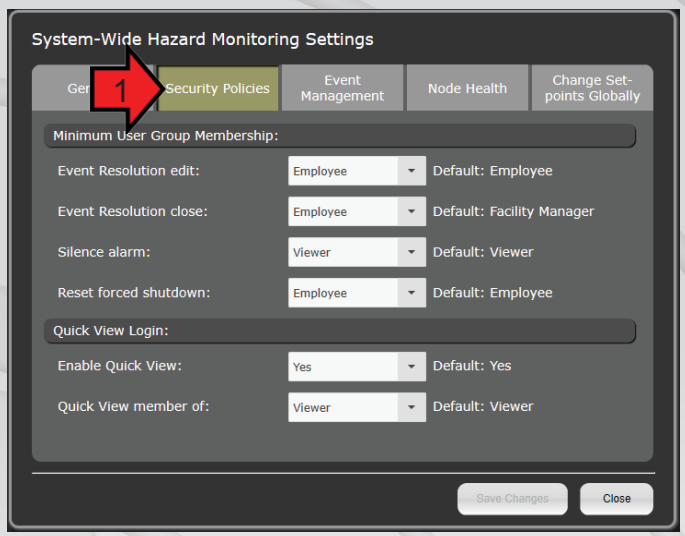


Figure 43

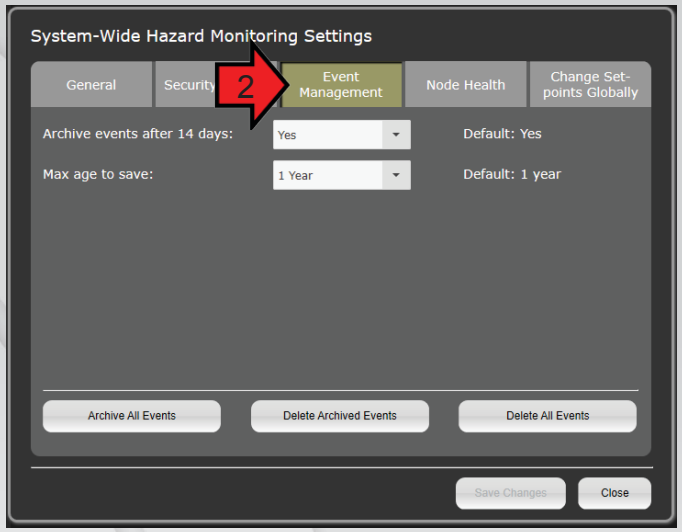


Figure 44

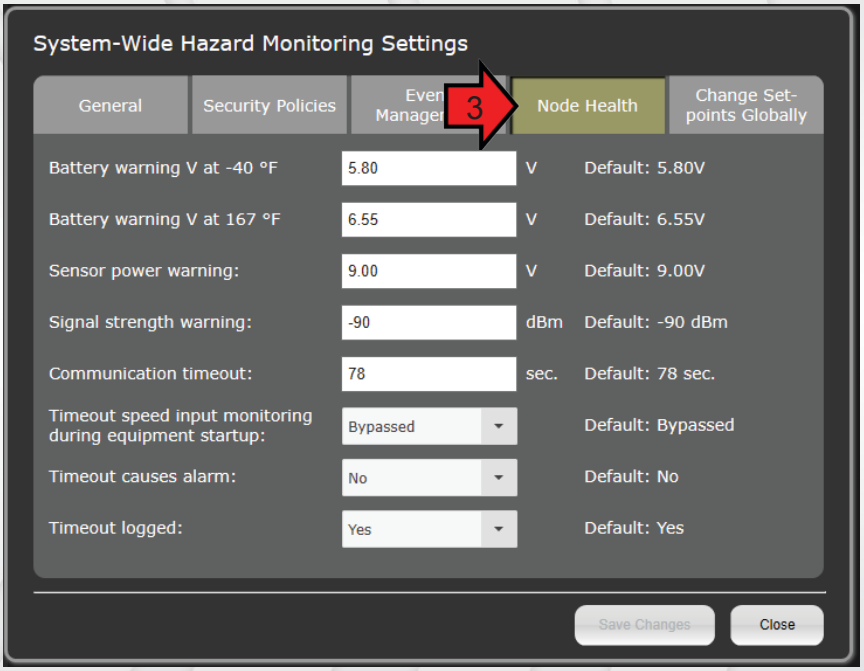


Figure 45

1. Security Policies sets the authorization levels of the different account types. (Figure 43)
2. Event Management sets a maximum time to keep events in the Event Resolution section before automatically archiving the event. All events can also be archived or deleted on this page. (Figure 44)
3. Node Health includes settings to alarm for: Battery Voltage, Sensor Power Settings, Signal Strength, and Communication time-out. (Figure 45)

Note: For user privileges view Document B. (page 47):

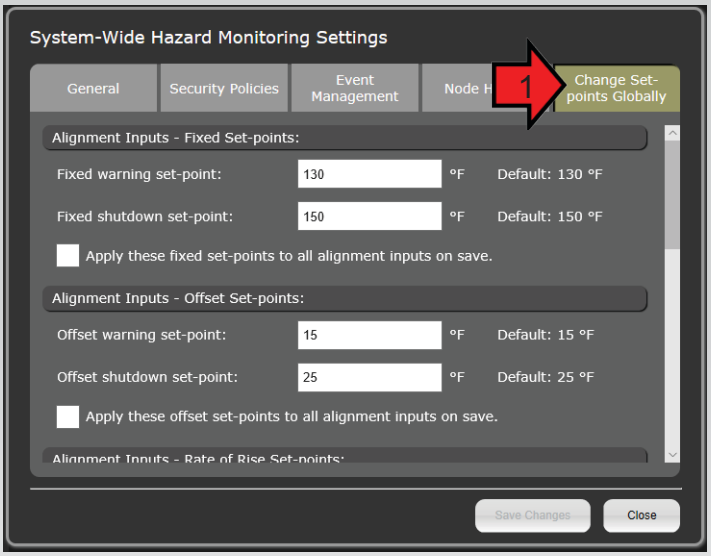
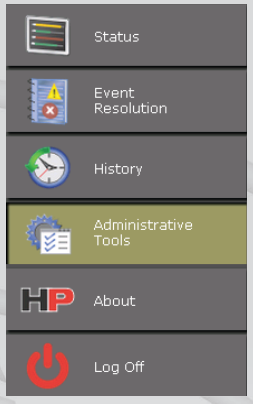


Figure 46

4. Change Set-Points Globally can be used to edit all current set points across all pieces of equipment by sensor type.

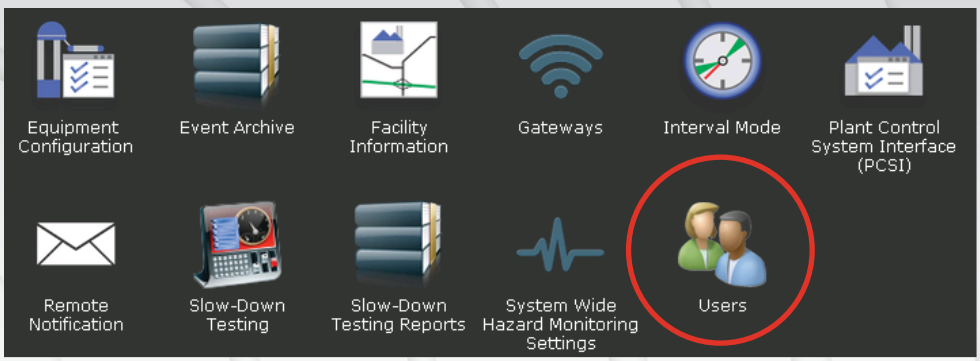
Warning: custom warning and shutdown temperatures will be overridden and must be re-entered by applying set points.



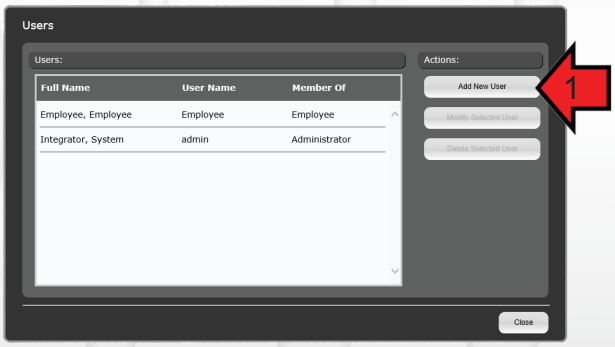
Users:

This section manages user accounts and their corresponding user level. Users can be added/removed to/from the system and given one of five different user levels.

Administrative Tools Subsections:



Add a New User:



1) Click “Add New User” to add a new user to your system manager.

Figure 47

Figure 48A

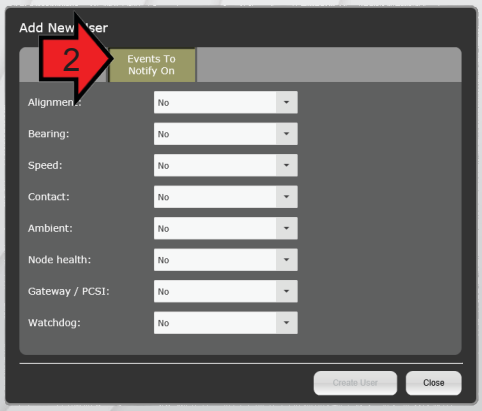


Figure 48B

2) Fill out information in both tabs and then click the Create User to make user information active.

Note: Users cannot create accounts with a higher clearance level than the one they are granted.

- For User Privileges view Document B. (page 43)

Modify existing user:

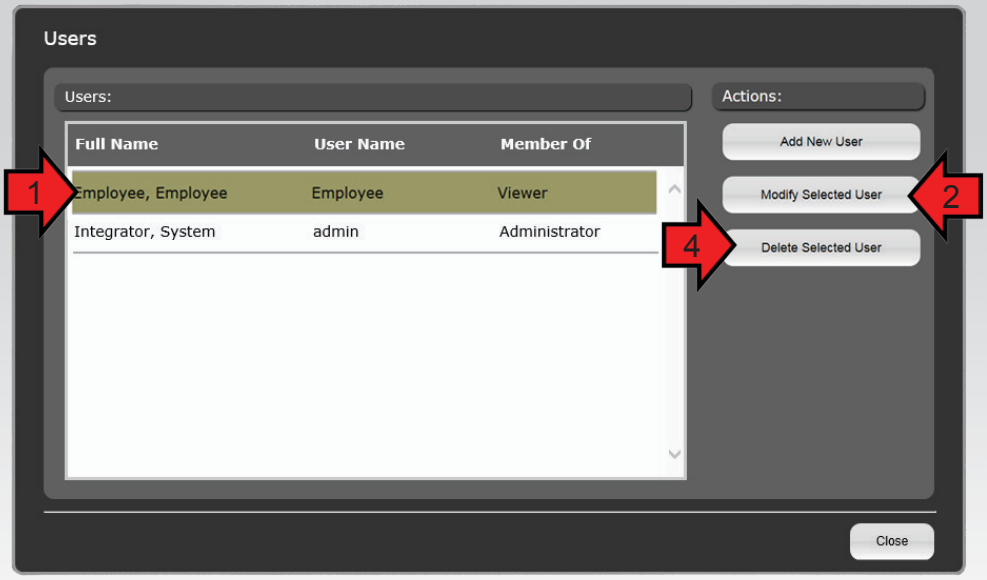


Figure 49

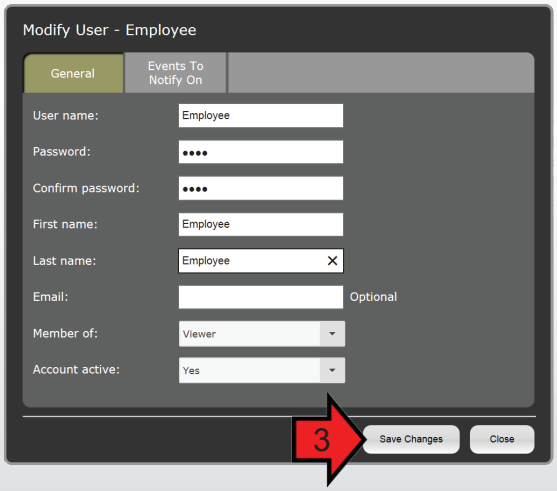
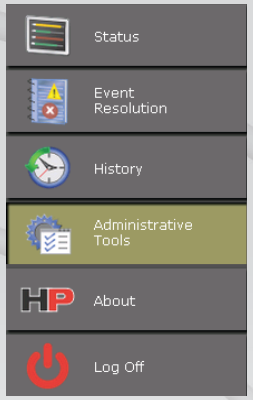


Figure 50

1) Select User to edit.
2) Click Modify User
3) After appropriate changes have been made, click “Save Changes”.
4) Delete User

Note: Users cannot modify accounts with a higher clearance level.

- For User Privileges view Document B. (page 47)



About

The About page shows general information regarding Electro-Sensors that may be helpful to the customer for contact and support. Software versions can also be referenced in this section.

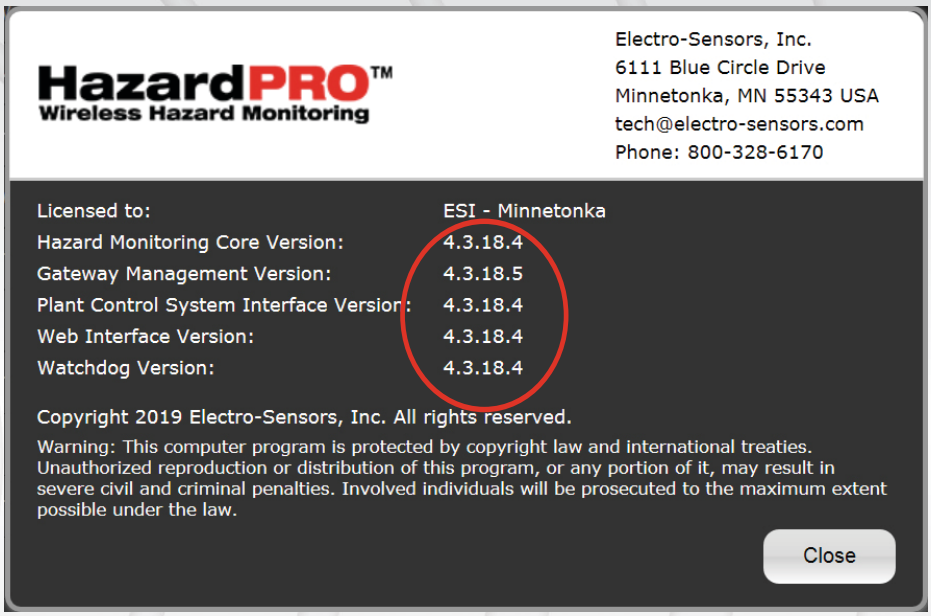


Figure 51

References

Reference Document A:
HazardPRO™ System Manager Temperature Set-Points

The following are set in the General tab:

Setting	Run Request Latency	Speed Slug Warning Delay
Measurement	Seconds	Seconds
Default	2 Seconds	10 Seconds
Minimum	1 Second	1 Second
Maximum	10 Seconds	30 Seconds

Setting	Fail-Safe Shutdown Temperature	
Measurement	Fahrenheit	Celsius
Default	175°F	79°C
Minimum	140°F	60°C
Maximum	250°F	139°C

Setting	Max Bearing Shutdown Offset	
Measurement	Fahrenheit	Celsius
Default	100°F	56°C
Minimum	50°F	28°C
Maximum	250°F	139°C

Setting	Max Alignment Shutdown Offset	
Measurement	Fahrenheit	Celsius
Default	50°F	28°C
Minimum	50°F	28°C
Maximum	250°F	139°C

The following are set in the Change Set-Points Globally tab for both Alignment Inputs and Bearing Inputs. These can also be set for individual inputs in the Equipment Configuration menu:

Set-Point	Fixed			
Type	Warning		Shutdown	
Measurement	Fahrenheit	Celsius	Fahrenheit	Celsius
Default	130°F	54°C	150°F	66°C
Minimum	100°F	38°C	115°F	46°C
Maximum	225°F	108°C	240°F	116°C

Set-Point	Ambient			
Type	Warning		Shutdown	
Measurement	Fahrenheit	Celsius	Fahrenheit	Celsius
Default	15°F	8°C	25°F	14°C
Minimum	5°F	3°C	15°F	9°C
Maximum	240°F	133°C	250°F	139°C

Set-Point	Rate of Rise			
Type	Warning (30 Seconds)		Shutdown (30 Seconds)	
Measurement	Fahrenheit	Celsius	Fahrenheit	Celsius
Default	7°F	4°C	14°F	8°C
Minimum	5°F	3°C	8°F	5°C
Maximum	27°F	15°C	30°F	17°C

Reference Document B:

Account Creation

Clearance Level	Viewer	Employee	Facility Manager	Corporate Manager	Administrator
Viewer	No	No	No	No	No
Employee	No	No	No	No	No
Facility Manager	Yes	Yes	Yes	No	No
Corporate Manager	Yes	Yes	Yes	Yes	No
Administrator	Yes	Yes	Yes	Yes	Yes

Administrative Tools Access Guide

User Profile	Equipment Configuration	Event Archive	Facility Info	Gate-ways	Interval Mode	PCSI	Remote Notification	Slow Down Testing	Slow Down Testing Reports	System Wide Hazard Monitoring Settings	Users
Facility Manager	Limited	Full	Full	No	Full	No	Limited	Full	Full	Limited	Full
Corporate Manager	Limited	Full	Full	No	Full	No	Limited	Full	Full	Limited	Full
Administrator	Full	Full	Full	Full	Full	Full	Full	Full	Full	Full	Full

Equipment Configuration

	Equipment General			Equipment Speed and Run Time			Node General					Node Input					
User Profile	Name	In Use	Bypass	Speed Section	Time to Move	Reset Running Hours	Assign ID	Name	In Use	Bypassed	Ambient in Use	Name	In Use	Bypassed	Input Type	Warning	Shut-down
Facility Manager	No	No	Yes	No	Yes	Yes	No	No	No	Yes	Yes	No	No	Yes	Yes	Yes	Yes
Corporate Manager	No	No	Yes	No	Yes	Yes	No	No	No	Yes	Yes	No	No	Yes	Yes	Yes	Yes
Admin	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Remote Notification

User Profile	General Settings	E-mail Server Settings
Facility Manager	Yes	No
Corporate Manager	Yes	No
Administrator	Yes	Yes

System Wide Hazard Monitoring Settings

User Profile	General	User Group Privileges	Event Management	Node Health
Facility Manager	Yes	Yes	Yes	No
Corporate Manager	Yes	Yes	Yes	No
Administrator	Yes	Yes	Yes	Yes

Section E

Hazard Monitoring Modbus Equipment Run Request Interface

Overview

The Equipment Run Request

Equipment States	Remarks	Value
Stopped	Plant control system has equipment stopped.	0X0000
Run Requested	Plant control system has equipment running.	0X0001

Factory Default Settings	
IP:	192.168.0.51
Port:	502
Device ID:	1 (Base 10), 0X01 (Hex)
Time-out:	500ms

Suggested Poll Rates

We suggest polling every 500 ms using a multiple register write. Polling faster than every 100 ms can result in latency or dropped requests. Typical response times generally do not exceed 50ms.

Accepted Functions

Write single register function number 6 (TCP/IP Modbus format).
Write multiple registers function number 16 (standard TCP/IP Modbus format).

Equipment Run Request Interface Register Map (16 bit unsigned integers)

Equipment Number	Modbus Address (Base 10)	Register Type	Values (Base 10)
1	0001	Word	0 = Stopped 1 = Running
2	0002	Word	
3	0003	Word	
...	...	Word	
...	...	Word	
30	0030	Word	
31	0031	Word	
32	0032	Word	

**All Values are base 10 unless expressed in hex notation (0X00).*

Most PLC's have simple ladder instructions that read and write Modbus values. The remaining information details the format of the Modbus transactions. In most cases, it will not be necessary to understand the content of the transaction to utilize the PLC instructions.

Equipment Starting Addresses

Equipment ID	Starting Address
1	1001
2	1201
3	1401
4	1601
5	1801
6	2001
7	2201
8	2401
9	2601
10	2801
11	3001
12	3201
13	3401
14	3601
15	3801
16	4001
17	4201
18	4401
19	4601
20	4801
21	5001
22	5201
23	5401
24	5601
25	5801
26	6001
27	6201
28	6401
29	6601
30	6801
31	7001
32	7201

**All Values are base 10 unless expressed in hex notation (0X00)*

MODBus Read Command Example

Most PLC's have simple ladder instructions that read and write Modbus values. The following information details the data packet layout of the Modbus transactions. In most cases, it will not be necessary to understand the content of the transaction to utilize the PLC instructions

Example Read

Example request to read registers 401 to 403

Request		Response	
Field Name	(Hex)	Field Name	(Hex)
Function	0x03	Function	0x03
Starting Address High	0x01	Byte Count	0x06
Starting Address Low	0x91	Register Value High (401)	Value
No. of Registers High	0x00	Register Value Low (401)	Value
No. of Registers Low	0x03	Register Value High (402)	Value
		Register Value Low (402)	Value
		Register Value High (403)	Value
		Register Value Low (403)	Value

**All Values are base 10 unless expressed in hex notation (0X00)*

TCP IP Data Packet Detail

Request Structure

Byte	Description	Default Value	Remarks
0	Transaction Identifier High Byte		Number to track request. Response will include this number.
1	Transaction Identifier Low Byte		
2	Protocol Identifier High Byte	0	All Modbus commands must be protocol 0.
3	Protocol Identifier Low Byte	0	
4	Length High Byte	0	Start counting at byte 6. Length will always be 0x06 for this command.
5	Length Low Byte	0x06	
6	Device ID		ID of device being requested.
7	Function	0x03	Modbus function identifier.
8	Read Address Start High Byte		NOTE: Unless your software is using zero based addressing this will typically be one less than the starting address you request in the TCP IP packet.
9	Read Address Start Low Byte		
10	Read Length High Byte		
11	Read Length Low Byte		

**All Values are base 10 unless expressed in hex notation (0X00)*

Response Structure

The register data in the response message are packed as two bytes per register, with the binary contents right justified with each byte. For each register, the first byte contains the high order bits and the second contains the low order bits.

Byte	Description	Default Value	Remarks
0	Transaction Identifier High Byte		Will be the same number as request which started this response.
1	Transaction Identifier Low Byte		
2	Protocol Identifier High Byte	0	All Modbus commands must be protocol 0.
3	Protocol Identifier Low Byte	0	
4	Length High Byte		Start counting at byte 6. Length will always be 0x06 for this command.
5	Length Low Byte		
6	Device ID		ID of device being requested.
7	Function	0x03	Modbus function identifier.
8	Byte Count		Number of bytes after byte 8. Holding registers are 16 bit words making the byte count 2 times the request length.
9	First Data Byte		First register high byte.
10	Second Data Byte		Second register low byte.

**All Values are base 10 unless expressed in hex notation (0X00)*

Example

Write registers 0001 to 0003 (This would represent Equipment 1, 2, and 3.)
In this example Equipment 1 and 3 are running and equipment 2 is stopped.

Request		**Response**	
Field Name	(Hex)	Field Name	(Hex)
Function	0X10	Function	0X10
Starting Address High	0X00	Starting Address High	0X00
Starting Address Low	0X00	Starting Address Low	0X01
No. of Registers High	0X00	No. of Registers High	0X00
No. of Registers Low	0X03	No. of Registers Low	0X03
Byte Count	0X06		
Register Value High (0001)	0X00		
Register Value Low (0001)	0X01		
Register Value High (0002)	0X00		
Register Value Low (0002)	0X00		
Register Value High (0003)	0X00		
Register Value Low (0003)	0X01		

* All Values are base 10 unless expressed in hex notation (0X00).

TCP/IP Data Packet Detail (Request Structure)

Byte	Description	Default Value	Remarks
0	Transaction Identifier High Byte		Number to track request. Response will include this number.
1	Transaction Identifier Low Byte		
2	Protocol Identifier High Byte	0	All Modbus commands must be protocol 0.
3	Protocol Identifier Low Byte	0	
4	Length High Byte		Start Counting at byte 6
5	Length Low Byte		
6	Device ID		ID of device responding
7	Function	0X10	Modbus function identifier.
8	Write Address Start High Byte		
9	Write Address Start Low Byte		
10	Write Length High Byte		
11	Write Length Low Byte		
12	Byte Count	2* Read Length	Number of bytes after byte 12. Holding registers are 16 bit words making the byte count 2 times the request length.
13	First Data Byte		First register high byte
14	Second Data Byte		First register low byte

*All values are base 10 unless expressed in hex notation (0x00).

TCP/IP Data Packet Detail (Request Structure)

Byte	Description	Default Value	Remarks
0	Transaction Identifier High Byte		Will be same number as request which started this response
1	Transaction Identifier Low Byte		
2	Protocol Identifier High Byte	0	All Modbus commands must be protocol 0
3	Protocol Identifier Low Byte	0	
4	Length High Byte	0	Start counting at byte 6. Length will always be 0X06 for this command.
5	Length Low Byte	0X06	
6	Device ID		ID of device being requested
7	Function	0X10	Modbus function Identifier
8	Write Address Start High Byte		
9	Write Address Start Low Byte		
10	Write Length High Byte		
11	Write Length Low Byte		

**All Values are base 10 unless expressed in hex notation (0X00).*

Hazard Monitoring Modbus Equipment State Interface

Overview

The Equipment State Interface will give the PLC access to the general status of each piece of equipment attached to the system. This can be used to simply display information on control screens or to close gates and shutdown equipment. Each piece of equipment can be in one of five states- not in use, normal / ok, bypassed, warning, and forced shutdown.

Equipment States	Remarks	Value
Not in Use	Hazard monitoring is not enabled.	0
Normal / OK	Functioning normally.	1
Bypassed	Equipment has been bypassed. All conditions will be reported normal.	2
Warning	Equipment is in a warning condition.	3
Forced Shutdown	Equipment is in a forced shutdown condition.	4

Factory Default Settings	
IP:	192.168.0.51
Port:	502
Device ID:	1 (Base 10), 0X01 (Hex)
Timeout:	500ms

Suggested Poll Rates

We suggest polling every 500 ms using a multiple register read. Polling faster than every 100 ms can result in latency or dropped requests. Typical response times generally do not exceed 50 ms.

Accepted Functions

Read holding registers using function number 4 (standard TCP/IP Modbus format).

Equipment State Interface Register Map (16 bit unsigned integer)

Equipment Number	Modbus Address (Base 10)	Register Type	Values (Base 10)
1	201	Word	0 = Not in Use 1 = Normal/OK 2 = Bypassed 3 = Warning 4 = Forced Shutdown
2	202	Word	
3	203	Word	
...	...	Word	
...	...	Word	
30	230	Word	
31	231	Word	
32	232	Word	

**All values are base 10 unless expressed in hex notation (0X00).*

Hazard Monitoring Modbus Equipment State Interface

Most PLCs have simple ladder instructions that read and write Modbus values. The remaining information details the format of the Modbus transactions. In most cases, it will not be necessary to understand the content of the transaction to utilize the PLC instructions.

Example Read

Example request to read registers 201 to 203

Request		Response	
Field Name	(Hex)	Field Name	(Hex)
Function	0X03	Function	0X03
Starting Address High	0X00	Byte Count	0X06
Starting Address Low	0XC8	Register Value High (201)	Value
No. of Registers High	0X00	Register Value Low (201)	Value
No. of Registers Low	0X03	Register Value High (202)	Value
		Register Value Low (202)	Value
		Register Value High (203)	Value
		Register Value Low (203)	Value

**All values are base 10 unless expressed in hex notation (0x00).*

TCP IP Data Packet Detail

Request Structure

Byte	Description	Default Value	Remarks
0	Transaction Identifier High Byte		Number to track request. Response will include this number.
1	Transaction Identifier Low Byte		
2	Protocol Identifier High Byte	0	All Modbus commands must be protocol 0.
3	Protocol Identifier Low Byte	0	
4	Length High Byte	0	Start Counting at byte 6. Length will always be 0X06 for this command.
5	Length Low Byte	0X06	
6	Device ID		ID of device being requested.
7	Function	0X03	Modbus function identifier.
8	Read Address Start High Byte		Note: Unless your software is using zero based addressing this will typically be one less than the starting address you request in the TCP IP packet.
9	Read Address Start Low Byte		
10	Read Length High Byte		
11	Read Length Low Byte		

**All values are base 10 unless expressed in hex notation (0x00).*

Response Structure

The register data in the response message are packed as two bytes per register, with the binary contents right justified within each byte. For each register, the first byte contains the high order bits and the second contains the low order bits.

Byte	Description	Default Value	Remarks
0	Transaction Identifier High Byte		Will be the same number as requests which started this response.
1	Transaction Identifier Low Byte		
2	Protocol Identifier High Byte	0	All Modbus commands must be protocol 0.
3	Protocol Identifier Low Byte	0	
4	Length High Byte		Start counting at byte 6.
5	Length Low Byte		
6	Device ID		ID of device responding.
7	Function	0X03	Modbus function Identifier.
8	Byte Count		Number of bytes after byte 8. Holding registers are 16 bit words making the byte count two times the request length.
9	First Data Byte		First register high byte.
10	Second Data Byte		First register low byte.

**All values are base 10 unless expressed in hex notation (0x00).*

Section Starting Offsets

Section ID	Starting Offset
A	+0
B	+32
C	+64
D	+96
E	+128
F	+160

Equipment ID & Section ID Starting Addresses

Equipment ID & Section ID	Starting Address
1A	1001
1B	1033
1C	1065
1D	1097
1E	1129
1F	1161
2A	1201
2B	1233
2C	1265
2D	1397
2E	1329
2F	1361
...	...
32A	7201
32B	7233
32C	7265
32D	7297
32E	7329
32F	7361

**All Values are base 10 unless expressed in hex notation (0X00)*

Section Starting Offsets

Equipment Section Offset	A	B	C	D	E	F	
Name							**Values**
Node State	+0	+32	+64	+96	+128	+160	0 = Not in Use 1 = Normal / OK 2 = Bypassed 3 = Warning 4 = Forced Shutdown
Communication Link Status	+1	+33	+65	+97	+129	+161	0 = Link has timed out 1 = Link is OK
Node Health Status	+2	+34	+66	+98	+130	+162	0 = Node Health Issue 1 = Node Health OK
Input Values							
Input 1 Temperature - Value	+3	+35	+67	+99	+131	+163	Temperature in Fahrenheit -40° to 240°
Input 2 Temperature - Value	+4	+36	+68	+100	+132	+164	Temperature in Fahrenheit -40° to 240°
Input 3 Temperature - Value	+5	+37	+69	+101	+133	+165	Temperature in Fahrenheit -40° to 240°
Input 4 Temperature - Value	+6	+38	+70	+102	+134	+166	Temperature in Fahrenheit -40° to 240°
Input 5 Temperature - Value	+7	+39	+71	+103	+135	+167	Temperature in Fahrenheit -40° to 240°
Input 6 Temperature - Value	+8	+40	+72	+104	+136	+168	Temperature in Fahrenheit -40° to 240°
Input 7 Speed - Value	+9	+41	+73	+105	+137	+169	Speed in RPM's 0-500 RPM
Input 8 Contact - Value	+10	+42	+74	+106	+138	+170	0 = Contact is Open 1 = Contact is Closed
Input 9 (Ambient A) Temperature - Value	+11	+43	+75	+107	+139	+171	Temperature in Fahrenheit -40° to 240°
Input 10 (Ambient B) Temperature - Value	+12	+44	+76	+108	+140	+172	Temperature in Fahrenheit -40° to 240°
Reserved							
Reserved	+13	+45	+77	+109	+141	+173	N/A
Reserved	+14	+46	+78	+110	+142	+174	N/A
Input State							
Input 1 Temperature - State	+15	+47	+79	+111	+143	+175	0 = Not in Use 1 = Normal/OK 2 = Bypassed 3 = Warning 4 = Forced Shutdown
Input 2 Temperature - State	+16	+48	+80	+112	+144	+176	
Input 3 Temperature - State	+17	+49	+81	+113	+145	+177	
Input 4 Temperature - State	+18	+50	+82	+114	+146	+178	
Input 5 Temperature - State	+19	+51	+83	+115	+147	+179	
Input 6 Temperature - State	+20	+52	+84	+116	+148	+180	
Input 7 Speed - State	+21	+53	+85	+117	+149	+181	
Input 8 Contact - State	+22	+54	+86	+118	+150	+182	
Input 9 (Ambient A) Temperature - State	+23	+55	+87	+119	+151	+183	
Input 10 (Ambient B) Temperature - State	+24	+56	+88	+120	+152	+184	
Reserved							
Reserved	+25	+57	+89	+121	+153	+185	N/A
Reserved	+26	+58	+90	+122	+154	+186	N/A
Reserved	+27	+59	+91	+123	+155	+187	N/A
Reserved	+28	+60	+92	+124	+156	+188	N/A
Reserved	+29	+61	+93	+125	+157	+189	N/A
Reserved	+30	+62	+94	+126	+158	+190	N/A
Reserved	+31	+63	+95	+127	+159	+191	N/A

Section Register Example Equipment 1

Equipment Section	A	B	C	D	E	F	
Name							**Values**
Node State	1001	1033	1065	0097	1129	1161	0 = Not in Use 1 = Normal / OK 2 = Bypassed 3 = Warning 4 = Forced Shutdown
Communication Link Status	1002	1034	1066	1098	1130	1162	0 = Link has timed out 1 = Link is OK
Node Health Status	1003	1035	1067	1099	1131	1163	0 = Node Health Issue 1 = Node Health OK
Input Values							
Input 1 Temperature - Value	1004	1036	1068	1100	1132	1164	Temperature in Fahrenheit -40° to 240°
Input 2 Temperature - Value	1005	1037	1069	1101	1133	1165	Temperature in Fahrenheit -40° to 240°
Input 3 Temperature - Value	1006	1038	1070	1102	1134	1166	Temperature in Fahrenheit -40° to 240°
Input 4 Temperature - Value	1007	1039	1071	1103	1135	1167	Temperature in Fahrenheit -40° to 240°
Input 5 Temperature - Value	1008	1040	1072	1104	1136	1168	Temperature in Fahrenheit -40° to 240°
Input 6 Temperature - Value	1009	1041	1072	1105	1137	1169	Temperature in Fahrenheit -40° to 240°
Input 7 Speed - Value	1010	1042	1073	1106	1138	1170	Speed in RPM's 0-500 RPM
Input 8 Contact - Value	1011	1043	1074	1107	1139	1171	0 = Contact is Open 1 = Contact is Closed
Input 9 (Ambient A) Temperature - Value	1012	1044	1076	1108	1140	1172	Temperature in Fahrenheit -40° to 240°
Input 10 (Ambient B) Temperature - Value	1013	1045	1077	1109	1141	1173	Temperature in Fahrenheit -40° to 240°
Reserved							
Reserved	1014	1046	1078	1110	1142	1174	N/A
Reserved	1015	1047	1079	1111	1143	1175	N/A
Input State							
Input 1 Temperature - State	1016	1048	1080	1112	1144	1176	0 = Not in Use 1 = Normal/OK 2 = Bypassed 3 = Warning 4 = Forced Shutdown
Input 2 Temperature - State	1017	1049	1081	1113	1145	1177	
Input 3 Temperature - State	1018	1050	1082	1114	1146	1178	
Input 4 Temperature - State	1019	1051	1083	1115	1147	1179	
Input 5 Temperature - State	1020	1052	1084	1116	1148	1180	
Input 6 Temperature - State	1021	1053	1085	1117	1149	1181	
Input 7 Speed - State	1022	1054	1086	1118	1150	1182	
Input 8 Contact - State	1023	1055	1087	1119	1151	1183	
Input 9 (Ambient A) Temperature - State	1024	1056	1088	1120	1152	1184	
Input 10 (Ambient B) Temperature - State	1025	1057	1089	1121	1153	1185	
Reserved							
Reserved	1026	1058	1090	1122	1154	1186	N/A
Reserved	1027	1059	1091	1123	1155	1187	N/A
Reserved	1028	1060	1092	1124	1156	1188	N/A
Reserved	1029	1061	1093	1125	1157	1189	N/A
Reserved	1030	1062	1094	1126	1158	1190	N/A
Reserved	1031	1063	1095	1127	1159	1191	N/A
Reserved	1032	1064	1096	1128	1160	1192	N/A

Hazard Monitoring Modbus PCSI Equipment RPM Link

Overview

The PCSI Equipment RPM Link gives access to the current RPM of each piece of equipment attached to the system that has a speed section assigned to it via a Modbus interface.

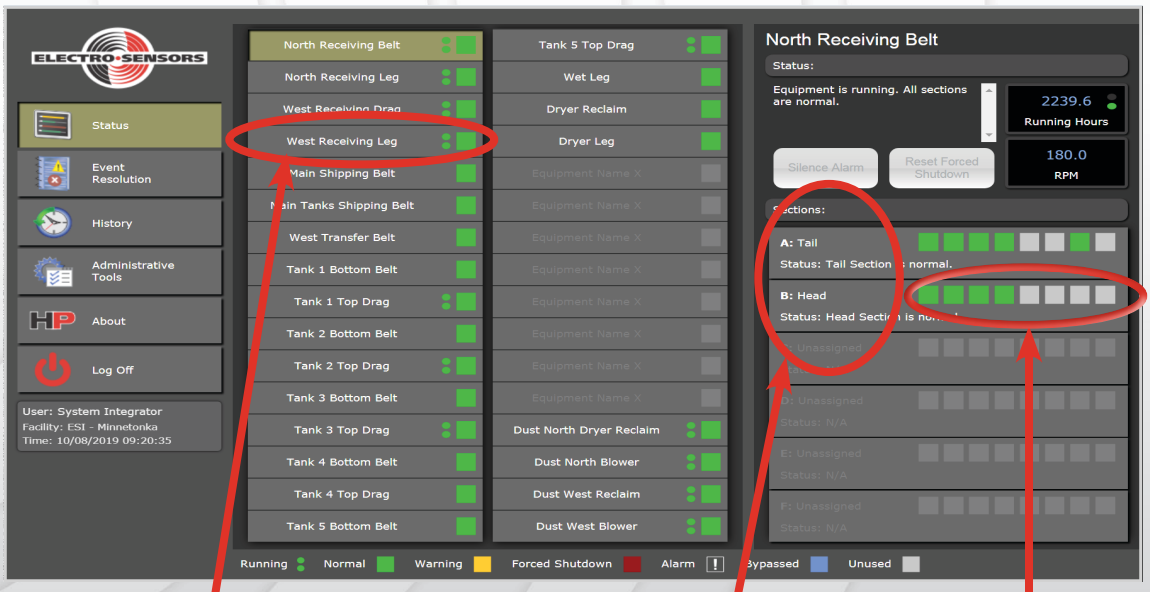
Factory Default Settings	
IP:	192.168.0.51
Port:	502
Device ID:	1 (Base 10), 0X01 (Hex)
Timeout:	500ms

Suggested Poll Rates

We suggest polling every 1000 ms using a multiple register write. Polling faster than every 100 ms can result in latency or dropped requests. Typical response times generally do not exceed 50ms.

Accepted Functions

Read holding registers using function number 3 (standard TCP/IP Modbus format).



Individual piece of plant equipment

Equipment made up of sections

Section made up of inputs

Equipment RPM Registers

Equipment Number	Modbus Address (Base 10)	Register Type	Values (Base 10)
1	401	Word	Current RPM
2	402	Word	
3	403	Word	
...	...	Word	
...	...	Word	
30	430	Word	
31	431	Word	
32	432	Word	

**All Values are base 10 unless expressed in hex notation (0X00)*

Section F
Wireless Antenna Guidelines

This instruction guideline will identify the different antennas, options, mounting, coaxial cable and technique required for proper installation.

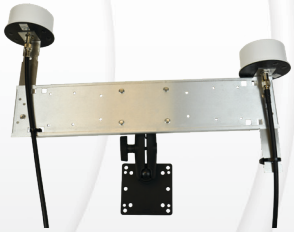
Safety: “Lock out tag out” the system, or determine that the system is safe while installing the antennas and coaxial cable.

Components: The components for HazardPRO are as follows: Antennas, RAM brackets (optional), and mounting hardware (described below). Coaxial cable is also needed between the System Manager and Receiving Antennas, as well as the Node and Sending Antennas.

Tools: The needed tools are: screw driver, adjustable wrench, drill, mounting hardware, and **silicone self-fusing tape**.

Antenna Brackets and Hardware:

- Optional RAM Brackets are used to mount antennas (the mounting hardware is not supplied).
  - **Hardware options:**
    - (Two per antenna) 10-24x1” phillips pan machine screws, coarse thread, zinc (not supplied).
    - (Two per antenna) #10 split lock washers *(Not Supplied)
    - (Two per antenna) 10-24 machine screw hex nuts, coarse thread, zinc (not supplied).
- Optional multi configurational Bracket



- Provides measured position and offset for multiple antennas
- Kit includes: bracket, hardware, and RAM mount.
- Part #: 775-007119
- Mounts omni, panel, patch, and whip antennas (Antennas sold separately)

- Unistrut or base attachment is an option (not supplied)
- **Silicon Self-Fusing Tape** is used to wrap external coaxial connections and/or any connections that are exposed to moisture or corrosion. This is **required** to ensure that the connections are sealed and protected.

Note: A coaxial termination document is located on page #: 57.

Antenna Types:

Receiving Antennas:

- All receiving antennas connect to the System Manager and run in pairs (2 antennas and 2 runs of coaxial cable).
- Both antennas must be separated by at least 12-24” and optimally should be placed at different levels or heights.

Sending Antennas:

- All sending antennas connect to the Node and transmit to the receiving antennas (1 per Node).
- Multiple sending antennas can be placed by each other, but they must be at least 6” apart, and optimally should be placed at different levels or heights.

Wireless Antenna Guidelines

Guidelines for antenna placement: Best results are achieved when a direct visual or a reflective signal can be maintained between the antennas. This applies to **all** antenna options below.

Antenna Options:

- External antenna whip (multi-directional, adjustable)
- Omni antenna (multi-directional)
- Patch/Panel antenna (directional, requires aiming & precision)

Mounting Options:

- **Never drill holes in the antenna body.** This can damage the antenna. Only drill holes in the bracket or the mounting structure.
- Use the template to pre-drill the holes in the metal plate or the RAM bracket then mount the antenna.
- Always mount the antennas with the **cable exiting from the bottom (Not Cable Up).**
- Multiple antennas can be mounted in the same area but require appropriate spacing and separation.
- If the antenna is located outside, place it high enough to be above a snow level (i.e. 24" above the roof line). Antennas must stay uncovered, and not get hit or damaged.

RAM bracket mounts, hardware:

- The antenna can be hard mounted to a bracket, you can utilize the RAM bracket to allow easy attachment or directional aiming.
- Tighten the lock ball on the RAM bracket so that it is firm and secure and aimed in the appropriate direction.
- Utilize the template to mark the holes, and pre drill the bracket.
- Firmly secure the antenna to ensure that it will not become loose and change direction due to wind or inclement weather.

Mounting for the antenna options:

External Whip Antennas (multi-directional)

- The antenna can be mounted directly to the node.
- A coaxial cable can be attached to the antenna and securely hard mounted. (Not supplied)

Omni Antennas

- Use the mounting brackets provided, then secure to a sturdy surface to ensure signal integrity.
- The omni antennas do not need to be directed or aimed toward other antennas. However they can be adjusted at different positions or angles to optimize the signal strength. **Note:** Neither the top nor bottom of omni antennas can be pointed at other antennas.
- Multiple antennas must be at least 12-24" apart, optimally placed at different levels or heights.

Patch/Panel Antennas (Directional, requires aiming)

- Multiple antennas must be at least 6" apart, optimally at different levels or heights.
- Patch/Panel Antennas require aiming to provide a direct visual or reflective signal between the antennas.

Wireless Antenna Guidelines

Coax Cables and Connections

Cable:

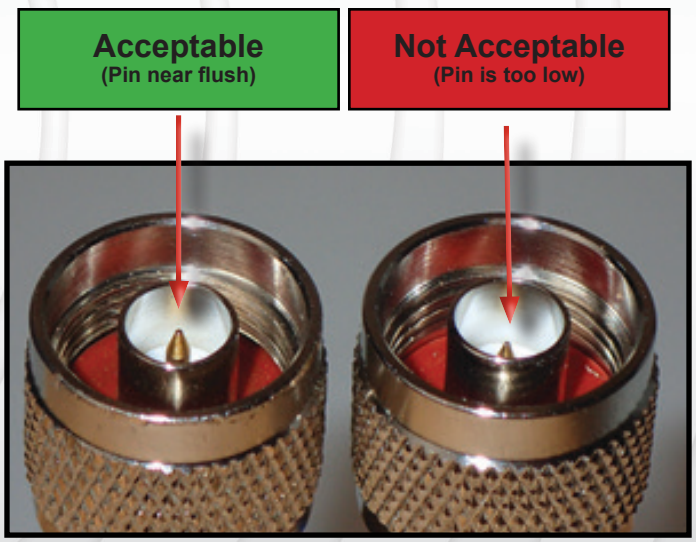
- Utilize the Coaxial cables provided, ensure the end connectors are clean and free of debris. If you are terminating a coaxial cable ensure that the center pin and grounding shields are correct (detailed coaxial termination instructions are available on page #: 69)
- Do not nick, or kink the coaxial cable, use gentle bends (8” diameter bends) around corners or through conduit.
- Always allow a drip loop to ensure that moisture does not accumulate in the connection or migrate into the antenna or the connection.
- Mount all antennas so that the cable exits the antenna from the bottom (dropping down).

Connections:

- Tighten as tight as possible by hand. Apply 1/8” to 1/4” additional turn using a wrench.
- Use Silicone Self-Fusing Tape (1” x 12”), to wrap external coaxial connections and/or any connections that are exposed to moisture or corrosion. This is required to ensure that the connections are sealed and protected. **Note**: If this connection isn’t properly sealed, moisture can enter the connection and the signal strength can degrade over time. The Silicone Self-Fusing Tape is required to ensure the connections are sealed and protected.

Pin Placement:

- If the pin placement does not meet the following requirements then the signal strength will be greatly diminished.



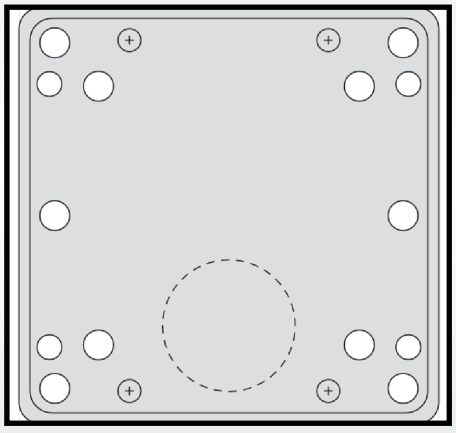
Wireless Antenna Guidelines

Examples and Templates

Single Patch antenna mounted to a RAM bracket

Two Omni Antennas mounted on antenna bracket

Single bracket template (you will need to select or drill holes to match the antenna and the mounting method)



Two panel antennas mounted to RAM brackets

Two omni antennas using antenna hardware

External Whip attached to side of Node

Section G
Coaxial Termination Instructions

This Section covers basic instructions on how to install end connectors for coaxial cable. There are different types of cables and end connectors.

Safety: Wear safety glasses to prevent metal braid from injuring eyes. The sharp edges of the cable can easily cut or scratch you. The tools also have sharp cutting blades.

Typical Connector Installations:

- Installation of sending and receiving antennas. Establish the proper length of the cable and how it will be routed. Both ends of the cable will need to be properly terminated.
- Node sending antenna with an attached coaxial cable.
- The System Manager receiving antennas with coaxial connections.

Components:

Coaxial Cable:

- 400 Series coaxial, low-loss 50 ohm
- 200 Series coaxial, low-loss 50 ohm

Tools:

- Razor Knife
- Pliers
- Stripping Tools (Set-up document available upon request)

Instructional Video
(https://youtu.be/UtSo7tFvRCw)

Tool Index Table:

Termination Type	Coaxial Type	Connector	Stripper	Crimp Tool	Center pin Crimp notch	Ferrule crimp notch
Male End	400	ANM-1406	L-Com # AT-strip-02	L-Com # HT-Crimp03	0.1	0.429
Female End	400	ANF-1406	L-Com # AT-strip-02	L-Com # HT-Crimp03	0.1	0.429
Male End	200	ANM-1202	L-Com # AT-strip-01	L-Com # HT-Crimp04	0.068	0.429
Female End	200	ANF-1202	L-Com # AT-strip-01	L-Com # HT-Crimp04	0.068	0.429

Male End Connector

Pin, Ferrule, Connectors

Female End Connector

Stripping tools:
400 top, 200 bottom

Step 1: Prepare the coaxial cable end

1) Make a clean cut on the cable and prepare for cable stripping.

Note: You will need to have the correct end connector (components section), stripping tool, and crimp tool (tool index table) before proceeding to the next steps.

Step 2: Cut and strip the coaxial cable end. Select the proper stripping tool (based on the size of the coax cable, see tool index).

1) Insert the ferrule onto the coaxial cable.
2) Insert the cable into the jaws of the stripping tool, on top of the blades.
   - Ensure the coaxial cable extends beyond the body of the stripping tool (see illustration)
   - Insert your index finger into the cable strippers finger ring; turn the cable stripper clockwise 3.5 times (or until cut is complete).
   - Open the crimp jaws and remove the cable.
   - Carefully remove the small segment of coaxial cable shield.

Note: Trim the center conductor to the appropriate length prior to crimping the center pin. (see pin termination table below)

Pin Termination Table: Measure the coaxial cable conductor length against the corresponding ruler measurements.

Termination type	Coaxial Type	Center Conductor pin length
Male End	400	.25”
Female End	400	.25”
Male End	200	.20”
Female End	200	.20”

Pin length should match values in Pin Termination Table

Red Bar = .25 In
Green Bar = .20 In

- Carefully remove the second cut segment of the outer jacket material. This will expose the braid (you can use a utility knife to split this jacket; **CAUTION**: Do **NOT** cut the braid).

Step 3: Install the connector pin on the coaxial cable center conductor.

1) Make sure the ferrule is properly seated on the coaxial cable.
2) Slide the pin over the center copper conductor. Allow the pin to bottom out.
3) Crimp the pin using the crimp tool. Seat the pin using the appropriate crimp (tool index table).

Step 4: Install the connector body over the connector pin.

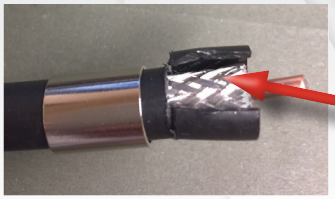
1) Fold the braid back to the outer jacket.
2) Slide connector onto the coaxial cable so the pin protrudes as far as possible through the connector (it is critical to get this seated as deep as possible. (See following images)
3) Fold the metal braid forward over the connector.
4) Slide the ferrule onto the connector.
5) Confirm that the pin depth through the connector is nearly flush with the connector body (this must be acceptable prior to crimping, (See following images).
6) Crimp the ferrule using the crimp tool. Seat the ferrule using the appropriate crimp. **(Refer to Tool Index Table).** Confirm that the connector is firmly secured to the cable.

Photos and Examples for each Termination Step

Step 1: Prepare the end

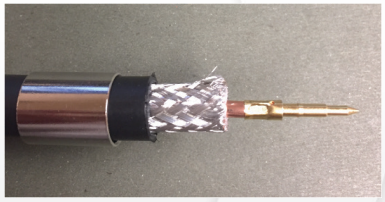
Step 2: Cut and strip - Extend the Coaxial Cable beyond the body of the stripping tool, after stripping, check and center conductor length. Reference the Pin Termination Table.

Remove this end piece



Do not cut into metal braid

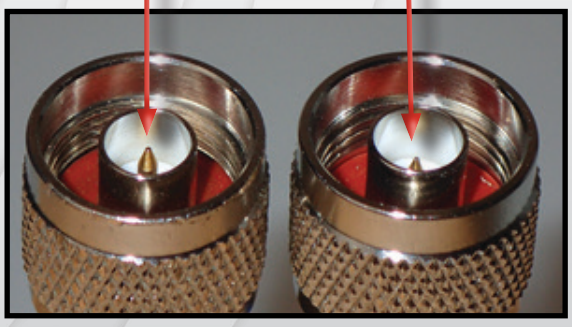
Step 3: Install the Pin on conductor end

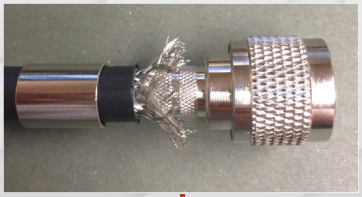


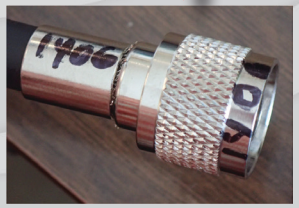
Step 4: Install the body: Push the connector body on as far as possible, confirm the pin depth before crimping

Acceptable
(Pin near flush)

Not Acceptable
(Pin is too low)

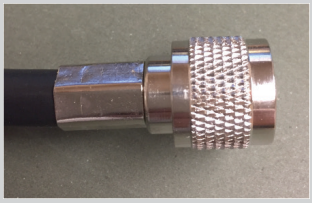






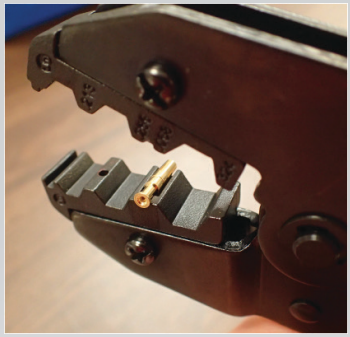
Slide ferrule onto connector

Crimp the ferrule
(Further Instructions on next page)



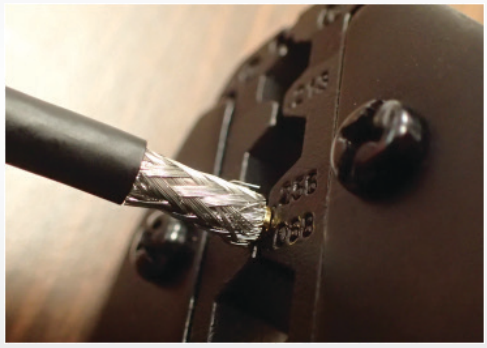
Finished Connector

Additional Crimping Tips



Place the pin in the correct crimp jaws

Close the crimp tool to barely hold the pin



Fully Insert the conductor into the pin, then crimp the pin

Instructional Video
(https://youtu.be/UtSo7tFvRCw)

Notes

Notes