PPC4000 SERIES FUEL AIR RATIO CONTROLLER

FM APPROVED

c UL us LISTED

DESCRIPTION

Fireye PPC4000, the newest member of the Nexus family, is a state of the art parallel positioning system for all types of liquid or gaseous fuel fired combustion systems. When combined with a Fireye flame safeguard system such as the Fireye BurnerLogix control, the PPC4000 offers the most compact and advanced parallel positioning system available. Four fuel profiles allow the PPC4000 to accommodate a variety of applications such as two fuels, with and without, the optional variable frequency/speed drive (VFD/VSD). With each profile having up to 24 points entered to assure a smooth “curve”, the microprocessors within the PPC4000 interpolate points between entered values and precisely position fuel and air servos to within ± 0.1 degree, and the VFD to within 0.1% of its full scale range. The result is improved efficiency by eliminating hysteresis typically found in slide wire or single point positioning systems. Additional gains in burner efficiency can be realized by adding the optional (VFD/VSD) drive board and Fireye O2 probe. The PPC4000 is capable of controlling a total of ten servo motors, four servos per profile. All servo motors and displays operate on a secure communications protocol and can be “daisy chained”/ multi-dropped together for simplified wiring. Available servos from Fireye have torque ranges of 4 Nm (3 ft./lb.), 20 Nm (15 ft./lb.), and 50 Nm (37 ft./lb.). Two independent PID control loops for temperature or pressure control provide precise, accurate control of firing rate for unmatched response to load changes. Ten safety rated user definable line voltage inputs are standard and can be configured for functions such as burner on, setpoint select, lead lag, setback, etc. The PPC4000 also contains programmable relays that can be used for various functions throughout the burner sequence. Built in lead lag sequencing for up to four boilers is included in every PPC4000. The PPC4000 contains an SD (Secure Digital) card for profiles and parameters upload/download capability.

The User Interface, NXD410, contains a tactile feel keypad and a four line backlit LCD screen. The NXD410 offers dedicated keys that facilitate various everyday tasks done by the boiler operator. Among these are C-MODE, BURNER ON/OFF, ADJUST SETPOINT, LOW FIRE, AUTO/MAN (modulation) and LEAD LAG (sequencing). This eliminates the tedious task of entering various modes and passcodes to search for the desired parameter. The NXD410 has a HOME screen that shows four lines of instant and pertinent information about the current state of the burner. A HOME key on the keypad will direct the user to this screen from anywhere within the menu system. An intuitive menu system and easy to use navigation keys optimally placed on the keypad provide an easy flow to all parameters in the system. An INFO key is available that allows the installer/operator to quickly check key system values while in commissioning mode. The NXD410 is panel mount only and is rated for NEMA 4X indoor environments.

When required, the operating system of the PPC4000 and NXD410 will automatically direct the user to the passcode setup screen and when entered correctly will take the user directly to the parameter requested, making the entire system user-friendly.

Key features of the PPC4000 system

- Four line user interface with direct key functions
- 7” and 13” Touchscreen support
- Capable of controlling up to 10 servos when application driven
- Non-monotonic servo operation
- Two independent VFD control channels
- Ten line voltage user-defined digital inputs
- Voltage free alarm relay contacts (normally open in non-lockout state)
- Four user selected line voltage burner profiles
- Five 4-20 mA analog transducer inputs
- Cold start thermal shock protection limits mechanical stress
- Assured low fire cutoff
- Sequencing for up to 6 boilers
- SD (Secure Digital) interface for backup and restore
- 16GB SDCARD media included
- Modbus-RTU communications via RS485 with read/write capability
- PID operation for precise process control
- Intuitive menu driven design
- User defined 4-20 mA outputs
- Minimal wiring to flame safeguard
- Optional O2 trim
- Track Modulation
- Boiler efficiency calculation
- Compatible with BurnerLogix
- Compatible with Flame-Monitor
- Engineered and manufactured to ACE standards for product excellence
- Small footprint: 5.0”(127mm) W x 8.0”(203.2mm) H x 4.0”(101.6mm) D
- No wiring base necessary
- Expert support from the Fireye team

A minimal Nexus system includes the PPC4000 parallel positioning controller, NXD410 User Interface, 59-562-2 UI interface cable, appropriate Fireye pressure and/or temperature transducers, and a minimum of two servos for a single fuel application. Optionally an O2 probe and (VFD/VSD) card can be added. Although a BurnerLogix flame safeguard is recommended, the Flame-Monitor provides direct compatibility to the PPC4000.

Warning: Electro-mechanical high steam pressure or high water temperature limits must remain in the running interlock circuit of the flame safeguard control.

This manual describes the installation, commissioning, operation and maintenance of the PPC4000 series fuel air ratio controls. It may be used in conjunction with the following other manuals:

- BL-1001 – BurnerLogix Flame Safeguard Bulletin
- YZEM-3001 – YZ300 Interlock Annunciator for use with BurnerLogix
- E-1101 – Flame-Monitor Flame Safeguard Bulletin
- E-3001 – E300 Expansion Module for use with Flame-Monitor
- NEXBK-1000 - Nexus bracket and coupling accessories
- NEX-3004 - Nexus FX04 series 4Nm servo motor
- NEX-3020 - Nexus FX20 series 20Nm servo motor
- NEX-3050 - Nexus FX50 series 50Nm servo motor
- NXCESO2-1001 - OXYGEN PROBE
- 133-750 - O2 mounting flange installation instructions
- NXD-4101 - NXD410 User Interface
- NXCESVFD - VFD plug-in board installation
- NXTSD-4001 - Touchscreen user's guide
- FXIATS-1 - Ambient air temperature transmitter

WARNING: Failure to properly install, operate, or commission the equipment in this manual could result in significant property damage, severe injury, or death. It is the responsibility of the owner or user to ensure that the equipment described is installed, operated and commissioned in compliance with this manual and other system component manuals, as well with all applicable national and local codes.

WARNING!!!

Boiler operation, maintenance, and troubleshooting shall only be conducted by trained personnel. Persons troubleshooting lockouts or resetting the control must respond properly to troubleshooting error codes as described in this product bulletin.

Jumpers being used to perform static test on the system must only be used in a controlled manner and must be removed prior to the operation of the control. Such tests may verify the external controllers, limits, interlocks, actuators, valves, transformers, motors and other devices are operating properly. Such tests must be conducted with manual fuel valves in the closed position only. Replace all limits and interlocks not operating properly, and do not bypass limits in interlocks. Failure to follow these guidelines may result in an unsafe condition hazardous to life and property.

TABLE OF CONTENTS

PPC4000 Control:

Supply Voltage:

PPC4000 120 VAC (+10%, -15%) 50/60 Hz

PPC4000-230V 230 VAC (+10%, -15%) 50/60 Hz

Power Consumption: 15 VA

Temperature Rating:

Operating: 32°F to 140°F (0°C to 60°C)

Storage: -4°F to 158°F (-20°C to 70°C)

Humidity Rating: 85% RH, non-condensing

Protection Category: NEMA 1 (IP01)

Unit Dimensions: 5.0" (127 mm) W x 8.0" (203.2mm) H x 4.0” (101.6mm) D

Shipping Weight: PPC4000: Approx. 3.2 lbs. (1.45 kg)

NXD410 User Interface:

Supply Voltage: NXD410 24 VDC @ 250 mA (supplied by PPC4000)

Power Consumption: 6 VA

Temperature Rating:

Operating: 32°F to 140°F (0°C to 60°C)

Storage: -4°F to 158°F (-20°C to 70°C)

Humidity Rating: 85% RH, non-condensing

Protection Category: NEMA 4X indoors only, IP65

Unit Dimensions: Panel Cutout: 5.35 (136mm)W x 3.78 (96mm)H

Shipping Weight: NXD410: Approx. 1.0 lbs. (.45 kg)

NXTSD407 Touchscreen Interface:

Supply Voltage: 24 VDC @ 0.65A

Power Consumption: 15.6 VA

Temperature Rating:

Operating: 32°F to 122°F (0°C to 50°C)

Storage: -4°F to 158°F (-20°C to 70°C)

Humidity Rating: 85% RH, non-condensing

Protection Category: NEMA 4X indoors only, IP66 (front)

Unit Dimensions: Panel Cutout: 7.36 (187mm)L x 5.79 (147mm)H

Shipping Weight: Approx. 2.2 lbs. (1 kg)

NXTSD413 Touchscreen Interface:

Supply Voltage: 24 VDC @ 1.15A

Power Consumption: 27.6 VA

Temperature Rating:

Operating: 32°F to 122°F (0°C to 50°C)

Storage: -4°F to 158°F (-20°C to 70°C)

Humidity Rating: 85% RH, non-condensing

Protection Category: NEMA 4X indoors only, IP66 (front)

Unit Dimensions: Panel Cutout: 13.22 (336mm)L x 10.51 (267mm)H

Shipping Weight: Approx. 6.2 lbs. (2.8 kg)

NXCESO2 Oxygen Probe:

Supply Voltage: 24 VDC ± 10%

Power Consumption: 27 VA, 13 VA (steady state)

Temperature Rating:

Operating: 32°F to 140°F (0°C to 60°C)

Storage: -4°F to 158°F (-20°C to 70°C)

Humidity Rating: 85% RH, non-condensing

Protection Category: NEMA 1 (IP01)

Unit Dimension: see Figure 6 on page 23

Shipping Weight:

NXCES02-8: 8.1 lbs (3.67 kg)

NXCES02-16: 9.2 lbs (4.17kg)

Servos:

Supply Voltage:

FX04: 24 VDC ±10%

FX20: 24 VDC ±10%

FX50: 24 VDC ±10%

Power Consumption (Peak):

FX04: 5 VA Nominal, 7.5 VA peak

FX20: 15 VA nominal, 35 VA peak

FX50: 20 VA nominal, 38 VA peak

Temperature Rating:

Operating: -4°F to 140°F (-20°C to 60°C)

Storage: -4°F to 158°F (-20°C to 70°C)

Humidity Rating: 85% RH, non-condensing

Protection Rating: NEMA 4, IP65

Torque Rating:

FX04: 4 Nm, 3.0 ft./lb.

FX20: 20 Nm, 15 ft./lb.

FX50: 50 Nm, 37 ft./lb.

Rotational Span: 1 degree to 99.9 degrees

Actuating time of 90 degree rotation: min = 30 seconds, max = 120 seconds

Repeatability: 0.3 degree | **Hysteresis:** 0.6 degree

Shipping Weight:

FX04: Approx. 2.27 lbs (1.1 kg)

FX20: Approx. 5.43 lbs (2.5 kg)

FX50: Approx. 6.10 lbs (2.77 kg)

Temperature Sensors:

Temperature Measurement Range:

FXIATS-140: -40°F to 140°F (-40°C to 60°C) - see FXIATS-1 bulletin for technical info

TS350-X: 32°F to 350°F (0°C to 176°C)

TS752-X: 32°F to 752°F (0°C to 400°C)

RTD Type: Platinum, 100 ohms ± 0.1% @32°F (0°C)

Temperature Coefficient:.00385 ohms/°C

Output: 4-20 mA, linear with temperature

Operating Temperature Range: -13°F to 185°F (-25°C to 85°C)

Accuracy: ± 0.75% of span

Thermowell Case: 300 Series stainless steel

Mechanical Fittings: 1/2”-14 NPT

Pressure Sensors:

Pressure Measurement Range: 0 to 15, -14.7 to 25, 0 to 30, 0 to 200, 0 to 300 PSI

Excitation Voltage: 9-30Vdc (supplied by PPC4000 control)

Accuracy: ± 0.25% Full Scale (at 25°C)

Output: 4-20 mA, linear with pressure

Maximum Over Pressure: 200% of full scale

Maximum Burst Pressure: 800% of full scale

Operating Temperature Range: -40°F to 185°F (-40°C to 85°C)

Fitting: 1/4” NPT Male

Electrical: 1/2” Conduit and Terminal Strip

WARNING: This equipment generates and can radiate radio frequency energy, and if not installed and used in accordance with the instruction manual may cause interference to radio communications. It has been tested and found to comply with the limits for a Class A computing device pursuant to Subpart J of part 15 of FCC Rules, which are designed to provide reasonable protection against such interference when operated in a commercial environment. Operation of this equipment in a residential area is likely to cause interference in which case the user, at his own expense, will be required to take whatever measures which may be required to correct the interference.

APPROVALS

Underwriter’s Laboratories Inc.:

File MJAT.MH10808, UL353

- LISTED SECTION OF A FUEL AIR RATIO SYSTEM

File MJAT2.MH10808, UL353 - COMPONENT

File MJAT7.MH10808, CSA-C22.2 No 24

- LISTED SECTION OF A FUEL AIR RATIO SYSTEM

File MJAT8.MH10808, CSA-C22.2 No 24

Factory Mutual:

FM Class 7610

PART NUMBERS AND APPROVALS

Table 1: Agency Approvals

Fireye Part Number	FM APPROVED	c UL us LISTED	c TÜV us	CE	DIN DVGW	DIN Geprüft
Control						
PPC4000	X	X	X			
PPC4000-230V						
User Interface						
NXD410		X				
NXTSD407		X				
NXTSD413		X				
Servos						
FX04, FX04-1	X	X	X			
FX20, FX20-1	X	X	X			
FX50, FX50-1	X	X	X			
Oxygen Probe						
NXCESO2-8						
NXCESO2-16						
Transducers						
BLPS-15	X	X				
BLPS-25	X	X				
BLPS-30	X	X				
BLPS-200	X	X				
BLPS-300	X	X				
TS350-2, -4, -8	X	X				
TS-752-2, -4, -8	X	X				
FXIATS-140		X				
Flame Safeguard						
YB110UV	X	X	X	X	X	X
YB110UVSC	X	X	X	X	X	X
YB110IR	X	X	X	X	X	X
YB110FR	X	X	X	X	X	X
YB110DC	X	X	X	X	X	X

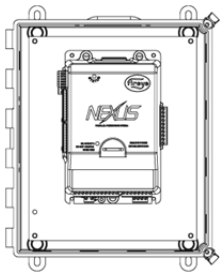
X = CERTIFICATION IN HAND

NOTE: The PPC4000 is compatible and agency approved with existing E110 Flame Monitor systems

ORDERING INFORMATION

Control	
PPC4000	Parallel positioning system, 120 VAC input. Used with flame safeguard control.
PPC4000-230V	Parallel positioning system, 230 VAC input. Used with flame safeguard control.
NXCESVFD	Plug-in assembly provides variable frequency (VFD/VSD) capability
60-2926	Enclosure, 12.5" x 10.5" x 6.5", UL listed, fitted for PPC4000
129-190	Kit, fan replacement
Display	
NXD410	User Interface with keypad, 24 VDC operation, 4 line back lit LCD display, panel mount only, includes mounting brackets.
59-562-2	Cable assembly, 10 feet length, for interfacing NXD410 to PPC4000
NXTSD407/NXTSD413	7" TFT or 13.3" wide color Touchscreen display, 800x480 or 1280x800 pixel (WVGA) resolution, LED backlight, 24VDC, includes mounting brackets
129-196-2	Replacement cable kit. Contains one 12' communications, one 12' power cable, and DB9 connector plug.
Servos	
FX04	Servo motor, 24 VDC operation, 4Nm, 3 lb.-ft. torque, **without** connectors, accepts 1/2 inch NPT fitting, minimum travel time of 30 seconds for 90°
FX04-1	Servo motor, 24 VDC operation, 4Nm, 3 lb.-ft. torque, **with** connectors, minimum travel time of 30 seconds for 90°
FX20	Servo motor, 24 VDC operation, 20Nm, 15 lb.-ft. torque, **without** connectors, accepts 1/2 inch NPT fitting, minimum travel time of 30 seconds for 90°
FX20-1	Servo motor, 24 VDC operation, 20Nm, 15 lb.-ft. torque, **with** connectors, minimum travel time of 30 seconds for 90°
FX50	Servo motor, 24 VDC operation, 50Nm, 37 lb.-ft. torque, **without** connectors, accepts 1/2 inch NPT fitting, minimum travel time of 30 seconds for 90°
FX50-1	Servo motor, 24 VDC operation, 50Nm, 37 lb.-ft. torque, **with** connectors, minimum travel time of 30 seconds for 90°
Servo Cables	
59-565-6	Cordset, 6 feet, 1/2" NPT connectors on both ends, PVC jacket, temperature rating -40°C to 105°C, meets NEMA 1,3,4,6P and IEC67
59-565-40	Cordset, 40 feet, 1/2" NPT connectors on both ends, PVC jacket, temperature rating -40°C to 105°C, meets NEMA 1,3,4,6P and IEC67
Connector Kit	
129-192	Connector, field wireable. Used for FX04-1, FX20-1, FX50-1 servos with connectors. Use cable 59-565
129-194	Male quick disconnect to convert non connector type FX series servos.
59-565	Cable, 1 twisted pair, 2 power wires, suitable for servo and Oxygen probe hookup.
O2 Probe	
NXCESO2-8, -16	O2 probe assembly, insertion length is 8, 16 inches
NXCESO2-8,-16	O2 probe assembly kit includes NXCESO2 probe, 35-381-2 flange and FXIATS-140 sensor
NXCES02P42, -1	Cartridge, probe replacement (model -1 for engineering code 00 only)
NXCES02P42-2	Replacement oxygen sensor for NXCES02-8 & NXCESO2-16, engineering code 4 and above
35-381-2	Flange, O2 probe mounting
129-189	Cover, mounting flange
Pressure Transducers	
BLPS-15, -25, -30	Pressure transducer, 0 to15 PSI (0 to 1030 mb), -14.7 to 25 PSI (-1013 to 1720 mb), 0 to 30 PSI (0 to 2070 mb), 4-20 mA output linear with pressure. ¼" NPTF mounting. Screw terminal connections and conduit adapter cover.
BLPS-200	Pressure transducer, 0 to 200PSI (0 to 13.8 Bar), 4-20 mA output linear with pressure. ¼" NPTF mounting. Screw terminal connections and conduit adapter cover.
BLPS-300	Pressure transducer, 0 to 300 PSI (0 to 20.7 Bar), 4-20 mA output linear with pressure. ¼" NPTF mounting. Screw terminal connections and conduit adapter cover.
Temperature Transducers	
TS350-2, -4, -8	Temperature sensor, Range 32°F to 350°F (0°C to 176°C), 4-20 mA output, linear with temperature. Insertion length is 2, 4, 8 inches. Stainless steel thermowell included.
TS-752-2, -4, -8	Temperature sensor, Range 32°F to 752°F (0°C to 400°C), 4-20 mA output, linear with temperature. Insertion length is 2, 4, 8 inches. Stainless steel thermowell included.
FXIATS-140	Ambient air temperature transmitter, -40°F to 140°F, 4-20mA output, 7 to 40VDC, NEMA enclosure

INSTALLATION PROCEDURE



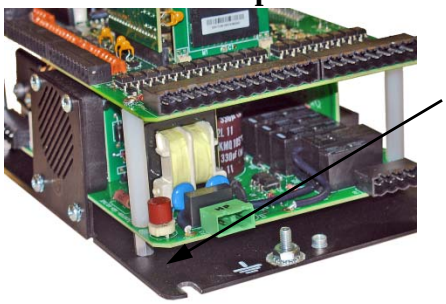
1) A UL listed fuel/air ratio system is comprised of the following items.
   a) PPC4000, fuel/air ratio controller
   b) 60-2926, enclosure
   c) NXD410, user interface
   d) FX series servos
2) Wiring must comply with all applicable codes, ordinances and regulations.
3) **Wiring must comply with NEC Class 1 (Line Voltage) wiring.**
4) To minimize interference from radio frequency energy generated by the PPC4000 control, it is necessary that all control wiring be placed in conduit. It is recommended that all low voltage signal wiring, i.e. servos, O2 probe, pressure/temperature transducer be placed in a separate conduit from line voltage wiring, i.e. relay outputs, line voltage digital inputs, profile select, flame safe-guard interface signals.
5) Limit switches, interlocks and relay outputs must be rated to simultaneously carry and break current to the ignition transformer, pilot valve(s) and main fuel valve(s) of the flame safeguard control.
6) Recommended wire routing of lead wires:
   a) Do not run high voltage ignition transformer wires in the same conduit with any other wires.
   b) Do not route analog transducer cables, display communication cables, modbus cables or servo motor cable in conduit with line voltage circuits. Use separate conduit where necessary.
7) Maximum wire lengths:
   a) Terminal inputs (Operating limits, interlocks, valves, etc.): 200 feet. (61 meters).
   b) Line voltage inputs: 500 feet (152 meters) to a normally open remote reset push-button, but should remain within sight and sound of the burner.
   c) Modbus communications RS-485: 1000 ft (305 meters) for baud rates of 19.2kbps & below.
   d) Servo & O2 probe: 200 feet (61 meters)
   e) Sensors: 100 feet (30 meters)

A good ground system should be provided to minimize the effects of AC quality problems. A properly designed ground system meeting all the safety requirements will ensure that any AC voltage quality problems, such as spikes, surges and impulses have a low impedance path to ground. A low impedance path to ground is required to ensure that large currents involved with any surge voltages will follow the desired path in preferences to alternative paths where extensive damage to equipment may occur.

NXD410 User Interface

The NXD410 is a panel mounted device. The device includes a gasket that must be properly seated to assure NEMA 4X (IP65) rating. Packed with every NXD410 device is a gasket and remote mounting bracket kit (not sold separately) containing four bracket assemblies as shown.

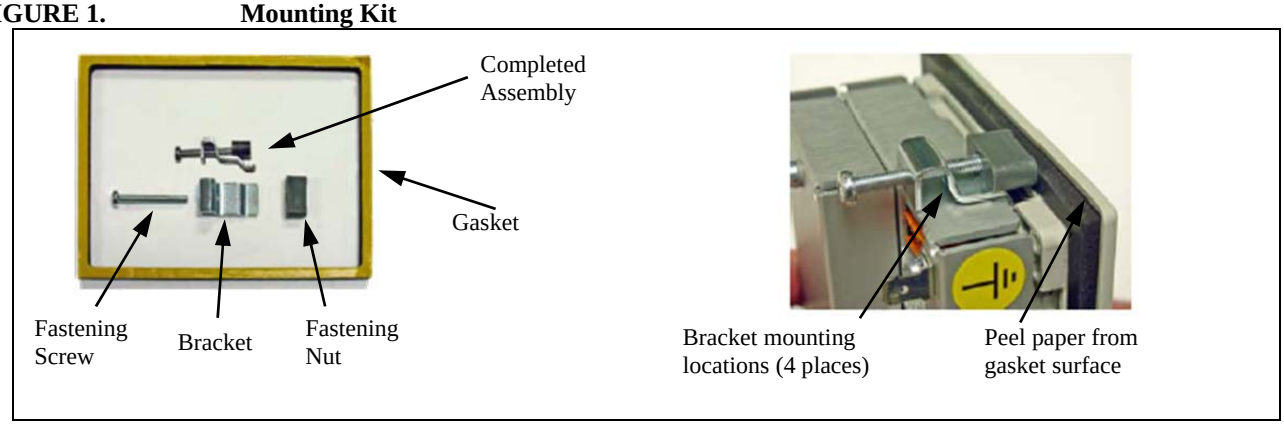
Replacement Fuses



23-227, F1 Main input protection fuse, 5A, 250VAC, radial can

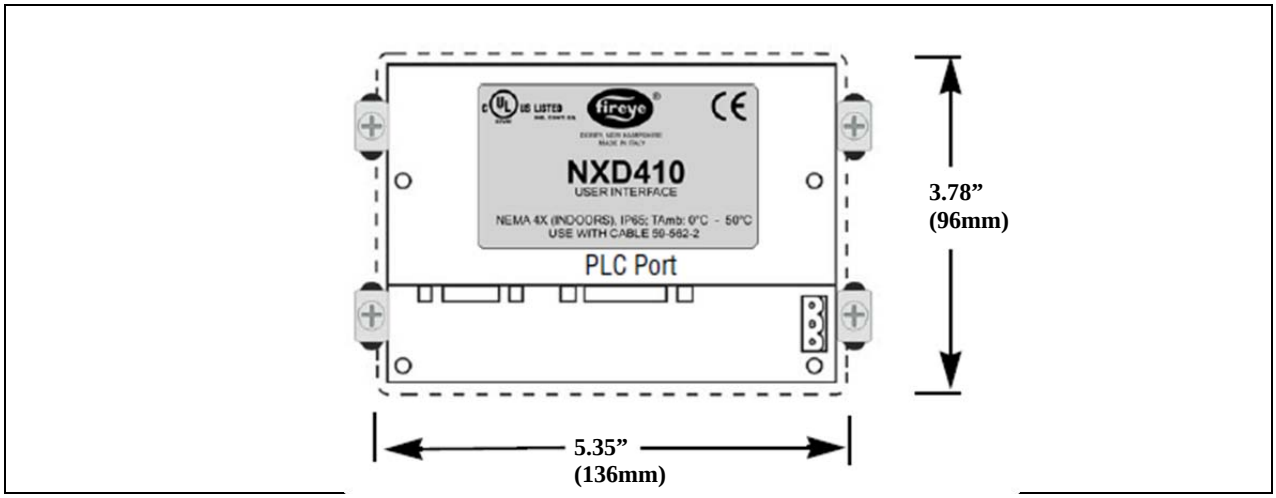
23-197, F3 Safety relay protection fuse, 10A, 250VAC, radial can

FIGURE 1. Mounting Kit



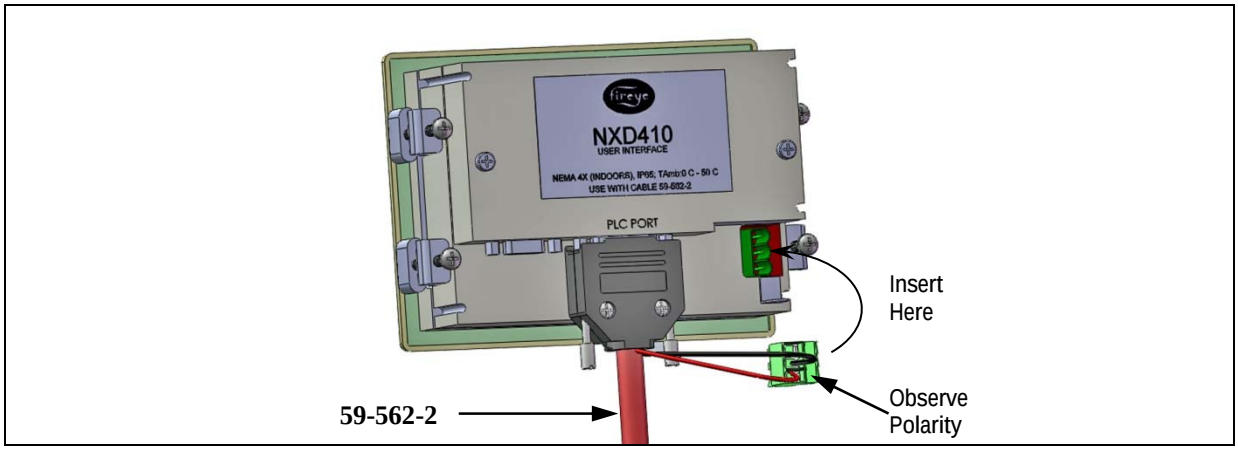
The bracket assembly mounts from the rear of the display with the fastening nut against the backside of the panel. Use the following dimensions for the panel cutout.

FIGURE 2. Panel Cutout

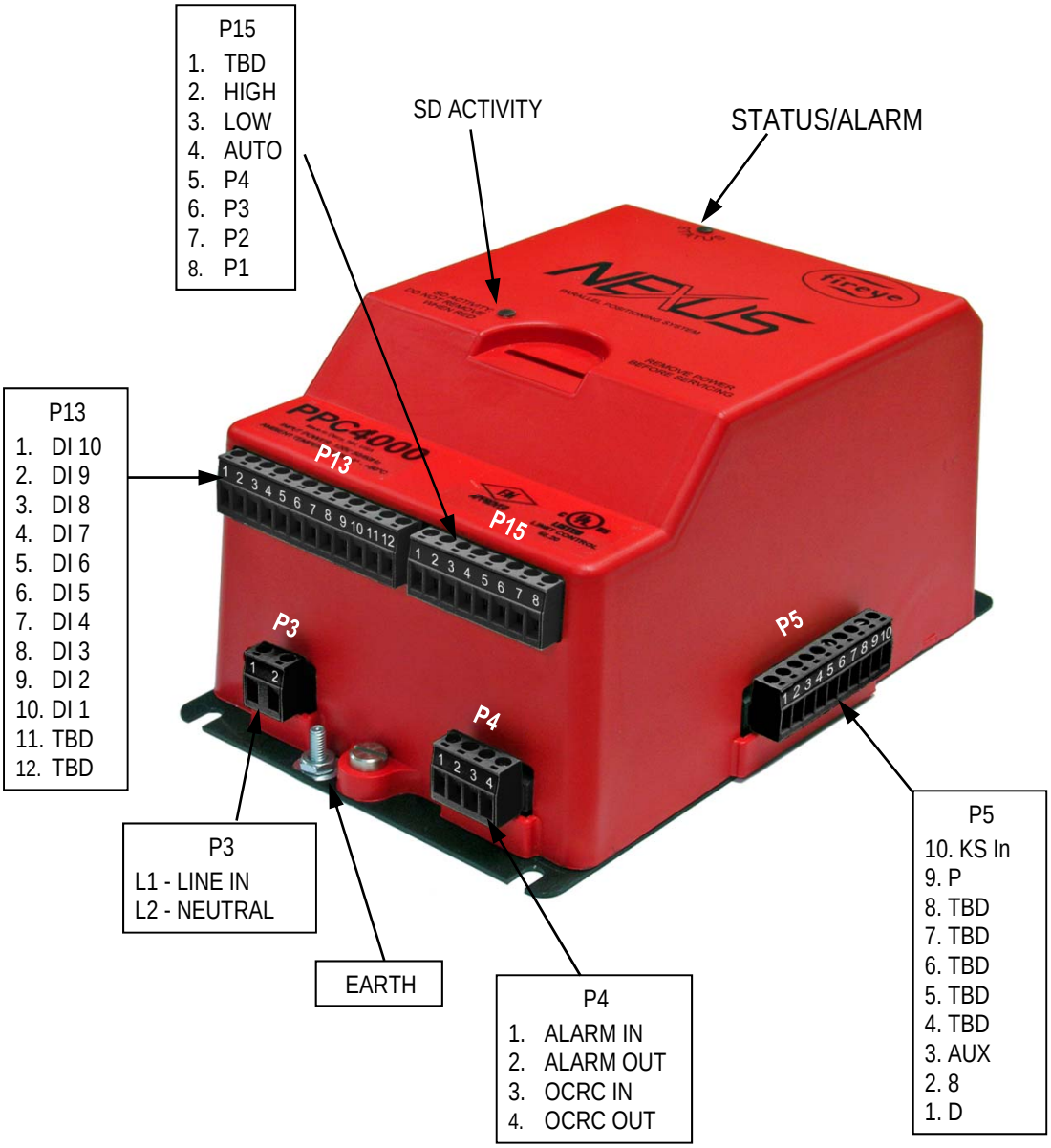


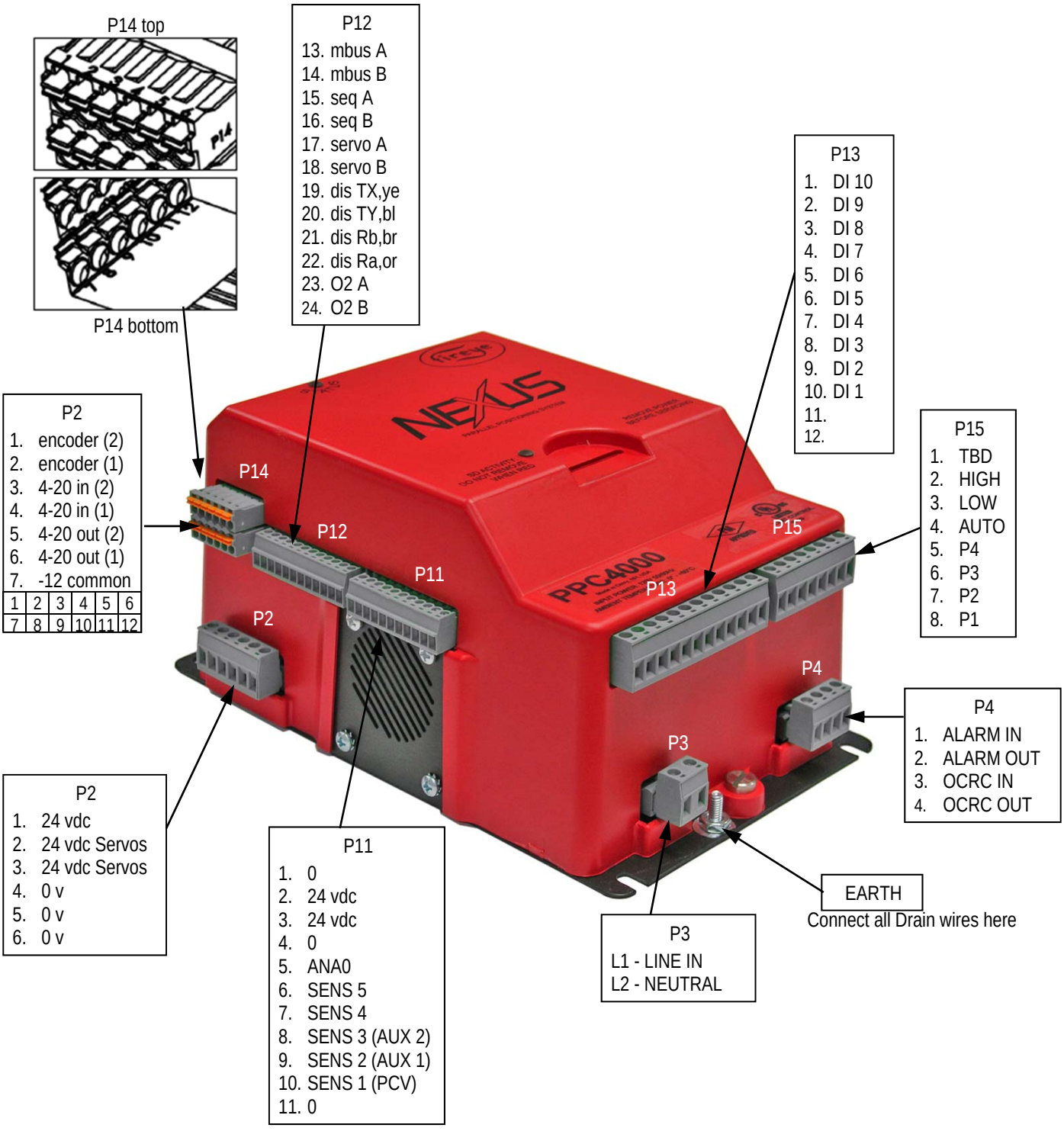
Use Fireye cable, part number 59-562-2 to connect from the NXD410 to the PPC4000 control. The DA15-FM connector plugs into the PLC port located on the backside of the NXD410. The cable distance from the PPC4000 to the NXD410 is limited to 10 feet (3 meters) wire run.

FIGURE 3. NXD410 Rear View



The bottom edge of the display must be mounted at least two inches from any cabinet door edge to allow sufficient clearance for the 59-562-2 cable.


P15
1. TBD
2. HIGH
3. LOW
4. AUTO
5. P4
6. P3
7. P2
8. P1
SD ACTIVITY
STATUS/ALARM
P13
1. DI 10
2. DI 9
3. DI 8
4. DI 7
5. DI 6
6. DI 5
7. DI 4
8. DI 3
9. DI 2
10. DI 1
11. TBD
12. TBD
P13
P15
P3
P4
P5
P3
L1 - LINE IN
L2 - NEUTRAL
EARTH
P4
1. ALARM IN
2. ALARM OUT
3. OCRC IN
4. OCRC OUT
P5
10. KS In
9. P
8. TBD
7. TBD
6. TBD
5. TBD
4. TBD
3. AUX
2. 8
1. D

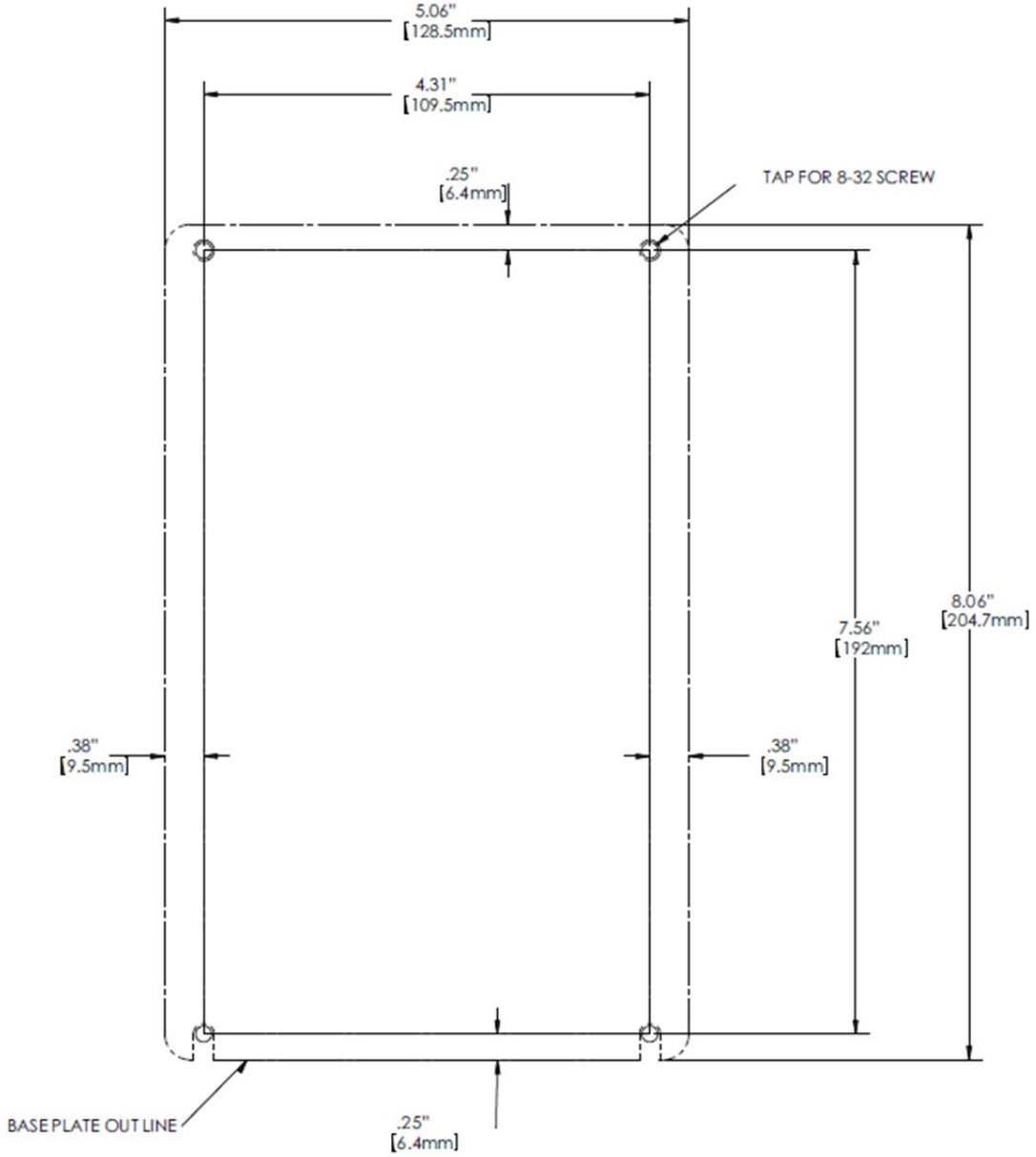

P14 top
P14 bottom
P12
13. mbus A
14. mbus B
15. seq A
16. seq B
17. servo A
18. servo B
19. dis TX,ye
20. dis TY,bl
21. dis Rb,br
22. dis Ra,or
23. O2 A
24. O2 B
P13
1. DI 10
2. DI 9
3. DI 8
4. DI 7
5. DI 6
6. DI 5
7. DI 4
8. DI 3
9. DI 2
10. DI 1
11.
12.
P2
1. encoder (2)
2. encoder (1)
3. 4-20 in (2)
4. 4-20 in (1)
5. 4-20 out (2)
6. 4-20 out (1)
7. -12 common
1 2 3 4 5 6
7 8 9 10 11 12
P15
1. TBD
2. HIGH
3. LOW
4. AUTO
5. P4
6. P3
7. P2
8. P1
P14
P12
P11
P2
P13
P15
P4
P3
P4
1. ALARM IN
2. ALARM OUT
3. OCRC IN
4. OCRC OUT
P2
1. 24 vdc
2. 24 vdc Servos
3. 24 vdc Servos
4. 0 v
5. 0 v
6. 0 v
P11
1. 0
2. 24 vdc
3. 24 vdc
4. 0
5. ANA0
6. SENS 5
7. SENS 4
8. SENS 3 (AUX 2)
9. SENS 2 (AUX 1)
10. SENS 1 (PCV)
11. 0
P3
L1 - LINE IN
L2 - NEUTRAL
EARTH
Connect all Drain wires here

PPC4000 INSTALLATION

Install the PPC4000 control where the relative humidity never reaches the saturation point. The Nexus PPC4000 system is designed to operate in a maximum 85% relative humidity continuous, non-condensing environment. Do not install the PPC4000 system where it can be subjected to vibration in excess of 0.5G continuous maximum vibration. The PPC4000 system is not a weather tight enclosure. The standard vertical position is recommended. Allow at least one inch clearance around the control for service and installation.

Refer to Figure 4 for mounting dimensions.

FIGURE 4. Mounting Dimensions



The PPC4000 is mounted to the cabinet back plate using 4 X #8-32 screws. Following the mounting dimensions shown in Figure 4, drill and tap 4 mounting holes. Firmly screw the control to the cabinet back plate.

WIRING CONNECTIONS

Terminal	Type	Description	Rating/wiring
P3.1	L1	Line Voltage Supply	120/230 VAC (+10%, -15%) 50/60 Hz
P3.2	L2/N	Line Voltage Common	
EARTH (stud)		Protective Earth	Chassis ground connection
P4.1	Input	Alarm Relay Input	Voltage free contacts
P4.2	Output	Alarm Relay Output	Voltage free contacts, 3A 250VAC
P4.3	Input	Operating Control Input	Connect to recycle limits In
P4.4	Output	Operating Control Output	Connect to recycle limits Out, 16A 250VAC
P2.1	Power	O2 Probe & User Interface Power	24 VDC, 59-562 - RED
P2.2	Power	Servo Power, uC controlled	24 VDC, 59-565 - RED
P2.3	Power	Servo Power, uC controlled	24 VDC, 59-565 - RED
P2.4	Common	O2, User Interface, Servo VDC Return	0 VDC, 59-562 - BLACK
P2.5	Common	O2, User Interface, Servo VDC Return	0 VDC, 59-565 - BLACK
P2.6	Common	O2, User Interface, Servo VDC Return	0 VDC, 59-565 - BLACK
P11.1	Common	0 VDC	VDC Return
P11.2	Power	Temp/Pressure Source Voltage	24 VDC Nominal (class 2)
P11.3	Power	Temp/Pressure Source Voltage	24 VDC Nominal (class 2)
P11.4	Common	0 VDC	VDC Return
P11.5	Output	Analog Output	4-20mA output
P11.6	Input	SENS 5 Sensor Analog Input	See Table 2 for sensor type, range and settings
P11.7	Input	SENS 4 Sensor Analog Input	
P11.8	Input	SENS 3 (AUX2) Sensor Analog Input	
P11.9	Input	SENS 2 (AUX1) Sensor Analog Input	
P11.10	Input	SENS 1 (PCV) Sensor Analog Input	
P11.11	Common	0 VDC	VDC Return
P12.1		Modbus-RTU A	
P12.2		Modbus-RTU B	
P12.3		SEQUENCING A	
P12.4		SEQUENCING B	
P12.5		Servo Comms A1	59-565, ORANGE
P12.6		Servo Comms B1	59-565, BROWN
P12.7		User Interface, Tx	59-562, YELLOW
P12.8		User Interface, Ty	59-562,BLUE
P12.9		User Interface, Rb	59-562, BROWN
P12.10		User Interface, Ra	59-562, ORANGE
P12.11		O2 Comms A1	59-565, ORANGE
P12.12		O2 Comms B1	59-565, BROWN

Terminal	Type	Description	Rating/wiring
P13.1	D1 10	Digital Input #10	120/230 VAC @ 1mA
P13.2	D1 9	Digital Input #9	120/230 VAC @ 1mA
P13.3	D1 8	Digital Input #8	120/230 VAC @ 1mA
P13.4	D1 7	Digital Input #7	120/230 VAC @ 1mA
P13.5	D1 6	Digital Input #6	120/230 VAC @ 1mA
P13.6	D1 5	Digital Input #5	120/230 VAC @ 1mA
P13.7	D1 4	Digital Input #4	120/230 VAC @ 1mA
P13.8	D1 3	Digital Input #3	120/230 VAC @ 1mA
P13.9	D1 2	Digital Input #2	120/230 VAC @ 1mA
P13.10	D1 1	Digital Input #1	120/230 VAC @ 1mA
P13.11	TBD	Reserve	120/230 VAC @ 1mA
P13.12	TBD	Reserve	120/230 VAC @ 1mA
P15.1	TBD		120/230 VAC @ 1mA
P15.2	Input	HIGH, FSG High Purge Output	120/230 VAC @ 1mA
P15.3	Input	LOW, FSG Low Fire Start	120/230 VAC @ 1mA
P15.4	Input	AUTO, FSG Modulation Mode	120/230 VAC @ 1mA
P15.5	Input	P4, Profile 4 Select	120/230 VAC @ 1mA
P15.6	Input	P3, Profile 3 Select	120/230 VAC @ 1mA
P15.7	Input	P2, Profile 2 Select	120/230 VAC @ 1mA
P15.8	Input	P1, Profile 1 Select	120/230 VAC @ 1mA
P5.1	Output	To FSG Low Fire Input (D)	120/230 VAC, 8A 250VAC
P5.2	Output	To FSG Open Damper Input (8)	120/230 VAC, 8A 250VAC
P5.3	Output	Aux Relay 1	120/230 VAC, 8A 250VAC
P5.4	Output	Reserve	
P5.5	Output	Reserve	
P5.6	Output	Reserve	
P5.7	Output	Reserve	
P5.8	Output	Reserve	
P5.9	Output	Safety Relay Output (P)	120/230 VAC, connect to non-recycle limits
P5.10	Output	Safety Relay Input	120/230 VAC, connect to non-recycle limits
P14.1		Encoder Input (2)	
P14.2		Encoder Input (1)	
P14.3		4-20 mA IN (2)	VFD (2) feedback
P14.4		4-20 mA IN (1)	VFD (1) feedback
P14.5		4-20 mA OUT (2)	VFD (2) drive
P14.6		4-20 mA OUT (1)	VFD (1) drive
P14.7 - P14.12		Common	Signal return

CAUTION: Ensure that electric power is turned off. Refer to SN-100 for recommended grounding techniques.

Be aware that power to some interlocks (operating controls, air flow switches, modulating circuits, etc.) may be derived from sources other than what is controlling the PPC4000.

PPC4000 MOUNTING AND WIRING

As a convenience, the PPC4000 is equipped with de-pluggable type terminal blocks. It is recommended the PPC4000 be wired with the terminal blocks inserted into the control as shipped.

Following the wiring connections table above, make all electrical connections in accordance with the application requirements. The suggested order of wiring is as follows:

1. Power inputs, L1, L2, Earth (AWG 18, 300 vac) P3.1, P3.2
2. NXD410 user interface using Fireye cable 59-562-2 P12.7-P12.10; P2.1, P2.4
3. Servo motors P2.2, P2.3, P2.5, P2.6, P12.5, P12.6, P12.11, P12.12
4. Alarm relay contacts if required (AWG 16-18, 300 vac)
5. Digital inputs (AWG 14-16, 300 vac) P13.1 - P13.10
6. Operating control to limit switches and flame safeguard P4.3, P4.4
7. Flame safeguard inputs to PPC4000 (AWG 18, 300 vac) P15.2, P15.3, P15.4
8. Relay outputs to flame safeguard (AWG 14-16, 300 vac) P5.1, P5.2, P5.9, P5.10
9. Profile select inputs (AWG 18, 300 vac) P15.5-P15.8
10. Pressure / Temperature sensors (shielded cable, Belden 9318)

PRESSURE AND TEMPERATURE SENSORS

1. Insure that the range of the selected pressure or temperature sensor is appropriate for the application. See Table 2.
   Note: A general rule to follow when selecting the sensor range is that the expected value of the monitored pressure or sensor should fall between 35-75% of the upper range of the sensor. For example, a steam boiler maintains 15 lbs. pressure, select the BLPS-30 Pressure Sensor, with a 0-30 PSI range
2. The sensors must be located where the ambient temperature will not exceed the maximum ambient operating temperature specified for the sensor. Insure that the pressure range programmed on the PPC4000 Control matches the installed pressure sensor.
3. Vacuum return systems will occassionally pull a positive pressure sensor into a vacuum condition which will cause a “sensor out of range” fault, requiring a manual reset. The BLPS-25’s range is -14.7 to 25 PSI and will operate normally should the system go to vacuum. Please note however, the available set point range is 1.0 PSI to 23.0 PSI in 0.1 PSI increments.
4. Do not mount any of the sensors where they could be used as a footstep.

Installation must be performed by a trained, experienced flame safeguard technician.

Table 2: SENSOR RANGE and SETTINGS

Part Number	Sensor Type	Set Point Range	Cut In	Cut Out	Mod Range	Increment Decrement
BLPS-15	0 - 15 PSI	1.0 - 14.0p	0 - 6.0p	0.3 - 6.0p	0.3 - 6.0p	0.1p
	0 - 1030m	70m - 950m	0 - 410m	20m - 410m	20m - 410m	10m
BLPS-25	-14.7 - 25 PSI	1.0 - 23.0p	0 - 6.0p	0.3 - 6.0p	0.3 - 6.0p	0.1p
	-1013 - 1720m	70m - 1500m	0 - 410m	20m - 410m	20m - 410m	10m
BLPS-30	0 - 30 PSI	1.0 - 28.0p	0 - 6.0p	0.3 - 6.0p	0.3 - 6.0p	0.1p
	0 - 2070m	70m - 1950m	0 - 410m	20m - 410m	20m - 410m	10m
BLPS-200	0 - 200 PSI	10 - 190p	0 - 60p	3 - 60p	3 - 60p	0.1p
	0 - 13.8B	0.70 - 13.0B	0.0 - 4.1B	0.2 - 4.10B	0.20 - 4.10B	.05B
BLPS-300	0 - 300 PSI	10 - 280p	0 - 60p	3 - 60p	3 - 60p	0.1p
	0 - 20.7B	0.70 - 19.3B	0.0 - 4.1B	0.2B - 4.10B	0.2B - 4.10B	.05B
	Note: 1 PSI = 68.94757 mbar					
TS350-X*	32º - 350ºF	35º - 338ºF	0º - 60ºF	3º - 60ºF	3º - 60ºF	1ºF
	0º - 176ºC	4º - 170ºC	0º - 60ºC	3º - 60ºC	3º - 60ºC	1ºC
TS752-X*	32º - 752ºF	35º - 725ºF	0º - 60ºF	3º - 60ºF	3º - 60ºF	1ºF
	0º - 400ºC	4º - 385ºC	0º - 60ºC	3º - 60ºC	3º - 60ºC	1ºC
	m = millibar, p = psi, B= BAR					

*Select Length X = -2", -4" or -8"

MOUNTING PRESSURE SENSORS

1. The steam pressure sensors (BLPS-15, -25, -30, -200, -300) provide a 1/4" NPT female fitting for connection to the steam header.
2. Make sure the boiler is shut down and zero steam pressure exists in the boiler vessel.
3. Disconnect power to the boiler controller so the boiler cannot sequence during installation of the steam pressure sensor.
4. Always mount the steam pressure sensor above the water line of the boiler.
5. Locate the pressure sensors where the ambient temperature will not exceed 185F.
6. Use only a small amount of pipe compound to seal the connection joints. Excess pipe compound may clog the fitting and prevent proper operation of the sensor.
7. Although the unit can withstand substantial vibration without damage or significant output effects, it is good practice to mount the pressure sensor where there is minimum vibration.
8. A steam trap (siphon loop) must be connected between the boiler and the pressure sensor to prevent boiler scale and corrosive vapors from affecting the pressure sensor element.
9. Make all pipe connections in accordance with approved standards.
10. When tightening the sensor, apply a wrench to the hex flats located just above the pressure fitting.
    DO NOT tighten by using a pipe wrench on the housing. Do not tighten the pressure sensor by hand.

WARNING: The electro-mechanical high steam limit and/or high hot water temperature limit MUST REMAIN in the 3-P running interlock circuit.

MOUNTING TEMPERATURE SENSORS

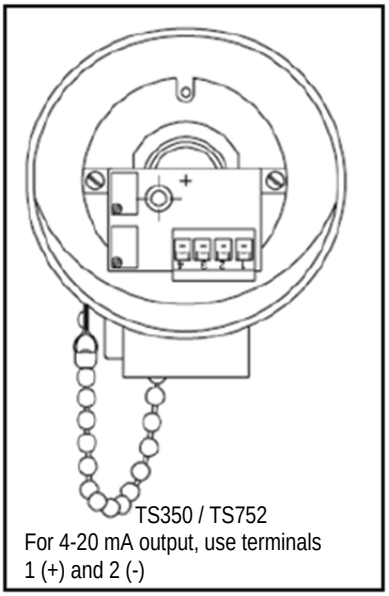
The immersion style temperature sensors have a ½" NPT mounting for the 2", 4", and 8" thermowell probes, and a ½" conduit fitting for electrical connections.

> **WARNING: Location of the temperature sensor to monitor boiler water temperature of a steam boiler is critical. The sensor should be mounted where it is always exposed to the circulation of the boiler water, not too close to a hot or cold inlet or steam coil. Consult the boiler manufacturer for guidance for its location or refer to Bulletin BLZPTS-1 for proper location and wiring of this temperature sensor.**

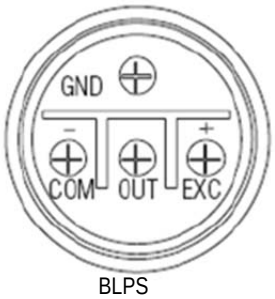
WIRING PRESSURE AND TEMPERATURE SENSORS

> **CAUTION: Disconnect power supply from the PPC4000 Control before connecting wires to prevent electrical shock and equipment damage.**

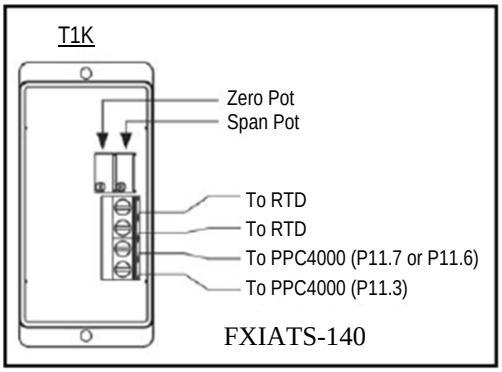
1. All wiring must be in accordance with National Electrical Code and local codes, ordinances, and regulations.
2. Sensor housing provides connection for 1/2" conduit.
3. The pressure and temperature sensors require 2 conductor, 18 gauge, shielded cable. Power limited, rated for 300V @105C. Use Belden 9318 or equivalent. The shield should be connected to the earth ground terminal on the base of the PPC4000 Control. The shield should be taped at the sensor to avoid unintended contact with the sensor housing.
4. All sensor wiring should be in a separate conduit. DO NOT install sensor wiring in any conduit or junction boxes with high voltage wiring.
5. Maximum wiring distance for sensor wiring is 100 feet.



TS350 / TS752
For 4-20 mA output, use terminals 1 (+) and 2 (-)



BLPS
For 4-20 mA output, use + EXC and - COM terminals



FXIATS-140

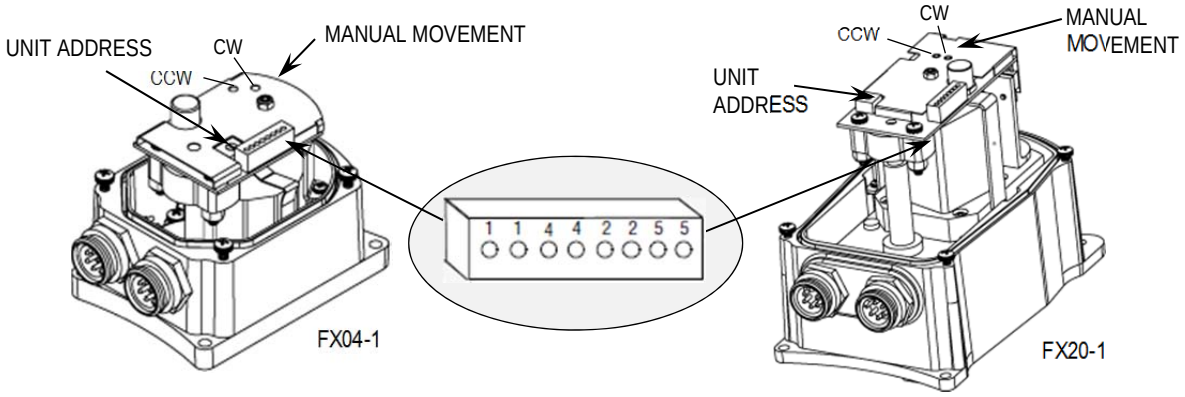
TS350/TS752	BLPS	SENS1	SENS2	SENS3	SENS4	SENS5
1+	+EXC	P11.2	P11.2	P11.3	-	-
2-	-COM	P11.10	P11.9	P11.8	-	-
FXIATS-140						
1+	-	-	-	P11.3	P11.3	P11.3
2-	-	-	-	P11.8	P11.7	P11.6

SERVO MOTOR SETUP AND WIRING

The PPC4000 must have a “master servo” in order to generate a valid modulation curve. In a typical setup, without VFD, the AIR servo is selected as the master servo; if a VFD is used, the first fuel servo is then selected as the master servo. The modulation rate, low fire to high fire, and therefore the servo(s) positions are derived from the master servo commissioning values. Each servo is equipped with an internal rotary switch that is used to select its communication address. The address range is 1 to 10. It does not matter what each servo address is but it is required that each servo have its own **unique** address.

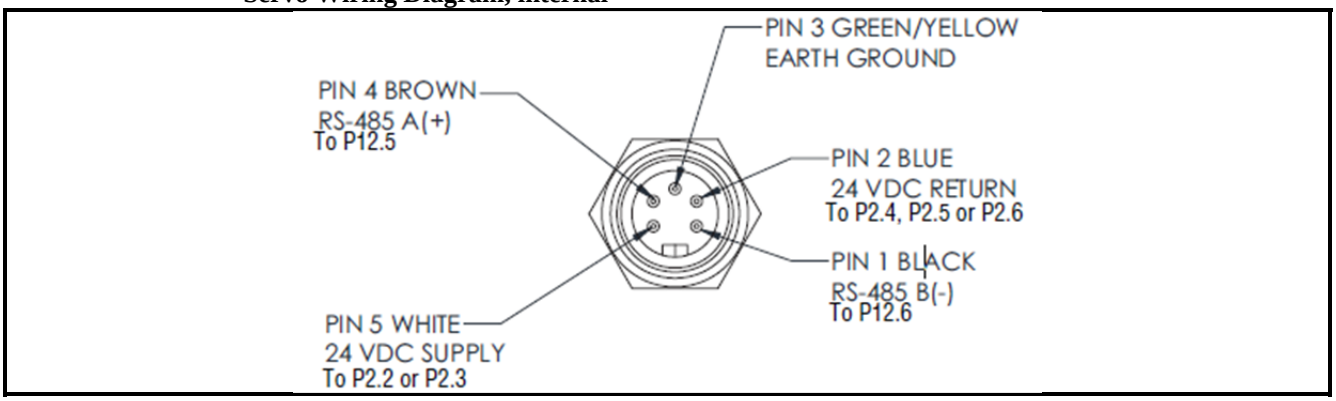
The servo addresses are learned during power on.

It is recommended that servos be wired to the PPC4000 in a multi-drop configuration. That is, cabling traverses from the control to the first servo, to the second servo, to the third servo, etc. Servo types FX04-1, FX20-1 and FX50-1 are pre-wired to connectors located on the body of the servo. Cordsets having female connectors on both ends are available in 6 and 40 foot lengths. Field wireable connectors and cable are also available. See ORDERING INFORMATION for part numbers. Servo types FX04, FX20 and FX50 allow the installation of conduit fittings and the user to wire di-rectly to the servos using the terminal strips located inside the servo. Always connect the ground first to eliminate any ESD (electro-static discharge) potential.



WARNING - DO NOT USE THE MANUAL MOVEMENT SWITCHES ON THE SERVO MOTORS DURING AUTOMATIC OPERATION OR THE FIRING CYCLE OF THE BURNER. USE OF THE MANUAL MOVEMENT SWITCHES OPERATES THE SERVOMOTORS INDEPENDENT OF THE PPC4000 CONTROL AND COULD RESULT IN AN OFF-RATIO CONDITION IF OPERATED DURING AUTOMATIC OPERATION OR THE FIRING CYCLE

Servo Wiring Diagram, internal



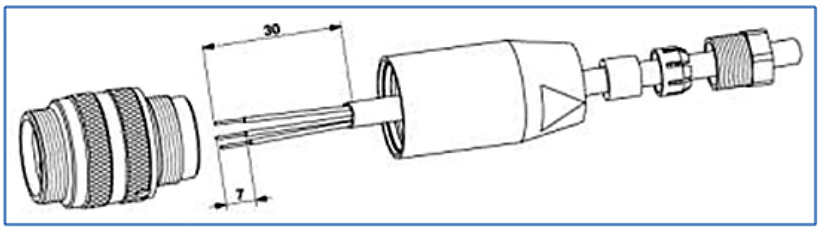
Refer to bulletins NEX-3004, NEX-3020 and NEX-3050 for operational details, setting the addresses and servo movement.

Note: The PPC-4000 provides two terminals for 24 Vdc supply for the servos P2.2 & P2.3 (24 Vdc return via P2.4-P2.6). The PPC-4000 can supply approximately 60 VA through these terminals[1], for any combination of connected servos. The PPC-4000 can supply up to twelve 4Nm servos or four 20Nm servos, or three 50Nm servos or some combination that will result in 60 VA of power[2]. If more power than this is required, an external power supply must be used[3]. See figure 5 for recommended wiring of the external power supply.

1. Power budget for the NXD410 display and oxygen probe does not impact the 60VA budget for the servos.
2. See nominal ratings on page 6.
3. Ratings for external power supply sizing should be based on peak servo ratings

Cables and Connectors

Cord sets having female connectors on both ends are available in 6 and 40 foot lengths. Field wireable connectors are available in kit form, 129-192. Fireye recommends cable part number 59-565 to be used for servo wiring.



As shown above the cable strip length is specified at 30 mm (1.2 in) and each wire strip length is 7 mm (0.275 in).

To use cable 59-565, strip one end as specified. Strip each wire and wire to connector as shown.

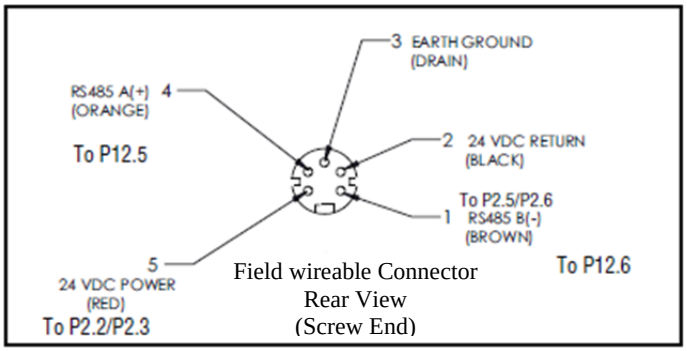
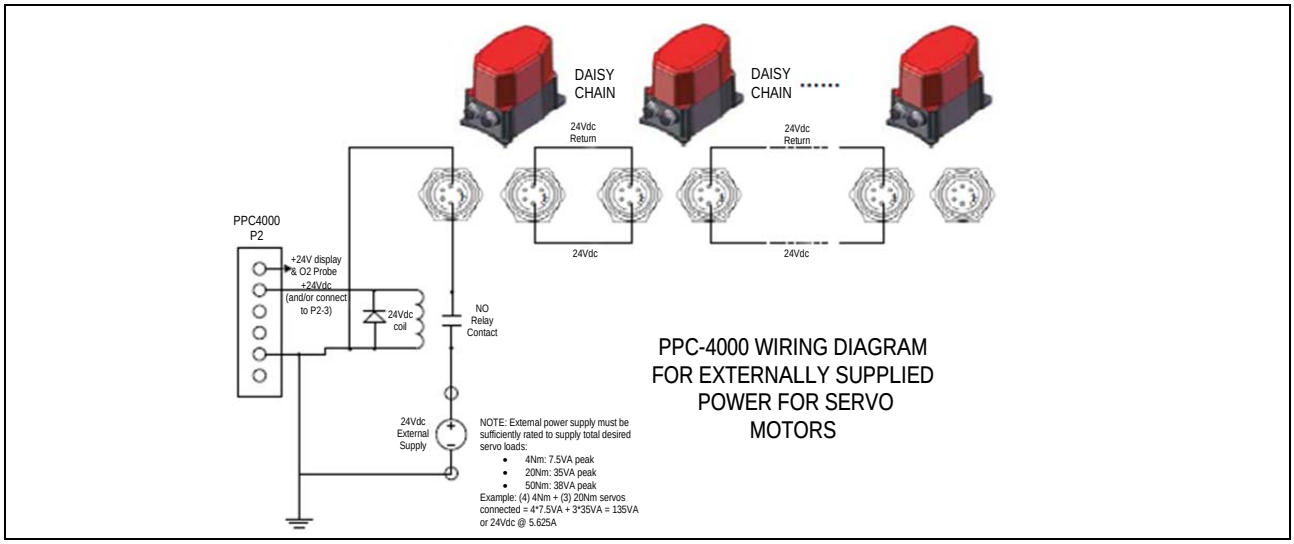


FIGURE 5. Field wireable connector, 129-192



NXCES02 OXYGEN PROBE

The NXCESO2 oxygen sensing probe is designed to operate with the PPC4000 and provides trimming of the air or fuel servos to maintain predefined O2 target levels resulting in optimum combustion. Refer to Commissioning and Adjust Ratio procedures. The NCESO2 also provides the stack temperature measurement. The user has the option to activate both O2 level and flue temperature level alarms and the alarms can be selected to be warning or lockout. Refer to O2 setup menu parameters later in this bulletin.

The NXCESO2 is available in 2 probe lengths, 8 and 16 inches to accommodate most stack diameters. The open end of the probe should be located close to the center of the stack (flue).

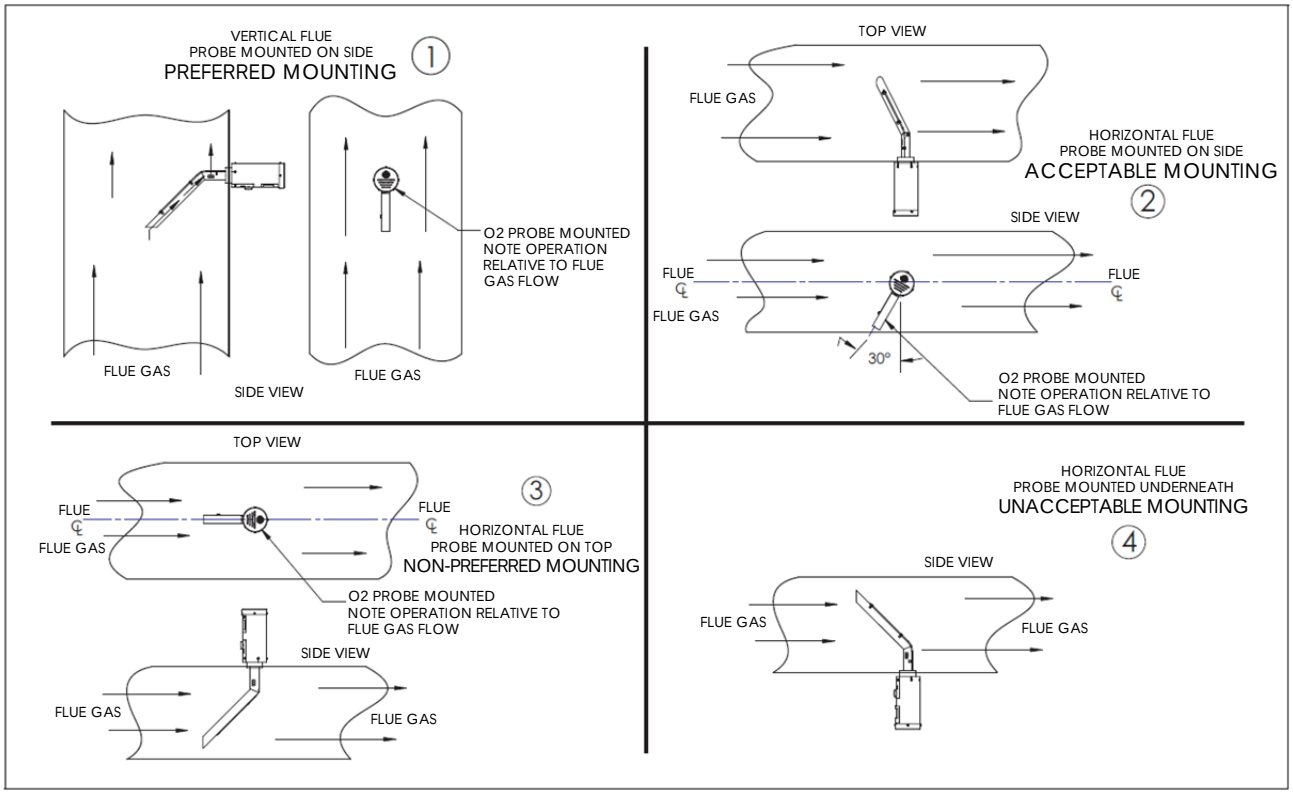
The NXCESO2 is 24 vdc powered from the PPC4000. Data exchange to and from the probe is done through modbus communications @ 57.6 kbaud using a twisted shielded pair. JP1 is a baud rate selector and must be left in place for proper connection to the PPC4000.

The NXCESO2 contains an integrated cooling fan that is controlled by the on-board microprocessor. The fan will turn on when the internal temperature exceeds 70°C (158°F) and turn off when the temperature drops below 45°C (113°F).

The O2 probe mounts in the stack using Fireye mounting flange kit 35-381-2. See 133-750 for mounting dimensions and instructions.

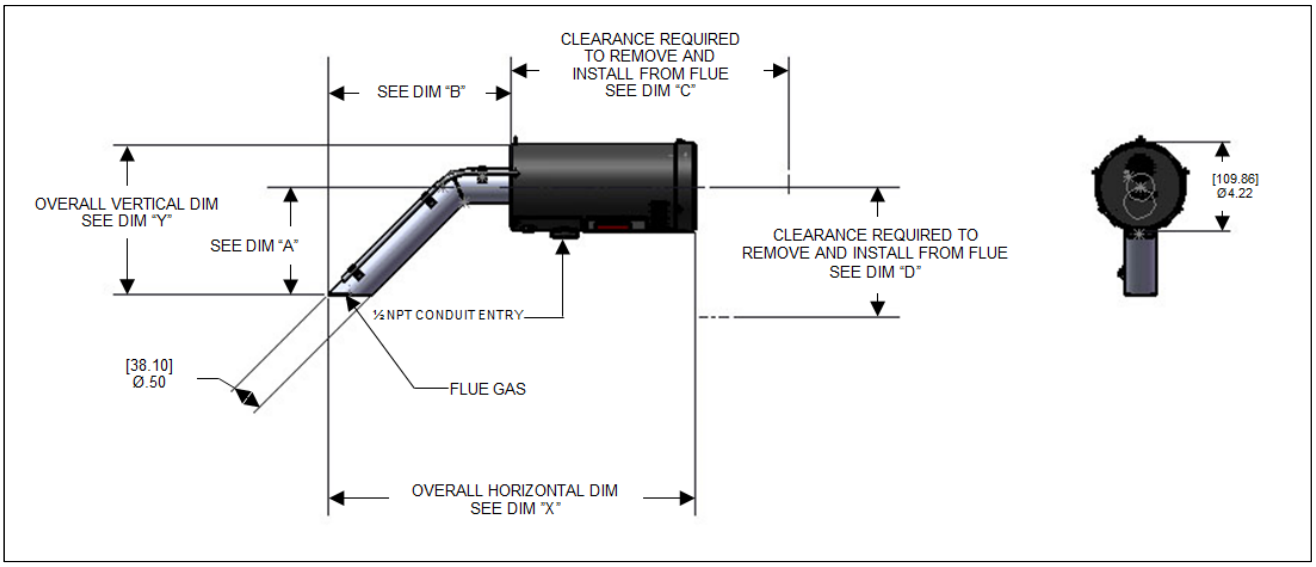
Recommended Oxygen Probe Mounting Positions

The probe must be mounted in a manner that ensures that the flue gases pass into the gas tube at its open end and out of the tube at the flange end. Furthermore, if possible, the flange should be vertical with the gas tube angled downwards to ensure that particulates do not build up within the sample tube. Probe mounting with the flange horizontal is acceptable. Inverted probe mounting is not acceptable.



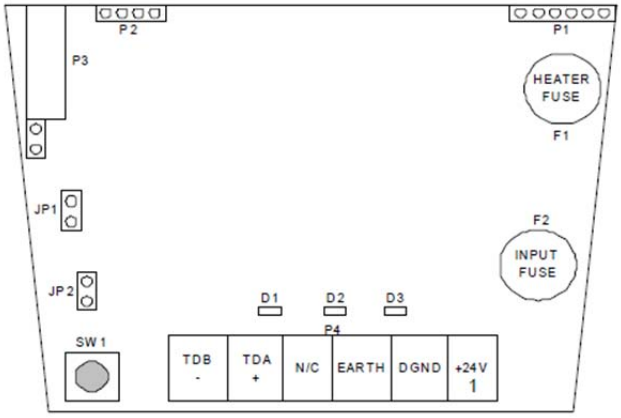
NXCESO2 Dimensional Information

FIGURE 6.



MODEL NUMBER	DIM "A"	DIM "B"	DIM "C"	DIM "D"	DIM "X"	DIM "Y"
NXCES02-8	(44) 5.5	(216) 8.00	(426) 16.75	(324) 12.75	(445) 18.00	(121) 7.40
NXCES02-16	(236) 13.3	(407) 16.00	(692) 27.25	(324) 12.75	(637) 26.00	(295)15.40

Wiring Connections



NXCESO2		DESCRIPTION	59-565	PPC4000
6	TDB (-)	MODBUS -	BROWN	P12-12
5	TDB (+)	MODBUS +	ORANGE	P12-11
4	N/C	-	-	
3	EARTH		DRAIN	EARTH
2	DGND	RETURN	BLACK	P2-5
1	+24V	POWER	RED	P2-1
	Remove power when servicing			

SW1	Provides fault reset and forced calibration	
JP1	Baud rate selector. In is 57600 (PPC4000), Out is 19200	
JP2	RS485 termination resistor	
F1	Heater Fuse	23-231 4A, 125V Type LFMX
F2	Input Fuse	

Refer to Fireye bulletin NXCESO2-1001 for complete details on the O2 probe.

NXD410 User Interface

The NXD410 User Interface provides the means to setup, monitor and display all information from the PPC4000 Control and connected accessories. The NXD410 provides a four line backlit LCD display screen and a multi-function tactile feel keypad. The NXD410 is panel mounted and connects directly to the PPC4000 using Fireye cable 59-562-2.

Explanation of NXD410 keypad

The > and < characters act as alignment indicators. To move to a sub-menu or modify a parameter, the user places the menu line or parameter between these two characters.

Several functions of the PPC4000 will cause the LED associated with that function to illuminate on the keypad.

For any parameter that requires a passcode, pressing a key on the keypad will direct the user to a passcode screen first where the user will input the appropriate level of passcode. If the passcode is currently enabled, pressing a key will direct the user directly to that parameter.

The NXD410 and PPC4000 Control contain a number of Quick Keys that allow the user to access that function directly. For these Quick Keys to operate the installer or operator must first access the KEYPAD SETUP menu where the user defines if a Quick Key is used or unused. Quick Keys are also non-volatile meaning the state of the switch function is retained in memory should a power recycle occur.

No	LED	Key Name	Description
1		BURNER ON/OFF	KEYPAD SETUP required. Used to turn the burner ON or OFF. Typically there are also other limits in the operating control circuit. The LED indicates the position of the keypad switch and illuminates when the burner is in the ON mode. When turning the burner off via this keypad switch the default method is assured low fire cutoff or move to low fire before OFF.
2		LOW FIRE	KEYPAD SETUP required. If in modulation mode, move servos to low fire position (P03). After burner startup, stay in low fire after MTFI. LED will illuminate when directed to low fire. Pressing AUTO | MAN will turn this off.
3		LEAD LAG	Used when SEQUENCING is enabled. If enabled through the sequencing setup sub-menu, selects PPC4000 Control to be MASTER or SLAVE. The LED illuminated indicates the unit is a MASTER. If the SEQUENCING does not provide for keypad selection then this key has no function.
4		AUTO MAN	Switch to automatic control (modulation) mode. LED will illuminate when in manual mode. This can be overridden by LOW FIRE.
5		C-MODE	Go to the Commissioning or Adjust Ratio Mode. LED illuminates when C-MODE is enabled (after passcode enabled). While in Commissioning Mode or Adjust Ratio Mode, hitting C-Mode is used to correctly terminate Commissioning and Adjust Ratio Mode.
6		ADJUST SETPOINT	Directs operator to setpoint currently controlling the burner, SETPOINT1, SETPOINT2, or SETBACK.
7		RESET	Allows reset of non-volatile lockout. LED illuminates when control is in lockout awaiting reset.
8		CHK RUN/FAULT	Fault History Display
9		MODIFY SAVE	MDFY: LED illuminates and enters modify mode. UP/DOWN arrows are used to modify current value. SAVE: Save current parameters/setup, extinguish LED
10		UP	Move up to the previous menu item. When in MODIFY mode, used to increment numerical value.
11		DOWN	Move down to the next menu item. When in MODIFY mode, used to decrement numerical value.
12		NEXT	When displayed item contains > symbol, direct user to the next submenu. Displayed item must be between > < marks on keypad. (Also, when in servo setup, forces scan for installed servos).
13		BACK	When displayed item contains < symbol, direct user to the previous parent menu. Displayed item must be between > < marks on keypad.
14		HOME	From anywhere and in any menu or submenu, immediately suspends any modify mode if enabled and directs user to default or main screen.
15		INFO	Pressing this key will enter INFO mode. Pressing key while in INFO mode, will exit INFO mode. Useful while in commissioning mode to check values of all parameters, digital inputs, measured value, etc.

NAVIGATING THROUGH DISPLAY MENUS

The PPC4000 and NXD410 present data to the user through menus and sub-menus. The data and information is organized in a logical and easy to access manner. The order of items displayed are arranged to be items most used by the operator and require a minimum of key presses. The UP, DOWN, NEXT, BACK and HOME keys are used to navigate into and out of these menus. The MDFY/SAVE key is used to both modify and save the selected parameter.

The HOME key is used to bring the user directly back to the top layer menu and display the default items. Any item in the top layer menu that contains a > character indicates there is a sub menu below it. The NEXT key is used to move to the next sub menu showing parameters for that item. The BACK key is used to revert from the sub menu back to the previous level menu. Various menu items may have several sub menus.

TOP LAYER MENU

		F	A	U	L	T		H	I	S	T	O	R	Y						>
		P	A	S	S	C	O	D	E		S	E	T	U	P					>
		O	I	L		T	E	M	P	(	3	)					1	4	7	F
		S	T	A	C	K		T	E	M	P	(	4	)			3	2	5	F
		G	A	S		P	R	E	S	(	5	)		X	X	.	X	i	n	w	c
		1	1	:	3	6	A	M				1	7	-	A	U	G	-	1	0	>
		W	A	I	T		F	O	R		P	U	R	G	E				s	0	6
HOME	>	S	E	T	P	O	I	N	T						1	2	.	0	p	s	i	< HOME
		M	E	A	S	U	R	E	D		V	A	L		1	0	.	6	p	s	i	
		M	O	D	U	L	A	T	I	O	N		R	A	T	E				0	%	
		A	I	R	(| 1 |)										8	3	.	2		
		G	A	S	(| 2 |)											4	.	3		
		F	G	R	(| 4 |)											3	.	4		
		F	A	N	(	V	F	D	1	)									9	8	0	
		O	2		L	E	V	E	L								2	0	.	9	%	
		C	O	2		L	E	V	E	L									*	*	*	
		F	L	U	E		T	E	M	P							1	7	2	°	F	
		E	F	F	I	C	I	E	N	C	Y								*	*	*	
		S	E	R	V	O		S	E	T	U	P									>	
		S	E	N	S	O	R		S	E	T	U	P								>	
		S	E	T	P	O	I	N	T		S	E	T	U	P						>	
		P	R	O	F	I	L	E		S	E	T	U	P							>	
		D	I	G	I	T	A	L		I	N	P	U	T		S	E	T	U	P	>	
		O	2		S	E	T	U	P												>	
		S	E	Q	U	E	N	C	I	N	G		S	E	T	U	P				>	
		T	H	E	R	M	A	L		S	H	O	C	K		S	E	T	U	P	>	
		S	E	T	B	A	C	K		S	E	T	U	P							>	
		C	O	M	M	U	N	I	C	A	T	I	O	N		S	E	T	U	P	>	
		K	E	Y	P	A	D		S	E	T	U	P								>	
		S	D		C	A	R	D		O	P	S		S	E	T	U	P			>	
		A	N	A	L	O	G		O	U	T		S	E	T	U	P				>	

*NOTE:

Some menu items may not show on the top layer menu. The visibility of the menu items is dependent on the system configuration.

The UP and DOWN keys are used to scroll forward and backward through the top layer menu. The menu is continuous in both directions. That is, when you reach the bottom and continue with the DOWN key, for example, the very top of the menu will be displayed on the next line. As stated earlier, hitting the HOME key from anywhere will bring you back to the HOME screen. The shaded area shown in the Top Layer Menu section on page 25 is the HOME screen. For items that contain the > character, the NEXT key is used to move to a sub menu for that particular item. Also, hitting the BACK key from a sub menu will bring you back to the line item from the menu you left. To move to a sub menu or to modify a parameter, that particular line must lie between the > < characters located on the keypad.

For example, assume you scroll down so the following is displayed:

	F	A	N	(	V	F	D	1	)										0	
>	S	E	R	V	O		S	E	T	U	P								>	<
	S	E	N	S	O	R		S	E	T	U	P							>	
	S	E	T	P	O	I	N	T		S	E	T	U	P					>	

Since SERVO SETUP is lying between the > < characters of the keypad, you press the NEXT key to enter the SERVO SETUP sub menu. The shaded area below is an extension of this particular sub menu:

	S	E	R	V	O		S	E	T	U	P									
>	D	I	S	P	L	A	Y		F	O	R	M	A	T				D	E	G	<
	S	E	R	V	O		S	P	E	E	D							3	0	S	
	S	E	R	V	O	S		I	N	S	T	A	L	L	E	D			4	>	
	S	E	R	V	O	1											A	I	R	>	
	S	E	R	V	O	2											G	A	S	>	
	S	E	R	V	O	3											O	I	L	>	
	S	E	R	V	O	4											F	G	R	>	

Pressing the BACK key from anywhere in this sub menu will take you back to the top layer menu at the place where you exited the top layer menu. Pressing the HOME key will take you back directly to the HOME screen. For the screen shown above, with DISPLAY FORMAT lying between the > < characters, pressing the MDFY/SAVE key will allow you to scroll through options to select the desired value. Pressing the MDFY/SAVE key will save the selected value. Using the DOWN key to display '**SERVO 1 AIR>**' between the > < characters and pressing NEXT will direct you to the SERVO 1 sub menu:

PPC4000 CONTROL OPERATION

This next section will be used to set up a basic low pressure steam boiler system with a single fuel. The application will implement an AIR and GAS servo and use profile 1.

The assumption is made that a BLPS sensor is installed and wired, two appropriately sized FX type servos are installed and wired and DI 1 (digital input) is used as the burner limit input. The servos are setup with unique addresses. For this exercise, assume the servo addresses are 1 for AIR and 2 for GAS. System wiring is done in accordance with **Error! Reference source not found.** (page 70). It is recommended the installer record the low and high fire positions of the air damper and gas butterfly valve and be generally knowledgeable about the burner and its operation.

	<	S	E	R	V	O		1												
>	S	E	R	V	O		N	A	M	E					U	N	U	S	E	D	<
	A	S	S	I	G	N	M	E	N	T										0	
	D	I	R	E	C	T	I	O	N										C	W	
	S	E	R	V	O		P	O	S	I	T	I	O	N			1	.	0	°	

On first application of power, with conditions as stated above, the display will indicate:

	S	T	A	N	D	B	Y											s	0	1
>	S	E	T	P	O	I	N	T							U	N	U	S	E	D	<
	M	E	A	S	U	R	E	D		V	A	L			U	N	U	S	E	D	
	M	O	D	U	L	A	T	I	O	N		R	A	T	E				0	%	

The Operating control relay (OCRC) will remain open and the servos will remain at their respective installed positions. For PASSCODE protected parameters, if the passcode is not enabled, the user will be automatically directed to the PASSCODE setup screen.

PASSCODE

The passcode setup screen is as follows:

	P	A	S	S	C	O	D	E		S	E	T	U	P						
>	S	I	T	E		C	O	D	E								*	*	*		<
	A	D	J	U	S	T		R	A	T	I	O					*	*	*		
	C	-	M	O	D	E											*	*	*		

At this screen the user scrolls down until the desired passcode level is between the > < characters, presses MDFY to enter modify mode, use the UP / DOWN keys to enter the correct value and presses SAVE to enter the value to the system. A correctly entered passcode will direct the user to the HOME screen as shown above.

The system has 3 levels of pass codes. Out of the box settings for internal PASSCODES are as follows:

Pass Code	Pass Code Level	Code*	Feature
SITE CODE	Level 1	154	Setpoint Setup
	Level 1	154	Sequencing Setup
ADJUST RATIO CODE	Level 2	256	Adjust Ratio Mode
	Level 2	256	O2 Setup
	Level 2	256	Erase Profiles
C-MODE	Level 3	903	Commissioning Mode
	Level 3	903	VFD1 and VFD2 Setups
	Level 3	903	All SDCard Operations
	Level 3	903	Erase All Data
	Level 3	903	Sensor Setup

* Level 1 pass code is changeable (0-999) and has a default of 154. Level 1 pass code protection can be turned OFF by setting it to 0. Level 2 and 3 pass codes are fixed. To change Level 1, the user must:

1. Access the PASSCODE menu, enter the C-MODE Level 3 passcode
2. Go back to the PASSCODE menu, now change the SITE CODE Level 1 passcode as desired

REAL TIME CLOCK

The PPC4000 contains a real time clock that is used to record fault history and implement the setback schedule. To operate properly, the real time clock should be checked and set correctly. If not correctly set the PPC4000 will use the clock information as it is available. The real time clock information is displayed in the top layer menu just above the HOME screen. The UP / DOWN keys are used to position the real time clock information to between the > < marks. Note the default time and date are shown.

	P	A	S	S	C	O	D	E		S	E	T	U	P						>
>	1	2	:	0	0	P	M		0	1	-	J	A	N	-	2	0	1	1	>	<
	S	T	A	N	D	B	Y											s	0	1	
	S	E	T	P	O	I	N	T		1					U	N	U	S	E	D	

The PPC4000 uses 12 hour format only, AM / PM. If the clock and date need adjustment, the NEXT key is pressed to move to the DATE / TIME SETUP submenu.

	<	D	A	T	E	/	T	I	M	E		S	E	T	U	P				
>	S	E	T		Y	E	A	R									2	0	1	1	<
	S	E	T		M	O	N	T	H									J	A	N	
	S	E	T		D	A	Y												0	1	
	S	E	T		H	O	U	R									1	2	P	M	
	S	E	T		M	I	N	U	T	E										0	
	S	E	T		S	E	C	O	N	D										0	

Use the UP / DOWN keys to position the item to be modified between the > < marks and use the MDFY/SAVE key to modify and save the new value. When done, press the HOME key to move back to the HOME screen.

SERVO SETUP

From the HOME screen the user scrolls to SERVO SETUP and presses NEXT to enter the sub menu. The following is displayed:

	<	S	E	R	V	O		S	E	T	U	P								
>	S	E	R	V	O		S	P	E	E	D							3	0	<
	S	E	R	V	O	S		I	N	S	T	A	L	L	E	D			>	
	S	E	R	V	O	1														

The speed of the servos can be selected within the range of 30 to 120 seconds in steps of 5 seconds. This is the speed of the servos to move 90 degrees. Use the UP/DOWN keys to place the item to be modified between the > < characters, press MDFY, use the UP/DOWN keys to select the desired value and then press SAVE. SERVOS INSTALLED is used to direct the control to scan the servo communication port and return the number of servos found. This is done by hitting the NEXT key only. For this example, after doing this, the display should be as follows:

	<	S	E	R	V	O		S	E	T	U	P								
>	S	E	R	V	O		S	P	E	E	D							3	0	<
	S	E	R	V	O	S		I	N	S	T	A	L	L	E	D		2		>
	S	E	R	V	O	1														

Scrolling DOWN will show the two installed servos:

	<	S	E	R	V	O		S	E	T	U	P								
>	S	E	R	V	O	S		I	N	S	T	A	L	L	E	D			2	>	<
	S	E	R	V	O		1													>	
	S	E	R	V	O		2													>	

The servos must now be configured to operate in the system. This is called naming the servo and tagging the servo to a profile. Scroll so that the SERVO 1 is between the > < characters and press NEXT to enter the SERVO 1 sub menu:

	<	S	E	R	V	O		1												
>	S	E	R	V	O		N	A	M	E					U	N	U	S	E	D	<
	A	S	S	I	G	N	M	E	N	T										0	
	D	I	R	E	C	T	I	O	N										C	W	
	S	E	R	V	O		P	O	S	I	T	I	O	N			1	.	0	°	

The first parameter that must be set is to name the servo. Each servo must be named and at least one servo of each profile must be named AIR. The table below lists the options for naming the servo and also to what profiles the servo is tagged.

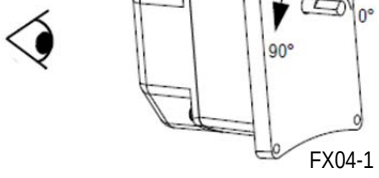
NAME	DESCRIPTION
UNUSED	SERVO NOT USED
FU1	FUEL1
FU2	FUEL 2
GAS	GAS
OIL	OIL
CUP	ROTARY CUP
PUM	PUMP
WAS	WASTE FUEL
PRI	PRIMARY AIR
FGR	FLUE GAS RECIRCULATION
AIR	MAIN COMBUSTION AIR
FAN	MAIN COMBUSTION FAN
SEC	SECONDARY AIR
SLE	BURNER SLEEVE

PROFILE ASSIGNMENT VALUE	
DISPLAY VALUE	PROFILES
0	NONE
1	1
2	2
2,1	2+1
3	3
3,1	3+1
3,2	3+2
3,2,1	3+2+1
4	4
4,1	4+1
4,2	4+2
4,2,1	4+2+1
4,3	4+3
4,3,1	4+3+1
4,3,2	4+3+2
4,3,2,1	4+3+2+1 (ALL)

Place the parameter to be modified between the > < characters and using the MDFY, UP, DOWN and SAVE keys, select AIR and profile 1 for servo 1. The options for the servo direction are CW (clockwise) and CCW (counter-clockwise).

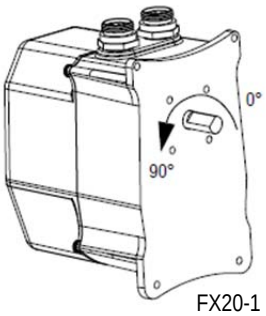
Note: It is necessary to ensure that each motor travels in the correct direction to match the mechanical configuration of the burner. The CW setting is for a servo to move counter-clockwise (looking toward the shaft) as the motor is driven toward 90°.

Clockwise rotation shown as viewed from the cover side



FX04-1

Clockwise rotation shown as viewed from the cover side



FX20-1

Fireye “D” hole couplings should be used in order to assure a secure connection to the driven member. Set screws alone are not recommended as they can come loose resulting in a potentially unsafe condition. Motor shafts are hardened generally preventing set screws from “biting” in and thus loosening after commissioning. Fireye bulletin NEXBK-1000 provides information on “D” hole couplings.

Move the servo position parameter to between the > < characters. At all times and while in P00 (STANDBY, burner off), the servo can be moved to any position. This is useful for checking the movement of the servo and driven member. Take care not to overdrive the servo such that the driven member is attempting to move beyond its mechanical end stop. The servo can be left in any position as it will be positioned properly during commissioning for all profile setpoints. It is recommended that all servo positions commissioned by the user be between 3° degrees and

97° degrees. To move the servo, press MDFY and using the UP and DOWN keys, set the target position. In this example set the target position to 10.0 degrees. Press SAVE and the display will indicate the original position and change as the servo is moving toward its target position.

The final display for servo 1 should look like the following:

<	S	E	R	V	O		1												
>	S	E	R	V	O		N	A	M	E							A	I	R	<
	A	S	S	I	G	N	M	E	N	T									1	
	D	I	R	E	C	T	I	O	N									C	W	
	S	E	R	V	O		P	O	S	I	T	I	O	N		1	0	.	0	°

Press the BACK key to return to the SERVO SETUP sub menu. Select SERVO 2 using the NEXT key to move the SERVO 2 sub menu. Set the parameters for SERVO 2. Name this servo as GAS, tag it to profile 1 and test its servo position for proper function and set its final position to 4.2 degrees. When done the display should be as follows:

<	S	E	R	V	O		2												
>	S	E	R	V	O		N	A	M	E							G	A	S	<
	A	S	S	I	G	N	M	E	N	T									1	
	D	I	R	E	C	T	I	O	N									C	W	
	S	E	R	V	O		P	O	S	I	T	I	O	N			4	.	2	°

At this point press the BACK twice to move back to the top layer menu at the point at which we left the top layer menu. Pressing the HOME key would have brought you back to the HOME screen.

CAUTION
On a previously commissioned system, care must be taken when replacing a servo motor believed to be defective. Although every effort is made to calibrate each servo, there may be slight differences from servo to servo. It is strongly recommended the installer, equipped with a combustion analyzer, use ADJUST RATIO to step through each profile that uses the replacement servo. Each profile set point should be checked and adjusted for proper combustion.

SENSOR SETUP

The PPC4000 contains inputs for five analog 4-20 mA transducers. The process control variable or the governing sensor for the boiler can only be SENSOR 1. The SENSOR SETUP menu is used to configure the various sensors in the system as to type of sensor and range of sensor.

From the top layer menu move SENSOR SETUP to between the > < characters and press NEXT to enter the SENSOR SETUP sub menu.

<	S	E	N	S	O	R		S	E	T	U	P								
>	U	N	I	T	S								E	N	G	L	I	S	H	<
	S	E	N	S	O	R		1												>
	S	E	N	S	O	R		2												>
	S	E	N	S	O	R		3												>
	S	E	N	S	O	R		4												>
	S	E	N	S	O	R		5												>

The parameter UNITS is to select units of measurement for all sensors. The options are ENGLISH and METRIC. ENGLISH is PSI and degrees F. METRIC is BAR and mBar and degrees C. This setting is global, meaning it applies to all sensors. Position SENSOR 1 and press the NEXT key to enter the SENSOR 1 sub menu.

<	S	E	N	S	O	R		1												
>	T	Y	P	E										U	N	U	S	E	D	<
	R	A	N	G	E									U	N	U	S	E	D	

For this application, at SENSOR TYPE press MDFY. Use the UP or DOWN keys to select STEAM and press SAVE. At SENSOR RANGE, press MDFY and use the UP or DOWN keys to select 15 PSI and press SAVE. The display will be as follows:

	<	S	E	N	S	O	R		1											
>	T	Y	P	E												S	T	E	A	M	<
	R	A	N	G	E						0		t	o		1	5	p	s	i	

See table 2 for sensor range and settings. Press the BACK key twice to get back to the top layer at the point where we left it or press HOME to go directly back to the HOME screen.

NOTE: The safety system in the PPC4000 will not allow the sensor configuration to be changed after fully configured, if the sensor is attached to other operating functions like thermal shock or setback. Sensor assignment to those operating functions must be set to UNUSED before the system will allow changes to the sensor configuration.

SENSOR SETPOINT SETUP

In the top layer menu, scroll to SETPOINT SETUP and press NEXT to enter this sub menu. From this menu, select what sensor is used for each setpoint and set the values for that setpoint based on the sensor selected.

The SETPOINT SETUP menu is as follows:

	<	S	E	T	P	O	I	N	T		S	E	T	U	P					
>	S	E	T	P	O	I	N	T		1		S	E	T	U	P				>	<
	S	E	T	P	O	I	N	T		2		S	E	T	U	P				>	
	S	E	T	P	O	I	N	T		3		S	E	T	U	P				>	

Select SETPOINT 1 and press the NEXT key to enter the sub menu. The values shown are the default values.

	<	S	E	T	P	O	I	N	T		1		S	E	T	U	P				
>	S	E	N	S	O	R		U	S	E	D				U	N	U	S	E	D	<
	L	I	M	I	T		T	Y	P	E								D	E	V	
	S	E	T	P	O	I	N	T										N	/	A	
	C	U	T		I	N												N	/	A	
	C	U	T		O	U	T											N	/	A	
	P	-	B	A	N	D												N	/	A	
	H	I	G	H		M	A	R	G	N	L							N	/	A	
	H	I	G	H		L	I	M	I	T								N	/	A	
	I	N	T	E	G	R	A	L												0	
	D	E	R	I	V	A	T	I	V	E										0	

The values shown above are all default values for SETPOINT 1. For SETPOINT 1 the options for SENSOR are limited to UNUSED and SENSOR 1. Using the MDFY, UP, DOWN and SAVE keys, change SENSOR to 1 and then scroll to change the setpoint to 10.0 PSI. Continue and set cut in, cut out and proportional band (P-BAND) to appropriate values.

For SETPOINT 2, the options for SENSOR are limited to UNUSED, SENSOR 1, and SENSOR 2.

For SETPOINT 3, the options for SENSOR are limited to UNUSED and SENSOR 3.

Definitions:

LIMIT TYPE

DEV - Values that deviated from setpoint. The advantage is these values will float with the setpoint.

SETPOINT - The target pressure or target temperature the control will maintain.

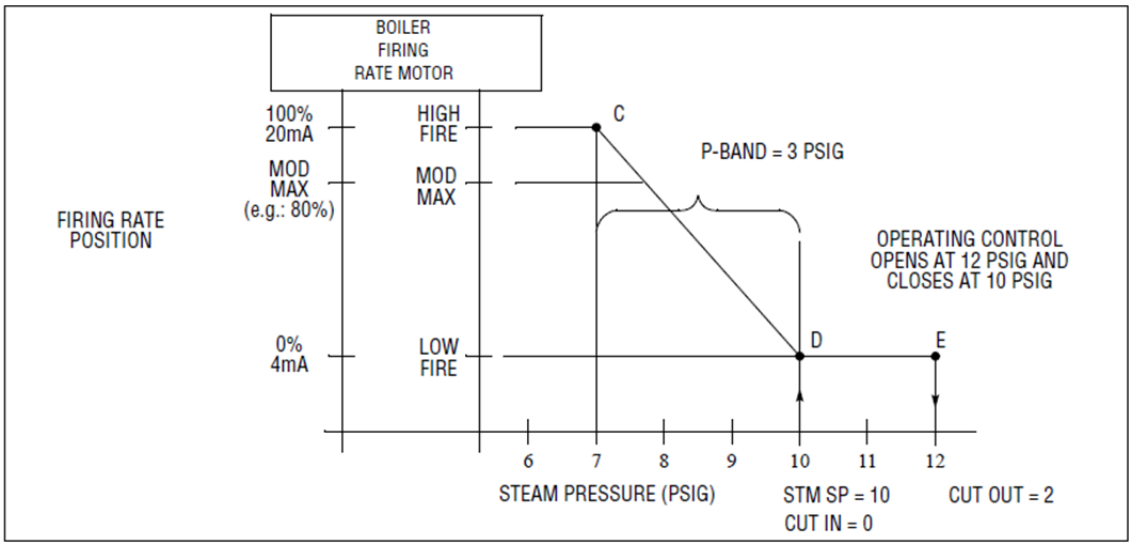
CUT IN (Cut In Value) - Determines the point in which the steam pressure (or water temperature) must reach to start a burner cycle. In DEV option, this a differential value that is subtracted from the steam pressure or water temperature setpoint.

CUT OUT (Cut Out Value) - Determines the point in which the steam pressure (or water temperature) must reach to end a burner cycle and initiate a normal shutdown. In DEV option, this is a differential value that is added to the steam pressure or water temperature setpoint.

P-BAND (Modulating Range) - This determines the proportional band and is the range of steam pressure (or water temperature) in which the firing rate motor is commanded from its low fire (0%) to its high fire position (100%). In DEV option, this is a differential value that is **subtracted** from the steam pressure setpoint or water temperature setpoint.

Whenever the steam pressure (or water temperature) is within the P-BAND, an increase in pressure (or temperature) value will reduce the control signal to the AIR/FUEL servos, causing the servos to drive towards its low fire position. Similarly, a decrease in the steam pressure (or water temperature) will increase the control output signal, causing the valves and dampers to move toward their respective high fire positions.

The value of the **P-BAND** determines how the PPC4000 responds to changes in the measured variable (steam pressure or water temperature). A small modulating range will cause the control to respond quickly to small changes in steam pressure or water temperature. A small value of P-**BAND** might result in the SERVOS to move excessively and possibly cause the burner to actually exhibit short cycle. A large value would reduce the movement of the SERVOS, but may cause the system to be somewhat sluggish in response to a change in steam pressure or water temperature. Matching the capacity of the boiler to load system demand are important considerations in setting the **P-BAND** setpoint. Care should be taken when selecting this variable.



HIGH MARGINAL - Provides an indication that the sensor value is approaching the high alarm limit before the alarm limit is actually reached. For example, a Marginal Stack Alarm may be an indication of the burner overfiring, fouled heat exchanger, tube leak in heat exchanger, etc. If the HIGH MARGINAL is exceeded for 4 seconds, the alarm relay will be activated but the system will not go to lockout.

HIGH LIMIT - When this is exceeded, the PPC4000 will proceed to lockout.

The user programs both HIGH MARGINAL and HIGH LIMIT for the temperature or pressure sensors based on the input signal received. The HIGH MARGINAL cannot be set higher than the HIGH LIMIT nor can either be set lower than the sum of SETPOINT plus CUT OUT. Alarm points for stack monitoring can be set anywhere within the sensor range.

Both INTEGRAL and DERIVATIVE terms are used to eliminate steady-state error and reduce overshoot. They each have a range of 0 to 100%. This value determines how much of the error to factor in the calculation. A value of 0 turns the function off.

When completed, press the BACK key to get back to the top layer menu at the point of exiting or press the HOME key to go directly to the home screen.

PROFILE SETUP

In the top layer scroll to PROFILE SETUP and press NEXT to enter this sub menu. This menu provides the means to name the profile, set the maximum modulation rate for this profile and when necessary erase the profile setpoints.

	<	P	R	O	F	I	L	E		S	E	T	U	P						
>	P	R	O	F	I	L	E		1							N	O	N	E	>	<
	P	R	O	F	I	L	E		2							N	O	N	E	>	
	P	R	O	F	I	L	E		3							N	O	N	E	>	
	P	R	O	F	I	L	E		4							N	O	N	E	>	
	E	R	A	S	E		A	L	L		D	A	T	A					N	O	

Using the NEXT key, select PROFILE 1.

	<	P	R	O	F	I	L	E		S	E	T	U	P						
>	P	R	O	F	I	L	E		1							N	O	N	E	<
	M	A	X		M	O	D	U	L	A	T	I	O	N		1	0	0	%	
	E	R	A	S	E		P	R	O	F	I	L	E					N	O	

Using the MDFY, UP, DOWN and SAVE keys, scroll through the choices for naming this profile and select GAS as the name. MAX MODULATION sets the maximum firing rate of the burner or inhibits the burner from reaching 100% modulation rate.

CAUTION: ERASE PROFILE will clear all setpoints from P01 to P23 for the profile selected. Executing this option will require a new commissioning of the burner. ERASE ALL DATA clears all setpoint data and all profiles. A complete control setup (servos, sensors, setpoints, inputs, keypad, etc.) and burner commissioning is required after executing this command. Both ERASE PROFILE and ERASE ALL DATA are pass code protected. **Care must be taken before using these commands.**

DIGITAL INPUTS

The PPC4000 provides the user with ten (10) line voltage operated digital inputs. The digital inputs are located on terminal block P13.10 (DI1) through P13.1 (DI10). All digital inputs are user defined from a list of functions. The same function can be tagged to multiple digital inputs. Some of the selectable digital input functions duplicate what is available through the keypad function keys, BURNER CONTROL, MANUAL MODULATE, SEQUENCING and LOW FIRE HOLD. The PPC4000 provides the user with the option of AND'ing or OR'ing these functions with the dedicated keypad functions or with other digital inputs configured as the same function. When selected as AND, it is required that all inputs be active for the function to be realized. The OR function requires either digital input or keypad function to be active for the function to be realized. Each digital input applies to all profiles.

From the top layer menu scroll to DIGITAL INPUT SETUP and press the NEXT key to enter the sub menu.

	<	D	I	G	I	T	A	L		I	N	P	U	T		S	E	T	U	P
>	D	I		1																>	<
	D	I		2																>	
	D	I		3																>	
	D	I		4																>	
	D	I		5																>	
	D	I		6																>	
	D	I		7																>	
	D	I		8																>	
	D	I		9																>	
	D	I		1	0															>	

The list of general purpose functions for all digital inputs is as follows:

														U	N	U	S	E	D
						B	U	R	N	E	R		C	O	N	T	R	O	L
>						S	E	T	P	O	I	N	T		2		S	L	C	T	<
							L	O	W		F	I	R	E		H	O	L	D
									A	L	A	R	M		R	E	S	E	T
					M	A	N	U	A	L		M	O	D	U	L	A	T	E
					O	2		T	R	I	M		D	I	S	A	B	L	E
						F	O	R	C	E	D		S	E	T	B	A	C	K
					S	E	T	B	A	C	K		O	V	E	R	I	D	E
						F	O	R	C	E		S	E	Q		M	S	T	R
						S	E	Q	U	E	N	C	I	N	G		O	F	F

If DIGITAL INPUT 1 (DI1) is to be set as BURNER CONTROL, at DI1 press the NEXT key to display the following:

	<	D	I	1		S	E	T	U	P										
>	U	S	E												U	N	U	S	E	D	<
	A	C	T	I	O	N												A	N	D	

AND / OR FUNCTION

For functions that duplicate the keypad functions, the user may select if the digital input is AND'ed or OR'ed with this function.

1. Selecting AND requires both or all of the digital inputs of this function to be active along with the keypad function for the function to be realized.
2. Selecting OR requires either the keypad or the digital input to be active for the function to be realized.

Should the user select multiple digital inputs for the same function and then choose some of the same inputs to be AND'ed and OR'd, the AND'ed requires these to be active to realize the function. For inputs that are set for logic OR, an active input will cause the function to be realized.

Assume the LOW FIRE function on the keypad is set to USED. Assume DI2 is set to LOW FIRE HOLD and its logic state is set to AND. Assume DI3 is set to LOW FIRE HOLD and its logic state is set to OR. To realize the LOW FIRE HOLD function the requirement is the keypad LOW FIRE and DI2 both must be active or DI3 alone must be active. The keypad function can be set to UNUSED and only the digital inputs can be used to realize the function. If only one digital input is used and is set to AND then this alone being active will realize the function.

KEYPAD SETUP

Several hot keys on the keypad have a default value of UNUSED. If the BURNER ON/OFF switch wants to be used to turn the burner on and off, this must also be set to used. NOTE: If DI1 was previously set to be used as a BURNER CONTROL switch and its ACTION was AND, using the keypad would be in addition to this. That is, both must be on for this action to take place.

From the top layer menu scroll to KEYPAD SETUP and press NEXT to enter the sub menu.

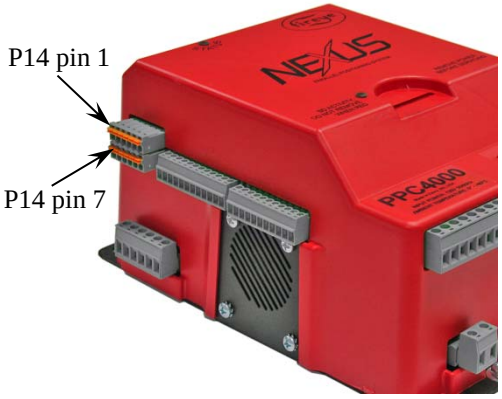
	<	K	E	Y	P	A	D		S	E	T	U	P							
>	B	U	R	N	E	R		O	N	/	O	F	F		U	N	U	S	E	D	<
	A	U	T	O	/	M	A	N							U	N	U	S	E	D	
	L	O	W		F	I	R	E							U	N	U	S	E	D	
	L	E	A	D	/	L	A	G							U	N	U	S	E	D	

The options for each function are UNUSED and USED. Using the MDFY, UP, DOWN and SAVE keys, set BURNER ON/OFF to USED. It is now required to have both the BURNER CONTROL switch going to DI1 closed as well as the keypad BURNER ON/OFF button depressed to start the burner.

Note: (X) refers to the profile number and only parameters for assigned profiles will be displayed.

VARIABLE FREQUENCY DRIVE

In addition to using a precision servo motor to control the air flow into a combustion chamber, the PPC4000 can control one or two variable frequency drives (VFD/VSD) with the result being better control over air flow and improvements in combustion. Electrical energy savings and additional gains in efficiency are quickly realized when controlling the combustion blower motor with a VFD. To obtain VFD/VSD control, it is necessary to insert a NXCESVFD plug-in daughter board into the PPC4000. The NXCESVFD provides two independent VFD/VSD channels with each channel containing one precision 4-20 mA output for VFD/VSD control, one calibrated 4-20 mA input used to monitor feedback from the VFD/VSD and one encoder input used to count pulses from a directly connected shaft encoder. All inputs and outputs are available through connector P14. Shielded cable should be used to connect VFD inputs and outputs to the NXCESVFD. Refer to installation manual NXCESVFD-1001.



	VFD1			VFD2		
Function	4-20 mA Out [To VFD]	4-20 mA In [From VFD]	Encoder In	4-20 mA Out [To VFD]	4-20 mA In [From VFD]	Encoder In
Signal	P14.6	P14.4	P14.2	P14.5	P14.3	P14.1
Common	P14.12	P14.10	P14.8	P14.11	P14.9	P14.7

Connect shield wires to EARTH post located on PPC4000 chassis.

Alternatively, since the NXCESVFD board supplies a 4-20 mA output, each channel's output can be designated or mapped to output modulation rate, setpoint, sensor value, servo position and combustion parameters derived from the O2 probe. The intent is to provide this output to a chart recorder or some other display device of the user's choice. See ANALOG OUT SETUP submenu.

NXCESVFD SPECIFICATIONS		
	VFD OUT:	4-20 mA, Input impedance of external device: Max. 750 ohms
	VFD IN:	4-20 mA, Input impedance: 100 ohms
	ENCODER IN:	2.4 Kohm pull-up to 24 vdc

Each VFD channel, if selected to be used as a VFD, is treated in the same manner as a servo motor. Each VFD is setup and configured through the SERVO SETUP submenu. After menu configuration the VFD must be commissioned in the profile assigned.

In order to use a VFD output as an indicating device, the VFD channel must not be configured to be used as a servo. Conversely in order for a VFD channel to be available to be used as a servo, its status in the ANALOG OUT SETUP submenu must be set to UNUSED. Shown below is the SERVO SETUP menu after servos have been learned to discover servo 1 and servo 2 and to show that both channels, VFD1 and VFD2, are available to be used to control VFD's. Any VFD channel used otherwise in the ANALOG OUT SETUP menu would not be displayed in the servo setup menu.

<	S	E	R	V	O		S	E	T	U	P								
>	S	E	R	V	O		S	P	E	E	D							3	0	<
	S	E	R	V	O	S		I	N	S	T	A	L	L	E	D			2	
	S	E	R	V	O		1												>	
	S	E	R	V	O		2												>	
	V	F	D		1														>	
	V	F	D		2														>	

Each VFD channel has its own separate and independent sub menu. The following assumes that VFD2 is moved between the two tick marks and the NEXT key is pressed to display the following configuration menu.

<	V	F	D		2														
V	F	D		N	A	M	E										F	A	N	2
A	S	S	I	G	N	M	E	N	T				4	,	3	,	2	,	1	3
D	I	S	P	L	A	Y		F	O	R	M	A	T		E	N	C	O	D	4
E	N	C	O	D	E	R		C	O	U	N	T	S			1	0	0	0	4a
R	U	N		M	O	D	E									A	U	T	O	5
G	A	I	N													1	.	0	%	6
I	N	T	E	G	R	A	L										0	.	1	6
T	O	L	E	R	A	N	C	E								H	I	G	H	7
A	C	C	E	L	/	D	E	C	E	L							3	0	s	8
S	T	O	P		T	I	M	E										0	s	9
V	F	D		2		P	O	S	I	T	I	O	N						0	10

Explanation of VFD parameters:

2. User selects name of VFD. The VFD must be named in order to be usable. The default is UNUSED.

    a. The list of names available is the same as the list available for servo motors. It is required that at least one of the servos be named AIR and the AIR servo is considered the "master/lead" drive, when a VFD is not used in a profile. If a VFD is used in a profile, the FUEL/GAS/OIL servo becomes the "master/lead" drive. A VFD is never the master/lead drive and the VFD name will not impact this rule.

3. The method for profile assignment for VFD's is the same as for servo motors.

    a. ASSIGNMENT set to a non-zero value prevents the VFD channel from being used as anything but UNUSED in ANALOG OUT SETUP sub menu.

4. DISPLAY FORMAT is used to select the method of feedback used from the VFD. Two methods of feedback can be selected, 4-20 mA or encoder. CNTS and PERCENT FULL SCALE are dependent on 4-20 mA from the VFD. Encoder counts is dependent on the use of an encoder. CNTS is the default and has a range of 0 - 1000 and is derived from the 4-20 mA feedback.%FS translates the 4-20 mA to a scale ranging from 0 - 100.0%. The scale for encoder counts is dependent on the encoder used.

    a. Total encoder count is determined by the encoder's counts per revolution specification and motor's maximum revolutions per minute, RPM. The allowable range is 300 to 5000 with a default of 1000. The user should refer to the following rule to determine the encoder pulses per second.

    $$\frac{\text{Max Motor RPM} * \text{Pulses per Revolution}}{60} = \text{encoder pulses per second}$$

    b. The system will then use this number to scale the counts to a value of 1000. Actual encoder pulses per second can be found in the INFO SCREEN.

5. RUN MODE gives the user the option of using the internal PPC4000 PID (preferred) to control the VFD position or using the internal VFD drive's PID to control the VFD setpoint. The options are AUTO (default) and MANUAL.

6. In AUTO mode, gain and integral terms are used by the VFD plug-in board to control the setpoint of the VFD. The VFD setpoint is the position of the VFD as commanded by the PPC4000. The goal would be to have little difference between the VFD commanded signal (setpoint) and feedback signal.

    a. Gain is the amplification of the error signal. This error signal is the deviation between feedback and control. A high gain can result in unstable operation and cause overshoot. The range is 1.0% to 100% with an increment of 0.1% and a default of 1.0%.

b. Integral is the time between error corrections or updates to the VFD. A high rate of updates (short integral time) to the VFD can result in unstable operation. Conversely too few updates (long integral time) to the VFD can result in large deviations from setpoint. Update time to the VFD output is done at ¼ second intervals. The range of value for INTEGRAL is 0 to 100 in increments of 0.1 with a default of 0.0. The lower the setting, the shorter the integration time will be. The default setting of 0.0 will inhibit integration. A setting of 100.0 will have the longest integration time.

NOTE: using the default values, the VFD should never overshoot its target. If overshooting is observed, the VFD drive is using its own PID control. If the user wishes to use the VFD's PID control, the user must set the PPC4000's VFD RUN MODE to MANUAL to disable the PID control. Either the VFD Drive or the PPC4000 can use PID control, not both. Before the user attempts commissioning, the PID control of the VFD system must be set properly or the commissioning process will be very difficult and time consuming waiting for the VFD to stabilize.

7. Tolerance is the acceptable error in feedback signal received from the VFD. Feedback signal can be the VFD's analog 4-20 mA of encoder pulses. Both feedback types are normalized to a range of 0 - 1000. Tolerance is expressed in terms of percentage of current feedback reading. A LOW tolerance requires the positioning error to be less than 4% of setpoint over a 30 second period. A HIGH tolerance requires the positioning error be less than 6% of setpoint over a 15 second period. Lockout occurs if the tolerance level is exceeded. Default is HIGH.

8. The ACCELeration / DECELeration time is the time required to move from minimum (0 Hz) to maximum (60 Hz) and from maximum to minimum speeds. The default value is 30 seconds and has a range of 0-255 seconds. With ACCEL and DECEL specified the rate of change of the 4-20 mA output is based on this time. During the accel/decel period, the VFD is allowed to move to its next position and not be checked for errors until the time has expired.

9. When using flame safeguard controls that require the air flow switch to be proved open before the start of a cycle, the VFD must be nearly stopped before the air flow switch may open. The STOP TIME parameter is the amount of time the PPC4000 will wait between cycles before closing the OCRC relay, allowing large motors to fully coast to a stop. User can adjust STOP TIME between 0 and 100s, with 1s increments. The default value for STOP TIME is 0 seconds.

10. Shows the current position during a burner cycle, of the VFD in units specified by DISPLAY FORMAT. Unlike a servo, the VFD position cannot be adjusted or displayed properly in standby. Manual adjustment of the position is prohibited during a burner cycle.

ENCODER INPUT

1. The encoder inputs on the NXCESVFD plug-in board are designed to use an encoder that provides an open collector output. The encoder input of the NXCESVFD is a 2.4 Kohm pull-up resistor internally connected to 24 vdc. The encoder selected must be able to handle 10 mA.

2. The PPC4000 tolerates maximum encoder counts over a range of 300 to 5000 counts per second. For a motor with a maximum RPM of 1750, the range of encoder would be 12 to 150 counts per revolution. Likewise for a motor with a maximum RPM of 3600, the range of encoder would be 5 to 80 counts per revolution.

3. Shielded cable should be used to connect the encoder output to the NXCESVFD. The drain wire must be connected to the EARTH post.

Operational Notes:

1. Consult the VFD manual for adapting, connecting and configuring the VFD to the combustion blower motor. Be sure all inputs and outputs are compatible with the PPC4000 and NXCESVFD.

2. The VFD is commissioned like any of the servo motors and must have a position for every setpoint for the commissioned profile.

3. For a VFD channel to be used as a VFD controller, the ANALOG OUT SETUP value for that VFD channel must be set to UNUSED. Only then will the VFD channel be displayed in the servo setup sub menu where the user selects that particular VFD channel and configures it for operation.

4. Making modifications to any of the VFD parameters in the servo setup submenu, requires the Commissioning pass code to be enabled.
5. Attempting to change a VFD channel to a value other than UNUSED in the ANALOG OUT sub menu while its ASSIGNMENT > 0 in the SERVO SETUP sub menu is not allowed.
6. Removal of a VFD from the commissioning table (set ASSIGNMENT to 0), will require a re-commissioning without the VFD. That is, lockout will occur if the profile (with the missing VFD) is used during the next burner cycle.
7. VFD's normally require motor start signals. This is usually derived from a relay energized by terminal M (combustion blower output) of the flame safeguard. The normally open contacts are connected to the start input terminals located the VFD.
8. Using ACCEL/DECEL prevents step changes in the 4-20 mA output signal to the VFD and should be set appropriately. However, adequate values for ACCEL and DECEL should also be set in the VFD to prevent over current conditions.
9. In VFD setup, DISPLAY FORMAT can be set to either CNT or %FS indicating the 4-20 mA feedback from the VFD is being used or can be set to ENCOD which requires an encoder connected to the combustion motor shaft and the maximum encoder counts per second value entered for ENCODER COUNTS. All of these options are scaled and normalized to a range of 0 - 1000. Therefore it is possible after commissioning and operating with one method (CNTS), the user can change the VFD setup to an alternate method (ENCOD). The system will treat this change transparently and attempt to control with this new setting. As long as the ENCODER COUNTS value entered is correct or the 4-20 mA is representing full range frequency, the change should be transparent. However, it is strongly recommended DISPLAY FORMAT be changed only if a complete commissioning or adjust ratio procedure is executed immediately after the change and for all profiles using the VFD.

Performance notes:

1. When controlling a VFD, setting GAIN and INTEGRAL to incorrect values can cause unstable operation of the VFD and subsequently large variations in the combustion blower motor rotation. When setting GAIN and INTEGRAL, the following is suggested:
    a. Make certain that the VFD drive is not using its own PID.
    b. Set the PPC4000's VFD RUN MODE to AUTO, and begin with the INTEGRAL set 0.0 and the GAIN is set to 1%.
    c. The GAIN and INTEGRAL settings can only be verified by observing the system's reaction to a step input. The best way to get a step response is by entering the Commissioning Mode and cycling between p00 and p01 settings. At p00, the VFD is set to 0Hz. Proceed to p01 by pressing the NEXT key, after entering the Commissioning Mode, and setting the VFD target speed to at least 50% if DISPLAY FORMAT is set to %FS or a count of 500 if it is set to CNTS. Note that the BURNER ON/OFF must also be set to ON and there must be a call for heat to go to p01. To go back to 0Hz, press the BURNER ON/OFF button so that it is OFF. Alternately pressing the BURNER ON/OFF will cycle to unit between p00 and p01 positions.
    d. Increase the GAIN until the VFD begins to oscillate after it steps to p01. Once oscillation is achieved, reduce the GAIN setting by 50%. For example, if a setting of 20 causes oscillation after the step, reduce the GAIN to 10 then proceed to step (e). Note that with the INTEGRAL set to 0.0, the VFD may not be able to reach the target speed.
    e. Increase the INTEGRAL setting until the VFD is able to reach the target speed with no oscillations.
    f. The GAIN and INTEGRAL may have to be adjusted several times to achieve the right balance of reaction time and oscillation but following the above method will get the settings close.

    A steady reading is defined as only the tenths digit changing or the combustion blower motor is not hunting.

COMMISSIONING WITH VFD

The VFD is commissioned like any servo motor and must have a position for every profile setpoint for the commissioned profile.

<	C	O	M	M	I	S	S	I	O	N	I	N	G				p	0	3
A	I	R	(	1	)										2	0	.	6	
G	A	S	(	2	)										1	3	.	4	
V	F	D		2													6	5	3

The VFD can be commissioned during the initial commissioning process or added to the current commissioning profile. The value shown for VFD in the servo setup table is based on the feedback received from the VFD. During COMMISSIONING and ADJUST RATIO, with MDFY on, this value is the commanded position.

ANALOG OUT SETUP

This menu is found in the top layer and is used to map various signal values to 1 of 3 available 4-20 mA outputs:

	Output	Return
ANA 0 OUT	P11.5	P11.4
VFD 1 OUT	P14.6	P14.12
VFD 2 OUT	P14.4	P14.10

The ANALOG OUTPUT SETUP menus is displayed as follows:

	<	A	N	A	L	O	G		O	U	T		S	E	T	U	P			
>	A	N	A		0		O	U	T						U	N	U	S	E	D	<
	V	F	D		1		O	U	T						U	N	U	S	E	D	
	V	F	D		2		O	U	T						U	N	U	S	E	D	

Pressing MDFY/SAVE at the > prompt will open the selection menu for items than can be mapped to the selected 4-20 mA analog output channel. Press MDFY/SAVE key again to save selection.

UNUSED	SERVO 1	STACK
CMD RATE	SERVO 2	O2
SETPOINT	SERVO 3	CO
STBK STPT	SERVO 4	
SENSOR 1	SERVO 5	
SENSOR 2	SERVO 6	
SENSOR 3	SERVO 7	
SENSOR 4	SERVO 8	
SENSOR 5	SERVO 9	
	SERVO 10	

OXYGEN PROBE SETUP

The NXCESO2 oxygen probe provides continuous oxygen (O2) content and stack temperature readings from the stack. When properly connected and configured to the PPC4000, it allows the PPC4000 to trim the air or fuel servo to achieve optimum combustion. Refer to earlier sections of this bulletin for information regarding installation and wiring of the NXCESO2.

To use oxygen trim properly, the installing personnel must be completely familiar with and know the limitations of the burner / boiler equipment at hand. It is not the purpose of the O2 probe and associated trim algorithm in the PPC4000 to extend the burner/boiler to operate beyond its design limitations. The purpose of O2 trim is to maintain a consistent fuel/air ratio through variations in temperature, humidity and fuel BTU content. When properly setup according to these instructions, O2 trim will result in more heat output per BTU input and increased combustion efficiency and fuel savings will be realized. It is expected the installing personnel read and understand the O2 SETUP menu items and commission the O2 probe in accordance with this bulletin.

To add O2 trim to the PPC4000 operation the NXCESO2 oxygen probe must be commissioned with the air and fuel servos. Commissioning with O2 can be done after the servos are commissioned or can be done along with the initial servo commissioning. During the commissioning process the PPC4000 will save the target O2 level at each profile setpoint. During normal operation the PPC4000 will trim either the air or fuel servo to maintain this established O2 target level. O2 trim occurs from low fire (p03) through high fire (pHigh). O2 trim will take effect only after all profile setpoints are commissioned with an O2 level. If O2 trim is enabled through the user interface and the system has yet to be commissioned to set the O2 levels, then O2 trim will be ignored.

The PPC4000 provides an extensive sub menu where the installing engineer must set a number of key boiler parameters relating to O2 trim operation. The O2 SETUP is passcode protected. All parameters in the O2 SETUP menu are readable but do require at least the Adjust Ratio passcode to be enabled before any parameter can be modified. The passcode will remain enabled for 5 minutes after the last key press. Any change to the O2 SETUP menu will take effect immediately.

In the top layer menu scroll to O2 SETUP and press NEXT to enter this sub menu. This menu provides the means to enter all O2 parameters relating to trim. If not enabled, when pressing the MDFY key, the user will be diverted to the passcode screen where at least the Adjust ratio code must be entered.

Most menu items are burner / boiler dependent and it is important the installing / commissioning engineer be familiar with the burner / boiler to understand its capabilities and limitations.

Menu item	Value	Description
O2 OPERATION	DISABLED	O_2 trim is not enabled. No further menu items are displayed.
	CONTROL	O_2 trim enabled for profiles selected. All menu items are displayed. The O2 level is shown in the top layer.
	MONITOR	Allows O_2 level to monitored with trim being disabled, but the O_2 level is shown in the top layer.
CALIBRATE	NOW>	When the NEXT key is pressed a calibrate signal is sent to the NXCESO2 probe. The function is operational only during STANDBY and PURGE.
ASSIGNMENT	4,3,2,1	User selects which profile O_2 trim is applied.
FUEL TYPE (X)	NONE	FUEL TYPE for each assigned profile is required to calculate boiler efficiency. The fuel type selected determines the constants used. Default is NONE.
	NAT.GAS	
	OIL #2	
	OIL #6	
	LNG	
	COKE	
	METHANE	
	PROPANE	

Menu item	Value	Description
HEAT LOSS	0.0%	Used to calculate boiler efficiency. Percentage of boiler output lost through the shell of the boiler at high fire. The default is 0% and ranges to 9.9% in 0.1% increment. The PPC4000 will calculate the heat loss at all firing rates and is dependent on burner turndown ratio.
TURNDOWN RATIO	3	Used to determine amount of heat loss at all firing rate positions. Calculated value is subtracted from gross efficiency. Default is 3 with a range of 1 to 10 and an increment of 1. A value of 1 will result in a constant heat loss across all firing rate values.
TRANSPORT DELAY	0s	The range is 0 to 60s. The default is 0s. This is the amount of time it takes for a step change in O_2 to be realized after a step change of air/fuel is made. Transport delay value should be calculated or derived at lowest air velocity (Low Fire)
TRIM TYPE	AIR FUEL	Default selection is AIR trim. As trimming the FUEL servo is more sensitive than trimming the AIR servo, the user should be cautious when selecting FUEL trim.
TRIM LIMIT RATIO	1	Trim limit ratio is used in determining trim limit. The range of value is 1 to 8 with the default value being 1. See section titled SETTING TRIM LIMITS.
TRIM LIMIT	DEFAULT MANUAL	Applies to degrees of trim at low fire. Selecting DEFAULT will implement a trim limit of 0.1 degrees at low fire. MANUAL allows users to enter trim limit at low fire for each profile assigned. See section titled SETTING TRIM LIMITS.
TRIM LIMIT (X)	0.1	Parameter shown if TRIM LIMIT is set to MANUAL. The term (X) refers to profile assignment. The range of trim limit allowed is 0.1 to 3 degrees in 0.1 degree increments. See section titled SETTING TRIM LIMITS.
TRIM P-GAIN (X)	6%	Sets the proportional gain term. The higher the gain term is, the more aggressive the O_2 trim. The range of value is 0 to 100% where 100% is maximum gain. Care should be used when selecting this term.
TRIM I-GAIN (X)	95	Sets the integral gain term and is the amount of error signal being fed back. The maximum value is 100% and a faster rate of integration (resets per minute) is realized. The range is 0- to 100%.
O2 FAULT ALM	WARNING LOCKOUT	Default value is WARNING and pertains to faults detected in the O2 probe. WARNING will disable O2 trim and burner operation will default to commissioned air and fuel servo settings. A LOCKOUT selection will cause burner shutdown with the lockout message recorded to fault history.
O2 LEVEL ALM	UNUSED WARNING LOCKOUT	Action that takes place if programmed O_2 levels are exceeded. UNUSED is no action taken. WARNING is alarm energized, burner remains on line. LOCKOUT results in burner shutdown and message recorded to fault history.

Menu item	Value	Description
O2 LO ALM@LO (X) O2 LO ALM@HI (X) O2 HI ALM@LO (X) O2 HI ALM@HI (X)	0.5%	LO refers to O2 level alarm limits below the O2 curve. HI refers to O2 level alarm limits above the O2 curve The values entered are the deviation from the current target value. The default value is 0.5% O2 deviation and the range of values is 0.1% to 5.0% in 0.1% increment. Enter values for each curve for low fire and high fire. The PPC4000 interpolates the alarm value between these points. See section titled GENERAL RULES FOR ALARM NOTIFICATION.
FLUE TEMP ALM	UNUSED WARNING	Action that takes place if programmed flue temp levels are exceeded. UNUSED is no action taken. WARNING is alarm energized, burner remains on line.
FLUE TEMP LO (X)	40F	Range of value is 40F (4C) to 800F (426C). The values represent the low limit and high limit to define the acceptance zone. The PPC4000 interpolates the alarm value between these points.
FLUE TEMP HI (X)	40F	
FLUE LO TIME	0 min	Enables a Low Fire Hold time when the flue temperature, as reported by the oxygen probe, is below the user setting specified in FLUE TEMP LO. Set to 0 to disable.

SETTING TRIM LIMITS

O2 trim limits (expressed in degrees) are derived from trim limit ratio, trim limit at low fire (p3) and the current firing rate of the burner. Care should be exercised when selecting these values. The trim limit applies to both clockwise and counter-clockwise directions and is a deviation from the commissioned position. The expression to determine trim limits is as follows:

Allowable Trim Limit = $T_0\left((R_{TD}-1)\left(\frac{M_P}{100}\right)+1\right)$

Where:

$\mathbf{R}_{TD}$ = user specified trim limit ratio (R_{TD}>1)

$\mathbf{M}_P$ = present firing rate of burner (0 to 100%)

$\mathbf{T}_0$ = user specified trim limit at low fire (0% firing rate)

A large trim limit ratio will yield a large value of trim limit at the high fire position. Care must be exercised when selecting these values.

A trim limit ratio of 1 will yield a constant trim limit from p03 to pHigh.

It is of absolute importance to realize that trim limit applies to both clockwise and counter-clockwise direction from the commissioned or untrimmed servo position. The trim limit values must be selected as to not reach the mechanical stop at either end of the trimmed servo travel. See section relating to operating with O2 trim.

There is typically a 10:1 ratio between air and fuel in any combustion system and therefore if selecting fuel as the trimming servo, trim limits should be selected so as to allow only sufficient movement to achieve the desired target.

At lower firing rates, a small movement of the servo is required to cause a significant change in the air/fuel ratio as compared to high fire.

It is the responsibility of the installing and operating personnel to ensure the trim limits selected do not allow a hazardous combustion condition to occur. In the event of an O2 probe failure the untrimmed commissioned servo setpoints will be used.

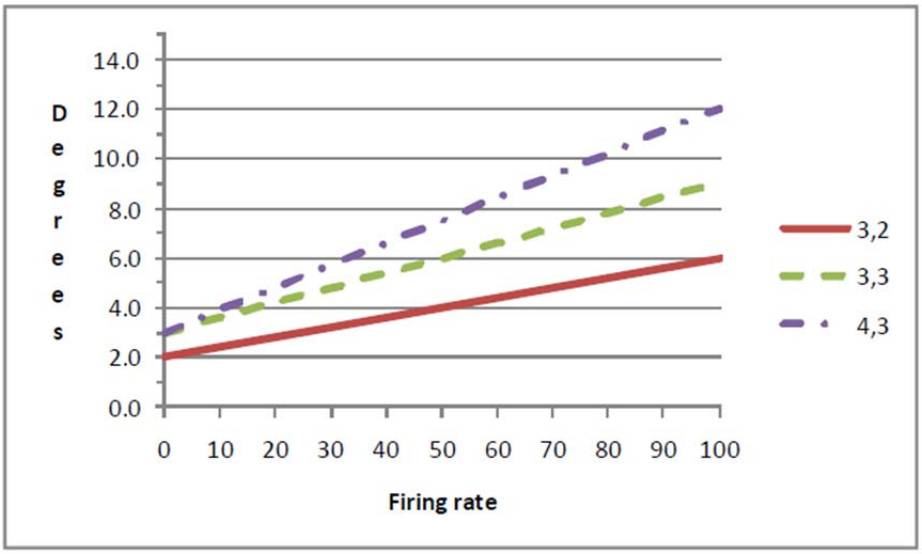
Trim limit ratio = 3 Trim Limit = 2 degrees	
Firing rate%	Trim limit Degrees
0	2.0
10	2.4
20	2.8
30	3.2
40	3.6
50	4.0
60	4.4
70	4.8
80	5.2
90	5.6
100	6.0

Trim limit ratio = 3 Trim Limit = 3 degrees	
Firing rate%	Trim limit Degrees
0	3.0
10	3.6
20	4.2
30	4.8
40	5.4
50	6.0
60	6.6
70	7.2
80	7.8
90	8.4
100	9.0

Trim limit ratio = 4 Trim Limit = 3 degrees	
Firing rate%	Trim limit Degrees
0	3.0
10	3.9
20	4.8
30	5.7
40	6.6
50	7.5
60	8.4
70	9.3
80	10.2
90	11.1
100	12.0

As can be seen from the above the trim limit is a progressively increasing number from low fire to high fire. The following illustrates the trim limits from the above tables:

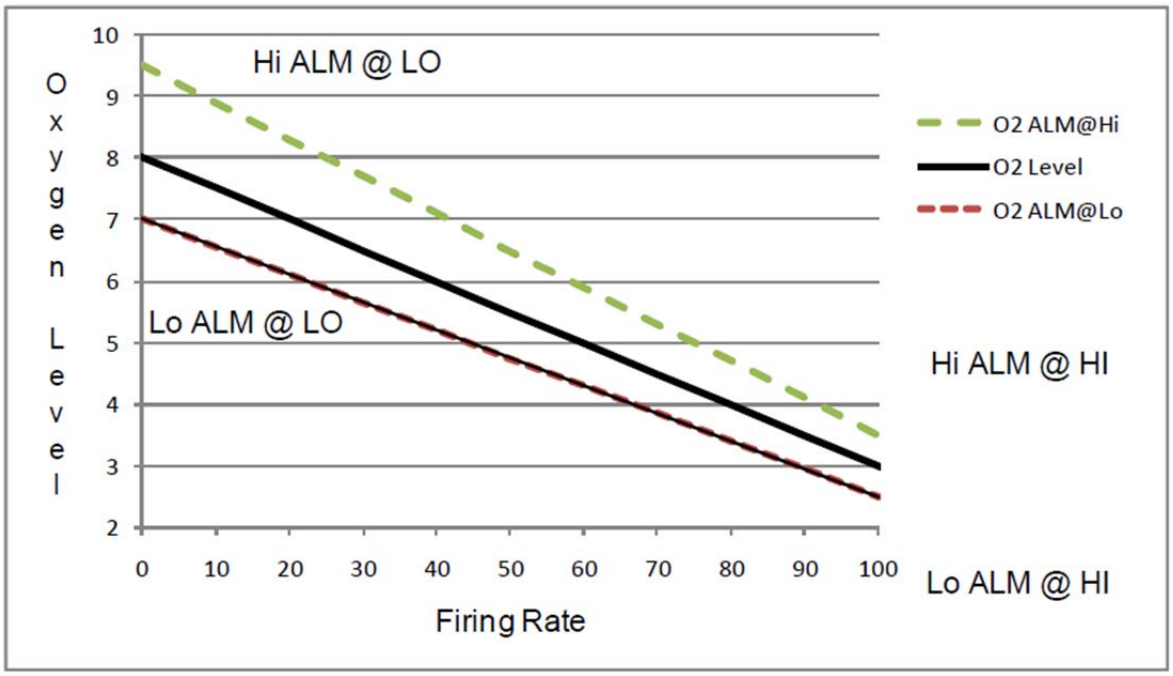
FIGURE 7. Effect of Trim Limit Ratio on Trim Limits



GENERAL RULES FOR O_2 ALARM NOTIFICATION

The values entered represent the deviation from the current O2 target value. LO alarm refers to O2 levels under the O2 curve. HI alarm values refer to values above the O2 curve. The acceptable zone lies between the LO curve and the HI curve. The following chart illustrates the HI and LO settings for above and below the O2 curve.

FIGURE 8. O_2 Level Alarm Limits



Each profile will have its own set of alarm level values. The alarm value for each succeeding profile setpoint is interpolated from these inputs.

Rules for alarm notification:

a. The O2 level drops below the absolute value of 0.5% O2 for 30 seconds.
b. The O2 level drops below the low alarm limit for 2 minutes.
c. The O2 levels drops below twice the low alarm level for 30 seconds.
d. The O2 level rises above the high alarm limit for 2 minutes.
e. The O2 level rises above twice the high alarm limit of 30 seconds.

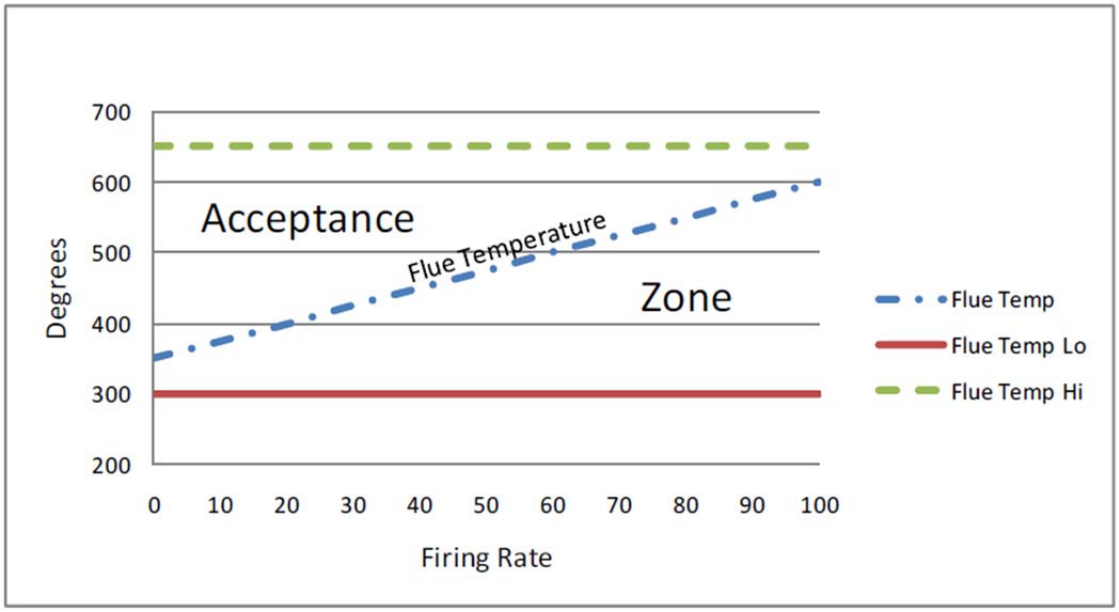
Note: The O2 level alarm timer is reset to 0 when the actual O2 level returns to within the acceptable zone.

FLUE TEMPERATURE ALARM LIMITS

The PPC4000 provides flue temperature limits for each profile. Available is the option to activate flue temperature limits as warning. In warning mode, a message will be posted to the display and alarm relay will be energized

To use flue temperature alarm the user must enter the low limit flue temperature and high limit flue temperature. When the burner is firing the flue temperature must remain in the acceptance zone defined by these two limits as shown in the following chart:

FIGURE 9. Flue Temperature Limits



Note: The PPC4000 requires the flue temperature to be above the high limit or below the low limit for 30 seconds before action takes place.

GAIN TERMS

O2 trim is performed using the current O2 level, the current saved target value and the boiler transport delay. These terms are used in a PID algorithm to determine the amount of servo trim to be applied.

1. P-GAIN is proportional gain and is the fractional part ranging from 0 to 1 (unity). Through the user interface P-GAIN is expressed as 0 to 100%. The default value of P-GAIN is 6% or approximately 1/16. Increasing values of P-GAIN add amplification to the O2 trim and make the responsiveness more aggressive. Caution should be exercised when selecting P-GAIN as overshoot of the target could occur.

2. I-GAIN is integral gain and defined as the reciprocal of Ti value in seconds ranging from 1 to 100 (subtracted from 101). The default value of 95 is 1/6 seconds. Selecting a value of 100 forces the fastest possible integration time of 1 second. A value of 0 is a special case and disables the integrator. A lower value of integration will slow down calculations and add time to reach the target value.

3. BOILER TRANSPORT DELAY can be defined as the derivative term when determining the amount of servo trim to be applied. Any spikes or rapid changes in O2 levels caused by any disturbances will be filtered by the boiler transport delay term and prevent large changes in trim to be applied. The default for boiler transport delay is 0 seconds and it is recommended this not be changed if the O2 readings are relatively steady.

UNDERSTANDING O2 ERROR CODES

Upon detection of an error condition (lockout or warning) relating to the O2 probe the PPC4000 will post to the display a singular message 'O2 FAULT eXX' on the HOME screen in place of the status message. In the event of a lockout condition resulting from O2 levels being exceeded, flue temperature levels being exceeded or a fault in the O2 probe, the PPC4000 will revert to the FAULT HISTORY menu with the details of the lockout described. For both lockout and warning events, the alarm relay will be energized. Lockouts are non-volatile and require a manual reset. Warnings are dynamic and will self-remove when the condition causing the warning no longer exists.

The message O2 FAULT eXX contains the error message causing the lockout or warning event. The error message 'eXX' is described in the following table:

e-code	VALUE	DESCRIPTION
44	BAD VECTOR	Incorrect communications with O2 probe
45	RETURN BOUNDS	
46	BAD ERROR CODE	
47	COMMUNICATION ERROR	Check wire, routing and connections to O2 probe
48	LOW LEVEL O2 LIMIT	O2 level exceeded limits set in O2 setup menu
49	HIGH LEVEL O2 LIMIT	
50	O2 LOW STACK TEMP LEVEL	Flue temperature exceeded limits set in O2 setup menu
51	O2 HIGH STACK TEMP LEVEL	
52	RESERVED	
53	RESERVED	
54	STACK TEMP PROBE DISCONNECTED	Hardware fault in probe
55	STACK TEMP OVER RANGE	Temp probe has exceeded its maximum range, 900F (482C)
56	STACK TEMP READ ERROR	Hardware fault in probe
57	AMBIENT TEMP READ ERROR	Hardware fault in probe
58	AMBIENT TEMP OVER LIMIT	Temperature in probe has exceeded 185F (85C)– check fan
59	AMBIENT TEMP UNDER LIMIT	Temperature in probe is lower than -13F (-25C)
60	CPU CRC ERROR	Hardware fault in probe
61	CPU RAM ERROR	
62	CPU SELF TEST	
63	24 VOLT LOW FAULT	Voltage in probe not within 18-30 vdc limits
64	24 VOLT HIGH FAULT	
65	12 VOLT OPEN FAULT	Voltage regulator in probe out of acceptable tolerance
66	12_VOLT_LOW_FAULT	
67	12 VOLT HIGH FAULT	
68	UNEXPECTED CALIBRATION FAULT	Illegal self-calibration perform
69	SENSOR O2 STUCK FAULT	O2 sensor not responding properly
70	SENSOR CALIBRATION NEEDED	O2 sensor subsystem cannot perform measurement
71	SENSOR HEATER SHORT FAULT	O2 heater fault
72	SENSOR HEATER OPEN FAULT	
73	SENSOR PUMP SHORT FAULT	O2 pump fault
74	SENSOR PUMP OPEN FAULT	
75	SENSOR CELL SHORT FAULT	O2 sensor fault
76	SENSOR CELL OPEN FAULT	
77	SENSOR CONVERSION TIMEOUT FAULT	O2 sensor taking too long to convert O2 level
78	SENSOR LOW VOLTAGE FAULT	O2 voltage level too low
79	SENSOR TOO COLD FAULT	O2 sensor heater temperature out of tolerance
80	SENSOR TOO HOT FAULT	
81	SENSOR AIR CALIBRATING	Sensor calibration in progress
82	SENSOR HEATER CALIBRATING	Heater calibration in progress
83	SENSOR COMM BUSY	
84	SENSOR COMM FAULT	Hardware fault in probe
85	SENSOR WARMING_UP	Sensor warming after power on
86	SENSOR IN STANDBY	O2 probe forced to standby condition

WARNING

It is the purpose of this bulletin to explain the operation of the PPC4000 control and the NXD410 User Interface along with required FX servo motors and pressure/temperature transducers. The servo motors control the air and fuel on the burner independently in accordance with the commissioned information. Being there are an infinite number of burner sizes and types, it is beyond the scope of this bulletin to show in absolute terms the proper combustion operation of the burner on which the equipment is installed. This bulletin is a detailed guide on how to properly setup the PPC4000 and associated equipment to achieve maximum efficiency. It is the responsibility of the commissioning personnel to know the capabilities and limitations of the burner/boiler. This would include the turn down ratio, ignition setting, low fire setting and high fire setting, and proper O2 levels at each firing point along the curve. It is expected the commissioning or operating personnel be sufficiently trained by the burner OEM to know the do's and don'ts of their particular burner and to have relevant experience in the theories and practices of combustion control. Fireye cannot accept any liability for any consequences resulting from inappropriate, negligent or incorrect installation, commissioning or adjustment of operating parameters of the equipment.

WARNING

- **If a LOCKOUT occurs at any point the PPC4000 will not attempt a re-start until the fault is cleared, unless the option to allow recycling is enabled in the primary flame safeguard. Before moving to the ignition position to attempt a re-start the system must perform any selected pre-purge.**
- **Ensure that a purge position is entered for each drive as required, failure to enter a purge position will mean all drives remain at their 'closed' positions.**
- **After entering and/or adjusting any profile points for any profile it is the responsibility of the commissioning personnel to verify that the resulting fuel air ratio is acceptable for the appliance being controlled.**

A profile is a set of points defining the servo motor positions along the burner's operating curve. The operating curve begins at standby (P00), extends through purge (P01), ignition light-off (P02) and up through the modulation firing rate (P03 to P23).

PROFILE SETPOINTS

Setpoints contain information about required motor positions. There must be at least one servo motor named as AIR in each profile. There are four profiles (or tables) of setpoints available in the PPC4000 control. The profiles may be represented using the diagram below:

Gas position (degrees)	Air Position (degrees)		Oil Position (degrees)	Air Position (degrees)
2.1°	1.9°	Close (P00)	1.7°	1.9°
2.1°	87.9°	Purge (P01)	1.7°	87.9°
24.6°	30.6°	Ignition (P02)	10.6°	28.7°
21.3°	25.8°	Low Fire (P03)	10.6°	28.7°
76.8°	85.6°	High Fire (Pxx)	50.2°	83.5°

COMMISSIONING RULES

1. Commissioning mode is used for entering new setpoints in a profile.
2. Existing setpoints can be modified in commission mode or adjust ratio mode.
3. Only commissioning mode can be used to modify setpoints P00, P01 and P02.
4. Setpoints P03 and higher will not be affected when C-MODE is exited at P02 or lower.
5. There are 24 possible positional setpoints per profile, number P00 to P23. P00, P01 and P02 are reserved for closed (standby), purge and ignition. Positions P03 through P23 traverse the burner's firing rate where P03 is always low fire. The last point entered is always considered high fire and will correspond to 100% modulation rate.
6. Using commission ratio mode, it is possible to step through each setpoint including close, purge and ignition.
7. Once a setpoint has been entered, it is not possible to go back and modify it again in the same commissioning session. That is, the BACK key is not usable in commissioning mode.
8. During commissioning mode if a controlled shutdown or lockout occurs, the current commissioning data will not be lost. The control will revert back to P00, also known as the closed position. After the shutdown condition is cleared, burner startup can once again resume using the new commissioned data prior to the shutdown.
9. For a system to operate, the minimum setpoints that must be entered are P00 through P03.
10. It is recommended that all servo positions commissioned by the user be between 3° degrees and 97° degrees.
11. The master servo (AIR/FUEL) must be commissioned in such a way that the current commissioning point must be at least 0.1 degree greater than the prior point. This rule applies to commissioning points greater than P03 (low fire). A violation of this rule will prevent the user from moving to the next commissioning point or exiting commissioning.
12. If a user is modifying any servo position (MDFY indicator is on) and then decide to access the INFO screen, the modify operation is automatically cancelled and whatever position that was entered prior to going to the INFO screen will be lost. The servo position will be reverted to the last successfully saved commissioned point

Entering commissioning mode:

To enter commissioning mode, the burner must be off and the user presses the C-MODE key located on the keypad. If not currently enabled, the system directs the user to the passcode setup screen where the user must enter the necessary commissioning passcode. If entered properly or if previously entered the LED indicator at the C-MODE key will illuminate and the display will indicate:

	<	C	O	M	M	I	S	I	O	N	I	N	G					p	0	0
>	A	I	R	(| 1 |)											3	.	1	°	<
	G	A	S	(| 3 |)											1	.	9	°	
	O	I	L	(| 2 |)											2	.	6	°	

It is usual to have no profile selected while in P00. Therefore all installed and named servos are shown as displayed above along with their current position. If a profile is selected while in P00, then only the servos pertaining to that profile are displayed.

NOTICE

The assumption is the user has completed the initial setup procedure, configuring sensors, setpoints and learning and mapping servos. If setpoint information is not entered the user can at least commission P00 but cannot move to P01. If servos are not learned and mapped to a profile, or only one servo is learned and mapped to a profile, even if that profile is not going to be used, then C-MODE cannot be entered. The User Interface will display and flash continuously the message INVALID OPERATION. The user can press the HOME or C-MODE key to exit commissioning to fix the problem

If a control was previously commissioned then the currently stored profile will be loaded and be used as the base setpoints. Note: this can only occur when a profile is actually selected. If not commissioned (out of the box condition) then the succeeding Pxx point should be the same as the preceding Pxx point. For example, when moving from P02 to P03, P03 assumes the same values as P02.

The NEXT key is used to move to the next setpoint, P01, P02, etc.

For illustrative purposes the shaded line represents the > < characters on the keypad and the AIR servo shown below is selected for modifications.

	C	O	M	M	I	S	S	I	O	N	I	N	G					p	0	0
>	A	I	R	(| 1 |)											3	.	1	°	<
	G	A	S	(| 3 |)											1	.	9	°	
	O	I	L	(| 2 |)											2	.	6	°	

To move a servo press the MDFY key and use the UP and DOWN keys to select the target position.

	C	O	M	M	I	S	S	I	O	N	I	N	G					p	0	0
>	A	I	R	(| 1 |)											8	.	4	°	<
	G	A	S	(| 3 |)											1	.	9	°	
	O	I	L	(| 2 |)											2	.	6	°	

When done, the user presses the SAVE key to direct the system to move the servo to the target position. After the SAVE key is pressed the value on the line showing the servo being modified will change back to the current position. This value will be changing as the servo moves to the new target position.

	C	O	M	M	I	S	S	I	O	N	I	N	G					p	0	0
>	A	I	R	(| 1 |)											3	.	1	°	<
	G	A	S	(| 3 |)											1	.	9	°	
	O	I	L	(| 2 |)											2	.	6	°	

	C	O	M	M	I	S	S	I	O	N	I	N	G					p	0	0
>	A	I	R	(| 1 |)											5	.	2	°	<
	G	A	S	(| 3 |)											1	.	9	°	
	O	I	L	(| 2 |)											2	.	6	°	

	C	O	M	M	I	S	S	I	O	N	I	N	G					p	0	0
>	A	I	R	(| 1 |)											8	.	4	°	<
	G	A	S	(| 3 |)											1	.	9	°	
	O	I	L	(| 2 |)											2	.	6	°	

Repeat as necessary for the GAS and OIL servo. The NEXT key is used to move to the next profile setpoint, P01, P02, etc.

Moving from P00 to P01 depends on the following. Since there might not be a profile selected the display should indicate as follows:

	C	O	M	M	I	S	S	I	O	N	I	N	G					p	0	0
>	N	O		P	R	O	F	I	L	E		S	E	L	E	C	T	E	D		<

P00 is considered the CLOSED position to which the servos will move to when the burner is off, STANDBY or in lockout. While commissioning P00, regardless of the position of the burner on

switch, the operating control relay (OCRC) remains open. When the user has finished setting the P00 position for all servos, P00 is complete and the user will press the NEXT key to set up P01. At this point a profile will need to be selected requiring the operating control relay to become closed. If the burner control switch is closed, the keypad BURNER ON/OFF pressed and LED illuminated and all other startup permissives are met (i.e. pressure / temperature), the PPC4000 will close the operating control relay (OCRC) and the YB110 (flame safeguard) will start the combustion motor through terminal M. If wired as recommended, this will force a profile to be selected. The YB110 controller will also enter the purge position and output to the PPC4000 the high fire command. The high fire command output from YB terminal X is connected to a designated digital input, HIGH, on the PPC4000 controller.

If a profile is selected but terminal X, P15.2, is not being annunciated by the YB, the display is as follows:

	C	O	M	M	I	S	S	I	O	N	I	N	G				p	0	1
>	W	A	I	T		F	O	R		P	U	R	G	E						<

Having a profile selected and the high fire output active results in only those servos mapped to the selected profile to be as shown in the following example:

	C	O	M	M	I	S	S	I	O	N	I	N	G				p	0	1
>	A	I	R	(	1	)										3	.	1	°	<
	G	A	S	(	3	)										1	.	9	°	

Position P01 is the purge position. If previously set the servos will move to their previously programmed positions and stop. With the UP and DOWN keys, the user moves the servo to be positioned into the shaded area and presses the MDFY key. The UP and DOWN keys are then used to select the new target position. The displayed value responds to the UP and DOWN keys. When the new target position is selected, the user presses the SAVE key to retain the settings and the selected servo will move to the new position.

When satisfied with all servo positions the user presses the NEXT key to force the output of the proven high fire switch that signals the YB110 control on terminal 8 to begin its pre-purge timer. During the purge period the servo positions are inhibited from being moved.

Once pre-purge is completed (30 seconds typical) the YB110 controller will request the PPC4000 to move to its ignition position, P02 by the low fire output from the YB110 controller on terminal 12. The display will indicate:

	C	O	M	M	I	S	S	S	I	O	N	I	N	G				p	0	2
>	A	I	R	(| 1 |)										8	7	.	5	°	<
	G	A	S	(| 3 |)											1	.	9	°	

If previously set, during the low fire start position the servos will move from their pre-purge position to their ignition or light-off positions and stop. Otherwise, the user moves the servo to be positioned into the shaded area and follows the procedure using the UP, DOWN and MDFY/SAVE keys to properly position the servos and save this data. The display may look like the following:

	C	O	M	M	I	S	S	S	I	O	N	I	N	G				p	0	2
>	A	I	R	(| 1 |)											7	.	5	°	<
	G	A	S	(| 3 |)											5	.	4	°	

When all servos are at the desired ignition light-off position, the user presses the NEXT key and the PPC4000 outputs to the YB110 controller the low fire start signal on terminal D. The YB110 controller will advance into PTFI only if the low fire start purge timer has expired and the low fire start switch is closed (terminal D). The YB110 controller will automatically sequence through PTFI and MTFI to AUTO.

Note: Since it is easily assumed the first 'guess' at the ignition positions will not provide a satisfactory light-off, it would be suggested to place the YB110 in the CHECK position during PTFI and MTFI to allow adjustment of the above servo positions to get the optimum light-off firing condition. To adjust the servos, the aforementioned procedure is used. The SAVE key retains the data.

After reaching the AUTO stage, the YB110 outputs this state on its terminal 11. Although the flame safeguard control is in AUTO (igniter off), the PPC4000 remains at P02 to allow adjustment of the servos. When satisfied with the servo positions the user is allowed to exit commissioning mode without affecting positions P03 and above (pre-commissioned unit) or the user presses the NEXT key to advance to P03. The following is displayed:. The following is displayed:

	C	O	M	M	I	S	S	I	O	N	I	N	G					p	0	3
>	A	I	R	(| 1 |)											7	.	5	°	<
	G	A	S	(| 3 |)											5	.	4	°	

Position P03 is defined as the low fire position of the burner and will be displayed as 0% modulation rate. At this point the user can make adjustments to the servos to achieve the correct fuel/air firing ratio.

	C	O	M	M	I	S	S	I	O	N	I	N	G					p	0	3
>	A	I	R	(| 1 |)											8	.	2	°	<
	G	A	S	(| 3 |)											6	.	3	°	

When complete setting the low fire position, the user presses the NEXT key to advance to the next setpoint, P04.

As a point of information, if this is a newly commissioned unit, hitting the NEXT key at P03 moves the display to indicate P04 but with the same servo positions as P03.

	C	O	M	M	I	S	S	I	O	N	I	N	G					p	0	4
>	A	I	R	(| 1 |)											8	.	2	°	<
	G	A	S	(| 3 |)											6	.	3	°	

At each subsequent setpoint position, the user will most likely increase each servo position in order to increase the firing rate of the burner. However, there are instances, although rare, where a particular servo position may need to be less than or equal to the previous or successive point. This is non-monotonic.

At any point during the commissioning process it may be necessary to check the state of other parameters in the system. For example, if the measured value begins to approach the cut off point, the boiler will shut down and interfere with the commissioning process. To view these parameters press the INFO key and bring up a list of system parameters with their respective values. Pressing the INFO key again will take you right back to the commissioning process.

It will be up to the user as to how many setpoints are entered. As a minimum, P03 must be entered and P23 is the maximum. The more setpoints entered the better the interpolation between each setpoint and the smoother the firing rate curve.

Ending Commissioning Mode:

Pressing the C-MODE key ends the Commisioning Mode and saves all changes to the current profile. The C-MODE LED will be extinguished. For commissioning mode, the last setpoint displayed (above p03) will become the new high fire (100% modulation) setpoint. All previously entered setpoints above the point when commissioning is ended will be cleared if the user exits commissioning above p02. If the PPC4000 has been commission above p03 and the user enters commissioning again but exits before reaching p03, all previous values above p03 will not be cleared.

On exiting commission mode, the passcode will be disabled.

Modulation Rate vs Commissioning Points:

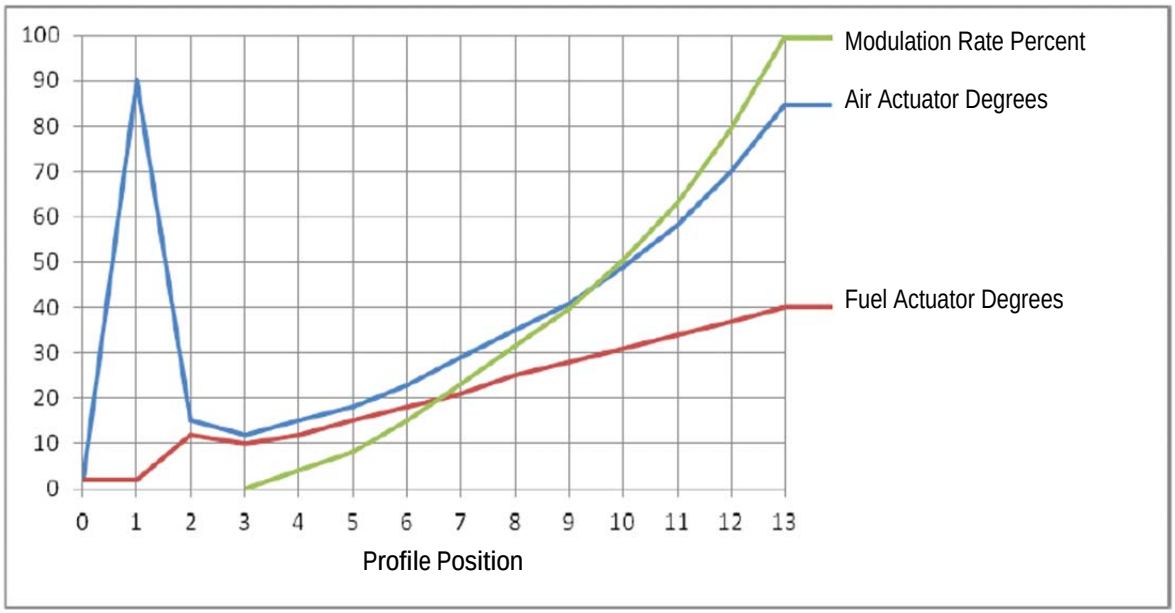
The firing rate curve (a.k.a. modulation rate) is automatically established by the installer during the commissioning process of the burner. Setpoint p03 is the first position in AUTO and corresponds to 0% firing rate of the burner. If the unit is only commissioned to p03 no modulation rate other than 0% is possible. The final commissioned point (at least p04) is always the 100% firing rate position. The modulation rate is based off a linear interpolation from the 0% to 100% master servo positions.

If no VFD is used in the current profile, the AIR servo is selected as the master servo.

If a VFD is selected for use in the active profile the first FUEL servo is the master servo.

Graph 1 depicts a typical air/fuel profile of a burner with 14 commissioned points and no VFD used in the current profile so the AIR actuator is the master. Its p03 position is 12 degrees and the p13 position is 85 degrees. Therefore, the 50% position is ((85-12) X 50%) + 12 = 48.5 degrees. This puts the 50% modulation rate close to the p10 position. The FUEL actuator at the 50% position will be at approximately 30 degrees.

Graph 1 (no VFD):



Graph 2 shows the same commissioned actuator positions for both the AIR and FUEL servos as shown graph 1 but with the FUEL actuator used as the master because a VFD is used. Notice how different the modulation curve appears. Because the FUEL's p03 position is 10 degrees and the p13 position is 40 degrees, the 50% position occurs at ((40-10) X 50%) + 10 = 25 degrees. This puts the 50% modulation rate close to the p8 position where the AIR servo is close to 35 degrees.

Graph 2 (VFD used):

The reason for the difference between the two example curves is due to the AIR servo's upward curving slope but the FUEL servo's slope is straight. The modulation rate curve will resemble the curve of master servo.

Selecting manual or automatic modulation rate:

To adjust the modulation rate, the user must first put the PPC4000 into the manual modulation mode. This is done by pressing the AUTO MAN button or by enabling this function through a digital input. Once the manual modulation rate is selected, the display will change from "MODULATION RATE" to "MANUAL MOD RATE".

For AUTO modulation:

	A	U	T	O													s	1	6
>	**M**	**O**	**D**	**U**	**L**	**A**	**T**	**I**	**O**	**N**		**R**	**A**	**T**	**E**		**1**	**0**	**0**	**%**	<
	A	I	R	(| 1 |)										6	9	.	5	°	
	G	A	S	(| 3 |)										3	8	.	0	°	

For MANUAL modulation:

	A	U	T	O													s	1	6	
>	**M**	**A**	**N**	**U**	**A**	**L**		**M**	**O**	**D**		**R**	**A**	**T**	**E**		**1**	**0**	**0**	**%**	<
	A	I	R	(	1	)										6	9	.	5	°	
	G	A	S	(	3	)										3	8	.	0	°	

To adjust the modulation rate, the user will press MDFY and use the UP and DOWN keys. The modulation will change with the UP and DOWN arrows. When complete the user presses the SAVE key to save the current position.

Only points P00, P01 and P02 can be altered without having any effect on the remaining points in the current profile. This would mean that in commissioning mode, if only P00, P01 and or P02 are changed or revised the remaining setpoints would not be altered if the C-MODE key were pressed to exit.

COMMISSIONING O2 TRIM WITH THE OXYGEN PROBE

Prior to commissioning with the oxygen probe the user must assure the oxygen probe is installed correctly, connected to the PPC4000, communicating with the PPC4000 and the O2 SETUP menu parameters are correctly set, i.e. OPERATION set to CONTROL, etc.

During the commissioning and adjust ratio procedures, O2 trim is not enabled.

Care should be taken when selecting trim limit ratio and maximum trim limit. The P-GAIN and I-GAIN terms determine the responsiveness of the trim function and are dependent on burner size, fuel type, and transport delay. It is recommended that default values be used to start and adjusted accordingly during system check out.

During commissioning with oxygen and with the O2 OPERATION set to CONTROL, the O2 level and flue temperature currently being measured is displayed with the servo position information.

	<	C	O	M	M	I	S	I	O	N	I	N	G					p	0	4	
>	A	I	R	(	1	)										2	7	.	2		<
	G	A	S	(	3	)										1	6	.	3		
	O	2		L	E	V	E	L								6	.	3	8	%	
	F	L	U	E		T	E	M	P								2	8	0	F	

The commissioning procedure previously described is the same with O2 trim.

The O2 trim function requires each profile setpoint from p03 (low fire) to pHigh (high fire) to have an O2 target value associated with that profile setpoint. During the commissioning process the installing personnel must insure the O2 target level is a true representation of the burner operation at that particular setpoint. This is done by waiting sufficient time at each profile setpoint for the O2 level to reach a true and reliable level.

It is the responsibility of the installing and operating personnel to ensure the O2 target levels are within the operating limits of the burner and will not allow a hazardous combustion condition to occur.

At each profile setpoint the target value is saved to interim memory by first using the MDFY key to position the air or fuel servo to their appropriate positions and pressing the SAVE key. After a sufficient wait time to achieve a reliable O2 reading the NEXT key is pressed to save the target value to the setpoint table and move forward to the succeeding profile setpoint.

During ommissioning and adjust ratio procedures, O2 trim is not enabled.

Profile setpoint pHigh is saved after waiting sufficient time to achieve a reliable O2 level reading and then pressing the C-MODE key to exit commissioning. Pressing the C-MODE key saves all profile setpoint data to permanent memory and defines the last setpoint entered as the high fire or 100% modulation point.

You cannot manually modify the O2 concentration under the commissioning/adjust ratio screen. A new O2 value is stored when any servo position is modified for the currently selected commissioning point. The O2 value that is stored is the current O2 value at the time that the new position is saved. Make sure the O2 concentration is stable and it is within the expected window before moving on to the next commissioning point. During times that commissioning or adjust ratio needs to be reviewed without affecting the saved O2 target levels, simply pressing the NEXT or BACK key will move to the next or previous setpoint without affecting the saved O2 target level for that previously commissioned profile setpoint.

OPERATION WITH O2 TRIM

With O2 trim enabled, if the firing rate changes by an amount of 30% or more, trim will be inhibited until the following conditions occur:

1. The air servo reaches its destination.
2. O2 below target if direction of travel is low fire to high fire.
3. O2 above target if direction of travel is high fire to low fire.
4. O2 within dead band about target.
5. O2 level stable - stable being steady reading plus/minus 0.2%.
6. Servos stop moving for 20 seconds regardless the O2 level.

The trim servo will never move the maximum range of the trim limit in one adjustment.

Inside the dead band, 0.2%, O2 trimming is inhibited.

Note: Status of O2 trim can be verified by hitting the HOME key and reviewing the top line. If O2 trim is active, the top line should read AUTO(t). If O2 trim is not active, the top line should read AUTO.

Trim Limit Test

To test the setting of the trim limit selected during O2 SETUP, it is suggested the user enter adjust ratio mode (O2 trim becomes disabled), move to each profile setpoint and move the trim servo to its maximum and minimum positions defined by the trim limit for that setpoint. Refer to rule shown in section SETTING TRIM LIMITS. The purpose of this test is to insure that no hazardous conditions (high CO levels) exist at the extreme positions of the trimmed servo. The user should be aware that to move the trimmed servo the MDFY and SAVE keys must be used and by pressing the NEXT or BACK key when done testing with this particular setpoint, the current O2 level will be saved as the target for this profile setpoint. The user should ensure the servos are moved back to their originally commissioned position to get back the original target O2 level before pressing the NEXT or BACK key.

Process Control

A key function of the PPC4000 is to maintain the process control variable setpoint. In the ADJUST SETPOINT menu setting a small value of P-BAND and high value of INTEGRAL could cause large and unnecessary swings in the firing rate and subsequently servo motors. It is during these large swings in firing rate that should be avoided when using O2 trim. The O2 trim algorithm will be constantly chasing the target and if the swings are large enough, be inhibited during these large

changes. With good PID control the user should set both P-BAND and INTEGRAL to provide the wanted performance yet avoid large firing rate changes.

While THERMAL SHOCK is active, O2 trim is disabled.

ADJUST RATIO PROCEDURE

Adjust ratio is used after the profile has been commissioned and all setpoints have been entered. Adjust ratio mode is used only for modifying an existing profile from low fire (P03 through P23) through high fire. No new setpoints can be entered with adjust ratio.

It is not possible to modify the close (P00), purge (P01) or ignition (P02) positions using adjust ratio mode. All other commissioned setpoints can be modified in any order.

It is not possible to modify any servo or VFD position so that it is higher than the high fire setpoint. It is also not possible to modify a master servo position so that it is higher than the leading adjacent setpoint or lower than the trailing adjacent setpoint.

Entering adjust ratio mode:

To enter adjust ratio mode, the burner may be on or off. The user presses the C-MODE key located on the keypad. If not currently enabled the system directs the user to the passcode setup screen where the user must enter the necessary adjust ratio passcode level 2. If the user enters the commissioning passcode while the burner is on, adjust ratio mode is entered. If entered properly or if previously entered the LED indicator at the C-MODE key will illuminate and the display will indicate:

	<	A	D	J	U	S	T		R	A	T	I	O					a	0	0
>	A	I	R	(| 1 |)											3	.	1	°	<
	G	A	S	(| 3 |)											1	.	9	°	

With the control in the burner off (STANDBY) position, a profile must be selected to view all the setpoints for that profile. If no profile is selected only P00 (shown as a00) will be displayed.

Note: Profile is selected through the action of the flame safeguard control following a burner on command.

If, while in adjust ratio mode and after burner on command is issued attempting to move to a01, there is no commissioning data for this profile, the display will indicate:

	<	A	D	J	U	S	T		R	A	T	I	O					a	0	0
>	N	O	T		C	O	M	M	I	S	S	I	O	N	E	D					<

At this point the user can and should exit Adjust Ratio mode. See exiting adjust ratio mode.

If the burner is commanded on and there is no profile selected waiting for the flame safeguard to turn on the display will indicate:

	<	A	D	J	U	S	T		R	A	T	I	O					a	0	0
>	N	O		P	R	O	F	I	L	E		S	E	L	E	C	T	E	D		<

If entering adjust ratio mode while the burner is in AUTO (modulating) the displayed setpoint will be the closest setpoint to the actual firing rate of the burner. If the calculated modulation point is between two setpoints, the burner will move to the lower setpoint.

While in adjust ratio mode and in STANDBY, s01, the burner can be made to turn on and will cycle through its normal sequence.

1. During the purge and ignition sequence the user will be able to view all programmed setpoints for that profile. No change to any setpoint can be made when below a03.
2. Upon reaching the AUTO state, s16, the modulation rate or servo positions will move to the point corresponding with the displayed adjust ratio setpoint.
3. Upon reaching AUTO, s16, if the displayed adjust ratio setpoint is a00, a01 or a02, the burner will hold at a03 (low fire). The user has the ability to move through all programmed setpoints, forward or backward, using the NEXT or BACK keys. Pressing the NEXT key will not allow the user to exceed the highest commissioned setpoint.
4. Only setpoints a03 and above can be adjusted, the user can move below a03 but will not be able to make any adjustments.
5. As the user moves through the setpoints the servo positions will also move to track the current setpoint selected. However, if the user moves below a03, the servos will remain at their a03 positions.
6. The user is inhibited from making any servo adjustments prior to the servos reaching the selected setpoint.
7. If a VFD is used in the current profile, an additional check is performed on the FUEL servo only to ensure that there are no non-linear setpoints entered. This means that no setpoint will be allowed that would make the servo movement change direction as the setpoint number is increased from a03 to the maximum setpoint entered. For example, if the user has entered 5.0 for a03, 10.0 for a04, and 15 for a05, if the user was adjusting a04, no value below 5.1 or higher than 14.9 would be allowed for the FUEL servo since the a04 value is bounded by the a03 and a05 values. If a VFD is not used in a profile, the same linearity restriction applies but to the AIR servo only not the FUEL servo.

During adjust ratio mode, the user can adjust each servo for that setpoint by using the MDFY/SAVE key followed by the UP and/or DOWN keys and saved by the MDFY/SAVE key.

During adjust ratio mode, the modulation algorithm is ignored. That is, the firing rate or servo positions will be determined by the selected profile setpoint. This applies to setpoint a03 and above. If the BACK is used to move below a03, the firing rate or servo positions will remain at a03.

While in Adjust Ratio, LOW FIRE and AUTO/MAN keypad states are ignored. The INFO as well as the BURNER ON keys are active during adjust ratio mode.

If the current process variable's cut out is exceeded, the burner will shutdown, the burner on limit switch can be opened to caused a burner shutdown, the BURNER ON key switch is pressed to cause a burner shutdown, or lockout can occur to cause a burner shutdown. For all of the above the adjust ratio procedure will remain in effect and revert back a00.

Exiting Adjust Ratio Mode

1. Pressing the C-MODE key forces all setpoints modified and saved to be transferred or saved to permanent memory for this profile. The C-MODE LED will be extinguished.
2. On exiting adjust ratio mode, the passcode will be disabled.

BOILER EFFICIENCY

With an O2 probe (NXCESO2) installed, the PPC4000 will provide boiler efficiency. Along with the O2 probe it is also necessary to install an inlet air temperature sensor (FXIATS-140) and configured to either sensors 3, 4 or 5. Parameters necessary to calculate boiler efficiency are entered through the O2 SETUP submenu. The PPC4000 uses the current O2 value to determine the current CO2 value.

Conditions required to display boiler efficiency:

1. In the O2 SETUP submenu, O2 OPERATION is configured to operate as MONITOR or CONTROL.
2. FUEL TYPE properly selected.
3. Inlet temperature sensor connected to sensor 3, 4 or 5.
4. Flue temperature is required to calculate efficiency.
5. Efficiency will be shown in AUTO only.
6. Items relating to efficiency are not shown if O2 OPERATION is DISABLED.

Sensor 3, 4 and 5

Sensors 3, 4 and 5 are provided to connect an inlet air temperature to be used for the boiler efficiency calculation. Fireye provides 3 ranges of inlet air temperature: -50°F to 300°F (-45°C to 149°C),

-40°F to +140°F (-40°C to 60°C), 32°F to 350°F (0°C to 176°C).

It is the responsibility of the installer to only designate either sensor 3, 4 or sensor 5 as inlet air, setting the others to UNUSED. Access to sensor 3, 4 or 5 configuration can be done under SENSOR SETUP in the top layer menu.

	S	E	N	S	O	R		4												
>	T	Y	P	E												I	N	L	E	T	<
	R	A	N	G	E							0		t	o		3	0	0	F	

The values shown represent the maximum value of the sensor range.

COLD START THERMAL SHOCK PROTECTION

Cold Start Thermal Shock Protection is a method to slowly increase the burner firing rate on a cold start to limit mechanical stress due to thermal differences. The PPC4000 offers two methods of thermal shock protection: Low Fire and Segment. After thermal shock is satisfied, THERMAL EXIT satisfied, operation of the boiler is handed over to either setpoint 1 or 2.

Thermal shock setpoints are accessed from the top layer menu and is indicated by THERMAL SHOCK SETUP >. Press the NEXT key to enter this submenu.

The setpoints associated with THERMAL SHOCK are:

	<	T	H	E	R	M	A	L		S	H	O	C	K		S	E	T	U	P	
>	M	E	T	H	O	D		T	Y	P	E		L	O	W		F	I	R	E	<
	S	E	N	S	O	R		U	S	E	D									1	
2	T	H	E	R	M	A	L		S	T	A	R	T	1	1	.	6	p	s	i	
1,2	T	H	E	R	M	A	L		E	X	I	T				1	8	0		F	
1	M	I	N	.		L	O	W		F	I	R	E					2	0	%	
2	T	I	M	E	D		O	V	E	R	R	I	D	E		3	0	m	i	n	

METHOD TYPE: user selects UNUSED, LOW FIRE or SEGMENT.

If UNUSED is selected then all menu items below this menu item are not displayed.

Line items marked with 1 are LOW FIRE method.

Line items marked with 2 are SEGMENT method.

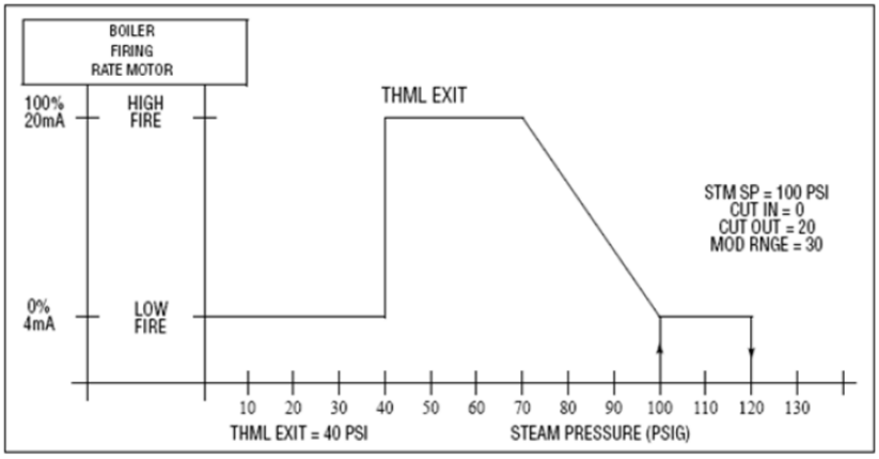
The factory default is UNUSED.

SENSOR USED: user selects which sensor to use for thermal shock protection. The options are sensor 1, 2 or 3. The sensor used choices are limited to what sensors are selected as USED in the SENSOR USAGE submenu. The thermal shock algorithm needs to know only the type and range of the sensor. **THERMAL SHOCK SETUP should be accessed only after all sensor and setpoints have been setup.**

LOW FIRE METHOD: This method of cold start thermal shock protection is generally used on Water Tube Boilers. The setpoints associated with this method of thermal shock protection is:

- **THERMAL EXIT** (Thermal Shock Exit Setpoint): The PPC4000 will hold the servo motors at the low fire (LF) position, P03, until the steam pressure (or water temperature) reaches the Thermal Shock Exit Setpoint (**THERMAL EXIT**). Once this steam pressure (or water temperature) is reached, the firing rate motor is positioned according to the modulating control algorithm. The units and range displayed are determined by the sensor type selected.
- **MIN. LOW FIRE** (Low fire minimum): Use this selection to set the servo positions are the calculated firing rate position during the low fire method operation. The range is 0 to 100% and the increments are 1%.

Cold Start Thermal Shock Protection – Low Fire Method



SEGMENT METHOD: This method of cold start thermal shock protection is generally used with Fire Tube Boilers. The setpoints associated with this method of thermal shock protection are:

- **THERMAL START** (Thermal Shock Start Point): Sets the start point for thermal shock protection. The firing rate is held at low fire, P03, until the thermal shock start point is achieved. The units and range displayed are determined by the sensor type selected.
- **THERMAL EXIT** (Thermal Shock Exit Point): Sets the steam pressure or water temperature exit point for thermal shock protection. Once this steam pressure (or water temperature) is reached, the firing rate is positioned according to the modulating control algorithm. The units and range displayed are determined by the sensor type selected.
- **TIMED OVERRIDE** (Timed Override Per Segment Setpoint): Sets the maximum time the PPC4000 holds the firing rate for each segment before automatically; increasing to the next segment. The allowable range is 0 to 30 minutes. If 0 is selected the control will move to the next segment only when the pressure or temperature reaches the next segment.

THERMAL START and THERMAL EXIT: Once the burner cycle starts, the PPC4000 will hold the firing rate in the low fire position until the steam pressure (or water temperature) reaches the Thermal Shock Start Point (**THERMAL STRT**). The PPC4000 divides the difference between the Thermal Shock Start Point (**THERMAL STRT**), low fire, and the Thermal Shock Exit Point (**THERMAL EXIT**) into sixteen (16) segments. The PPC4000 will increase the firing rate position by the value of one segment, and wait until the steam pressure (or water temperature) increases by

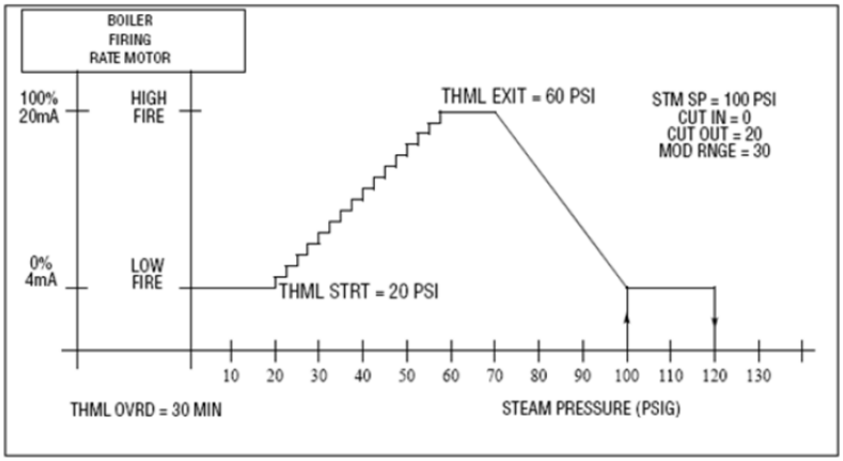
the amount of one segment before moving on to the next segment. Once the steam pressure (or water temperature) increases by the calculated amount, the PPC4000 increases the firing rate by the value of one segment and repeats the process. The PPC4000 steps the firing rate until the steam pressure (or water temperature) reaches the Thermal Shock Exit Point (**THERMAL EXIT**). At that point, the firing rate is at the high fire position, and will remain at the high fire position until the steam pressure (or water temperature) breaks into the proportional band.

NOTE:

1. If the sensor being used for thermal shock is the same type as the PCV sensor (steam or water) the Thermal Shock Exit value cannot be greater than the PCV setpoint.

TIMED OVERRIDE: The Timed Override Per Segment Setpoint (**THERMAL OVERRIDE**) allows the user to program a maximum time period, 0 to 30 minutes, in which the control will wait before forcing an increase in firing rate to the next segment position. If the steam pressure (or water temperature) DOES NOT increase to the appropriate value, the PPC4000 will automatically advance the firing rate position to the next segment position.

Cold Start Thermal Shock Protection – Segment Method



COMMUNICATIONS SETUP

The communications setup is needed to configure the PPC4000 to effectively perform Modbus and sequencing communications. Communication setup can be accessed from the top menu screen and the underlying setup screen is shown below:

<	C	O	M	M	U	N	I	C	A	T	I	O	N		S	E	T	U	P
B	A	U	D		R	A	T	E							5	7	6	0	0
U	N	I	T		A	D	D	R	E	S	S						2	4	7

The baud-rate and unit address is configurable in the communication setup screen. The selections for baud-rates are: 57600 (default), 38400, 19200, 9600, 4800. In order for Modbus master and slave to communicate effectively, the baud-rate must be set to be identical at the master and the slave.

The selection for unit addresses are: 1 through 247, where 247 is default. It should be noted that an address conflict in the sequencing chain or Modbus chain will result in communication lockup, whereby devices with address conflict cannot effectively communicate. So, it is important that the addresses are unique on all communication devices.

SETBACK OPERATION

With the real time clock in the PPC4000, scheduled setback operation can be implemented to allow the system to operate to an alternate steam pressure or water temperature during off peak times. The scheduled setback time applies to every day of the week. That is, there are not individual setback times for each day of the week. Digital inputs are available that allow the user to override the setback operation for a pre-determined time when in setback mode or to place the system in a forced setback mode.

From the top layer menu, the user scrolls to SETBACK SETUP> and presses the NEXT key to access this submenu.

<	S	E	T	B	A	C	K		S	E	T	U	P						
>	S	E	N	S	O	R		U	S	E	D								1	<
	L	I	M	I	T		T	Y	P	E							D	E	V	
	S	T	B	C	K		S	E	T	P	T			1	2	.	6	P	S	I	
	C	U	T		I	N											0	P	S	I	
	C	U	T		O	U	T										3	P	S	I	
	P	-	B	A	N	D											3	P	S	I	
	I	N	T	E	G	R	A	L												0	
	D	E	R	I	V	A	T	I	V	E										0	
	E	N	D		S	T	B	C	K						5	:	3	0	A	M	
	B	E	G	I	N		S	T	B	C	K			1	0	:	0	0	P	M	
	O	V	E	R	R	I	D	E		H	O	U	R	S				0	-	8	
	S	T	B	C	K		S	U	N			A	L	L		S	T	B	C	K	
	S	T	B	C	K		M	O	N				N	O		S	T	B	C	K	
	S	T	B	C	K		T	U	E				N	O		S	T	B	C	K	
	S	T	B	C	K		W	E	D				N	O		S	T	B	C	K	
	S	T	B	C	K		T	H	U				N	O		S	T	B	C	K	
	S	T	B	C	K		F	R	I				S	C	H	E	D	U	L	E	
	S	T	B	C	K		S	A	T			A	L	L		S	T	B	C	K	

For setback to work properly the user should ensure the real time clock has been properly set up. See previous section titled REAL TIME CLOCK.

The sensor used option applies to sensor 1 and sensor 2. If no sensors are setup then USED cannot be selected. Typically sensor 1 is the process control variable and in the case of a steam boiler could be a common header sensor.

STBCK STEAM and STBCK WATER refer to the sensor selected and its configuration. Only sensors selected can be shown. (If a sensor selected is made unused at a later time then all setback setup information is cancelled or erased).

END STBCK (End Setback Period): This setpoint determines at what time the PPC4000 changes over from the setback setpoint to the normal setpoint (SETPOINT 1 or SETPOINT 2).

BGN STBCK (Begin Setback Period): This setpoint determines at what time the PPC4000 starts the setback schedule.

STBCK SUN (Daily Setback Options): This selects the options for operating in the setback mode for Sunday. These options are:

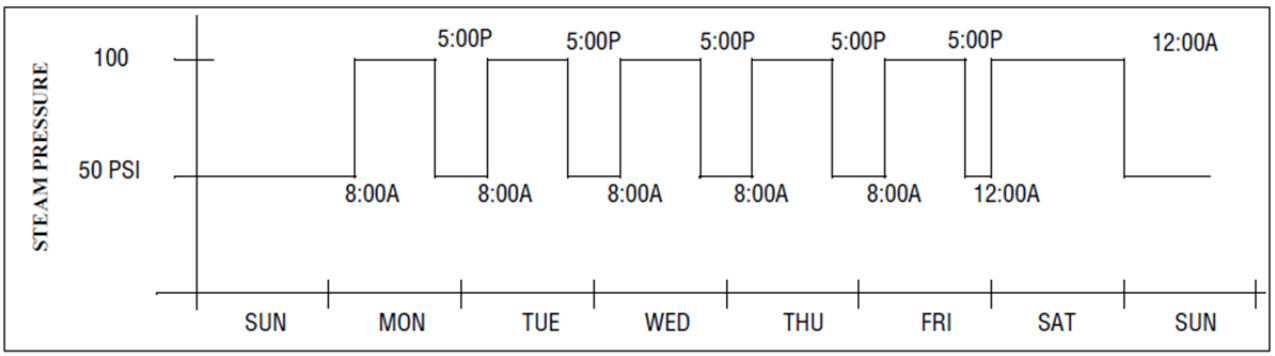
- **ALL STBCK** (All Setback). The PPC40000 controls the boiler at the setback setpoint for the entire day (24 hours).
- **NO STBCK** (No Setback). The PPC4000 DOES NOT setback the boiler for this day, but controls the boiler at the normal setpoint for the entire day (24 hours).
- **SCHEDULE** (Scheduled Setback) The PPC4000 controls the boiler according to the Setback Schedule for the time specified in END STBCK and BEGIN SETBCK.

Assured Low Fire Cutoff

If the modulation rate is greater than 25% at the Begin Setback period (**BEGIN STBCK**) when the PPC4000 is scheduled to operate according to the reduced setback setpoints, the PPC4000 will delay opening the operating control output until the servo motors reach the low fire position, P03.

SETBACK OVERRIDE: In addition, the PPC4000 provides the ability to program a digital input to override the setback mode of the PPC4000 control for a programmed period of time from 1 to 8 Hours (**OVERRIDE HOURS**). If the PPC4000 is operating in the setback mode and the digital input is active (set to SETBACK OVERRIDE) and momentarily closed then opened, the PPC4000 will exit the setback mode and control according to the steam pressure (or water temperature) setpoint (**SETPOINT 1** or **SETPOINT 2**) for the programmed period of time (1 to 8 Hours). If the contact is closed and opened BEFORE the programmed time period expires, the PPC4000 will return to the setback mode.

FORCED SETBACK: The PPC4000 provides a programmable digital input to force the PPC4000 to operate according to its setback setpoints for as long as this contact is closed, regardless of the programmed setback schedule. **FORCED SETBACK** has highest priority.



NORMAL OPERATING SETPOINTS	SETBACK SETPOINTS	
SETPOINT 1 = 100 PSI	SETBACK = USED	STBCK SUN = ALL STBCK
	END STBCK = 0:800AM	STBCK MON=SCHEDULE
	BEGIN STBCK = 5:00PM	STBCK TUE=SCHEDULE
	STBCK STEAM = 50 PSI	STBCK WED=SCHEDULE
		STBCK THU=SCHEDULE
		STBCK FRI=SCHEDULE
		STBCK SAT = NO STBCK

STANDBY WATER

Only Sensor 2 can be used to maintain the boiler in a standby condition. Sensor 2 can be configured to use either a temperature or pressure sensor. The normal configuration would be for Sensor 1 to be a pressure sensor and Sensor 2 to be a temperature sensor so a lower than boiling point temperature can be maintained in the boiler. The following setup shows how to do that.

Install a temperature sensor to the Sensor 2 input and configure it in the following manner:

SENSOR 2 SETUP menu:
SENSOR TYPE: STANDBY
SENSOR RANGE: (user set to currently installed temperature sensors)
SETPOINT 2 SETUP menu:
SENSOR USED: 2
SETPOINT: (set by user to the desired standby water temperature)

All other parameters are set to for SETPOINT 2 are user selectable based on need.

Note: If the boiler is set up as a sequencing slave and is being commanded to be off by the master, the Standby Water function will override that and allow the slave boiler to run to maintain the Standby Water setpoint.

It is possible for the user to connect and configure either two temperature sensors or two pressure sensors to a PPC4000 and try to use one as the PCV and the other as Standby. However, this would probably not work well even if one-way valves were used. However, if the PCV sensor (Sensor 1) is a temperature sensor, the Standby Water sensor (Sensor 2) could be a pressure sensor. This would restrict the user to a standby water temperature always over the boiling point of water. If the user wishes to do that, the following Standby Water Temperature/Pressure Table can be used to calculate the standby water temperature.

Standby Water Temperature/Pressure Table

Pressure PSI Guage	Saturation Temp °F	Saturation Temp °C		Pressure PSI Guage	Saturation Temp °F	Saturation Temp °C
1	215.92	101.82		110	344.16	173.42
10	239.35	115.19		120	350.05	176.69
20	258.74	125.96		130	355.60	179.78
30	273.99	134.44		140	360.87	182.70
40	286.70	141.50		150	365.87	185.48
50	297.65	147.58		160	370.63	188.13
60	307.31	152.95		170	375.19	190.66
70	315.99	157.77		180	379.56	193.09
80	323.89	162.16		190	383.76	195.42
90	331.15	166.19		200	387.80	197.66
100	337.88	169.93				

TRACK MODULATION

Track modulation is the application of a 4-20 mA signal to the sensor 1 input and having the modulation rate move the servos associated with the current profile to the corresponding firing rate position. The 4-20 mA input signal corresponds to 0% to 100% firing rate with 4 mA being 0% firing rate and 20 mA being 100% firing rate.

To use TRACK MODULATION, SENSOR 1 usage must be set to TRACK. There is no setpoint information associated with TRACK MODULATION as the firing rate is determined by the signal input level being applied. Typically the 4-20 mA signal is supplied from an external controller having its own pressure or temperature input and PID control.

When in TRACK MODULATION mode the PCV signal level is displayed as a 0 to 100% level corresponding to the level of the signal being applied. The modulation rate will be identical to this value and the servos will be moved to their respective positions corresponding to this modulation rate.

After burner turn on and safety start-up, in AUTO the servos will move to the position corresponding to the TRACK MODULATION input level.

Lockout and shutdown will occur if the TRACK MODULATION input exceeds 21mA or goes below 3mA.

NOTE: Track modulation bypasses the ability for the PPC4000 to control the burner using its internal setpoint control. It is recommended that the user configure a digital input for BURNER ON/OFF.

OPERATING SEQUENCE

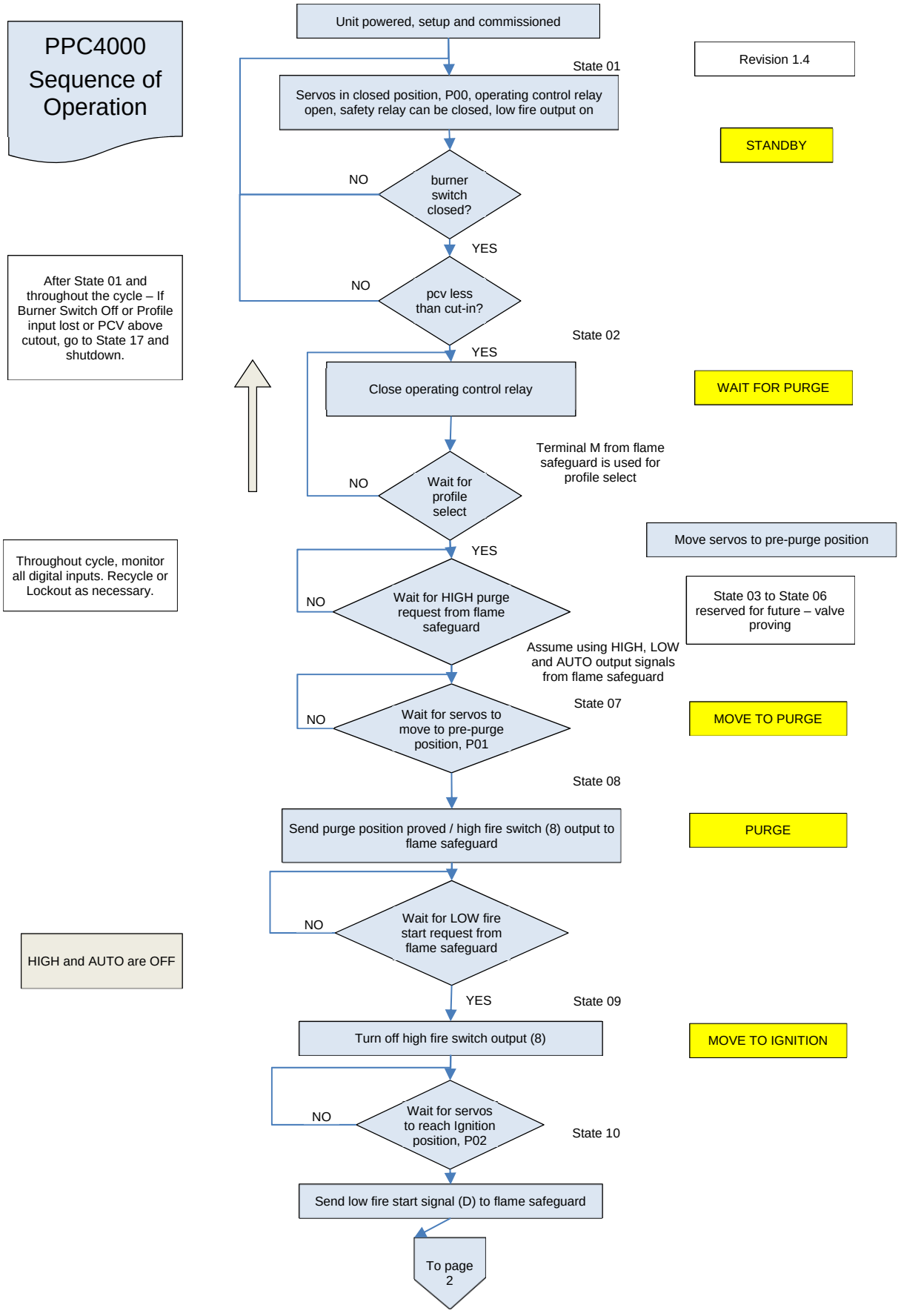
This PPC4000 control performs burner start-up and shut-down in conjunction with an external burner flame safeguard controller, YB110 for example. The flame safeguard controller provides burner management functions such as flame detection, interlock safety, combustion air flow monitoring as well as controlling the combustion air fan, ignition, pilot valve(s) and main fuel valve(s).

The start-up and shutdown sequence is handled by a progression of stages, each requiring a certain set of conditions to move on to the next stage. The progression through the stages requires specific 'handshaking' between the PPC4000 and flame safeguard controllers. This is accomplished with a variety of signals as shown in the following table.

Name	PPC4000	YB110	Description
LOW	P15.3	12	From YB110: Indicates to PPC4000 that purge is complete and go to ignition position. While in AUTO directs PPC4000 to low fire position (P03).
HIGH	P15.2	X	From YB110: Indicates to PPC4000 to move servos to purge position.
AUTO	P15.4	11	From YB110: Indicates to PPC4000 that burner has completed light-off sequence and is now in AUTO ready to modulate.
Low Fire Start	P5.1	D	From PPC4000: Active when servos are at standby (P00). Active when servos at their ignition positions and signals YB110 to being PTFI light-off. During AUTO becomes active when AIR servo is within 5 degrees of low fire.
High Fire Switch	P5.2	8	From PPC4000: Active when servos at their pre-purge positions (P01). Signals YB110 to begin purge time. During AUTO becomes active when AIR servo is within 5 degrees of high fire.
Operating Control	P4.3 - IN P4.4 - OUT	3	From PPC4000: Operating control relay contacts to be placed in L1-3 circuit of YB110. Signal YB110 to begin burner sequence.
Safety Relay	P5.10 – IN P5.9 - OUT	P	From PPC4000: Safety relay contacts to be placed in 3-P circuit of YB110.

The current burner stage is usually shown on the NXD410 User Interface placed after the current burner status. The following describes each possible stage.

LOGIC STATE	MESSAGE		DESCRIPTION
s01	STANDBY	s01	Burner is in off condition. Burner control switch is open. Keypad Burner ON/OFF commanding burner off. Servos are in P00 position.
s02	WAIT FOR PURGE	s02	Command given to turn burner on. Wait for YB110 command, terminal X
s03 s04 s05 s06	N/A		Does not apply to PPC4000
s07	MOVE TO PURGE	s07	Burner now on. Profile selected, command from YB110 terminal X to PPC4000 P15.2 to move servos to pre-purge position
s08	PURGE	s08	Servo motors at purge position. PP4000 sends output from P5.2 to YB110 to terminal 8 to start purge time.
s09	MOVE TO IGNITION	s09	YB110 purge time complete. Output on terminal 12 to PPC4000 P15.3, command servos to ignition position.
s10	IGNITION	s10	Servos at ignition position. PP4000 sends output from P5.1 to YB110 to terminal D.
s11 s12 s13 s14	N/A		Does not apply to PPC4000
s15	MOVE TO LOW FIRE	s15	YB110 completes light-off sequence and moves to AUTO. PPC4000 receives command on P15.4. Hold position for 10 seconds.
s16	AUTO	s16	No change in YB110. PPC4000 begins modulation to satisfy demand.
s17	CYCLE COMPLETE	s17	Controlled shutdown: pressure/temperature satisfied, burner on/off keypad commands burner off; servos moved to low fire for assured low fire cutoff. Lockout or burner limit open – move to s01
s18	LOCKOUT	s18	All lockouts go to this stage.


PPC4000
Sequence of Operation
Unit powered, setup and commissioned
Revision 1.4
State 01
Servos in closed position, P00, operating control relay open, safety relay can be closed, low fire output on
STANDBY
NO
burner switch closed?
YES
NO
pcv less than cut-in?
After State 01 and throughout the cycle – If Burner Switch Off or Profile input lost or PCV above cutout, go to State 17 and shutdown.
State 02
YES
Close operating control relay
WAIT FOR PURGE
Terminal M from flame safeguard is used for profile select
NO
Wait for profile select
Move servos to pre-purge position
YES
Throughout cycle, monitor all digital inputs. Recycle or Lockout as necessary.
NO
Wait for HIGH purge request from flame safeguard
State 03 to State 06 reserved for future – valve proving
Assume using HIGH, LOW and AUTO output signals from flame safeguard
State 07
NO
Wait for servos to move to pre-purge position, P01
MOVE TO PURGE
State 08
Send purge position proved / high fire switch (8) output to flame safeguard
PURGE
NO
Wait for LOW fire start request from flame safeguard
HIGH and AUTO are OFF
YES
State 09
Turn off high fire switch output (8)
MOVE TO IGNITION
NO
Wait for servos to reach Ignition position, P02
State 10
Send low fire start signal (D) to flame safeguard
To page 2

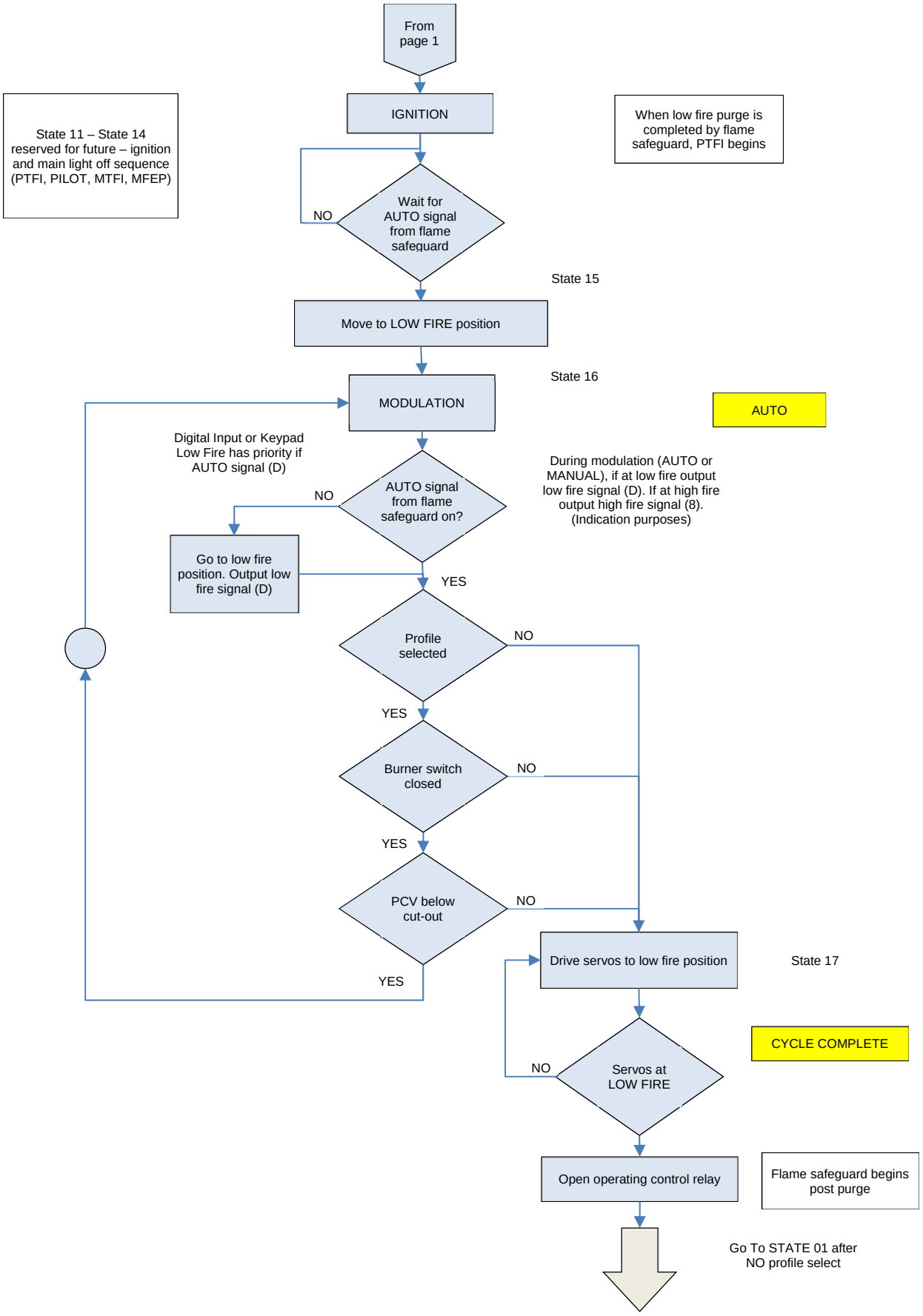
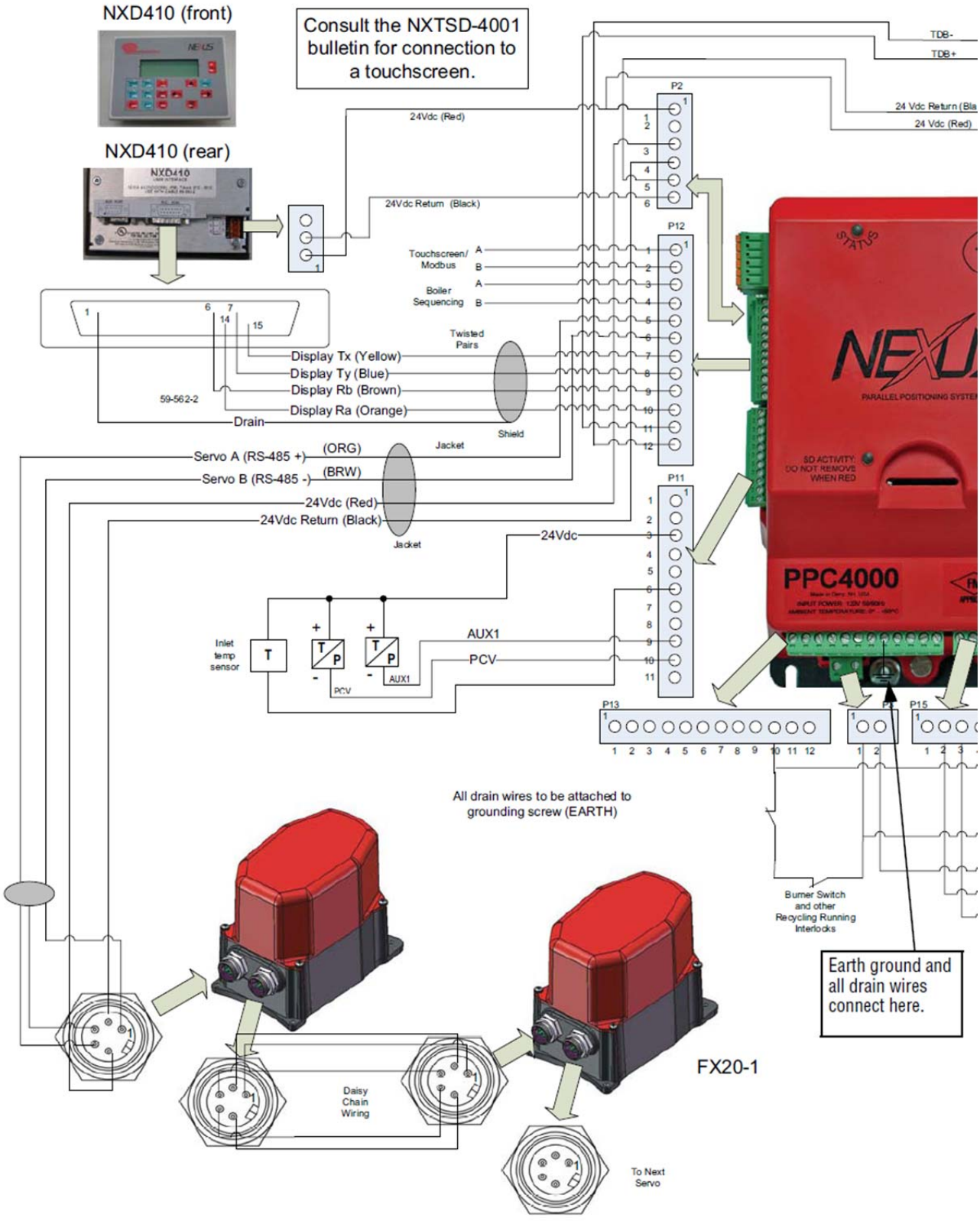
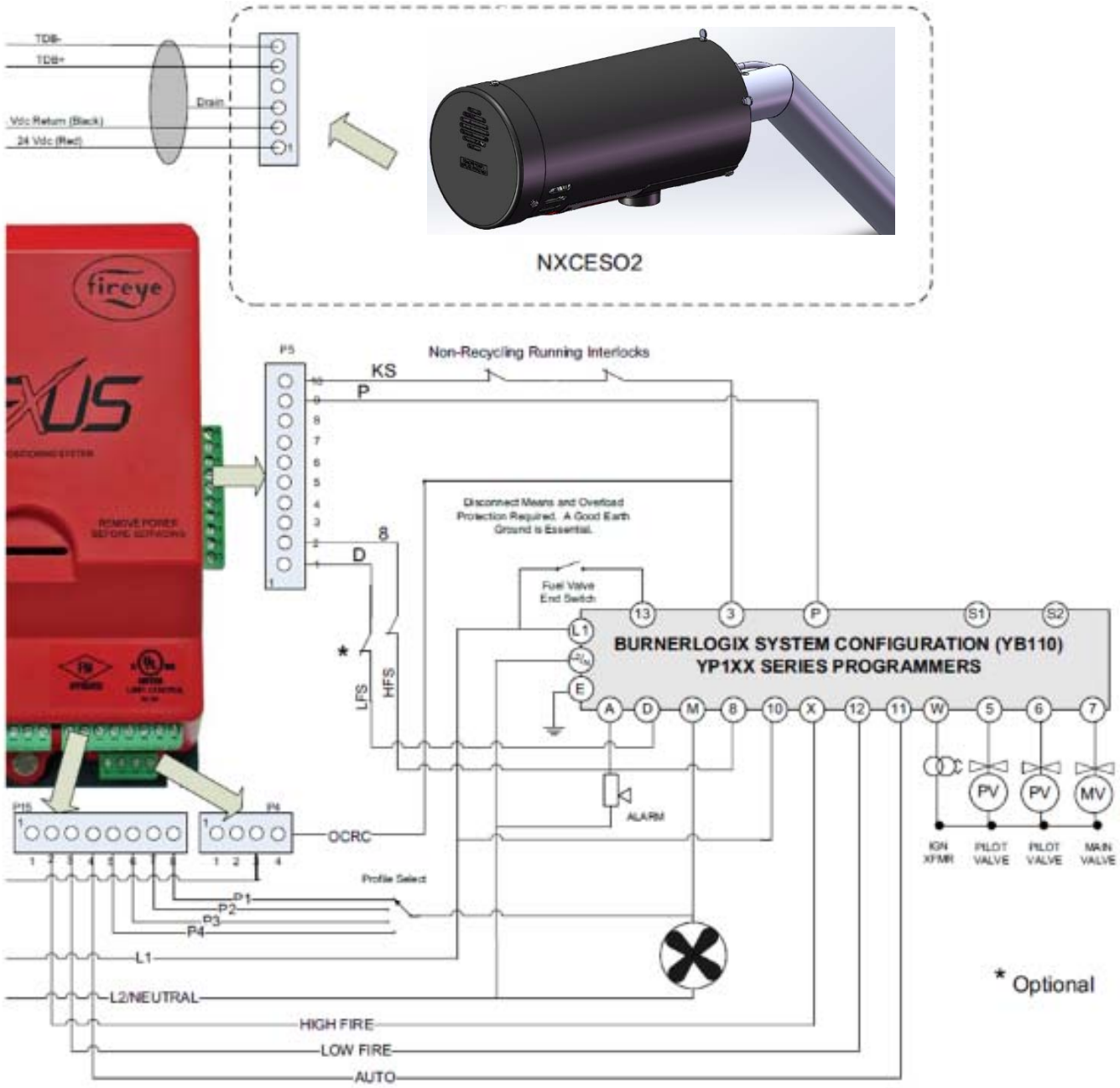

From page 1
IGNITION
When low fire purge is completed by flame safeguard, PTFI begins
State 11 – State 14 reserved for future – ignition and main light off sequence (PTFI, PILOT, MTFI, MFEP)
Wait for AUTO signal from flame safeguard
NO
State 15
Move to LOW FIRE position
State 16
MODULATION
AUTO
Digital Input or Keypad Low Fire has priority if AUTO signal (D)
During modulation (AUTO or MANUAL), if at low fire output low fire signal (D). If at high fire output high fire signal (8). (Indication purposes)
AUTO signal from flame safeguard on?
NO
Go to low fire position. Output low fire signal (D)
YES
Profile selected
NO
YES
Burner switch closed
NO
YES
PCV below cut-out
NO
YES
Drive servos to low fire position
State 17
CYCLE COMPLETE
Servos at LOW FIRE
NO
Open operating control relay
Flame safeguard begins post purge
Go To STATE 01 after NO profile select

FIGURE 10. System Wiring Diagram (Burnerlogix)YB110





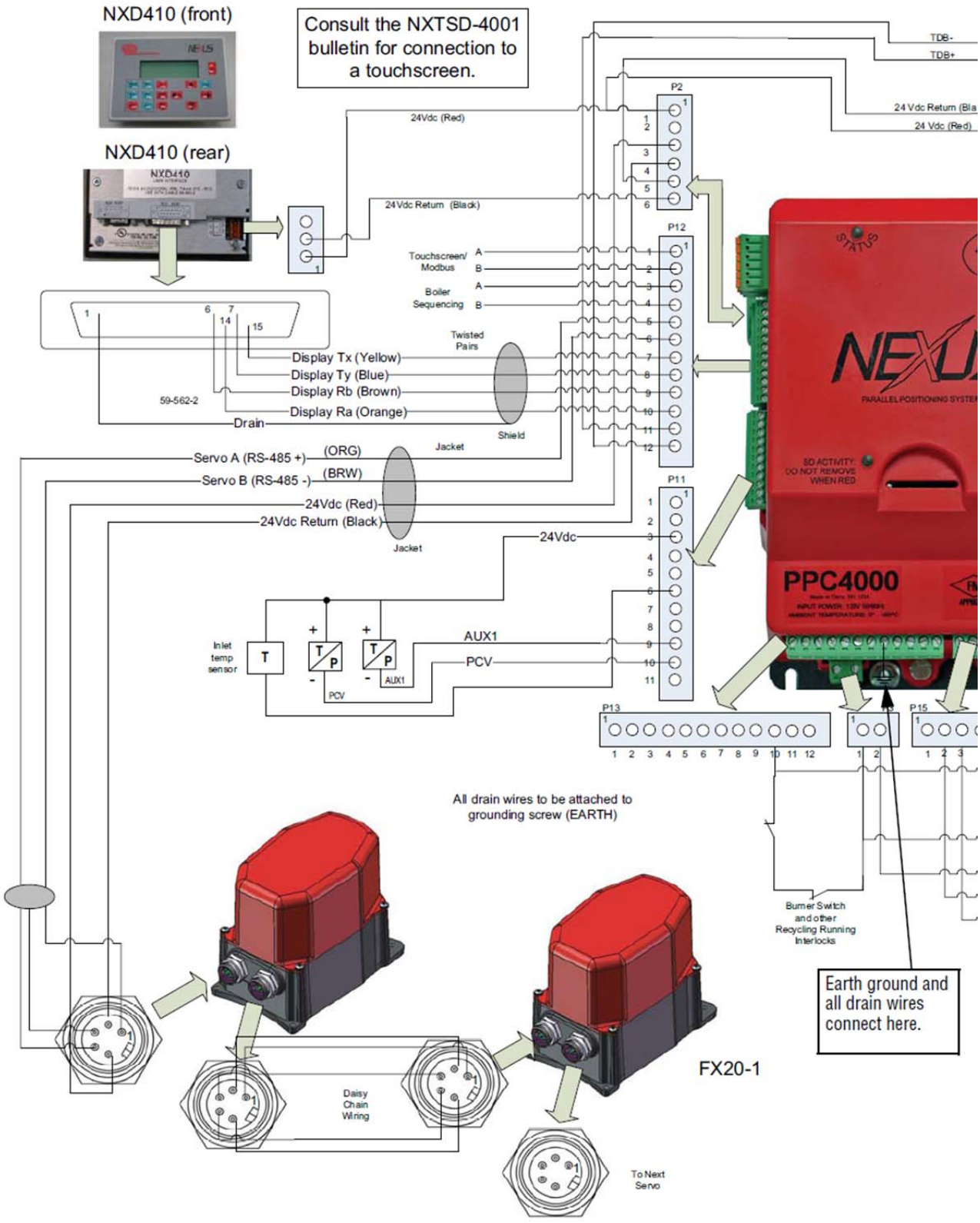
PPC4000 System Wiring Diagram

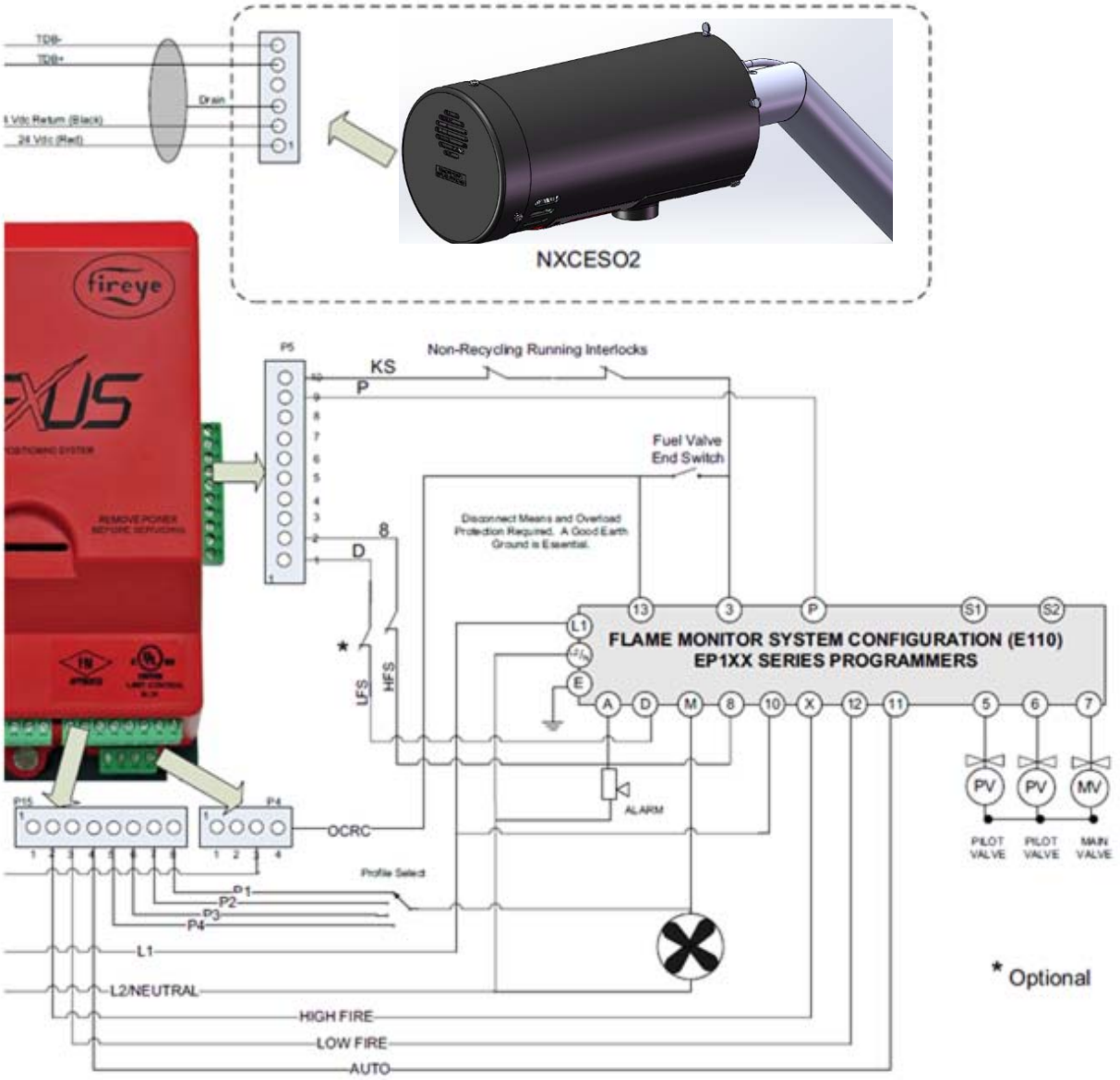
Burnerlogix (YB110) shown

Revision 2.7

PPC4000-WD

FIGURE 11. System Wiring Diagram (E110)





PPC4000 System Wiring Diagram

Burnerlogix (E110) shown

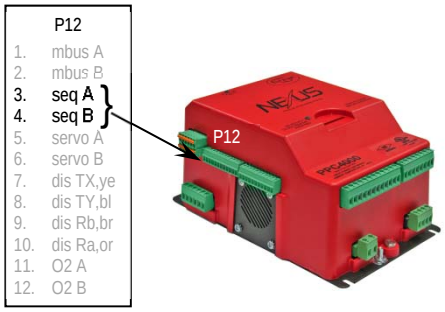
Revision 2.7

PPC4000-WD

BOILER SEQUENCING

Sequencing is used in a multiple boiler (2-6) environment where a master boiler, during normal operation, is established to control the remaining slave boilers in order to achieve the desired setpoint as set in the master boiler. Any boiler can be a master, and in a sequencing operation, only one boiler can be the master at a time. In a sequencing operation, the slave boilers are allowed to come on line and control their own firing rate to maintain a 'warm' state so they can be ready when called upon by the master boiler. SENSOR 2 will be configured as STANDBY WATER and SETPOINT 2 will be configured to use SENSOR 2 with the appropriate setpoints. The STANDBY WATER operation is the mode of operation of the slave boiler when the master boiler is not demanding any help from the slave to maintain the system pressure/temperature. This mode of operation is the default startup state that the slaves will normally be in until they are commanded to be otherwise by the master boiler control.

The master boiler controls the individual slave's operation through an independent sequencing only communications link. The independent communications link is located on terminals P12.3 (SEQUENCING A) and P12.4 (SEQUENCING B). Refer to the WIRING CONNECTIONS section. A twisted shielded pair is recommended such as Belden and each unit is daisy chained to the next unit. That is, a cable is routed from the first unit to the second unit (A connected to A | B connected to B), from the second unit to the third unit and from the third unit to the fourth unit. The drain wires are connected to each other and at the first and last unit the drain wire is connected to chassis or earth ground.



Before the SEQUENCING sub menu is accessed the COMMUNICATION SETUP menu should be accessed where each boiler is given a unique address. The address will be used to identify the master and slaves. The baud rate for sequencing is unique and independent from the baud rate shown in the COMMUNICATION SETUP sub menu.

A boiler is made a master through keypad setting, digital input or the modbus communication gateway. The system has to be instructed as to which method is selected through the SEQUENCING SETUP menu. Below is the complete SEQUENCING sub menu with the assumption that 3 slaves are available with addresses 3, 2 and 4 respectively.

	<	S	E	Q	U	E	N	C	I	N	G		S	E	T	U	P			
>	M	A	S	T	E	R		S	L	C	T				K	E	Y	P	A	D	<
	S	L	A	V	E	S		A	V	A	I	L	A	B	L	E				3	
	1	S	T		S	L	A	V	E		O	N								3	
	2	N	D		S	L	A	V	E		O	N								2	
	3	R	D		S	L	A	V	E		O	N								4	
	S	L	A	V	E		O	N		R	A	T	E					8	0	%	
	S	L	A	V	E	3		O	N		D	L	Y						2	m	
	S	L	A	V	E	2		O	N		D	L	Y						3	m	
	S	L	A	V	E	4		O	N		D	L	Y						6	m	
	S	L	A	V	E		O	F	F		R	A	T	E				3	0	%	
	S	L	A	V	E		O	F	F		D	E	L	A	Y				2	m	

MASTER SELECT METHOD

This parameter provides for the selection of the master boiler via the keypad, digital input or communications. The available selections are:

UNUSED: No SEQUENCING selected, operates on own PID.

KEYPAD: Master selection via the Keypad - the LEAD/LAG button is used to select the master.

INPUT: Master via digital input. (Refer to DIGITAL INPUT select)

COMMS: Master selection via modbus communications.

LEAD/LAG LED Status

The LED associated with the LEAD/LAG push button is active only when the master select method is KEYPAD can have the following state:

OFF	Boiler is in slave mode
ON	Boiler is in master mode
BLINKING	Boiler is transitioning from slave to master, or from master to slave.

Note: Status of sequencing master can also be verified by hitting the HOME key and revewing the top line. If sequencing master is active, the top line should read AUTO(m)

SEQUENCING CONFIGURATION

The master boiler is programmed as to how many slaves exist, the order in which slaves are turned on, the modulation firing rate that, when exceeded, will begin the slave turn on procedures and the delay on and off time for each slave to be turned on and off. Below is a table showing parameters programmed into each master. The value in the last column of the 1st, 2nd, and 3rd Slave On values are the communication addresses previously mentioned that the slaves are set to within each of their own “Communication” setup menus.

SLAVES AVAILABLE

Each master is programmed as to how many slaves it will be controlling. The minimum is 0 and the maximum is 5. The remaining items in the SEQUENCING sub menu will be dependent on the slaves available.

1ST SLAVE ON (communication address)

2ND SLAVE ON (communication address)

3RD SLAVE ON (communication address)

The order in which each slave is commanded on is programmed into the master's parameters using each slave's communication address to identify each slave. Each boiler must have its own unique communication address identifier. Each boiler in the system, if it can be a master, must indicate the priority order of the remaining boilers in the system. The priority is not restricted to ascending or descending addresses. In fact, each master can have a different priority order of the remaining slaves.

Note: Communication addresses should NEVER be changed while the boilers are in sequencing (more than one boiler on). Established operation will be disrupted.

>	S	L	A	V	E	S		A	V	A	I	L	A	B	L	E			3	<
	1	**S**	**T**		**S**	**L**	**A**	**V**	**E**		**O**	**N**							**3**	
	2	**N**	**D**		**S**	**L**	**A**	**V**	**E**		**O**	**N**							**2**	
	3	**R**	**D**		**S**	**L**	**A**	**V**	**E**		**O**	**N**							**4**	

When configured, SETPOINT 2 is used as the STANDBY WATER setpoint. Although commanded to remain off by the master, each slave is to maintain the STANDBY WATER setpoint which is typically the 'warm' state. When commanded to be on by the master boiler, the slave's SETPOINT 2 setpoint values are ignored because its operation and firing rate is controlled by the master boiler. While in STANBY WATER, the slave will modulate according to its own PID.

The master boiler has to be operational and controlling the system in order for the master to assume control. The slave boiler state is initially in the “STANDBY” state when the master is not calling for any additional support to maintain the system. If the slave boiler is in any other initial state, then the slave must be commanded to go to the “STANDBY” state until the master determines that a state change is needed.

SLAVE ON RATE (1-100%)

This value determines the firing rate of the master boiler at which the first and all subsequent slave boilers come on. Slaves are brought on line according to the priority order previously discussed. The master and the last slave on will modulate in unison controlled by the master.

SLAVE 1 ON DELAY (0-255 minutes)

SLAVE 2 ON DELAY (0-255 minutes)

SLAVE 3 ON DELAY (0-255 minutes)

The timer to command a slave on begins when the modulation rate exceeds the SLAVE ON RATE. While the time set above is expiring and the boiler load falls below the slave ON RATE, the command to begin to bring on the slave will be cancelled. After the first slave is commanded on and reaches AUTO and the master's modulation rate is still above the SLAVE ON RATE (expected), the timer to bring on the next slave is initiated. A value of 0 will initiate the next slave to turn on as soon as the slave ON RATE is exceeded.

	S	L	A	V	E		O	N		R	A	T	E				8	0	%
>	**S**	**L**	**A**	**V**	**E**		**3**		**O**	**N**		**D**	**L**	**Y**				**2**	**m**	<
	S	**L**	**A**	**V**	**E**		**2**		**O**	**N**		**D**	**L**	**Y**				**3**	**m**	
	S	**L**	**A**	**V**	**E**		**4**		**O**	**N**		**D**	**L**	**Y**				**6**	**m**	

SLAVE OFF RATE (1-100%)

When the master boiler and last slave boiler on modulate below this rate and exceed the time value set in SLAVE OFF DELAY, the last slave commanded on will be turned off. At this point, the master and the previous (if any) commanded on slave will begin to modulate in unison until they together are below this setting. This will continue until only the master boiler remains on.

The slave OFF RATE can never be equal to or larger than the slave ON RATE.

SLAVE OFF DELAY (0-255 minutes)

This option sets the time delay when the modulation rate is at or below the value set in SLAVE OFF RATE and the last slave turned on being turned off. This also sets the time delay between successive slaves being turned off should the modulation rate stay below the SLAVE OFF RATE setting. The slave off delay is common to all slaves.

	S	L	A	V	E		4		O	N		D	L	Y				6	m	
>	**S**	**L**	**A**	**V**	**E**		**O**	**F**	**F**		**R**	**A**	**T**	**E**			**3**	**0**	**%**	<
	S	**L**	**A**	**V**	**E**		**O**	**F**	**F**		**D**	**L**	**Y**					**2**	**m**	

OPERATION NOTES:

If the master boiler is turned off, fails to come on within 30 seconds, or goes to lockout while operating as the master, it will stop communicating and sequencing will be disabled. All slave boilers will revert to their own PID settings.

Should a slave boiler fail to come on within 3 minutes, due to a burner limit being off, lockout or associated lockout in the flame safeguard, the master will call for the next slave in the priority list. Extended purge time in a slave's flame safeguard control is considered normal operation and the master will wait through the extended purge.

Although it was previously stated there can be only one master, there will be times when the user will attempt to make a slave a master while a master is still in existence.* The current master will continue to be a master until it is made a slave and the new master will continue to be a slave until no further communications is received from the previous master. It was previously established that there is a communication timeout of 30 seconds. It is expected the user will eventually make the former master a slave and at that time it should stop communicating as a master and now the new master can take control. When the new master takes control it will of course operate according to its own PID and control under its SETPOINT 1 parameters. The former master will await commands from the new master.

If the master boiler is switched to manual modulation it will remain as master bringing on slave boilers as required. This will allow the master boiler to be "base loaded" if required, yet still control the slaves. If a master boiler is base loaded it still continues to calculate its theoretical firing rate using its pre-programmed PID settings. If the calculated firing rate output exceeds the ON RATE, the master will begin to bring on the slave boilers and set their firing rate to the calculated firing rate output.

During system startup, if the master boiler is in a thermal shock state trying to get to AUTO, it will cease communications to the slaves, allowing the slaves to operate under their own PID settings.

If the SDCARD is used to restore data to a PPC4000 that is operating in a sequencing environment, the communication and sequencing sub menus should be checked and verified for proper configuration.

Within the INFO screen, the variable SEQUENCING displays the current state of the control.

0 = none (sequencing not selected)

1 = slave

2 = master

3 = none going to slave

4 = none going to master

5 = slave going to none

6 = master going to none

7 = slave going to master

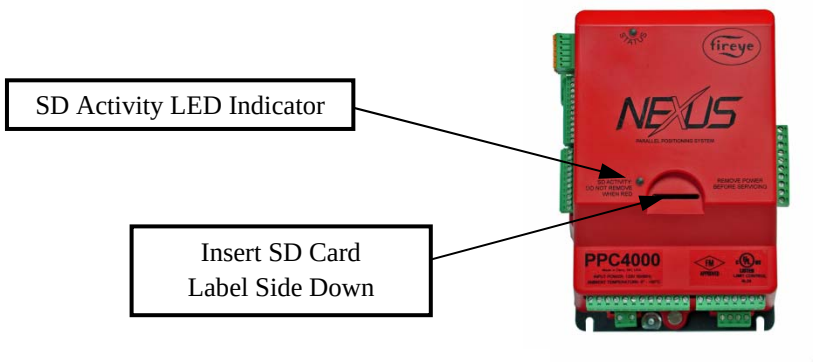
8 = master going to slave

**Note: Leaving a second burner's lead/lag switch "on" (with LED flashing) will put it into "Lead Standby". If the current lead selected boilers' FSG faults (ie. flame failure, external limits are open, or the PPC4000 faults), the "Lead Standby" will assert itself as "Lead" once the current lead's communications is terminated.*

SDCARD OPERATION

The PPC4000 provides the means to backup and restore settings and profile data using a secure digital (SD) memory card. The front of the PPC4000 contains a slot where the SD card is inserted and removed. An LED is included that illuminates when SD operations are being processed. NXF4000 units are shipped with a **16GB SDCARD** media installed. An SD card should never be inserted or removed while the LED is lit.

Figure 12



SD cards are available in various types and capacities. The different types are SDSC (standard capacity), SDHC (high capacity) and SDXC (extended capacity). SDHC types have a capacity ranging from 4GB to 32 GB. SDHC types use FAT32 only. (It is highly recommended that use be limited to SDHC types.) Any particular brand SD card may be used.

> SDCARD operations can only occur while the PPC4000 is in STANDBY or LOCKOUT state. All PPC4000 units are shipped with 16GB SDCARD media.

Functions included in the SD operations menu include BACKUP, RESTORE, DELETE and FORMAT. From the top layer menu at the line named SD CARD OPS SETUP press the NEXT key to open up the following sub-menu:

	<	S	D		C	A	R	D		O	P	S		S	E	T	U	P		
>	B	A	C	K	U	P													>	<
	R	E	S	T	O	R	E												>	
	D	E	L	E	T	E													>	
	F	O	R	M	A	T													>	

In order to enter any of the sub menus listed above, an SD card must be installed.

BACKUP OPERATION

The BACKUP function provides options that backup all profiles and setup data collectively, all profiles only, each profile individually or setup data only. Selecting BACKUP with the NEXT key moves to the following sub menu:

	<	B	A	C	K	U	P													
>	P	A	R	A	M	E	T	E	R	S		O	N	L	Y				>	<
	P	R	O	F	I	L	E	S	,	P	A	R	A	M	E	T	E	R	S	>
	A	L	L		P	R	O	F	I	L	E	S		O	N	L	Y			>
	P	R	O	F	I	L	E		1		O	N	L	Y						>
	P	R	O	F	I	L	E		2		O	N	L	Y						>
	P	R	O	F	I	L	E		3		O	N	L	Y						>
	P	R	O	F	I	L	E		4		O	N	L	Y						>

Depending on what BACKUP type is selected, the PPC4000 applies a unique file name and extension that includes the current date (ddmmyy) and time (hhmm) in military format to uniquely identify the file type. To insure accuracy and consistency it is extremely useful to assure the real time clock of the PPC4000 is correctly set prior to any BACKUP operation.

Backup Option	Format	Example
Profiles and Parameters	PFLWddmmyyhhmm.ext	PFLW2206110847.PFW
All profiles only	PFLOddmmyyhhmm.ext	PFLO2206110849.PFO
Individual profiles		
Profile 1	PFL1ddmmyyhhmm.ext	PFL12206110912.PFL
Profile 2	PFL2ddmmyyhhmm.ext	PFL22206111343.PFL
Profile 3	PFL3ddmmyyhhmm.ext	PFL32206111836.PFL
Profile 4	PFL4ddmmyyhhmm.ext	PFL42206112016.PFL
Parameters only	SETPddmmyyhhmm.ext	SETP2206110923.SPD

The BACKUP files are stored on the SD card in a folder named FIREYE. If the folder does not exist, it will be created automatically during the first BACKUP operation. If necessary, any of the files stored on the SD card can be renamed using a PC and a file explorer utility. A unique name of the user's choosing may better describe the application. The length of the file name is limited to 15 characters maximum not including the '.' and the 3 character extension. In order to be restored properly the extension must remain the same as what was assigned by the PPC4000. The file name and extension are not case sensitive.

A BACKUP operation is performed by first inserting an SD card into the slot located in the front of the PPC4000 as shown in FIG 11. The SD card will insert in only one direction so do not apply excessive force. The SD card should 'click' when fully inserted.

Execution of any BACKUP command requires the C-MODE pass code to be enabled. Select the desired BACKUP operation by moving the selection between the two tick marks on the display. Use the UP and DOWN keys as necessary. Press the NEXT key to begin the BACKUP operation. If the pass code is not enabled, the user will be diverted to the pass code screen where the correct C-MODE pass code must be entered. If correct, the BACKUP sub menu will re-appear. The NEXT key is used to begin the BACKUP process. If no SD card is installed the display will indicate:

	<	P	R	O	F	I	L	E	S	,	P	A	R	A	M	E	T	E	R	S
>	N	O		S	D		C	A	R	D		I	N	S	T	A	L	L	E	D	<

Otherwise the selected BACKUP operation will be executed and the display will indicate:

	<	P	R	O	F	I	L	E	S	,	P	A	R	A	M	E	T	E	R	S
>	I	N		P	R	O	G	R	E	S	S	.	.	.							<

When complete, the display will indicate:

	<	P	R	O	F	I	L	E	S	,	P	A	R	A	M	E	T	E	R	S
>	B	A	C	K	U	P			C	O	M	P	L	E	T	E					<

The PPC4000 performs a read back of the file written to the SD card and if found to be incorrect the display will indicate the failure:

	<	P	R	O	F	I	L	E	S	,	P	A	R	A	M	E	T	E	R	S
>	I	N	V	A	L	I	D		F	O	R	M	A	T							<
	V	E	R	I	F	Y		F	A	I	L	E	D							
	W	R	I	T	E		P	R	O	T	E	C	T		O	N				
	N	O		S	D		C	A	R	D		I	N	S	T	A	L	L	E	D
	S	D		O	P	E	R	A	T	I	O	N		A	B	O	R	T	E	D

Note: only the single reason for failure is indicated.

The SD card can be removed by pressing lightly on the SD card and then releasing. The SD will eject upward where it can be lifted out of its slot.

At this time the user can press the BACK key to remain in the BACKUP selection sub menu or press the HOME key to exit SD operations.

RESTORE OPERATION

The RESTORE operation is used to restore or replace the current profiles and setup data collectively, all profiles only, any profile individually or setup data only. Note: During any RESTORE operation, FAULT HISTORY is left unchanged.

At the SD CARD OPS SETUP sub menu select the RESTORE function by pressing the NEXT key. The RESTORE sub menu is displayed with the following options:

	<	R	E	S	T	O	R	E											
>	P	R	O	F	I	L	E	S	,	P	A	R	A	M	E	T	E	R	S	>	<
	A	L	L		P	R	O	F	I	L	E	S		O	N	L	Y			>	
	T	O		P	R	O	F	I	L	E		1								>	
	T	O		P	R	O	F	I	L	E		2								>	
	T	O		P	R	O	F	I	L	E		3								>	
	T	O		P	R	O	F	I	L	E		4								>	
	P	A	R	A	M	E	T	E	R	S		O	N	L	Y					>	

The above listed options are explained as follows:

1. PROFILES & PARAMETERS - restores all profiles and all setup data from a file with extension '.PFW'. All data currently present in the PPC4000 will be overwritten and replaced by the SD card file.

2. ALL PROFILES ONLY - all four profiles in the PPC4000 will be overwritten and replaced from a file extension '.PFO'.

3. TO PROFILE X - restores profile data only to a specific PPC4000 profile (X can be 1, 2, 3 or 4) from a file with extension '.PFL'. Any stored profile data file can be restored to any profile.

4. PARAMETERS ONLY - restores configuration and setup data only from a file with extension '.SPD'. This would include sensor data, setpoint information, servos, digital inputs, keypad data, etc.

To begin the restore operation the user selects the desired restore function and presses the NEXT key. The PPC4000 checks the presence of an SD card installed and then checks the proper C-MODE pass code is enabled and if so the sub menu pertaining to the selected function appears:

	<	T	O		P	R	O	F	I	L	E		2							
>	P	F	L	1	1	9	0	5	1	1	0	8	4	2	.	P	F	L		>	<
	P	F	L	1	2	0	0	6	1	1	1	0	2	7	.	P	F	L		>	
	P	F	L	2	1	9	0	5	1	1	0	8	4	3	.	P	F	L		>	
	P	F	L	3	1	9	0	5	1	1	0	8	4	4	.	P	F	L		>	
	P	F	L	3	2	2	0	6	1	1	2	0	2	6	.	P	F	L		>	
	P	F	L	4	1	9	0	5	1	1	0	8	4	5	.	P	F	L		>	

As a convenience, only file names with the extension pertaining to the function selected will appear. The UP and DOWN keys are used to scroll downward and upward through the list of files. Files that have been renamed by the user will also appear as long as the extension and file name length are correct.

The user selects the file to be restored and presses NEXT to begin the RESTORE operation. The PPC4000 checks the selected file for validity and if found not be correct the appropriate error message is displayed as previously described. During the RESTORE operation, the display will indicate:

	<	T	O		P	R	O	F	I	L	E		2						
>	I	N		P	R	O	G	R	E	S	S	.	.	.						<

When complete the display will indicate:

	<	T	O		P	R	O	F	I	L	E		2						
>	R	E	S	T	O	R	E		C	O	M	P	L	E	T	E				<

The SD card can be removed by pressing lightly on the SD card and then releasing. The SD will eject upward where it can be lifted out of its slot.

At this time the user can press the BACK key to remain in the BACKUP selection sub menu or press the HOME key to exit SD operations.

Recommendation: It's strongly advised that a power cycle be applied to the PPC4000 after a RESTORE is done. This would enable all data structures to initialize properly.

DELETE OPERATION

The purpose of DELETE is to allow the user to remove files from the SD card. The files to be removed are files located on the SD card in the FIREYE folder pertaining to the PPC4000 and are identified by the various extensions used.

From the SD CARD OPS SETUP menu the user selects DELETE. The PPC4000 checks the presence of an SD card properly installed and operating then displays the following:

	<	D	E	L	E	T	E													
>	P	F	L	1	1	9	0	5	1	1	0	8	4	2	.	P	F	L		>	<
	P	F	L	2	1	9	0	5	1	1	0	8	4	3	.	P	F	L		>	
	P	F	L	3	1	9	0	5	1	1	0	8	4	4	.	P	F	L		>	
	P	F	L	O	1	9	0	5	1	1	0	8	4	6	.	P	F	O		>	
	P	F	L	W	1	9	0	5	1	1	0	8	4	7	.	P	F	W		>	
	S	E	T	P	1	9	0	5	1	1	0	8	4	8	.	S	P	D		>	

The UP and DOWN keys are used to scroll down through the list of files.

The file selected for deletion is moved to between the tick marks. To begin the DELETE operation the user presses the NEXT key. The PPC4000 checks that the proper C-MODE pass code is enabled and if so the DELETE process begins. At the completion the display will indicate the following:

	<	D	E	L	E	T	E												
>	D	E	L	E	T	E		C	O	M	P	L	E	T	E				<

The SD card can be removed by pressing lightly on the SD card and then releasing. The SD will eject upward where it can be lifted out of its slot.

At this time the user can press the BACK key to remain in the BACKUP selection sub menu or press the HOME key to exit SD operations.

FORMAT OPERATION

The PPC4000 can be used to format the SD card. The formatting method will only be FAT32. At the FORMAT on the SD OPS SETUP sub menu press NEXT to display the following:

	<	F	O	R	M	A	T												
>	D	A	T	A		W	I	L	L		B	E		L	O	S	T		>	<

Execution of each of the FORMAT command will be activated by pressing the NEXT key. After checking the C-MODE pass code is enabled and an SD card is installed, the formatting process begins. It would not be a good thing to interfere with this operation.

	<	F	O	R	M	A	T												
>	F	O	R	M	A	T		I	N		P	R	O	G	R	E	S	S			<

At the completion of the formatting process the display indicates the following:

	<	F	O	R	M	A	T												
>	F	O	R	M	A	T		C	O	M	P	L	E	T	E					<

The SD card can be removed by pressing lightly on the SD card and then releasing. The SD will eject upward where it can be lifted out of its slot.

At this time the user can press the BACK key to remain in the BACKUP selection sub menu or press the HOME key to exit SD operations.

PPC4000 OPERATION AFTER A RESTORE

When a profile only is restored it is possible that data resident in the restored profile is NOT in synchronization with the corresponding parameter data. That is, the number of servos used in the rofile may not agree with the number of servos connected to the PPC4000. Also, the addresses and assignment designations in the servo setup may not agree with the data in the profile. Likewise, when parameter data is restored this data may not agree with data that is resident in the stored profiles. For these reasons, after any or all profile only or parameter data only restore operation it will be necessary to enter commissioning mode. Attempting a burner cycle with restored profile or parameter data will result in lockout with the message NOT COMMISSIONED displayed. If profile and parameter data are synchronized then simply press NEXT at each profile setpoint to accept the settings. At the last profile setpoint exit commissioning mode with the C-MODE key. The number of commissioned profile setpoints can be viewed within the INFO screen.

Since a restore operation of PROFILES & PARAMETERS causes all data to be in synchronization, the PPC4000 will be ready to operate. Commissioning with the new data is not necessary but as always the operator should take the necessary steps to assure the restored profile and data settings are adequate for the burner. That is, the actual servo addresses and sensor types agree with the equipment installed.

Profile Setup Work Sheet

Commissioning Date _____ Location _____

Profile# _____

Profile Setpoint	Drive #					VFD#	OXYGEN		STACK	CO	Net Eff
	Name						LEVEL		TEMP		
	CW	r	r	r	r	%FS					
	CCW	r	r	r	r	CNTS	Wet	Dry			
		(°)	(°)	(°)	(°)	ENCODE			°F / °C	PPM	
p00											
p01											
p02											
p03											
p04											
p05											
p06											
p07											
p08											
p09											
p10											
p11											
p12											
p13											
p14											
p15											
p16											
p17											
p18											
p19											
p20											
p21											
p22											
p23											

Notes:

Setpoint	
Cut-in	
Cut-out	
P-Band	
Integral	
Derivative	

Boiler Manuf.	
Boiler Type	
Boiler Size	
Burner Type	
Burner Size	
Ambient Temp.	

Profile Setup Work Sheet

Commissioning Date _____ Location _____

Profile# _____

Profile Setpoint	Drive #					VFD#	OXYGEN		STACK	CO	Net Eff
	Name						LEVEL		TEMP		
	CW	r	r	r	r	%FS					
	CCW	r	r	r	r	CNTS	Wet	Dry			
		(°)	(°)	(°)	(°)	ENCODE			°F / °C	PPM	
p00											
p01											
p02											
p03											
p04											
p05											
p06											
p07											
p08											
p09											
p10											
p11											
p12											
p13											
p14											
p15											
p16											
p17											
p18											
p19											
p20											
p21											
p22											
p23											

Notes:

Setpoint	
Cut-in	
Cut-out	
P-Band	
Integral	
Derivative	

Boiler Manuf.	
Boiler Type	
Boiler Size	
Burner Type	
Burner Size	
Ambient Temp.	

LOCKOUTS:

When a safety shutdown occurs, the control will indicate the reason for the lockout through the Alarm/Status LED and also describe the lockout on the User Interface. The alarm relay located on terminals P4.1 to P4.2 will be energized. The non-volatile memory will remember the status (Run or Lockout) of the control even if a power failure occurs. By momentarily depressing and releasing the reset button located on the User Interface or through a programmable digital input, the control can be reset. The button must be held down for one second and then released. Very little force is required to do this. Do not press hard.

The action of a lockout will cause the safety relay output located at terminal P5.9 to P5.10 to be de-energized thus opening the non-recycling interlock in the flame safeguard circuit. This is followed by all other relays in the PPC4000 moving to a de-energized state.

ERROR MESSAGES:

The following list provides error codes and explanations to help people in the field respond more effectively to issues that arise.

Error Code	Displayed	Reason for error	Possible remedy
e1	PPC4000 FAULT	ARM CPU self-test	Replace PPC4000
e2	PPC4000 FAULT	ARM CPU code CRC	Replace PPC4000
e3	Z BOARD FAULT	PPC4000 cannot communicate with the Z board	Check or replace Z board
e4	SAFETY RELAY ON	This means that there is an active line voltage on P5 pin 9, when there shouldn't be. This could be as a result of a wring problem or the internal safety relay contacts are welded.	Check wiring to specific terminal
e5	SAFETY RELAY OFF	This means that the system is not sensing a live/interlock voltage on its safety relay input. This could be as a result of a wiring problem, no line voltage to P5 pin 10, or the safety fuse is blown.	Check Fuse
e6	RELAY 8 ON	This means that there is an active line voltage on P5 pin 2, when there shouldn't be. This could be as a result of a wring problem or the internal HIGH FIRE relay contacts are welded.	Check wiring to specific terminal
e7	RELAY 8 OFF	This means that there is NO active line voltage on P5 pin 2. This could be as a result of a faulty HIGH FIRE relay or the contacts are bad.	Replace PPC4000
e8	RELAY D ON	This means that there is an active line voltage on P5 pin 1, when there shouldn't be. This could be as a result of a wring problem or the internal LOW FIRE relay contacts are welded.	Check wiring to specific terminal
e9	RELAY D OFF	This means that there is NO active line voltage on P5 pin 1. This could be as a result of a faulty LOW FIRE relay or the contacts are bad.	Replace PPC4000
e10	Unused	Unused	
e11	INVALID PROFILE	The user is supplying line voltage to more than 1 of the following P15-5,6,7,8	Check wiring
e12	HIGH TEMPERATURE	Internal Temperature is above 80C	Check Fan or provide better ventilation
e13	CHECK WIRING	User supplying line voltage to terminal to more than one of the following terminals at one time: P15-2,3,4	Check wiring
e14	CHECK WIRING	User has not connected one or more of the following terminals: P15-2,3,4	Check wiring
e15	NO AIR SERVO	The user has no servo named "AIR" in the	Name one servo in current profile "AIR"

Error Code	Displayed	Reason for error	Possible remedy
		current profile	
e16	NO FUEL SERVO	The user has no servo in the current profile with one of these names: FU1,FU2,GAS,OIL,CUP,PUM,WAS,PRI	Name one servo in current profile as a fuel servo
e17	INVALID SETPOINT	User has not configured setpoint 2 to be using sensor 1	Configure setpoint 2 to use sensor 1
e18	Unused	Unused	
e19	SENSOR 1 MARGINAL	SENSOR 1 has reached user defined marginal setting	This could be normal operation
e20	SENSOR 1 MARGINAL	SENSOR 1 has reached user defined marginal setting	This could be normal operation
e21	SENSOR 2 MARGINAL	SENSOR 2 has reached user defined marginal setting	This could be normal operation
e22	SENSOR 2 MARGINAL	SENSOR 2 has reached user defined marginal setting	This could be normal operation
e23	SENSOR 2 MARGINAL	SENSOR 2 has reached user defined marginal setting	This could be normal operation
e24	SENSOR 3 MARGINAL	SENSOR 3 has reached user defined marginal setting	This could be normal operation
e25	SENSOR 3 MARGINAL	SENSOR 3 has reached user defined marginal setting	This could be normal operation
e26	SENSOR 3 MARGINAL	SENSOR 3 has reached user defined marginal setting	This could be normal operation
e27	SENSOR1 HIGH LIMIT	SENSOR 1 has reached user defined limit setting	This could be normal operation
e28	SENSOR1 HIGH LIMIT	SENSOR 1 has reached user defined limit setting	This could be normal operation
e29	SENSOR2 HIGH LIMIT	SENSOR 2 has reached user defined limit setting	This could be normal operation
e30	SENSOR2 HIGH LIMIT	SENSOR 2 has reached user defined limit setting	This could be normal operation
e31	SENSOR2 HIGH LIMIT	SENSOR 2 has reached user defined limit setting	This could be normal operation
e32	SENSOR3 HIGH LIMIT	SENSOR 3 has reached user defined limit setting	This could be normal operation
e33	SENSOR3 HIGH LIMIT	SENSOR 3 has reached user defined limit setting	This could be normal operation
e34	SENSOR3 HIGH LIMIT	SENSOR 3 has reached user defined limit setting	This could be normal operation
e35	SENSOR1 UNDER RNG	SENSOR 1 input is under 2mA	Defective sensor or check wiring
e36	SENSOR1 OVER RNG	SENSOR 1 input is over 22mA	Defective sensor or check wiring
e37	SENSOR2 UNDER RNG	SENSOR 2 input is under 2mA	Defective sensor or check wiring
e38	SENSOR2 OVER RNG	SENSOR 2 input is over 22mA	Defective sensor or check wiring
e39	SENSOR3 UNDER RNG	SENSOR 3 input is under 2mA	Defective sensor or check wiring
e40	SENSOR3 OVER RNG	SENSOR 3 input is over 22mA	Defective sensor or check wiring
e41	Z BOARD	Z Board internal error	Replace Z Board
e42	Z BOARD	Z Board internal error	Replace Z Board
e43	PPC4000 FAULT	PPC4000 Internal Error	Replace PPC4000 (notify Fireye about this error)
e44	PPC4000 FAULT	PPC4000 Internal Error	Replace PPC4000 (notify Fireye about this error)
e45	PPC4000 FAULT	PPC4000 Internal Error	Replace PPC4000 (notify Fireye about this error)
e46	O2 FAULT	O2 Probe PPC4000 FAULT	Replace O2 Probe
e47	O2 FAULT	O2 is not communicating with the PPC4000	Check Wiring or add 200 Ohm resistor
e48	O2 FAULT	O2 Probe is reporting that the O2 level is below the user configured minimum	This could be normal operation
e49	O2 FAULT	O2 Probe is reporting that the O2 level is above the user configured maximum	This could be normal operation

Error Code	Displayed	Reason for error	Possible remedy
e50	O2 FAULT	O2 Probe is reporting that the stack temperature is below the user configured minimum	This could be normal operation
e51	O2 FAULT	O2 Probe is reporting that the stack temperature is above the user configured maximum	This could be normal operation
e52	O2 FAULT	O2 Probe PPC4000 FAULT	Replace O2 Probe
e53	O2 FAULT	O2 Probe PPC4000 FAULT	Replace O2 Probe
e54	O2 FAULT	O2 thermocouple is disconnected or defective	Check thermocouple for breakage or replace it
e55	O2 FAULT	O2 stack temperature is above the user configurable temperature or thermocouple is defective	This could be normal operation
e56	O2 FAULT	O2 stack temperature is below 0 Celsius or thermocouple is defective	This could be normal operation
e57	O2 FAULT	O2 Probe PPC4000 FAULT	Replace O2 Probe
e58	O2 FAULT	O2 probe temperature is above 85 Celsius	Check O2 Probe fan
e59	O2 FAULT	O2 probe temperature is below -25 Celsius	This could be normal operation if it is really cold
e60	O2 FAULT	O2 Probe PPC4000 FAULT	Replace O2 Probe
e61	O2 FAULT	O2 Probe PPC4000 FAULT	Replace O2 Probe
e62	O2 FAULT	O2 Probe PPC4000 FAULT	Replace O2 Probe
e63	O2 FAULT	The 24V supply to the O2 probe is under	Measure supply voltage at the probe
e64	O2 FAULT	The 24V supply to the O2 probe is over	Measure supply voltage at the probe
e65	O2 FAULT	O2 Probe 12V supply open	Replace O2 Probe
e66	O2 FAULT	O2 Probe 12V supply low	Replace O2 Probe
e67	O2 FAULT	O2 Probe 12V supply high	Replace O2 Probe
e68	O2 FAULT	O2 Probe unexpected calibration fault	Replace O2 Probe cartridge
e69	O2 FAULT	O2 Probe stuck	Replace O2 Probe cartridge
e70	O2 FAULT	O2 Probe calibration needed	This could be normal operation
e71	O2 FAULT	O2 Probe heater shorted	Replace O2 Probe cartridge
e72	O2 FAULT	O2 Probe heater open	Replace O2 Probe cartridge
e73	O2 FAULT	O2 Probe pump short	Replace O2 Probe cartridge
e74	O2 FAULT	O2 Probe pump open	Replace O2 Probe cartridge
e75	O2 FAULT	O2 Probe nernst cell short	Replace O2 Probe cartridge
e76	O2 FAULT	O2 Probe nernst cell open	Replace O2 Probe cartridge
e77	O2 FAULT	O2 Probe conversion timeout	Replace O2 Probe cartridge
e78	O2 FAULT	O2 Probe low voltage	Replace O2 Probe cartridge
e79	O2 FAULT	O2 Probe too cold	This could be normal operation
e80	O2 FAULT	O2 Probe too hot	Replace O2 Probe cartridge
e81	O2 FAULT	O2 Probe air calibration	Replace O2 Probe cartridge
e82	O2 FAULT	O2 Probe heater calibration	Replace O2 Probe cartridge
e83	O2 FAULT	O2 Probe comm busy	Replace O2 Probe cartridge
e84	O2 FAULT	O2 Probe comm fault	Replace O2 Probe cartridge

Error Code	Displayed	Reason for error	Possible remedy
e85	O2 FAULT	O2 Probe Sensor warming up	This could be normal operation
e86	O2 FAULT	O2 Probe sensor in standby	Replace O2 Probe cartridge
e87	Unused	Unused	
e88	PPC4000 FAULT	PPC4000 Internal Error	Replace PPC4000 (notify Fireye about this error)
e89	NOT COMMISSIONED	User has less than 3 points in the current profile	Recommission current profile
e90	PPC4000 FAULT	FRAM chip may be bad	Replace PPC4000
e91	PPC4000 FAULT	Helper CPU may not be programmed	Replace PPC4000
e92	Unused	Unused	
e93	PPC4000 FAULT	The main and helper CPUs are not communicating	Replace PPC4000
e94	PPC4000 FAULT	Helper CPU has detected an internal error	Replace PPC4000
e95	PPC4000 FAULT	Helper CPU has detected an internal error	Replace PPC4000
e96	PPC4000 FAULT	Helper CPU has detected an internal error	Replace PPC4000
e97	PPC4000 FAULT	Helper CPU has detected an internal error	Replace PPC4000
e98	PPC4000 FAULT	The main and helper CPUs are not communicating	Replace PPC4000
e99	PPC4000 FAULT	Helper CPU may not be programmed properly	Replace PPC4000
e100	CHECK WIRING	Pin stuck-at-fault detected	Replace PPC4000
e101	CHECK WIRING	Pin stuck-at-fault detected	Replace PPC4000
e102	PPC4000 FAULT	Helper CPU has detected an internal error	Replace PPC4000
e103 to e121	PPC4000 FAULT	PPC4000 Internal Error	Replace PPC4000 (notify Fireye about this error)
e122	SERVO 1 LOST	Communications to the servo has stopped	Check servo address selection, check wiring.
e123	SERVO 2 LOST	Communications to the servo has stopped	Check servo address selection, check wiring, add 200 resistor.
e124	SERVO 3 LOST	Communications to the servo has stopped	Check servo address selection, check wiring, replace servo.
e125	SERVO 4 LOST	Communications to the servo has stopped	In this order: check servo address selection, check wiring, add 200 resistor, replace servo.
e126	SERVO 5 LOST	Communications to the servo has stopped	In this order: check servo address selection, check wiring, add 200 resistor, replace servo.
e127	SERVO 6 LOST	Communications to the servo has stopped	In this order: check servo address selection, check wiring, add 200 resistor, replace servo.
e128	SERVO 7 LOST	Communications to the servo has stopped	In this order: check servo address selection, check wiring, add 200 resistor, replace servo.
e129	SERVO 8 LOST	Communications to the servo has stopped	In this order: check servo address selection, check wiring, add 200 resistor, replace servo.
e130	SERVO 9 LOST	Communications to the servo has stopped	In this order: check servo address selection, check wiring, add 200 resistor, replace servo.
e131	SERVO 10 LOST	Communications to the servo has stopped	In this order: check servo address selection, check wiring, add 200 resistor, replace servo.
e132 to e141	Unused	Unused	

Error Code	Displayed	Reason for error	Possible remedy
e142	SERVO 1 STUCK	Expected shaft movement does not equal measured shaft movement	In this order: Excessive torque, servo hitting hard stop, defective servo.
e143	SERVO 2 STUCK	Expected shaft movement does not equal measured shaft movement	In this order: Excessive torque, servo hitting hard stop, defective servo.
e144	SERVO 3 STUCK	Expected shaft movement does not equal measured shaft movement	In this order: Excessive torque, servo hitting hard stop, defective servo.
e145	SERVO 4 STUCK	Expected shaft movement does not equal measured shaft movement	In this order: Excessive torque, servo hitting hard stop, defective servo.
e146	SERVO 5 STUCK	Expected shaft movement does not equal measured shaft movement	In this order: Excessive torque, servo hitting hard stop, defective servo.
e147	SERVO 6 STUCK	Expected shaft movement does not equal measured shaft movement	In this order: Excessive torque, servo hitting hard stop, defective servo.
e148	SERVO 7 STUCK	Expected shaft movement does not equal measured shaft movement	In this order: Excessive torque, servo hitting hard stop, defective servo.
e149	SERVO 8 STUCK	Expected shaft movement does not equal measured shaft movement	In this order: Excessive torque, servo hitting hard stop, defective servo.
e150	SERVO 9 STUCK	Expected shaft movement does not equal measured shaft movement	In this order: Excessive torque, servo hitting hard stop, defective servo.
e151	SERVO 10 STUCK	Expected shaft movement does not equal measured shaft movement	In this order: Excessive torque, servo hitting hard stop, defective servo.
e152 to e161	Unused	Unused	
e162	SERVO 1 ERROR	Servo has detected an Internal FAULT	Replace servo
e163	SERVO 2 ERROR	Servo has detected an Internal FAULT	Replace servo
e164	SERVO 3 ERROR	Servo has detected an Internal FAULT	Replace servo
e165	SERVO 4 ERROR	Servo has detected an Internal FAULT	Replace servo
e166	SERVO 5 ERROR	Servo has detected an Internal FAULT	Replace servo
e167	SERVO 6 ERROR	Servo has detected an Internal FAULT	Replace servo
e168	SERVO 7 ERROR	Servo has detected an Internal FAULT	Replace servo
e169	SERVO 8 ERROR	Servo has detected an Internal FAULT	Replace servo
e170	SERVO 9 ERROR	Servo has detected an Internal FAULT	Replace servo
e171	SERVO 10 ERROR	Servo has detected an Internal FAULT	Replace servo
e172 to e181	Unused	Unused	
e182	SERVO 1 VOLTAGE	Voltage supply to servo is above 33V	Excessive voltage to servo or defective servo
e183	SERVO 2 VOLTAGE	Voltage supply to servo is above 33V	Excessive voltage to servo or defective servo
e184	SERVO 3 VOLTAGE	Voltage supply to servo is above 33V	Excessive voltage to servo or defective servo
e185	SERVO 4 VOLTAGE	Voltage supply to servo is above 33V	Excessive voltage to servo or defective servo
e186	SERVO 5 VOLTAGE	Voltage supply to servo is above 33V	Excessive voltage to servo or defective servo
e187	SERVO 6 VOLTAGE	Voltage supply to servo is above 33V	Excessive voltage to servo or defective servo
e188	SERVO 7 VOLTAGE	Voltage supply to servo is above 33V	Excessive voltage to servo or defective servo
e189	SERVO 8 VOLTAGE	Voltage supply to servo is above 33V	Excessive voltage to servo or defective servo

Error Code	Displayed	Reason for error	Possible remedy
e190	SERVO 9 VOLTAGE	Voltage supply to servo is above 33V	Excessive voltage to servo or defective servo
e191	SERVO 10 VOLTAGE	Voltage supply to servo is above 33V	Excessive voltage to servo or defective servo
e192 to e201	Unused	Unused	
e202	SERVO 1 VOLTAGE	Voltage supply to servo is below 21.4V	Insufficient voltage to servo under load or defective servo
e203	SERVO 2 VOLTAGE	Voltage supply to servo is below 21.4V	Insufficient voltage to servo under load or defective servo
e204	SERVO 3 VOLTAGE	Voltage supply to servo is below 21.4V	Insufficient voltage to servo under load or defective servo
e205	SERVO 4 VOLTAGE	Voltage supply to servo is below 21.4V	Insufficient voltage to servo under load or defective servo
e206	SERVO 5 VOLTAGE	Voltage supply to servo is below 21.4V	Insufficient voltage to servo under load or defective servo
e207	SERVO 6 VOLTAGE	Voltage supply to servo is below 21.4V	Insufficient voltage to servo under load or defective servo
e208	SERVO 7 VOLTAGE	Voltage supply to servo is below 21.4V	Insufficient voltage to servo under load or defective servo
e209	SERVO 8 VOLTAGE	Voltage supply to servo is below 21.4V	Insufficient voltage to servo under load or defective servo
e210	SERVO 9 VOLTAGE	Voltage supply to servo is below 21.4V	Insufficient voltage to servo under load or defective servo
e211	SERVO 10 VOLTAGE	Voltage supply to servo is below 21.4V	Insufficient voltage to servo under load or defective servo
e212 to e221	Unused	Unused	
e222	SERVO 1 OFF RATIO	Servo may have exceeded its torque capacity	In this order: Excessive torque, position hitting hard stop, defective servo.
e223	SERVO 2 OFF RATIO	Servo may have exceeded its torque capacity	In this order: Excessive torque, position hitting hard stop, defective servo.
e224	SERVO 3 OFF RATIO	Servo may have exceeded its torque capacity	In this order: Excessive torque, position hitting hard stop, defective servo.
e225	SERVO 4 OFF RATIO	Servo may have exceeded its torque capacity	In this order: Excessive torque, position hitting hard stop, defective servo.
e226	SERVO 5 OFF RATIO	Servo may have exceeded its torque capacity	In this order: Excessive torque, position hitting hard stop, defective servo.
e227	SERVO 6 OFF RATIO	Servo may have exceeded its torque capacity	In this order: Excessive torque, position hitting hard stop, defective servo.
e228	SERVO 7 OFF RATIO	Servo may have exceeded its torque capacity	In this order: Excessive torque, position hitting hard stop, defective servo.
e229	SERVO 8 OFF RATIO	Servo may have exceeded its torque capacity	In this order: Excessive torque, position hitting hard stop, defective servo.
e230	SERVO 9 OFF RATIO	Servo may have exceeded its torque capacity	In this order: Excessive torque, position hitting hard stop, defective servo.
e231	SERVO 10 OFF RATIO	Servo may have exceeded its torque capacity	In this order: Excessive torque, position hitting hard stop, defective servo.
e232 to e241	Unused	Unused	
e242	PPC4000 FAULT	PPC4000 Internal 24V supply to high	Replace PPC4000
e243	PPC4000 FAULT	PPC4000 Internal 24V supply to low	Replace PPC4000
e244	PPC4000 FAULT	PPC4000 Internal 5V supply to high	Replace PPC4000
e245	PPC4000 FAULT	PPC4000 Internal 5V supply to low	Replace PPC4000

Error Code	Displayed	Reason for error	Possible remedy
e246	PPC4000 FAULT	Main processor failure	Replace PPC4000
e247	PPC4000 FAULT	Main processor failure	Replace PPC4000
e248	PPC4000 FAULT	Main processor failure	Replace PPC4000
e249	PPC4000 FAULT	External watchdog timer malfunction	Replace PPC4000
e250	PPC4000 FAULT	PPC4000 Internal Error	Replace PPC4000
e251	SENSOR4 UNDER RNG	PCV input is under 2mA	Defective sensor or check wiring
e252	SENSOR4 OVER RNG	PCV input is over 22mA	Defective sensor or check wiring
e253	SENSOR4 UNDER RNG	PCV input is under 2mA	Defective sensor or check wiring
e254	SENSOR4 OVER RNG	PCV input is over 22mA	Defective sensor or check wiring
e255	NOT COMMISSIONED	User restored a file from the SD card that has not been verified	Recommission current profile
e256	VFD1 OFF RATIO	VFD input is moving too slow to meet timeout	Check VFD for proper setup
e257	VFD2 OFF RATIO	VFD input is moving too slow to meet timeout	Check VFD for proper setup
e258	VFD BOARD FAULT	VFD Board is missing or CPU is not programmed	Replace VFD Board
e259	PPC4000 FAULT	VFD Board communication problem	Replace VFD Board or PPC4000
e260	VFD1 MISSING	VFD was commissioned to current profile but is not available	Replace VFD Board or fix VFD 1 use in setup
e261	VFD2 MISSING	VFD was commissioned to current profile but is not available	Replace VFD Board or fix VFD 2 use in setup
e262 to e265	Unused	Unused	
e266	VFD BOARD FAULT	VFD Board CPU error	Replace VFD Board
e267	VFD BOARD FAULT	VFD Board CPU error	Replace VFD Board
e268	VFD BOARD FAULT	VFD Board CPU error	Replace VFD Board
e269	VFD BOARD FAULT	VFD Board CPU error	Replace VFD Board
e270	VFD BOARD FAULT	VFD Board CPU error	Replace VFD Board
e271	VFD BOARD FAULT	VFD Board CPU error	Replace VFD Board
e272	VFD1 INPUT BELOW 4mA	VFD 1 input is less than 2 mA	Defective input or check wiring
e273	VFD BOARD FAULT	VFD Board CPU error	Replace VFD Board
e274	VFD BOARD FAULT	VFD Board CPU error	Replace VFD Board
e275	VFD BOARD FAULT	VFD Board CPU error	Replace VFD Board
e276	VFD BOARD FAULT	VFD Board has not been calibrated	Replace VFD Board
e277	VFD BOARD FAULT	VFD Board CPU error	Replace VFD Board
e278	VFD2 INPUT BELOW 4mA	VFD 2 input is less than 2 mA	Defective input or check wiring
e279	VFD BOARD FAULT	VFD Board CPU error	Replace VFD Board
e280	VFD BOARD FAULT	VFD Board communication problem	Replace VFD Board or PPC4000
e281	CHECK VFD1 INPUT	VFD 1 input is either under 2mA either over 21mA	Defective input or check wiring
e282	CHECK VFD2 INPUT	VFD 2 input is either under 2mA either over 21mA	Defective input or check wiring
e283	P0 NOT COMMISSIONED	p00 not commissioned	Commission the p00 servo positions

Error Code	Displayed	Reason for error	Possible remedy
e284	PPC4000 FAULT	PPC4000 main CPU timing error	Replace PPC4000 (notify Fireye about this error)
e285	PPC4000 FAULT	PPC4000 main CPU timing error	Replace PPC4000 (notify Fireye about this error)
e286	PPC4000 FAULT	PPC4000 main CPU timing error	Replace PPC4000 (notify Fireye about this error)
e287	PPC4000 FAULT	PPC4000 main CPU timing error	Replace PPC4000 (notify Fireye about this error)
e288	PPC4000 FAULT	PPC4000 main CPU timing error	Replace PPC4000 (notify Fireye about this error)
e289	PPC4000 FAULT	PPC4000 main CPU timing error	Replace PPC4000 (notify Fireye about this error)
e290	PPC4000 FAULT	PPC4000 main CPU timing error	Replace PPC4000 (notify Fireye about this error)
e291	LESS THAN 2 SERVOS	Less than 2 servos have been assigned to the current profile	Assign at least to servos (at least one AIR and one Fuel) to the profiles being used.
e292 to e318	Unused	Unused	
e319	NO SENSOR-SETPT DATA	Stored “sensor data” is corrupted	Pressing RESET will restore factory default values
e320	NO SERVO SETUP DATA	Stored “servo data” is corrupted	Pressing RESET will restore factory default values
e321	NO DIG I/P DATA	Stored “di data” is corrupted	Pressing RESET will restore factory default values
e322	NO PASSCODE DATA	Stored “passcode data” is corrupted	Pressing RESET will restore factory default values
e323	NO P0 DATA	Stored “p0 data” is corrupted	Pressing RESET will restore factory default values
e324	NO PROFILE1 DATA	Stored “profile 1 data” is corrupted	Pressing RESET will restore factory default values
e325	NO PROFILE2 DATA	Stored “profile 2 data” is corrupted	Pressing RESET will restore factory default values
e326	NO PROFILE3 DATA	Stored “profile 3 data” is corrupted	Pressing RESET will restore factory default values
e327	NO PROFILE4 DATA	Stored “profile 4 data” is corrupted	Pressing RESET will restore factory default values
e328	NO PROFL SETUP DATA	Stored “profile setup data” is corrupted	Pressing RESET will restore factory default values
e329	NO KEYPAD SETUP DATA	Stored “keypad setup data” is corrupted	Pressing RESET will restore factory default values
e330	NO KEY STATES DATA	Stored “key states data” is corrupted	Pressing RESET will restore factory default values
e331	NO THERML SHOCK DATA	Stored “thermal shock data” is corrupted	Pressing RESET will restore factory default values
e332	NO FAULT HISTRY DATA	Stored “fault history data” is corrupted	Pressing RESET will restore factory default values
e333	NO SETBACK DATA	Stored “setback data” is corrupted	Pressing RESET will restore factory default values
e334	NO COMM SETUP DATA	Stored “communication data” is corrupted	Pressing RESET will restore factory default values
e335	NO SEQUENCING DATA	Stored “sequencing data” is corrupted	Pressing RESET will restore factory default values
e336	NO O2 SETUP DATA	Stored “o2 setup data” is corrupted	Pressing RESET will restore factory default values
e337	NO ADJUSTED O2 DATA	Stored “adjusted o2 data” is corrupted	Pressing RESET will restore factory default values
e338	NO ANALOG OUT DATA	Stored “analog out data” is corrupted	Pressing RESET will restore factory default values
e339	NO VFD SETUP DATA	Stored “vfd setup data” is corrupted	Pressing RESET will restore factory default values
e340	NO VFD PROFILE1 DATA	Stored “vfd profile 1 data” is corrupted	Pressing RESET will restore factory default values
e341	NO VFD PROFILE2 DATA	Stored “vfd profile 2 data” is corrupted	Pressing RESET will restore factory default values
e342	NO VFD PROFILE3 DATA	Stored “vfd profile 3 data” is corrupted	Pressing RESET will restore factory default values
e343	NO VFD PROFILE4 DATA	Stored “vfd profile 4 data” is corrupted	Pressing RESET will restore factory default values
e344 to e368	Unused	Unused	

Error Code	Displayed	Reason for error	Possible remedy
e369	PPC4000 FAULT	“sensor data” is corrupted	Pressing RESET will restore values from stored memory
e370	PPC4000 FAULT	“servo data” is corrupted	Pressing RESET will restore values from stored memory
e371	PPC4000 FAULT	“di data” is corrupted	Pressing RESET will restore values from stored memory
e372	PPC4000 FAULT	“passcode data” is corrupted	Pressing RESET will restore values from stored memory
e373	PPC4000 FAULT	“p0 data” is corrupted	Pressing RESET will restore values from stored memory
e374	PPC4000 FAULT	“profile 1 data” is corrupted	Pressing RESET will restore values from stored memory
e375	PPC4000 FAULT	“profile 2 data” is corrupted	Pressing RESET will restore values from stored memory
e376	PPC4000 FAULT	“profile 3 data” is corrupted	Pressing RESET will restore values from stored memory
e377	PPC4000 FAULT	“profile 4 data” is corrupted	Pressing RESET will restore values from stored memory
e378	PPC4000 FAULT	“profile setup data” is corrupted	Pressing RESET will restore values from stored memory
e379	PPC4000 FAULT	“keypad setup data” is corrupted	Pressing RESET will restore values from stored memory
e380	PPC4000 FAULT	“key states data” is corrupted	Pressing RESET will restore values from stored memory
e381	PPC4000 FAULT	“thermal shock data” is corrupted	Pressing RESET will restore values from stored memory
e382	PPC4000 FAULT	“fault history data” is corrupted	Pressing RESET will restore values from stored memory
e383	PPC4000 FAULT	“setback data” is corrupted	Pressing RESET will restore values from stored memory
e384	PPC4000 FAULT	“communication data” is corrupted	Pressing RESET will restore values from stored memory
e385	PPC4000 FAULT	“sequencing data” is corrupted	Pressing RESET will restore values from stored memory
e386	PPC4000 FAULT	“o2 setup data” is corrupted	Pressing RESET will restore values from stored memory
e387	PPC4000 FAULT	“adjusted o2 data” is corrupted	Pressing RESET will restore values from stored memory
e388	PPC4000 FAULT	“analog out data” is corrupted	Pressing RESET will restore values from stored memory
e389	PPC4000 FAULT	“vfd setup data” is corrupted	Pressing RESET will restore values from stored memory
e390	PPC4000 FAULT	“vfd profile 1 data” is corrupted	Pressing RESET will restore values from stored memory
e391	PPC4000 FAULT	“vfd profile 2 data” is corrupted	Pressing RESET will restore values from stored memory
e392	PPC4000 FAULT	“vfd profile 3 data” is corrupted	Pressing RESET will restore values from stored memory

Error Code	Displayed	Reason for error	Possible remedy
e393	PPC4000 FAULT	“vfd profile 4 data” is corrupted	Pressing RESET will restore values from stored memory
e394	PPC4000 FAULT	"Burner Info data" is corrupted	Pressing RESET will restore values from stored memory
e395	PPC4000 FAULT	"FSG Setup data" is corrupted	Pressing RESET will restore values from stored memory
e396	PPC4000 FAULT	"FSG DI data" is corrupted	Pressing RESET will restore values from stored memory
e397	PPC4000 FAULT	"Valve Proving data" is corrupted	Pressing RESET will restore values from stored memory
e398	PPC4000 FAULT	"User Output data" is corrupted	Pressing RESET will restore values from stored memory
e399	PPC4000 FAULT	"CO Setup data" is corrupted	Pressing RESET will restore values from stored memory
e400 to e419	Unused	Unused	
e420	SERVO FAULT	Manual move button pressed on servo 1	Inspect Servo for button obstruction (wires touching)
e421	SERVO FAULT	Manual move button pressed on servo 2	Inspect Servo for button obstruction (wires touching)
e422	SERVO FAULT	Manual move button pressed on servo 3	Inspect Servo for button obstruction (wires touching)
e423	SERVO FAULT	Manual move button pressed on servo 4	Inspect Servo for button obstruction (wires touching)
e424	SERVO FAULT	Manual move button pressed on servo 5	Inspect Servo for button obstruction (wires touching)
e425	SERVO FAULT	Manual move button pressed on servo 6	Inspect Servo for button obstruction (wires touching)
e426	SERVO FAULT	Manual move button pressed on servo 7	Inspect Servo for button obstruction (wires touching)
e427	SERVO FAULT	Manual move button pressed on servo 8	Inspect Servo for button obstruction (wires touching)
e428	SERVO FAULT	Manual move button pressed on servo 9	Inspect Servo for button obstruction (wires touching)
e429	SERVO FAULT	Manual move button pressed on servo 10	Inspect Servo for button obstruction (wires touching)
e430 to e522	Unused	Unused	
e523	PPC4000 FAULT	Invalid Sequencing Data	

O2 Probe field calibration instruction

It's important to calibrate the O2 Probe periodically in order to achieve accurate oxygen measurement and maintain optimum combustion efficiency. Calibration of the probe can be accomplished by the following steps:

1. Start a burner cycle.

2. At the pre-purge phase, place the Burnerlogix FSG (or equivalent) in "check mode" by utilizing the RUN/CHECK slide switch located on the side of the Burnerlogix control. When in check mode, the FSG will stay in the pre-purge state indefinitely.

3. Keep system in pre-purge for at least 5 minutes in order to purge all traces of burnt/unburnt fuel. This purge time is needed to create the free-air (20.95% oxygen concentration) condition that is expected in order for the probe to calibrate properly. Extended purge time may be required for larger systems.

Note: System with multiple boilers with common flue gas outlet should be managed properly to avoid "fouling" of the probe with stack gases generated by adjacent boiler in operation.

4. After 5 minutes (or more) purge time, go to the PPC4000 display (NXD410 or Touchscreen) and navigate to the O2 SETUP menu.

5. Initiate the O2 probe calibration by executing the CALIBRATE NOW option. Calibration time is less than 15 seconds.

6. Observe the O2 reading after calibration to make sure that the O2 readout is about (20.8% ± 0.1%).

7. Upon successful calibration, remove the FSG from check mode to allow the system to continue normal burner sequence.

MARGINAL ALARMS

The user has the option to program in marginal high limits for each of the analog transducers, including the O2 probe. A marginal condition is expected to occur before a non-volatile lockout state, giving the operator sufficient time to resolve the condition and avoid a nuisance shutdown. In these instances where an input is creating a marginal control, the control will continue to operate normally but will energize the alarm relay as an indication of the condition and display a message explaining the condition. The first line of the HOME screen will be used to post the message.

Marginal Condition	Description
SENSOR 1 MARGINAL	Sensor 1 has exceeded its programmed high marginal limit.
SENSOR 2 MARGINAL	Sensor 2 has exceeded its programmed high marginal limit.
SENSOR 3 MARGINAL	Sensor 3 has exceeded its programmed high marginal limit.
SENSOR 4 MARGINAL	Sensor 4 has exceeded its programmed high marginal limit.
SENSOR 5 MARGINAL	Sensor 5 has exceeded its programmed high marginal limit.
O2 ERROR DETECTED	The O2 probe is reporting an error condition. The control will stop trimming to the O2 level and revert to commissioned values.

FAULT HISTORY

The FAULT HISTORY submenu allows the user to examine the last 10 lockouts experienced by the PPC4000 control. When a lockout occurs the PPC4000 automatically displays the FAULT HISTORY submenu. Along with the lockout cause the FAULT HISTORY displays the total lockouts encountered, the actual time and date of the lockout, when in the cycle the fault occurred and at what profile position. The UP/DOWN keys are used to scroll forward and backward through the fault history submenu. The FAULT HISTORY submenu is exited by using the HOME key.

NOTICE

When Fireye products are combined with equipment manufactured by others and/or integrated into systems designed or manufactured by others, the Fireye warranty, as stated in its General Terms and Conditions of Sale, pertains only to the Fireye products and not to any other equipment or to the combined system or its overall performance.

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