PF2100F USER MANUAL REV 1.0.2

FLARE IGNITION SYSTEM

WARNINGS

THIS EQUIPMENT IS SUITABLE FOR USE IN CLASS 1, DIVISION 2, GROUPS ABCD OR NON-HAZARDOUS LOCATIONS ONLY.

WARNING: EXPLOSION HAZARD
DO NOT DISCONNECT WHILE CIRCUIT IS LIVE UNLESS AREA IS KNOWN TO BE NON-HAZARDOUS OR EQUIVALENT

WARNING: EXPLOSION HAZARD
SUBSTITUTION OF COMPONENTS MAY IMPAIR SUITABILITY FOR CLASS 1, DIVISION 2.

DO NOT SERVICE UNLESS AREA IS KNOWN TO BE NON-HAZARDOUS

DO NOT OPEN WHEN ENERGIZED

INSTALLATION & USE MUST CONFORM TO THE DIRECTIONS IN THIS MANUAL

SYSTEM MUST BE PROPERLY CONNECTED TO EARTH-GROUND FOR EFFECTIVE OPERATION OF FLAME DETECTION CIRCUITRY

ELECTRICAL DEVICES CONNECTED TO THE CONTROLLER MUST MEET CERTAIN ELECTRICAL STANDARDS AND BE WITHIN VOLTAGE LIMITS

REPLACEMENT FUSES MUST BE CERAMIC AND OF CORRECT RATING

HW & FW VERSIONING

This version of the manual was written for use with PF2100F systems that have the following hardware and firmware versions.

ITEM	*HW VERSION*	*FW VERSION*
Door Card	v1.71	F1.7.040
Terminal Card	v1.7	F1.7.038
Modbus Card	v2.0	v4.3

System hardware and firmware versions can be found printed on separate labels inside of the enclosure on each circuit board. (Sections 1.5, 2.4)

Please refer to the Profire Energy Inc. website for the latest documentation.

APPROVALS

Class 1, Division 2
Grp ABCD
IP54
CSA Type 4x

C US
#248705

CSA 22.2 No. 199-2007
CSA C22.2 No. 0-M91
CSA C22.2 No. 0.4-04
CSA C22.2 No. 94-91
CSA C22.2 No. 142-M1987
CSA C22.2 No. 213-M1987
CSA E60079-0:2007
CSA E60079-15:2005
UL 508, 17th Edition
ANSI-ISA-12.12.01-2007
UL 60079-0:2005
UL 60079-15:2002

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1 Overview

The PF2100F FIS (Flare Ignition System) is an electronic control and monitoring system designed for use on a wide array open flares and unenclosed incinerators. It provides electronic pilot ignition, flame detection, temperature control, and remote monitoring. Safety is improved by providing the means to light the pilot electronically. This eliminates the need for the old 'rag on a stick' method, which could be quite dangerous.

1.1 Available Models

The PF2100F is available in two configurations:
BASE MODEL and **INTERNAL COIL MODEL**.

The Base Model is for use with externally mounted ignition coils. This is useful when the controller must be mounted more than 5m (15ft) away from the flare. An external ignition coil can be purchased separately from Profire for use with this model.

The Internal Coil model includes a built-in ignition coil and can be used whenever the controller can be mounted less than 5m (15ft) away from the flare.

Both of these models can be further enhanced by adding an optional Modbus Expansion card.

Note: The 4-20mA Expansion Card is not supported by the PF2100F at this time.

MODELS

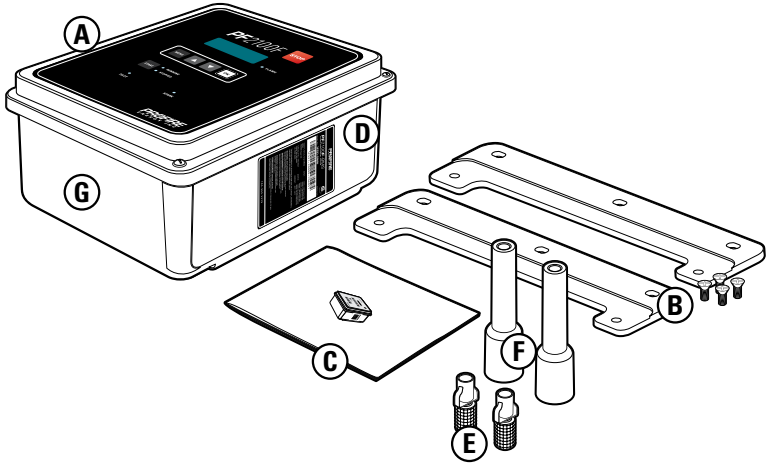
F0000 Base Model

FC000 Internal Coil Model

1.2 Included Components

The PF2100F comes packaged with the following (varies across models). If any components are missing, contact Profire immediately.

CODE	DESCRIPTION	F0000	FC000
A	PF2100F	•	•
B	Mounting Brackets & Screws	•	•
C	Instruction Manual (If Requested*)	*	*
D	Internal Coil		•
E	Ferrules (2)		•
F	Straight Silicone Boots (2)		•
G	Ignition Cable (20ft)		•



1.3 Optional Components

The following components may be required to install the PF2100F but are not included with the system. Profire offers some of these components for sale individually and also in various kits.

Please contact Profire Sales for further information.

1. **MOUNTING HARDWARE**
   - Channel Bar
   - Conduit Ports
   - Liquid Tight Ports
   - Rubber Grommets

2. **WIRE**
   - Ignition Wire
   - Thermocouple Wire

3. **RODS AND CONNECTORS**
   - Kanthal Ignition Rods (Various Lengths)

4. **VALVES**
   - DC Solenoids
   - Safety Valves with Proof of Closure
   - Proportional Valves

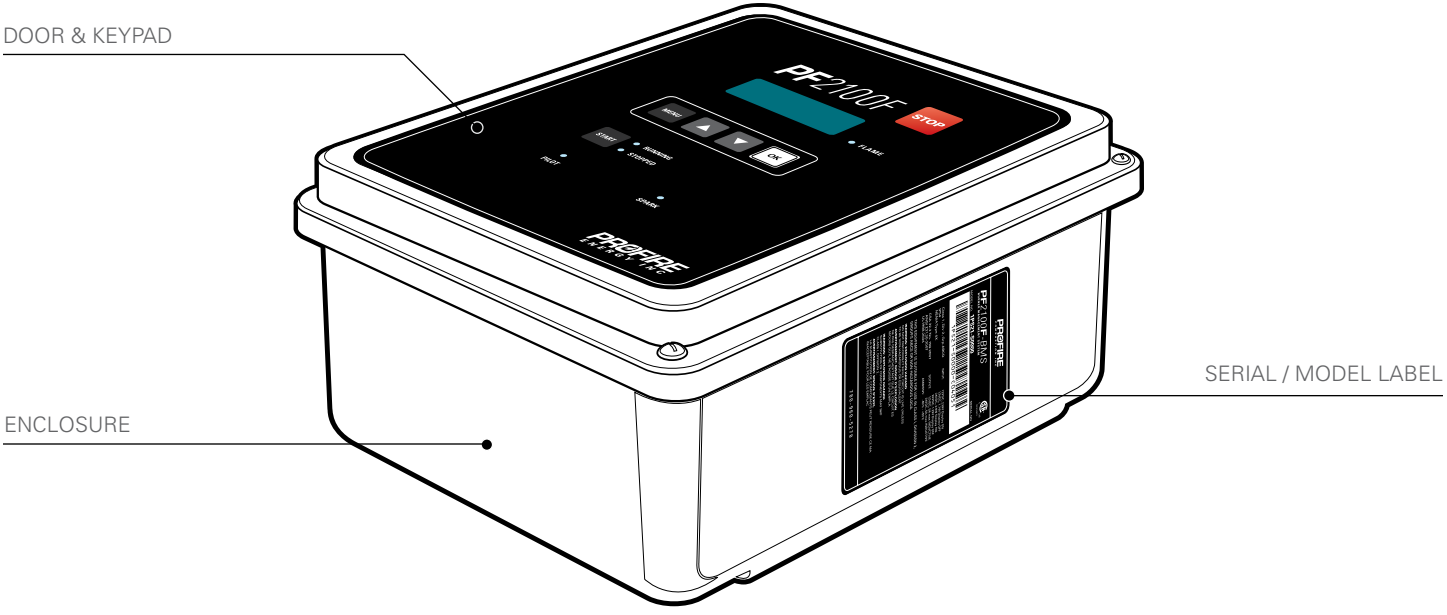
5. **THERMOCOUPLES**
   - Single, Type K

6. **PILOT ASSEMBLY**
   - Nozzles
   - Brackets
   - Mixers
   - Orifices

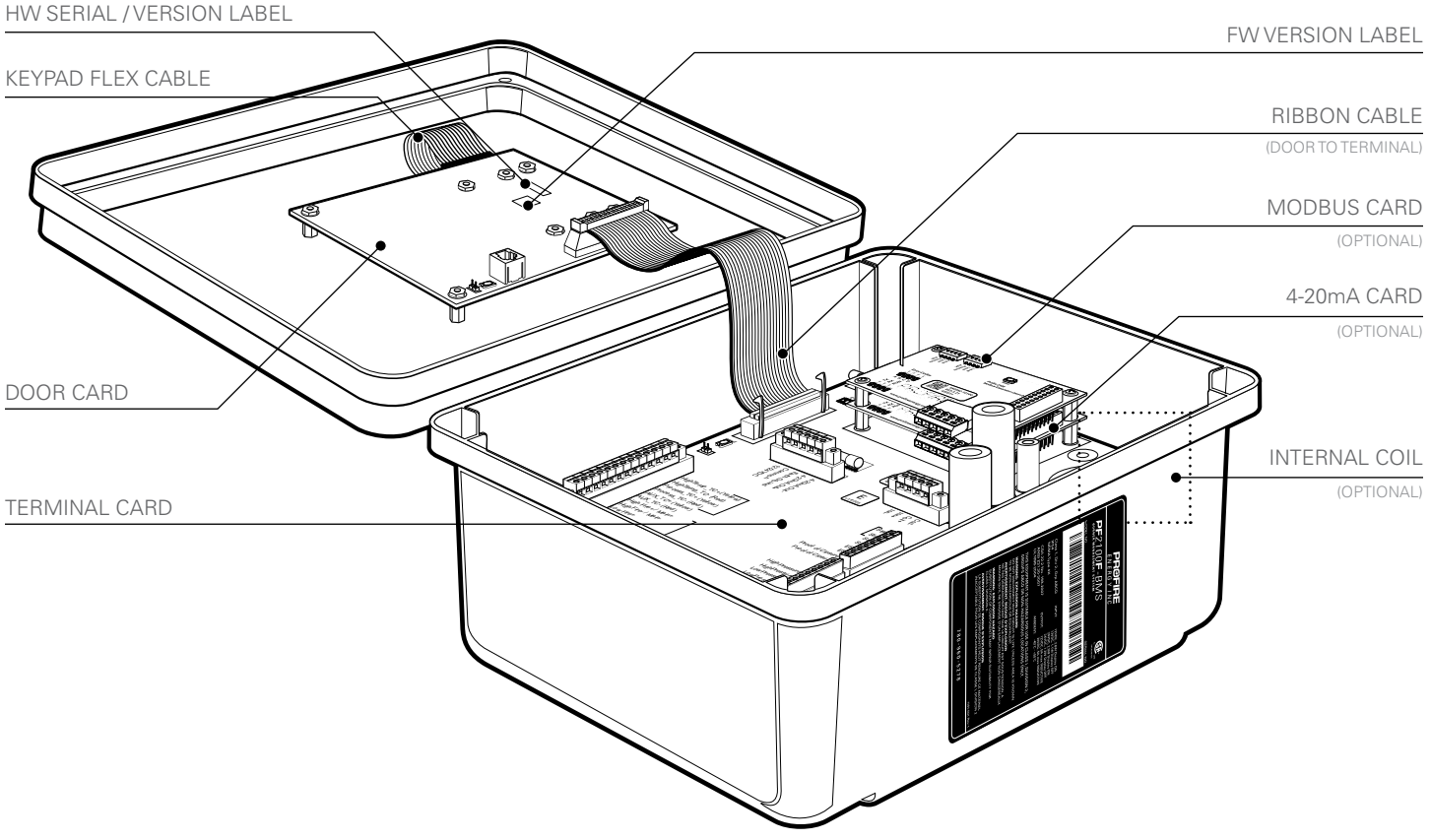
7. **AUTONOMY**
   - Batteries
   - Solar Chargers
   - Solar Panels

8. **ACCESSORIES**
   - Modbus Expansion Cards
   - External Ignition Coils
   - External Ignition Coils with Enclosure

1.4 External Diagram



1.5 Internal Diagram



1.6 Installation Types

Below are examples of some of the applications that the PF2100F can be used in.

1. Flare Stack
2. Flare Pit

1.7 Regulatory Requirements

The PF2100F is certified for use in Class I, Division 2, Group ABCD locations. Certain modes of operation or wiring options may be against code in some locations or for flares exceeding a certain heat rating.

Profire makes no assertion as to the suitability of a particular component for a given application. It is up to the customer to examine the local codes and safety requirements to determine if the PF2100F and any other associated components sold by Profire are suitable for use in a given application.

CANADA
The PF2100F is not designed to meet CSA B149 requirements which are becoming legislated in Canada, therefore it is not suitable for use on enclosed burners.

USA
The PF2100F currently meets the requirements for use in the United States.

Other
Consult local codes and safety regulations to determine if the PF2100F can be used in your jurisdiction.

2 Installation

This section includes the steps that should typically be followed when wiring up a PF2100F system in the field. If you are new to the PF2100F, you should read this section in its entirety and follow these instructions closely.

STEPS

1. Review Installation Warnings
2. Choose a Mounting Location
3. Mount the System
4. Get Familiar with the Terminal Card
5. Connect the Required Wiring including Power, Valves, Thermocouples, and Ignition Coil / Flame Detection wiring
6. Connect the Optional Wiring including Status Contact, Dry Contact Inputs, and Expansion Cards

At the end of this section is a table for looking up information about specific terminals and circuits.

Keep in mind that the PF2100F is a versatile system which can be used in many different applications. As such, it is important to know the application for which you are installing the system before you begin your work. The steps provided here are general and will help you to identify questions that need to be answered to complete the installation properly.

To know which options are required, you should consult the engineer or technician who designed the site. You should also consult your local electrical and gas code.

Profire also offers a number of Application Guides for installing the PF2100F in various application and jurisdictions. These include recommended fuel trains, bill of materials, system settings, and P&ID diagrams. These can be found on our website or you can contact a member of the Profire Sales team to discuss your application further.

2.1 Installation Warnings

Before installing the PF2100F, please review the following list of warnings. Failure to observe these may result in death, electrocution, property damage, product damage, and/or government fines.

ALL MODELS

1. The PF2100F is NOT intended for use on enclosed burners or fire tubes as it may pose a safety risk and may be against code in some jurisdictions. For these applications, please consider using our PF2100F system.

2. The PF2100F is NOT designed to control a pilot or main solenoid. The PF2100F is NOT CSA B149 compliant. If you require automatic electronic control of a valve train, please consider using our PF2100F system.

3. Failure to properly ground the pilot assembly back to the PF2100F's EGND screw may result in accidental electrocution, product damage, or simply failure to ignite the pilot.

4. The PF2100F generates 20kV- 40kV at its high voltage output terminal which can cause burns or cardiac arrest. Do not touch or place any object near the ignition coil's high voltage terminal or connected ignition wire while the product is operating. Even without making physical contact with the terminal, it is possible to draw a spark from several inches away, especially if the pilot bracket is not properly grounded.

5. Never leave the PF2100F running unattended without the door screws securely tightened down. This is to prevent moisture from penetrating inside of the enclosure and damaging the product. Moisture damage to the internal circuitry is not covered by the product warranty if the door has been left open.

BATTERY MODELS

6. Never store or ship the unit with the battery connected. Disconnect the battery's negative wire from the charge controller and cover the fork connector with electrical tape or some other insulator that will prevent it from shorting to other components. Failure to observe this warning may result in accidental electrocution, fire, product damage, or simply a dead battery.

7. Never operate the unit with the zener diode removed from across the load terminals of the charge controller as this may lead to failure.

8. Never power these from any DC power supply or from a solar panel rated for more than 12V nominal (40W). This may lead to failure of the charge controller.

9. Be careful not to damage the temperature sensor on the charge controller. It is delicate and if damaged, the charge controller will not function.

2.2 Mounting Locations

The PF1300F should be mounted at the base of the Flare Stack or in another location that is both safe and easily accessible. The recommended mounting height is 1.5m (5ft) above the ground or platform that the operator will be standing on.

Please consider the following when choosing an install location:

1. **ACCESSIBILITY**
   The operator should be able to easily access the system to observe its operation and to adjust settings. The system should not be mounted facing the sun to make it easier to observe the LED indicators on the front panel.

2. **SECURITY**
   In some situations, it may be desirable to mount the system in a location that is not accessible to the general public to prevent accidental and intentional tampering.

3. **OPERATOR SAFETY**
   The system should not be mounted in a dangerous location such as close to the top of the flare stack where an operator might be placed in undue danger.

4. **PERFORMANCE**
   Choose a mounting location that will allow ground and ignition wires to be kept as short as possible. This will ensure the best ignition and flame detection.

5. **PRODUCT PROTECTION**
   To protect the system from being damaged, it should not be mounted:

   a. Where chemicals may splatter or bubble over from the flare onto the system. Chemicals on the keypad may interfere with an operator's ability to control the product or view the LED indicators.

   b. Near the top of the flare where excessive heat may damage the product. Refer to the maximum operating temperature listed in this document.

   c. To anything that may tip over due to wind or snow. For example, a pole that is not set properly into the ground or a tripod that is not secured with anchor bolts or guy wires.

   d. In locations that may be prone to flooding.

2.3-A Mounting Instructions (Non-Metallic Enclosure)

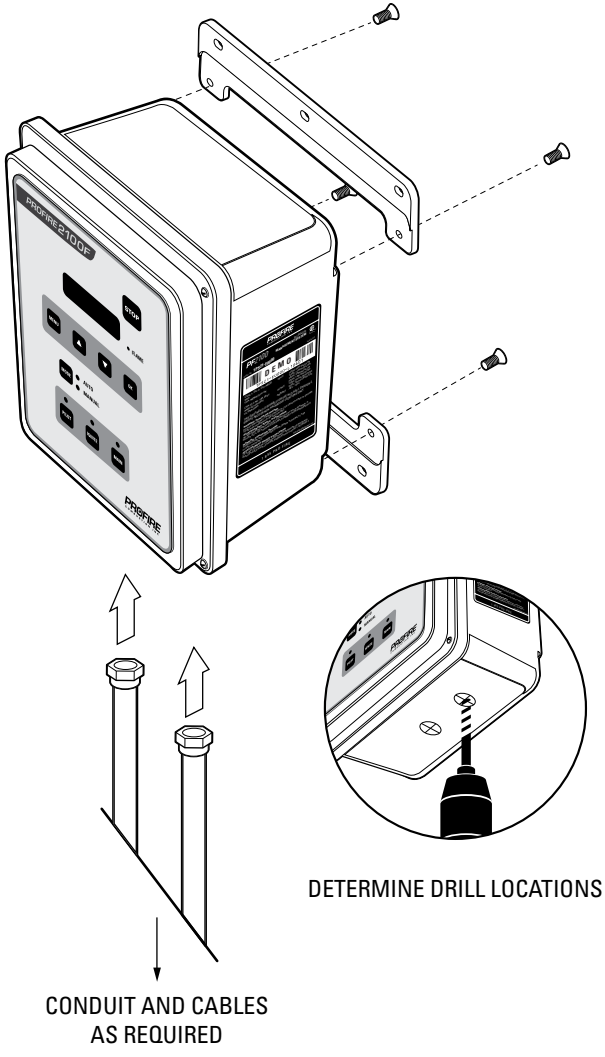
1. Remove and open the included bag of components taped to the mounting brackets.

2. Attach the two mounting brackets to the back of the PF2100F enclosure using the 4 screws.

3. Determine the best location to drill holes in the product enclosure for the wires to enter. It is recommended that these holes be drilled on the bottom of the enclosure (as shown).

4. Install grommets or conduit ports as required.

5. Securely mount the enclosure to either a pole, structure or building which satisfies the location requirements previously listed in section 2.2 (Mounting Locations).



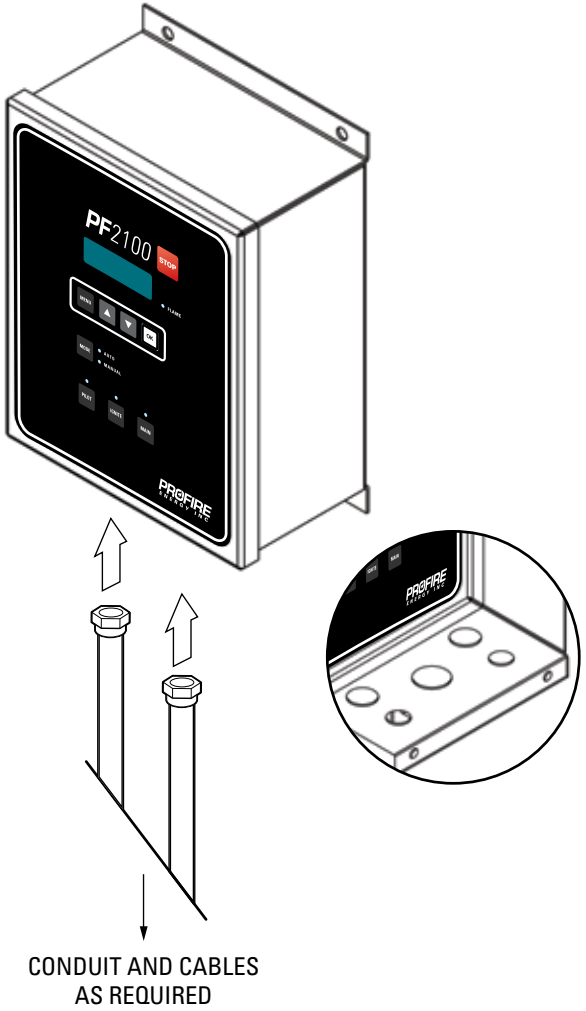
2.3-B Mounting Instructions (Metallic Enclosure)

1. Remove and open the included bag of components taped to the mounting brackets.

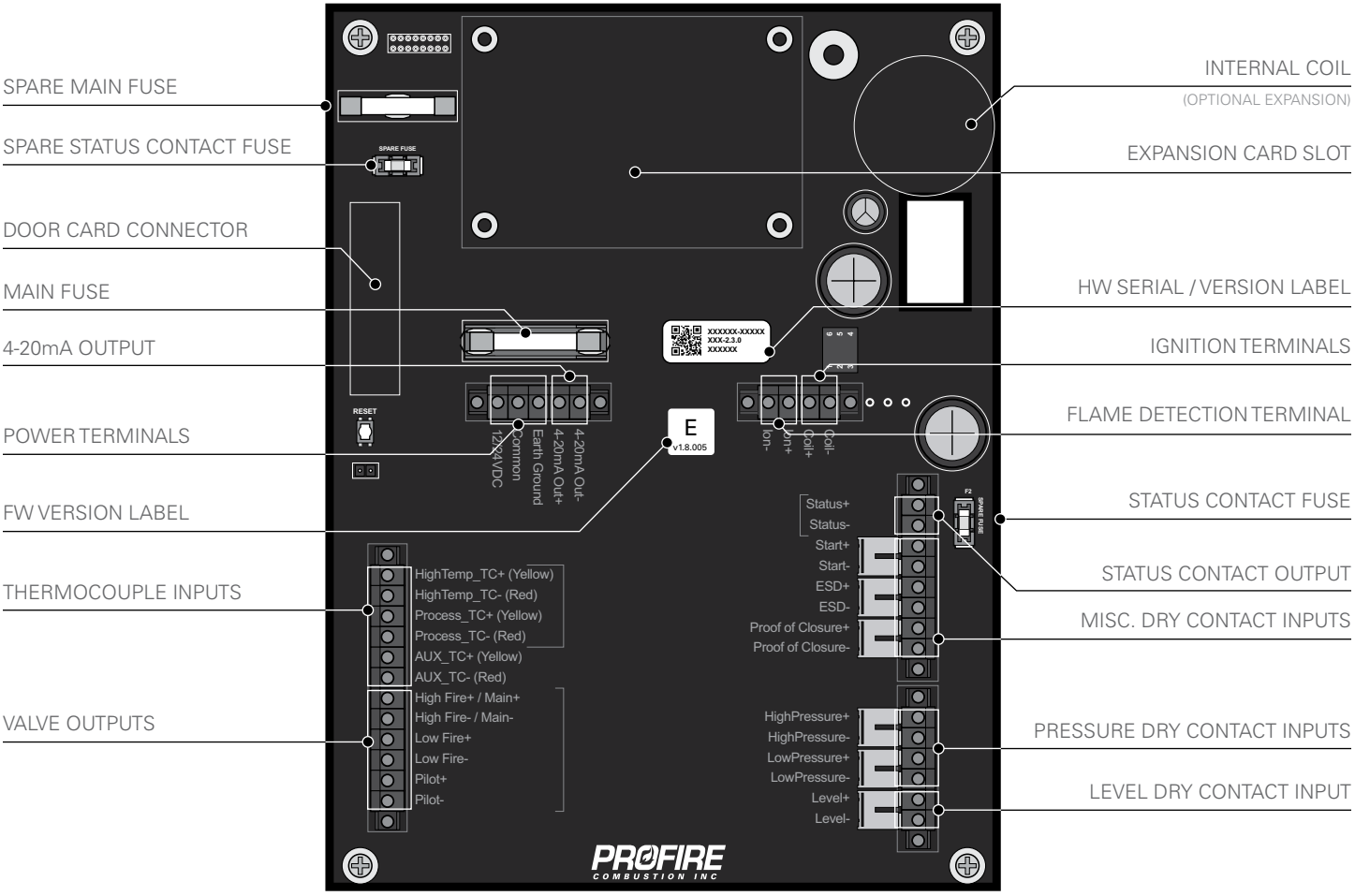
2. Determine the best location for conduit attachment, on the bottom of the enclosure.

3. Install grommits and conduit ports required.

4. Securely mount the enclosure to either a pole, structure or building which satisfies the location requirements previously listed in section 2.2 (Mounting Locations).



2.4 Terminal Card Diagram



2.5 Terminal Descriptions

This table provides a brief description of each terminal and references to further detail.

TERMINAL	EXPECTED CONNECTIONS	DESCRIPTION	SECTION
12/24VDC	Input power from a DC source	Input power 10VDC - 28VDC, 5A MAX	2.6.1
Common	Ground back to DC source	Internally connected to EGND	2.6.1
EGND	Earth Ground		2.6.1
4-20mA Out +	PLC 4-20mA positive input	This output can be used to echo the Pilot Temperature to a PLC. A resistance of 120Ω to 250Ω is expected.	2.6.2, 2.7.3
4-20mA Out -	Ground return for the 4-20mA output		
HighTemp_TC + (YELLOW)	High Temp Thermocouple positive lead	"**TYPE K**" thermocouple must be connected between the "+" and "-" terminals and must not be electrically connected to ground. An uninterrupted connection using "**TYPE K**" thermocouple wire is required for an accurate reading.	2.6.3
HighTemp_TC - (RED)	High Temp Thermocouple negative lead		
Process_TC + (YELLOW)	Pilot Thermocouple 1 positive lead		
Process_TC - (RED)	Pilot Thermocouple 1 negative lead		
AUX_TC + (YELLOW)	Pilot Thermocouple 2 positive lead		
AUX_TC - (RED)	Pilot Thermocouple 2 negative lead		

2.5 Terminal Description Continued...

TERMINAL	EXPECTED CONNECTIONS	DESCRIPTION	SECTION
High Fire/Main +	Unused in PF2100F	Solenoid valves must be connected between the "+" and "-" terminals. The negative terminal is not directly connected to ground so a common return wire for the High Fire, Low Fire and Pilot valves cannot be used. Maximum continuous current is 2A. If "Low Power" mode is enabled, a peak load of 4A is permitted.	2.6.2
High Fire/Main -	Unused in PF2100F		
Low Fire +	Unused in PF2100F		
Low Fire -	Unused in PF2100F		
Pilot +	Pilot Valve positve terminal		
Pilot -	Pilot Valve negative terminal. Do not connect to ground.		
Ion +	Optional flame detection positive input. Connect to flame rod or external coil Ion terminal (depending on configuration)	A Kanthal rod should be placed directly in the pilot flame and connected to this input. The pilot assembly must be grounded for the flame detection to function properly. Input is protected from high voltage and can be connected in series with the high voltage terminals of an external ignition coil, allowing a single flame-rod to be used for both ignition and flame detection. A 65VAC signal is applied to the flame rod. The source impedance is very high so there is no danger of sparking. Ionization flame detection is optional on the PF2100F. This terminal can be left unconnected if a pilot thermocouple is being used.	2.6.4 - 2.6.7
Ion -	Flame Detection negative input. Connect to ground screw on pilot assembly or burner housing.	Ground return for flame detection.	
Coil +	Driver for the low voltage primary of the ignition coil.	The primary of the ignition coil should be connected to this terminal. The 12/24VDC input power will be applied for 1 ms and turned off for 50 ms while sparking. This output is protected by a 250mA thermal fuse.	2.6.4 - 2.6.7
Coil -	Ground return for the ignition coil.		

2.5 Terminal Description Continued...

TERMINAL	EXPECTED CONNECTIONS	DESCRIPTION	SECTION
Status +	Connect to PLC positive input contact or other alarm device.	The status "+" and "-" contacts will be closed when the system is running and opened when the system is shutdown. Dry contact output to indicate system status to an external device. ie. PLC. Note that the contacts are DC only and are not internally connected to power or ground. 40VDC, 250mA, 15Ω	2.7.1
Status -	Connect to PLC negative input contact or other alarm device.		
Start +	Remote start input from an external device. ie. PLC.	Dry contact switch is expected. The input is internally pulled up to 9VDC via a 3.75kΩ resistance. Jumper "+" and "-" if not used. All input contacts can use a single common ground return if desired.	2.7.2
Start -	Ground		
ESD +	External Shutdown input, typically plant ESD loop.		
ESD -	Ground		
Proof of Closure +	Unused in PF2100F		
Proof of Closure -	Ground		
High Pressure +	Input from a mechanical High Pressure switch.		
High Pressure -	Ground		
Low Pressure +	Input from a mechanical Low Pressure switch.		
Low Pressure -	Ground		
Level +	Input from a float-switch mounted in the bath/tank.		
Level -	Ground		

2.6 Required Wiring

The wiring in this section of the document is required for all PF2100F installations. Skipping or performing any steps in this section incorrectly will likely result in the PF2100F not functioning properly.

2.6.1 Power

The PF2100F can be powered from 12VDC or 24VDC. The maximum current that the PF2100F can safely handle without blowing the main fuse is 5A. The system on its own draws only about 100mA. The rest of the current is drawn by loads on attached circuits such as the valves. Ensure that you select a power supply that is rated appropriately for the total amount of current that will be consumed by all devices attached to it.

WIRING STEPS

1. Wire the Common terminal to the negative terminal of the power supply.
2. Wire the Earth Ground terminal to the shield of all conduit ports installed in the enclosure.
3. Connect the Earth Ground terminal to an actual earth ground connection.
4. Wire the 12/24VDC terminal to the positive terminal of the power supply.

2.6.2 Valves

Only two of the four valve control outputs are supported by the PF2100F: Pilot, and High Fire/Main.

WIRING STEPS

1. Wire the Pilot valve to the Pilot +/- terminals
2. Connect valve EGND wires to Earth Ground.

NOTES

1. It is possible to connect multiple valves to the same control output in parallel or series. If you do this, ensure that the configuration you are using meets local codes and also does not exceed the total current rating of the PF2100F.
2. The negative valve control wires are NOT connected directly to ground. Therefore, you cannot use a common return wire for all valves.

PILOT VALVE

The Pilot valve is optional. It will typically be used when the pilot gas comes from a tank.

LOW FIRE VALVE

The Low Fire valve output is not supported by the PF2100F.

HIGH FIRE/MAIN VALVE

The PF2100F supports the use of a main valve. This configuration is not recommeded for flare operation, but information on the valves behavior can be provided in section 5.6.

2.6.3 Thermocouples

All thermocouple inputs in the PF2100F are optional. The Process TC and AUX TC terminals can be connected to two independent pilot thermocouples, each capable of being used for flame detection. The HighTemp TC terminal can be connected to a seperate thermocouple for high temperature shutdown applications.

All thermocouples are cold junction compensated. For this reason it is important to ensure that Type-**k** thermocouple wire and connectors are used exclusively. The temperature compensation is done using an ambient temperature sensor located on the terminal card near the thermocouple terminals.

WIRING STEPS (OPTIONAL)

1. Connect a single Type-k thermocouple to the Process TC input, and place this thermocouple in the location of the pilot flame.
2. Connect a single Type-k thermocouple to the AUX TC input, and place this thermocouple in the location of the pilot flame.
3. Connect a single Type-k thermocouple to the HighTemp TC input, and place this thermocouple in a location where a high temperature should cause a system shutdown.

NOTES

All Thermocouples must be:

1. Isolated from ground
2. Isolated from power
3. Type K thermocouples
4. Connected with 20 AWG or larger Type K extension wire
5. Placed a safe distance from high voltage lines and shielded when necessary.

PILOT THERMOCOUPLES (Process TC and AUX TC)

Two pilot thermocouples can be used for flame detection and pilot flame temperature measurement. These thermocouples are independent, and both can be optionally omitted if ionization is being used for flame detection.

HIGH TEMPERATURE THERMOCOUPLE

This thermocouple is used for the high-temp shutdown. The system can shutdown if an open circuit, short-circuit or short-to-ground is detected on this thermocouple. This thermocouple is optional, and by default, the PF2100F does not expect this input.

2.6.4 Ignition Coil / Flame Detection

There are numerous ways to wire the ignition and flame detection circuits correctly but there are also a number of things that must be carefully considered before choosing an approach. This section provides some tips to help you achieve reliable ignition and flame detection and then concludes with specific instructions on how to wire up various common configurations.

There are four possible ways to wire the ignition coil and flame detection circuit with the PF2100F as illustrated in the table below. Wiring instructions and diagrams are provided for each.

WIRE LENGTHS

When wiring the ignition and flame detection circuits, wire length must be carefully considered. If the wire lengths are too long, the PF2100F may not be able to deliver enough energy to the ignition rod to ignite the pilot. Or the PF2100F may not receive enough signal from the flame rod to be able to detect flame.

GROUNDING

Properly grounding the pilot assembly back to the PF2100F is critical for proper ignition and flame detection. This can be accomplished I many ways. A ground wire should be run from the Ion- or EGND terminal of the PF2100F over to the pilot assembly. This wire can either be connected to a ground screw on the pilot bracket or to the flare housing. If it is connected to the flare housing, use a multimeter to verify that the flare housing has electrical continuity with the pilot assembly. If not, another wire must be added to connect it.

ROD POSITIONING

Rod positioning must also be carefully considered to ensure proper ignition and flame detection. The ignition rod should be positioned (by bending it if necessary) so that there is a 1/8" to ¼" gap between it and the front of the pilot nozzle. The flame rod should be positioned (by bending it if necessary) such that 2" to 3" of its length is positioned within the pilot flame. Care should be taken to ensure that the ignition rod and flame rod are not directly in line with each other. Otherwise, the ignition rod may cast a shadow on the flame rod such that there is no flame present at the flame rod and therefore no flame is detected.

FLAME ANCHORING

The term "Flame Anchoring" refers to how much in contact the flame is with the pilot nozzle. Poor flame anchoring causes poor flame detection. Poor flame anchoring can be caused when there is too much gas pressure resulting in the flame burning primarily outside of the nozzle as opposed to along the inside and outside surfaces of the nozzle. It can also be caused by wind or draft from the flare.

USING EXTRA RODS TO IMPROVE FLAME DETECTION

In some challenging installations, adding one or two additional rods may be required. A second flame detection rod can help in cases where the flame may blow away from the primary rod from time-to-time. The addition of a ground rod positioned further away from the nozzle tip can assist with detecting flames that are not well anchored. Use of additional rods should only be used as a last resort since normally another less costly solution can be found.

INTERNAL VS EXTERNAL COIL

If less than 5m (15ft) of ignition wire are required to connect the PF2100F to the flare housing, the internal coil configuration can be used. Otherwise the external coil configuration must be used.

The Internal Coil Configuration refers to an internal coil included inside the PF2100F, while the External Coil Configuration refers to a coil not included with the PF2100F and located in a separate enclosure or inside the flare housing.

SINGLE ROD VS DUAL ROD

A single Kanthal rod can be used for both ignition and flame detection to save cost if desired. This often results in a performance trade-off between ignition and flame detection. This option is only available with external coils.

Using two Kanthal rods (one for ignition and one for flame detection) allows for greater flexibility in rod placement and often yields better performance.

WIRING OPTIONS

CONFIGURATION (COIL TYPE)	SINGLE ROD	DUAL ROD
Internal Coil		•
External Coil	•	•

IGNITION COIL VS HIGH ENERGY IGNITION

In addition to a standard ignition coil, the PF2100F supports the use of a High Energy Ignition (HEI) system for ignition. To use an HEI system, connect the HEI system's positive input to the Coil+ terminal on the PF2100F, and the HEI system's negative input to the Coil- terminal. Consult the HEI system's documentation for information on connecting it to a pilot assembly and properly grounding it. The wiring instructions in the following sections only apply to systems installed with traditional ignition coils.

2.6.5 Internal Coil, Dual Rod

Use this configuration when the PF2100F is <5m (15ft) from the flare and you want greater flexibility for rod placement.

WIRING STEPS

1. Connect the Pilot Assembly ground screw to the PF2100F's Ion- terminal using a 16 AWG (or thicker) ground wire

2. Connect the Kanthal Flame Detection Rod to the PF2100F's Ion+ terminal. Use the included Ferrule and Straight Silicone Boot to ensure that the connection is robust. It is recommended to use 7mm Ignition Wire but 16 AWG may be acceptable for shorter runs.

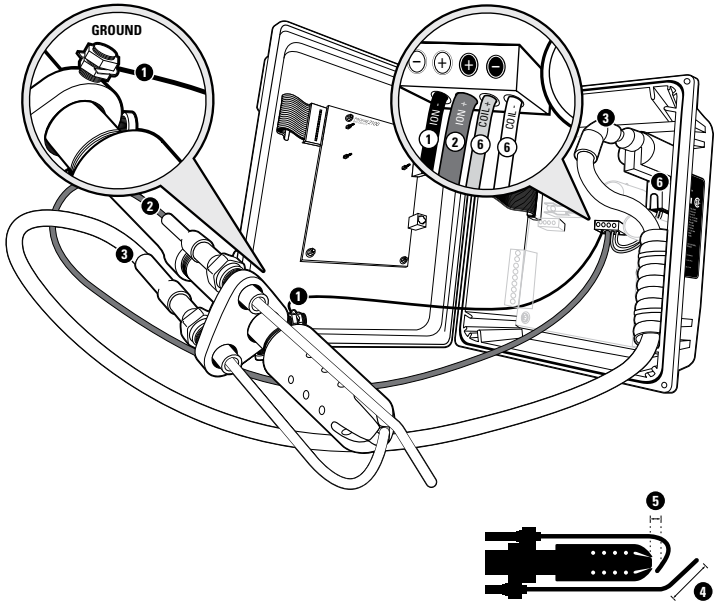
3. Connect the Kanthal Ignition Rod to the PF2100F's Internal Coil Output Terminal using the included ignition wire. Use the included Ferrule and Straight Silicone Boot to ensure that the connection is robust.

4. Adjust the Flame Rod positioning (bend it if necessary) so that 2 to 3" of the rod will be inside the pilot flame.

5. Adjust the Ignition Rod positioning (bend it if necessary) so that there is a 1/8 to 1/4" gap between the rod and the front of the pilot nozzle.

6. Verify that the Coil+ terminal is connected to the black pigtail on the ignition coil.

7. Verify that the Coil- terminal is connected to the white pigtail on the ignition coil.

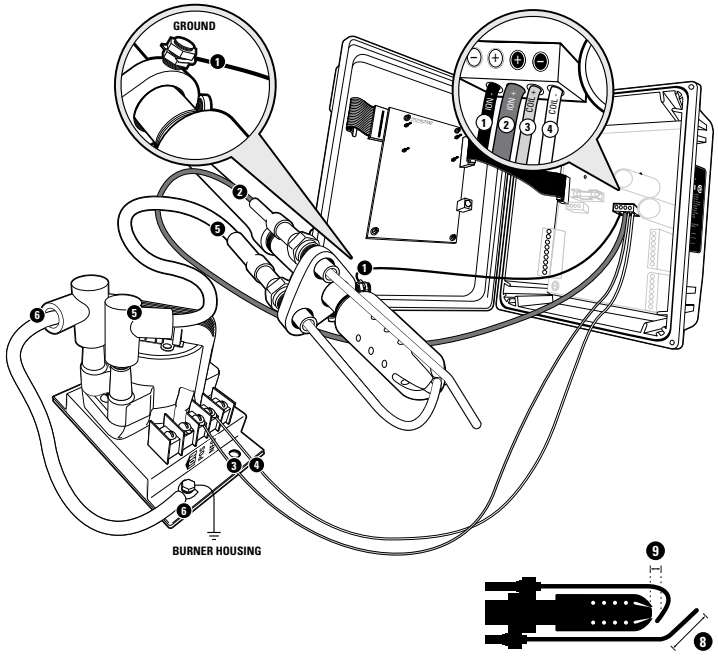


2.6.6 External Coil, Dual Rod

Use this configuration when the PF2100F is >5m (15ft) from the flare and you want greater flexibility for rod placement.

WIRING STEPS

1. Connect Pilot Assembly ground screw to the PF2100F's Ion- terminal using a 16 AWG (or thicker) ground wire.
2. Connect the Kanthal Flame Detection Rod to the PF2100F's Ion+ terminal. Use the included Ferrule and Straight Silicone Boot to ensure that the connection is robust. It is recommended to use 7mm Ignition Wire but 16 AWG may be acceptable for shorted runs.
3. Connect Coil+ terminal on the External Coil to the Coil+ terminal on the PF2100F using 16 AWG (or thicker) wire.
4. Connect Coil- terminal on the External Coil to the Coil- terminal on the PF2100F using 16 AWG (or thicker) wire.
5. Connect the Kanthal Ignition Rod to the free High Voltage terminal on the External Coil. Use the included 90 degree Bakelite Connector to ensure that the connection is robust. 7mm Ignition Wire must be used.
6. Connect the other High Voltage terminal on the External Coil to one of the mounting screws on another 90 degree Bakelite Connector and 7mm Ignition Wire.
7. Using a multimeter, verify that the coil base plate and the Pilot Assembly are both securely connected to earth ground. If not, you may need to run a ground wire between them.
8. Adjust the Flame Rod positioning (bend it if necessary) so that 2 to 3" of the rod will be inside the pilot flame.
9. Adjust the Ignition Rod positioning (bend it if necessary) so that there is a 1/8 to 1/4" gap between the rod and the front of the pilot nozzle.

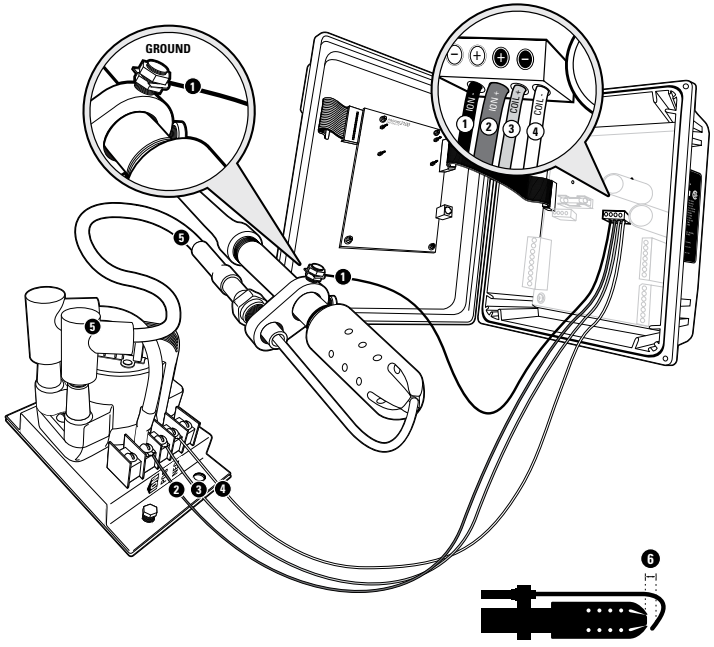


2.6.7 External Coil, Single Rod

Use this configuration when the PF2100F is >5m (15ft) from the flare and you want to save cost by using a single rod.

WIRING STEPS

1. Connect the Pilot Assembly ground screw to the PF2100F's Ion- terminal using a 16 AWG (or thicker) ground wire
2. Connect the Ion terminal on the External Coil to the Ion+ terminal on the PF2100F. It is recommended to use 7mm Ignition Wire but 16 AWG may be acceptable for shorted runs.
3. Connect the Coil+ terminal on the External Coil to the Coil+ terminal on the PF2100F using 16 AWG (or thicker) wire.
4. Connect the Coil- terminal on the External Coil to the Coil- terminal on the PF2100F using 16 AWG (or thicker) wire.
5. Connect the single Kanthal Rod to the free High Voltage terminal on the External Coil. Use the included 90 degree Bakelite Connector to ensure that the connection is robust. 7mm Ignition Wire must be used.
6. Use a 90˚ Bakelite connector and 7mm Ignition Wire to connect the other High Voltage terminal on the External Coil to the Ion terminal on the coil base plate.
7. Adjust the Kanthal Rod positioning (bend it if necessary) so that 2 to 3" of the rod will be inside the pilot flame and so that there is a 1/8 to 1/4" gap between the rod and the front of the pilot nozzle.



2.7 Optional Wiring

The wiring in this section of the document is optional.

2.7.1 Status Contact

The status contact is a dry contact output comprised of a solid state relay. It can be thought of as a switch which the PF2100F controls. Neither contact is internally connected to power or ground so these connections must be provided externally as required. When the system is running, the contacts are internally connected together and when the system is not running, the contacts are open circuited. These contacts are typically used for remote monitoring of the PF2100F's status. An alarm, siren, trouble lamp, or PLC are examples of devices that might be connected to this contact.

The status contacts are rated for DC only so it is important to observe the correct polarity when attaching an external device. The positive status contact terminal should always be at a voltage potential that is greater than or equal to the negative terminal. Be careful not to exceed the voltage and current ratings which are 40VDC, 250mA. The impedance when closed is15Ω. There is a fuse on the status contact to protect it.

A spare fuse is also included.

2.7.2 Dry Contact Inputs

There are 6 dry contact inputs on the PF2100F. The expected connection to each of these is a switch. These contacts must all be closed (shorted) in order for the system to start. Jumpers are provided for each of these by default. If you need to use a particular contact for your application, simply remove the associated jumper and connect a switch in its place.

START CONTACT

The Start Contact can be used to attach a remote start/stop switch. This is typically connected to a PLC dry contact output.

When the contact is open, the system is stopped. For safety reasons, a double action is required to start the system remotely via this contact. This is accomplished by closing the switch, opening it, and then closing it again. Once the system is running, simply open the switch again to stop it.

ESD CONTACT

The ESD Contact can be used to attach an emergency shutdown switch. This is typically connected to a mushroom switch mounted on a remote panel or to a PLC dry contact output.

When the contact is open, the system is stopped. The system cannot be started via this contact but this contact must be closed in order to start the system.

PROOF OF CLOSURE CONTACT

The Proof of Closure Contact is unused on the PF2100F. A main valve should not be connected to the system so there is no need for Proof of Closure.

HIGH PRESSURE CONTACT

The High Pressure Contact can be connected to a High Pressure Switch installed in the fuel train.

LOW PRESSURE CONTACT

The Low Pressure Contact can be connected to a Low Pressure Switch installed in the fuel train.

The Low Pressure Contact is time averaged to help reject brief fluctuations in gas pressure. The contact must be open continuously for 2 seconds before the system will shutdown. If "Auto Restart" is enabled, the system will restart automatically when the Low Pressure Contact recloses.

LEVEL CONTACT

The Level Contact can be connected to a Level Switch. This is used to signal when the level drops below a certain minimum.

The Level Contact is time averaged to help reject brief fluctuations in tank level which might be a result of vibration. The contact must be open continuously for 2 seconds before the system will shutdown.

2.7.3 4-20mA Temperature Output

The 4-20mA Output can provide the **highest** pilot temperature encoded as a 4-20mA signal. This is useful if a PLC on site needs to know the pilot temperature. In this case, wire the PF2100F's 4-20mA Output to a PLC's 4-20mA Input. Note that the PF2100F provides the loop power. The PLC resistance is expected to be in the range of 120 Ohms and 250 Ohms.

The 4-20mA output signal will be scaled such that 4mA represents OC and 20mA represents 1350°C.

2.7.4 Modbus Expansion Card

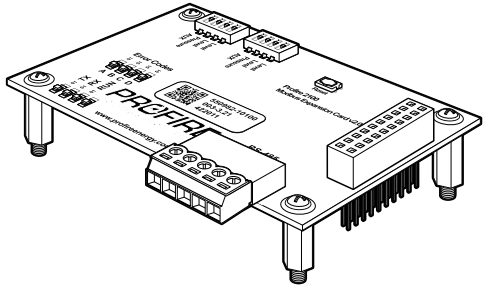
An optional Modbus Expansion Card can be installed in the PF2100F which provides the following additional features:

REMOTE MONITORING

This card allows for remote monitoring of the PF2100F status including process temperature, and pilot temperature.

REMOTE START / STOP

This card can also be used to remotely start and stop the system and to adjust some setpoint values.



MODBUS ***EXPANSION CARD***

Some PF2100F models come with this card pre-installed.

Refer to the "Modbus Expansion Card Manual" for further details on installation and operation of this card.

3 User Interface & Settings

The user interface is comprised of two parts: a physical interface (including things such as keys and indicator lights) and a software interface (including things such as menus and status screens).

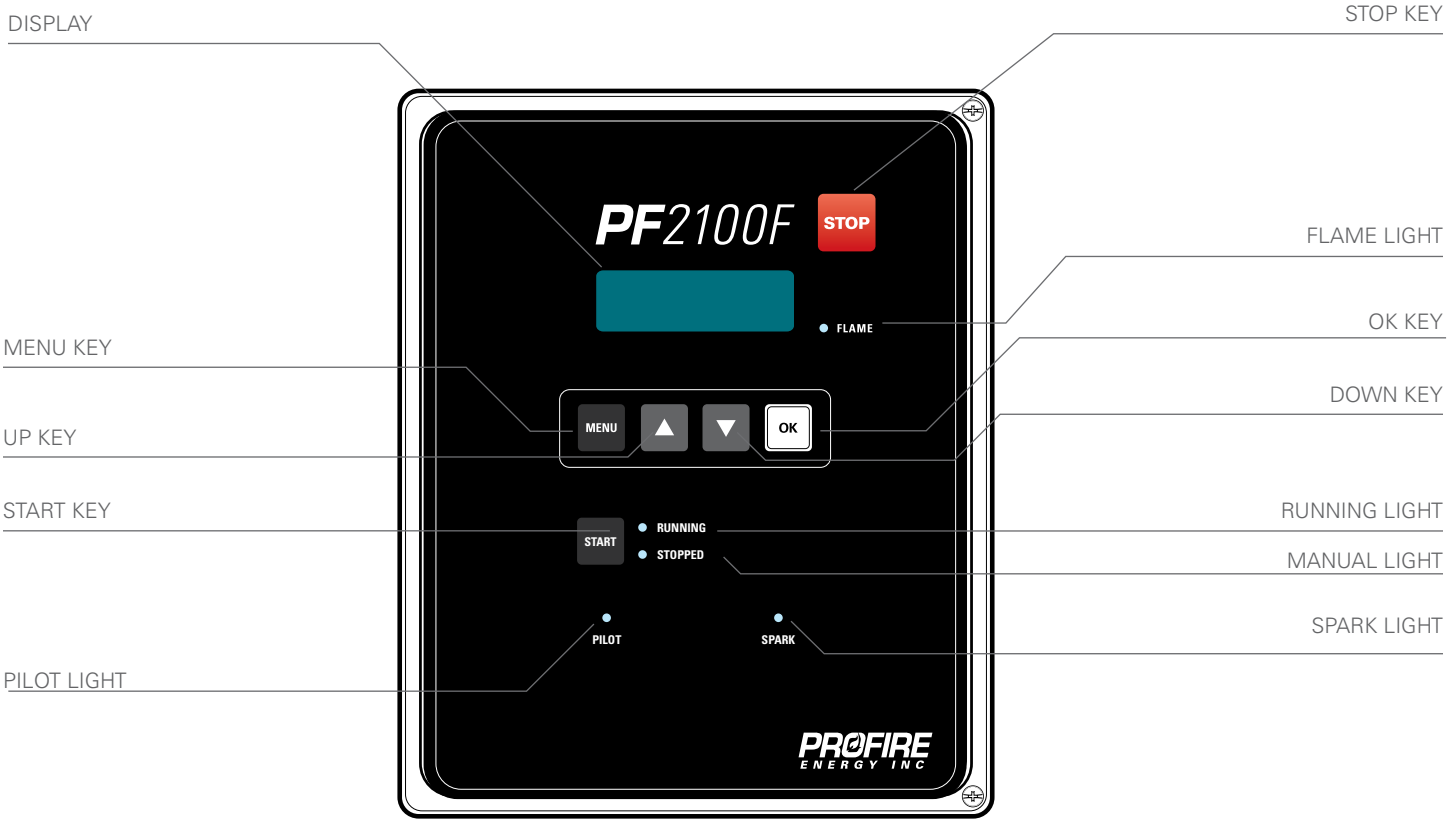
This section of the manual is organized into four sub-sections. The first two deal with the physical and software interfaces. At the end of the software interface sub-section is a menu map which is useful for quick reference. Following this is a table that provides summary information about each item in the menu map along with the location in the manual where more detailed information can be found. The next sub-section contains detailed information about all of the settings that can be adjusted and is organized alphabetically by topic. The final sub-section contains instructions on how to operate the system.

3.1 Hardware User Interface

The hardware user interface consists of three parts:

1. Indicator lights
2. A Keypad
3. An illuminated display

3.1.1 Keypad Diagram



3.1.2 Indicator Lights

FLAME LIGHT

Indicate s that the system is detecting the pilot flame.

RUNNING LIGHT

Indicates that the system is running in auto mode.

STOPPED LIGHT

Indicates that the system is stopped in manual mode.

PILOT LIGHT

Indicates that the pilot valve is open.

SPARK IGHT

Indicates that the system is sparking to ignite the pilot.

3.1.3 Keys

STOP KEY

Used to stop the system immediately or in other words, turn off the burner.

MENU KEY

Used to navigate through the menu.

UP KEY

Used to adjust a setting upwards and to scroll up through lists.

DOWN KEY

Used to adjust a setting downwards and to scroll down through lists.

OK KEY

Used to enter a menu, acknowledge a prompt, save an edited setting, or return to the home screen.

START KEY

Used to start the system and switch to Auto Mode.

PILOT KEY

Used to test the pilot valve while the system is stopped.

IGNITE KEY

Used to test the ignition coil while the system is stopped.

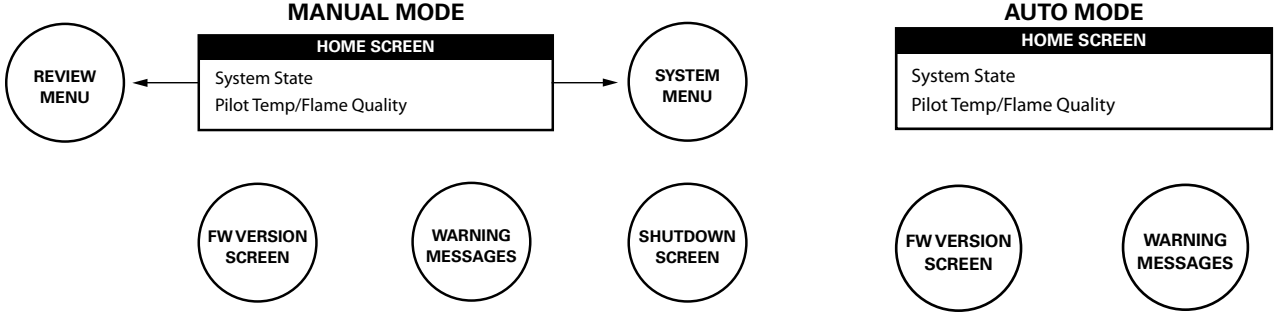
3.1.4 Display

The display on the PF2100F has two lines of text which are used to show system status, warnings, alarms, prompts, and menus. It is illuminated for ease of reading in both bright sunlight and dark locations. The display is the means through which the software user interface is presented.

When the system first powers on the display will show the system name and firmware version for a few seconds, after this it will show the Home Screen.

3.2 Software User Interface

The software user interface is shown on the PF2100F display. Through it, the state of the system is presented to the user. The user can also change settings via this interface. Below is a diagram showing the various types of information that can be accessed through the interface. Most items are accessed through what is known as the Home Screen whereas others can be accessed from anywhere in the interface. Some items are accessible in all modes whereas others can only be accessed in Manual Mode or only in Auto Mode. Each of these items will be discussed in further detail in the sub-sections that follow.



3.2.1 Manual vs. Auto Mode

When the system first powers on, it will normally be in Manual Mode. If the Auto Restart feature is enabled and no alarm conditions are present, it may switch automatically to Auto Mode after power up. Otherwise, the user must manually put the system into Auto Mode by using the Keypad, the Start Contact, or the Modbus Expansion Card. For further details on how to start the system, refer to section 3.5.1 (Starting the System).

In Manual Mode, an operator can manually open the pilot valve and spark the ignition coil using the PF2100F keypad. This can be used during commissioning to test the pilot valve and ignition coil, but it cannot be used for continuous operation.

In Auto Mode, the PF2100F performs its Flare Control Algorithm, which is the intended mode of operation.

3.2.2 Home Screen

The Home Screen is shown on the display after power up, after waking the display from sleep, and after the user acknowledges a shutdown message. It is the starting point for most user interaction with the menu system. To return to the Home Screen and log out from any point in the user interface, the user can press and hold the OK key for three seconds.

On the Home Screen, one of three values is always shown on the bottom line of the display, with System State always displayed on the top line:

1. Pilot Thermocouple 1 temperature
2. Pilot Thermocouple 2 temperature
3. Ionization flame quality

If the Pilot Thermocouple 1 input is an open circuit (i.e. no thermocouple connected) the system will display the Pilot Thermocouple 2 input. If this thermocouple is also an open circuit, the system will display the ionization flame quality.

3.2.3 System State

The System State is the Process Control State of the system. In both modes, the top line of the Home Screen always shows the System State.

3.2.5 System Menus

The System Menus store all of the system settings in an organized fashion. These menus are also used to show historical and system status information as well as to provide access to calibration features. These menus cannot be accessed while the system is running in Auto Mode. Some menus can only be accessed while the system is stopped. Some menus require a Level 2 password and others require an optional Level 1 password.

3.2.6 Review Menu

The Review Menu provides a quick way for an operator to check key setpoints and system status.

3.2.7 Firmware Version Screen

The Firmware Version Screen shows the firmware version of all cards in the system including the Door Card, Terminal Card, and any installed Expansion Cards.

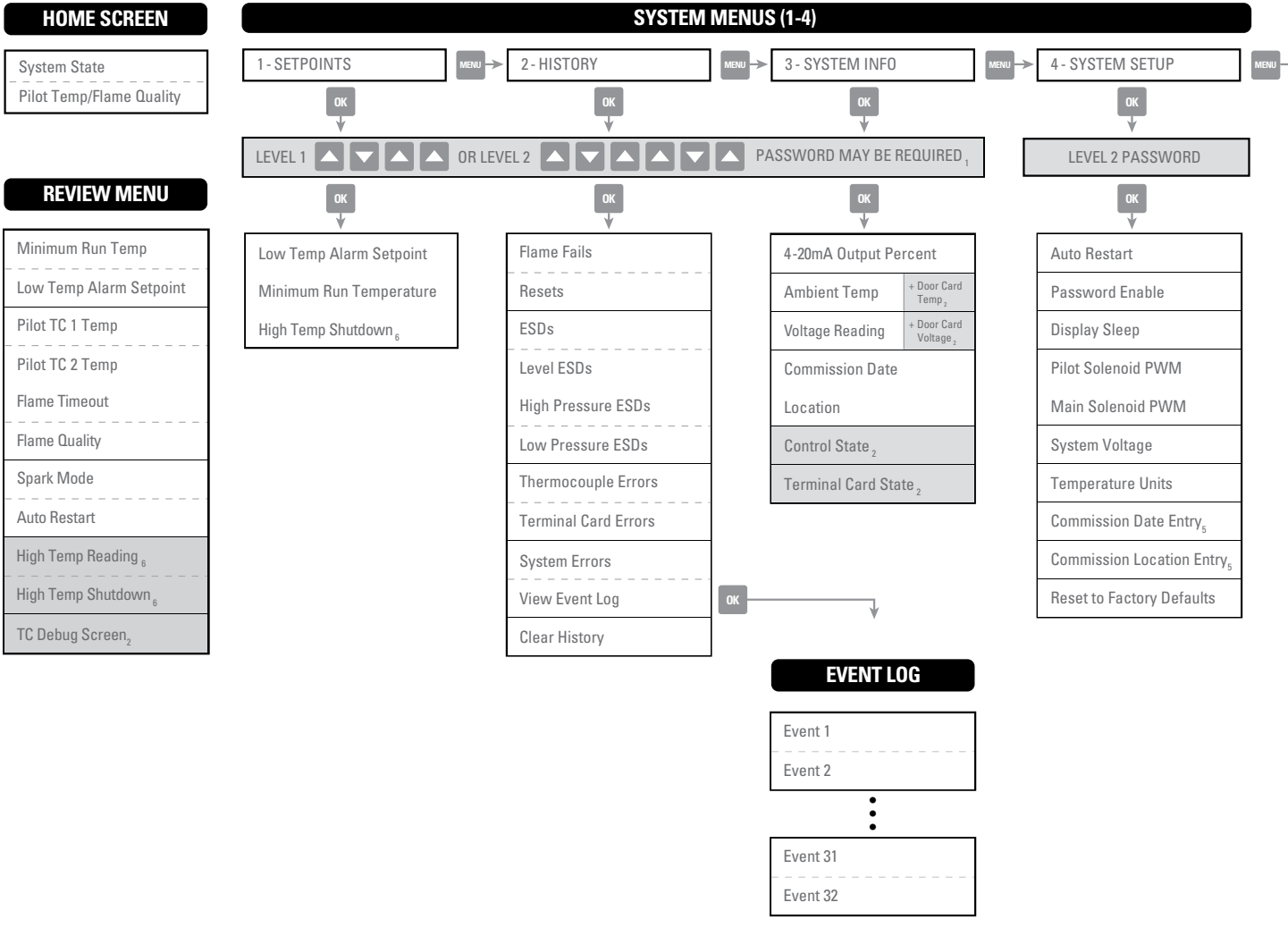
3.2.8 Warning Messages

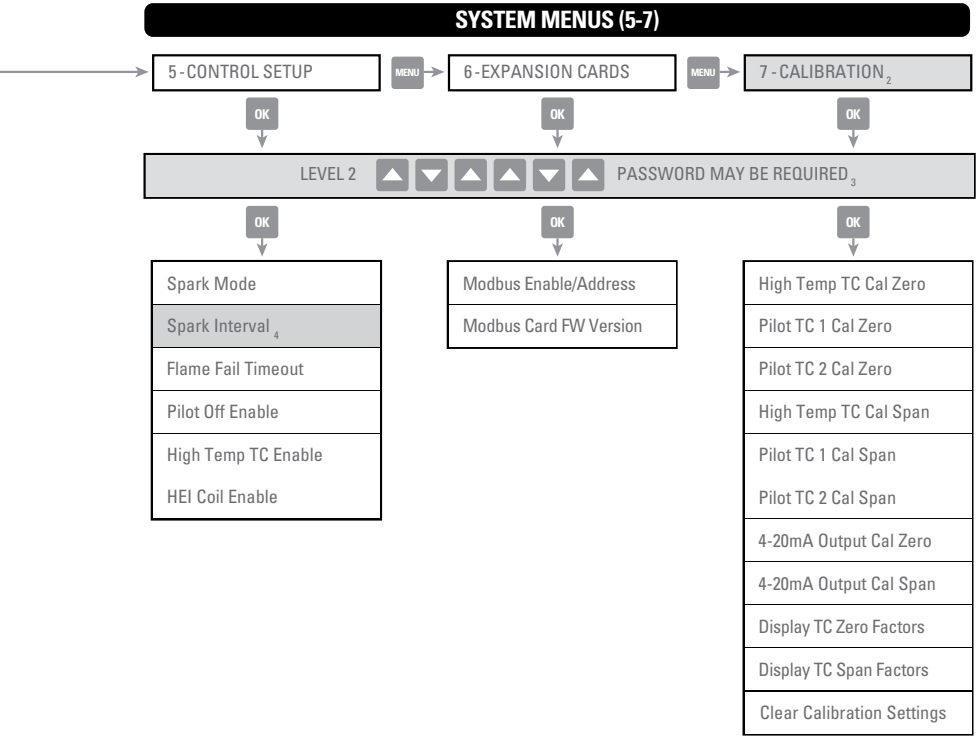
When the system detects a warning condition, it will flash a warning message across the bottom line of the Home Screen. Some messages can be dismissed by pressing the OK key (eg, "Unit restarted from PRS event"). Others persist until the warning condition is resolved (eg, "LO Volt Warning").

3.2.9 Shutdown Screen

When the system shuts down as a result of an alarm condition, it will flash the word "SHUTDOWN" in large text on the display alternately with a more detailed message explaining the reason that the system shut down. The Shutdown Screen can always be dismissed by pressing OK, toggling the Start Contact, or sending the Start Command via Modbus.

3.3 Menu Map


HOME SCREEN
System State
Pilot Temp/Flame Quality
REVIEW MENU
Minimum Run Temp
Low Temp Alarm Setpoint
Pilot TC 1 Temp
Pilot TC 2 Temp
Flame Timeout
Flame Quality
Spark Mode
Auto Restart
High Temp Reading 6
High Temp Shutdown 6
TC Debug Screen 2
SYSTEM MENUS (1-4)
1 - SETPOINTS
MENU
2 - HISTORY
MENU
3 - SYSTEM INFO
MENU
4 - SYSTEM SETUP
MENU
OK
LEVEL 1
OR LEVEL 2
PASSWORD MAY BE REQUIRED 1
LEVEL 2 PASSWORD
Low Temp Alarm Setpoint
Minimum Run Temperature
High Temp Shutdown 6
Flame Fails
Resets
ESDs
Level ESDs
High Pressure ESDs
Low Pressure ESDs
Thermocouple Errors
Terminal Card Errors
System Errors
View Event Log
Clear History
4-20mA Output Percent
Ambient Temp
+ Door Card Temp 2
Voltage Reading
+ Door Card Voltage 2
Commission Date
Location
Control State 2
Terminal Card State 2
Auto Restart
Password Enable
Display Sleep
Pilot Solenoid PWM
Main Solenoid PWM
System Voltage
Temperature Units
Commission Date Entry 5
Commission Location Entry 5
Reset to Factory Defaults
EVENT LOG
Event 1
Event 2
Event 31
Event 32



SCREEN	NAVIGATION	ADJUSTMENTS
HOME SCREEN (AUTO)	▲▼ TO ENTER REVIEW	N/A
HOME SCREEN (MANUAL)	MENU ▲▼ TO ENTER REVIEW	N/A
REVIEW	▲▼ TO CYCLE OK TO RETURN HOME	N/A
EVENT LOG	▲▼ TO CYCLE OK TO RETURN HOME	N/A
SYSTEM MENUS	MENU TO CYCLE OK TO RETURN HOME	▲▼ TO ADJUST OK TO ACCEPT MENU TO CANCEL
ANY	START TOGGLES MODES (AUTO/MANUAL) ▲+▼ CHECK FIRMWARE VERSIONS & ENTER DEBUG MODE OK PRESS AND HOLD FOR 3s TO EXIT DEBUG MODE, LOCK MENUS AND RETURN HOME	N/A

FOOTNOTES

1 Required if enabled in Menu 4 and password has timed out
2 Viewable in Debug Mode
3 Required if password has timed out
4 Hidden if Spark Mode is set to "Until Flame"
5 Edit fields using arrow keys. Advance fields using OK
6 Visible if High Temp TC is enabled

3.3.1 Setpoints (MENU 1)

This menu is used to adjust the Process Control Setpoints.

MENU MAP	ON SCREEN	BRIEF DESCRIPTION	RANGE	DEFAULT SETTING	SECTION
Low Temp Alarm Setpoint	Low Alarm Temp	The Status Contact will close if the system is running and either Pilot Temperature exceeds this value	0 to 1349˚C (32 to 2460˚F)	200˚C (392˚F)	3.4
Minimum Run Temperature	Minimum Run Temp	If either Pilot Temperature is greater than this setpoint, a flame is detected.	1 to 1349˚C (34 to 2460˚F)	600˚C (1112˚F)	3.4
High Temp Shutdown Temperature	High Temp Shutdown	If enabled, the system will immediately shut down if the High Temp reading exceeds this value	1 to 1350˚C (34 to 2462˚F)	1350˚C (2462˚F)	3.4

3.3.2 History (MENU 2)

This menu contains read only event counters and the event log.

MENU MAP	ON SCREEN	BRIEF DESRIPTION	RANGE	DEFAULT SETTING	SECTION
Flame Fails	Flame Fails	Number of Shutdowns due to failure to light the pilot.	0 to 1000	N/A	3.5
Resets	Resets	Number of power failures or manual resets.	0 to 1000	N/A	3.5
ESDs	ESDs	Number of system shutdowns caused by faults.	0 to 1000	N/A	3.5
High Pressure ESDs	HPR ESDs	Number of High Pressure Shutdowns.	0 to 1000	N/A	3.5
Low Pressure ESDs	LPR ESDs	Number of Low Pressure Shutdowns.	0 to 1000	N/A	3.5
Level ESDs	LVL ESDs	Number of Level Contact Shutdowns.	0 to 1000	N/A	3.5
Thermocouple Errors	Open TCs	Number of Thermocouple Shutdowns.	0 to 1000	N/A	3.5
Terminal Card Errors	Term Errs	Number of Terminal Card Shutdowns.	0 to 1000	N/A	3.5

3.3.2 History (MENU 2) Continued...

MENU MAP	ON SCREEN	BRIEF DESRIPTION	RANGE	DEFAULT SETTING	SECTION
System Errors	Sys Errs	Number of System Errors Shutdowns.	0 to 1000	N/A	3.5
View Event Log	View Events?	Log of recent events.	Yes/No	No	3.5
Clear History	Clear History?	Clears all History and logged events.	Yes/No	No	3.5

3.3.3 System Info (MENU 3)

This menu contains read only information about the system.

MENU MAP	ON SCREEN	BRIEF DESCRIPTION	RANGE	DEFAULT SETTING	SECTION
4-20mA Output Percent	4-20 Output	Current status of the 4-20mA Output	0 to 100%	N/A	3.4, 4.2
Ambient Temperature Reading	Ambient Temp	Current ambient temperature. Used for thermocouple cold junction compensation.	-55˚C to 65˚C (-70˚F to 150˚F)	N/A	2.6
Voltage Reading	System Voltage	Current voltage applied to the system	8V to 35V	N/A	3.4
Commision Date	Commission Date	Date that the system was commissioned	DD-MMM-YYYY	N/A	3.4
Location	Location	The install location of the system (if entered by user)	N/A	N/A	3.4
Control State	Control State	Debug Information	N/A	Hidden	
Terminal Card State	Term Card	Debug Information	N/A	Hidden	

3.3.4 System Setup (MENU 4)

This menu contains various optional system settings. It cannot be accessed while the PF2100F is running.

MENU MAP	ON SCREEN	BRIEF DESCRIPTION	RANGE	DEFAULT SETTING	SECTION
Auto Restart	Auto Restart	Enables system to restart from a power failure, low pressure, or high voltage event	On/Off	Off	3.4
Password Enable	Password	Enables Password Protection (Menu 1-3)	On/Off	Off	3.4
Sleep Mode for the Display	Display Sleep	Enable Sleep Mode for the Display	Never, After 10 MIn	Never	3.4
Pilot Valve Power Setting	Pilot Solenoid PWM	Adjusts the Pilot Valve PWM duty cycle	20%, 40%, 60%, 100%	60%	3.4
Main Valve Power Setting	Main Solenoid PWM	Adjusts the Main Valve PWM duty cycle	20%, 40%, 60%, 100%	60%	3.4
System Voltage Setting	System Voltage	Configures the expected input voltage for the system	12V, 24V	12V	3.4
Temperature Display Units	Temp Units	Configures the temperature units displayed by the system	Fahrenheit, Celsius	Celsius	3.4
Commission Date Entry	Commission Date	Set the date that the system was commissioned	DD-MMM-YYYY	01-JUN-2012	3.4
Commission Location Entry	Commission Loc	Set the install location of the system. 14 Characters Max.	A-Z, 0-9 -. /		3.4
Reset to Factory Defaults	Restore Factory Defaults?	Restore all settings to the factory default	Yes/No	No	3.5

3.3.5 Control Setup (MENU 5)

This menu contains various settings for controlling flare behaviour

MENU MAP	ON SCREEN	BRIEF DESCRIPTION	RANGE	DEFAULT SETTING	SECTION
Spark Mode	Spark Mode	Adjusts the system's behavior for sparking its ignition coil	Spark < Pilot SP, Continuous	Spark < Pilot SP	3.4
Spark Interval with Detected Flame	Spark Interval	Adjusts the time between ignition coil sparks when a flame is detected, and the Spark Mode is set to Always.	30- 600 sec	Hidden, 30 sec	3.4
Flame Fail Timeout	Flame Fail Timeout	Adjusts how long the system attempts to ignite or re-ignite before shutting down.	Disabled, 1 to 120n	2m	3.4
Pilot Off Enable	Pilot Off	Enables Pilot Off feature	Disabled/ Enabled	Enabled	3.4
High Temp TC Enable	High Temp TC	Enables the High Temperature Thermo-couple for shutdown	Disabled/ Enabled	Disabled	3.4

3.3.6 Expansion Cards (MENU 6)

This menu contains settings relating to expansion cards.

MENU MAP	ON SCREEN	BRIEF DESCRIPTION	RANGE	DEFAULT SETTING	MORE INFO
Modbus Card Enable and Address Selection	Modbus Card	Enable control and set an address for the Modbus Expansion Card	Disabled, 1 to 254	Disabled	3.4
Modbus Card Firmware Version	MBUS FW	Display Modbus Expansion Card firmware version	N/A	N/A	3.4

3.3.7 Calibration (MENU 7)

This menu is used to adjust the calibration of thermocouples, 4-20mA Output, and 4-20mA Expansion Card inputs. This menu is hidden by default.

MENU MAP	ON SCREEN	DESCRIPTION	RANGE	DEFAULT SETTING	SECTION
Calibrate High Temp TC Zero Point	Cal Proc TC Zero?	Calibrate High Temp Thermocouple zero point by shorting the input	Yes/No	No	3.5
Calibrate Pilot TC 1 Zero Point	Cal: Pilot 1 Temp TC Zero?	Calibrate Pilot 1 Thermocouple zero point by shorting the input	Yes/No	No	3.5
Calibrate Pilot TC 2 Zero Point	Cal: Pilot 2 Temp TC Zero?	Calibrate Pilot 2 Thermocouple zero point by shorting the input	Yes/No	No	3.5
Calibrate High Temp TC Span	Cal: High Temp TC	Calibrate High Temp Thermocouple span point by applying a calibrated reference then adjusting the on-screen reading.	N/A	N/A	3.5
Calibrate Pilot TC 1 Span	Cal: Pilot 1 Temp TC =	Calibrate Pilot 1 Thermocouple span point by applying a calibrated reference then adjusting the on-screen reading.	N/A	N/A	3.5
Calibrate Pilot TC 2 Span	Cal: Pilot 2 Temp TC =	Calibrate Pilot 2 Thermocouple span point by applying a calibrated reference then adjusting the on-screen reading	N/A	N/A	3.5
Calibrate 4-20mA Output Zero	Cal: 4-20 Low Adj for 4mA	Calibrate 4-20mA Output zero point by adjusting output until multimeter reads 4mA	N/A	N/A	3.5
Calibrate 4-20mA Output Span	Cal: 4-20 Hi Adj for 20mA	Calibrate 4-20mA Output span by adjusting output until multimeter reads 20mA	N/A	N/A	3.5
Display Thermocouple Calibration Zero Factors	Cal Factors Zero	Thermocouple calibration zero point information for debug	N/A	N/A	3.5
Display Thermocouple	Cal Factors Span	Thermocouple calibration span information	DD-MM-MM-YYYY	01-JUN-2012	3.5
Calibration Span Factors		for debug			

3.3.7 Calibration (MENU 7) Continued...

MENU MAP	ON SCREEN	DESCRIPTION	RANGE	DEFAULT SETTING	SECTION
Clear Calibration Setting	Clear All CAL Settings?	Restore all calibration settings to their factory defaults	Yes/No	No	3.5.8

3.3.8 Review Menu

This read only menu allows various commonly needed system settings and status parameters to be reviewed while the system is running.

MENU MAP	ON SCREEN	BRIEF DESCRIPTION	RANGE	DEFAULT SETTING	SECTION
Minimum Run Temperature	Run Temp		N/A	N/A	3.4
Low Temp Alarm Setpoint	Alarm Temp		N/A	N/A	3.4
Pilot TC 1 Temperature	Plt1 Temp		N/A	N/A	3.4
Pilot TC 2 Temperature	Plt2 Temp		N/A	N/A	3.4
Flame Fail Timeout	FlamTimeout		N/A	N/A	3.4
Ionization Flame Quality	FlamQuality		N/A	N/A	3.4
Spark Mode	Spark		N/A	N/A	3.4
Auto Restart	Auto Restart		N/A	N/A	3.4
High Temp TC Reading	High Temp		N/A	N/A	3.4
High Temp ESD Setpoint	HT ESD		N/A	N/A	3.4

3.4 Settings (Grouped Alphabetically)

This section of the document contains detailed descriptions of all system settings organized alphabetically by topic.

Not all settings need to be modified for a given installation. The settings that need to be modified for every installation are these:

1. Valve Modulation Settings
2. System Voltage Setting
3. Process Control Settings
4. Process Setpoints (High Temp ESD, Minimum Run Temp, Low Temp Alarm)

3.4.2 4-20mA Output Settings

The 4-20mA Output is built into the Terminal Card and can be used to echo the Pilot temperature to the PLC. The 4-20mA Output encodes the pilot thermocouple signal as a 4-20mA signal. The signal is scaled so that 4mA = 0°C and 20mA = 1350°C.

3.4.5 Commissioning Settings

The date and location of commissioning can be stored in the PF2100F. This information is optional and is purely for the customer's use. These two settings can be viewed in menu 3 and edited in menu 4.

COMMISSION DATE (MENU 4)
This is the date on which the PF2100F was commissioned. Use the Up and Down keys to edit the date and OK to advance to the next date field.

COMMISSION LOCATION (MENU 4)
This is the location where the PF2100F was installed. Use the Up and Down keys to edit each character and OK to advance to the next character.

3.4.6 Display Settings

There are two settings that affect the behavior of the display: Display Sleep and Temperature Display Units.

DISPLAY SLEEP (MENU 4)
When enabled, the display will turn off to conserve power after 10 minutes of inactivity (no user key presses). Otherwise, the display will always remain on.

TEMPERATURE DISPLAY UNITS (MENU 4)
The PF2100F always operates in Celsius. This includes storage of temperature setpoints, thermocouple measurements, temperature calculations, and modbus communications. This setting only affects the temperature units on the display. This may lead to small rounding errors when operating in Fahrenheit.

3.4.7 Modbus Expansion Card Settings

This setting all applies to the Modbus Expansion Card which must be installed in the PF2100F's expansion slot.

MODBUS ENABLE/ADDRESS (MENU 6)
The Modbus Card is disabled by setting the address to zero and enabled by setting the address to any non-zero value. The address is shown on the display as a decimal number which can be set to any value in the range of 1 to 254. This corresponds to hexadecimal values 0x01 to 0xFE.

3.4.8 Password Setting

There are two levels of password protection. Menus 1-3 may be optionally protected by the Level 1 Password. Menus 4-7 are always protected by the Level 2 Password. These passwords can not be modified.

Level 1 Password △ ▽ △ △ OK

Level 2 Password △ ▽ △ △ ▽ △ OK

For convenience, once a password has been entered it unlocks all menus that it protects for a period of time. Therefore it does not need to be re-entered again when returning to the menu later. The menus will remain unlocked for 10 minutes or until the user manually locks the menus again. To lock the menus manually, press and hold the OK button for 3 or more seconds. The display will briefly show "Password Logout" to indicate that the menus are now locked again.

PASSWORD ENABLE (MENU 4)
When enabled, the Level 1 or Level 2 Password must be entered to access menus 1-3 and the Quick Setpoint Adjust feature.

3.4.9 Flare Control Settings

For the PF2100F, Flare Control refers to controlling the temperature of the flare. The Flare Control algorithm requires a Pilot Temperature control signal for this control.

There are four settings that affect the behavior of the Flare Control Algorithm:

1. Pilot Off
2. Flame Fail Timeout
3. Spark Mode
4. Spark Interval

PILOT OFF (MENU 5)
By default, when the Pilot Temperature reaches the Minimum Run Temp, the pilot valve remains open. When the Pilot Off setting is enabled and the Minimum Run Temp setpoint is reached, the pilot valve closes after a 5 second delay. If the Pilot Temperature drops below the setpoint, the pilot valve will immediately re-open

SPARK MODE (MENU 5)
The PF2100F supports two sparking modes:

- **Until Flame**

In this mode, the PF2100F will only spark the ignition coil when there is no flame detected

- **Always**

In this mode, the PF2100F will always spark the ignition coil, regardless of whether or not a flame is detected. The Spark Interval allows to frequency of sparking to be reduced once a flame is detected.

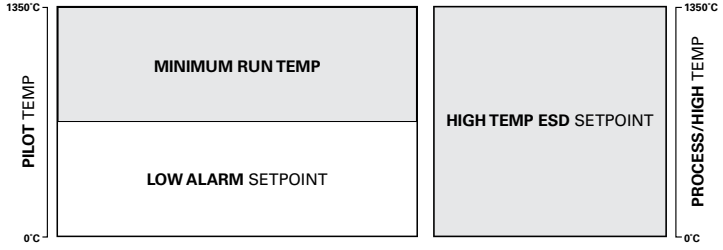
FLAME FAIL TIMEOUT (MENU 5)
When the PF2100F is started, if a flame is not detected within the Flame Fail Timeout period, the system will shut down. Similarly, if the flame is lost during operation and is not relit within this period, the system will shut down.

This period can be adjusted from 1 minute to 2 hours, but it can also be set to "Never" and disabled entirely. With the timeout disabled, the PF2100F will continue its Flare Control and spark indefinitely even if a flame is never detected.

SPARK INTERVAL (MENU 5)
When the PF2100F is in the Continuous spark mode, the delay between sparks when a flame is detected can be adjusted through this setting. The ignition coil sparks for a fixed 2 second period, but the time between these sparks can be adjusted between 8 seconds (default value) and 1 minute. Increasing this time can help reduce the wear on the ignition coil in the continuous spark mode.

3.4.10 Setpoints

The PF2100F uses three setpoints. The following diagram illustrates the upper and lower bounds of each setpoint:



HIGH TEMP ESD SETPOINT (MENU 1)
This setpoint is used to protect the flare and other equipment from overheating. If the High Temp TC is enabled and its temperature goes above this setpoint, the system will immediately shut down.

MINIMUM RUN TEMP (MENU 1)
This setpoint defines the Pilot Temperature that the PF2100F considers an indicator of flame. If either Pilot Thermocouple measures a temperature higher than this setpoint, the PF2100F operates assuming a detected flame.

This setting must be set to at least 1˚C higher than the Low Alarm Setpoint.

LOW ALARM SETPOINT (MENU 1)
If the Pilot Temperature falls below this setpoint, the status contact will open and the Flame LED will remain off. Between this setpoint and the Pilot TC Setpoint, the Flame LED will blink.

3.4.11 Restart Settings

The PF2100F can be configured to automatically restart after certain alarm conditions clear.

When the system restarts, it will continuously attempt to ignite until a flame is detected for the duration of the "Flame Timeout" period.

AUTO RESTART (MENU 4)
If this setting is enabled, the system will restart automatically once all alarm conditions are cleared and if the reason that the system stopped running was any of the following:

1. System Input Voltage too low (including power cycle)
2. System Input Voltage too high
3. Low Pressure Contact open

3.4.12 System Voltage

The PF2100F is designed to operate with a nominal 12VDC or 24VDC Power Supply. It will not be damaged by applying any voltage in or near this range regardless of menu settings. The valves attach to the PF2100F are not designed to accept both 12VDC and 24VDC. They typically only work with one or the other. If the valve voltage ratings are exceeded, the valves may become damaged.

SYSTEM VOLTAGE SETTING (MENU 4)
The purpose of this setting is to select voltage limits to protect and ensure the proper operation of the attached valves. If the PF2100F detects that the input voltage is getting close to these limits, it will present a warning message on the display. If the voltage exceeds these limits, it will shut down which cuts power to the valves to prevent them from being damaged.

The following options are available:

VOLTAGE SETTING	CHOOSE THIS OPTION WHEN...
12V	The Power Supply and all valves are 12VDC
24V	The Power Supply and all valves are 24VDC

The exact limits used are shown in the following table. Note that the high voltage limits also depend on the "Pilot Valve Power Setting" and "Main Valve Power Setting" which can also be found in Menu 4.

VOLTAGE SETTING	PILOT PWM SETTING	LOW VOLT ALARM	LOW VOLT WARNING	HIGH VOLT WARNING	HIGH VOLT ALARM
12V	100%	<= 8.4V	<= 9.9V	>= 14.6V	>= 15.6V
12V	< 100%	<= 8.4V	<= 9.9V	>= 16.1V	>= 16.8V
24V	100%	<= 17.9V	<= 19.9V	>= 28.6V	>= 30.0V
24V	< 100%	<= 17.9V	<= 19.9V	>= 33.1V	>= 40.0V

Note that if the system has the "Auto Restart" feature enabled (Menu 4), the system will automatically relight the flare after a high or low voltage alarm clears. Otherwise, the system will remain shut down.

3.4.14 Valve Modulation Settings

The valve outputs can be modulated with a pulsed DC signal to conserve power through a technique known as Pulse Width Modulation (PWM). The duty cycle of the modulation can be adjusted independently for each valve. Each can be set to 100%, 60%, 40%, or 20%. The 100% setting applies continuous DC voltage (ie, no modulation) to the valve and is the highest power option. The 20% setting applies DC voltage only 20% of the time and is the lowest power option. Only valves that are compatible with modulation should be used with a duty cycle less than 100%. These valves are sometimes called "Low Power" or "Peak-and-Hold" valves since they require only short periodic voltage pulses to hold the valve open. Do not use a duty cycle of 100% with low power valves as this can damage them. Likewise, do not use a duty cycle of 20% with a High Power valve as it will not work properly.

If a multimeter is used to measure the valve power, the measured voltage will be reduced proportionally with the PWM setting.

There are two valve power settings that can be adjusted to match the needs of various applications. These are as follows:

PILOT VALVE POWER SETTING (MENU 4)
Adjusts the PWM Duty Cycle of the Pilot Valve output.

MAIN VALVE POWER SETTING (MENU 4)
Adjusts the PWM Duty Cycle of both the Low Fire and High Fire Valve outputs.

3.5 Operating the System

This section of the manual describes how to operate the system including how to start and stop it in various ways, how to review key system settings, how to adjust setpoints while the system is running, how to check the system firmware versions, how to reset the system settings to defaults, and how to manually calibrate the various inputs and outputs.

3.5.1 Starting the System

There are five different ways to start the system:

MANUALLY VIA THE START & OK KEYS
This is the most common way to start the system.

The steps to do this are as follows:

1. Ensure that the system is stopped in Manual Mode with all alarms clear so that the Home Screen displays "Ready".
2. Press the Start Key and the system's process control algorithm will take over to turn the valves on and off as required by the systems settings and the current flame detection status. The system will also be in Auto Mode which will allow the system to automatically restart from faults specified in the system settings.

MANUALLY VIA THE PILOT AND IGNITE KEYS
This method of starting the system is useful primarily during commissioning when it may be desired to test the pilot valve, main valve, ignition circuit, and flame detection circuitry in a slow sequence.

The steps to do this are as follows:

1. Ensure that the system is stopped in Manual Mode with all alarms clear so that the Home Screen displays "Ready".
2. Press and hold the Pilot Key to open the Pilot Valve. Listen to ensure that you can hear the Pilot Valve click open and that you can hear the hiss of gas flowing through it.
3. While continuing to hold the Pilot Key, press and hold the Ignite Key to being sparking. Visually check the Pilot Nozzle for spark and flame. If you cannot see the Pilot Nozzle, listen for the sound of sparking and try to determine if it is coming from the ignition rod or from some other unintended location.
4. Continue holding the two keys with the Flame LED lights showing that a flame is detected.
5. Release both keys to stop the system.

AUTOMATICALLY WHEN POWER IS APPLIED
If the Auto Restart feature is enabled, the system will attempt to Automatically Start after a power failure. This will only succeed if all alarms are clear.

REMOTELY VIA THE START CONTACT

This method can be used to start the system from a remote switch mounted elsewhere on the site or via a PLC output contact.

The steps to do this are as follows:

1. Open the Start Contact and then close it again to acknowledge any Shutdown Message that may be showing on the display. If no Shutdown Message is present, it is not required to do this but it will still work if you do.

2. Repeat the step above once to remotely start the system in Auto Mode. This will only work if all alarms are clear.

REMOTELY VIA THE MODBUS CARD (IF INSTALLED)

This method can be used to start the system via a remote device over a Modbus RTU network.

The steps to do this are as follows:

1. The remote device should write "1234" to the 40100 register to place the system into Auto Mode.

2. The remote device should poll the 40100 register and wait for it to clear to zero which indicates that the system has processed the command.

3. The remote device should poll the 10001 register and wait for it to become set to one which indicates that process control is running.

3.5.2 Stopping the System

There are five different ways to stop the system:

MANUALLY VIA THE STOP KEY
This is the most common way to stop the system.

The steps to do this are as follows:

1. Press the Stop key. The system will stop immediately and display a shutdown message reading "User Stop"

REMOTELY VIA THE START CONTACT
This method can be used to stop the system from a remote switch mounted elsewhere on the site or via a PLC output relay

The steps to do this are as follows:

1. Open the Start Contact and leave it open. The system will stop immediately.

VIA A SHUTDOWN CONDITION
Whenever any shutdown condition is present, the system will stop and will not automatically restart after the condition is removed. Examples of conditions that cause a Shutdown include the Process Temperature rising above the High Temp ESD Setpoint, the High Pressure Contact Opening, or the ESD Contact Opening. Many other conditions can cause shutdowns. Some are dependent on system settings.

REMOTELY VIA THE MODBUS CARD (IF INSTALLED)
This method can be used to stop the system via a remote device over a Modbus RTU network.

The steps to do this are as follows:

1. The remote device should write "4321" to the 40100 register to stop the system.

2. The remote device should poll the 40100 register and wait for it to clear to zero which indicates that the system has processed the command.

3. The remote device should poll the 10001 register and wait for it to become set to zero which indicates that the system is stopped.

3.5.3 Adjusting Settings & Reviewing Status

There are four ways to check and adjust system settings and to view system status:

HOME SCREEN
The Home Screen displays the System State and the Pilot Temperature. The information displayed on the Home Screen is read only. The Home Screen is accessible at any time by pressing and holding the OK Key for 3 seconds.

REVIEW MENU
The Review Menu is used to check key setpoints and to view various real time system measurements such as temperature. All information in this menu is read only. To access it, press the Up or Down Key while on the Home Screen.

SYSTEM MENUS
Menus 1, 4, 5, and 6 are used for checking and adjusting settings. Menus 2 and 3 are used for read only values. Menu 7 is used for calibration and is usually hidden. The System Menus are accessed by pressing the Menu Key from the Home Screen while in Manual Mode. System menus are not accessible while the system is running.

Menu 3 contains some system status information that is not found elsewhere in the menu system. Refer to section 3.3.3 (System Info) for more details.

When the system is stopped, all settings can be checked and adjusted. When the system is running, only some settings can be checked through the Review Menu, and none of the settings can be adjusted. The following table illustrates the circumstances under which various settings can be checked and adjusted. For more information about the menu system and the user interface, refer to section 3.2 (Software User Interface).

MODE	HOME SCREEN	REVIEW MENU AVAILABLE	SYSTEM MENUS AVAILABLE
System Stopped	System State Pilot Temperature/ Ionization	Yes	1-6 (and sometimes 7)
System Running	System State Pilot Temperature/ Ionization	Yes	None

3.5.4 Viewing Event Counters

Menu 2 contains a series of counters that increment automatically in response to various events. These counters can be used to troubleshoot issues with a particular installation. Each counter will count to a maximum of 1000 and then will stop incrementing. At the bottom of Menu 2 is an option to clear these counters. Clearing the counters also clears the event log.

ESDs

Increments each time the system shuts down as a result of the ESD Contact opening, the High Temp ESD Setpoint being exceeded by either Pilot Temp or High Temp (if enabled), or a high or low voltage alarm.

HIGH PRESSURE ESDs

Increments each time the system shuts down as a result of the High Pressure Contact opening.

LEVEL ESDs

Increments each time the system shuts down as a result of the Level Contact opening.

LOW PRESSURE ESDs

Increments each time the system shuts down as a result of the Low Pressure Contact opening.

THERMOCOUPLE ERRORS

Increments each time the system shuts down as a result of a thermocouple issue such as a short circuit, open circuit, or ground short.

RESETS

Increments each time the door card is reset by a power loss or by manually pressing the reset button.

SYSTEM ERRORS

Increments each time the system shuts down as a result of an internal system error.

TERMINAL CARD ERRORS

Increments each time the system shuts down as a result of a terminal card error.

3.5.5 Viewing the Event Log

The Event Log can be accessed from the end of Menu 2. The log contains entries for various types of events such as, System Starts, Stops, Shutdowns, Menu Accesses, etc. The log holds a maximum of 32 events. The first event (#1) is the most recent and the last event (#32) is the oldest.

When the log is full, the oldest event is removed from the list to make room for the next newest event. Navigate through the log using the up and down arrow keys. Press OK to return to the Home Screen. The log can be cleared using the item at the end of Menu 2. Clearing the log also resets all event counters to zero.

The following is an alphabetical list of all possible Event Log entries including a brief description of their meaning and the associated counter which will increment when that event occurs:

ENTRY	DESCRIPTION	ASSOCIATED COUNTER
AUTO	The system switched to Auto Mode because the user pressed the MODE and OK button.	
AUX ESD	The "Aux Temp Mode" setting is set to "Temp ESD" and the Aux Temp signal exceeded the "Aux Setpoint".	ESDs
ESD	The system shut down as a result of the ESD contact being open.	ESDs
FLAME FAIL	The pilot went out and could not be relit automatically within the specified number of attempts (3 attempts on initial start; user defined for other cases).	Flame Fails
HI PRS ESD	The system shut down because the High Pressure Contact was opened or the "4-20mA High Pressure Setpoint" was exceeded.	High Pressure ESDs
HI VOLT	The system input voltage exceeded the High Voltage Alarm threshold.	ESDs
HT ESD	The "High Temp ESD Setpoint" was exceeded by either "Proc Temp" or "Aux Temp" (if enabled) and caused the system to shutdown.	ESDs
LEVEL ESD	The system shut down because the Level Contact was opened or the "4-20mA Low Level Setpoint" was dropped below.	Level ESDs
LO PRS ESD	The system shut down because the Low Pressure Contact was opened or the "4-20mA Low Pressure Setpoint" was dropped below.	Low Pressure ESDs

3.5.5 Viewing Event Log Continued...

ENTRY	DESCRIPTION	ASSOCIATED COUNTER
LO VOLT	The system input voltage dropped below the Low Voltage Alarm threshold.	ESDs
LOW ALARM	The "Proc Temp" signal dropped below the "Low Temp Alarm Setpoint".	
MANUAL	The system switched to Manual Mode because the user pressed the MODE button.	
MENU:CTL	Menu 5 "Control" was entered. This will show even if no settings are modified.	
MENU:SETPT	Menu 1 "Setpoints" was entered. This will show even if no settings are modified.	
MENU:SYS	Menu 4 "System" was entered. This will show even if no settings are modified.	
POC STOP	The "Proof of Closure Contact" was open when it should not have been causing the system to shutdown.	
RELIGHT	The pilot was successfully relit after it went out unexpectedly.	Relights
RESET	The system was reset due to a loss of power or a manual press of the Door Card's reset button.	Resets
RETRY	The Pilot failed to light and one or more retry attempts were made.	
RUNNING	The system successfully lit the pilot.	
START	The system switched to Auto mode at a point in time when the pilot was not lit.	
STOPPED	The system stopped because the user pressed the STOP button while the Pilot Valve was open.	
SYSTEM ERR	An internal system error has occurred.	System Errors
TCERR:AUX	The AUX Thermocouple is out of range.	Thermocouple Errors
TCERR:HT	The High Temp Thermocouple is out of range or grounded.	Thermocouple Errors
TCERR:PROC	The Process Thermocouple is out of range.	Thermocouple Errors

ENTRY	DESCRIPTION	ASSOCIATED COUNTER
TC NOT EQ	The system detected an unacceptable difference between the Process and High Temp Thermocouple readings. The acceptable difference varies with the HT ESD Setpoint (ESD) as follows: · 15C when ESD < 200C · 25C when 200C <= ESD < 400C · 35C when 400C <= ESD < 800C · 45C when 800C <= ESD	
TERM ERR	Communications between the Terminal Card and the Door Card has been interrupted.	Terminal Card Errors

3.5.6 Viewing Firmware Versions

From any point in the User Interface press the Up and Down Keys simultaneously. The system will then show four different firmware versions in sequence:

CARD	CURRENT FW VERSION	NOTE
Door Card	DC FW: F1.7.040	
Terminal Card	TC FW: E1.7.038	
Modbus Expansion Card	MBUS FW: v4.3	Will show "---" if not installed or not enabled in Menu 6

The expansion card firmware versions are only shown if the cards are installed and enabled. They can also be viewed in menu 6.

3.5.7 Resetting to Defaults

The system settings can all be reset to factory defaults by following these instructions:

1. Ensure that the system is stopped
2. Navigate to the "Reset to Factory Defaults" menu item at the bottom of Menu 4
3. Use the Arrow Keys to change the setting to "Yes" and then press the OK Key
4. The system will display "Parameter Saved" and will then reboot

   After rebooting, the system will display the message "CONFIGURATION RESET TO DEFAULT" alternating with "Check Settings and Setpoints"
5. Press the OK Key to acknowledge this warning

This process only resets the user settings back to factory defaults and does not affect the calibration settings. To reset the calibration settings to defaults, refer to the Field Calibration section below.

Note that older versions of firmware did reset both the user settings and the calibration settings to defaults.

Also note that all settings are stored on the Door Card. If the Door Card is replaced for any reason, the settings will need to be re-entered and calibration may need to be performed.

3.5.8 Field Calibration

It is possible to field calibrate the thermocouples used by the 2100F. In general, it should not be necessary to do this in the field because the system has already been calibrated at the factory. However, there are circumstances where this may be necessary such as if the door or terminal card was replaced in the field or if the system is very old and has drifted out of calibration. Before recalibrating the system, it is strongly recommended that you explore all other possible solutions first. For example, verify that system settings are correct and that the devices attached to the system are calibrated correctly. If it is deemed necessary to proceed with recalibrating the PF2100F, follow the procedures below carefully. Failure to perform the calibration correctly may result in worse performance than if the system had been left alone.

The PF2100F uses a two-point calibration system to provide readings with greater accuracy than a single-point offset calibration. The first point compensates for any fixed offset in the system and the second point defines the slope. If the calibration fails for any reason, there is an option in the calibration menu to clear all calibration data.

CALIBRATING THE THERMOCOUPLES

For thermocouples, the first calibration point is zero volts which corresponds to the ambient temperature of the terminal block where the thermocouple plugs into the Terminal Card. The second calibration point is referenced to a known temperature that is well above the ambient temperature. This temperature is typically the hottest temperature at which the system will operate but should not be higher than 1350˚C and should not be lower than ambient + 20˚C.

The calibration procedure is as follows:

1. Ensure that the system is stopped.
2. Remove the 3 pairs of thermocouple wires (High Temp, Process, and Aux) from the P8 Pluggable Header on the Terminal Card.
3. Short each pair of thermocouple inputs individually using a jumper or short piece of copper wire (ie, short HT+ to HT-, short Proc+ to Proc-, and short Aux+ to Aux-).
4. Press the UP and Down Keys simultaneously to unlock the Calibration Menu (Menu 7) which is normally hidden.
5. Press the Menu Key repeatedly until Menu 7 is shown.
6. Press OK, enter the L2 Password if prompted △ ▽ △ △ ▽ △ OK
7. "Cal High Temp TC Zero" will show on the display.
8. Press OK and the message "Calibrating Wait…" will appear on the display for about 5 seconds. Afterwards, the message "Parameter Saved" will show on the display briefly.
9. Press the Menu Key to go to the next item.
10. Repeat steps 8 and 9 for the "Cal Pilot TC 1 Zero" and "Cal Pilot 2 TC Zero" menu items.
11. Reconnect the 3 pairs of thermocouple wires (High Temp, Process, and Aux) to the P8 Pluggable Header on the Terminal Card.
12. Set the High Temp, Pilot 1, and Pilot 2 thermocouples to a known reference temperature using a dry block or other calibrated reference. The reference temperature should be at least 20C above the ambient temperature and preferably close to the maximum planned operating temperature.
13. "Cal High Temp TC Span" will show on the display.
14. Use the Up and Down Keys to adjust the temperature displayed on the PF2100F to match the temperature being applied to the thermocouple. Note that multiple key presses may be required before the temperature value on the display changes. This is because each key press is adjusting a fractional multiplication factor internal to the system.
15. Press OK and the message "Parameter Saved" will show on the display briefly.
16. Press the Menu Key to go to the next item.
17. Repeat steps 14-16 for the "Cal Pilot TC 1 Span" and "Cal Pilot TC 2Span" menu items.
18. Press and hold the OK key for 3 seconds until the message "Password Logout" is displayed on the screen. The Calibration Menu is now hidden again.

CALIBRATING THE 4-20MA OUTPUT

For the 4-20mA Output, the first calibration point is 4mA and the second calibration point is 20mA. You will need a current meter capable of measuring current to 0.1mA accuracy.

The calibration procedure is as follows:

1. Ensure that the system is stopped.
2. Connect a current meter in series with the 4-20mA Output.
3. Set the current meter to a range setting that covers both 4mA and 20mA.
4. Press the UP and Down Keys simultaneously to unlock the Calibration Menu (Menu 7) which is normally hidden.
5. Press the Menu Key repeatedly until Menu 7 is shown.
6. Press OK, enter the L2 Password if prompted △ ▽ △ △ ▽ △ OK
7. Press the Menu Key repeatedly until "Cal 4-20 Out Zero" is shown on the display.
8. Use the Up and Down Keys to adjust the output current until the current meter reads 4.0mA.
9. Press OK and the message "Parameter Saved" will show on the display briefly.
10. Press the Menu Key repeatedly until "Cal 4-20 Out Span" is shown on the display.
11. Use the Up and Down Keys to adjust the output current until the current meter reads 20.0mA.
12. Press OK and the message "Parameter Saved" will show on the display briefly.
13. Press and hold the OK key for 3 seconds until the message "Password Logout" is displayed on the screen. The Calibration Menu is now hidden again.

RESETTING CALIBRATION DATA

If you want to reset the calibration settings to default, use the "Cal Data" option at the end of Menu 7.

This process resets the following calibrations to defaults:

- Calibration of the Thermocouples
- Calibration of the 4-20mA Output

The procedure to do this is as follows:

1. Ensure that the system is stopped
2. Press the UP and Down Keys simultaneously to unlock the Calibration Menu (Menu 7) which is normally hidden.
3. Press the Menu Key repeatedly until Menu 7 is shown.
4. Press OK, enter the L2 Password if prompted △ ▽ △ △ ▽ △ OK
5. Press the Menu Key repeatedly until "Cal Data" is shown on the display
6. Use the Up or Down keys to select "Yes".
7. Press OK and the message "Parameter Saved" will show on the display briefly.
8. Press and hold the OK key for 3 seconds until the message "Password Logout" is displayed on the screen. The Calibration Menu is now hidden again.

4 Modes & Behaviour

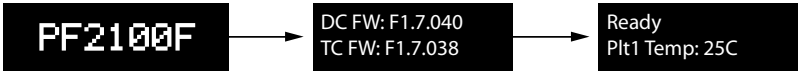
This section of the manual describes the behaviour of the PF2100F when various features are enabled vs disabled. Simplified state diagrams are provided and discussed to give a high level understanding of how the system works. Following this, detailed behaviour descriptions are provided including process charts to illustrate the behaviour of the system when various features are enabled and in response to various external events. These are provided for the Process Control Algorithm and Input/Output Contacts. Finally, examples of common applications are provided including process charts and recommended Process Control settings.

4.1 State Diagrams

The following diagrams illustrate the various states that the PF2100F goes through when the system is powered on, when starting the system in Auto or Manual modes, and once the Process Control algorithm takes over. The current state is always shown on the display.

4.1.1 Power On Sequence

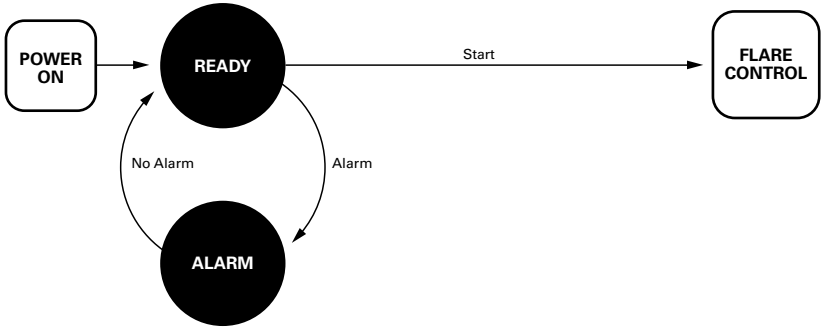
When power is applied to the system it will display "PF2100F" in large text followed by the firmware versions of the Door and Terminal Card. The system will then display the Home Screen which will show the system state. The system state will be "Ready" if no alarms or present. Otherwise, the state will be "Alarm".



4.1.2 Starting in Auto Mode

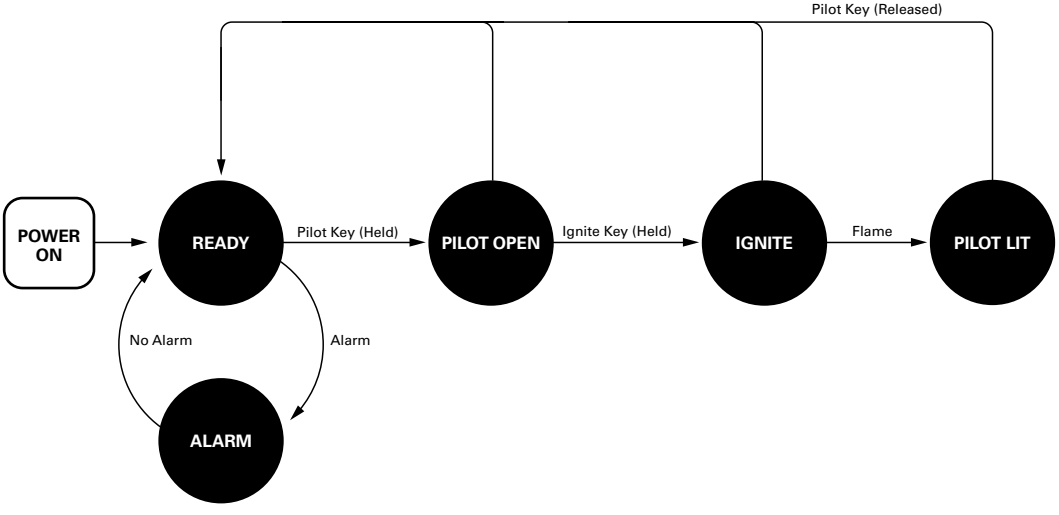
When the system is started in Auto Mode, it will run through the ignition sequence automatically. In Auto Mode, the PF2100F will automatically attempt to relight the pilot if a flame is not detected.

NOTE
The "Flare Control" state in the diagram is actually a collection of several states that will be explained in more detail further on.



4.1.3 Testing in Manual Mode

When the system is started in Manual Mode, it must be manually moved through the ignition sequence. Manual Mode should only be used for testing the functionality of the pilot valve and ignition coil and is not intended for flare control.



4.1.4 Flare Control

The key to the PF2100F's Flare Control Algorithm is pilot flame detection. The majority of flare control decisions made by the PF2100F are based on whether or not a flame is detected by the system.

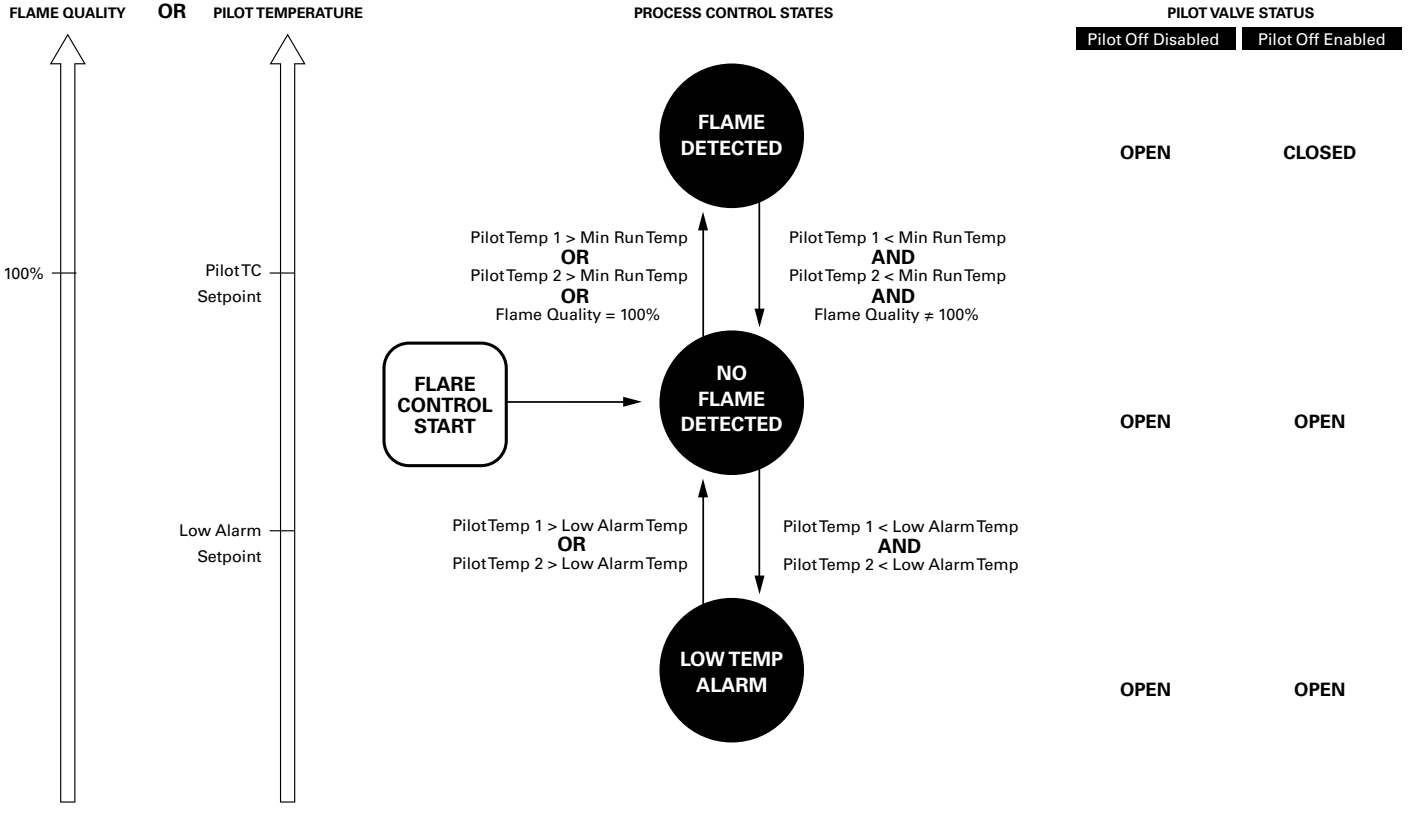
The PF2100F checks three conditions to determine if a flame is detected. If any of these conditions are met, the PF2100F considers a flame present:

- Pilot 1 Thermocouple > Minimum Run Temperature
- Pilot 2 Thermocouple > Minimum Run Temperature
- Ionization Flame Quality = 100%

The PF2100F does not need to be configured for specific flame detection behavior. At least one of the inputs from the conditions above must be connected in order for the PF2100F to perform its Flare Control Algorithm, but it does not matter which condition is met, or if any combination of them are met. As long as at least one condition is satisfied, a flame is detected. The Flare Control Algorithm does not make any distinction between flames detected by these three conditions.

The PF2100F does not support any other combination of conditions for flame detection. As an example, the PF2100F cannot be configured to require the Pilot 1 Thermocouple and Pilot 2 Thermocouple to agree that a flame is detected.

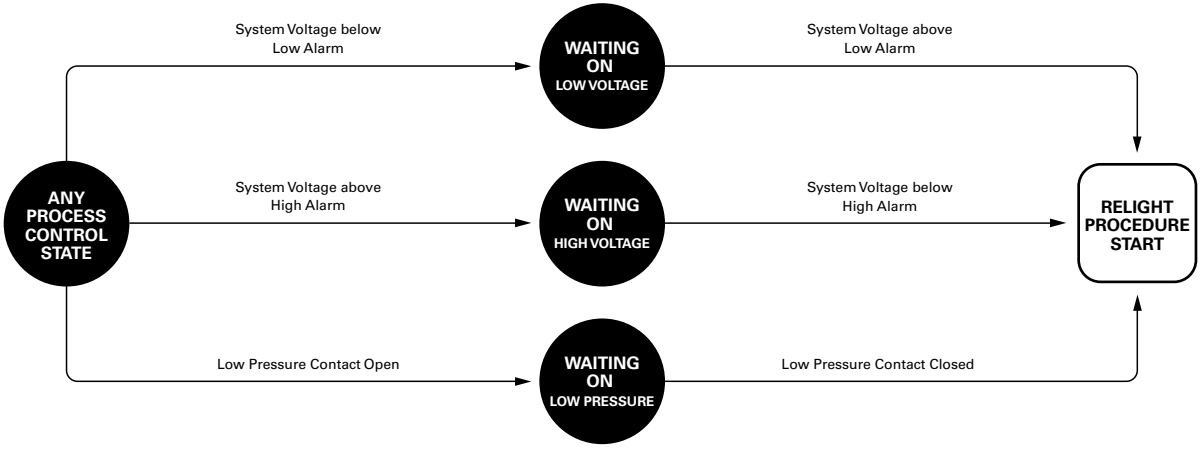
The diagram below shows how the Flare Control Algorithm makes flare control decisions based on the status of flame detection.


FLAME QUALITY
OR
PILOT TEMPERATURE
100%
Pilot TC Setpoint
Low Alarm Setpoint
PROCESS CONTROL STATES
FLAME DETECTED
Pilot Temp 1 > Min Run Temp
OR
Pilot Temp 2 > Min Run Temp
OR
Flame Quality = 100%
Pilot Temp 1 < Min Run Temp
AND
Pilot Temp 2 < Min Run Temp
AND
Flame Quality ≠ 100%
FLARE CONTROL START
NO FLAME DETECTED
Pilot Temp 1 > Low Alarm Temp
OR
Pilot Temp 2 > Low Alarm Temp
Pilot Temp 1 < Low Alarm Temp
AND
Pilot Temp 2 < Low Alarm Temp
LOW TEMP ALARM
PILOT VALVE STATUS
Pilot Off Disabled
Pilot Off Enabled
OPEN
CLOSED
OPEN
OPEN
OPEN
OPEN

4.1.5 Waiting States

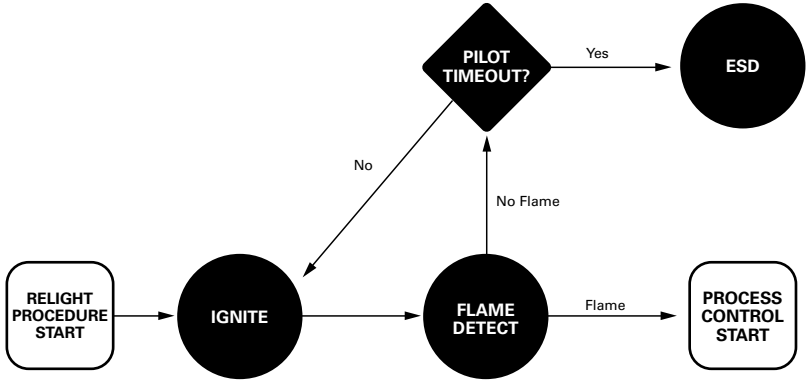
In all waiting states, the system turns off the main and pilot valves and waits for some event to occur before restarting. There is a group of waiting states which may be optionally enabled through the Auto Restart setting. Each of these states can be entered automatically from any other Process Control state if the associated condition is satisfied. Once that condition is cleared, the system will automatically restart via the Relight procedure.

The following waiting states are enabled when the "Auto Restart" feature is enabled.



4.1.6 Relight Procedure

After the system has been initially started, if it needs to be automatically relit, the procedure below is followed. Note that the number of retries varies depending on the mode and reason for pilot being off.



5 Troubleshooting

This section of the manual is designed to aid you in troubleshooting the PF2100F. It begins with a list of Common Issues and Solutions. Following this are reference tables containing Shutdown Messages, Alarm Codes, and Warning Messages. This section concludes with a pair of step-by-step guides for troubleshooting issues with Flame Detection and thermocouples.

If you are having trouble with your PF2100F System, please consult the following resources in this order:

- Consult this section for solutions to see if one matches your needs.
- Consult the support section of our website at **www.profireenergy.com.**
- Contact us on our support line at **1-855-PRO-FIRE** (776-3473).

5.1 Common Issues & Solutions

The following list of issues is organized alphabetically by topic. Under each issue is a list of possible solutions.

EXPANSION CARDS

1. Cannot Write Setpoints via Modbus

a. Check that the system has the latest firmware.

b. Check that the Modbus Card has the latest firmware. Firmware older than v4.0 did not support this feature.

FLAME DETECTION

1. System Has Visible Flame But Cannot Detect It

a. The flame rod, pilot assembly and the gap between them should be fully engulfed in flame. If not, adjust the rod positioning.

b. Check that the flame detection wiring does not exceed the recommended maximum length.

c. Check that the Ion+ wire is securely connected as per the appropriate wiring diagram.

d. Check that the ground connection between the PF2100F and the pilot assembly is present and secure.

e. Consult the instructions in the section 5.5 (Flame Detection Troubleshooting Guide) for further details on Flame Detection.

SHUTDOWN

1. System shuts down with a High/Low Voltage message shutdown

a. Ensure that the system voltage setting is set to match the power supply's nominal voltage.

b. Check that the system has the latest firmware.

c. Ensure that some other load is not causing the supply to droop periodically. This can be done by simply removing other devices from the supply or if that is not an option, monitor the supply voltage with a data logger.

d. Ensure that the power supply is rated appropriately for the valves and other peripheral devices.
Refer section 2.6.1 (Power) for details.

2. System shuts down on High Temperature ESD

a. Check that the HT ESD setpoint is not set too close to the operating temperature of the system. Measurement accuracy and process control overshoot can cause the system to shutdown if they are too close.

3. System shuts down on an Open TC Error

a. Check if one of the thermocouples is not connected inside of the PF2100F.

b. Check that there are no breaks in the thermocouple wiring.

SOLAR POWER

1. Solar output voltage is 12V when 24V is expected

a. Check if the solar panels are incorrectly wired in parallel rather than series

2. Expected battery life is not achieved

a. The PF2100F is not setup to use low power valves with a PWM setting of 20%

b. The PF2100F is not setup to put the display to sleep when not being used

c. The solar panel is undersized

d. The solar panel is shaded or not located in full sun

3. The battery is not being charged at all

a. Check if the Solar Charger is damaged or defective. Look for flashing error codes on the controller's LEDs.

b. The solar panel is undersized

c. The solar panel is shaded or not located in full sun

d. The battery is defective

SOLENOIDS

1. Valves are not opening

a. Check if the positive and negative wires are reversed.

b. Ensure that each valve has a separate negative return wire connected to the correct terminal. A common ground wire

cannot be used and will not work.

c. Check if the proper PWM setting is used for each valve.

d. Check if the valve voltage ratings match the system voltage (12V or 24V).

2. System shuts down with terminal card command refused, master power, solenoid feedback.

a. Check solenoid wiring to ensure that no wires are crossed and separate return wires are used for each valve.

STATUS CONTACT

1. Status Contact Opens But System Continues to Run

a. Check that the system has the latest firmware. Some older firmware versions had a bug that might lead to this under certain circumstances. If you can't update your firmware immediately, repositioning the flame rod so that it is more fully immersed in the flame can lessen the occurrence of this issue.

2. Status Contact Never Closes

a. The current or voltage ratings on the status contact may have been exceeded. Verify that you are not exceeding these ratings. If the ratings were exceeded, check the terminal Card HW version to determine the appropriate solution.

i. v1.6: Replace the Terminal Card.
ii. v1.7: Replace the Status Contact Fuse on the Terminal Card.

THERMOCOUPLES

1. Thermocouple Readings are Bouncing

a. Verify that the Valve PWM Settings are correct for the valves that are being used. Using incorrect settings for a valve can result in more noise than necessary. The lowest noise will result when the PWM setting is set to 20% for low power valves and 100% for regular valves.

b. Verify that proper system grounding is being observed. Especially check that all solenoids are properly connected to earth ground.

2. Thermocouple Readings are Incorrect

a. Check if the thermocouple wiring polarity is reversed. Yellow should be connected to positive, and red to negative.

b. Check that no thermocouple pairs are crossed (ie, positive from one TC paired with negative from another TC).

c. Ensure that only type-k thermocouple wire and connectors are used. Even small sections of other types of wire can significantly disrupt the measurement.

d. If a head connection is used, verify that none of the above wiring issues exist there either.

e. Check if the thermocouple is defective by trying a different thermocouple that is known to be good or by connecting the suspect thermocouple to a process calibrator.

f. Check that the PF2100F is in proper calibration using a process calibrator. If not, recalibrate the system.

5.2 Shutdown Messages

The following is a list of messages that may flash on the PF2100F display after the system has shutdown. Typically, the word "SHUTDOWN" in large text will flash alternately with one of the messages below. These messages indicate the reason that the system last shutdown and can be cleared by pressing the OK key (except where noted). Use the table below to determine the meaning of these messages. This table is organized alphabetically.

ON SCREEN	DESCRIPTION	POSSIBLE SOLUTIONS
Ambient Temps Not Equal	The Ambient Temperature read by the Door Card does not match the one reported by the Terminal Card.	
Pilot Thermocouple Error	The Pilot Thermocouple is open or shorted.	
Comparison Setpoints	One of the Setpoints in the Door Card does not match the corresponding value in the Terminal Card.	
Comparison: C_byte x y	The Door Card's internal control byte (x) did not match the Terminal Card's internal status byte (y).	
Comparison: ESD DC:xxx TC:xxx	The Door Card and Terminal Card do not agree on the state of the ESD Contact. "xxx" will be either "ON" or "OFF".	
Comparison: LVL DC:xxx TC:xxx	The Door Card and Terminal Card do not agree on the state of the Level Contact. "xxx" will be either "ON" or "OFF".	
Comparison: MAN DC:xxx TC:xxx	The Door Card and Terminal Card do not agree on the state of the Main Valve Output. "xxx" will be either "ON" or "OFF".	
Comparison: PLT DC:xxx TC:xxx	The Door Card and Terminal Card do not agree on the state of the Pilot Valve Output. "xxx" will be either "ON" or "OFF".	
Comparison: PoC DC:xxx TC:xxx	The Door Card and Terminal Card do not agree on the state of the Proof of Closure Contact. "xxx" will be either "ON" or "OFF".	
Comparison: PRH DC:xxx TC:xxx	The Door Card and Terminal Card do not agree on the state of the High Pressure Contact. "xxx" will be either "ON" or "OFF".	

5.2 Shutdown Messages Continued...

ON SCREEN	DESCRIPTION	POSSIBLE SOLUTIONS
Comparison: PRL DC:xxx TC:xxx	The Door Card and Terminal Card do not agree on the state of the Low Pressure Contact. "xxx" will be either "ON" or "OFF".	
Comparison: STRT DC:xxx TC:xxx	The Door Card and Terminal Card do not agree on the state of the Start Contact. "xxx" will be either "ON" or "OFF".	
Control Error	The Internal Control State is not valid.	
DC MSP430 No Communications	The TC430 Temperature chip on the Door Card is not responding.	
EEPROM Error	The EEPROM settings are corrupted.	
ESD Input	The ESD Input was open while the system was running or attempting to start.	
Expansion Card Error / Modbus Card: Card Fail	The Modbus Expansion Card is not responding. This may indicate that it is not installed correctly or that it is enabled when not present at all.	
Flame Fail	The system failed to ignite the pilot within the allocated flame fail timeout period.	
Flame Rod Test Error / Adjust Flame Rod Position	The Flame Rod or associated wiring may be shorted to ground thus preventing it from properly detecting flame.	
High Pressure	The High Pressure Contact remained open for more than 2s after the main valve opened. This error can also be triggered by the 4-20 Input Card if the Pressure reading remains above the 4-20 Pressure High Setpoint for 2s after the main valve opened.	
High Temp	The Process Temperature rose above the High Temp ESD Setpoint.	
High Temp Setpnt Mismatch	The Door Card and Terminal Card do not agree on the value of the High Temp ESD Setpoint.	

5.2 Shutdown Messages Continued...

ON SCREEN	DESCRIPTION	POSSIBLE SOLUTIONS
High Voltage xx.x Volts	The system voltage remained above the High Voltage Alarm point for 20s or more and Auto Restart is disabled. "xx.x" is the voltage reading at the point in time when the shutdown occurred. See section 3.4.12 (System Voltage) for a description of these alarm points.	
HT Thermocouple Error	The High Temp Thermocouple is open or shorted.	
Ignite Key Stuck	The Ignite Key was held for more than 30s while in manual mode.	
KEY STUCK ERROR / XXXX	One of the keypad keys was stuck at System Startup. This may indicate a defective keypad. This error must be resolved in order to continue using the system. The particular key stuck will be displayed in place of XXXX and will be one of the following: DOWN, IGN, MAIN, MODE, OK, PLT, MENU, STOP, UP	
Level Input	The Level Contact is open and "Level Event Restart" is set to "Off".	
Low Pressure	The Low Pressure Contact is open and "Auto Restart" is set to "Off".	
Low Voltage xx.x Volts	The system voltage remained below the Low Voltage Alarm point for 20s or more and "Auto Restart" is set to "Off". "xx.x" is the voltage reading at the point in time when the shutdown occurred. See section 3.4.12 (System Voltage) for a description of these alarm points.	
Master Power Error	The Master Power switch to the powered valve outputs was in the wrong state. This may indicate a Terminal Cards hardware failure.	
Modbus Card: Shutdown	The system shut down because a remote shutdown command was recieved via Modbus.	
Modbus Card: Shutdown / Remote Cmd Error	The system recieved an undefined command from the Modbus Expansion Card.	

5.2 Shutdown Messages Continued...

ON SCREEN	DESCRIPTION	POSSIBLE SOLUTIONS
Pilot Key Stuck	The Pilot Key was held for more than 30s while in manual mode.	
Pro Thermocouple Error	The Process Thermocouple is open or shorted.	
Proof of Closure / Should be Closed	The Proof of Closure Contact was detected to be Open when it was not expected to be. This may indicate a faulty valve or wiring.	
Purge Values Mismatch	The Door Card and Terminal Card do not agree on the value of the Purge Time Setting.	
Run CRC Error	Main Program Memory CRC Error	
Solenoid Feedback Error / Check Solenoid Wiring	The solenoids were observed to have a state opposite to the one being driven by the PF2100F. Check that the wiring is correct and not shorted to power or ground.	
System Error	Illegal Process Control or Display State	
Terminal Card Ambient Fail	The Terminal Card could not measure the ambient temperature. The Door Card failed to detect this.	
Terminal Card Command Refused	The Terminal Card recieved a valid command from the Door Card but the command was refused because it would result in an invalid or unsafe state. The Door Card failed to detect this.	
Terminal Card Communication	The Termincal Card is not communicating with the Door Card. This may indicate a faulty ribbon cable or incompatible firmware. The Door Card failed to detect this.	
Terminal Card High TC Grounded	The Terminal Card detected that the High Temp Thermocouple was shorted to ground. The Door Card failed to detect this.	
Terminal Card High Temp Alarm	The Terminal Card detected that the High Temp Thermocouple exceeded the High Temp ESD Setpoint. The Door Card failed to detect this.	

5.2 Shutdown Messages Continued...

ON SCREEN	DESCRIPTION	POSSIBLE SOLUTIONS
Terminal Card Reciprocal Comp	The Terminal Card detected that the Door Card status or High Temp ESD Setpoint did not match. The Door Card failed to detect this.	
Terminal Card Shutdown Detect	The Terminal Card detected an alarm condition. The Door Card failed to detect this.	
Terminal Card Voltage Sense	The Terminal Card detected that the system voltage was outside of allowable limits. The Door Card failed to detect this. See section 3.4.12 (System Voltage) for a description of these alarm points.	
Thermocouples Not Equal / Check Wiring	The High Temp and Process Thermocouples are reading temperatures that are too far apart. This may indicate a failed thermocouple or improper wiring.	
User Stop	The user pressed the Stop key on the keypad.	

5.3 Alarm Codes

The following is a list of alarm codes that may show on the Alarm screen of the PF2100F display. These codes indicate a persistent problem that must be cleared before the system can be restarted. Use the table below to determine the meaning of these codes.

ON SCREEN	DESCRIPTION	POSSIBLE SOLUTIONS
PilotTC	The system is in a mode that requires the Pilot Thermocouple and the Thermocouple is open or otherwise wired incorrectly.	
DC_TC	The TC430 temperature sensor on the Door Card is not responding.	
ESD_Inp	The ESD Contact is Open.	
FlmTest	There is a problem with the Flame Detection wiring or circuitry.	
PoC_Inp	The Proof of Closure contact is open.	
HiVolt	The system voltage is above the High Voltage Alarm point.	
HT_ESD	The Process Temperature is above the High Temp ESD Setpoint.	
HT_TC	The High Temp Thermocouple is open or otherwise wired incorrectly.	
LoVolt	The system voltage is below the Low Voltage Alarm point.	
LowPrs	The Low Pressure Contact is Open and the "Auto Restart" is set to "Off".	
Lvl_Inp	The Low Level Contact is Open and the "Level Event Restart" is set to "Off".	

5.3 Alarm Codes Continued...

ON SCREEN	DESCRIPTION	POSSIBLE SOLUTIONS
MbusErr	The Modbus Card is not responding. This may indicate that it is not installed correctly or that it is enabled when not present at all.	
ProcTC	The Process Thermocouple is open or otherwise wired incorrectly.	
RemShut	Modbus Shutdown Command Received	
Sys_Err	System Error – The Terminal Card is not communicating with the Door Card. This may indicate a faulty ribbon cable or incompatible firmware.	
TC_MM	The High Temp and Process Thermocouples are reading temperatures that are too far apart. This may indicate a failed thermocouple, improper wiring, or a damaged Door or Terminal Card.	
Val_MM	The Door and Terminal Card's setpoints do not match.	

5.4 Warning Messages

The following is a list of warning messages that may flash periodically on the PF2100F display. These messages indicate a problem that may be developing or a condition from which the system may automatically restart once cleared. Use the table below to determine the meaning of these messages.

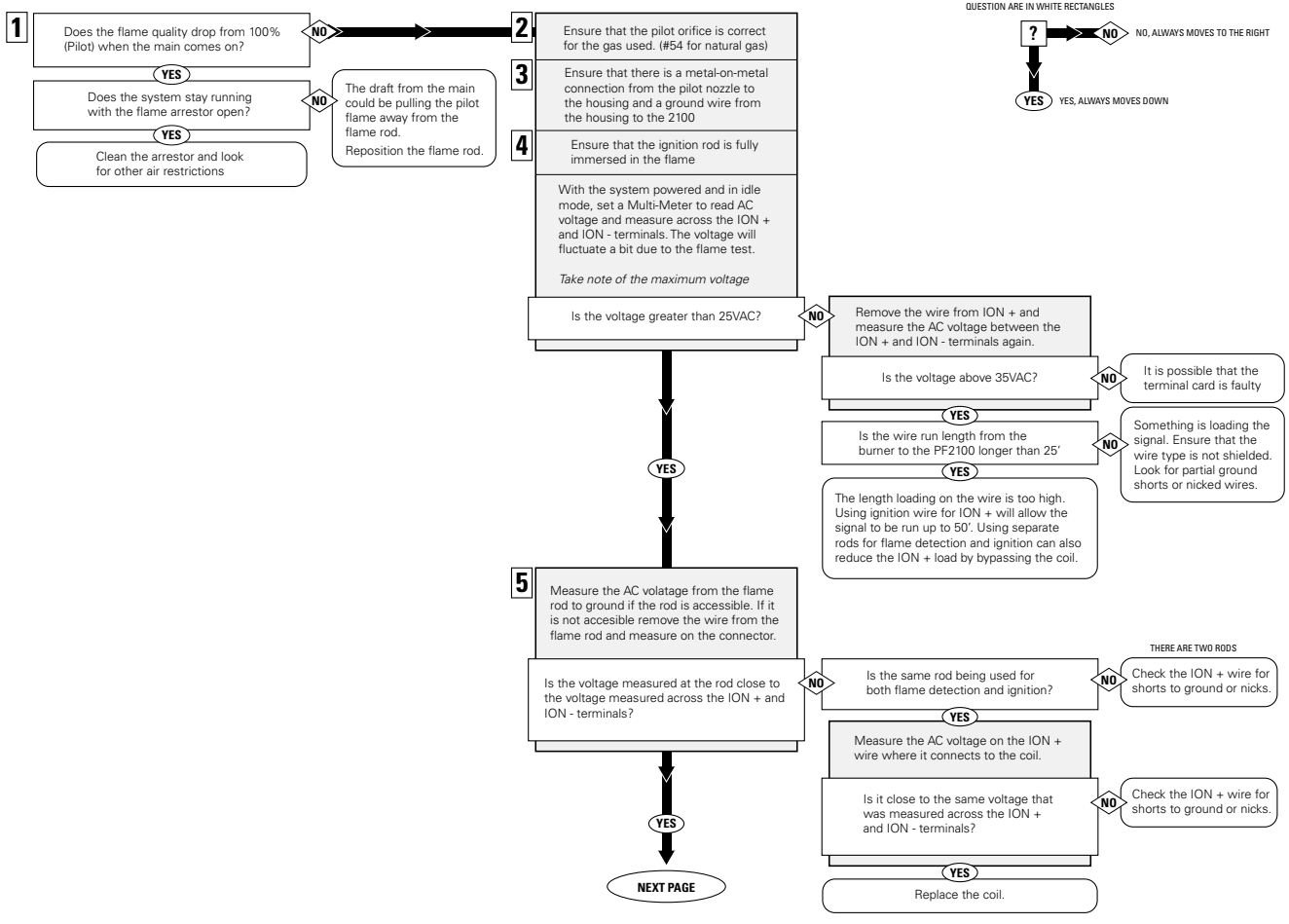
ON SCREEN	DESCRIPTION	POSSIBLE SOLUTIONS
Check all settings / Other settings have changed	A major process control setting was changed and the process control setpoints were reset to factory defaults. This includes the High Temp ESD Setpoint, the Pilot Off Setpoint, the Low Fire Setpoint, the Process Setpoint, the Low Temp Alarm Setpoint, the Deadband setting, and the Aux Setpoint.	
HI Volt Warning	The system voltage is getting close to the High Voltage Alarm threshold and may stop or shutdown soon.	
High Prs Warning	The High Pressure Contact is open or the 4-20 Pressure Input is above the 4-20 Pressure High Setpoint. The contact must be closed shortly after the main valve opens and the 4-20 Pressure is below the setpoint or the system will shutdown.	
LO Volt Warning	The system voltage is getting close to the Low Voltage Alarm threshold and may stop or shutdown soon.	
Unit restarted from LVL event	The system has recently restarted from a Level event. Press OK to clear this message.	
Unit restarted from PRS event	The system has recently restarted from a Low Pressure event. Press OK to clear this message.	
Unit restarted from VLT event	The system has recently restarted from a Low or High Voltage event. Press OK to clear this message.	

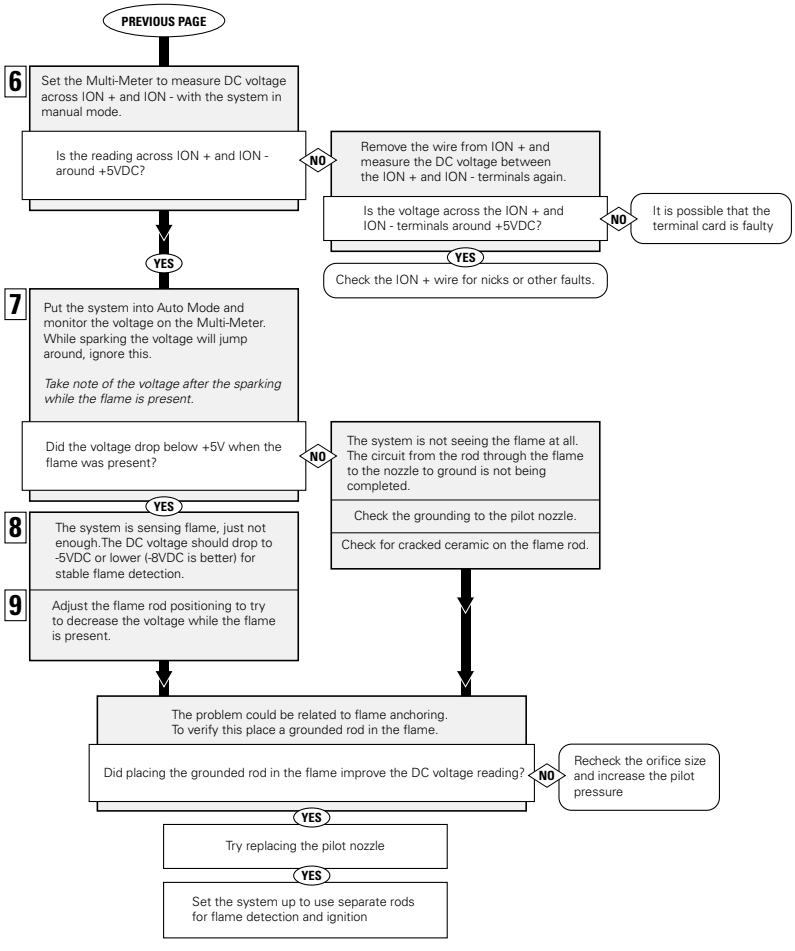
5.4 Warning Messages Continued...

ON SCREEN	DESCRIPTION	POSSIBLE SOLUTIONS
Waiting: HiVolt	The system will automatically restart once the system voltage falls below the High Voltage Alarm Threshold.	
Waiting: LoVolt	The system will automatically restart once the system voltage rises above the Low Voltage Alarm Threshold.	
Waiting: Low PRS	The system will automatically restart once the Low Pressure Contact is closed.	
Waiting: LVL	The system will automatically restart once the Level Contact is closed.	
Waiting:STRT Inp	The system will automatically restart once the Start Contact is closed.	

5.5 Flame Detection Troubleshooting Guide

System is not detecting flame.




PREVIOUS PAGE
6
Set the Multi-Meter to measure DC voltage across ION + and ION - with the system in manual mode.
Is the reading across ION + and ION - around +5VDC?
NO
Remove the wire from ION + and measure the DC voltage between the ION + and ION - terminals again.
Is the voltage across the ION + and ION - terminals around +5VDC?
NO
It is possible that the terminal card is faulty
YES
Check the ION + wire for nicks or other faults.
YES
7
Put the system into Auto Mode and monitor the voltage on the Multi-Meter. While sparking the voltage will jump around, ignore this.
Take note of the voltage after the sparking while the flame is present.
Did the voltage drop below +5V when the flame was present?
NO
The system is not seeing the flame at all. The circuit from the rod through the flame to the nozzle to ground is not being completed.
Check the grounding to the pilot nozzle.
Check for cracked ceramic on the flame rod.
YES
8
The system is sensing flame, just not enough.The DC voltage should drop to -5VDC or lower (-8VDC is better) for stable flame detection.
9
Adjust the flame rod positioning to try to decrease the voltage while the flame is present.
The problem could be related to flame anchoring.
To verify this place a grounded rod in the flame.
Did placing the grounded rod in the flame improve the DC voltage reading?
NO
Recheck the orifice size and increase the pilot pressure
YES
Try replacing the pilot nozzle
YES
Set the system up to use separate rods for flame detection and ignition

5.6 Appendix A - Main Valve

The PF2100F supports the use of a main valve in addition to the pilot valve. This configuration is NOT recommended, and may violate local codes. The main valve operation is simple: The main valve is open when a flame is detected.

GENERAL FEATURES

- Designed for use with flare applications
- Meets or exceeds all relevant codes and standards
- Easy installation with clearly marked component I/O
- Easily accessible removable terminal connections
- Electronic spark ignition
- Low-power operating mode to accommodate solar panel or TEG applications
- Transient protected and fail-safe circuits
- All solid state circuit components
- CSA compliant for Class I, Division 2 locations
- Certified for use on B.149 compliant valve trains
- Optional internal or external ignition coil

INPUTS & OUTPUTS

(6) Digital inputs for safety interlock device connections
(5) Digital outputs
(1) 4-20mA output
(1) Flame-rod input
(3) Thermocouple inputs

TECHNICAL SPECIFICATIONS

TEMPERATURE RATINGS	*MIN*	*MAX*
Operating Range	-40˚C (-40˚F)	+55˚C (+130˚F)
Storage Range	-40˚C (-40˚F)	+80˚C (176˚F)
POWER CONSUMPTION	*12V*	*24V*
Controller only, display ON	2.6 W	2.9 W
Controller only, display OFF	1.1 W	1.2 W
Maximum Total Current Draw	5A	5A
Maximum Valve Current Draw	2A	2A
Ignition Voltage (Internal Coil)	up to 20 kV	up to 40 kV
TERMINAL BLOCKS	*VALUE*	
Maximum Wire Gauge	12 AWG	
STATUS CONTACT	*VALUE*	
Type	Dry	
MAX Voltage	40VDC	
MAX Continuous Current	250mA	
Impedance (When Closed)	15Ω	
PHYSICAL DIMENSIONS	*VALUE*	
Width	30.9 cm (12.15 in)	
Height	23.4 cm (9.23 in)	
Depth	13.4 cm (5.28 in)	
WEIGHT	*VALUE*	
F0000 Model	4.0lbs / 1.8kg	
FC000 Model	6.0lbs / 2.6kg	
FUSES	*VALUE*	
Main Fuse Rating	5A / 250V Ceramic, Fast Blow	
Status Contact Fuse Rating	250mA / 125V Ceramic, Fast Blow	
Replacement Main Fuse	LittelFuse 0314005.HXP	
Replacement Status Contact Fuse	LittelFuse 0453.250 or 0451.250	

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