PROFIRE

PF3100

# PRODUCT MANUAL

DOC-001149
v10.0

PROFIRE

# CONTENTS

# 1 IMPORTANT SAFETY INFORMATION

Refer to PF3100 BMS Control Panel Manual for additional UL508A panel shop certification warnings.

All PF3100 installations must follow the installation, commissioning, operation, and maintenance procedures outlined in this manual. Failure to comply with the instructions and warnings in this manual may result in death, serious injury, electrocution, property damage, product damage and/or government fines. All PF3100 installations must be performed in accordance with local electrical code(s) by a capable electrician and must be field inspected by the Authority Having Jurisdiction to ensure compliance with local electrical and gas codes.

**WARNING:**
EXPLOSION HAZARD - DO NOT DISCONNECT EQUIPMENT WHILE THE CIRCUIT IS LIVE OR UNLESS THE AREA IS KNOWN TO BE FREE OF IGNITABLE CONCENTRATIONS.

**WARNING:**
EXPLOSION HAZARD - SUBSTITUTION OF COMPONENTS MAY IMPAIR SUITABILITY FOR CLASS I, DIVISION 2 HAZARDOUS LOCATIONS.

**FOR PF3101-00/00A/00B BMS CONTROLLER CARD/MODULE:**
**WARNING:** FOR SUPPLY CONNECTIONS, USE WIRES ACCEPTABLE FOR AT LEAST 75°C (167°F).

**FOR PF3103-00D TEMPERATURE MODULE:**
**WARNING:** OPEN CIRCUIT BEFORE REMOVING COVER.

**AVERTISSEMENT:**
RISQUE D'EXPLOSION. NE PAS DÉBRANCHER PENDANT QUE LE CIRCUIT EST SOUS TENSION OU À MOINS QUE L'EMPLACEMENT NE SOIT EXEMPT DE CONCENTRATIONS INFLAMMABLES.

**AVERTISSEMENT:**
RISQUE D'EXPLOSION. NE PAS DEBRANCHER TANT QUE LE CIRCUIT EST SOUS TENSION, A MOINS QU'LL NE S'AGISSE D'UN EMPLACEMENT NON DANGEREUX.

**POUR PF3101-00/00A/00B BMS CONTROLLER CARD/MODULE:**
**AVERTISSEMENT:** POUR LES CONNEXIONS D'ALIMENTATION, UTILISEZ DES FILS ADAPTÉS À UNE TEMPÉRATURE D'AU MOINS 75°C (167°F).

**POUR PF3103-00D TEMPERATURE MODULE:**
**AVERTISSEMENT:** OUVRIR LE CIRCUIT AVANT D'ENLEVER LE COUVERCLE.

# 2 DOCUMENT SCOPE

The Profire PF3100 is a modular combustion control system that can be customized and scaled to monitor and control a wide variety of industrial heating applications. The system is designed to ensure safe burner ignition and reliable process temperature control while supporting applications requiring ionization and/or UV flame detection, peripheral input device monitoring, fuel-air ratio control and oxygen trim. Configuration of the system is performed through the user interface module which also provides real-time status, state and alert information.

This document outlines the information required to design, commission, install and maintain a PF3100 system. Included are the ratings and input/output capabilities of each PF3100 card, the PF3100 system states and operating sequence, installation instruction and diagrams, commissioning and maintenance procedures, and additional information pertaining to use and functionality of a PF3100 system. The information contained in this document applies to PF3100 cards with the hardware and firmware versions listed below:

| PF3100 CARD | HARDWARE VERSION | FIRMWARE VERSION |
|---|---|---|
| **PF3100-00 UI Card** | v1.3.x / v1.4.x<br>* v1.4.x is not compatible with firmware below NA-43.5 | NA-45.0 |
| **PF3101-00 BMS Controller Card** | v1.3.x | NA-45.0 |
| **PF3102-00 Ion Pilot Card** | v2.2.x | NA-45.0 |
| **PF3102-01 UV Pilot Card** | v1.0.x | NA-45.0 |
| **PF3102-03 Pilot Spark Card** | v1.1.x | Not applicable |
| **PF3103-00 Temperature Card** | v1.4.x | NA-45.0 |
| **PF3106-00 Network Card** | v2.1.x | Not applicable |
| **PF3107-00 Modbus Card** | v1.3.x | NA-45.0 |
| **PF3113-00 I/O Expansion Card** | v2.0.x | NA-45.0 |

The hardware version is printed on the bottom line of the serial number label affixed to each card, while the firmware version can be found using the Network Discovery Tool (System Screen > Config Tab > Diagnostics). Note that all connected cards must be running the same version of firmware for the system to operate correctly.

## 2.1 ADDITIONAL DOCUMENTATION

Visit the Profire Documentation Website for additional PF3100 documents, or to access archived documentation. Contact Profire for Appendix A: Functional Safety design for additional functional safety information required for IEC 61511 analysis.

# 3 APPROVALS AND RATINGS

## 3.1 CERTIFICATIONS

The following matrix identifies the PF3100 equipment and cards that make up each model, as well as the applicable certifications for each.

| MODEL | ENCLOSURE TYPE | | | | | PF3100 HARDWARE | | | | | | | | | CERTIFICATIONS | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | UIX Enclosure | CTX Enclosure | AUX Enclosure | EPX Enclosure | TLX Enclosure | PF3100-00 UI Card | PF3101-00 BMS Controller Card | PF3102-00 Ion Pilot Card | PF3102-01 UV Pilot Card | PF3102-03 Pilot Spark Card | PF3103-00 Temperature Card | PF3106-00 Network Switch Card | PF3107-00 Modbus Comm Card | PF3113-00 I/O Expansion Card | EC 61508: 2010 Parts 1-7 (SIL 2) (Note 5) | UL 60730-2-5:2014 Ed.3 CSA C22.2#60730-2-5 :2014 Ed.1 ANSI Z21.20:2014 Ed.1 | UL 61010-1:2012 Ed.3+R:29Apr2016 CSA C22.2#61010-1-12:2012 Ed.3 | Class I, Div. 2, GRP ABCD; T4 (Note 6) | Class I, Div. 1, GRP BCD; T4 (Note 7) | Class I, Div. 1, GRP BCD, T6, IP66, 4X Class I, Zone 1 AExd IIB+H2 T6 Gb, IP66 Ex d IIB+H2 T6 Gb, IP66 (Note 8) |
| **PF3100-00** | | | | | | ● | | | | | | | | | ● | ● [1] | | ● | | |
| **PF3100-00A** | ● | | | | | ● | | | | | | | | | ● | ● [1] | | ● | | |
| **PF3100-00B** | ● | | | | | ● | | | | | | ● | | | ● | ● [1] | | ● | | |
| **PF3100-00C** | ● | | | | | ● | ● | | | | | | | | ● | ● [2] | | ● | | |
| **PF3100-00D** | ● | | | | | ● | ● | | | | | ● | | | ● | ● [2] | | ● | | |
| **PF3100-00E** | ● | | | | | ● | ● | ● | | | | | | | ● | ● | | ● | | |
| **PF3100-00J** | ● | | | | | ● | | | | | | | ● | | ● | ● [1] | | ● | | |
| **PF3100-00K** | ● | | | | | ● | ● | | | | | | ● | | ● | ● [2] | | ● | | |
| **PF3100-00T** | ● | | | | | ● | | | | | | ● | ● | | ● | ● [1] | | ● | | |
| **PF3100-00U** | ● | | | | | ● | ● | | | | ● | | | | ● | ● [2] | | ● | | |
| **PF3101-00** | | | | | | | ● | | | | | | | | ● | ● [2] | | | | |
| **PF3101-00A** | | ● | | | | | ● | | | | | | | | ● | ● [2] | | ● | | |
| **PF3101-00B** | | ● | | | | | ● | | | | | ● | | | ● | ● [2] | | ● | | |
| **PF3102-00** | | | | | | | | ● | | | | | | | ● | ● [3] | | | | |
| **PF3102-00A** | | | | ● | | | | ● | | | | | | | ● | ● [3] | | | | ● |
| **PF3102-01** | | | | | | | | | ● | | | | | | ● | | ● [4] | ● [9] | | |
| **PF3102-03** | | | | | | | | | | ● | | | | | ● | | ● [4] | ● [9] | | |
| **PF3103-00** | | | | | | | | | | | ● | | | | ● | ● [1] | | | | |
| **PF3103-00D** | | | | | ● | | | | | | ● | | | | ● | ● [1] | | | ● | |
| **PF3106-00** | | | | | | | | | | | | ● | | | ● | ● [1] | | | | |
| **PF3106-00A** | | | ● | | | | | | | | | ● | | | ● | ● [1] | | ● | | |
| **PF3107-00** | | | | | | | | | | | | | ● | | ● | ● [1] | | | | |
| **PF3107-00A** | | | ● | | | | | | | | | | ● | | ● | ● [1] | | ● | | |
| **PF3113-00** | | | | | | | | | | | | | | ● | ● | | ● [4] | ● [9] | | |

[1] must be installed with a PF3101-00x card/module and a PF3102-00x card/module to maintain compliance.
[2] must be installed with a PF3102-00x Ion Pilot card/module to maintain compliance.
[3] must be installed with a PF3101-00x BMS Controller card/module to maintain compliance.
[4] Evaluation must be conducted following installation to verify compliance.
[5] Refer to Appendix A: Functional Safety Design for Details - available upon request.
[6] In accordance with ISA 12.12.01:2015 Ed.6 • CSA C22.2#213:2016 Ed.2
[7] In accordance with ISA 12.12.01:2015 Ed.6 • CSA C22.2#213:2016 Ed.2 • CSA C22.2#30:1986 Ed.3+G1;G2 • UL 1203:2013 Ed.5 +R:16Oct2018
[8] In accordance with ANSI/ISA 60079-1:091 • ANSI/UL 1203 – 2013 • CAN/CSA-C22.2 No. 60079-1:11
[9] Certified as a recognized component.

## 3.2 PRODUCT DECLARATIONS

| SYSTEM PARAMETER | DECLARED VALUE |
|---|---|
| **Maximum Ionization Flame Failure Lock-Out Time** | 4 seconds |
| **Maximum UV Flame Failure Lock-Out Time** | 4 seconds |
| **Maximum Ignition Time** | 10 seconds |
| **Maximum Pilot-Flame Establishing Period** | 10 seconds |
| **Maximum Main-Flame Establishing Period** | 10 seconds |
| **Minimum Pre-Purge Time** | 10 seconds |
| **Minimum Post-Purge Time** | 10 seconds |
| **Minimum Recycle Time** | 10 seconds |
| **Maximum Start-up Lock-Out Time** | 10 seconds |
| **Maximum Number of Start-up Retries** | 3 |
| **Maximum number of BMS Controller cards per UI card** | 16 |
| **Maximum number of BMS Controller cards per appliance** | 16 |
| **Maximum number of Pilot cards per BMS Controller card** | 14 |
| **Maximum number of Temperature cards per BMS Controller card** | 5 |
| **Maximum number of IO Expansion cards per BMS Controller card** | 5 |
| **Maximum number of cards on IO Network (Pilot + Temperature + IO Expansion) per BMS Controller card** | 14 |
| **Maximum number of Temperature inputs per appliance** | 20 |
| **Maximum number of I/O Expansion inputs per appliance** | 45 |

## 3.3 PRODUCT SPECIFICATIONS

| SYSTEM PARAMETER | RATING | |
|---|---|---|
| | 12V MODE | 24V MODE |
| **Voltage Range** | 10.2 to 16.2 $V_{DC}$ | 20.4 to 32.4 $V_{DC}$ |
| **PF3100-00 UI Card Power Consumption (with USB)** | 5.5 W | 5.5 W |
| **PF3101-00 BMS Card Power Consumption (with LED board)** | 2.1 W | 2.6 W |
| **PF3102-00 Ion Pilot Card Power Consumption** | 1.7 W | 1.8 W |
| **PF3102-01 UV Pilot Card Power Consumption** | 1.1 W | 1.0 W |
| **PF3102-03 Pilot Spark Card Power Consumption (Peak while sparking)** | 2.1 W | 11.9 W |
| **PF3103-00 Temperature Card Power Consumption** | 1.0 W | 1.0 W |
| **PF3106-00 Network Card Power Consumption** | 0.6 W | 0.6 W |
| **PF3107-00 Modbus Card Power Consumption** | 1.3 W | 1.3 W |
| **PF3113-00 I/O Expansion Card Power Consumption** | 1.2 W | 1.4 W |
| **Operating and Storage Temperature** | -40°C to 55°C (-40°F to 131°F) | |

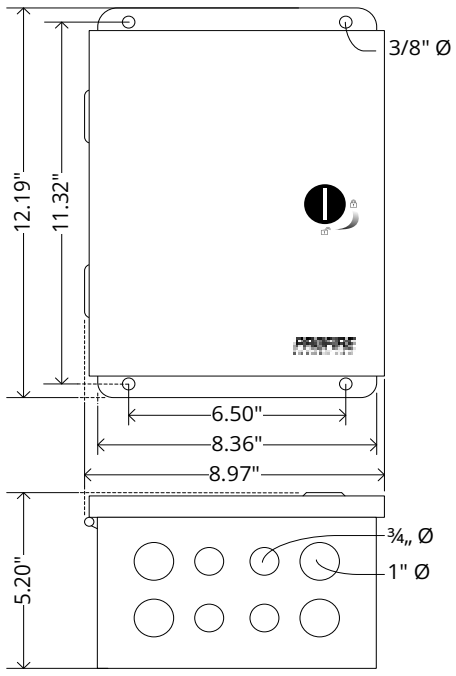
*PF3100 Electromagnetic Field Immunity has been verified in accordance with IEC 61000-4-3:2010 and IEC 61000-4-6:2010.*

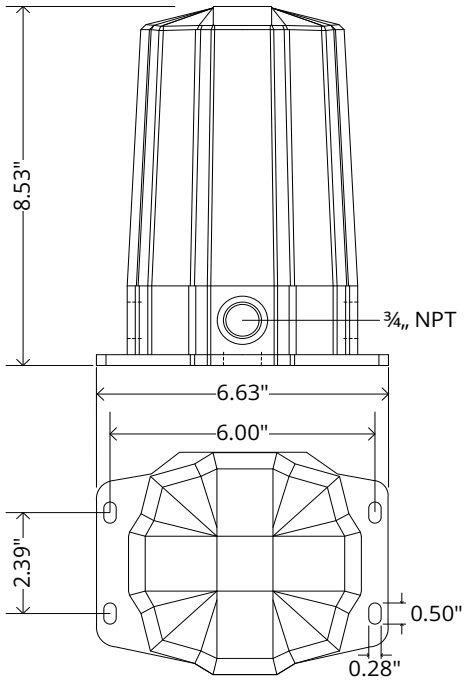
## 3.4 ENCLOSURE SPECIFICATIONS

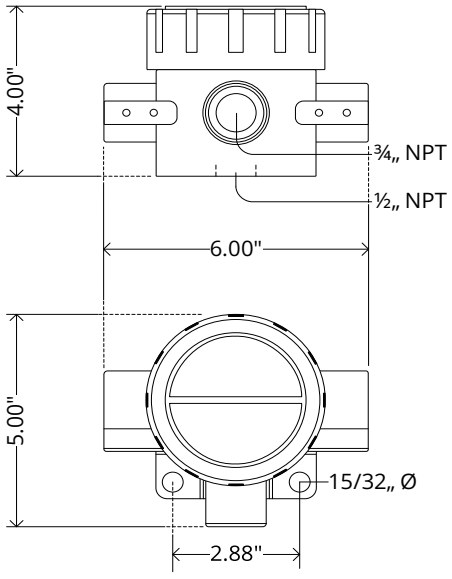
| | UIX/CTX/AUX ENCLOSURE | EPX ENCLOSURE | TLX ENCLOSURE |
|---|---|---|---|
| **MATERIAL** | Polyester painted steel | Aluminum | Aluminum |
| **CONDUIT ENTRY** | UIX, CTX and AUX:<br>4 x ¾" pre-cut, bottom entry<br>4 x ½" pre-cut, bottom entry<br>UIX and CTX only:<br>1 x ½" keyed, pre-cut, side entry | 4 x ¾" NPT | 3 x ¾" NPT<br>1 x ½" NPT |
| **MOUNTING** | Channel bar or direct mount | Channel bar or direct mount | ½" NPT thermowell |
| **TYPE** | 4 | 4X | 4X |
| **INGRESS PROTECTION** | IP66 | IP66 | IP66 |
| **OPERATING/STORAGE TEMPERATURE** | -40°C to 55°C<br>(-40°F to 131°F) | -40°C to 60°C<br>(-40°F to 140°F) | -40°C to 55°C<br>(-40°F to 131°F) |

### 3.4.1 ENCLOSURE DIMENSIONS

| UIX/CTX/AUX | EPX | TLX |
|---|---|---|

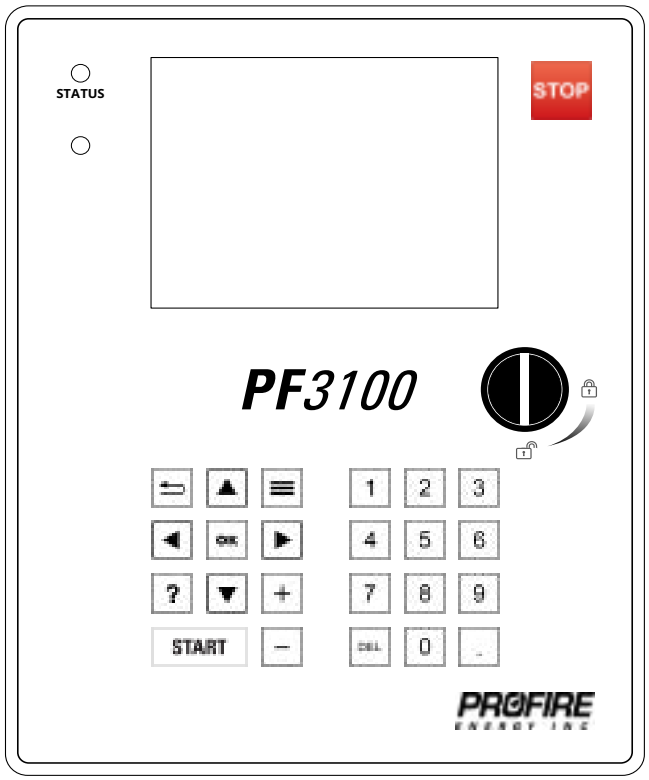


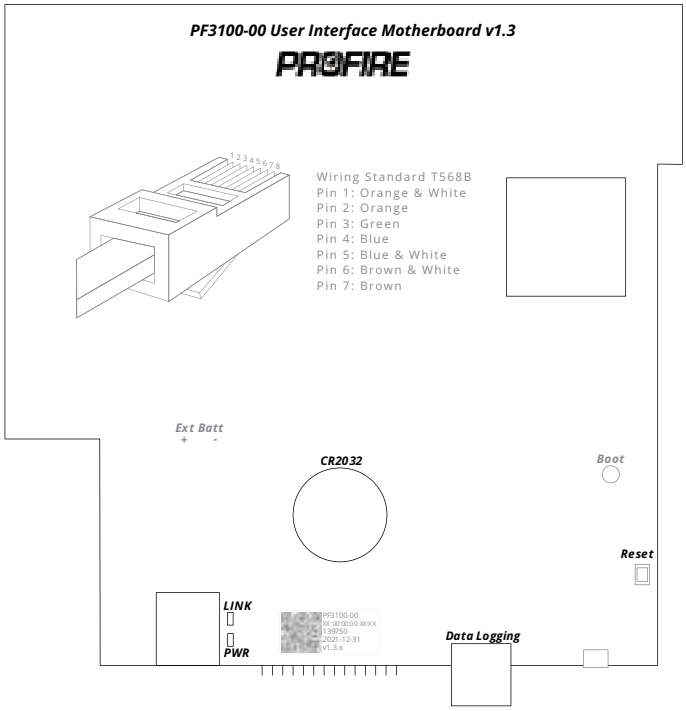



# 4 PF3100-00 USER INTERFACE CARD

The PF3100 User Interface card is the primary access point for commissioning and monitoring the PF3100 system. It consists of a 5.7" color display and a full keypad for navigation and configuration, as well as an appliance status LED indicator and a USB port for data logging and settings file management.



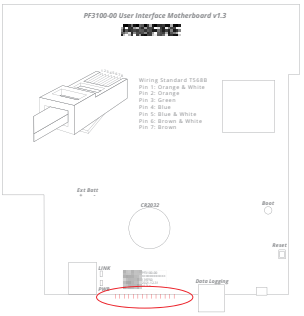

## 4.1 TERMINAL RATINGS

| NAME | SAFETY RATED | INPUT/OUTPUT | ELECTRICAL RATINGS |
|---|---|---|---|
| PFRN Controller Network | Yes | I/O | Power consumer: 36 $V_{DC}$, 1A maximum |
| USB Port | No | I/O | 5V, 500mA maximum |
| SD Card Port | No | I/O | N/A |
| Battery | No | I | 3V, 225mAh |
| Keypad | No | I | N/A |

# 4.2 KEYPAD

## 4.2 DETAILS

| | |
|---|---|
| **TERMINALS** | 14-pin connector on bottom of UI card |

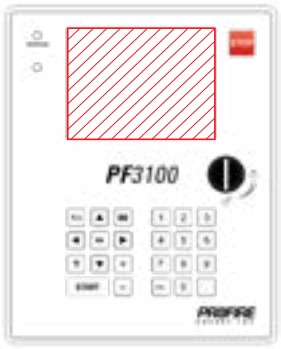




## 4.2.2 KEYPAD FUNCTIONALITY

| BUTTON | DESCRIPTION |
|---|---|
| STOP | Stop a single controller [1] |
| | Stop a single appliance [1] |
| | Stop all appliances [1] |
| ⮌ | Return to previous screen |
| ☰ | Bring up Appliance Quick Adjust menu |
| | Bring up Flame Diagnostics menu from the Controller Status screen |
| | Bring up multi-controller settings menu while adjusting settings |
| | Save a screenshot to a connected USB storage device (hold down) |
| | Toggles between Table and Graph view when configuring FARC channels. |
| OK | Select a highlighted item |
| ? | Displays configuration options of password protected drop-down settings. |
| + − | Make incremental changes to numeric settings |
| | Make incremental changes on Quick Adjust menu |
| | Scroll full pages of information (Event log, Controller Status Screen, etc.) |
| ▲ ◀ ▶ ▼ | Navigate menus and highlight items |
| START | Start a single controller from the Ready state |
| | Start a single appliance when all associated controllers are in the Ready state |
| | Start all appliances when all controllers are in the Ready state |
| 1 2 3 4 5 6 7 8 9 DEL 0 . | Change numeric settings<br>Delete key can also be used to unassign items in the configuration wizards. |

*1 The keypad is intended to aid in commissioning and system navigation and must not be incorporated into any safety function. If user shutdown is a required safety function, then the BMS Controller card ESD input(s) or external ignition switch(es) must be used.*

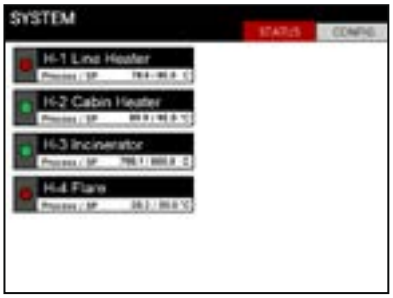
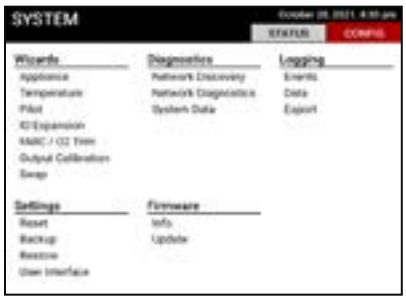
## 4.3 USER INTERFACE DISPLAY



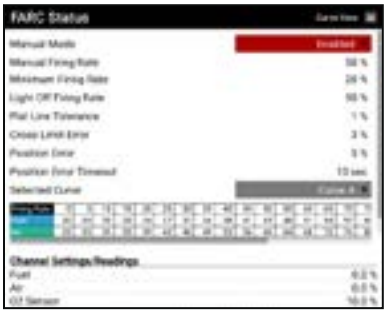
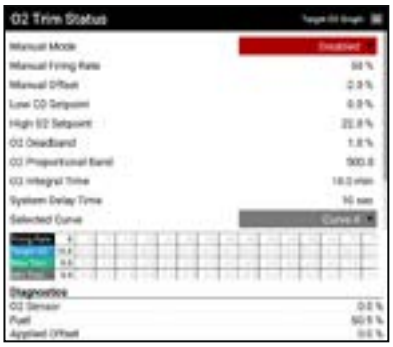

### 4.3.1 DETAILS

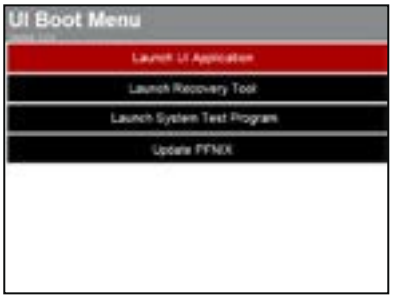
| | |
|---|---|
| **TYPE** | Transmissive color TFT-LCD |
| **SIZE** | 5.7” |
| **RESOLUTION** | 640 x 480 |

### 4.3.2 PF3100 STATUS AND CONFIGURATION SCREENS

| SCREEN NAME | SCREENSHOT | NAVIGATION | DESCRIPTION |
|---|---|---|---|
| System Screen - Status Tab |  | Press ⇆ repeatedly from any screen. | Displays all the configured appliances as well as their current state and process temperature. |
| System Screen - Config Tab |  | From the System Status Tab, press ▶. press ▼ to highlight desired option, then press OK to launch. | Provides access to configuration wizards, system diagnostics, data logging tools, settings file management utilities and a firmware update tool. |
| Appliance Screen - Status Tab |  | From System Status Tab, press ▼ to highlight desired appliance, then press OK. | Displays the temperature readings, input readings and output signals for the selected appliance as well as the current state of every BMS controller in the appliance. |

| SCREEN NAME | SCREENSHOT | NAVIGATION | DESCRIPTION |
|---|---|---|---|
| Controller Status Screen |  | From Appliance Status Tab, press ▼ and ▶ to highlight desired controller, then press OK. | Displays detailed information for all inputs and outputs of the selected controller and connected cards. |
| Flame Diagnostics Screen |  | From Controller Status Screen, press ☰. | Displays flame strength readings for each Pilot card.<br>Green indicates a strong flame, orange indicates a weak flame and red indicates a poor flame. |
| Appliance Screen - Alerts Tab |  | From Appliance Status Tab, press ▶. | Displays all active alerts (alarms, waits, warnings and main permissives) for the appliance. Pressing OK on an alert displays additional troubleshooting Details if available. |

| SCREEN NAME | SCREENSHOT | NAVIGATION | DESCRIPTION |
|---|---|---|---|
| Appliance Screen - Settings Tab |  | From Appliance Alerts Tab, press ▶ . | Contains configuration settings for all controllers in the appliance. |
| Appliance Screen - FARC Settings Dialog |  | From Appliance Status Tab, press ▼ and ▶ to highlight "FARC" option *, then press OK . Use ☰ to toggle between Table View and Curve View.<br>* This option is only visible when the FARC Enable setting (FARC/$O_2$ Trim Wizard > General Tab) is set to Enabled | Contains FARC table and additional tuning settings. |
| Appliance Screen - $O_2$ Trim Settings Dialog |  | From Appliance Status Tab, press ▼ and ▶ to highlight "$O_2$ Trim" option *, then press OK . Use ☰ to cycle through Table and Graph views.<br>* This option is only visible when the Trim Channel (FARC/$O_2$ Trim Wizard > $O_2$ Trim Tab) is not set to Disabled | Contains $O_2$ Trim tables and additional tuning settings. |

| SCREEN NAME | SCREENSHOT | NAVIGATION | DESCRIPTION |
|---|---|---|---|
| Quick Adjust Dialog |  | From System Screen or Appliance Screen, press ▬. | Allows for quick adjustment of the appliance Process Setpoint. Use + and − to make incremental adjustments. |
| Lockout Screen |  | N/A – Lockout Screen appears automatically upon controller lockout. | Displays important shutdown information upon a controller lockout. The screen persists until it is acknowledged by a user. |
| UI Boot Menu |  | From Power Off, press and hold ▬ while powering up the UI.<br>* It may take up to 30 seconds for the Boot Menu to appear. | Provides access to useful troubleshooting tools as well as utilities for updating the UI operating system. Contact Profire for instructions on how and when to use the Boot Menu utilities. |

## 4.4 STATUS LED

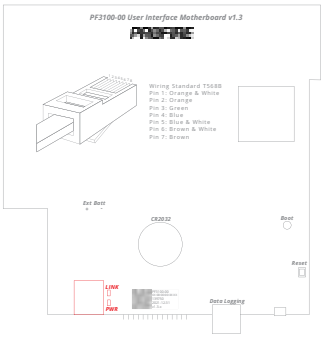

### 4.4.1 DETAILS

| | |
|---|---|
| **COLOR** | Green/Amber/Red |
| **INDICATION** | Appliance Run Status |

### 4.4.2 SYSTEM BEHAVIOR

| SCENARIO | LED COLOR | LED BEHAVIOR |
|---|---|---|
| All appliances are stopped | Red | Solid |
| All appliances are running | Green | Solid |
| Some appliances are running and one or more are stopped | Green | Blinking |
| Status LED is malfunctioning Contact Profire | Amber | Any |

# 4.5 PFRN CONTROLLER NETWORK PORT




## 4.5.1 DETAILS

| | |
|---|---|
| **PFRN CLASS** | Interface |
| **TYPE** | Power consuming PFRN port |
| **CONNECTOR TYPE** | 8P8C |

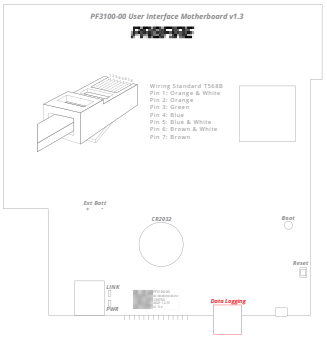
## 4.5.2 INTENDED FIELD DEVICE CONNECTIONS

| FIELD DEVICE | CONFIGURATION REQUIREMENTS | CONNECTION DIAGRAMS |
|---|---|---|
| PF3101-00 BMS Controller card | N/A | 8P8C PFRN Connector Wiring<br>UI PFRN Connector Options |
| PF3101-00 BMS Controller card via PF3106-00 Network card | | |
| PF3101-00 BMS Controller card via PF3107-00 Modbus card | | |

## 4.5.3 LED BEHAVIOR

| NAME | COLOR | LED BEHAVIOR | INTERPRETATION | CORRECTIVE ACTION |
|---|---|---|---|---|
| Pwr | Blue | Off | Port has no power | Make sure connected power producer card (BMS controller card, Network card, Modbus card) is powered on.<br>Check PFRN wire terminations |
| | | On – Solid | Port has power | N/A |
| | | On – Flickering | Port has intermittent power | Check PFRN wire terminations |
| Link | Green | Off | Port is not communicating | Check PFRN wire terminations |
| | | On – Solid | Port is communicating normally | N/A |
| | | On – Flickering | | |

## 4.6 USB PORT



**WARNING:**
DO NOT REMOVE OR INSTALL A USB STICK UNLESS THE AREA IS KNOWN TO BE NON-HAZARDOUS.

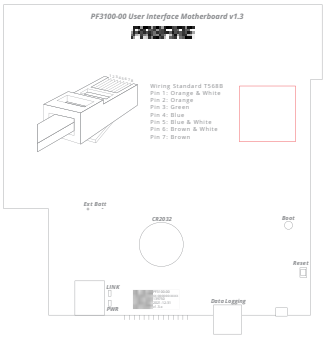
### 4.6.1 DETAILS

| | |
|---|---|
| **RECOMMENDED CAPACITY** | 1 GB |
| **RECOMMENDED OPERATING RATING** | -40°C – 60°C (-40°F – 140°F) |

### 4.6.2 USB FUNCTIONALITY

| FUNCTION | PROCEDURE |
|---|---|
| Save controller settings to USB drive | Use the Backup tool to save settings to a USB drive. |
| Load controller settings from USB drive | Use the Restore tool to load settings to a USB drive. |
| Update card firmware | Use the Firmware Update tool to modify the firmware of a connected card. |
| Export event log | Use the Event Logging and Export tools to view and save system events. |
| Export data log | Use the Data Logging and Export tools to trend and save system data. |

## 4.7 SD CARD SLOT



**WARNING:**
DO NOT REMOVE OR INSTALL THE SD CARD UNLESS THE AREA IS KNOWN TO BE NON-HAZARDOUS.

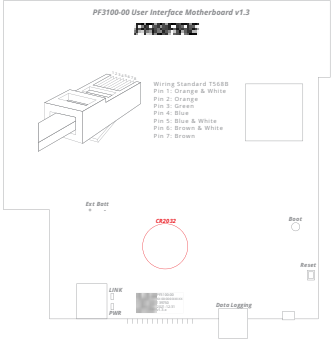
### 4.7.1 DETAILS

| | |
|---|---|
| **RECOMMENDED SIZE** | Standard or mini/micro with adapter |
| **RECOMMENDED CAPACITY** | 8GB |

### 4.7.2 SD CARD FUNCTIONALITY

| FUNCTION | PROCEDURE |
|---|---|
| Update UI operating system (PFnix) | **UI Boot Menu > Update PFnix**<br>Contact Profire for approved PFnix update file and update procedure.<br>* This is different than a firmware update. For UI firmware update procedure refer to Firmware Update section. |

## 4.8 BATTERY



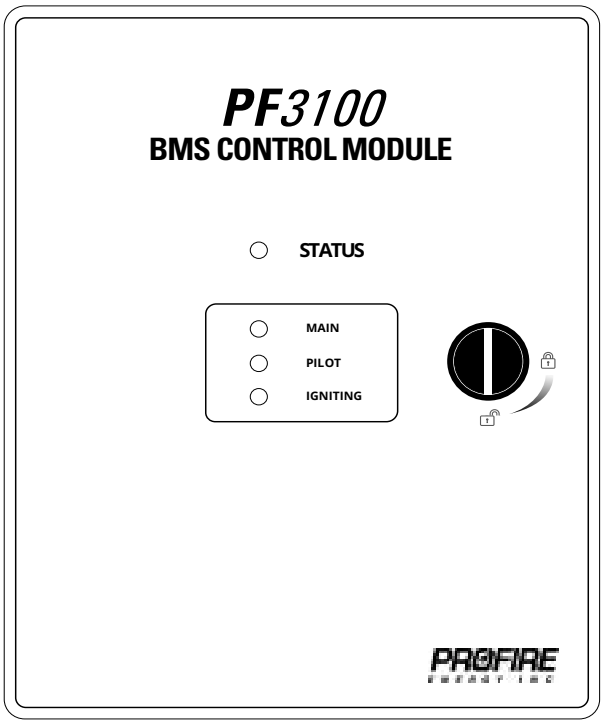
**WARNING:**
EXPLOSION HAZARD. BATTERIES MUST ONLY BE CHANGED IN AN AREA FREE OF IGNITABLE CONCENTRATIONS.

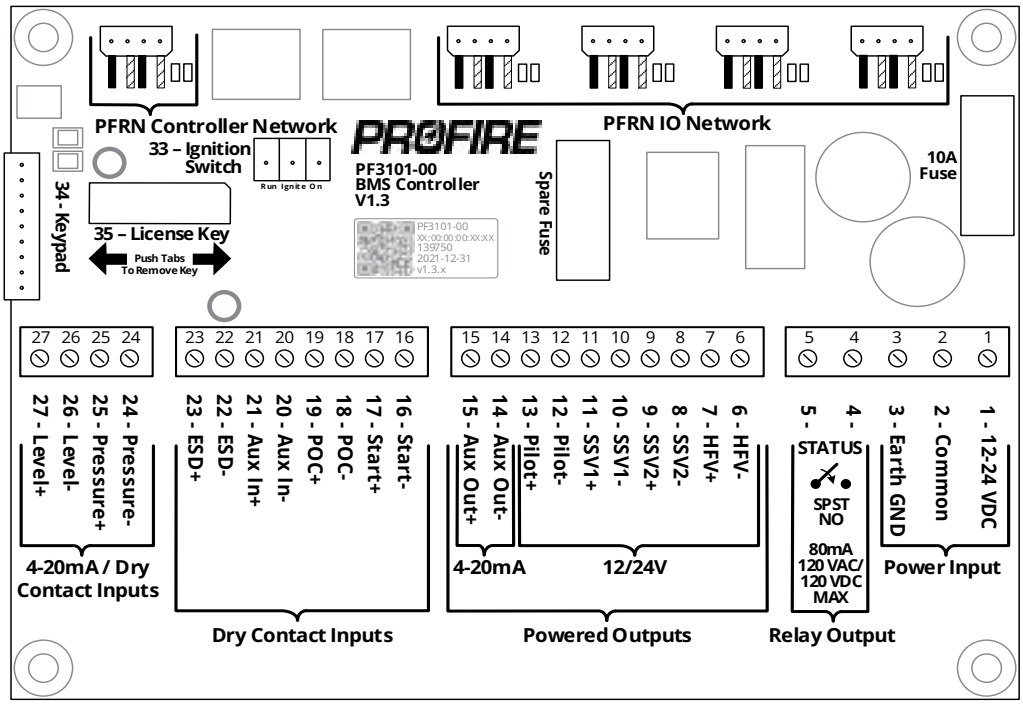
### 4.8.1 DETAILS

| | |
|---|---|
| **VOLTAGE** | 3V |
| **TYPE** | CR 2032 |

# 5 PF3101-00 BMS CONTROLLER CARD

The BMS Controller card is the dedicated hub for all I/O cards and instrumentation associated with a specific burner in an appliance. All inputs are monitored by the BMS to identify shutdown conditions and to determine safety output behavior and state transitions.



## 5.1 TERMINAL RATINGS

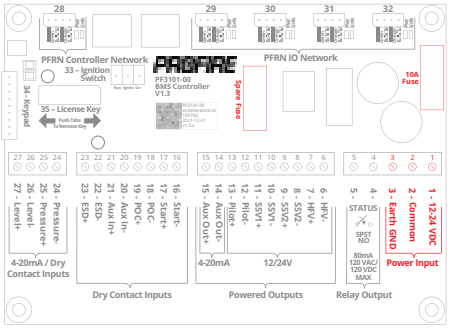
| NAME | SAFETY RATED | TERMINAL | | INPUT/OUTPUT | ELECTRICAL RATINGS |
|---|---|---|---|---|---|
| Power Input | No | 1 | 12-24 VDC | I | 12-24 $V_{DC}$<br>10A maximum<br>*Fused at 10A |
| | | 2 | Common | | |
| | | 3 | Earth GND | GND | |
| Relay Output | No | 4 | STATUS A | - | Dry contact<br>120 $V_{AC}$/$V_{DC}$<br>80mA maximum |
| | | 5 | STATUS B | | |
| HFV | No | 6 | - | O | 12-24 $V_{DC}$<br>2A maximum<br>Pulsed Output with configurable PWM<br>Expected Load: Inductive/Resistive |
| | | 7 | + | | |
| SSV2 | Yes | 8 | - | O | |
| | | 9 | + | | |
| SSV1 | Yes | 10 | - | O | |
| | | 11 | + | | |
| Pilot | Yes | 12 | - | O | |
| | | 13 | + | | |
| Aux Out | No | 14 | - | O | 12-24 $V_{DC}$<br>20mA maximum<br>Maximum output device impedance:<br>12V Mode: 250Ω, 24V Mode: 900Ω |
| | | 15 | + | | |
| Start | Yes | 16 | - | I | 30 $V_{DC}$ max, 2mA minimum wetting current |
| | | 17 | + | O | 12-24 $V_{DC}$, 100mA maximum [1] |
| POC | Yes | 18 | - | I | 30 $V_{DC}$ max, 2mA minimum wetting current |
| | | 19 | + | O | 12-24 $V_{DC}$, 100mA maximum [1] |
| Aux In | Yes | 20 | - | I | 30 $V_{DC}$ max, 2mA minimum wetting current |
| | | 21 | + | O | 12-24 $V_{DC}$, 100mA maximum [1] |
| ESD | Yes | 22 | - | I | 30 $V_{DC}$ max, 2mA minimum wetting current |
| | | 23 | + | O | 12-24 $V_{DC}$, 100mA maximum [1] |
| Pressure | Yes | 24 | - | I | Digital Mode: 30 $V_{DC}$ max, 2mA minimum wetting current<br>4-20 Mode: 30 $V_{DC}$ max, 25mA maximu<br>Input resistance ~200Ω |
| | | 25 | + | O | 12-24 $V_{DC}$, 50mA maximum |
| Level | Yes | 26 | - | I | Digital Mode: 30 $V_{DC}$ max, 2mA minimum wetting current<br>4-20 Mode: 30 $V_{DC}$ max, 25mA maximum<br>Input resistance ~200Ω |
| | | 27 | + | O | 12-24 $V_{DC}$, 50mA maximum |
| PFRN Controller Network | Yes | 28 | | I/O | 36 $V_{DC}$, 1A maximum |
| PFRN I/O Network | Yes | 29 | | I/O | 36 $V_{DC}$, 1A maximum |
| | | 30 | | I/O | |
| | | 31 | | I/O | |
| | | 32 | | I/O | |
| Ignition Switch | Yes | 33 | Run | I | 3.3 $V_{DC}$ |
| | | | Ignite | I | |
| | | | On | O | 3.3 $V_{DC}$ |
| Keypad | No | 34 | | O | 3.3 $V_{DC}$ |
| License Key | No | 35 | | I | 3.3 $V_{DC}$ |

[1] *The combined current requirements of the Start, POC, Aux In and ESD input devices cannot exceed 100mA.*

## 5.2 CONTROLLER POWER INPUT

### 5.2.1 DETAILS

| | |
|---|---|
| **TERMINALS** | 1, 2 & 3 |
| **NAME** | Power Input |
| **TYPE** | BMS power input |
| **FUSE** | 10A ceramic - Replacement fuses must be of correct type and rating. Contact Profire for replacement fuses. |




**WARNING:**
EXPLOSION HAZARD. DO NOT REMOVE OR REPLACE FUSE WHEN ENERGIZED.

### 5.2.2 INTENDED FIELD DEVICE CONNECTIONS

| FIELD DEVICE | CONFIGURATION REQUIREMENTS | CONNECTION DIAGRAMS |
|---|---|---|
| 12V Power Supply | **Controller Settings > Setup > System Voltage**<br>Controller Voltage: 12V<br>Voltage Restart: As desired | Power Input Wiring |
| 24V Power Supply | **Controller Settings > Setup > System Voltage**<br>Controller Voltage: 24V<br>Voltage Restart: As desired | |

### 5.2.3 VOLTAGE ALERT BEHAVIOR – 12V MODE

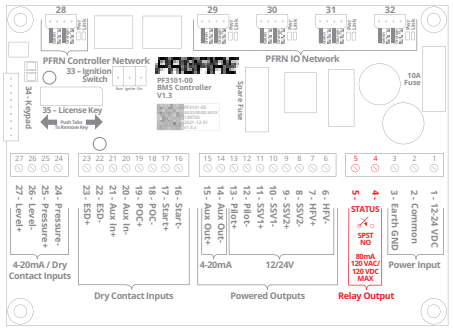
| SCENARIO | | | | STATE TRANSITION | CONTROLLER ALERTS |
|---|---|---|---|---|---|
| SYSTEM VOLTAGE | LOW VOLTAGE RESTART | HIGH VOLTAGE RESTART | CONTROLLER STATE | | |
| 12V Mode: Below 9.6V *<br>24V Mode: Below 19.2V* | Enabled | Any | Any running state | Waiting | Low Voltage Wait |
| | | | Any stopped state | No effect | Low Voltage Wait |
| | Disabled | Any | Any running state | Lockout | Low Voltage Alarm |
| | | | Any stopped state | Alarm | Low Voltage Alarm |
| 12V Mode: 9.6V to 9.9V *<br>24V Mode: 19.2V to 19.9V * | Any | Any | Any | No effect | Low Voltage Warning |
| 12V Mode: 9.9V to 16.1V *<br>24V Mode: 19.9V to 33.1V * | Any | Any | Any | No effect | N/A |
| 12V Mode: 16.1V to 16.8V *<br>24V Mode: 33.1V to 33.6V * | Any | Any | Any | No effect | High Voltage Warning |
| 12V Mode: Above 16.8V *<br>24V Mode: Above 33.6V * | Any | Enabled | Any running state | Waiting | High Voltage Wait |
| | | | Any stopped state | No effect | High Voltage Wait |
| | Any | Disabled | Any running state | Lockout | High Voltage Alarm |
| | | | Any stopped state | Alarm | High Voltage Alarm |

** All listed voltage thresholds are +/- 1.0 V*

## 5.3 STATUS CONTACT

### 5.3.1 DETAILS

| | |
|---|---|
| **TERMINALS** | 4 & 5 |
| **NAME** | Relay Output |
| **TYPE** | Normally open dry contact |




### 5.3.2 INTENDED FIELD DEVICE CONNECTIONS

| FIELD DEVICE | CONFIGURATION REQUIREMENTS | CONNECTION DIAGRAMS |
|---|---|---|
| Site equipment status panel | **Controller Settings > Outputs > Status Contact**<br>Status Contact Mode: As desired | Run Status – AC<br>Run Status – DC |
| Tank pump motor enable via relay | **Controller Settings > Outputs > Status Contact**<br>Status Contact Mode: High Level/Flow | Run Status – Pump Control |

### 5.3.3 STATUS CONTACT BEHAVIOR BY CONTROLLER STATE

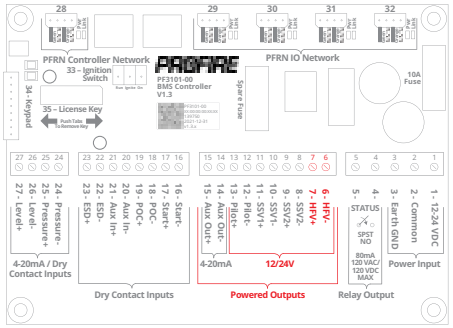
| STATUS CONTACT MODE SETTING | CONDITION | LOCKOUT | ALARM | READY | WAITING | STARTUP CHECKS | PROVEN PRE-PURGE | IGNITION | PILOT | LOW FIRE | PROCESS CONTROL |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Run Status | Any | O | O | O | C | C | C | C | C | C | C |
| Run and Start Status | Start contact open | O | O | O | O | - | - | - | - | - | - |
| | Start contact closed | O | O | O | C | C | C | C | C | C | C |
| Heating Status | Any | O | O | O | O | O | O | C | C | C | C |
| Pilot Flame Monitor | Flame quality < 50% | O | O | O | O | O | O | O | O | O | O |
| | Flame quality > 50% | O | O | O | C | C | C | C | C | C | C |
| Low Temp Warning | Process temp < Low temp | O | O | O | O | O | O | O | O | O | O |
| | Process temp > Low temp | O | O | O | C | C | C | C | C | C | C |
| High Level/Flow | Level > High Trip | O | O | O | O | O | O | O | O | O | O |
| | Level < High Trip | O | O | O | C | C | C | C | C | C | C |

*O – Open, C- Closed*

## 5.4 HIGH FIRE VALVE SOLENOID OUTPUT

### 5.4.1 DETAILS

| | |
|---|---|
| **TERMINALS** | 6 & 7 |
| **NAME** | HFV |
| **ALTERNATE NAME** | Fan Output |
| **TYPE** | Powered solenoid output with configurable PWM |




### 5.4.2 INTENDED FIELD DEVICE CONNECTIONS

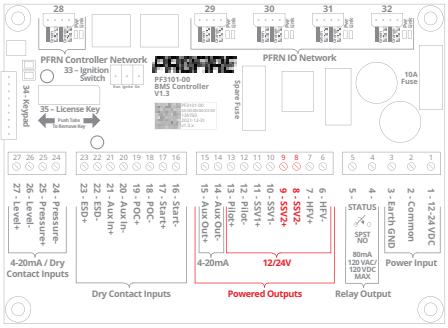
| FIELD DEVICE | CONFIGURATION REQUIREMENTS | CONNECTION DIAGRAMS |
|---|---|---|
| Normally closed gas shutoff valve – Peak and hold | **Controller Settings > Outputs > Valves**<br>High Fire PWM: As desired<br>HFV Output Mode: Valve | Solenoid Output – 12V/24V |
| Normally closed gas shutoff valve – Constant current | **Controller Settings > Outputs > Valves**<br>High Fire PWM: 100%<br>HFV Output Mode: Valve | Solenoid Output – 12V/24V |
| Forced draft fan motor enable via relay | **Controller Settings > Outputs > Valves**<br>High Fire PWM: 100%<br>HFV Output Mode: Forced Draft Fan | HFV Output – Fan Control Wiring |
| Purge fan enable via relay | **Controller Settings > Outputs > Valves**<br>High Fire PWM: 100%<br>HFV Output Mode: Purge Fan | HFV Output – Fan Control Wiring |
| Not Used | N/A | N/A |

### 5.4.3 HFV OUTPUT BEHAVIOR BY CONTROLLER STATE

| HFV OUTPUT MODE SETTING | CONDITION | POWER ON | LOCKOUT | ALARM | READY | WAITING | STARTUP CHECKS | PROVEN PRE-PURGE | IGNITION | PILOT | LOW FIRE | PROCESS CONTROL - HIGH FIRE | PROCESS CONTROL - PID CONTROL | PROCESS CONTROL - INCINERATE | PROCESS CONTROL - INCINERATE NO ASSIST |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Valve | Any | D | D | D | D | D | - | - | D | D | D | E | E | D | D |
| Forced Draft Fan | Not Purging | D | D | D | D | D | D | - | E | E | E | - | E | - | - |
| | Purging | E | E | E | E | E | - | E | - | - | - | - | - | - | - |
| Purge Fan | Not Purging | D | D | D | D | D | D | - | D | D | D | - | D | D | D |
| | Purging | E | E | E | E | E | - | E | - | - | - | - | - | - | - |

*E = Energized, D = De-energized*

## 5.5 MAIN VALVE SOLENOID OUTPUT 2




### 5.5.1 DETAILS

| | |
|---|---|
| **TERMINALS** | 8 & 9 |
| **NAME** | SSV2 |
| **ALTERNATE NAME** | Incinerator Waste Gas Valve |
| **TYPE** | Powered solenoid output with configurable PWM |

### 5.5.2 INTENDED FIELD DEVICE CONNECTIONS

| FIELD DEVICE | CONFIGURATION REQUIREMENTS | CONNECTION DIAGRAMS |
|---|---|---|
| Normally closed main gas shutoff valve – Peak and hold | **Controller Settings > Outputs > Valves**<br>SSV2 PWM: As desired | Solenoid Output – 12V/24V |
| Normally closed main gas shutoff valve – Constant current | **Controller Settings > Outputs > Valves**<br>SSV2 PWM: 100% | Solenoid Output – 12V/24V |
| Normally closed incinerator waste gas shutoff valve | **Controller Settings > Outputs > Valves**<br>SSV2 PWM: As above<br>**Controller Settings > Process Control > Incinerator Control**<br>Incinerator Enable: Enabled | Solenoid Output – 12V/24V |

### 5.5.3 SSV2 OUTPUT BEHAVIOR BY CONTROLLER STATE

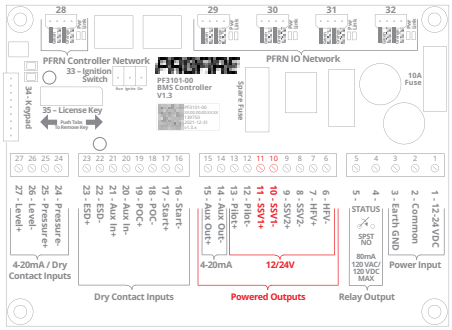
| INCINERATOR ENABLE SETTING | POWER ON | LOCKOUT | ALARM | READY | WAITING | STARTUP CHECKS | PROVEN PRE-PURGE | IGNITION | PILOT | LOW FIRE | PROCESS CONTROL - HIGH FIRE | PROCESS CONTROL - PID CONTROL | PROCESS CONTROL - INCINERATE | PROCESS CONTROL - INCINERATE NO ASSIST |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Disabled | D | D | D | D | D | D | D | D | D | E | E | E | - | - |
| Enabled | D | D | D | D | D | - | - | D | D | D | - | - | E | E |

*E = Energized, D = De-energized*

## 5.6 MAIN VALVE SOLENOID OUTPUT 1

### 5.6.1 DETAILS

| | |
|---|---|
| **TERMINALS** | 10 & 11 |
| **NAME** | SSV1 |
| **ALTERNATE NAME** | Incinerator Assist Gas Valve |
| **TYPE** | Powered solenoid output with configurable PWM |




### 5.6.2 INTENDED FIELD DEVICE CONNECTIONS

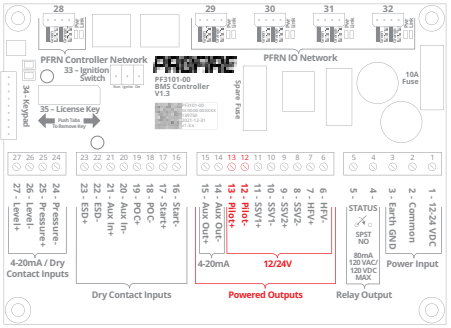
| FIELD DEVICE | CONFIGURATION REQUIREMENTS | CONNECTION DIAGRAMS |
|---|---|---|
| Normally closed main gas shutoff valve – Peak and hold | **Controller Settings > Outputs > Valves**<br>SSV1 PWM: As desired | Solenoid Output – 12V/24V |
| Normally closed main gas shutoff valve – Constant current | **Controller Settings > Outputs > Valves**<br>SSV1 PWM: 100% | Solenoid Output – 12V/24V |
| Normally closed incinerator assist gas shutoff valve | **Controller Settings > Outputs > Valves**<br>SSV1 PWM: As above<br>**Controller Settings > Process Control > Incinerator Control**<br>Incinerator Enable: Enabled | Solenoid Output – 12V/24V |

### 5.6.3 SSV1 OUTPUT BEHAVIOR BY CONTROLLER STATE

| INCINERATOR ENABLE SETTING | POWER ON | LOCKOUT | ALARM | READY | WAITING | STARTUP CHECKS | PROVEN PRE-PURGE | IGNITION | PILOT | LOW FIRE | PROCESS CONTROL - HIGH FIRE | PROCESS CONTROL - PID CONTROL | PROCESS CONTROL - INCINERATE | PROCESS CONTROL - INCINERATE NO ASSIST |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Disabled | D | D | D | D | D | D | D | D | D | E | E | E | - | - |
| Enabled | D | D | D | D | D | - | - | D | D | E | - | - | E | D |

*E = Energized, D = De-energized*

# 5.7 PILOT VALVE SOLENOID OUTPUT




## 5.7.1 DETAILS

| | |
|---|---|
| **TERMINALS** | 12 & 13 |
| **NAME** | Pilot |
| **TYPE** | Powered solenoid output with configurable PWM |

## 5.7.2 INTENDED FIELD DEVICE CONNECTIONS

| FIELD DEVICE | CONFIGURATION REQUIREMENTS | CONNECTION DIAGRAMS |
|---|---|---|
| Normally closed gas shutoff valve – Peak and hold | **Controller Settings > Outputs > Valves**<br>Pilot Valve PWM: As desired<br>**Controller Settings > Process Control > Process Temp Control**<br>Pilot Off Mode: As desired<br>**Controller Settings > Inputs > Flame Detection**<br>Main Flame Detect: As desired | Solenoid Output – 12V/24V |
| Normally closed gas shutoff valve – Constant current | **Controller Settings > Outputs > Valves**<br>Pilot Valve PWM: 100%<br>**Controller Settings > Process Control > Process Temp Control**<br>Pilot Off Mode: As desired<br>**Controller Settings > Inputs > Flame Detection**<br>Main Flame Detect: As desired | Solenoid Output – 12V/24V |

## 5.7.3 PILOT OUTPUT BEHAVIOR BY CONTROLLER STATE

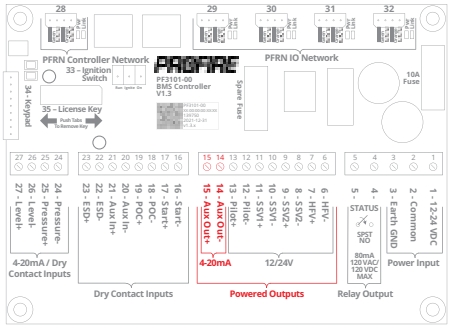
| INCINERATOR ENABLE SETTING | POWER ON | LOCKOUT | ALARM | READY | WAITING | STARTUP CHECKS | PROVEN PRE-PURGE | IGNITION | PILOT | LOW FIRE | PROCESS CONTROL |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Disabled<br>Off at Setpoint<br>Follow Main | D | D | D | D | D | D | D | E | E | E | E |
| Off after Main On | D | D | D | D | D | D | D | E | E | D [2,3] | D [2,3] |

[1] E = Energized, D = De-energized
[2] Main Flame Detect setting must be enabled
[3] Energized under reignition conditions in accordance with configured Pilot Relight Mode and Pilot Relight Timeout settings (Controller Settings > Outputs > Ignition).

## 5.8 AUXILIARY 4-20mA OUTPUT

### 5.8.1 DETAILS

| | |
|---|---|
| **TERMINALS** | 14 & 15 |
| **NAME** | Aux Out |
| **TYPE** | 4-20mA powered output |




### 5.8.2 INTENDED FIELD DEVICE CONNECTIONS

| FIELD DEVICE/APPLICATION | CONFIGURATION REQUIREMENTS | CONNECTION DIAGRAMS |
|---|---|---|
| 4-20mA proportional fuel gas valve using internal PID algorithm | **Controller Settings > Process Control > Process Temp Control**<br>Low Fire Mode: Not disabled<br>**Controller Settings > Process Control > Cold Start Ramping**<br>All settings: As desired<br>**Controller Settings > Outputs > 4-20 Aux Out**<br>4-20 Aux Out Mode: PID Control<br>Manual Override: Disabled<br>All other settings: As desired<br>**FARC Settings (If applicable)**<br>Off Position: As desired<br>Light Off Position: As desired | Proportional Valve/Actuator Wiring |
| 4-20mA proportional fuel gas valve using Modbus Firing Rate input | Same as previous with the following exceptions:<br>**Controller Settings > Outputs > 4-20 Aux Out**<br>4-20 Aux Out Mode: Modbus Firing Rate | Proportional Valve/Actuator Wiring |
| 4-20mA proportional fuel gas valve using external firing rate input | Same as previous with the following exceptions:<br>**Controller Settings > Outputs > 4-20 Aux Out**<br>4-20 Aux Out Mode: Appliance Firing Rate<br>**I/O Wizard > Add Inputs Tab**<br>Input Type: Appliance Firing Rate | Proportional Valve/Actuator Wiring |
| 4-20mA proportional fuel gas valve using Primary and Secondary PID control.<br><br>4-20mA proportional fuel gas valve using cascaded Primary and Secondary PID control.<br><br>4-20mA proportional fuel gas valve using a PID staging input in conjunction with Primary and Secondary PID control. | **I/O Wizard > Create Inputs & I/O Modules Tabs**<br>Create a Secondary PID control input<br>Create a PID staging input if required<br>**Controller Settings > Outputs > 4-20 Aux Out**<br>4-20 Aux Out Mode: PID Control<br>**Controller Settings > Process Control > Secondary PID**<br>All settings: As desired per PID control preferences<br>**Controller Settings > Process Control > Advanced PID**<br>Cascaded PID: As required<br>PID Staging Mode: As desired<br>Secondary Input: Assign secondary PID input created above<br>Staging Input: Assign staging input created above if required<br>All other settings: As desired<br>Refer to PID Tuning Guide document for additional configuration Details. | Proportional Valve/Actuator Wiring |
| BMS input echo to PLC (Process temp, Pressure or Level/Flow | **Controller Settings > Outputs > 4-20 Aux Out**<br>4-20 Aux Out Mode: Desired Echo setting | 4-20mA Echo to PLC |
| Not Used | **Controller Settings > Outputs > 4-20 Aux Out**<br>4-20 Aux Out Mode: Disabled | N/A |

### 5.8.3 AUXILIARY OUTPUT POSITION BY CONTROLLER STATE – PID CONTROL/APPLIANCE FIRING RATE/ MODBUS FIRING RATE

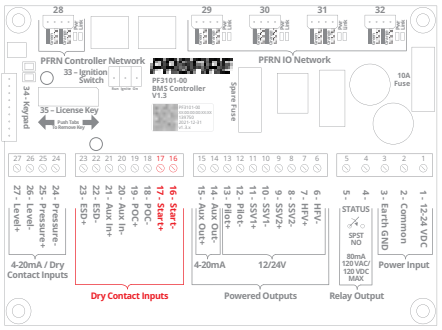
| 4-20 AUX OUT MODE SETTING | FARC ENABLE SETTING | POWER ON | LOCKOUT | ALARM | READY | WAITING | STARTUP CHECKS | REQUEST PURGE POSITION | PROVE AIRFLOW | PRE-PURGE | REQUEST PILOT POSITION | IGNITION | PILOT | REQUEST LIGHT OFF POSITION | LOW FIRE | PROCESS CONTROL - HIGH FIRE | PROCESS CONTROL – PID CONTROL | PROCESS CONTROL - INCINERATE | PROCESS CONTROL - INCINERATE NO ASSIST |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Disabled | Any | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| PID Control | Disabled | Purge Position | | | | | - | - | Purge Position | - | Pilot Position | | | - | Minimum Position | - | Variable position between Minimum and 100% per PID algorithm | | |
| | Enabled | Off Position | | | | | | Purge Position | | | Pilot Position | | | Light Off | | - | | | |
| Appliance Firing Rate | Disabled | Purge Position | | | | | - | - | Purge Position | - | Pilot Position | | | - | | - | Variable position between Minimum and 100% per firing rate input | | |
| | Enabled | Off Position | | | | | | Purge Position | | | Pilot Position | | | Light Off | | - | | | |
| Modbus Firing Rate | Disabled | Purge Position | | | | | - | - | Purge Position | - | Pilot Position | | | - | | - | Variable position between Minimum and 100% per Modbus Firing Rate Holding Register 40162[1] | | |
| | Enabled | Off Position | | | | | | Purge Position | | | Pilot Position | | | Light Off | | - | | | |

[1]*Refer to PF3107-00 Modbus Register Map for Details*

### 5.8.4 AUXILIARY OUTPUT BEHAVIOR BY CONTROLLER STATE – INPUT ECHO

| 4-20 AUX OUT MODE SETTING | AUX OUT BEHAVIOR | EXAMPLE |
|---|---|---|
| Process Temp Echo | Temperature input value is echoed out on the Aux output as a 4-20mA signal mapped against the configured High Temp setpoint. | **Controller Settings > Process Control > Process Temp Control**<br>High Temp SP: 100°<br>4mA output signal corresponds to a reading of 0°<br>20mA output signal corresponds to a reading of 100°<br>A temperature reading of 50°, in this case, is represented as a 12mA Aux output signal. |
| Fuel Pressure Echo | BMS input value is echoes out on the Aux output as an identical 4-20mA signal | An input of 12mA is represented as an identical 12mA Aux output signal. |
| Level/Flow Echo | | |

# 5.9 REMOTE START INPUT




## 5.9.1 DETAILS

| | |
|---|---|
| **TERMINALS** | 16 & 17 |
| **NAME** | Start |
| **TYPE** | Digital Input |

## 5.9.2 INTENDED FIELD DEVICE CONNECTIONS

| FIELD DEVICE | CONFIGURATION REQUIREMENTS | CONNECTION DIAGRAMS |
|---|---|---|
| Remote control panel BMS start switch | N/A | Digital Input – Dry Contact<br>Digital Input – Wet Contact |
| Start Signal from PLC | N/A | Digital Input – Dry Contact<br>Digital Input – Wet Contact |
| Not Used | N/A | N/A - Install wire jumper between terminals 16 and 17 |

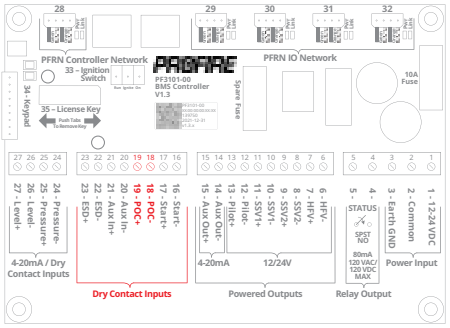
## 5.9.3 SYSTEM BEHAVIOR – REMOTE START INPUT

| SCENARIO | | STATE TRANSITION | CONTROLLER ALERTS |
|---|---|---|---|
| START INPUT STATE | CONTROLLER STATE | | |
| Energized | Any | No effect | N/A |
| De-energized | Any stopped | No effect | Start Contact Open wait |
| | Any running | Waiting | Start Contact Open wait |
| Energized to de-energized to energized within 30 seconds[1] | Lockout | Ready/Alarm[2] | N/A |
| | Ready | Startup | N/A |

*[1]The system does not register an energized to de-energized to energized transition unless the input remains in each state for at least 500ms.*

*[2]The Remote Start Input can be used to acknowledge a lockout message only when the system has performed fewer than 5 remote lockout acknowledgements (i.e., lockout acknowledgements initiated via Modbus or Remote Start Input) within the last 15 minutes. A further attempt to acknowledge a lockout message using the Remote Start Input will be rejected unless it is initiated after the 15-minute window elapses. Lockout messages can always be acknowledged locally using the OK button or the external ignition switch.*

# 5.10 PROOF OF CLOSURE INPUT




## 5.10.1 DETAILS

| | |
|---|---|
| **TERMINALS** | 18 & 19 |
| **NAME** | POC |
| **TYPE** | Digital Input |

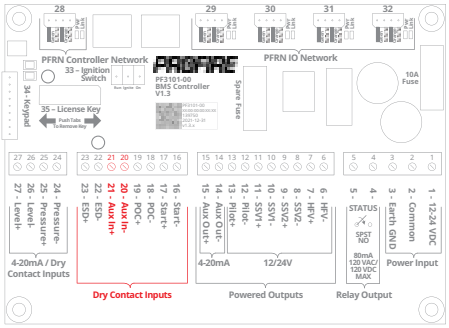
## 5.10.2 INTENDED FIELD DEVICE CONNECTIONS

| FIELD DEVICE | CONFIGURATION REQUIREMENTS | CONNECTION DIAGRAMS |
|---|---|---|
| Main valve (SSV) proof of closure switch | **Controller Settings > Inputs > Proof Of Closure**<br>Proof Of Closure: Enabled | Digital Input – Dry Contact<br>Digital Input – Wet Contact |
| Incinerator assist gas valve (SSV1) proof of closure switch | **Controller Settings > Process Control > Incinerator Control**<br>Incinerator Enable: Enabled<br>Incinerator PoC Valve: Assist<br>**Controller Settings > Inputs > Proof Of Closure**<br>Proof Of Closure: Enabled | Digital Input – Dry Contact<br>Digital Input – Wet Contact |
| Incinerator waste gas valve (SSV2) proof of closure switch | **Controller Settings > Process Control > Incinerator Control**<br>Incinerator Enable: Enabled<br>Incinerator PoC Valve: Waste<br>**Controller Settings > Inputs > Proof Of Closure**<br>Proof Of Closure: Enabled | Digital Input – Dry Contact<br>Digital Input – Wet Contact |
| Not Used | **Controller Settings > Inputs > Proof Of Closure**<br>Proof Of Closure: Disabled | N/A |

## 5.10.3 SYSTEM BEHAVIOR – PROOF OF CLOSURE INPUT

| SCENARIO | | | STATE TRANSITION | CONTROLLER ALERTS |
|---|---|---|---|---|
| SYSTEM CONFIGURATION | CONTROLLER STATE | POC INPUT | | |
| Proof Of Closure: Disabled | Any | Any | No effect | N/A |
| Proof Of Closure: Enabled | Any non-main state | Energized | No effect | N/A |
| | | De-energized | Lockout/Alarm | POC Contact Open alarm |
| Proof Of Closure: Enabled<br>Incinerator Enable: Disabled | Any main fuel state | Energized | No effect | POC Contact Failed to Open warning |
| | | De-energized | No effect | N/A |
| Proof Of Closure: Enabled<br>Incinerator Enable: Enabled<br>Incinerator PoC Valve: Waste | Low Fire | Energized | No effect | N/A |
| | | De-energized | Lockout | POC Contact Open alarm |
| | Incinerate | Energized | No effect | POC Contact Failed to Open warning |
| | | De-energized | No effect | N/A |
| | Incinerator No Assist | Energized | No effect | POC Contact Failed to Open warning |
| | | De-energized | No effect | N/A |
| Proof Of Closure: Enabled<br>Incinerator Enable: Enabled<br>Incinerator PoC Valve: Assist | Low Fire | Energized | No effect | POC Contact Failed to Open warning |
| | | De-energized | No effect | N/A |
| | Incinerate | Energized | No effect | POC Contact Failed to Open warning |
| | | De-energized | No effect | N/A |
| | Incinerate No Assist | Energized | No effect | N/A |
| | | De-energized | Lockout | POC Contact Open alarm |

# 5.11 AUXILIARY INPUT




## 5.11.1 DETAILS

| | |
|---|---|
| **TERMINALS** | 20 & 21 |
| **NAME** | Aux In |
| **TYPE** | Digital Contact |

## 5.11.2 INTENDED FIELD DEVICE CONNECTIONS

| FIELD DEVICE | CONFIGURATION REQUIREMENTS | CONNECTION DIAGRAMS |
|---|---|---|
| High Fire Valve (HFV) proof of closure switch | **Controller Settings > Inputs > Aux In Contact**<br>Aux In Contact Mode: Proof of Closure HF | Digital Input – Dry Contact<br>Digital Input – Wet Contact |
| Proof of low fire position switch on a main fuel temperature control valve | **Controller Settings > Inputs > Aux In Contact**<br>Aux In Contact Mode: Proof of Low Fire | Digital Input – Dry Contact<br>Digital Input – Wet Contact |
| Main valve (SSV) proof of closure switch | **Controller Settings > Inputs > Aux In Contact**<br>Aux In Contact Mode: Proof of Closure 2<br>**Controller Settings > Process Control > Incinerator Control**<br>Incinerator Enable: Disabled | Digital Input – Dry Contact<br>Digital Input – Wet Contact |
| Incinerator waste gas valve (SSV2) proof of closure switch | **Controller Settings > Inputs > Aux In Contact**<br>Aux In Contact Mode: Proof of Closure 2<br>**Controller Settings > Process Control > Incinerator Control**<br>Incinerator Enable: Enabled | Digital Input – Dry Contact<br>Digital Input – Wet Contact |
| Pilot valve proof of closure switch | **Controller Settings > Inputs > Aux In Contact**<br>Aux In Contact Mode: Proof of Pilot | Digital Input – Dry Contact<br>Digital Input – Wet Contact |
| Low fuel pressure switch | **Controller Settings > Inputs > Aux In Contact**<br>Aux In Contact Mode: Low Fuel Pressure<br>Main Permissive Masking: As desired<br>**Controller Settings > Inputs > Fuel Pressure Input**<br>Low Fuel Pressure Restart: As desired<br>Restart Mode: As desired | Digital Input – Dry Contact<br>Digital Input – Wet Contact |
| Proof of airflow switch | **Controller Settings > Inputs > Aux In Contact**<br>Aux In Contact Mode: Proof of Airflow<br>**Controller Settings > Outputs > Valves**<br>HFV Output Mode: Forced Draft or Purge Fan<br>**FARC/$O_2$ Trim Wizard**<br>Configured as required by a fuel-air ratio control expert | Digital Input – Dry Contact<br>Digital Input – Wet Contact |
| Main permissive switch | **Controller Settings > Inputs > Aux In Contact**<br>Aux In Contact Mode: Main Permissive<br>Main Permissive Masking: As desired | Digital Input – Dry Contact<br>Digital Input – Wet Contact |

### 5.11.3 SYSTEM BEHAVIOR – PROOF OF CLOSURE HF

| SCENARIO | | STATE TRANSITION | CONTROLLER ALERTS |
|---|---|---|---|
| CONTROLLER STATE | AUX INPUT STATE | | |
| Pilot or Incinerate No Assist | Energized | No effect | N/A |
| | De-energized | Lockout | POC HF Contact Open |
| Any other state | Any | No effect | N/A |

### 5.11.4 SYSTEM BEHAVIOR – AUX IN PROOF OF CLOSURE 2

| SCENARIO | | | STATE TRANSITION | CONTROLLER ALERTS |
|---|---|---|---|---|
| INCINERATOR ENABLE | CONTROLLER STATE | AUX INPUT STATE | | |
| Any | Any non-main state | Energized | No effect | N/A |
| | | De-energized | Lockout/Alarm | POC2 Contact Open alarm |
| Disabled | Any main fuel state | Energized | No effect | POC2 Contact Failed to Open warning |
| | | De-energized | No effect | N/A |
| Enabled | Low Fire | Energized | No effect | N/A |
| | | De-energized | Lockout | POC2 Contact Open alarm |
| | Incinerate | Energized | No effect | POC2 Contact Failed to Open warning |
| | | De-energized | No effect | N/A |
| | Incinerator No Assist | Energized | No effect | POC2 Contact Failed to Open warning |
| | | De-energized | No effect | N/A |

### 5.11.5 SYSTEM BEHAVIOR – AUX IN PROOF OF PILOT

| SCENARIO | | | STATE TRANSITION | CONTROLLER ALERTS |
|---|---|---|---|---|
| PILOT OFF MODE SETTING | CONTROLLER STATE | AUX INPUT STATE | | |
| Off at setpoint or Follow Main | Any non-fuel state | Energized | No effect | N/A |
| | | De-energized | Lockout/Alarm | POP Contact Open alarm |
| | Any fuel state | Energized | No effect | POP Contact Failed to Open warning |
| | | De-energized | No effect | N/A |
| Off after main on | Any non-fuel state | Energized | No effect | N/A |
| | | De-energized | Lockout/Alarm | POP Contact Open alarm |
| | Pilot | Energized | No effect | POP Contact Failed to Open warning |
| | | De-energized | No effect | N/A |
| | Any main fuel state | Energized | No effect | N/A |
| | | De-energized | Lockout | POP Contact Open Alarm |

### 5.11.6 SYSTEM BEHAVIOR – AUX IN LOW FUEL PRESSURE

| SCENARIO | | | STATE TRANSITION | CONTROLLER ALERTS |
|---|---|---|---|---|
| SETTINGS CONFIGURATION | CONTROLLER STATE | AUX INPUT STATE | | |
| Any | Any | Energized | No effect | N/A |
| Low Fuel Pressure Restart: Disabled | Any | De-energized | Lockout/Alarm | Low Fuel Pressure Dry Contact alarm |
| Low Fuel Pressure Restart: Enabled<br>Restart Mode: Wait | Any stopped state | De-energized | No effect | Low Fuel Pressure Dry Contact wait [1] |
| | Any running state | De-energized | Waiting [1] | Low Fuel Pressure Dry Contact wait [1] |
| Low Fuel Pressure Restart: Enabled<br>Restart Mode: Main Permissive | Any non-main state | De-energized | No effect | Aux In Low Fuel Pressure main permissive |
| | Any main fuel state | De-energized | Pilot [2] | Aux In Low Fuel Pressure main permissive |

*[1] When Main Permissive Masking is Enabled and there is a main permissive alert present on the controller, the pressure wait is hidden and the controller remains in its current state.*
*[2] When Pilot Off mode is set to Off After Main On, the controller transitions to the Waiting state, then purges the system before reigniting and proceeding to Pilot.*

### 5.11.7 SYSTEM BEHAVIOR – BMS CARD AUX IN PROOF OF AIRFLOW

| SCENARIO | | | STATE TRANSITION | CONTROLLER ALERTS |
|---|---|---|---|---|
| HFV OUTPUT MODE SETTING | CONTROLLER STATE | AUX INPUT STATE | | |
| Any | Startup Checks | Energized | Lockout | Airflow Input Stuck |
| | | De-energized | Proven Pre-Purge | N/A |
| | Proven Pre Purge | Energized | No effect | N/A |
| | | De-energized | Lockout | Failed to Prove Airflow While Purging |
| Forced Draft Fan | Any fuel state | Energized | No effect | N/A |
| | | De-energized | Lockout | Failed to Prove Airflow While Running |
| Purge Fan | Any fuel state | Any | No effect | N/A |

### 5.11.8 SYSTEM BEHAVIOR – AUX IN MAIN PERMISSIVE

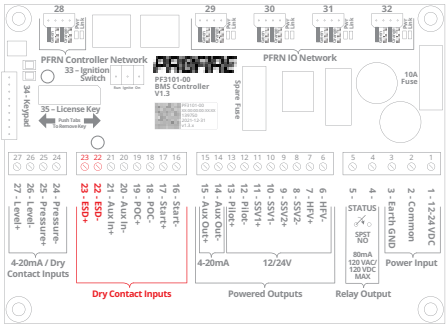
| SCENARIO | | | STATE TRANSITION | CONTROLLER ALERTS |
|---|---|---|---|---|
| SETTINGS CONFIGURATION | CONTROLLER STATE | AUX INPUT STATE | | |
| Aux In Contact Mode: Main Permissive | Any non-main state | Energized | No effect | N/A |
| | | De-energized | No effect | Aux In Contact Open main permissive |
| | Any main fuel state | Energized | No effect | N/A |
| | | De-energized | Pilot [1] | Aux In Contact Open main permissive |

*[1] When Pilot Off mode is set to Off After Main On, the controller transitions to the Waiting state, then purges the system before reigniting and proceeding to Pilot.*

### 5.11.9 SYSTEM BEHAVIOR – AUX IN PROOF OF LIGHT OFF

| SCENARIO | | STATE TRANSITION | CONTROLLER ALERTS |
|---|---|---|---|
| CONTROLLER STATE | AUX INPUT STATE | | |
| Pilot State | Energized | No effect | N/A |
| | De-energized | No effect | POLO Contact Open main permissive |
| Any other state | Any | No effect | N/A |

# 5.12 EMERGENCY SHUTDOWN INPUT




## 5.12.1 DETAILS

| | |
|---|---|
| **TERMINALS** | 22 & 23 |
| **NAME** | ESD |
| **TYPE** | Digital Input |

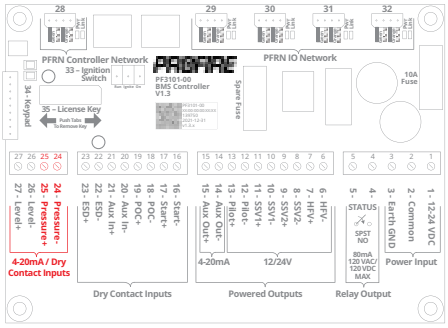
## 5.12.2 INTENDED FIELD DEVICE CONNECTIONS

| FIELD DEVICE | CONFIGURATION REQUIREMENTS | CONNECTION DIAGRAMS |
|---|---|---|
| External emergency stop pushbutton | N/A | Digital Input – Dry Contact<br>Digital Input – Wet Contact |
| Shutdown signal from PLC | N/A | |
| Plant ESD Loop | N/A | |

## 5.12.3 SYSTEM BEHAVIOR – EMERGENCY SHUTDOWN INPUT

| SCENARIO | | STATE TRANSITION | CONTROLLER ALERTS |
|---|---|---|---|
| ESD INPUT STATE | CONTROLLER STATE | | |
| De-energized | Any running | Lockout | ESD Contact Open alarm |
| | Any stopped | Alarm | ESD Contact Open alarm |
| Energized | Any | No effect | N/A |

# 5.13 FUEL PRESSURE INPUT




## 5.13.1 DETAILS

| | |
|---|---|
| **TERMINALS** | 24 & 25 |
| **NAME** | Pressure |
| **TYPE** | Configurable digital or 4-20mA input |

## 5.13.2 INTENDED FIELD DEVICE CONNECTIONS

| FIELD DEVICE | CONFIGURATION REQUIREMENTS | CONNECTION DIAGRAMS |
|---|---|---|
| Low and high-pressure switch in series. | **Controller Settings > Inputs > Fuel Pressure Input**<br>Fuel Pressure Input Mode: Dry Contact<br>All other settings: Ignored | Combined Low/High Pressure Switch |
| High-pressure switch | **Controller Settings > Inputs > Fuel Pressure Input**<br>Fuel Pressure Input Mode: Dry Contact High Press.<br>All other settings: Ignored | Digital Input – Dry Contact<br>Digital Input – Wet Contact |
| Low-pressure switch | **Controller Settings > Inputs > Fuel Pressure Input**<br>Fuel Pressure Input Mode: Dry Contact<br>Low Fuel Pressure Restart: Ignored *<br>Restart Mode: Ignored *<br>* Use the Auxiliary Input to connect a low fuel pressure switch if Low Fuel Pressure Restart functionality is required. | Digital Input – Dry Contact<br>Digital Input – Wet Contact |
| 4-20mA pressure transmitter | **Controller Settings > Inputs > Fuel Pressure Input**<br>Fuel Pressure Input Mode: 4-20 Input<br>All other settings: As desired<br>**Controller Settings > Inputs > Aux In Contact**<br>Main Permissive Masking: As desired<br>**UI Config Tab > Settings > UI Settings**<br>Pressure Units: As desired | Loop Powered Transmitter<br>Self Powered Transmitter |
| Not used | **Controller Settings > Inputs > Fuel Pressure Input**<br>Fuel Pressure Input Mode: Disabled<br>All other settings: Ignored | N/A |

### 5.13.3 SYSTEM BEHAVIOR – PRESSURE INPUT IN DRY CONTACT MODE

| SCENARIO | | | STATE TRANSITION | CONTROLLER ALERTS |
|---|---|---|---|---|
| CONFIGURATION DETAILS | CONTROLLER STATE | PRESSURE INPUT | | |
| Any | Any | Energized | No effect | N/A |
| | | De-energized | Lockout/Alarm | Fuel Pressure Contact Open alarm |

### 5.13.4 SYSTEM BEHAVIOR – PRESSURE INPUT IN 4-20 MODE

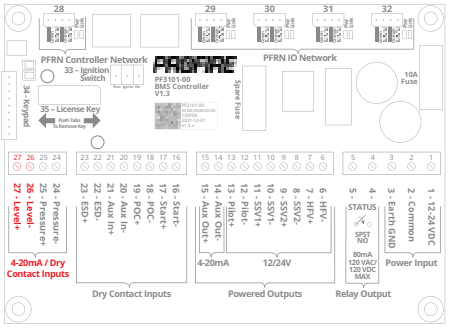
| SCENARIO | | | STATE TRANSITION | CONTROLLER ALERTS |
|---|---|---|---|---|
| CONFIGURATION DETAILS | CONTROLLER STATE | PRESSURE INPUT | | |
| Low Pressure Restart: Any<br>Restart Mode: Any | Any | Out of Range | Lockout/Alarm | Pressure Input Range Error alarm |
| | Any non-main state | High Trip | No effect | High Fuel Pressure warning |
| | Any main fuel state | High Trip | Lockout | High Fuel Pressure After Main On |
| Low Pressure Restart: Disabled<br>Restart Mode: Any | Any | Low Trip | Lockout/Alarm | Low Fuel Pressure |
| Low Pressure Restart: Enabled<br>Restart Mode: Wait | Any stopped | Low Trip | No effect | Low Fuel Pressure Wait [1] |
| | Any running | Low Trip | Waiting | Low Fuel Pressure Wait [1] |
| Low Pressure Restart: Enabled<br>Restart Mode: Main Permissive | Any non-main state | Low Trip | No effect | Low Fuel Pressure main permissive |
| | Any main fuel state | Low Trip | Pilot [2] | Low Fuel Pressure main permissive |

*[1] When Main Permissive Masking setting is Enabled and there is a main permissive alert present on the controller, the pressure wait is hidden and the controller remains in its current state.*
*[2] When Pilot Off mode is set to Off After Main On, the controller transitions to the Waiting state, then purges the system before reigniting and proceeding to Pilot.*

### 5.13.3 SYSTEM BEHAVIOR – PRESSURE INPUT IN DRY CONTACT HIGH PRESSURE MODE

| SCENARIO | | | STATE TRANSITION | CONTROLLER ALERTS |
|---|---|---|---|---|
| CONFIGURATION DETAILS | CONTROLLER STATE | PRESSURE INPUT | | |
| Any | Any | Energized | No effect | N/A |
| | Any non-main state | De-energized | No effect | High Fuel Pressure warning |
| | Any main fuel state | De-energized | Lockout | High Fuel Pressure After Main On |

# 5.14 LEVEL/FLOW INPUT




## 5.14.1 DETAILS

| | |
|---|---|
| **TERMINALS** | 26 & 27 |
| **NAME** | Level/Flow |
| **TYPE** | Configurable digital or 4-20mA input |

## 5.14.2 INTENDED FIELD DEVICE CONNECTIONS

| FIELD DEVICE | CONFIGURATION REQUIREMENTS | CONNECTION DIAGRAMS |
|---|---|---|
| 4-20mA level or flow transmitter | **Controller Settings > Inputs > Level/Flow Input**<br>Level/Flow Input Mode: 4-20 Input<br>Local Level/Flow Input: Enabled<br>All other settings: As desired<br>**Controller Settings > Inputs > Aux In Contact**<br>Main Permissive Masking: As desired<br>**System Settings > UI Settings**<br>Volume Units: As desired | Loop Powered Transmitter<br>Self Powered Transmitter |
| Digital level or flow switch | **Controller Settings > Inputs > Level/Flow Input**<br>Level/Flow Input Mode: Dry Contact<br>Local Level/Flow Input: Enabled<br>Low Level/Flow Restart*: As desired<br>Low Level/Flow Delay*: As desired<br>All other settings: Ignored<br>**Controller Settings > Inputs > Aux In Contact**<br>Main Permissive Masking: As desired<br>* Low Level/Flow Restart and Low Level/Flow Delay settings apply whether connected to a low switch or a high switch. | Digital Input – Dry Contact<br>Digital Input – Wet Contact |
| Level Sharing – Appliance level/flow device wired to another controller in the appliance | **Controller Settings > Inputs > Level/Flow Input**<br>Level/Flow Input Mode: Same for all controllers<br>Local Level/Flow Input: Disabled<br>All other settings: As desired | N/A – There should be nothing connected to the Level/Flow input of this controller. |
| Not used | **Controller Settings > Inputs > Level/Flow Input**<br>Level/Flow Input Mode: Disabled | N/A |

### 5.14.3 SYSTEM BEHAVIOR – LEVEL/FLOW INPUT

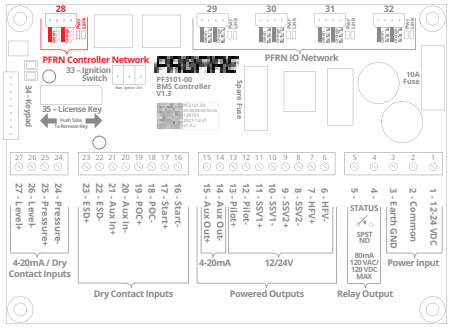
| SCENARIO | | | STATE TRANSITION | CONTROLLER ALERTS |
|---|---|---|---|---|
| CONFIGURATION DETAILS | CONTROLLER STATE | INPUT STATE | | |
| Input Mode: Dry Contact<br>Level/Flow Restart: Disabled | Any | Energized [1] | No effect | N/A |
| | | De-energized [2] | Lockout/Alarm | Level/Flow Contact Open alarm |
| Input Mode: Dry Contact<br>Level/Flow Restart: Enabled | Any | Energized [1] | No effect | N/A |
| | Any stopped state | De-energized [2] | No effect | Level/Flow Contact Open wait [5] |
| | Any running state | De-energized [2] | Waiting [5] | Level/Flow Contact Open wait [5] |
| Input Mode: 4-20 Input<br>Level/Flow Restart: Any | Any | Out of Range [3] | Lockout/Alarm | Level/Flow Range Error alarm |
| | | High Trip [4] | No effect | High Level/Flow warning |
| Input Mode: 4-20 Input<br>Level/Flow Restart: Disabled | Any | Low Trip [4] | Lockout/Alarm | Low Level/Flow alarm |
| Input Mode: 4-20 Input<br>Level/Flow Restart: Enabled | Any stopped state | Low Trip [4] | No effect | Low Level/Flow wait [5] |
| | Any running state | Low Trip [4] | Waiting [5] | Low Level/Flow wait [5] |

*[1] The appliance Level/Flow input is energized when the first communicating Local Level/Flow input is energized.*
*[2] The appliance Level/Flow input is de-energized when the first communicating Local Level/Flow input is de-energized.*
*[3] The appliance Level/Flow input is out of range when all Local Level/Flow inputs are out of range.*
*[4] The appliance Level/Flow input is tripped when the first communicating Local Level/Flow input is tripped.*
*[5] When Main Permissive Masking setting is Enabled and there is a main permissive alert present on the controller, the level wait is hidden and the controller remains in its current state.*

THE FOLLOWING IS FOR APPLICATIONS THAT HAVE MULTIPLE LEVEL/FLOW DEVICES MONITORING A SINGLE LEVEL/FLOW INPUT (I.E., LEVEL/FLOW SHARING):

**WARNING:**
LEVEL/FLOW INPUT REDUNDANCY IS SUPPORTED FOR HARDWARE REDUNDANCY ONLY (I.E., THE SYSTEM CONTINUES TO RUN IF A LEVEL/FLOW INPUT LOSES COMMUNICATION WITH THE APPLIANCE OR GOES OUT OF RANGE, BUT THE LEVEL/FLOW INPUT STATE IS DETERMINED BY A SINGLE INPUT ONLY). THE INPUT STATE OF THE LEVEL/FLOW INPUT IS DETERMINED BY THE FIRST LOCAL LEVEL/FLOW INPUT TO ESTABLISH COMMUNICATION WITH THE APPLIANCE ONLY.

# 5.15 PFRN CONTROLLER NETWORK




## 5.15.1 DETAILS

| | |
|---|---|
| **TERMINAL** | 28 only |
| **NAME** | PFRN Controller Network |
| **PFRN CLASS** | Interface - Controller |
| **TYPE** | Power producing PFRN port |
| **CONNECTOR TYPE** | PF3100 PFRN Connector |

## 5.15.2 INTENDED FIELD DEVICE CONNECTIONS

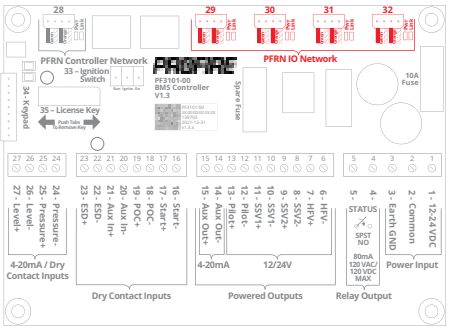
| FIELD DEVICE | CONFIGURATION REQUIREMENTS | CONNECTION DIAGRAMS |
|---|---|---|
| PF3100-00 UI card | Appliance Wizard<br>Follow on-screen instructions to configure appliance | PFRN Connector Wiring<br>UI PFRN Connection Options |
| PF3107-00 Modbus card | | |
| PF3106-00 Network card | | |

## 5.15.3 SYSTEM BEHAVIOR – DIAGNOSTIC LEDS

| NAME | COLOR | LED BEHAVIOR | INTERPRETATION | ISSUE/CORRECTIVE ACTION |
|---|---|---|---|---|
| Pwr[1] | Blue | Off | Port has no power | No BMS Power – Check all PFRN wire terminations and make sure BMS Controller card is powered on. Hardware fault - Contact Profire for replacement card |
| | | On – Solid | Port has power | N/A |
| | | On – Flickering | Port has intermittent power | Hardware fault - Contact Profire for replacement card |
| Link[1] | Green | Off | Port is not communicating | No PFRN Communication – Cycle power to BMS controller card and check PFRN wire terminations at BMS and UI connector. |
| | | On – Solid | Port is communicating normally | N/A |
| | | On – Flickering | Port is communicating normally | N/A |

*[1] The Pwr and Link LED labels are incorrectly swapped on v1.3.x BMS Controller cards; the LED labelled "Pwr" is actually the "Link" LED and vice versa.*

# 5.16 PFRN I/O NETWORK




## 5.16.1 DETAILS

| | |
|---|---|
| **TERMINALS** | 29, 30, 31 & 32 |
| **NAME** | PFRN IO Network |
| **PFRN CLASS** | Controller - IO |
| **TYPE** | Power producing PFRN ports |
| **CONNECTOR TYPE** | PF3100 PFRN Connector |

## 5.16.2 INTENDED FIELD DEVICE CONNECTIONS

| FIELD DEVICE | CONFIGURATION REQUIREMENTS | CONNECTION DIAGRAMS |
|---|---|---|
| PF3102-00 Ion Pilot card | **Pilot Wizard**<br>Follow on-screen instructions | PFRN Connector Wiring<br>I/O Card PFRN Wiring Options |
| PF3102-01 UV Pilot card | **Controller Settings > Setup > Other**<br>Comm Loss Restart: As desired | |
| PF3103-00 Temperature card | **Temperature Wizard** - Follow on-screen instructions | |
| PF3113-00 I/O Expansion card | **I/O Wizard** - Follow on-screen instructions | |
| Any card above via PF3106-00 Network card | As above | |

## 5.16.3 SYSTEM BEHAVIOR – DIAGNOSTIC LEDS

| NAME | COLOR | LED BEHAVIOR | INTERPRETATION | ISSUE/CORRECTIVE ACTION |
|---|---|---|---|---|
| Pwr[1] | Blue | Off | Port has no power | No BMS Power – Check all PFRN wire terminations and make sure BMS Controller card is powered on. Hardware fault - Contact Profire for replacement card |
| | | On – Solid | Port has power | N/A |
| | | On – Flickering | Port has intermittent power | Hardware fault - Contact Profire for replacement card |
| Link[1] | Green | Off | Port is not communicating | No PFRN Communication – Cycle power to BMS controller card and check PFRN wire terminations at BMS and UI connector. |
| | | On – Solid | Port is communicating normally | N/A |
| | | On – Flickering | | |

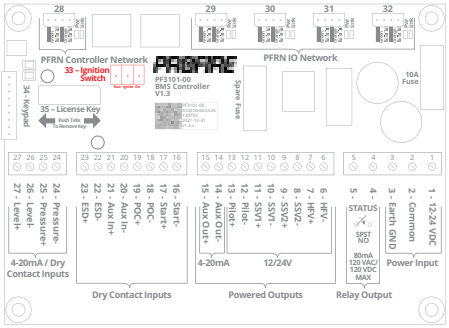
[1] *The Pwr and Link LED labels are incorrectly swapped on v1.3.x BMS Controller cards; the LED labelled "Pwr" is actually the "Link" LED and vice versa.*

### 5.16.4 SYSTEM BEHAVIOR – LOST COMMUNICATIONS

| SCENARIO | | | STATE TRANSITION | CONTROLLER ALERTS |
|---|---|---|---|---|
| **BMS LOST COMMUNICATIONS WITH:** | **COMM LOSS RESTART SETTING** | **CONTROLLER STATE** | | |
| PF3102-00 Ion Pilot card(s) or PF3102-01 UV Pilot card(s) When Minimum Pilots Running setting is satisfied | Any | Any | No effect | Pilot Module Comm warning |
| PF3102-00 Ion Pilot card(s) or PF3102-01 UV Pilot card(s) When Minimum Pilots Running setting is not satisfied | Disabled | Any | Lockout/ Alarm | Pilot Module Comm Error alarm |
| | Enabled | Any stopped | No effect | Pilot Module Comm warning<br>Loss of Communications wait *<br>* The wait turns into an alarm after 5 minutes |
| | | Any running | Waiting | |
| PF3103-00 Temperature card<br>See note 2 for behavior with redundant inputs | Any | Any | Lockout/ Alarm | No Valid Primary Process Temp alarm |
| PF3113-00 IO Expansion card with Main Permissive input<br>See note 2 for behavior with redundant inputs | Any | Any non-main | No effect | IO Expansion Input Invalid main permissive |
| | Any | Any main state | Pilot [1] | |
| PF3113-00 with Wait input<br>See note 2 for behavior with redundant inputs | Any | Any stopped | No effect | IO Expansion Input Invalid wait |
| | Any | Any running | Waiting | |
| PF3113-00 with Alarm input<br>See note 2 for behavior with redundant inputs | Any | Any | Lockout/ Alarm | IO Expansion Input Invalid alarm |
| PF3113-00 with Warning input<br>See note 2 for behavior with redundant inputs | Any | Any | No effect | IO Expansion Input Invalid warning |
| PF3113-00 with Display input | Any | Any | No effect | N/A |

*[1] When Pilot Off mode is set to Off After Main On, the controller transitions to the Waiting state, then purges the system before reigniting and proceeding to Pilot.*
*[2] The system acts on a communication loss event only when all redundant inputs lose communication with the BMS controller (e.g., A running system with three thermocouple devices measuring a single temperature input continues to run if one or two of the thermocouple inputs lose communication with the BMS controller).*

# 5.17 EXTERNAL IGNITION SWITCH INPUT




## 5.17.1 DETAILS

| | |
|---|---|
| **TERMINALS** | 33 (Run, Ignite, On) |
| **NAME** | Ignition Switch |
| **TYPE** | Digital Input |

## 5.17.2 INTENDED FIELD DEVICE CONNECTIONS

| FIELD DEVICE | CONFIGURATION REQUIREMENTS | CONNECTION DIAGRAMS |
|---|---|---|
| Profire PF3100 Ignition Switch | **Controller Settings > Setup > Other**<br>BMS User Interface: Enabled | N/A – Connect Profire-supplied Ignition Switch only to BMS Controller card Ignition Switch terminals. |
| Not used | **Controller Settings > Setup > Other**<br>BMS User Interface: Disabled | N/A |

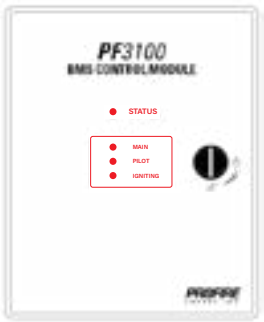
## 5.17.3 SYSTEM BEHAVIOR – EXTERNAL IGNITION SWITCH

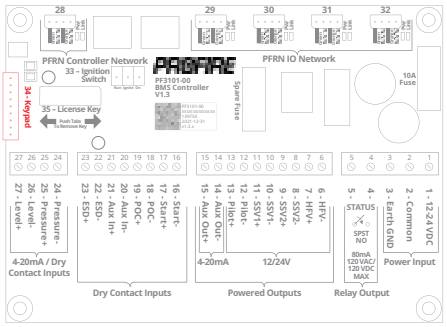
| SCENARIO | | | STATE TRANSITION | CONTROLLER ALERTS |
|---|---|---|---|---|
| BMS USER INTERFACE SETTING | SWITCH STATE | CONTROLLER STATE | | |
| Disabled | Any | Any | No effect | N/A |
| Enabled | Stop | Any | Lockout/Alarm | Stopped via External Switch alarm |
| | Run | Any | No effect | N/A |
| | Ignite for less than 1s | Any | No effect | N/A |
| | Ignite for more than 1s and less than 10s | Ready | Startup | N/A |
| | | Any state other than Ready | No effect | N/A |
| | Ignite for more than 10s | Any | Lockout/Alarm | External Switch Stuck alarm |
| | Run to Stop to Run | Lockout | Ready/Alarm | Any alert conditions that persist after the lockout is acknowledged are displayed. |

## 5.18 BMS FRONT PANEL LED OUTPUT

### 5.18.1 DETAILS

| | |
|---|---|
| **TERMINAL** | 34 |
| **NAME** | Keypad |
| **ALTERNATE NAME** | LED Board |
| **TYPE** | Digital Output |




### 5.18.2 INTENDED FIELD DEVICE CONNECTIONS

| FIELD DEVICE | CONFIGURATION REQUIREMENTS | CONNECTION DIAGRAMS |
|---|---|---|
| Profire LED display board | **Controller Settings > Setup > Other**<br>BMS User Interface: Enabled | N/A – Connect Profire-supplied Ignition Switch only to BMS Controller card Ignition Switch terminals. |
| Not used | **Controller Settings > Setup > Other**<br>BMS User Interface: Disabled | N/A |

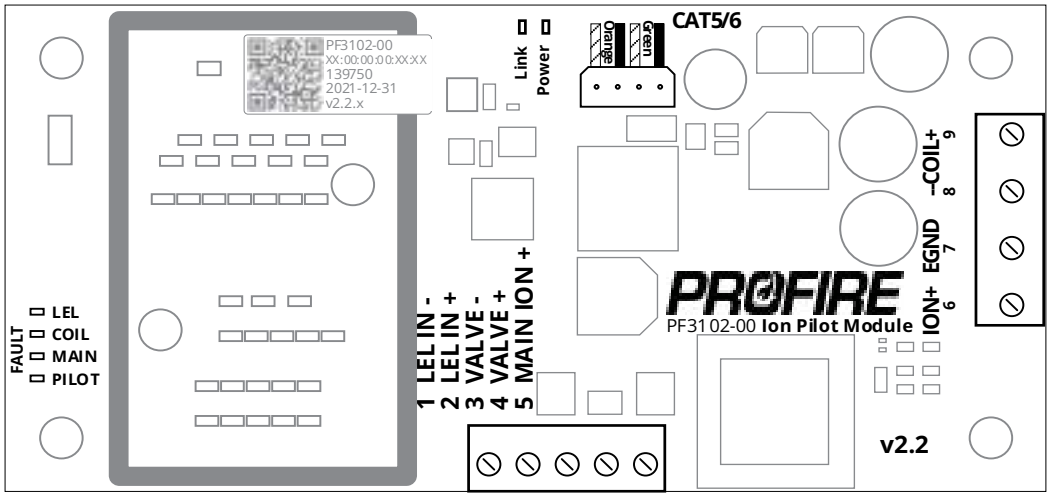
### 5.18.3 SYSTEM BEHAVIOR - BMS ENCLOSURE LEDS

| SCENARIO | | | INDICATION |
|---|---|---|---|
| **LED NAME** | **LED COLOR** | **LED BEHAVIOR** | |
| Status | Red | Solid | Controller stopped – in Ready state |
| | | Slow flashing | Controller stopped – alarm present |
| | | Fast flashing | Controller stopped – in Lockout state |
| | Amber | Solid | Controller running – warnings present |
| | | Slow flashing | Controller running – waits and warnings present |
| | Green | Solid | Controller running – no waits or warnings present |
| | | Slow flashing | Controller running – waits present |
| Main | Blue | On | SSV valve outputs energized |
| | | Off | SSV valve outputs de-energized |
| Pilot | Blue | On | Pilot valve output energized |
| | | Off | Pilot valve output de-energized |
| Igniting | Blue | On | Ignition coil output(s) energized |
| | | Off | Ignition coil output(s) de-energized |

# 6 PF3102-00 ION PILOT CARD

The Ion Pilot card is an I/O card designed to connect to a BMS controller card to facilitate the following:

1. Pilot flame ignition for a single pilot flame.
2. Ionization flame detection or thermocouple flame detection for a single pilot flame.
3. Ionization flame detection for a main flame.



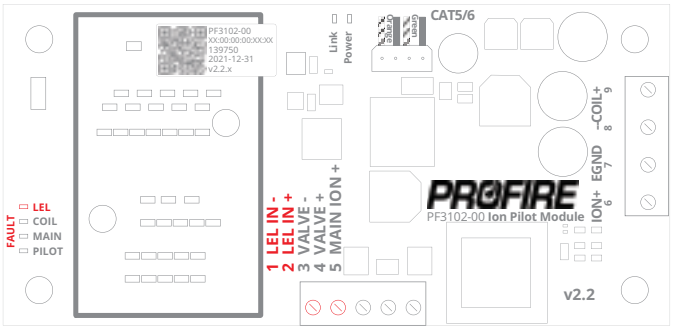

## 6.1 TERMINAL RATINGS

| NAME | SAFETY RATED | TERMINAL | | INPUT/ OUTPUT | ELECTRICAL RATINGS |
|---|---|---|---|---|---|
| PFRN I/O Network | Yes | - | CAT5/6 | I/O | 36 $V_{DC}$, 1A maximum |
| Ion Aux Input | Yes | 1 | LEL IN - | I | 18$V_{DC}$ max, 25mA maximum |
| | | 2 | LEL IN + | O | 12$V_{DC}$, 50mA maximum |
| Pilot Output | Yes | 3 | VALVE - | O | 0-12$V_{DC}$<br>2A maximum<br>Pulsed Output with configurable PWM<br>Expected Load: Inductive/Resistive |
| | | 4 | VALVE + | | |
| Main Flame Detection | Yes | 5 | MAIN ION + | I/O | 65 $V_{rms}$ output<br>20kΩ source impedance |
| Pilot Flame Detection | Yes | 6 | ION - | I/O | 65 $V_{rms}$ output<br>20kΩ source impedance |
| | | 7 | ION + | | |
| Earth Ground | | 8 | EGND | | |
| Coil Output | Yes | 9 | COIL - | O | 14$V_{DC}$ pulsed output<br>2A Peak, ~100m$A_{rms}$ while sparking |
| | | 10 | COIL + | | |

## 6.2 ION AUXILIARY INPUT

### 6.2.1 DETAILS

| | |
|---|---|
| **TERMINALS** | 1 & 2 |
| **NAME** | Ion Aux In |
| **ALTERNATE NAME** | LEL |
| **TYPE** | 4-20mA analog input |




### 6.2.2 INTENDED FIELD DEVICE CONNECTIONS

| FIELD DEVICE | CONFIGURATION REQUIREMENTS | CONNECTION DIAGRAMS |
|---|---|---|
| Digital input switch | **Pilot Wizard > Allocate Pilot Tab**<br>Ion Aux In Type: Dry Contact<br>Enabled/Disabled: Enabled<br>**Controller Settings > Inputs > Ion Aux In**<br>Ion Aux Input Mode: High Trip Alarm<br>All other settings: Ignored | Digital Input – Dry Contact<br>Digital Input – Wet Contact |
| 4-20mA transmitter for high trip shutdown | **Pilot Wizard > Allocate Pilot Tab**<br>Ion Aux In Type: 4-20 Input<br>Enabled/Disabled: Enabled<br>**Controller Settings > Inputs > Ion Aux In**<br>Ion Aux Input Mode: High Trip Alarm<br>All other settings: As Desired | Loop Powered Transmitter<br>Self Powered Transmitter |
| 4-20mA temperature transmitter for flame detection<br>* All connected Ion Pilot Modules must be configured for TC flame detection (i.e., Ionization detection and thermocouple detection cannot be used at the same time for a single appliance). | **Pilot Wizard > Allocate Pilot Tab**<br>Ion Aux In Type: 4-20 Input<br>Enabled/Disabled: Enabled<br>**Controller Settings > Inputs > Ion Aux In**<br>Ion Aux Input Mode: TC Flame Detect<br>All other settings: As Desired | TC Flame Detection |
| Not used | **Pilot Wizard**<br>Ion Aux In Type: Disabled | N/A |

### 6.2.3 SYSTEM BEHAVIOR – ION AUX INPUT

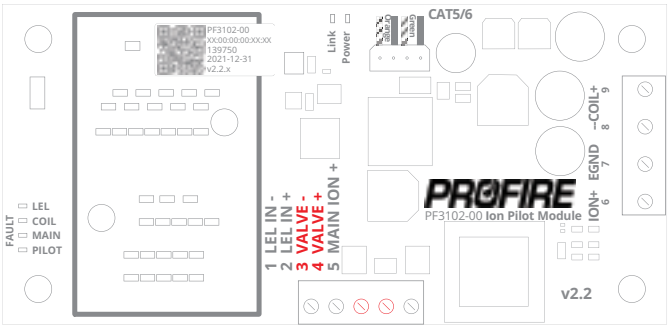
| SCENARIO | | | PILOT FLAME | LEL FAULT LED | STATE TRANSITION | CONTROLLER ALERTS |
|---|---|---|---|---|---|---|
| ION AUX INPUT MODE | ION AUX INPUT SIGNAL | CONTROLLER STATE | | | | |
| High Trip Alarm - Digital | Energized | Any | N/A | Off | No effect | N/A |
| | De-energized | Any | N/A | Off | Lockout/Alarm | Ion Aux In Tripped alarm |
| High Trip Alarm – 4-20 | Out of Range | Any | N/A | On | Lockout/Alarm | Ion Aux In Contact Range Error alarm |
| | At or above Trip Point | Any | N/A | Off | Lockout/Alarm | Ion Aux In Tripped alarm |
| | Below Trip Point[1] | Any | N/A | Off | No effect | N/A[1] |
| TC Flame Detect | Out of Range | Any | N/A | On | Lockout/Alarm | Ion Aux In Contact Range Error alarm |
| | At or above Trip Point | Any | Detected | Off | Refer to Operating Sequence section for behavior | |
| | Below Trip Point | Any | Not detected | Off | | |

*[1] When returning from a high trip event, the controller does not consider the trip event to be cleared until the signal drops below the configured Ion Aux In Trip Point minus the configured Ion Aux In Deadband.*

## 6.3 ION PILOT VALVE OUTPUT

### 6.3.1 DETAILS

| | |
|---|---|
| **TERMINALS** | 3 & 4 |
| **NAME** | Valve |
| **TYPE** | 12V Powered solenoid output with configurable PWM |




### 6.3.2 INTENDED FIELD DEVICE CONNECTIONS

| FIELD DEVICE | CONFIGURATION REQUIREMENTS | CONNECTION DIAGRAMS |
|---|---|---|
| 12V normally closed gas shutoff valve – Peak and hold | **Pilot Wizard > Allocate Pilot Tab**<br>Enabled/Disabled: Enabled<br>**Pilot Wizard > Ignition Settings Tab**<br>Minimum Pilots Running: As required per appliance safety specifications<br>Pilot Relight Mode: As desired<br>**Controller Settings > Outputs > Valves**<br>Pilot Valve PWM: As desired<br>**Controller Settings > Process Control > Process Temp Control**<br>Pilot Off Mode: As desired<br>**Controller Settings > Inputs > Flame Detection**<br>Main Flame Detect: As desired per Pilot off Mode | Solenoid Output |
| 12V normally closed gas shutoff valve – Constant current | **Same as above except:**<br>**Controller Settings > Outputs > Valves**<br>Pilot Valve PWM: 100% | Solenoid Output |
| 24V normally closed gas shutoff valve | Not Supported - Connect to the BMS card Pilot Solenoid Output rather than the Ion Pilot card Valve output. | |

### 6.3.3 ION PILOT VALVE OUTPUT BEHAVIOR BY CONTROLLER STATE

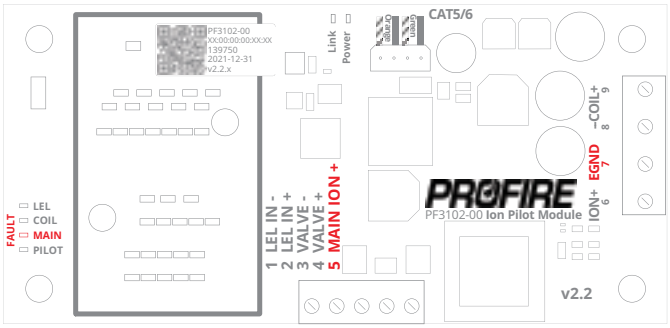
| PILOT OFF MODE SETTING | POWER ON | LOCKOUT | ALARM | READY | WAITING | STARTUP CHECKS | PROVEN PRE-PURGE | IGNITION | PILOT | LOW FIRE | PROCESS CONTROL |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Disabled<br>Off at Setpoint<br>Follow Main | D | D | D | D | D | D | D | E | E | E | E |
| Off after Main On | D | D | D | D | D | D | D | E | E | D [2,3] | D [2,3] |

[1] *E = Energized, D = De-energized*
[2] *Main Flame Detect setting must be enabled*
[3] *Energized under reignition conditions in accordance with configured Pilot Relight Mode and Pilot Relight Timeout settings (Controller Settings > Outputs > Ignition).*

## 6.4 MAIN IONIZATION FLAME DETECTION INPUT

### 6.4.1 DETAILS

| | |
|---|---|
| **TERMINALS** | 5 & 7 |
| **NAME** | Main Ion |
| **TYPE** | Ionization flame detection input using flame rectification |




### 6.4.2 INTENDED FIELD DEVICE CONNECTIONS

| FIELD DEVICE | CONFIGURATION REQUIREMENTS | CONNECTION DIAGRAMS |
|---|---|---|
| Flame rod installed in main flame only | **Pilot Wizard > Allocate Pilot Tab**<br>Flame Detection Gain: As desired<br>Enabled/Disabled: Enabled<br>**Controller Settings > Inputs > Flame Detection**<br>Main Flame Detect: Enabled | See main flame detection rod wiring in any of the following diagrams:<br>Single Rod Ignition Wiring<br>Dual Rod Ignition Wiring<br>Ion Pilot High Energy Ignition Wiring |
| Not used | **Controller Settings > Inputs > Flame Detection**<br>Main Flame Detect: Disabled | N/A |

### 6.4.3 SYSTEM BEHAVIOR – MAIN FLAME DETECTION

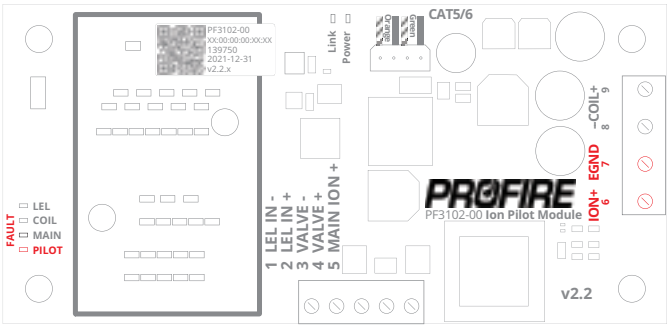
| PILOT FLAME DIAGNOSTIC READINGS[1] | | CONTROLLER INTERPRETATION | MAIN FAULT LED | STATE TRANSITION | CONTROLLER ALERTS |
|---|---|---|---|---|---|
| Flame Strength | Above 600mV | Strong main flame detected | Off | Refer to Operating Sequence section for behavior | |
| | Between 500mV and 600mV | Weak main flame detected | Off | | |
| | Below 500mV | No main flame detected | Off | | |
| AC ($V_{PP}$) | Above 300mV with passed load monitor check | Acceptable flame load | Off | No effect | N/A |
| | Below 300mV | Unacceptable flame load | On | Lockout/Alarm | Main Load Monitor Error alarm |
| DC High | 700mV to 3000mV[2] | Acceptable flame voltage | Off | No effect | N/A |
| | Above 3000mV[2] or Below 700mV | Unacceptable flame voltage | On | Lockout/Alarm | Main Flame Detect Voltage Error alarm |
| DC Low | Any | For reference only | Off | No effect | N/A |

*[1] Flame Diagnostic readings are displayed on the Flame Diagnostics screen.*
*[2] This value may exceed 3000mV under flame sharing conditions.*

# 6.5 PILOT IONIZATION FLAME DETECTION INPUT

## 6.5.1 DETAILS

| | |
|---|---|
| **TERMINALS** | 6 & 7 |
| **NAME** | ION+ |
| **TYPE** | Ionization flame detection input utilizing flame rectification. |




## 6.5.2 INTENDED FIELD DEVICE CONNECTIONS

| FIELD DEVICE | CONFIGURATION REQUIREMENTS | CONNECTION DIAGRAMS |
|---|---|---|
| Flame rod installed in pilot flame | **Pilot Wizard > Allocate Pilot Tab**<br>Flame Detection Gain: As desired<br>Ion Aux In Type: As desired<br>Enabled/Disabled: Enabled<br>**Pilot Wizard > Ignition Settings Tab**<br>Minimum Pilots Running: As required per appliance safety specifications<br>**Controller Settings > Inputs > Ion Aux Input**<br>Ion Aux In Mode (If enabled above): Cannot be set to TC Flame Detect | Single Rod Ignition Wiring<br>Dual Rod Ignition Wiring<br>Ion Pilot High Energy Ignition Wiring |

## 6.5.3 SYSTEM BEHAVIOR – PILOT FLAME DETECTION

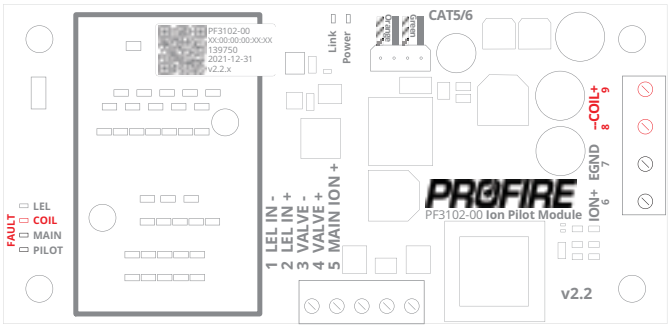
| PILOT FLAME DIAGNOSTIC READINGS | | CONTROLLER INTERPRETATION | PILOT FAULT LED | STATE TRANSITION | CONTROLLER ALERTS |
|---|---|---|---|---|---|
| Flame Strength | Above 600mV | Strong main flame detected[1] | Off | Refer to Operating Sequence section for behavior | |
| | Between 500mV and 600mV | Weak main flame detected[1] | Off | | |
| | Below 500mV | No main flame detected[1] | Off | | |
| AC ($V_{PP}$) | Above 300mV with passed load monitor check | Acceptable flame load | Off | No effect | N/A |
| | Below 300mV | Unacceptable flame load | On | Lockout/Alarm | Pilot Load Monitor Error alarm |
| DC High | 700mV to 3000mV[2] | Acceptable flame voltage | Off | No effect | N/A |
| | Above 3000mV[2] or Below 700mV | Unacceptable flame voltage | On | Lockout/Alarm | Pilot Flame Detect Voltage Error alarm |
| DC Low | Any | For reference only | Off | No effect | N/A |

*[1] Pilot flame detection is determined based on the flame strength of all configured pilots in accordance with the configured Minimum Pilots Running setting (Pilot Wizard > Ignition Settings Tab).*
*[2] This value may exceed 3000mV under flame sharing conditions.*

## 6.6 PILOT IGNITION COIL OUTPUT

### 6.6.1 DETAILS

| | |
|---|---|
| **TERMINALS** | 8 & 9 |
| **NAME** | Coil |
| **TYPE** | Powered ignition output |




### 6.6.2 INTENDED FIELD DEVICE CONNECTIONS

| FIELD DEVICE | CONFIGURATION REQUIREMENTS | CONNECTION DIAGRAMS |
|---|---|---|
| Ignition coil | **Controller Settings > Outputs > Ignition**<br>Ignition Mode: Coil<br>All other settings: As desired | Single Rod Ignition Wiring<br>Dual Rod Ignition Wiring |
| Separate ignition module with 12V DC input | **Controller Settings > Outputs > Ignition**<br>Ignition Mode: HEI<br>All other settings: As desired | Ion Pilot High Energy Ignition Wiring |

### 6.6.3 ION PILOT COIL OUTPUT BEHAVIOR BY CONTROLLER STATE

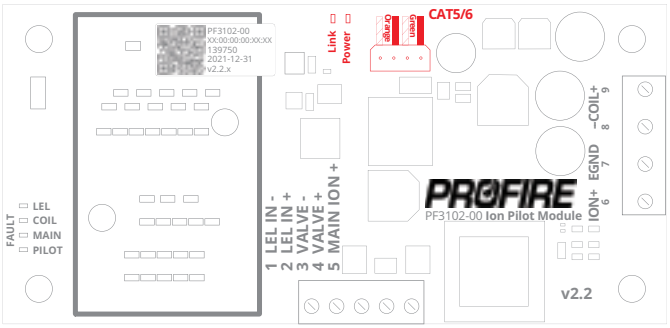
| IGNITION MODE | POWER ON | LOCKOUT | ALARM | READY | WAITING | STARTUP CHECKS | PROVEN PRE-PURGE | IGNITION | PILOT | LOW FIRE | PROCESS CONTROL |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Coil | D | D | D | D | D | D | D | E [3] | D [2,3] | D [2,3] | D [2,3] |
| HEI | D | D | D | D | D | D | D | E [4] | D [2,4] | D [2,4] | D [2,4] |

*[1] E = Energized, D = De-energized*
*[2] Energized under reignition conditions in accordance with configured Pilot Relight Mode and Pilot Relight Timeout settings (Controller Settings > Outputs > Ignition).*
*[3] Coil output is energized with a pulsed output when Ignition Mode is set to Coil.*
*[4] Coil output is energized with a steady 12V output when Ignition Mode is set to HEI.*

## 6.7 PFRN PORT

### 6.7.1 DETAILS

| | |
|---|---|
| **TERMINAL** | 10 |
| **NAME** | PFRN |
| **TYPE** | PFRN I/O Network Port |




### 6.7.2 INTENDED FIELD DEVICE CONNECTIONS

| FIELD DEVICE | CONFIGURATION REQUIREMENTS | CONNECTION DIAGRAMS |
|---|---|---|
| PF3101-00 BMS card PFRN I/O Network port | **Pilot Wizard > Allocate Pilot Tab**<br>Enabled/Disabled: Enabled<br>**Controller Settings > Setup > Other**<br>Comm Loss Restart: As desired | PFRN Connector Wiring<br>I/O Card PFRN Wiring Options |
| PF3101-00 BMS card PFRN I/O Network port via PF3106-00 Network Switch card | **Pilot Wizard > Allocate Pilot Tab**<br>Enabled/Disabled: Enabled<br>**Controller Settings > Setup > Other**<br>Comm Loss Restart: As desired | |

### 6.7.3 SYSTEM BEHAVIOR – PFRN DIAGNOSTIC LEDS

| NAME | COLOR | LED BEHAVIOR | INTERPRETATION | ISSUE/CORRECTIVE ACTION |
|---|---|---|---|---|
| Pwr | Blue | Off | Port has no power | No BMS Power - Make sure BMS Controller card is powered on. Wiring fault - Check PFRN wire terminations at BMS and Pilot card. Hardware fault - Contact Profire for replacement. |
| | | On – Solid | Port has power | N/A |
| | | On – Flickering | Port has intermittent power | Wiring fault - Check PFRN wire terminations at BMS and Pilot card. Hardware fault - Contact Profire for replacement. |
| Link | Green | Off/flickering | Port is not communicating | No PFRN Communication – Cycle power to BMS card and check PFRN wire terminations at BMS and Pilot card. |
| | | On – Solid | Port is communicating normally | N/A |

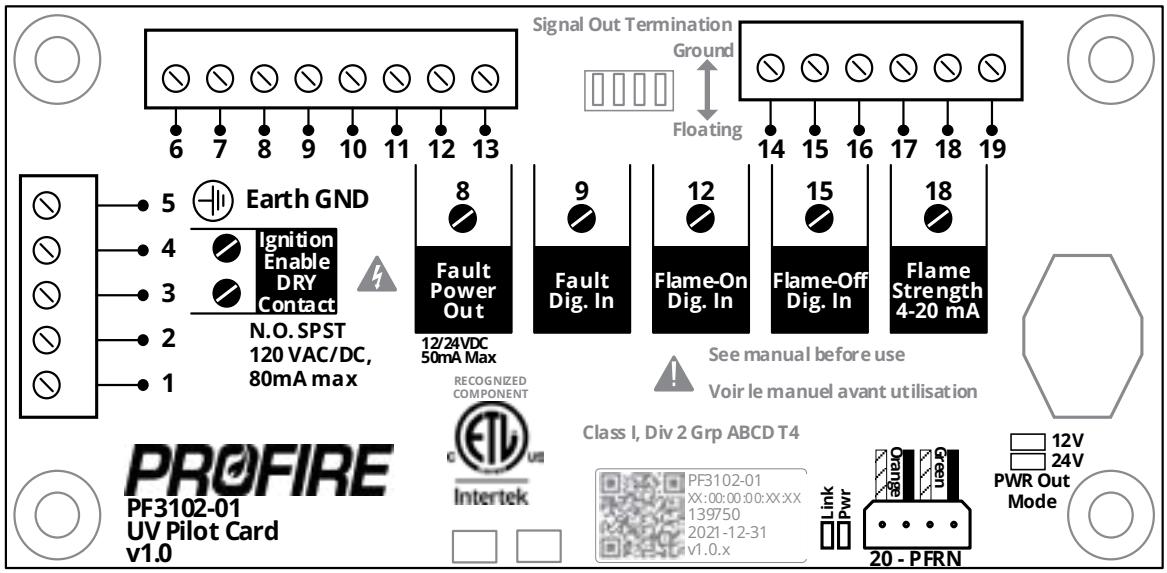
### 6.7.4 SYSTEM BEHAVIOR UPON COMMUNICATION LOSS

Refer to BMS PFRN I/O Network System Behavior for behavior under communication loss conditions.

# 7 PF3102-01 UV PILOT CARD

The UV Pilot card is an I/O card designed to connect to a BMS controller card to facilitate the following:

1. Pilot flame ignition
2. Pilot UV flame detection.
3. Main UV flame detection.



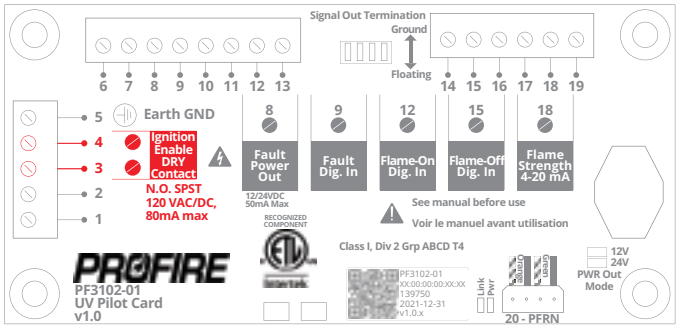

## 7.1 TERMINAL RATINGS

| NAME | SAFETY RATED | TERMINAL | | INPUT/ OUTPUT | ELECTRICAL RATINGS |
|---|---|---|---|---|---|
| Not used | - | 1 | Not used | | |
| | | 2 | | | |
| Ignition Enable | Yes | 3 | A | O | Normally open dry contact<br>120 VAC/VDC maximum<br>80mA maximum |
| | | 4 | B | | |
| Earth Ground | - | 5 | EGND | - | |
| Not used | - | 6 | Not used | | |
| | | 7 | | | |
| UV Fault | Yes | 8 | Power Out | O | 12/24VDC, 25mA maximum |
| | | 9 | Dig. In | I | 30 VDC max, 0.7mA minimum wetting current |
| Not used | - | 10 | Not used | | |
| | | 11 | | | |
| Flame-On | Yes | 12 | Dig. In | I | 30 VDC max, 0.7mA minimum wetting current |
| Not used | - | 13 | Not used | | |
| | | 14 | | | |
| Flame-Off | Yes | 15 | Dig. In | I | 30 VDC max, 0.7mA minimum wetting current |
| Not used | - | 16 | Not used | | |
| | | 17 | | | |
| Flame Strength | No | 18 | 4-20mA | I | 30 VDC, 25mA maximum |
| Not used | - | 19 | Not used | | |
| PFRN I/O Network | Yes | 20 | PFRN | I/O | 36 VDC, 1A maximum |

## 7.2 IGNITION ENABLE RELAY CONTACT

### 7.2.1 DETAILS

| | |
|---|---|
| **TERMINALS** | 3 & 4 |
| **NAME** | Ignition Enable Dry Contact |
| **TYPE** | Normally open dry contact |




### 7.2.2 INTENDED FIELD DEVICE CONNECTIONS

| FIELD DEVICE | CONFIGURATION REQUIREMENTS | CONNECTION DIAGRAMS |
|---|---|---|
| High Energy Ignition module via relay | **Pilot Wizard > Allocate Pilot Tab**<br>Enabled/Disabled: Enabled | UV Pilot High Energy Ignition Wiring |
| PF3102-03 Pilot Spark card | **Pilot Wizard > Allocate Pilot Tab**<br>Enabled/Disabled: Enabled | UV Pilot to Spark Card Wiring |

### 7.2.3 UV PILOT IGNITION ENABLE RELAY BEHAVIOR BY CONTROLLER STATE

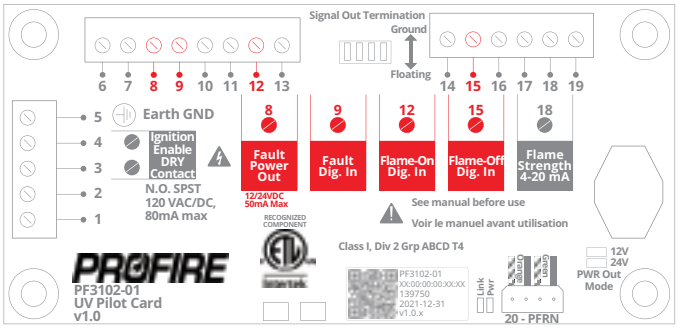
| SYSTEM CONFIGURATION | POWER ON | LOCKOUT | ALARM | READY | WAITING | STARTUP CHECKS | PROVEN PRE-PURGE | IGNITION | PILOT | LOW FIRE | PROCESS CONTROL |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Any | D | D | D | D | D | D | D | E | D[2] | D[2] | D[2] |

[1] *E = Energized, D = De-energized*
[2] *Energized under reignition conditions in accordance with configured Pilot Relight Mode and Pilot Relight Timeout settings (Controller Settings > Outputs > Ignition).*

## 7.3 REQUIRED UV FLAME SCANNER INPUTS

### 7.3.1 DETAILS

| | |
|---|---|
| **TERMINALS** | 8 & 9, 12, 15 |
| **NAME** | Fault, Flame On, Flame Off |
| **TYPE** | Digital Inputs |



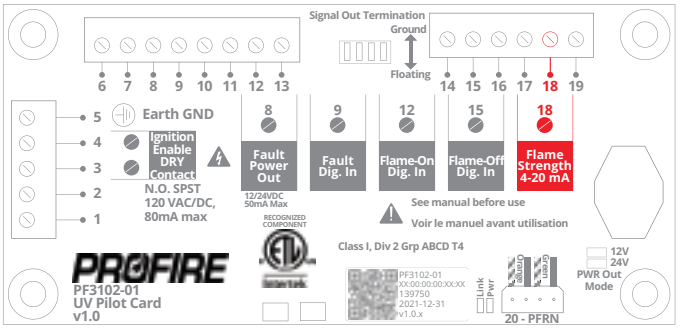

### 7.3.2 INTENDED FIELD DEVICE CONNECTIONS

| FIELD DEVICE | CONFIGURATION REQUIREMENTS | CONNECTION DIAGRAMS |
|---|---|---|
| UV flame scanner - Fireye 65UV5 or equivalent | **Pilot Wizard –** Follow on-screen instructions to configure card | UV Flame Scanner Wiring |

### 7.3.3 SYSTEM BEHAVIOR – UV FLAME DETECTION

| SCENARIO | | | CONTROLLER INTERPRETATION | STATE TRANSITION | CONTROLLER ALERTS |
|---|---|---|---|---|---|
| FAULT INPUT | FLAME ON INPUT | FLAME OFF INPUT | | | |
| Energized | Any | Any | No fault | No effect | N/A |
| De-energized | Any | Any | Fault | Lockout/Alarm | UV Flame Detect Fault alarm |
| Any | Energized | Energized | Fault | Lockout/Alarm | UV Flame Detect Mismatch alarm |
| | De-energized | De-energized | Fault | Lockout/Alarm | UV Flame Detect Mismatch alarm |
| | Energized | De-energized | Flame detected | Refer to Operating Sequence section for behavior | |
| | De-energized | Energized | Flame not detected | | |

# 7.4 UV FLAME SCANNER FLAME STRENGTH INPUT




## 7.4.1 DETAILS

| | |
|---|---|
| **TERMINAL** | 18 |
| **NAME** | Flame Strength |
| **TYPE** | Display only 4-20mA analog input |

## 7.4.2 INTENDED FIELD DEVICE CONNECTIONS

| FIELD DEVICE | CONFIGURATION REQUIREMENTS | CONNECTION DIAGRAMS |
|---|---|---|
| UV flame scanner 4-20mA flame strength output | **Pilot Wizard > Allocate Pilot Tab**<br>Enabled/Disabled: Enabled | UV Flame Scanner Wiring |
| Not Used | N/A | N/A |

## 7.4.3 SYSTEM BEHAVIOR – UV FLAME STRENGTH

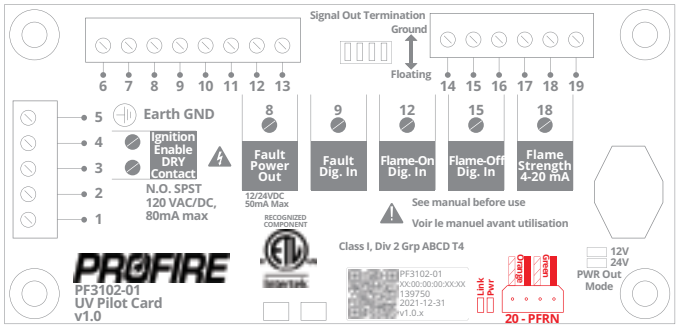
| SYSTEM CONFIGURATION | FLAME STRENGTH INPUT | CONTROLLER STATE | STATE TRANSITION | CONTROLLER ALERTS |
|---|---|---|---|---|
| Any | Any | Any | No effect | N/A |

** UV Flame strength reading does not affect system behavior and is displayed on the Flame Diagnostics screen.*

## 7.5 PFRN PORT

### 7.5.1 DETAILS

| | |
|---|---|
| **TERMINAL** | 20 |
| **NAME** | PFRN |
| **TYPE** | PFRN I/O Network Port |




### 7.5.2 INTENDED FIELD DEVICE CONNECTIONS

| FIELD DEVICE | CONFIGURATION REQUIREMENTS | CONNECTION DIAGRAMS |
|---|---|---|
| PF3101-00 BMS card PFRN I/O Network port | **Pilot Wizard > Allocate Pilot Tab**<br>Enabled/Disabled: Enabled | PFRN Connector Wiring<br>I/O Card PFRN Wiring Options |
| PF3101-00 BMS card PFRN I/O Network port via PF3106-00 Network Switch card | | |

### 7.5.3 SYSTEM BEHAVIOR – PFRN DIAGNOSTIC LEDS

| NAME | COLOR | LED BEHAVIOR | INTERPRETATION | ISSUE/CORRECTIVE ACTION |
|---|---|---|---|---|
| Pwr | Blue | Off | Port has no power | No BMS Power - Make sure BMS Controller card is powered on.<br>Wiring fault - Check PFRN wire terminations at BMS and Pilot card.<br>Hardware fault - Contact Profire for replacement. |
| | | On – Solid | Port has power | N/A |
| | | On – Flickering | Port has intermittent power | Wiring fault - Check PFRN wire terminations at BMS and Pilot card.<br>Hardware fault - Contact Profire for replacement. |
| Link | Green | Off/flickering | Port is not communicating | No PFRN Communication – Cycle power to BMS card and check PFRN wire terminations at BMS and Pilot card. |
| | | On – Solid | Port is communicating normally | N/A |

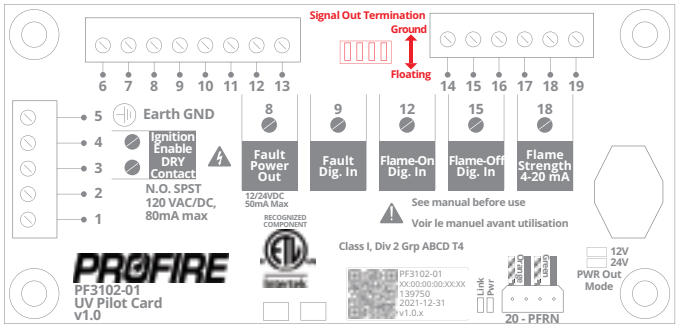
### 7.5.4 SYSTEM BEHAVIOR UPON COMMUNICATION LOSS

Refer to BMS PFRN I/O Network System Behavior for behavior under communication loss conditions.

## 7.6 DIP SWITCHES

### 7.6.1 DETAILS

| | |
|---|---|
| **TERMINALS** | DIP Switch 1,2,3,4 |
| **NAME** | Signal Out Termination |
| **TYPE** | DIP Switch |



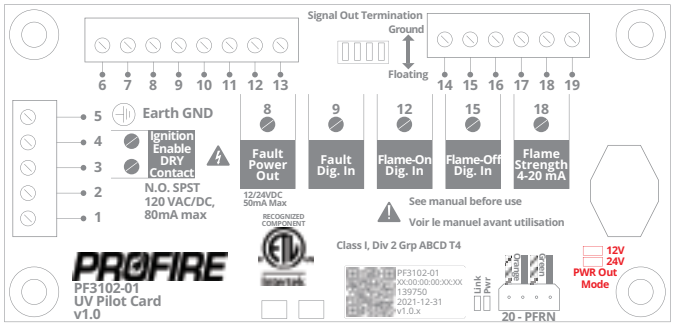

### 7.6.2 INTENDED APPLICATIONS

| FIELD DEVICE | CONFIGURATION REQUIREMENTS | CONNECTION DIAGRAMS |
|---|---|---|
| N/A | All switches must be in the “Ground” position | N/A |

## 7.7 POWER SETTING LEDS

### 7.7.1 DETAILS

| | |
|---|---|
| **TERMINAL** | N/A |
| **NAME** | Power Out Mode (12V/24V) |
| **TYPE** | LED |

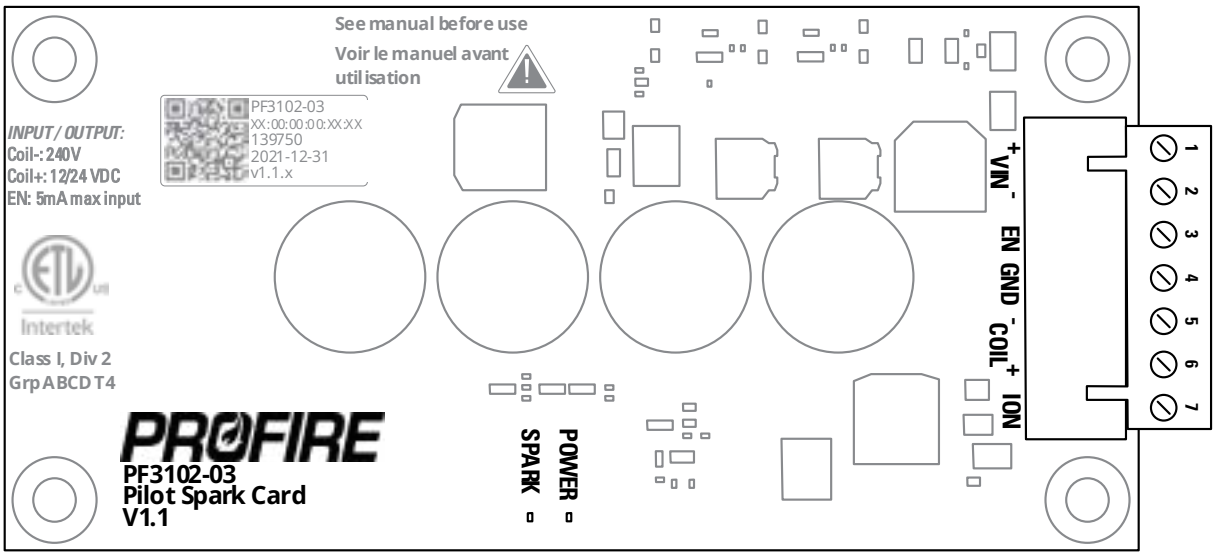



### 7.7.2 INTENDED APPLICATIONS

| FIELD DEVICE | CONFIGURATION REQUIREMENTS | CONNECTION DIAGRAMS |
|---|---|---|
| N/A | Not applicable for PF3102-01 UV Pilot Cards | N/A |

# 8 PF3102-03 PILOT SPARK CARD

The Pilot Spark Card is a high energy ignition module that is designed to be used in conjunction with an ignition coil to produce an intense spark for the purpose of igniting a pilot flame in applications where pilot ignition is problematic.



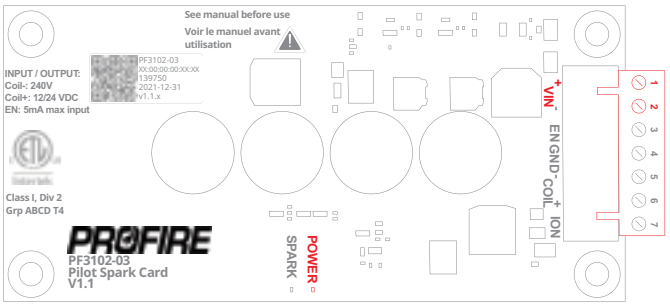

## 8.1 TERMINAL RATINGS

| NAME | SAFETY RATED | TERMINAL | | INPUT/ OUTPUT | ELECTRICAL RATINGS |
|---|---|---|---|---|---|
| Power In | No | 1 | VIN + | I | 12/24VDC, 2A maximum |
| | | 2 | VIN - | | |
| Card Enable | Yes | 3 | EN | I | 12/24VDC, 5mA maximum |
| Ground | - | 4 | GND | - | |
| Coil Output | Yes | 5 | COIL - | O | 12VDC, 2A maximum |
| | | 6 | COIL + | | |
| Coil Return | No | 7 | ION | I | Ground return path |

## 8.2 POWER INPUT

### 8.2.1 DETAILS

| | |
|---|---|
| **TERMINALS** | 1 & 2 |
| **NAME** | VIN |
| **TYPE** | Power input |



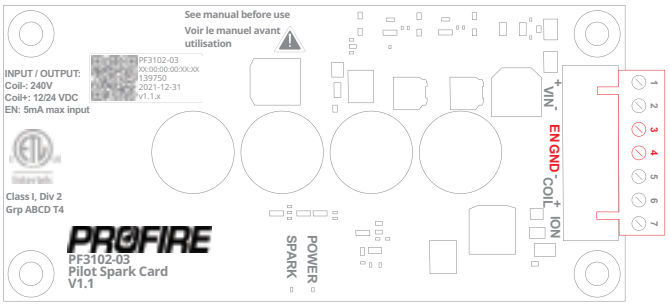

### 8.2.2 INTENDED FIELD DEVICE CONNECTIONS

| FIELD DEVICE | CONFIGURATION REQUIREMENTS | CONNECTION DIAGRAMS |
|---|---|---|
| 12V Power Supply | N/A | Power Input Wiring |
| 24V Power Supply | N/A | |

## 8.3 COIL ENABLE INPUT

### 8.3.1 DETAILS

| | |
|---|---|
| **TERMINALS** | 3 & 4 |
| **NAME** | EN |
| **TYPE** | Digital input |



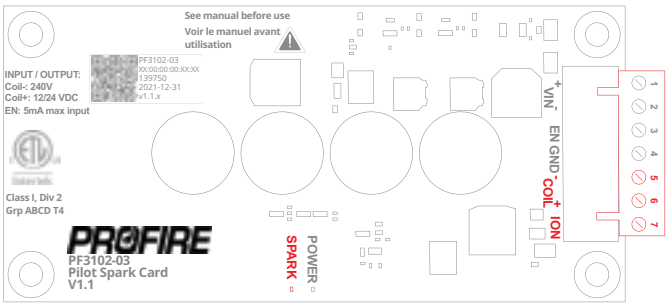

### 8.3.2 INTENDED FIELD DEVICE CONNECTIONS

| FIELD DEVICE | CONFIGURATION REQUIREMENTS | CONNECTION DIAGRAMS |
|---|---|---|
| UV Pilot card Ignition enable contact | **Pilot Wizard** – Follow on-screen instructions to enable UV pilot card | UV Pilot to Spark Card Wiring |

## 8.4 COIL IGNITION OUTPUT

### 8.4.1 DETAILS

| | |
|---|---|
| **TERMINALS** | 5, 6 & 7 |
| **NAME** | COIL |
| **TYPE** | Powered ignition output |

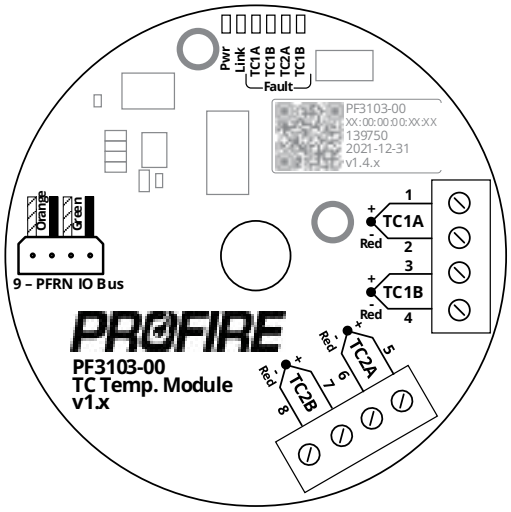



### 8.4.2 INTENDED FIELD DEVICE CONNECTIONS

| FIELD DEVICE | CONFIGURATION REQUIREMENTS | CONNECTION DIAGRAMS |
|---|---|---|
| Ignition coil | N/A | UV Pilot to Spark Card Wiring |

# 9 PF3103-00 TEMPERATURE CARD

The TC Temp card is an I/O card designed to connect to a BMS controller card to facilitate the monitoring of up to four thermocouple temperature inputs.



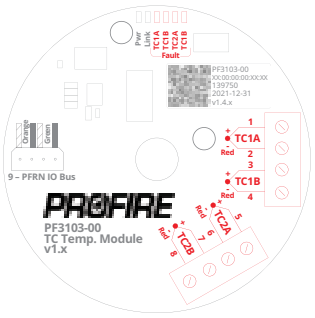

## 9.1 TERMINAL RATINGS

| NAME | SAFETY RATED | TERMINAL | | INPUT/ OUTPUT | ELECTRICAL RATINGS |
|---|---|---|---|---|---|
| TC1 | Yes * | 1 | TC1A + | I | Differential: -6mV to 55mV |
| | | 2 | TC1A - Red | | |
| | | 3 | TC1B + | I | |
| | | 4 | TC1B - Red | | |
| TC2 | Yes * | 5 | TC2A + | I | |
| | | 6 | TC2A - Red | | |
| | | 7 | TC2B + | I | |
| | | 8 | TC2B - Red | | |
| PFRN I/O Network | Yes | 9 | PFRN | I/O | 36 $V_{DC}$, 1A maximum |

**Input is safety rated only when configured for use with a dual element thermocouple. Inputs configured for single element thermocouples are not safety rated.*

## 9.2 THERMOCOUPLE INPUTS

### 9.2.1 DETAILS




| | |
|---|---|
| **TERMINALS** | 1 & 2 and 3 & 4 and 5 & 6 and 7 & 8 |
| **NAME** | TC1A and TC1B and TC2A and TC2B |
| **TYPE** | Type K Thermocouple inputs |

### 9.2.2 INTENDED FIELD DEVICE CONNECTIONS

| FIELD DEVICE | CONFIGURATION REQUIREMENTS | CONNECTION DIAGRAMS |
|---|---|---|
| Ungrounded Type K thermocouple | **Temperature Wizard > Create Inputs Tab**<br>Input Type: As desired [1]<br>All other settings: As desired<br>**Temperature Wizard > Temp Modules Tab**<br>Dual Mode: Assign input to either<br>(1) TC1A and TC1B or (2) TC2A and TC2B<br>Single Mode: Assign input to either<br>(1) TC1A, (2) TC1B, (3) TC2A or (4) TC2B<br>**Temperature Wizard > Setpoints Tab**<br>All settings: As desired<br>**System Settings > UI Settings**<br>Temperature Units: As desired | Dual-Element Thermocouple Wiring<br>Single-Element Thermocouple Wiring |
| Grounded or non-Type K thermocouple | N/A – Not supported | N/A – Not supported |

*[1] Bath Input mode is required to be set to Dual if the Bath Input is specified as a safety function.*

### 9.2.3 SYSTEM BEHAVIOR – NON-REDUNDANT TEMPERATURE INPUTS

| SCENARIO | | STATE TRANSITION | CONTROLLER ALERTS |
|---|---|---|---|
| TEMPERATURE INPUT STATE | MODE | | |
| Open/Out of Range | Disabled | No effect | Thermocouple Failure Warning |
| | Process Control | Lockout/Alarm | No Valid Primary Process Temperature |
| | Aux Process or High Temp ESD | Lockout/Alarm | No Valid Auxiliary Temperature alarm |
| | Display Only | No effect | Thermocouple Failure warning |
| Above High Temp Setpoint | Disabled or Display Only | No effect | N/A |
| | Process Control | Lockout/Alarm | Primary Process Temperature High ESD |
| | Aux Process or High Temp ESD | Lockout/Alarm | Auxiliary Temperature High ESD alarm |
| Below High Temp Setpoint | Disabled or Display Only | No effect | N/A |
| | High Temp ESD | No effect | N/A [1] |
| | Process Control or Aux Process | Normal Operation – Refer to Operating Sequence section for Details | |
| Below Low Temp Setpoint | Process Control | No effect | Low Process Temp warning |

*[1] High Auxiliary Temperature Warning displayed If temperature is above its configured High Temp Warning Setpoint.*

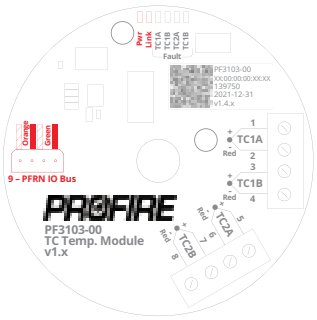
### 9.2.4 SYSTEM BEHAVIOR – REDUNDANT TEMPERATURE INPUTS

A temperature input is redundant if it is measured by multiple thermocouple devices (i.e., one created temperature input (Temperature Wizard > Create Inputs Tab) is assigned to more than one temperature card input slot (Temperature Wizard > Temp Modules Tab) either on the same card or on another card).

| SCENARIO | | STATE TRANSITION | CONTROLLER ALERTS |
|---|---|---|---|
| INPUT READING | MODE | | |
| Open/Out of Range (note 1) | Disabled or Display Only | No effect | Thermocouple Failure Warning |
| | Process Control | Lockout/Alarm | No Valid Primary Process Temperature |
| | Aux Process or High Temp ESD | Lockout/Alarm | No Valid Auxiliary Temperature alarm |
| Above High Temp Setpoint (note 1) | Disabled or Display Only | No effect | N/A |
| | Process Control | Lockout/Alarm | Primary Process Temperature High ESD |
| | Aux Process or High Temp ESD | Lockout/Alarm | Auxiliary Temperature High ESD alarm |
| Below High Temp Setpoint (note 1) | Disabled or Display Only | No effect | N/A |
| | High Temp ESD | No effect | N/A [2] |
| | Process Control or Aux Process | Normal Operation – Refer to Operating Sequence section for Details | |
| Below Low Temp Setpoint (note 1) | Process Control | No effect | Low Process Temp warning |

*[1] The input reading for redundant inputs is determined by the first communicating input that has a valid temperature reading (i.e., not open or out of range) only.*
*[2] High Auxiliary Temperature Warning displayed If temperature is above its configured High Temp Warning Setpoint.*

## 9.3 PFRN PORT




### 9.3.1 DETAILS

| | |
|---|---|
| **TERMINAL** | 9 |
| **NAME** | PFRN IO Bus |
| **TYPE** | PFRN I/O Network Port |

### 9.3.2 INTENDED FIELD DEVICE CONNECTIONS

| FIELD DEVICE | CONFIGURATION REQUIREMENTS | CONNECTION DIAGRAMS |
|---|---|---|
| PF3101-00 BMS card PFRN I/O Network port | N/A | PFRN Connector Wiring<br>I/O Card PFRN Wiring Options |
| PF3101-00 BMS card PFRN I/O Network port via PF3106-00 Network Switch card | | |

### 9.3.3 SYSTEM BEHAVIOR – DIAGNOSTIC LEDS

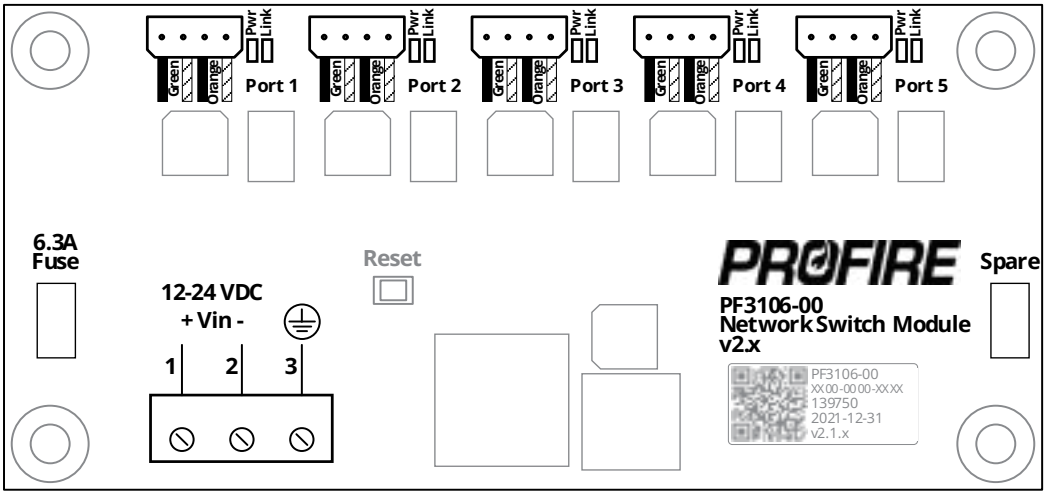
| NAME | COLOR | LED BEHAVIOR | INTERPRETATION | ISSUE/CORRECTIVE ACTION |
|---|---|---|---|---|
| Pwr | Blue | Off | Port has no power | No BMS Power - Make sure BMS Controller card is powered on.<br>Wiring fault - Check PFRN wire terminations at BMS and Temperature card.<br>Hardware fault - Contact Profire for replacement. |
| | | On – Solid | Port has power | N/A |
| | | On – Flickering | Port has intermittent power | Wiring fault - Check PFRN wire terminations at BMS and Temperature card.<br>Hardware fault – Contact Profire for replacement. |
| Link | Green | Off/flickering | Port is not communicating | No PFRN Communication – Cycle power to BMS Controller card and check PFRN wire terminations at BMS and Temperature card. |
| | | On – Solid | Port is communicating normally | N/A |

### 9.3.4 SYSTEM BEHAVIOR UPON COMMUNICATION LOSS

Refer to BMS PFRN I/O Network System Behavior for behavior under communication loss conditions.

# 10 PF3106-00 NETWORK CARD

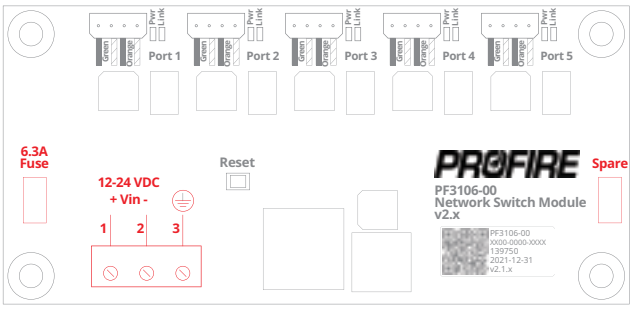
The Network Switch card is a PFRN bus expansion card designed to facilitate system scalability by allowing additional controller or I/O cards to be added to satisfy the requirements of a variety of heating applications.




## 10.1 TERMINAL RATINGS

| NAME | SAFETY RATED | TERMINAL | | INPUT/ OUTPUT | ELECTRICAL RATINGS |
|---|---|---|---|---|---|
| Power In | No | 1 | Vin + | I | 12-24 $V_{DC}$<br>6.3A maximum<br>*Fused at 6.3A |
| | | 2 | Vin - | | |
| | | 3 | EGND | GND | |
| PFRN Network | Yes | | Port 1 | I/O | 36 $V_{DC}$<br>1A maximum |
| | | | Port 2 | I/O | |
| | | | Port 3 | I/O | |
| | | | Port 4 | I/O | |
| | | | Port 5 | I/O | |

## 10.2 POWER INPUT




### 10.2.1 DETAILS

| | |
|---|---|
| **TERMINALS** | 1, 2 & 3 |
| **NAME** | Vin |
| **TYPE** | Power input |

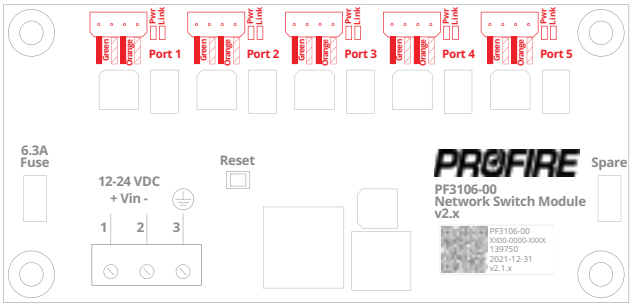
### 10.2.2 INTENDED FIELD DEVICE CONNECTIONS

| FIELD DEVICE | CONFIGURATION REQUIREMENTS | CONNECTION DIAGRAMS |
|---|---|---|
| 12V Power Supply | N/A | Power Input Wiring |
| 24V Power Supply | | |

## 10.3 PFRN PORTS

### 10.3.1 DETAILS

| | |
|---|---|
| **NAME** | Port 1, Port 2, Port 3, Port 4 & Port 5 |
| **TYPE** | PFRN bus expansion port (Controller or I/O network) |




### 10.3.2 INTENDED FIELD DEVICE CONNECTIONS

| FIELD DEVICE | CONFIGURATION REQUIREMENTS | CONNECTION DIAGRAMS |
|---|---|---|
| PF3101-00 BMS card PFRN Controller Network port | N/A | PFRN Connector Wiring<br>I/O Card PFRN Wiring Options |
| PF3101-00 BMS card PFRN I/O Network port | N/A | PFRN Connector Wiring<br>I/O Card PFRN Wiring Options |

** Network cards cannot be connected to PFRN Controller Network port(s) and PFRN I/O Network port(s) at the same time. Separate cards must be used when expansion of both the Controller network and I/O network is required.*

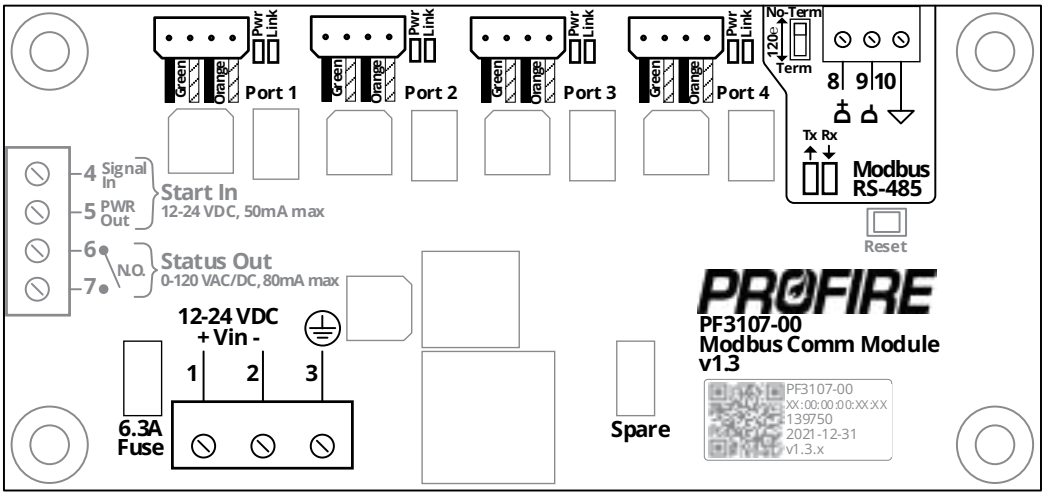
### 10.3.3 SYSTEM BEHAVIOR – DIAGNOSTIC LEDS

| NAME | COLOR | LED BEHAVIOR | INTERPRETATION | ISSUE/CORRECTIVE ACTION |
|---|---|---|---|---|
| Pwr | Blue | Off | Port has no power | No Power – Make sure Network card has power supplied to Power Input terminals.<br>Wiring fault – Check PFRN wire terminations at Network card and connected card.<br>Hardware fault – Contact Profire for replacement. |
| | | On – Solid | Port has power | N/A |
| | | On – Flickering | Port has intermittent power | Wiring fault – Check PFRN wire terminations at Network card and connected card.<br>Hardware fault – Contact Profire for replacement. |
| Link | Green | Off/flickering | Port is not communicating | No PFRN Communication – Cycle power to system and check PFRN wire terminations at Network card and connected card. |
| | | On – Solid | Port is communicating normally | N/A |
| | | On – Flickering | | |

# 11 PF3107-00 MODBUS CARD

The Modbus Comm card is a PFRN bus expansion and communication card designed to connect between a UI card and one or more BMS controller cards to facilitate the following:

1. PFRN Controller Network expansion to allow additional BMS controller cards to be added to the system.
2. Modbus communication capabilities to each BMS controller card in the system.



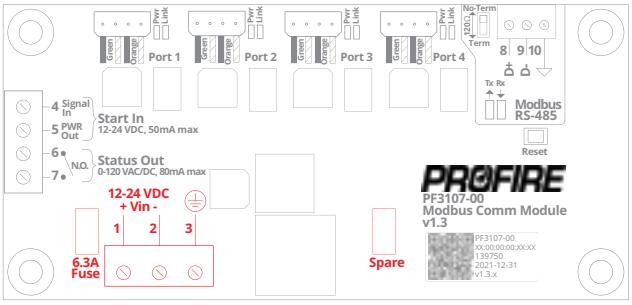

## 11.1 TERMINAL RATINGS

| NAME | SAFETY RATED | TERMINAL | | INPUT/ OUTPUT | ELECTRICAL RATINGS |
|---|---|---|---|---|---|
| Power In | No | 1 | Vin + | I | 12-24 $V_{DC}$<br>6.3A maximum<br>*Fused at 6.3A |
| | | 2 | Vin - | | |
| | | 3 | EGND | GND | |
| Start Input | - | 4 | Signal In | Not Used | |
| | | 5 | PWR Out | | |
| Status Output | - | 6 | N.O. A | | |
| | | 7 | N.O. B | | |
| Modbus RS-485 | No | 8 | D+ | I/O | RS-485, -6V – 6V Common Mode Range with reference to terminal 10 (RS-485 GND) |
| | | 9 | D- | | |
| | | 10 | RS-485 GND | | |
| PFRN Controller Network | Yes | | Port 1 | I/O | 36 $V_{DC}$<br>1A maximum |
| | | | Port 2 | I/O | |
| | | | Port 3 | I/O | |
| | | | Port 4 | I/O | |

## 11.2 POWER INPUT

### 11.2.1 DETAILS

| | |
|---|---|
| **TERMINALS** | 1, 2 & 3 |
| **NAME** | Vin |
| **TYPE** | Power input |
| **FUSE** | 6.3A. Replacement fuses must be of correct type and rating. Contact Profire for replacement fuses. |




**WARNING:**
EXPLOSION HAZARD. DO NOT REMOVE OR REPLACE FUSE WHEN ENERGIZED.

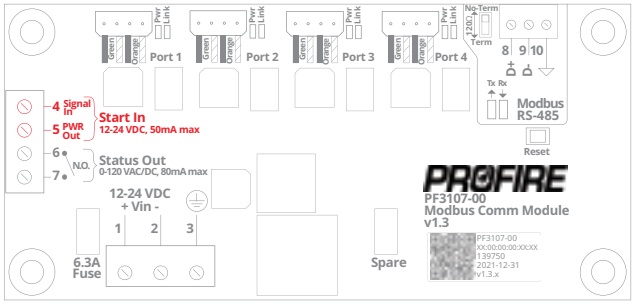
### 11.2.2 INTENDED FIELD DEVICE CONNECTIONS

| FIELD DEVICE | CONFIGURATION REQUIREMENTS | CONNECTION DIAGRAMS |
|---|---|---|
| 12V Power Supply | N/A | Power Input Wiring |
| 24V Power Supply | | |

## 11.3 START INPUT

### 11.3.1 DETAILS

| | |
|---|---|
| **TERMINALS** | 4 & 5 |
| **NAME** | Start In |
| **TYPE** | Not currently supported |



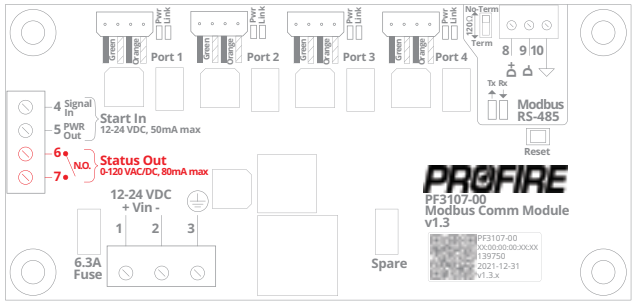

### 11.3.2 INTENDED FIELD DEVICE CONNECTIONS

| CONFIGURATION REQUIREMENTS | CONNECTION DIAGRAMS |
|---|---|
| Input not currently supported on PF3107-00 Modbus card. Instead, use:<br>PF3101-00 BMS Controller card Remote Start input, or<br>Modbus Start/Stop Input/Holding Registers (30100/40100). Refer to PF3107-00 Modbus Register Map for Details. | N/A – Not currently supported |

## 11.4 STATUS OUTPUT

### 11.4.1 DETAILS

| | |
|---|---|
| **TERMINALS** | 6 & 7 |
| **NAME** | Status Out |
| **TYPE** | Not currently supported |



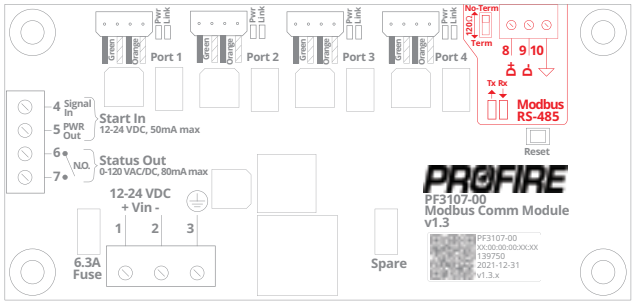

### 11.4.2 INTENDED FIELD DEVICE CONNECTIONS

| CONFIGURATION REQUIREMENTS | CONNECTION DIAGRAMS |
|---|---|
| Output not currently supported on PF3107-00 Modbus card. Instead, use:<br>PF3101-00 BMS Controller card Run Status contact, or<br>PF3113-00 I/O Expansion card Normally Open or Normally Closed Dry Contacts | N/A – Not currently supported |

## 11.5 MODBUS CONNECTION

### 11.4.1 DETAILS

| | |
|---|---|
| **TERMINALS** | 8, 9 & 10 |
| **NAME** | Modbus RS-485 |
| **PROTOCOL** | Modbus RTU |
| **TYPE** | RS-485 communication terminals |




### 11.4.2 INTENDED FIELD DEVICE CONNECTIONS

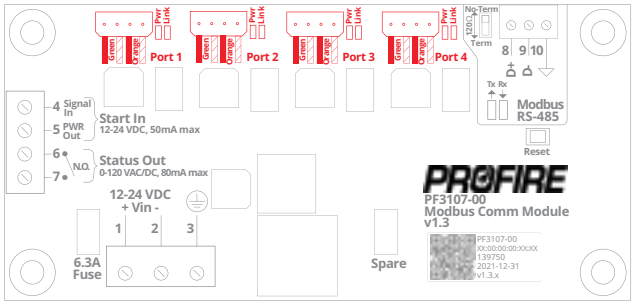
| FIELD DEVICE | CONFIGURATION REQUIREMENTS | CONNECTION DIAGRAMS |
|---|---|---|
| Modbus Master communication module | **PF3100 Controller Configuration**<br>No configuration required<br>**PF3107-00 Hardware Configuration**<br>120Ω termination resistor switch: As required<br>Modbus Master Configuration<br>Data Bits: 8<br>Stop Bits: 1<br>Parity: None<br>Baud rate: 9600 or 19200<br>* Power cycle of PF3100 is required following a change of the Baud rate.<br>Slave Address: Last byte of BMS controller MAC address from Serial Number Label.<br>e.g., A BMS controller with a MAC address of A0:00:00:00:00:2B has a Modbus address of 2B or 43 in decimal form. | Modbus Input Wiring |

*Refer to PF3107-00 Modbus Register Map document for additional Modbus information.*

## 11.6 PFRN PORTS

### 11.6.1 DETAILS

| | |
|---|---|
| **NAME** | Port 1, Port 2, Port 3 & Port 4 |
| **TYPE** | PFRN Controller Network Ports |




### 11.6.2 INTENDED FIELD DEVICE CONNECTIONS

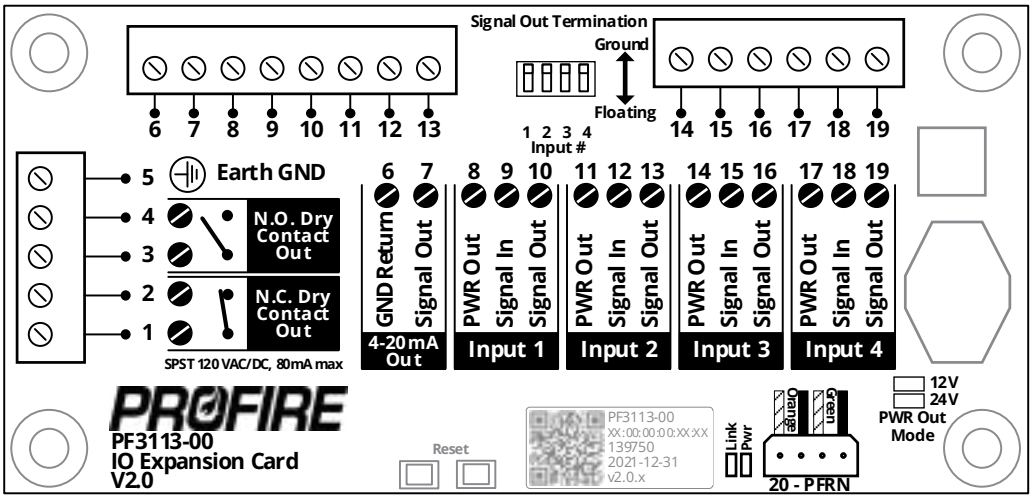
| FIELD DEVICE | CONFIGURATION REQUIREMENTS | CONNECTION DIAGRAMS |
|---|---|---|
| PF3101-00 BMS card PFRN Controller Network port | N/A | PFRN Connector Wiring<br>UI PFRN Connection Options |

### 11.6.3 SYSTEM BEHAVIOR – DIAGNOSTIC LEDS

| NAME | COLOR | LED BEHAVIOR | INTERPRETATION | ISSUE/CORRECTIVE ACTION |
|---|---|---|---|---|
| Pwr | Blue | Off | Port has no power | No Power – Make sure Network card has power supplied to Power Input terminals.<br>Wiring fault – Check PFRN wire terminations at Network card and connected card.<br>Hardware fault – Contact Profire for replacement. |
| | | On – Solid | Port has power | N/A |
| | | On – Flickering | Port has intermittent power | Wiring fault – Check PFRN wire terminations at Network card and connected card.<br>Hardware fault – Contact Profire for replacement. |
| Link | Green | Off | Port is not communicating | No PFRN Communication – Cycle power to system and check PFRN wire terminations at Network card and connected card. |
| | | On – Solid | Port is communicating normally | N/A |
| | | On – Flickering | | |

# 12 PF3113-00 I/O EXPANSION CARD

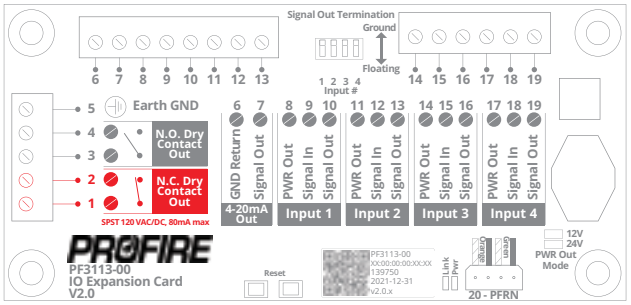
The IO Expansion card is an I/O card designed to be connected to a BMS controller card to allow (1) monitoring of up to four additional input devices, (2) control of an additional 4-20mA output device and (3) use of two additional configurable status relay contacts.




## 12.1 TERMINAL RATINGS

| NAME | SAFETY RATED | TERMINAL | | INPUT/ OUTPUT | ELECTRICAL RATINGS |
|---|---|---|---|---|---|
| Dry Contacts | No | 1 | N.C. – A | - | Dry contact<br>120 $V_{AC}/V_{DC}$<br>80mA max |
| | | 2 | N.C. – B | | |
| | Yes | 3 | N.O. – A | - | |
| | | 4 | N.O. – B | | |
| Earth Ground | - | 5 | EGND | GND | |
| 4-20mA output | No | 6 | GND Return | O | 25mA max, 12V Mode: 14$V_{DC}$, 24V Mode: 24$V_{DC}$<br>Maximum output device impedance: 12V Mode: 250Ω, 24V Mode: 900Ω |
| | | 7 | Signal Out | | |
| Input 1 | Yes | 8 | PWR Out | O | 50mA max, 12V Mode: 14$V_{DC}$, 24V Mode: 24 $V_{DC}$, |
| | | 9 | Signal In | I | Digital Mode: 30 $V_{DC}$ max, 0.7mA minimum wetting current |
| | | | | | 4-20 Mode: 30 $V_{DC}$ max, 25mA max |
| | No | 10 | Signal Out | O | Pass through output 30 $V_{DC}$ max, 25mA max |
| Input 2 | Yes | 11 | PWR Out | O | 50mA max, 12V Mode: 14$V_{DC}$, 24V Mode: 24 $V_{DC}$, |
| | | 12 | Signal In | I | Digital Mode: 30 $V_{DC}$ max, 0.7mA minimum wetting current |
| | | | | | 4-20 Mode: 30 $V_{DC}$ max, 25mA max |
| | No | 13 | Signal Out | O | Pass through output 30 $V_{DC}$ max, 25mA max |
| Input 3 | Yes | 14 | PWR Out | O | 50mA max, 12V Mode: 14$V_{DC}$, 24V Mode: 24 $V_{DC}$, |
| | | 15 | Signal In | I | Digital Mode: 30 $V_{DC}$ max, 0.7mA minimum wetting current |
| | | | | | 4-20 Mode: 30 $V_{DC}$ max, 25mA max |
| | No | 16 | Signal Out | O | Pass through output 30 $V_{DC}$ max, 25mA max |
| Input 4 | Yes | 17 | PWR Out | O | 50mA max, 12V Mode: 14$V_{DC}$, 24V Mode: 24 $V_{DC}$, |
| | | 18 | Signal In | I | Digital Mode: 30 $V_{DC}$ max, 0.7mA minimum wetting current |
| | | | | | 4-20 Mode: 30 $V_{DC}$ max, 25mA max |
| | No | 19 | Signal Out | O | Pass through output 30 $V_{DC}$ max, 25mA max |
| PFRN I/O Network | Yes | 20 | PFRN | I/O | 36 $V_{DC}$, 1A maximum |

# 12.2 NORMALLY CLOSED DRY CONTACT




## 12.2.1 DETAILS

| | |
|---|---|
| **TERMINALS** | 1 & 2 |
| **NAME** | N.C. Dry Contact Out |
| **TYPE** | Normally closed dry contact |

## 12.2.2 INTENDED FIELD DEVICE CONNECTIONS

The PF3113-00 normally closed contact is not safety rated and cannot be used for safety critical functions.

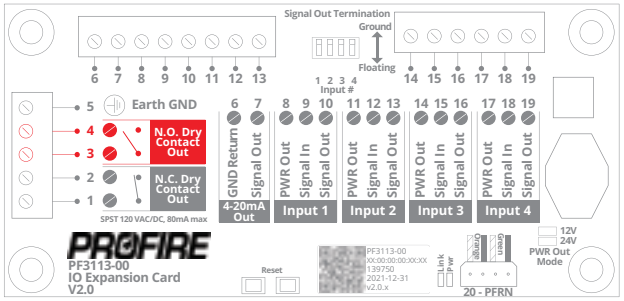
| FIELD DEVICE | CONFIGURATION REQUIREMENTS | CONNECTION DIAGRAMS |
|---|---|---|
| Site equipment status panel | **I/O Wizard > I/O Modules Tab**<br>N.C. Dry Contact: As desire | Run Status – AC<br>Run Status – DC |

## 12.2.3 NORMALLY CLOSED DRY CONTACT BEHAVIOR

| MODE | CONDITION | CONTACT STATE |
|---|---|---|
| Disabled | Any | CLOSED |
| Started Status | No controllers in the appliance are in a running state | CLOSED |
| | One or more controllers in the appliance are in a running state | OPEN |
| High Temp Status | No controllers in the appliance have high temperature alarms present | CLOSED |
| | Any controller in the appliance has a high temperature alarm present | OPEN |
| No Alert status | Any controller in the appliance has encountered a shutdown or has alerts present | CLOSED |
| | No controllers in the appliance have encountered a shutdown or have alerts present | OPEN |
| Appliance Process Control | No controller in the appliance is in a Process Control state | CLOSED |
| | Any controller in the appliance is in a Process Control state | OPEN |
| Controller Process Control | Connected controller is not in a Process Control state | CLOSED |
| | Connected controller is in a Process Control state | OPEN |
| Temp Setpoint Trip | Configured temperature input is below its corresponding setpoint * | CLOSED |
| | Configured temperature input is above its corresponding setpoint | OPEN |
| Input Setpoint Trip | Configured input is below its corresponding setpoint * | CLOSED |
| | Configured input is above its corresponding setpoint | OPEN |
| Purge Status | Connected controller is not Purging | CLOSED |
| | Connected controller is Purging | OPEN |
| Appliance Alarm | Any controller in the appliance has encountered a shutdown or has an alarm present | CLOSED |
| | No controllers in the appliance have encountered a shutdown or have alarms present | OPEN |
| Appliance Wait | Any controller in the appliance has a wait present | CLOSED |
| | No controllers in the appliance have waits present | OPEN |
| Appliance Warning | Any controller in the appliance has a warning present | CLOSED |
| | No controllers in the appliance have main warning present | OPEN |
| Appliance Main Permissive | Any controller in the appliance has main permissive present | CLOSED |
| | No controllers in the appliance have main permissive present | OPEN |
| Controller Running | Connected controller is in a non-running state | CLOSED |
| | Connected controller is in a running state | OPEN |

** Input must go below its configured setpoint minus deadband to transition from Closed to Open*

# 12.3 NORMALLY OPEN DRY CONTACT




## 12.3.1 DETAILS

| | |
|---|---|
| **TERMINALS** | 3 & 4 |
| **NAME** | N.O. Dry Contact Out |
| **TYPE** | Normally open dry contact |

## 12.3.2 INTENDED FIELD DEVICE CONNECTIONS

| FIELD DEVICE | CONFIGURATION REQUIREMENTS | CONNECTION DIAGRAMS |
|---|---|---|
| Site equipment status panel | **I/O Wizard > I/O Modules Tab**<br>N.C. Dry Contact: As desire | Run Status – AC<br>Run Status – DC |

## 12.3.3 NORMALLY OPEN DRY CONTACT BEHAVIOR

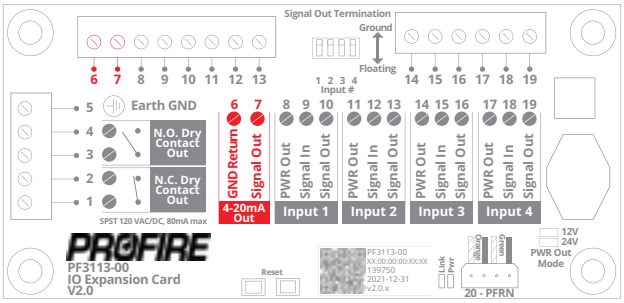
| MODE | CONDITION | CONTACT STATE |
|---|---|---|
| Disabled | Any | OPEN |
| Started Status | No controllers in the appliance are in a running state | OPEN |
| | One or more controllers in the appliance are in a running state | CLOSED |
| High Temp Status | No controllers in the appliance have high temperature alarms present | OPEN |
| | Any controller in the appliance has a high temperature alarm present | CLOSED |
| No Alert status | Any controller in the appliance has encountered a shutdown or has alerts present | OPEN |
| | No controllers in the appliance have encountered a shutdown or have alerts present | CLOSED |
| Appliance Process Control | No controller in the appliance is in a Process Control state | OPEN |
| | Any controller in the appliance is in a Process Control state | CLOSED |
| Controller Process Control | Connected controller is not in a Process Control state | OPEN |
| | Connected controller is in a Process Control state | CLOSED |
| Temp Setpoint Trip | Configured temperature input is below its corresponding setpoint * | OPEN |
| | Configured temperature input is above its corresponding setpoint | CLOSED |
| Input Setpoint Trip | Configured input is below its corresponding setpoint * | OPEN |
| | Configured input is above its corresponding setpoint | CLOSED |
| Purge Status | Connected controller is not Purging | OPEN |
| | Connected controller is Purging | CLOSED |
| Appliance Alarm | Any controller in the appliance has encountered a shutdown or has an alarm present | OPEN |
| | No controllers in the appliance have encountered a shutdown or have alarms present | CLOSED |
| Appliance Wait | Any controller in the appliance has a wait present | OPEN |
| | No controllers in the appliance have waits present | CLOSED |
| Appliance Warning | Any controller in the appliance has a warning present | OPEN |
| | No controllers in the appliance have main warning present | CLOSED |
| Appliance Main Permissive | Any controller in the appliance has main permissive present | OPEN |
| | No controllers in the appliance have main permissive present | CLOSED |
| Controller Running | Connected controller is in a non-running state | OPEN |
| | Connected controller is in a running state | CLOSED |

** Input must go below its configured setpoint minus deadband to transition from Closed to Open*

## 12.4 4-20 mA OUTPUT

### 12.4.1 DETAILS

| | |
|---|---|
| **TERMINALS** | 6 & 7 |
| **NAME** | 4-20mA Out |
| **TYPE** | 4-20mA powered output |




### 12.4.2 INTENDED FIELD DEVICE CONNECTIONS

The PF3113-00 I/O Expansion card 4-20mA output is not safety rated and cannot be used for safety critical functions.

| FIELD DEVICE | CONFIGURATION REQUIREMENTS | CONNECTION DIAGRAMS |
|---|---|---|
| Proportional actuator controlled by PID control on 4-20mA input(s) | **I/O Wizard > Add Inputs Tab**<br>Create up to four 4-20mA inputs as desired<br>**I/O Wizard > I/O Modules Tab**<br>Inputs 1-4: Assign as per field wiring<br>4-20 Output: PID Output Controlled by 4-20mA Input<br>Select I/O Card 4-20 Inputs: Up to four as desired<br>All selected inputs are averaged to determine the input reading used by the PID output.<br>**I/O Wizard > Configure PID Parameters Dialog**<br>Setpoint: As desired<br>PID Parameters: As desired<br>Direction: As desired<br>Mode: Auto<br>System Stop Output: As desired/required<br>Output Limits: As desired/required | Proportional Valve/Actuator Wiring |
| Proportional actuator controlled by PID control on thermocouple input(s) | **Temperature Wizard > Create Inputs Tab**<br>Create up to four temperature inputs as desired<br>* Note that these inputs must be created in the Temperature Wizard rather than in the I/O Wizard<br>**I/O Wizard > I/O Modules Tab**<br>Inputs 1-4: Assign as per field wiring<br>4-20 Output: PID Output Controlled by TC Input<br>Select Temperature Inputs: Up to four as desired<br>All selected inputs are averaged to determine the input reading used by the PID output.<br>**I/O Wizard > Configure PID Parameters Dialog**<br>Setpoint: As desired<br>PID Parameters: As desired<br>Direction: As desired<br>Mode: Auto<br>System Stop Output: As desired/required<br>Output Limits: As desired/required | Proportional Valve/Actuator Wiring |

| FIELD DEVICE | CONFIGURATION REQUIREMENTS | CONNECTION DIAGRAMS |
|---|---|---|
| FARC air actuator | **I/O Wizard > Add Inputs Tab**<br>Refer to Configurable I/O Expansion inputs section for instructions on configuring FARC valve and air position feedback inputs<br>Refer to Configurable I/O Expansion inputs section for instructions on configuring an $O_2$ sensor input if desired.<br>**I/O Wizard > I/O Modules Tab**<br>4-20 Output: Air Position Controlled by FARC<br>Name: As desired<br>**FARC / $O_2$ Trim Wizard > General Tab**<br>FARC Enable: Enabled<br>All other settings: As desired<br>**FARC / $O_2$ Trim Wizard > Channels Tab > Channel Configuration Menu (Repeat for all channels)**<br>All settings: As desired<br>**FARC / $O_2$ Trim Wizard > Channels Tab > Configure Curves Menu**<br>Configure FARC table(s) in accordance with safety design documentation and fuel-air ratio profiles.<br>**FARC / $O_2$ Trim Wizard > $O_2$ Trim Tab**<br>All Settings: As per safety design documentation<br>**FARC / $O_2$ Trim Wizard > $O_2$ Trim Tab > Configure $O_2$ Curve Menu**<br>Configure $O_2$ curve in accordance with safety design documentation and $O_2$ Trim profile.<br>**Output Calibration Wizard**<br>Ensure all outputs are calibrated prior to starting an appliance for use in a FARC application. Refer to Output Calibration Wizard section. | Proportional Valve/Actuator Wiring |
| FARC aux channel actuator | **I/O Wizard > Add Inputs Tab**<br>Refer to Configurable I/O Expansion inputs section for instructions on configuring Aux position feedback inputs if required.<br>**I/O Wizard > I/O Modules Tab**<br>4-20 Output: Aux Position Controlled by FARC<br>Channel: As desired<br>Name: As desired<br>**FARC / $O_2$ Trim Wizard > Channels Tab > Channel Configuration Menu (Repeat for all channels)**<br>All settings: As desired<br>**FARC / $O_2$ Trim Wizard > Channels Tab > Configure Curves Menu**<br>Configure FARC table(s) in accordance with safety design documentation and fuel-air ratio profiles.<br>**FARC / $O_2$ Trim Wizard > $O_2$ Trim Tab**<br>All Settings: As per safety design documentation<br>**FARC / $O_2$ Trim Wizard > $O_2$ Trim Tab > Configure $O_2$ Curve Menu**<br>Configure $O_2$ curve in accordance with safety design documentation and $O_2$ Trim profile.<br>**Output Calibration Wizard**<br>Ensure all outputs are calibrated prior to starting an appliance for use in a FARC application. Refer to Output Calibration Wizard section. | Proportional Valve/Actuator Wiring |

### 12.4.3 4-20mA OUTPUT BEHAVIOR – PID CONTROL

| CONTROLLER STATE | SYSTEM BEHAVIOR |
|---|---|
| Any stopped state | PID is stopped – output is held at the configured System Stop Output position |
| Any running state | PID is operating – output is changed within the configured Low Output Limit and High Output Limit in accordance with configured PID parameters |

### 12.4.4 4-20mA OUTPUT BEHAVIOR – FARC ACTUATOR

| POST PURGE MODE | CONTROLLER STATE | OUTPUT SIGNAL [1, 2] |
|---|---|---|
| Purge | Any stopped state – post purging | Purge Position |
| Hold Last | | Last position before purge event |
| Any | Any stopped state – not post purging | Off Position |
| | Waiting or Startup Checks | Off Position |
| | Request Purge or Prove Airflow or Pre-Purge | Purge Position |
| | Request Pilot Position | Pilot Position |
| | Pilot | Pilot Position |
| | Pilot - Request Light Off | Light Off Position |
| | Low Fire | Light Off Position |
| | Process Control | Normal conditions: FARC table position corresponding to the current firing rate.<br>Cross limiting conditions: FARC table position corresponding to Cross Limiting scheme [3 4] |

*[1] FARC channel output positions are specified separately for each channel.*

*[2] Channel output positions are displayed on the UI in % in accordance with the configured channel position settings and the FARC table, but the corresponding mA output values are dependent on the configured Output Inversion setting as follows:*
*Disabled: 0% corresponds to 4mA, 100% corresponds to 20mA; Output = (Displayed output reading x 16mA) + 4mA*
*Enabled: 0% corresponds to 20mA, 100% corresponds to 4mA; Output = ((100% - Displayed output reading) x 16mA) + 4mA*
*Example: A channel output of 75% corresponds to a 4-20mA output of:*
*16mA when direction setting is Disabled (75% x 16mA) + 4mA.*
*8mA when direction setting is Enabled ((100% - 75%) x 16mA) + 4mA.*

*[3] Cross limiting is applied to all leading FARC channels when the actual position of a lagging channel exceeds its expected position from the FARC table by ignoring the current firing rate and driving the leading channel outputs to their FARC table values corresponding to the actual position of the lagging channel.*

*[4] Cross limiting is applied to all lagging FARC channels when the actual position of a leading channel is less than its expected position from the FARC table by ignoring the current firing rate and driving the lagging channel outputs to their FARC table values corresponding to the actual position of the leading channel.*

***Example: Current firing rate = 50%, Expected fuel Position = 32%, Actual Fuel Position = 35%***

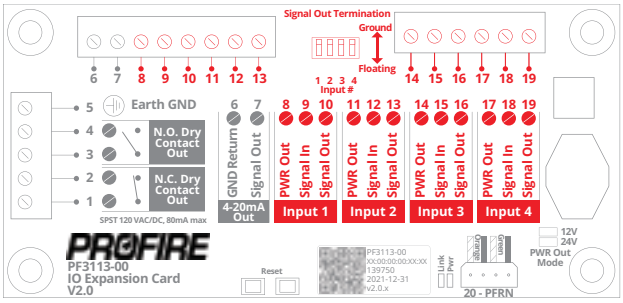
| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Firing Rate | 30 | 35 | 40 | 45 | 50 | 55 | 60 | 65 | 70 |
| Fuel (lagging) | 20 | 23 | 26 | 29 | 32 | 35 | 38 | 41 | 44 |
| Air (leading) | 23 | 28 | 33 | 38 | 43 | **48** | 53 | 58 | 63 |

*In the example above, the firing rate remains at 50%, the fuel channel output remains at 32% and the air channel output is increased to **48%** (the FARC Table value corresponding to a fuel output of 35%).*

# 12.5 CONFIGURABLE I/O EXPANSION INPUTS

## 12.5.1 DETAILS

| | |
|---|---|
| **TERMINALS** | 8/9/10 and 11/12/13 and 14/15/16 and 17/18/19 |
| **NAME** | Input 1 and Input 2 and Input 3 and Input 4 |
| **TYPE** | Configurable digital or 4-20mA inputs |




## 12.5.2 INTENDED FIELD DEVICE CONNECTIONS

| FIELD DEVICE/APPLICATION | CONFIGURATION REQUIREMENTS | CONNECTION DIAGRAMS |
|---|---|---|
| Digital fuel pressure switch<br>Digital flow switch<br>Digital level switch<br>Generic digital input switch | **I/O Wizard > Add Inputs Tab**<br>Input Type: As per device type<br>Signal Type: Digital<br>Input Mode: As desired<br>Name: As per equipment tag<br>**I/O Wizard > I/O Modules Tab**<br>Input 1-4: Assign as per field wiring<br>Module Voltage: As required per device ratings | Digital Input – Dry Contact<br>Digital Input – Wet Contact |
| 4-20mA fuel pressure transmitter<br>4-20mA flow transmitter<br>4-20mA level transmitter<br>4-20mA temperature transmitter<br>Generic 4-20mA transmitter | **I/O Wizard > Add Inputs Tab**<br>Input Type: As per device type (use Custom for temperature inputs)<br>Signal Type: 4-20<br>Name: As per equipment tag<br>All other settings: As desired<br>**I/O Wizard > I/O Modules Tab**<br>Input 1-4: Assign as per field wiring<br>Transmitter Span Low: Reading corresponding to a 4mA transmitter output signal<br>Transmitter Span High: Reading corresponding to a 20mA transmitter output signal<br>Module Voltage: As required per device ratings | Loop Powered Transmitter<br>Self Powered Transmitter<br>4-20mA Echo to PLC |
| Secondary PID control input<br>PID Staging Input | **I/O Wizard > Add Inputs Tab & I/O Modules Tab**<br>Create and assign a 4-20mA output as above<br>Refer to BMS Controller Card Aux Output section for additional configuration Details and output behavior. | Loop Powered Transmitter<br>Self Powered Transmitter<br>Analog Input from PLC |
| External firing rate signal from PLC | **I/O Wizard > Add Inputs Tab**<br>Input Type: Appliance Firing Rate<br>All other settings: Ignored<br>**I/O Wizard > I/O Modules Tab**<br>Input 1-4: As per field wiring<br>All other settings: As desired<br>Refer to BMS Controller Card Aux Output section for additional configuration Details and output behavior. | Analog Input from PLC |

| FIELD DEVICE/APPLICATION | CONFIGURATION REQUIREMENTS | CONNECTION DIAGRAMS |
|---|---|---|
| FARC valve position feedback input | **I/O Wizard > Add Inputs Tab**<br>Input Type: FARC Valve Position<br>All other settings: Ignored<br>**I/O Wizard > I/O Modules Tab**<br>Input 1-4: As per field wiring<br>All other settings: As desired<br>**FARC / $O_2$ Trim Wizard > General Tab**<br>FARC Enable: Enabled<br>All other settings: As required per safety design documentation | Loop Powered Transmitter<br>Self Powered Transmitter |
| FARC air position feedback input | **I/O Wizard > Add Inputs Tab**<br>Input Type: FARC Air Position<br>All other settings: Ignored<br>**I/O Wizard > I/O Modules Tab**<br>Input 1-4: As per field wiring<br>4-20 Output: Air Position Controlled by FARC<br>All other settings: As desired<br>**FARC / $O_2$ Trim Wizard > General Tab**<br>FARC Enable: Enabled<br>All other settings: As required per safety design documentation | Loop Powered Transmitter<br>Self Powered Transmitter |
| FARC Aux channel position feedback input | **I/O Wizard > Add Inputs Tab**<br>Input Type: CHx Feedback Position<br>All other settings: Ignored<br>**I/O Wizard > I/O Modules Tab**<br>Input 1-4: As per field wiring<br>4-20 Output: CHx Position Controlled by FARC<br>All other settings: As desired<br>**FARC / $O_2$ Trim Wizard > General Tab**<br>FARC Enable: Enabled<br>All other settings: As required per safety design documentation<br>**FARC /Or Trim Wizard > Channels Tab > Channel Configuration Menu**<br>Position Feedback: Select appropriate channel | Loop Powered Transmitter<br>Self Powered Transmitter |
| Bleed valve proof of open switch(es) | **I/O Wizard > Add Inputs Tab**<br>Input Type: Bleed Valve Proof of Open<br>All other settings: Ignored<br>**I/O Wizard > I/O Modules Tab ***<br>Input 1-4: As per field wiring<br>All other settings: As desired<br>* Input applies only to the BMS controller card to which it is connected (via I/O Expansion card). Multi-BMS applications require each BMS to have a dedicated I/O Expansion card connected with the single Bleed Valve Proof of Open logical input assigned. | Digital Input – Dry Contact<br>Digital Input – Wet Contact |

| FIELD DEVICE/APPLICATION | CONFIGURATION REQUIREMENTS | CONNECTION DIAGRAMS |
|---|---|---|
| Oxygen sensor | **I/O Wizard > Add Inputs Tab**<br>Input Type: $O_2$ Sensor Reading<br>Name: As per equipment tag<br>Units: As desired<br><br>**I/O Wizard > I/O Modules Tab**<br>Input 1-4: As per field wiring<br>All other settings: As desired<br><br>**FARC / $O_2$ Trim Wizard > $O_2$ Trim Tab**<br>All Settings: As per safety design documentation<br><br>**FARC / $O_2$ Trim Wizard > $O_2$ Trim Tab > Configure $O_2$ Curve Menu**<br>Configure $O_2$ curve in accordance with safety design documentation and $O_2$ Trim profile. | Loop Powered Transmitter<br>Self Powered Transmitter |
| 4-20mA transmitter with separate low trip and high trip behavior<br>* This application is not safety rated. Separate devices must be used to maintain safety rating. | **I/O Wizard > Add Inputs Tab**<br>**Input 1:**<br>Input Type: As per device type<br>Signal Type: 4-20<br>Input Mode: Desired high trip behavior<br>Low Setpoint: Set to transmitter 4mA position<br>High Trip Setpoint: As desired<br>All other settings: As desired<br><br>**Input 2:**<br>Input Type: Same as above<br>Signal Type: 4-20<br>Input Mode: Desired low trip behavior<br>Low Setpoint: As desired<br>High Trip Setpoint: Set to transmitter 20mA position<br>All other settings: As desired<br><br>**I/O Wizard > I/O Modules Tab**<br>Input 1: Assign Input 1 from above<br>Input 2: Assign Input 2 from above<br>All other settings: As desired<br><br>**PF3113 Hardware Configuration**<br>DIP Switch 1: Floating<br>DIP Switch 2: Ground | Single Transmitter to Multiple Inputs |

### 12.5.3 SYSTEM BEHAVIOR – IO EXPANSION CARD DIGITAL INPUT

| SCENARIO | | | STATE TRANSITION | CONTROLLER ALERTS |
|---|---|---|---|---|
| INPUT MODE | CONTROLLER STATE | INPUT STATE (SEE WARNING BELOW FOR APPLICATIONS USING REDUNDANT INPUTS) | | |
| Any except Proof of Airflow | Any | Energized | No effect | N/A |
| Alarm | Any stopped state | De-energized | Alarm | IO Expansion Digital Input Open alarm |
| | Any running state | De-energized | Lockout | IO Expansion Digital Input Open alarm |
| Wait | Any stopped state | De-energized | No effect | IO Expansion Digital Input Open wait |
| | Any running state | De-energized | Waiting | IO Expansion Digital Input Open wait |
| Warning | Any | De-energized | No effect | IO Expansion Digital Input Open warning |
| Main Permissive | Any non-main state | De-energized | No effect | IO Expansion Digital Input Open main permissive |
| | Any main fuel state | De-energized | Pilot [1] | IO Expansion Digital Input Open main permissive |
| Display Only | Any | De-energized | No effect | N/A |
| Non-fuel State Alarm | Any non-fuel state | De-energized | Alarm/Lockout | IO Expansion Digital Input Open alarm |
| | Any fuel state | De-energized | No effect | N/A |
| Pilot State Alarm | Any state other than Pilot | De-energized | No effect | N/A |
| | Pilot | De-energized | Lockout | IO Expansion Digital Input Open alarm |
| Main State Alarm | Any non-main state | De-energized | No effect | N/A |
| | Any main state | De-energized | Lockout | IO Expansion Digital Input Open alarm |
| Local Proof of Airflow | Refer to Proof of Airflow Behavior table below for system behavior | | | |

*[1] When Pilot Off mode is set to Off After Main On, the controller transitions to the Waiting state, then purges the system before reigniting and proceeding to Pilot.*

The following is for applications that have multiple input devices monitoring a single controller input (i.e., input redundancy), that is, a single created input (I/O Expansion Wizard > Add Inputs Tab) is assigned to more than one card input slot (I/O Expansion Wizard > I/O Modules Tab):

**WARNING:**
I/O EXPANSION INPUT REDUNDANCY IS SUPPORTED FOR HARDWARE REDUNDANCY ONLY (I.E., THE SYSTEM CONTINUES TO RUN IF A REDUNDANT INPUT LOSES COMMUNICATION WITH THE BMS CONTROLLER, BUT THE REDUNDANT INPUT STATE IS DETERMINED BY A SINGLE INPUT ONLY). THE INPUT STATE OF THE REDUNDANT INPUT IS DETERMINED BY THE FIRST INPUT TO ESTABLISH COMMUNICATION WITH THE BMS CONTROLLER ONLY.

### 12.5.4 SYSTEM BEHAVIOR – IO EXPANSION CARD 4-20mA INPUT

| SCENARIO | | | STATE TRANSITION | CONTROLLER ALERTS |
|---|---|---|---|---|
| INPUT MODE | CONTROLLER STATE | INPUT STATE (SEE WARNING BELOW FOR APPLICATIONS USING REDUNDANT INPUTS) | | |
| Any except Proof of Airflow | Any | Not tripped | No effect | N/A |
| Any[1] | Any | Out of Range | Alarm/Lockout | IO Expansion Input Invalid alarm |
| Alarm | Any stopped state | Low Trip | Alarm | IO Expansion Analog Input Low alarm |
| | | High Trip | Alarm | IO Expansion Analog Input High alarm |
| | Any running state | Low Trip | Lockout | IO Expansion Analog Input Low alarm |
| | | High Trip | Lockout | IO Expansion Analog Input High alarm |
| Wait | Any stopped state | Low Trip | No effect | IO Expansion Analog Input Low wait |
| | | High Trip | No effect | IO Expansion Analog Input High wait |
| | Any running state | Low Trip | Waiting | IO Expansion Analog Input Low wait |
| | | High Trip | Waiting | IO Expansion Analog Input High wait |
| Warning | Any | Low Trip | No effect | IO Expansion Analog Input Low warning |
| | | High Trip | No effect | IO Expansion Analog Input High warning |
| Main Permissive | Any non-main state | Low Trip | No effect | IO Expansion Analog Input Low main permissive |
| | | High Trip | No effect | IO Expansion Analog Input High main permissive |
| | Any main fuel state | Low Trip | Pilot[2] | IO Expansion Analog Input Low main permissive |
| | | High Trip | Pilot[2] | IO Expansion Analog Input High main permissive |
| Display Only | Any | Any | No effect | N/A |
| Non-fuel State Alarm | Any non-fuel state | Low Trip | Alarm/Lockout | IO Expansion Analog Input Low alarm |
| | | High Trip | Alarm/Lockout | IO Expansion Analog Input High alarm |
| | Any fuel state | Low Trip | No effect | N/A |
| | | High Trip | No effect | N/A |
| Pilot State Alarm | Any state other than Pilot | Low Trip | No effect | N/A |
| | | High Trip | No effect | N/A |
| | Pilot | Low Trip | Lockout | IO Expansion Analog Input Low alarm |
| | | High Trip | Lockout | IO Expansion Analog Input High alarm |
| Main State Alarm | Any non-main state | Low Trip | No effect | N/A |
| | | High Trip | No effect | N/A |
| | Any main state | Low Trip | Lockout | IO Expansion Analog Input Low alarm |
| | | High Trip | Lockout | IO Expansion Analog Input High alarm |
| Local Proof of Airflow | Refer to Proof of Airflow Behavior table below for system behavior | | | |
| Secondary PID Input | Refer to PID Tuning Guide document for advanced PID system behavior | | | |

[1] *Except in Display Only or Warning states.*

[2] *When Pilot Off mode is set to Off After Main On, the controller transitions to the Waiting state, then purges the system before reigniting and proceeding to Pilot.*

The following is for applications that have multiple input devices monitoring a single controller input (i.e., input redundancy), that is, a single created input (I/O Expansion Wizard > Add Inputs Tab) is assigned to more than one card input slot (I/O Expansion Wizard > I/O Modules Tab):

**WARNING:**
I/O EXPANSION INPUT REDUNDANCY IS SUPPORTED FOR HARDWARE REDUNDANCY ONLY (I.E., THE SYSTEM CONTINUES TO RUN IF A REDUNDANT INPUT LOSES COMMUNICATION WITH THE BMS CONTROLLER OR GOES OUT OF RANGE, BUT THE REDUNDANT INPUT STATE IS DETERMINED BY A SINGLE INPUT ONLY). THE INPUT STATE OF THE REDUNDANT INPUT IS DETERMINED BY THE FIRST INPUT TO ESTABLISH COMMUNICATION WITH THE BMS CONTROLLER ONLY.

### 12.5.5 SYSTEM BEHAVIOR – IO EXPANSION CARD LOCAL PROOF OF AIRFLOW INPUT

This section is for a proof of airflow input wired to an I/O Expansion card. Refer to System Behavior – BMS Card Aux In Proof of Airflow section for a proof of airflow input wired to a BMS Controller card. Proof of Airflow inputs apply only to the BMS controller card to which they are connected (either directly through the BMS Aux In contact or through an I/O Expansion card). Each BMS requiring a Proof of Airflow input must have either (1) a proof of airflow switch wired to its Aux In contact or (2) a proof of airflow device wired to a dedicated I/O Expansion card with a single logical Local Proof of Airflow input.

| SIGNAL TYPE SETTING | HFV OUTPUT MODE SETTING | CONTROLLER STATE | INPUT STATE | STATE TRANSITION | CONTROLLER ALERTS |
|---|---|---|---|---|---|
| Digital | Any | Startup Checks | Energized | Lockout | Airflow Input Stuck |
| | | | De-energized | Pre-Purge | N/A |
| | | Proven Pre-Purge | Energized | No effect | N/A |
| | | | De-energized | Lockout | Failed to Prove Airflow While Purging |
| | Forced Draft Fan | Any fuel state | Energized | No effect | N/A |
| | | | De-energized | Lockout | Failed to Prove Airflow While Running |
| | Purge Fan | Any fuel state | Any | No effect | N/A |
| 4-20 | Any | Any | Out of Range | Alarm/Lockout | I/O Expansion POAF Input Invalid alarm |
| | | Any | High Trip | | |
| | | Startup Checks | Valid range [1] | Lockout | Airflow Input Stuck |
| | | | Low Trip | Pre-Purge | N/A |
| | | Proven Pre-Purge | Valid range [1] | No effect | N/A |
| | | | Low Trip | Lockout | Failed to Prove Airflow While Purging |
| | Forced Draft Fan | Any fuel state | Valid range [1] | No effect | N/A |
| | | | Low Trip | Lockout | Failed to Prove Airflow While Running |
| | Purge Fan | Any fuel state | Valid range [1] | No effect | N/A |
| | | | Low Trip | No effect | N/A |

*[1] An input is in the valid range when it is above the configured Low Trip setting and below the configured High Trip setting.*

### 12.5.6 SYSTEM BEHAVIOR – FARC POSITION FEEDBACK INPUT

| SCENARIO | | | STATE TRANSITION | CONTROLLER ALERTS |
|---|---|---|---|---|
| INPUT SIGNAL | CROSS LIMIT ERROR | CONTROLLER STATE | | |
| Out of Range | Any | Any running | Lockout | IO Expansion Invalid alarm |
| | | Any stopped | Alarm | |
| Within position error of expected position | Below Cross Limit Error setting | Any | No effect | N/A |
| Outside position error of expected position | | Any running | Lockout | FARC Fuel Channel Position |
| | | Any stopped | Alarm | |
| Any | Above Cross Limit Error setting | Any running | Lockout | FARC Cross Limit Error alarm |
| | | Any stopped | Alarm | |

### 12.5.7 SYSTEM BEHAVIOR – BLEED VALVE PROOF OF OPEN INPUT

| SCENARIO | | STATE TRANSITION | CONTROLLER ALERTS |
|---|---|---|---|
| CONTROLLER STATE | INPUT STATE | | |
| Any non-main state | Energized | No effect | N/A |
| | De-energized | Alarm/Lockout | Bleed Valve Closed With Mains Off alarm |
| Any main state | Energized | Lockout | Bleed Valve Open With Mains On alarm |
| | De-energized | No effect | N/A |

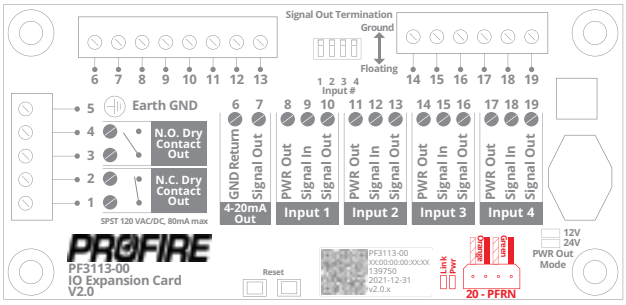
### 12.5.8 SYSTEM BEHAVIOR – OXYGEN SENSOR INPUT

| SCENARIO | | | STATE TRANSITION | $O_2$ TRIM CONTROLLER BEHAVIOR | CONTROLLER ALERTS |
|---|---|---|---|---|---|
| CONTROLLER STATE | WARMUP COMPLETE [1] | INPUT STATE | | | |
| Process Control | Yes | Above High Setpoint | N/A | Actively trimming to achieve Target $O_2$ Setpoint [2] | High Measured %$O_2$ warning |
| | | Above Target $O_2$ Value | N/A | Actively trimming to achieve Target $O_2$ Setpoint [2] | $O_2$ Trim at Limit warning<br>* If at Max Trim value |
| | | At Target $O_2$ Value | N/A | Not trimming | N/A |
| | | Below Target $O_2$ Value | N/A | Actively trimming to achieve Target $O_2$ Setpoint [2] | O2 Trim at Limit warning<br>* If at Min Trim value |
| | | Below Low Setpoint | Lockout | Not trimming | Low %$O_2$ alarm |
| | No | Any | N/A | Not trimming | N/A |
| Not Process Control | No | Any | N/A | Not trimming | N/A |

*[1] The $O_2$ Trim warmup period is determined in accordance with the Warmup Mode setting (FARC/$O_2$ Trim Wizard > $O_2$ Trim Tab).*

*[2] In accordance with the configured Trim Channel setting, $O_2$ Proportional Band setting, $O_2$ Integral Time setting and $O_2$ Trim table limits (FARC/$O_2$ Trim Wizard > $O_2$ Trim Tab). Trimming consists of applying an offset to the output value of the configured Trim Channel to achieve the configured Target $O_2$ value for the current firing rate of the system.*

## 12.6 PFRN PORT




### 12.6.1 DETAILS

| | |
|---|---|
| **TERMINAL** | 20 |
| **NAME** | PFRN |
| **TYPE** | PFRN I/O Network Port |

### 12.6.2 INTENDED FIELD DEVICE CONNECTIONS

| FIELD DEVICE | CONFIGURATION REQUIREMENTS | CONNECTION DIAGRAMS |
|---|---|---|
| PF3101-00 BMS card PFRN I/O Network port | N/A | PFRN Connector Wiring<br>I/O Card PFRN Wiring Options |

### 12.6.3 SYSTEM BEHAVIOR – DIAGNOSTIC LEDS

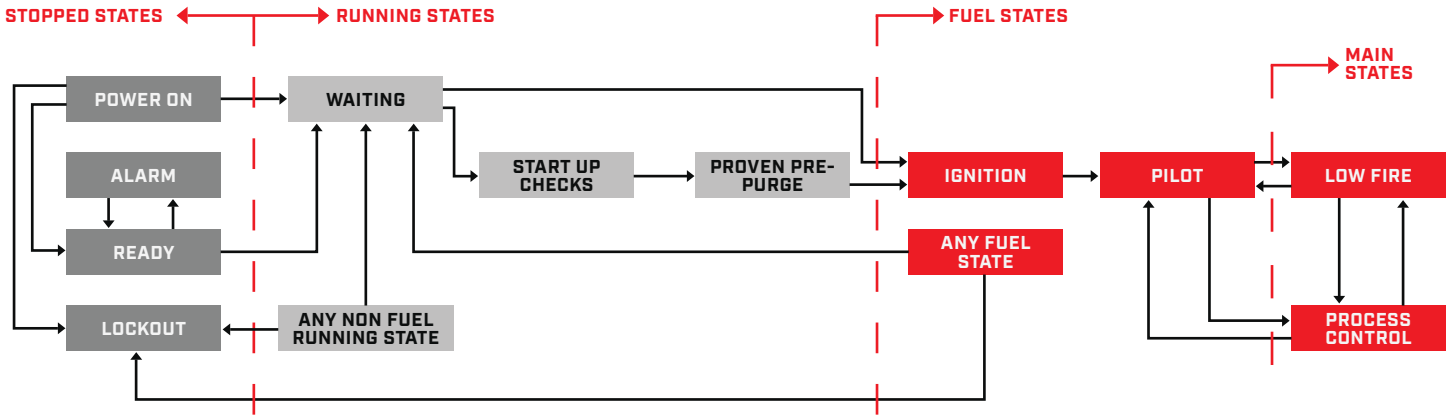
| NAME | COLOR | LED BEHAVIOR | INTERPRETATION | ISSUE/CORRECTIVE ACTION |
|---|---|---|---|---|
| Pwr | Blue | Off | Port has no power | No BMS Power – Make sure BMS Controller card is powered on.<br>Wiring fault – Check PFRN wire terminations at BMS and I/O Expansion card.<br>Hardware fault – Contact Profire for replacement. |
| | | On – Solid | Port has power | N/A |
| | | On – Flickering | Port has intermittent power | Wiring fault – Check PFRN wire terminations at BMS and I/O Expansion card.<br>Hardware fault – Contact Profire for replacement. |
| Link | Green | Off/flickering | Port is not communicating | No PFRN Communication – Cycle power to BMS card and check PFRN wire terminations at BMS and I/O Expansion card. |
| | | On – Solid | Port is communicating normally | N/A |

### 12.6.4 SYSTEM BEHAVIOR UPON COMMUNICATION LOSS

Refer to BMS PFRN I/O Network System Behavior for behavior under communication loss conditions.

# 13 OPERATING SEQUENCE

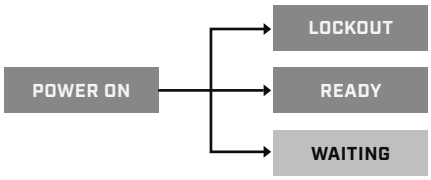
The PF3100 utilizes a state-based control scheme to monitor the system and control all safety outputs. Each state has specific entry and exit requirements and defined output behavior. The sections below outline the state transitions and safety output behavior for each controller state. Each BMS controller in an appliance operates independently in accordance with the operating sequence detailed below.




| STATE | STOPPED STATE | RUNNING STATE | FUEL STATE | MAIN STATE |
|---|---|---|---|---|
| Power On | YES | NO | NO | NO |
| Alarm | YES | NO | NO | NO |
| Ready | YES | NO | NO | NO |
| Lockout | YES | NO | NO | NO |
| Waiting | NO | YES | NO | NO |
| Startup Checks | NO | YES | NO | NO |
| Proven Pre-Purge | NO | YES | NO | NO |
| Ignition | NO | YES | YES | NO |
| Pilot | NO | YES | YES | NO |
| Low Fire | NO | YES | YES | YES |
| Process Control | NO | YES | YES | YES |

## 13.1 POWER ON STATE

The controller always enters the Power On state upon power up. All safety outputs are held de-energized, and a purge event is triggered upon entry into the state. The controller quickly transitions out of the Power On state in accordance with the state transition tables below.




### 13.1.1 SAFETY OUTPUT BEHAVIOR - POWER ON STATE

| CARD | OUTPUT | OUTPUT STATE |
|---|---|---|
| PF3101-00 BMS Controller card | Pilot | De-energized |
| | SSV1 | De-energized |
| | SSV2 | De-energized |
| PF3102-00 Ion Pilot card | Valve | De-energized |
| | Coil | De-energized |
| PF3102-01 UV Pilot card | Ignition Enable | Open |

### 13.1.2 TRANSITIONS TO THE POWER ON STATE

| FROM | SCENARIO | CONDITION |
|---|---|---|
| Power Off | Any | Any |

### 13.1.3 TRANSITIONS FROM THE POWER ON STATE

| TO | SCENARIO | CONDITION |
|---|---|---|
| Lockout | Any | Unacknowledged lockout message present |
| Alarm<br>* via Ready | Any | Alarm condition present |
| Ready | Controller was not running at last power down | **Low Voltage Restart** setting is set to **Enabled**, AND<br>No alarm conditions present |
| | Any | **Low Voltage Restart** setting is set to **Disabled**, AND<br>No alarm conditions or unacknowledged lockout messages present |
| Waiting | Controller was running at last power down | **Low Voltage Restart** setting is set to **Enabled**, AND<br>No alarm conditions or unacknowledged lockout messages present |

## 13.2 ALARM STATE

The controller transitions to the Alarm state when (1) an alarm condition is present and (2) the controller is not running. The controller cannot transition out of the Alarm state until all alarm conditions are cleared. All safety outputs are held de-energized while the controller is in the Alarm state.


### 13.2.1 SAFETY OUTPUT BEHAVIOR - ALARM STATE

| CARD | OUTPUT | OUTPUT STATE |
|---|---|---|
| PF3101-00 BMS Controller card | Pilot | De-energized |
| | SSV1 | De-energized |
| | SSV2 | De-energized |
| PF3102-00 Ion Pilot card | Valve | De-energized |
| | Coil | De-energized |
| PF3102-01 UV Pilot card | Ignition Enable | Open |

### 13.2.2 TRANSITIONS TO THE ALARM STATE

| FROM | SCENARIO | CONDITION |
|---|---|---|
| Ready | Any | Alarm condition present |
| Power On<br>* via Ready | Any | Alarm condition present |
| Lockout<br>* via Ready | Lockout message acknowledged by user | Alarm condition present |

### 13.2.3 TRANSITIONS TO THE ALARM STATE

| TO | SCENARIO | CONDITION |
|---|---|---|
| Ready | Any | No alarm conditions present |

## 13.3 READY STATE

The controller transitions to the Ready state when all alarm conditions are cleared and holds all safety outputs de-energized. A user can only start the controller from the Ready state.


### 13.3.1 SAFETY OUTPUT BEHAVIOR - READY STATE

| CARD | OUTPUT | OUTPUT STATE |
|---|---|---|
| PF3101-00 BMS Controller card | Pilot | De-energized |
| | SSV1 | De-energized |
| | SSV2 | De-energized |
| PF3102-00 Ion Pilot card | Valve | De-energized |
| | Coil | De-energized |
| PF3102-01 UV Pilot card | Ignition Enable | Open |

### 13.3.2 TRANSITIONS TO THE POWER ON STATE

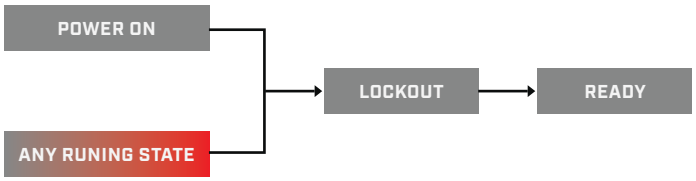
| FROM | SCENARIO | CONDITION |
|---|---|---|
| Power On | Controller was not running at last power down | **Low Voltage Restart** setting is set to **Enabled**, AND<br>No alarm conditions present |
| | Any | **Low Voltage Restart** setting is set to **Disabled**, AND<br>No alarm conditions or unacknowledged lockout messages present |
| Lockout | Lockout message acknowledged by user | Any |
| Alarm | Any | No alarm conditions present |

### 13.3.3 TRANSITIONS FROM THE READY STATE

| TO | SCENARIO | CONDITION |
|---|---|---|
| Alarm | Any | Alarm condition present |
| Waiting | Controller started by user | Any |

## 13.4 LOCKOUT STATE

The controller transitions to the Lockout state (1) when there is an alarm condition present while the system is running and (2) upon power up when there is an unacknowledged lockout message present when the system was last powered down. The safety outputs are held de-energized, and a purge event is initiated upon entry into the state.




### 13.4.1 SAFETY OUTPUT BEHAVIOR - LOCKOUT STATE

| CARD | OUTPUT | OUTPUT STATE |
|---|---|---|
| PF3101-00 BMS Controller card | Pilot | De-energized |
| | SSV1 | De-energized |
| | SSV2 | De-energized |
| PF3102-00 Ion Pilot card | Valve | De-energized |
| | Coil | De-energized |
| PF3102-01 UV Pilot card | Ignition Enable | Open |

### 13.4.2 TRANSITIONS TO THE LOCKOUT STATE

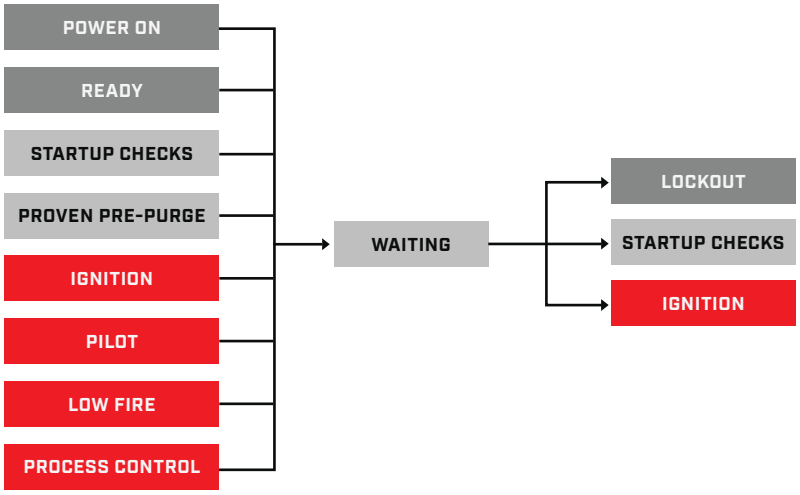
| FROM | SCENARIO | CONDITION |
|---|---|---|
| Power On | Any | Unacknowledged lockout message present |
| Waiting | Any | Alarm condition present |
| | Controller stopped by user | Any |
| Startup Checks | Any | Alarm condition present |
| | Controller stopped by user | Any |
| | Airflow detected | Any |
| Pre-Purge | Any | Alarm condition present |
| | Controller stopped by user | Any |
| | Purge position not proven | Controller not in Request Pilot Position sub-state |
| | Airflow not proven | Controller in Prove Airflow or Pre-Purge sub-state |
| | Pilot position not proven | Controller in Request Pilot Position sub state |
| Ignition | Any | Alarm condition present |
| | Controller stopped by user | Any |
| | Pilot ignition failure | **Ignition Attempts** setting has been exceeded |
| | Flame loss | **Relight Attempts** setting exceeded |
| | Flame detected upon transition into Ignition state | Any |
| Pilot | Any | Alarm condition present |
| | Controller stopped by user | Any |
| | Flame loss | **Relight Attempts** setting exceeded |
| | Light Off Position not proven | Controller is in Request Light Off Position sub state, AND **Position Error Timeout** setting has elapsed |
| Low Fire or Process Control | Any | Alarm condition present |
| | Controller stopped by user | Any |
| | Flame loss | **Relight Attempts** setting exceeded |

### 13.4.3 TRANSITIONS FROM THE LOCKOUT STATE

| TO | SCENARIO | CONDITION |
|---|---|---|
| Ready | Lockout message acknowledged | Any |
| Alarm via Ready | Lockout message acknowledged | Alarm condition present |

## 13.5 WAITING STATE

The controller transitions to the Waiting state when (1) the controller is started from a stopped state or (2) a wait condition in present while in a running state. Waiting is a running state that holds all safety outputs de-energized. A purge event is triggered when entering the Waiting state from a fuel state.




### 13.5.1 SAFETY OUTPUT BEHAVIOR - WAITING STATE

| CARD | OUTPUT | OUTPUT STATE |
|---|---|---|
| PF3101-00 BMS Controller card | Pilot | De-energized |
| | SSV1 | De-energized |
| | SSV2 | De-energized |
| PF3102-00 Ion Pilot card | Valve | De-energized |
| | Coil | De-energized |
| PF3102-01 UV Pilot card | Ignition Enable | Open |

### 13.5.2 TRANSITIONS TO THE WAITING STATE

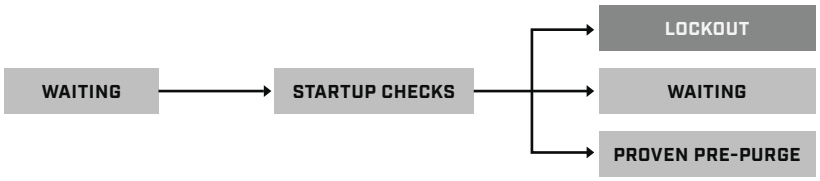
| FROM | SCENARIO | CONDITION |
|---|---|---|
| Power On | Controller was running at last power down | **Low Voltage Restart** setting is set to **Enabled**, AND<br>No alarm conditions or unacknowledged lockout messages present |
| Ready | User start | Any |
| Startup Checks<br>Pre-Purge | Any | Wait condition present |
| Ignition | Any | Wait condition present |
| | Pilot Ignition failure | **Ignition Attempts** setting has not been exceeded |
| | Flame loss | **Relight Attempts** setting has not been exceeded |
| Pilot | Any | Wait condition present |
| | Flame loss | **Relight Attempts** setting has not been exceeded |
| Low Fire | Any | Wait condition present |
| | Any | Main permissive condition present, AND<br>**Pilot Off Mode** setting is set to **Off after Main On** or **Follow Main** |
| | Flame loss | **Relight Attempts** setting has not been exceeded |
| | Process temperature is above its configured Process setpoint | **Pilot Off Mode** setting is set to **Off after Main On** or **Follow Main** |
| Process Control -<br>High Fire | Any | Wait condition present |
| | Any | Main permissive condition present, AND<br>**Pilot Off Mode** setting is set to **Off after Main On** or **Follow Main** |
| | Flame loss | **Relight Attempts** setting has not been exceeded |
| | Process temperature is above its configured Process setpoint | **Low Fire Mode** setting is set to **Disabled**, AND<br>**Pilot Off Mode** setting is set to **Off after Main On** or **Follow Main** |
| Process Control -<br>Incinerate | Any | Wait condition present |
| | Any | Main permissive condition present, AND<br>**Pilot Off Mode** setting is set to **Off after Main On** or **Follow Main** |
| | Flame loss | **Relight Attempts** setting has not been exceeded |
| Process Control -<br>Incinerate No Assist | Any | Wait condition present |
| | Any | Main permissive condition present, AND<br>**Pilot Off Mode** setting is set to **Off after Main On** or **Follow Main** |
| | Flame loss | **Relight attempts** setting has not been exceeded |
| | Process temperature is above its configured Process setpoint and below its Low Fire setpoint | **Pilot Off Mode** setting is set to **Off after Main On or Follow Main** |
| Process Control -<br>PID Control | Any | Wait condition present |
| | Any | Main permissive condition present, AND<br>**Pilot Off Mode** setting is set to **Off after Main On or Follow Main** |
| | Flame loss | **Relight Attempts** setting has not been exceeded |
| | Process temperature is above its configured Process setpoint and below its Low Fire setpoint | **Low Heat Standby Mode** setting is set to **Wait**, AND<br>**Low Heat Standby Delay** has elapsed |
| | Process temperature is above its configured Low Fire setpoint | **Pilot Off Mode** setting is set to **Off after Main On or Follow Main** |

### 13.5.3 TRANSITIONS FROM THE WAITING STATE

| TO | SCENARIO | CONDITION |
|---|---|---|
| Lockout | Any | Alarm condition present |
| | Controller stopped by user | Any |
| Startup Checks | Any | **FARC Enable** setting is **Enabled**, AND<br>No alarm or wait conditions present |
| Ignition | Any | **FARC Enable** setting is **Disabled**, AND<br>No alarm or wait conditions present |

## 13.6 STARTUP CHECKS STATE

The controller transitions to the Startup Checks state when the system is configured for FARC applications. It is to ensure that the airflow monitoring device is not stuck open prior to pre-purging. It is a running state that holds all safety outputs de-energized.




### 13.6.1 SAFETY OUTPUT BEHAVIOR – STARTUP CHECKS STATE

| CARD | OUTPUT | OUTPUT STATE |
|---|---|---|
| PF3101-00 BMS Controller card | Pilot | De-energized |
| | SSV1 | De-energized |
| | SSV2 | De-energized |
| PF3102-00 Ion Pilot card | Valve | De-energized |
| | Coil | De-energized |
| PF3102-01 UV Pilot card | Ignition Enable | Open |

### 13.6.2 TRANSITIONS TO THE STARTUP CHECKS STATE

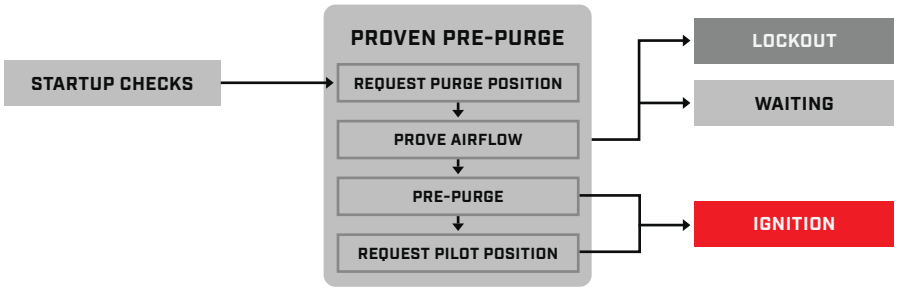
| FROM | SCENARIO | CONDITION |
|---|---|---|
| Waiting | Any | **FARC Enable** setting is **Enabled**, AND<br>No alarm or wait conditions present |
| N/A - State skipped entirely | | FARC Enable setting is Disabled |

### 13.6.3 TRANSITIONS FROM THE STARTUP CHECKS STATE

| TO | SCENARIO | CONDITION |
|---|---|---|
| Lockout | Any | Alarm condition present |
| | Controller stopped by user | Any |
| | Airflow detected | Any |
| Waiting | Any | Wait condition present |
| Proven Pre-Purge | Absence of airflow proven | No alarm or wait conditions present |

## 13.7 PROVEN PRE-PURGE SEQUENCE

The Proven Pre-Purge sequence is a collection of sub-states that ensures a proper pre-purge for all forced draft heating applications. The safety outputs are held de-energized through all the Proven Pre-Purge sub-states. The sub-states are detailed in the sections below:




### 13.7.1 REQUEST PURGE POSITION STATE

The controller transitions to the Request Purge Position sub-state to ensure that all FARC channel outputs are driven to their respective Purge Positions before initiating a pre-purge. All safety outputs are held de-energized for the duration of the Request Purge Position sub-state.

#### 13.7.1.1 SAFETY OUTPUT BEHAVIOR – REQUEST PURGE POSITION STATE

| CARD | OUTPUT | OUTPUT STATE |
|---|---|---|
| PF3101-00 BMS Controller card | Pilot | De-energized |
| | SSV1 | De-energized |
| | SSV2 | De-energized |
| PF3102-00 Ion Pilot card | Valve | De-energized |
| | Coil | De-energized |
| PF3102-01 UV Pilot card | Ignition Enable | Open |

#### 13.7.1.2 TRANSITIONS TO THE REQUEST PURGE POSITION STATE

| FROM | SCENARIO | CONDITION |
|---|---|---|
| Startup Checks | Absence of airflow proven | No alarm or wait conditions present |

#### 13.7.1.3 TRANSITIONS FROM THE REQUEST PURGE POSITION STATE

| TO | SCENARIO | CONDITION |
|---|---|---|
| Lockout | Any | Alarm condition present |
| | Controller stopped by user | Any |
| | Purge position not proven | Any |
| Waiting | Any | Wait condition present |
| Prove Airflow | Purge position proven | No alarm or wait conditions present |

### 13.7.2 PROVE AIRFLOW STATE

The controller transitions to the Prove Airflow sub-state to energize the fan (HFV) output and ensure that adequate airflow is detected before proceeding with the pre-purge sequence. All safety outputs are held de-energized for the duration of the Prove Airflow sub-state.

#### 13.7.2.1 SAFETY OUTPUT BEHAVIOR – PROVE AIRFLOW STATE

| CARD | OUTPUT | OUTPUT STATE |
|---|---|---|
| PF3101-00 BMS Controller card | Pilot | De-energized |
| | SSV1 | De-energized |
| | SSV2 | De-energized |
| PF3102-00 Ion Pilot card | Valve | De-energized |
| | Coil | De-energized |
| PF3102-01 UV Pilot card | Ignition Enable | Open |

#### 13.7.2.2 TRANSITIONS TO THE PROVE AIRFLOW STATE

| FROM | SCENARIO | CONDITION |
|---|---|---|
| Request Purge Position | Purge position proven | No alarm or wait conditions present |

#### 13.7.2.3 TRANSITIONS FROM THE PROVE AIRFLOW STATE

| TO | SCENARIO | CONDITION |
|---|---|---|
| Lockout | Any | Alarm condition present |
| | Controller stopped by user | Any |
| | Purge position not proven | Any |
| | Airflow not proven | Any |
| Waiting | Any | Wait condition present |
| Pre-Purge | Airflow has been proven | No alarm or wait conditions present |

### 13.7.3 PRE-PURGE STATE

The controller transitions to the Pre-Purge sub-state to ensure that adequate airflow is detected for the duration of the pre-purge time. The fan (HFV) output is held energized, and the output positioners are held at their respective purge positions. All safety outputs are held de-energized for the duration of the Pre-Purge sub-state.

#### 13.7.3.1 SAFETY OUTPUT BEHAVIOR – PRE-PURGE STATE

| CARD | OUTPUT | OUTPUT STATE |
|---|---|---|
| PF3101-00 BMS Controller card | Pilot | De-energized |
| | SSV1 | De-energized |
| | SSV2 | De-energized |
| PF3102-00 Ion Pilot card | Valve | De-energized |
| | Coil | De-energized |
| PF3102-01 UV Pilot card | Ignition Enable | Open |

#### 13.7.3.2 TRANSITIONS TO THE PRE-PURGE STATE

| FROM | SCENARIO | CONDITION |
|---|---|---|
| Prove Airflow | Airflow has been proven | No alarm or wait conditions present |

#### 13.7.3.3 TRANSITIONS FROM THE PRE-PURGE STATE

| TO | SCENARIO | CONDITION |
|---|---|---|
| Lockout | Any | Alarm condition present |
| | Controller stopped by user | Any |
| | Airflow not proven for duration of purge | Any |
| | Purge position not proven for duration of purge | Any |
| Waiting | Any | Wait condition present |
| Request Pilot Position | Pre-purge has completed successfully | FARC enabled, AND<br>No alarm or wait conditions present |
| Ignition | Pre-purge has completed successfully | FARC disabled, AND<br>No alarm or wait conditions present |

### 13.7.4 REQUEST PILOT POSITION STATE

The controller transitions to the Request Pilot Position sub-state after a successful pre-purge. The fan (HFV) output remains energized, and all FARC channel outputs are driven to their respective Pilot Positions. All safety outputs are held de-energized for the duration of the Request Pilot Position sub-state.

#### 13.7.4.1 SAFETY OUTPUT BEHAVIOR – REQUEST PILOT POSITION STATE

| CARD | OUTPUT | OUTPUT STATE |
|---|---|---|
| PF3101-00 BMS Controller card | Pilot | De-energized |
| | SSV1 | De-energized |
| | SSV2 | De-energized |
| PF3102-00 Ion Pilot card | Valve | De-energized |
| | Coil | De-energized |
| PF3102-01 UV Pilot card | Ignition Enable | Open |

#### 13.7.4.2 TRANSITIONS TO THE REQUEST PILOT POSITION STATE

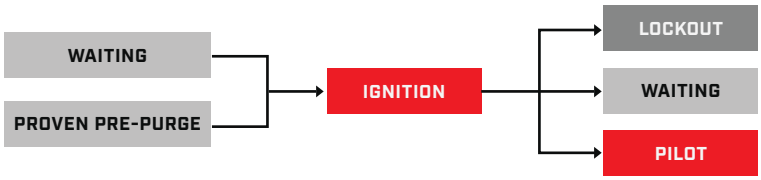
| FROM | SCENARIO | CONDITION |
|---|---|---|
| Pre-Purge | Pre-purge has completed successfully | No alarm or wait conditions present |

#### 13.7.4.3 TRANSITIONS FROM THE REQUEST PILOT POSITION STATE

| TO | SCENARIO | CONDITION |
|---|---|---|
| Lockout | Any | Alarm condition present |
| | Controller stopped by user | Any |
| | Pilot position not proven | Any |
| Waiting | Any | Wait condition present |
| Ignition | Pilot position proven | No alarm or wait conditions present |

## 13.8 IGNITION STATE

The controller transitions to the Ignition state to initiate pilot light off for all connected pilot cards. The Ignition state is a fuel state that energizes the pilot valve outputs and ignition outputs but holds all main valve outputs de-energized. Successful pilot ignition is required for the controller to transition into any other fuel state.




### 13.8.1 SAFETY OUTPUT BEHAVIOR - IGNITION STATE

| CARD | OUTPUT | OUTPUT STATE |
|---|---|---|
| PF3101-00 BMS Controller card | Pilot | Energized |
| | SSV1 | De-energized |
| | SSV2 | De-energized |
| PF3102-00 Ion Pilot card | Valve | Energized |
| | Coil | Energized |
| PF3102-01 UV Pilot card | Ignition Enable | Closed* |

** Open when associated Flame Source setting (found in Ignition Wizard) is configured as Main.*

### 13.8.2 TRANSITIONS TO THE IGNITION STATE

| FROM | SCENARIO | CONDITION |
|---|---|---|
| Waiting | Any | **FARC Enable** setting is **Disabled**, AND<br>No alarm or wait conditions present |
| Proven Pre-Purge | Pre-purge sequence completed successfully | No alarm or wait conditions present |

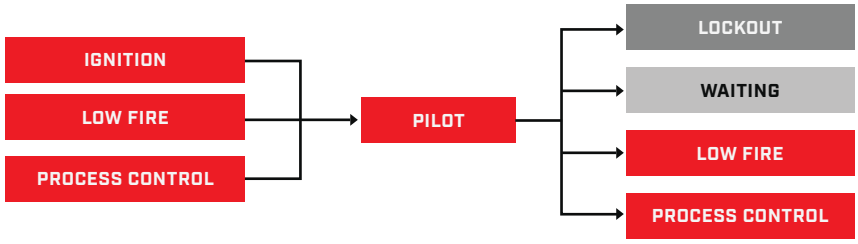
### 13.8.3 TRANSITIONS FROM THE IGNITION STATE

| TO | SCENARIO | CONDITION |
|---|---|---|
| Lockout | Any | Alarm condition present |
| | Controller stopped by user | Any |
| | Pilot ignition failure* | **Ignition Attempts** setting has been exceeded |
| | Flame loss | **Relight Attempts** setting has been exceeded |
| | Flame detected upon transition into Ignition state | Any |
| Waiting | Any | Wait condition present |
| | Pilot ignition failure* | **Ignition Attempts** settings has not been exceeded |
| | Flame loss | **Relight Attempts** settings has not been exceeded |
| Pilot | Successful pilot flame ignition | No alarm or wait conditions present, AND<br>**Minimum Pilots Running** setting is satisfied |

** Pilot ignition failure - Controller has remained in the Ignition state for the duration of the the configured Trial for Ignition Time setting without establishing flame.*

## 13.9 PILOT STATE

The controller transitions to the Pilot state (1) after successful pilot ignition, or (2) from a main fuel state upon high temperature or a main permissive condition. The Pilot state is a fuel state that holds the pilot valve outputs energized while holding the ignition outputs and main fuel valve outputs de-energized.




### 13.9.1 SAFETY OUTPUT BEHAVIOR - PILOT STATE

| CARD | OUTPUT | OUTPUT STATE |
|---|---|---|
| PF3101-00 BMS Controller card | Pilot | Energized |
| | SSV1 | De-energized |
| | SSV2 | De-energized |
| PF3102-00 Ion Pilot card | Valve | Energized |
| | Coil | De-energized [1] |
| PF3102-01 UV Pilot card | Ignition Enable | Open [2] |

*[1] Energized under reignition conditions in accordance with configured Pilot Relight Mode and Pilot Relight Timeout settings (Controller Settings > Outputs > Ignition).*
*[2] Closed under reignition conditions in accordance with configured Pilot Relight Mode and Pilot Relight Timeout settings (Controller Settings > Outputs > Ignition) when Flame Source setting (Ignition Wizard) is configured as (1) Pilot and Main or (2) Pilot.*

### 13.9.2 TRANSITIONS TO THE PILOT STATE

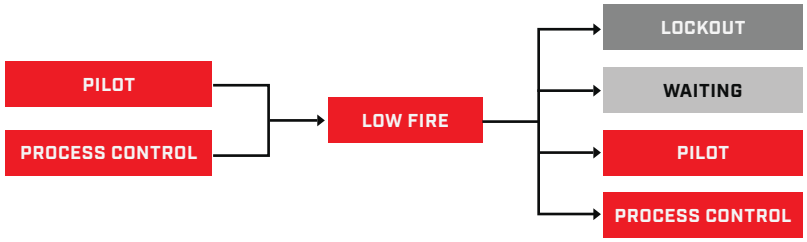
| FROM | SCENARIO | CONDITION |
|---|---|---|
| Ignition | Successful pilot flame ignition | No alarm or wait conditions present, AND<br>**Minimum Pilots Running** setting is satisfied |
| Low Fire | Any | Main permissive condition present, AND<br>**Pilot Off Mode** setting is set to **Disabled** or **Off at Setpoint** |
| | Process temperature is above its configured Low Fire setpoint | **Pilot Off Mode** setting is set to **Disabled** or **Off at Setpoint** |
| Process Control<br>- High Fire | Any | Main permissive condition present, AND<br>**Pilot Off Mode** setting is set to Disabled or Off at Setpoint |
| | Process temperature is above its configured Process setpoint | **Low Fire Mode** setting is set to **Disabled**, AND<br>**Pilot Off Mode** is set to **Disabled** or **Off at Setpoint** |
| Process Control<br>- Incinerate | Any | Main permissive condition present, AND<br>**Pilot Off Mode** setting is set to **Disabled** or **Off at Setpoint** |
| Process Control<br>- Incinerate No Assist | Any | Main permissive condition present, AND<br>**Pilot Off Mode** setting is set to **Disabled** or **Off at Setpoint** |
| | Process temperature is above its configured Waste Gas Off setpoint | **Pilot Off Mode** setting is set to **Disabled** or **Off at Setpoint** |
| Process Control<br>- PID Control | Any | Main permissive condition present, AND<br>**Pilot Off Mode** setting is set to **Disabled** or **Off at Setpoint** |
| | Process temperature is above its configured Process setpoint and below its Low Fire setpoint | **Low Heat Standby Mode** setting is set to **Main Permissive,** AND<br>**Low Heat Standby Delay** has elapsed |
| | Process temperature is above its configured Low Fire setpoint | **Pilot Off Mode** setting is set to **Disabled** or **Off at Setpoint** |

### 13.9.3 TRANSITIONS FROM THE PILOT STATE

| TO | SCENARIO | CONDITION |
|---|---|---|
| Lockout | Any | Alarm condition present |
| | Controller stopped by user | Any |
| | Light Off Position has not been proven | **HFV Output Mode** setting is set to **Forced Draft**, AND **Position Error Timeout** setting has elapsed |
| | Flame loss | **Relight Attempts** setting has been exceeded |
| Waiting | Any | Wait condition present |
| | Flame loss | **Relight Attempts** setting limit has not been exceeded |
| Low Fire | Process temperature is below its configured Low Fire setpoint | **Low Fire Mode** setting is **not set to Disabled**, AND No main permissive conditions present, AND **Incinerator Enable** setting is set to **Disabled** |
| | Process temperature is below its configured Waste Gas On setpoint | No main permissive conditions present, AND **Incinerator Enable** setting is set to **Enabled** |
| Process Control - High Fire | Process temperature is below its configured Process setpoint | No main permissive conditions present, AND **Low Fire Mode** setting is set to **Disabled** |

## 13.10 LOW FIRE STATE

The Low Fire state is a main fuel state that holds the system at its lowest stable firing rate. The safety output behavior is dependent on system behavior and is summarized below.




### 13.10.1 SAFETY OUTPUT BEHAVIOR – LOW FIRE STATE

| CARD | OUTPUT | OUTPUT STATE |
|---|---|---|
| PF3101-00 BMS Controller card | Pilot | Energized [1] |
| | SSV1 | Energized |
| | SSV2 | Energized [2] |
| PF3102-00 Ion Pilot card | Valve | Energized [1] |
| | Coil | De-energized [3] |
| PF3102-01 UV Pilot card | Ignition Enable | Open [4] |

*[1] De-energized when Pilot Off Mode is set to Off After Main On*
*[2] De-energized when Incinerator Enable is set to Enabled*
*[3] Energized under reignition conditions in accordance with configured Pilot Relight Mode and Pilot Relight Timeout settings (Controller Settings > Outputs > Ignition).*
*[4] Closed under reignition conditions in accordance with configured Pilot Relight Mode and Pilot Relight Timeout settings (Controller Settings > Outputs > Ignition) when Flame Source setting (Ignition Wizard) is configured as (1) Pilot and Main or (2) Pilot.*

### 13.10.2 TRANSITIONS TO THE LOW FIRE STATE

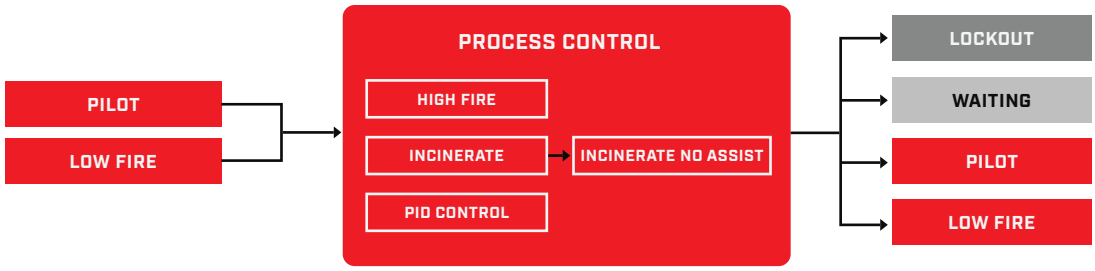
| FROM | SCENARIO | CONDITION |
|---|---|---|
| Pilot | Process temperature is below its configured Low Fire setpoint | **Low Fire Mode** setting is **not set to Disabled**, AND No main permissive conditions present, AND **Incinerator Enable** setting is set to **Disabled** |
| | Process temperature is below its configured Waste Gas On setpoint | No main permissive conditions present, AND **Incinerator Enable** setting is set to **Enabled** |
| Process Control – High Fire | Process temperature is above its configured Process setpoint | Any |
| Process Control – Incinerate | Process temperature is below its configured Waste Gas On setpoint | Any |

### 13.10.3 TRANSITIONS FROM THE LOW FIRE STATE

| TO | SCENARIO | CONDITION |
|---|---|---|
| Lockout | Any | Alarm condition present |
| | Controller stopped by user | Any |
| | Flame loss | **Relight Attempts** setting has been exceeded |
| Waiting | Any | Wait condition present |
| | Any | Main permissive condition present, AND<br>**Pilot Off Mode** setting is set to **Off after Main On** or **Follow Main** |
| | Flame loss | **Relight Attempts** setting has not been exceeded |
| | Process temperature is above its configured Low Fire setpoint | **Pilot Off Mode** setting is set to **Off after Main On** or **Follow Main** |
| Pilot | Any | Main permissive condition present, AND<br>**Pilot Off Mode** setting is set to **Disabled** or **Off at Setpoint** |
| | Process temperature is above its configured Low Fire setpoint | **Pilot Off Mode** setting is set to **Disabled** or **Off at Setpoint** |
| Process Control – High Fire | Process temperature is below its configured Process setpoint | **Low Fire Mode** setting is **not set to Disabled**, AND<br>No alarm or wait or main permissive conditions present |
| Process Control - Incinerate | Process temperature is above its configured Waste Gas On setpoint | **Incinerator Enable** setting is set to **Enabled**, AND<br>No alarm or wait or main permissive conditions present |
| Process Control – PID Control | Process temperature is below its configured Process setpoint | **4-20 Aux Out Mode** setting is set to **PID Control**, AND<br>No alarm or wait or main permissive conditions present |

## 13.11 PROCESS CONTROL STATES

The controller transitions to a Process Control state when its heat demand is the highest. The Process Control state to which the controller transitions is dependent on the system configuration settings. The state transition conditions and safety output behavior for each Process Control state are detailed in the sections below.




### 13.11.1 HIGH FIRE STATE

#### 13.11.1.1 SAFETY OUTPUT BEHAVIOR – HIGH FIRE STATE

| CARD | OUTPUT | OUTPUT STATE |
|---|---|---|
| PF3101-00 BMS Controller card | Pilot | Energized [1] |
| | SSV1 | Energized |
| | SSV2 | Energized |
| PF3102-00 Ion Pilot card | Valve | Energized [1] |
| | Coil | De-energized [2] |
| PF3102-01 UV Pilot card | Ignition Enable | Open [3] |

*[1] De-energized when Pilot Off Mode is set to Off After Main On*
*[2] Energized under reignition conditions in accordance with configured Pilot Relight Mode and Pilot Relight Timeout settings (Controller Settings > Outputs > Ignition).*
*[3] Closed under reignition conditions in accordance with configured Pilot Relight Mode and Pilot Relight Timeout settings (Controller Settings > Outputs > Ignition) when Flame Source setting (Ignition Wizard) is configured as (1) Pilot and Main or (2) Pilot.*

#### 13.11.1.2 TRANSITIONS TO THE HIGH FIRE STATE

| FROM | SCENARIO | CONDITION |
|---|---|---|
| Pilot | Process temp below configured Process setpoint | **Low Fire Mode** setting is **Disabled**, AND<br>No alarm or wait or main permissive conditions present |
| Low Fire | Process temp below configured Process setpoint | No alarm or wait or main permissive conditions present |

#### 13.11.1.3 TRANSITIONS FROM THE HIGH FIRE STATE

| TO | SCENARIO | CONDITION |
|---|---|---|
| Lockout | Any | Alarm condition present |
| | Controller stopped by user | Any |
| | Flame loss | **Relight Attempts** setting exceeded |
| Waiting | Any | Wait condition present |
| | Any | Main permissive condition present, AND<br>**Pilot Off Mode** setting is set to **Off after Main On** or **Follow Main** |
| | Flame loss | **Relight attempts** setting has not been exceeded |
| | Process temperature is above its configured Process setpoint | **Low Fire Mode** setting is set to **Disabled**, AND<br>**Pilot Off Mode** setting is set to **Off after Main On** or **Follow Main** |
| Pilot | Any | Main permissive condition present, AND<br>**Pilot Off Mode** setting is set to **Disabled** or **Off at Setpoint** |
| | Process temp above configured Process setpoint | **Low Fire Mode** setting is set to **Disabled**, AND<br>**Pilot Off Mode** is set to **Disabled** or **Off at Setpoint** |
| Low Fire | Process temp above configured Process setpoint | Any |

## 13.11.2 INCINERATE STATE

### 13.11.2.1 SAFETY OUTPUT BEHAVIOR - INCINERATE STATE

| CARD | OUTPUT | OUTPUT STATE |
|---|---|---|
| PF3101-00 BMS Controller card | Pilot | Energized [1] |
| | SSV1 | Energized |
| | SSV2 | Energized |
| PF3102-00 Ion Pilot card | Valve | Energized [1] |
| | Coil | De-energized [2] |
| PF3102-01 UV Pilot card | Ignition Enable | Open [3] |

*[1] De-energized when Pilot Off Mode is set to Off After Main On*
*[2] Energized under reignition conditions in accordance with configured Pilot Relight Mode and Pilot Relight Timeout settings (Controller Settings > Outputs > Ignition).*
*[3] Closed under reignition conditions in accordance with configured Pilot Relight Mode and Pilot Relight Timeout settings (Controller Settings > Outputs > Ignition) when Flame Source setting (Ignition Wizard) is configured as (1) Pilot and Main or (2) Pilot.*

### 13.11.2.2 TRANSITIONS TO THE INCINERATE STATE

| FROM | SCENARIO | CONDITION |
|---|---|---|
| Low Fire | Process temperature is above its configured Waste Gas On setpoint | **Incinerator Enable** setting is set to **Enabled**, AND<br>No alarm or wait or main permissive conditions present |
| Incinerate No Assist | Process temperature is below its configured Assist Gas Off Setpoint | No alarm or wait or main permissive conditions present |

### 13.11.2.3 TRANSITIONS FROM THE INCINERATE STATE

| TO | SCENARIO | CONDITION |
|---|---|---|
| Lockout | Any | Alarm condition present |
| | Controller stopped by user | Any |
| | Flame loss | **Relight Attempts** setting has been exceeded |
| Waiting | Any | Wait condition present |
| | Any | Main permissive condition present, AND<br>**Pilot Off Mode** setting is set to **Off after Main On** or **Follow Main** |
| | Flame loss | **Relight Attempts** setting has not been exceeded |
| Pilot | Any | Main permissive condition present, AND<br>**Pilot Off Mode** setting is set to **Disabled** or **Off at Setpoint** |
| Low Fire | Process temperature is below its configured Waste Gas On setpoint | **Incinerator Enable** setting is set to **Enabled**, AND<br>No alarm or wait or main permissive conditions present |
| Incinerate No Assist | Process temperature is above its configured Assist Gas Off Setpoint | No alarm or wait or main permissive conditions present |

### 13.11.3 INCINERATE NO ASSIST STATE

#### 13.11.3.1 SAFETY OUTPUT BEHAVIOR – INCINERATE NO ASSIST STATE

| CARD | OUTPUT | OUTPUT STATE |
|---|---|---|
| PF3101-00 BMS Controller card | Pilot | Energized [1] |
| | SSV1 | De-energized |
| | SSV2 | Energized |
| PF3102-00 Ion Pilot card | Valve | Energized [1] |
| | Coil | De-energized [2] |
| PF3102-01 UV Pilot card | Ignition Enable | Open [3] |

*[1] De-energized when Pilot Off Mode is set to Off After Main On*
*[2] Energized under reignition conditions in accordance with configured Pilot Relight Mode and Pilot Relight Timeout settings (Controller Settings > Outputs > Ignition).*
*[3] Closed under reignition conditions in accordance with configured Pilot Relight Mode and Pilot Relight Timeout settings (Controller Settings > Outputs > Ignition) when Flame Source setting (Ignition Wizard) is configured as (1) Pilot and Main or (2) Pilot.*

#### 13.11.3.2 TRANSITIONS TO THE INCINERATE NO ASSIST STATE

| FROM | SCENARIO | CONDITION |
|---|---|---|
| Incinerate | Process temperature is above its configured Assist Gas Off Setpoint | No alarm or wait or main permissive conditions present |

#### 13.11.3.3 TRANSITIONS FROM THE INCINERATE NO ASSIST STATE

| TO | SCENARIO | CONDITION |
|---|---|---|
| Lockout | Any | Alarm condition present |
| | Controller stopped by user | Any |
| | Flame loss | **Relight Attempts** setting has been exceeded |
| Waiting | Any | Wait condition present |
| | Any | Main permissive condition present, AND **Pilot Off Mode** setting is set to **Off after Main On** or **Follow Main** |
| | Flame loss | **Relight Attempts** setting has not been exceeded |
| | Process temperature is above its configured Waste Gas Off setpoint | **Pilot Off Mode** setting is set to **Off after Main On** or **Follow Main** |
| Pilot | Any | Main permissive condition present, AND **Pilot Off Mode** setting is set to **Disabled** or **Off at Setpoint** |
| | Process temperature is above its configured Waste Gas Off setpoint | **Pilot Off Mode** setting is set to **Disabled** or **Off at Setpoint** |
| Incinerate | Process temperature is below its configured Assist Gas Off Setpoint | No alarm or wait or main permissive conditions present |

### 13.11.4 PID CONTROL STATE

#### 13.11.4.1 SAFETY OUTPUT BEHAVIOR – PID CONTROL STATE

| CARD | OUTPUT | OUTPUT STATE |
|---|---|---|
| PF3101-00 BMS Controller card | Pilot | Energized [1] |
| | SSV1 | Energized |
| | SSV2 | Energized |
| PF3102-00 Ion Pilot card | Valve | Energized [1] |
| | Coil | De-energized [2] |
| PF3102-01 UV Pilot card | Ignition Enable | Open [3] |

*[1] De-energized when Pilot Off Mode is set to Off After Main On*
*[2] Energized under reignition conditions in accordance with configured Pilot Relight Mode and Pilot Relight Timeout settings (Controller Settings > Outputs > Ignition).*
*[3] Closed under reignition conditions in accordance with configured Pilot Relight Mode and Pilot Relight Timeout settings (Controller Settings > Outputs > Ignition) when Flame Source setting (Ignition Wizard) is configured as (1) Pilot and Main or (2) Pilot.*

#### 13.11.4.2 TRANSITIONS TO THE PID CONTROL STATE

| FROM | SCENARIO | CONDITION |
|---|---|---|
| Low Fire | Process temperature is below its configured Process setpoint | **4-20 Aux Out Mode** setting is set to **PID Control**, AND No alarm or wait or main permissive conditions present |

#### 13.11.4.3 TRANSITIONS FROM THE PID CONTROL STATE

| TO | SCENARIO | CONDITION |
|---|---|---|
| Lockout | Any | Alarm condition present |
| | Controller stopped by user | Any |
| | Flame loss | **Relight Attempts** setting has been exceeded |
| Waiting | Any | Wait condition present |
| | Any | Main permissive condition present, AND **Pilot Off Mode** setting is set to **Off after Main On** or **Follow Main** |
| | Flame loss | **Relight Attempts** setting has not been exceeded |
| | Process temperature is above its configured Process setpoint and below its Low Fire setpoint | **Low Heat Standby Mode** setting is set to **Wait**, AND **Low Heat Standby Delay** has elapsed |
| | Process temperature is above its configured Low Fire setpoint | **Pilot Off Mode** setting is set to **Off after Main On** or **Follow Main** |
| Pilot | Any | Main permissive condition present, AND **Pilot Off Mode** setting is set to **Disabled** or **Off at Setpoint** |
| | Process temperature is above its configured Process setpoint and below its Low Fire setpoint | **Low Heat Standby Mode** setting is set to **Main Permissive**, AND **Low Heat Standby Delay** has elapsed |
| | Process temperature is above its configured Low Fire setpoint | **Pilot Off Mode** setting is set to **Disabled** or **Off at Setpoint** |

# 14 INSTALLATION

**WARNING:**
INSTALLATION AND MODIFICATION SHALL NOT BE PERFORMED WHILE THE SYSTEM IS ENERGIZED. DISCONNECT POWER SOURCE PRIOR TO CONNECTING DEVICES OR MODIFYING WIRING.

Installers and commissioners of the PF3100 system must:

- Understand local codes and how they apply to the installation (for both electrical and mechanical aspects of the installation),
- Understand the electrical and mechanical limitations of the product,
- Understand the safety and operational effects of modifying system settings or wiring,
- Verify all required safety functions prior to completing the commissioning of the appliance,
- Be fluent in the English language (the only language this product supports),
- Be familiar with navigating the product menus and modifying settings.

## 14.1 MOUNTING CONSIDERATIONS

The UIX, CTX and AUX enclosures should be mounted:

- Upright in such a way that the screen/status indicators are clearly visible (if applicable),
- Near to the appliance/burner/component being controlled to minimize cable run lengths while maintaining hazardous location requirements,
- Such that the enclosure door can be fully opened during maintenance and commissioning,
- Such that the screen and keypad are protected from direct sunlight exposure.

The EPX and TLX enclosures should be mounted:

- Close to the burner/temperature element under control to limit cable run lengths,
- In an orientation that maintains accessibility during maintenance and commissioning.

### 14.1.1 HAZARDOUS LOCATION MOUNTING

**WARNING:**
EXPLOSION HAZARD - SUBSTITUTION OF COMPONENTS MAY IMPAIR SUITABILITY FOR CLASS I, DIVISION 2 HAZARDOUS LOCATIONS.

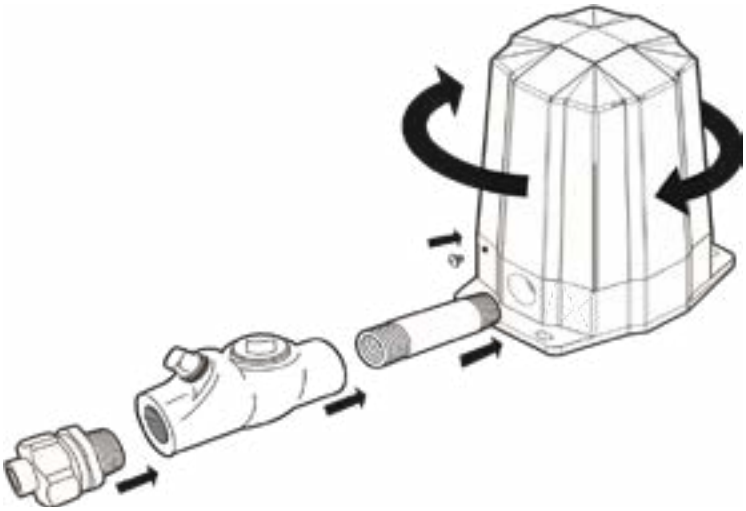
**WARNING:**
DO NOT DRILL HOLES IN, OR OTHERWISE MODIFY, ANY ENCLOSURES AS ANY SUCH MODIFICATIONS WILL COMPROMISE HAZARDOUS LOCATION SUITABILITY.

**WARNING:**
APPROPRIATELY ZONED WIRING METHODS MUST BE USED BETWEEN MODULES TO MAINTAIN HAZARDOUS LOCATION RATINGS.

#### 14.1.1.1 EPX ENCLOSURE MOUNTING

To maintain the hazardous location rating for the EPX enclosure, all the following conditions must be met:

- The enclosure lid must be tightened down until it is flush with the base and the locking screw must be fully secured,
- Each unused conduit entry port must be sealed with appropriately rated pipe plugs,
- Any conduit entry ports in use must be sealed in accordance with local electrical code(s),
- All fittings must have at least 5 full threads of engagement,
- All fittings must be ¾" NPT.



#### 14.1.1.2 TLX ENCLOSURE MOUNTING

To maintain the hazardous location rating for the TLX enclosure, all the following conditions must be met:

- The enclosure lid must be fully tightened down,
- Any conduit entry ports in use must be sealed in accordance with local electrical code(s),
- Each unused conduit entry port must be sealed with appropriately sized and rated pipe plugs,
- Thermocouple probe must be installed in an appropriately rated thermowell.

# 14.2 HARDWARE INSTALLATION DIAGRAMS

## 14.2.1 ION PILOT MODULE

Installation Notes:

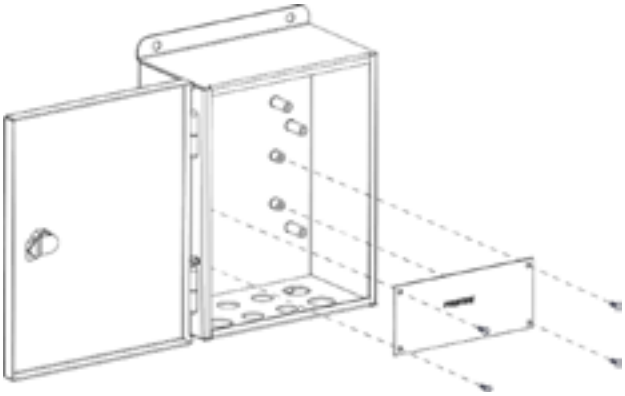
1. Install four #10-32 screws through the Ion Pilot card to attach it to the coil bracket.
2. Tighten to 26 in-lbs
3. Loosen two adjacent #6-32 screws from bottom inside of enclosure, then line up bracket and tighten down the screws
4. Install enclosure lid making sure it is fully seated.
5. Tighten #10-32 enclosure lock screw.

## 14.2.2 TEMPERATURE MODULE

Installation Notes:

1. Install two #10-32 screws through the Temperature card into the enclosure standoffs.
2. Tighten to 26 in-lbs
3. Install enclosure lid making sure it is fully seated.

## 14.2.3 REPLACEMENT CARDS



Installation Notes:

1. Install four #10-32 screws through the card into the enclosure standoffs.
2. Tighten to 26 in-lbs
3. Close enclosure door and secure lock with a flat head screwdriver.

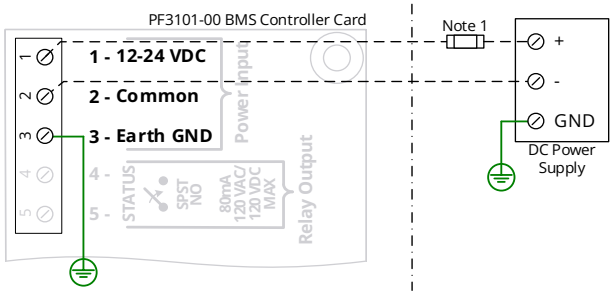
# 14.3 CONNECTION DIAGRAMS

**CAUTION:**
ELECTRICAL DEVICES CONNECTED TO THE CONTROLLER MUST MEET LOCAL ELECTRICAL CODES AND BE WITHIN THE VOLTAGE LIMITS SPECIFIED IN THIS MANUAL.

**CAUTION:**
ALL FIELD WIRING MUST BE PROPERLY FUSED AND SIZED IN ACCORDANCE WITH LOCAL CODES.

**CAUTION:**
WIRES MUST BE INSTALLED SUCH THAT THE CONNECTION DOES NOT RELY ON THE STRUCTURAL INTEGRITY OF THE WIRE INSULATION AND NO MORE THAN ONE CONDUCTOR IS TERMINATED IN A SINGLE TERMINAL.

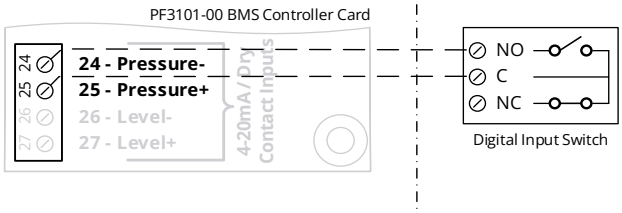
## 14.3.1 POWER INPUT WIRING




Installation Notes:

1. The power supply must be fused in accordance with local electrical codes.
2. Power input wiring is shown for the BMS Controller card as an example only. The power input to the Modbus, Network and Pilot Spark cards can be wired in the same way.

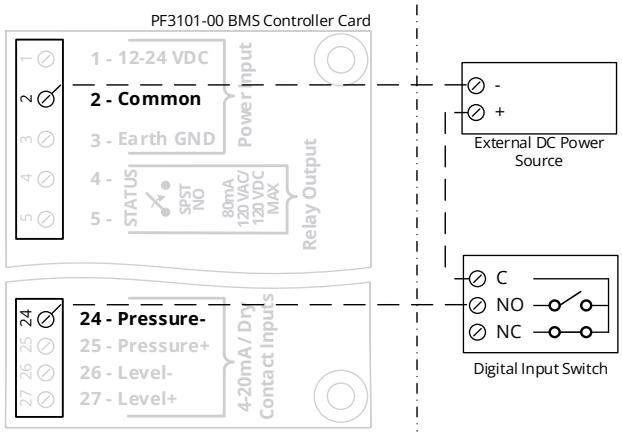
## 14.3.2 DIGITAL INPUT – DRY CONTACT




Installation Notes:

1. Pressure input wiring shown as an example only. Device can be wired to other digital inputs in the same way. For I/O Expansion inputs, the PWR Out terminal corresponds to the "+" terminal in the diagram and the Signal In terminal corresponds to the "-" terminal in the diagram.
2. The PF3100 system uses energized-to-run logic for all digital inputs. Wire to NO or NC contacts accordingly.
3. BMS: + terminal output matches system voltage input.
   I/O Expansion – 12V Mode: PWR output is 14V
   I/O Expansion – 24V Mode: PWR output is 24V
   Ion Pilot Aux In - + terminal output is 12V

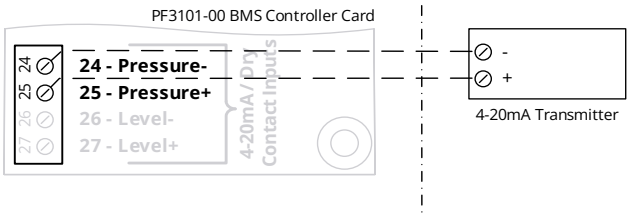
## 14.3.3 DIGITAL INPUT – WET CONTACT




Installation Notes:

1. Pressure input wiring shown as an example only. Device can be wired to other digital inputs in the same way. For I/O Expansion inputs, the PWR Out terminal corresponds to the "+" terminal in the diagram and the Signal In terminal corresponds to the "-" terminal in the diagram.
2. The PF3100 system uses energized-to-run logic for all digital inputs. Wire to NO or NC contacts accordingly.
3. External power source must be Earth grounded.
4. External power source must not (1) exceed $30V_{DC}$, or (2) drop below -0.5V with reference to BMS Controller card Common terminal (terminal 2).

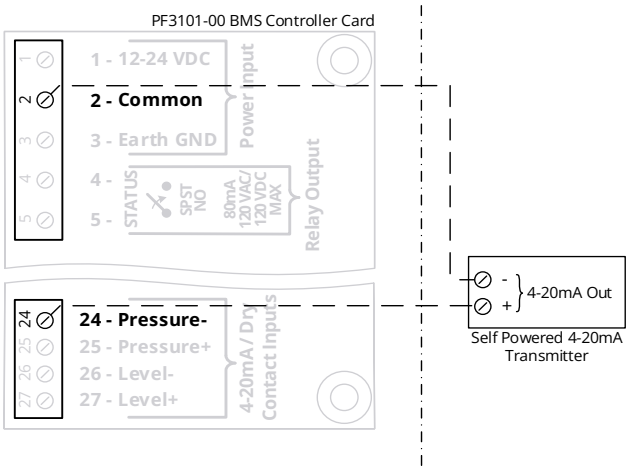
### 14.3.4 ANALOG INPUT - LOOP POWERED 4-20mA TRANSMITTER




Installation Notes:

1. Pressure input wiring shown as an example only. Device can be wired to other analog inputs in the same way. For I/O Expansion inputs, the PWR Out terminal corresponds to the "+" terminal in the diagram and the Signal In terminal corresponds to the "-" terminal in the diagram.
2. BMS: + terminal output matches system voltage input.
   I/O Expansion – 12V Mode: PWR output is 14V
   I/O Expansion – 24V Mode: PWR output is 24V
   Ion Pilot Aux In - + terminal output is 12V

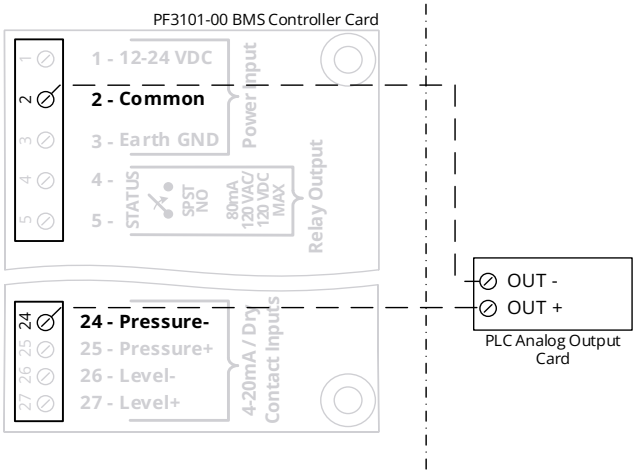
### 14.3.5 ANALOG INPUT – SELF POWERED 4-20mA TRANSMITTER




Installation Notes:

1. Pressure input wiring shown as an example only. Device can be wired to other analog inputs in the same way. For I/O Expansion inputs, the PWR Out terminal corresponds to the "+" terminal in the diagram and the Signal In terminal corresponds to the "-" terminal in the diagram.
2. Field device must be Earth grounded.
3. Transmitter signal output must be referenced about BMS Controller card Common terminal (terminal 2).

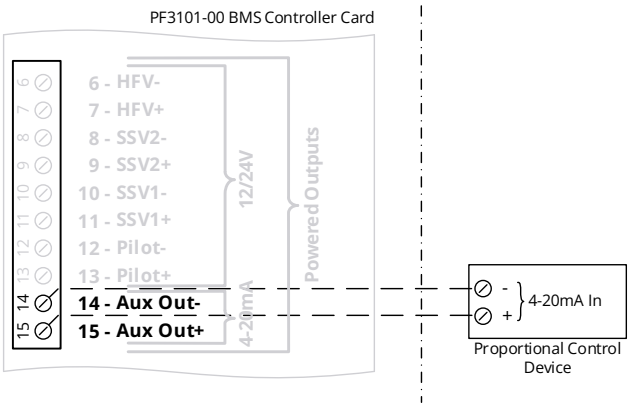
### 14.3.6 ANALOG INPUT – INPUT FROM PLC




Installation Notes:

1. Pressure input wiring shown as an example only. Device can be wired to other analog inputs in the same way. For I/O Expansion inputs, the PWR Out terminal corresponds to the "+" terminal in the diagram and the Signal In terminal corresponds to the "-" terminal in the diagram.
2. PLC output signal must be referenced about BMS Controller card Common terminal (terminal 2).

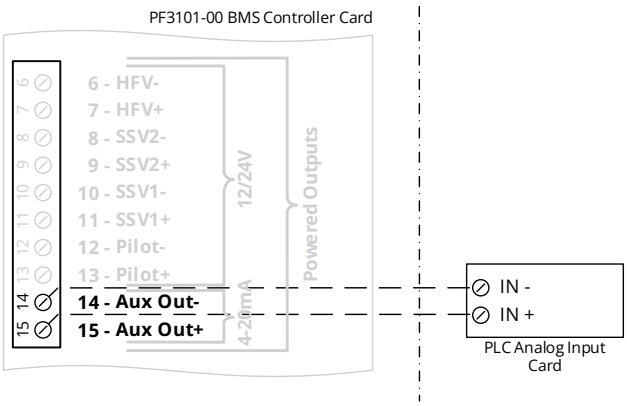
### 14.3.7 PROPORTIONAL VALVE OR ACTUATOR WIRING




Installation Notes:

1. BMS Aux Out wiring shown as an example only. The same wiring method can be used to connect to the I/O Expansion 4-20mA Output, where the GND Return terminal corresponds to the "-" terminal in the diagram and the Signal Out terminal corresponds to the "+" terminal in the diagram.

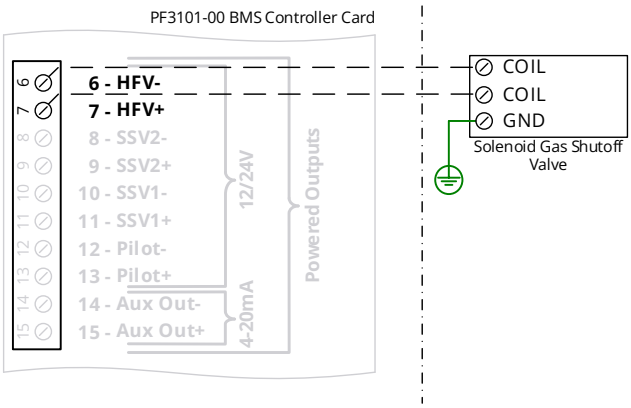
### 14.3.8 ANALOG OUTPUT – 4-20mA ECHO TO PLC




Installation Notes:

1. BMS Aux Out wiring shown as an example only. The same wiring method can be used to connect to the I/O Expansion 4-20mA Output, where the GND Return terminal corresponds to the "-" terminal in the diagram and the Signal Out terminal corresponds to the "+" terminal in the diagram.

### 14.3.9 SOLENOID OUTPUT – 12V/24V



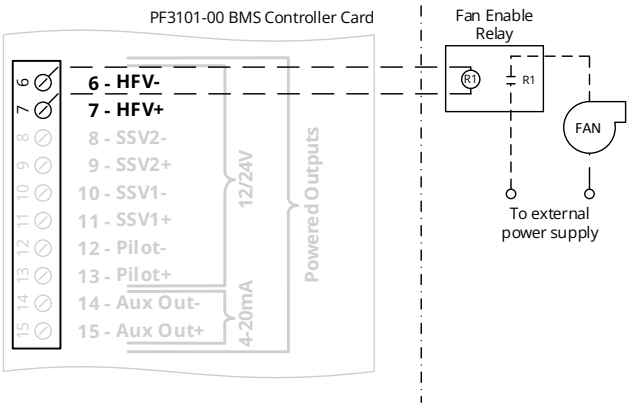

Installation Notes:

1. HFV output wiring shown as an example only. Solenoids can be wired to the other valve outputs in the same way.
2. Solenoid powered outputs are rated to 5A max individually, however the power input to the BMS is fused at 10A. Care must be taken as to not exceed the 10A max input when using multiple high-powered solenoids.
3. Solenoid valve outputs are assumed to be in safe state when de-energized. Normally closed valves must be used such that gas-flow to the burner is stopped when the output is in the de-energized state. Solenoid valve outputs can also be connected to normally open bleed valves when utilizing a double block and bleed configuration.

**CAUTION:**
DO NOT CONNECT SOLENOID DEVICE MINUS (-) TERMINALS TO GROUND, AS THE BMS SOLENOID OUTPUT MINUS (-) TERMINALS ARE NOT GROUNDED.

**CAUTION:**
DO NOT JUMPER SOLENOID MINUS TERMINALS TOGETHER UNDER ANY CIRCUMSTANCE, AS THIS WILL COMPROMISE THE SAFETY INTEGRITY OF THE SYSTEM.

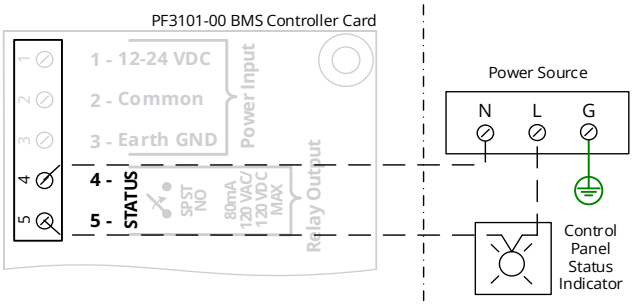
## 14.3.10 HFV OUTPUT - FAN CONTROL WIRING




Installation Notes:

1. A relay must be used to isolate the HFV contacts from high-transient currents from the fan motor.

## 14.3.11 RUN STATUS – AC SOURCE

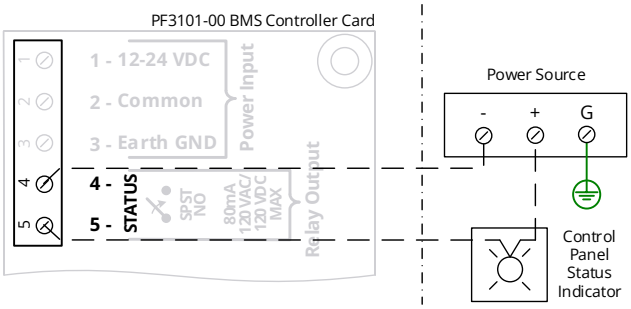



Installation Notes:

1. BMS Controller card Status contact wiring shown as an example only. The I/O Expansion card status contacts can be wired in the same way.

**WARNING:**
120VAC WIRING SHOULD BE INSTALLED BY A QUALIFIED ELECTRICIAN.

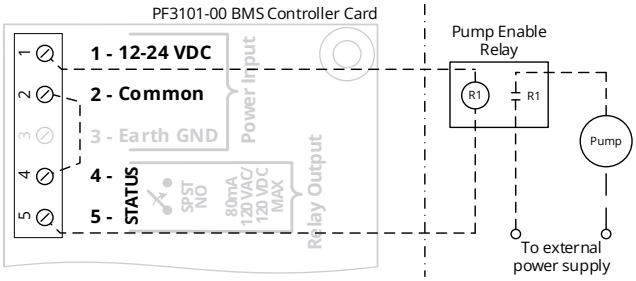
## 14.3.12 RUN STATUS – DC SOURCE




Installation Notes:

1. BMS Controller card Status contact wiring shown as an example only. The I/O Expansion card status contacts can be wired in the same way.

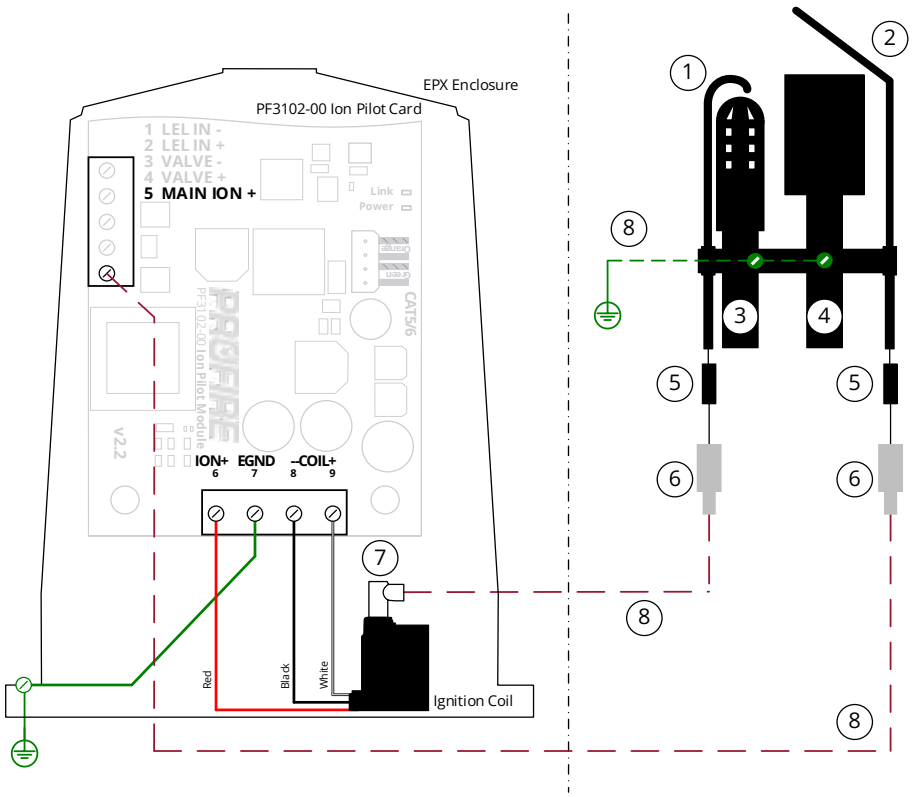
## 14.3.13 RUN STATUS – PUMP CONTROL




Installation Notes:

1. A relay must be used to isolate the Run Status contacts from high-transient currents associated with motors and pumps

### 14.3.14 SINGLE ROD IGNITION WIRING




Legend:

| # | DESCRIPTION |
|---|---|
| 1 | Pilot ignition/ flame detection rod |
| 2 | Main flame detection rod |
| 3 | Pilot nozzle |
| 4 | Main burner |
| 5 | Ferrule |
| 6 | Straight silicone boot |
| 7 | 90° spark plug connector |
| 8 | 7mm ignition wire |

Installation Notes:

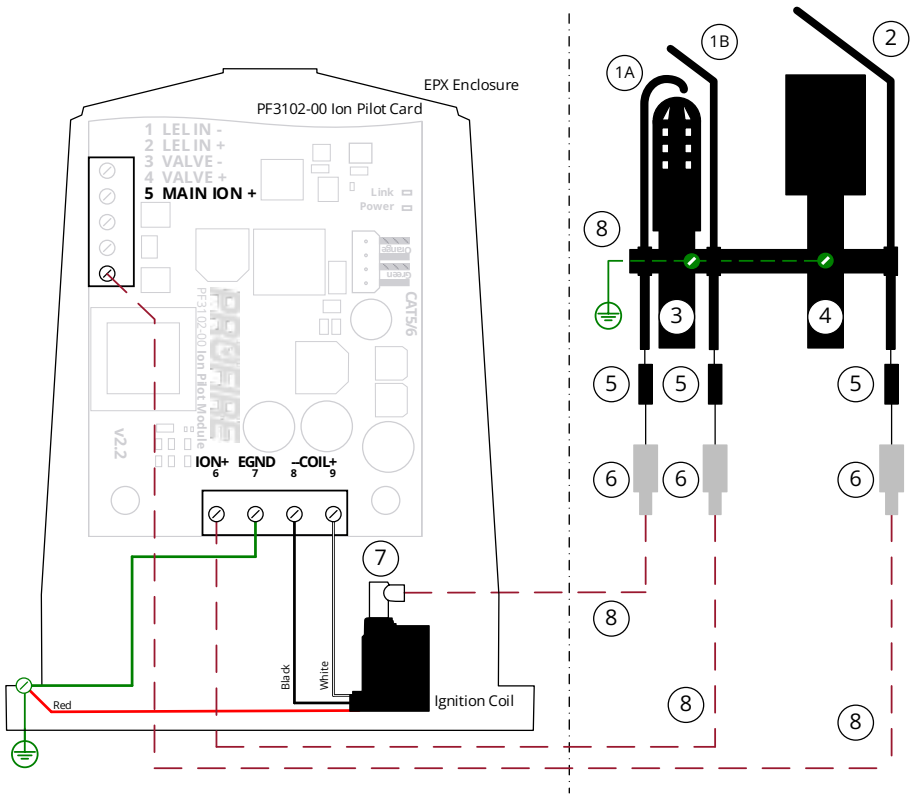
1. The wire length between the ignition coil and pilot should be no more than 3m (10ft).
2. Connect burner housing to EGND terminal with ignition wire to avoid ground-loading.
3. Optimal spark gap distance between pilot nozzle and ignition rod is 6mm (0.25”).

**WARNING:**
FAILURE TO PROVIDE A LOW-IMPEDANCE PATH FROM THE BURNER ASSEMBLY TO THE PF3100 MAY RESULT IN ELECTRIC SHOCK, PRODUCT DAMAGE, FAILURE TO IGNITE THE PILOT, OR FAILURE TO DETECT FLAME.

**WARNING:**
FLAME RODS ARE NOT INTENDED TO BE MOUNTED IN CLASS I, DIVISION 1 OR 2 HAZARDOUS LOCATIONS. FLAME ROD INSTALLATION SHALL BE IN ACCORDANCE WITH LOCAL ELECTRICAL CODES.

**WARNING:**
IGNITION COILS CAN GENERATE 20 KV - 40 KV AT THEIR HIGH VOLTAGE OUTPUT TERMINALS AND CAN CAUSE CARDIAC ARREST. DO NOT TOUCH OR PLACE ANY OBJECT NEAR THE IGNITION COIL OR CONNECTED IGNITION WIRE WHILE THE PRODUCT IS OPERATING. IT IS POSSIBLE TO DRAW A SPARK FROM SEVERAL INCHES AWAY IF THE PILOT BRACKET IS NOT PROPERLY GROUNDED.

## 14.3.15 DUAL ROD IGNITION WIRING




Legend:

| # | DESCRIPTION |
|---|---|
| 1A | Pilot ignition rod |
| 1B | Pilot flame detection rod |
| 2 | Main flame detection rod |
| 3 | Pilot nozzle |
| 4 | Main burner |
| 5 | Ferrule |
| 6 | Straight silicone boot |
| 7 | 90° spark plug connector |
| 8 | 7mm ignition wire |

Installation Notes:

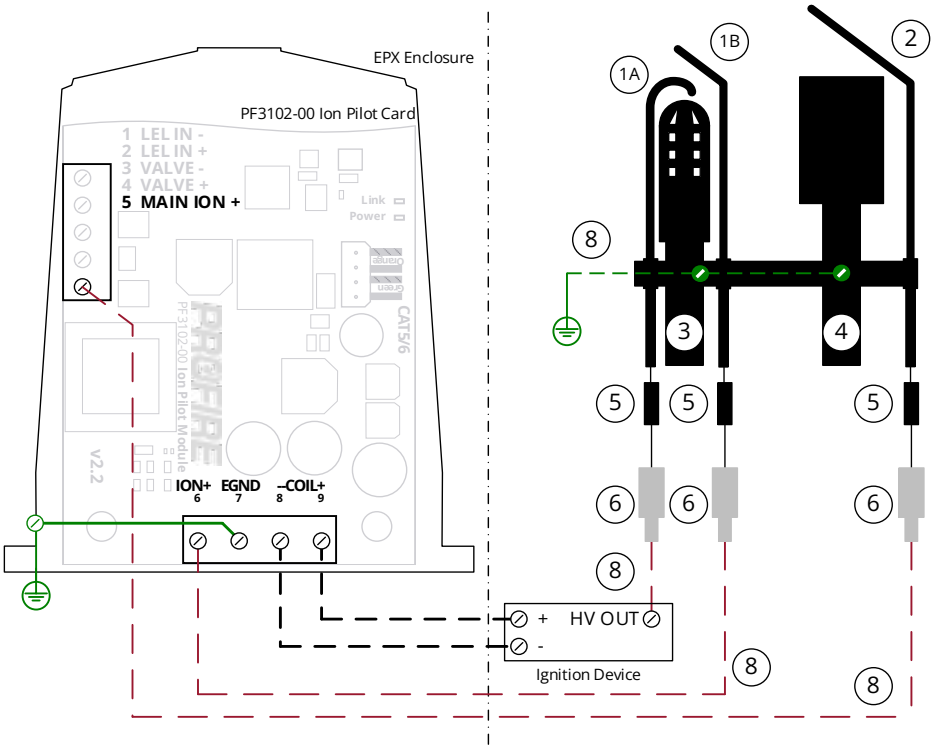
1. The wire length between the ignition coil and pilot should be no more than 3m (10ft).
2. Connect burner housing to EGND terminal with ignition wire to avoid ground-loading.
3. Optimal spark gap distance between pilot nozzle and ignition rod is 6mm (0.25").

**WARNING:**
FAILURE TO PROVIDE A LOW-IMPEDANCE PATH FROM THE BURNER ASSEMBLY TO THE PF3100 MAY RESULT IN ELECTRIC SHOCK, PRODUCT DAMAGE, FAILURE TO IGNITE THE PILOT, OR FAILURE TO DETECT FLAME.

**WARNING:**
FLAME RODS ARE NOT INTENDED TO BE MOUNTED IN CLASS I, DIVISION 1 OR 2 HAZARDOUS LOCATIONS. FLAME ROD INSTALLATION SHALL BE IN ACCORDANCE WITH LOCAL ELECTRICAL CODES.

**WARNING:**
IGNITION COILS CAN GENERATE 20 KV - 40 KV AT THEIR HIGH VOLTAGE OUTPUT TERMINALS AND CAN CAUSE CARDIAC ARREST. DO NOT TOUCH OR PLACE ANY OBJECT NEAR THE IGNITION COIL OR CONNECTED IGNITION WIRE WHILE THE PRODUCT IS OPERATING. IT IS POSSIBLE TO DRAW A SPARK FROM SEVERAL INCHES AWAY IF THE PILOT BRACKET IS NOT PROPERLY GROUNDED.

## 14.3.16 ION PILOT HIGH ENERGY IGNITION MODULE WIRING




Legend:

| # | DESCRIPTION |
|---|---|
| 1A | Pilot ignition rod |
| 1B | Pilot flame detection rod |
| 2 | Main flame detection rod |
| 3 | Pilot nozzle |
| 4 | Main burner |
| 5 | Ferrule |
| 6 | Straight silicone boot |
| 7 | 90° spark plug connector |
| 8 | 7mm ignition wire |

Installation Notes:

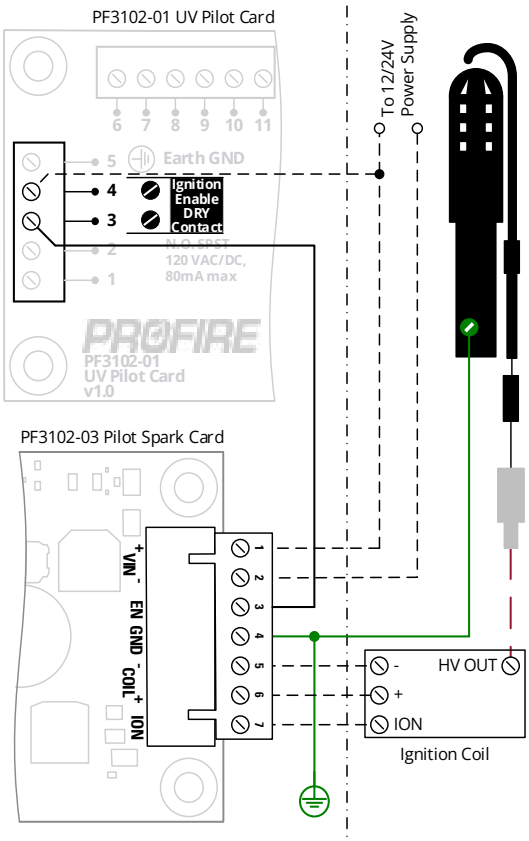
1. The wire length between the ignition coil and pilot should be no more than 3m (10ft).
2. Connect burner housing to EGND terminal with ignition wire to avoid ground-loading.
3. Optimal spark gap distance between pilot nozzle and ignition rod is 6mm (0.25”).

**WARNING:**
FAILURE TO PROVIDE A LOW-IMPEDANCE PATH FROM THE BURNER ASSEMBLY TO THE PF3100 MAY RESULT IN ELECTRIC SHOCK, PRODUCT DAMAGE, FAILURE TO IGNITE THE PILOT, OR FAILURE TO DETECT FLAME.

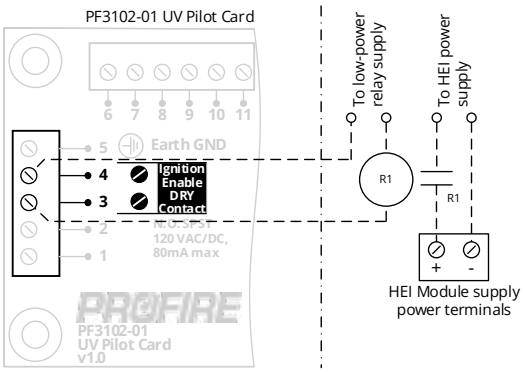
**WARNING:**
FLAME RODS ARE NOT INTENDED TO BE MOUNTED IN CLASS I, DIVISION 1 OR 2 HAZARDOUS LOCATIONS. FLAME ROD INSTALLATION SHALL BE IN ACCORDANCE WITH LOCAL ELECTRICAL CODES.

**WARNING:**
IGNITION COILS CAN GENERATE 20 KV - 40 KV AT THEIR HIGH VOLTAGE OUTPUT TERMINALS AND CAN CAUSE CARDIAC ARREST. DO NOT TOUCH OR PLACE ANY OBJECT NEAR THE IGNITION COIL OR CONNECTED IGNITION WIRE WHILE THE PRODUCT IS OPERATING. IT IS POSSIBLE TO DRAW A SPARK FROM SEVERAL INCHES AWAY IF THE PILOT BRACKET IS NOT PROPERLY GROUNDED.

### 14.3.17 UV PILOT TO SPARK CARD WIRING



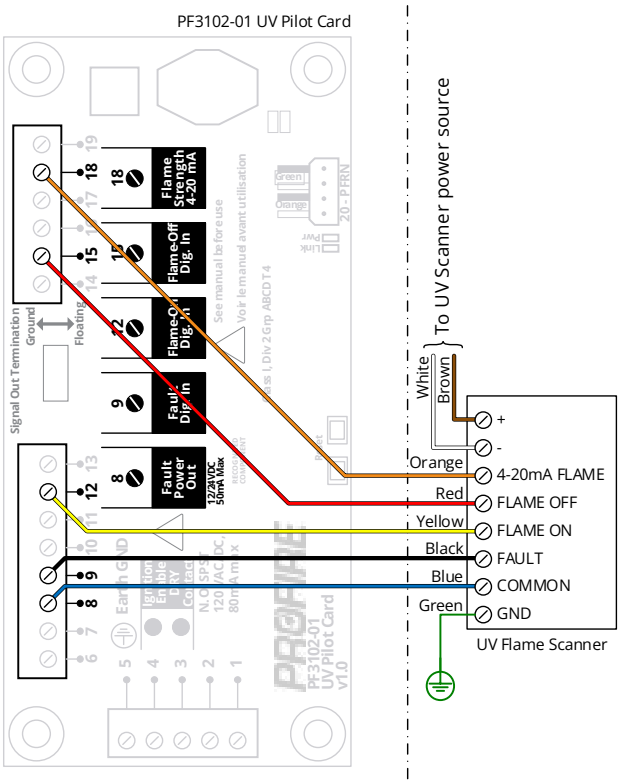

### 14.3.18 UV PILOT HIGH ENERGY IGNITION MODULE WIRING




Installation Notes:

1. A fault tolerant safety relay must be used for this application

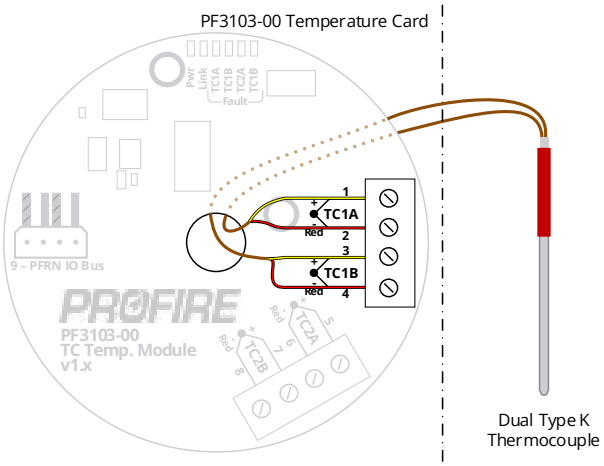
## 14.3.19 UV FLAME SCANNER WIRING




Installation Notes:

1. Wire colors shown are applicable for Fireye 65UV5-1004E UV Flame Scanner only.

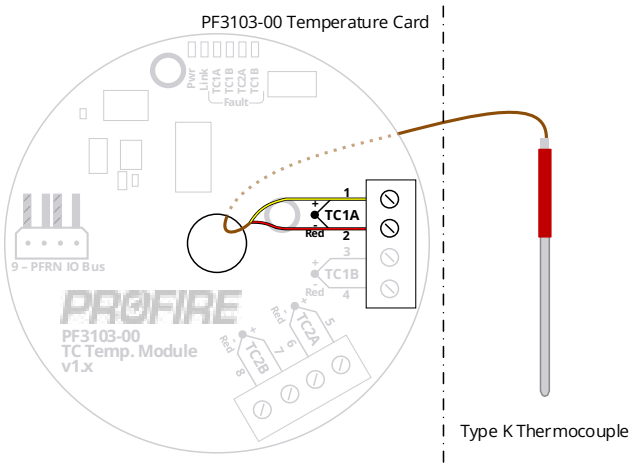
## 14.3.20 DUAL-ELEMENT THERMOCOUPLE WIRING




Installation Notes:

1. TC1 input wiring shown as an example only. Thermocouple can also be wired to TC2 in the same way.
2. Thermocouple must be ungrounded Type K.
3. Thermocouple wire run lengths should be minimized where possible.
4. Thermocouple wires should not be run in the same conduit as high-noise signals (e.g., valve wires, motor wires, etc.)

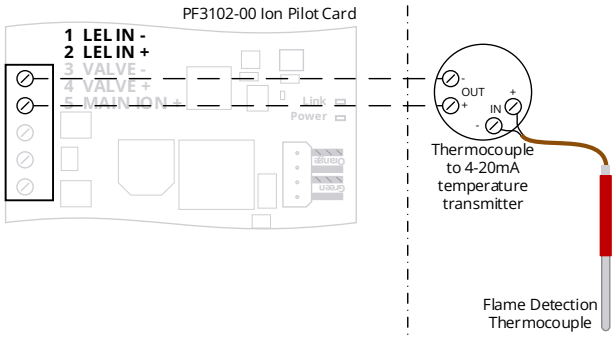
## 14.3.21 SINGLE-ELEMENT THERMOCOUPLE WIRING



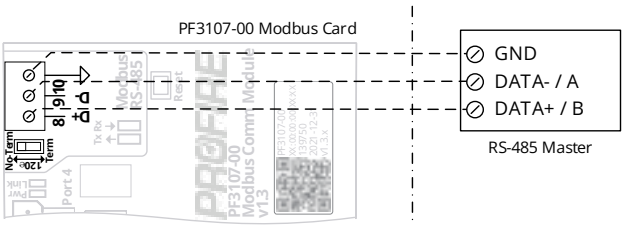

Installation Notes:

1. TC1A input wiring shown as an example only. Thermocouple can be wired to TC1B, TC2A and TC2B in the same way.
2. Thermocouple must be ungrounded Type K.
3. Thermocouple wire run lengths should be minimized where possible.
4. Thermocouple wires should not be run in the same conduit as high-noise signals (e.g., valve wires, motor wires, etc.)

## 14.3.22 THERMOCOUPLE FLAME DETECTION



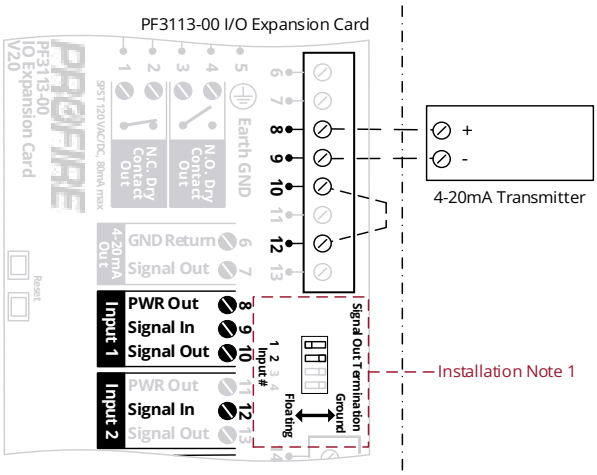

## 14.3.23 MODBUS INPUT WIRING




Installation Notes:

1. Modbus wires should not be run in the same conduit as high-noise signals (e.g., valve wires, motor wires, etc.)
2. Move Dip switch to the “Term” position to activate the termination resistor. Termination is recommended if the Modbus card is on the end of the Modbus chain

## 14.3.24 SINGLE TRANSMITTER TO MULTIPLE I/O EXPANSION INPUTS

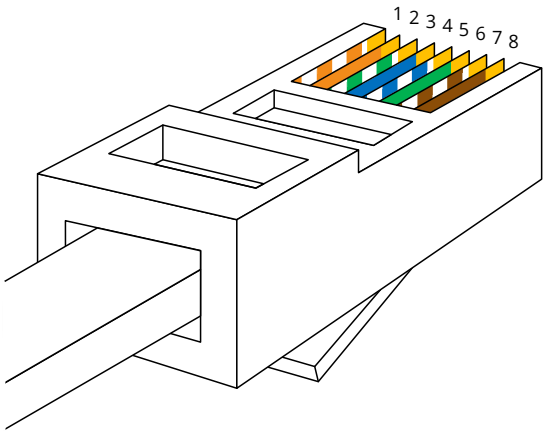



Installation Notes:

1. Set DIP switch to the "Floating" position for any input that is echoed out from its Signal Out terminal to another input and set the rest of the DIP switched to the "Ground" position.
2. The Voltage at terminal 8 (PWR Out) corresponds to the configured voltage output setting for the I/O Expansion Card (I/O Wizard > I/O Modules Tab > Module Voltage.)
3. Input 1 and 2 wiring is shown as an example only. The wiring concepts apply to any combination of the 4 I/O Expansion inputs.
4. Wiring for a loop powered transmitter is shown as an example only. Self powered transmitters can also be used – In this case, terminal 8 (PWR Out) is to be left unused

**WARNING:**
I/O EXPANSION CARD INPUTS CONNECTED TO THE SIGNAL OUT TERMINAL OF ANOTHER I/O EXPANSION CARD INPUT ARE NOT SAFETY RATED.

## 14.3.25 8P8C PFRN CONNECTOR WIRING




Wire Colors per T568B wiring standard:

| WIRE | COLOR |
|---|---|
| 1 | Orange & White |
| 2 | Orange |
| 3 | Green & White |
| 4 | Blue * |
| 5 | Blue & White * |
| 6 | Green |
| 7 | Brown & White * |
| 8 | Brown * |

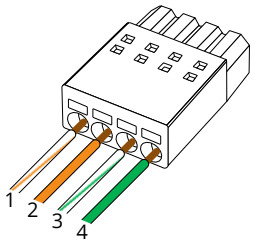
** Not required*

Installation Notes:

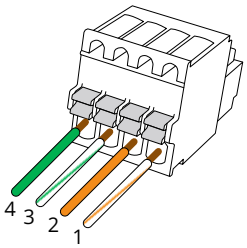
1. Solid core Cat5e or higher rated Ethernet cable should be used for all PFRN connections.
2. PFRN cable runs must not exceed 250m (820 ft).

## 14.3.26 PF3100 PFRN CONNECTOR WIRING

**Connector Style 1**




**Connector Style 2**



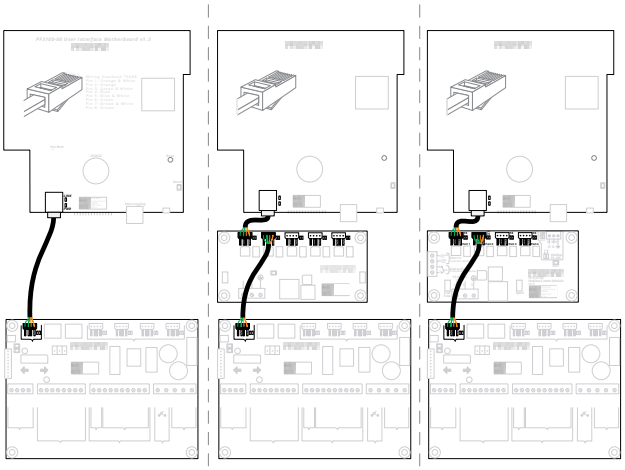

Wire Colors for PF3100 PFRN connector:

| WIRE | COLOR |
|---|---|
| 1 | Orange & White |
| 2 | Orange |
| 3 | Green & White |
| 4 | Green |

Installation Notes:

1. Solid core Cat5e or higher rated Ethernet cable should be used for all PFRN connections.
2. PFRN cable runs must not exceed 250m (820 ft).

### 14.3.27 UI PFRN CONNECTION OPTIONS



Option 1: Direct connection from UI card to BMS Controller card.

Option 2: Connection from UI card to BMS controller card via Network card.

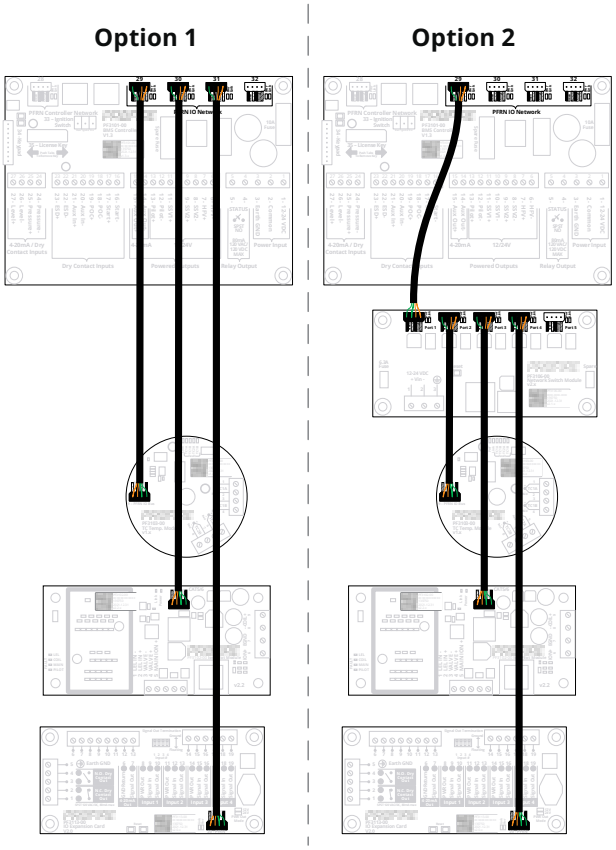
Option 3: Connection from UI card to BMS Controller card via Modbus card.

Option 4: (Not shown) Connection from UI card to BMS Controller card via Modbus card and Network card.

Installation Notes:

1. Solid core Cat5e or higher rated Ethernet cable should be used for all PFRN connections.
2. PFRN cable runs must not exceed 250m (820 ft).
3. UI PFRN connections must not connect to BMS PFRN IO Network terminals 29, 30, 31 or 32.

### 14.3.28 I/O CARD PFRN WIRING OPTIONS




Option 1: Direct connection from I/O cards to BMS Controller card.

Option 2: Connection from I/O cards to BMS controller card via Network card.

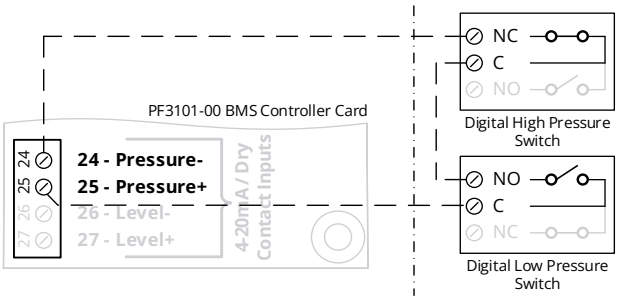
I/O Cards:

- PF3102-00 Ion Pilot Card
- PF3102-01 UV Pilot Card
- PF3103-00 Temperature Card
- PF3113-00 I/O Expansion Card

Installation Notes:

1. Solid core Cat5e or higher rated Ethernet cable should be used for all PFRN connections.
2. PFRN cable runs must not exceed 250m (820 ft).
3. I/O card PFRN connections must not connect to BMS PFRN Controller Network terminal 28.

### 14.3.29 COMBINED LOW/HIGH PRESSURE SWITCH WIRING




Installation Notes:

1. The PF3100 system uses energized-to-run logic for all digital inputs. Wire to NO contact of the low-pressure switch and NC contact of the high-pressure switch.
2. + terminal output matches system voltage input.

# 15 SYSTEM CONFIGURATION

The PF3100 system is designed to be modular and scalable to accommodate a variety of different heating applications. The section below outlines key concepts and terminology that are useful to understand when designing a PF3100 system.

## 15.1 APPLIANCE

An Appliance is made up of one or more BMS controller cards working together and represents the actual heating appliance that exists on site. Each appliance on site must be represented as a separate appliance on the PF3100. A single UI card can control multiple appliances, but information cannot be shared between them.

## 15.2 BMS CONTROLLER

Each burner in an appliance must have its own BMS controller card. The controller cards connect to pilot cards, temperature cards, expansion cards and burner or appliance instrumentation. A BMS controller card can share information with other controllers connected to the same appliance only.

## 15.3 I/O CARD

### 15.3.1 PILOT CARD

Pilot cards connect to each BMS controller card and are responsible for the ignition and flame detection of individual pilot burners.

### 15.3.2 TEMPERATURE CARD

Temperature cards connect to BMS controller cards and are responsible for monitoring various appliance temperatures using Type K thermocouples.

### 15.3.3 I/O EXPANSION CARD

I/O Expansion cards can be connected to BMS controller cards in an appliance to give the system enhanced input and output capabilities.

## 15.4 MODBUS CARD

Modbus cards must be connected (if required) into a PFRN Controller Network port between the UI and BMS controller card(s) to enable the system to communicate via Modbus.

## 15.5 NETWORK CARD

Network cards can be connected (1) to a PFRN Controller Network port between the UI and BMS controller card(s) to allow additional BMS controller cards to be connected to the system, or (2) into a PFRN I/O Network port to allow additional I/O cards to be connected to a BMS controller.

## 15.6 COMMUNICATION

The PF3100 system uses a proprietary communication protocol called PFRN. This is a robust safety network based on Ethernet protocols which allows for easy installation and expansion. The PFRN network also distributes DC power to the I/O cards.

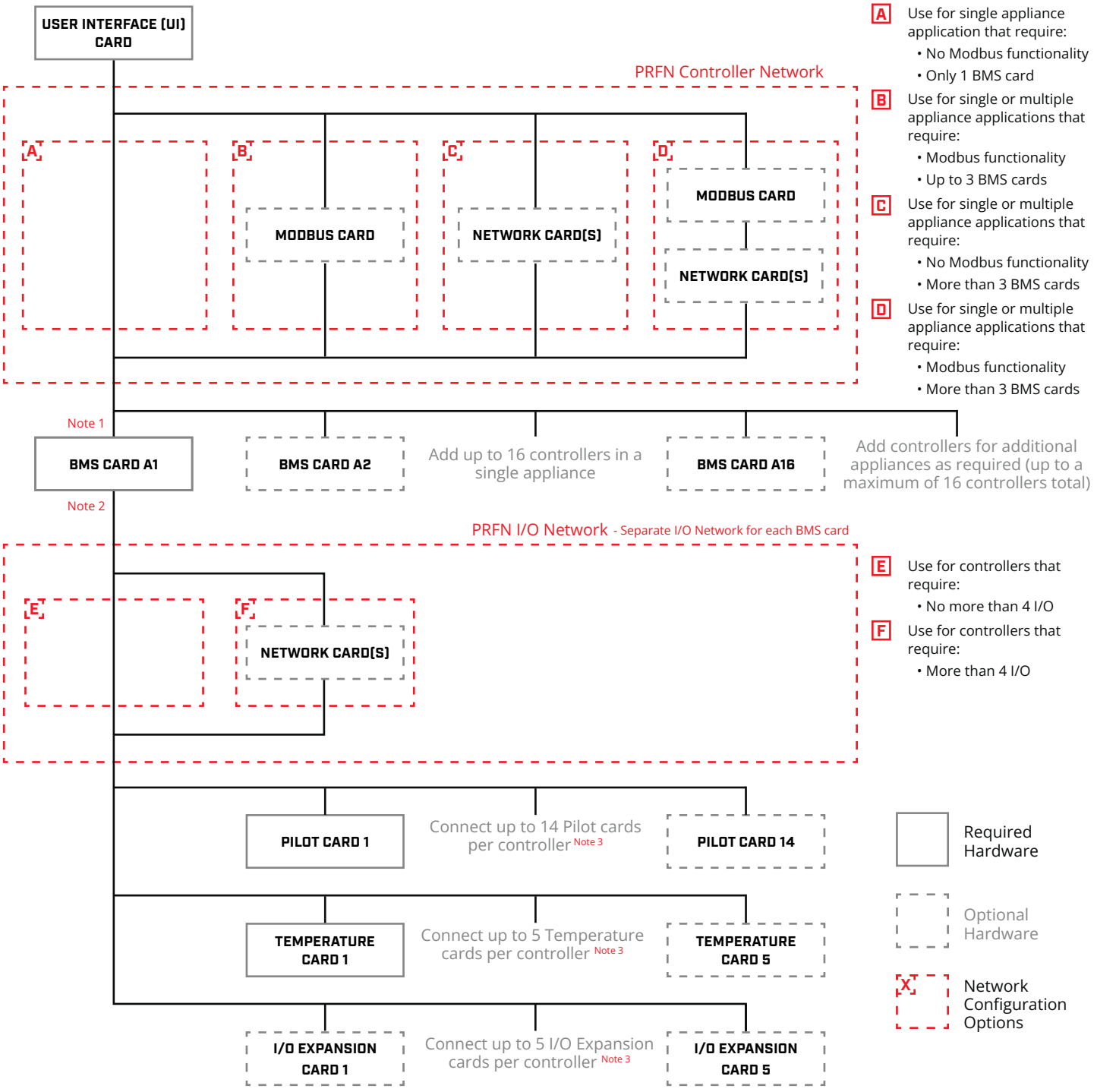
## 15.7 CARD IDENTIFICATION

Each card has a label providing important hardware information. The serial number doubles as a MAC address for communication and is referenced on-screen to distinguish between cards.


Line 1: Card Hardware Model Number
Line 2: Card Serial Number/MAC Address
Line 3: Lot Code
Line 4: Hardware Build Date
Line 5: Hardware Version

## 15.8 SYSTEM SCALING

At a minimum, each PF3100 system is comprised of one BMS controller card, one ion pilot card and one temperature card for each appliance under control. Only one User Interface card is required to control all the appliances in a system. BMS controller cards, pilot cards, temperature cards and I/O Expansion cards can be added as required to accommodate larger or more complex appliances in accordance with the diagram below:




[1] PFRN Controller Network connections must only connect to port 28 of the BMS cards.
[2] PFRN I/O Network connections must only connect to ports 29, 30, 31 and/or 32 of the BMS cards.
[3] The number of Pilot Cards + Temperature Cards + I/O Expansion Cards connected to a single BMS PFRN I/O Network cannot exceed 14.

# 16 COMMISSIONING

Ensure that all modules and instrumentation are mounted and wired in accordance with local safety codes and design documentation then follow the steps outlined in the sections below to commission the system.

**WARNING:**
SYSTEM SETTINGS AND APPLIANCE CONFIGURATION DETAILS MUST ONLY BE MODIFIED BY QUALIFIED PERSONNEL FAMILIAR WITH THE BOTH THE APPLIANCE UNDER PF3100 CONTROL AND RELATED PLANT PROCESSES THAT COULD BE AFFECTED.

**WARNING:**
ALL SAFETY FUNCTIONS BEING USED MUST BE END-TO-END PROVEN FOLLOWING COMMISSIONING OF THE SYSTEM.

**WARNING:**
DO NOT BYPASS ANY OF THE SAFETY FUNCTIONS OR MODIFY ANY OF THE INTERNAL CIRCUITRY OF THE SYSTEM. DOING SO CAN LEAD TO DEATH, SERIOUS INJURY, ELECTROCUTION, PROPERTY DAMAGE, PRODUCT DAMAGE AND/OR GOVERNMENT FINES.

## 16.1 PASSWORDS

Each setting and configuration wizard has a pre-defined security level based on its potential safety and reliability impact. To modify any setting, the password corresponding to its security level must first be entered. The security levels are as follows:

- L1 security level: Settings that do not impact the safety-integrity of the system but can impact operation.
- L2 security level: Settings that impact the safety-integrity of the system.
- L3 security level: Settings that impact fuel-air ratio control applications.
  Note: The L3 password is required to configure custom passwords

PF3100 passwords are not published publicly. Please refer to the documentation accompanying your PF3100 order or Contact Profire technical support.

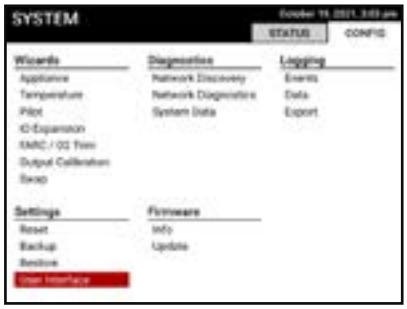
## 16.2 UPDATE FIRMWARE

The firmware must match on (1) the User Interface, (2) all BMS controllers and (3) all connected I/O cards for the system to operate as intended.

1. Ensure all cards are powered on and connected to the PFRN communication network.
2. Update all cards to ensure that they are all running the same version of firmware. Refer to the Firmware Update section for instructions.
3. Use the Network Discovery Tool to troubleshoot firmware and communication issues.

## 16.3 USER INTERFACE SETTINGS

The User Interface settings (System Screen > Config Tab > Settings) apply to all appliances in the system.





4. Configure all User Interface settings as desired. The table below outlines the available configuration options:

| SETTING | DEFAULT | OPTIONS | DESCRIPTION |
|---|---|---|---|
| Date / Time | Jan. 01, 1970 | Any | Specifies the current date and time |
| Display Sleep Timeout | 3.0 min | 0.5 min – 60 min | Specifies the time of user inactivity after which the UI screen turns off. |
| Temperature Units | Celsius | C | Celsius — Specifies the display units for all temperature card inputs. |
| | | F | Fahrenheit |
| Pressure Units | kPa | kPa | Kilopascals — Specifies the display units for the BMS pressure input when Fuel Pressure Input Mode setting is set to 4-20. |
| | | PSI | Pounds per square inch |
| | | inWC | Inches of water column |
| | | cmWC | Centimeters of water column |
| | | kg/cm2 | Kilograms per square centimeter |
| | | % | Percent |
| | | mA | Milliamps |
| Volume Units | Liters | L | Liters — Specifies the display units for the BMS level/flow input when Level/Flow Input Mode setting is set to 4-20. |
| | | m3 | Cubic meters |
| | | Gal | US gallons |
| | | BBL | Barrels |
| | | % | Percent |
| | | mA | Milliamps |
| | | L/min | Liters per minute |
| Debug Mode | Disabled | Enabled | Appliance software diagnostic events are displayed to the user through an on-screen pop-up menu. |
| | | Disabled | Appliance software diagnostic events are hidden. |
| Level 1 Password Enabled | Enabled | Enabled | The L1 password or higher must be used to access non-safety critical settings. |
| | | Disabled | The L1 settings can be modified with no password. |
| Set Custom Passwords | | Allows users with the L3 password to set custom L1, L2, and L3 passwords. Note: Default passwords cannot be restored once changed. Contact Profire to recover forgotten passwords. | |

## 16.4 APPLIANCE WIZARD

The Appliance Wizard is used to create and modify appliances and assign BMS Controller cards to each appliance.

### 16.4.1 CREATE APPLIANCE TAB



5. Select “Add Appliance” and create all the appliances that are to be controlled.
6. Name each appliance based on equipment tag, location, type, etc. to differentiate between them on screen (e.g., H-123, North Incinerator, Cabin Heater).
7. Press then to advance to the Assign Controllers Tab.



### 16.4.2 ASSIGN CONTROLLERS TAB

8. Assign each controller to its associated appliance to match field wiring. All connected BMS Controller cards are listed and identified by the serial numbers printed on the labels affixed to each card.
9. Name each controller to specify which burner it is controlling (e.g., East Burner, West Burner).
10. Press then to advance to the Review Tab.

### 16.4.3 REVIEW TAB

11. Ensure that there are no errors and select “Accept” to save all changes and exit the Appliance Wizard.

## 16.5 TEMPERATURE WIZARD

The Temperature Wizard is used to create, assign and configure temperature inputs.

12. Select the appliance for which the temperature inputs are to be configured. Temperature inputs must be configured for each appliance separately.

### 16.5.1 CREATE INPUTS TAB

13. Select "Add Input" and create the temperature inputs associated with the selected appliance.


14. Configure and name each input based on design documentation. The table below describes the available configuration options.

| SETTING | DEFAULT | OPTIONS | DESCRIPTION |
|---|---|---|---|
| Mode | Primary Process | Primary Process | The temperature input is used to determine system behavior and dictate state transitions. |
| | | Disabled | The temperature input is ignored. |
| | | Display Only | The temperature input readings are displayed to the user, but otherwise ignored. |
| | | High Temp ESD | The temperature input is used to trigger high temperature shutdowns only. |
| | | Aux Process | The temperature input is used in conjunction with the primary process temperature to determine system behavior and dictate state transitions. |
| App. Shutdown (Appliance Shutdown) | Enabled | Enabled | An input temperature reading above its corresponding High Temp setting shuts down all controllers in the appliance. |
| | | Disabled | An input temperature reading above its corresponding High Temp setting shuts down only the controller to which it is connected. |
| Input Type | Dual | Single | The temperature input is a single-element thermocouple. |
| | | Dual | The temperature input is a dual-element thermocouple. |

### 16.5.1.1 ADJUST SETPOINTS DIALOG

15. Select "Adjust Setpoints" to configure the setpoints and process settings for each input in accordance with design specifications. The table below describes the available configuration options.

| SETTING | DEFAULT | OPTIONS | DESCRIPTION |
|---|---|---|---|
| High Temp | 90 °C<br>194 °F | 0 °C – 1350 °C<br>32 °F – 2462 °F | Specifies the process temperature above which (1) the appliance shuts down or (2) controller shuts down, in accordance with the App. Shutdown setting above. |
| Pilot Off Mode | Off At Setpoint | Disabled | The pilot valve outputs are de-energized when the process temperature is above the configured High Temp SP. |
| | | Off At Setpoint | The pilot valve outputs are de-energized when the process temperature is above the configured Pilot Off SP. |
| | | Off After Main On | The pilot valve outputs are de-energized after the main valves are energized. |
| | | Follow Main | The pilot valve outputs are de-energized with the main valves when the process temperature is above the configured Low Fire SP. |
| Pilot Off SP | 85 °C<br>185 °F | 0 °C – 1350 °C<br>32 °F – 2462 °F | Specifies the process temperature at which the pilot valve outputs are de-energized when Pilot Off Mode is set to Off At Setpoint. |
| Low Fire Mode | Disabled | Disabled | The main valves are de-energized when the process temperature is above the configured Process SP.<br>* It is recommended that Low Fire Mode is enabled for all applications over 1 000 000 Btuh. |
| | | On At Process SP | The main valve outputs are energized when the process temperature drops below the configured Process Temp SP minus deadband. |
| | | On At Lowfire SP | The main valve outputs are energized when the process temperature drops below the configured Low Fire SP minus deadband. |
| Low Fire SP | 85 °C<br>185 °F | 0 °C – 1350 °C<br>32 °F – 2462 °F | Specifies the process temperature at which the main valve outputs are de-energized when Low Fire Mode is enabled. |
| Process SP | 80 °C<br>176 °F | 0 °C – 1350 °C<br>32 °F – 2462 °F | Specifies the process temperature that the system attempts to maintain. |
| Process Deadband | 2 °C<br>3.6 °F | 0 °C – 100 °C<br>3.6 °F – 180 °F | Specifies the deadband applied around the Process setpoint to prevent fluctuation between states when the process temperature is near the setpoint. |
| Low Temp SP | 0 °C<br>32 °F | -200 °C – 1350 °C<br>-328 °F – 2462 °F | Specifies the process temperature below which the system displays a warning on the Appliance Alerts Screen. |
| High Temp Warning | 80 °C<br>176 °F | 0 °C – 1350 °C<br>32 °F – 2462 °F | Specifies the temperature above which the system displays a high temperature warning on the Appliance Alerts Screen. |
| Warning Deadband | 2 °C<br>3.6 °F | 0 °C – 100 °C<br>3.6 °F – 180 °F | Specifies the deadband applied around the High Temp Warning setting to prevent the high temperature warning from setting and clearing sporadically when the temperature is near the setpoint. |

16. Select “Finished” then press then to advance to the Temp Modules Tab.

### 16.5.2 TEMP MODULES TAB



17. Name each temperature card and assign each input to its corresponding card as wired in the field (e.g., ensure that the temperature card physically installed in the appliance bath corresponds to the Bath input from the Create Inputs tab.
18. Press then to advance to the Review Tab.

### 16.5.3 REVIEW TAB

19. Ensure that there are no errors and select “Accept” to save all changes and exit the Temperature Wizard.

## 16.6 PILOT WIZARD

The Pilot Wizard is used to configure ignition settings and assign connected Ion Pilot and UV Pilot cards for each appliance.

20. Select the appliance for which the pilot cards are to be configured. Pilot cards must be configured for each appliance separately.

### 16.6.1 ALLOCATE PILOT TAB


PILOT CONFIGURATION WINDOW - ION PILOT CARD


PILOT CONFIGURATION WINDOW - UV PILOT CARD


21. Select a slot and press to open a list of MAC addresses associated with all connected pilot cards. Select desired card and press .
22. Configure card settings per design specifications and repeat for all connected pilot cards. The table below outlined the configuration options available.

| SETTING | DEFAULT | OPTIONS | DESCRIPTION |
|---|---|---|---|
| Name | Pilot Module | Any up to 16 characters long. | Specifies the name of the selected Pilot card. |
| Flame Detection Gain<br>* Only visible for Ion Pilot cards | 7 | 3 - 7 | Specifies the flame signal amplification level. |
| Ion Aux In Type<br>* Only visible for Ion Pilot cards | Disabled | Disabled | The Ion Aux input is ignored. |
| | | Dry Contact | The Ion Aux input is configured as a dry contact input |
| | | 4-20 Input | The Ion Aux input is configured as a 4-20mA input and affects system behavior in accordance with the Ion Aux Input settings. |
| Flame Source<br>* Only visible for UV Pilot cards | Pilot and Main | Pilot and Main | The pilot card is used by the system for both pilot and main flame detection |
| | | Pilot | The pilot card is used by the system for pilot flame detection only |
| | | Main | The pilot card is used by the system for main flame detection only |
| Enabled/Disabled | Enabled | Enabled | The pilot card is used by the system for ignition/flame detection in accordance with the configured settings. |
| | | Disabled | The ignition card is ignored by the system. |

23. Press then to advance to the Ignition Settings Tab.

### 16.6.2 IGNITION SETTINGS TAB


24. Configure appliance-wide ignition settings per design specifications. The table below outlines the available configuration options:

| SETTING | DEFAULT | OPTIONS | DESCRIPTION |
|---|---|---|---|
| Main Flame Detect | Disabled | Enabled | Main flame detection is required. |
| | | Disabled | Main flame detection is not required. |
| Ignition Mode | Coil | Coil | The Ion Pilot card coil output is connected to an ignition coil. |
| | | HEI | The Ion Pilot card coil output is connected to a separate ignition module with DC input to control sparking. |
| Pilot Relight Mode | No Relight | No Relight | Lost pilot flames are not automatically reignited. |
| | | During Flame Fail | The controller attempts to reignite lost pilot flames for the duration of the Pilot Flame Fail (FFRT) setting. |
| | | During Timeout | Minimum Pilots Running requirement satisfied: The controller attempts to reignite lost pilot flames for the duration of the configured Pilot Relight Timeout setting.<br>Minimum Pilots Running requirement not satisfied: The controller attempts to reignite lost pilot flames for the duration of the configured Pilot Flame Fail (FFRT) setting. |
| Ignition Attempts | 3 attempts | 1 - 3 attempts | Specifies the number of times the system will attempt pilot ignition. |
| Relight Attempts | 3 attempts | 0 – 3 attempts | Specifies the number of relight attempts allowed following a flame failure. |
| Minimum Pilots Running | 1 | 1 – 14 pilots | Specifies the number of pilots that must have flame proven for the controller to remain running. |
| Pilot Relight Timeout | 30 s | 10 s – 600 s | Specifies the duration for which the system attempts to reignite lost pilot flames in multi-pilot applications when the Minimum Pilots Running requirement is satisfied and Pilot Relight Mode is set to During Timeout. |
| Pilot Flame Fail (FFRT) | 4 s | 0.8 s – 4 s | Specifies the time between pilot flame failure and controller shutdown (or restart if allowable relights remain).<br>* Time starts when Minimum Pilots Running setting is not satisfied. |
| Main Flame Fail (FFRT) | 4 s | 0.8 s – 4 s | Specifies the time between main flame failure and controller shutdown (or restart if allowable relights remain).<br>* Time starts when no main flame detectors are detecting flame. |

25. Press ■ then ▶ to advance to the Review Tab.

### 16.6.3 REVIEW TAB

26. Ensure that there are no errors and select “Accept” to save all changes and exit the Pilot Wizard.

## 16.7 I/O EXPANSION WIZARD

The I/O Expansion Wizard is used to configure inputs and outputs for use with the IO Expansion Card.

### 16.7.1 SELECT APPLIANCE SCREEN

27. Select the appliance for which the I/O expansion inputs are to be configured. I/O expansion inputs must be configured for each appliance separately.

### 16.7.2 ADD INPUTS TAB



28. Select "Add Input" and follow the on-screen menus to set up all required inputs per design documentation. The table below outlines the configuration options available:

| SETTING | OPTIONS | DESCRIPTION |
|---|---|---|
| Input Type | Pressure | The input represents a fuel pressure device. |
| | Flow | The input represents a process flow device. |
| | Level | The input represents a fluid level device. |
| | Custom | The input represents a generic input device. |
| | Appliance Firing Rate | The input represents an external 4-20mA firing rate signal. |
| | FARC Fuel Position | The input represents a 4-20mA fuel actuator position feedback signal. |
| | FARC Air Position | The input represents a 4-20mA air actuator position feedback signal. |
| | Bleed Valve Proof of Open | The input represents a bleed valve proof of open switch. |
| | FARC Aux Position | The input represents a 4-20mA FARC actuator position feedback signal. |
| | $O_2$ Sensor Reading | The input represents a 4-20mA oxygen concentration sensor. |
| Signal Type | Digital | The input represents a swtich. |
| | 4-20 | The input represents a4-20mA transmitter. |
| Input Mode | Alarm | Input trip shuts down the controller and prevents starting until cleared. |
| | Wait | Input trip transitions the controller to the Waiting state and prevents transitions to any fuel state until cleared. |
| | Warning | Input trip generates an alert but does not affect system behavior. |
| | Main Permissive | Input trip transitions the controller out of any main fuel state and prevents re-entry until cleared. |
| | Local Proof of Airflow | Input trip shuts down the controller when attempting to prove airflow. |
| | Secondary PID Input | The input is used for PID control in accordance with the Advanced PID Control settings. |
| | Display Only | The input does not generate alerts or otherwise affect system behavior. |
| | Non-fuel State Alarm | Input trip causes an alarm, but only when the controller is in a non-fuel state. |
| | Pilot State Alarm | Input trip causes an alarm, but only when the controller is in the Pilot state. |
| | Main State Alarm | Input trip causes an alarm, but only when the controller is in a main-fuel state. |
| Name | Any | Specifies the input name displayed on the Appliance Status Screen. |
| Units | Pressure: KpA, PSI, inWC, cmWC, kg/cm2<br>Level: L, m3, USGAL, BBL, ft3<br>Flow: Any level unit per second, minute, hour, or day<br>Custom: %, mA, UI temperature units | Specifies the input units displayed on the Appliance Status Screen. |
| Low Setpoint | Any | Specifies the threshold below which a low trip event occurs. |
| High Setpoint | Any | Specifies the threshold above which a high trip event occurs. |
| Deadband | Any above 0 | Specifies the deadband applied around each setpoint to prevent fluctuation between states when input is near the trip points. |

29. Press ■ then ▶ to advance to the I/O Modules Tab.

### 16.7.3 I/O MODULES TAB



30. Name each card and assign each created input to the physical input location to which it is wired in the field. Note that a single created (non-FARC) input can be assigned to multiple physical inputs for redundancy.
31. Configure 4-20 Output mode, Dry Contact behavior and Module Voltage per design documentation. The table below outlines the configuration options available.

| SETTING | OPTIONS | DESCRIPTION |
|---|---|---|
| Name | Any up to 16 characters long | Specifies the name of the selected I/O Expansion card. |
| Input 1 | Any input created on the Add Inputs tab | Specifies the input device wired to terminals 8, 9 and 10 on the I/O Expansion card. |
| Input 2 | Any input created on the Add Inputs tab | Specifies the input device wired to terminals 11, 12 and 13 on the I/O Expansion card. |
| Input 3 | Any input created on the Add Inputs tab | Specifies the input device wired to terminals 14, 15 and 16 on the I/O Expansion card. |
| Input 4 | Any input created on the Add Inputs tab | Specifies the input device wired to terminals 17, 18 and 19 on the I/O Expansion card. |
| 4-20 Output | PID Output Controlled by 4-20mA Input | The I/O Expansion 4-20mA output is modulated in accordance with the PID configuration parameters. |
| | PID Output Controlled by TC Input | |
| | Air Position Controlled by FARC | The I/O Expansion 4-20mA output is connected to a proportional airflow actuator for a fuel-air ratio control application. |
| | Aux Position Controlled by FARC | The I/O Expansion 4-20mA output is connected to a proportional actuator for a multi-channel fuel-air ratio control application. |
| N.O. Dry Contact/ N.C. Dry Contact | Disabled | Refer to I/O Expansion card Normally Closed Dry Contact and Normally Open Dry Contact sections for behavior in each mode. |
| | Started Status | |
| | High Temp Status | |
| | No Alert Status | |
| | Appliance Proc Control | |
| | Controller Proc Control | |
| | Temp Setpoint Trip | |
| | Input Setpoint Trip | |
| | Purge Status | |
| | Appliance Alarm | |
| | Appliance Wait | |
| | Appliance Warning | |
| | Appliance Main Permissive | |
| | Controller Running | |
| Module Voltage | 12V | The I/O Expansion PWR Out terminals supply 12V. |
| | 24V | The I/O Expansion PWR Out terminals supply 24V. |
| Dry Contact Trip Configuration * Only applicable when Dry Contact mode above is set to Temp Setpoint Trip or Input Setpoint Trip. | Any configured temperature input | Specifies the temperature input used to determine dry contact behavior. |
| | Any configured I/O expansion input | Specifies the I/O Expansion input used to determine dry contact behavior. |

#### 16.7.3.1 PID CONFIGURATION PARAMETERS

The PID Configuration menu is accessed by (1) configuring the I/O Expansion 4-20 Output as a PID control output, or (2) selecting a configured I/O Expansion 4-20 PID output from the Appliance Status Screen.

32. Configure all I/O Expansion PID parameters per design documentation. The table below outlines the configuration options available:


| SETTING | OPTIONS | DESCRIPTION |
|---|---|---|
| PID Input | | Indicates the I/O Expansion input(s) for which the following configuration applies. All selected inputs are averaged to determine the input reading used by the PID output. |
| Name | Any | Specifies the name displayed on the Appliance Status Screen representing the I/O Expansion PID output. |
| Setpoint | Any | Specifies the PID Input reading that the system attempts to maintain. |
| Proportional Band | Any | Specifies the proportional term used by the I/O Expansion PID algorithm. |
| Integral Time | 0 min – Any | Specifies the integral term used by the I/O Expansion PID algorithm. |
| Derivative Time | 0 min – Any | Specifies the derivative term used by the I/O Expansion PID algorithm. |
| Sample Time | 0 sec - Any | Specifies the time between samples for the I/O Expansion PID algorithm. |
| Integral Reset Range | Any | Specifies the range above and below the input Setpoint within which the I/O Expansion PID integral error accumulates. |
| Direction | Direct | Specifies that the I/O Expansion PID output increases as the input increases. |
| | Reverse | Specifies that the I/O Expansion PID output decreases as the input increases. |
| Mode | Auto | The I/O Expansion 4-20 Output is modulated automatically by the I/O Expansion PID algorithm based on the configured PID settings above. |
| | Manual | The I/O Expansion 4-20 Output delivers a 4-20mA signal in accordance with the configured Manual Output setting below. |
| Manual Output | 0 % - 100 % | Specifies the I/O Expansion 4-20 Output signal when in Manual Mode. |
| System Stop Output | 0 % - 100 % | Specifies the I/O Expansion 4-20 Output signal when the controller is stopped. |
| Low Output Limit | 0 % - 100 % | Specifies the lowest possible output value for the I/O Expansion 4-20 Output. |
| High Output Limit | 0 % - 100 % | Specifies the highest possible output value for the I/O Expansion 4-20 Output. |

33. Select “Finished” and press to return to the I/O Modules Tab.
34. Press then to advance to the Review Tab.

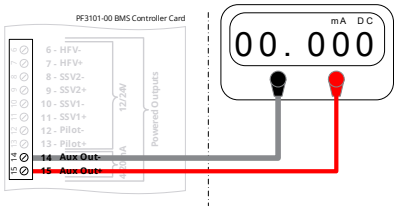
### 16.7.4 REVIEW TAB

35. Ensure that there are no errors and select “Accept” to save all changes and exit the I/O Expansion Wizard.

## 16.8 OUTPUT CALIBRATION WIZARD

The Output Calibration Wizard is used to calibrate the BMS card and I/O Expansion card 4-20 mA outputs.

36. Disconnect field device from output to be calibrated and connect a process calibrator in its place.

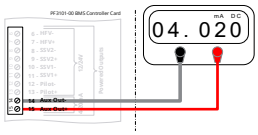



### 16.8.1 OUTPUTS TAB

37. Select the appropriate output from the list and press [ ].


OK

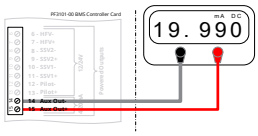
38. Adjust the 4mA value to match the reading on the process calibrator using [ ] and [ ].


+


OK

39. Adjust the 20mA value to match the reading on the process calibrator using [ ] and [ ].


-


OK

40. Check the calibration. Use [ ] and [ ] to change the output value and verify against the process calibrator reading.


41. Reconnect field device.

42. Repeat above steps for all outputs listed.

43. Press [ ] then [ ] to advance to the Review Tab.

### 16.8.2 REVIEW TAB

44. Ensure that there are no errors and select “Accept” to save all changes and exit the Output Calibration Wizard.

## 16.9 FARC/$O_2$ TRIM WIZARD

The FARC/$O_2$ Trim Wizard is used to configure fuel-air ratio curves, define oxygen trimming profiles and specify configuration parameters associated with single-burner fuel-air ratio control applications. Users require a L3 password to access the FARC/$O_2$ Trim Wizard - all configuration should be done by a FARC expert.

45. Before accessing the FARC/$O_2$ Trim Wizard, first ensure that all FARC inputs and outputs are created and assigned in the I/O Expansion Wizard.

### 16.9.1 GENERAL TAB


46. Configure FARC settings per design documentation in accordance with the table below:

| SETTING | OPTIONS | DESCRIPTION |
|---|---|---|
| FARC Enable | Enabled | Specifies that all FARC inputs, outputs and curves are used by the system.<br>* Note that the HFV Output Mode is automatically changed to Forced Draft Fan when FARC is enabled. |
| | Disabled | Specifies that all FARC inputs, outputs and curves are ignored by the system. |
| 4-20 Aux Out Mode | PID Control<br>Appliance Firing Rate | Refer to 4-20 Aux Output Mode setting for descriptions. While this setting has multiple configuration options, only the options listed to the left are available for FARC applications. |
| Low Fire Mode | On at Process SP<br>On at Low Fire SP | Refer to the Low Fire Mode setting for descriptions. While this setting has multiple configuration options, only the options listed to the left are available for FARC applications. |
| Minimum Firing Rate | 0 - 70% | Specifies the minimum allowable firing rate when in a main state. |
| Light Off Firing Rate | 0 – 100% | Specifies the firing rate at which the controller holds during light off of the main burner. |
| Flat Line Tolerance | 1 – 10% | Specifies the tolerance applied around flat portions of a FARC curve where the internal flat line cross limiting algorithm is used. |
| Cross Limit Error | 0 - 15% | Specifies the maximum tolerance by which the requested channel position may differ from its actual position when the channel is actively being cross limited and a fuel-rich* condition is created.<br>* Applies to any lagging channel – not just fuel. |
| Position Error | 0 - 10% | Specifies the maximum tolerance by which the requested channel position and its actual position may differ. |
| Position Error Timeout | 1 – 10 sec | Specifies the time for which a position error must be present before the system acts. |
| Curve A Name | Any | Specifies the name of FARC Curve A. (e.g., “Summer Profile”) |
| Curve B Name | Any | Specifies the name of FARC Curve B. (e.g., “Winter Profile”) |
| Remote Curve Selection | Enabled<br>Disabled | Specifies whether FARC curve can be changed by writing to Modbus Register 40219. Refer to PF3107-00 Modbus Register Map for Details.<br>* NOTE: It is recommended that Remote Curve Selection be enabled only when O2 sensor is installed. This will ensure shutdown in the event that an improperly configured curve is selected. |

47. Press then to advance to the Channels Tab.

### 16.9.2 CHANNELS TAB

The Channels Tab is populated automatically with the FARC channels configured in the I/O Expansion Wizard.


48. Press ▼ to select a channel and ✉ to open its channel-specific configuration window. Configure per design documentation and repeat for each channel. The table below outlinesthe configuration options available:



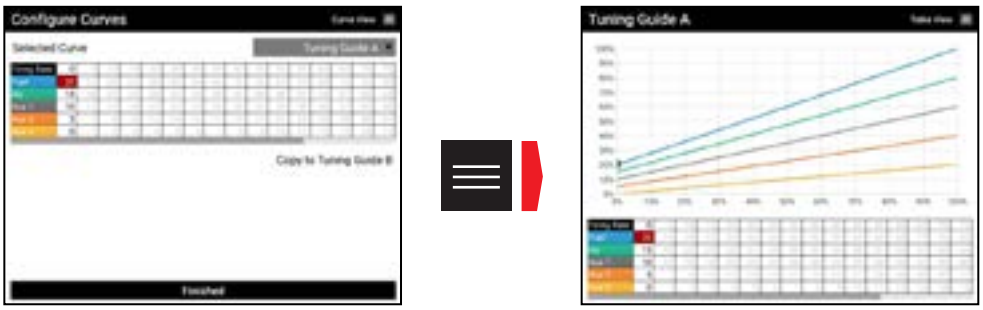
| SETTING | OPTIONS | DESCRIPTION |
|---|---|---|
| Name | Any | Specifies the name of the selected FARC channel. |
| Position Feedback | None or any I/O Expansion input configured as a FARC Aux feedback input. | Specifies the feedback input that corresponds to the channel output.<br>* This option is not available for the Air and Fuel channels as a feedback input for these channels is not optional. |
| Cross Limiting | Disabled | Specifies that cross limiting is not applied to the selected channel.<br>* This option is not available for the Air and Fuel channels. |
| | Lead | Specifies channel output leads the fuel output upon firing rate increase.<br>* The Air channel is a leading channel and cannot be changed. |
| | Lag | Specifies channel output lags the air output upon firing rate increase.<br>* The Fuel channel is a lagging channel and cannot be changed. |
| Output Inversion | Disabled | Specifies that the 0% position of the connected actuator corresponds to a 4mA input signal. |
| | Enabled | Specifies that the 100% position of the connected actuator corresponds to a 4mA input signal. |
| Post Purge Mode | Purge | Specifies that the channel output is driven to its configured Purge Position while post purging. |
| | Hold Last | Specifies that the channel output is held at its current position while post purging. |
| Purge Position | 0 – 100 % | Specifies the channel output position when the system is purging. |
| Pilot Position | 0 – 100 % | Specifies the channel output position when in the Pilot state. |
| Off Position | 0 – 100 % | Specifies the channel output position when stopped and not purging. |

49. Select “Configure Curves” to set up the FARC profile tables.


50. Configure the table in accordance with safety design documentation and manufacturer specifications as well as the slope and feedback requirements outlined in the table below for each channel at each firing rate increment. Refer to the PF3100 FARC User Guide for detailed configuration instructions.

| SCENARIO | | SLOPE REQUIREMENT | POSITION FEEDBACK REQUIREMENT |
|---|---|---|---|
| CHANNEL | CROSS LIMITING SETTING | | |
| Air | N/A – Always enabled | Cannot decrease | N/A – Always enabled |
| Fuel | | | |
| Aux | Enabled | Cannot change direction | Must be enabled |
| | Disabled | No requirements | Not required |

** All unconfigured columns on the table are linearly interpolated from the configured points.*




51. Ensure that both Curve A and Curve B are configured correctly and select “Finished”.
52. Press then to advance to the $O_2$ Trim Tab.

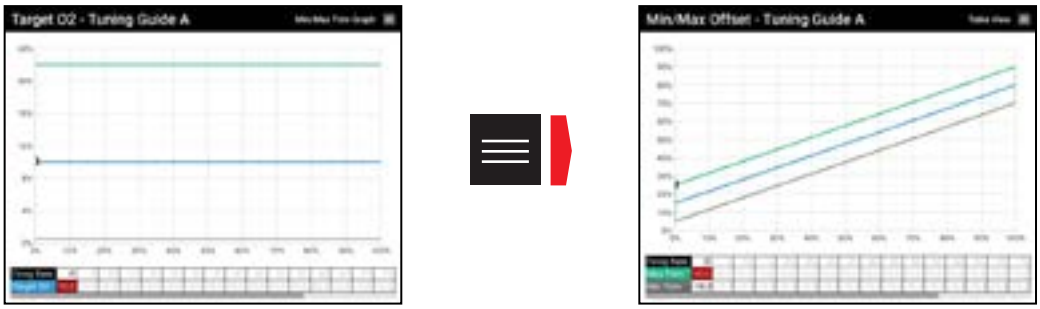
### 16.9.3 $O_2$ TRIM TAB



53. Configure $O_2$ Trim settings in accordance with safety design documentation and heater manufacturer specifications. Refer to the PF3100 FARC User Guide for detailed configuration instructions. The table below outlines the configuration settings available:

| SETTING | OPTIONS | DESCRIPTION |
|---|---|---|
| Trim Channel | Air | Specifies the FARC channel to which the $O_2$ trim profile is applied. |
| | Fuel | |
| | Disabled | |
| Low $O_2$ Setpoint | 0 – 22% | Specifies the $O_2$ sensor input threshold below which the system registers a low $O_2$ event. |
| High $O_2$ Setpoint | 0 – 22% | Specifies the $O_2$ sensor input threshold above which the system registers a high $O_2$ event. |
| $O_2$ Deadband | 0 - 3 % | Specifies the deadband applied around each configured trip point to prevent fluctuation between states. |
| $O_2$ Sensor Warmup Mode | Time Delay | Specifies that the $O_2$ Trim table is ignored until the configured $O_2$ Sensor Warmup Time has elapsed. |
| | Stack Temp | Specifies that the $O_2$ Trim table is ignored until the system reached the Process Control state and the configured Stack Temperature Input has reached the configured Minimum Stack Temperature. |
| $O_2$ Sensor Warmup Time | 1 – 100 sec | Specifies the time after entering Process Control for which to wait before initiating $O_2$ trim when $O_2$ Sensor Warmup Mode is set to Time Delay. |
| Stack Temperature Input | Any configured High Temp ESD or Aux Process input from the Temperature Wizard. | Specifies the temperature input used to determine appliance warmup. |
| Minimum Stack Temperature | 0 – 1350 °C | Specifies the temperature above which $O_2$ trim is initiated. |
| Stack Temperature Deadband | 0 – 100 °C | Specifies the deadband applied around the Minimum Stack Temperature setting to prevent fluctuation between enabling and disabling of $O_2$ Trim. |
| $O_2$ Proportional Band | 1 - 1000 | Specifies the proportional term with respect to transmitter span used by the $O_2$ Trim PI algorithm. |
| $O_2$ Integral Time | 0 – 100 min | Specifies the integral term used by the $O_2$ Trim PI algorithm. |
| System Delay Time | 1 – 300 sec | Specifies the sample time used by the $O_2$ Trim PI algorithm. |

54. Select “Configure $O_2$ Curve” to configure the oxygen trimming profiles.
55. Specify Target $O_2$, Max Trim and Min trim values for every firing rate increment. All unconfigured columns on the table are linearly interpolated from the configured points.




56. Ensure that $O_2$ trim profiles for both Curve A and Curve B are configured correctly and select “Finished”.
57. Press then to advance to the Review Tab.

### 16.9.4 REVIEW TAB

58. Ensure that there are no errors and select “Accept” to save all changes and exit the FARC/$O_2$ Trim Wizard.

## 16.10 BMS CONTROLLER SETTINGS

The settings below are available for all connected controllers. Settings are linked across controllers by default for multi-controller appliances. Select a setting and press ■ to adjust for each controller independently.

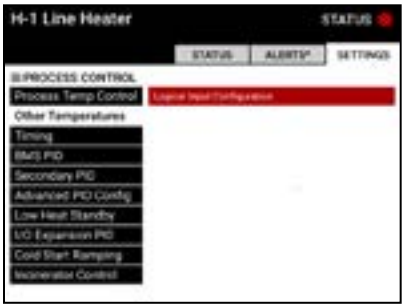

59. Configure all BMS settings below for each connected controller in accordance with manufacturer specifications and safety design documentation.

### 16.10.1 PROCESS CONTROL

#### 16.10.1.1 PROCESS TEMP CONTROL


| SETTING | DEFAULT | OPTIONS | DESCRIPTION |
|---|---|---|---|
| High Temp SP | 90 °C<br>194 °F | | |
| Pilot Off Mode | Off At Setpoint | | |
| Pilot Off SP | 85 °C<br>185 °F | | |
| Low Fire Mode | Disabled | | Refer to Temperature Wizard Adjust Setpoints Dialog above for configuration options and descriptions. |
| Low Fire SP | 85 °C<br>185 °F | | |
| Process Temp SP | 80 °C<br>176 °F | | |
| Low Temp SP | 0 °C<br>32 °F | | |

### 16.10.1.2 OTHER TEMPERATURES






The Process Temp Control settings above pertain only to the primary process temperature input. The Logical Input Configuration link shown in the Other Temperatures menu can be used to view the settings of all configured temperatures. Changes to the settings must be made in the Temperature Wizard.

### 16.10.1.3 TIMING


| SETTING | DEFAULT | OPTIONS | DESCRIPTION |
|---|---|---|---|
| Natural Draft Pre Purge | Disabled | Enabled<br>Disabled | Specifies whether the system observes both a post-purge and a pre-purge for natural draft applications. |
| Pre Purge Time | 60 s | 10s – 900 s | Specifies the time for which the system purges prior to pilot ignition. |
| Purge Time | 60 s | 10 s - 900 s | Specifies the time for which the system purges upon power up and following a lockout. |
| Trial for Ignition Time | 10 s | 4 s - 10 s | Specifies the time for which the system attempts pilot ignition. |
| Pilot to Main Delay | 15 s | 5 s - 600 s | Specifies the time for which the system remains in the Pilot state before proceeding to light off the main valves. |
| Low to High Fire Delay | 30 s | 30 s - 600 s | Specifies the time for which the system remains in the Low Fire state before proceeding to High Fire. |
| Non-Fuel State Alarm Time | 2 s | 2 s - 600 s | Specifies the alarm set time for all I/O Expansion inputs configured as Non-Fuel State alarms. |
| Pilot State Alarm Time | 2 s | 2 s - 600 s | Specifies the alarm set time for all I/O Expansion inputs configured as Pilot State alarms. |
| Main State Alarm Time | 2 s | 2 s - 600 s | Specifies the alarm set time for all I/O Expansion inputs configured as Main State alarms. |

### 16.10.1.4 BMS PID


| SETTING | DEFAULT | OPTIONS | DESCRIPTION |
|---|---|---|---|
| Proportional Band | 10 °C<br>18 °F | 0.1 °C – 999.9 °C<br>0.2 °F – 1799.8 °F | Specifies the proportional term used by the primary PID algorithm. |
| Integral Time | 4 min | 0 min – 999.9 min | Specifies the integral term used by the primary PID algorithm. |
| Derivative Time | 0 min | 0 min – 999.9 min | Specifies the derivative term used by the primary PID algorithm. |
| Sample Time | 1 s | 0.1 s – 99999 s | Specifies the time between samples for the primary PID algorithm. |
| Integral Reset Range | 5 °C<br>9 °F | 0 °C - 1350 °C<br>0 °F - 2430 °F | Specifies the range above and below the Process Setpoint within which the primary PID integral error accumulates. |
| PID Deadband Primary | 0 °C<br>0 °F | 0 °C – 10 °C<br>0 °F – 18 °F | Specifies the primary PID deadband applied to limit fluctuation between states when the primary process temperature is near configured setpoints. |
| Rate Limit Primary | 100%/s | 1 %/s – 100 %/s | Specifies the maximum rate of change of the BMS Controller Aux output during primary PID control. |

### 16.10.1.5 SECONDARY PID


| SETTING | DEFAULT | OPTIONS | DESCRIPTION |
|---|---|---|---|
| Proportional Band Secondary | 10 °C<br>18 °F | 0.1 °C – 999.9 °C<br>0.2 °F – 1799.8 °F | Specifies the proportional term used by the secondary PID algorithm. |
| Integral Time Secondary | 4 min | 0 min – 999.9 min | Specifies the integral term used by the secondary PID algorithm. |
| Derivative Time Secondary | 0 min | 0 min – 999.9 min | Specifies the derivative term used by the secondary PID algorithm. |
| Integral Reset Range Secondary | 5 °C<br>9 °F | 0 °C - 1350 °C<br>0 °F - 2430 °F | Specifies the range above and below the secondary process setpoint within which the secondary PID integral error accumulates. |
| PID Deadband Secondary | 0 °C<br>0 °F | 0 °C – 10 °C<br>0 °F – 18 °F | Specifies the secondary PID deadband applied to limit fluctuation between states when the secondary process temperature is near configured setpoints. |
| Rate Limit Secondary | 100%/s | 1 %/s – 100 %/s | Specifies the maximum rate of change of the BMS Controller Aux output during secondary PID control. |

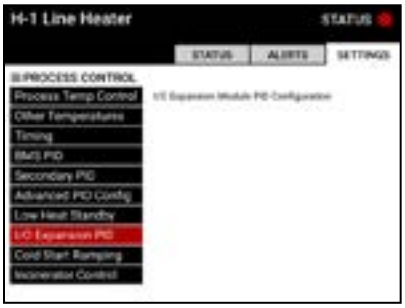
### 16.10.1.6 ADVANCED PID CONFIG


| SETTING | DEFAULT | OPTIONS | DESCRIPTION |
|---|---|---|---|
| Integral Jacketing | Enabled | Enabled | PID integral error does not accumulate when the PID output is operating at 100% or at its configured Minimum Position. |
| | | Disabled | PID integral error continues to accumulate when the PID output is operating at 100% or at its configured Minimum Position. |
| Cascaded PID | Disabled | Enabled | Cascaded PID is enabled |
| | | Disabled | Cascaded PID is disabled |
| PID Staging Mode | Disabled | Disabled | The system controls based on the Primary process temperature only. |
| | | High Input | The system switches from primary to secondary input control when the configured Staging Input is above its High Trip setpoint. |
| | | Low Input | The system switches from primary to secondary input control when the configured Staging Input is below its Low Trip setpoint. |
| | | Primary In Range | The system switches from primary to secondary input control when the primary temp is above the configured Primary Setpoint Min setting. |
| | | Secondary In Range | The system switches from primary to secondary input control when the configured secondary temperature is between the configured Secondary Setpoint Min and Secondary Setpoint Max settings below. |
| | | Primary AND Secondary in Range | The system switches from primary to secondary input control when both the primary and secondary temperatures are between their configured Setpoint Min and Setpoint Max settings below. |
| | | Primary OR Secondary in Range | The system switches from primary to secondary input control when either the primary or secondary temperature is between its configured Setpoint Min and Setpoint Max settings below. |
| PID Ramp Time | 5 s | 0 s – 60 s | Specifies the time the BMS controller Aux output takes to ramp to 100% upon entry into the PID control state. |
| Primary Setpoint Max | 90 °C<br>194 °F | 0 °C - 1350 °C<br>32 °F - 2462 °C | Specifies the maximum value to which the primary process setpoint can be changed by the system.<br>* Must be set between the configured Process Setpoint and Low Fire Setpoint. |
| Primary Setpoint Min | 0 °C<br>32 °F | 0 °C - 1350 °C<br>32 °F - 2462 °C | Specifies the minimum value to which the primary process setpoint can be changed by the system.<br>* Must be set between the configured Process Setpoint and Low Temp Setpoint. |
| Secondary Setpoint Max | 90 °C<br>194 °F | 0 °C - 1350 °C<br>32 °F - 2462 °C | Specifies the maximum value to which the secondary process setpoint can be changed by the system.<br>* Must be set between the configured Process Setpoint and Low Fire Setpoint. |
| Secondary Setpoint Min | 0 °C<br>32 °F | 0 °C - 1350 °C<br>32 °F - 2462 °C | Specifies the minimum value to which the secondary process setpoint can be changed by the system.<br>* Must be set between the configured Process Setpoint and Low Temp Setpoint. |
| Secondary Input | - | Any temperature or Secondary PID I/O Expansion Input | Specifies the input used as a secondary PID input. |
| Staging Input | - | Any configured I/O expansion input | Specifies the I/O Expansion input used as a staging input |

### 16.10.1.7 LOW HEAT STANDBY


| SETTING | DEFAULT | OPTIONS | DESCRIPTION |
|---|---|---|---|
| Low Heat Standby Mode | Disabled | Disabled | The controller does not use Low Heat Standby functionality |
| | | Wait | Specifies that the controller transitions to the Waiting state if all the following conditions are met for the duration of the Low Heat Standby Delay setting:<br>1. The controller is in the PID Control state.<br>2. The process temperature is between the Process setpoint and Low Fire Setpoint.<br>3. Basic PID: The firing rate is at the configured Minimum Firing Rate.<br>Cascaded PID: The Primary setpoint is at the configured Primary Setpoint Min setting. |
| | | Main Permissive | Specifies that the controller transitions to the Pilot state if all the following condition are met for the duration of the Low Heat Standby Delay setting:<br>1. The controller is in the PID Control state.<br>2. The process temperature is between the Process setpoint and Low Fire Setpoint.<br>3. Basic PID: The firing rate is at the configured Minimum Firing Rate. Cascaded PID: The Primary setpoint is at the configured Primary Setpoint Min setting. |
| Low Heat Standby Delay | 1 min | 1 min – 1440 min | Specifies the time for which the Low Heat Standby conditions must be met for the system to initiate a Low Heat Standby state transition. |

### 16.10.1.8 I/O EXPANSION PID




The I/O Expansion Card PID Configuration link can be used to access the PID configuration settings for the I/O Expansion card inputs.

### 16.10.1.9 COLD START RAMPING


| SETTING | DEFAULT | OPTIONS | DESCRIPTION |
|---|---|---|---|
| Temp Ramp | Disabled | Disabled | Cold start ramping is not used. |
| | | Enabled | Firing rate is modulated upon start up to attempt to maintain the rate of temperature increase specified by the step size settings below. |
| Temp Step Size | 0 °C<br>0 °F | 0 °C - 1350 °C<br>0 °F - 2430 °F | Specifies the maximum temperature increase allowed over a specified period upon start up. |
| Time Step Size | 0 min | 0 min – 65535 min | |

### 16.10.1.10 INCINERATOR CONTROL


| SETTING | DEFAULT | OPTIONS | DESCRIPTION |
|---|---|---|---|
| Incinerator Enable | Disabled | Enabled | The appliance is an incinerator. |
| | | Disabled | The appliance is not an incinerator. |
| Incinerator POC Valve | Waste | Waste | The POC input is connected to a proof of closure switch on the waste gas valve. |
| | | Assist | The POC input is connected to a proof of closure switch on the assist gas valve. |
| High Temp SP | See Process Temp Control settings above | | |
| Pilot Off SP | | | |
| Waste Gas Off Setpoint | 84 °C<br>183.2 °F | 0 °C - 1350 °C<br>32 °F - 2462 °F | Specifies the process temperature above which the waste gas valve is de-energized. |
| Assist Gas Off Setpoint | 82 °C<br>179.6 °F | 0 °C - 1350 °C<br>32 °F - 2462 °F | Specifies the process temperature above which the assist gas valve is de-energized. |
| Process Temp SP | See Process Temp Control settings above | | |
| Waste Gas On Setpoint | 50 °C<br>122 °F | 0 °C - 1350 °C<br>32 °F - 2462 °F | Specifies the process temperature above which the waste gas valve is energized. |
| Waste Gas Off Deadband | 2 °C<br>3.6 °F | 0 °C - 100 °C<br>0 °F - 180 °F | Specifies the deadband applied to prevent fluctuation between states when the process temperature is near the setpoints. |
| Assist Gas Off Deadband | 2 °C<br>3.6 °F | 1 °C - 200 °C<br>1.8 °F - 360 °F | |
| Waste Gas On Deadband | 2 °C<br>3.6 °F | 2 °C - 2 °C<br>3.6 °F - 3.6 °F | |

## 16.10.2 INPUTS

### 16.10.2.1 AUX IN CONTACT


| SETTING | DEFAULT | OPTIONS | DESCRIPTION |
|---|---|---|---|
| Aux In Contact Mode | Disabled | Disabled | The Aux In contact is ignored. |
| | | Proof of Closure High Fire | The Aux In contact is connected to a proof of closure switch on the high fire valve. |
| | | Proof of Closure 2 | The Aux In contact is connected to a proof of closure switch. |
| | | Proof of Pilot | The Aux In contact is connected to a proof of pilot position switch. |
| | | Low Fuel Pressure | The Aux In contact is connected to a low fuel pressure switch.<br>* Low fuel pressure alert behavior is dictated by the Low Fuel Pressure Restart and Restart Mode settings on the Pressure Settings Screen. |
| | | Proof of Airflow | The Aux In contact is connected to a proof of airflow switch. |
| | | Main Permissive | The Aux In contact trip transitions the system out of any main fuel state and prevents re-entry until cleared. |
| | | Proof of Light Off Position | The Aux In contact is connected to a proof of low fire position switch on the temperature control valve. |
| Main Permissive Masking | Disabled | Enabled | Waits listed below are ignored and removed from the Appliance Alerts Screen when a main permissive is present on the controller.<br>Waits affected:<br>- All I/O Expansion waits<br>- Low Fuel Pressure<br>- Low Fuel Pressure Dry Contact<br>- Low Tank Level<br>- Tank Level Contact Open |
| | | Disabled | Input waits are not ignored. |

### 16.10.2.2 FLAME DETECTION


| SETTING | DEFAULT | OPTIONS | DESCRIPTION |
|---|---|---|---|
| Main Flame Detect | Disabled | Refer to Pilot Wizard Ignition Settings Tab section for configuration options and descriptions. | |

### 16.10.2.3 FUEL PRESSURE INPUT


| SETTING | DEFAULT | OPTIONS | DESCRIPTION |
|---|---|---|---|
| Fuel Pressure Input Mode | Disabled | Disabled | The fuel pressure input is ignored. |
| | | Dry Contact | The fuel pressure input is connected to a low-pressure switch and high-pressure switch in series (or a low-pressure switch if Low Pressure restart is not required). |
| | | 4-20 | The fuel pressure input is connected to a 4-20mA transmitter. |
| | | Dry Contact High Pressure | The fuel pressure input is connected to a high-pressure switch. |
| Low Fuel Press Restart | Disabled | Enabled | Low-pressure event [1] behavior is dictated by Restart Mode setting. |
| | | Disabled | A low-pressure event [1] causes an alarm. |
| Restart Mode | Wait | Wait | A low-pressure event [1] causes a wait. |
| | | Main Permissive | A low-pressure event [1] causes a main permissive. |
| 4-20 Fuel Pressure Max | 207 kPa<br>30 psi | Any | Specifies the maximum reading of the pressure transmitter. |
| 4-20 High Fuel Pressure SP | 172 kPa<br>25 psi | 0 % - 100 % of Max | Specifies the transmitter reading above which the appliance shuts down on high pressure. |
| 4-20 Low Fuel Pressure SP | 20.7 kPa<br>3 psi | 0 % - 100 % of Max | Specifies the transmitter reading below which the system registers a low-pressure event. |
| Fuel Pressure Deadband | 2.6 kPa<br>0.4 psi | 0 % - 6.25 % of Max | Specifies the deadband applied to prevent fluctuation between states. |
| Low Fuel Pressure Delay | 2 s | 2 s – 20 s | Specifies the time for which a low-pressure event 1 must be present before the system acts. |

*[1] A low-pressure event is (1) a pressure input reading below its configured 4-20 Low Fuel Pressure SP when it is configured in 4-20 Mode, and (2) a de-energized Auxiliary input when it is configured in Low Fuel Pressure Mode.*

### 16.10.2.4 ION AUX INPUT

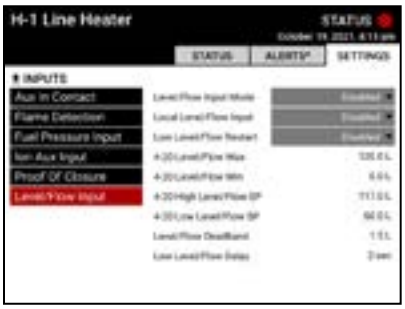

The Ion Aux Input is located on the Ion Pilot card and can be used for either (1) thermocouple flame detection (with a thermocouple to 4-20mA converter) or (2) to connect a generic 4-20mA transmitter for high trip shutdown. The Ion Aux In Type setting must be enabled in the Pilot Wizard for the following settings to take effect.

| SETTING | DEFAULT | OPTIONS | DESCRIPTION |
|---|---|---|---|
| Ion Aux In Mode | High Trip Alarm | TC Flame Detect | The Ion Aux input is used as a 4-20mA flame detection input and the trial for ignition time is increased from 10 to 120 seconds. |
| | | High Trip Alarm | The Ion Aux input is connected to digital input device or a 4-20mA transmitter for shut down upon a high trip event. |
| Ion Aux In Trip Point | 14 mA<br>62.5 % | 4 mA - 20 mA<br>0 % - 100 % | Specifies the Ion Aux input reading above which the system shuts down. |
| Ion Aux In Deadband | 6 mA<br>12.5 % | 4 mA - 20 mA<br>0 % - 100 % | Specifies the deadband applied to prevent fluctuation between states. |

### 16.10.2.5 PROOF OF CLOSURE


| SETTING | DEFAULT | OPTIONS | DESCRIPTION |
|---|---|---|---|
| Proof of Closure | Disabled | Enabled | The POC input is connected to a proof of closure switch on the main valves. |
| | | Disabled | The proof of closure input is ignored. |

### 16.10.2.6 LEVEL/FLOW INPUT



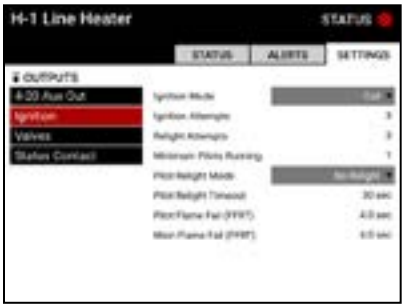

| SETTING | DEFAULT | OPTIONS | DESCRIPTION |
|---|---|---|---|
| Level/Flow Input Mode | Disabled | Disabled | The Level/Flow input is ignored. |
| | | Dry Contact | The Level/Flow input is connected to a Level or Flow switch. |
| | | 4-20 | The Level/Flow input is connected to 4-20mA Level or Flow transmitter. |
| Local Level/Flow Input | Disabled | Enabled | The Level/Flow input device is physically wired to the controller. |
| | | Disabled | The Level/Flow input device is physically wired to a different controller in the appliance. |
| Low Level/Flow Restart | Disabled | Enabled | The system transitions into the Waiting state upon a low-level/flow event and does not proceed until cleared. |
| | | Disabled | The appliance shuts down on low-level/flow events. |
| 4-20 Level/Flow Max | 120 L<br>31.7 gal | 0 L – Any | The maximum reading of the level or flow transmitter. |
| 4-20 Level/Flow Min | 0 L<br>0 gal | 0 L – Any | The minimum reading of the level or flow transmitter. |
| 4-20 High Level/Flow SP | 117 L<br>31 gal | 0 % - 100 % of Max | Specifies the transmitter reading above which the appliance shuts down on high level/flow. |
| 4-20 Low Level/Flow SP | 60 L<br>15.9 gal | 0 % - 100 % of Max | Specifies the transmitter reading below which the system registers a low level/flow event. |
| Level/Flow Deadband | 1.5 L<br>0.4 gal | 0 % - 6.25 % of Max | Specifies the deadband applied to prevent fluctuation between states. |
| Low Level/Flow Delay | 2 s | 2 s – 20 s | Specifies the time for which a low-level/flow event must be present before the system acts. |

### 16.10.3 OUTPUTS

#### 16.10.3.1 4-20 AUX OUT

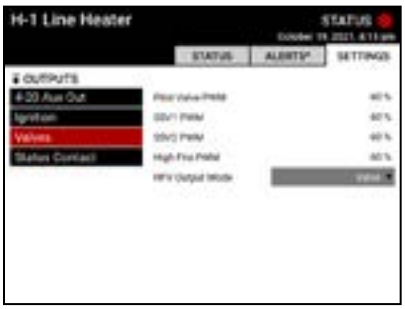

| SETTING | DEFAULT | OPTIONS | DESCRIPTION |
|---|---|---|---|
| 4-20 Aux Out Mode | Disabled | Disabled | The Aux output is disabled |
| | | Manual | The Aux output delivers a 4-20mA signal in accordance with the configured Manual Control Output setting below. |
| | | Temp Echo | The Aux output delivers a percentage value of the process temperature in relation to the High Temp Setpoint, mapped as a 4-20mA signal.<br>Example:<br>High Temp SP setting = 100 °<br>Process temperature reading = 50 °<br><br>Aux output in % = (50°/100°) x 100 = 50%<br>Aux output in mA = 12mA |
| | | Pressure Echo | The Aux output delivers a 4-20mA signal identical to the 4-20mA Pressure input signal. |
| | | Level Echo | The Aux output delivers a 4-20mA signal identical to the 4-20mA Level/ Flow input signal. |
| | | PID Control | The Aux output delivers a 4-20mA signal in accordance with configured position settings and the internal PID control algorithm |
| | | Appliance Firing Rate | The Aux output delivers a 4-20mA signal in accordance with configured position settings and a 4-20mA I/O Expansion card firing rate input. |
| | | Modbus Firing Rate | The Aux output delivers a 4-20mA signal in accordance with configured position settings and Modbus Holding Register 40162 firing rate input.<br>Note: Refer to PF3107-00 Modbus Register Map for Details. |
| Manual Override | Disabled | Enabled | The Aux output delivers a 4-20mA signal in accordance with the configured Manual Control Output setting below. |
| | | Disabled | The Manual Control Output setting below is ignored. |
| Manual Control Output | 0 % | 0 % - 100 % | Specifies the Aux output signal when 4-20 Aux Out Mode setting is set to Manual or when the Manual Override setting is set to Enabled. |
| Purge Position | 100 % | 0 % - 100 % | Specifies the Aux output signal when requesting purge position. Applicable when 4-20 Aux Out Mode setting is set to BMS PID. |
| Pilot Position | 25 % | 0 % - 100 % | Specifies the Aux output signal when requesting pilot position. Applicable when 4-20 Aux Out Mode setting is set to BMS PID. |
| Minimum Firing Rate | 40 % | 0 % - 70 % | Specifies the minimum allowable Aux output signal when in a main state. Applicable when 4-20 Aux Out Mode setting is set to BMS PID. |

### 16.10.3.2 IGNITION




| SETTING | DEFAULT | OPTIONS | DESCRIPTION |
|---|---|---|---|
| Ignition Mode | Coil | | Refer to Pilot Wizard Ignition Settings Tab section for configuration options and descriptions. |
| Ignition Attempts | 3 attempts | | |
| Relight Attempts | 3 attempts | | |
| Minimum Pilots Running | 1 | | |
| Pilot Relight Mode | During Flame Fail | | |
| Pilot Relight Timeout | 30 s | | |
| Pilot Flame Fail (FFRT) | 4 s | | |
| Main Flame Fail (FFRT) | 4 s | | |

### 16.10.3.3 VALVES




| SETTING | DEFAULT | OPTIONS | DESCRIPTION |
|---|---|---|---|
| Pilot Valve PWM | 60 % | 20 % - 100 % | Specifies the duty cycle of the BMS Controller Pilot valve output and the Ion Pilot card Valve output. |
| SSV1 PWM | 60 % | 20 % - 100 % | Specifies the duty cycle of the SSV1 valve output. |
| SSV2 PWM | 60 % | 20 % - 100 % | Specifies the duty cycle of the SSV2 valve output. |
| High Fire PWM | 60 % | 20 % - 100 % | Specifies the duty cycle of the HFV valve output. |
| HFV Output Mode | Valve | Valve | The HFV output is connected to a normally closed high fire valve. |
| | | Forced Draft Fan | The HFV output is connected to a relay enabling a forced draft fan. |
| | | Purge Fan | The HFV output is connected to a relay enabling a purge fan. |

#### 16.10.3.4 STATUS CONTACT


| SETTING | DEFAULT | OPTIONS | DESCRIPTION |
|---|---|---|---|
| Status Contact Mode | Run Status | | Refer to Status Contact Behavior section for configuration options and system behavior. |

### 16.10.4 SETUP

#### 16.10.4.1 COMMISSIONING


| SETTING | DEFAULT | OPTIONS | DESCRIPTION |
|---|---|---|---|
| Commission Date | - | Any | Specifies the date that the system was commissioned. |
| Controller Name | Not Set | Any | Specifies the controller names as configured above in the Appliance Wizard. |
| Location | Not Set | Any | Specifies the controller location. |
| Appliance Size | 1 controller | Read Only<br>1 – 16 controllers | Displays the number of controllers in the appliance. |
| Min Controllers Running | 1 controller | 1 – 16 controllers | Specifies the number of controllers that must be running for the appliance to remain running.<br>* Cannot be set higher than the Appliance Size for multi-burner applications. |

### 16.10.4.2 SYSTEM VOLTAGE


| SETTING | DEFAULT | OPTIONS | DESCRIPTION |
|---|---|---|---|
| Controller Voltage | 24 V | 12 V | The controller is supplied by a 12 V power source. |
| | | 24 V | The controller is supplied by a 24 V power source. |
| Voltage Deadband | 0.2 V | 0 V - 0.5 V | Specifies the deadband applied to the input voltage to prevent fluctuation between states when the reading is near the trip points. |
| Low Voltage Restart | Disabled | Enabled | The system automatically restarts following a power loss while running. |
| | | Disabled | The system does not automatically restart following a power loss event. |
| High Voltage Restart | Disabled | Enabled | The system transitions to the Waiting state upon a high voltage event. |
| | | Disabled | The system shuts down upon a high voltage event. |

### 16.10.4.3 OTHER


| SETTING | DEFAULT | OPTIONS | DESCRIPTION |
|---|---|---|---|
| Comm Loss Restart | Disabled | Enabled | The system goes to the Waiting state upon Pilot card communication loss. |
| | | Disabled | The system goes to Lockout upon Pilot card communication loss. |
| BMS User Interface | Enabled | Enabled | BMS Enclosure LED indicators enabled. |
| | | Disabled | BMS Enclosure LED indicators disabled. |
| BMS Wait Timeout | 2 min | 0 min | BMS Wait Timeout setting is ignored. |
| | | 1 – 120 min | Specifies the time after which a BMS wait becomes an alarm. Applicable waits: BMS Low Voltage • BMS High Voltage • BMS Low Fuel Pressure (4-20mA and Dry contact mode) • BMS Low Level/Flow • BMS Level/Flow Open • Loss of Communications |
| IO Wait Timeout | 2 min | 0 min | IO Wait Timeout setting is ignored. |
| | | 1 – 120 min | Specifies the time after which an I/O Expansion wait becomes an alarm. Applicable waits: I/O Expansion Input Invalid • I/O Expansion Input Low Trip • I/O Expansion Input High Trip • I/O Expansion Input Open |

## 16.10.5 CALIBRATION

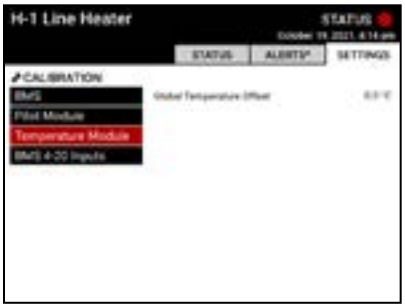
### 16.10.5.1 BMS


| SETTING | DEFAULT | OPTIONS | DESCRIPTION |
|---|---|---|---|
| Level/Flow Offset | 0 mA | -3.2 mA – 3.2 mA | Specifies the offset applied to the BMS Level/Flow input readings. |
| Level/Flow Scaling Factor | 0.00 | -0.50 – 0.50 | |
| Pressure Offset | 0 mA | -3.2 mA – 3.2 mA | Specifies the offset applied to the BMS Pressure input readings. |
| Pressure Scaling Factor | 0.00 | -0.50 – 0.50 | |
| Factory Cal Error Mode | Alarm | Alarm | Calibration errors prevent the system from starting. |
| | | Warning | Calibration errors are displayed as warnings, but do not otherwise affect system behavior. |
| | | Suppress | Calibration errors are ignored. |

### 16.10.5.2 PILOT MODULE


| SETTING | DEFAULT | OPTIONS | DESCRIPTION |
|---|---|---|---|
| Ion Aux In Offset | 0.0 % | -20 % - 20 % | Specifies the offset applied to the Ion Pilot card Aux input readings. |
| Ion Aux In Scaling Factor | 0.00 | Read Only | |

### 16.10.5.3 TEMPERATURE MODULE




| SETTING | DEFAULT | OPTIONS | DESCRIPTION |
|---|---|---|---|
| Global Temperature Offset | 0.0 °C<br>0.0 °F | -50 °C - 50 °C<br>-90 °F – 90 °F | Specifies the offset applied to the temperature card inputs. |

### 16.10.5.4 BMS 4-20 INPUTS

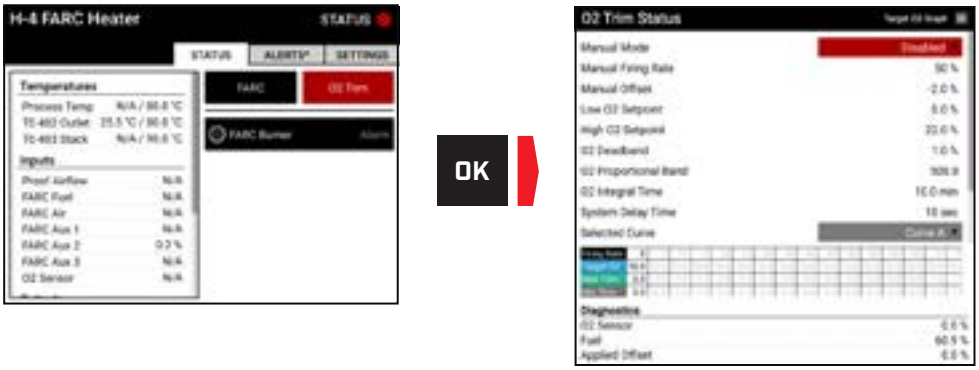

| SETTING | DEFAULT | OPTIONS | DESCRIPTION |
|---|---|---|---|
| 4-20 High Range Limit | 22.0 mA | 19 mA – 22 mA | Specifies the trip points for the 4-20mA out of range alarms. |
| 4-20 Low Range Limit | 3.0 mA | 3 mA – 5 mA | |

## 16.11 FARC TUNING SETTINGS


60. Configure all FARC settings in accordance with manufacturer specifications and safety design documentation. Manual Mode must be Enabled to make changes to the table. Refer to the PF3100 FARC User Guide for detailed configuration instructions.

| SETTING | OPTIONS | DESCRIPTION |
|---|---|---|
| Manual Mode | Enabled | When in the Process Control state, the system sets the firing rate to match the configured Manual Firing Rate setting and moves all channel outputs to their corresponding positions from the active FARC table. |
| | Disabled | The system ignores the Manual Firing Rate setting below. |
| Manual Firing Rate | 0 - 100% | Specifies the firing rate of the system when the Manual Mode setting is set to Enabled. |
| Selected Curve | Curve A | Specifies that configuration changes made from this menu apply to FARC Curve A |
| | Curve B | Specifies that configuration changes made from this menu apply to FARC Curve B |
| Fuel-Air Ratio Table Firing Rate | Not adjustable – fixed 5% increments | Specifies the firing rate to which all values in the column apply |
| Fuel-Air Ratio Table - Air | 0 – 100% | Specifies the air actuator position for a given firing rate. |
| Fuel-Air Ratio Table - Fuel | 0 – 100% | Specifies the fuel actuator position for a given firing rate. |
| Fuel-Air Ratio Table – Aux Channels | 0 – 100% | Specifies the auxiliary channel actuator position for a given firing rate. |

## 16.12 $O_2$ TRIM TUNING




61. Configure all $O_2$ Trim settings in accordance with manufacturer specifications and safety design documentation. Manual Mode must be Enabled to make changes to the table. Refer to the PF3100 FARC User Guide for detailed configuration instructions.

| SETTING | OPTIONS | DESCRIPTION |
|---|---|---|
| Manual Mode | Enabled | When in the Process Control state, the system sets the firing rate and offset to match the configured Manual Firing Rate setting and Manual Offset setting, respectively, and moves all channel outputs to their corresponding positions from the active FARC table. |
| | Disabled | The system ignores the Manual Firing Rate and Manual Offset settings below. |
| Manual Firing Rate | 0 - 100% | Specifies the firing rate of the system when the Manual Mode setting is set to Enabled. |
| Manual Offset | -100% - +100% | Specifies the $O_2$ Trim offset when the Manual Mode setting is set to Enabled. |
| $O_2$ Proportional Band | Refer to FARC/$O_2$ Trim Wizard $O_2$ Trim Tab above for configuration options and descriptions. | |
| $O_2$ Integral Time | | |
| Selected Curve | Curve A | Specifies that configuration changes made from this menu apply to FARC Curve A |
| | Curve B | Specifies that configuration changes made from this menu apply to FARC Curve B |
| $O_2$ Trim Table Firing Rate | Not adjustable – fixed 5% increments | Specifies the firing rate to which all values in the column apply |
| $O_2$ Trim Table – Target $O_2$ | 0 – 22% | Specifies the desired $O_2$ concentration for a given firing rate. |
| $O_2$ Trim Table – Max Trim | 0% - +100% | Specifies the desired maximum offset applied for a given firing rate. |
| $O_2$ Trim Table – Min Trim | -100% – 0% | Specifies the desired minimum offset applied for a given firing rate. |

## 16.13 TEST SYSTEM

All settings changes must be verified against the safety design documentation and equipment manufacturer specifications prior to starting the system. All safety functions must be validated to ensure that the system behaves as required in all safety shut down situations.

62. Ensure that all safety settings are configured in accordance with safety design documentation and equipment manufacturer specifications.
63. Test all safety functions to ensure that the system has been configured correctly.

## 16.14 SAVE SETTINGS

Once commissioning is complete, settings should be backed up to a USB storage device. Saved settings can be restored on the system or used to commission a separate system (in conjunction with the Swap Wizard) identically.

64. Use the Settings Backup Tool to save settings to a USB storage device.

# 17 SYSTEM OPERATION

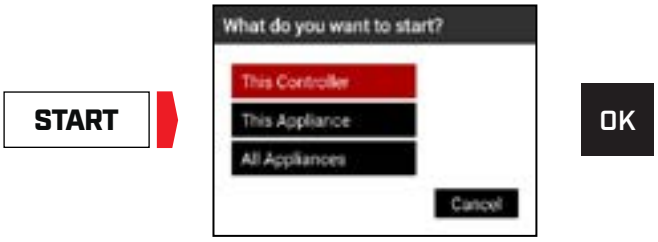
The following sections outline the procedures required for basic operation of a commissioned PF3100 system including starting and stopping controllers or appliances, finding status and alert information, making quick setpoint adjustments and acknowledging lockout messages.

## 17.1 STARTING THE SYSTEM

Controllers and appliances can be started (from the Ready state only) using the methods outlined below:

**Start individual controllers:**

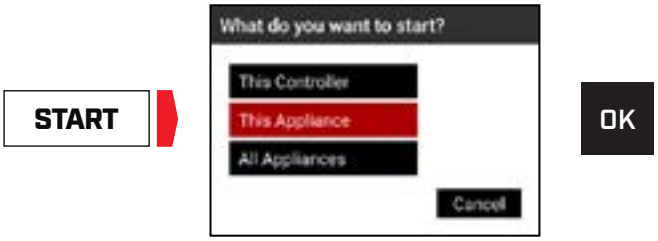
- User Interface – Navigate to desired controller status screen, press START, select "This Controller", then press OK.




- External Ignition Switch (If installed and enabled) – Turn switch to ignite position and hold for 1 second.
- Remote start input – From the Ready state, toggle input from energized to de-energized to energized within 30 seconds.
- Modbus – Write start command to the Start/Stop Modbus register (30100/40100).
  Refer to PF3107-00 Modbus Register Map for Details.

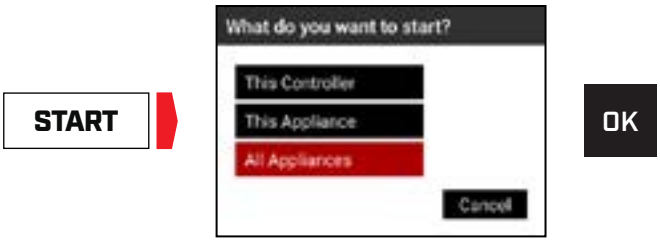
**Start individual appliance:**

- User Interface – Navigate to desired appliance status screen, press START, select "This Appliance", then press OK.




**Start all appliances:**

- User Interface – Press START from any screen, select "All Appliances", then press OK.



## 17.2 ACCESSING SYSTEM STATUS INFORMATION

### 17.2.1 REAL-TIME STATUS INFORMATION

Useful status information is displayed on the Appliance Status Screen and Controller Status Screen. Advanced status information can be found on the Flame Diagnostics Screen and System Data Screen. The information available includes but is not limited to:

- Controller state information
- Input readings
- Output status
- Flame quality

### 17.2.2 ALERT ANNUNCIATION

All alerts are annunciated on the Alerts Screen while active and can be found in the Event Log after they have been cleared. The alert types are as follows:

- Alarm – Prevents the controller from entering any running state.
- Wait – Prevents the controller from entering any fuel state.
- Main Permissive – Prevents the controller from entering any main fuel state.
- Warning – Provides information to the user but does not affect system behavior.

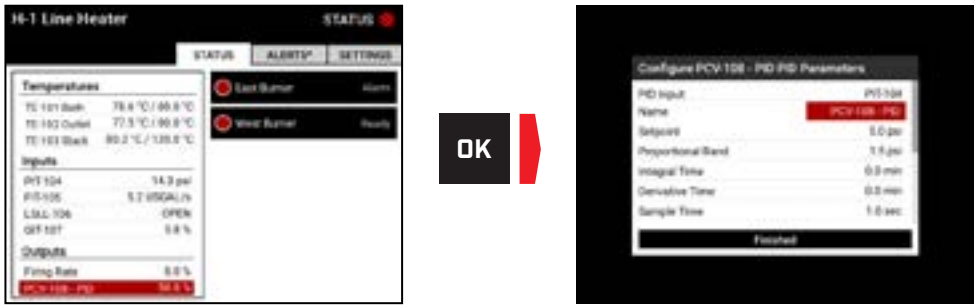
Refer to the Alert Codes section for descriptions of each alert.

## 17.3 ADJUSTING SETPOINTS

The Quick Adjust Dialog can be accessed, while the appliance is running, from the Appliance Status Screen by pressing ☰ and entering a valid password. + and - can then be used to incrementally adjust the configured Process Setpoint, Low Fire Setpoint and Pilot Off Setpoint for the appliance. Additional settings and configuration wizards cannot be accessed while the appliance is running and must be modified by capable personnel only.

## 17.4 ADJUSTING INPUT AND OUTPUT SETTINGS

Configurable inputs and outputs can be adjusted from the Appliance Status screen by selecting the desired item and pressing OK to bring up a configuration dialog. Use the keypad to adjust the settings as desired. The displayed settings are dependent on the security level of the password used to access the menu.



## 17.5 STOPPING THE SYSTEM

Controllers and appliances can be stopped using the methods outlined below:

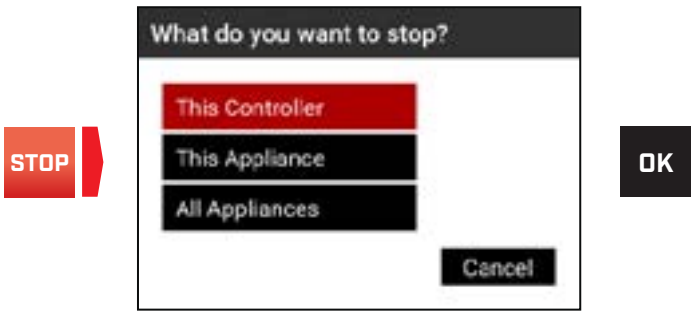
**Stop individual controllers:**

**Safety-Rated Stopping Methods:**

- External Ignition Switch (If installed and enabled) – Turn switch to stop position.
- ESD input – Toggle input to de-energized position.

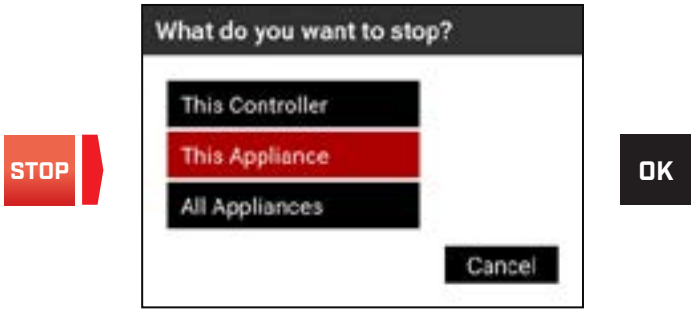
**Non-Safety-Rated Stopping Methods:**

- Modbus – Write stop command to the Start/Stop Modbus register (30100/40100). Refer to PF3107-00 Modbus Register Map for Details.
- User Interface – Navigate to desired controller status screen, press STOP, select "This Controller", then press OK.



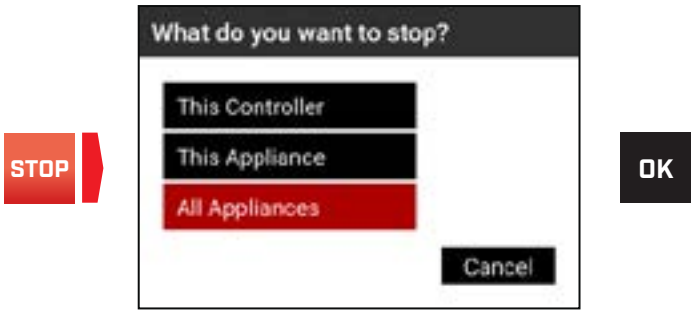

**Stop individual appliance:**

- User Interface – Navigate to desired appliance status screen, press STOP, select "This Appliance", then press OK.




**Stop all appliances:**

- User Interface – From any screen, press STOP, select "All Appliances", then press OK.



## 17.6 REIGNITING A LOST PILOT

Lost pilots can be re-ignited without stopping the controller for multi-pilot applications where one or more pilot flames are lost and the Minimum Pilots Running setting is still satisfied. From the Controller Status Screen, select the lost pilot and press OK to attempt pilot reignition while maintaining the current controller state.


## 17.7 ACKNOWLEDGING LOCKOUTS

Lockout messages appear when a controller enters the Lockout state and must be acknowledged for the controller to transition to any other state. The following methods can be used to acknowledge and clear a lockout message from the screen:


- User Interface: Press OK.
- External Ignition Switch: Toggle switch from Run to Stop to Run position within 30 seconds.
- Remote Start input: Toggle input from energized to de-energized to energized within 30 seconds.
- Modbus – Write Acknowledge command to the Clear Shutdown Code Modbus register (30143/40143). Refer to PF3107-00 Modbus Register Map for Details.

**Note:** The Remote Start Input can be used to acknowledge a lockout message only when the system has performed fewer than 5 remote lockout acknowledgements (i.e., lockout acknowledgements initiated via Modbus or Remote Start Input) within the last 15 minutes. A further attempt to acknowledge a lockout message using the Remote Start Input will be rejected unless it is initiated after the 15-minute window elapses. Lockout messages can always be acknowledged locally using the OK button or the external ignition switch.

# 17.8 ADVANCED PF3100 SOFTWARE FEATURES

## 17.8.1 PID CONTROL

Below is a brief overview of the PID control features available on the PF3100. Refer to PID Tuning Guide document for additional Details and configuration information. The following terms are used to describe the system behavior in the various PID control modes:

- Primary Process Temperature: The main process temperature as specified in the Temperature Wizard Create Inputs Tab.
- Secondary PID Input: An auxiliary process temperature as specified in the Temperature Wizard Create Inputs Tab or a Secondary PID Input as configured in the I/O Expansion Wizard Add Inputs Tab.
- Temperature Control Valve (TCV): A device installed in the main fuel train that restricts gas flow proportionally in accordance with a 4-20mA input from the BMS controller. This device must be wired to the BMS Aux output terminals.

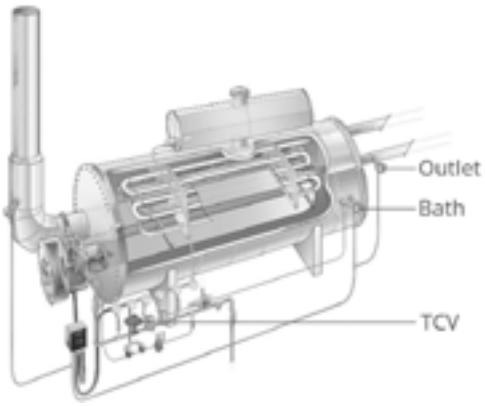
### 17.8.1.1 BASIC PID CONTROL

In basic PID control applications, the TCV is controlled in accordance with the configured BMS PID settings to attempt to maintain the Primary Process Temperature at its configured Process Setpoint.

### 17.8.1.2 CASCADED PID CONTROL

In Cascaded PID control applications, the TCV is controlled and the Primary Process Setpoint is adjusted, both in accordance with the configured BMS PID settings, Secondary PID settings, and Advanced PID settings to attempt to maintain stability of a lagging Secondary PID Input at its configured Setpoint.

Example - Consider a line heater application where a stable outlet temperature is desired. The TCV directly controls fuel flow to the main burners heating the Bath which in turn heats the Outlet process fluid.




| PID INPUT | NAME | PROCESS SETPOINT | SETPOINT MAX SETTING | SETPOINT MIN SETTING | PID PARAMETERS |
|---|---|---|---|---|---|
| Primary Process | Bath | 400°F | 380°F | 420°F | As required per PID tuning |
| Secondary PID | Outlet | 375°F | N/A | N/A | |

In this example, the controller is free to change the Primary Process Setpoint between 380°F and 420°F, in accordance with the configured PID parameters, as required to attempt to maintain stability of the Outlet temperature. With basic PID control on the Outlet only, the Outlet temperature is achieved at the expense of Bath stability. With Cascaded PID control, the Outlet temperature can be achieved while maintaining Bath stability.

### 17.8.1.3 PID STAGING

PID Staging allows control based on either the Primary Process Temperature or the Secondary PID Input depending on a specific trigger condition. The controller modulates the TCV based on the configured Primary Process PID settings until the condition specified by the PID Staging Mode Setting is satisfied. At which point, the controller modulates the TCV based on the configured Secondary PID settings.

### 17.8.2 FUEL-AIR RATIO CONTROL (FARC)

The following section provides an overview of the PF3100 FARC capabilities. Refer to the PF3100 FARC User Guide for additional Details and configuration instructions. A FARC system consists of a forced draft appliance with actuators controlling air flow and fuel flow and up to three additional actuators controlling other process inputs. The PF3100 allows specific actuator positions to be configured in 5% firing rate increments to control the fuel-air ratio of the combustion inputs across the entire operating range of the appliance.

#### 17.8.2.1 BASIC FARC

A basic FARC application controls fuel and air channels only. Feedback signals from these actuators are monitored by the system to ensure that the fuel-air mixture is within the configured parameters.

#### 17.8.2.2 MULTICHANNEL FARC

Up to three additional channels may be added for advanced FARC applications consisting of additional process inputs (e.g., flue gas recirculation, auxiliary fuel supply, etc.). Configuration options on the additional channels allow for flexibility in terms of position feedback and cross limiting requirements.

#### 17.8.2.3 $O_2$ TRIM

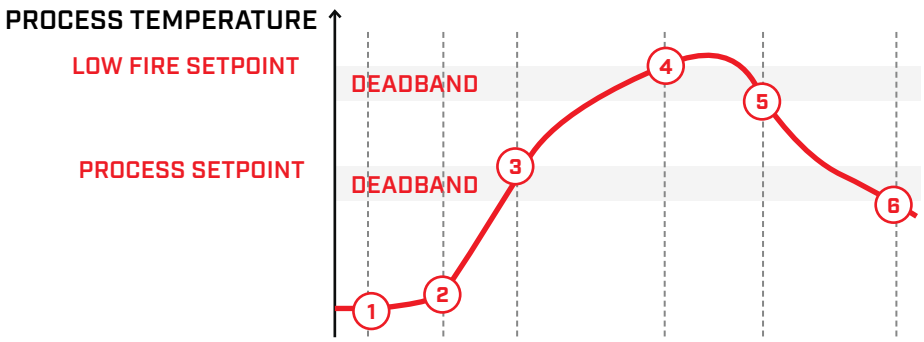
The addition of a stack oxygen sensor allows for a FARC channel to be trimmed to achieve optimal efficiency while maintaining the configured fuel-air ratio within the configured parameters.

### 17.8.3 DEADBANDS

Deadbands are applied under certain conditions to avoid fluctuations between states when a process variable is close to its configured setpoint or trip point.

#### 17.8.3.1 TEMPERATURE DEADBANDS

Temperature deadbands are applied to prevent valve chattering when a temperature reading is near a configured setpoint. Generally, the deadband is ignored on the transition from one state to another in one direction but is applied on the transition in the reverse direction (e.g., For a system configured for High Fire Valve control with Low Fire enabled (see image below), the deadband is ignored on the transition from Low Fire to Pilot (transition 4) but is applied on the subsequent transition back to Low Fire (transition 5). Similarly, the deadband in ignored at transition 3, but applied at transition 6).




| CONTROLLER STATE TRANSITION | |
|---|---|
| 0 | Waiting to Ignition to Pilot |
| 1 | Pilot to Low Fire |
| 2 | Low Fire to High Fire |
| 3 | High Fire to Low Fire |
| 4 | Low Fire to Pilot |
| 5 | Pilot to Low Fire |
| 6 | Low Fire to High Fire |

#### 17.8.3.2 4-20mA INPUT DEADBANDS

4-20mA input deadbands are applied to both the High and Low Trip setpoints when clearing trip conditions only. The system registers a high trip event as soon as the input reading exceeds the configured High Trip setpoint and clears the event only after the input reading has dropped below the High Trip setpoint minus the deadband. Similarly, a low trip event is registered when the input reading dops below the configured Low Trip setpoint and clears the event only after the input reading has risen above the Low Trip setpoint plus the deadband.

# 18 Software Utilities

The following section outlines the diagnostic, troubleshooting and upgrade tools available on all PF3100 systems.

## 18.1 QUICK START SETUP TOOL

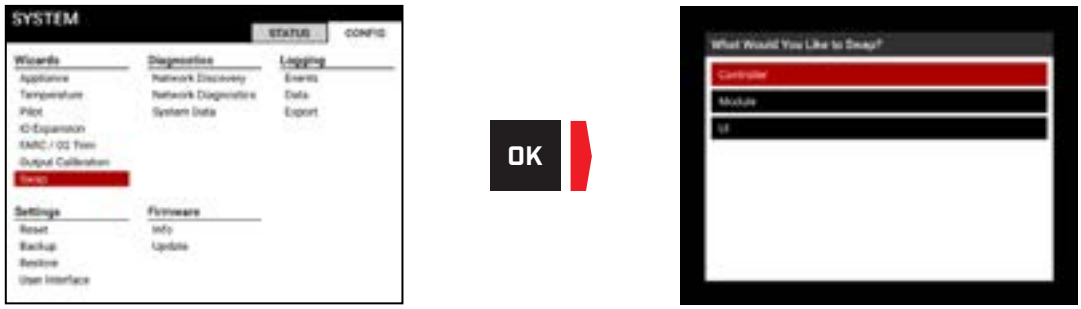
The Quick Start Setup tool is accessible only when the system has no configured appliances. The tool guides the user through a firmware update and the Appliance, Temperature and Pilot Wizards to achieve basic system configuration. Refer to the Commissioning section above for additional commissioning Details.


## 18.2 SWAP WIZARD

### 18.2.1 CONTROLLER SWAP

The Controller Swap tool is used to replace BMS controller cards in already-commissioned systems. A new controller is inserted into the system in place of the previous controller without the need to reconfigure all connected I/O modules or BMS settings.

1. Navigate to the Swap Wizard and select “Controller”.



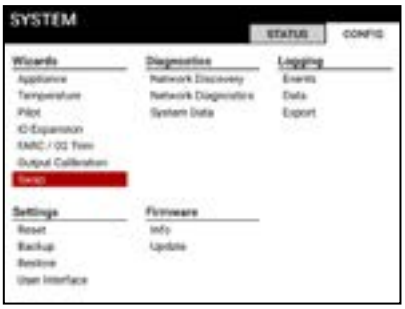

2. Choose a valid settings file to load, then select the originally commissioned controller on the Swap Modules tab and its replacement from the “Available Controllers” dialog.

3. Advance to the Review Tab and make note of any issues that will require additional commissioning (e.g., Calibration information does not transfer over to a replacement controller. Output calibration must be done separately for each controller using the Output Calibration Wizard), then select “Accept” to complete the swap.


### 18.2.2 MODULE SWAP

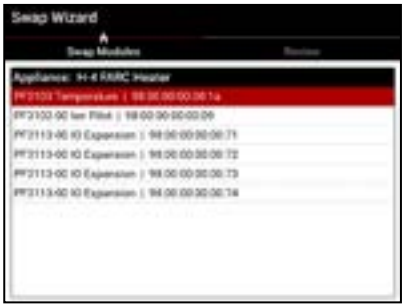
The Module Swap tool allows I/O cards to be removed from the system and replaced without the need to reconfigure each module.

1. Navigate to the Swap Wizard and select “Module”.






2. The Swap Modules Tab lists all the non-communicating cards that are expected to be communicating with the system. Select a card and assign an appropriate replacement card.





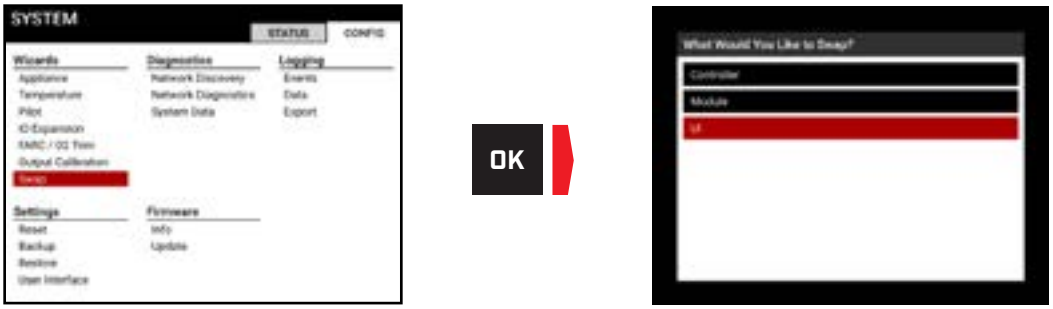

3. Repeat previous step for all listed cards.

4. Advance to the Review Tab and make note of any issues that will require additional commissioning (e.g., Calibration information does not transfer over to replacement I/O Expansion cards. Output calibration must be performed again for replacement I/O Expansion cards using the Output Calibration Wizard), then select “Accept” to complete the swap.


### 18.2.3 UI SWAP

The UI Swap tool allows the User Interface card to be removed from the system and replaced without the need to reconfigure the UI card settings.

1. Navigate to the Swap Wizard and select “UI”.

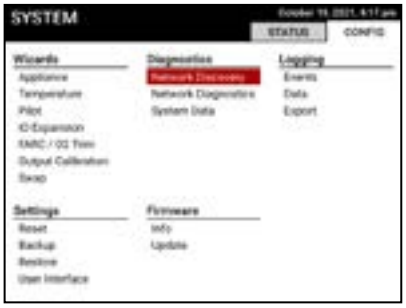



2. Select a valid settings file, confirm the on-screen network map and select “Yes” to complete the swap.

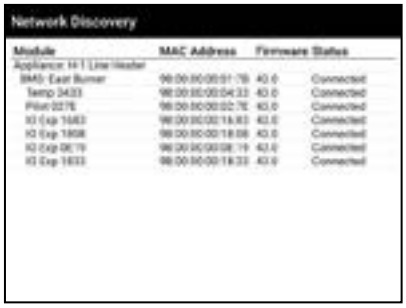
## 18.3 DIAGNOSTICS

### 18.3.1 NETWORK DISCOVERY

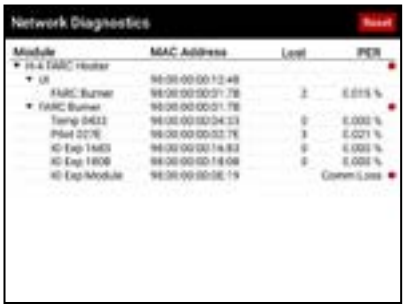
The Network Discovery tool is a communication diagnostic utility used to verify that each card in a system is connected, assigned and running the correct version of firmware. Connection issues can help identify PFRN wiring or firmware mismatch problems and assignment issues can help identify configuration or installation errors.



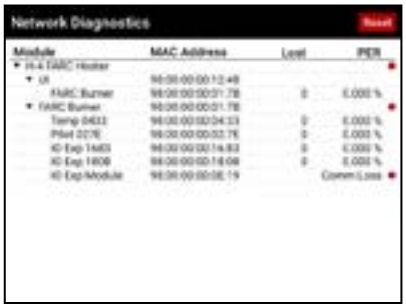

OK




### 18.3.2 NETWORK DIAGNOSTICS

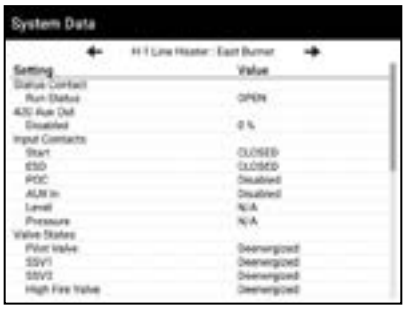



OK




The Network Diagnostics tool displays the number of lost communication packets and the packet error rate for each connected card in the system since the last reset (with the “Reset” button at the top of the screen) or power cycle. This information is useful when troubleshooting communication issues.

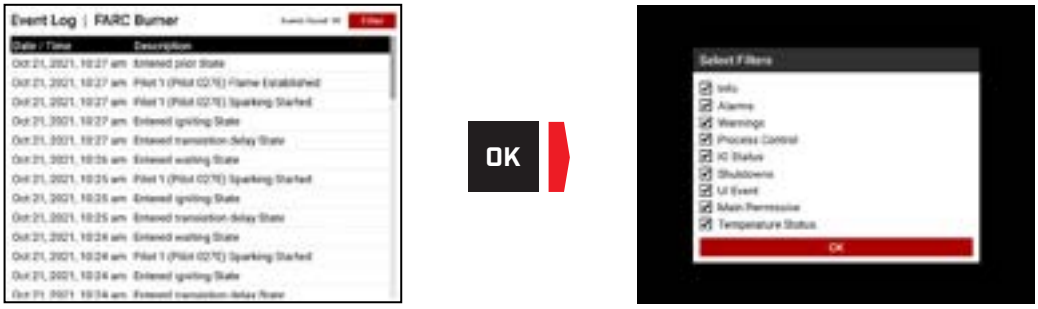
### 18.3.3 SYSTEM DATA



The System Data Screen displays raw input and output data for the inputs and outputs of every connected card. This screen is useful for troubleshooting.

## 18.4 LOGGING

### 18.4.1 EVENT LOGGING



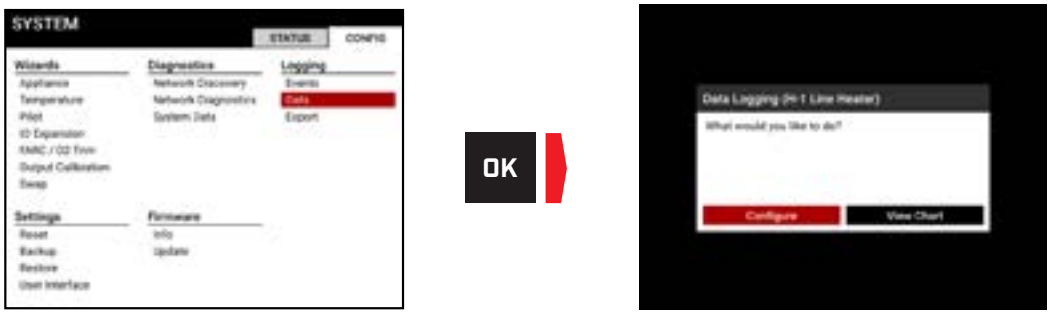

The Event Logging tool provides a detailed list of events for each BMS Controller card in a system. The list logs shutdowns, state transitions, present and cleared alerts, settings changes, input and output state changes and firmware updates. The Event Log can be exported to a USB storage device by using the Export Tool and is useful to have on hand when Contacting Profire for troubleshooting support.

### 18.4.2 DATA LOGGING

The Data Logging tool provides the ability to log and graph configured input and output readings. Data is logged in configurable intervals and can be displayed in a chart on-screen or exported to a USB storage device by using the Export Tool.

#### 18.4.2.1 DATA LOGGING SETUP

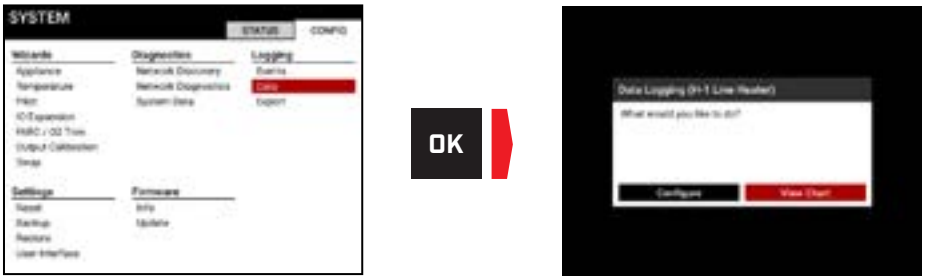
1. Navigate to the Data Logging tool and press OK, select desired appliance, then select “Configure”.




2. Specify the logging interval for each listed input and output and select “Finished”

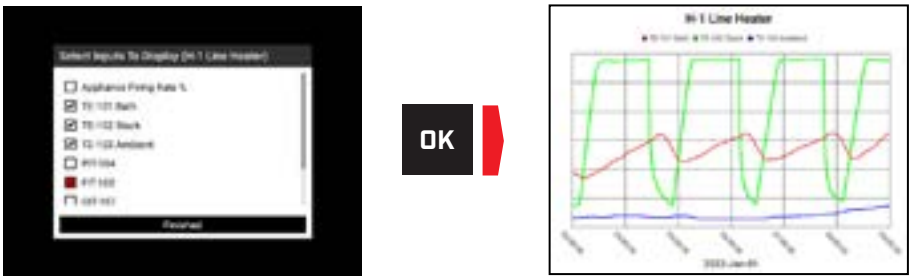
#### 18.4.2.2 DATA CHARTING

1. Navigate to the Data Logging tool and press OK, select desired appliance, then select “View Chart”.



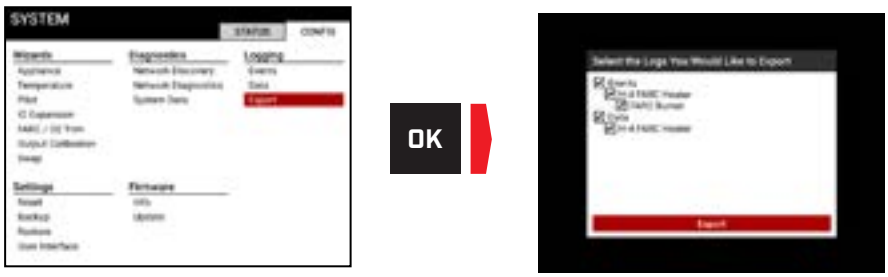

2. Specify the start date and time, the display scale and whether to update the chart with real-time data, then select “OK”.

3. Select the inputs/outputs to display and select “Finished”.




### 18.4.3 EXPORT TOOL

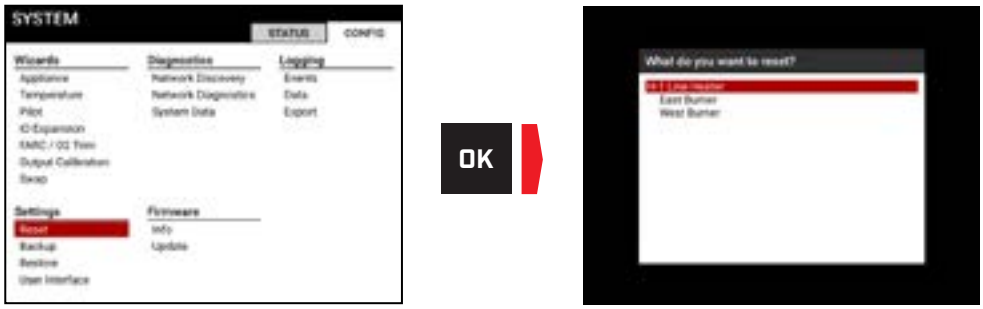
The Export tool saves Event Log and/or Data Log data to a USB storage device. Navigate to the Export tool and press OK, then follow the on-screen instructions to save desired information to the connected USB drive.



## 18.5 SETTINGS

### 18.5.1 RESET TO DEFAULTS

The Settings Reset utility is used to reset all system settings to their respective default values. Navigate to the Settings Reset tool and follow the on-screen instructions to select the appliances/controllers to be reset.

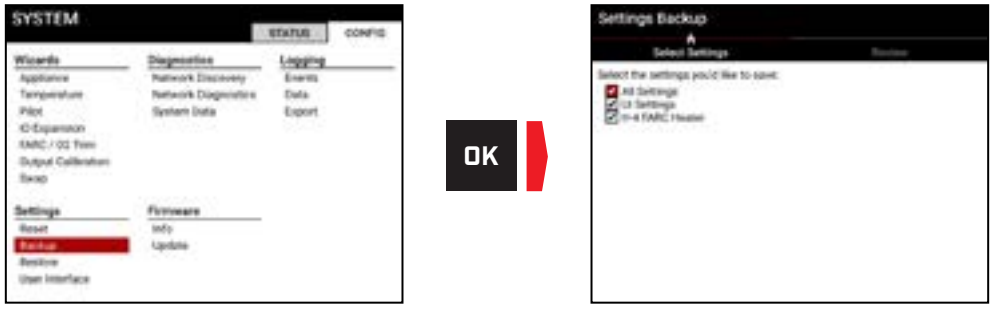



Backup

The Settings Backup utility is used to save system settings to a USB storage device. It is good practice to use this tool after a system has been fully commissioned.

#### 18.5.1.1 SETTINGS BACKUP PROCEDURE

4. Insert a USB storage device into the USB port on the PF3100-00 User Interface card.
5. Navigate to the Settings Backup tool and press OK, then select the settings to be saved.




6. Select “Accept” from the Review Tab and name the settings file as desired.

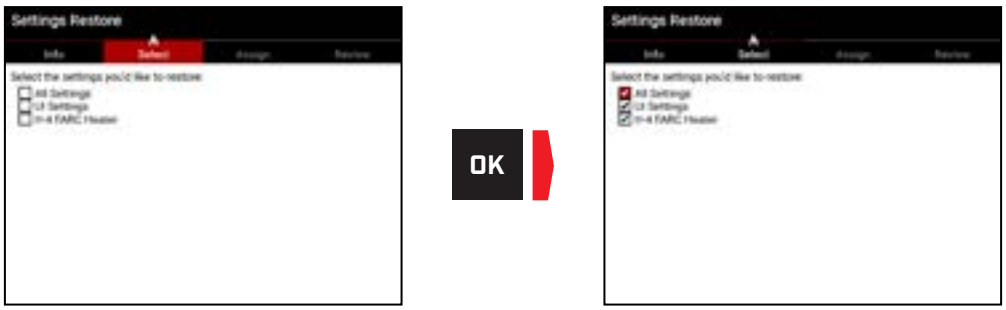
### 18.5.2 RESTORE

The Settings Restore utility is used to load system settings from a USB storage device. This is useful for situations requiring a BMS Controller replacement or commissioning of a system that has identical configuration requirements as one that is already commissioned.

#### 18.5.2.1 SETTINGS RESTORE PROCEDURE

1. Insert USB drive containing desired settings file into the USB port on the PF3100-00 User Interface card.
2. Navigate to the Settings Restore tool and press OK.
3. Select desired settings file from the USB device or local UI storage.


4. On the Select Tab, choose whether to restore (1) the UI settings only, (2) the controller settings only, or (3) all the settings.



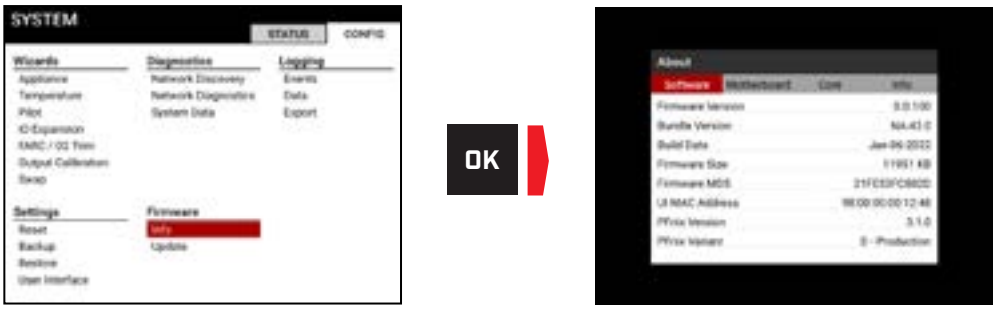

5. On the Assign Tab, select the controller to which the settings are to be restored.


6. Proceed to the Review Tab and select “Accept” to confirm the restore.
7. Review the Results, and check/recommission any settings that were not restored successfully (e.g., If a settings file from a controller is restored on another controller, the calibration settings will not be restored to the new controller – output calibration must be re-performed through the Output Calibration Wizard following the restore).

# 18.6 FIRMWARE

## 18.6.1 INFO

The Firmware Info Screen provides important firmware and hardware information for the User Interface card only. For other connected cards, refer to the Network Discovery tool above.

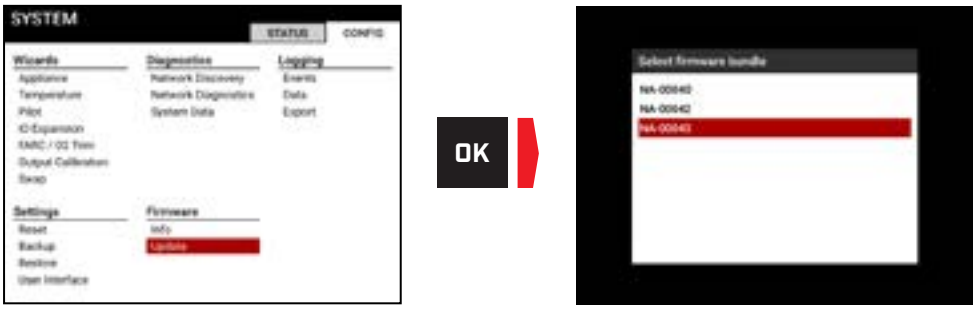



## 18.6.2 FIRMWARE UPDATE

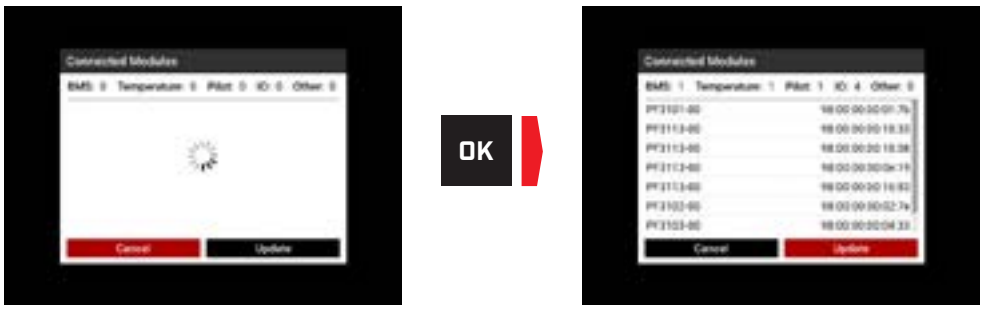
The Firmware Update tool allows for all PF3100 cards to be field upgraded with an update file saved to a USB drive.

### 18.6.2.1 FIRMWARE UPDATE PROCEDURE

1. Download the desired firmware version from the Profire Firmware Update Website and save it to a USB storage device.
2. Insert USB storage device into the USB port on the PF3100-00 User Interface card.
3. Navigate to the Settings Backup tool and save all settings to the USB storage device.
4. Navigate to the Firmware Update tool and press OK, then select the firmware file to be installed




5. Ensure that all connected cards are displayed on screen.




6. Select “Update” and press OK.

7. Wait for the Update Report Screen to be shown and confirm that all cards have been updated.


8. If any cards were not updated successfully, select “Restart Update” and press OK. Otherwise, select “Continue” and press OK.
9. Press OK to proceed to the update of the User Interface card.
10. Select Restore to load the auto-saved settings from before the firmware update or navigate to the Settings Restore Utility to load saved settings from the USB storage device.

# 19 MAINTENANCE

**WARNING:**
DO NOT MODIFY ANY SYSTEM WIRING OR HANDLE THE ELECTRONICS WHILE THE SYSTEM IS POWERED.

**CAUTION:**
DO NOT DISASSEMBLE OR MODIFY THE CARDS IN ANY WAY. THE CARDS ARE NOT FIELD REPAIRABLE AND MUST BE SENT BACK TO PROFIRE FOR REPLACEMENT IF DAMAGED.

**CAUTION:**
ALL ENCLOSURES MUST BE SECURELY CLOSED AFTER OPENING. IMPROPER CLOSURE MAY RESULT IN MOISTURE OR OTHER ENVIRONMENTAL DAMAGE AND MAY COMPROMISE THE INTEGRITY OF THE PRODUCT.

## 19.1 TOOLS REQUIRED

The following tools are required for maintenance and commissioning:

- Large flat-head screwdriver to open and close enclosures.
- 3mm terminal block screwdriver for securing wiring to card terminal blocks.
- #1 and #2 Phillips screwdriver for removing and replacing cards in enclosures.
- Digital multimeter or process calibrator for troubleshooting.

## 19.2 REGULAR MAINTENANCE RECOMMENDATIONS

The following items should be performed periodically to ensure that the PF3100 control system is in good working order:

- Replace any cards or enclosures showing signs of damage, water ingress or corrosion.
- Validate functionality of UI screen and all keypad buttons.
- Ensure all electrical connections are properly terminated with minimal exposed copper in accordance with local electrical codes.
- Calibrate and validate functionality of all connected input and output devices (thermocouples, transmitters, valves, etc.)
- Validate system behavior under all shutdown conditions.
- Verify that all field inspection certifications are valid.

## 19.3 REPAIR AND REPLACEMENT

Contact Profire customer service for card replacements. Care must be taken when handling replacement cards to avoid damage and electrical static discharge. All replacement cards must be installed in place of the original card with four #10-32 screws tightened to 26 in*lb.

Ensure that a firmware update is performed on all replacement cards to ensure that all connected cards are running the same version of firmware.

## 19.4 DECOMMISSIONING

The useful life of the PF3100 is 10 years. When decommissioning the system, the appliance should be safely shut down (i.e., all safety outputs are turned off and there are no gas leaks on site). Once the appliance is in a safe state, the power should be disconnected from the PF3100. All electronics must be disposed of in accordance with local rules and regulations.

## 19.5 MANUFACTURER NOTIFICATION

Any failures that are detected and that compromise functional safety must be reported to Profire customer service as soon as possible.

# 20 ALERT CODES

## 20.1 ALARMS

Alarms are alerts that prevent a controller from entering any running state. The table below describes each alarm and indicates the unique shutdown codes used to identify them both over Modbus and on the UI.

| CODE | | ALERT NAME | DESCRIPTION |
|---|---|---|---|
| UI/MODBUS | | | |
| 1000 | 1 | Pilot Flame Detected While Off | Pilot flame is detected before the pilot ignition sequence is initiated. |
| 1001 | 2 | Main Flame Detected While Off | Main flame is detected before the pilot ignition sequence is initiated. |
| 1002 | 3 | POC Contact Open | The BMS Controller Proof of Closure input is de-energized when it is expected to be energized. |
| 1003 | 4 | POC HF Contact Open | The BMS Controller Aux input (configured as a Proof of Closure High Fire input) is de-energized when in Pilot state or Incinerate No Assist state. |
| 1004 | 5 | POC2 Contact Open | The BMS Controller Aux input (configured as a Proof of Closure 2 input) is de-energized when it is expected to be energized. |
| 1005 | 6 | POP Contact Open | The BMS Controller Aux input (configured as a Proof of Pilot input) is de-energized when it is expected to be energized. |
| 1006 | 7 | Level/Flow Contact Open | 4-20 Mode: This alarm cannot be set.<br>Dry Contact Mode: The Appliance or Controller Level/Flow input is de-energized.<br>* This alarm can only be present when the Level/Flow Restart setting is set to Disabled. |
| 1007 | 8 | Low Level/Flow | 4-20 Mode: The BMS Appliance or Controller Level/Flow input reading is less than Low Level/Flow SP setting.<br>Dry Contact Mode: This alarm cannot be set.<br>* This alarm can only be present when the Low Level/Flow Restart setting is set to Disabled. |
| 1008 | 9 | Fuel Pressure Contact Open | 4-20 Mode: This alarm cannot be set.<br>Dry Contact Mode: The BMS Controller Pressure input is de-energized.<br>Dry Contact High Press Mode: This alarm cannot be set. |
| 1009 | 10 | Low Fuel Pressure | 4-20 Mode: BMS Controller Pressure input reading is less than its Low Pressure SP setting.ntact Mode: This alarm cannot be set.<br>Dry Contact High Press Mode: This alarm cannot be set<br>* This alarm can only be present when the Low Fuel Pressure Restart setting is set to Disabled. |
| 1010 | 11 | Low Fuel Pressure Dry Contact | The Aux Input (configured as a Low Pressure input) is de-energized.<br>* This alarm can only be present when the Low Fuel Pressure Restart setting is set to Disabled. |
| 1011 | 12 | ESD Contact Open | The ESD (Emergency Shutdown) input is de-energized. |
| 1012 | 13 | Primary Process Temperature High ESD | Process temperature input reading is above its High Temp SP setting. |
| 1013 | 14 | Incompatible Firmware | A card has a different firmware version than the BMS Controller to which it is connected. |
| 1014 | 15 | Reserved | |
| 1015 | 16 | Reserved | |
| 1016 | 17 | Pilot Solenoid Error<br>* Alarm 1020 has the same name | A wiring or hardware error is detected on the Pilot- terminal (terminal 12) of the BMS Controller card. |

| CODE | | ALERT NAME | DESCRIPTION |
|---|---|---|---|
| UI | MODBUS | | |
| 1017 | 18 | SSV1 Solenoid Error<br>* Alarm 1021 has the same name | A wiring or hardware error is detected on the SSV1- terminal (terminal 10) of the BMS Controller card. |
| 1018 | 19 | SSV2 Solenoid Error<br>* Alarm 1022 has the same name | A wiring or hardware error is detected on the SSV2- terminal (terminal 8) of the BMS Controller card. |
| 1019 | 20 | HF Solenoid Error<br>* Alarm 1023 has the same name | A wiring or hardware error is detected on the HFV- terminal (terminal 6) of the BMS Controller card. |
| 1020 | 21 | Pilot Solenoid Error<br>* Alarm 1016 has the same name | A wiring or hardware error is detected on the Pilot+ terminal (terminal 13) of the BMS Controller card. |
| 1021 | 22 | SSV1 Solenoid Error<br>* Alarm 1017 has the same name | A wiring or hardware error is detected on the SSV1+ terminal (terminal 11) of the BMS Controller card. |
| 1022 | 23 | SSV2 Solenoid Error<br>* Alarm 1018 has the same name | A wiring or hardware error is detected on the SSV2+ terminal (terminal 9) of the BMS Controller card. |
| 1023 | 24 | HF Solenoid Error<br>* Alarm 1019 has the same name | A wiring or hardware error is detected on the HFV+ terminal (terminal 7) of the BMS Controller card. |
| 1024 | 25 | Low Voltage | Any Mode: Temperature or Pilot card voltage is below 32V[1].<br>12V Mode: BMS Controller card input voltage is below 9.6V[1].<br>24V Mode: BMS Controller card input voltage is below 19.2V[1].<br>[1] This alarm can only be present when the Low Voltage Restart setting is set to Disabled.<br>2 Pressing the OK button on the alert text opens a dialog that identifies the offending card and input. |
| 1025 | 26 | High Voltage | Any Mode: Temperature or Pilot card voltage is above 40V[1].<br>12V Mode: BMS Controller card input voltage is above 16.8V[1].<br>24V Mode: BMS Controller card input voltage is above 33.6V[1].<br>[1] This alarm can only be present when the High Voltage Restart setting is set to Disabled.<br>[2] Pressing the OK button on the alert text opens a dialog that identifies the offending card and input. |
| 1026 | 27 | Pilot Module Comm Error | PFRN connection between the BMS controller card and a Pilot card has been lost and the Minimum Pilots Running requirement is not satisfied.<br>[1] This alarm sets immediately when the Comm Loss Restart setting is Disabled and sets after 5 minutes when the Comm Loss Restart setting is Enabled.<br>[2] Pressing the OK button on the alert text opens a dialog that identifies the offending card. |
| 1027 | 28 | Incomplete Commissioning | The commissioning date setting has not been set. |
| 1028 | 29 | Cross Compare Failure | Internal BMS Controller card fault. Contact Profire. |
| 1029 | 30 | Cross Compare Packet Timeout | Internal BMS Controller card fault. Contact Profire. |
| 1030 | 31 | Factory Calibration Error | Internal BMS Controller card fault. Contact Profire.<br>* This alarm can only be present when the Factory Cal Error Mode setting (BMS Settings > Calibration > BMS) is set to Alarm. |

*Continued on Next Page*

| CODE UI/MODBUS | | ALERT NAME | DESCRIPTION |
|---|---|---|---|
| 1031 | 32 | Invalid Configuration | Each of the conditions in the following list cause this alarm. Pressing the OK button on the alert text opens a dialog with additional troubleshooting information:<br>**High Temp Setpoint Error:**<br>1. High Temp SP below Pilot Off SP (If Pilot off Mode = Pilot off at SP)<br>2. High Temp SP below Low Fire SP (If Low Fire setting is enabled)<br>3. High Temp SP below Process Temp SP<br>**Pilot Off Setpoint Error:**<br>4. Pilot off SP below Low Fire SP (If Low Fire setting is enabled)<br>5. Pilot off SP below Process Temp SP<br>**Low Fire Setpoint Error:**<br>6. Low Fire SP below Process Temp SP + 1<br>**Process SP Error:**<br>7. Process Temp SP below 0<br>**Main Flame Config Error:**<br>8. Pilot Off Mode set to Off After Main On and Main Flame Detect is Disabled.<br>**Level/Flow Setpoint Error:**<br>9. Level/Flow High SP below Low SP + Deadband (when in 4-20 mode)<br>10. Level/Flow Low SP below Deadband (when in 4-20 mode)<br>**Pressure Setpoint Error:**<br>11. Pressure High SP below Low SP + Deadband (when in 4-20 mode)<br>12. Pressure Low SP below Deadband (when in 4-20 mode)<br>**Appliance Configuration Error:**<br>13. Minimum Controllers Running setting is greater than the number of controllers in the appliance<br>**Proof of Airflow Configuration Error:**<br>14. Proof of Airflow is enabled and HFV Mode setting is not set to Forced Draft or Purge Fan<br>15. HFV Mode setting is set to Forced Draft or Purge Fan and Proof of Airflow is not enabled<br>**PID Configuration Error:**<br>16. Low Fire is Disabled and 4-20 Aux Out Mode setting is set to PID Control, Appliance Firing Rate, or Modbus Firing Rate<br>**Incinerator Configuration Error:**<br>17. Waste Gas Off SP is above Pilot Off SP<br>18. Assist Gas Off SP is above Waste Gas Off SP minus Waste Gas Off Deadband<br>19. Waste Gas On SP is above Assist Gas Off SP minus Assist Gas Off Deadband<br>20. Process Temp SP is above Assist Gas Off SP.<br>21. Process Temp SP is below Waste Gas On SP. |
| 1032 | 33 | Ignition Switch Stuck | The BMS Controller Ignition Switch input is stuck in the Start position. |
| 1033 | 34 | Auxiliary Temperature High ESD | Auxiliary temperature input reading is above its High Temp SP setting. |

| CODE | | ALERT NAME | DESCRIPTION |
|---|---|---|---|
| UI/MODBUS | | | |
| 1034 | 35 | Reserved | |
| 1035 | 36 | Pilot Load Monitor Error | AC voltage on Pilot ionization input too low to reliably detect flame.<br>[1] Usually caused by loading of the flame rod to ground<br>[2] Pressing the OK button on the alert text opens a dialog that identifies the offending card and input. |
| 1036 | 37 | Pilot Flame Detect Voltage Error | Pilot flame voltage test failure. Contact Profire.<br>* Pressing the OK button on the alert text opens a dialog that identifies the offending card and input. |
| 1037 | 38 | Pilot Flame Quality Mismatch | Internal Pilot card fault. Contact Profire. |
| 1038 | 39 | Main Load Monitor Error | AC voltage on Main ionization input too low to reliably detect flame.<br>[1] Usually caused by loading of the flame rod to ground<br>[2] Pressing the OK button on the alert text opens a dialog that identifies the offending card and input. |
| 1039 | 40 | Main Flame Detect Voltage Error | Main flame voltage test failure. Contact Profire.<br>* Pressing the OK button on the alert text opens a dialog that identifies the offending card and input. |
| 1040 | 41 | Main Flame Quality Mismatch | Internal Pilot card fault. Contact Profire. |
| 1041 | 42 | Ion Pilot Module Valve Test Failed | A wiring or hardware error is detected on the Valve+- terminal (terminal 4) of the Ion Pilot card. |
| 1042 | 43 | Ion Pilot Module Valve Test Failed | A wiring or hardware error is detected on the Valve- terminal (terminal 3) of the Ion Pilot card. |
| 1043 | 44 | Reserved | |
| 1044 | 45 | Reserved | |
| 1045 | 46 | Pilot Flame Fail | Pilot flame has been lost or failed to ignite |
| 1046 | 47 | Main Flame Fail | Main flame has been lost or failed to ignite |
| 1047 | 48 | High Fuel Pressure After Main On | 4-20 Mode: BMS Controller Pressure input reading is greater than its High Pressure SP setting. *<br>Dry Contact Mode: This alarm cannot be set.<br>Dry Contact High Press Mode: BMS Controller Pressure input is de-energized. *<br>* This alarm can only be present in main fuel states. |
| 1048 | 49 | Stopped Via External Switch | The BMS Controller Ignition Switch input is in the Stop position. |
| 1049 | 50 | User Stop | The Controller received a stop command from the UI card or through the Modbus card. |
| 1050 | 51 | Safety Core Temperature Too High | Card temperature is too high |
| 1051 | 52 | Safety Core Temperature Too Low | Card temperature is below rated minimum operating temperature |
| 1052 | 53 | Reserved | |
| 1053 | 54 | Controller Settings CRC Failed | The BMS Controller settings are invalid. |

*Continued on Next Page*

| CODE | | ALERT NAME | DESCRIPTION |
|---|---|---|---|
| UI | MODBUS | | |
| 1054 | 55 | Reserved | |
| 1055 | 56 | Input Pin Connection Test Failed | Internal BMS Controller card fault. Contact Profire. |
| 1056 | 57 | State Mismatch | Internal BMS Controller card fault. Contact Profire. |
| 1057 | 58 | Reserved | |
| 1058 | 59 | Ion Aux In Tripped | 4-20 Mode: An Ion Pilot card LEL (Aux In) input reading is above the Ion Aux In Trip Point setting. [1]<br>Dry Contact Mode: The Ion Pilot card LEL (Aux In) input is de-energized. [1]<br>[1] This alarm can only be present when Ion Aux In Mode setting is set to High Trip Alarm<br>[2] Pressing the OK button on the alert text opens a dialog that identifies the offending card and input. |
| 1059 | 60 | Ion Aux In Contact Range Error | 4-20 Mode: An Ion Pilot card LEL (Aux In) input reading is below 3mA OR above 22 mA.<br>Dry Contact Mode: Internal Ion Pilot card fault. Contact Profire. |
| 1060 | 61 | Ion Aux In Contact Mismatch | Internal Ion Pilot card fault. Contact Profire. |
| 1061 | 62 | Ion Aux In Contact Cross Compare Failure | Internal Ion Pilot card fault. Contact Profire. |
| 1062 | 63 | Level/Flow Input Range Error | 4-20 Mode: The BMS Controller Level/Flow input reading is below 4-20 Low Range Limit setting OR above 4-20 High Range Limit setting (BMS Settings > Calibration > BMS 4-20 Inputs).<br>Dry Contact Mode: Internal BMS card fault. Contact Profire.<br>* This alarm can only be present for single controller appliances |
| 1063 | 64 | Level/Flow Input Mismatch Error | Internal BMS Controller card fault. Contact Profire.<br>* This alarm can only be present for single controller appliances |
| 1064 | 65 | Pressure Input Range Error | 4-20 Mode: The BMS Controller Pressure input reading is below 4-20 Low Range Limit setting OR above 4-20 High Range Limit setting (BMS Settings > Calibration > BMS 4-20 Inputs).<br>Dry Contact Mode: Internal BMS card fault. Contact Profire. |
| 1065 | 66 | Pressure Input Mismatch Error | Internal BMS Controller card fault. Contact Profire. |
| 1066 | 67 | Start Contact Mismatch Error | Internal BMS Controller card fault. Contact Profire. |
| 1067 | 68 | ESD Contact Mismatch Error | Internal BMS Controller card fault. Contact Profire. |
| 1068 | 69 | POC Contact Mismatch Error | Internal BMS Controller card fault. Contact Profire. |
| 1069 | 70 | Aux In Contact Mismatch Error | Internal BMS Controller card fault. Contact Profire. |
| 1070 | 71 | No Valid Primary Process Temperature | The system does not have a valid Primary Process Temperature input reading due to configuration errors or communication loss.<br>* Pressing the OK button on the alert text opens a dialog that identifies the offending card and input. |
| 1071 | 72 | No Valid Auxiliary Temperature | The system does not have a valid Auxiliary Temperature input reading due to configuration errors or communication loss.<br>* Pressing the OK button on the alert text opens a dialog that identifies the offending card and input. |

| CODE | | ALERT NAME | DESCRIPTION |
|---|---|---|---|
| UI | MODBUS | | |
| 1072 | 73 | Reserved | |
| 1073 | 74 | Reserved | |
| 1074 | 75 | No Appliance Level/Flow | The appliance does not have a Local Level/Flow Input enabled. |
| 1075 | 76 | Reserved | |
| 1076 | 77 | Appliance Startup Cancelled | The appliance startup was cancelled by the User Interface or Modbus card. |
| 1077 | 78 | Appliance Startup Timeout | The appliance was not able to successfully start all the BMS controllers within the appliance. |
| 1078 | 79 | Appliance Startup Mismatch | During appliance startup one of the BMS cards reported settings that did not match the other BMS cards. |
| 1079 | 80 | Reserved | |
| 1080 | 81 | Controller Disabled | This BMS has been disabled in the appliance settings. |
| 1081 | 82 | Minimum Controllers Rule Violated | Number of BMS Controllers running is less than the Min Controllers Running setting (BMS Settings > Setup > Commissioning). |
| 1082 | 83 | Controller Network Wiring Error | An I/O card is connected to the PFRN Controller Network (BMS Controller terminal 28). |
| 1083 | 84 | IO Network Wiring Error | A UI card or Modbus card is connected to the PFRN I/O Network (BMS Controller terminals 29,30,31 or 32). |
| 1084 | 85 | Failed to Prove Airflow While Running | The BMS Controller Aux input (configured as a Proof of Airflow input) is de-energized while in a fuel state, OR<br>An I/O Expansion input (configured as a Proof of Airflow input) is not satisfied while in a fuel state. |
| 1085 | 86 | Failed to Prove Airflow While Purging | The BMS Controller Aux input (configured as a Proof of Airflow input) is de-energized while purging, OR<br>An I/O Expansion input (configured as a Proof of Airflow input) is not satisfied while purging. |
| 1086 | 87 | Multiple Primary Process Temperatures | More than one temperature input is configured as a Primary Process input. |
| 1087 | 88 | Primary Process Temperature Configuration Error | Process Deadband setting is set above 100°C (180°F). |
| 1088 | 89 | Auxiliary Temperature Configuration Error | Aux Temp High Temp SP setting is set above 1350°C (2462°F), OR<br>Aux Temp High Temp SP setting is less than Process Setpoint + 1, OR<br>Auxiliary Temperature Deadband setting is set above 100°C (180°F) |
| 1089 | 90 | No Primary Process Temperature Configured | No temperature input has been configured as a Primary Process input. |
| 1090 | 91 | UV Flame Detect Fault | UV Pilot card Fault input de-energized. |
| 1091 | 92 | UV Flame Detect Mismatch | UV Pilot card Flame On and Flame Off inputs are either (1) both energized, or (2) both de-energized. |
| 1092 | 93 | UV Input Out of Range | UV Scanner input invalid. Contact Profire. |

| CODE | | ALERT NAME | DESCRIPTION |
|---|---|---|---|
| UI | MODBUS | | |
| 1093 | 94 | UV Input Address Fault | Internal UV Pilot card fault. Contact Profire. |
| 1094 | 95 | IO Expansion Input Invalid | An I/O Expansion card input configured as an alarm is not reading a valid input signal.<br>* Pressing the OK button on the alert text opens a dialog that identifies the offending card and input. |
| 1095 | 96 | I/O Expansion POAF Input Invalid | The I/O Expansion card input configured as a Proof of Airflow input is not reading a valid input signal. |
| 1096 | 97 | IO Expansion Analog Input High | A 4-20mA I/O Expansion card input configured as an alarm is above its High Setpoint setting.<br>* Pressing the OK button on the alert text opens a dialog that identifies the offending card and input. |
| 1097 | 98 | IO Expansion Analog Input Low | A 4-20mA I/O Expansion card input configured as an alarm is below its Low Setpoint setting.<br>* Pressing the OK button on the alert text opens a dialog that identifies the offending card and input. |
| 1098 | 99 | IO Expansion Digital Input Open | A digital I/O Expansion card input configured as an alarm is de-energized.<br>* Pressing the OK button on the alert text opens a dialog that identifies the offending card and input. |
| 1099 | 100 | IO Expansion Configuration Error | An IO Expansion card Alarm input satisfies any of the following:<br>1. 4-20mA input configured in Bleed Valve Proof of Open mode.<br>2. High setpoint is less than the low setpoint plus the deadband.<br>3. Digital input configured in any of the following modes:<br>• Appliance Firing Rate<br>• FARC Air/Fuel/Aux<br>• $O_2$ Sensor<br>• Secondary PID<br>* Pressing the OK button on the alert text opens a dialog that identifies the offending card and input. |
| 1100 | 101 | Invalid Appliance Firing Rate Input | The I/O Expansion card input configured as a Firing Rate input is not reading a valid 4-20mA signal.<br>* This alarm can only set when Manual Override setting is Disabled |
| 1101 | 102 | Failed to Prove Purge Position | An I/O Expansion card input configured as a FARC position feedback input is unsatisfied for the duration of the Request Purge Position state. |
| 1102 | 103 | Failed to Prove Pilot Position | An I/O Expansion card input configured as a FARC position feedback input is unsatisfied for the duration of the Request Pilot Position state. |
| 1103 | 104 | Failed to Prove Light Off Position | An I/O Expansion card input configured as a FARC position feedback input is unsatisfied for the duration of the Request Light Off Position Error timeout during the Pilot state. |
| 1104 | 105 | FARC Cross Limit Error | The cross limit error exceeds the configured Cross Limit Error setting. |
| 1105 | 106 | FARC Fuel Channel Position Error | The difference between the requested and actual position of the FARC fuel actuator exceeds the configured position error threshold. |
| 1106 | 107 | FARC Air Channel Position Error | The difference between the requested and actual position of the FARC air actuator exceeds the configured position error threshold. |
| 1107 | 108 | Reserved | |

| CODE | | ALERT NAME | DESCRIPTION |
|---|---|---|---|
| UI/MODBUS | | | |
| 1108 | 109 | PID Configuration Error | 4-20 Aux Out Mode setting is set to PID, Low Fire Mode setting is enabled and any of the following Advanced PID Config conditions exist:<br>1. Primary Setpoint Min > Primary Setpoint Max<br>2. Secondary Setpoint Min > Secondary Setpoint Max<br>3. Secondary Input invalid (Both a temperature input and I/O expansion input have been configured as Secondary PID inputs).<br>4. Staging Input Invalid (Input type selected in the I/O Expansion Wizard is not suitable for PID staging). |
| 1109 | 110 | Pilot Configuration Error | The number of connected and enabled Pilot cards is lower than the configured Minimum Pilots Running setting. |
| 1110 | 111 | Bleed Valve Closed with Main Off | The bleed valve proof of open contact is open, indicating the bleed valve is closed (no flow) during main off. |
| 1111 | 112 | Bleed Valve Open with Main ON | The bleed valve proof of open contact is closed, indicating that the bleed valve is open (flow) while the main is on. |
| 1112 | 113 | The Bleed Valve Input is Invalid | The bleed valve proof of open contact input is invalid. |
| 1113 | 114 | BMS Wait Timeout | A BMS wait has been present for longer than the configured BMS Wait Timeout setting. |
| 1114 | 115 | IO Expansion Wait Timeout | An IO Expansion wait has been present for longer than the configured IO Wait Timeout setting |
| 1115 | 116 | One or more descriptors are Invalid | Internal BMS Card Fault. Contact Profire. |
| 1116 | 117 | Settings CRC Mismatch | Settings have been corrupted and cannot be verified |
| 1117 | 118 | Airflow Input Stuck | The Proof of Airflow contact is closed during the Startup Checks State. |
| 1118 | 119 | Secondary PID Configuration Error | 1. Input Mode setting (I/O Wizard > Add Inputs Tab) is configured as “Secondary PID input” for more than one input.<br>2. Secondary PID input Signal Type setting (I/O Wizard > Add Inputs Tab) is configured as “Digital”<br>3. Aux Out Mode setting (BMS Settings > Outputs > 4-20 Aux Out) is not set to “BMS PID”.<br>4. Secondary PID input is not assigned as the Secondary Input (BMS Settings > Process Control > Advanced PID Config). |
| 1119 | 120 | UV Flame Detect Stale Data | Internal UV Pilot card fault. Contact Profire. |
| 1120 | 121 | IO 4-20 Output PID Configuration Error | 4-20 Output setting (I/O Wizard > I/O Modules Tab) is set to PID Output Controlled by TC Input but has no temperature input assigned.<br>* Pressing the OK button on the alert text opens a dialog that identifies the offending card and input. |
| 1121 | 122 | IO Expansion Dry Contact Configuration Error | IO Expansion Dry Contact setting (I/O Wizard > I/O Modules Tab) is configured as Temp Setpoint Trip or Input Setpoint Trip and Dry Contact Trip Configuration setting (I/O Wizard > I/O Modules Tab) is unassigned or assigned input has an invalid mode configured.<br>* Pressing the OK button on the alert text opens a dialog that identifies the offending card and input. |
| 1122 | 123 | System is in Calibration Mode | The system is currently calibrating a 4-20 mA output. |
| 1123 | 124 | Low %$O_2$ | The Oxygen Sensor input reading is less than its configured Low Setpoint setting.<br>* This alarm is ignored when the controller is not actively trimming $O_2$ (e.g., the controller is not in Process Control or the warmup conditions have not been met. |

| CODE | | ALERT NAME | DESCRIPTION |
|---|---|---|---|
| UI/MODBUS | | | |
| 1124 | 125 | Cross Limiting Enabled on Invalid Curve | Cross limiting is enabled on a curve that contains an inflection point. |
| 1125 | 126 | No Position Feedback On Cross Limited Channel | Cross limiting is enabled on a FARC channel that does not have a corresponding position feedback input configured. |
| 1126 | 127 | FARC Settings Error | Fuel or Air FARC channel settings have been improperly configured through a Settings Restore with a corrupted settings file. |
| 1127 | 128 | FARC Requires Proof of Airflow | FARC is enabled with no proof of airflow input configured. |
| 1128 | 129 | FARC Requires Forced Draft Fan | FARC is enabled and HFV Output Mode settings is not set to Forced Draft Fan. |
| 1129 | 130 | FARC Requires Low Fire | FARC is enabled and Low Fire Mode setting is set to Disabled. |
| 1130 | 131 | FARC Requires Aux Out | FARC is enabled and Aux Out Mode settings is not set to PID Control, Appliance Firing Rate, or Modbus Firing Rate. |
| 1131 | 132 | FARC Table Requires Commissioning | FARC is enabled and the currently selected FARC curve is not commissioned. |
| 1132 | 133 | FARC Fuel and Air Channels not Assigned | FARC is enabled with no corresponding Fuel or Air channels configured. |
| 1133 | 134 | FARC Air Control Output Configuration Error | FARC is enabled and there is:<br>• More than one FARC Air Output configured, or<br>• Less than one FARC Air Output configured. |
| 1134 | 135 | FARC Light Off Firing Rate Error | FARC is enabled and the Light Off Firing Rate setting is less than the Minimum Firing Rate setting. |
| 1135 | 136 | FARC Settings Out of Range | FARC Position error, cross limit error or FARC mode settings are configured with invalid values. |
| 1136 | 137 | FARC Aux 1 Channel Position Error | The difference between the requested and actual position of the FARC Aux 1 channel actuator exceeds the configured position error threshold. |
| 1137 | 138 | FARC Aux 2 Channel Position Error | The difference between the requested and actual position of the FARC Aux 2 channel actuator exceeds the configured position error threshold. |
| 1138 | 139 | FARC Aux 3 Channel Position Error | The difference between the requested and actual position of the FARC Aux 3 channel actuator exceeds the configured position error threshold. |
| 1139 | 140 | FARC Feedback Missing | FARC channel Position Feedback Setting is enabled with no corresponding feedback input configured. |
| 1140 | 141 | FARC Redundant Inputs | A FARC input is assigned to multiple IO Expansion input slots. |
| 1141 | 142 | Bleed Valve Proof of Open Configuration Error | There is more than one Bleed Valve Input configured or settings have been configured with invalid values. |
| 1142 | 143 | $O_2$ Sensor Configuration Error | There is more than one $O_2$ sensor input configured, or settings have been configured with invalid values. |
| 1143 | 144 | FARC Output Configuration Error | There are multiple outputs configured for a single FARC channel. |
| 1144 | 145 | Appliance Firing Rate Configuration Error | There is more than one Firing Rate input configured or settings have been configured with invalid values. |
| 1145 | 146 | Logical Temperature Input Name Collision | Two or more configured temperature inputs have the same name. |
| 1146 | 147 | Proof of Airflow Configuration Error | A single BMS has a Proof of Airflow input configured on both its Aux Input and its I/O Expansion card, or there is more than one Local Proof of Airflow logical input created in the I/O Wizard. |
| 1147 | 148 | TC Flame Detect Requires a 4-20 Input | TC Flame Detect is enabled and Ion Aux In / LEL Input is not configured as a 4-20mA input or TC Flame Detect is enabled with a UV Pilot card. |

| CODE | | ALERT NAME | DESCRIPTION |
|---|---|---|---|
| UI/MODBUS | | | |
| 1148 | 149 | $O_2$ Trim Enabled Without Stack Input | $O_2$ Sensor Warmup Mode setting is configured as Stack Temp with no valid temperature input assigned. |
| 1149 | 150 | Manual $O_2$ Trim Requires Manual FARC | $O_2$ Trim Manual Mode setting is enabled, and FARC Manual Mode setting is disabled |
| 1150 | 151 | $O_2$ Trim Requires Correctly Commissioned Curves | Commissioned $O_2$ Trim target values do not have corresponding offset values set, or vice versa. The FARC table must also be commissioned. |
| 1151 | 152 | FARC Enabled on a Multi-Controller System | FARC is enabled on an appliance that has more than one controller. |
| 1152 | 153 | IO Expansion Span Config Error | An IO Expansion input has equal Span Max and Span Min settings. |
| 1153 | 154 | Controller Not In An Appliance | A controller is not recognized by the appliance. Re-run the Appliance Wizard. |
| 1154 | 155 | Low Heat Standby Configuration Error | Low Heat Standby setting is Enabled and BMS Aux Output setting is not set to one of the following:<br>• Manual Control<br>• PID Control<br>• Appliance Firing Rate<br>• Modbus Firing Rate |
| 1155 | 156 | FARC Feedback Configuration Error | An assigned FARC channel feedback input is not the correct type. Re-run the FARC/$O_2$ Trim Wizard. |
| 1156 | 157 | $O_2$ Trim Requires an $O_2$ Sensor | $O_2$ Trim setting is Enabled and no $O_2$ Sensor has been configured in the I/O Expansion Wizard. |
| 1157 | 158 | POLO Enabled with TCV Disabled | Aux in Contact Mode setting (BMS Settings > Inputs > Aux In Contact) is set to Proof of Light Off and 4-20 Aux Out Mode setting (BMS Settings > Outputs > 4-20 Aux Out) is not set to PID Control, Appliance Firing Rate, Manual Control, or Modbus Firing Rate. |
| 1158 | 159 | Natural Draft Pre Purge Configuration Error | Natural Draft Pre Purge setting is enabled and HFV Output Mode is not set to Valve. |
| 1159 | 160 | Too Many IO Modules Configured | There are more than 14 I/O Modules connected to a single BMS PFRN I/O Network |
| 1160 | 1161 | Main UV Module Enabled without Main Detect | A UV Pilot module is configured for main flame detection but the Main Flame Detect setting is set to Disabled |
| 1161 | 1162 | Main Flame Detect Enabled with No Main Flame Modules | The Main Flame Detect setting is Enabled, but no UV Pilot modules are configured for main flame detection (this alarm only applies when there are no enabled Ion Pilot modules). |

## 20.2 WAITS

Waits are alerts that prevent a controller from entering any fuel state. The table below describes each wait and indicates the unique codes used to identify them.

| CODE | ALERT NAME | DESCRIPTION |
|---|---|---|
| 2000 | Low Voltage | Any Mode: Temperature or Pilot card voltage is below 32V[1].<br>12V Mode: BMS Controller card input voltage is below 9.6V[1].<br>24V Mode: BMS Controller card input voltage is below 19.2V[1].<br>[1] This wait can only be present when the Low Voltage Restart setting is set to Enabled.<br>[2] Pressing the OK button on the alert text opens a dialog that identifies the offending card and input. |
| 2001 | High Voltage | Any Mode: Temperature or Pilot card voltage is above 40V[1].<br>12V Mode: BMS Controller card input voltage is above 16.8V[1].<br>24V Mode: BMS Controller card input voltage is above 33.6V[1].<br>[1] This wait can only be present when the High Voltage Restart setting is set to Enabled.<br>[2] Pressing the OK button on the alert text opens a dialog that identifies the offending card and input. |
| 2002 | Low Fuel Pressure | 4-20 Mode: BMS Controller Pressure input reading is less than its Low Pressure SP setting.<br>Dry Contact Mode: This wait cannot be set.<br>Dry Contact High Press Mode: This wait cannot be set<br>* This wait can only be present when the Low Fuel Pressure Restart setting is set to Enabled and the Restart Mode setting is set to Wait. |
| 2003 | Low Fuel Pressure Dry Contact | The Aux Input (Configured as a Low Pressure input) is de-energized.<br>* This wait can only be present when the Low Fuel Pressure Restart setting is set to Enabled and the Restart Mode setting is set to Wait. |
| 2004 | Low Level/Flow | 4-20 Mode: The Appliance or Controller Level/Flow input reading is less than Low Level/Flow SP setting.<br>Dry Contact Mode: This alarm cannot be set.<br>* This wait can only be present when the Low Level/Flow Restart setting is set to Enabled. |
| 2005 | Proc Temp Too High | The process temperature input reading is too high for the controller to transition into a fuel state. |
| 2006 | Start Contact Open | The BMS Controller Start input is de-energized. setting (BMS Settings > Process Control > Timing) |
| 2007 | Purging | The BMS Controller has initiated purging and is waiting for the duration of its associated timing setting (BMS Settings > Process Control > Timing) |
| 2008 | Loss of Communications | PFRN connection between the BMS controller card and a Pilot card has been lost.<br>* This wait can only be present when the Comm Loss Restart setting (BMS Settings > Setup > Other) is set to Enabled. |

| CODE | ALERT NAME | DESCRIPTION |
|---|---|---|
| 2009 | IO Expansion Input Invalid | An I/O Expansion card input configured as a wait is not reading a valid input signal.<br>* Pressing the OK button on the alert text opens a dialog that identifies the offending card and input. |
| 2010 | IO Expansion Analog Input High | A 4-20mA I/O Expansion card input configured as a wait is above its High Setpoint setting.<br>* Pressing the OK button on the alert text opens a dialog that identifies the offending card and input. |
| 2011 | IO Expansion Analog Input Low | A 4-20mA I/O Expansion card input configured as a wait is below its Low Setpoint setting.<br>* Pressing the OK button on the alert text opens a dialog that identifies the offending card and input. |
| 2012 | IO Expansion Digital Input Open | A digital I/O Expansion card input configured as a wait is<br>de-energized.<br>* Pressing the OK button on the alert text opens a dialog that identifies the offending card and input. |
| 2013 | Level/Flow Contact Open | 4-20 Mode: This alarm cannot be set.<br>Dry Contact Mode: The Appliance or Controller Level/Flow input is de-energized.<br>* This wait can only be present when the Level/Flow Restart setting is set to Enabled. |
| 2014 | IO Expansion Configuration Error | An IO Expansion card Wait input satisfies any of the following:<br>1. 4-20mA input configured in Bleed Valve Proof of Open mode.<br>2. High setpoint is less than the low setpoint plus the deadband.<br>3. Digital input configured in any of the following modes:<br>• Appliance Firing Rate<br>• FARC Air/Fuel/Aux<br>• O2 Sensor<br>• Secondary PID<br>* Pressing the OK button on the alert text opens a dialog that identifies the offending card and input. |
| 2015 | Low Heat Standby | Low Heat Standby Mode is configured as a Wait, the Controller is in the PID Control State, and one of the following conditions is present for the duration of the configured Low Heat Standby Delay:<br>1. Basic PID: Firing Rate is at the configured Minimum Firing Rate and the Process Temperature is greater than the Process Setpoint.<br>2. Cascaded PID: PID Process Setpoint is at the configured Primary Setpoint Min setting and the Process Temperature is greater than the Primary Setpoint Min setting and Secondary Input is greater than the Secondary Process Setpoint minus Deadband. |

## 20.3 WARNINGS

Warnings are alerts that are displayed only and do not affect controller operation in any way. The table below describes each warning and indicates the unique codes used to identify them.

| CODE | ALERT NAME | DESCRIPTION |
|---|---|---|
| 3000 | Low Voltage | 12V Mode: BMS Controller card input voltage is between 9.6V and 9.9V.<br>24V Mode: BMS Controller card input voltage is between 19.2V and 19.9V.<br>* Pressing the OK button on the alert text opens a dialog that identifies the offending card and input. |
| 3001 | High Voltage | 12V Mode: BMS Controller card input voltage is between 16.1V and 16.8V.<br>24V Mode: BMS Controller card input voltage is between 33.1V and 33.6V.<br>* Pressing the OK button on the alert text opens a dialog that identifies the offending card and input. |
| 3002 | High Fuel Pressure | 4-20 Mode: BMS Controller Pressure input reading is greater than its High Pressure SP setting. *<br>Dry Contact Mode: This warning cannot be set.<br>Dry Contact High Press Mode: BMS Controller Pressure input is<br>de-energized. *<br>* This warning can only be present in non-fuel states. |
| 3003 | Low Process Temp | The process temperature input reading is less than its Low Temp SP setting. |
| 3004 | High Level/Flow | 4-20 Mode: The Appliance or Controller Level/Flow input reading is above the High Level/Flow SP setting.<br>Dry Contact Mode: This warning cannot be set. |
| 3005 | Reserved | |
| 3006 | Grounded Thermocouple | A Temperature card thermocouple input is detecting a grounded thermocouple.<br>* Pressing the OK button on the alert text opens a dialog that identifies the offending card and input. |
| 3007 | POC Contact Failed to Open | The BMS Controller Proof of Closure input is energized when it is expected to be de-energized. |
| 3008 | POC2 Contact Failed to Open | The BMS Controller Aux input (configured as a Proof of Closure 2 input) is energized when it is expected to be de-energized. |
| 3009 | POP Contact Failed to Open | The BMS Controller Aux input (configured as a Proof of Pilot input) is energized when it is expected to be de-energized. |
| 3010 | Thermocouple Failure | A configured temperature card input is open or invalid, OR<br>Readings from a dual element thermocouple do not match, OR<br>Internal temperature card ambient temperature fault. Contact Profire.<br>* Pressing the OK button on the alert text opens a dialog that identifies the offending card and input. |

| CODE | ALERT NAME | DESCRIPTION |
|---|---|---|
| 3011 | High Auxiliary Temperature | A Temperature card input configured as a High Temp ESD input is reading a value above its High Temp Warning SP setting. |
| 3012 | Factory Calibration Error | Internal BMS Controller card fault. Contact Profire.<br>* This warning can only be present when the Factory Cal Error Mode setting (BMS Settings > Calibration > BMS) is set to Warning. |
| 3013 | Level/Flow Input Range Error | 4-20 Mode: The BMS Controller Level/Flow input reading is below 4-20 Low Range Limit setting OR above 4-20 High Range Limit setting (BMS Settings > Calibration > BMS 4-20 Inputs).<br>Dry Contact Mode: Internal BMS card fault. Contact Profire.<br>* This warning can only be present for multiple controller appliances |
| 3014 | Level/Flow Input Mismatch Error | Internal BMS Controller card fault. Contact Profire.<br>* This warning can only be present for multiple controller appliances |
| 3015 | Appliance Communication Error | A BMS controller assigned to the appliance is not communicating. |
| 3016 | Partially Running Appliance | An appliance has a combination of both stopped and running BMS controllers. |
| 3017 | IO Expansion Input Invalid | An I/O Expansion card input configured as a warning is not reading a valid input signal.<br>* Pressing the OK button on the alert text opens a dialog that identifies the offending card and input. |
| 3018 | IO Expansion Analog Input High | A 4-20mA I/O Expansion card input configured as a warning is above its High Setpoint setting.<br>* Pressing the OK button on the alert text opens a dialog that identifies the offending card and input. |
| 3019 | IO Expansion Analog Input Low | A 4-20mA I/O Expansion card input configured as a warning is below its Low Setpoint setting.<br>* Pressing the OK button on the alert text opens a dialog that identifies the offending card and input. |
| 3020 | IO Expansion Digital Input Open | A digital I/O Expansion card input configured as a warning is de-energized.<br>* Pressing the OK button on the alert text opens a dialog that identifies the offending card and input. |
| 3021 | IO Expansion Configuration Error | An IO Expansion card Warning input satisfies any of the following:<br>1. 4-20mA input configured in Bleed Valve Proof of Open mode.<br>2. High setpoint is less than the low setpoint plus the deadband.<br>3. Digital input configured in any of the following modes:<br>• Appliance Firing Rate<br>• FARC Air/Fuel/Aux<br>• $O_2$ Sensor<br>• Secondary PID<br>* Pressing the OK button on the alert text opens a dialog that identifies the offending card and input. |

| CODE | ALERT NAME | DESCRIPTION |
|---|---|---|
| 3022 | PID Configuration Warning | 4-20 Aux Out Mode setting is set to PID, Low Fire Mode setting is enabled and any of the following Advanced PID Config conditions exist:<br>1. Cascade Primary SP Max is above Low Fire SP<br>2. Cascade Primary SP Max is below Process Temp SP<br>3. Cascade Primary SP Min is above Process Temp SP<br>4. Cascade Primary SP Min is below 0<br>5. Cascade Secondary SP Max is below Secondary SP<br>6. Cascade Secondary SP Min is above Secondary SP<br>7. Cascade Secondary SP Min is below 0<br>8. Cascade Primary/Secondary out of range<br>* Pressing the OK button on the alert text opens a dialog that identifies the offending card and input. |
| 3023 | Pilot Module Comm Warning | Controller has lost communication with a pilot card. |
| 3024 | FARC System In Manual Mode | FARC Manual Mode setting is enabled. |
| 3025 | Appliance Firing Rate Input Invalid | The I/O Expansion card input configured as a Firing Rate input is not reading a valid 4-20mA signal and Aux Out Manual Override setting is enabled. |
| 3026 | IO Expansion Module Internal Voltage Fault | Internal card fault. Contact Profire.<br>* Pressing the OK button on the alert text opens a dialog that identifies the offending card and input. |
| 3027 | $O_2$ Trim at Limit | The Oxygen Sensor input reading is at its configured Max or Min Setpoint setting.<br>* This warning is hidden when the controller is not actively trimming $O_2$ (e.g., the controller is not in Process Control or the warmup conditions have not been met. |
| 3028 | High Measured %$O_2$ | The Oxygen Sensor input reading is above its configured High Setpoint setting.<br>* This warning is hidden when the controller is not actively trimming $O_2$ (e.g., the controller is not in Process Control or the warmup conditions have not been met. |
| 3029 | Manual $O_2$ Trim | $O_2$ Trim Manual Mode setting is enabled |

## 20.4 MAIN PERMISSIVES

Main Permissives are alerts that prevent a controller from entering any main fuel state. The table below describes each main permissive and indicates the unique codes used to identify them.

| CODE | ALERT NAME | DESCRIPTION |
|---|---|---|
| 4000 | Low Fuel Pressure | 4-20 Mode: BMS Controller Pressure input reading is less than its Low Pressure SP setting.<br>Dry Contact Mode: This alarm cannot be set.<br>Dry Contact High Press Mode: This alarm cannot be set<br>* This alarm can only be present when the Low Fuel Pressure Restart setting is set to Enabled and the Restart Mode setting is set to Main Permissive. |
| 4001 | Aux In Low Fuel Pressure | BMS Controller Aux input (configured as a Low Pressure input) is de-energized.<br>* This alarm can only be present when the Low Fuel Pressure Restart setting is set to Enabled and the Restart Mode setting is set to Main Permissive. |
| 4002 | Switching to Curve A | The BMS Controller is holding the main valves de-energized while switching from FARC Curve B to FARC curve A. |
| 4003 | Switching to Curve B | The BMS Controller is holding the main valves de-energized while switching from FARC Curve A to FARC curve B. |
| 4004 | IO Expansion Input Invalid | An I/O Expansion card input configured as a main permissive is not reading a valid input signal.<br>* Pressing the OK button on the alert text opens a dialog that identifies the offending card and input. |
| 4005 | IO Expansion Analog Input High | A 4-20mA I/O Expansion card input configured as a main permissive is above its High Setpoint setting.<br>* Pressing the OK button on the alert text opens a dialog that identifies the offending card and input. |

| CODE | ALERT NAME | DESCRIPTION |
|---|---|---|
| 4006 | IO Expansion Analog Input Low | A 4-20mA I/O Expansion card input configured as a main permissive is below its Low Setpoint setting.<br>* Pressing the OK button on the alert text opens a dialog that identifies the offending card and input. |
| 4007 | IO Expansion Digital Input Open | A digital I/O Expansion card input configured as a main permissive is de-energized.<br>* Pressing the OK button on the alert text opens a dialog that identifies the offending card and input. |
| 4008 | IO Expansion Configuration Error | An IO Expansion card Main Permissive input satisfies any of the following:<br>1. 4-20mA input configured in Bleed Valve Proof of Open mode.<br>2. High setpoint is less than the low setpoint plus the deadband.<br>3. Digital input configured in any of the following modes:<br>• Appliance Firing Rate<br>• FARC Air/Fuel/Aux<br>• $O_2$ Sensor<br>• Secondary PID<br>* Pressing the OK button on the alert text opens a dialog that identifies the offending card and input. |
| 4009 | Aux In Contact Open | The Aux Input (configured as a Main Permissive input) is de-energized. |
| 4010 | Low Heat Standby | Low Heat Standby Mode is configured as a Main Permissive, the Controller is in the PID Control State, and one of the following conditions is present for the duration of the configured Low Heat Standby Delay:<br>1. Basic PID: Firing Rate is at the configured Minimum Firing Rate and the Process Temperature is greater than the Process Setpoint.<br>2. Cascaded PID: PID Process Setpoint is at the configured Primary Setpoint Min setting and the Process Temperature is greater than the Primary Setpoint Min setting. |
| 4011 | POLO Contact Open | The Aux Input (configured as Proof Of Light Off Position input) is de-energized.<br>* This main permissive can only be present when the system is in the Pilot state; the Aux Input contact state is ignored in all other states when configured as a Proof of Light Off Position input. |
| 4012 | Modbus Main Permissive | Modbus Holding Register 40167 is set.<br>Refer to PF3107-00 Modbus Register Map for Details. |

# 21 GLOSSARY

## 21.1 TERMS

| TERM | DEFINITION |
|---|---|
| Flame Establishment Period | The time between the signal to initiate fuel flow and the signal indicating presence of flame. |
| Flame Failure Lock-Out Time / Flame Failure Response Time (FFRT) | The time between the signal indicating absence of flame and de-energization of the safety outputs (Lockout). |
| Ignition Time | The time for which the ignition outputs are energized during a trial for ignition. |
| Post Purge Time | Purge time that takes place immediately following the shutting off of the fuel supply. |
| Pre-Purge Time | The time between the confirmation of proof of airflow and the admission of fuel to the burner. |
| Purge Time | Period during which air is introduced to displace air/fuel mixtures or products of combustion from the combustion zone and flue ways. |
| Recycle Time | The time between the signal to de-energize safety outputs following a loss of flame and the signal to initiate a system restart. |
| Start-up Lock-out Time | The time between fuel flow energizing on start-up to fuel flow de-energizing due to no flame presence. |

## 21.2 ACRONYMS

| TERM | DEFINITION |
|---|---|
| BMS | Burner Management System |
| ESD | Emergency Shutdown |
| HEI | High Energy Ignition |
| HFV | High Fire Valve |
| LED | Light Emitting Diode |
| PFRN | Profire Reliability Network.  Proprietary communication protocol |
| PID | Proportional-integral-derivative |
| POC | Proof of Closure |
| PWM | Pulse Width Modulation |
| SIL | Safety Integrity Level |
| SSV | Safety Shutoff Valve |
| UI | User Interface |

# 22 DOCUMENT REVISION HISTORY

## 22.1 HARDWARE AND FIRMWARE VERSIONS

| DOCUMENT VERSION | RELEASE DATE | APPLICABLE SYSTEM FIRMWARE | APPLICABLE CARD HARDWARE | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | PF3100-00 UI CARD | PF3101-00 BMS CONTROLLER CARD | PF3102-00 ION PILOT CARD | PF3102-01 UV PILOT CARD | PF3102-03 PILOT SPARK CARD | PF3103-00 TEMPERATURE CARD | PF3106-00 NETWORK SWITCH CARD | PF3107-00 MODBUS COMM CARD | PF3113-00 I/O EXPANSION CARD |
| v10.0 r_1 | 02 FEB 2026 | NA-44.0 | v1.3.x<br>v1.4.x | v1.3.x | v2.2.x | v1.0.x | v1.1.x | v1.4.x | v2.1.x | v1.3.x | v2.0.x |
| v10.0 | 15 APR 2025 | NA-44.0 | v1.3.x<br>v1.4.x | v1.3.x | v2.2.x | v1.0.x | v1.1.x | v1.4.x | v2.1.x | v1.3.x | v2.0.x |
| v9.0 | 15 JAN 2024 | NA-43.6 | v1.3.x<br>v1.4.x | v1.3.x | v2.2.x | v1.0.x | v1.1.x | v1.4.x | v2.1.x | v1.3.x | v2.0.x |
| v8.0 | 14 NOV 2022 | NA-43.3 | v1.3.x | v1.3.x | v2.2.x | v1.0.x | v1.1.x | v1.4.x | v2.1.x | v1.3.x | v2.0.x |
| v7.0 | 26 OCT 2022 | NA-43.2 | v1.3.x | v1.3.x | v2.2.x | v1.0.x | v1.1.x | v1.4.x | v2.1.x | v1.3.x | v2.0.x |
| v6.0 | 21 OCT 2022 | NA-43.1 | v1.3.x | v1.3.x | v2.2.x | v1.0.x | v1.1.x | v1.4.x | v2.1.x | v1.3.x | v2.0.x |
| v5.0 | 31 JAN 2022 | NA-43 | v1.3.x | v1.3.x | v2.2.x | v1.0.x | v1.1.x | v1.4.x | v2.1.x | v1.3.x | v2.0.x |
| v4.0 | 30 JUN 2020 | NA-41 | v1.3.x | v1.3.x | v2.2.x | v1.0.x | v1.1.x | v1.4.x | v2.1.x | v1.3.x | v2.0.x |
| v3.0 | 20 NOV 2018 | NA-40 | v1.3.x | v1.3.x | v2.2.x | v1.0.x | v1.1.x | v1.4.x | v2.1.x | v1.3.x | v2.0.x |

## 22.2 DOCUMENT CHANGE SUMMARY

### 22.2.1 VERSION 10.0 R_1

- Corrected I/O Expansion dry contact behavior tables on p. 71 and 72 to include newly added modes

### 22.2.2 VERSION 10.0

- Updated to include the following new I/O Expansion Dry Contact status modes
  - Appliance Alarm Status
  - Appliance Wait Status
  - Appliance Warning Status
  - Appliance Main Permissive Status
  - Controller Running Status

- Updated to include the following new I/O Expansion Input alarm modes
  - Non-fuel State alarm
  - Pilot State alarm
  - Main State alarm
- Updated to reflect support for new Modbus firing rate control
- Updated to reflect support for new Ignition Attempts setting
- Updated to reflect support for customizable passwords
- Updated to reflect support for remote FARC curve switching via Modbus
- Updated to reflect support for Natural Draft Pre Purge functionality
- Updated to reflect support for new Modbus Main Permissive

### 22.2.3 VERSION 9.0

- Updated product warnings.
- Updated to reflect renaming of BMS Aux Input Proof of Low Fire Setting (to Proof of Closure High Fire).
- Updated to include new BMS Aux Input Proof of Light Off Position mode.
- Renamed alarm 1003 to POC HF Contact Open.
- Added alarm 1157 POLO Enabled with TCV Disabled.
- Added Main Permissive 4011 POLO Contact Open.

### 22.2.4 VERSION 8.0

- Updated Flame Detection threshold notes to specify behavior changes under flame sharing conditions.
- Updated applicable firmware versions to include NA-43.3 release.

### 22.2.5 VERSION 7.0

- No material changes
- Updated applicable firmware versions to include NA-43.2 release.

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