



PF1800 USER MANUAL REV 1.1
BURNER MANAGEMENT SYSTEM

WARNING

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.

MUST CONFORM TO THE DIRECTIONS IN THIS MANUAL

THE UNIT MUST BE PROPERLY CONNECTED TO EARTH-GROUND FOR EFFECTIVE IONIZATION OPERATION

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

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

DO NOT OPEN WHEN ENERGIZED

SUBSTITUTION OF COMPONENTS MAY IMPAIR THE SUITABILITY FOR USE IN CLASS 1, DIVISION 2

REPLACEMENT FUSES MUST BE CERAMIC

APPROVALS (PENDING)

CSA 22.2 No. 199-2007

ANSI Z21.20-2007

UL1998-2004

Class 1, Division 2, Grp

ABCD, T4A

CSA

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

FOR ANY QUESTIONS PLEASE CALL

1 855 PRO FIRE
(776-3473)



GENERAL FEATURES

- Designed for the natural draft-fire, tube heater industry (<1MM Btuh)
- Meets or exceeds all relevant codes and standards
- Easy installation with clearly marked component I/O
- Easily accessible removable terminal connections
- Rapid 3 second shut-down on flame-out
- DC voltage spark ignition
- Low-power design to accommodate solar panel or TEG applications
- Auto-relight or manual operation
- Transient protected and fail-safe circuits

ENCLOSURE

Polyester

309 x 234 x 134 mm (12.15" x 9.23" x 5.28")

overall dimensions 2.3 kg (5 lb)

CSA and UL compliant for Class 1, Division 2 locations

Enclosure type 4, 4X, 12, 13

CIRCUIT BOARDS

All solid state

CSA compliant for Class 1, Division 2 locations

Certified for use on B.149 compliant valve trains

IGNITION BASE AND COIL

For non-hazardous mounting area only

Ignition coil mounted in the PF1800 is optionally available.

TEMPERATURE RATING

-40°C to +55°C (Tested to -60°C)

-40°F to +130°F (Tested to -76°F)

INPUTS & OUTPUTS

(4) Digital inputs for safety interlock device connections

(4) Digital outputs

(1) Flame-rod input

(2) Thermocouple inputs

See Section 1.3 for thermocouple inputs

FUSE

Only equivalent fuse should be used to replace a blown fuse.

Factory fuse: LittleFuse 0314005.HXP

(5A, 250V Ceramic, Fast Blow)

POWER REQUIREMENTS

10VDC to 28VDC (voltage must match solenoid rating) 5A MAX

POWER CONSUMPTION	12V	24V	
Controller only, display ON	2.6 W	2.8 W	
Controller only, display OFF	1.1 W	1.4 W	



1.1 Mounting Locations

- The control panel can be mounted on the unit skid or on a building wall providing it does not infringe on a Class 1, Division 1 area.
- Use control panel mounting tabs to mount in a location that faces away from the burner housing so the operator is facing both the enclosure and the burner housing while operating. Other considerations may include panel access, traffic, wire-runs and visibility.
- The control panel should be mounted about 1.5m (5') above ground level.
- If an external ignition coil is used, it must be mounted in a Class 1, Division 2 enclosure or a non-hazardous location, ideally inside the burner housing.

1.2 P&ID and Wiring Diagram


Any design used, should be approved by a qualified inspector and approved by the gas authority having jurisdiction at the site where the system is to be installed.

Additional P&ID and wiring diagrams are provided in a separate application note.


1.3 Terminal Description

CONNECTION	DESCRIPTION	EXPECTED CONNECTIONS	RATINGS
12/24VDC	Input power 10VDC-28VDC, 5A MAX	Input power from a DC source	10VDC - 28VDC Internally fused at 5A
Common	Common	Ground from DC source	Internally connected to EGND
EGND	Earth Ground	Earth or Chassis ground	Internally connected to Common
HighTemp_TC + (YELLOW)	Thermocouple input. High Temp shutdown thermocouple.	"TYPE K" thermocouple must be connected between the "+" and "-" terminals and must not be electrically connected to ground.	
HighTemp_TC - (RED)	Thermocouple Input. Negative terminal of High Temp Shutdown thermocouple.	An uninterrupted connection using "TYPE K" thermocouple wire is required for an accurate reading.	
Process_TC + (YELLOW)	Thermocouple input. Process thermocouple.	"TYPE K" thermocouple must be connected between the "+" and "-" terminals and must not be electrically connected to ground.	
Process_TC - (RED)	Thermocouple Input. Negative terminal of Process thermocouple.	An uninterrupted connection using "TYPE K" thermocouple wire is required for an accurate reading.	
Main +	Positive terminal of the Main valve	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 Main and Pilot valves cannot be used.	Maximum continuous current is 2A. If "Low Power" mode is enabled, a peak load of 4A is permitted.
Main -	Negative terminal of the Main valve		
Pilot +	Positive terminal of the Pilot valve	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 Main and Pilot valves cannot be used.	
Pilot -	Negative terminal of the Pilot valve		

1.3 Terminal Description Continued...

CONNECTION	DESCRIPTION	EXPECTED CONNECTIONS	RATINGS 
Ion +	Flame Detection Input. Connected to a Flame-rod.	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.
Ion -	Ground	Ground return for flame detection. Must be connected to the burner housing.	
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.
Coil -	Ground	Ground return for the ignition coil.	
Status + Status -	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.	250VAC/DC, 200mA, 15Ω
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.	
Start -	Ground	Ground return for switch. All switches can use a single common ground return.	
ESD +	External Shutdown input.	Dry contact switch is expected. The input is internally pulled up to 9VDC via a 3.75kΩ resistance. Jumper "+" and "-" if not used.	
ESD -	Ground	Ground return for switch. All switches can use a single common ground return.	

1.3 Terminal Description Continued...

CONNECTION	DESCRIPTION	EXPECTED CONNECTIONS	RATINGS 
Pressure +	Input from a mechanical pressure switch.	Dry contact switch is expected. The input is internally pulled up to 9VDC via a 3.75kΩ resistance. Jumper “+” and “-” if not used.	
Pressure -	Ground	Ground return for switch. All switches can use a single common ground return.	
Level +	Input from a float-switch mounted in the bath.	Dry contact switch is expected. The input is internally pulled up to 9VDC via a 3.75kΩ resistance. Jumper “+” and “-” if not used.	
Level -	Ground	Ground return for switch. All switches can use a single common ground return.	

1.4 Thermocouples

ALL THERMOCOUPLES MUST BE ISOLATED FROM THE GROUND

PROCESS THERMOCOUPLE

"TYPE K"

Primary temperature control device provides high-temp shutdown. 20 AWG or larger *"TYPE K"* extension wire must be used. System will shutdown if an open circuit or short circuit is detected. Should be placed in the same thermowell as *HIGH TEMPERATURE THERMOCOUPLE*.

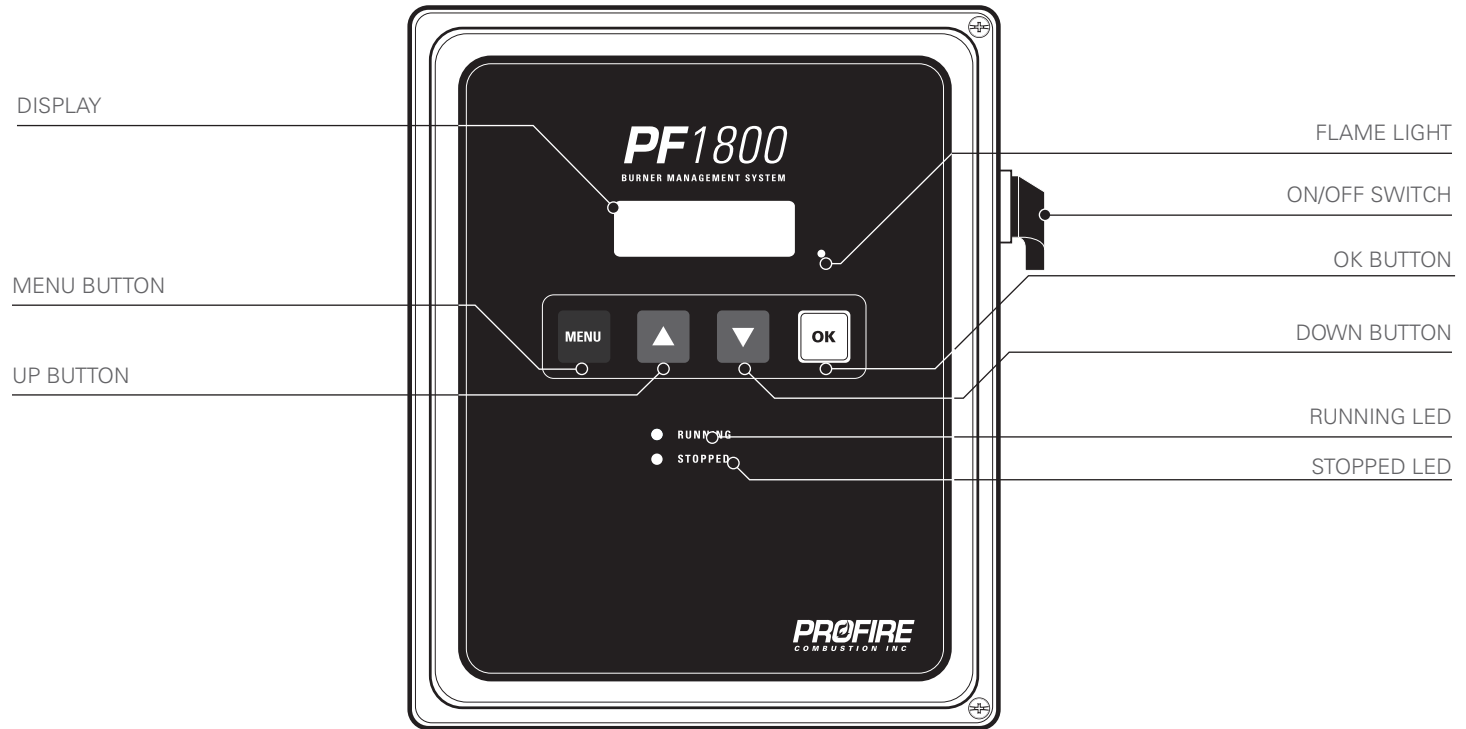
HIGH TEMPERATURE THERMOCOUPLE

"TYPE K"

Provides high-temp shutdown. 20 AWG or larger *"TYPE K"* extension wire must be used. System will shutdown if an open circuit, short-circuit or short-to-ground is detected. Should be placed in the same thermowell as *PROCESS THERMOCOUPLE*.

- * TE101 and TE102 may be different elements in the same head of a *"TYPE K"* thermocouple
- * For all thermocouples, avoid locating extension wire near high-voltage lines. Shield if necessary.

2.1 Keypad Layout



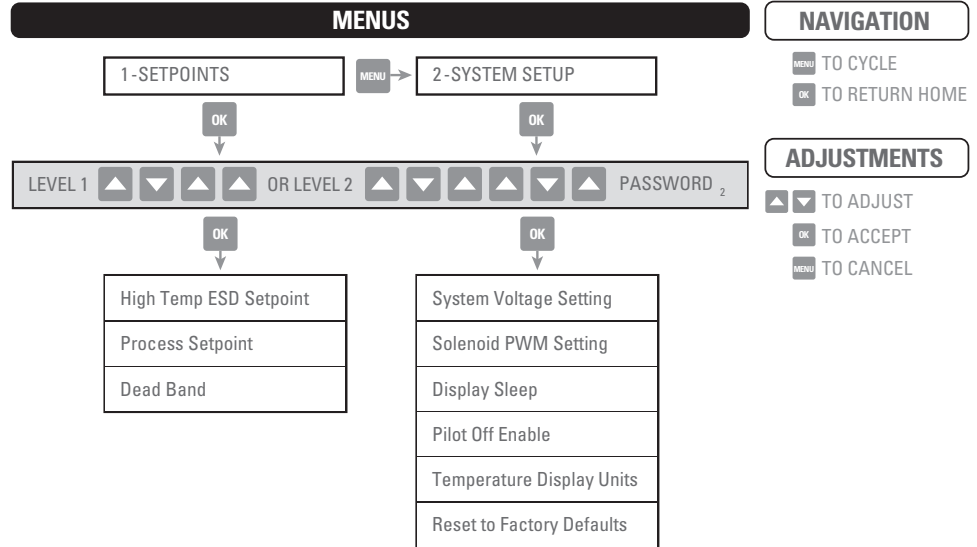
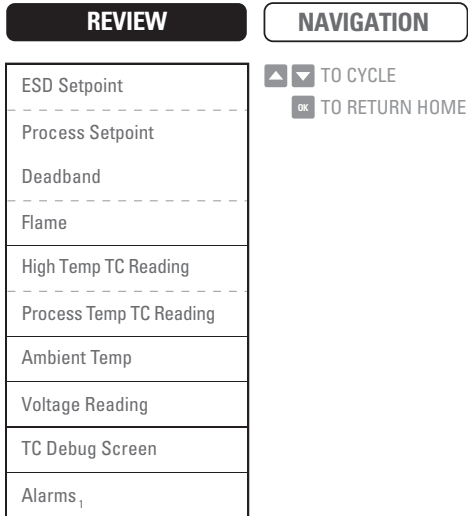
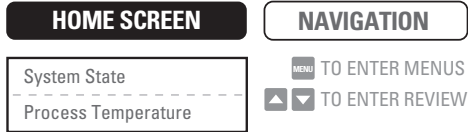
2.2 Menu Operation

The system must be in manual mode in order to access the menus. Press the "MENU" button to step through the menus. When the desired menu is displayed, press the "OK" button to enter that menu. Once in the menu, the "MENU" button will step through the parameters.

While viewing the desired parameter use the Δ and ∇ buttons to adjust the setting and "OK" to accept the change. To exit back to the "Home" screen, press the "OK" button without making any changes. From the "Home" screen, use the Δ and ∇ buttons to review the current system settings and status.

2.3 Menu Map

MANUAL MODE



FOOTNOTES

- 1 Hidden when No Alarms are present.
- 2 Required after password times out.

AUTO MODE (MENUS NOT ACCESSIBLE)

HOME SCREEN

ADJUSTMENTS

Process Setpoint

Process Temperature

▲ ▼ TO ADJUST PROCESS SETPOINT IN REAL TIME*

*Will also adjust Pilot Off and Low Fire Setpoints if enabled.

GLOBAL NAVIGATION


(CAN BE ENTERED AT ANY TIME)

▲ + ▼ CHECK FIRMWARE VERSIONS
& ENTER DEBUG MODE

OK PRESS AND HOLD FOR 3s TO
LOCK MENUS AND RETURN HOME


2.4.1 (MENU 1) Setpoints

This menu always is password protected. The password is $\Delta \nabla \Delta \Delta \nabla \Delta$  Cannot be accessed while BMS is running.

ON SCREEN	DESCRIPTION	FUNCTION	RANGE	DEFAULT SETTING	USER SETTING 
High Temp ESD Setpoint: x°C	Adjusts the High Temperature shutdown setpoint	If process temperature reaches this setpoint, the system will shutdown and alarm.	0 to 1350°C (32 to 2462°F)	90°C (149°F)	
Proc Setpoint: x°C (x°F)	Main process temperature setpoint. Adjusts the temperature at which the Main valve will turn off.	When the Process temperature rises above this setpoint, the main valve will close. The Main valve will re-open when the temperature drops below this setpoint minus the deadband.	0 to 1350°C (32 to 2462°F)	80°C (122°F)	
Dead Band: x°C (x°F)	Adjusts the Dead Band	The temperature buffer below the Proc setpoint	0 to 150°C (0 to 13°F)	2°C (11°F)	

2.4.2 (MENU 2) System Setup

This menu always is password protected. The password is $\triangle \nabla \triangle \triangle \nabla \triangle$  Cannot be accessed while BMS is running.

ON SCREEN	DESCRIPTION	FUNCTION	RANGE	DEFAULT SETTING	USER SETTING 
System Voltage: 12V	Configures the expected input voltage for the system	Used by the system to determine the over and under voltage lockout points. At 12V the valid input range is 9.5V to 17V. At 24V the valid input range is 19V to 34V.	12V or 24V	12V	
Solenoid Power: High	Enables the Low Power mode for the Solenoids	Indicates the power setting for the solenoid drive circuits.	High/Low	High	
Display Sleep, Never	Sleep Mode for the Display	Allows the Display to turn off after 10 min to save power.	Never / after 10 min	Never	
Pilot Off: ENABLED	Pilot Control	If enabled, the Pilot will turn off when the process temperature rises to the Proc Setpoint.	Disabled / Enabled	Enabled	
Temp Display: Celsius	Configures the temperature units used by the system	All display temperatures will be converted to the chosen unit.	Fahrenheit or Celsius	Celsius	
Restore Factory Defaults = NO	Restore all settings to the factory default	All parameters will be reset to the default settings.	YES or NO	NO	

3.1 Typical Startup

The operation sequence is as follows:

1. Ensure system is installed correctly and all components are functioning properly.
2. Open manual valves.
3. Turn ON / OFF switch to "ON"
4. The purge cycle begins. The 60s purge time is started when power is applied, or the main valve is off and no flame is detected.
5. The ignition cycle begins. The pilot solenoid is opened and ignition is turned on for a 10 second trial period. If the flame is seen, the flame indicator turns on and the main valve is opened. If the flame is not seen after this trial period, the pilot will turn off.
6. Check main valve indicator light to ensure valve is open.

3.2 Resets

- When the unit faults out, normally because an unsafe condition was detected, a reset is required.
- Before the unit can be reset, the condition causing the fault needs to be corrected. Some of the conditions that require a reset are:
 - Power supplied to the solenoids from an external source
 - Gas pressure out of range
 - Thermocouple wiring loose
 - Flame-out
- A local reset can be done by turning the ON / OFF switch to "OFF" and then back to "ON" again.

3.3 Changing Setpoints While Running

When in Auto Mode, the Process setpoint can be adjusted in real time using the UP & DOWN keys on the Home Screen. To adjust any other settings, the system must be stopped in manual mode.

3.4 Operational Description

On the PF1800 the pilot quality is monitored by a rectification circuit. When the pilot quality gets above the minimum acceptable (50%) the STATUS contact will close to indicate that the system is running.

TEMPERATURE CONTROL OPERATION

The PF1800 can be operated in various configurations. In all configurations, the pilot control output and spark ignition are used. However, control of the main valve and temperature control varies, depending on the installation and unit settings.

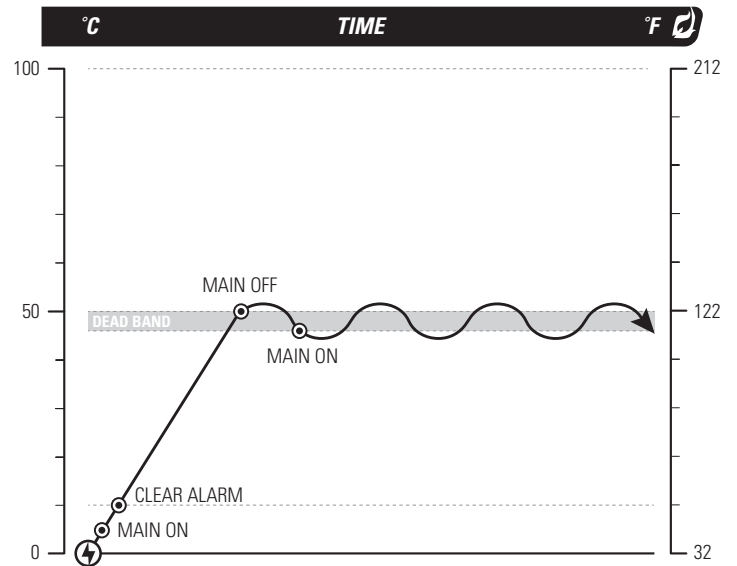
The PF1800 also has process high temperature monitoring. If the process temperature increases above the High Temp ESD setpoint, the unit will shut down by closing the main and pilot valves and then waiting for operator intervention. The Process High Shutdown is a dual system monitored by each microprocessor for redundant safety.

3.5.1 Pilot and Main

If the process temperature setpoint is exceeded, the main valve closes until the temperature falls below the setpoint minus the dead band setting.

In this configuration, the “Pilot Off” feature is disabled. This setup fires the main fully until the thermocouple reading exceeds “Process” setpoint.


EXAMPLE SETTINGS	°C	°F
High Temp ESD Setpoint	100	212
Process Setpoint	50	122
Low Alarm Setpoint	10	50
Dead Band	4	7

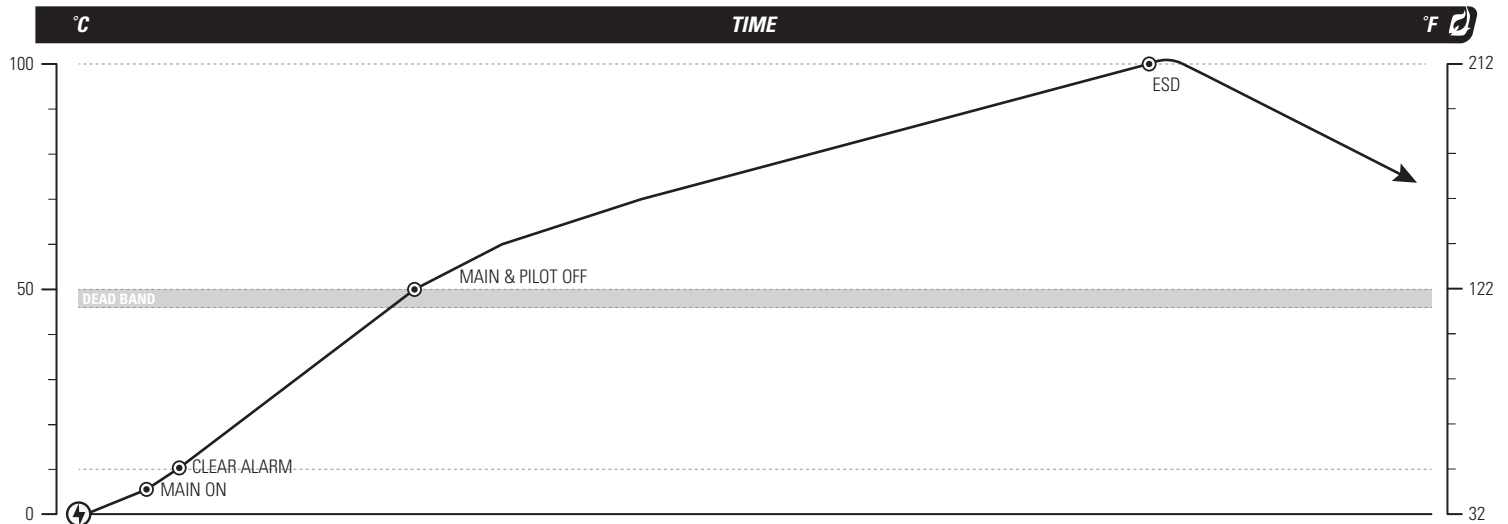


3.5.2 High Temperature Emergency Shutdown

This particular graph is a representation of the a “High Temperature Shutdown.” As shown, the ‘Pilot Off’ feature is enabled. This means that there is no heat being applied to the firetube, yet the temperature continues to increase.

Once the High Temp ESD setpoint has been reached, the system will shut down and require user input to acknowledge the error.

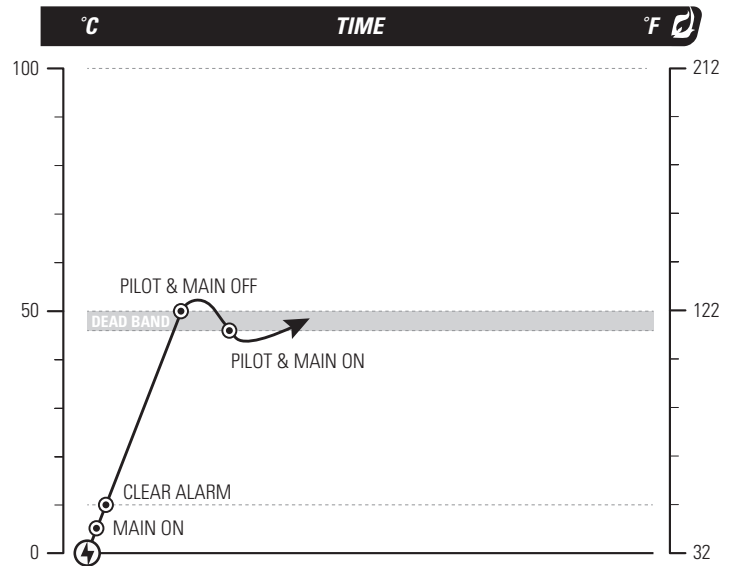
EXAMPLE SETTINGS	°C	°F	
High Temp ESD Setpoint	100	212	
Process Setpoint	50	122	
Low Alarm Setpoint	10	50	
Dead Band	4	7	



3.5.3 Pilot Off Control

The operation is the same as the Pilot and Main control but the pilot will also turn off when the main does. The unit will not re-light until the temperature is below the "Process" setpoint minus the dead band.

EXAMPLE SETTINGS	°C	°F
High Temp ESD Setpoint	100	212
Process Setpoint	50	122
Low Alarm Setpoint	10	50
Dead Band	4	7



4.1 Normal Operation

SYSTEM STATUS	RESPONSE
System off and there is a flame	The system is in Power Save mode. Press any button to wake.
System off and there is no flame	The system is in Power Save mode. Press any button to wake. If still no response, check power.
Ready	Unit is in manual mode <ul style="list-style-type: none"> • Turn switch to ON position

4.2 Error Messages

When there is more than one alarm, the abbreviated on-screen display will be shown. When a shutdown occurs, the system will enter a “lock-out” state with all outputs off. Selecting the “OK” button, toggling the “Start” contacts, or a power cycle, will be required to clear any of the following errors once the problem has been corrected.

ON SCREEN	DESCRIPTION	CAUSE	CORRECTIVE ACTION
Proc Thermocouple Error Or Proc TC	Thermocouple error	Process thermocouple is open or value is out of range	<ul style="list-style-type: none"> • Check thermocouple wiring • Replace thermocouple
HH Thermocouple Error Or ProH TC	Thermocouple error	High Temp thermocouple is open or value is out of range	<ul style="list-style-type: none"> • Check thermocouple wiring • Replace thermocouple
ESD Input Or ESD Inp	Emergency Shut Down	ESD input open	<ul style="list-style-type: none"> • Check contact
Flame Fail Or Flame	Flame Fail	Pilot not detected, retry limit expired	<ul style="list-style-type: none"> • Check fuel, air & ignition • Return to auto mode and try again • Check flame detection during ignition trial



4.2 Error Messages Continued...

ON SCREEN	DESCRIPTION	CAUSE	CORRECTIVE ACTION
Start Input Open Or STRT INP	Remote Start input is open	Start contacts open	<ul style="list-style-type: none"> • Close START contacts • Check wiring
Pressure Or IVP	Low Pressure Switch open	Low Pressure switch input open	<ul style="list-style-type: none"> • Check pressure switch wiring • Check fuel pressure • Check wiring
Level Input Or Lvl Inp	Level switch open	Level switch has opened	<ul style="list-style-type: none"> • Check level switch wiring • Check bath level • Check wiring
High Temp Or Hi Temp	High Temperature Shutdown	Process or High Temp thermocouple has reached the High Temp ESD setpoint	<ul style="list-style-type: none"> • Verify setpoints • Allow bath to cool • Calibrate Process and High Temp
High Voltage Or Hi Volt	High Voltage	Voltage input to the board is too high	<ul style="list-style-type: none"> • Reduce the input voltage • If the system is running off of 2V, ensure that the system setting is correct in menu 4
Low Voltage Or Lo Volt	Low Voltage	Voltage input to the board is too low	<ul style="list-style-type: none"> • Increase the input voltage • If the system is running off of 24V, ensure that the system setting is correct in menu 4
Flame Detected Before Start	Flame detected before start	Flame detected when trying to ignite the burner	<ul style="list-style-type: none"> • Ensure valves are closed • If the distance from the pilot valve to the nozzle is long then try increasing the purge time • Check for other sources of flame
Solenoid Feedback Error	Solenoid power error	A solenoid output is detected as being on when it should be off, or off when it should be on	<ul style="list-style-type: none"> • Check for shorted outputs • Check solenoid wiring
Master Power not Detected	Master power error	Master power switch is not turning on, or is on when it should be off	<ul style="list-style-type: none"> • Check for shorted outputs

4.2 Error Messages Continued...

ON SCREEN	DESCRIPTION	CAUSE	CORRECTIVE ACTION
Error xx Or Sys Err	Internal system error	Internal error detected in the system	<ul style="list-style-type: none"> • Reset both boards or cycle power • Replace terminal card
EEPROM Error	Internal system error	The Door Card micro cannot communicate with the EEPROM or there was a CRC error in the EEPROM	<ul style="list-style-type: none"> • Reset the Door Card or cycle power • Replace the door card
Flame Test	Internal System Error	Fault in the flame detection circuit.	<ul style="list-style-type: none"> • Move the flame rod further into the flame • Check the grounding from the pilot nozzle to the PF2100 • Replace the ribbon cable • Replace terminal card
TCs Not Equal	Thermocouple error	The High Temp Thermocouple reading on the door and terminal cards is not the same, or "High Temp" and "Process" readings are greater than 10°C (50°F) apart. The three temperatures will be shown. DC High Temp, TC High Temp, Proc Temp	<ul style="list-style-type: none"> • Reset both, or cycle power • Check the thermocouple wiring • Verify that the "Process" and "High Temp" thermocouples are reading the same temperature
Ambient Temps Not Equal	Internal System Error	The ambient (cold injunction) temperature as read on the door card and terminal card are more than 10°C (50°F) apart	<ul style="list-style-type: none"> • Verify the thermocouple wiring • Calibrate the thermocouples
Control Error	Internal System Error	Error in the control system	<ul style="list-style-type: none"> • Reset or cycle power • Replace the door card
Key Stuck Error "Key name"	Keypad problem	Key shorted at startup	<ul style="list-style-type: none"> • Reset or cycle power • Inspect ribbon cable connection • Replace the keypad
OFF	Switch Off	Switch Off	<ul style="list-style-type: none"> • Turn switch On
Comparison "error"	Internal System Error		<ul style="list-style-type: none"> • Reset or cycle power • Reverse ribbon • Replace the ribbon cable • Replace terminal

4.2 Error Messages Continued...

ON SCREEN	DESCRIPTION	CAUSE	CORRECTIVE ACTION
Terminal Card Communications	Communication error	Communication error between the door card and terminal card	<ul style="list-style-type: none"> • Reset or cycle power • Check ribbon cable connection • Reverse ribbon • Replace ribbon • Replace the terminal card
Terminal Card Command Refused	Internal system error	The terminal card has rejected a command sent by the door card	<ul style="list-style-type: none"> • Check the solenoid wiring, if there are crossed wires or if a common wire is used for the negative return this error can result. • Reset or cycle power • Reverse ribbon • Replace the ribbon cable • Replace one or both cards
Terminal Card Output Feedback	Solenoid power error	A solenoid output is detected as being on when it should be off, or off when it should be on	<ul style="list-style-type: none"> • Reset or cycle power • Check for shorted outputs
Terminal Card Reciprocal Comp	Internal system error	The reciprocal comparison between the cards does not agree	<ul style="list-style-type: none"> • Reset or cycle power • Reverse ribbon • Replace the ribbon cable • Replace one or both cards
Terminal Card Shutdown Detect	External system error	Contact input detected open by the terminal card: ESD, High Pressure, Low Pressure, Level	<ul style="list-style-type: none"> • Reset or cycle power • Check wiring • Reverse ribbon • Replace the ribbon cable
Terminal Card Invalid Command	Internal system error	The terminal card has received an invalid command from the door card.	<ul style="list-style-type: none"> • Reset or cycle power • Reverse ribbon • Replace the ribbon cable • Replace the door card

4.2 Error Messages Continued...

ON SCREEN	DESCRIPTION	CAUSE	CORRECTIVE ACTION
Terminal Card High Temp Alarm	High Temperature Shutdown	Process or High Temp Thermocouple has reached the High Temp ESD setpoint. This is detected by the terminal card first.	<ul style="list-style-type: none"> Reset or cycle power Allow bath to cool
Terminal Card HHTC Grounded	Thermocouple error	High Temp Thermocouple is shorted to ground.	<ul style="list-style-type: none"> Check for wiring faults with the thermocouples Check for a short to ground on the high temp thermocouple.

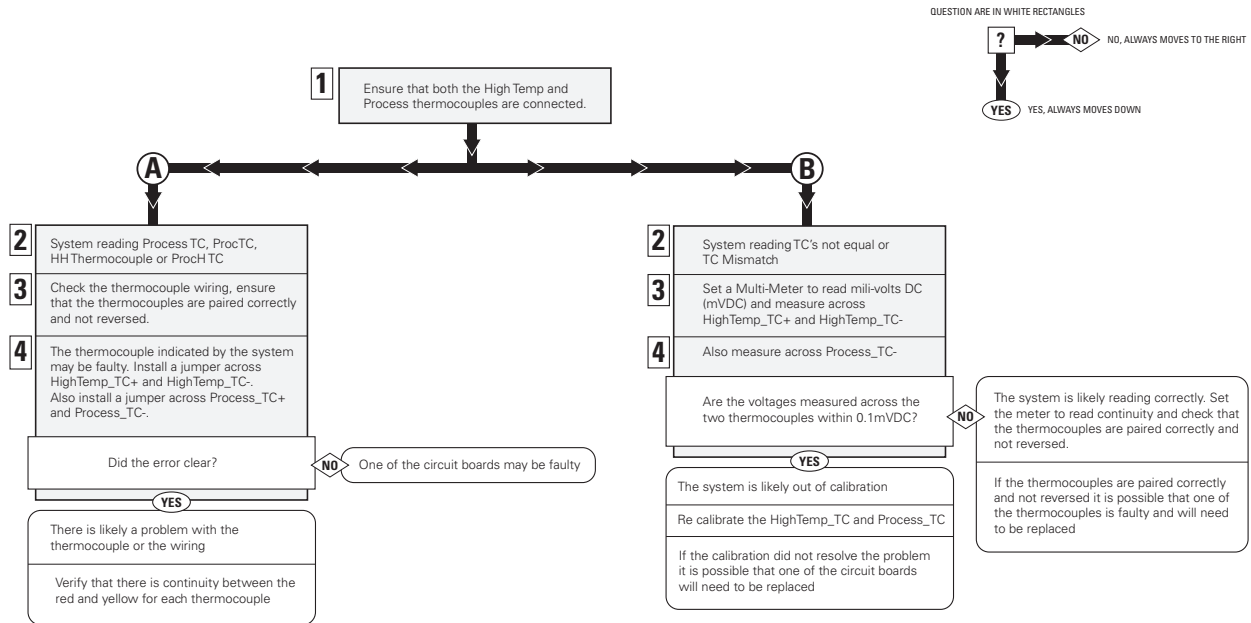
4.3 Calibration

Factory calibration has been performed.

ON SCREEN	DESCRIPTION	FUNCTION	RANGE	DEFAULT SETTING	USER SETTING
Cal: Proc TC Zero = No	Process thermocouple zero calibration	Short the Proc "+" and "-" contacts and select Yes	N/A	N/A	
Cal: HighTempTC Zero = No	High Temp thermocouple zero calibration	Short the ProH "+" and "-" contacts and select Yes	N/A	N/A	
Cal: Proc TC Span = xxC	Process thermocouple span calibration	Provide a calibrated 212°F signal (from thermocouple in a block or meter) to the Process TC input and adjust the reading to match the applied temperature.	N/A	N/A	
Cal: High Temp TC Span = xxC	High Temperature thermocouple calibration	Provide a calibrated 212°F signal (from thermocouple in a block or meter) to the High Temp TC input and adjust the reading to match the applied temperature.	N/A	N/A	

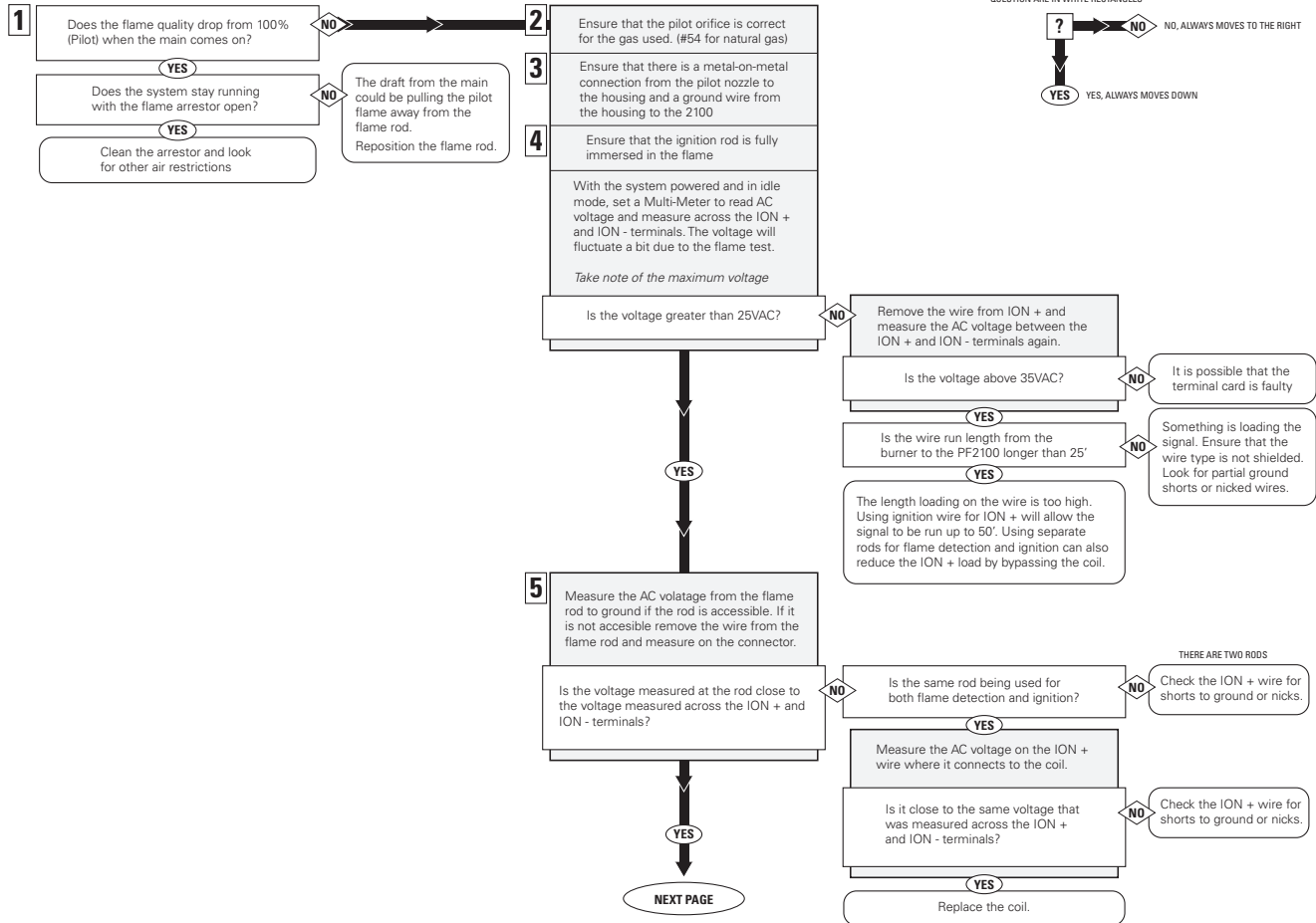
4.4 Thermocouple Troubleshooting

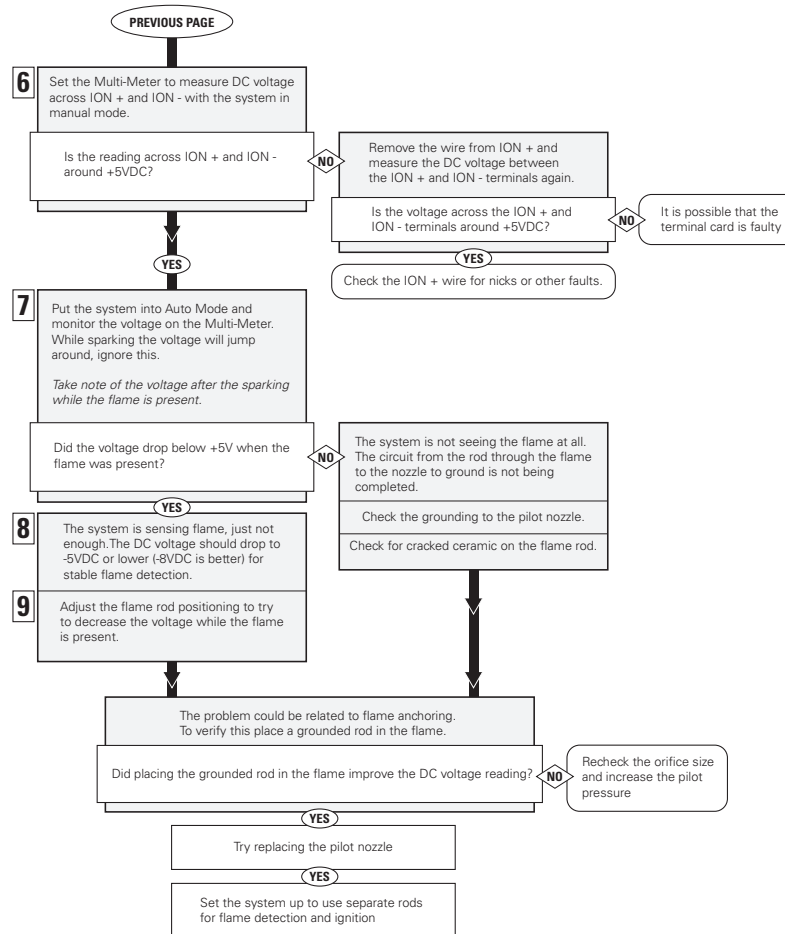
Problem with Thermocouples.



4.5 Flame Detection Troubleshooting

System is not detecting flame.







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