NXF-4100
November 1, 2021

NXF4000, PPC4000

Fuel-Air Ratio Controllers

Technical Bulletin

FM APPROVED

c UL us LISTED

DESCRIPTION

The NXF4000 and PPC4000 controls are advanced parallel positioning control systems for all types of combustion systems. The NXF4000 includes an integrated flame safeguard, whereas the PPC4000 is designed to be coupled with an external flame safeguard such as the Fireye BurnerLogix Y series or Fireye BurnerPRO series. Using an external flame safeguard may be desirable for retrofit applications or for applications where a specific feature of the flame safeguard is desired.

Best-in-class support for four fuel profiles allows these controls to accommodate a large variety of applications. Up to ten servos can be connected in total, with three sizes available: 4Nm (3 ft.-lb.), 20Nm (15 ft.-lb.) and 50Nm (37 ft.lb.). The servos connect in a daisy-chain using standard Modbus wiring. Each profile can have up to four servos and 24 points, ensuring a smooth combustion curve. Microprocessor control interpolates points to control servos within ±0.1° to maintain precise fuel-air control under all conditions. The secure Modbus connection is constantly monitoring the feedback for safe operation. Control is improved over single-point jackshaft systems since hysteresis is eliminated.

Additional gains in efficiency can be realized by using the optional VFD control or O_2 trim control. The VFD add-on card can control up to two VFDs and monitors feedback for closed-loop control. The O_2 trim system can be configured to monitor or to control to an O_2 target setpoint.

The control can connect to multiple analog inputs and digital inputs. The assignments for these inputs can be customized to fit the application. A user-defined analog output is available as well as three user-defined digital outputs (NXF4000 only). PID control is standard and can be set up for pressure or temperature applications. Dual setpoints can be configured and easily changed with a digital input. A setback feature based on time of day can be used to apply a setback setpoint as desired based upon occupancy or use patterns.

Integrated peer-to-peer sequencing is standard for up to six boilers. A separate Modbus connection is provided for this purpose and hot standby for the lag boilers can be enabled for steam boiler systems by adding water temperature transmitters to each boiler. The lead boiler can be chosen manually or via digital input.

The standard user interface is the NXD410TS (4.3”) touchscreen. This interface provides instant and pertinent information on operation as well as an intuitive menu structure for setup and commissioning. Fault history is available for the last ten faults. Multiple passcode levels are used for access control. The NXTSD507HD (7”) and NXTSD512HD (12”) touchscreens are also available to use with or in place of the NXD410TS for enhanced display and features.

NOTE: This bulletin supersedes Fireye bulletins NXF-4001, PPC-4001 and MOD-4001.

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WARNINGS

WARNING: Electro-mechanical high pressure (steam) or high temperature (water) limits must remain in the non-recycle limit circuit of the flame safeguard control.

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 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 or interlocks. Failure to follow these guidelines may result in an unsafe condition hazardous to life and property.

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, is required to take whatever measures which may be required to correct the interference.

KEY FEATURES

- Four available fuel profiles with up to four connected servos per profile
- Ten servos can be connected in total with non-monotonic operation
- Three servo choices: 4Nm (3 ft.-lb.), 20Nm (15 ft.-lb.) and 50Nm (37 ft.lb.)
- Servos are available with quick disconnect fittings for ease of maintenance
- Built-in 24VDC power supply for servos, user interfaces and accessories
- NXF4000 features internal flame safeguard functionality
- NXF4000 available with IR or UV amplifiers for use with standard flame scanners
- NXF4000 available with direct-coupled amplifier for use with integrated flame scanners
- NXF4000 offers intelligent valve proving for two- or three-valve systems
- NXF4000 offers input option for airflow switch test
- NXF4000 offers input option for fuel valve proof of closure
- PPC4000 is compatible with most external flame safeguards
- Five 4-20mA analog inputs are available
- NXF4000 has 15 programmable line-voltage digital inputs available
- PPC4000 has 10 programmable line-voltage digital inputs available
- One user-defined 4-20mA analog output is available
- NXF4000 has three user-defined line-voltage digital outputs available
- Optional VFD interface card adds allows up to two VFDs to be connected, with 4-20mA or encoder feedback
- Optional VFD interface card adds up to two user-defined 4-20mA analog output if these are not used for VFD control
- Two optional O_2 trim probes available (standard and high temperature) for monitor and control
- Boiler efficiency calculation available with optional O_2 trim
- Thermal shock algorithm is available for cold starts
- Up to six boilers can be connected for peer-to-peer sequencing
- Internal PID load control is available for precise steam or hot water setpoint control
- External 4-20mA signal can be connected for direct control by building automation or PLC
- If additional water sensor is connected hot standby function can be used to maintain a hot water setpoint so boiler is always ready to make steam quickly
- SD card can be used to backup and restore parameters
- Software is available to read SD card parameters on a PC
- Initial SD card is provided at shipping
- Modbus RTU via RS-485 for connection to building automation or PLC
- BACnet/IP, BACnet MS/TP and Ethernet/IP available via MB485ETH-CG gateway
- Standard 4.3” touchscreen user interface with virtual four-line display and function buttons
- Optional 7” or 12” touchscreen user interface with Modbus TCP server, remote VNC viewer and additional features can be used with or in place of 4.3” user interface
- Small footprint with no wiring base (integrated terminal blocks)
- Expert support from the Fireye team

DIFFERENCES BETWEEN THE NXF4000 AND PPC4000

The NXF4000 is a full-featured parallel positioning system that incorporates the flame safeguard functionality using an add-on amplifier. There are three amplifier choices: ultraviolet (UV), infrared (IR) or direct coupled (DC). There are multiple scanners available for the UV (not self-checking) and IR amplifiers, as well as multiple choices of Fireye Phoenix and InSight scanners that can be used with the DC amplifiers.

The PPC4000 is a full-featured parallel positioning system that is decoupled from the flame safeguard. This allows any flame safeguard that is designed to work with an actuator to be used. A typical example of this is the Fireye BurnerLogix. The wiring between the PPC4000 and the flame safeguard is the same wiring that is typically between a flame safeguard and an actuator, the commands to drive to the high and low positions as well as feedback. As far as system design, the PPC4000 is a drop-in replacement for an actuator in terms of function, while upgrading single-point linkage control to full microprocessor control with multiple servos, profiles and commissioned points of combustion.

All the same accessories work with both the NXF4000 and PPC4000. This includes user interfaces, VFD add-on card, O_2 trim system, sensors and servos. Most features are also duplicated as well, with a few exceptions: the PPC4000 has only 10 digital inputs instead of 15, and only 1 user digital output instead of 3. This is because the connection between the PPC4000 and the flame safeguard needs to connect to some of those inputs and outputs.

The NXF4000 is a great choice for new designs as it is more compact and economical. The PPC4000 is a great choice for retrofits or for installations where a separate flame safeguard is required either for functionality or by preference.

SPECIFICATIONS

NXF4000 Control, PPC4000 Control

Supply voltage:	120VAC 50/60 Hz (NXF4000, PPC4000) 230VAC 50/60 Hz (NXF4000-230V, PPC4000-230V)
Power consumption:	15VA
Operating temperature:	0°C to 60°C (32°F to 140°F)
Storage temperature:	-20°C to 70°C (-4°F to 158°F)
Humidity rating:	85% RH, non-condensing
Protective category:	IP10 (NEMA 1)
Dimensions:	127mm (5.0in) W x 203.2mm (8.0in) H x 101.6mm (4.0in) D
Shipping weight:	1.45kg (3.2lb)

NXD410TS User Interface

Supply voltage:	24VDC ± 20%
Power consumption:	5W (0.21A)
Operating temperature:	0°C to 50°C (32°F to 122°F)
Storage temperature:	-30°C to 80°C (-22°F to 176°F)
Humidity rating:	85% RH, non-condensing
Protective category:	IP40 (NEMA 1)
Dimensions:	128mm (5.03in) W x 87mm (3.43in) H x 32mm (1.26in) D
Shipping weight:	0.34kg (0.75lb)

NXTSD507HD User Interface

Supply voltage:	24VDC ± 20%
Power consumption:	10.8W (0.45A)
Operating temperature:	-20°C to 50°C (-4°F to 122°F)
Storage temperature:	-30°C to 80°C (-22°F to 176°F)
Humidity rating:	85% RH, non-condensing
Protective category:	IP67 (NEMA 4X), indoor use only
Dimensions:	201mm (7.91 in) W x 140mm (5.51in) H x 40mm (1.57in) D
Shipping weight:	1.1kg (2.5lb)

NXTSD512HD User Interface

Supply voltage:	24VDC ± 20%
Power consumption:	21.6W (0.9A)
Operating temperature:	-20°C to 50°C (-4°F to 122°F)
Storage temperature:	-30°C to 80°C (-22°F to 176°F)
Humidity rating:	85% RH, non-condensing
Protective category:	IP67 (NEMA 4X), indoor use only
Dimensions:	313.4mm (12.3in) W x 215.5mm (8.48in) H x 50mm (1.97in) D
Shipping weight:	2.5kg (5.5lb)

NXCESO2 Oxygen Probe

Supply voltage:	24VDC ± 10%
Power consumption:	27W (1.1A)
Operating temperature:	0°C to 60°C (32°F to 140°F)
Storage temperature:	-20°C to 70°C (-4°F to 158°F)
Humidity rating:	85% RH, non-condensing
Protective category:	IP10 (NEMA 1)
Shipping weight:	NXCESO2-8: 3.67kg (8.1lb) NXCESO2-16: 4.17kg (9.2lb)

FXCESO2 Oxygen Probe with FXO2TRIM Interface

Supply voltage:	24VDC ± 10%
Power consumption:	27W (1.1A)
Operating temperature:	FXCESO2: > 85°C (>185°F) FXO2TRIM-1: 0°C to 60°C (32°F to 140°F)
Storage temperature:	-20°C to 70°C (-4°F to 158°F)
Humidity rating:	85% RH, non-condensing
Protective category:	FXCESO2-8(-16)(-30): IP20 (NEMA 1) FXO2TRIM-1: IP65 (NEMA 4)
Shipping weight:	FXCESO2-8: 2.5kg (5.5b) FXCESO2-16: 3.5kg (7.7b) FXCESO2-30: 4.5kg (9.9b) FXO2TRIM-1: 0.6kg (1.32lb)

FX04 Servo

Supply voltage:	24VDC ± 10%
Power consumption:	Nominal: 5W (0.21A) Peak: 7.5W (0.31A)
Operating temperature:	-20°C to 60°C (-4°F to 140°F)
Storage temperature:	-20°C to 70°C (-4°F to 158°F)
Humidity rating:	85% RH, non-condensing
Protective category:	IP65 (NEMA 4)
Torque rating:	4 Nm (3 ft-lb)
Rotational span:	1° to 99.9°
Time for 90-degree rotation:	30 to 120 seconds
Repeatability:	0.3°
Hysteresis:	0.6°
Shipping weight:	1.1kg (2.27lb)

FX20 Servo

Supply voltage:	24VDC ± 10%
Power consumption:	Nominal: 15W (0.62A) Peak: 35W (1.46A)
Operating temperature:	-20°C to 60°C (-4°F to 140°F)
Storage temperature:	-20°C to 70°C (-4°F to 158°F)
Humidity rating:	85% RH, non-condensing
Protective category:	IP65 (NEMA 4)
Torque rating:	20 Nm (15 ft-lb)
Rotational span:	1° to 99.9°
Time for 90-degree rotation:	30 to 120 seconds
Repeatability:	0.3°
Hysteresis:	0.6°
Shipping weight:	2.5kg (5.43lb)

FX50 Servo

Supply voltage:	24VDC ± 10%
Power consumption:	Nominal: 20W (0.83A) Peak: 38W (1.58A)
Operating temperature:	-20°C to 60°C (-4°F to 140°F)
Storage temperature:	-20°C to 70°C (-4°F to 158°F)
Humidity rating:	85% RH, non-condensing
Protective category:	IP65 (NEMA 4)
Torque rating:	50 Nm (37 ft-lb)
Rotational span:	1° to 99.9°
Time for 90-degree rotation:	30 to 120 seconds
Repeatability:	0.3°
Hysteresis:	0.6°
Shipping weight:	2.77kg (6.1lb)

Temperature Sensors

Measurement range:	FXIATS-140: -40°C to 60°C (-40°F to 140°F) TS350-2(-4)(-8): 0°C to 172°C (32°F to 350°F) TS752-2(-4)(-8): 0°C to 400°C (32°F to 752°F)
RTD type:	Pt100 (0.00385 ohms per degree Celsius)
Operating temperature:	-25°C to 85°C (-13°F to 185°F)
Output:	4-20mA, linear with temperature
Accuracy:	± 0.75% of span
Thermowell case:	300 series stainless steel
Mechanical fitting:	½” NPT
Electrical fitting:	½” trade size conduit, female thread

Pressure Sensors

Measurement range:	BLPS-15: 0mBar to 1030mBar (0psi to 15psi) BLPS-25: -1013mBar to 1720mBar (-14.7psi to 25psi) BLPS-30: 0mBar to 2070mBar (0psi to 30psi) BLPS-200: 0Bar to 13.8Bar (0psi to 200psi) BLPS-300: 0Bar to 20.7Bar (0psi to 300psi)
Voltage:	9-30VDC (can be supplied by NXF4000 or PPC4000)
Operating temperature:	-40°C to 85°C (-40°F to 185°F)
Output:	4-20mA, linear with pressure
Accuracy:	± 0.25% of span
Maximum over pressure:	200% of span
Maximum burst pressure:	800% of span
Mechanical fitting:	¼” NPT
Electrical fitting:	½” trade size conduit, female thread

PMSTR-4000 Plant Master

Screen type:	TFT, 4-wire analog resistive
Resolution:	800 x 480
Diagonal screen area:	177.8mm (7 in.)
Backlight:	LED rated at 20,000 hours at 25°C
Nominal voltage:	100VAC-240VAC (45Hz-65Hz)
Nominal power consumption:	124.3VA
Internal power supply maximum output:	96W (24VDC)
Relay output ratings:	230VAC/2A, pilot duty only
Analog input resolution:	16-bit
Analog output resolution:	12-bit
Operating temperature range:	0°C to 60°C (32°F to 140°F)
Operating humidity:	10% to 95%, non-condensing
Storage temperature range:	-20°C to 85°C (-4°F to 185°F)
Shock during operation:	25g acceleration for 11ms
Degree of protection:	IP66 (NEMA 4X), indoor use only (not UV stabilized)
Unit dimensions:	270mm x 370mm (10.64 in. x 14.59 in.)
Unit dimensions depth:	151mm (5.92 in.)
Weight:	4.76kg (10.5 lb.)

APPROVALS

	FM APPROVED	c UL us LISTED	c SP us	CE	DIN DVGW CERT	DIN Geprüft
Controls						
NXF4000		X		X		X
NXF4000-230V				X		X
PPC4000	X	X	X			
PPC4000-230V						
User Interfaces						
NXD410TS		X		X		
NXTSD507HD		X		X		
NXTSD512HD		X		X		
Communication Gateways						
MB485ETH-CG		X		X		
Servos						
FX04	X	X	X	X		X
FX04-1	X	X	X	X		X
FX20	X	X	X	X		X
FX20-1	X	X	X	X		X
FX50	X	X	X	X		X
FX50-1	X	X	X	X		X
NXF4000 Flame Safeguard Amplifiers						
NXCESUV		X		X		X
NXCESIR		X		X		X
NXCESDC		X		X		X
NXF4000 Approved Flame Scanners						
UV1AL-3		X		X		
UV1AL-6		X		X		
UV5-1		X		X		
UV90L-1		X		X		
48PT2-1003	X	X		X		
48PT2-1007	X	X		X		
48PT2-9003	X	X		X		
48PT2-9007	X	X		X		
85UVF4-1QDWR	X	X		X		
85UVF4-2QDWR	X	X		X		
85IRF4-1QDWR	X	X		X		
85IRF4-2QDWR	X	X		X		
95IRS2-1	X	X				
95IRS2-2	X	X				
95UVS2-1	X	X				
95UVS2-2	X	X				
95UVS2-3	X	X				
95DSS2-1	X	X				
95DSS3-1WINC	X	X		X	X	

	FM APPROVED	c UL us LISTED	c us	CE	DIN DVGW CERT	DIN Geprüft
Oxygen Trim						
NXCESO2-8		X				
NXCESO2-8		X				
FXCESO2-8		X		X		X
FXCESO2-16		X		X		X
FXCESO2-30		X		X		X
FXO2TRIM-1				X		X
Temperature and Pressure Sensors						
BLPS-15	X	X		X		X
BLPS-25	X	X		X		X
BLPS-30	X	X		X		X
BLPS-200	X	X		X		X
BLPS-300	X	X		X		X
TS350-2	X	X		X		X
TS350-4	X	X		X		X
TS350-5	X	X		X		X
TS752-2	X	X		X		X
TS752-4	X	X		X		X
TS752-8	X	X		X		X
Plant Master						
PMSTR-4000		X				

Underwriter's Laboratories, Inc.

File MCCZ.MP1537
Controls, Primary Safety

File MCCZ7.MP1537
Controls, Primary Safety Certified for Canada

UL508A (Plant Master)
Enclosed Industrial Control Panels

CE

(PIN) 0063CT1349
EN 298:2012, EN 1643:2014, prEN 12067-2:2016, EN 14459:2007

DIN CERTO

Registration Number 5F251

ORDERING INFORMATION

Controls

NXF4000	Parallel positioning system with integrated flame safeguard, 120VAC input.
NXF4000-230V	Parallel positioning system with integrated flame safeguard, 230VAC input.
PPC4000	Parallel positioning system, 120VAC input. Use with external flame safeguard.
PPC4000-230V	Parallel positioning system, 230VAC input. Use with external flame safeguard.
60-3004	Terminal block kit for NXF4000 and PPC4000 controls. **Bulletin: 133-789**
129-190	Fan replacement kit for NXF4000 and PPC4000 controls. **Bulletin: 133-763**

NXF4000

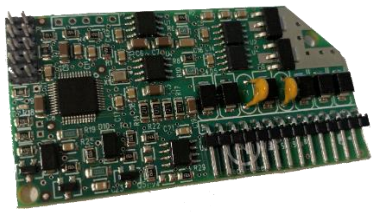
60-3004

129-190

Add-on (Daughter) Cards

NXCESUV	Ultraviolet amplifier add-on card for NXF4000. For use with approved UV scanners. **Bulletin: NXCESAMP-1001**
NXCESIR	Infrared amplifier add-on card for NXF4000. For use with approved IR scanners. **Bulletin: NXCESAMP-1001**
NXCESDC	Direct-couple amplifier add-on card for NXF4000. For use with approved integrated scanners. **Bulletin: NXCESAMP-1001**
NXCESVFD	Two-channel VFD and analog output add-on card for NXF4000 or PPC4000. **Bulletin: NXCESVFD-1001**

NXCESUV – NXCESUV – NXCESDC



NXCESVFD

User Interfaces

NXD410TS	Touchscreen interface, 4.3-inch diagonal screen size, 24VDC, for use with NXF4000 or PPC4000 parallel positioning system. **Bulletin: NXD-4102**
NXTSD507HD	Touchscreen interface, 7-inch diagonal screen size, 24VDC, for use with NXF4000 or PPC4000 parallel positioning system. **Bulletin: TSD-4001**
NXTSD512HD	Touchscreen interface, 12.1-inch diagonal screen size, 24VDC, for use with NXF4000 or PPC4000 parallel positioning system. **Bulletin: TSD-4001**
60-3008	Bezel adapter to fit NXD410TS into NXD410 cutout. **Bulletin: 133-792**
59-561	Cable to connect NXD410TS to NXF4000 or PPC4000, separate power and communication, sold by the foot (specify number of feet needed as quantity).
59-565	Cable to connect NXTSD507HD and NXTSD512HD to NXF4000 or PPC4000, separate power and communication, sold by the foot (specify number of feet needed as quantity).

NXD410TS

NXTSD512HD

Communication Gateways

MB485ETH-CG	Fireye universal communication gateway, Modbus RTU or Modbus TCP to Modbus RTU, Modbus TCP, BACnet MS/TP, BACnet/IP or Ethernet/IP. **Bulletin: CG-1001**

MB485ETH-CG

Servos

FX04	Servo motor, 24 VDC operation, 4Nm (3 ft.lb.) torque, ½" NPT conduit threaded, minimum travel time of 30 seconds for 90°, 56k baud for NXF4000/PPC4000. **Bulletin: NEX-3001**
FX04-1	Servo motor, 24 VDC operation, 4Nm (3 ft.lb.) torque, quick disconnect connectors, minimum travel time of 30 seconds for 90°, 56k baud for NXF4000/PPC4000. **Bulletin: NEX-3001**
FX20	Servo motor, 24 VDC operation, 20Nm (15 ft.lb.) torque, ½" NPT conduit threaded, minimum travel time of 30 seconds for 90°, 56k baud for NXF4000/PPC4000. **Bulletin: NEX-3001**
FX20-1	Servo motor, 24 VDC operation, 20Nm (15 ft.lb.) torque, quick disconnect connectors, minimum travel time of 30 seconds for 90°, 56k baud for NXF4000/PPC4000. **Bulletin: NEX-3001**
FX50	Servo motor, 24 VDC operation, 50Nm (37 ft.lb.) torque, ½" NPT conduit threaded, minimum travel time of 30 seconds for 90°, 56k baud for NXF4000/PPC4000. **Bulletin: NEX-3001**
FX50-1	Servo motor, 24 VDC operation, 50Nm (37 ft.lb.) torque, quick disconnect connectors, minimum travel time of 30 seconds for 90°, 56k baud for NXF4000/PPC4000. **Bulletin: NEX-3001**
59-565-6	Quick disconnect cord set, 1.83 meters (6 feet), PVC jacket, temperature rating -40°C to 105°C, meets NEMA 1,3,4,6P and IEC67.
59-565-40	Quick disconnect cord set, 12.19 meters (40 feet), PVC jacket, temperature rating -40°C to 105°C, meets NEMA 1,3,4,6P and IEC67.
59-565	Cable to connect FX series servos, separate power and communication, sold by the foot (specify number of feet needed as quantity).
129-192	Quick disconnect connector for field wiring, female (cable 59-565 recommended).
129-194	Quick disconnect connector for converting servos, male.
44-164	Cover for unused quick disconnect connectors, NEMA 4 rated.
44-164-1	Cover for unused quick disconnect connectors, NEMA 4, Class I Division 2 rated.
60-2685-25	24VDC power supply, 100-240VAC 50/60 Hz input, 60W (2.5A), DIN rail mounted. **Bulletin: CU-118**
60-2685-50	24VDC power supply, 100-240VAC 50/60 Hz input, 120W (5A), DIN rail mounted. **Bulletin: CU-118**

FX04-1

FX20

FX50-1

Scanners

UV Scanners

UV1AL-3	UV scanner, ½" NPT mount, 0.92 meters (3 feet), TC-ER cable with flying leads. **Bulletin: SC-108**
UV1AL-6	UV scanner, ½" NPT mount, 1.83 meters (6 feet), TC-ER cable with flying leads. **Bulletin: SC-108**
UV5-1	UV scanner, front and side viewing, 2 meters (6.56 feet), detachable cable with flying leads. **Bulletin: SC-108**
UV90L-1	UV scanner, front and side viewing, terminal block. **Bulletin: SC-108**
4-742-1	Replacement tube for UV90L-1.

UV1AL-3

UV5-1

UV90L-1

IR Scanners

48PT2-1003	IR scanner, ½" NPT mount straight mount, 2.44 meters (8 feet), TC-ER cable with flying leads. **Bulletin: SC-103**
48PT2-1007	IR scanner, ½" NPT mount straight mount, 1.22 meters (4 feet), TC-ER cable with flying leads. **Bulletin: SC-103**
48PT2-9003	IR scanner, ½" NPT mount 90° mount, 2.44 meters (8 feet), TC-ER cable with flying leads. **Bulletin: SC-103**
48PT2-9007	IR scanner, ½" NPT mount 90° mount, 1.22 meters (4 feet), TC-ER cable with flying leads. **Bulletin: SC-103**
4-263-1	Replacement photo detector for 48PT2.

48PT2-1003

48PT2-9003

Phoenix Integrated Scanners

85UVF4A-1QDWR	Phoenix Series II scanner, UV with 8-pin electrical quick disconnect. FM, UL/c approved. Uses 60-2692 or 60-2919 mounting flange and 59-546 cable. **Bulletin: CU-114**
85UVF4A-2QDWR	Phoenix Series II scanner, fiber optic, UV with 8-pin electrical quick disconnect. FM, UL/c approved. Uses 60-2692 or 60-2919 mounting flange and 59-546 cable. **Bulletin: CU-114**
85IRF4A-1QDWR	Phoenix Series II scanner, IR with 8-pin electrical quick disconnect. FM, UL/c approved. Uses 60-2692 or 60-2919 mounting flange and 59-546 cable. **Bulletin: CU-114**
85IRF4A-2QDWR	Phoenix Series II scanner, fiber optic, IR with 8-pin electrical quick disconnect. FM, UL/c approved. Uses 60-2692 or 60-2919 mounting flange and 59-546 cable. **Bulletin: CU-114**
59-546-3	Quick disconnect cord for Phoenix integrated scanner, 8 conductors, 3 meters (9.84 feet).
59-546-6	Quick disconnect cord for Phoenix integrated scanner, 8 conductors, 6 meters (19.68 feet).
59-546-9	Quick disconnect cord for Phoenix integrated scanner, 8 conductors, 9 meters (29.53 feet).
59-546-12	Quick disconnect cord for Phoenix integrated scanner, 8 conductors, 12 meters (39.37 feet).
59-546-15	Quick disconnect cord for Phoenix integrated scanner, 8 conductors, 15 meters (49.21 feet).
59-546-30	Quick disconnect cord for Phoenix integrated scanner, 8 conductors, 30meters (98.43 feet).
59-546-45	Quick disconnect cord for Phoenix integrated scanner, 8 conductors, 45 meters (147.64 feet).
59-546-60	Quick disconnect cord for Phoenix integrated scanner, 8 conductors, 60 meters (196.85 feet).
59-546-90	Quick disconnect cord for Phoenix integrated scanner, 8 conductors, 90 meters (295.28 feet).
59-546	8-conductor cable for Phoenix integrated scanner, sold by the foot.
21-885	Quick disconnect connector for field wiring, 8 pins, female (cable 59-546 recommended).

85UVF4-1QDWR

InSight Integrated Scanners

95DSS2-1	InSight I integrated scanner, fiber optic, IR and UV (dual) with 12-pin electrical quick disconnect. FM, UL/c approved. Uses 60-2692 or 60-2919 mounting flange and 59-497 cable. **Bulletin: CU-95**
95DSS3-1WINC	InSight II integrated scanner, IR and UV (dual) with 12-pin electrical quick disconnect. FM, UL/c approved. NEMA 4X housing. FM, UL/c, CE approved. Uses 60-2692 or 60-2919 mounting flange and 59-497 cable. **Bulletin: CU-113**
59-497-020-WR	Quick disconnect cord for InSight integrated scanner, two straight connectors, 12 conductors, 6 meters (20 feet).
59-497-020C-WR	Quick disconnect cord for InSight integrated scanner, one straight connector and one flexible conduit connector, 12 conductors, 6 meters (20 feet).
59-497-020R-WR	Quick disconnect cord for InSight integrated scanner, two 90° connectors, 12 conductors, 6 meters (20 feet).
59-497-020RC-WR	Quick disconnect cord for InSight integrated scanner, one 90° connector and one flexible conduit connector, 12 conductors, 6 meters (20 feet).

95DSS2-1

95DSS3-1WINC

Integrated Scanner Accessories

35-127-1	Heat insulator, 1“ NPT x 3”.
35-127-3	Heat insulator, 1“ BSP x 3”.
60-2692	Metal mounting flange, 1“ NPT (includes 35-127-1).
60-2692SS	Stainless mounting flange, 1“ NPT (includes 35-127-1).
60-2693	Metal mounting flange, 1“ BSP (includes 35-127-3).
60-2693SS	Stainless mounting flange, 1“ BSP (includes 35-127-3).
60-2919-1	Mounting flange with heat insulator incorporated, 1“ NPT.
60-2919-2	Mounting flange with heat insulator incorporated, 1“ BSP.
60-1664-3	Swivel mount adapter, 1“ NPT.
60-1664-4	Swivel mount adapter, 1“ BSP.
60-1199-1	Sealing coupling with quartz window, 1” NPT.
60-1199-2	Sealing coupling with quartz window, 1” BSP.
53-121	Orifice kit (9 pieces) for use with 60-1664-1(-2), 60-1199-1(-2), 60-2692 and 60-2693.
97-1048	Insulating jacket for high temperature applications. **Bulletin: CU-103**
60-2720	Vortex-tube cooler kit for high temperature applications. **Bulletin: CU-103**
60-2685-25	24VDC power supply, 100-240VAC 50/60 Hz input, 60W (2.5A), DIN rail mounted. **Bulletin: CU-118**
60-2685-50	24VDC power supply, 100-240VAC 50/60 Hz input, 120W (5A), DIN rail mounted. **Bulletin: CU-118**

Oxygen Trim

NXCESO2-8	Standard O_2 probe assembly, 216 mm (8.5 inch) insertion depth. **Bulletin: NXCESO2-1001**
NXCESO2-16	Standard O_2 probe assembly, 407 mm (16 inch) insertion depth. **Bulletin: NXCESO2-1001**
FXIATS-140	Ambient air temperature sensor, -40°C to 60°C (-40°F to 140°F), 4-20mA **Bulletin: FXIATS-1**
35-381-2	O_2 probe mounting flange. **Bulletin: 133-750**
NXCESO2-8-KIT	Kit, NXCESO2-8 with FXIATS-140 and 35-381-2.
NXCESO2-16-KIT	Kit, NXCESO2-16 with FXIATS-140 and 35-381-2.
FXCESO2-8	High temperature O_2 probe assembly, 215 mm (8 inch) insertion depth. Requires FXO2TRIM-1 control board. **Bulletin: FXCESO2-1001**
FXCESO2-16	High temperature O_2 probe assembly, 406 mm (16 inch) insertion depth. Requires FXO2TRIM-1 interface module. **Bulletin: FXCESO2-1001**
FXCESO2-30	High temperature O_2 probe assembly, 757 mm (30 inch) insertion depth. Requires FXO2TRIM-1 interface module. **Bulletin: FXCESO2-1001**
FXO2TRIM-1	O_2 probe interface module for FXCESO2 probes. **Bulletin: FXCESO2-1001**
59-612-33	Interconnecting cable from FXCESO2 probe to FXO2TRIM-1 interface module, 10 meters (33 feet).
59-565	Cable to connect NXCESO2 and FXO2TRIM-1, separate power and communication, sold by the foot (specify number of feet needed as quantity).
129-192	Quick disconnect connector for field wiring, female (cable 59-565 recommended).
129-190	Fan replacement kit for NXCESO2. **Bulletin: 133-763**

NXCESO2-8

FXCESO2-8

FXO2TRIM-1

Temperature and Pressure Sensors

BLPS-15	Pressure transducer, 0mBar to 1030mBar (0psi to 15psi), 4-20mA output linear to pressure, ¼" NPT mount. **Bulletin: BLZPTS-1**
BLPS-25	Pressure transducer, -1013mBar to 1720mBar (-14.7psi to 25psi), 4-20mA output linear to pressure, ¼" NPT mount. **Bulletin: BLZPTS-1**
BLPS-30	Pressure transducer, 0mBar to 2070mBar (0psi to 30psi), 4-20mA output linear to pressure, ¼" NPT mount. **Bulletin: BLZPTS-1**
BLPS-200	Pressure transducer, 0Bar to 13.8Bar (0psi to 200psi), 4-20mA output linear to pressure, ¼" NPT mount. **Bulletin: BLZPTS-1**
BLPS-300	Pressure transducer, 0Bar to 20.7Bar (0psi to 300psi), 4-20mA output linear to pressure, ¼" NPT mount. **Bulletin: BLZPTS-1**
TS350-2	Temperature transmitter Pt100, 0°C to 176°C (32°F to 350°F), 4-20mA output linear to temperature, ½" NPT stainless thermowell with 51 mm (2 inch) insertion depth. **Bulletin: BLZPTS-1**
TS350-4	Temperature transmitter Pt100, 0°C to 176°C (32°F to 350°F), 4-20mA output linear to temperature, ½" NPT stainless thermowell with 102 mm (4 inch) insertion depth. **Bulletin: BLZPTS-1**
TS350-8	Temperature transmitter Pt100, 0°C to 176°C (32°F to 350°F), 4-20mA output linear to temperature, ½" NPT stainless thermowell with 204 mm (8 inch) insertion depth. **Bulletin: BLZPTS-1**
TS752-2	Temperature transmitter Pt100, 0°C to 400°C (32°F to 752°F), 4-20mA output linear to temperature, ½" NPT stainless thermowell with 51 mm (2 inch) insertion depth. **Bulletin: BLZPTS-1**
TS752-4	Temperature transmitter Pt100, 0°C to 400°C (32°F to 752°F), 4-20mA output linear to temperature, ½" NPT stainless thermowell with 102 mm (4 inch) insertion depth. **Bulletin: BLZPTS-1**
TS752-8	Temperature transmitter Pt100, 0°C to 400°C (32°F to 752°F), 4-20mA output linear to temperature, ½" NPT stainless thermowell with 204 mm (8 inch) insertion depth. **Bulletin: BLZPTS-1**
FXIATS-140	Ambient air temperature sensor, -40°C to 60°C (-40°F to 140°F), 4-20mA **Bulletin: FXIATS-1**

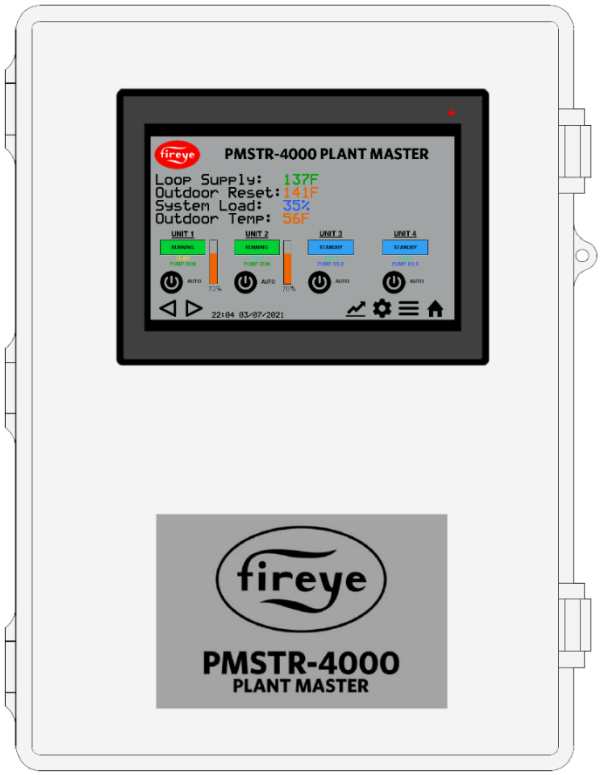
BLPS-200

TS350-4

FXIATS-140

Plant Master

PMSTR-4000	Plant master for NXF4000 and PPC4000, 7” touchscreen, UL508A listed industrial control panel, IP66/NEMA4X rated. **Bulletin: PMSTR-4001**
BLPS-15	Pressure transducer, 0mBar to 1030mBar (0psi to 15psi), 4-20mA output linear to pressure, ¼” NPT mount. **Bulletin: BLZPTS-1**
BLPS-30	Pressure transducer, 0mBar to 2070mBar (0psi to 30psi), 4-20mA output linear to pressure, ¼” NPT mount. **Bulletin: BLZPTS-1**
BLPS-200	Pressure transducer, 0Bar to 13.8Bar (0psi to 200psi), 4-20mA output linear to pressure, ¼” NPT mount. **Bulletin: BLZPTS-1**
TS350-2	Temperature transmitter Pt100, 0°C to 176°C (32°F to 350°F), 4-20mA output linear to temperature, ½” NPT stainless thermowell with 51 mm (2 inch) insertion depth. **Bulletin: BLZPTS-1**
FXIATS-140	Ambient air temperature sensor, -40°C to 60°C (-40°F to 140°F), 4-20mA **Bulletin: FXIATS-1**



PMSTR-4000

MINIMUM SYSTEM NXF4000

A minimum viable NXF4000 system would contain the following components:

1. NXF4000 or NXF4000-230V control
2. Terminal block kit 60-3004
3. One of the following choices:
    a. Total of two of the following: FX04, FX20, or FX50 servos
    b. Total of two of the following: FX04-1, FX20-1, or FX50-1 servos **AND** associated 59-565 connection cables
    c. One FX04, FX20, or FX50 servo **AND** NXCESVFD VFD card
    d. One FX04-1, FX20-1, or FX50-1 servo **AND** associated 59-565 connection cables **AND** NXCESVFD VFD card
4. One of the following choices:
    a. NXCESUV amplifier **AND** UV90L, UV5 or UV1AL scanner
    b. NXCESIR amplifier **AND** 48PT2 scanner
    c. NXCESDC amplifier **AND** 85 series (Phoenix) or 95 series (InSight/InSight2) integrated scanner
5. One of the following choices:
    a. NXD410TS **AND** associated 59-561 connection cable
    b. NXTSD507HD **AND** associated 59-565 connection cable
    c. NXTSD512HD **AND** associated 59-565 connection cable
6. One of the following choices:
    a. External 4-20mA modulation signal
    b. BLPS-15, -25, -30, -200 or -300 steam pressure transducer
    c. TS350 or TS752 temperature sensor with 4-20mA transmitter

MINIMUM SYSTEM PPC4000

A minimum viable PPC4000 system would contain the following components:

1. PPC4000 or PPC4000-230V control
2. Terminal block kit 60-3004
3. Compatible flame safeguard such as one of the following:
    a. BurnerLogix Y series
    b. BurnerPRO series
4. One of the following choices:
    a. Total of two of the following: FX04, FX20, or FX50 servos
    b. Total of two of the following: FX04-1, FX20-1, or FX50-1 servos **AND** associated 59-565 connection cables
    c. One FX04, FX20, or FX50 servo **AND** NXCESVFD VFD card
    d. One FX04-1, FX20-1, or FX50-1 servo **AND** associated 59-565 connection cables **AND** NXCESVFD VFD card
5. One of the following choices:
    a. NXD410TS **AND** associated 59-561 connection cable
    b. NXTSD507HD **AND** associated 59-565 connection cable
    c. NXTSD512HD **AND** associated 59-565 connection cable
6. One of the following choices:
    a. External 4-20mA modulation signal
    b. BLPS-15, -25, -30, -200 or -300 steam pressure transducer
    c. TS350 or TS752 temperature sensor with 4-20mA transmitter

Section 2: Installation

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INSTALLATION PROCEDURE

1. A UL-listed or CE-approved NXF4000 system is comprised of the following components:
    a. NXF4000 or NXF4000-230V fuel-air ratio controller with integral FSG functionality
    b. FSG add-on card with approved scanner
        i. NXCESIR with 48PT2-xxxx
        ii. NXCESUV with UV1AL-x, UV90L-1 or UV5-1
        iii. NXCESDC with specific 85-series or 95-series integrated scanners
    c. NXD410TS, NXTSD507HD or NXTSD512HD user interface
    d. FX series servos and/or NXCESVFD add-on card
2. A UL-listed PPC4000 system is comprised of the following components:
    a. PPC4000 fuel-air ratio controller
    b. NXD410TS, NXTSD507HD or NXTSD512HD user interface
    c. FX series servos and/or NXCESVFD add-on card
    d. UL-listed external FSG (BurnerLogix Y or BurnerPRO recommended)
3. Wiring must comply with all applicable codes, ordinances and regulations.
4. Wiring must comply with NEC Class 1 (Line Voltage) wiring.
5. To minimize interference from radio frequency energy generated by the NXF4000 or PPC4000 control, it is necessary that all control wiring be placed in conduit. It is recommended that all low voltage signal or communication wiring (examples: servos, O_2 probe, pressure/temperature transducer) be placed in a separate conduit from line voltage wiring (examples: relay outputs, line voltage digital inputs, profile select).
6. 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 NXF4000 or external FSG.
7. Do not run high voltage ignition transformer wires in the same conduit with any other wires.
8. Maximum wire lengths:
    a. Terminal inputs (operating limits, interlocks, valves, etc.): 61 meters (200 feet)
    b. Line voltage inputs: 152 meters (500 feet)
        i. For safety, remote reset pushbuttons should remain within sight and sound of the burner.
    c. Modbus communications RS-485: 305 meters (1000 feet)
    d. Servos and O_2 probes: 61 meters (200 feet)
    e. Sensors: 30 meters (100 feet)
9. 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.

WARNING: All installation, service and troubleshooting of Fireye products must be performed by a qualified technician.

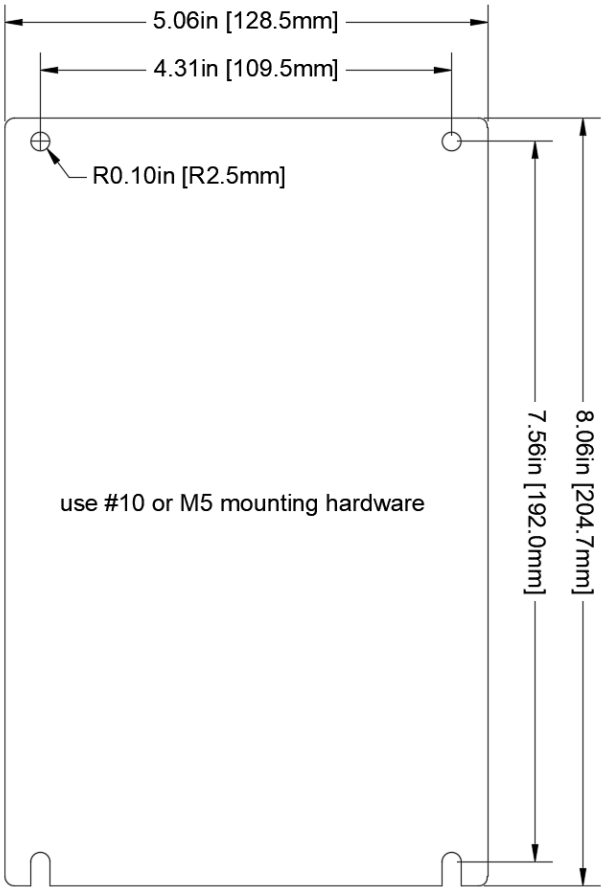
NXF4000 AND PPC4000

The NXF4000 and PPC4000 mount to the back panel of the enclosure using four 10-32 or M5x0.8 machine screws. It is recommended that the back panel is tapped for the mounting screws to facilitate easy removal of the control. The bottom two mounting holes are slotted for convenience.

Mounting guidelines:

1. Install the control where the relative humidity never reaches the saturation point.
2. The control is designed to operate in a non-condensing environment with a maximum 85% relative humidity (continuous).
3. Do not install the control where it can be subjected to vibration in excess of 0.5G.
4. The control is not a weather tight enclosure.
5. A vertical mounting position is recommended.
6. Allow a service clearance of 50mm (2in) around the control for removing and replacing terminal blocks.
7. Protect the control from ingress of drilling debris when installing conduit. Debris can easily enter the top of the control through the ventilation opening and cause damage.

Refer to the figure below for mounting dimensions. Note that the figure is not to scale.



Mounting diagram – NOT TO SCALE

ADD-ON CARDS

The add-on cards for FSG functionality (NXF4000) and VFD functionality (NXF4000 and PPC4000) must be fitted into the control for use. The cards fit within the footprint of the control, inserted under the removable cover.

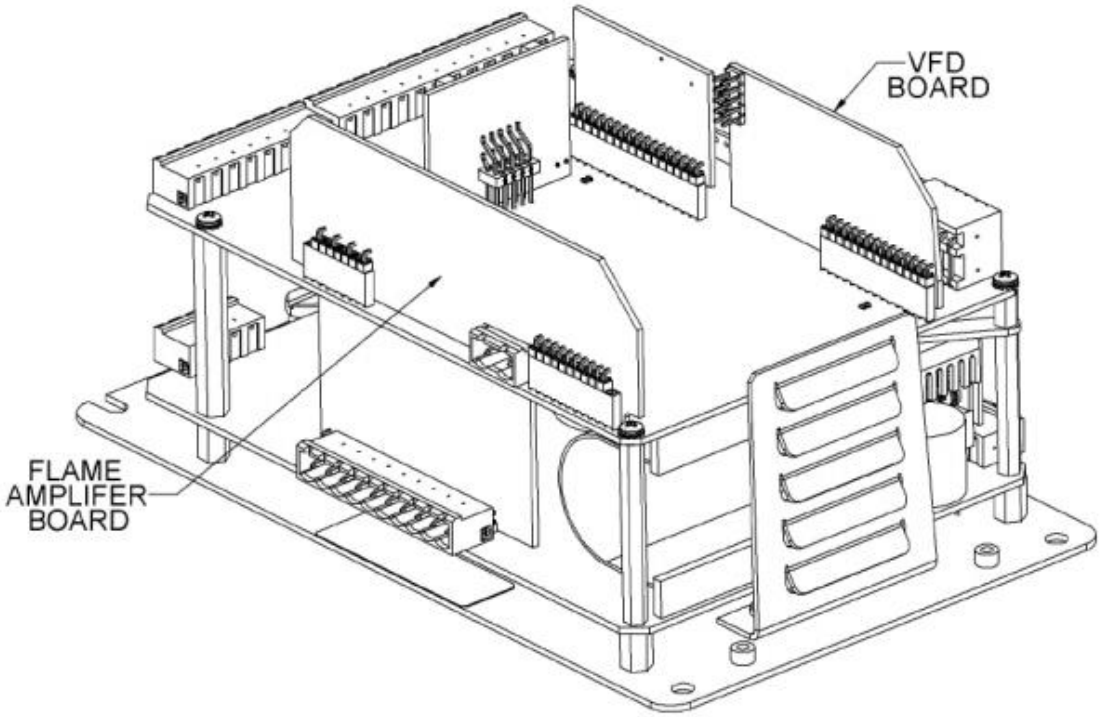
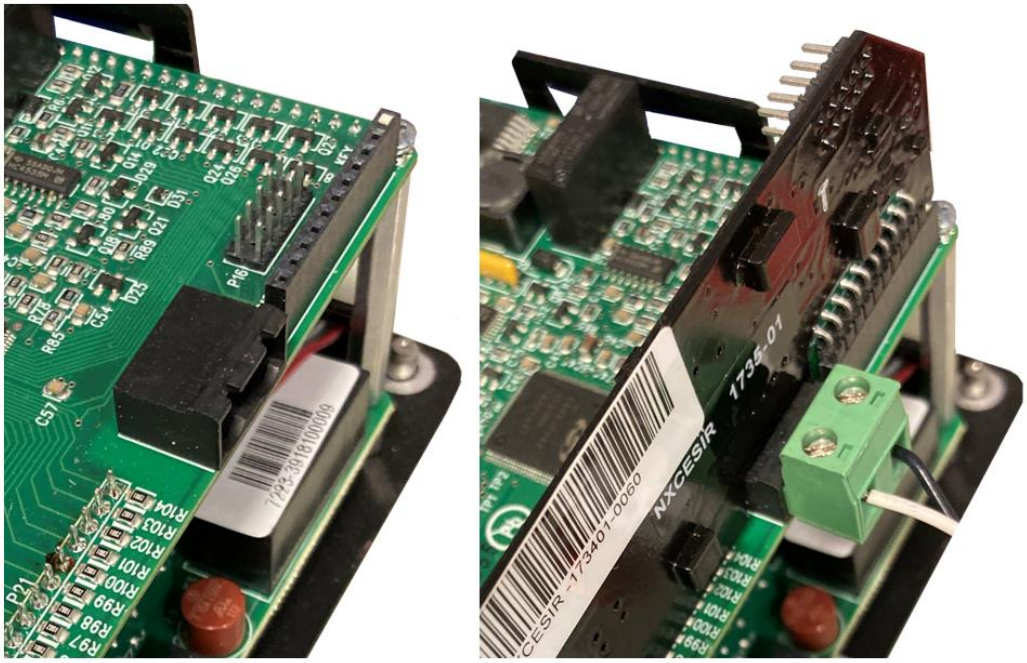


Diagram of NXF4000 with cover removed

WARNING: Proper ESD practices should be applied when handling or installing the add-on cards. Ensure that electric power is turned off. Refer to Fireye bulletin 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 the NXF4000.

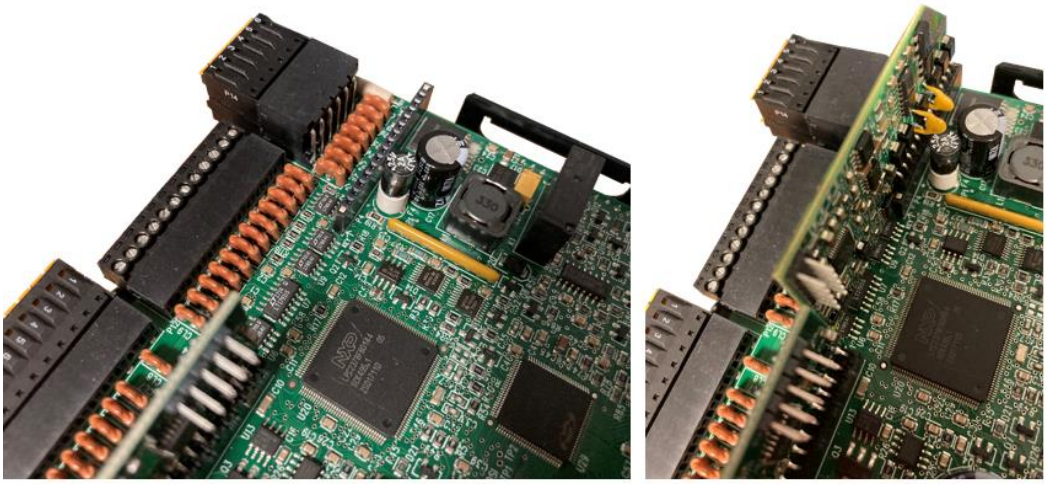
Use the following procedure to install add-on cards:

1. Turn off power (if control is already installed).
2. Remove all terminal blocks and set aside (if control is already installed).
3. Loosen three captive screws on control cover and lift off cover. If cover does not come off easily, ensure that all screws are fully loosened and that all terminal blocks are fully detached and not interfering. Do not force cover off.
4. Insert FSG add-on card (NXCESIR, NXCESUV or NXCESDC) into provided header on the upper-right side of the top PCB. Before pressing the card into the header, ensure all pins are lined up. The FSG card should seat into the header easily. Before replacing the cover, check that all pins on the front and rear headers are fully inserted.



Location for FSG add-on card showing unpopulated on left, populated on right

5. Insert VFD add-on card (NXCESVFD) into provided header on the upper-left side of the top PCB. Before pressing the card into the header, ensure all pins are lined up. The VFD card should seat into the header easily. Before replacing the cover, check that all pins on the header are fully inserted.



Location for VFD add-on card showing unpopulated on left, populated on right

6. Replace the cover and tighten the three captive screws. If the cover does not seat easily, check that the terminal blocks are not interfering or jammed between the cover and the control. Do not over-tighten the cover screws.
7. Replace all terminal blocks and ensure that each is fully seated.
8. Apply power to the control and check operation.

Encoder Mounting

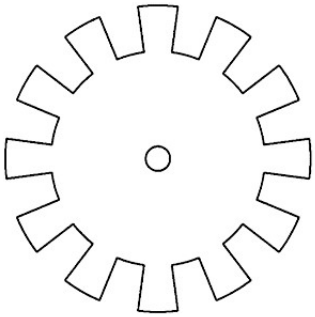
An external encoder can be used instead of a 4-20mA signal to provide independent VFD feedback. This may be required for some installations by preference or code.

There are a couple of different options for mounting and using encoders. First, the encoder can be ordered as an integrated part of the motor. If this is an option, make sure that the encoder type and CPR is compatible with what is needed. If it is not, converter modules can be used to change the output type (from line driver to open-collector, for example) or to reduce the CPR by dividing the pulses. It is common for many integrated encoders to have 1024 CPR, so converter modules that divide the pulses by a factor of 64 are often used in this application. Using an integrated encoder is the easiest option to choose if available.

An external encoder can also be used. There are two choices for this method. First, a slim or low-profile encoder can be fitted to the main shaft and the blower wheel then fitted onto the main shaft after that. This method would require that the shaft is long enough as well as the design supports this and leaves clearance for the electrical connections to be secured. Lastly, a motor with a tail shaft can be used and the encoder then fitted to the tail shaft directly.

A multi-tooth speed wheel with an inductive proximity sensor is another low-cost method of implementing speed feedback outside of the VFD. Based on the minimum CPR calculations, a 12-tooth wheel will work with either 1750 or 3500 rpm motors, while a 6-tooth wheel could be used with 3500 rpm motors.

If using the speed wheel option, fabricate the wheel so that the inductive proximity sensor can be mounted close enough to pick up each tooth clearly. These speed wheels will typically mount on the tail shaft of the motor where it connects to the rear bearing, while the inductive proximity sensor threaded body will be secured to the rear cover of the motor.



Speed wheel with 12 teeth

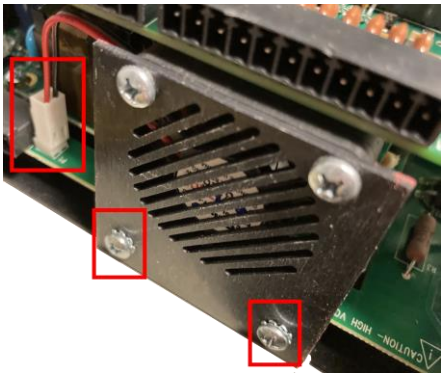
Inductive proximity sensor

FAN REPLACEMENT

The cooling fan is designed to last at least three years and is controlled automatically by the internal temperature sensor in the NXF4000 or PPC4000. It is normal for the fan to cycle on and off automatically.

If the fan will not turn on and operation is affected by this, it can be replaced using part 129-190. If the fan does not run during start-up of the control, it needs to be replaced. To replace, first remove power and follow the steps outlined in the previous section to remove the control cover. Locate the cooling fan on the left side of the control. Remove the two screws and connector as shown in the figure below. Once the assembly is removed, the fan can be removed from the mounting plate and replaced. Take care to position the fan in the same orientation so that the airflow direction is the same.

Once the fan has been changed on the mounting plate, reconnect in the reverse order of removal, replace the cover and terminal blocks and apply power. The fan should run during start-up of the control.



Remove connector and screws

Remove 129-290 fan from mounting plate

NXD410TS

Note: See bulletin NXD-4102 for more detail on the NXD410TS touchscreen.

Method

The NXD410TS requires a non-symmetrical cutout and is secured using two knurled-head thumb nuts. Refer to the figure below for the layout of these thumb nuts.

View of NXD410TS showing placement of the knurled-head thumb nuts (one on each side)

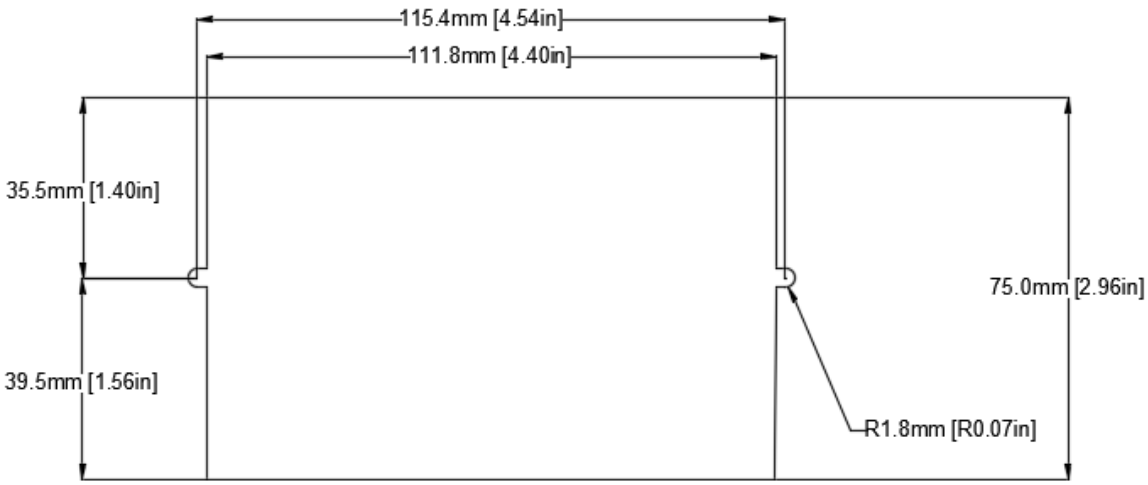
The thumb nuts attach to threaded posts which are threaded into inserts on each side of the screen. See the figure to the right for a diagram of the thumb nut attached to the post. The post and thumb nuts use M4x0.7 thread and the posts are 25mm long. If a post and thumb nut are lost and need replacement, an M4x0.7 screw that is 10mm long can be used in combination with a washer.

Post with knurled-head thumb nut

Cutout

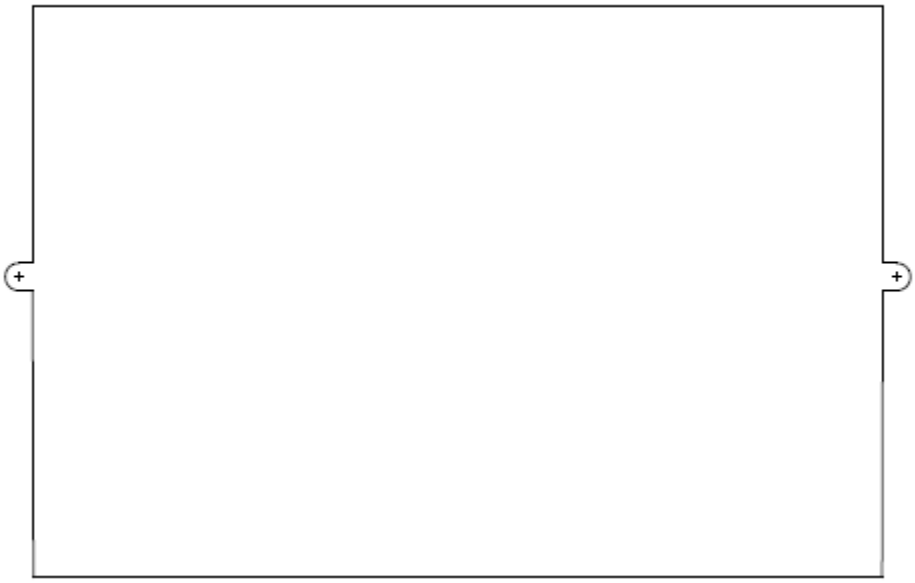
Use the following dimensions to mark the necessary cutout and holes to mount the screen. The orientation of the diagram is from the face of the panel where the cutout is being made. A template is also provided below that may be printed at 100% scale and used to provide a guide.

NXD410TS non-symmetrical cutout (shown from panel face)



Template

NXD410TS cutout template (print at 100%)



NXTSD507HD

Note: See bulletin TSD-4001 for more detail on the NXTSD507HD and NXTSD512HD touchscreens.

Method

The NXTSD507HD requires a non-symmetrical cutout and is secured using eight knurled-head thumb nuts. Refer to the figure below for the layout of these thumb nuts.

Rear of NXTSD507HD showing placement of the knurled-head thumb nuts

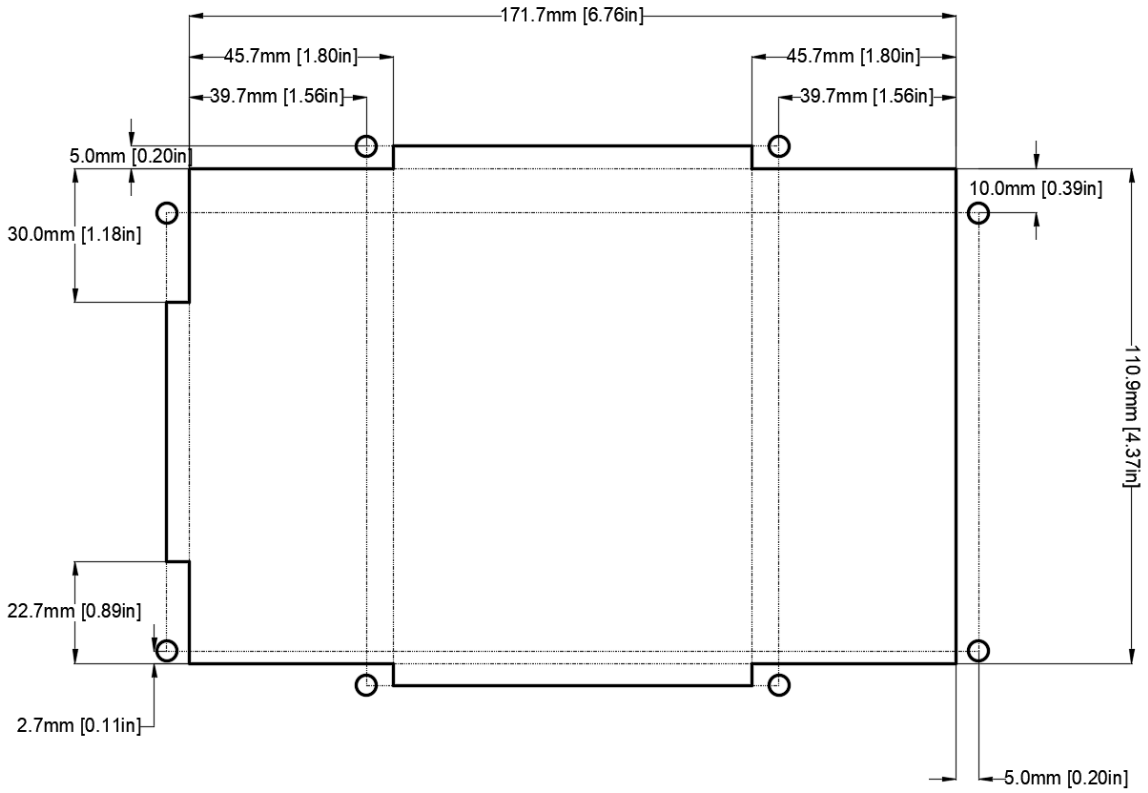
The thumb nuts attach to threaded posts which are threaded into inserts around the bezel of the screen. See the figure to the right for a diagram of the thumb nut attached to the post. The post and thumb nuts use M4x0.7 thread and the posts are 25mm long. If a post and thumb nut are lost and need replacement, an M4x0.7 screw that is 10mm long can be used in combination with a washer.

Post with knurled-head thumb nut

Cutout

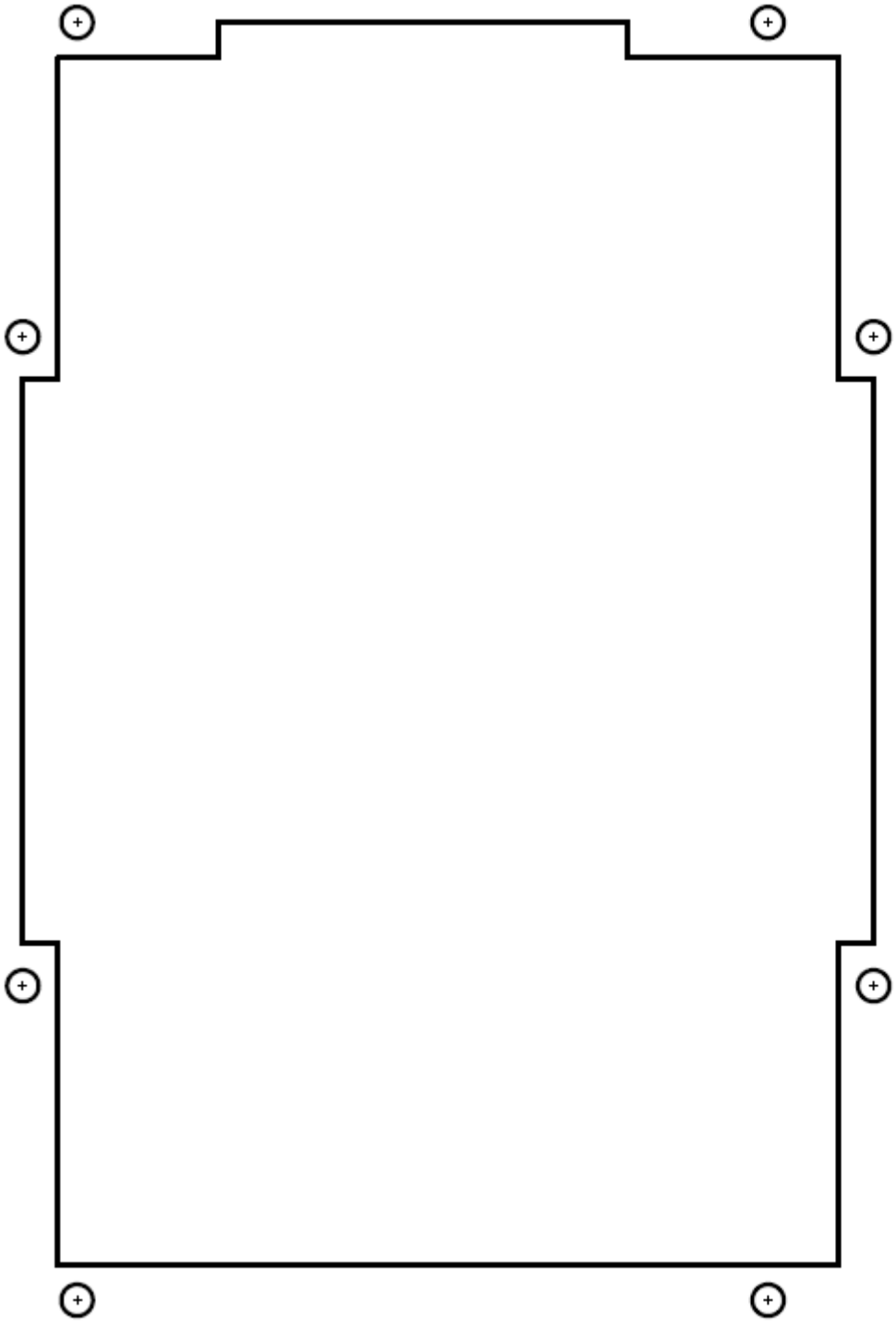
Use the following dimensions to mark the necessary cutout and holes to mount the screen. The orientation of the diagram is from the face of the panel where the cutout is being made. A template is also provided on the following page that may be printed at 100% scale and used to provide a guide.

NXTSD507HD Non-symmetrical cutout (shown from panel face)



Holes are for M4x0.7 threaded posts with knurled-head thumb nuts (minimum clearance shown)

Template

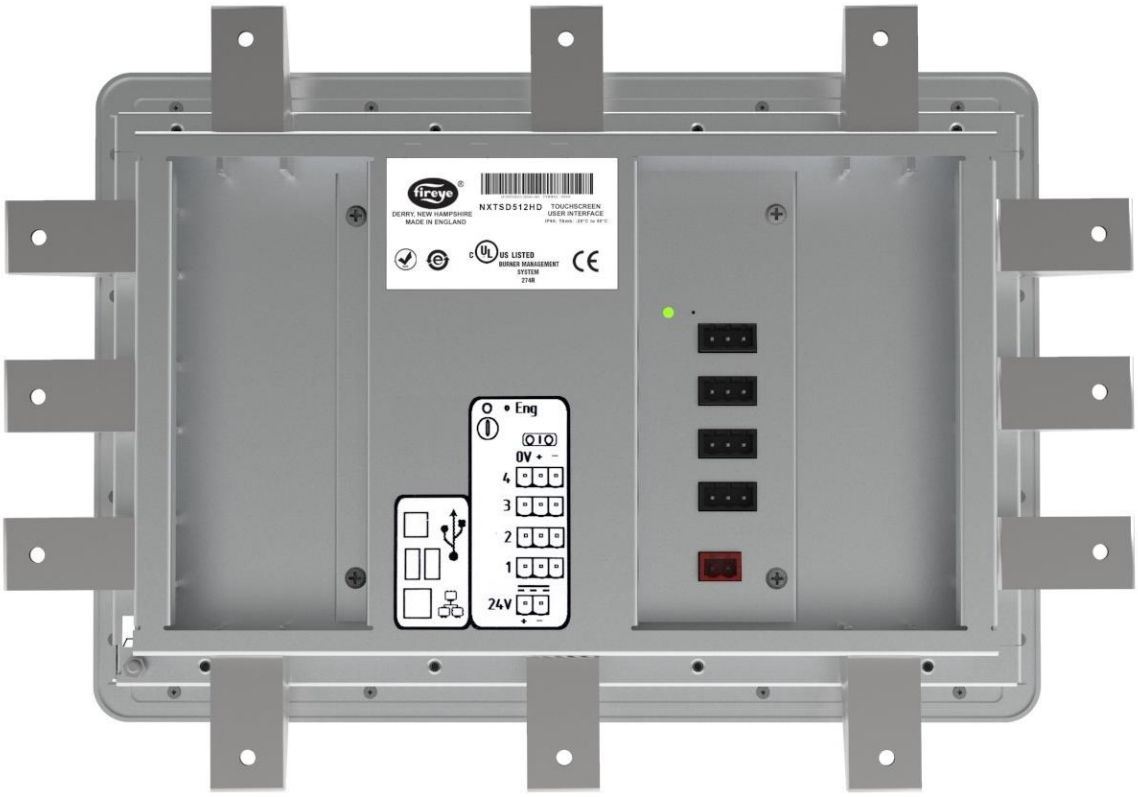


NXTSD512HD

Note: See bulletin TSD-4001 for more detail on the NXTSD507HD and NXTSD512HD touchscreens.

Method

The NXTSD512HD requires a rectangular cutout and is secured using up to 12 retaining clips with securing screws. Refer to the figure below for the layout of these clips. Note that it may not be necessary to use all the clips to achieve a proper fit.



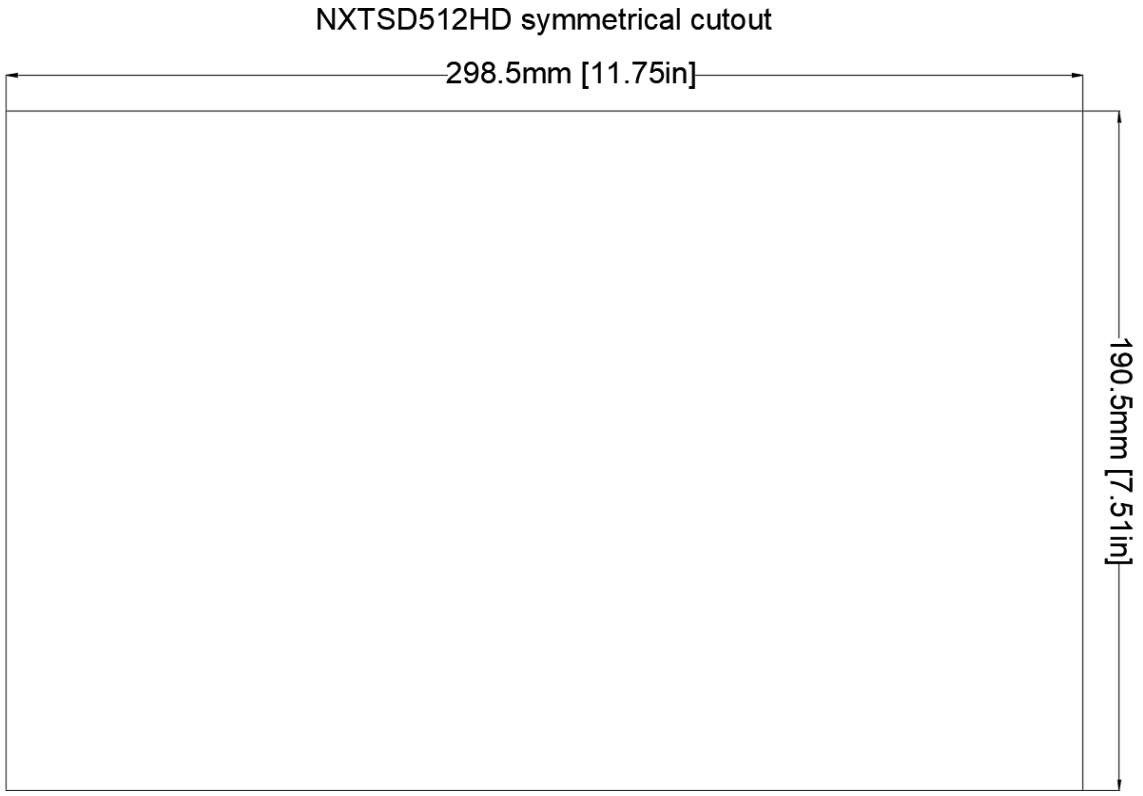
NXTSD512HD showing placement of the retaining clips

The retaining clips accept an M4x0.7 threaded screw (40mm length provided). The figure below shows the retaining clip. The clips first latch into the perimeter of the screen from the rear using hooks. As the screws are tightened, they push against the back of the panel. As this happens, pressure is applied to the retaining clips to secure the screen. Tighten the screws evenly and only to a sufficient pressure to ensure that they remain in position. A medium strength thread-locking compound (commonly referred to as “blue”) may be used to prevent loosening of the screws if the equipment is subject to vibration or will be in transit.

Post with knurled-head thumb nut

Cutout

Use the following dimensions to mark the necessary cutout to mount the screen. The orientation of the screen is with the widest dimension horizontal.



FX SERVOS

Note: See bulletin NEX-3001 for more detail on the FX series servos.

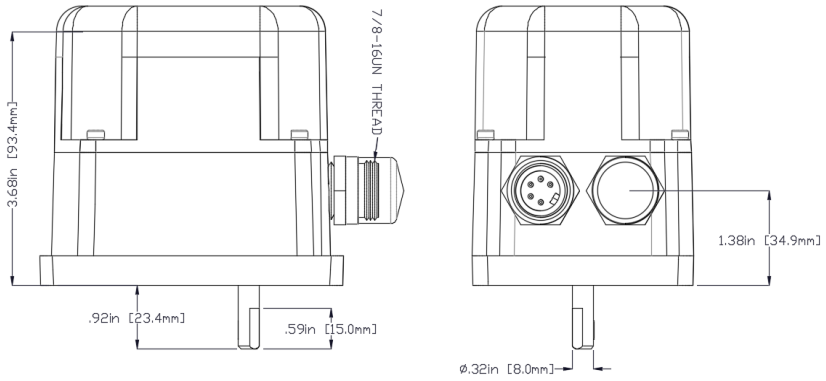
The FX series servos can be mounted in any orientation. Ensure that the installation has future service accessibility.

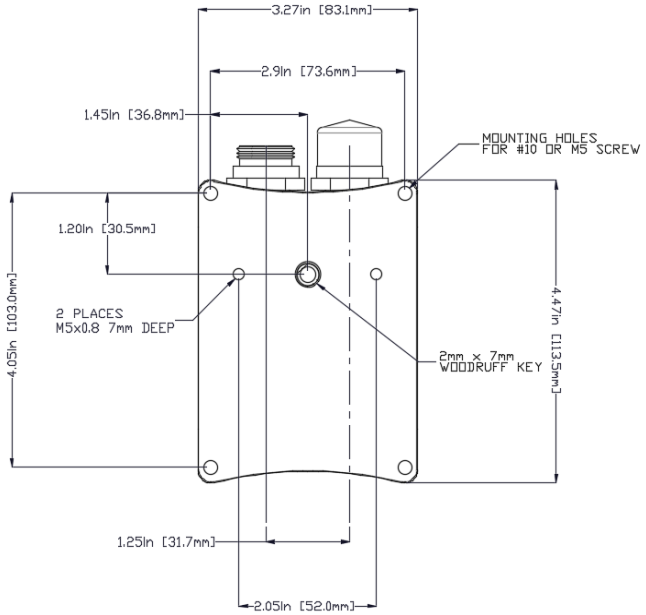
The output drive shaft should be connected using a suitable arm, link or coupling to ensure a secure connection.

Class I Division 2 Hazardous Location requires that suitable wiring methods shall be used which meet the applicable requirements.

FX04

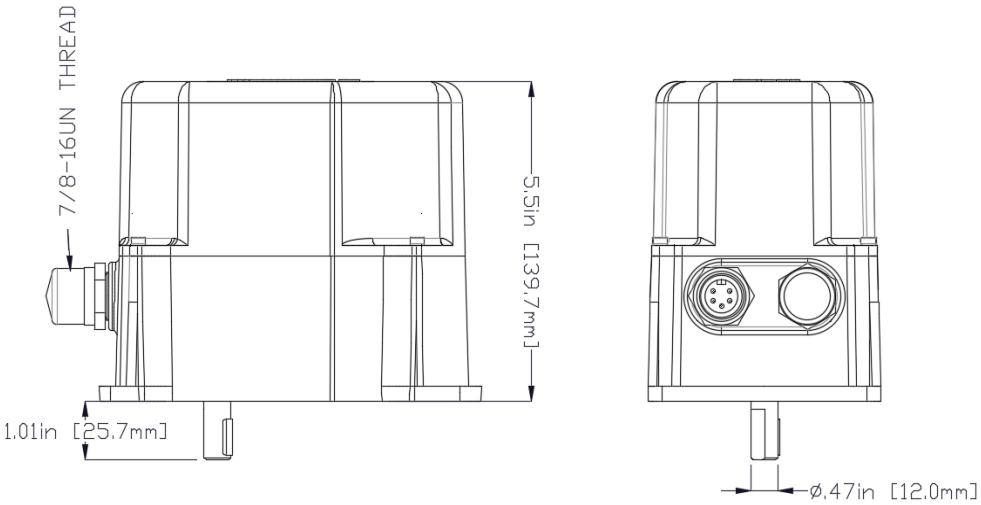
The FX04 has four M5 mounting holes that can be used to mount the servo to the bracket using 10-24, 10-32 or M5x0.8 screws/bolts with nuts. There are also two threaded M5x0.8 blind tapped holes with a depth of 7mm that can be used. See the figures below for FX04 dimensions.

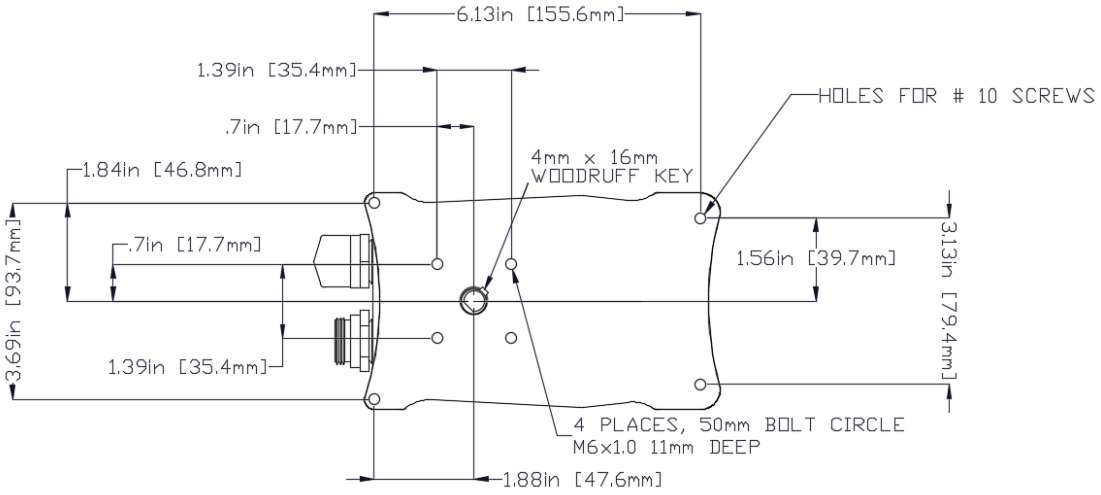




FX20

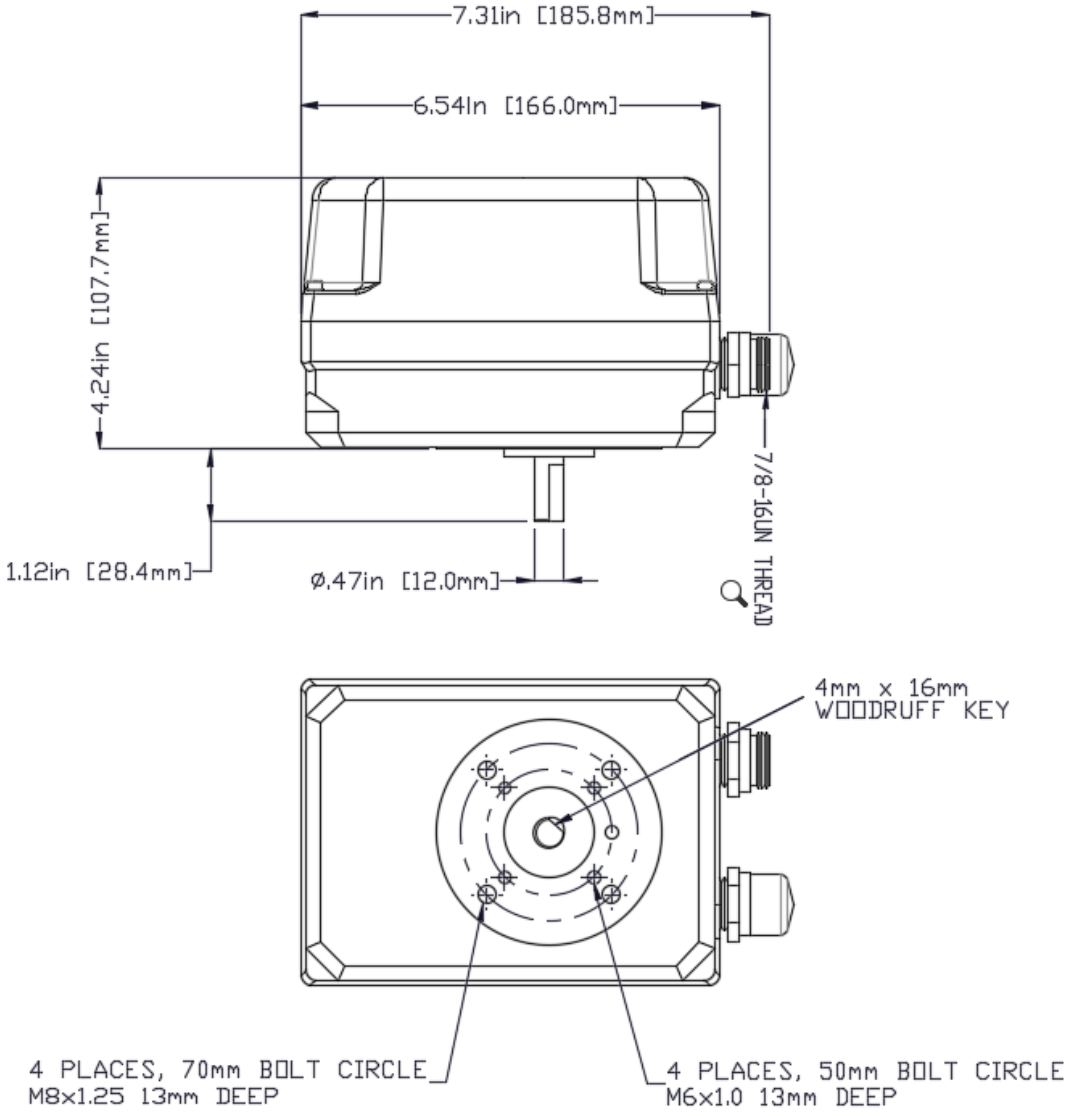
The FX20 has four M5 mounting holes that can be used to mount the servo to the bracket using 10-24, 10-32 or M5x0.8 screws/bolts with nuts. There are also four threaded M6x1.0 blind tapped holes with a depth of 11mm on a 50mm bolt circle that can be used. See the figures below for FX20 dimensions.





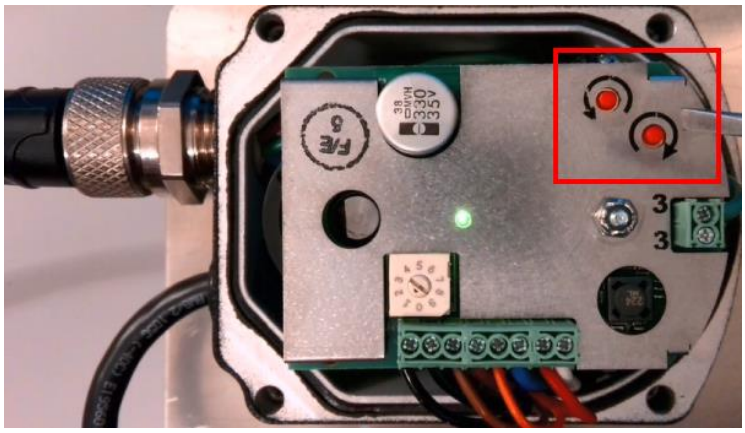
FX50

The FX50 has two mounting options. The first is four threaded M6x1.0 blind tapped holes with a depth of 13mm on a 50mm bolt circle. The second is four threaded M8x1.25 blind tapped holes with a depth of 13mm on a 70mm bolt circle. See the figures below for FX50 dimensions.



FX Servo Adjustment

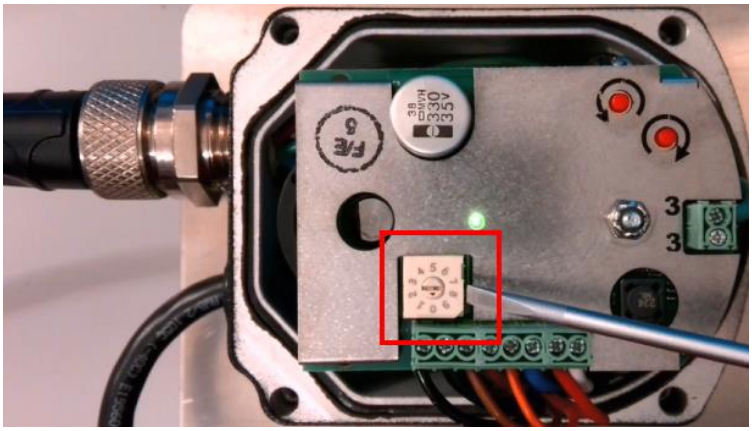
The direction of rotation is relative to looking at the cover side of the servo. Once power is applied to the servo, but before commissioning, use the manual rotation buttons located under the cover of the servo to stroke the servo from fully closed to fully open. Once the servo is fully positioned closed, move the associated valve or damper to its closed position and snug the adjustment screws on the coupling. Use the manual rotation buttons to ensure that the valve or damper will actuate fully through 90° of rotation without binding. Also note which direction that the servo needs to rotate as this information is needed during commissioning. See figure below for the location of the manual buttons.



Location of manual movement buttons

FX Servo Addressing

The servos can be addressed from 0-9, with 1-9 representing addresses 1 through 9, and with 0 representing 10. The address is changed by using a small slotted screwdriver to select the address from a rotary dial, located under the cover. While the address can be changed with power on, it will not be applied until the servo undergoes a power cycle. Note that each servo must have a unique address or there will be communication issues on the servo bus. See figure below for the location of the address selection dial.



Location of address selection dial

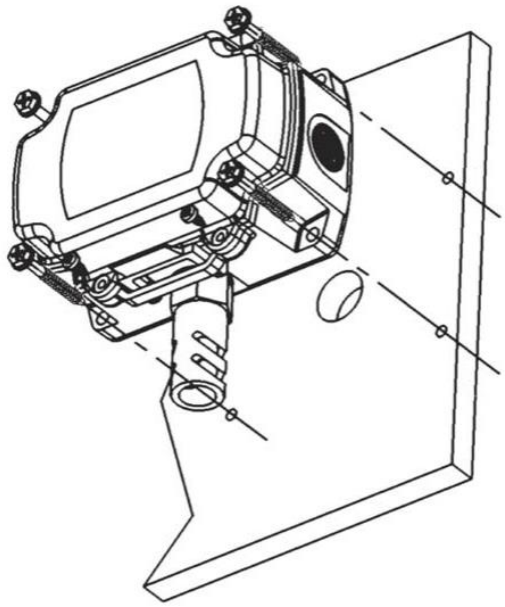
TEMPERATURE AND PRESSURE TRANSMITTERS

FXIATS-140

Note: See bulletin FXIATS-1 for more detail on installation and wiring of this sensor.

FXIATS-140 temperature transmitter placement is critical for good performance. The transmitter should be mounted under an eave, shield or in an area that is out of the elements or direct sunlight. The transmitter should be mounted with the sensor pointing down to prevent water collection in the sensor cavity. The transmitter should never be in direct sunlight or you will have higher than expected temperature readings by as much as 30%.

The sensor shield and probe should always point down and be mounted between 1.2 meters (4 feet) above the ground and at least 0.3 meters (1 foot) below the eave. This keeps the sensor above ground or roof radiation and prevents measurement of trapped heat from under the eave. Drill the mounting holes and mount as shown in the figure below. Snug the mounting screws to ensure that the foam backing compresses to about 50% of its thickness to make a gasket type seal against the wall surface.



FXIATS-140 temperature transmitter installation

Avoid locations where severe shock or vibration, excessive moisture or corrosive fumes are present. Make sure all connections are in accordance with the job wiring diagram and in accordance with national and local electrical codes. Use copper conductors only.

Do not exceed ratings of this device, permanent damage not covered by warranty may result. The transmitter is not designed for AC voltage operation.

TS Temperature Transmitters

Note: See bulletin BLZPTS-1 for more detail on installation and wiring of these transmitters.

The TS series temperature transmitters convert the reading of a Pt100 RTD into a 4-20mA signal in a scale that can be read by the NXF4000 or PPC4000.

Each model TS series temperature transmitter has the option of 2-, 4- or 8-inch insertion depth with a ½" NPT male thread. Choose the size that will place the end of the immersion well in an area with good circulation. For a pipe mount, this is typically the center of the pipe. Also choose a location that will always have good water circulation from a pump as a temperature transmitter can't be accurate for control if there is no flow.

WARNING: Do not rely on a connected temperature transmitter as the only source of shutdown. The control will shut down the burner based on this temperature transmitter for load control but requires an additional automatic and manual temperature control wired into the limit strings as required by applicable code.

When the NXF4000 or PPC4000 is used with a steam boiler, it is highly recommended that a temperature transmitter is installed to measure the temperature of the water inside the vessel. This is commonly referred to as "shell" or "belly" temperature. Once installed this transmitter can provide control for functions such as thermal shock and standby operation. While it is possible to activate the thermal shock function using the pressure transmitter, it may not accurately reflect the actual water temperature in the boiler if the non-return valve is leaking steam into the cold boiler. See figures below for an illustration of this point.

When choosing a temperature transmitter for use, choose one with a range that will cover all applicable use cases. A TS350 is typical for most hot water boiler applications as well as for a steam boiler temperature sensor on low pressure steam boilers at 1 Bar (15 psi) or less. A TS752 is typical for a steam boiler temperature sensor on steam boilers with an operating pressure greater than 1 Bar (15 psi) as the temperature of saturated steam at higher pressures can be in excess of what the TS350 can measure.

BLPS Pressure Transmitters

Note: See bulletin BLZPTS-1 for more detail on installation and wiring of these transmitters.

The BLPS series pressure transmitters convert operating pressure into a 4-20mA signal in a scale that can be read by the NXF4000 or PPC4000.

The BLPS series pressure transmitters have a ¼" NPT male thread for mounting. Choose a mounting location in the steam header with accessibility for servicing. Always use a 180° syphon (shown in figure below) with a ¼" NPT coupler when mounting the pressure transmitter to the steam header. The syphon will fill with water and provide a barrier between the direct temperature of the steam and the transmitter. Without the syphon, the transmitter will be subject to temperature outside of the design limits and may fail. In lieu of using a syphon, the transmitter may also be connected to an engineered "controls tree" if provided by the boiler manufacturer. The design of the controls tree has the piping drop and rise before controls are mounted, also providing a location for a water barrier to form.

Syphon with ¼" NPT male threads and a 180° bend

When choosing a pressure transmitter for use, choose one with a range that will cover all applicable use cases. For low pressure steam boilers, it is advised to choose the BLPS-25 as this model is compound, reading both vacuum and pressure. Using this transmitter can avoid lockouts with a vacuum on the transmitter as a comparable BLPS-30 would put out a reading under 4mA, which could trigger a lockout.

WARNING: Do not rely on a connected pressure transmitter as the only source of shutdown. The control will shut down the burner based on this pressure transmitter for load control but requires an additional automatic and manual pressure control wired into the limit strings as required by applicable code.

PLANT MASTER PMSTR-4000

Note: See bulletin PMSTR-4001 for more detail on installation and wiring of this device.

The PMSTR-4000 Plant Master provides central control of a steam or hot water system for up to eight NXF4000 or PPC4000 control units. The connection to each control uses standard Modbus wiring to a dedicated sequencing bus.

The PMSTR-4000 offers increased savings during operation by considering how many units to operate as a system, rather than allowing each unit to calculate an independent demand. Automatic lead rotation promotes even operating hours over time. All operating parameters and setpoints are adjustable so operation can be fine-tuned to the installation.

Options such as outdoor temperature setpoint reset, warm weather shutdown, time-of-day schedule functionality and pump control with feedback alarms provide versatility allowing installation in many different types of systems.

The PMSTR-4000 can be used in conjunction with any compatible NXF4000 or PPC4000 user interface. Local functionality such as thermal shock and hot standby are available and can be enabled at each control.

Watchdog timers in the NXF4000 and PPC4000 controls ensure that operation will revert to local control if there is a communication issue with the PMSTR-4000. This prevents any situation where there is a lack of output for the process.

The PMSTR-4000 has UL508A listing for enclosed industrial control panels. The enclosure is IP66 (NEMA 4X) rated.

The PMSTR-4000 is configured using the attached 7” touchscreen. Communication is available to a PLC/SCADA/BMS using Modbus TCP/IP and/or Modbus RTU via RS-232, RS-422 or RS-485. All operating information is available to read, and many control functions are available to write as well. All communication parameters are configurable.

Mounting

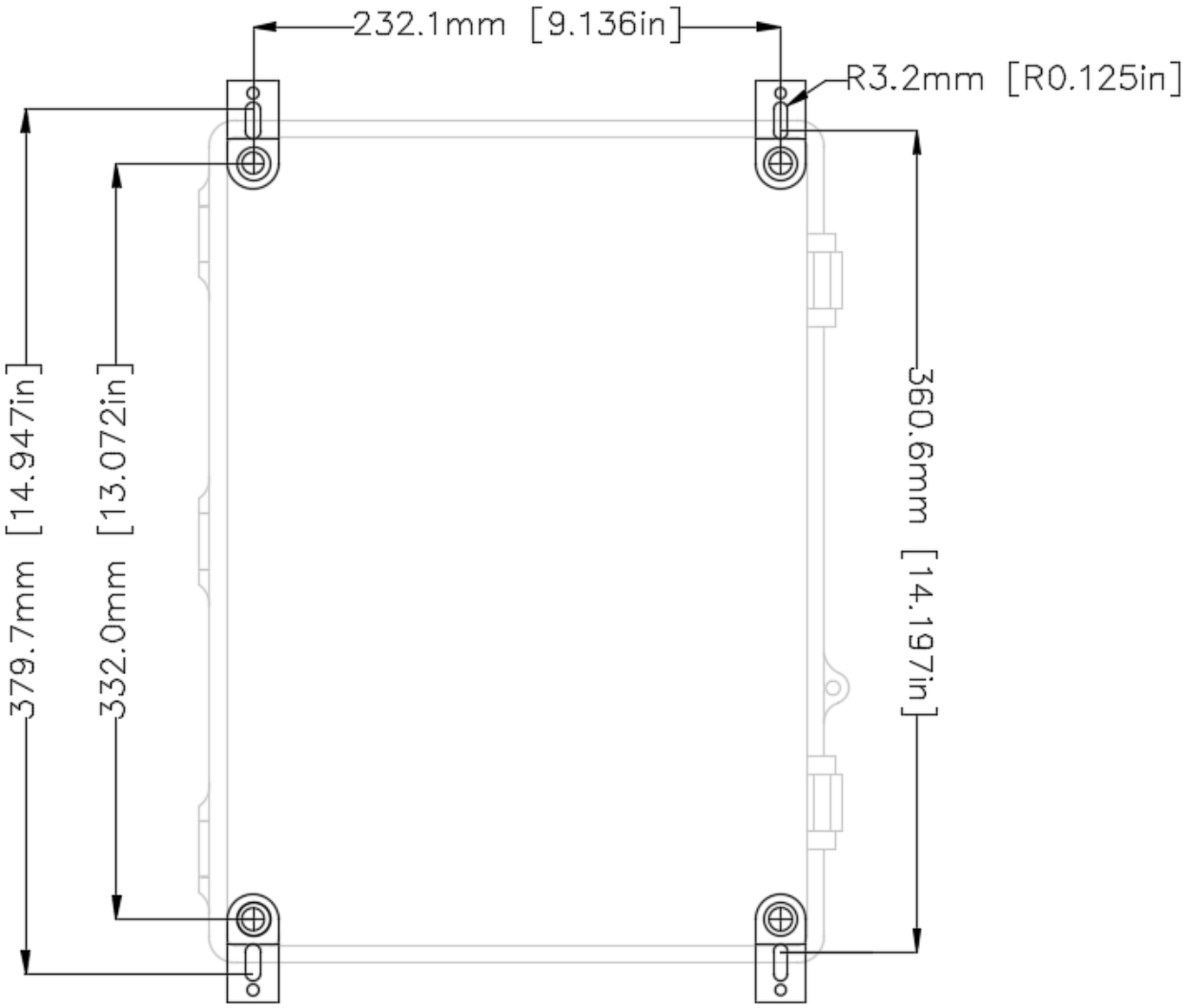
The PMSTR-4000 enclosure is designed for mounting indoors as the ABS poly blend of the enclosure is not UV stabilized. The enclosure has four mounting bosses that are designed for connecting to the provided mounting clips using M5 x 0.8mm bolts. These mounting clips can be mounted in any orientation that works best.

Mounting clip boss

Mounting clip fastened to boss

Dimensional Diagram

The following diagram shows the PMSTR-4000 footprint with the mounting clips attached and oriented in an up/down arrangement.



OXYGEN PROBES

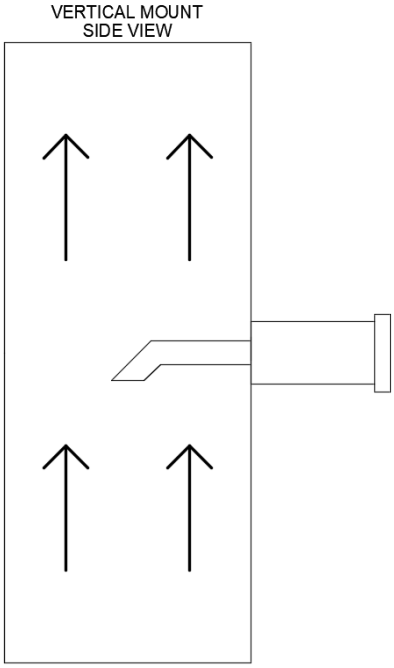
Note: See bulletins NXCESO2-1001, FXCESO2-1001 and/or 133-750 for more detail on installation and wiring of these probes.

There are two oxygen probe options for the NXF4000 and PPC4000. These oxygen probes are designed to provide continuous oxygen concentration readings allowing the NXF4000 or PPC4000 to trim the air or fuel servo to obtain optimum combustion efficiency. Each offers fast, accurate response and excellent reliability when mounted in accordance with the guidelines shown. Each incorporates a type K thermocouple to measure the stack temperature. With the addition of the FXIATS-140 ambient air temperature transmitter, efficiency calculations can be made.

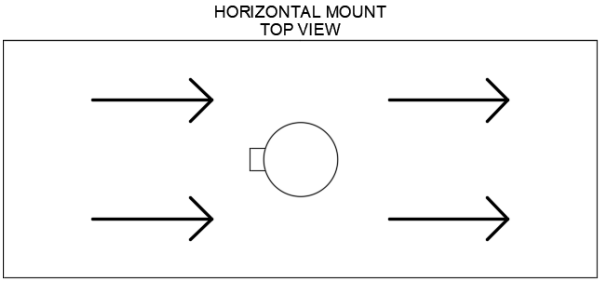
The first option is the NXCESO2, which uses a zirconium dioxide wide band lambda sensor which offers a fast 100ms response and is easy to replace. The NXCESO2 is available with a probe in either 216mm (8.5in) or 407mm (16in). The type K thermocouple used to measure the stack temperature can read up to 426°C (800°F). A mounting flange is offered to ease installation. This probe is designed for environments with an ambient temperature up to 60°C (140°F).

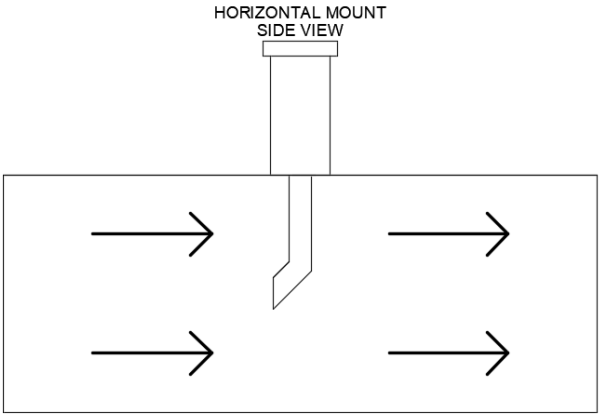
The second option is the FXCESO2 with the accompanying FXO2TRIM-1 control board. This probe uses a zirconia oxide sensor. The FXCESO2 is available with a probe in either 216mm (8.5in), 407mm (16in) or 757mm (31.4in). The type K thermocouple used to measure the stack temperature can read up to 540°C (1000°F). A mounting flange is offered to ease installation. This probe is designed for environments with an ambient temperature that may be outside of the range of the NXCESO2. This is possible because the FXO2TRIM-1 control board is mounted remotely from the probe, in an area with a lower ambient temperature. Use the FXCESO2 for installations requiring a higher ambient rating, longer probe length or higher stack temperature readings.

Select a location in the stack with accessibility for servicing the oxygen probe. Always mount the oxygen probes so that the flue gas passes into the probe at the open end. Select a length that will put the open end as close to the center of the stack as possible. Also ensure that the open-end points down to drain so that there is no build-up or condensate or other matter in the probe. The preferred method of mounting is in a vertical stack. If mounted in a horizontal stack it is best to mount the probe at the top pointing down, but it is also possible to mount the probe on the side. When mounted on the side, rotate so that the probe assembly has a downward angle of at least 10° and rotate so that the open end is also pointed down at an angle to better collect flue gas. Never mount the probe in a horizontal stack pointing up. See figures below for the mounting options outlined above.

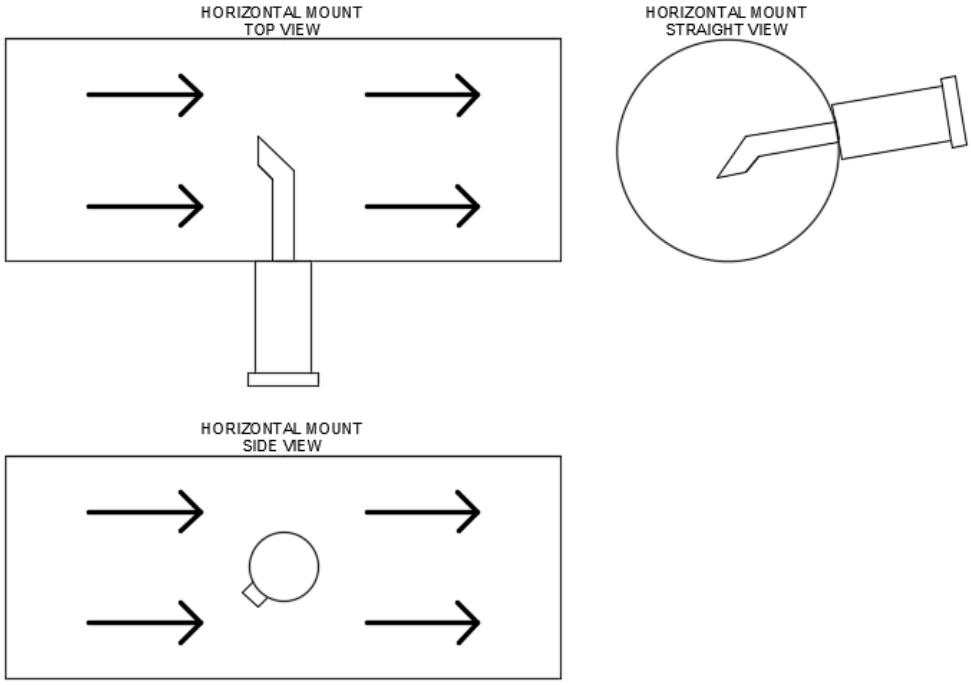


Preferred mounting





Alternate mounting when stack is horizontal (preferred)



Alternate mounting when stack is horizontal (acceptable)

Section 3: Wiring

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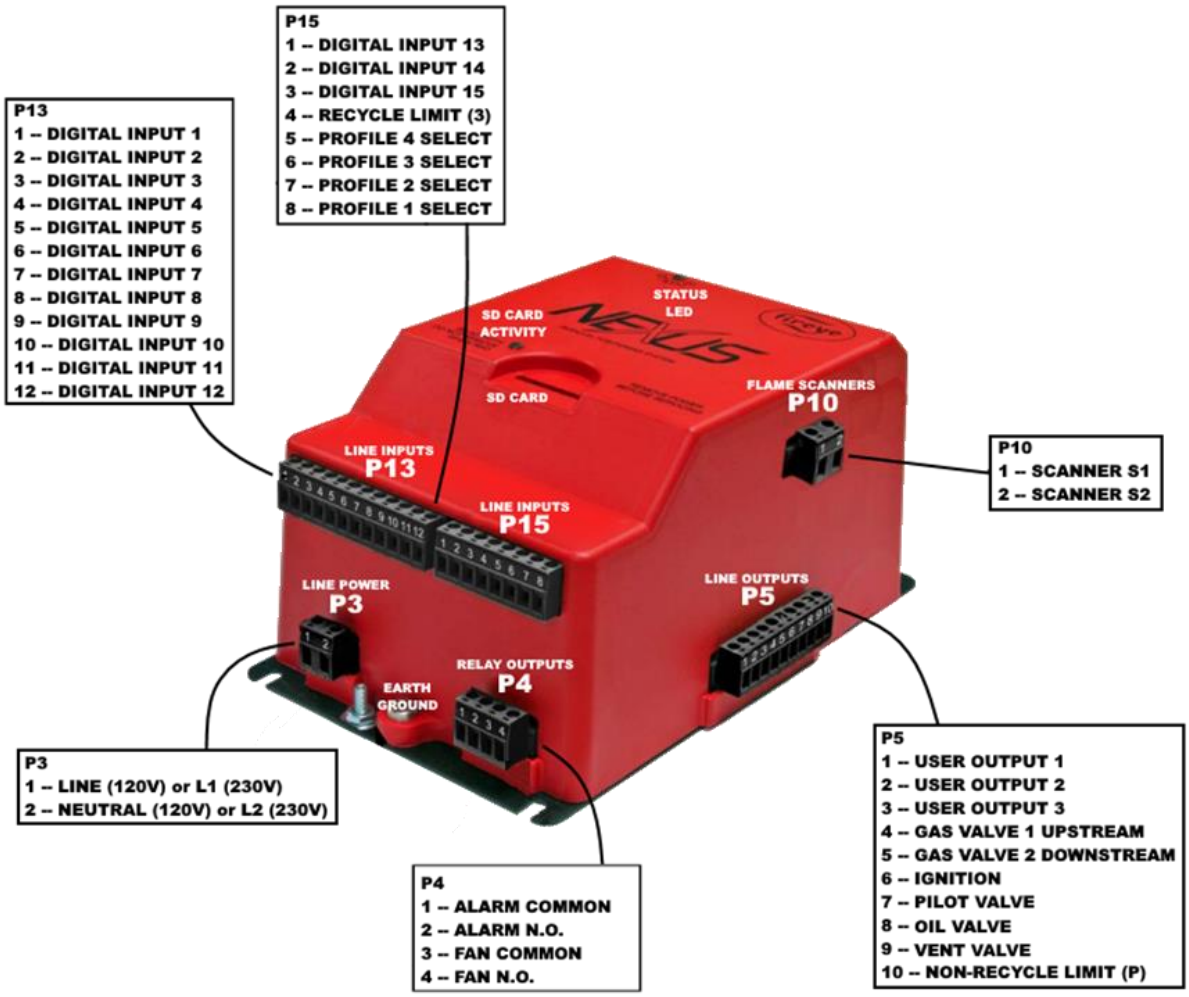
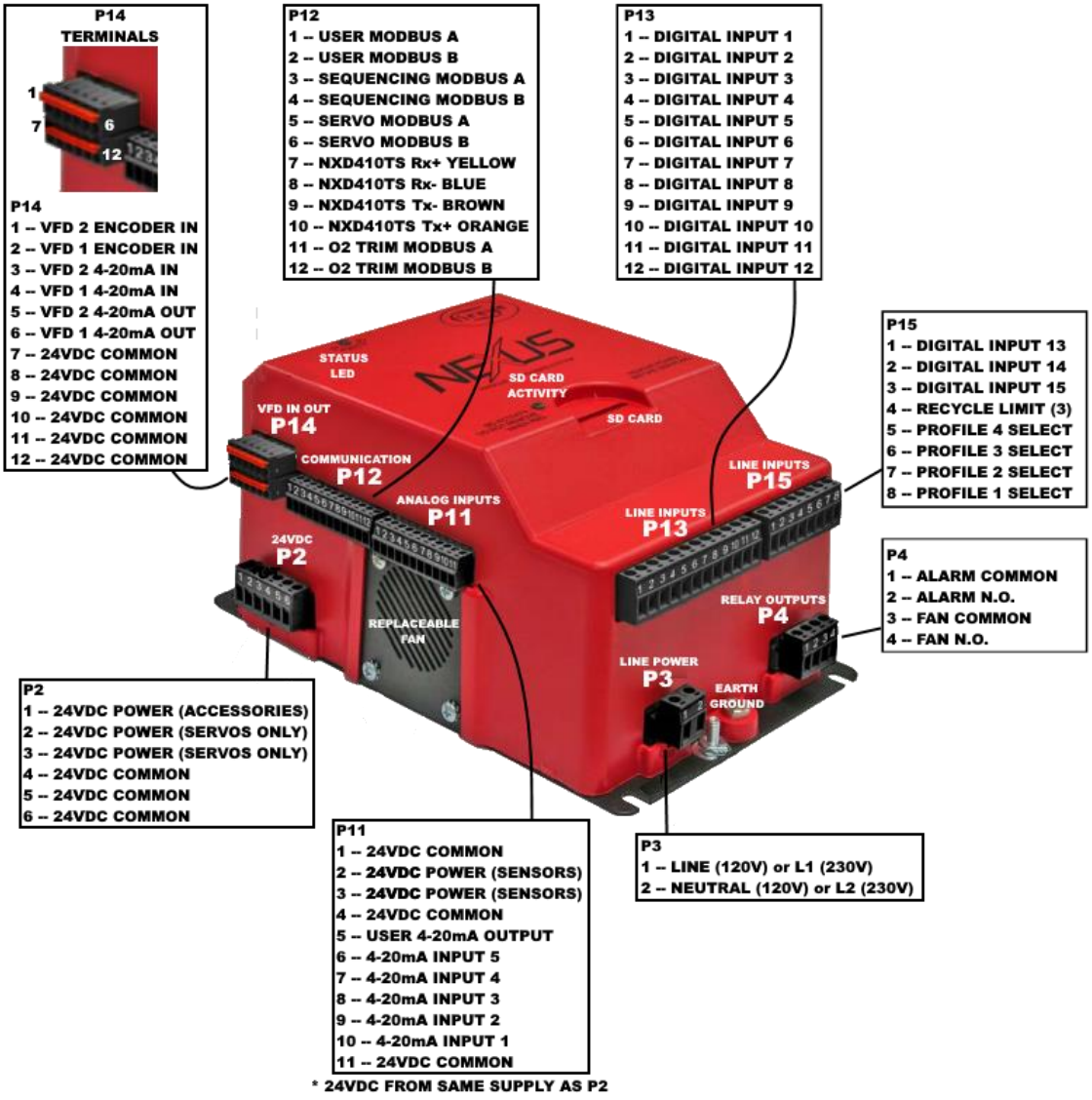
TERMINAL DIAGRAMS

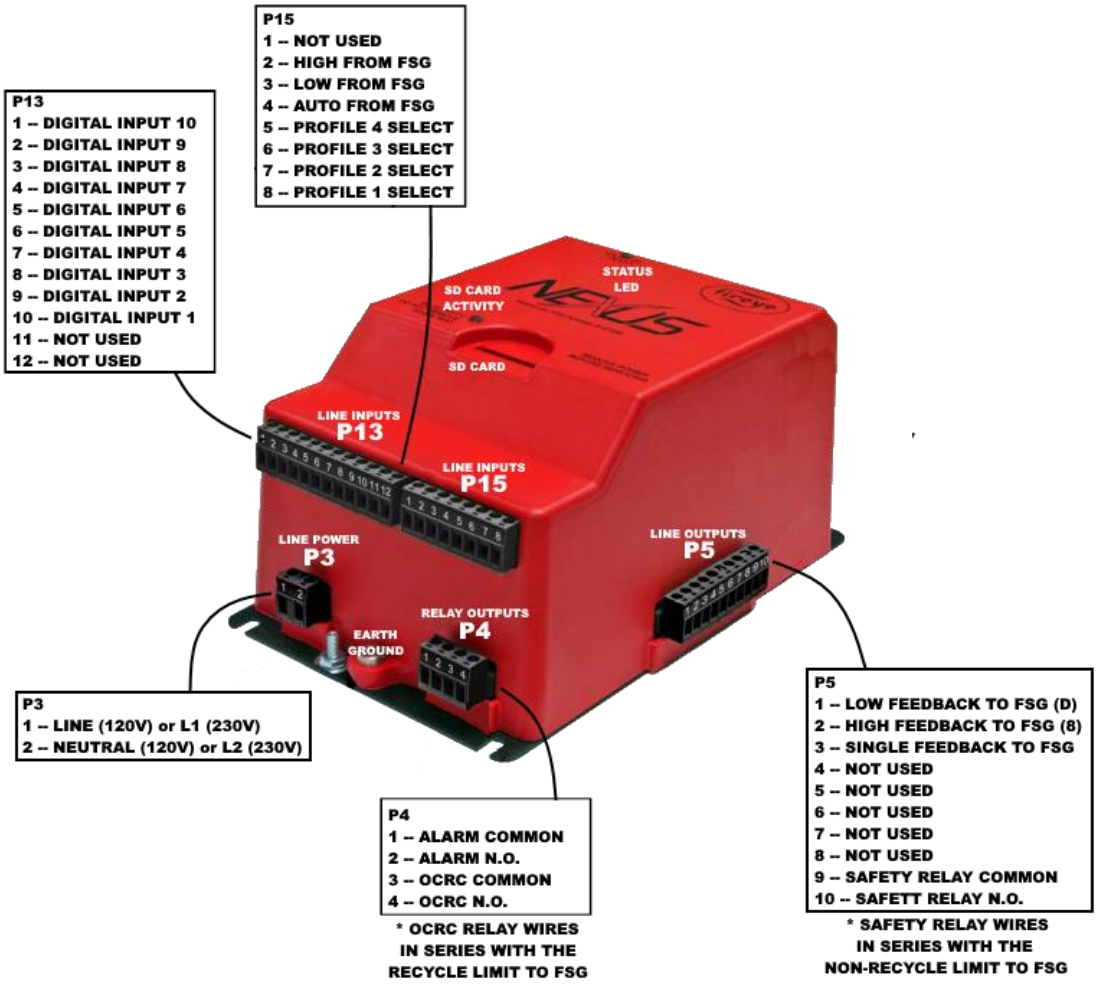
NXF4000 Diagram (Right and Bottom Terminals)



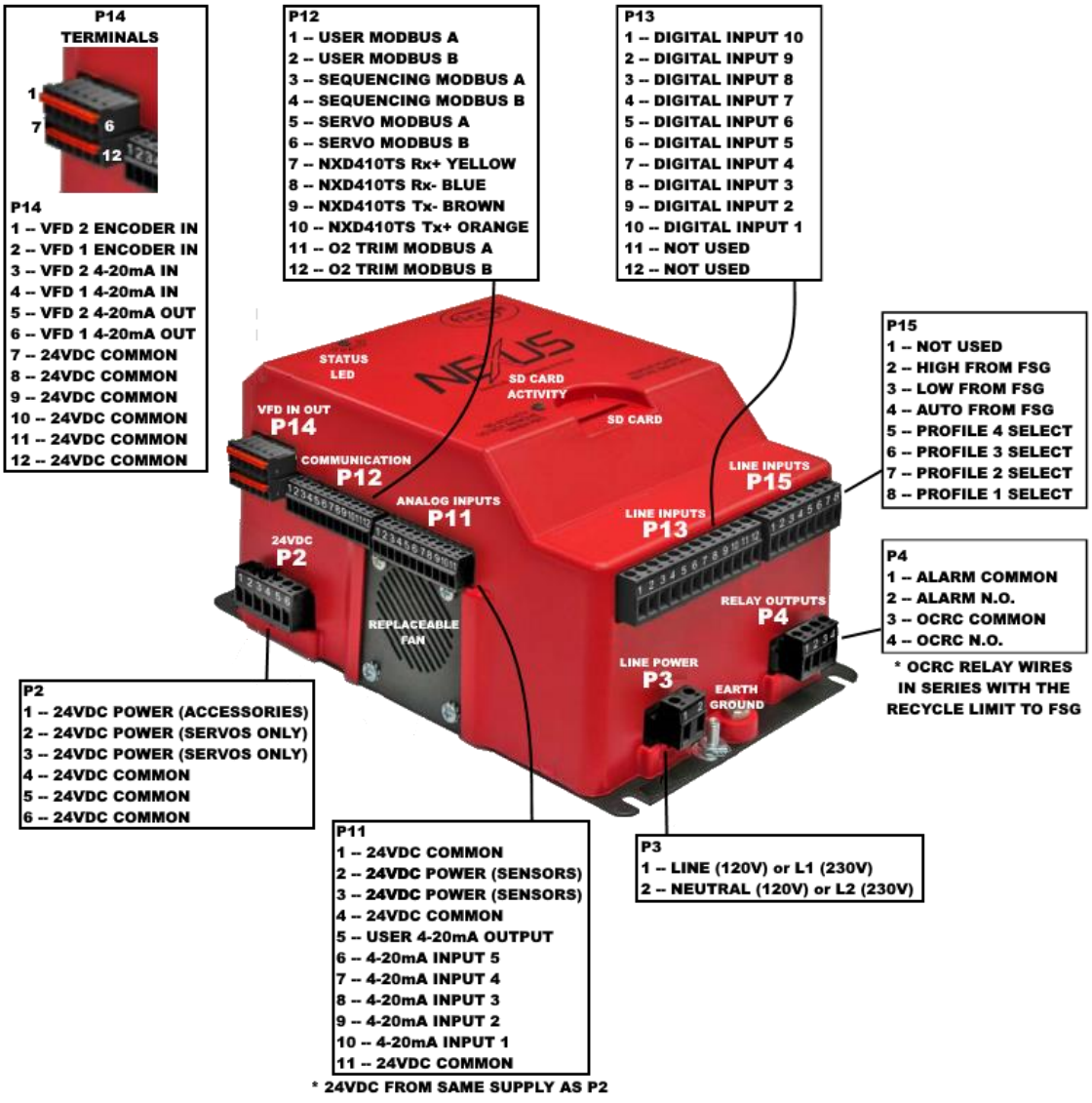
NXF4000 Diagram (Left and Bottom Terminals)



PPC4000 Diagram (Right and Bottom Terminals)



PPC4000 Diagram (Left and Bottom Terminals)



TERMINAL BLOCK KIT 60-3004

Terminal blocks are not shipped with either the NXF4000 or PPC4000. Part number 60-3004 (Terminal Block Kit) must be ordered if needed for a new installation. Replacements of existing controls do not require this kit as the terminal blocks will already be present.

One of each terminal shown below is shipped with 60-3004. Note that while P10 is only used with the NXF4000, it is shipped with each terminal block kit.

Terminal block P14 is supplied with the NXCESVFD add-on card.

Position	Description	Supplied With
P2	6-position terminal block, labeled (screw terminals 5.08mm pitch)	60-3004
P3	2-position terminal block, labeled (screw terminals 7.62mm pitch)	60-3004
P4	4-position terminal block, labeled (screw terminals 5.08mm pitch)	60-3004
P5	10-position terminal block, labeled (screw terminals 5.08mm pitch)	60-3004
P10	2-position terminal block, labeled (screw terminals 7.62mm pitch) **ONLY USED WITH NXF4000 (DISCARD FOR PPC4000)**	60-3004
P11	11-position terminal block, labeled (screw terminals 3.5mm pitch)	60-3004
P12	12-position terminal block, labeled (screw terminals 3.5mm pitch)	60-3004
P13	12-position terminal block, labeled (screw terminals 5.08mm pitch)	60-3004
P14	6-position/2-row terminal block (spring terminals, 3.5mm pitch)	NXCESVFD
P15	8-position terminal block, labeled (screw terminals 5.08mm pitch)	60-3004

WIRING CONNECTIONS AND RATINGS

WARNING: Published load ratings assume that contacts will not be required to handle inrush current more often than once every 15 seconds. Using switches, solenoids, relays or other devices with a tendency to chatter may lead to premature failure. Following the tripping of a circuit breaker, blown fuse, power interruption or any anomaly with external current consuming devices, it is recommended to initiate a test of an operating cycle with the fuel input turned off. This is to ensure proper operation.

WARNING: Ensure that electric power is turned off before servicing. 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 NXF4000.

Line outputs listing VA ratings permit the connection of transformers, solenoids, valves and similar devices whose inrush current is approximately the same as their running current. Motor loads should not be directly connected – use an interposing relay, starter or contactor if necessary. The total for all loads connected to these outputs must not exceed 2000VA.

Relay outputs rated as pilot duty only permit the connection of relays, solenoid valves, lamps, and similar devices where the total operating load does not exceed the published rating and where the total inrush current does not exceed 10 times the rating. For the combustion air fan, this output is intended to be connected to a motor starter, contactor, relay or VFD enable input. Do not connect the combustion air fan directly through this relay.

P2 (24VDC Power Supply)

Terminal	Type	Description	Notes
P2.1	Power	24VDC power for Fireye-approved accessories **DO NOT USE FOR SERVO POWER**	59-561 Red 59-565 Red
P2.2		24VDC power for Fireye FX servos	59-565 Red
P2.3			
P2.4	Common	0VDC common for internal 24VDC power supply	59-561 Black 59-565 Black
P2.5			
P2.6			

WARNING: Do not connect any devices to the 24VDC power supply other than Fireye-approved servos, user interfaces or accessories.

INTERNAL POWER SUPPLY IS RATED FOR 120W TOTAL – ONLY 85W CAN BE USED FOR SERVO POWER
ONLY APPROVED ACCESSORIES LISTED BELOW MAY BE CONNECTED

Servos	User interfaces	O_2 trim interfaces	Other accessories
FX04 = 7.5W	NXD410TS = 5W	NXCESO2 = 12W	MB485ETH-CG = 3W
FX20 = 35W	NXTSD507HD = 10.8W	FXO2TRIM-1 = 10W	
FX50 = 38W	NXTSD512HD = 21.6W		

P3 (Line Power)

Terminal	Type	Description	Notes
P3.1	Incoming Line	Line (120VAC input) or L1 (230VAC input)	120VAC 230VAC (-230V models) 50/60 Hz +10% to -15%
P3.2		Neutral (120VAC input) or L2 (230VAC input)	
⏚		Earth ground, 8-32 threaded stud	
⚠	**Refer to Fireye document *SN-100* for recommended grounding techniques.**		

P4 (Relay Outputs)

Terminal	Type	Description	Notes
P4.1	Relay	Alarm output, common	Pilot duty only 5A @ 250VAC
P4.2		Alarm output, normally open	
P4.3	Relay	**NXF4000:** Combustion air fan output, dry contact **PPC4000:** OCRC relay, dry contact **(see note below)**	16A @ 250VAC
P4.4		**NXF4000:** Combustion air fan output, dry contact **PPC4000:** OCRC relay, dry contact **(see note below)**	
NOTE: The OCRC relay must be wired in series with the recycle limits of the flame safeguard.			

P5 (Line Outputs)

Terminal	Type	Description	Notes
	WARNING: Electro-mechanical high pressure (steam) or high temperature (water) limits must remain in the non-recycle limit circuit of the flame safeguard control.		
P5.1	Line Out	**NXF4000:** User programmable digital output 1 **PPC4000:** Low fire position feedback to FSG (legacy D)	480VA max load
P5.2	Line Out	**NXF4000:** User programmable digital output 2 **PPC4000:** High fire position feedback to FSG (legacy 8)	480VA max load
P5.3	Line Out	**NXF4000:** User programmable digital output 3 **PPC4000:** Single feedback to FSG (BurnerPRO)	480VA max load
P5.4	Line Out	**NXF4000:** Gas valve 1 (upstream) **PPC4000:** not used	575VA max load **(see note 1 below)**
P5.5	Line Out	**NXF4000:** Gas valve 2 (downstream) **PPC4000:** not used	575VA max load **(see note 1 below)**
P5.6	Line Out	**NXF4000:** Ignition **PPC4000:** not used	575VA max load **(see note 1 below)**
P5.7	Line Out	**NXF4000:** Pilot valve **PPC4000:** not used	575VA max load **(see note 1 below)**
P5.8	Line Out	**NXF4000:** Oil valve **PPC4000:** not used	575VA max load **(see note 1 below)**
P5.9	**NXF4000:** Line Out **PPC4000:** Relay	**NXF4000:** Vent valve **PPC4000:** Safety relay, dry contact **(see note 2 below)**	**NXF4000:** 575VA max load **(see note 1 below)** **PPC4000:** 16A @ 250VAC
P5.10	**NXF4000:** Line In **PPC4000:** Relay	**NXF4000:** Non-recycle limits (legacy P input) **PPC4000:** Safety relay, dry contact **(see note 2 below)**	**NXF4000**: 120VAC/230VAC @ 1mA **PPC4000:** 16A @ 250VAC

NOTE 1: Outputs P5.4 through P5.9 source power from input P5.10. This is a redundant safety feature that allows all outputs to become de-energized upon an opening of a non-recycle limit. **The total of all loads connected to outputs P5.4 through P5.9 must not exceed 2000VA.**
NOTE 2: The safety relay must be wired in series with the non-recycle limits of the flame safeguard.

P10 (Flame Scanners)

Terminal	Type	Description	Notes
	WARNING: Always remove power when handling UV scanner wiring due to the high voltage present.		
P10.1	Input	S1 scanner connection **NXF4000 ONLY**	UV: 300VAC IR: 12VDC DC: 12VDC
P10.2	Input	S2 scanner connection **NXF4000 ONLY**	

P11 (Analog Inputs)

Terminal	Type	Description	Notes
P11.1	Common	0VDC common for sensors	From internal 24VDC power supply -- see terminals P2.1-P2.6 for note on total power available.
P11.2	Power	24VDC power for sensors **Use for sensors only – max load 100mA**	
P11.3			
P11.4	Common	0VDC common for internal 24VDC power supply	
P11.5	Analog Out	4-20mA user programmable output	Reference to common **Device max. 750-ohm**
P11.6	Analog In	4-20mA input, sensor 5	Reference to common 100-ohm impedance
P11.7	Analog In	4-20mA input, sensor 4	Reference to common 100-ohm impedance
P11.8	Analog In	4-20mA input, sensor 3	Reference to common 100-ohm impedance
P11.9	Analog In	4-20mA input, sensor 2	Reference to common 100-ohm impedance
P11.10	Analog In	4-20mA input, sensor 1 (PCV)	Reference to common 100-ohm impedance
P11.11	Common	0VDC common for sensors	See P11.1 note above

P12 (Communication)

Terminal	Type	Description	Notes
P12.1	Modbus	User Modbus RTU connection A+ **(see note below)**	59-565 Orange
P12.2		User Modbus RTU connection B- **(see note below)**	59-565 Brown
NOTE: The above connection is also used for the NXTSD507HD and NXTSD512HD. A Modbus TCP server is provided with these user interfaces for user Modbus connectivity.			
P12.3	Modbus	Sequencing Modbus RTU connection A+	For peer-to-peer sequencing
P12.4		Sequencing Modbus RTU connection B-	
P12.5	Modbus	Servo Modbus RTU connection A+	59-565 Orange
P12.6		Servo Modbus RTU connection B-	59-565 Brown
P12.7	Terminal	NXD410TS terminal Rx+	59-561 Yellow
P12.8		NXD410TS terminal Rx-	59-561 Blue
P12.9		NXD410TS terminal Tx-	59-561 Brown
P12.10		NXD410TS terminal Tx+	59-561 Orange
P12.11	Modbus	O_2 trim Modbus RTU connection A+	59-565 Orange
P12.12		O_2 trim Modbus RTU connection B-	59-565 Brown

P13 (Line Inputs)

Terminal	Type	Description	Notes
P13.1	Line In	**NXF4000:** Digital input 1 **PPC4000:** Digital input 10	120VAC/230VAC @ 1mA
P13.2	Line In	**NXF4000:** Digital input 2 **PPC4000:** Digital input 9	120VAC/230VAC @ 1mA
P13.3	Line In	**NXF4000:** Digital input 3 **PPC4000:** Digital input 8	120VAC/230VAC @ 1mA
P13.4	Line In	**NXF4000:** Digital input 4 **PPC4000:** Digital input 7	120VAC/230VAC @ 1mA
P13.5	Line In	**NXF4000:** Digital input 5 **PPC4000:** Digital input 6	120VAC/230VAC @ 1mA
P13.6	Line In	**NXF4000:** Digital input 6 **PPC4000:** Digital input 5	120VAC/230VAC @ 1mA
P13.7	Line In	**NXF4000:** Digital input 7 **PPC4000:** Digital input 4	120VAC/230VAC @ 1mA
P13.8	Line In	**NXF4000:** Digital input 8 **PPC4000:** Digital input 3	120VAC/230VAC @ 1mA
P13.9	Line In	**NXF4000:** Digital input 9 **PPC4000:** Digital input 2	120VAC/230VAC @ 1mA
P13.10	Line In	**NXF4000:** Digital input 10 **PPC4000:** Digital input 1	120VAC/230VAC @ 1mA
P13.11	Line In	**NXF4000:** Digital input 11 **PPC4000:** not used	120VAC/230VAC @ 1mA
P13.12	Line In	**NXF4000:** Digital input 12 **PPC4000:** not used	120VAC/230VAC @ 1mA

P14 (VFD In Out)

Terminal	Type	Description	Notes
P14.1	Pulse In	Encoder feedback input for VFD 2	Reference to common **2.4k pull up to 24VDC** **Use open collector type**
P14.2	Pulse In	Encoder feedback input for VFD 1	Reference to common **2.4k pull up to 24VDC** **Use open collector type**
P14.3	Analog In	4-20mA feedback input from VFD 2	Reference to common 100-ohm impedance
P14.4	Analog In	4-20mA feedback input from VFD 1	Reference to common 100-ohm impedance
P14.5	Analog Out	4-20mA command to VFD 2 4-20mA user programmable output **(see note below)**	Reference to common **Device max. 750-ohm**
P14.6	Analog Out	4-20mA command to VFD 1 4-20mA user programmable output **(see note below)**	Reference to common **Device max. 750-ohm**
NOTE: The two analog outputs from the NXCESVFD add-on card can be used as user programmable outputs if not needed for VFD use.			
P14.7	Common	0VDC common for VFD inputs and outputs	Common to internal 24VDC power supply (non-isolated)
P14.8			
P14.9			
P14.10			
P14.11			
P14.12			

P15 (Line Inputs)

Terminal	Type	Description	Notes
P15.1	Line In	**NXF4000:** Digital input 13 **PPC4000:** not used	120VAC/230VAC @ 1mA
P15.2	Line In	**NXF4000:** Digital input 14 **PPC4000:** High fire position command from FSG	120VAC/230VAC @ 1mA
P15.3	Line In	**NXF4000:** Digital input 15 **PPC4000:** Low fire position command from FSG	120VAC/230VAC @ 1mA
P15.4	Line In	**NXF4000:** Recycle limits (legacy 3 input) **PPC4000:** Run in auto command from FSG	120VAC/230VAC @ 1mA
P15.5	Line In	Profile 4 select	120VAC/230VAC @ 1mA
P15.6	Line In	Profile 3 select	120VAC/230VAC @ 1mA
P15.7	Line In	Profile 2 select	120VAC/230VAC @ 1mA
P15.8	Line In	Profile 1 select	120VAC/230VAC @ 1mA

WIRING DIAGRAMS

WARNING: Wiring diagrams as shown are only examples. Conditions specific to the installation must be considered. These diagrams are only intended to assist with designing an appropriate site-specific wiring diagram.

WARNING: Ensure that all digital inputs used are programmed for their specific functions. During commissioning, verify program settings and thoroughly test each digital input for proper operation.

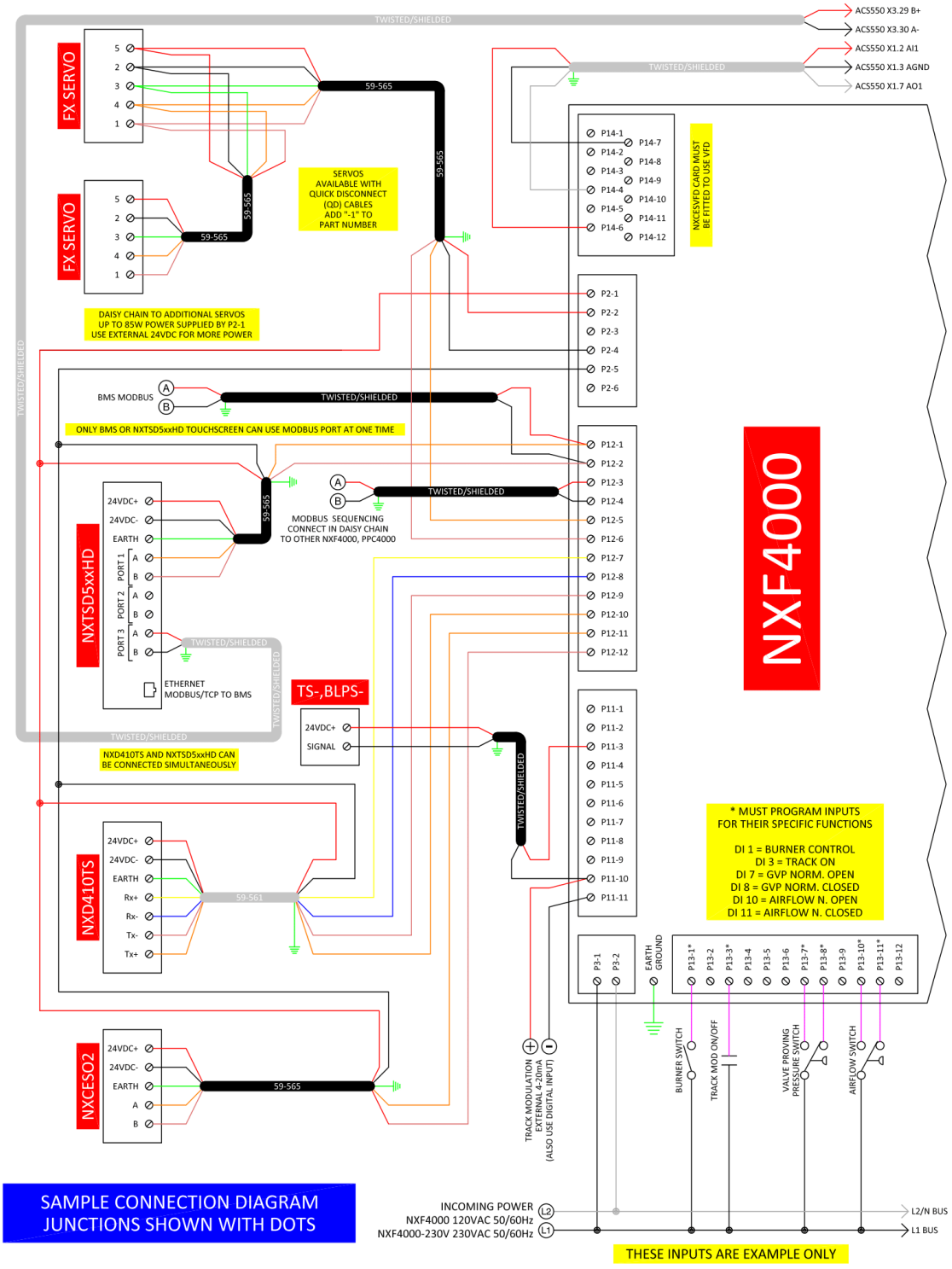
The wiring diagrams as shown are intended to be used as examples for designing site-specific wiring. Each sample diagram is based upon the most common configurations and may not reflect the needs for all installations. Changes should be made with the understanding of the principles behind the example wiring diagrams to suit site-specific installations.

Programmable digital inputs are used for many features. Any of the digital inputs available can be used for any function. Specific input numbers are shown in the example wiring diagram, but any can be used as long as the correct input is programmed for the correct function.

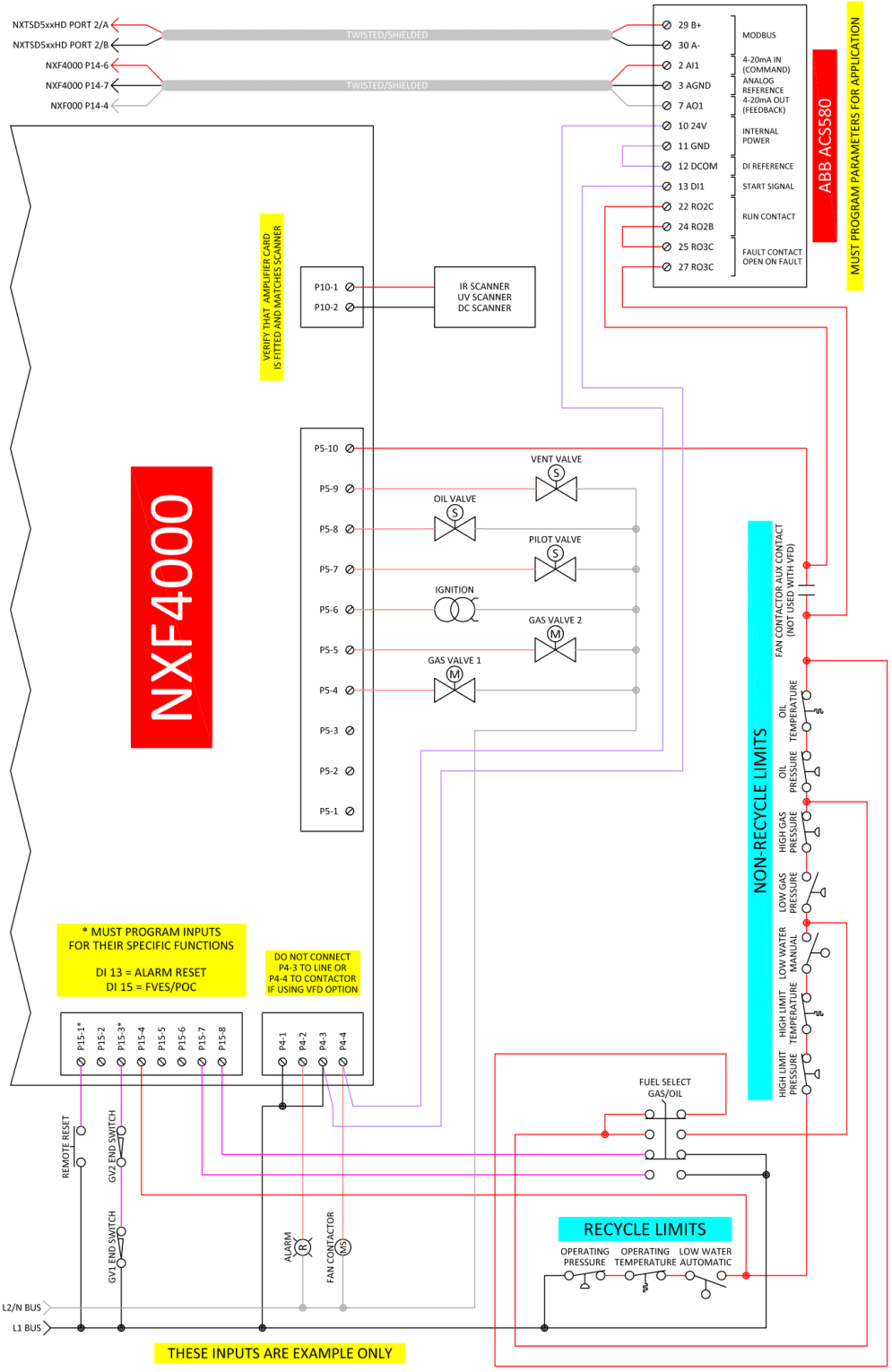
It is very important to verify that any programmable digital input is properly programmed as well as to verify that operation is as intended. Digital input programming is non-volatile and will remain programmed unless intentionally erased or overwritten by the SD card.

If a digital input for a safety function is wired properly but not programmed (and not verified during commissioning), important safety functions may be missing from operation. For example, if the combustion airflow switch is connected to two digital inputs that are not programmed, the NXF4000 will assume they are in the non-recycle limit and will operate without the combustion airflow switch being monitored at all.

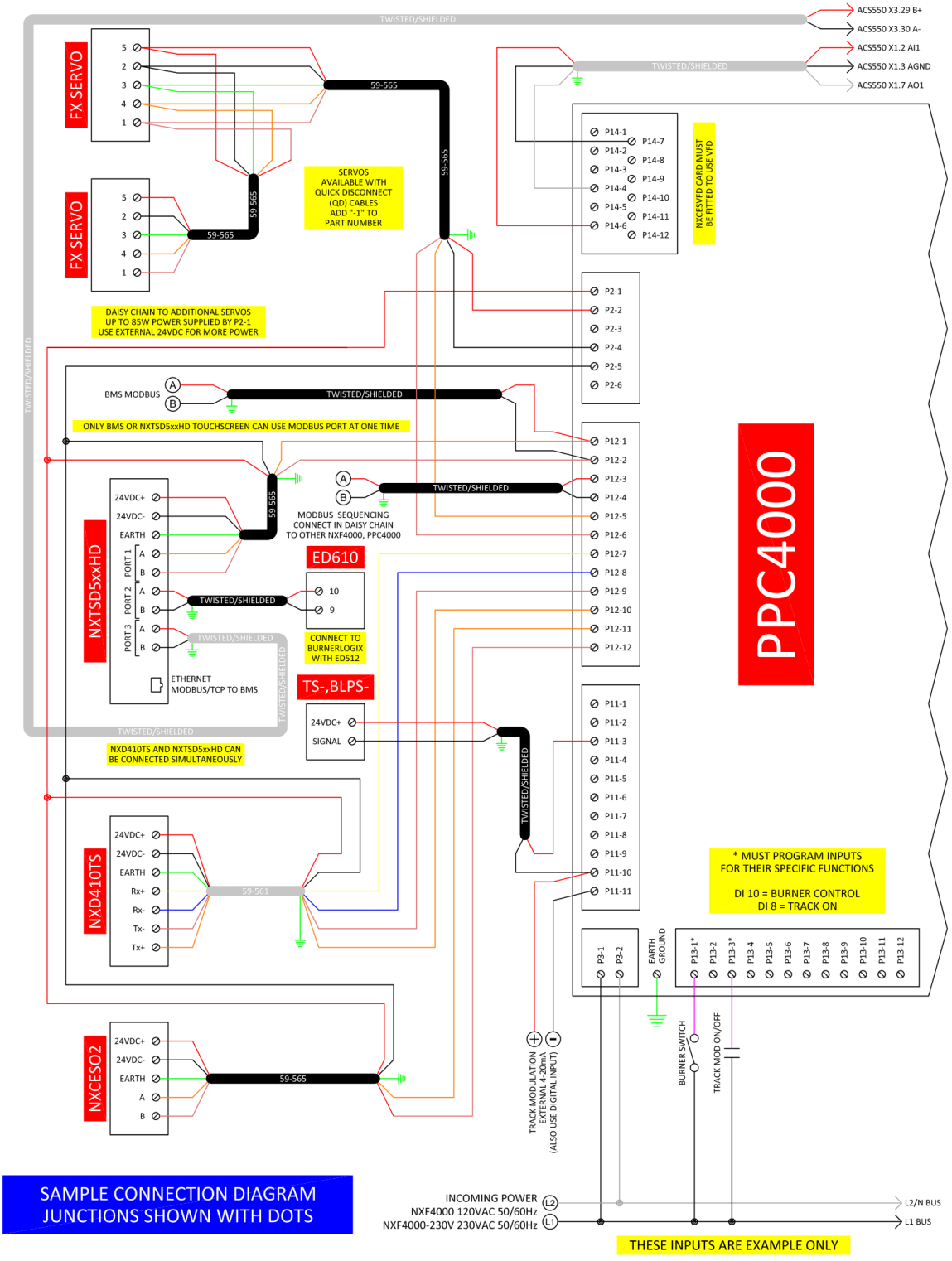
NXF4000 Example Wiring (page 1)



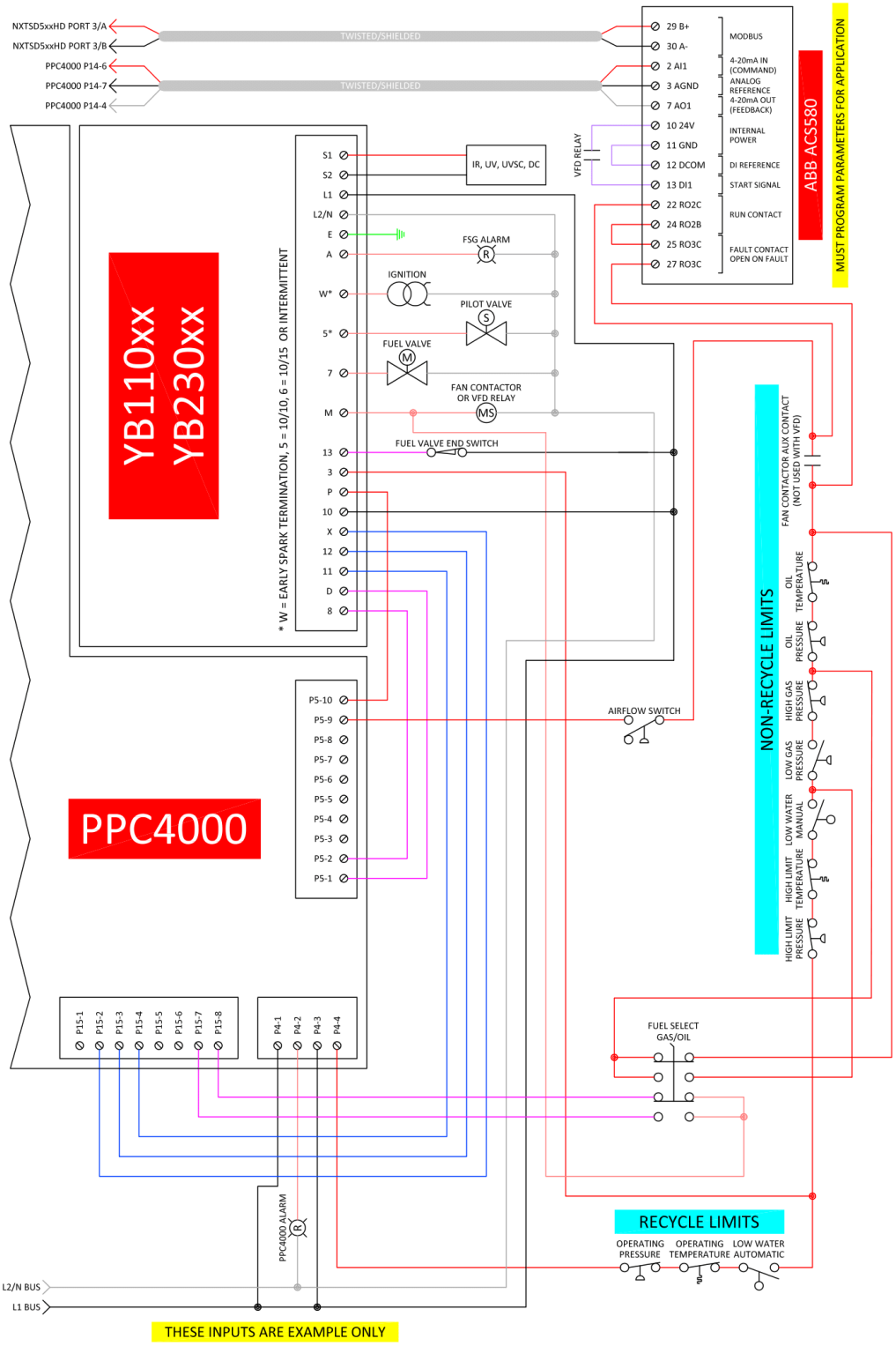
NXF4000 Example Wiring (page 2)



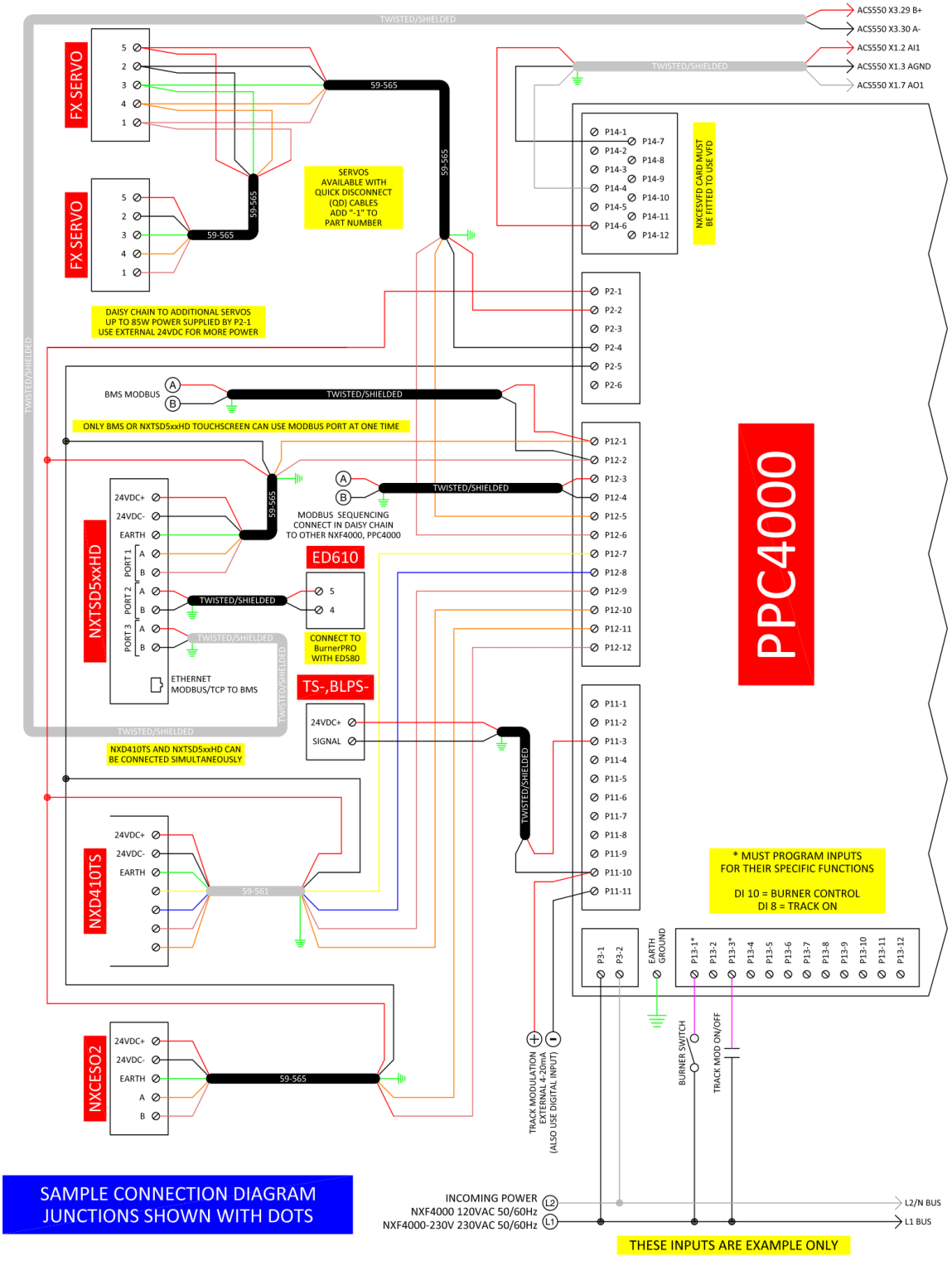
PPC4000 with BurnerLogix Example Wiring (page 1)



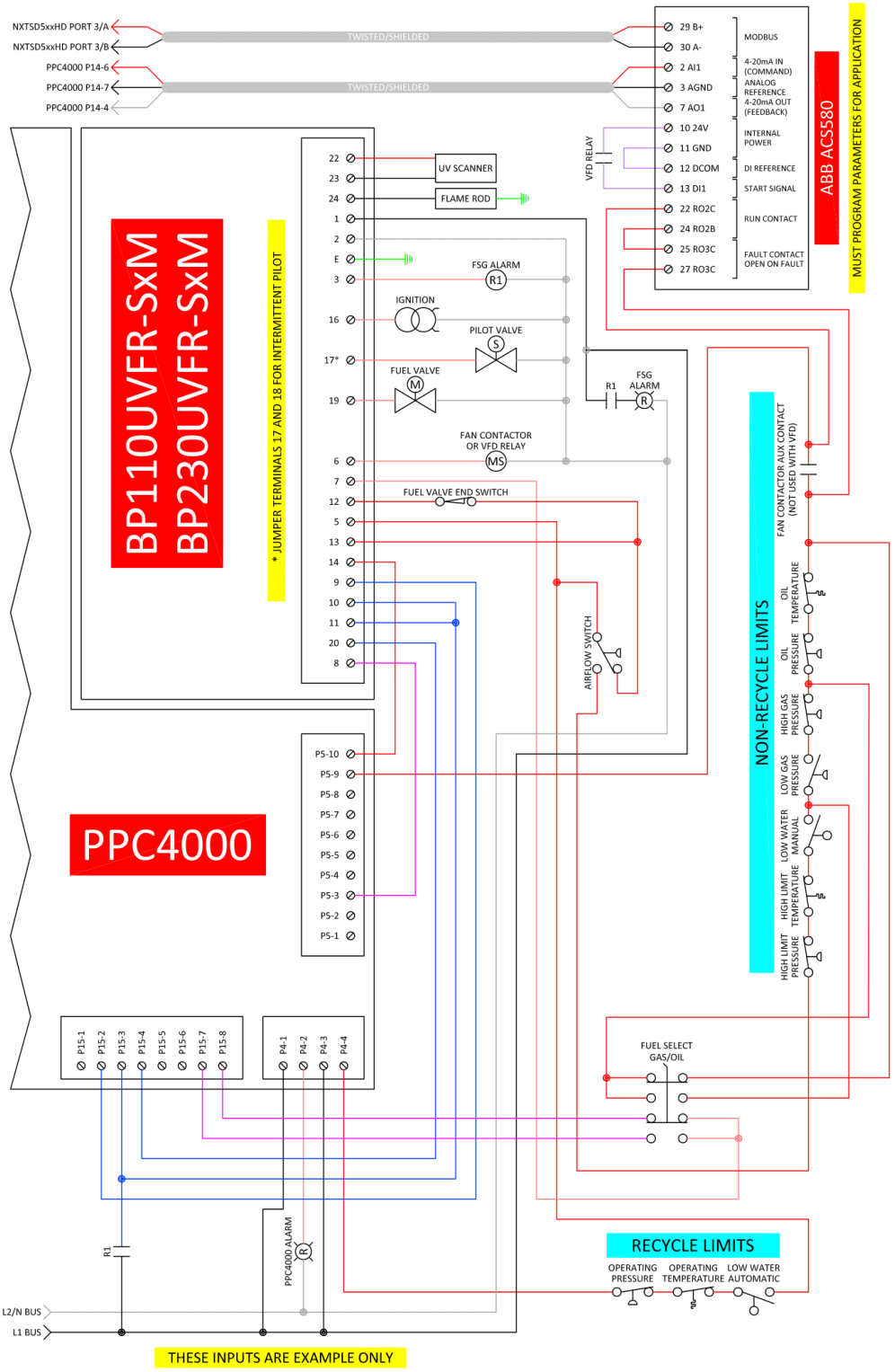
PPC4000 with BurnerLogix Example Wiring (page 2)



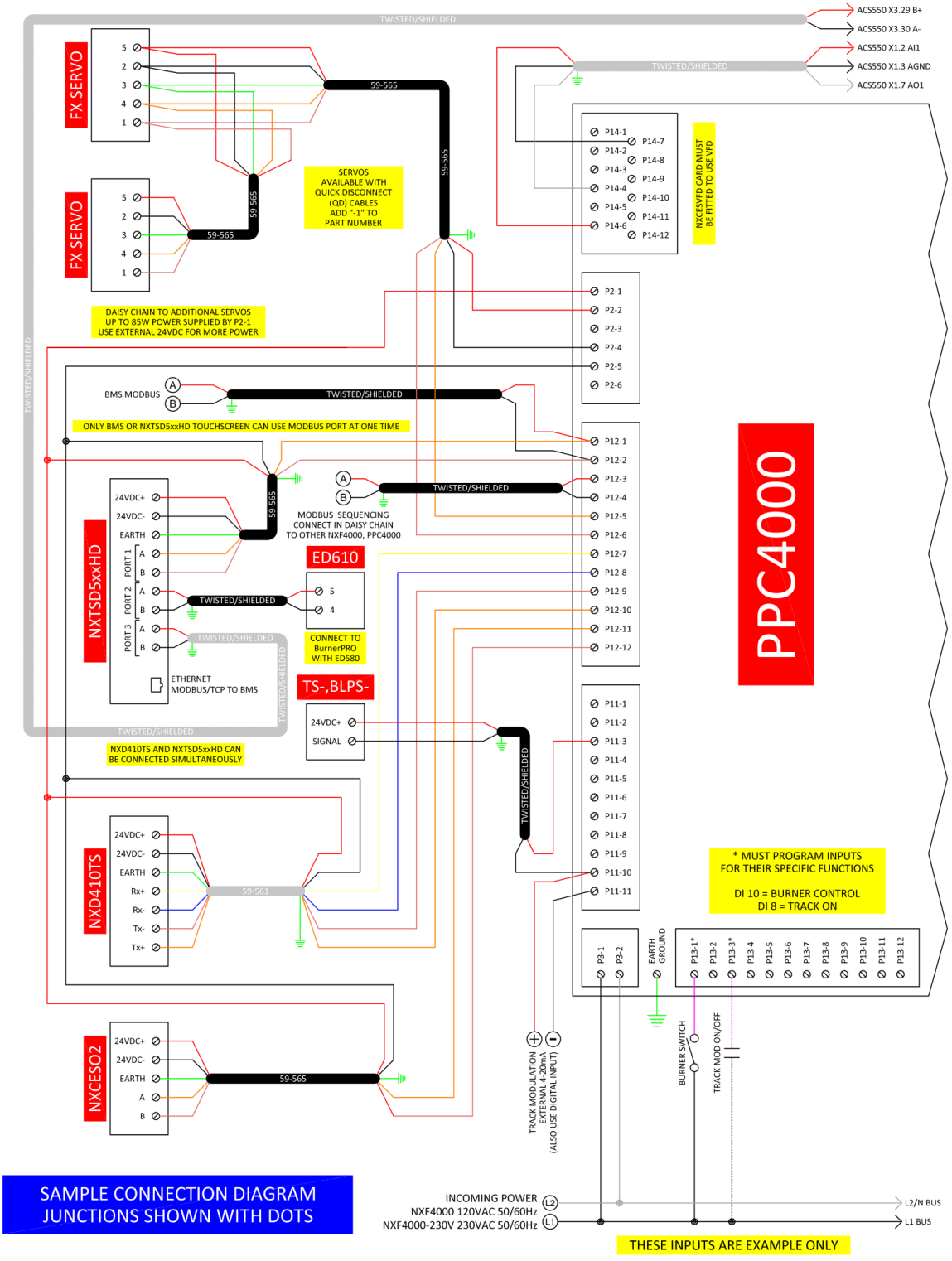
PPC4000 with BurnerPRO (No Valve Proving) Example Wiring (page 1)



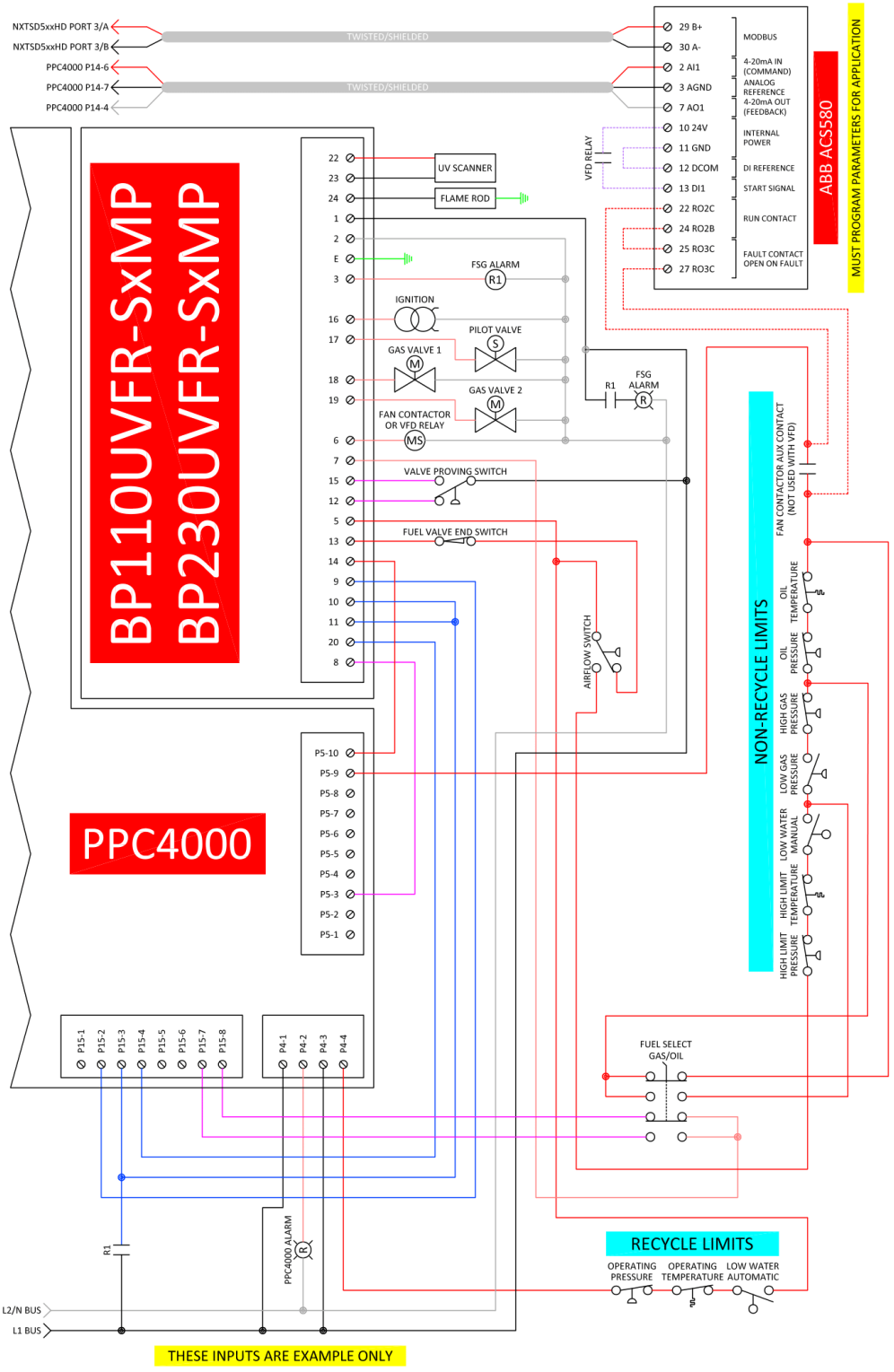
PPC4000 with BurnerPRO (No Valve Proving) Example Wiring (page 2)



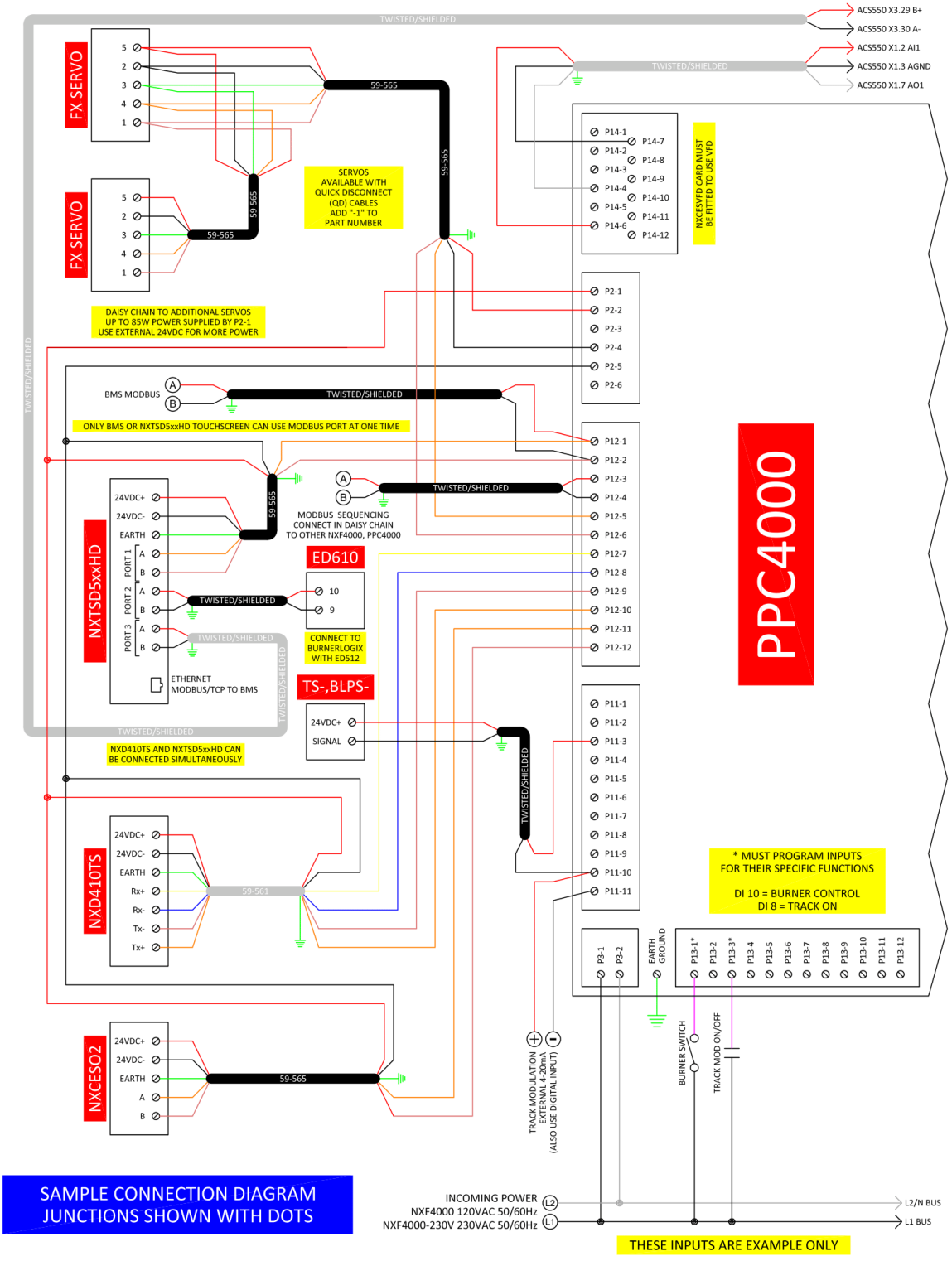
PPC4000 with BurnerPRO (With Valve Proving) Example Wiring (page 1)



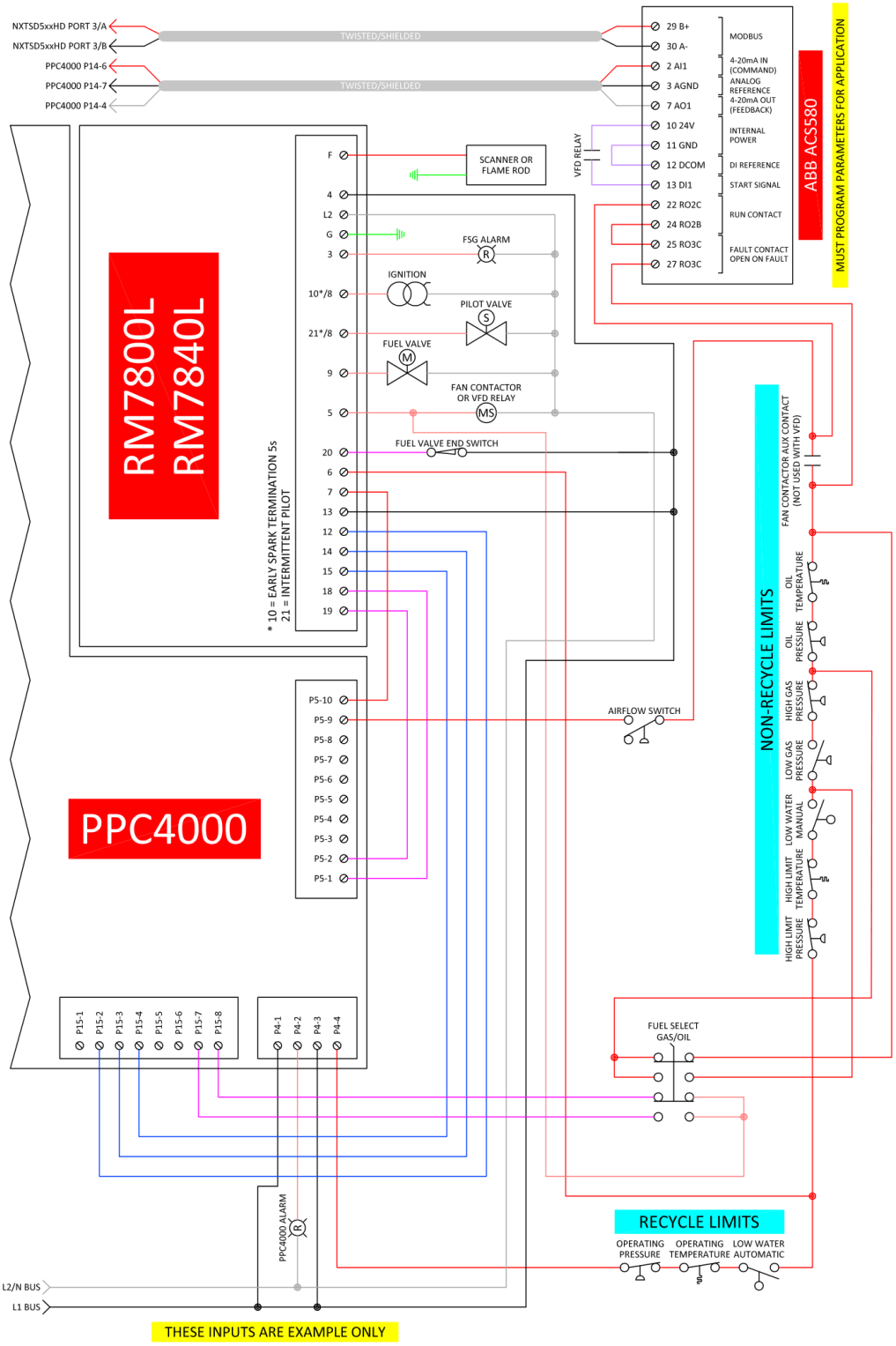
PPC4000 with BurnerPRO (With Valve Proving) Example Wiring (page 2)



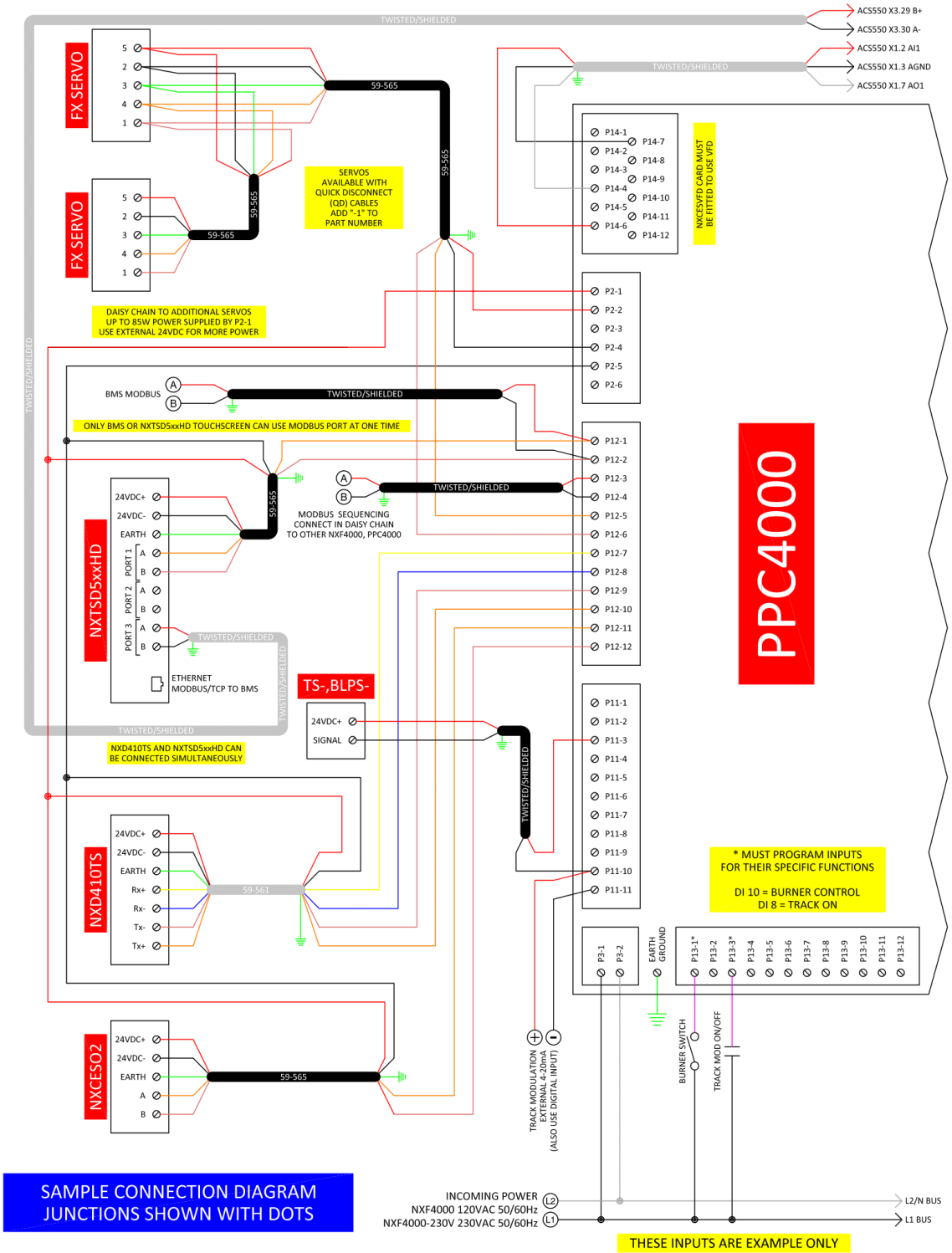
PPC4000 with 7800 SERIES Example Wiring (page 1)



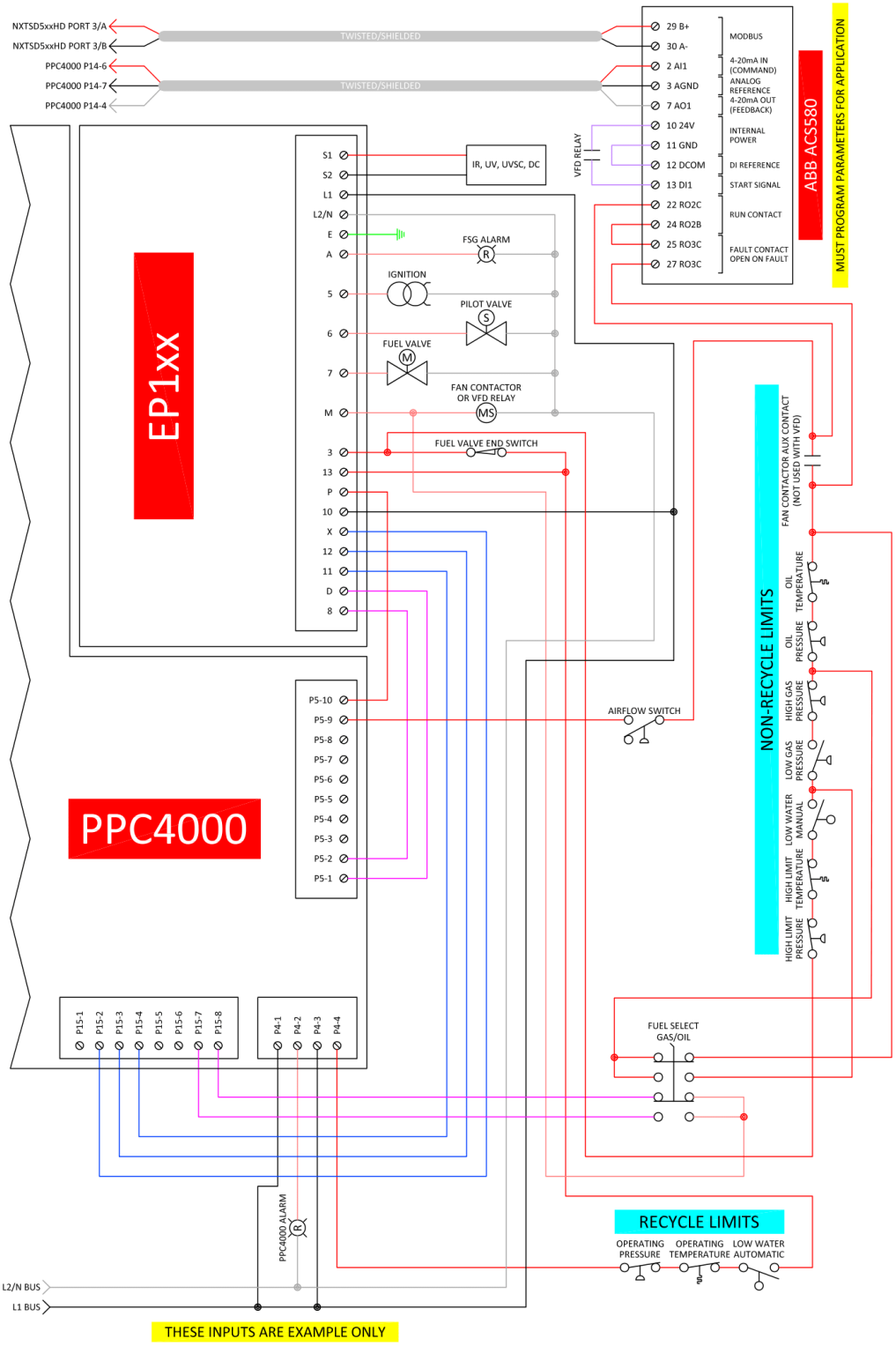
PPC4000 with 7800 SERIES Example Wiring (page 2)



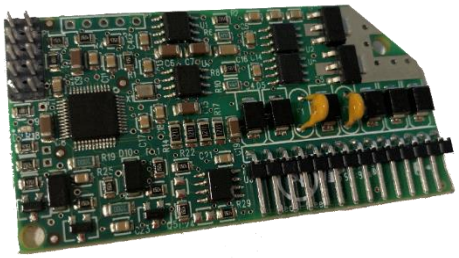
PPC4000 with FLAME MONITOR Example Wiring (page 1)



PPC4000 with FLAME MONITOR Example Wiring (page 2)



VFD WIRING



For the NXF4000 and PPC4000, the NXCESVFD add-on card must be added to the system to enable the use of a VFD. To fit this card, the control must be powered down, the cover removed, and the card fitted to the top board of the control in the header provided. Once the cover is replaced, apply power and the VFD can be wired to the connections on terminal block P14 and the VFD channels can be configured for use. See *Installation* section for additional details.

The NXCESVFD offers interfaces for up to two VFDs with either encoder feedback or with 4-20mA feedback from the VFD. The analog outputs from any unused channels can be used as user-assignable analog outputs.

The NXF4000 and PPC4000 can have up to ten servos connected with up to four in use with any profile. Additionally, one or two VFDs may be added per profile. The minimum configuration supported is two servos, or one servo with one VFD. It is not possible to configure the control to only use one or two VFDs if there are not any servos, or to just use one servo alone without at least one VFD.

Supported Drives

It is recommended that a constant torque (vector control) drive is used. This is due to the resolution provided in the control of the motor, which allows for a quicker response to a change in commands.

If a variable torque (volt/hertz control, or HVAC) drive is used there can be a lag in the response that is large enough to cause lockouts due to improper feedback. Lengthening the acceleration and deceleration times may allow the response to match what is expected but this will result in noticeably diminished performance in the burner response to the process.

Safety Requirement

In a parallel positioning system, all channels of control must be closed loop. This means that feedback is checked to ensure that the commanded signals are being carried out properly. With the servos, this is done internally by an encoder and is part of the secure transmission between the servo and the control. Both the commands and feedback are carried out over the same bus connection. The VFD is treated the same as a servo in that feedback is required. Since the VFD is an external device, the connections between the control and the VFD are hard-wired. This allows for a couple of different options to be used to supply the feedback.

4-20mA Feedback from the VFD

The command signal to the VFD is an analog 4-20mA signal. The feedback can be provided by the VFD, also using a 4-20mA signal. The requirement for this to work is that the function of the 4-20mA output is properly assigned to indicate the running frequency of the VFD, in the same scale as the commanded frequency (typically 50Hz or 60Hz). Safety is provided with this method since the VFD is analyzing the electrical connection to the motor to determine if the motor is running as it should be. The VFD would have an internal fault if the motor was not running properly based upon the voltage and frequency being supplied.

If there was a situation where the motor was running but there was not any connection to the combustion air fan, the control would lockout based upon an airflow interlock safety fault.

Encoder Feedback

If required for the installation, an external encoder can be mounted to the motor shaft to provide the feedback to the control. If this option is used, the 4-20mA control signal still goes to the VFD, but the 4-20mA output from the VFD is not connected and instead the signal from the encoder provides feedback to the control. Note that when using an encoder, the VFD must be configured so that 4mA represents 0Hz and 20mA represents 50Hz or 60Hz (full motor RPM that is used to calculate the encoder pulses). When using 4-20mA feedback it is possible to program a minimum motor speed as the feedback can be scaled to take this into account.

Encoder Selection

The encoder selected must have an open-collector NPN output type. The NXF4000 and PPC4000 have an internal pull-up resistor to work with this signal**.** 24VDC power is supplied to the encoder to produce the pulses.

The encoder can be either a single-channel or a quadrature-type. If the encoder is a quadrature-type it may have many outputs such as A, A', B, B', Z and Z', but only one output (A or B) is connected to the control.

Note that the output from an open-collector encoder should be limited to 30 feet or less and should be protected from noise as much as possible. Do not install in the same conduit as high-voltage wiring and use shielded cable.

It is also possible to use a "speed wheel" attached to the motor shaft with pulses detected by an inductive proximity sensor with NPN normally open output. The speed wheel must have the correct number of teeth.

The encoder output counts pulses as the motor shaft rotates. It is important to select an encoder with the correct number of counts per revolution (CPR). This can be determined using the following formula to determine the "counts" value to enter during configuration:

(Motor RPM x CPR) / 60

The NXF4000 and PPC4000 can have the encoder scale values set from 300 to 5000. This equates to a usable CPR range of 11 to 171 for a 1750-rpm motor, and a range of 6 to 85 for a 3500-rpm motor. If the encoder used has too many pulses, "divide-by" modules are available to re-scale the output. When commissioning, the encoder values are scaled from 0 to 1000, with 1000 representing full motor speed. Note that the encoder scale value entered is not going to represent the maximum speed of the motor.

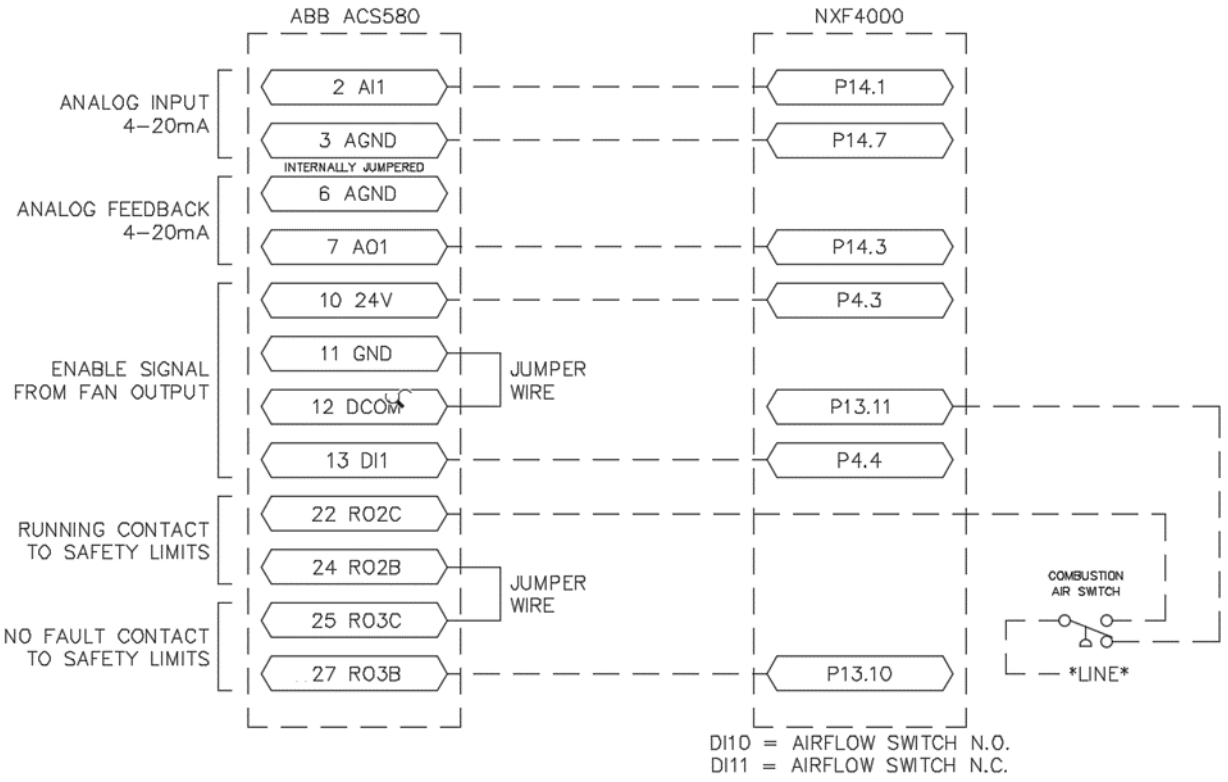
Encoder Wiring

Description	NXF4000/PPC4000 Terminal	Encoder Terminal
Power supply 24VDC	P2.1	+VDC
Signal from encoder	**VFD1:** P14.5 **VFD2:** P14.6	A or B (non-inverted signals)
Power supply common	**VFD1:** P14.8 **VFD2:** P14.7	COM
Shield	to earth ground	n/a

Note that the encoder terminals have generic names – these will vary by manufacturer, but each should have a terminal to cover the function.

Multiple terminal options are listed for 24VDC power and common on the NXF4000 and PPC4000. Any available terminal can be used.

Wiring Example ABB ACS580 to NXF4000



Wiring Example ABB ACS580 to PPC4000

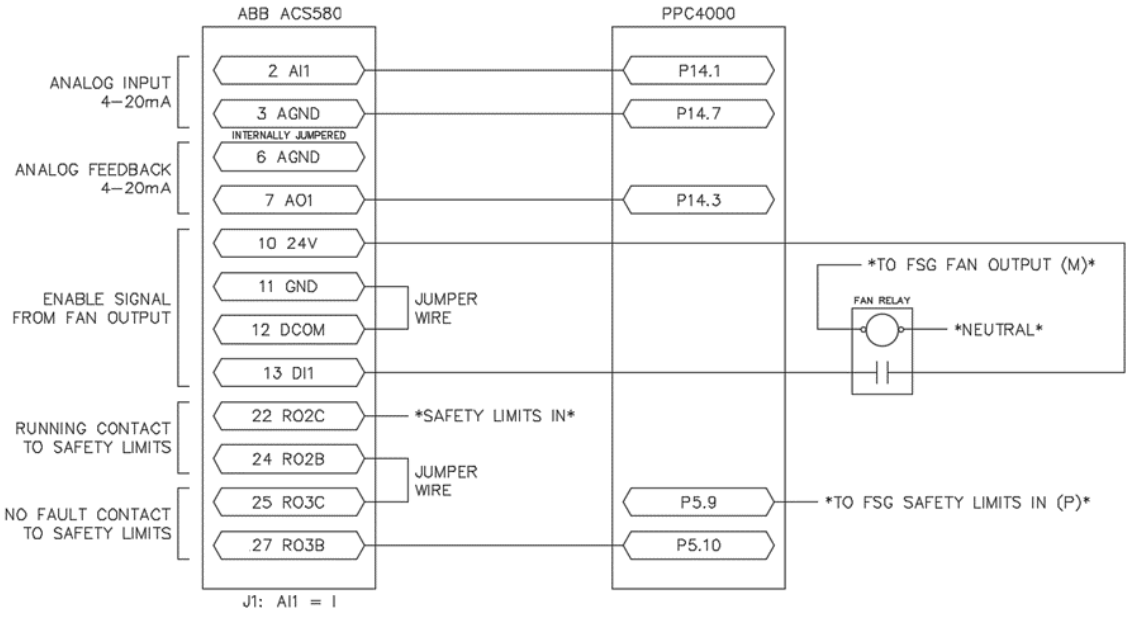


ABB ACS550 Parameters

Number	Name	Value
Group 99: Start-Up Data		
9905	MOTOR NOM VOLT	*set during start-up*
9906	MOTOR NOM CURR	*set during start-up*
9907	MOTOR NOM FREQ	*set during start-up*
9908	MOTOR NOM SPEED	*set during start-up*
9909	MOTOR NOM POWER	*set during start-up*
Group 10: Start/Stop/Dir		
1001	EXT1 COMMANDS	DI 1
1003	DIRECTION	FORWARD
Group 11: Reference Select		
1103	REF1 SELECT	AI 1
1104	REF1 MIN	*min frequency* (ex: 30.0 Hz)
1105	REF1 MAX	*max frequency* (ex: 60.0 Hz)
Group 13: Analogue Inputs		
1301	MINIMUM AI1	20.0 %
1302	MAXIMUM AI1	100.0 %
1303	FILTER AI1	2.0 s
Group 15: Analogue Outputs		
1501	AO1 CONTENT SEL	OUTPUT FREQ
1502	AO1 CONTENT MIN	*min frequency* (ex: 30.0 Hz)
1503	AO1 CONTENT MAX	*max frequency* (ex: 60.0 Hz)
1504	MINIMUM AO1	4.0 mA
1505	MAXIMUM AO1	20.0 mA
Group 16: System Controls		
1606	LOCAL LOCK	ON
Group 20: Limits		
2007	MINIMUM FREQ	*min frequency* (ex: 30.0 Hz)
2008	MAXIMUM FREQ	*max frequency* (ex: 60.0 Hz)
Group 21: Start/Stop		
2101	START FUNCTION	DC MAGN
Group 22: Accel/Decel		
2201	ACC/DEC 1/2 SEL	NOT SEL
2202	ACCELER TIME 1	30.0 s
2203	DECELER TIME 1	30.0 s
Group 30: Fault Functions		
3001	PANEL COMM ERR	LAST SPEED
Group 34: Panel Display / Process Variables		
3408	SIGNAL 2 PARAM	AI 1
3411	OUTPUT 2 DSP FORM	+0.0
3412	OUTPUT 2 UNIT	mA
3413	OUTPUT 2 MIN	4.0 mA
3414	OUTPUT 2 MAX	20.0 mA
3415	SIGNAL 3 PARAM	AO 1
3418	OUTPUT 3 DSP FORM	+0.0
3419	OUTPUT 3 UNIT	mA
3420	OUTPUT 3 MIN	4.0 mA
3421	OUTPUT 3 MAX	20.0 mA

ABB ACS580 Parameters

Number	Name	Value
99 – Motor data		
99.03	Motor type	*set during start-up*
99.04	Motor control mode	Scalar
99.06	Motor nominal current	*set during start-up*
99.07	Motor nominal voltage	*set during start-up*
99.08	Motor nominal frequency	*set during start-up*
99.09	Motor nominal speed	*set during start-up*
99.10	Motor nominal power	*set during start-up*
12 – Standard AI		
12.15	AI1 unit selection	mA
12.16	AI1 filter time	2.000 s
12.17	AI1 min	4.000 mA
12.18	AI1 max	20.000 mA
12.19	AI1 scaled at AI1 min	*min frequency* (ex: 30.000 Hz)
12.20	AI1 scaled at AI1 max	*max frequency* (ex: 60.000 Hz)
13 – Standard AO		
13.12	AO1 source	Output frequency
13.15	AO1 unit selection	mA
13.17	AO1 source min	*min frequency* (ex: 30.0)
13.18	AO1 source max	*max frequency* (ex: 60.0)
13.19	AO1 out at AO1 src min	4.000 mA
13.20	AO1 out at AO1 src max	20.000 mA
19 – Operation mode		
19.17	Local control disable	Yes
20 – Start/stop/direction		
20.01	Ext1 commands	In1 Start
20.03	Ext1 in1 source	DI1
20.21	Direction	Forward
23 – Speed reference ramp		
23.11	Ramp set selection	Acc/Dec time 1
23.12	Acceleration time 1	30.000 s
23.13	Deceleration time 1	30.000 s
30 – Limits		
30.13	Minimum frequency	*min frequency* (ex: 30.00 Hz)
30.14	Maximum frequency	*max frequency* (ex: 60.00 Hz)

ABB ACS550/ACS580 Parameter Notes

1. Consult ABB ACS550 or ACS580 documentation for additional details on installation, wiring or configuration.
2. Analog input filter time should be set appropriately to ensure a smooth input signal.
3. When a minimum and maximum frequency are selected, the same value should be entered for all parameters that reference them in the chart above. The range does not have to be 0-60Hz if the scaling is consistent. It is often advised to set the minimum frequency high enough to ensure adequate motor cooling in the event of prolonged operation at low frequencies.
4. Best practice is to always set the direction to forward. If the motor rotates in the wrong direction, swap any two leads from the drive output to the motor where they connect at the drive. Do not swap incoming drive power as this will not affect rotation.

VFD Bypass

With four available fuel profiles, it is possible to use a VFD bypass with two fuels. The fuel selections would be as follows:

1. Fuel 1 (gas) with no VFD bypass.
2. Fuel 2 (oil/propane) with no VFD bypass.
3. Fuel 1 (gas) with VFD bypass (across the line).
4. Fuel 2 (oil/propane) with VFD bypass (across the line).

The VFD will usually have an output to indicate if the VFD bypass is active. Use this output with relay logic to direct the fuel selection switch voltage to the proper fuel selection input.

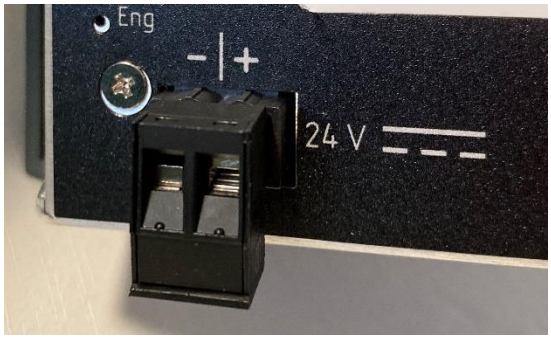
USER INTERFACES

NXD410TS

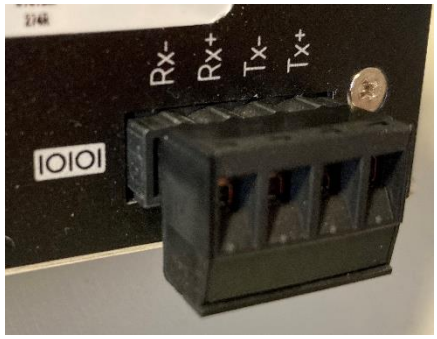
Note: See bulletin NXD-4102 for more detail on the NXD410TS touchscreen.

The recommended cable (59-561) contains six wires: two power wires (18AWG) and four communication wires (22AWG) in two twisted pairs. There is also a drain wire.

The figures below show the connectors for both power and communications.



Power



Communications

The connector labeled 24V supplies the 24VDC power to the unit. The connection is polarity sensitive and is designated on the legend. It is recommended to use wire between 16AWG and 18AWG for this connection. The connector is a two-position 5.08mm pluggable terminal block with screw terminals.

The connector labeled "10101" (symbol/icon for serial port) is the RS-422 serial port used for the terminal communication to the NXF4000 or PPC4000. The connections are polarity sensitive and are designated on the legend. There are connections required for both send and receive – if one is correct and the other is not, operation may be erratic. It is recommended to use a single cable with two twisted wire pairs between 18AWG and 22AWG for this connection. The connector is a four-position 5.08mm pluggable terminal block with screw terminals.

If the NXD410TS is being used to replace the NXD410, the existing 59-562-2 cable can be used simply by removing and discarding the DSUB connector on the terminal end. The cable itself is identical and may be reused.

The wiring between the devices is shown in the table below:

59-561 wire color	Wire gauge	NXF4000/PPC4000 terminal	NXD410TS terminal
Red	18AWG	P2.1	24V(+)
Black	18AWG	P2.4	24V(-)
Yellow	22AWG	P12.7	10101(Rx+)
Blue	22AWG	P12.8	10101(Rx-)
Brown	22AWG	P12.9	10101(Tx-)
Orange	22AWG	P12.10	10101(Tx+)

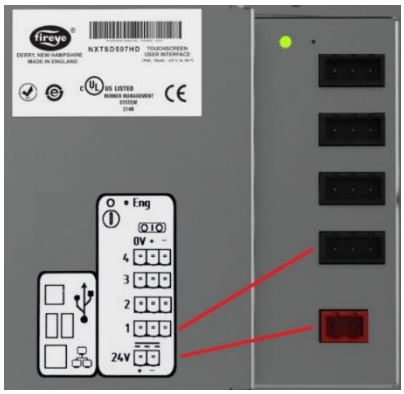
In the event of electrical noise in the cabling, the drain wire inside the 59-561 cable can be connected to earth ground on one end of the cable. Normally this is not required as the twisted pairs used for the communication wiring handles the noise rejection.

NXTSD507HD and NXTSD512HD

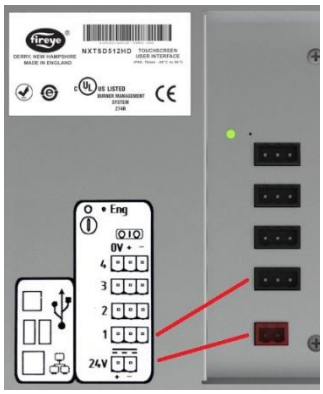
Note: See bulletin TSD-4001 for more detail on the NXTSD507HD and NXTSD512HD touchscreens.

The recommended cable (59-565) contains four wires: two power wires (18AWG) and two communication wires (22AWG) in a twisted pair. There is also a drain wire and the cable is available by the foot.

The figures below show the connectors for both power and communications.



NXTSD507HD



NXTSD512HD

The connector labeled 24V supplies the 24VDC power to the unit. The connection is polarity sensitive and is designated on the legend. It is recommended to use wire between 16AWG and 18AWG for this connection. The connector is a two-position 5.08mm pluggable terminal block with screw terminals.

The connector labeled 1 is the RS-485 serial port used for Modbus RTU communication to the NXF4000 or PPC4000. The connection is polarity sensitive and is designated on the legend. It is recommended to use a twisted pair wire between 18AWG and 22AWG for this connection. The connector is a three-position 5.08mm pluggable terminal block with screw terminals.

The wiring between the devices is shown in the table below:

59-565 wire color	Wire gauge	NXF4000/PPC4000 terminal	NXTSD5xxHD terminal
Red	18AWG	P2.1	24V(+)
Black	18AWG	P2.4	24V(-)
Brown	22AWG	P12.1	1(+)
Orange	22AWG	P12.2	1(-)

In the event of electrical noise in the cabling, the drain wire inside the 59-565 cable can be connected to earth ground on one end of the cable. Normally this is not required as the twisted pair used for the communication wiring handles the noise rejection.

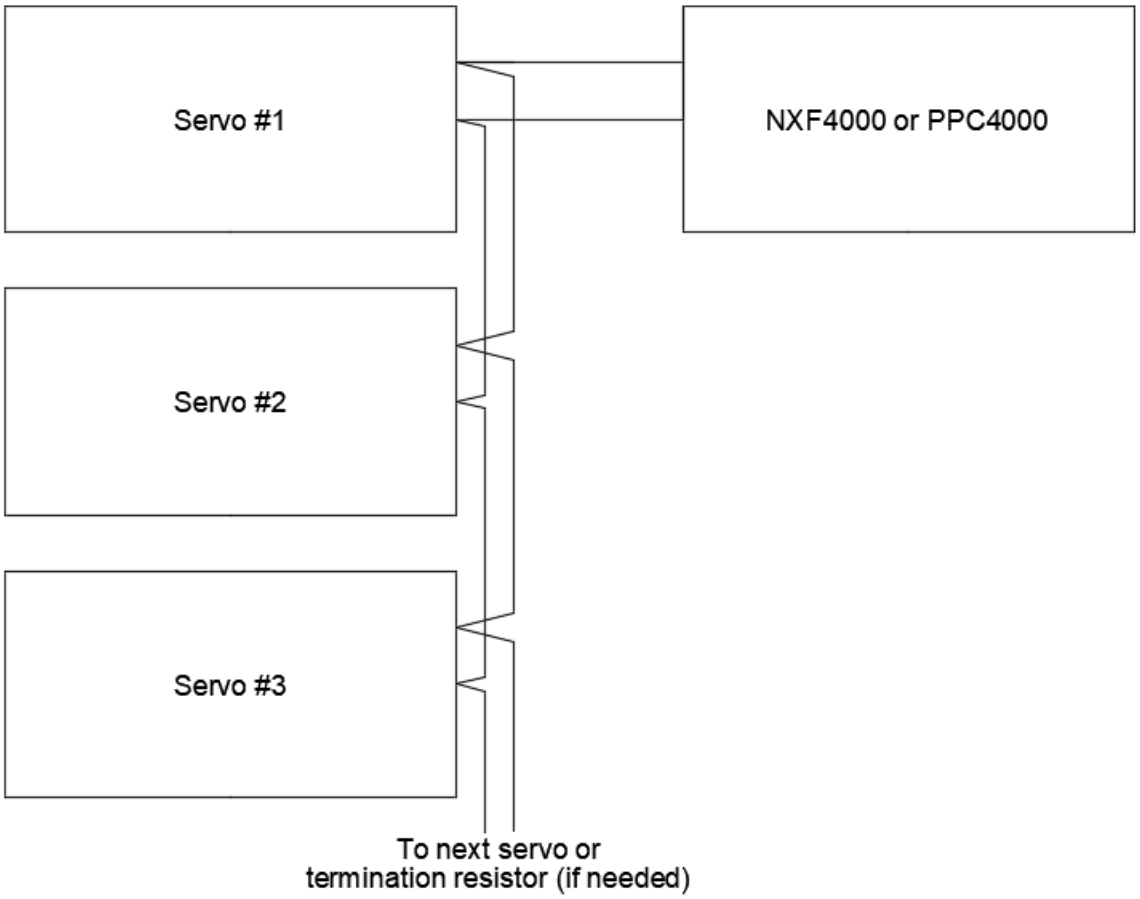
If either a third-party power supply or a different cable than the one recommended above is used, connect NXTSD5xxHD terminal 1(0V) to the 24VDC common of the NXF4000 or PPC4000 (P2.4). This will ensure that the Modbus connection and the power supply have the same earth potential.

WARNING: Use of third-party power supply is permitted, provided the power supply meets NEC CLASS 2 to protect against fire and electrical shock.

FX SERVOS

Note: See bulletin NEX-3001 for more detail on the FX series servos.

The FX servos communicate with the NXF4000 or PPC4000 using the Modbus RTU protocol via RS-485. They communicate at a fixed baud rate of 57600. The servos should be wired in a point-to-point (daisy-chain) topology as per the RS-485 specification. The terminals for the Modbus sequencing network are P12.3 (A) and P12.4 (B).



Never wire the servos in a star topology. This means to wire each servo directly to the Modbus terminals on the NXF4000 or PPC4000. Doing so will likely result in communication faults.

If communication faults are encountered when the servos are correctly wired in a point-to-point manner, termination resistors may be required across the Modbus terminals on the last connected servo. The resistor value is typically 120 to 200 ohms and is selected to match the impedance of the communication cable used. For 59-565 cable, the recommended termination resistor value is 200 ohms and should be connected between terminals 1 and 4 on the last connected servo.

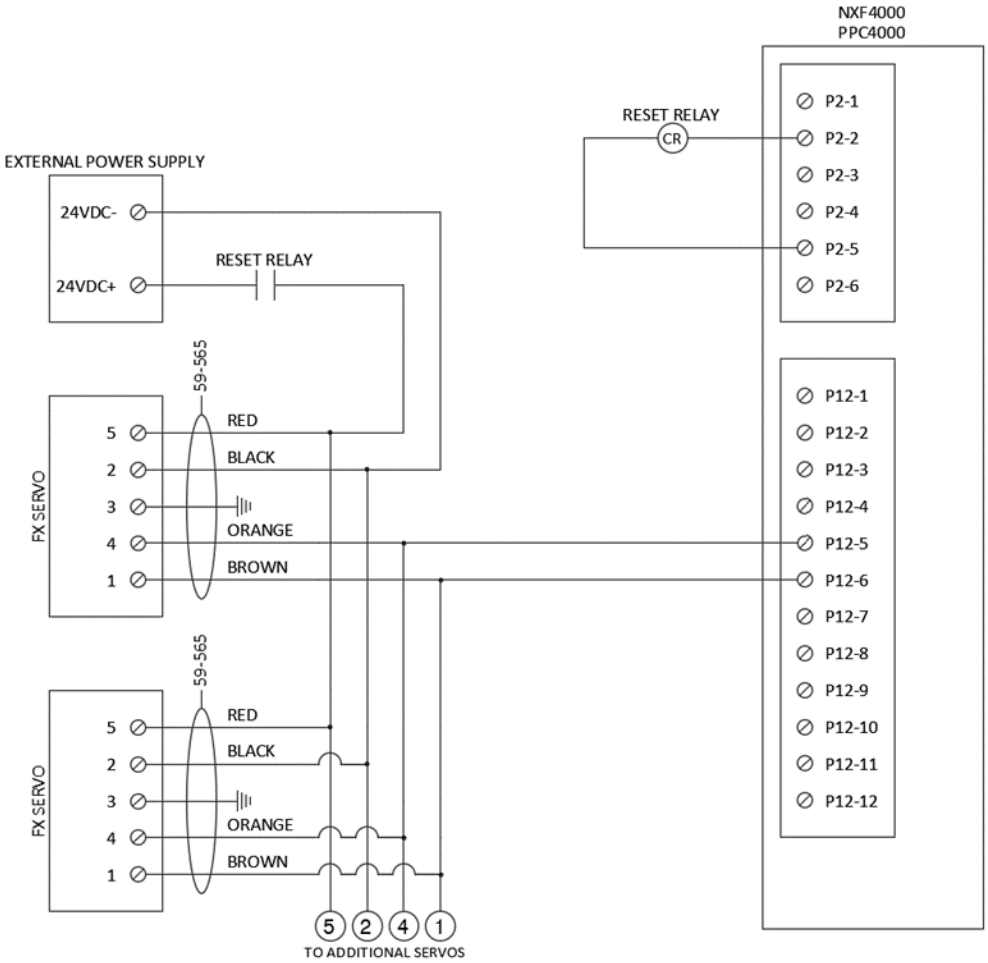
Power Requirements

The internal 24VDC power supply can supply 120W of power to all connected devices, but only 85W of power for servos. This is because the servo power is internally connected through a switch which can reset the servo power as needed as part of the servo self-test routine.

The power requirements are as follows:

Servo	Power
FX04	7.5W
FX20	35W
FX50	38W

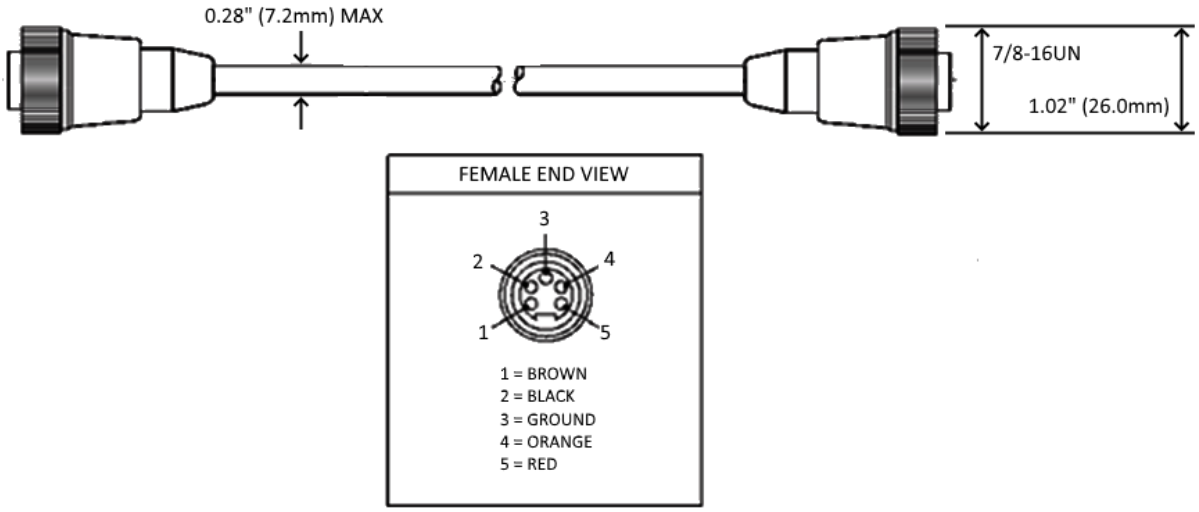
Add together the power requirements for each servo to verify that the total is 85W or less. **If the total is greater than 85W, connect all or some of the servos to an external power supply as shown in the diagram below.** When using an external power supply, run the +24VDC through a 24VDC relay that is connected between P2.2 and P2.5. This will allow the NXF4000 or PPC4000 to power cycle the servos when a servo self-test routine is performed. If this is not done there may be nuisance servo communication errors.



Quick Disconnect Cord Sets

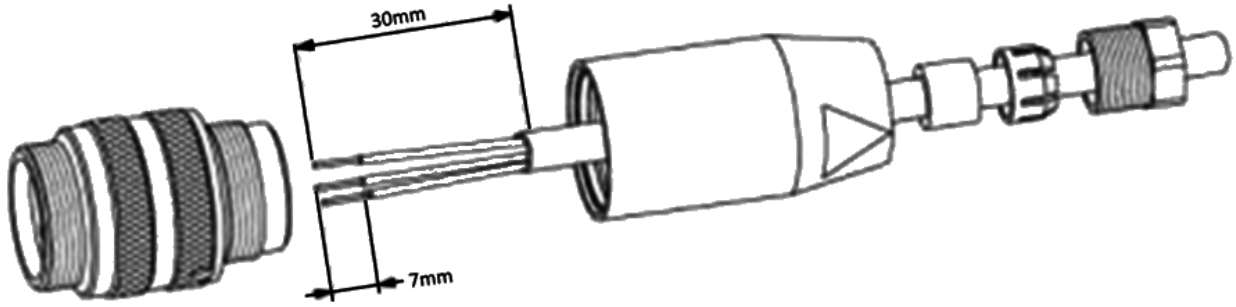
Cord sets having female connectors on both ends are available in 1.83 meter/6 foot (59-565-6) and 12.19 meter/40 foot (59-565-40) lengths. Use 44-164 cover for any unused quick disconnect connectors to maintain NEMA 4 rating.

Class I Division 2 Hazardous Location requirements for FX series servos with electrical connectors state that the coupling nut must be tightened after mating the cable to the servo. Use 44-164-1 cover for any unused quick disconnect connectors in a Class I Division 2 application (also maintains NEMA 4 rating).



Quick Disconnect Field Wiring

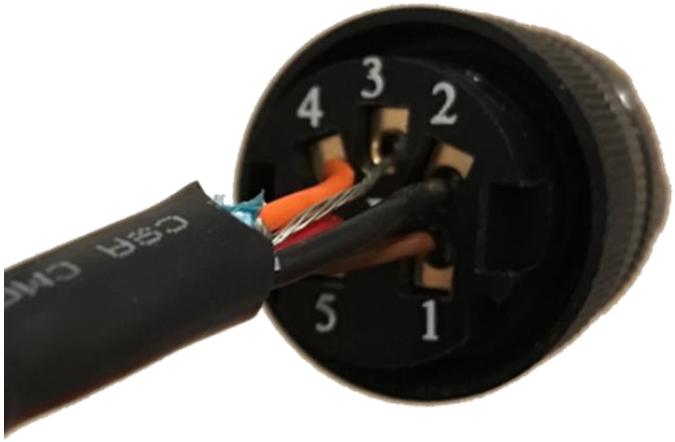
Quick disconnect connectors are available in kit form for field wiring, 129-192. Fireye recommends cable part number 59-565 to be used for servo wiring.



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 terminate to connector as shown in the image and table below:

Terminal	Description	Color (59-565 cable)
1	Modbus B(-)	Brown
2	24VDC common	Black
3	Earth ground	Drain (bare)
4	Modbus A(+)	Orange
5	24VDC power	Red



Field Wiring Using Fixed Cable or Conduit

Loosen the four housing cover screws and pull the cover up to remove. For the electrical installation of the FX series servo motor, use the prescribed cable type corresponding to the environmental conditions.

Feed cables through suitable conduit and place the stripped ends of the leads into screw connection terminals and terminate. Cable type 59-565 contains a drain wire, and care should be taken when routing this to terminal 3. Tubing should be placed over this bare wire. Wire ends should be properly stripped such that no bare wires protrude from the terminals and thus produce the risk of a current surge or a short circuit.

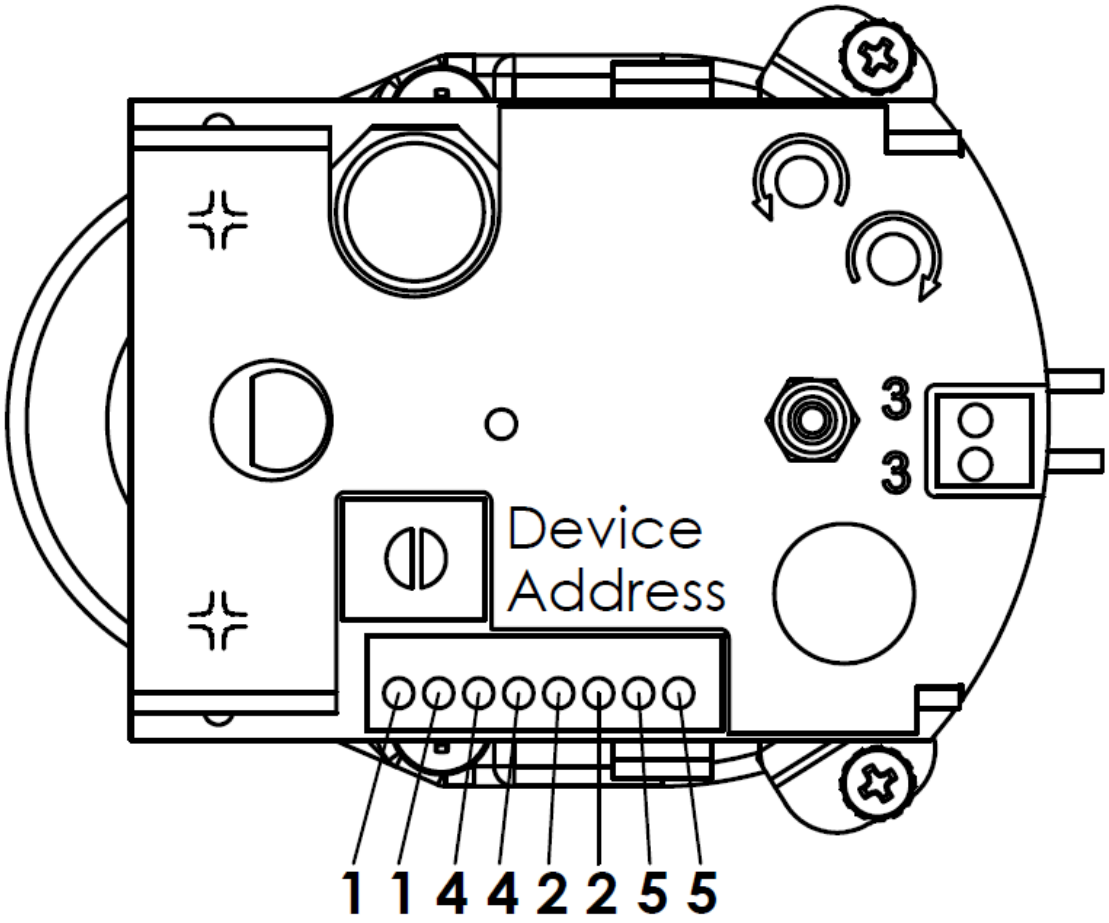
Store the cables such that they are not pinched when the housing cover is fitted. Also ensure that there is not any interfere with the internal end travel switch mechanism or potentiometer coupling shaft.

There are two terminals for each connection in the FX04 and FX20 to make it easier to wire the servos in a serial or daisy-chain as recommended by the RS-485 standard. The FX50 has larger terminals designed to accommodate two wires each.

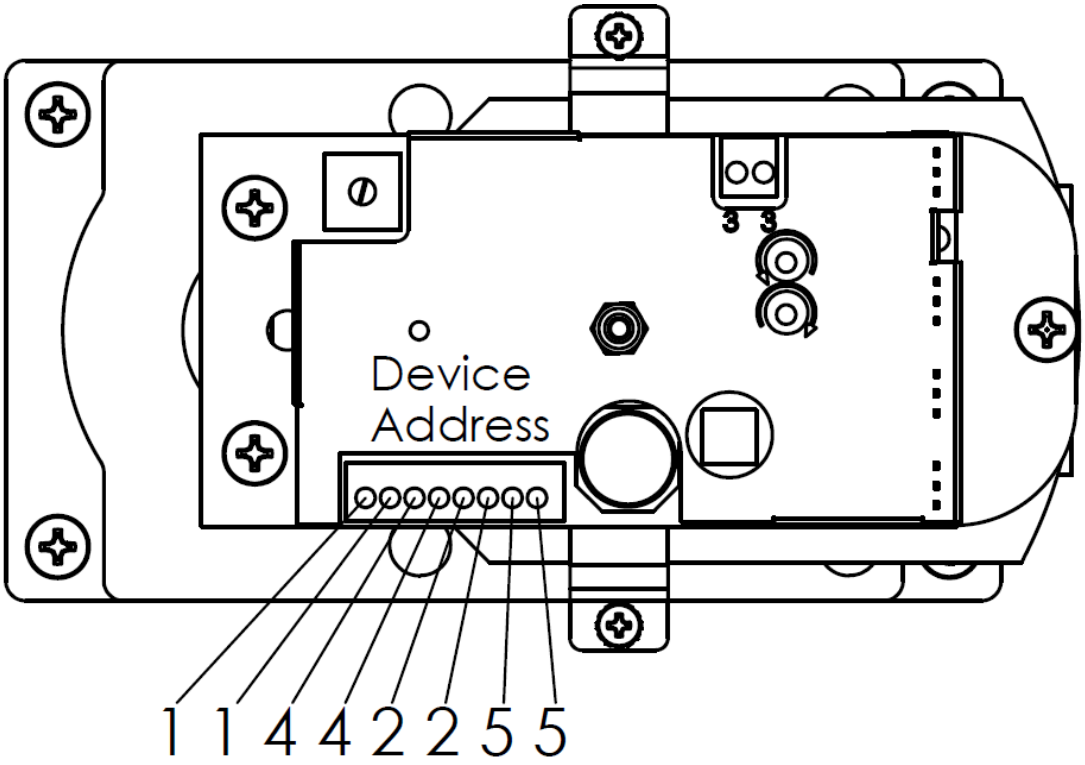
Below is a table showing the descriptions of the terminals. For the 59-565 cable, the black and red wires are 18AWG and the brown and orange wires are a twisted pair. Note this is the same table as in the previous section.

Terminal	Description	Color (59-565 cable)
1	Modbus B(-)	Brown
2	24VDC common	Black
3	Earth ground	Drain (bare)
4	Modbus A(+)	Orange
5	24VDC power	Red

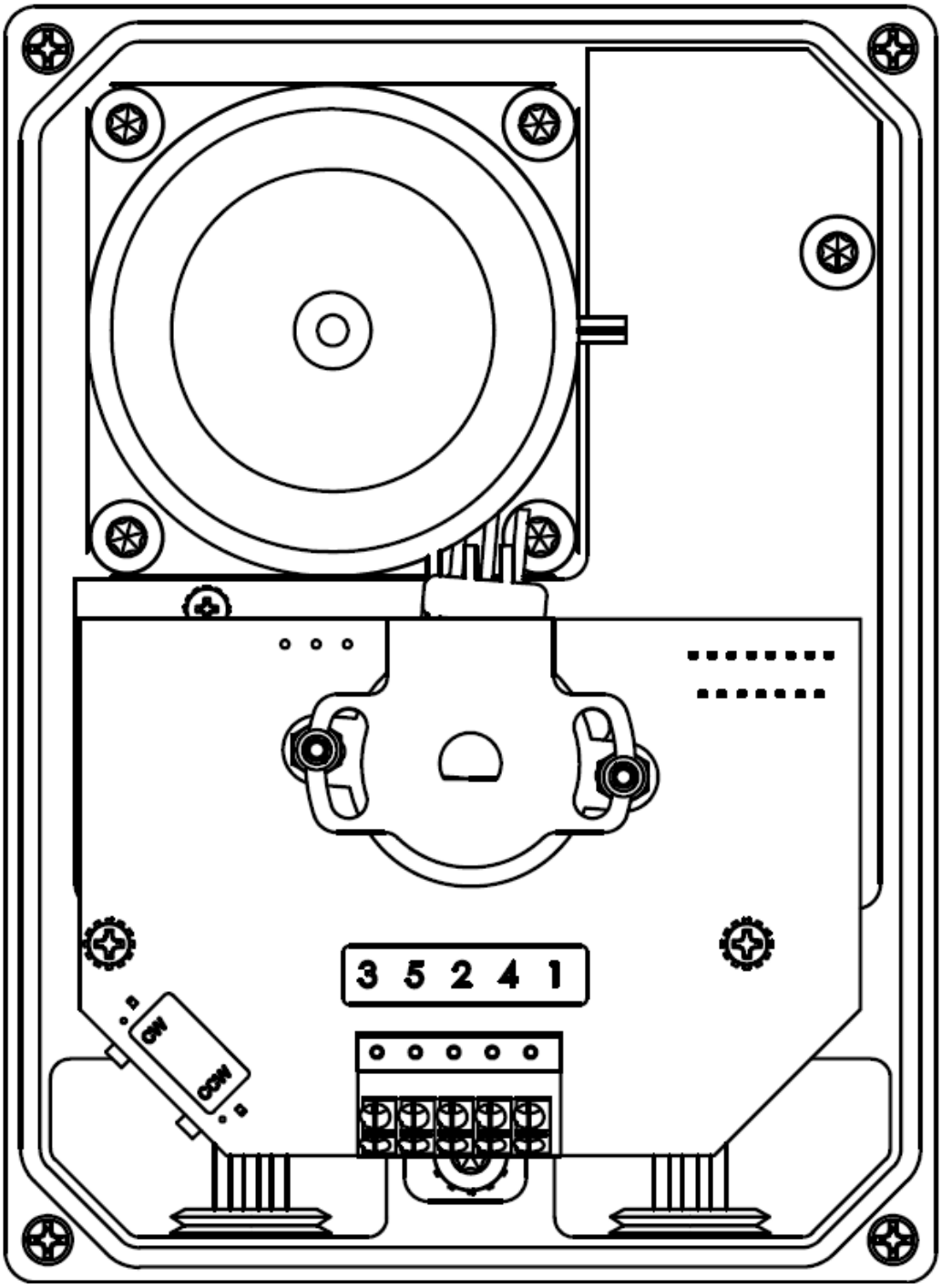
FX04 Terminal Layout



FX20 Terminal Layout



FX50 Terminal Layout



DIGITAL INPUTS

15 (NXF4000) or 10 (PPC4000) digital inputs are available for programmable use. Each of these inputs require a line voltage connection from the same source as control power. See *PARAMETERS* section for additional details on options for these inputs.

USER DIGITAL OUTPUTS

The NXF4000 has three user outputs that can be programmed to indicate different status details. See *PARAMETERS* section for additional details on options for these outputs.

These user outputs are at line voltage from the same source as control power. The maximum load allowed is 480VA, which is pilot duty (suitable for a pilot light or relay). Connect a relay of the same voltage to these outputs if dry contacts are required (to switch a voltage from a different source).

The PPC4000 does not offer user digital outputs.

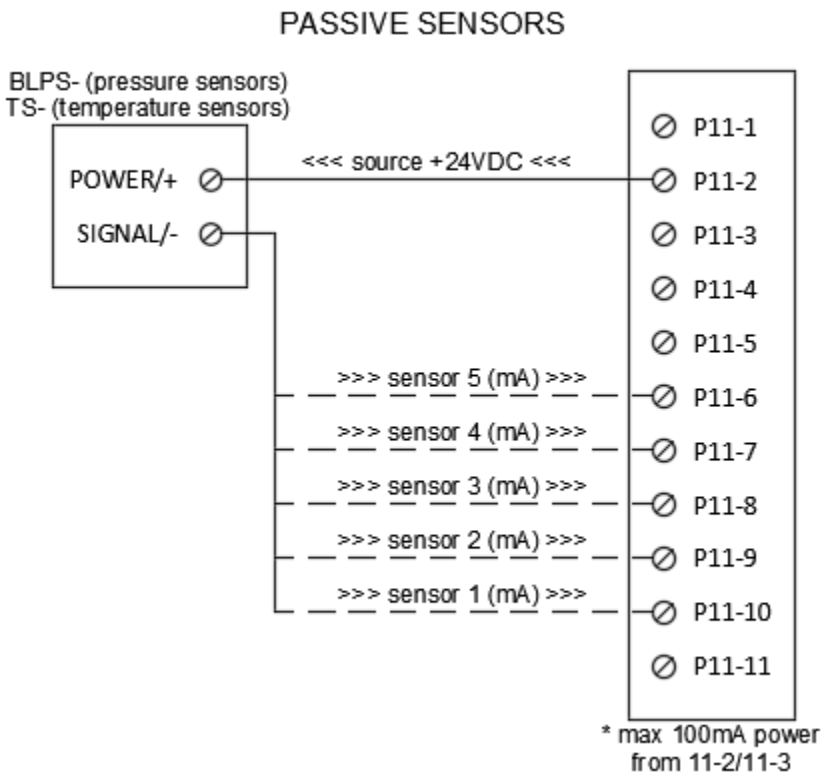
SENSORS

Note: See bulletin FXIATS-1 and/or BLZPTS-1 for more detail on installation and wiring of Fireye sensors.

Up to five 4-20mA sensors can be connected to the NXF4000 or PPC4000.

Passive Sensors

Passive sensors use “loop power”. This means that the sensor electronics are powered from being part of the current loop. Fireye sensors FXIATS-1, BLPS-, and TS- are all passive sensors.

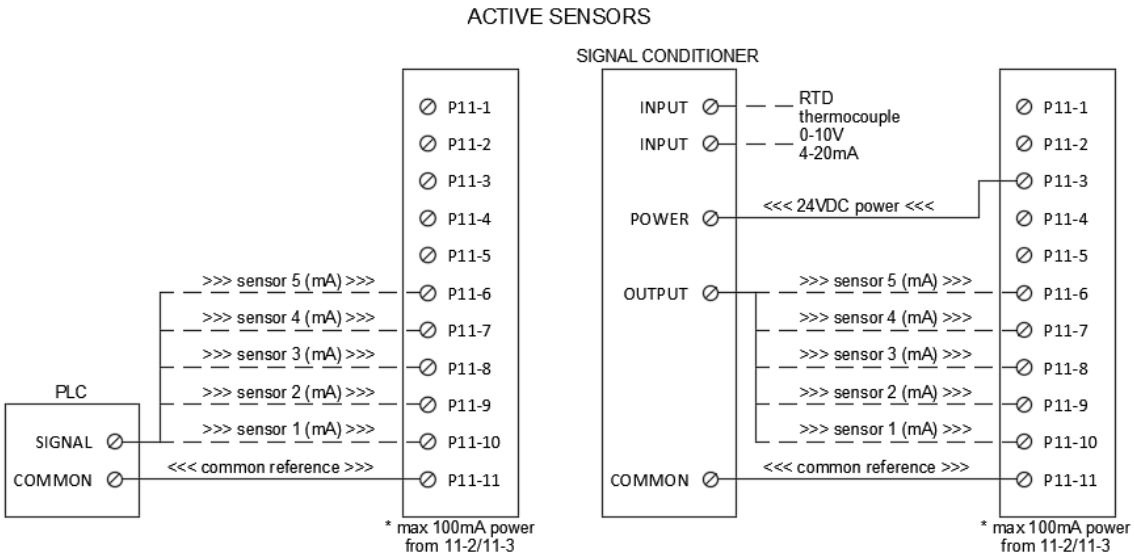


It is recommended that shielded cable is used to connect any sensor. Only ground the shield on one side of the connection to prevent ground loops.

Active Sensors

Active sensors are signals sourced from an external power supply. This is the type of signal that would typically be provided by a PLC or signal conditioner.

With an active sensor, the common (0V) connection of the external power supply must be connected to the power supply common of the NXF4000 or PPC4000 (terminal P11.1, P11.4 or P11.11). This is needed so that the control has a reference point to interpret the signal.



It is recommended that shielded cable is used to connect any remote mounted sensor. Only ground the shield on one side of the connection to prevent ground loops. It is not necessary to use shielded cable when wiring a signal conditioner to the NXF4000 or PPC4000 if it is in close proximity (same enclosure) but shielded cable should be used from the remote sensor to the signal conditioner.

BLPS Pressure Sensor Wiring

BLPS pressure sensors use passive wiring. Wire the terminal **+EXC** to P11.2 and **-COM** to P11.10 (for sensor 1).

TS Temperature Sensor Wiring

TS temperature sensors use passive wiring. Depending upon how many terminals the sensor has, wiring is slightly different:

- **4 or 6 terminals:** Wire the terminal **1(+)** to P11.2 and **2(-)** to P11.10 (for sensor 1).
- **7 terminals:** Wire the terminal **6(+)** to P11.2 and **7(-)** to P11.10 (for sensor 1).

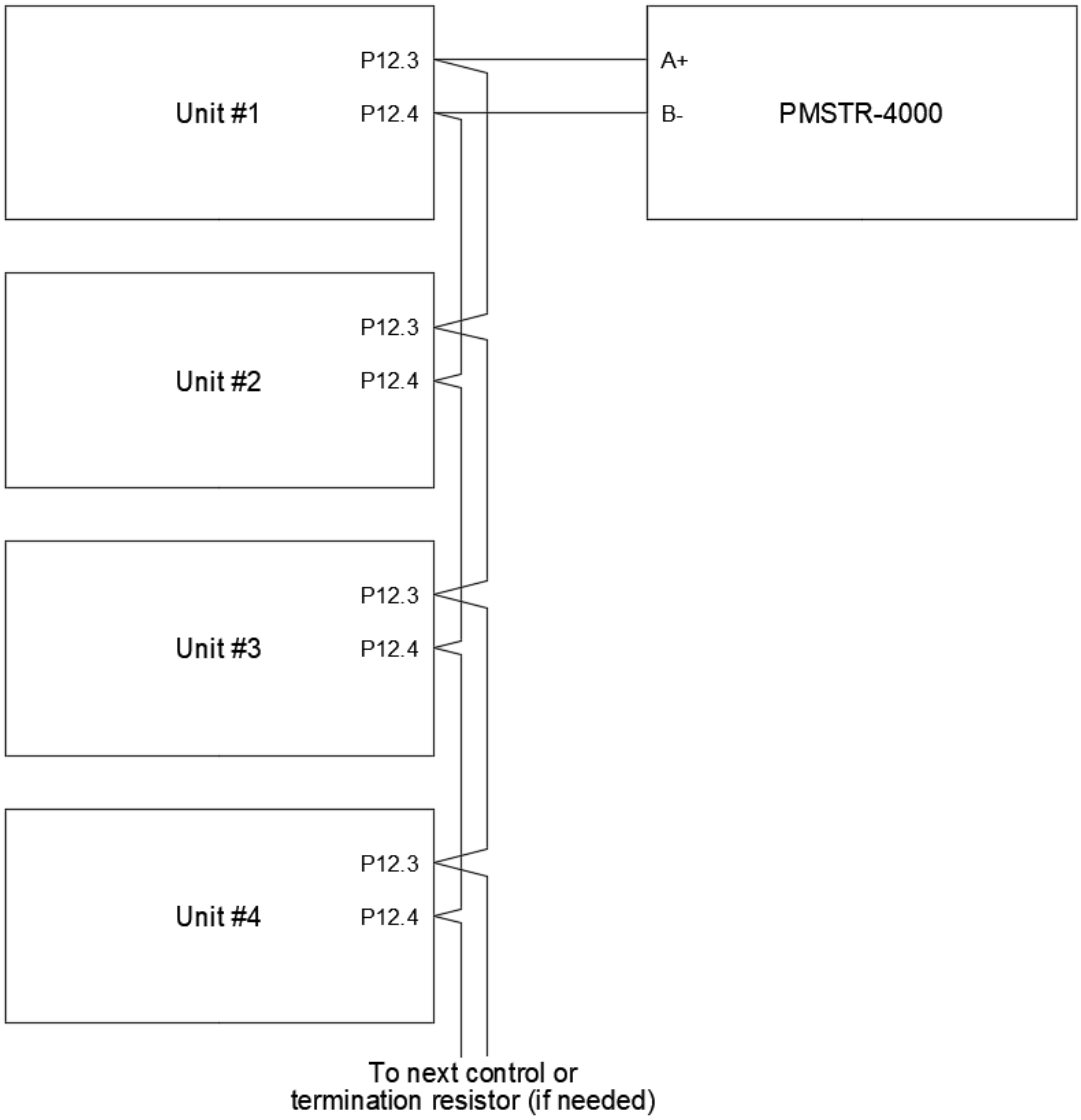
PLANT MASTER PMSTR-4000

Note: See bulletin PMSTR-4001 for more detail on installation and wiring of the PMSTR-4000.

Up to eight NXF4000 and PPC4000 units can be mixed on the sequencing network.

The network uses the Modbus RTU protocol via RS-485. The controls should be wired in a point-to-point (daisy-chain) topology as per the RS-485 specification. The terminals for the Modbus sequencing network are P12.3 (A+) and P12.4 (B-).

If there are communication issues or long wiring runs are made, termination resistance may be required at the last device. This is a resistor with a value between 100Ω and 200Ω that is placed across the Modbus A+ and Modbus B- terminals.



ANALOG OUTPUT

One programmable analog output is provided. See *PARAMETERS* section for additional details on options for this output.

A 4-20mA signal is generated from terminal P11.5 to match the assignment of the programmable analog output. Use terminal P11.1, P11.4 or P11.11 as a common reference for this signal.

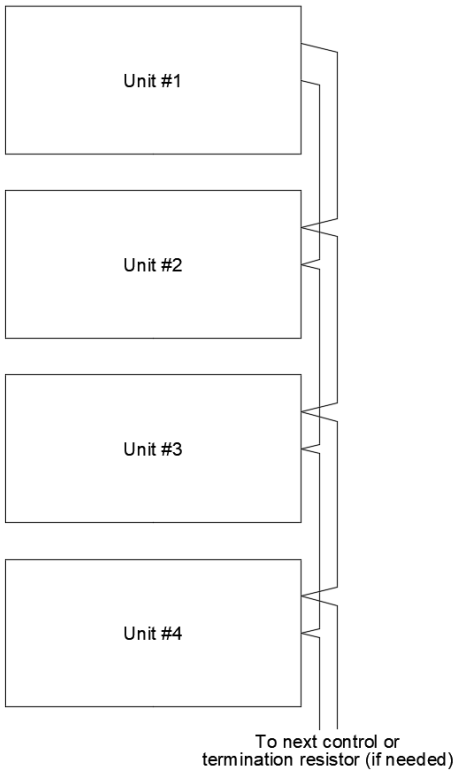
If an NXCESVFD card is fitted, the analog outputs for any unused channels can also be used as programmable analog outputs. P14.6 is referred to as VFD 1 OUT and P14.5 is referred to as VFD 2 OUT under ANALOG OUT SETUP. Use terminals P14.7 through P14.12 as a common reference for these signals.

SEQUENCING

Multiple NXF4000 and PPC4000 can be connected using Modbus to create a peer-to-peer sequencing network. NXF4000 and PPC4000 units can be mixed on this network.

The network uses the Modbus RTU protocol via RS-485. The controls should be wired in a point-to-point (daisy-chain) topology as per the RS-485 specification. The terminals for the Modbus sequencing network are P12.3 (A) and P12.4 (B). See the *FX Servos* section for more complete information on wiring topology, including termination, as that network is connected in a similar manner.

See *PARAMETERS* section for addition details on how to set up and use the sequencing feature.



SPECIAL WIRING APPLICATIONS

This section contains special wiring applications that can be used when needed.

Connecting Externally Proven Devices to the NXF4000

Connecting an externally proven device such as a third-party draft control or combustion air damper is sometimes necessary with the NXF4000. With a traditional flame safeguard this is accomplished by deriving the call for the draft control or combustion air damper from the call for heat at the end of the recycle limit string. An additional contact is then added at the end to keep the control from starting the sequence until the draft control or combustion air damper has proven. This is the method to use with the PPC4000 with external flame safeguard.

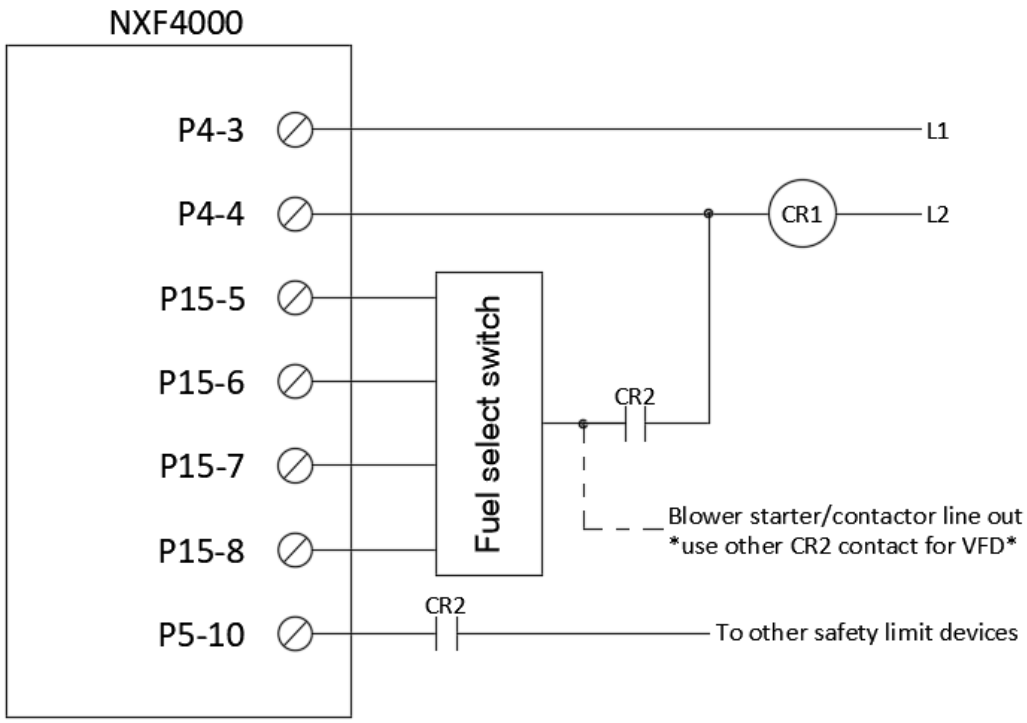
This method does not work with an NXF4000 since the call for heat is derived internally from the load controller. If this method was used, the draft control or combustion air damper would run whenever the recycle limit string was complete.

This wiring method works by taking advantage of the time allowed by the control while waiting for a profile selection. Normally the output from the blower terminal is wired through a fuel selection switch to engage a profile. The control will wait indefinitely after a call for heat for a profile to be selected.

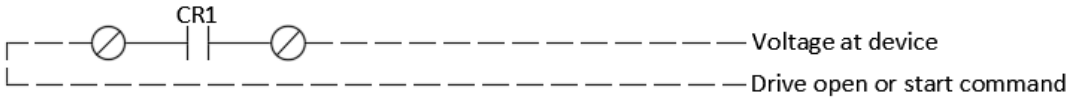
Two relays are required to be added for this method to work. The first will connect to the existing blower command. This will interpose to the external voltage to command the external device to open or run. The second will connect to the voltage or contact at the external device to signal that the interlock is proven, and the sequence can continue. One normally open contact from the second relay will supply power to the fuel selection switch (or profile selection terminal directly if only one profile is used). The second normally open contact will start the blower by connecting line voltage from the blower terminal to the blower contactor or by closing the VFD start contact. A third normally open contact should be placed in the safety limit device string. This allows the external device to prove before the blower runs.

WAIT FOR PROFILE will be displayed while waiting for the proven signal during the startup of the sequence. Losing the proven signal at any other time will cause the blower to shut off, resulting in either a return to standby or a lockout due to the safety limit opening.

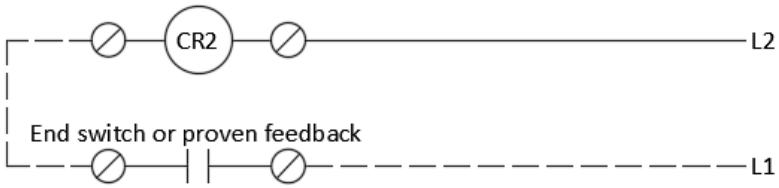
Wiring Example



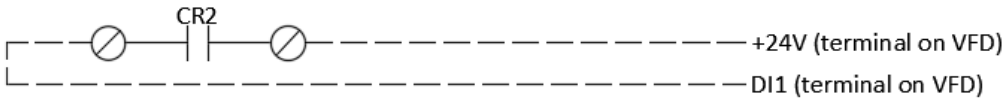
To CALL on external device



To PROVEN on external device



To VFD (ABB ACS550 example)



First-Out Annunciation

First-out annunciation is a method of monitoring the connection to each limit device for the purposes of quickly identifying which limit is causing a shutdown or lockout.

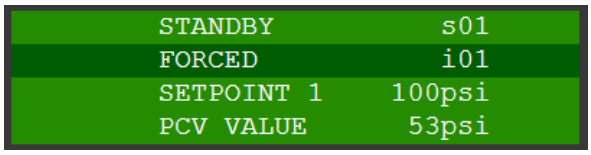
When using the PPC4000 with the BurnerLogix flame safeguard, first-out annunciation is available by using the YZ300 Interlock Annunciator. When using the YZ300, there are terminals available for each limit and the message strings shown on the BurnerLogix display can be custom programmed. The YZ300 connects to the BurnerLogix using an ED-580 cable.

The 15 digital inputs on the NXF4000 can be used as a first-out annunciator if wired and programmed properly. Typically, not all digital inputs are available as some may be used for other dedicated features such as valve proving, airflow switch and fuel valve end switch. Usually at least ten digital inputs will be available for first-out annunciation. Both the recycle and non-recycle limits can be annunciated.

Two relays must be added to the wiring for this method to work. One relay is connected to the end of the non-recycle limits. The other is an off-delay timer with a control signal. This type of timer will close the contacts whenever there is voltage on the control signal input (trigger). Removing the trigger voltage will keep the contacts closed for the duration of the setpoint before opening. The normally open contacts of the relay added will be used to turn the timer trigger on. The normally open contacts of the timer will complete the non-recycle limit circuit “3-P” (P15-4 to P5-10).

The setpoint of the timer should only be one second. The purpose of this timer is to delay the opening of the non-recycle limit input P5-10 very briefly so that the correct digital input reverts the unit to standby or triggers a lockout before a general LOST P5.10 INPUT lockout is issued.

The message shown while in standby or lockout will be FORCED iXX, with XX representing the digital input number. This allows for determining which specific limit is open. See examples of the messages below.



Message while in standby. FORCED i01 represents the limit LOW WATER AUTO RESET.

Message when locked out. FORCED i06 represents the limit HIGH PRESSURE.

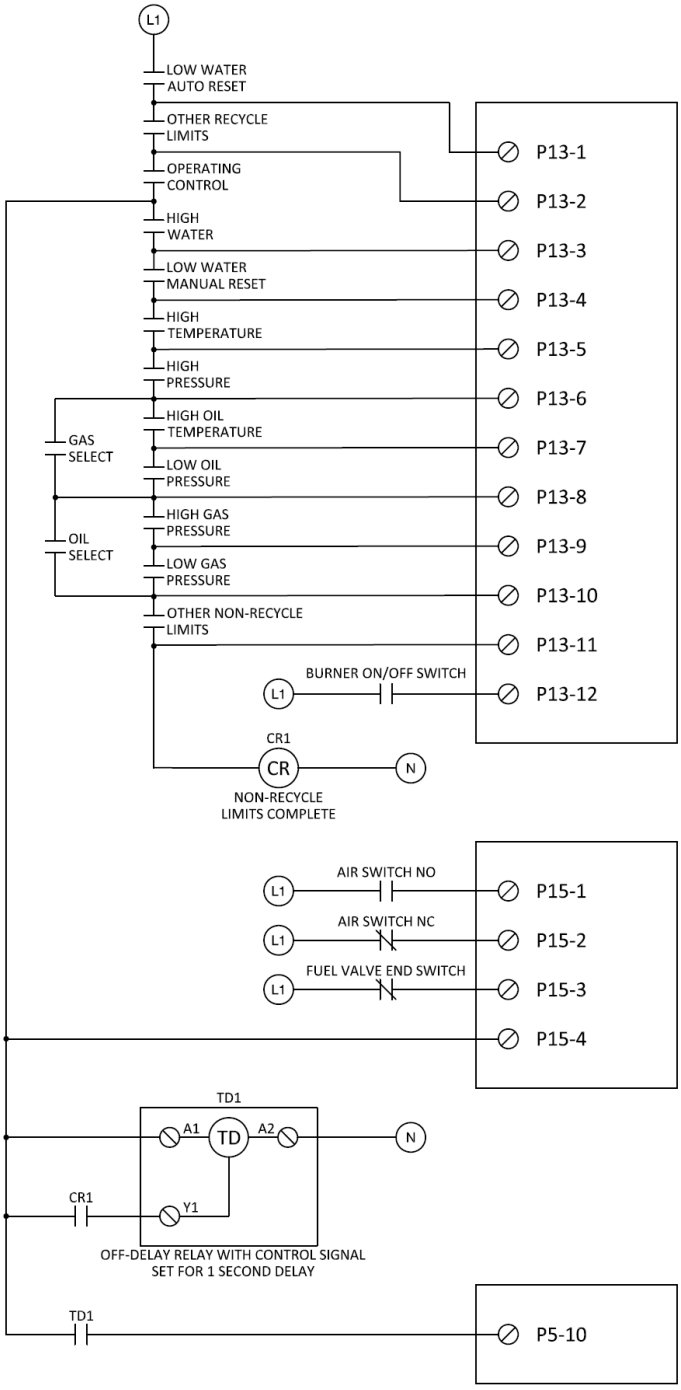
The digital inputs have an option called GENERIC that can be used to hold the control in standby (recycle limits) or trigger a lockout (non-recycle limits) when the input state is 0 (OFF). See *PARAMETERS* section for additional details.

It is important to note that in the microprocessor, the inputs are scanned in order from DI1 to DI15. Since all the recycle and non-recycle limits are in series, wiring the first-out annunciation should begin with DI1 for the first recycle limit. The last non-recycle limit should be connected to the highest value digital input used for annunciation. The burner control switch should also be connected to a dedicated input.

Reserve all the highest inputs from DI15 in reverse order for other dedicated functions such as airflow switch, airflow switch check, valve proving and/or fuel valve end switches.

Wiring Example

This is an example of wiring that can be used. Adjust accordingly for the quantity of available digital inputs as well as the quantities of recycle and non-recycle limits. Multiple limits can also be connected where a single limit is shown – the specific message will simply refer to a group of limits rather than a single limit. This will still allow for quicker troubleshooting in a no-start condition.



Using External End Switches with the NXF4000

Sometimes it is a specification requirement to use external end switches to independently verify the purge and ignition positions during the start-up sequence. While this is straightforward when using a PPC4000 with an external flame safeguard, doing so with an NXF4000 requires special wiring.

This method takes advantage of the time allowed by the control for the airflow switch to prove. The airflow switch must prove within 60 seconds of the purge position being reached.

Using this method requires two digital inputs to be programmed for use with an air switch. The action “AND” allows this function to be used on multiple sets of inputs, so the actual air switch can also be wired to two digital inputs or can be in the safety limit string. Two inputs are used so that there can be a switch check to ensure that the purge end switch changes states when the burner is idle.

The end switch for the purge position latches a relay using power from the blower output. One contact of this relay is in series with the normally open contact from the airflow switch. This only allows the switch to prove if the end switch is made.

After purging finishes, the relay stays latched on, allowing the airflow switch to stay made. The latching relay also provides power to the low fire end switch. The low fire end switch also latches a relay when made. One contact of this relay is in series with the pilot valve output, allowing the pilot to light only if the end switch closes.

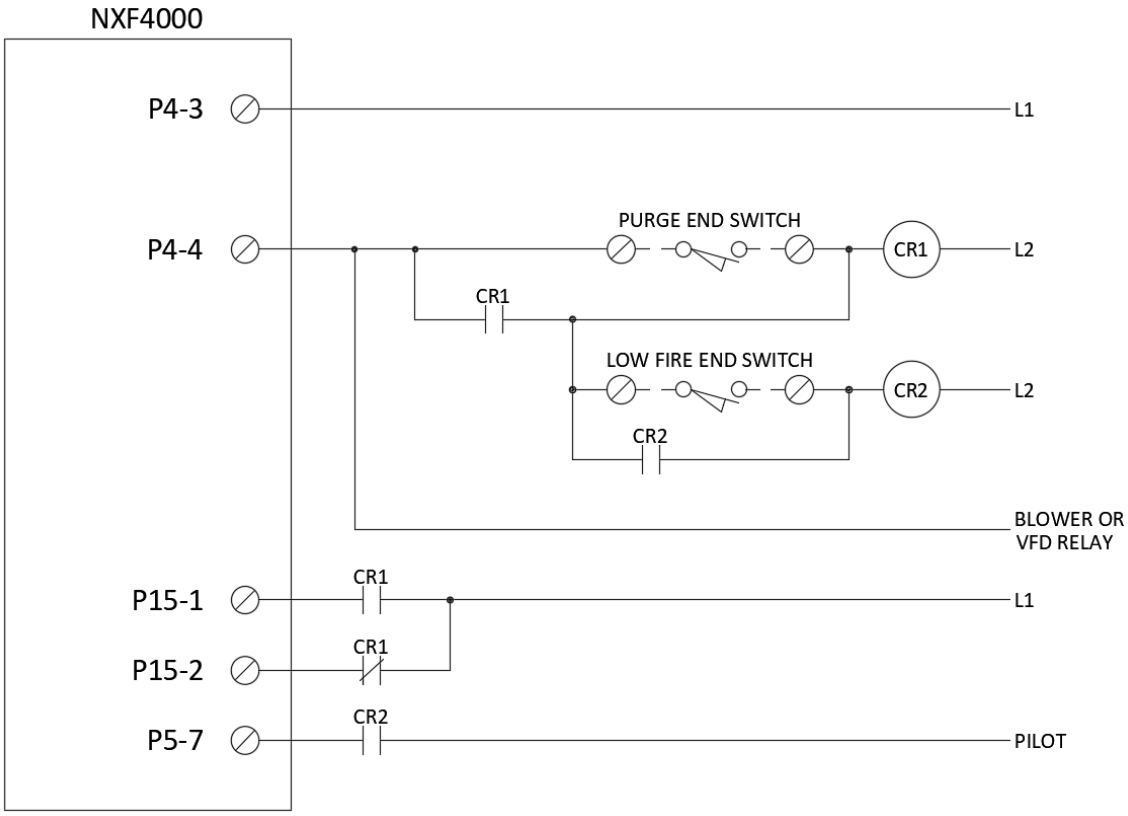
Each relay requires two poles and operates at line voltage. The low fire end switch relay can be omitted, and the low fire end switch directly wired in series with the pilot valve if the pilot is interrupted.

Wiring Example

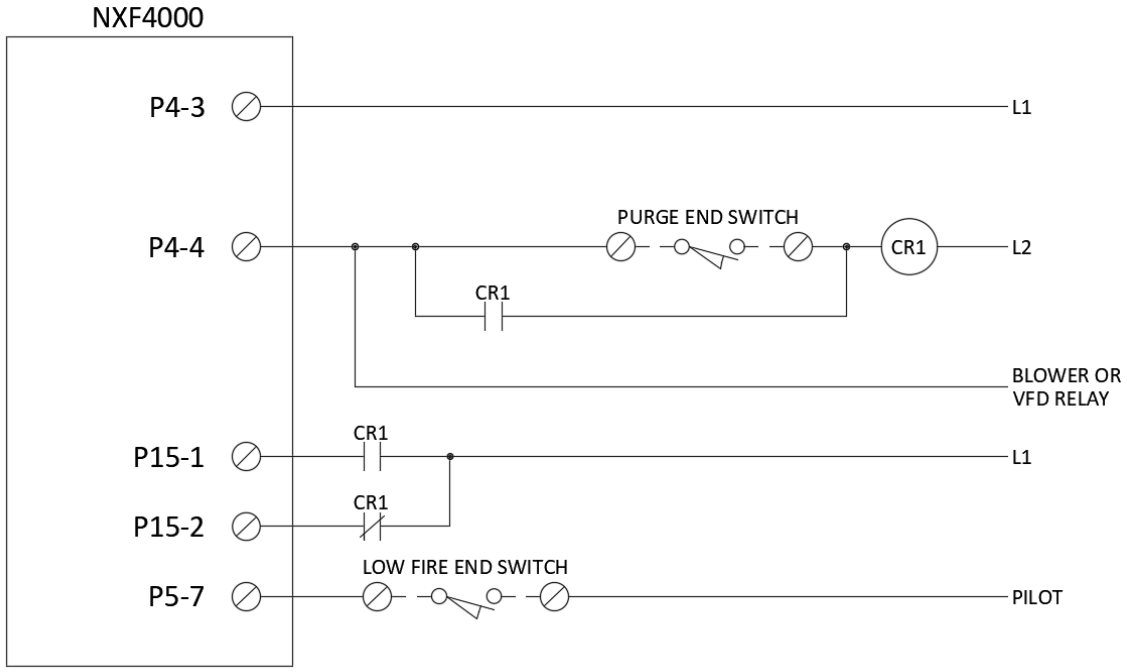
This wiring example uses digital inputs 13 and 14, programmed as follows (see *PARAMETERS* section for additional details):

```
DIGITAL INPUT SETUP → DI 13 → USE → AIRFLOW N.OPEN
DIGITAL INPUT SETUP → DI 13 → ACTION → AND
DIGITAL INPUT SETUP → DI 14 → USE → AIRFLOW N.CLOSED
DIGITAL INPUT SETUP → DI 14 → ACTION → AND
```

This diagram below requires two double-pole relays. Use this wiring for an intermittent pilot (or if pilot type is not known).



This diagram requires one double-pole relay. Use this wiring for an interrupted pilot.



Using a Single Servo

The minimum requirement for the NXF4000 or PPC4000 is to connect either two servos, or to connect a single servo and a VFD with feedback. It is possible to connect a single servo without a VFD if an NXCESVFD card is fitted with the output connected to the feedback.

This method simulates a VFD being connected. As such, it is still required to input values to the VFD channel during commissioning.

For VFD 1, this requires placing a jumper wire from P14.4 to P14.6. No jumper wire is required for the analog common as both terminals share the same internal reference.

For VFD 2, this requires placing a jumper wire from P14.3 to P14.5.

Section 4: Operation

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NXD410TS

The NXD410TS interface is a 4.3” touchscreen that is used for operation, monitoring and commissioning of the NXF4000. Refer to bulletin *NXD-4102* for more detail on these touchscreens.

The NXD410TS display provides four lines of information. The active area of the display is highlighted on the second line. The four directional keys (located on the right-hand corner) are used to navigate through the menus and to update values. The next section shows the various symbols and their functions.

The NXD410TS contains several 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 non-volatile meaning the state of the function is retained in memory should a power recycle occur.

NXTSD507HD AND NXTSD512HD

The NXTSD507HD and NXTSD512HD are touchscreen user interfaces that offer additional benefits. These can be used as the only user interface or in combination with an NXD410TS.

The same quick keys outlined in the previous NXD410TS section also exist on these touchscreens. The menu structure is different as the different main categories are presented as drop-down choices. This allows choosing sub menus and entering parameter settings. The same passcodes exist and must be entered before changes can be made.

In addition, local security is required before certain functions can be performed. Refer to bulletin *TSD-4001* for more detail on these touchscreens.

The NXTSD507HD and NXTSD512HD touchscreens require an additional level of local security beyond the passcodes. Local security will prevent changing parameters or commissioning if the local passwords are not known.

Local security defaults (all are case sensitive):

User	Password	View screen	Change settings	Screen options	Shutdown screen
Default	<none>	X	---	---	---
Eng	**Eng**	X	X	---	---
Admin	**Admin**	X	X	X	X

LEGACY USER INTERFACES

Existing installations may have a user interface installed that is no longer offered for sale. The most common of these is the NXD410 keypad. Follow the same instructions for the NXD410 keypad as are described for the NXD410TS keypad. The same four-line display and quick keys are present on each and both function the same other than the form factor (LCD display and mechanical keys vs. touchscreen).

NXD410

Other user interfaces encountered in the field may be the NXTSD407 or NXTSD413 touchscreens. As with the NXTSD507HD and NXTSD512HD, these have the same menus but are laid out in a different manner. Refer to bulletin *NXTSD-4001* for more detail on operation using these touchscreens.

NAVIGATION

Quick Keys

Button	Key Name	Description
	BURNER ON	Used to turn the burner on or off. The button changes from gray to green when the burner is in the ON mode. This button can be enabled via the **KEYPAD SETUP** menu. Note that this button does not override any recycle limits.
	LOW FIRE	Used to force the burner into low fire operation. The button changes from gray to green when active. This button can be enabled via the **KEYPAD SETUP** menu.
	LEAD LAG	Used to make the control the master when sequencing is enabled. The button changes from gray to green when active. This button can be enabled via the **KEYPAD SETUP** menu. **SEQUENCING SETUP → MASTER SLCT** must also be set to KEYPAD.
	AUTO MAN	Used to force the burner into manual firing rate operation. The button changes from gray to green when active. This button can be enabled via the **KEYPAD SETUP** menu.
	C-MODE NXD410TS	Used to go to the Commissioning or Adjust Ratio mode. The mode entered depends upon the passcode used and whether the burner is firing at the time. While in Commissioning Mode or Adjust Ratio mode, this button is also used to exit Commissioning or Adjust Ratio mode.
	C-MODE NXTSD507HD NXTSD512HD	
	ADJUST RATIO NXTSD507HD NXTSD512HD	Used to go to the Adjust Ratio mode. The mode entered depends upon the passcode used and whether the burner is firing at the time. While in Commissioning Mode or Adjust Ratio mode, this button is also used to exit Commissioning or Adjust Ratio mode.
	ADJUST SETPOINT NXD410TS	Used to go to the setpoint screen for the currently active setpoint.

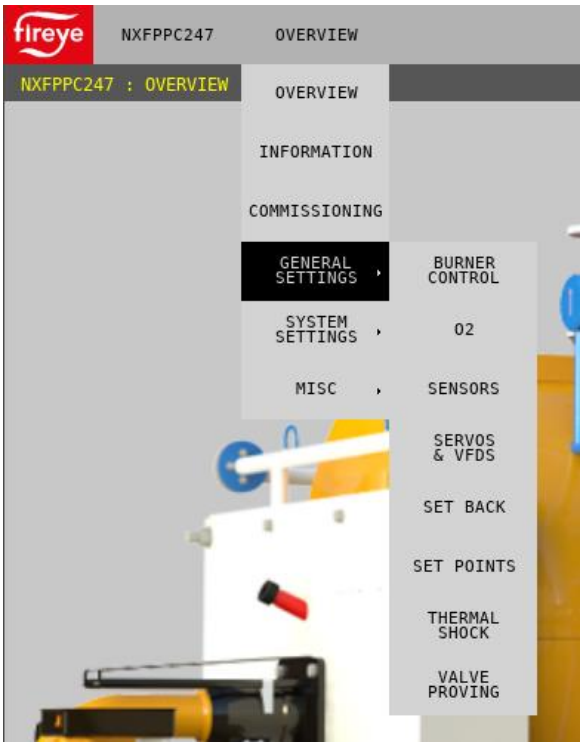
Button	Key Name	Description
	RESET	Allows reset of non-volatile lockout.
	CHECK/RUN NXTSD507HD NXTSD512HD	This button will toggle check mode on and off. It is only visible if the current state supports check mode when check mode is active (GENERAL SETTINGS → BURNER CONTROL → RUN/CHECK ENABLE).
	CHECK/RUN and FAULT NXD410TS	Normally used to access fault history information. If **BURNER CNTRL SETUP → ENABLE RUN/CHECK** is set to YES and the current state supports check mode, this button will toggle check mode.
	MODIFY/SAVE NXD410TS	In modify mode the button changes from red to green. In this mode changes to a value are allowed. Pressing again restores the button to red and saves the entry.
	UP/DOWN NXD410TS	Used to navigate up and down through the menu structure. When in modify mode these are used to increment/decrement the values. Most values will scroll from maximum to minimum or from minimum to maximum in a loop.
	BACK/NEXT NXD410TS	Used to move forward or backward through the menu options. This only applies to what is on the second (highlighted) line of the display.
	HOME NXD410TS	Used to return to the home display from any other screen.
	INFO NXD410TS	Used to access the information screen where system and diagnostic information can be accessed.
	HELP NXD410TS	Used to access the help legend on-screen showing the meaning of each Quick Key.

Menu Structure

With the NXD410TS, the menu structure accessible from the HOME quick key presents the menu in a cyclical list. The whole list is can navigated in either direction using either the UP or DOWN quick keys. Press the NEXT quick key to enter the specific menu.

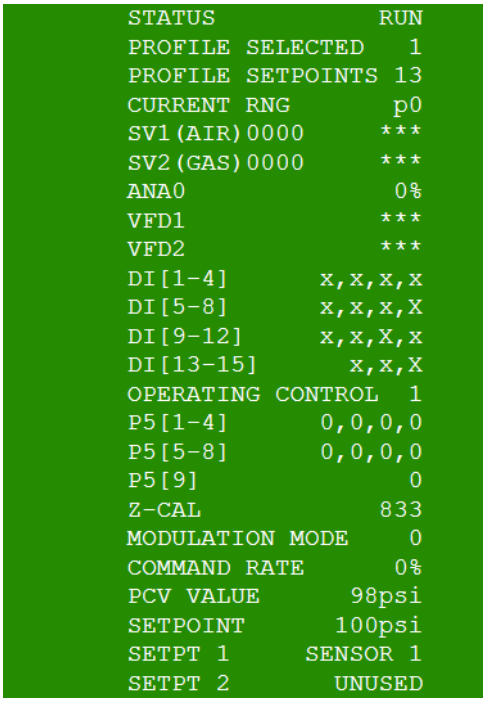
With the NXTSD507HD and NXTSD512HD, the menu structure is presented ad drop-down menus with sub menus as needed.

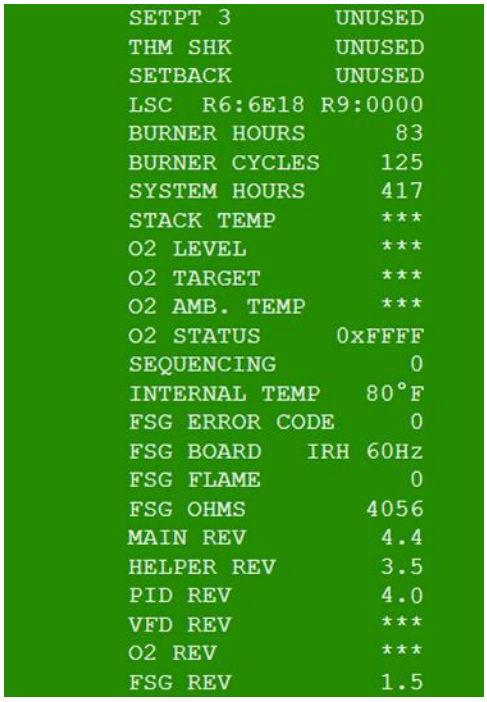
```
STANDBY          s01
BURNER OFF
SETPOINT 1    100psi
PCV VALUE      98psi
MODULATION RATE   0%
AIR(1)           ***
GAS(2)           ***
SERVO SETUP        >
SENSOR SETUP       >
SETPOINT SETUP     >
PROFILE SETUP      >
BURNER CNTRL SETUP >
DIGITAL INPUT SETUP>
USER OUTPUT SETUP  >
O2 SETUP           >
SEQUENCING SETUP   >
THERMAL SHOCK SETUP>
SETBACK SETUP      >
COMMUNICATION SETUP>
KEYPAD SETUP       >
SD CARD OPS SETUP  >
ANALOG OUT SETUP   >
FAULT HISTORY      >
PASSCODE SETUP     >
SENSOR 1       98psi
11:08PM 12-JAN-2020>
```



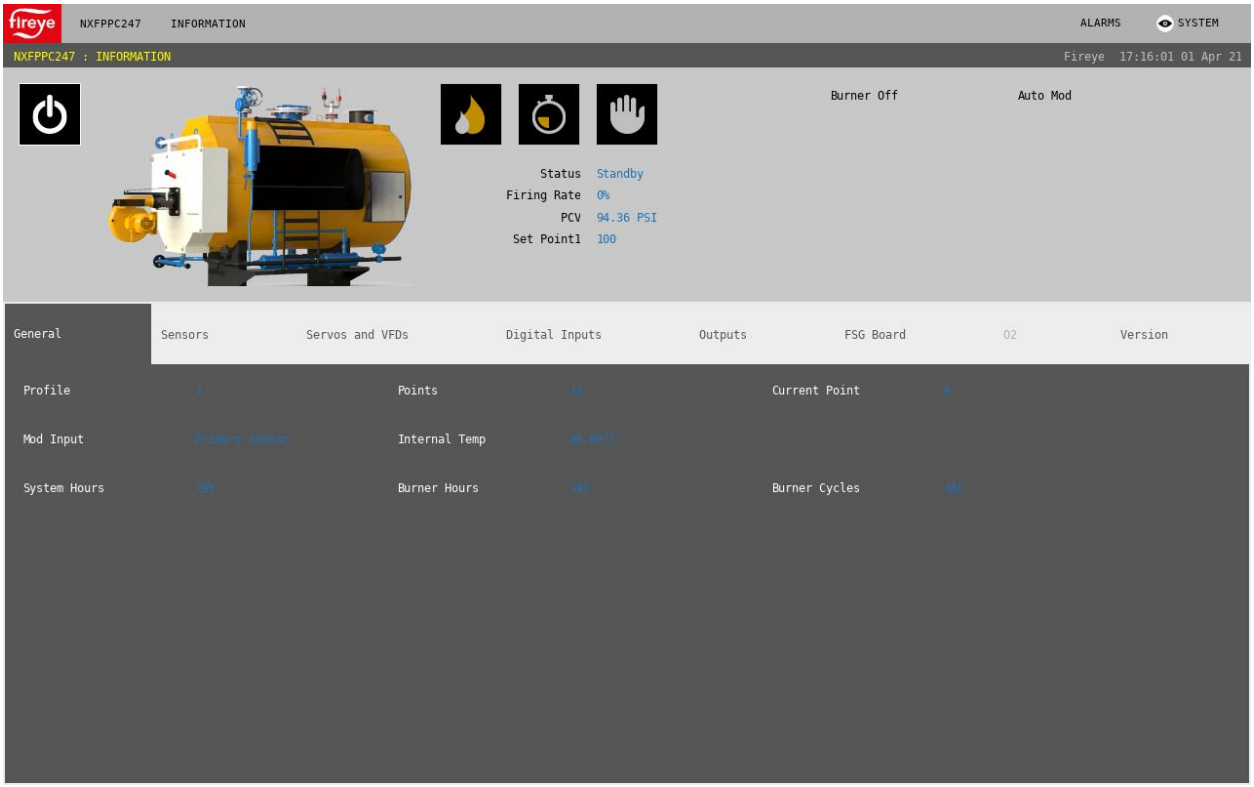
Information Screen

With the NXD410TS, the information screen is accessible from the INFO quick key. This screen shows diagnostic information about the inputs, sensors, software and more. This is also where burner cycles and hours can be viewed. The whole list can be navigated in either direction using either the UP or DOWN quick keys. Pressing the INFO quick key again exits back to the same screen being viewed prior to accessing the INFO screen.



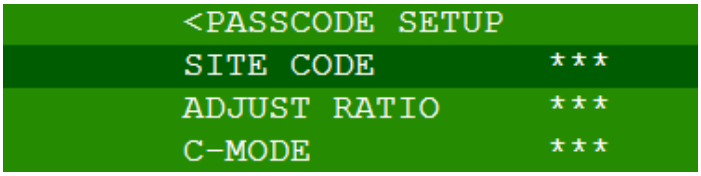


With the NXTSD507HD and NXTSD512HD, the information screen is accessible by choosing INFORMATION in the drop-down menu. The different information categories are then presented as tabs.



Security

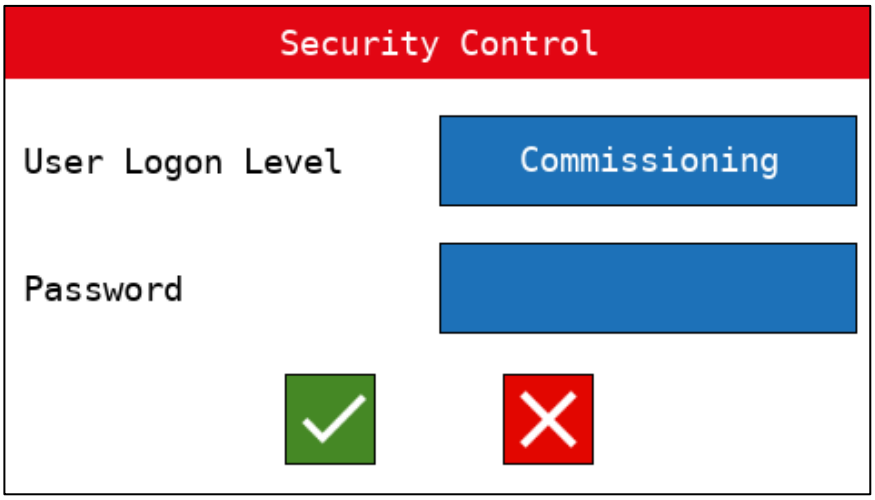
There are three levels of passcode: SITE, ADJUST RATIO and C-MODE.

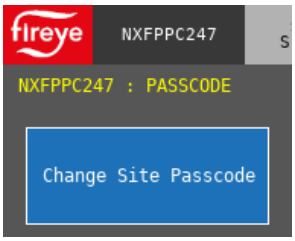


Each passcode level has different access as shown in the table below. The passcodes for ADJUST RATIO and C-MODE are not changeable, but the passcode for SITE can be changed by first going to the PASSCODE SETUP menu, entering the C-MODE passcode successfully, and then entering a value for the SITE passcode. This will become the new SITE passcode. Entering 000 for the SITE passcode will disable the SITE passcode entirely, removing any barrier to access that the SITE passcode provided.

Level	Passcode	Access Allowed
SITE	**154** (this is default, can be changed)	SETPOINT SETUP SEQUENCING SETUP
ADJUST RATIO	**256** (can't be changed)	SETPOINT SETUP SEQUENCING SETUP O2 SETUP PROFILE SETUP (erasing profiles only) Adjust ratio mode
C-MODE	**903** (can't be changed)	Full access (no restrictions)

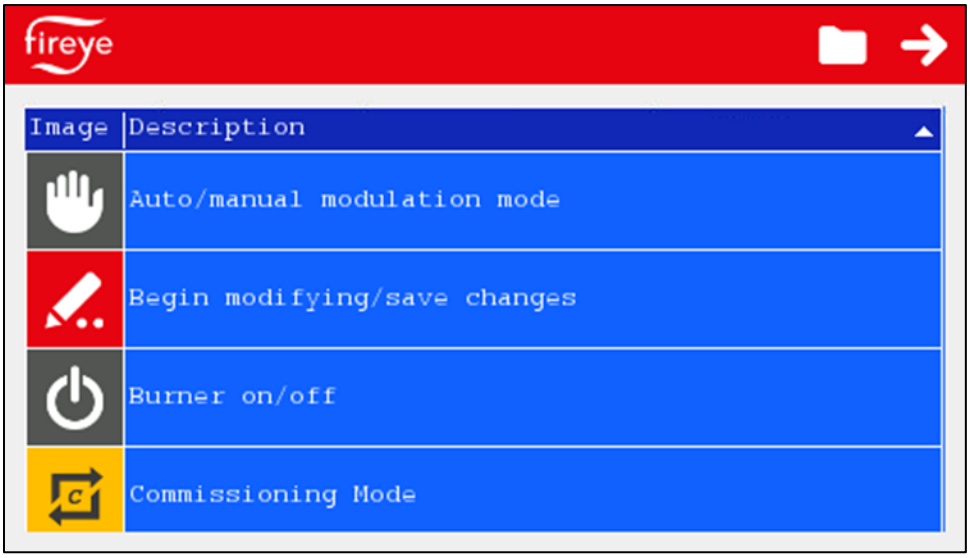
With the NXTSD507HD and NXTSD512HD, a pop-up will ask for the passcodes when necessary. There is also an option in the drop-down menu (SYSTEM SETTINGS → PASSCODE) that allows changing the SITE passcode.



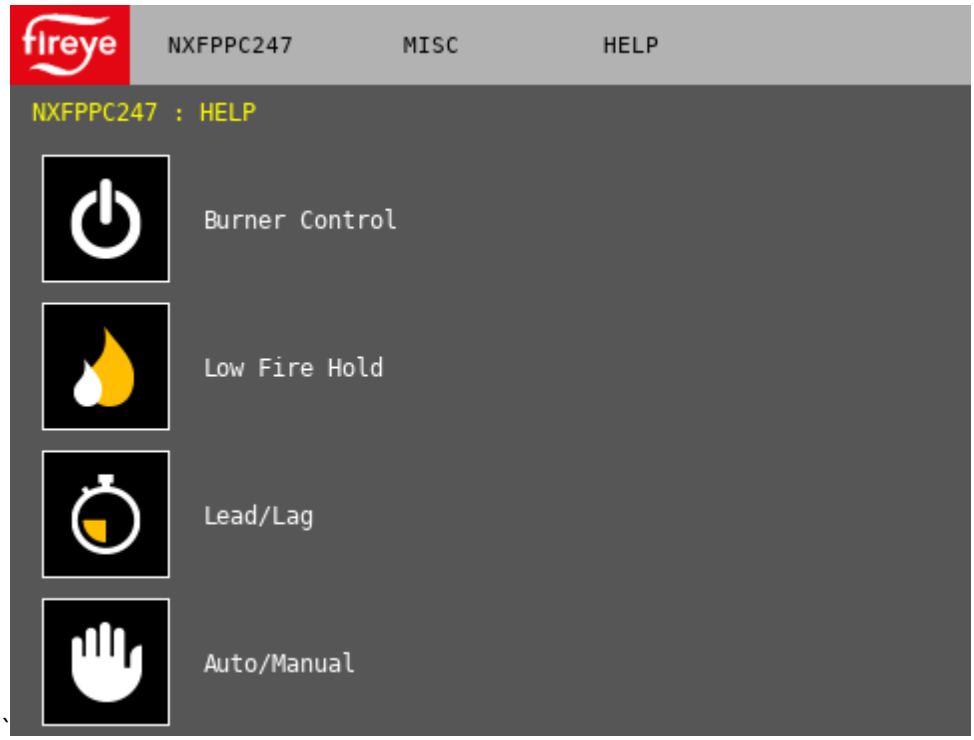


Help

With the NXD410TS, pressing the folder icon on the upper right corner will display the help screen. The help screen contains a legend with the definitions for all the quick keys. Swipe the help screen to slide the legend up and down. Pressing the arrow icon on the upper right will exit the help screen.



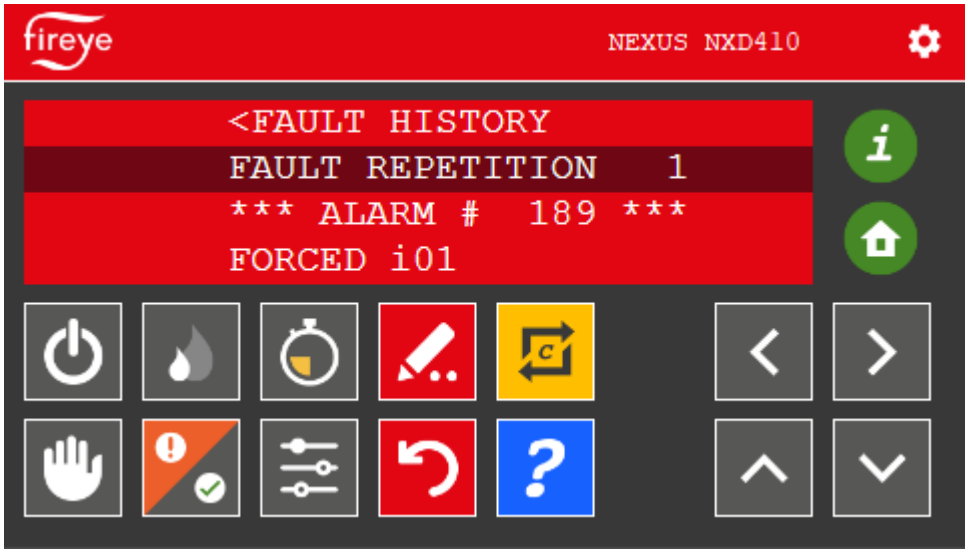
With the NXTSD507HD and NXTSD512HD, choose MISC. → HELP in the drop-down menu.



Lockout and Fault History

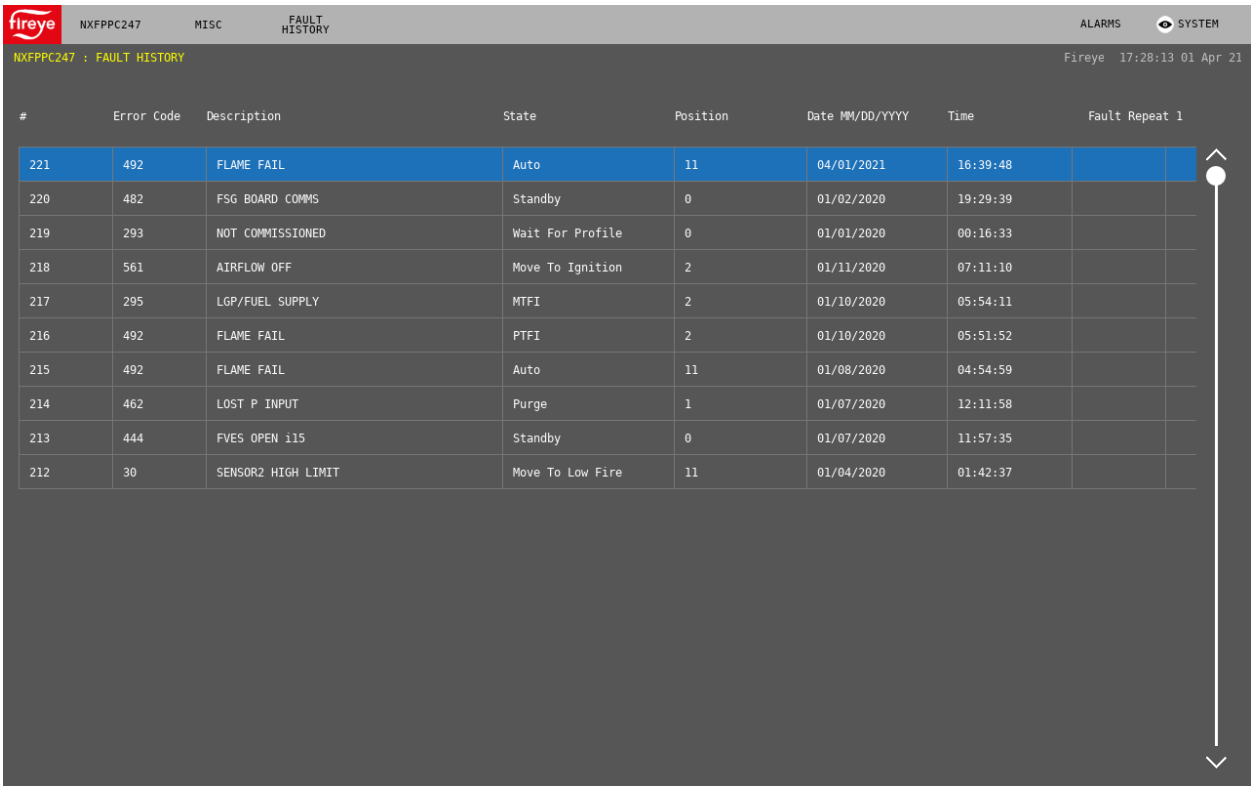
With the NXD410TS, if there is a lockout, the display background will turn red and the lockout information will be displayed. Use the UP/DOWN quick keys to look at all the lockout information, including the error code (begins with “e”), operating state, combustion curve position and time/date of the lockout. Scrolling down through the fault history will show the last 10 faults.

This same information can be viewed at any time by pressing the combined CHECK/RUN and FAULT HISTORY quick key.



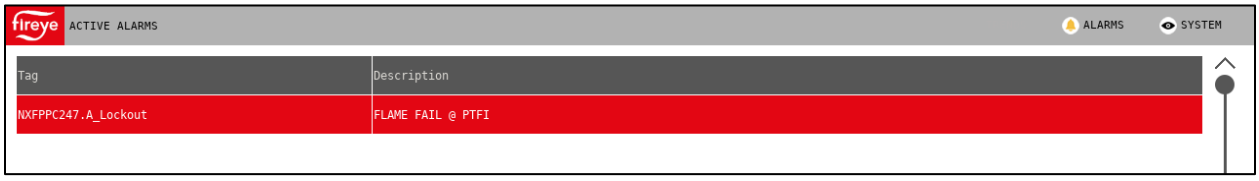
With the NXTSD507HD and NXTSD512HD, and active lockout will show in a banner located at the bottom of the screen, as well as in a red highlight on the overview.

Choosing MISC. → FAULT HISTORY in the drop-down menu will display the fault history contained in the NXF4000 or PPC4000 non-volatile memory.

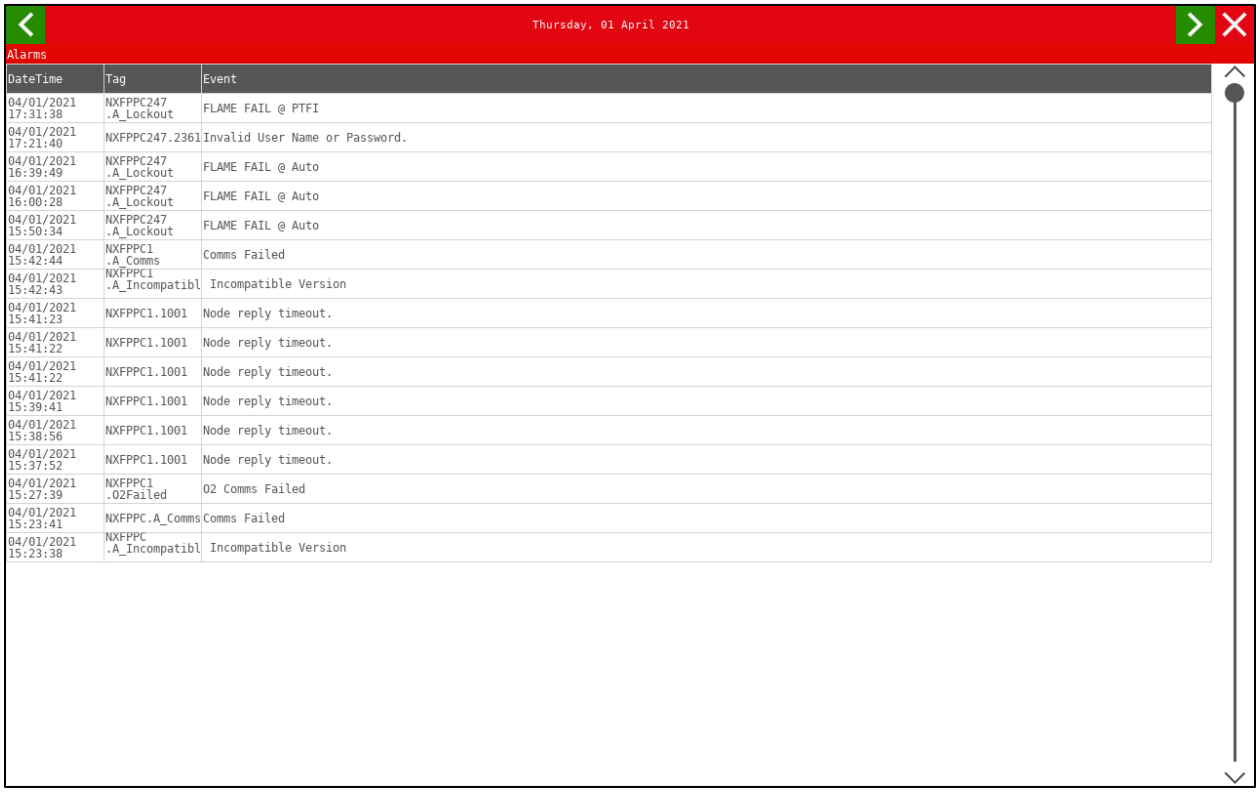


#	Error Code	Description	State	Position	Date MM/DD/YYYY	Time	Fault Repeat 1
221	492	FLAME FAIL	Auto	11	04/01/2021	16:39:48	
220	482	FSG BOARD COMMS	Standby	0	01/02/2020	19:29:39	
219	293	NOT COMMISSIONED	Wait For Profile	0	01/01/2020	00:16:33	
218	561	AIRFLOW OFF	Move To Ignition	2	01/11/2020	07:11:10	
217	295	LGP/FUEL SUPPLY	MTFI	2	01/10/2020	05:54:11	
216	492	FLAME FAIL	PTFI	2	01/10/2020	05:51:52	
215	492	FLAME FAIL	Auto	11	01/08/2020	04:54:59	
214	462	LOST P INPUT	Purge	1	01/07/2020	12:11:58	
213	444	FVES OPEN i15	Standby	0	01/07/2020	11:57:35	
212	30	SENSOR2 HIGH LIMIT	Move To Low Fire	11	01/04/2020	01:42:37	

The NXTSD507HD and NXTSD512HD also captures alarms and system events locally. System events are abnormal occurrences such as communication loss, invalid password and similar. This allows more alarms to be retained than the NXF4000 and PPC4000 limit of the previous ten. Choose ALARMS → ACTIVE to see the currently active alarms.



Choose ALARMS → LOG to see the full history of all alarms and events in the touchscreen memory.

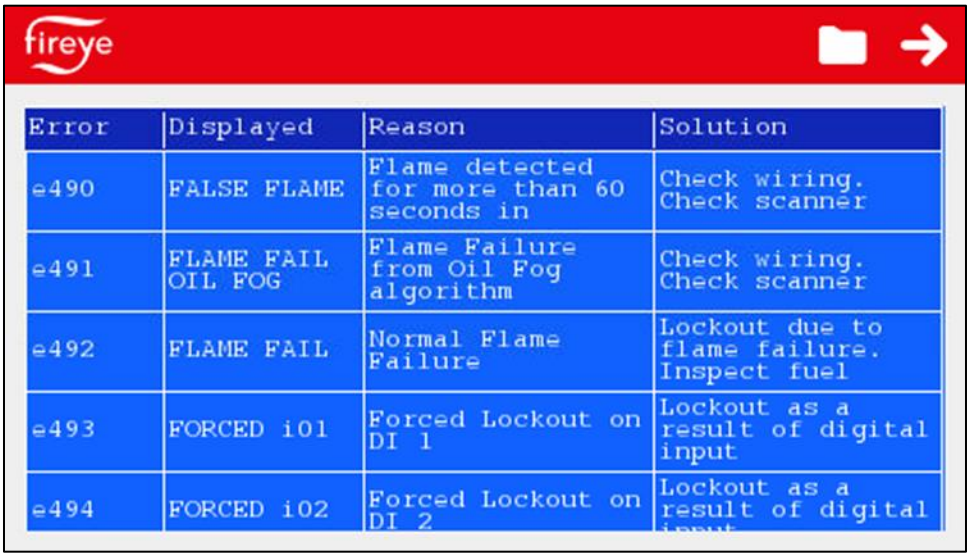


DateTime	Tag	Event
04/01/2021 17:31:38	NXFPPC247 .A_Lockout	FLAME FAIL @ PTFI
04/01/2021 17:21:40	NXFPPC247.2361	Invalid User Name or Password.
04/01/2021 16:39:49	NXFPPC247 .A_Lockout	FLAME FAIL @ Auto
04/01/2021 16:00:28	NXFPPC247 .A_Lockout	FLAME FAIL @ Auto
04/01/2021 15:50:34	NXFPPC247 .A_Lockout	FLAME FAIL @ Auto
04/01/2021 15:42:44	NXFPPC1 .A_Comms	Comms Failed
04/01/2021 15:42:43	NXFPPC1 .A_Incompatibl	Incompatible Version
04/01/2021 15:41:23	NXFPPC1.1001	Node reply timeout.
04/01/2021 15:41:22	NXFPPC1.1001	Node reply timeout.
04/01/2021 15:41:22	NXFPPC1.1001	Node reply timeout.
04/01/2021 15:39:41	NXFPPC1.1001	Node reply timeout.
04/01/2021 15:38:56	NXFPPC1.1001	Node reply timeout.
04/01/2021 15:37:52	NXFPPC1.1001	Node reply timeout.
04/01/2021 15:27:39	NXFPPC1 .O2Failed	O2 Comms Failed
04/01/2021 15:23:41	NXFPPC.A_Comms	Comms Failed
04/01/2021 15:23:38	NXFPPC .A_Incompatibl	Incompatible Version

Lockout Help

When a lockout is displayed, pressing the HELP quick key will show a concise reason and solution for the error. The error code help table will jump to the proper index for the current lockout code. See *TROUBLESHOOTING* section for additional details. This only applies to the NXD410TS as the NXTSD507HD and NXTSD512HD both show more information in the fault history.

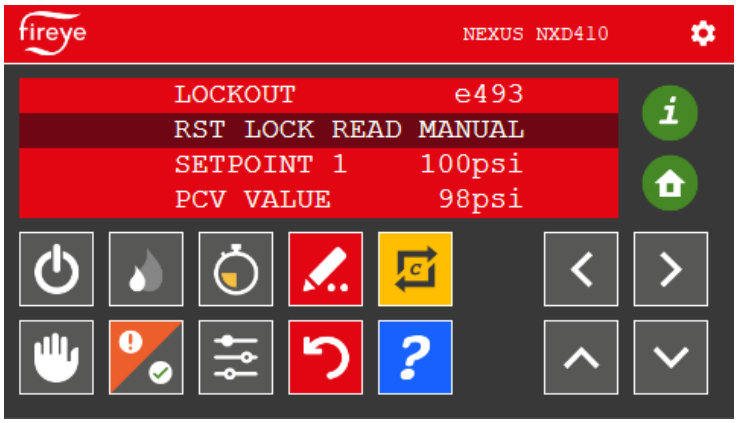
If the help screen is showing the quick key legend, press the folder icon to switch to the error code help table. Pressing the arrow icon on the upper right will exit the help screen.

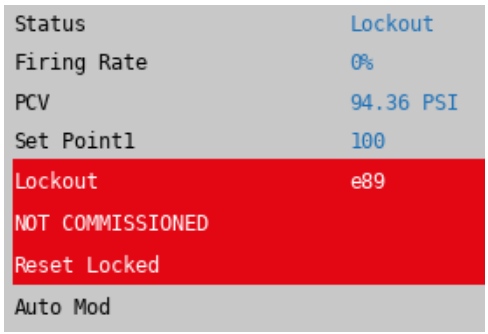


Lockout Reset and Reset Lock

If there is a lockout, it can be reset one of three ways: via the RESET quick key, via a digital input or via Modbus. Note that any remote reset scheme used should only be done within sight and sound of the burner to ensure safety.

There is a fault repetition counter in the NXF4000 and PPC4000 that counts how many faults have occurred during a power cycle. If this counter reaches six (the sixth lockout), the control will go into "Reset Lock" mode. When in this mode, a power cycle is necessary to reset the lockout and fault repetition counter.



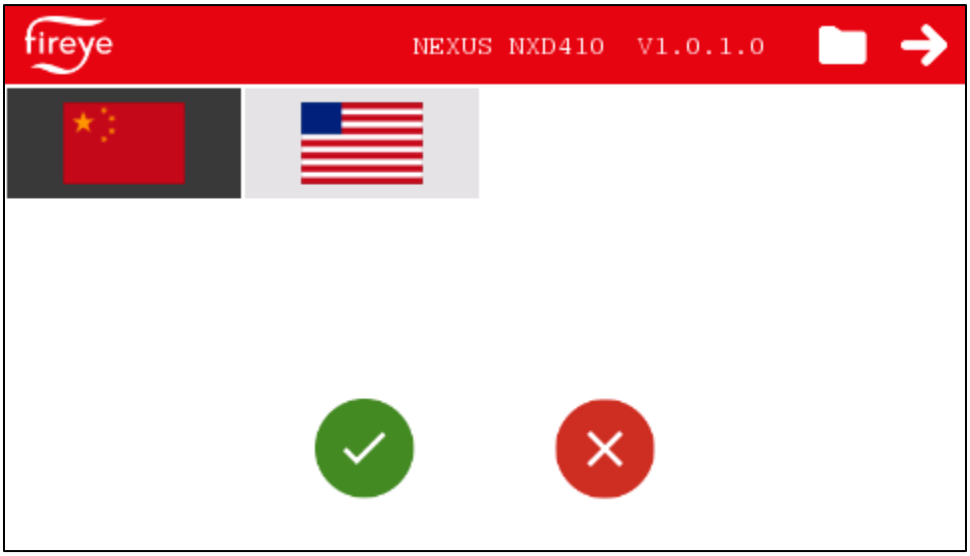


WARNING: NOTICE: Regulation prohibits the system from allowing more than five reset attempts in a 15-minute window. If five reset attempts are made without addressing the lockout, the system will prevent the user from issuing additional resets and it will force the user to wait for the balance of 15 minutes. Reset operation will be restored after the wait period. It is expected that qualified personnel assess the lockout condition and apply the proper remedy to address the lockout. A single reset attempt is usually enough to restore normal system operation.

Cycling power to the control will also restore the ability to reset before the 15 minutes have elapsed.

Language Support

With the NXD410TS, pressing the gear icon on the upper right corner will display the language setup screen. The choices are presented using flag icons. The choices are Simplified Chinese or English. Pressing the arrow icon on the upper right will exit the help screen.



With the NXTSD507HD and NXTSD512HD, there are many language options available. These language templates can be modified using the *Fireye Theme Editor* software program. See bulletin *TSD-4001* for more detail on this process.

To change the language, choose SYSTEM → OPTIONS. Language will be the first option page shown. Simply select the desired language and then touch the green checkmark to apply the change.

OPERATION

General operation is described using the NXD410TS keypad. Refer to bulletin *TSD-4001* for more detail on operation using the NXTSD507HD or NXTSD512HD touchscreens.

Enable/Disable

To turn the burner control on and off, use the BURNER ON quick key. This requires that this quick key is enabled from the KEYPAD SETUP menu and that the correct AND/OR option is chosen to work with any digital inputs programmed for use as BURNER CONTROL. The quick key will have a gray background while off and a green background while on. See *PARAMETERS* section for additional details.

Note that when using the NXTSD507HD or NXTSD512HD, this key will always be enabled.

Low Fire Hold

To apply the low fire hold, use the LOW FIRE HOLD quick key. This requires that this quick key is enabled from the KEYPAD SETUP menu and that the correct AND/OR option is chosen to work with any digital inputs programmed for use as LOW FIRE HOLD. The quick key will have a gray background while off and a green background while on. See *PARAMETERS* section for additional details.

Note that when using the NXTSD507HD or NXTSD512HD, this key will always be enabled.

Low fire hold has priority over the manual or automatic modulation rates.

Lead Lag

When using the peer-to-peer sequencing, the lead control can be chosen using the LEAD LAG quick key. This requires that this quick key is enabled from the KEYPAD SETUP menu and that using the keypad is the chosen method for selecting the lead. The quick key will have a gray background while off and a green background while on. See *PARAMETERS* section for additional details.

Note that when using the NXTSD507HD or NXTSD512HD, the method to use for MASTER SELECT should be COMMS instead of KEYPAD. However, the key must still be enabled in the KEYPAD menu.

Auto or Manual Modulation

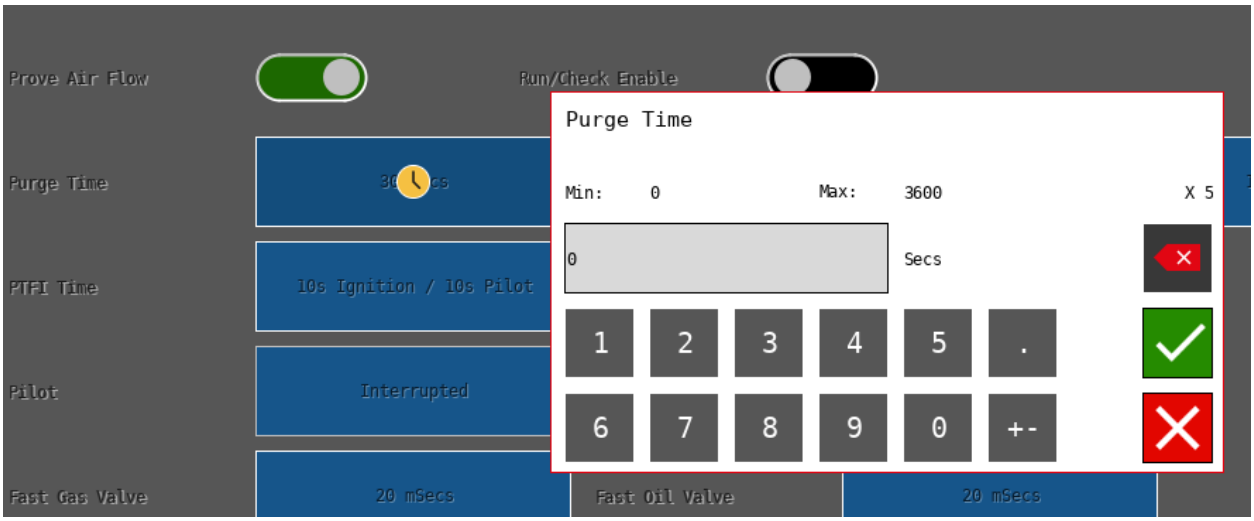
Automatic or manual control can be toggled using the AUTO MAN quick key. This requires that this quick key is enabled from the KEYPAD SETUP menu. To adjust the manual rate, place the line displaying the MANUAL MOD RATE on the second line, then use the procedure outlined in the *Modifying Values* section. The quick key will have a gray background while off and a green background while on. See *PARAMETERS* section for additional details.

The manual modulation rate will have priority over the automatic modulation rate but can be overridden by the low fire hold.

Modifying Values

With the NXD410TS, place the value to modify on the second line of the display. This is the line with the darker background. Once this is done, press the MODIFY/SAVE quick key to enable writing a new value. If the value is writable, the MODIFY/SAVE quick key will turn green. Once that is done, the UP/DOWN arrows can be used to modify the value. Pressing MODIFY/SAVE again will write the value. Once done, the MODIFY/SAVE quick key will return to red.

With the NXTSD507HD and NXTSD512HD, simply touch the value to modify and a pop-up will appear to enter the new value. The minimum and maximum allowed values will also be displayed.



If a passcode is needed for the chosen value to be written, the interface will automatically display the screen or pop-up for entering that value. Follow this same procedure to enter the passcode.

Navigating to Menus

With the NXD410TS, press the HOME quick key to return to the home display area. From there, use the UP/DOWN arrow keys to scroll through the available menus. To enter a menu, press the NEXT quick key (forward arrow). Continue using this method to enter any nested sub-menus. To return to a previous menu, use the BACK quick key. Also use the BACK quick key to escape when MODIFY/SAVE is active and no change is desired.

With the NXTSD507HD and NXTSD512HD, the Fireye logo returns to the OVERVIEW screen. The menus are all accessible using drop-down menus by touching the name of the current screen to display all of the other available options. From the OVERVIEW screen, touch OVERVIEW to display the menu.

Adjusting Setpoints

With the NXD410TS, use the ADJUST SETPOINT quick key to quickly access the menu for setpoint 1. This can also be accessed from the home screen by scrolling down to the SETPOINT SETUP menu.

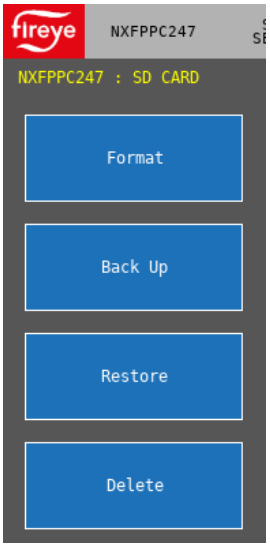
With the NXTSD507HD and NXTSD512HD, GENERAL SETTINGS → SET POINTS will display the setpoint screen.

Choose the specific setpoint to adjust. Choose a value to adjust and then enter either the SITE CODE, ADJUST RATIO or C-MODE passcode to allow adjustment. Users with the SITE CODE passcode can adjust the setpoint, cut in and cut out points, alarm points and PID tuning parameters. The SITE CODE is designed to allow changes in operation but no in the configuration.

SD Card

The NXF4000 has an on-board SD card reader and ships with an SD card inserted. Any SD card (up to 32GB has been confirmed to work) formatted with the FAT32 file system can be used. The NXF4000 and PPC4000 also can format the SD card.

With the NXD410TS, the menu will jump to the SD CARD OPS SETUP line of the home screen automatically when the SD card is inserted. The arrows can also be used to access this menu if the card is already inserted. From this menu, choose the desired action: BACKUP, RESTORE, DELETE or FORMAT.



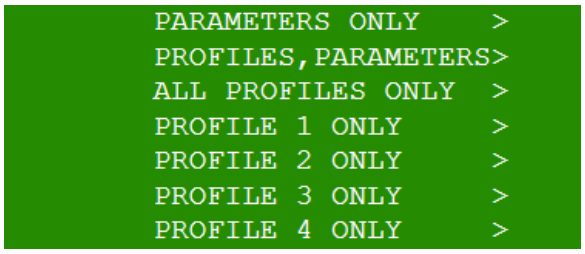
With the NXTSD507HD and NXTSD512HD, SYSTEM SETTINGS → SD CARD will display the SD card screen.

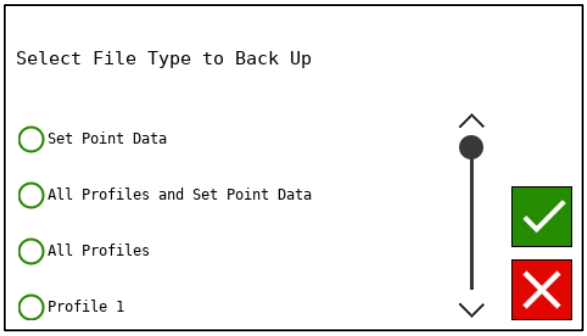
Backup

The backup is organized into different categories:

NXD410TS	NXTSD507HD NXTSD512HD	Description
PARAMETERS ONLY	SET POINT DATA	All settings other than profile settings are backed up. This excludes the combustion curves.
PROFILES, PARAMETERS	ALL PROFILES AND SET POINT DATA	All settings are backed up.
ALL PROFILES ONLY	ALL PROFILES	Combustion curve and profile settings are backed up.
PROFILE 1 ONLY PROFILE 2 ONLY PROFILE 3 ONLY PROFILE 4 ONLY	PROFILE 1 PROFILE 2 PROFILE 3 PROFILE 4	Combustion curve data from the selected profile is backed up. This can later be restored to a different profile, but the profile will still need to be confirmed by moving through the points.

All the backup files will have a different extension depending upon the type of file. The default name will be based upon the time and date set in the control but can be changed to a different name if the SD card is inserted into a PC (will still be recognized). Note that a backup can only be done when the control is in the standby state or the message will read NOT IN STANDBY.





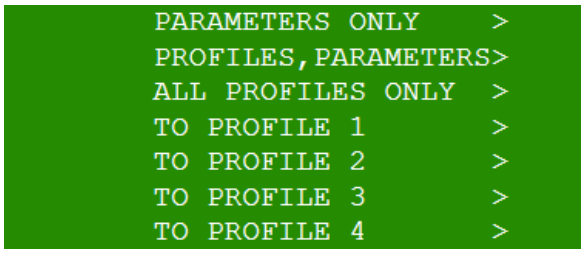
Restore

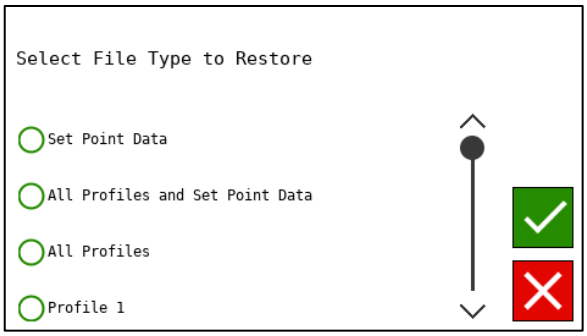
WARNING: The restore function is intended for backing up local profiles and parameters only. It is up to the technician performing this operation to ensure that restoring profiles and/or parameters is safe. Never restore profiles and/or parameters without subsequently verifying that the parameters are correct and confirming safe operation. Failure to do so could result in significant property damage, severe injury, or death.

The restore is organized into the same categories as the backup:

NXD410TS	NXTSD507HD NXTSD512HD	Description
PARAMETERS ONLY	SET POINT DATA	All settings other than profile settings are restored from a valid backup file. This excludes the combustion curves.
PROFILES, PARAMETERS	ALL PROFILES AND SET POINT DATA	All settings are restored from a valid backup file..
ALL PROFILES ONLY	ALL PROFILES	Combustion curve and profile settings are restored from a valid backup file.
PROFILE 1 ONLY PROFILE 2 ONLY PROFILE 3 ONLY PROFILE 4 ONLY	PROFILE 1 PROFILE 2 PROFILE 3 PROFILE 4	Combustion curve data from a valid backup file is restored to the selected profile. This can be from a different profile number. The profile will need to be confirmed by moving through the points.

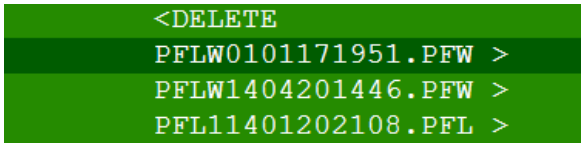
Once an option is chosen all available backup files are shown so the one to restore can be selected. If the backup file is invalid (corrupted or from an incompatible firmware or model such as the PPC4000), this will be indicated. Note that restoring can only be done when the control is in the standby state or the message will read NOT IN STANDBY.

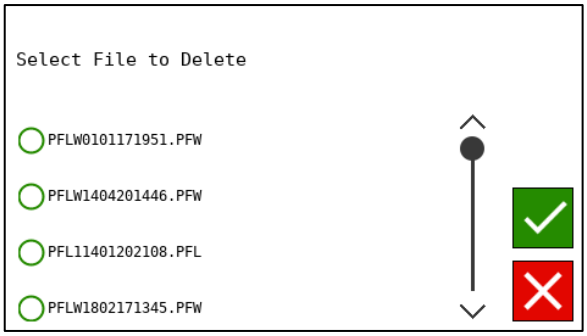




Delete/Format

When DELETE is selected, all the valid files on the SD card are shown in a list. This list is in the same format that is shown when selecting a backup file to restore, except that they are not organized by type. All files are shown in alpha-numeric order regardless of extension.





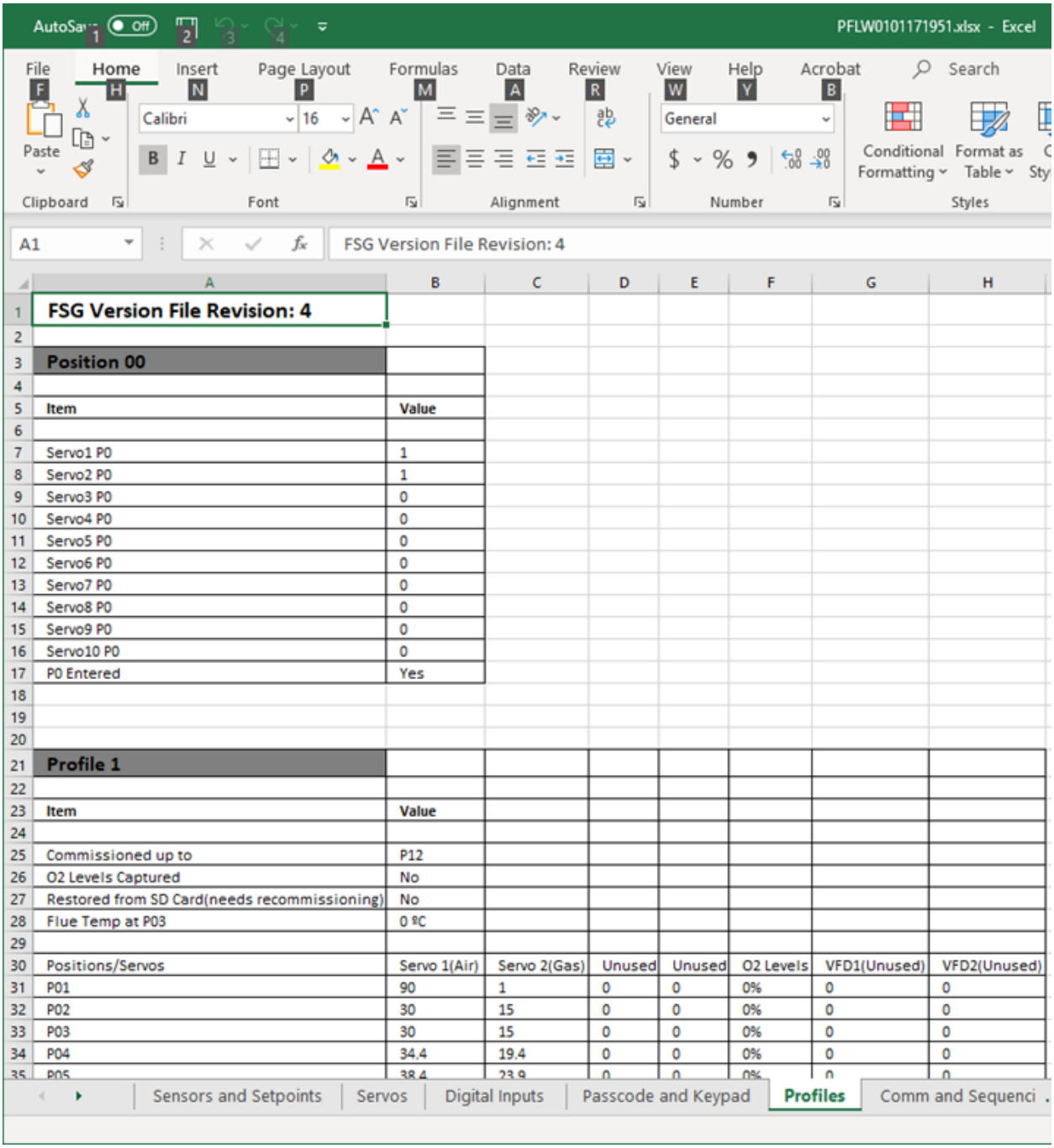
Choosing FORMAT will format the SD card using the compatible FAT32 file system. Note that formatting will result in the loss of all current files on the SD card and the action can't be reversed.

Commissioning

See *COMMISSIONING* section for full detail on the commissioning process.

SD Card Reader Software

Software is also available so that any backup file can be viewed on a PC using Microsoft Excel or a similar. Search for “SD Card File Reader” on the Fireye website (www.fireye.com). This program converts the backup file into an .xlsx (Excel) file that can be saved for reference. All the setup and commissioning data is presented using different tabs.



	A	B	C	D	E	F	G	H
1	**FSG Version File Revision: 4**							
2								
3	**Position 00**							
4								
5	**Item**	**Value**						
6								
7	Servo1 P0	1						
8	Servo2 P0	1						
9	Servo3 P0	0						
10	Servo4 P0	0						
11	Servo5 P0	0						
12	Servo6 P0	0						
13	Servo7 P0	0						
14	Servo8 P0	0						
15	Servo9 P0	0						
16	Servo10 P0	0						
17	P0 Entered	Yes						
18								
19								
20								
21	**Profile 1**							
22								
23	**Item**	**Value**						
24								
25	Commissioned up to	P12						
26	O2 Levels Captured	No						
27	Restored from SD Card(needs recommissioning)	No						
28	Flue Temp at P03	0 ºC						
29								
30	Positions/Servos	Servo 1(Air)	Servo 2(Gas)	Unused	Unused	O2 Levels	VFD1(Unused)	VFD2(Unused)
31	P01	90	1	0	0	0%	0	0
32	P02	30	15	0	0	0%	0	0
33	P03	30	15	0	0	0%	0	0
34	P04	34.4	19.4	0	0	0%	0	0
35	P05	38.4	23.9	0	0	0%	0	0

Section 5: Parameters

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USER INTERFACE

See OPERATION section for additional details on operating the user interfaces. Some pertinent information is duplicated below for convenience.

Menu Structure

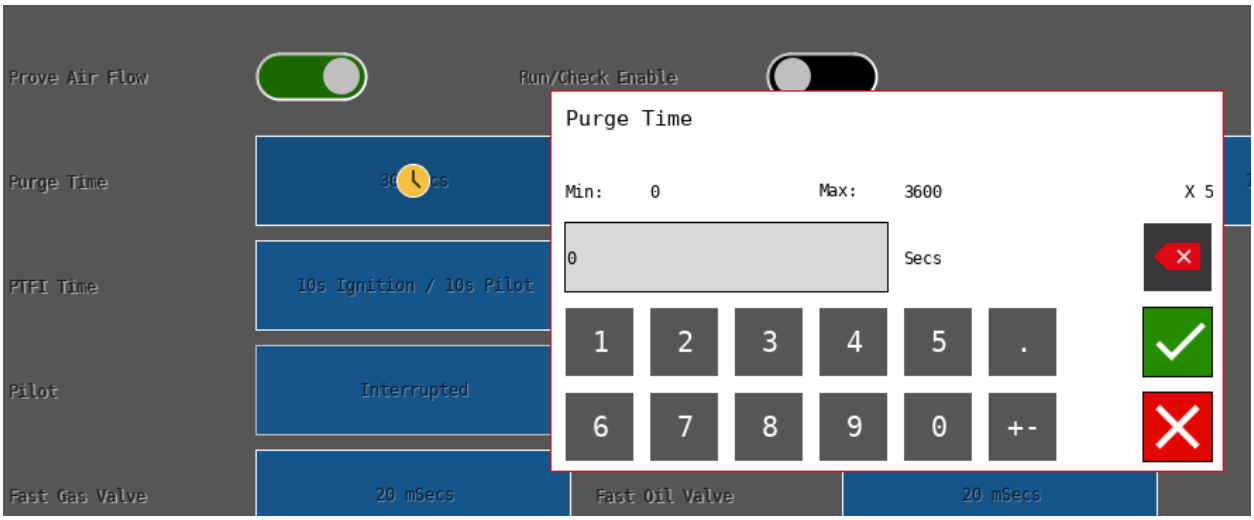
With the NXD410TS, the menu structure accessible from the HOME quick key presents the menu in a cyclical list. The whole list is can navigated in either direction using either the UP or DOWN quick keys. Press the NEXT quick key to enter the specific menu.

With the NXTSD507HD and NXTSD512HD, the menu structure is presented ad drop-down menus with sub menus as needed.

Modifying Values

With the NXD410TS, place the value to modify on the second line of the display. This is the line with the darker background. Once this is done, press the MODIFY/SAVE quick key to enable writing a new value. If the value is writable, the MODIFY/SAVE quick key will turn green. Once that is done, the UP/DOWN arrows can be used to modify the value. Pressing MODIFY/SAVE again will write the value. Once done, the MODIFY/SAVE quick key will return to red.

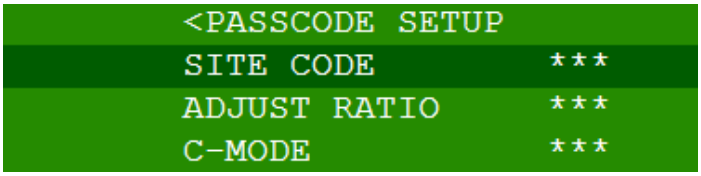
With the NXTSD507HD and NXTSD512HD, simply touch the value to modify and a pop-up will appear to enter the new value. The minimum and maximum allowed values will also be displayed.



If a passcode is needed for the chosen value to be written, the interface will automatically display the screen or pop-up for entering that value. Follow this same procedure to enter the passcode.

Passcode Access Levels

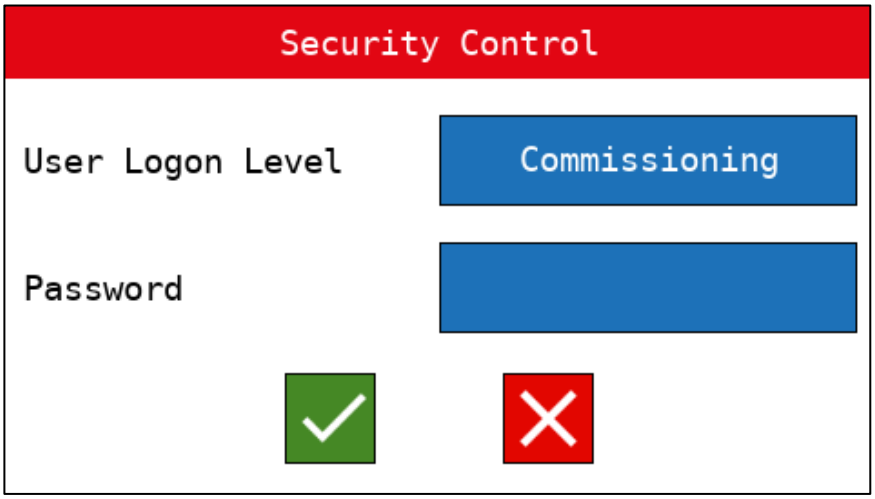
There are three levels of passcode: SITE, ADJUST RATIO and C-MODE.

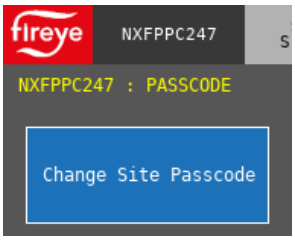


Each passcode level has different access as shown in the table below. The passcodes for ADJUST RATIO and C-MODE are not changeable, but the passcode for SITE can be changed by first going to the PASSCODE SETUP menu, entering the C-MODE passcode successfully, and then entering a value for the SITE passcode. This will become the new SITE passcode. Entering 000 for the SITE passcode will disable the SITE passcode entirely, removing any barrier to access that the SITE passcode provided.

Level	Passcode	Access Allowed
SITE	**154** (this is default, can be changed)	SETPOINT SETUP SEQUENCING SETUP
ADJUST RATIO	**256** (can't be changed)	SETPOINT SETUP SEQUENCING SETUP O2 SETUP PROFILE SETUP (erasing profiles only) Adjust ratio mode
C-MODE	**903** (can't be changed)	Full access (no restrictions)

With the NXTSD507HD and NXTSD512HD, a pop-up will ask for the passcodes when necessary. There is also an option in the drop-down menu (SYSTEM SETTINGS → PASSCODE) that allows changing the SITE passcode.





PARAMETER LISTING NOTES

The main descriptions for each parameter show the location while using the NXD410TS. The MENU descriptions shown in gray show the drop-down menu location when using the NXTSD507HD or NXTSD512HD. TAB shows which tab the parameter is located, if tabs are used for that parameter group.

SERVO SETUP

NXTSD507HD and NXTSD512HD MENU = GENERAL SETTINGS → SERVOS & VFDS

Sub-menu	Option	Choice	Description
SERVO SPEED SPEED TAB = GENERAL	n/a	Min: 30 Max: 120	Sets the servo travel speed for all servos. This is how long in seconds it will take for a connected servo to travel 90 angular degrees.
SERVOS INSTALLED SERVOS (CLICK…SEARCH) TAB = GENERAL	n/a	<varies>	Choose this option to have the control automatically search for connected Modbus servos. Once this scan is complete, the remaining menu options will be populated.
SERVO 1 TAB = SERVO1 SERVO 2 TAB = SERVO2 SERVO 3 TAB = SERVO3 SERVO 4 TAB = SERVO4 SERVO 5 TAB = SERVO5 SERVO 6 TAB = SERVO6 SERVO 7 TAB = SERVO7 SERVO 8 TAB = SERVO8 SERVO 9 TAB = SERVO9 SERVO 10 TAB = SERVO10	SERVO NAME NAME The servo names are primarily for identification. The only rule with the servo names is that one servo or VFD must have the name AIR	UNUSED	The servo is not being used. Select this option to disable the connected servo from being used.
		FU1	Fuel 1
		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
	ASSIGNMENT ASSIGNED PROFILES	NONE	Not used with any profile
		4,3,2,1	Selects which profiles the servo will be commanded by. Any combinations or profiles 1 through 4 are possible.
	SERVO DIRECTION DIRECTION	CW	The servo will rotate clockwise. The direction is relative to the back of the servo, looking at the servo cover. If looking at the shaft, the direction would be counterclockwise (anti-clockwise).
		CCW	The servo will rotate counterclockwise (anti-clockwise). The direction is relative to the back of the servo, looking at the servo cover. If looking at the shaft, the direction would be clockwise.
	SERVO POSITION POSITION	<varies>	Shows the current servo position in angular degrees (view only).
VFD 1 TAB = VFD1 VFD 2 TAB = VFD2	VFD NAME NAME The servo names are primarily for identification. The only rule with the servo names is that one servo or VFD must have the name AIR	UNUSED	The VFD channel is not being used. Select this option to disable the VFD channel from being used.
		FU1	Fuel 1
		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

Sub-menu	Option	Choice	Description
VFD 1 TAB = VFD1 VFD 2 TAB = VFD2	ASSIGNMENT ASSIGNED PROFILES	NONE	Not used with any profile
		4,3,2,1	Selects which profiles the servo will be commanded by. Any combinations or profiles 1 through 4 are possible.
	DISPLAY FORMAT	CNTS	VFD feedback is provided from the 4-20mA input on the NXCESVFD add-on card. The display format of the feedback is from 0 to 1000.
		%FS	VFD feedback is provided from the 4-20mA input on the NXCESVFD add-on card. The display format of the feedback is from 0.0% to 100.0%. This option is functionally identical to the previous, except for the manner in which the VFD feedback is displayed.
		ENCOD	VFD feedback is provided from the encoder input on the NXCESVFD add-on card. The display format of the feedback is the raw counts, depending upon encoder configuration.
	ENCODER COUNTS	Min: 300 Max: 5000	The scaling of encoder feedback is set using this parameter. The formula to calculate this value is **(Motor RPM x Encoder CPR) / 60**. See *WIRING* section for additional details.
	RUN MODE	AUTO	The NXF4000 or PPC4000 controls the PID function for the VFD. The VFD is programmed to take a direct speed command. This is the recommended run mode.
		MANUAL	The VFD will use the internal PID to choose a speed based upon the input signal. The NXF4000 or PPC4000 will only issue the setpoint. This is not recommended as it may lead to lockouts from failure to reach the required positions.
	GAIN	Min: 1.0% Max:100.0%	This is the proportional gain for the VFD internal PID calculation. This only needs to be adjusted if the VFD is reacting too fast or too slow for satisfactory operation. The default is 1%.
	INTEGRAL	Min: 0.0 Max:100.0	This is the integral time (in seconds) for the VFD internal PID calculation. 0.0 disables the integral calculation. This only needs to be adjusted if the VFD is having trouble reaching the desired speed. The default is 0.0.
	TOLERANCE Sets the allowable deviation from the target speed. Falling outside of this tolerance range will result in a lockout.	LOW	The positioning error must be less than 4% (40 counts) over a period of 30 seconds.
		HIGH	The positioning error must be less than 6% (60 counts) over a period of 15 seconds. Only choose this setting if it can result in safe combustion. This is the default setting.
	ACCEL/DECEL ACCEL/DECEL TIME	Min: 0s Max: 255s	This is the time it takes the VFD to ramp to full speed. This setting should be equal to or slightly more than the similar parameters in the VFD. Lengthening this time is normally one way to solve tolerance errors. The default is 30 seconds.
	STOP TIME	Min: 0s Max: 100s	This is the time that the NXF4000 or PPC4000 will wait between cycles before restarting. This gives the motor time to come to a stop and for the airflow switch to change states. The default is 0 seconds.
	VFD POSITION POSITION	<varies>	Shows the current VFD position in the selected format (view only).

SENSOR SETUP

NXTSD507HD and NXTSD512HD MENU = GENERAL SETTINGS → SENSORS

Sub-menu	Option	Choice	Description
UNITS TAB = n/a	n/a	ENGLISH	Sets the units of measure to Imperial (USA). This setting will use PSI for pressure and Fahrenheit for all temperature measurements. This setting can only be changed when all sensors are set to UNUSED.
		METRIC	Sets the units of measure to Metric (SI). This setting will use mB (millibar) or Bar for pressure and Celsius for all temperature measurements. This setting can only be changed when all sensors are set to UNUSED.
SENSOR 1 TAB = n/a Sensor 1 is the primary process control variable for the system.	TYPE	UNUSED	This sensor is not used.
		WATER	This is a water sensor. Choose the appropriate range from the available options.
		STEAM	This is a steam sensor. Choose the appropriate range from the available options.
		TRACK	An external 4-20mA signal will be used for modulation. A digital input must also be assigned as TRACK ON for this selection to function properly. See *Wiring* section for details on how to properly connect this signal as it will typically vary from how a sensor is connected. Failure to connect the signal properly can cause damage to the external device or the NXF4000/PPC4000 control.
	RANGE Options for a water sensor.	UNUSED	No range selected.
		32 to 350F 0 to 176C	This must match the scaled range of the 4-20mA temperature transmitter.
		32 to 752F 0 to 400C	
	RANGE Options for a steam sensor.	UNUSED	No range selected.
		0 to 15psi 0 to 1030mB	This must match the scaled range of the 4-20mA pressure transducer.
		0 to 30psi 0 to 2070mB	
		0 to 200psi 0 to 13.8B	
		0 to 300psi 0 to 20.7B	
		-14.7 to 25psi -1013 - 1720mB	This must match the scaled range of the 4-20mA pressure transducer. This is the recommended range to use for low pressure steam boilers where there may be a vacuum present when there is no steam pressure. If this range is not used, that vacuum can cause lockouts by forcing the sensor below 4mA (failure mode).
SENSOR 2 TAB = n/a Sensor 2 is typically the standby water temperature sensor for a steam boiler but can also be monitored to create an alarm condition.	TYPE	UNUSED	This sensor is not used.
		WATER	This is a water sensor. Choose the appropriate range from the available options.
		STEAM	This is a steam sensor. Choose the appropriate range from the available options.
		STANDBY	This sensor will be used for the standby function. This function exists to keep a steam boiler warm by controlling to a water temperature when the boiler is disabled by track modulation or by the peer-to-peer sequencing master.
	RANGE Options for a water sensor or standby sensor.	UNUSED	No range selected.
		32 to 350F 0 to 176C	This must match the scaled range of the 4-20mA temperature transmitter.
		32 to 752F 0 to 400C	

Sub-menu	Option	Choice	Description
SENSOR 2 TAB = n/a Sensor 2 is typically the standby water temperature sensor for a steam boiler but can also be monitored to create an alarm condition.	RANGE Options for a steam sensor.	UNUSED	No range selected.
		0 to 15psi 0 to 1030mB	This must match the scaled range of the 4-20mA pressure transducer.
		0 to 30psi 0 to 2070mB	
		0 to 200psi 0 to 13.8B	
		0 to 300psi 0 to 20.7B	
		-14.7 to 25psi -1013 - 1720mB	This must match the scaled range of the 4-20mA pressure transducer. This is the recommended range to use for low pressure steam boilers where there may be a vacuum present when there is no steam pressure. If this range is not used, that vacuum can cause lockouts by forcing the sensor below 4mA (failure mode).
SENSOR 3 TAB = n/a Sensor 3 data can be viewed on the user interface and can also be monitored to create an alarm condition (i.e. lockout on high stack temperature).	TYPE	UNUSED	This sensor is not used.
		WATER	This is a water sensor. Choose the appropriate range from the available options.
		STEAM	This is a steam sensor. Choose the appropriate range from the available options.
		INLET	This sensor monitors the inlet temperature of the combustion air. If oxygen trim is fitted, this sensor will be used for the efficiency calculation. Choose the appropriate range from the available options. Note that there can only be one INLET sensor.
		OUTDOOR	This is a temperature sensor. There is no outdoor specific function (reserved for future use). Choose the appropriate range from the available options.
		STACK	This is a temperature sensor. There is no stack specific function (reserved for future use). Choose the appropriate range from the available options.
	RANGE Options for a water, inlet, outdoor or stack sensor.	UNUSED	No range selected.
		32 to 350F 0 to 176C	This must match the scaled range of the 4-20mA temperature transmitter.
		32 to 752F 0 to 400C	
	RANGE Options for a steam sensor.	UNUSED	No range selected.
		0 to 15psi 0 to 1030mB	This must match the scaled range of the 4-20mA pressure transducer.
		0 to 30psi 0 to 2070mB	
		0 to 200psi 0 to 13.8B	
		0 to 300psi 0 to 20.7B	
		-14.7 to 25psi -1013 - 1720mB	This must match the scaled range of the 4-20mA pressure transducer. This is the recommended range to use for low pressure steam boilers where there may be a vacuum present when there is no steam pressure. If this range is not used, that vacuum can cause lockouts by forcing the sensor below 4mA (failure mode).

Sub-menu	Option	Choice	Description
SENSOR 4 TAB = n/a	TYPE	UNUSED	This sensor is not used.
		INLET	This sensor monitors the inlet temperature of the combustion air. If oxygen trim is fitted, this sensor will be used for the efficiency calculation. Choose the appropriate range from the available options. Note that there can only be one INLET sensor.
		FLAME	This is a 4-20mA input used to measure the actual flame signal from a Fireye integrated scanner. This option is only available when an NXCESDC amplifier is fitted (NXF4000 only).
	RANGE Options for an inlet sensor.	UNUSED	No range selected.
		-50 to 300F -49 to 149C	This must match the scaled range of the 4-20mA temperature transmitter.
		-40 to 140F -40 to 60C	
		32 to 350F 0 to 176C	
	RANGE Option for flame signal.	4-20 mA	4-20mA is the only option (no option for unused).
SENSOR 5 TAB = n/a	TYPE	UNUSED	This sensor is not used.
		INLET	This sensor monitors the inlet temperature of the combustion air. If oxygen trim is fitted, this sensor will be used for the efficiency calculation. Choose the appropriate range from the available options. Note that there can only be one INLET sensor.
	RANGE Options for an inlet sensor.	UNUSED	No range selected.
		-50 to 300F -49 to 149C	This must match the scaled range of the 4-20mA temperature transmitter.
		-40 to 140F -40 to 60C	
		32 to 350F 0 to 176C	

SETPOINT SETUP

NXTSD507HD and NXTSD512HD MENU = GENERAL SETTINGS → SET POINTS

Sub-menu	Option	Choice	Description
SETPOINT 1 TAB = SET POINT1	SENSOR USED SENSOR	1	Setpoint 1 will always use sensor 1. This value cannot be changed.
	LIMIT TYPE	DEV	The cut-in and cut-out values will be a deviation of the setpoint. This means that they are always relative to the setpoint, so changing the setpoint will change the cut-in and cut-out values appropriately. This value cannot be changed.
	SETPOINT	<varies>	The setpoint must be within the boundaries of sensor 1. It must also be less than the setting of the high marginal value.
	CUT IN	Typical min: 0 units Typical max: 60 units A unit is a degree (C or F), psi, mB or Bar	Subtract this value from the setpoint to determine when the call for heat will return. Example: If the setpoint is 100psi and the cut in is 3psi, the call for heat will return when the pressure falls below 97psi. The value that can be entered can range from 0 to 60 units if the calculated setpoint less cut in is greater than 0 and is less than the high marginal setpoint.
	CUT OUT	Typical min: 3 units Typical max: 60 units A unit is a degree (C or F), psi, mB or Bar	Add this value to the setpoint to determine when the call for heat is gone. Example: If the setpoint is 100psi and the cut out is 3psi, the call for heat is gone when the pressure exceeds 103psi. The value that can be entered can range from 3 to 60 units (degrees, psi, Bar) if the calculated setpoint plus cut out is less than the high marginal setpoint.
	P-BAND	Typical min: 3 units Typical max: 60 units A unit is a degree (C or F), psi, mB or Bar	The proportional band is part of the firing rate calculation while in automatic modulation. See the *PID Calculation Notes* section following this table for more information.
	HIGH MARGNL HIGH MARGIN LIMIT	<varies>	The high marginal setpoint must be within the boundaries of sensor 1. It must also be lower than the high limit setpoint. When the value of the sensor is above this setpoint and below the setpoint for the high limit, the alarm relay output will activate, and an alarm message will display on the user interface. Note that this setpoint must be chosen as the controlling setpoint for this function to work.
	HIGH LIMIT HIGH ALARM LIMIT	<varies>	The high limit setpoint must be within the boundaries of sensor 1. It must also be higher than the high marginal setpoint. When the value of the sensor is above this setpoint, the control will lockout. Note that this setpoint must be chosen as the controlling setpoint for this function to work.
	INTEGRAL	Min: 0 Max: 100	The integral can be used in addition to the proportional/derivative calculations to create a more responsive firing rate output. See the *PID Calculation Notes* section following this table for more information. A value of 0 disables this function, while a value of 1 = 12s and a value of 100 = 1200s (proportionate in between).

Sub-menu	Option	Choice	Description
SETPOINT 1 TAB = SET POINT1	DERIVATIVE	Min: 0 Max: 100	The derivative can be used in addition to the proportional/integral calculations to create a more responsive firing rate output. See the *PID Calculation Notes* section following this table for more information. A value of 0 disables this function, while a value of 1 = 12s and a value of 100 = 1200s (proportionate in between).
SETPOINT 2 TAB = SET POINT2	SENSOR USED SENSOR	UNUSED	This setpoint is not used.
		1	Setpoint 2 will use sensor 1. This will be an alternative setpoint that can be used if a digital input is programmed for the function SETPOINT 2 SLCT. Toggling this input will switch from setpoint 1 and setpoint 2. This includes all the other settings such as PID tuning and high alarm settings.
		2	Setpoint 2 will use sensor 2. The only valid use for this is hot standby function. This requires that the sensor type for sensor 1 is steam and the sensor type for sensor 2 is standby. See the *Hot Standby Notes* section following this table for more information.
	LIMIT TYPE	DEV	Same as for setpoint 1.
	SETPOINT	<varies>	
	CUT IN	Typical min: 0 units Typical max: 60 units A unit is a degree (C or F), psi, mB or Bar	
	CUT OUT	Typical min: 3 units Typical max: 60 units A unit is a degree (C or F), psi, mB or Bar	
	P-BAND	Typical min: 3 units Typical max: 60 units A unit is a degree (C or F), psi. mB or Bar	
	HIGH MARGNL HIGH MARGIN LIMIT	<varies>	Same as for setpoint 1. Setpoint 2 must be in active use (selected or hot standby being used) for this setpoint to function.
	HIGH LIMIT HIGH ALARM LIMIT	<varies>	
	INTEGRAL	Min: 0 Max: 100	Same as for setpoint 1.
	DERIVATIVE	Min: 0 Max: 100	

Sub-menu	Option	Choice	Description
SETPOINT 3 TAB = SET POINT3	SENSOR USED SENSOR	UNUSED	This setpoint is not used.
		3	Setpoint 3 will use sensor 3. The only function this will have is to create a high limit alarm (lockout) when the value exceeds this setpoint.
	LIMIT TYPE	DEV	Same as for setpoint 1. There is no function for this setting (reserved for future use).
	SETPOINT	<varies>	
	CUT IN	Typical min: 0 units Typical max: 60 units A unit is a degree (C or F), psi, mB or Bar	Same as for setpoint 1. There is no function for this setting (reserved for future use).
	CUT OUT	Typical min: 3 units Typical max: 60 units A unit is a degree (C or F), psi, mB or Bar	
	P-BAND	Typical min: 3 units Typical max: 60 units A unit is a degree (C or F), psi, mB or Bar	
	HIGH MARGNL HIGH MARGIN LIMIT	<varies>	
	HIGH LIMIT HIGH ALARM LIMIT	<varies>	Same as for setpoint 1. Exceeding this setpoint will cause a "SENSOR 3 HIGH LIMIT" lockout. Can be used for a high stack temperature.
	INTEGRAL	Min: 0 Max: 100	Same as for setpoint 1. There is no function for this setting (reserved for future use).
	DERIVATIVE	Min: 0 Max: 100	

PID Calculation Notes

The firing rate is determined by the PID calculation. This algorithm is composed of three terms that are added together to determine how far a process is from the setpoint. By default, only the proportional calculation is used for the firing rate calculation.

For the proportional calculation, the firing rate will vary from 0% to 100% linearly while the process variable is in the proportional band. Example: If the setpoint is 100psi and the proportional band is 10psi, the firing rate will vary proportionately when the actual pressure is between 90psi and 100psi (92.5psi = 75%, 95psi = 50%, 97.5psi = 25%). Any pressure below 90psi would mean 100% firing rate and any pressure above 100psi would mean 0% firing rate (low fire).

If the proportional band is not enough to hold the setpoint, an integral calculation can be used and added to the output. The integral calculation is time based. Theoretically, the integral setpoint is how long it would take for an output of 50% to double if none of the ambient conditions changed. For example, if the integral is set to 30 seconds, an output of 50% would take 30 seconds to ramp up to 100%. If the PID algorithm is updated once every second, $1/30^{th}$ of that output would be added every second, meaning that after the first second the output would change from 50% to 51.67%. This means that a lower integral value is more aggressive and will result in potentially bigger swings in output more quickly. The integral is entered as a value from 0 to 100 into the user interface. 0 disables integral control, 1 is equal to approximately 12 seconds and 100 is equal to approximately 1200 seconds. Anything in between is linear (50 is equal to approximately 600 seconds). Note that since the process value is constantly changing based on load, the integral calculation is also constantly changing so the amount that will be added with every PID update is not going to be the same. Once the process value is over the setpoint, the integral value is decreased in the same manner depending upon how far past the setpoint the process variable is.

The last component that can be added to the equation is the derivative calculation. This calculation is also time based, following the same structure as integral (0 is disabled, 1-100 represents 12s to 1200s). The derivative only reacts to a rapid change in value. The derivative attempts to correct for the future by applying the current rate of change using a slope, and the value entered represents how long it takes for the derivative effect to subside. A lower derivative value will not have as long-lasting of an effect as a higher derivative would. It is recommended that if integral and derivative are both used simultaneously that the derivative setpoint is no more than 25% of the integral setpoint.

Hot Standby Notes

Hot standby is a function of a lead/lag scheme. The concept is that the boiler is kept hot while it is in standby to the system. This is so that the production of steam is hastened when the boiler is brought online.

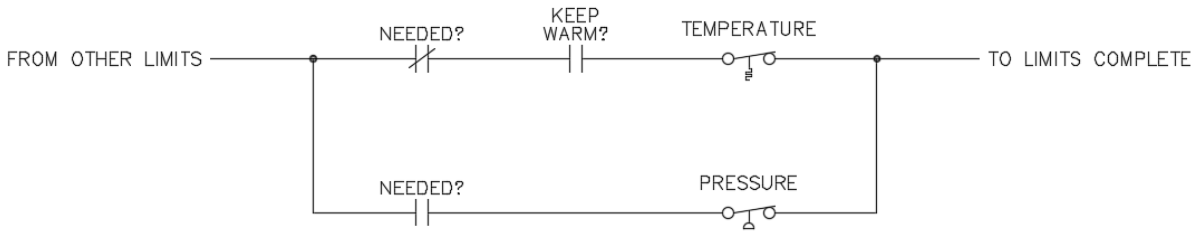
Without a lead/lag scheme the idea of hot standby doesn't make sense. Suppose the need is to keep a boiler with a 100psi setpoint at 300°F when it is in standby. 300°F corresponds to approximately 52psi on the steam table. This correlation between temperature and pressure is often overlooked when trying to understand the concept of hot standby. Looking at it from the perspective of pressure, if the reading was 52psi, the boiler would be running anyway because it is well under the 100psi setpoint.

The only way that the concept of hot standby works is if a third-party such as a lead/lag system, building management system or a boiler operator manually controlling the system is sending an enable/disable signal via the limit string to override the operating control. In that case, a parallel means to enable the boiler must be provided based upon water temperature that would maintain the desired 300°F even when the lead/lag or building management system is not enabling the boiler. With the NXF4000 or PPC4000, that control system is either the peer-to-peer sequencing or track modulation using the digital input enable.

While pressure can be used as the process variable for hot standby, it is not a good practice to do so. This is not even an option unless the boiler is isolated with a non-return valve. If it isn't, the header pressure will be read by the boiler pressure sensor indicating that the boiler is ready to produce steam, but the actual water in the vessel will not be up to temperature. A boiler system that doesn't have non-return valves would not be ideal for a lead/lag system in the first place as these boilers would most likely either be operated manually or simultaneously.

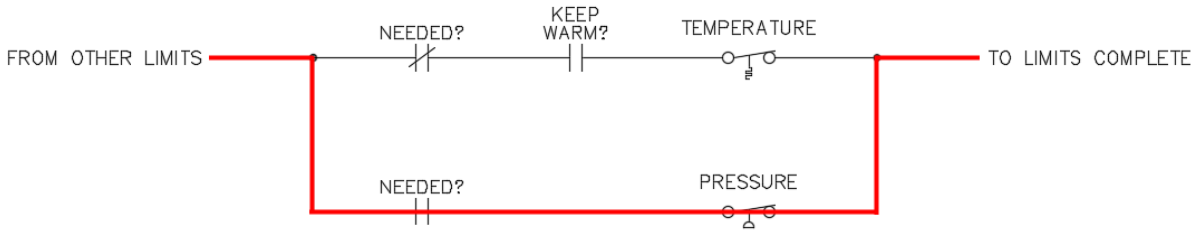
More likely, the non-return valves will leak which would manifest itself in much the same way as if the non-return valve was not installed. The boiler may indicate that the pressure is at or above the hot standby setpoint, but since the pressure was back-fed the water below the steam could be much colder. By using the water temperature, it is ensured that the water is reaching the setpoint. Note that it is common for non-return valves to leak. If the boiler is not kept hot, there is a potential for damage to the vessel from over-firing while cold. A more practical ramification is that there can also be a large delay in the production of steam when a boiler is brought on-line if it is not already at a higher temperature.

The following diagram demonstrates using hard-wired logic how the concept of hot standby works:

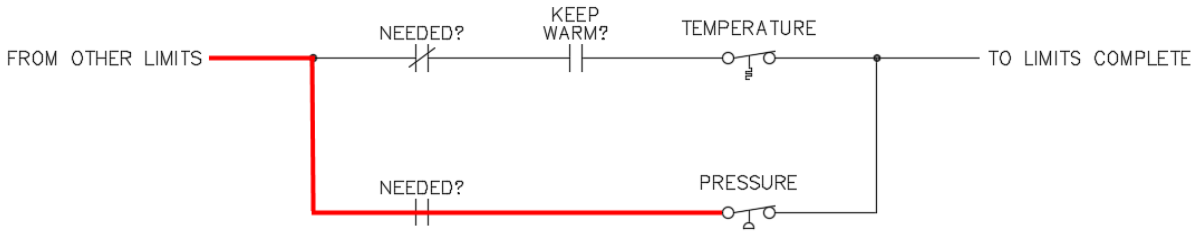


The following scenarios apply when the boiler is needed, so the pressure setpoint is used:

Setpoint = 6.89 Bar (100psi)
Pressure = 6.21 Bar (90psi)
Standby Setpoint = 148.9°C (300°F)
Temperature = 166.1°C (331°F)
Limits are complete since pressure < setpoint.

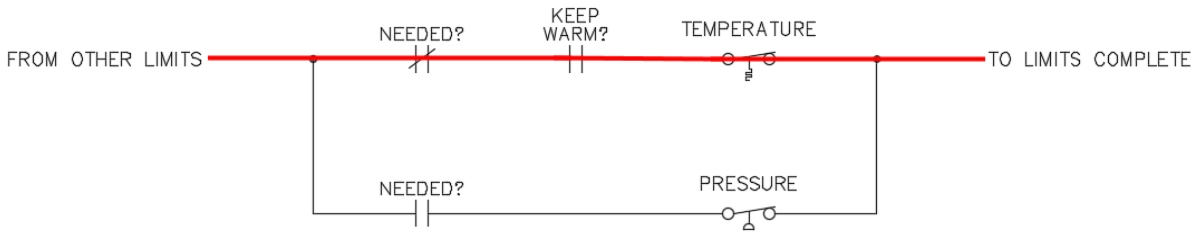


Setpoint = 6.89 Bar (100psi)
Pressure = 7.58 Bar (110psi)
Standby Setpoint = 148.9°C (300°F)
Temperature = 173.3°C (344°F)
Limits are open since pressure > setpoint.

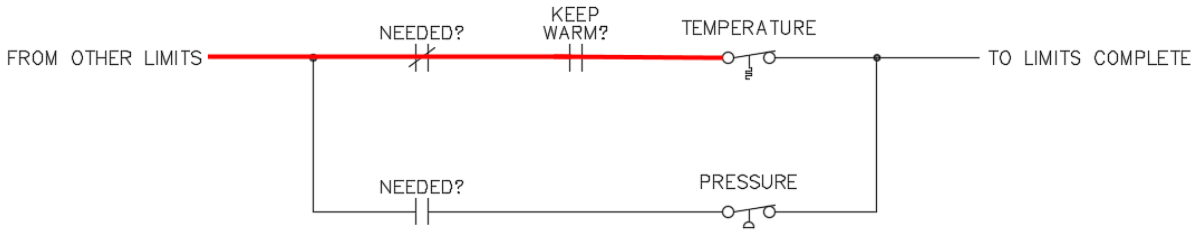


The following scenarios apply when the boiler is not needed, so the temperature setpoint is used (hot standby):

Setpoint = 6.89 Bar (100psi)
Pressure = 1.38 Bar (20psi)
Standby setpoint = 148.9°C (300°F)
Temperature = 126.7°C (260°F)
Limits are complete since temperature < setpoint.



Setpoint = 6.89 Bar (100psi)
Pressure = 4.83 Bar (70psi)
Standby setpoint = 148.9°C (300°F)
Temperature = 157.8°C (316°F)
Limits are open since temperature > setpoint.



PROFILE SETUP

NXTSD507HD and NXTSD512HD MENU = SYSTEM SETTINGS → PROFILES

Sub-menu	Option	Choice	Description
PROFILE 1 TAB = PROFILE1 PROFILE 2 TAB = PROFILE2 PROFILE 3 TAB = PROFILE3 PROFILE 4 TAB = PROFILE4	PROFILE NAME NAME	UNUSED	This profile is not used.
		GAS	The profile name will appear as GAS. This will typically indicate a natural gas fuel. See the *Profile Output Sequence Charts* section following this table for more information (chart 1). This option is typically used for installations following North American codes.
		WAS	The profile name will appear as WAS. This will typically indicate a waste oil fuel. See the *Profile Output Sequence Charts* section following this table for more information (chart 3).
		FUE	The profile name will appear as FUE. This will typically indicate a generic oil fuel. See the *Profile Output Sequence Charts* section following this table for more information (chart 3).
		COG	The profile name will appear as COG. This will typically indicate a coke oven gas fuel. See the *Profile Output Sequence Charts* section following this table for more information (chart 3).
		SOL	The profile name will appear as SOL. This will typically indicate a solid fuel. See the *Profile Output Sequence Charts* section following this table for more information (chart 3).
		OIL	The profile name will appear as OIL. This will typically indicate a light oil (diesel, no. 2) fuel. See the *Profile Output Sequence Charts* section following this table for more information (chart 3).
		HVY	The profile name will appear as HVY. This will typically indicate a heavy oil (no. 6) fuel. See the *Profile Output Sequence Charts* section following this table for more information (chart 3).
		GAS1	The profile name will appear as GAS1. This will typically indicate a natural gas fuel. See the *Profile Output Sequence Charts* section following this table for more information (chart 2). This option is typically used for installations following European codes.
		GAS2	The profile name will appear as GAS2. This will typically indicate a natural gas fuel. See the *Profile Output Sequence Charts* section following this table for more information (chart 2). This option is typically used for installations following European codes.
		OIL1	The profile name will appear as OIL1. This will typically indicate a light oil (diesel, no. 2) fuel. See the *Profile Output Sequence Charts* section following this table for more information (chart 3).
		OIL2	The profile name will appear as OIL2. This will typically indicate a light oil (diesel, no. 2) fuel. See the *Profile Output Sequence Charts* section following this table for more information (chart 4). Use this option when the oil uses a natural gas pilot.
	MAX MODULATION MAX MOD RATE	Min: 1% Max: 100%	Sets the maximum firing rate for the selected profile. Must be set higher than the minimum modulation rate.

Sub-menu	Option	Choice	Description
PROFILE 1 TAB = PROFILE1 PROFILE 2 TAB = PROFILE2 PROFILE 3 TAB = PROFILE3 PROFILE 4 TAB = PROFILE4	MIN MODULATION MIN MOD RATE	Min: 0% Max: 99%	Sets the minimum firing rate for the selected profile. Must be set lower than the maximum modulation rate.
	ERASE PROFILE n/a	YES TRASH ICON	Set to yes to erase the contents of the profile from memory. If this is not done, the profile points will still be in memory if the burner is commissioned again. Once completed, the option will change to read DONE.
CLEAR ALL CONFIG TAB = ALL CONFIG	n/a	YES TRASH ICON	Set to yes to erase the contents of all the profiles from memory. This will also erase all the configuration settings, restoring the factory defaults. Once completed, the option will change to read DONE.

Profile Output Sequence Charts

The sequence of the digital outputs is shown in the following charts. The sequence used is based upon the name chosen. These charts only apply to the NXF4000 as the PPC4000 uses an external flame safeguard.

The exact timing depends on the PTFI and MTFI settings, which each have two numbers (i.e. 5/10). These two numbers are shown as x and y in the chart. If the timing was 5/10, x = 5 and y = 10.

Chart 1 (GAS):

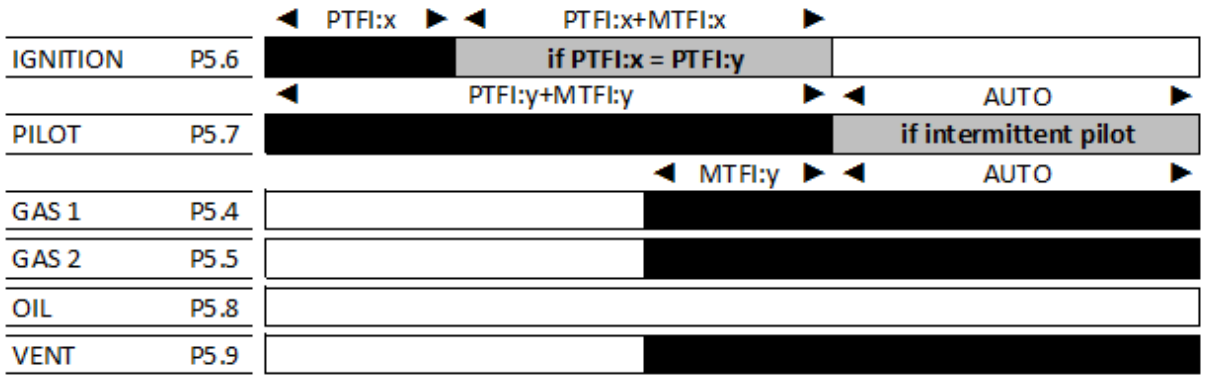


Chart 2 (GAS1 and GAS2):

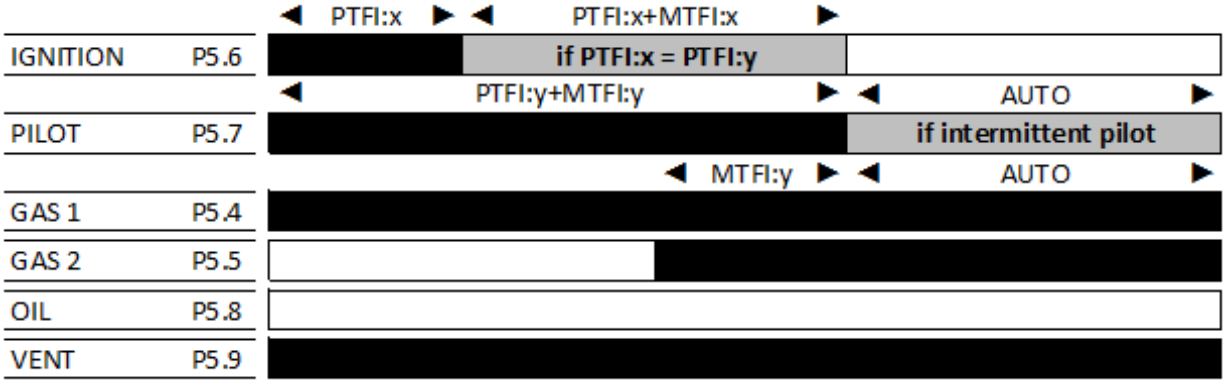


Chart 3 (OIL, WAS, FUE, COG, SOL, HVY, and OIL1):

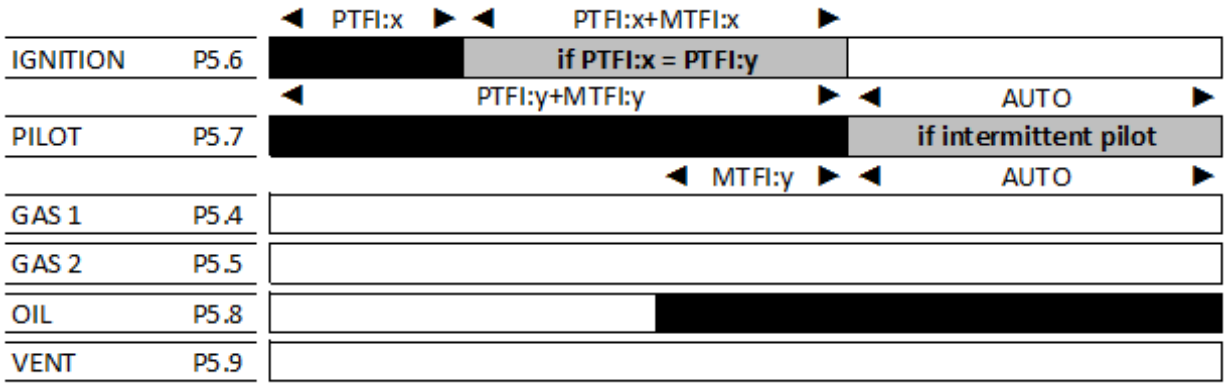
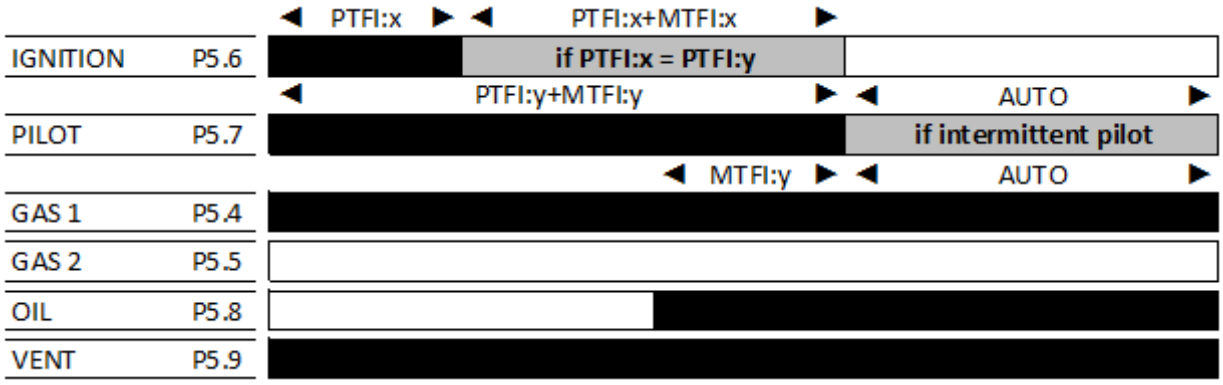


Chart 4 (OIL2):



BURNER CONTROL SETUP

NXTSD507HD and NXTSD512HD MENU = GENERAL SETTINGS → BURNER CONTROL

WARNING: Settings may be subject to local codes or burner manufacturer recommendations. Please follow all such requirements when modifying the burner control options.

These settings apply to the NXF4000 only (this menu is not present on the PPC4000).

Sub-menu	Option	Choice	Description
PROVE P OPEN TAB = n/a	n/a SLIDER ON/OFF	NO	The state of the non-recycle limit input (terminal P5.10) is not considered when starting a new cycle. This is the default setting.
		YES	The state of the non-recycle limit input (terminal P5.10) is considered when starting a new cycle. A cycle can only start with the absence of voltage on terminal P5.10. This option should be used when the airflow switch is in the non-recycle limit string, so that a change of state to off can be detected (to prove airflow switch is not stuck). When waiting for P to prove open, keypad will display P CLOSED.
PURGE TIME TAB = n/a	n/a	Min: 00:00 Max: 60:00	The purge time can be adjusted as needed to provide the required air changes before a combustion cycle. Can be set in 5 second increments from no purge up to 60 minutes of purge. The default is 30 seconds.
POSTPURGE TIME TAB = n/a	n/a	Min: 00:00 Max: 60:00	The postpurge time can be adjusted as needed to provide the required air changes after a combustion cycle. Can be set in 5 second increments from no purge up to 60 minutes of purge. The default is 15 seconds.
RECYCLE TAB = n/a	n/a SLIDER ON/OFF	NO	Any opening of the non-recycle limit input (terminal P5.10) will result in a lockout. This is the default setting.
		YES	Any opening of the non-recycle limit input (terminal P5.10) will shut the burner down. A new cycle will begin when the non-recycle limit input closes.
24-HOUR RECYCLE TAB = n/a	n/a SLIDER ON/OFF	NO	Run time will not be considered during a cycle This is the default setting.
		YES	A timer will start with any new cycle. After 24 continuous hours running, the burner control will shut down and initiate a new cycle. This option is used where a burner is subject to continuous operation and does not have a self-checking flame scanner. The new cycle serves to check the integrity of the flame scanner.
PTFI TIME TAB = n/a	n/a	10/10	Ignition output P5.6 and pilot output P5.7 are both energized throughout the entire PTFI period of 10 seconds. This is the default for 120V controls.

Sub-menu	Option	Choice	Description
PTFI TIME TAB = n/a	n/a	5/15	Ignition output P5.6 is energized for the first 5 seconds of PTFI (early spark termination). The pilot output P5.7 is energized through the entire PTFI period of 15 seconds. Choose a setting with early spark termination when the spark may be picked up by the flame scanner as a proven pilot.
		5/10	Ignition output P5.6 is energized for the first 5 seconds of PTFI (early spark termination). The pilot output P5.7 is energized through the entire PTFI period of 10 seconds. Choose a setting with early spark termination when the spark may be picked up by the flame scanner as a proven pilot.
		5/5	Ignition output P5.6 and pilot output P5.7 are both energized throughout the entire PTFI period of 5 seconds.
		3/6	Ignition output P5.6 is energized for the first 3 seconds of PTFI (early spark termination). The pilot output P5.7 is energized through the entire PTFI period of 6 seconds. Choose a setting with early spark termination when the spark may be picked up by the flame scanner as a proven pilot.
		3/8	Ignition output P5.6 is energized for the first 3 seconds of PTFI (early spark termination). The pilot output P5.7 is energized through the entire PTFI period of 8 seconds. Choose a setting with early spark termination when the spark may be picked up by the flame scanner as a proven pilot. This is the default for 230V controls.
		3/13	Ignition output P5.6 is energized for the first 3 seconds of PTFI (early spark termination). The pilot output P5.7 is energized through the entire PTFI period of 13 seconds. Choose a setting with early spark termination when the spark may be picked up by the flame scanner as a proven pilot.
MTFI TIME TAB = n/a	n/a	10/15	Ignition output P5.6 is energized for the first 10 seconds of MTFI. The pilot output P5.7 is energized for the first 15 seconds of MTFI. This is the default for 120V controls.
		10/10	Ignition output P5.6 and pilot output P5.7 are both energized for the first 10 seconds of MTFI.
		3/5	Ignition output P5.6 is energized for the first 3 seconds of MTFI. The pilot output P5.7 is energized for the first 5 seconds of MTFI.
		0/15	The ignition output P5.6 is not on during MFTI and the pilot output P5.7 is energized for the first 15 seconds of MTFI. If a setting with early spark termination is selected for the PTFI TIME option, the ignition output cannot be reenergized during MTFI.
		0/10	The ignition output P5.6 is not on during MFTI and the pilot output P5.7 is energized for the first 10 seconds of MTFI. If a setting with early spark termination is selected for the PTFI TIME option, the ignition output cannot be reenergized during MTFI.
		0/5	The ignition output P5.6 is not on during MFTI and the pilot output P5.7 is energized for the first 5 seconds of MTFI. If a setting with early spark termination is selected for the PTFI TIME option, the ignition output cannot be reenergized during MTFI. This is the default for 230V controls.

Sub-menu	Option	Choice	Description
MTFI TIME TAB = n/a		0/3	The ignition output P5.6 is not on during MFTI and the pilot output P5.7 is energized for the first 3 seconds of MTFI. If a setting with early spark termination is selected for the PTFI TIME option, the ignition output cannot be reenergized during MTFI.
PILOT TAB = n/a	n/a	INTERRUPTED	The pilot output P5.7 will be energized following the settings of the PTFI TIME and MTFI TIME options. This is also known as a non-continuous pilot. This is the default setting.
		INTERMITTENT	The pilot output P5.7 will remain energized from the beginning of the PTFI state until the end of the auto state (end of cycle). The settings of PTFI TIME and MTFI time will not affect the pilot output. This is also known as a continuous pilot.
FFRT TAB = n/a	n/a	1 sec	FFRT is the Flame Failure Response Time. This is the time required for the control to lockout after detecting a flame failure. This is the default for 120V controls is 4 seconds and the default for 230V controls is 1 second.
		2 sec	
		3 sec	
		4 sec	
PROVE AIRFLOW TAB = n/a	n/a	NO	This option applies when digital inputs are used for airflow switch monitoring. When this option is set to no, these inputs are not monitored at all.
		YES	This option applies when digital inputs are used for airflow switch monitoring. When this option is set to yes, the state of the airflow switch is monitored. Both the normally closed and normally open poles of the switch must be connected. This is the default setting.
PROFILE SELECT TAB = n/a	n/a	AUTO	The control will use the profile section digital inputs to choose the profile. This is the default setting.
		1	Forces selected profile to be active regardless of any profile selection digital input.
		2	
		3	
		4	
ENABLE RUN/CHECK TAB = n/a	n/a SLIDER ON/OFF	NO	Disables the run/check option. This is the default setting.
		YES	This setting enables the run/check button functionality for 2 hours. Interacting with the user interface will reset the timer for 2 hours, meaning that the function will only deactivate due to inactivity. See the *Run/Check Function* section following this table for more details on the run/check function.
SCANNER TYPE TAB = n/a	n/a	IR	The fitted amplifier is an NXCESIR, which is designed to interface with a Fireye infrared scanner. This option is read only.
		UV	The fitted amplifier is an NXCESUV, which is designed to interface with a Fireye ultraviolet scanner. This option is read only.
		DC	The fitted amplifier is an NXCESDC, which is designed to interface with a Fireye integrated scanner. This option is read only.
IR THRESHOLD TAB = n/a	n/a	Min: 0 Max: 10	This setting attenuates the flame signal using an algorithm. Higher settings attenuate the signal more, and a setting of 0 disables the function. This parameter only applies when the scanner type is IR. The default setting is 0.

Sub-menu	Option	Choice	Description
FAST GAS VALVE TAB = n/a	n/a	Min: 20ms Max: 150ms	This parameter allows the control to react to fast line disturbances or interrupts that could trip the main gas shutoff valve(s) connected to terminals P5.4 and P5.5. See the *Fast Gas/Oil Valves* section following this table for more details. The setting is particularly useful for valves which could potentially react to one missing line cycle. A lower setting provides the fastest reaction time (for valves that react quickly), while a higher setting provides the slowest reaction time. The default setting is 150ms.
FAST OIL VALVE TAB = n/a	n/a	Min: 20ms Max: 150ms	This parameter allows the control to react to fast line disturbances or interrupts that could trip the main oil shutoff valve connected to terminal P5.9. See the *Fast Gas/Oil Valves* section following this table for more details. The setting is particularly useful for valves which could potentially react to one missing line cycle. A lower setting provides the fastest reaction time (for valves that react quickly), while a higher setting provides the slowest reaction time. The default setting is 150ms.
VALVE PROVING SETUP MENU = GENERAL SETTINGS → VALVE PROVING	TEST TIME 1	Min: 00:05 Max: 21:00	Test time 1 represents the time for the gas valve proving evacuation test to complete. See *Valve Proving Method* section following this table for more details. Can be set in 5 second increments. The default is 25 seconds.
	TEST TIME 2	Min: 00:05 Max: 21:00	Test time 2 represents the time for the gas valve proving fill test to complete. See *Valve Proving Method* section following this table for more details. Can be set in 5 second increments. The default is 25 seconds.
	METHOD TEST METHOD	3-VALVE (NO)	The valve proving test will automatically power two gas valves in addition to a normally open vent valve located in between as needed. This is the default setting.
		2-VALVE	The valve proving test will automatically power two gas valves as needed. Use this option when there is either no vent valve, or the vent valve is connected to the same terminal as the upstream valve.
	TEST AT TEST STAGE	PRE PURGE	The valve proving test will be performed prior to the prepurge timing. The blower will be energized during the test. This is the default setting.
		POST PURGE	The valve proving test will be performed after the postpurge is complete, before returning to standby. The blower will be energized during the test.

Run/Check Function

When configured for YES, the user gains the ability to freeze the burner sequence at the following states:

- PURGE
- IGNITION
- PTFI
- PILOT

This allows for adjustment of the burner/boiler system during setup, commissioning or maintenance.

The run/check button on the user interface or a configured digital input can be used to apply check mode. The chosen state will be held until the run/check button or digital input change states to restore run mode. Note that if check mode is enabled during the PILOT state, the function will only remain enabled for 10 seconds.

The run/check function is automatically enabled during commissioning. Applying check mode during PTFI allows time for the pilot flame to be inspected and for servo/VFD positions to be edited before entering MTFI.

Fast Gas/Oil Valves

Power to the ignition, pilot and fuel valve outputs is internally switched through a safety relay which provides a second level of security. The power that is switched through this relay is sourced directly from the non-recycle limit input, which in turn gets power from the recycle limit input. A loss of line voltage on the recycle limit input will initiate a controlled shutdown, while a loss of line voltage on the non-recycle limit input will result in a lockout. This will also result in a loss of line voltage to the fuel value outputs, regardless of the switched state of the output relays.

In normal operation, the control will shut down or a lockout will occur without any unintended consequences. Certain gas valves can introduce a situation where a momentary loss of line voltage on the recycle or non-recycle limit will not last long enough to be detected by the input circuit. This momentary loss (passed through the safety relay) is detected by the fuel valve, causing it to open quickly. If the limit is still powered and the control is still running, the valve will initiate reopening.

The control will normally lock out at this point due to a flame failure as the fuel valve closing will cut off the fuel supply. Most valves cannot open as fast as they close, so they do not reopen during this time.

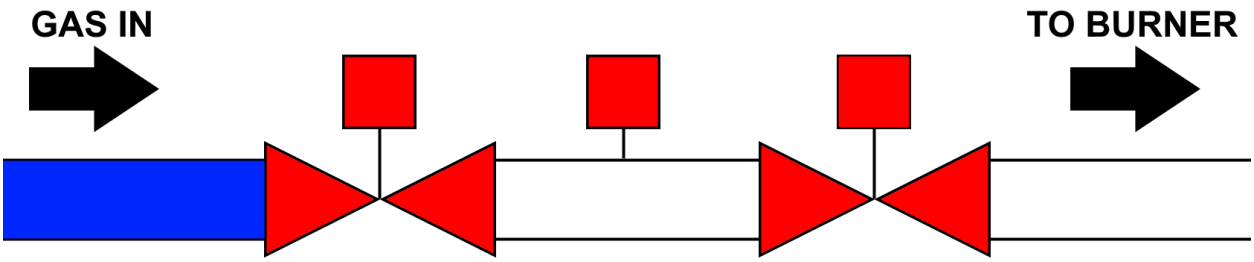
Adjusting the fast gas/oil valve setting to a lower setting will allow the control to react faster to a momentary loss of line voltage at the recycle or non-recycle input. This is not normally set to the minimum valve as setting this too low can also result in nuisance lockouts due to bouncing switches (switches near their setpoint).

Valve Proving Method

WARNING: Using the valve proving function does not mean that other manual methods of testing the integrity of the gas train should not be used. This includes methods such as the bubble leak test.

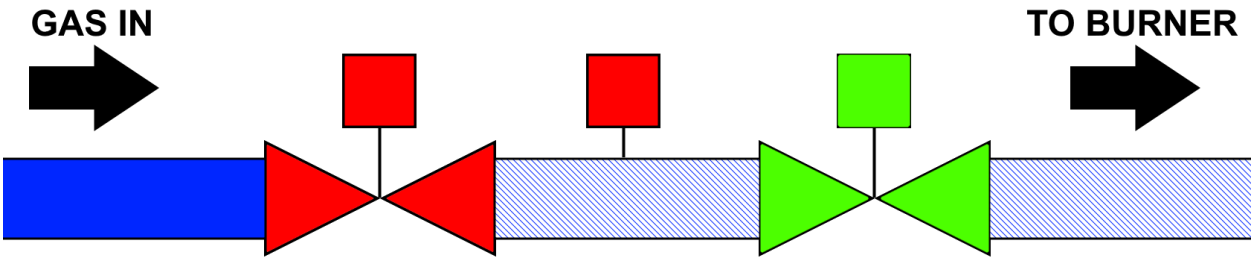
The valve proving test exists to test the integrity of the gas train. Enabling valve proving requires that two gas valves are used and that a gas pressure switch is installed in between. Both the normally open and normally closed terminals of the gas pressure switch must be connected to programmable digital inputs to enable the test.

Whether valve proving is programmed to occur at the beginning of the sequence (before the prepurge) or at the end of the sequence (after postpurge), the test consists of the same steps. In the following diagrams, blue represents gas is present, red indicates the valve is closed or the switch is in the normally closed state and green indicates the valve is open or the switch is in the normally open state.



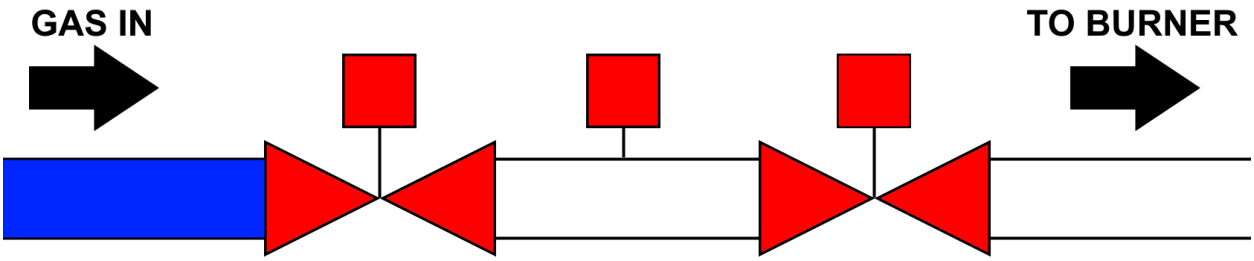
Gas train when in standby

The first step is the evacuation. The downstream valve is opened so any gas that was present in between the valves is evacuated into the combustion chamber (to be then evacuated during prepurge). The length of time the valve remains is fixed at three seconds.



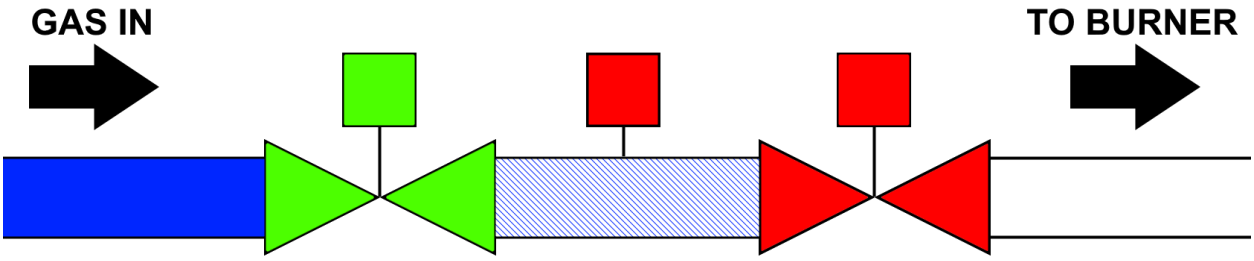
Gas train during evacuation

Following the evacuation, a test is performed for a set amount of time to ensure that the gas pressure switch remains in the normally closed state. This time period is be adjustable with a default of 25 seconds. If the test fails, a lockout will occur. This lockout indicates that the upstream valve may be leaking since the space in between is pressurizing.



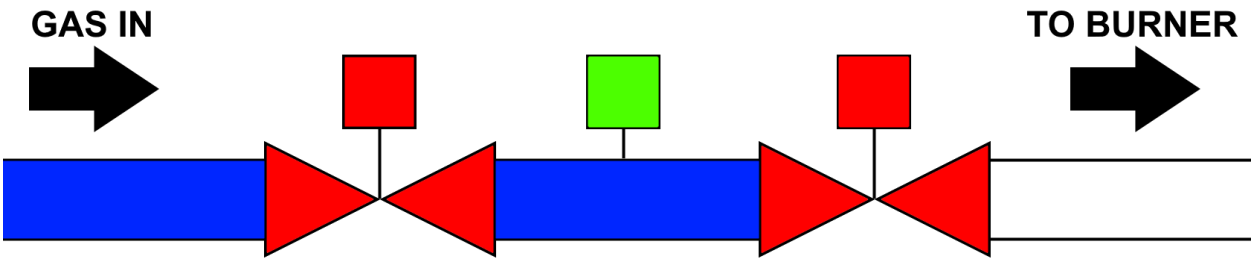
Gas train during evacuation test

After the evacuation test is passed, the upstream gas valve opens for three seconds to pressurize the space between the safety shutoff valves.



Gas train during pressurization

Following the pressurization, a test is performed for a set amount of time to ensure that the gas pressure switch changes to the normally open state. This time period is be adjustable with a default of 25 seconds. If the test fails, a lockout will occur. This lockout indicates that the downstream valve may be leaking since the space in between is losing pressure. Following this test, the control will continue to ignition or standby.



Gas train during pressurization test

DIGITAL INPUT SETUP

NXTSD507HD and NXTSD512HD MENU = SYSTEM SETTINGS → DIGITAL INPUTS

WARNING: Certain safety functions such as airflow switch monitoring, fuel valve end switch monitoring and valve proving pressure switch monitoring require that the requisite digital inputs are properly programmed. During commissioning, always check to ensure that these inputs function properly and initiate lockouts when required.

WARNING: Do not use digital inputs to connect remote reset devices. Resetting a lockout should only be done by personnel located within sight and sound of the boiler, burner or other appliance that is locked out.

The NXF4000 has 15 programmable digital inputs, while the PPC4000 only has 10. Also note that physical terminals numbers are different between the two controls. See *WIRING* section for additional details on terminal designations.

Different digital inputs have different options. The required options are shown in the description and each option is also explained in the table below.

Sub-menu	Option	Choice	Description
DI 1 DI 2 DI 3 DI 4 DI 5 DI 6 DI 7 DI 8 DI 9 DI 10 **NXF4000 and PPC4000** TAB = n/a DI 11 DI 12 DI 13 DI 14 DI 15 **NXF4000 only** TAB = n/a	USE	UNUSED	The digital input has no assignment.
		BURNER CONTROL	The digital input will set the burner control status to on. At least one digital input or the keypad button must be set to allow for the burner control to be set to on. The keypad button for this function can also be used with an AND/OR action. ASSIGNMENT: n/a ACTION: Required
		SETPOINT 2 SLCT	The digital input will force setpoint 2 to be the controlling setpoint. This requires that setpoint 2 is properly set up and is using the same sensor as setpoint 1. ASSIGNMENT: n/a ACTION: Required
		LOW FIRE HOLD	The digital input will force modulation to low fire during auto. The keypad button for this function can also be used with an AND/OR action. ASSIGNMENT: n/a ACTION: Required
		ALARM RESET	The digital input can be used to reset a lockout. This would normally be wired to a pushbutton. Do not wire to a relay as used for resetting from a remote location. ASSIGNMENT: n/a ACTION: Required

Sub-menu	Option	Choice	Description
DI 1 DI 2 DI 3 DI 4 DI 5 DI 6 DI 7 DI 8 DI 9 DI 10 **NXF4000 and PPC4000** TAB = n/a DI 11 DI 12 DI 13 DI 14 DI 15 **NXF4000 only** TAB = n/a	USE	MANUAL MODULATE	The digital input applies the manual modulation mode. The modulation rate will be defined by the value entered on the keypad. The keypad button for this function can also be used with an AND/OR action. ASSIGNMENT: n/a ACTION: Required
		O2 TRIM DISABLE	The digital input forces the O_2 trim to become disabled. The O_2 trim will be restored to the previous state when the input is turned off. ASSIGNMENT: n/a ACTION: Required
		FORCED SETBACK	The digital input forces the setback setpoint to be applied regardless of the function defined for the time/date. ASSIGNMENT: n/a ACTION: Required
		SETBACK OVERRIDE	The digital input forces the setback setpoint to be removed regardless of the function defined for the time/date. ASSIGNMENT: n/a ACTION: Required
		FORCE SEQ. MSTR	The digital input sets the control to be the master when part of a peer-to-peer sequencing network. The keypad button for this function can also be used with an AND/OR action. ASSIGNMENT: n/a ACTION: Required
		SEQUENCING OFF	The digital input turns sequencing off and allows the control to resume operation based on the locally connected sensor. ASSIGNMENT: n/a ACTION: Required
		TRACK ON	The digital input enables the control when a sensor is configured for track input (direct 4-20mA control). Hot standby can be enabled for the period when this input is off. ASSIGNMENT: n/a ACTION: Required
		LOCKOUT	The digital input initiates a lockout whenever voltage is detected, based on the settings entered. ASSIGNMENT: Required ACTION: n/a
		GVP NORM. OPEN **NXF4000 only**	The digital input is used for the valve proving function. This input monitors the normally open pole of the gas pressure switch. Setting this input and the matching normally closed option enables valve proving. ASSIGNMENT: Required ACTION: n/a

Sub-menu	Option	Choice	Description
DI 1 DI 2 DI 3 DI 4 DI 5 DI 6 DI 7 DI 8 DI 9 DI 10 **NXF4000 and PPC4000** TAB = n/a DI 11 DI 12 DI 13 DI 14 DI 15 **NXF4000 only** TAB = n/a	USE	GVP NORM. CLOSED **NXF4000 only**	The digital input is used for the valve proving function. This input monitors the normally closed pole of the gas pressure switch. Setting this input and the matching normally closed option enables valve proving. ASSIGNMENT: Required ACTION: n/a
		GENERIC **NXF4000 only**	The digital input is used for different configurable options. On or off states can initiate lockouts, a return to standby or revert to pilot. The input can be monitored during all states or only during certain states. These inputs can be used to create a first-out annunciation if the wiring method described in the *WIRING* section is followed. ASSIGNMENT: Required ACTION: n/a STATE: Required INPUT STATE: Required GOTO: Required
		PURGE HOLD **NXF4000 only**	The digital input is used to hold the control in purge. Purge can be held indefinitely using this input. ASSIGNMENT: Required ACTION: Required
		FVES/POC **NXF4000 only**	The digital input is used to monitor the fuel valve end switches (also known as proof of closure switches). Multiple inputs can be programmed for this function (use AND action). This is the default assignment for digital input 15, applied to profiles 1-4. ASSIGNMENT: Required ACTION: Required
		RUN/CHECK **NXF4000 only**	The digital input applies the check mode. The keypad button for this function can also be used with an AND/OR action. ASSIGNMENT: n/a ACTION: Required
		AIRFLOW N.CLOSED **NXF4000 only**	The digital input monitors the normally closed contact of the airflow switch (blower off state). ASSIGNMENT: n/a ACTION: Required
		AIRFLOW N.OPEN **NXF4000 only**	The digital input monitors the normally open contact of the airflow switch (blower on state). ASSIGNMENT: n/a ACTION: Required
		FORCED BLOWER ON **NXF4000 only**	The digital input will force the blower output on when the control is in standby. ASSIGNMENT: n/a ACTION: Required

Sub-menu	Option	Choice	Description
DI 1 DI 2 DI 3 DI 4 DI 5 DI 6 DI 7 DI 8 DI 9 DI 10 **NXF4000 and PPC4000** TAB = n/a DI 11 DI 12 DI 13 DI 14 DI 15 **NXF4000 only** TAB = n/a	USE	LGP CHECK **NXF4000 only**	The digital input connects to a gas pressure switch that can only be monitored after the downstream gas valve opens. This input must be proven by the end of the first five seconds of MTFI/MFEP and remain on during the run cycle. Use this input when the applicable code requires a gas pressure switch to be used in this manner. ASSIGNMENT: n/a ACTION: n/a
	ASSIGNMENT	4,3,2,1	Assignment refers to which profiles the input will be used with. Any combination of profiles 1 through 4 can be entered. If the input will apply to all profiles, this will display N/A.
	ACTION	AND	Choosing AND means that multiple inputs can be programmed for the same function and all of them must be true for the action to occur (as if wired in series). Certain options (burner control, low fire hold, auto/manual and lead/lag) can also be programmed to work with the keypad, and the AND/OR choice will also be applied when analyzing those inputs. If this does not apply to an input, this will display N/A.
		OR	Choosing OR means that any of the inputs programmed for the same function can be true for the action to occur (as if wired in parallel). Certain options (burner control, low fire hold, auto/manual and lead/lag) can also be programmed to work with the keypad, and the AND/OR choice will also be applied when analyzing those inputs. If this does not apply to an input, this will display N/A.
	STATE	ALL	The input will be evaluated in all operating states, including standby and lockout.
		AFTER PREPURGE	The input will be evaluated after the prepurge state is complete, until the end of the burner cycle.
		HF PURGE ONLY	The input will only be evaluated during the high fire purge.
		AFTER HF PURGE	The input will be evaluated after the high fire purge is complete, until the end of the burner cycle.
		AFTER LF PURGE	The input will be evaluated after the low fire purge is complete, until the end of the burner cycle.
		PTFI-MTFI	The input will only be evaluated during the PTFI and MTFI states.
		MTFI-AUTO	The input will only be evaluated during the MTFI and automatic modulation states.
	INPUT STATE	0	The condition is true when the input is off, and the chosen state is active.
		1	The condition is true when the input is on, and the chosen state is active.
	GOTO	LOCKOUT	When the condition is true, the control will lockout.
		STANDBY 1S	When the condition is true for greater than one second, the control will return to standby.
		STANDBY 3S	When the condition is true for greater than three seconds, the control will return to standby.

Sub-menu	Option	Choice	Description
DI 1 DI 2 DI 3 DI 4 DI 5 DI 6 DI 7 DI 8 DI 9 DI 10 **NXF4000 and PPC4000** TAB = n/a DI 11 DI 12 DI 13 DI 14 DI 15 **NXF4000 only** TAB = n/a	GOTO	ALARM	When the condition is true, the control will show an alarm message on the display and active the alarm relay. Operation will continue.
		REVERT TO PILOT	See *Revert to Pilot Sequence* following this table.

Revert to Pilot Sequence

WARNING: All profiles must use the same pilot gas train when enabling the revert to pilot function.

A digital input programmed for the GENERIC function can be used to enable the revert to pilot function. Typically, the STATE parameter would be set for AFTER PREPURGE and the INPUT STATE parameter set to 1 (revert to pilot when the input has voltage).

When the input is true, the first event that occurs is that the pilot output is energized. After that, the servos are commanded to the low fire position (p3). After a short stabilization period at low fire, the fuel valve outputs are deenergized and the servos are simultaneously driven to the ignition position (p2). The state of operation will display PILOT and the user interface will also indicate that revert to pilot is active.

At this point, the selected profile can be changed if desired. When using revert to pilot, all profiles must use the same pilot gas train. If one of the profiles does not use the pilot gas train (such as a direct-spark oil application) then revert to pilot should not be used. When the profile is changed, the servos will move to the ignition (p2) point for the new profile.

When the input changes back to false, revert to pilot will be canceled. The control will enter PTFI to prove the pilot, then continue sequencing from MTFI to automatic modulation mode.

If the revert to pilot input is active during the initial start, the control will hold at the PILOT state until the input is removed. At this point, sequencing will continue as described above.

USER OUTPUT SETUP

NXTSD507HD and NXTSD512HD MENU = SYSTEM SETTINGS → OUTPUTS

WARNING: Never use programmable line voltage outputs for safety-related functions. These outputs are intended for monitoring and non-critical control functions only.

The NXF4000 has three programmable line voltage outputs that can be used to indicate various conditions. A relay at the same voltage as the control can be fitted to the programmable output to provide dry contacts.

The PPC4000 does not offer programmable outputs.

Sub-menu	Option	Choice	Description
USER OUTPUT 1 USER OUTPUT 2 USER OUTPUT 3 TAB = USER	USE	UNUSED	The digital output is not used.
		ALWAYS ON	The digital output is always energized. ASSIGNMENT: Required
		MIRROR INPUT 1 MIRROR INPUT 2 MIRROR INPUT 3 MIRROR INPUT 4 MIRROR INPUT 5 MIRROR INPUT 6 MIRROR INPUT 7 MIRROR INPUT 8 MIRROR INPUT 9 MIRROR INPUT 10 MIRROR INPUT 11 MIRROR INPUT 12 MIRROR INPUT 13 MIRROR INPUT 14 MIRROR INPUT 15	The digital output is energized when the indicated digital input has voltage. This can be used as an alternative to connecting a second wire to the digital input terminal. ASSIGNMENT: Required
		FLAME ON	The digital output will be energized whenever a flame signal is detected, even if it is a false flame signal. ASSIGNMENT: Required
		LOCKOUT	The digital output will be energized whenever there is a lockout. This applies to all profiles.
		ON OFF STATE	The digital output will energize when the operational state matches the one chosen for the ON parameter, and will deenergize when the operational state matches the one chosen for the OFF parameter. ASSIGNMENT: Required ON: Required OFF: Required
		LOW FIRE	The digital output will be energized whenever the actual modulation rate is less than 6% and will deenergize when the modulation rate is greater than 11% (while in AUTO). When not in AUTO, the relay will be energized when the master servo is within 5° of the ignition (p2) position. ASSIGNMENT: Required

Sub-menu	Option	Choice	Description
USER OUTPUT 1 USER OUTPUT 2 USER OUTPUT 3 TAB = USER	USE	HIGH FIRE	The digital output will be energized whenever the actual modulation rate is greater than 93% and will deenergize when the modulation rate is less than 88% (while in AUTO). When not in AUTO, the relay will be energized when the master servo is within 5° of the purge (p1) position. ASSIGNMENT: Required
		MARGINAL 1	The digital output will energize when the marginal setpoint for the chosen setpoint 1, 2 or 3 is reached. See *Alarm Notification Note* following the table for more detail. ASSIGNMENT: Required
		MARGINAL 2	
		MARGINAL 3	
		MARGINAL ALL	The digital output will energize when the marginal setpoint for the any of setpoint 1, 2 or 3 is reached. See *Alarm Notification Note* following the table for more detail. ASSIGNMENT: Required
		O2 TRIM LIMIT	The digital output will energize when the programmed O_2 trim limit is reached. See *Alarm Notification Note* following the table for more detail. ASSIGNMENT: Required
		HIGH FLUE TEMP	The digital output will energize when the programmed O_2 flue temperature limit is reached. See *Alarm Notification Note* following the table for more detail. ASSIGNMENT: Required
		O2 PROBE LIMITS	The digital output will energize when any O_2 probe limit is reached. See *Alarm Notification Note* following the table for more detail. ASSIGNMENT: Required
		ALL LIMITS	The digital output will energize when any marginal or O_2 limit is reached. See *Alarm Notification Note* following the table for more detail. ASSIGNMENT: Required
		CALL FOR HEAT	The digital output is energized when the non-recycle limit is complete (voltage on terminal P15.4). ASSIGNMENT: Required
		MODBUS CONTROL	The digital output can be directly controlled using Modbus. Writing a 0 will turn the output off and writing a 1 will turn the output on. See the *MODBUS* section for additional detail. ASSIGNMENT: Required

Sub-menu	Option	Choice	Description
USER OUTPUT 1 USER OUTPUT 2 USER OUTPUT 3 TAB = USER	ASSIGNMENT	4,3,2,1	Assignment refers to which profiles the output will be used with. Any combination of profiles 1 through 4 can be entered. If the output will apply to all profiles, this will display N/A.
	ON...OFF	STANDBY	All servos are at the p0 position and there is no call to run.
		WAIT FOR PROFILE	The control has a call to run and is waiting for a profile to be selected.
		GAS VALVE PROVE1	The control is currently running the evacuation portion of valve proving.
		GAS VALVE PROVE2	The control is currently running the evacuation test portion of valve proving.
		GAS VALVE PROVE3	The control is currently running the pressurization portion of valve proving.
		GAS VALVE PROVE4	The control is currently running the pressurization test portion of valve proving.
		MOVE TO PURGE	Valve proving is finished, moving servos to the purge (p1) position.
		PURGE	Servos are at the purge (p1) position and purge is timing.
		MOVE TO IGNITON	Purging is finished, moving servos to the ignition (p2) position.
		PTFI	Servos are at the ignition position and the control is testing the pilot flame.
		PILOT	If early spark termination is used, this is the state after the ignition output is deenergized, but the pilot is still proving. This is also the state that the revert to pilot function will return to.
		MTFI	The pilot has proven, and the main valve outputs are energized.
		MFEP	This is the state after the pilot output is deenergized, but the main flame is still proving.
		MOVE TO LOW FIRE	Servos are moved to the low fire (p3) position before being released to automatic modulation. If there is only one user point defined (only p3) then this is the eventual running state.
		AUTO	Servos are released to modulate to maintain the load and will move from p3 to the max defined point as needed.
		POST PURGE	The call to run is lost and the control is purging prior to shutting down.
		LOCKOUT	The control is locked out due to a fault.

Alarm Notification Note

The alarm relay output (P4.1 and P4.2) is normally energized with any of the following alarms: lockout, marginal sensor 1, marginal sensor 2, marginal sensor 3, O_2 trim limit, O_2 high flue temperature limit and any O_2 probe limit.

If a user output is configured for a specific alarm, the selected output terminal will be energized instead of having that alarm trigger the general alarm. This transfers the function of alarm notification from the general alarm output to the selected programmable output.

O2 SETUP

NXTSD507HD and NXTSD512HD MENU = GENERAL SETTINGS → O2

WARNING: Ensure that limits entered as part of O_2 trim control are within safe boundaries for the equipment and installation.

WARNING: Take caution when activating O_2 trim to trim using a fuel servo. Adjusting the fuel servo changes the energy output and can also be more sensitive to changes. It is advised to trim using the air servo.

The NXF4000 has three programmable line voltage outputs that can be used to indicate various conditions. A relay at the same voltage as the control can be fitted to the programmable output to provide dry contacts.

The PPC4000 does not offer programmable outputs.

Sub-menu	Option	Choice	Description
O2 OPERATION TAB = n/a	n/a	DISABLE	The O_2 trim function is disabled and there are no attempts to communicate with an O_2 probe. No operating information will be displayed.
		CONTROL	The O_2 trim function is enabled for trim control for the selected profiles and will continuously communicate with an O_2 probe to display operating information for all profiles.
		MONITOR	The O_2 trim function is disabled for trim control but will continuously communicate with an O_2 probe to display operating information.
CALIBRATE NOW TAB = CALIBRATION	n/a	n/a START	When selected, a calibration signal is sent to the connected O_2 probe. This can only be done in standby and purge and should only be done after an extended purging period to ensure that only free air (no combustion byproduct) is being tested. A message will indicate the status once completed (ERROR or DONE).
ASSIGNMENT ASSIGNED PROFILES TAB = MONITOR, CONTROL	n/a	4,3,2,1	Assignment refers to which profiles the O_2 trim function will be used with. Any combination of profiles 1 through 4 can be entered. If the output will apply to all profiles, this will display N/A.
FUEL TYPE(1...4) FUEL TYPE TAB = PROFILE1…4	n/a	NONE	No fuel type is assigned.
		NAT.GAS	The fuel type for each assigned profile is required to calculate boiler efficiency. The fuel type selected determines the constants used. The default selection is NONE.
		OIL#2	
		OIL#6	
		LNG	
		COKE	
		METHANE	
		PROPANE	
HEAT LOSS TAB = MONITOR, CONTROL	n/a	Min: 0.0% Max: 9.9%	Used to calculate boiler efficiency. This indicates the percentage of boiler output lost through the shell of the boiler at high fire. The NXF4000 or PPC4000 will calculate the heat loss at all firing rates and is dependent on burner turndown ratio. The default is 0%.

Sub-menu	Option	Choice	Description
TURNDOWN RATIO TAB = MONITOR, CONTROL	n/a	Min: 1 Max: 9	Used to determine amount of heat loss at all firing rate positions. Calculated value is subtracted from gross efficiency. A value of 1 will result in a constant heat loss across all firing rate values. The default is 3.
TRANSPORT DELAY TAB = CONTROL	n/a	Min: 0s Max: 60s	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). The default is 0 seconds.
TRIM TYPE TAB = CONTROL	n/a	AIR	When O_2 trim is active, adjustments will be made to the air servo position. Trimming the air servo is advised. This is the default setting.
		FUEL	When O_2 trim is active, adjustments will be made to the fuel servo position. It is not advised to trim the fuel servo as it is more sensitive to movement and can affect the energy output. Note that the fuel servo may be defined as GAS, OIL or similar depending upon the fuel defined for the profile.
TRIM LIMIT RATIO TAB = CONTROL	n/a	Min: 1 Max: 8	Trim limit ratio is used in determining trim limit. See *COMMISSIONING* section for additional detail. The default is 1.
TRIM LIMIT TRIM LIMIT MODE TAB = CONTROL	n/a	DEFAULT	Applies to degrees of trim at low fire. Selecting DEFAULT will make the trim limit setting inaccessible but the last setting will be retained. The default setting for a new control is 0.1°.
		MANUAL	Selecting MANUAL allows users to enter the trim limit at low fire for each profile assigned. See *COMMISSIONING* section for additional detail.
TRIM LIMIT(1...4) TRIM LIMIT TAB = PROFILE1…4	n/a	Min: 0.1 Max: 3.0	Sets the range of trim allowed per profile when the trim limit parameter is set to MANUAL. See *COMMISSIONING* section for additional detail. The default for each profile is 2.0°.
TRIM P-GAIN(1...4) TRIM P-GAIN TAB = PROFILE1…4	n/a	Min: 0% Max: 100%	Sets the proportional gain term per profile. The O_2 trim will be more aggressive with higher gain terms. See *COMMISSIONING* section for additional detail. The default for each profile is 6%.
TRIM I-GAIN(1...4) TRIM I-GAIN TAB = PROFILE1…4	n/a	Min: 0 Max: 100	Sets the integral gain term per profile, which is the amount of error that is fed back. The higher the gain term is, the faster the O_2 trim will adjust. See *COMMISSIONING* section for additional detail. The default for each profile is 95.
O2 FAULT ALARM TAB = CONTROL	n/a	WARNING	Faults detected in the O_2 probe will deactivate O_2 trim and revert to the commissioned curve. This is the default setting.
		LOCKOUT	Faults detected in the O_2 probe will result in a lockout.
O2 LEVEL ALARM TAB = CONTROL	n/a	UNUSED	No action is taken if O_2 alarm levels are exceeded.
		WARNING	If O_2 alarm levels are exceeded, the alarm output is energized and an alarm message is displayed, but the burner remains running. This is the default setting.
		LOCKOUT	There will be a lockout if O_2 alarm levels are exceeded.

Sub-menu	Option	Choice	Description
O2 LO ALM@LO(1...4) LOW AT LOW TAB = PROFILE1…4	n/a	Min: 0.1% Max: 5.0%	LO alarms refer to how far the O_2 level can deviate below the target O_2 before a level alarm occurs. HI alarms refer to how far the O_2 level can deviate above the target O_2 before a level alarm occurs. The default for each profile is 0.5%
O2 LO ALM@HI(1...4) LOW AT HIGH TAB = PROFILE1…4			
O2 HI ALM@LO(1...4) HIGH AT LOW TAB = PROFILE1…4			
O2 HI ALM@HI(1...4) HIGH AT HIGH TAB = PROFILE1…4			
FLUE TEMP ALM STACK TEM P ALARM TAB = CONTROL	n/a	UNUSED	No action is taken if the programmed flue temperature high limit is exceeded.
		WARNING	If the programmed flue temperature high limit is exceeded, the alarm output is energized and an alarm message is displayed, but the burner remains running. This is the default setting.
		LOCKOUT	There will be a lockout if the programmed flue temperature high limit is exceeded
FLUE TEMP LO(1...4) STACK LOW TAB = PROFILE1…4	n/a	Min: 4ºC (40ºF) Max: 426ºC (800ºF)	LO and HI represent the range that the flue temperature acceptance zone. The control interpolates the alarm value between these points automatically. The condition must persist for greater than 30 seconds before an alarm will occur. The default LO for each profile is 65ºC (150ºF) and the default HI for each profile is 100ºC (212ºF).
FLUE TEMP HI(1...4) STACK HIGH TAB = PROFILE1…4			
FLUE LO TIME STACK TEMP LOW TIME TAB = CONTROL	n/a	Min: 0 min Max: 60 min	Enables a low fire hold time based upon the flue temperature. Low fire will hold for this time whenever the flue temperature falls outside of the acceptance zone. Setting to 0 minutes disables this function. The default setting is 0 minutes.

SEQUENCING SETUP

NXTSD507HD and NXTSD512HD MENU = SYSTEM SETTINGS → SEQUENCING

Peer-to-peer sequencing is used in a multi-boiler installation. Up to six NXF4000 and/or PPC4000 controls can be connected on a dedicated communication bus. During normal operation, a master boiler is established to control the other (slave) boilers in order to achieve the desired setpoint selected in the master boiler. Any boiler can be a master, but only one boiler can be the master at any given time.

When configured as a slave, the hot standby function can be configured to override the master's off command. This can be used to keep the boiler ready to make steam more quickly when it is brought back online. The slave boiler will fire using the setpoint set up for the STANDBY temperature sensor (setpoint 2).

Sub-menu	Option	Choice	Description
MASTER SLCT MASTER SELECT TAB = MASTER	n/a	UNUSED	Sequencing will be disabled for this control.
		KEYPAD	The LEAD/LAG key on the keypad will select the control to be the sequencing master. See *Sequencing Details* section following this table.
		INPUT	A programmed digital input will select the control to be the sequencing master. See *Sequencing Details* section following this table.
		COMMS	A Modbus command will select the control to be the sequencing master. See *Sequencing Details* section following this table.
SLAVES AVAILABLE TAB = MASTER	n/a	Min: 0 Max: 5	Selects how many slaves the master can control.
1ST SLAVE ON 2ND SLAVE ON 3RD SLAVE ON 4TH SLAVE ON 5TH SLAVE ON SLAVE ADDRESS 1…5 TAB = SLAVES	n/a	Min: 1 Max: 247	Selects a slave for the indicated position. Slaves can't be selected for more than one position. See *Communication Setup* for additional detail on setting unit addresses.
SLAVE ON RATE TAB = SLAVES	n/a	Min: 0% Max: 100%	This is the master modulation rate that must be exceeded for a slave timer to begin counting toward bringing a slave online. The default setting is 80%.
SLAVE (1) ON DELAY SLAVE (2) ON DELAY SLAVE (3) ON DELAY SLAVE (4) ON DELAY SLAVE (5) ON DELAY SLAVE ON DELAY 1…5 TAB = SLAVES	n/a	Min: 0m Max: 255m	This is the amount of time that the modulation rate must exceed the SLAVE ON RATE parameter before a slave is commanded online. If the modulation rate falls below this parameter during the count, the timer will reset, and counting will begin again. The default for each slave has a different value.
SLAVE OFF RATE TAB = SLAVES	n/a	Min: 1% Max: 100%	The master modulation rate must fall below this value for a slave timer to begin counting toward commanding a slave offline. This value must be less than the defined SLAVE ON RATE. The default setting is 30%.
SLAVE OFF DELAY TAB = SLAVES	n/a	Min: 0m Max: 255m	This is the amount of time that the modulation rate must fall below the SLAVE OFF RATE parameter before a slave is commanded offline. If the modulation rate rises above this parameter during the count, the timer will reset, and counting will begin again. This parameter applies to all slaves. The default setting is 2 minutes.

Sequencing Details

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 to connected slaves and sequencing will be disabled. All slave boilers will revert to their own PID settings.

Should a slave boiler fail to come on within three minutes (due to a burner limit, lockout or other condition), the master will call for the next slave in the priority list. An extended purge time in a slave is considered normal operation and the master will not recognize this as an alarm.

Although there can be only one master, there will be times when the user will attempt to choose a new master. This results in a situation where there are temporarily two masters as the role is transitioned. The new master will continue to be a slave until no further communications is received from the previous master. It is expected that the former master will transition to a slave at this point. This is all done by pressing using the keypad, digital input or Modbus commands to change each control from master to slave or the opposite. When the new master takes control, it will operate according to its own PID and control using its own 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, without losing the ability to control the connected slaves. If a master boiler is base loaded, it continues to calculate its theoretical firing rate using its PID settings. This calculated firing rate is used in conjunction with the slave on and slave off setpoints and timers.

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. This will result in the slaves operating under their own PID settings.

If the SD card is used to restore data to an NXF4000 or PPC4000 that is operating in a sequencing environment, the communication setup and sequencing setup should be checked and verified for proper configuration.

THERMAL SHOCK SETUP

NXTSD507HD and NXTSD512HD MENU = GENERAL SETTINGS → THERMAL SHOCK

Thermal shock protection (also known as cold start) is a method to slowly increase the burner firing rate on a cold start to limit mechanical stress due to thermal differences. The NXF4000 and PPC4000 offers two algorithms for thermal shock protection: Low Fire and Segment. After thermal shock is satisfied, operation of the boiler is handed over to the controlling setpoint.

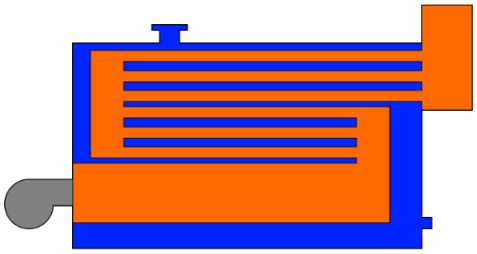
Sub-menu	Option	Choice	Description
METHOD TYPE THERMAL SHOCK MODE TAB = n/a	n/a	UNUSED	Thermal shock will be disabled for this control.
		LOW FIRE	Low fire algorithm will be used for thermal shock. See *Thermal Shock Methods* section following this table for additional detail.
		SEGMENT	Low fire algorithm will be used for thermal shock. See *Thermal Shock Methods* section following this table for additional detail.
SENSOR USED SENSOR TAB = LOW FIRE, SEGMENT	n/a	UNUSED	No sensor is assigned.
		1	Use sensor 1 for this function.
		2	Use sensor 2 for this function.
		3	Use sensor 3 for this function.
THERMAL START TAB = SEGMENT	n/a	<varies by sensor range>	When using the segment algorithm, sets the temperature or pressure that where the incremental firing rate increases will begin. Low fire will be held when the sensor reading is below this value. It is not recommended to use a pressure for thermal shock. See *Benefits of Adding a Temperature Sensor to a Steam Boiler* and *Thermal Shock Methods* sections following this table for additional detail.
THERMAL EXIT TAB = LOW FIRE, SEGMENT	n/a	<varies by sensor range>	When using the low fire or segment algorithm, sets the temperature or pressure that where the incremental firing rate increases will end. Automatic modulation will occur when the sensor reading is above this value. When using the low fire algorithm, low fire will be held when the sensor reading is below this value. It is not recommended to use a pressure for thermal shock. See *Benefits of Adding a Temperature Sensor to a Steam Boiler* and *Thermal Shock Methods* sections following this table for additional detail.
MINIMUM LOW FIRE TAB = LOW FIRE	n/a	Min: 0% Max: 100%	When using the low fire algorithm, this is the firing rate that will be held during the thermal shock period.
TIMED OVERRIDE TAB = SEGMENT	n/a	Min: 0min Max: 30min	When using the segment algorithm, sets the maximum amount of time that the control will stay on any one step. Setting this to zero disables the time limit. The default setting is 0 minutes. See *Benefits of Adding a Temperature Sensor to a Steam Boiler* and *Thermal Shock Methods* sections following this table for additional detail.

Benefits of Adding a Temperature Sensor to a Steam Boiler

A boiler is a pressure vessel that allows the conversion of energy from a burner firing into a furnace into hot water or steam. While the material is typically carbon steel, it can also be stainless steel, cast iron, cast aluminum or another type of alloy. Regardless of the material used, the manufacturer of the boiler vessel will have instructions regarding how to properly fire into the furnace to prevent and delay metal fatigue for as long as possible. It is possible to get well over 50 years of service from a carbon steel boiler if the main sources of corrosion and damage (oxygen and thermal stress) can be avoided.

Thermal stress is the mechanical stress caused by any change in temperature of a material. With a gradual change in temperature, materials will expand and contract in size at a uniform rate and the stresses will be minimized. If there is a large difference in temperature between the surfaces of a material and the center, there will be a lot of stress in the material which can likely result in fractures in the material. As these fractures accumulate over time, this can result in failures. As a boiler is usually under a lot of pressure, these failures have the potential to be catastrophic.

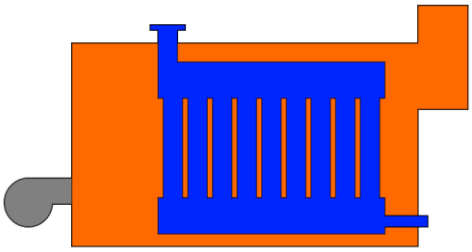
One of the main boiler designs is the firetube. In a firetube, the burner fires into a furnace that is surrounded by water. The flue gases are drawn to the exhaust outlet in tubes. These tubes make multiple passes through the water to scrub as much heat out as possible. Shown here is a basic version of a three-pass boiler.



Firetube boiler

As the difference in temperature between the water and the furnace increases, more thermal stress is introduced. The material used dictates how much of a problem this may be and what control strategies can be used to mitigate this stress.

The other main boiler design is the watertube. In a watertube, the water is contained in tubes that pass through the furnace. Due to this design, the tubes can flex to displace some of the thermal stress. Watertube boilers also do not hold nearly as much water but can operate at much higher pressures.



Watertube boiler

In a hot water boiler, the vessel is filled completely with water and pumps are used to provide circulation. Preventing thermal stress in a hot water boiler requires monitoring the water temperature and restricting the firing rate or output of the burner as appropriate.

Mixing or diverting valves can also be used to increase the temperature of incoming water by recirculating some of the heated water back into the inlet.

In a steam boiler, the vessel is filled partially with water. Steam is generated above the water line and the steam pressure provides the means to use the steam. Preventing thermal stress in a steam boiler is not as simple as monitoring the steam pressure and restricting the firing rate or output. Instead of monitoring the steam pressure, it is very important to monitor the water temperature below the water line to get a true indication of the potential for thermal stress.

Incoming water can also be pre-heated using economizers, deaerators or other means. This allows the water to turn to steam quicker which not only reduces thermal stress but also improves overall system efficiency.

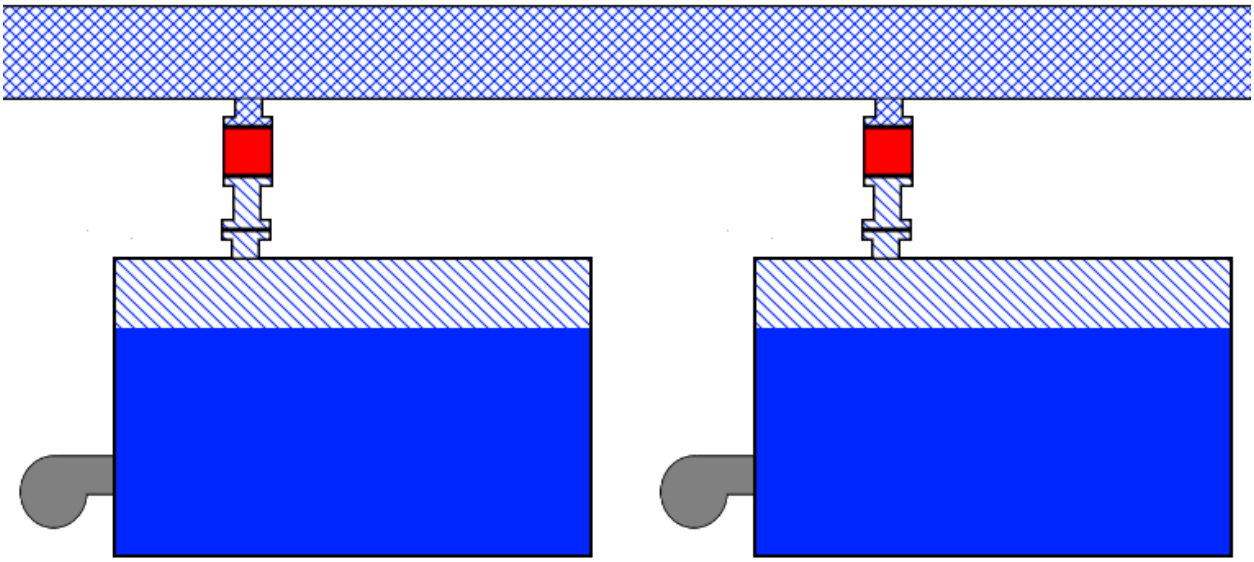
There is a correlation between the steam pressure and the water temperature in a boiler. As the boiling point of water is 100°C (212°F), this is what the water temperature should be when the steam pressure is 0 Bar (0psi). As the gauge pressure increases, the water temperature will also increase at a known rate. The table on the next slide shows the temperatures for different pressure readings. For example, the water temperature of a boiler at 6.89 Bar (100psi) should be approximately 170°C (338°F).

PSI	°F
0	212
2	219
4	224
6	230
8	233
10	239
20	259
30	274
40	286
50	298
60	307
70	316
80	324
90	331
100	338
110	344
120	350
130	356
140	361
150	366
160	371
170	375
180	380
190	384
200	388

BAR	°C
0.00	100
0.14	103.9
0.28	106.7
0.41	110.0
0.55	111.7
0.69	115.0
1.38	126.1
2.07	134.4
2.76	141.1
3.45	147.8
4.14	152.8
4.83	157.8
5.52	162.2
6.21	166.1
6.89	170.0
7.58	173.3
8.27	176.7
8.96	180.0
9.65	182.8
10.34	185.6
11.03	188.3
11.72	190.6
12.41	193.3
13.10	195.6
13.79	197.8

Saturated steam table

When multiple boilers are connected to a common steam header, it is common to include a non-return valve between the boiler steam outlet and the header. This mechanical valve only allows steam into the header when the boiler steam pressure exceeds the header. The amount it opens is proportional to the pressure differential. If the header pressure is higher the valve remains closed.

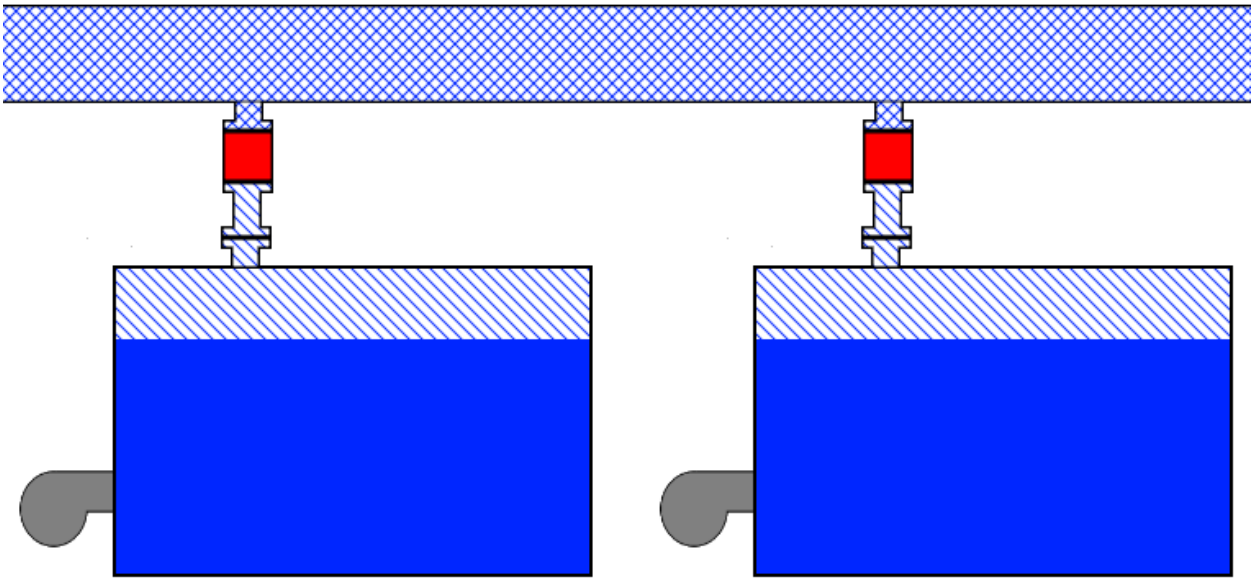


There are several reasons why steam pressure should not be used to determine if a boiler is outside of the thermal shock zone. The formula to calculate the temperature from the steam pressure is not linear, it is logarithmic. In other words, it is a complicated formula. Even so, using a linear equation could result in a value that was close enough or safe to use, but there is a much more important reason why it is a bad practice to rely on the pressure instead of reading the temperature.

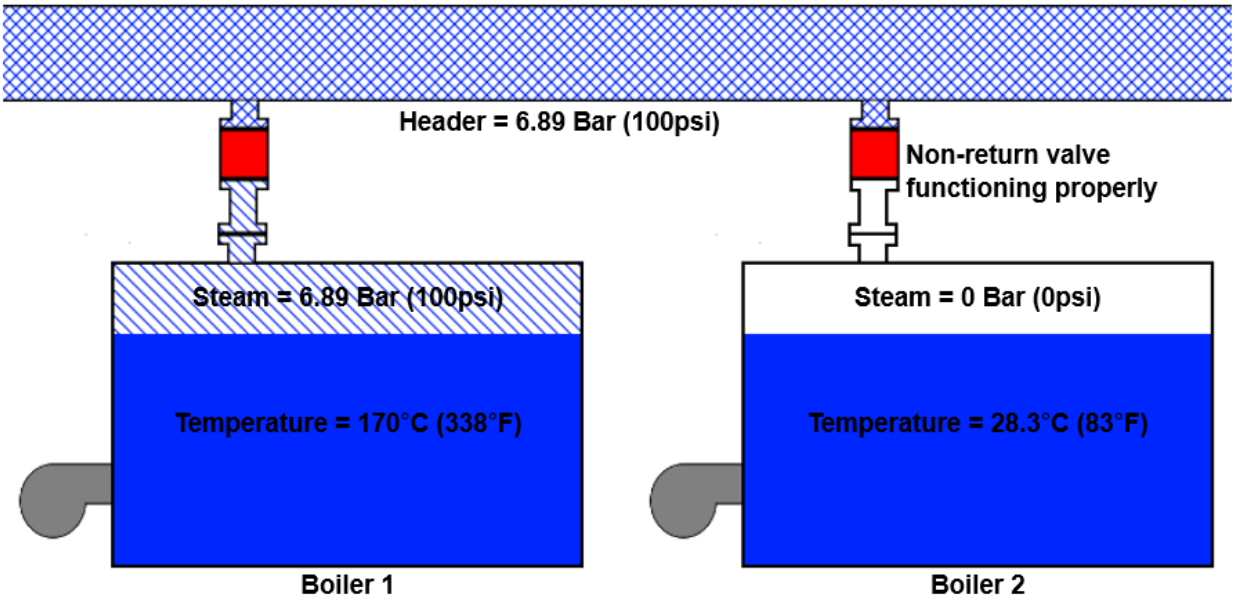
The first big issue is that if there is no pressure, the temperature can only be assumed to be under 100°C (212°F), but it can't be measured.

The second and biggest issue is that it is common for a non-return valve in a steam system to leak pressure from the header into the boiler. As it does so, the area above the water line will eventually pressurize to be equal to that of the header. While this area does have steam and is under pressure, the water in the vessel does not have the temperature corresponding to the steam pressure being measured. The water could be any temperature. Without a temperature sensor the proper control method can't be utilized to prevent thermal stress.

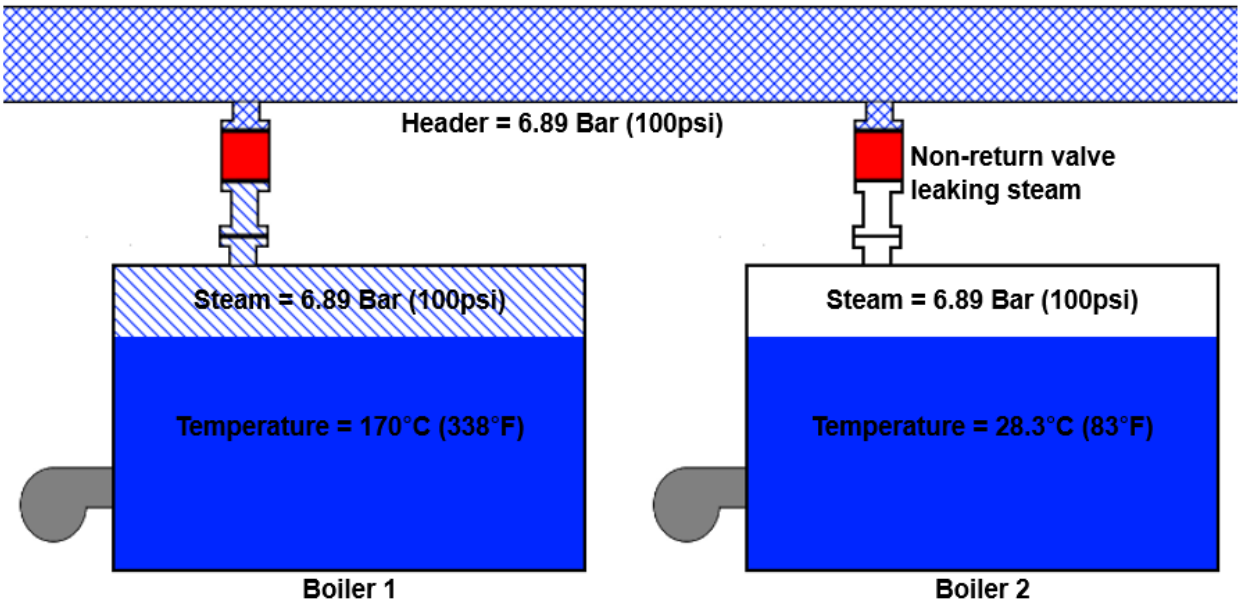
The following examples all show a system with two boilers. Both boilers are running, and everything is working properly.



Boiler 1 is running and producing 6.89 Bar (100psi), which is going into the header. The non-return valve is keeping the steam out of boiler 2, which is not making any steam and is cold since it has been off for several days.



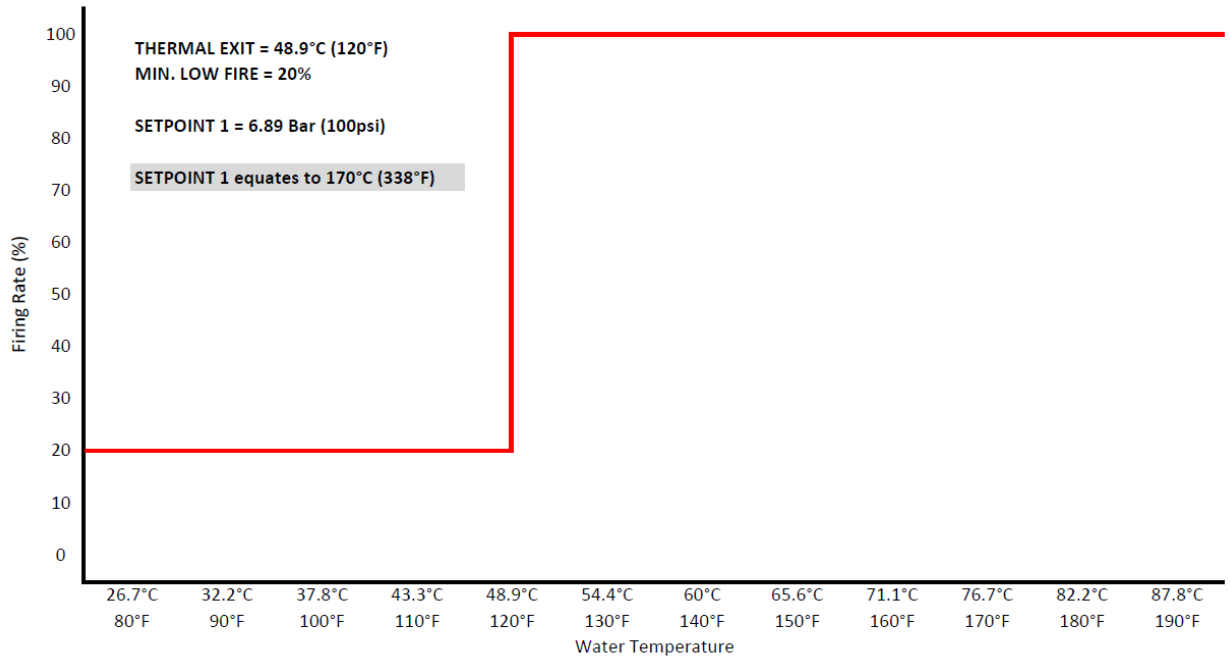
Boiler 1 is running and producing 6.89 Bar (100psi), which is going into the header. The non-return valve is leaking steam into boiler 2, which is not making any steam of its own and is cold since it has been off for several days.



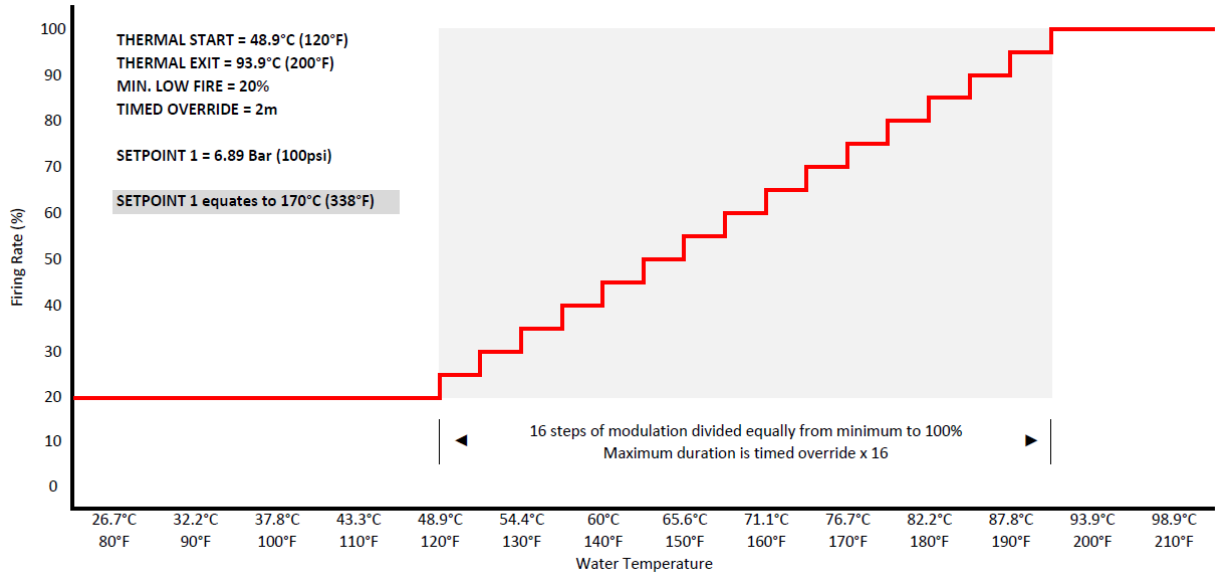
The last example clearly shows that while the pressure would indicate a safe condition and allow the control to modulate, the actual temperature does not match and could lead to thermal stress. Adding a temperature sensor to your steam boiler is a very inexpensive way to help ensure that damage to a boiler from thermal stress is minimized or eliminated. Trying to achieve the same functionality using steam pressure would be an alternative in a perfect world, but the reality is that something as simple and common as a leaking non-return valve could easily end up costing a lot in boiler repair down the line.

Thermal Shock Methods

The first algorithm option for thermal shock is LOW FIRE. Using this method, a setpoint is selected that will allow modulation to begin. At any temperature below that setpoint, the burner will modulate only at the selected firing rate. Note that this only works in one direction. Once the setpoint has been exceeded, if the temperature were to slightly fall below again the burner would not go back to low fire as it would with a simple low fire hold. The following diagram shows how the firing rate tracks using this method.



The second algorithm option for thermal shock is SEGMENT. Using this method, a setpoint is selected that will allow modulation to begin. This is the “start” setpoint. Between this setpoint and the “stop” setpoint, modulation will be divided into 16 steps. The steps will begin at the minimum firing rate entered and will end with high fire. As the temperature for each step is satisfied, modulation will proceed to the next step. A maximum time for each step can be entered so that the overall time in thermal shock mode can be limited. Note that once modulation has moved to the next step it will not go back down even if the temperature temporarily drops. The following diagram shows how the firing rate tracks using this method.



SETBACK SETUP

NXTSD507HD and NXTSD512HD MENU = GENERAL SETTINGS → SET BACK

For setback to work properly the user should ensure the real time clock has been properly set up. See *COMMISSIONING* section for additional detail.

Setback allows one action to be chosen for each day of the week. There is also a single time range per day that can be used to determine the action. Setback is typically used to change a setpoint automatically during periods of unoccupancy or when a process is not needed.

The setback setpoint can also be forced using a digital input. This can effectively be used as a third setpoint if needed (when setpoint 1 and setpoint 2 are already being used).

Sub-menu	Option	Choice	Description
SENSOR USED SENSOR TAB = n/a	n/a	UNUSED	Setback is not used.
		1	Setback will use sensor 1. This includes all the other settings such as PID tuning and high alarm settings.
		2	Setback will use sensor 2. This includes all the other settings such as PID tuning and high alarm settings. Note that this option will only work if sensor 2 is the same type as sensor 1.
LIMIT TYPE TAB = n/a	n/a	DEV	The cut-in and cut-out values will be a deviation of the setpoint. This means that they are always relative to the setpoint, so changing the setpoint will change the cut-in and cut-out values appropriately. This value cannot be changed.
STBCK SETPT SET POINT TAB = SET POINT	n/a	<varies>	The setpoint must be within the boundaries of the selected sensor.
CUT IN TAB = SET POINT	n/a	Typical min: 0 units Typical max: 60 units A unit is a degree (C or F), psi, mB or Bar	Subtract this value from the setpoint to determine when the call for heat will return. Example: If the setpoint is 100psi and the cut in is 3psi, the call for heat will return when the pressure falls below 97psi. The value that can be entered can range from 0 to 60 units if the calculated setpoint less cut in is greater than 0.
CUT OUT TAB = SET POINT	n/a	Typical min: 3 units Typical max: 60 units A unit is a degree (C or F), psi, mB or Bar	Add this value to the setpoint to determine when the call for heat is gone. Example: If the setpoint is 100psi and the cut out is 3psi, the call for heat is gone when the pressure exceeds 103psi. The value that can be entered can range from 3 to 60 units (degrees, psi, Bar).
P-BAND TAB = SET POINT	n/a	Typical min: 3 units Typical max: 60 units A unit is a degree (C or F), psi, mB or Bar	The proportional band is part of the firing rate calculation while in automatic modulation. See the *PID Calculation Notes* following the SETPOINT SETUP table for more information.
INTEGRAL TAB = SET POINT	n/a	Min: 0 Max: 100	The integral can be used in addition to the proportional/derivative calculations to create a more responsive firing rate output. See the *PID Calculation Notes* following the SETPOINT SETUP table for more information. A value of 0 disables this function, while a value of 1 = 12s and a value of 100 = 1200s (proportionate in between).

Sub-menu	Option	Choice	Description
DERIVATIVE TAB = SET POINT	n/a	Min: 0 Max: 100	The derivative can be used in addition to the proportional/integral calculations to create a more responsive firing rate output. See the *PID Calculation Notes* following the SETPOINT SETUP table for more information. A value of 0 disables this function, while a value of 1 = 12s and a value of 100 = 1200s (proportionate in between).
END STBCK END TIME TAB = TIME SETTINGS	n/a	<time of day>	This setpoint determines at what time the control changes over from the setback setpoint to the normal setpoint (setpoint 1 or setpoint 2).
BGN STBCK START TIME TAB = TIME SETTINGS	n/a	<time of day>	This setpoint determines at what time the control changes over from the normal setpoint (setpoint 1 or setpoint 2) to the setback setpoint.
OVERRIDE HOURS TAB = TIME SETTINGS	n/a	Min: 0 Max: 8	This allows a digital input configured for SETBACK OVERRIDE to connect to a momentary pushbutton to force from using the setback setpoint to using the normal setpoint (setpoint 1 or setpoint 2). This override will only last for the number of hours set by this parameter, then the control will return to using the setback setpoint. Pressing the momentary pushbutton while in the override mode will stop the timer and immediately return operation to setback setpoint. Setting this to zero disables the function. The default setting is 0.
STBCK SUN SUNDAY TAB = TIME SETTINGS	n/a	ALL STBCK	The control uses the setback setpoint for the entire day (24 hours).
STBCK MON MONDAY TAB = TIME SETTINGS	n/a	NO STBCK	The control uses the normal setpoint (setpoint 1 or setpoint 2) for the entire day (24 hours).
STBCK TUE TUESDAY TAB = TIME SETTINGS			
STBCK WED WEDNESDAY TAB = TIME SETTINGS			
STBCK THU THURSDAY TAB = TIME SETTINGS		SCHEDULE	The control uses the setback setpoint between the END STBCK and BGN STBCK times, and uses the normal setpoint (setpoint 1 or setpoint 2) when outside of that time range.
STBCK FRI FRIDAY TAB = TIME SETTINGS			
STBCK SAT SATURDAY TAB = TIME SETTINGS			

COMMUNICATION SETUP

NXTSD507HD and NXTSD512HD MENU = SYSTEM → OPTIONS

It is important to note that the peer-to-peer sequencing bus and the user Modbus connection both utilize the same unit address. This means that if peer-to-peer sequencing is enabled after commissioning, any Modbus connection to building automation or a plant PLC/SCADA system may stop working until the corresponding unit address is changed in that system.

Sub-menu	Option	Choice	Description
BAUD RATE	n/a	4800 9600 19200 38400 57600	This sets the baud rate for the user Modbus connection. This is the connection used for BMS or for connection to NXTSD507HD and NXTSD512HD touchscreens. The default setting is 57600.
UNIT ADDRESS DEVICE CONFIGURATION PAGE = MISCELLANEOUS	n/a	Min: 1 Max: 247	This sets the unit address for both the user Modbus as well as for peer-to-peer sequencing. These addresses cannot be different. The default setting is 247. If using a NXTSD507HD or NXTSD512HD touchscreens the address must be changed from 1 to 6 to enable peer-to-peer sequencing. This requires that the touchscreen communication setup is modified as well so that communication can continue.

KEYPAD SETUP

NXTSD507HD and NXTSD512HD MENU = SYSTEM SETTINGS → KEYPAD

These parameters refer to the quick keys on the user interfaces. These keys can be enabled or disabled, and all functions can be used from digital inputs instead.

Note that when writes are initiated by the user Modbus connection, these writes will activate the corresponding quick key. For example, if the writable point for BURNER ON is set to 1, the burner on quick key will change to on. This can be overridden on the keypad, but it the Modbus write is continuous it will turn on again with the next write cycle.

Sub-menu	Option	Choice	Description
BURNER ON KEY BURNER CONTROL	n/a SLIDER ON/OFF	UNUSED	The burner on key on the keypad will not be used. A digital input must be set for BURNER CONTROL (one source of burner control is required).
		USED	The burner on key on the keypad will be used. A digital input can be set for BURNER CONTROL as well. The AND/OR action chosen will determine if both sources must be active or if either can be active.
AUTO MAN KEY AUTO/MANUAL	n/a SLIDER ON/OFF	UNUSED	The auto/manual key on the keypad will not be used.
		USED	The auto/manual key on the keypad will be used. This will allow setting a manual modulation rate instead of using the calculated PID firing rate.
LOW FIRE KEY LOW FIRE HOLD	n/a SLIDER ON/OFF	UNUSED	The low fire key on the keypad will not be used. A digital input can be set for LOW FIRE HOLD if desired.
		USED	The low fire key on the keypad will be used. A digital input can be set for LOW FIRE HOLD as well. The AND/OR action chosen will determine if both sources must be active or if either can be active.
LEAD LAG KEY LEAD/LAG	n/a SLIDER ON/OFF	UNUSED	The lead/lag key on the keypad will not be used. A digital input can be set for FORCE SEQ. MSTR if desired.
		USED	The lead/lag key on the keypad will be used. A digital input can be set for FORCE SEQ. MSTR as well. The AND/OR action chosen will determine if both sources must be active or if either can be active.

SD CARD OPS SETUP

NXTSD507HD and NXTSD512HD MENU = SYSTEM SETTINGS → SD CARD

WARNING: The restore function is intended for backing up local profiles and parameters only. It is up to the technician performing this operation to ensure that restoring profiles and/or parameters is safe. Never restore profiles and/or parameters without subsequently verifying that the parameters are correct and confirming safe operation. Failure to do so could result in significant property damage, severe injury, or death.

The SD card can be used to backup and restore setup parameters and commissioned profile data.

Sub-menu	Option	Choice	Description
BACKUP TAB = n/a	n/a	PARAMETERS ONLY	All setup parameters will be backed up. None of the profile commission data will be backed up. The file name will have the date and time embedded with an PFW extension. PFLWddmmyyhhmm.PFW
		PROFILES, PARAMETERS	Setup parameters and commission data from all profiles will be backed up (full backup). The file name will have the date and time embedded with an SPD extension. SETPddmmyyhhmm.SPD
		ALL PROFILES ONLY	Commission data from all profiles will be backed up. None of the setup parameters will be backed up. The file name will have the date and time embedded with an PFO extension. PFLOddmmyyhhmm.PFO
		PROFILE 1 ONLY	Commission data from the selected profile will be backed up. None of the setup parameters will be backed up. The file name will have the date and time embedded with an PFL extension. PFL1ddmmyyhhmm.PFL PFL2ddmmyyhhmm.PFL PFL3ddmmyyhhmm.PFL PFL4ddmmyyhhmm.PFL
		PROFILE 2 ONLY	
		PROFILE 3 ONLY	
		PROFILE 4 ONLY	

Sub-menu	Option	Choice	Description
RESTORE TAB = n/a	n/a	PARAMETERS ONLY	All setup parameters will be restored. None of the profile commission data will be restored. Choose a file from the list of available backups.
		PROFILES, PARAMETERS	Setup parameters and commission data from all profiles will be restored (full restore). Choose a file from the list of available backups.
		ALL PROFILES ONLY	Commission data from all profiles will be restored. None of the setup parameters will be restored. Choose a file from the list of available backups.
		PROFILE 1 ONLY	Commission data from the selected profile will be restored. None of the setup parameters will be restored. Choose a file from the list of available backups.
		PROFILE 2 ONLY	
		PROFILE 3 ONLY	
		PROFILE 4 ONLY	
DELETE TAB = n/a	n/a	<all backups listed>	A list of all available backups of all types will be displayed. Select the backup to delete from the SD card.
FORMAT TAB = n/a	n/a	DATA WILL BE LOST	Selecting this option will format the SD card. This will erase all the contents and delete everything. This action is not reversible.

ANALOG OUT SETUP

NXTSD507HD and NXTSD512HD MENU = SYSTEM SETTINGS → OUTPUTS

The NXF4000 and PPC4000 each have one programmable 4-20mA analog output that can be used to indicate various conditions. If the NXCESVFD add-on card is fitted, one or both 4-20mA analog outputs can also be used for the same purpose, if not used for VFD feedback. Note that the VFD outputs are shown even if they are not fitted.

Sub-menu	Option	Choice	Description
ANA 0 OUT VFD 1 OUT VFD 2 OUT TAB = ANALOGUE	n/a	UNUSED	This analog output is not used.
		MOD RATE	The analog range represents the modulation rate in the scale 0% to 100%.
		SETPOINT	The analog range represents the setpoint. The range will match the range of the controlling sensor (sensor selected for the setpoint, or the sensor selected for setback).
		SENSOR 1 SENSOR 2 SENSOR 3 SENSOR 4 SENSOR 5	The analog range represents the current value of the selected sensor. The range will match the range of the sensor.
		SERVO 1 SERVO 2 SERVO 3 SERVO 4 SERVO 5 SERVO 6 SERVO 7 SERVO 8 SERVO 9 SERVO 10	The analog range represents the current position of the selected servo in the scale 0º to 100º.
		STACK	The analog range represents the flue gas temperature as measured by the O_2 probe. The range is 0ºC to 500ºC (32ºF to 932ºF).
		O2	The analog range represents the O_2 concentration as measured by the O_2 probe. The range is 0% to 20%.
		MODBUS	The digital output can be directly controlled using Modbus. Writing 400 will output 4mA and writing 2000 will output 20mA. See the *MODBUS* section for additional detail.

PLANT MASTER PMSTR-4000

See Fireye bulletin *PMSTR-4001* for additional detail on installation and operation of the PMSTR-4000.

Option Group 1 – General

Option	Description	Min	Max	Default	Notes
1.0	Total units connected to PMSTR-4000	1	8	2	How many units to lead/lag.
1.1	Software revision (format = X.Y)	---	---	---	Read only indication of PMSTR-4000 software revision.
1.2	Option code	0	999	0	Reserved.
1.3	Screen beep control	0	1	1	Enable/disable screen beep.
1.4	Screen saver control	0	1	1	Enable/disable screen saver.
1.5	Screen saver timer	0	999	60	Screen saver delay in minutes when enabled.
1.6	Date/time format	0	1	0	Date/time format. 0 = MM/DD/YYYY 1 = DD/MM/YYYY
1.7	Setpoint screen passcode	0	999	0	Setpoint screen passcode from 000-999. Setting to 000 disables passcode requirement.

Option Group 2 – Sensor

Option	Description	Min	Max	Default	Notes
2.0	Type of system	0	3	3	Assignment for display units. 0 = °C 1 = °F 2 = mBar 3 = psi
2.1	PV input low scale	0	9999	0	Sensor low scale.
2.2	PV input high scale	0	9999	200	Sensor high scale.

Option Group 3 – Aux Input

Option	Description	Min	Max	Default	Notes
3.0	Aux input use	0	1	1	Assignment for aux input. 0 = outdoor temperature sensor 1 = remote setpoint
3.1	Aux input low scale	-999	999	0	Aux input low scale.
3.2	Aux input high scale	0	9999	200	Aux input high scale.

Option Group 4 – Pump

Option	Description	Min	Max	Default	Notes
4.0	Use pump	0	1	0	Enable pump outputs.
4.1	Use pump alarms	0	1	0	Create pump alarms if operation not proven in time.
4.2	Lead unit pump will run continuously	0	1	0	Pump for lead unit runs continuously.
4.3	Time for pump to prove before alarm	0	9999	20	Time for pump to prove before alarm, in seconds.
4.4	Pump off delay time after unit is disabled	0	9999	120	Time pump will remain enabled after unit disabled.
4.5	Pump output logic	0	1	0	Polarity of outputs. 0 = output on when enabled 1 = output off when enabled

Option Group 5 – Timers

Option	Description	Min	Max	Default	Notes
5.0	Unit start delay after pump starts on enable	0	999	15	Time unit will remain disabled following pump enable.
5.1	Unit delay before modulation	0	999	30	Delay after unit running before modulation allowed.
5.2	Time previous lead unit will overlap	0	999	3	How long former lead will remain enabled after lead changes.
5.3	Time of no load before lead is disabled	0	999	5	How long a no-load condition must last before lead is disabled.

Option Group 6 – Outside Air

Option	Description	Min	Max	Default	Notes
6.0	Outdoor reset start temperature	-99	99	30	Lowest outside temperature in reset slope.
6.1	Outdoor reset design temperature	0	120	70	Highest outside temperature in reset slope.
6.2	Outdoor reset minimum reset	0	999	120	Lowest setpoint in reset slope.
6.3	Outdoor reset maximum reset	0	999	180	Highest setpoint in reset slope.
6.4	Outdoor temperature system shutdown	0	120	80	Temperature where system will become disabled.

Option Group 7 – Setpoints

Option	Description	Min	Max	Default	Notes
7.0	Use setpoint 2 with priority	0	1	0	Setpoint 2 will have priority over all other setpoints.
7.1	Maximum units to run when setpoint 1 in use	1	8	2	Choose to limit total units allowed to run for setpoint 1.
7.2	Maximum units to run when setpoint 2 in use	1	8	2	Choose to limit total units allowed to run for setpoint 2.
7.3	Proportional band for PID	0	999	10	Proportional band for PID algorithm in PV units.
7.4	Integral time for PID	0	999	60	Integral time for PID algorithm in seconds. 0 disables integral.
7.5	Derivative time for PID	0	999	0	Derivative time for PID algorithm in seconds. 0 disables derivative.

Option Group 8 – Setpoint 1 Skips

Option	Description	Min	Max	Default	Notes
8.0	Skip unit 1 as lead when setpoint 1 in use	0	1	0	Skip unit 1 as lead when using setpoint 1.
8.1	Skip unit 2 as lead when setpoint 1 in use	0	1	0	Skip unit 2 as lead when using setpoint 1.
8.2	Skip unit 3 as lead when setpoint 1 in use	0	1	0	Skip unit 3 as lead when using setpoint 1.
8.3	Skip unit 4 as lead when setpoint 1 in use	0	1	0	Skip unit 4 as lead when using setpoint 1.
8.4	Skip unit 5 as lead when setpoint 1 in use	0	1	0	Skip unit 5 as lead when using setpoint 1.
8.5	Skip unit 6 as lead when setpoint 1 in use	0	1	0	Skip unit 6 as lead when using setpoint 1.
8.6	Skip unit 7 as lead when setpoint 1 in use	0	1	0	Skip unit 7 as lead when using setpoint 1.
8.7	Skip unit 8 as lead when setpoint 1 in use	0	1	0	Skip unit 8 as lead when using setpoint 1.

Option Group 9 – Setpoint 2 Skips

Option	Description	Min	Max	Default	Notes
9.0	Skip unit 1 as lead when setpoint 2 in use	0	1	0	Skip unit 1 as lead when using setpoint 2.
9.1	Skip unit 2 as lead when setpoint 2 in use	0	1	0	Skip unit 2 as lead when using setpoint 2.
9.2	Skip unit 3 as lead when setpoint 2 in use	0	1	0	Skip unit 3 as lead when using setpoint 2.
9.3	Skip unit 4 as lead when setpoint 2 in use	0	1	0	Skip unit 4 as lead when using setpoint 2.
9.4	Skip unit 5 as lead when setpoint 2 in use	0	1	0	Skip unit 5 as lead when using setpoint 2.
9.5	Skip unit 6 as lead when setpoint 2 in use	0	1	0	Skip unit 6 as lead when using setpoint 2.
9.6	Skip unit 7 as lead when setpoint 2 in use	0	1	0	Skip unit 7 as lead when using setpoint 2.
9.7	Skip unit 8 as lead when setpoint 2 in use	0	1	0	Skip unit 8 as lead when using setpoint 2.

Option Group 10 – Setpoint 1 Order

Option	Description	Min	Max	Default	Notes
10.0	Rotation order position 1 when setpoint 1 in use	1	8	1	Position 1 in rotation order when using setpoint 1.
10.1	Rotation order position 2 when setpoint 1 in use	1	8	2	Position 2 in rotation order when using setpoint 1.
10.2	Rotation order position 3 when setpoint 1 in use	1	8	3	Position 3 in rotation order when using setpoint 1.
10.3	Rotation order position 4 when setpoint 1 in use	1	8	4	Position 4 in rotation order when using setpoint 1.
10.4	Rotation order position 5 when setpoint 1 in use	1	8	5	Position 5 in rotation order when using setpoint 1.
10.5	Rotation order position 6 when setpoint 1 in use	1	8	6	Position 6 in rotation order when using setpoint 1.
10.6	Rotation order position 7 when setpoint 1 in use	1	8	7	Position 7 in rotation order when using setpoint 1.
10.7	Rotation order position 8 when setpoint 1 in use	1	8	8	Position 8 in rotation order when using setpoint 1.

Option Group 11 – Setpoint 2 Order

Option	Description	Min	Max	Default	Notes
11.0	Rotation order position 1 when setpoint 2 in use	1	8	1	Position 1 in rotation order when using setpoint 2.
11.1	Rotation order position 2 when setpoint 2 in use	1	8	2	Position 2 in rotation order when using setpoint 2.
11.2	Rotation order position 3 when setpoint 2 in use	1	8	3	Position 3 in rotation order when using setpoint 2.
11.3	Rotation order position 4 when setpoint 2 in use	1	8	4	Position 4 in rotation order when using setpoint 2.
11.4	Rotation order position 5 when setpoint 2 in use	1	8	5	Position 5 in rotation order when using setpoint 2.
11.5	Rotation order position 6 when setpoint 2 in use	1	8	6	Position 6 in rotation order when using setpoint 2.
11.6	Rotation order position 7 when setpoint 2 in use	1	8	7	Position 7 in rotation order when using setpoint 2.
11.7	Rotation order position 8 when setpoint 2 in use	1	8	8	Position 8 in rotation order when using setpoint 2.

Option Group 12 – Commands

Option	Description	Min	Max	Default	Notes
12.0	Applies all default values when set to 1	0	1	0	Set to 1 to apply defaults. Will automatically reset to 0.
12.1	Clear all data log memory when set to 1	0	1	0	Set to 1 to clear all data log memory. Will automatically reset to 0.

Option Group 13 – Network IP Address

Option	Description	Min	Max	Default	Notes
13.0	IP address first byte	0	255	192	IP address first byte.
13.1	IP address second byte	0	255	168	IP address second byte.
13.2	IP address third byte	0	255	0	IP address third byte.
13.3	IP address fourth byte	0	255	11	IP address fourth byte.

Option Group 14 – Network Subnet Mask

Option	Description	Min	Max	Default	Notes
14.0	Subnet mask first byte	0	255	255	Subnet mask first byte.
14.1	Subnet mask second byte	0	255	255	Subnet mask second byte.
14.2	Subnet mask third byte	0	255	255	Subnet mask third byte.
14.3	Subnet mask fourth byte	0	255	0	Subnet mask fourth byte.

Option Group 15 – Network Default Gateway

Option	Description	Min	Max	Default	Notes
15.0	Default gateway first byte	0	255	0	Default gateway first byte.
15.1	Default gateway second byte	0	255	0	Default gateway second byte.
15.2	Default gateway third byte	0	255	0	Default gateway third byte.
15.3	Default gateway fourth byte	0	255	0	Default gateway fourth byte.

Option Group 16 – Modbus RTU

Option	Description	Min	Max	Default	Notes
16.0	Modbus RTU server node address	1	255	1	Modbus RTU server node address.
16.1	Modbus RTU server baud rate	0	6	3	Modbus RTU server baud rate. 0 = 4800 1 = 9600 2 = 19200 3 = 38400 4 = 57600 5 = 115200 6 = 187500
16.2	Modbus RTU server data bits	0	1	1	Modbus RTU server data bits. 0 = 7 data bits 1 = 8 data bits
16.3	Modbus RTU server parity	0	2	0	Modbus RTU server parity. 0 = No parity 1 = even parity 2 = odd parity
16.4	Modbus RTU server stop bits	0	1	0	Modbus RTU server stop bits. 0 = 1 stop bit 1 = 2 stop bits

Option Group 17 – Sunday Schedule

Option	Description	Min	Max	Default	Notes
17.0	Sunday schedule action in range	0	2	0	Sunday action between start and end times. 0 = Enabled using normal setpoint (no action) 1 = Enabled using setpoint 2 2 = System disabled
17.1	Sunday schedule start of range	0	23	8	Sunday start of range. Start hour must be earlier than end hour. Hours are in 24-hour format and start range is inclusive (start hour is in range).
17.2	Sunday schedule action outside of range	0	2	0	Sunday action outside of start and end times. 0 = Enabled using normal setpoint (no action) 1 = Enabled using setpoint 2 2 = System disabled
17.3	Sunday schedule end of range	0	23	17	Sunday end of range. End hour must be later than end hour. Hours are in 24-hour format and end range is inclusive (end hour is in range).

Option Group 18 – Monday Schedule

Option	Description	Min	Max	Default	Notes
18.0	Monday schedule action in range	0	2	0	Monday action between start and end times. 0 = Enabled using normal setpoint (no action) 1 = Enabled using setpoint 2 2 = System disabled
18.1	Monday schedule start of range	0	23	8	Monday start of range. Start hour must be earlier than end hour. Hours are in 24-hour format and start range is inclusive (start hour is in range).
18.2	Monday schedule action outside of range	0	2	0	Monday action outside of start and end times. 0 = Enabled using normal setpoint (no action) 1 = Enabled using setpoint 2 2 = System disabled
18.3	Monday schedule end of range	0	23	17	Monday end of range. End hour must be later than end hour. Hours are in 24-hour format and end range is inclusive (end hour is in range).

Option Group 19 – Tuesday Schedule

Option	Description	Min	Max	Default	Notes
19.0	Tuesday schedule action in range	0	2	0	Tuesday action between start and end times. 0 = Enabled using normal setpoint (no action) 1 = Enabled using setpoint 2 2 = System disabled
19.1	Tuesday schedule start of range	0	23	8	Tuesday start of range. Start hour must be earlier than end hour. Hours are in 24-hour format and start range is inclusive (start hour is in range).
19.2	Tuesday schedule action outside of range	0	2	0	Tuesday action outside of start and end times. 0 = Enabled using normal setpoint (no action) 1 = Enabled using setpoint 2 2 = System disabled
19.3	Tuesday schedule end of range	0	23	17	Tuesday end of range. End hour must be later than end hour. Hours are in 24-hour format and end range is inclusive (end hour is in range).

Option Group 20 – Wednesday Schedule

Option	Description	Min	Max	Default	Notes
20.0	Wednesday schedule action in range	0	2	0	Wednesday action between start and end times. 0 = Enabled using normal setpoint (no action) 1 = Enabled using setpoint 2 2 = System disabled
20.1	Wednesday schedule start of range	0	23	8	Wednesday start of range. Start hour must be earlier than end hour. Hours are in 24-hour format and start range is inclusive (start hour is in range).
20.2	Wednesday schedule action outside of range	0	2	0	Wednesday action outside of start and end times. 0 = Enabled using normal setpoint (no action) 1 = Enabled using setpoint 2 2 = System disabled
20.3	Wednesday schedule end of range	0	23	17	Wednesday end of range. End hour must be later than end hour. Hours are in 24-hour format and end range is inclusive (end hour is in range).

Option Group 21 – Thursday Schedule

Option	Description	Min	Max	Default	Notes
21.0	Thursday schedule action in range	0	2	0	Thursday action between start and end times. 0 = Enabled using normal setpoint (no action) 1 = Enabled using setpoint 2 2 = System disabled
21.1	Thursday schedule start of range	0	23	8	Thursday start of range. Start hour must be earlier than end hour. Hours are in 24-hour format and start range is inclusive (start hour is in range).
21.2	Thursday schedule action outside of range	0	2	0	Thursday action outside of start and end times. 0 = Enabled using normal setpoint (no action) 1 = Enabled using setpoint 2 2 = System disabled
21.3	Thursday schedule end of range	0	23	17	Thursday end of range. End hour must be later than end hour. Hours are in 24-hour format and end range is inclusive (end hour is in range).

Option Group 22 – Friday Schedule

Option	Description	Min	Max	Default	Notes
22.0	Friday schedule action in range	0	2	0	Friday action between start and end times. 0 = Enabled using normal setpoint (no action) 1 = Enabled using setpoint 2 2 = System disabled
22.1	Friday schedule start of range	0	23	8	Friday start of range. Start hour must be earlier than end hour. Hours are in 24-hour format and start range is inclusive (start hour is in range).
22.2	Friday schedule action outside of range	0	2	0	Friday action outside of start and end times. 0 = Enabled using normal setpoint (no action) 1 = Enabled using setpoint 2 2 = System disabled
22.3	Friday schedule end of range	0	23	17	Friday end of range. End hour must be later than end hour. Hours are in 24-hour format and end range is inclusive (end hour is in range).

Option Group 23 – Saturday Schedule

Option	Description	Min	Max	Default	Notes
23.0	Saturday schedule action in range	0	2	0	Saturday action between start and end times. 0 = Enabled using normal setpoint (no action) 1 = Enabled using setpoint 2 2 = System disabled
23.1	Saturday schedule start of range	0	23	8	Saturday start of range. Start hour must be earlier than end hour. Hours are in 24-hour format and start range is inclusive (start hour is in range).
23.2	Saturday schedule action outside of range	0	2	0	Saturday action outside of start and end times. 0 = Enabled using normal setpoint (no action) 1 = Enabled using setpoint 2 2 = System disabled
23.3	Saturday schedule end of range	0	23	17	Saturday end of range. End hour must be later than end hour. Hours are in 24-hour format and end range is inclusive (end hour is in range).

Timer Status

Timer	Description	Notes
T1	Start timer lag 1	Shows time remaining for the start timer for lag 1. Counts down from setpoint while timing and stays at zero when lag is enabled.
T2	Start timer lag 2	Shows time remaining for the start timer for lag 2. Counts down from setpoint while timing and stays at zero when lag is enabled.
T3	Start timer lag 3	Shows time remaining for the start timer for lag 3. Counts down from setpoint while timing and stays at zero when lag is enabled.
T4	Start timer lag 4	Shows time remaining for the start timer for lag 4. Counts down from setpoint while timing and stays at zero when lag is enabled.
T5	Start timer lag 5	Shows time remaining for the start timer for lag 5. Counts down from setpoint while timing and stays at zero when lag is enabled.
T6	Start timer lag 6	Shows time remaining for the start timer for lag 6. Counts down from setpoint while timing and stays at zero when lag is enabled.
T7	Start timer lag 7	Shows time remaining for the start timer for lag 7. Counts down from setpoint while timing and stays at zero when lag is enabled.
T8	Lead change overlap timer	Shows time remaining for the overlap when former lead runs after a lead change. Counts down from setpoint while timing and resets to setpoint when finished timing.
T9	Stop timer lag 1	Shows time remaining for the stop timer for lag 1. Counts down from setpoint while timing and resets to setpoint when finished timing.
T10	Stop timer lag 2	Shows time remaining for the stop timer for lag 2. Counts down from setpoint while timing and resets to setpoint when finished timing.
T11	Stop timer lag 3	Shows time remaining for the stop timer for lag 3. Counts down from setpoint while timing and resets to setpoint when finished timing.
T12	Stop timer lag 4	Shows time remaining for the stop timer for lag 4. Counts down from setpoint while timing and resets to setpoint when finished timing.
T13	Stop timer lag 5	Shows time remaining for the stop timer for lag 5. Counts down from setpoint while timing and resets to setpoint when finished timing.
T14	Stop timer lag 6	Shows time remaining for the stop timer for lag 6. Counts down from setpoint while timing and resets to setpoint when finished timing.
T15	Stop timer lag 7	Shows time remaining for the stop timer for lag 7. Counts down from setpoint while timing and resets to setpoint when finished timing.
T16	No load shutdown timer	Shows time remaining to shut off all units when load demand is at zero. Counts down from setpoint while timing and resets to setpoint when finished timing.

Timer	Description	Notes
T17	Pump off delay timer unit 1	Shows time remaining for pump off delay for unit 1. Applies only when pump is enabled. Counts down from setpoint while timing and resets to setpoint when finished timing.
T18	Pump off delay timer unit 2	Shows time remaining for pump off delay for unit 2. Applies only when pump is enabled. Counts down from setpoint while timing and resets to setpoint when finished timing.
T19	Pump off delay timer unit 3	Shows time remaining for pump off delay for unit 3. Applies only when pump is enabled. Counts down from setpoint while timing and resets to setpoint when finished timing.
T20	Pump off delay timer unit 4	Shows time remaining for pump off delay for unit 4. Applies only when pump is enabled. Counts down from setpoint while timing and resets to setpoint when finished timing.
T21	Pump off delay timer unit 5	Shows time remaining for pump off delay for unit 5. Applies only when pump is enabled. Counts down from setpoint while timing and resets to setpoint when finished timing.
T22	Pump off delay timer unit 6	Shows time remaining for pump off delay for unit 6. Applies only when pump is enabled. Counts down from setpoint while timing and resets to setpoint when finished timing.
T23	Pump off delay timer unit 7	Shows time remaining for pump off delay for unit 7. Applies only when pump is enabled. Counts down from setpoint while timing and resets to setpoint when finished timing.
T24	Pump off delay timer unit 8	Shows time remaining for pump off delay for unit 8. Applies only when pump is enabled. Counts down from setpoint while timing and resets to setpoint when finished timing.
T25	Start delay timer unit 1	Shows time remaining for the start delay timer for unit 1. Applies only when pump is enabled. Counts down from setpoint while timing and stays at zero when unit is enabled.
T26	Start delay timer unit 2	Shows time remaining for the start delay timer for unit 2. Applies only when pump is enabled. Counts down from setpoint while timing and stays at zero when unit is enabled.
T27	Start delay timer unit 3	Shows time remaining for the start delay timer for unit 3. Applies only when pump is enabled. Counts down from setpoint while timing and stays at zero when unit is enabled.
T28	Start delay timer unit 4	Shows time remaining for the start delay timer for unit 4. Applies only when pump is enabled. Counts down from setpoint while timing and stays at zero when unit is enabled.
T29	Start delay timer unit 5	Shows time remaining for the start delay timer for unit 5. Applies only when pump is enabled. Counts down from setpoint while timing and stays at zero when unit is enabled.
T30	Start delay timer unit 6	Shows time remaining for the start delay timer for unit 6. Applies only when pump is enabled. Counts down from setpoint while timing and stays at zero when unit is enabled.
T31	Start delay timer unit 7	Shows time remaining for the start delay timer for unit 7. Applies only when pump is enabled. Counts down from setpoint while timing and stays at zero when unit is enabled.
T32	Start delay timer unit 8	Shows time remaining for the start delay timer for unit 8. Applies only when pump is enabled. Counts down from setpoint while timing and stays at zero when unit is enabled.

Section 6: Commissioning

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PRE-COMMISSIONING

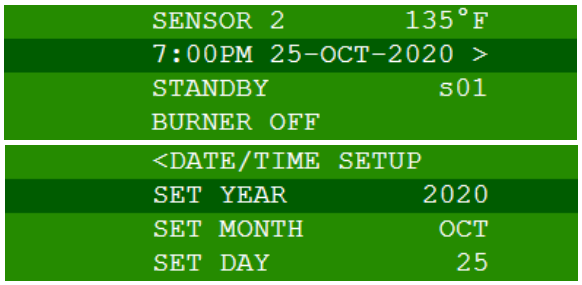
WARNING: The steps outlined in this section offer general guidelines when commissioning a system. Changes to the examples will need to be made for site-specific conditions. Example diagrams and images shown may not always match written example instructions.

This section covers all the necessary steps prior to commissioning. This includes setting parameters and checking elements of the electrical and mechanical installation. These steps are a general guide and may not include every condition present on a job site. Adjustments will have to be made to the specific steps as necessary.

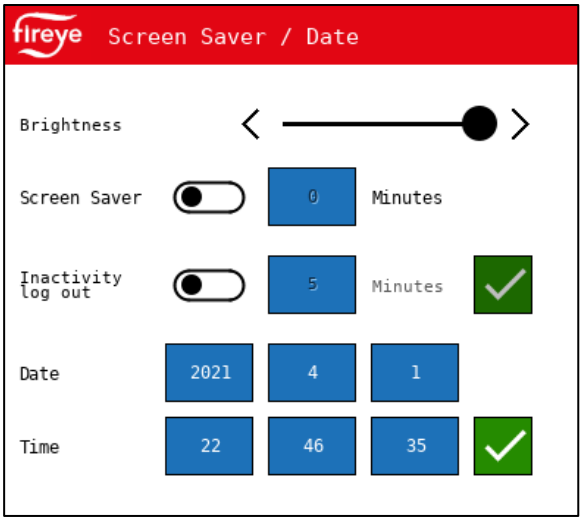
Setting the Real-Time Clock

The real-time clock should be set so that any time-stamped alarms will display the correct time.

To set the time with the NXD410TS, first make sure that the home position is showing. Press the HOME key if this is not the case. Next, use the UP key to scroll until the current date/time are highlighted on the second line. Press the NEXT key to display the date/time settings and then use the UP/DOWN keys and MODIFY/SAVE to edit the values as appropriate.



To set the time with the NXTSD507HD and NXTSD512HD, first log in at the Admin level. Next, go to the menu SYSTEM → OPTIONS, then touch the folder icon until the SCREEN SAVER / DATE page is showing.



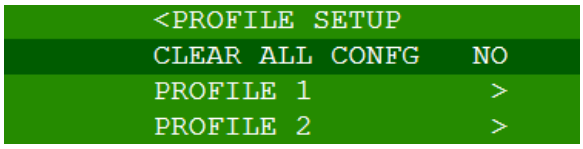
The real-time clock will also be used for setback functions.

Erasing Existing Configurations

The first step is to erase all the existing profiles and parameters. This is so that the control will in the same state as when shipped from the factory.

If the burner has already been commissioned and it is desired to keep the parameters only, it is possible to erase just the profiles as well.

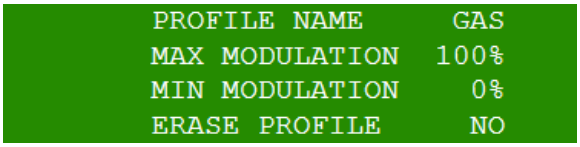
With the NXD410TS, navigate down to the PROFILE SETUP menu, then hit the NEXT quick key. Navigate to the option CLEAR ALL CONFG, then hit the MODIFY/SAVE quick key. Use the UP/DOWN quick keys to select YES, then hit MODIFY/SAVE to apply. After a pause, the setting will change to DONE to indicate success.



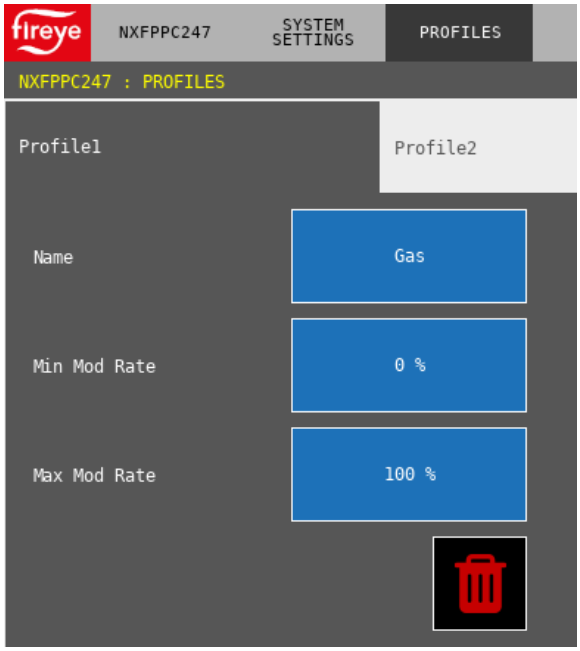
With the NXTSD507HD and NXTSD512HD, go to the menu SYSTEM SETTINGS → PROFILES. Navigate to the ALL CONFIG tab and touch the trash icon to erase. A confirmation pop-up will appear before proceeding.

Create a New Profile

To create a new profile with the NXD410TS, navigate to PROFILE SETUP → PROFILE 1 then hit the NEXT quick key.



To create n new profile with the NXTSD507HD and NXTSD512HD, go to the menu SYSTEM SETTINGS → PROFILES. Navigate to the tab PROFILE1.



The first option is to either select NONE to disable the profile, or to select a profile name. There are 11 different profile names available that represent fuel choices. Each profile name is associated with one of four sequence charts that show how the outputs are energized for that fuel choice.

Other options for each profile are to set minimum and maximum modulation limits. This can be useful when commissioning or when a temporary modulation limit is desired. The other option is to erase just the specific profile. This works similarly to how the entire configuration was erased, except all the setup options and other profiles are retained.

This step should be repeated for each profile required.

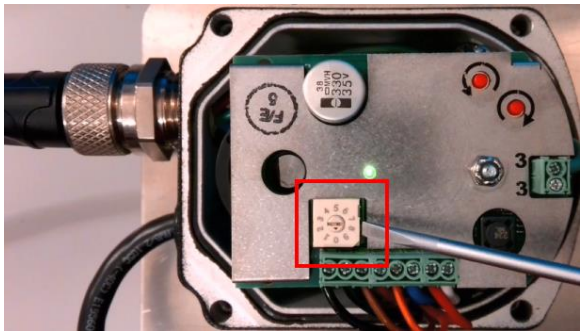
Servos

Check that the servos are wired properly and that the power load of the servos does not exceed the capacity of the internal power supply. See *WIRING* section for additional details.

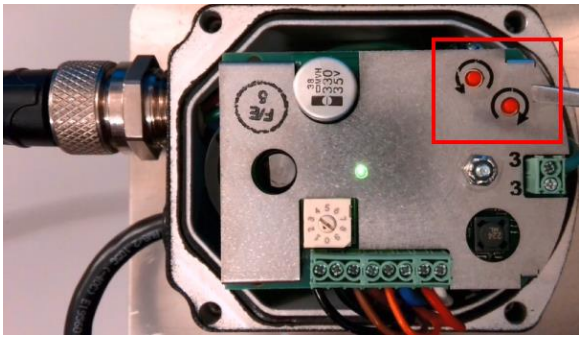
The FX servos are addressed from 1-10 using a rotary switch located under the cover. The address is checked at power-up, so changing the address while powered requires rebooting the servo. Simply select the required address using a small slotted screwdriver. Note that address 10 is represented by 0 on the rotary switch and is likely the position selected for a new servo. Confirm that all the addresses are properly set before continuing.

The FX servos have manual movement buttons located under the cover. The servo can be moved CW or CCW. Use these buttons to move the servo while selecting the position to tighten the couplings to the servo shaft. Also use these buttons to ensure that the servo can move freely in the desired direction and for the desired span before commissioning.

This step confirms that the servos are wired properly, addressed properly and can move freely throughout the span of the connected valve or damper.



Rotary address selector (FX04 shown)



Manual movement buttons (FX04 shown)

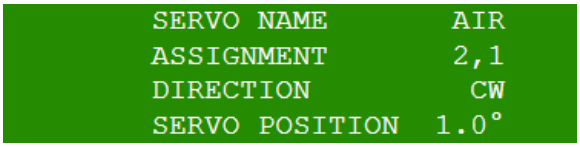
Discover Servos

To set up servos, make sure that they are all wired and addressed properly as described in the previous section. Once that is done the NXF4000 or PPC4000 can auto-discover the connected servos. To search with the NXD410TS, navigate to the menu SERVO SETUP → SERVOS INSTALLED. The servo Modbus network will be scanned, and the discovered servos will then be able to be set up. To search with the NXTSD507HD and NXTSD512HD, go to the menu GENERAL SETTINGS → SERVOS & VFDS. Navigate to the tab GENERAL and touch the number entry for SERVOS (CLICK TO SEARCH) to initiate auto-discovery.

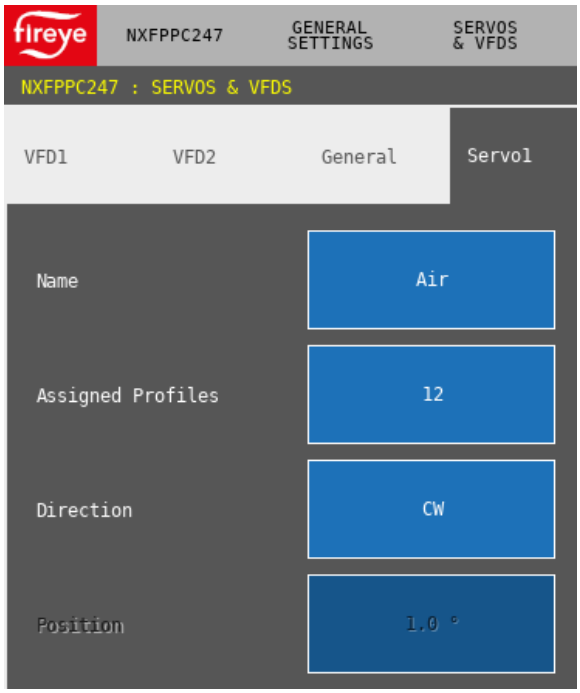
The only global servo setting (applies to all servos) is SERVO SPEED (NXD410TS) or SPEED (NXTSD507HD and NXTSD512HD). This is how long the control spaces out the travel commands to result in a full 90º of movement. The default is 30 seconds for 0º to 90º and the maximum setting allowed is 120 seconds.

Set Up Servos

Once the servos are discovered, they can be set up. With the NXD410TS, browse the SERVO SETUP menu to find each servo listed. With the NXTSD507HD and NXTSD512HD, go to the menu GENERAL SETTINGS → SERVOS & VFDS. Each servo will have a separate tab.



A name must be chosen to enable use of the servo. If a servo is to remain unused, set the name to UNUSED. The other choices are: AIR, FAN, SEC, SLE, FU1, FU2, GAS, OIL, CUP, PUM, WAS, PRI and FGR. The name of the servo doesn't have any significance to commissioning with the one exception that at least one servo or VFD should have the name AIR. There also needs to be at least one fuel servo with one of the following names: FU1, FU2, GAS, OIL, CUP, PUM, WAS, PRI. Failure to have a servo/VFD assigned to AIR or name a fuel servo will result in a lockout.



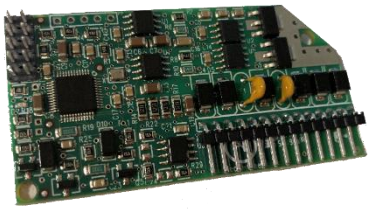
Once the name is chosen, choose the profiles that this servo is used with under ASSIGNMENT. This can be one or more profiles. Next, choose the direction required, CW or CCW. Lastly, the current servo position is shown for informational purposes in angular degrees.

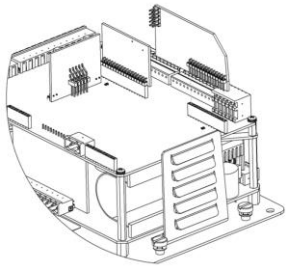
Note that if the servo direction is set to CCW, the position indicated will begin at 99.9° instead of 1.0° and will decrease as the dampers/valves open instead of increase.

VFDs

VFD Add-on Card NXCESVFD

The NXCESVFD add-on card must be added to the system in order to enable the use of a VFD. To fit this card, the control must be powered down, the cover removed, and the card fitted to the top board of the control in the header provided. Once the cover is replaced, apply power and the VFD can be wired to the connections on terminal block P14 and the VFD channels can be configured for use.





The NXCESVFD offers interfaces for up to two VFDs with either encoder feedback or with 4-20mA feedback from the VFD. The analog outputs from any unused channels can be used as user-assignable analog outputs.

Types of Drives

It is recommended that a constant torque (vector control) drive is used. This is due to the resolution provided in the control of the motor, which allows for a quicker response to a change in commands.

If a variable torque (volt/hertz control, or HVAC) drive is used there can be a lag in the response that is large enough to cause lockouts due to improper feedback. Lengthening the acceleration and deceleration times may allow the response to match what is expected but this will result in noticeably diminished performance in the burner response to the process.

VFD Safety Requirement

With the NXF4000 and PPC4000, all channels of control must be closed loop. This means that feedback is checked to ensure that the commanded signals are being carried out properly. With the servos, this is done internally by an encoder and is part of the secure transmission between the servo and the control. Both the commands and feedback are carried out over the same Modbus connection. The VFD is treated the same as a servo in that feedback is required. Since the VFD is an external device, the connections between the NXF4000 or PPC4000 and the VFD are hard-wired. This allows for a couple of different options to be used to supply the feedback.

4-20mA Feedback from the VFD

The command signal to the VFD is an analog 4-20mA signal. The feedback can be provided by the VFD, also using a 4-20mA signal. The requirement for this to work is that the function of the 4-20mA output is properly assigned to indicate the running frequency of the VFD, in the same scale as the commanded frequency (typically 50Hz or 60Hz). Safety is provided with this method since the VFD is analyzing the electrical connection to the motor to determine if the motor is running as it should be. The VFD would have an internal fault if the motor was not running properly based upon the voltage and frequency being supplied.

If there was a situation where the motor was running but there was not any connection to the combustion air fan, the NXF4000 or PPC4000 would lockout based upon an airflow interlock safety fault.

Encoder Feedback

If required for the installation, an external encoder can be mounted to the motor shaft to provide the feedback to the NXF4000 or PPC4000. If this option is used, the 4-20mA signal from the control still goes to the VFD, but the 4-20mA output from the VFD is not connected and instead the signal from the encoder provides feedback. See *INSTALLATION* and *WIRING* sections for additional details on encoder selection, wiring and mounting options.

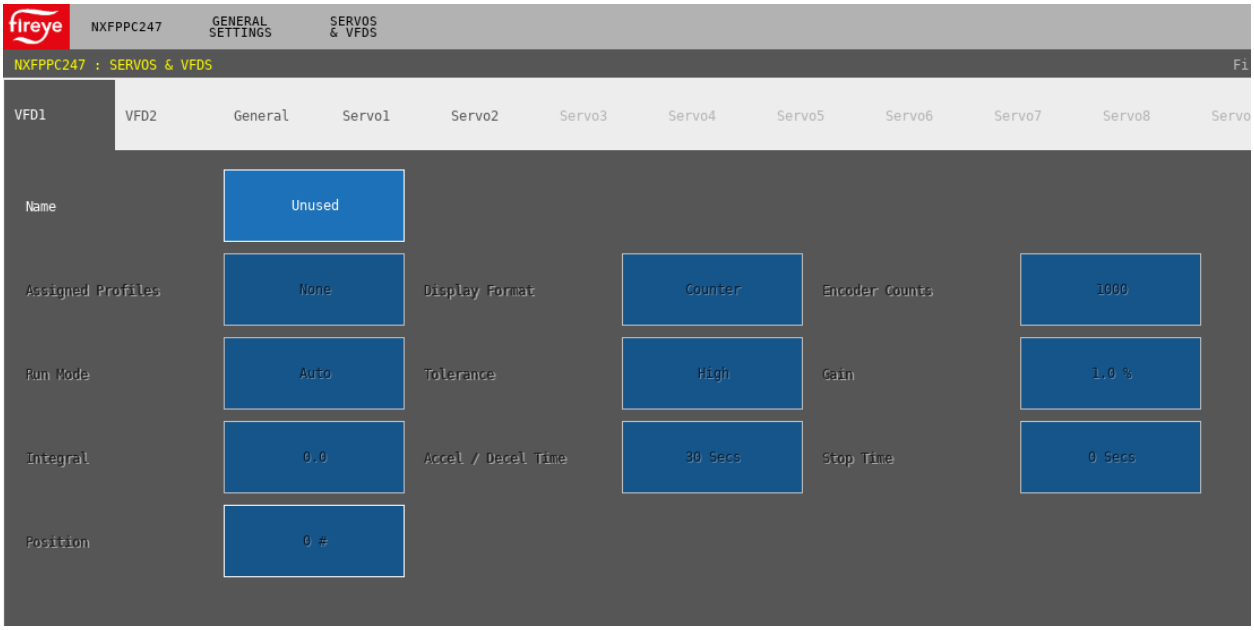
Set Up VFDs

A VFD channel can be configured whether the NXCESVFD card is fitted or not. If it is configured and the card is not present, there will be a lockout indicating this when entering commissioning mode.

How the VFD is configured depends upon the type of feedback used. It is most common to use the 4-20mA feedback, and the trainer is wired to accept 4-20mA feedback by looping the 4-20mA VFD output signal to the feedback input.

VFD NAME	FAN
ASSIGNMENT	NONE
DISPLAY FORMAT	CNTS
ENCODER COUNTS	N/A
RUN MODE	AUTO
GAIN	1.0%
INTEGRAL	0.0
TOLERANCE	HIGH
ACCEL/DECEL	30s
STOP TIME	0s
VFD POSITION	0

With the NXD410TS, the VFD channels can be configured from the SERVO SETUP menu. There is a menu for both VFD1 and VFD2. With the NXTSD507HD and NXTSD512HD, go to the menu GENERAL SETTINGS → SERVOS & VFDS. Each VFD will have a separate tab.



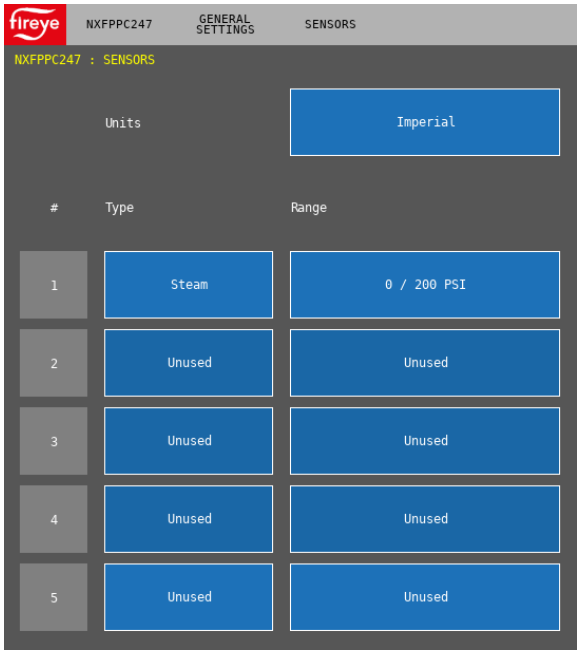
To enable the VFD for use, a name must be selected for the VFD. All the same names are available as with the servos and the same rules apply (at least one servo or VFD must be named AIR).

See PARAMETERS section for additional details on each how to set up each VFD option.

Set Up Sensors

With the NXD410TS, sensors are set up from the SENSOR SETUP menu. Each sensor has a separate menu. With the NXTSD507HD and NXTSD512HD, go to the menu GENERAL SETTINGS → SENSORS.

The only global sensor setting is to choose between metric or standard units. To make a change to these settings, all the sensor types must be set to UNUSED.



Each sensor has specific sensors that are supported:

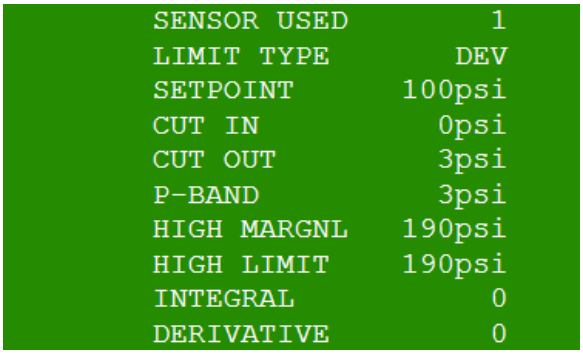
SENSOR 1: STEAM, WATER, TRACK
SENSOR 2: STEAM, WATER, STANDBY
SENSOR 3: STACK, OUTDOOR, INLET, STEAM, WATER
SENSOR 4: INLET, FLAME
SENSOR 5: INLET

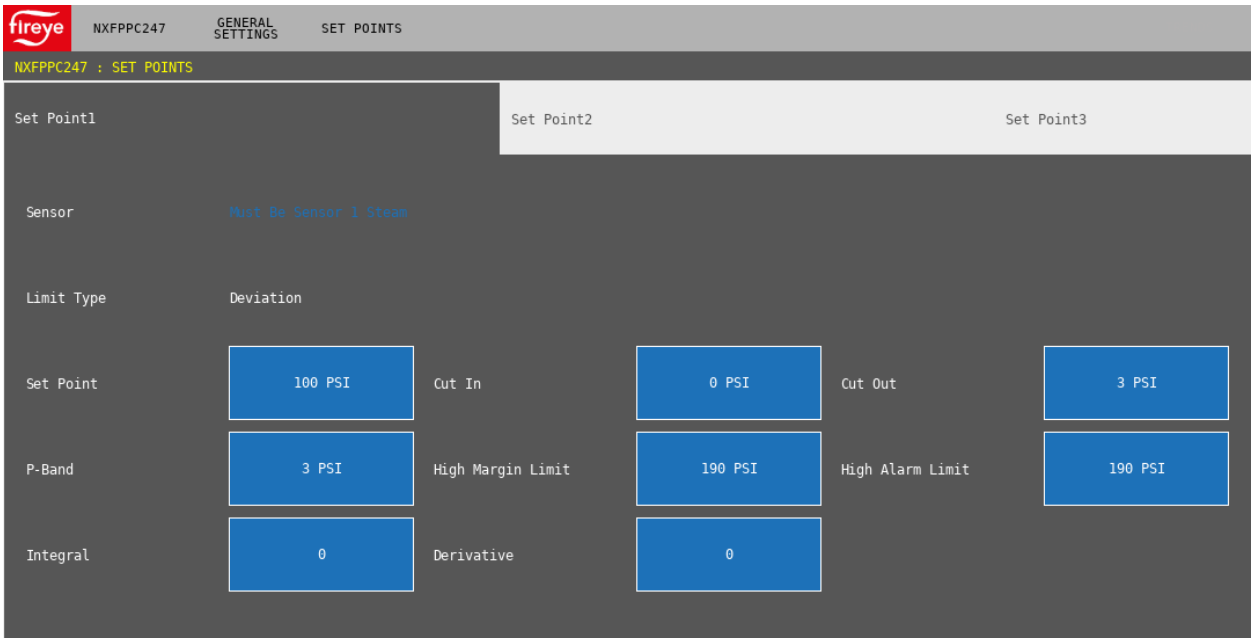
The ranges available correspond to the available sensors from Fireye. See *OVERVIEW* section for a complete listing of available sensors.

Set Up Setpoint

With the NXD410TS, setpoints are set up from the SETPOINT SETUP menu. With the NXTSD507HD and NXTSD512HD, go to the menu GENERAL SETTINGS → SET POINTS. Each setpoint has a separate tab.

Setpoint 1 is the setpoint used for the process control. Setpoint 2 can be set to be an alternate setpoint for process control, or to be a setpoint for hot standby when used with track modulation or if peer-to-peer sequencing is enabled. Setpoint 3 can be used for the marginal and high alarms. Cut in and cut out hysteresis as well as PID settings are configured per setpoint.





See PARAMETERS section for additional details on setpoint options.

Digital Inputs

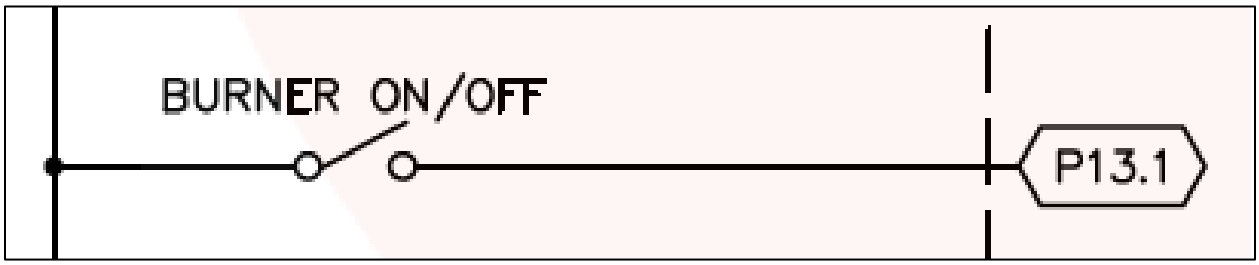
With the NXD410TS, digital inputs are programmed from the DIGITAL INPUT SETUP menu. With the NXTSD507HD and NXTSD512HD, go to the menu SYSTEM SETTINGS → DIGITAL INPUTS.

The NXF4000 has 15 available digital inputs, while the PPC4000 has 10 available digital inputs. There are many different options that can be selected for each input.

The examples shown are generic and based upon the diagram shown in the WIRING section. Note that since these are examples, other inputs can be used for the same functions.

Example Digital Input 1: Burner Control

Digital input 1 is used for the Burner On/Off switch. This assignment could be used with either an NXF4000 or a PPC4000.



With the NXD410TS, this must be programmed as:

`DIGITAL INPUT SETUP → DI 1 → USE = BURNER CONTROL`

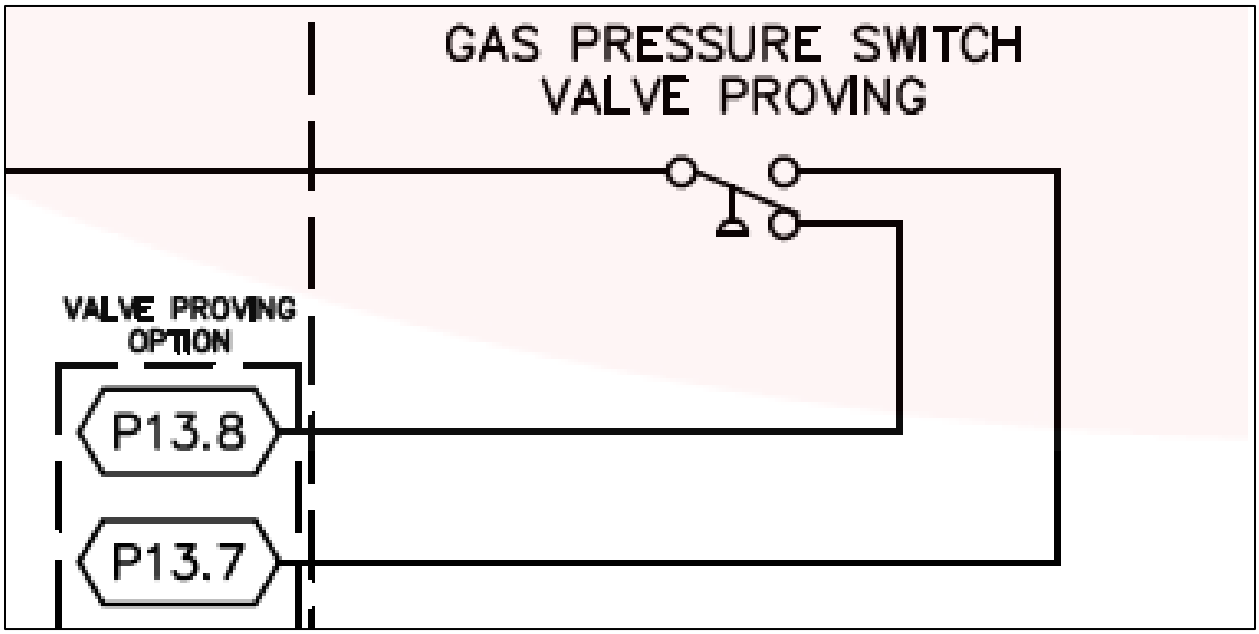
Since the burner control switch on the NXD410TS will be able to be used as well:

`DIGITAL INPUT SETUP → DI 1 → ACTION = AND`

With the NXTSD507HD and NXTSD512HD, this is programmed as:

Example Digital Inputs 7 and 8: Valve Proving

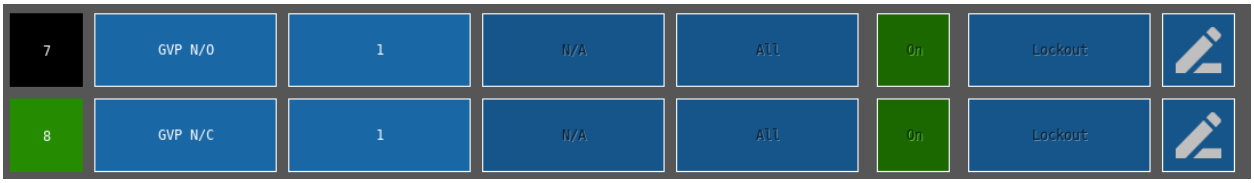
Digital inputs 7 and 8 are used for valve proving. Configuring the digital inputs for this function also implicitly enables valve proving. This assignment can only be used with an NXF4000 since it is a flame safeguard function.



With the NXD410TS, this must be programmed as:

```
DIGITAL INPUT SETUP → DI 7 → USE = GVP NORM. OPEN
DIGITAL INPUT SETUP → DI 7 → ASSIGNMENT = 1
DIGITAL INPUT SETUP → DI 8 → USE = GVP NORM. CLOSED
DIGITAL INPUT SETUP → DI 8 → ASSIGNMENT = 1
```

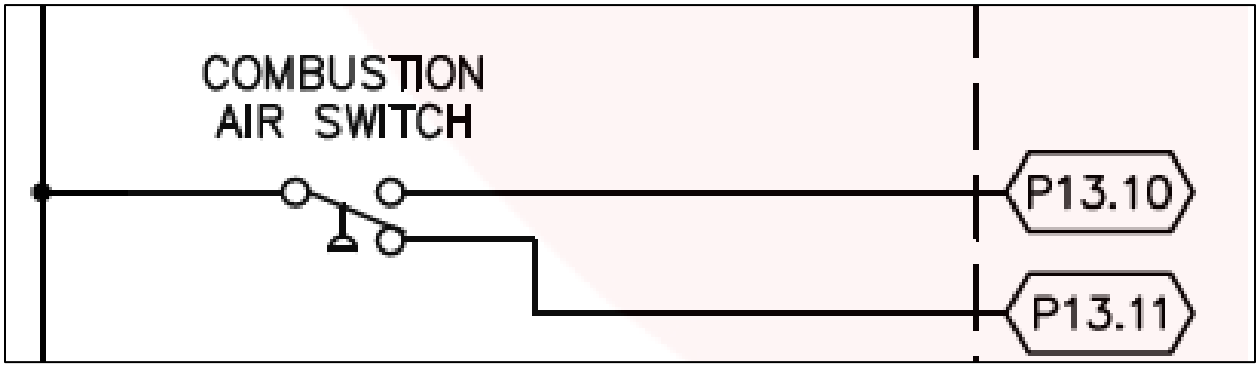
With the NXTSD507HD and NXTSD512HD, this is programmed as:



Notice with the NXTSD507HD and NXTSD512HD, the digital input number will show in green if the digital input is currently active.

Example Digital Inputs 10 and 11: Airflow Switch

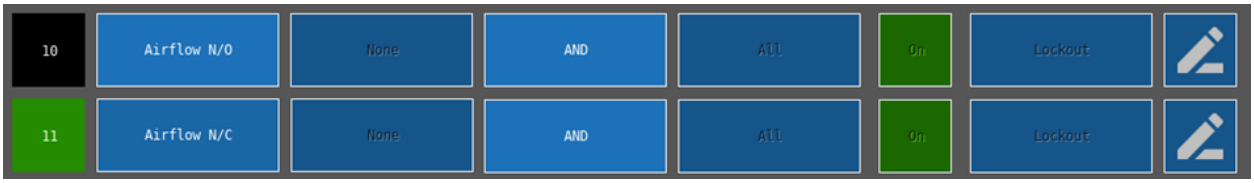
Digital inputs 10 and 11 are used to monitor the combustion air switch. This also includes a check that the switch changes states to off when the burner is idle. This assignment can only be used with an NXF4000 since it is a flame safeguard function.



With the NXD410TS, this must be programmed as:

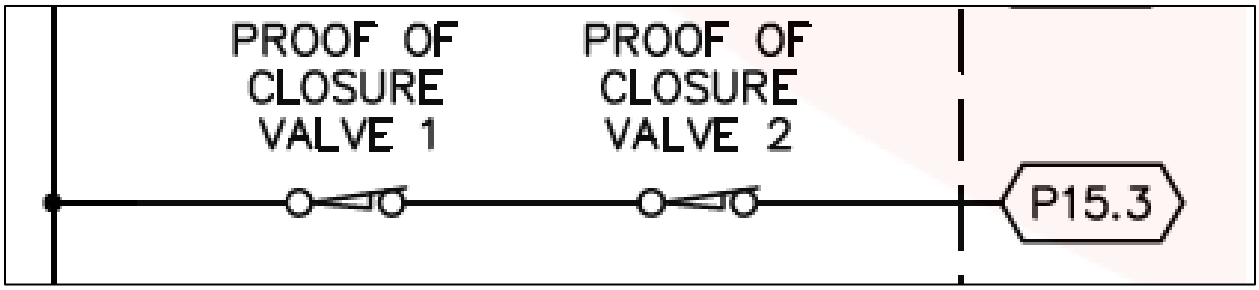
`DIGITAL INPUT SETUP → DI 10 → USE = AIRFLOW N. OPEN`
`DIGITAL INPUT SETUP → DI 11 → USE = AIRFLOW N. CLOSED`

With the NXTSD507HD and NXTSD512HD, this is programmed as:



Example Digital Input 15: Fuel Valve End Switch (POC)

Digital input 15 is used for the fuel valve end switches (proof of closure). This assignment can only be used with an NXF4000 since it is a flame safeguard function.



With the NXD410TS, this must be programmed as:

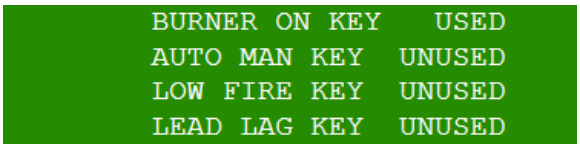
`DIGITAL INPUT SETUP → DI 15 → USE = FVES/POC`
`DIGITAL INPUT SETUP → DI 15 → ASSIGNMENT = 1`

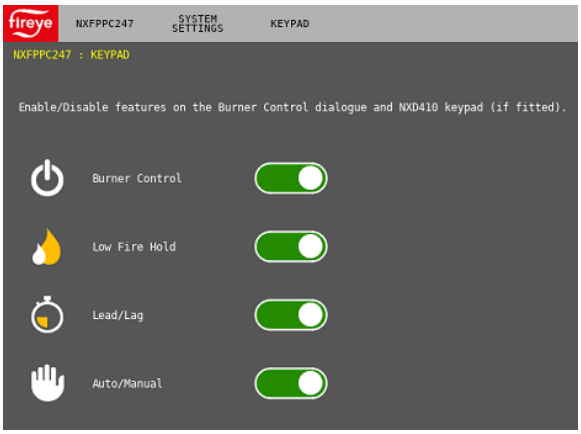
With the NXTSD507HD and NXTSD512HD, this is programmed as:

Note that this input is programmed for this function by default when the configuration is cleared, or if the control is new and has never been set up.

Set Up Keypad

With the NXD410TS, the quick keys for burner on/off, auto/manual and low fire must be enabled for use. This is done from the KEYPAD SETUP menu. With the NXTSD507HD and NXTSD512HD, go to the menu SYSTEM SETTINGS → KEYPAD.





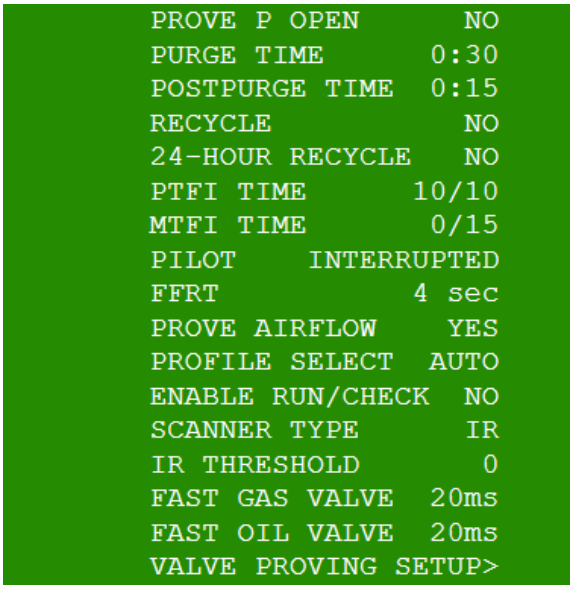
The burner on/off input can also come from a digital input if desired. If both the digital input and quick key are enabled, either an AND (both need to be on) or OR (either one can be on) configuration can be used. Note that there needs to be at least one source for burner on/off.

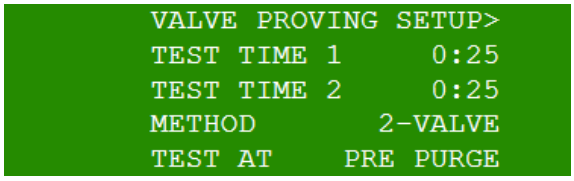
See PARAMETERS section for additional details on setpoint options.

Set Up Burner Control

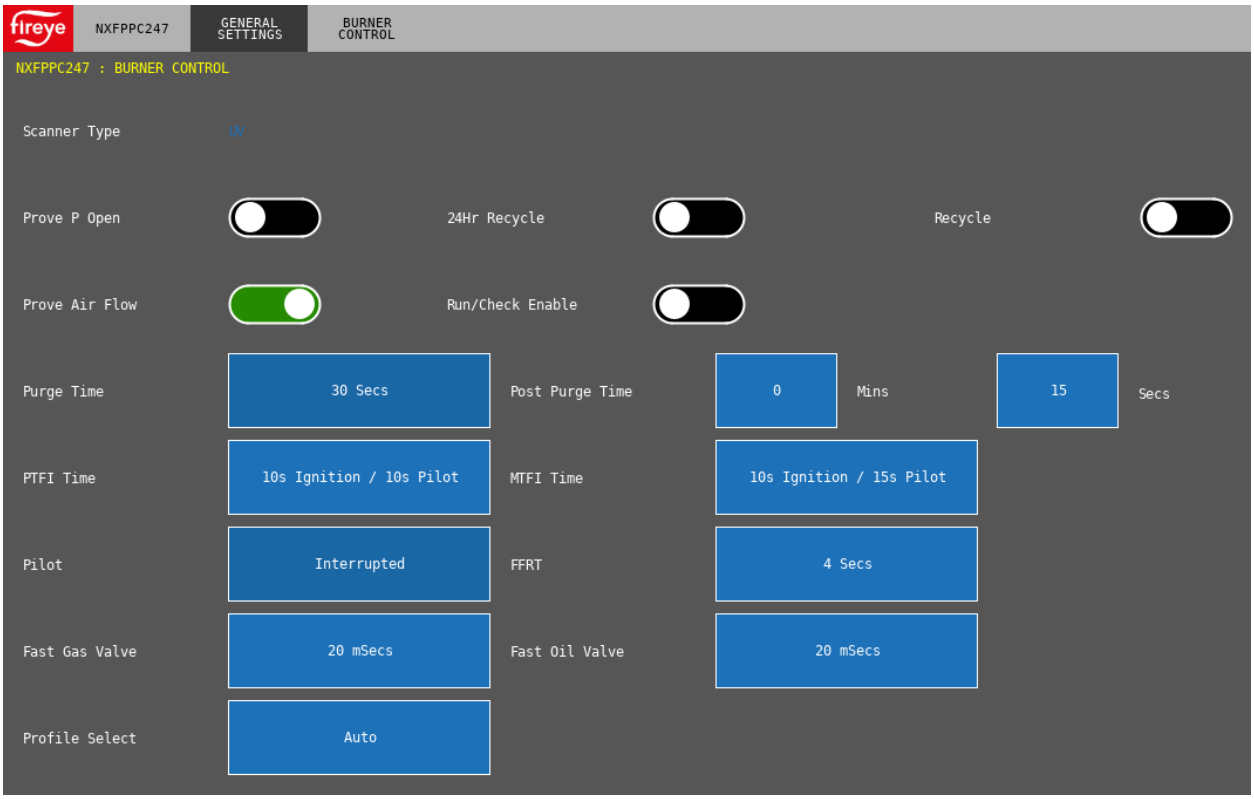
These menus only apply to commissioning an NXF4000. A PPC4000 uses a separate flame safeguard, so any burner control options will be directly set on the that control.

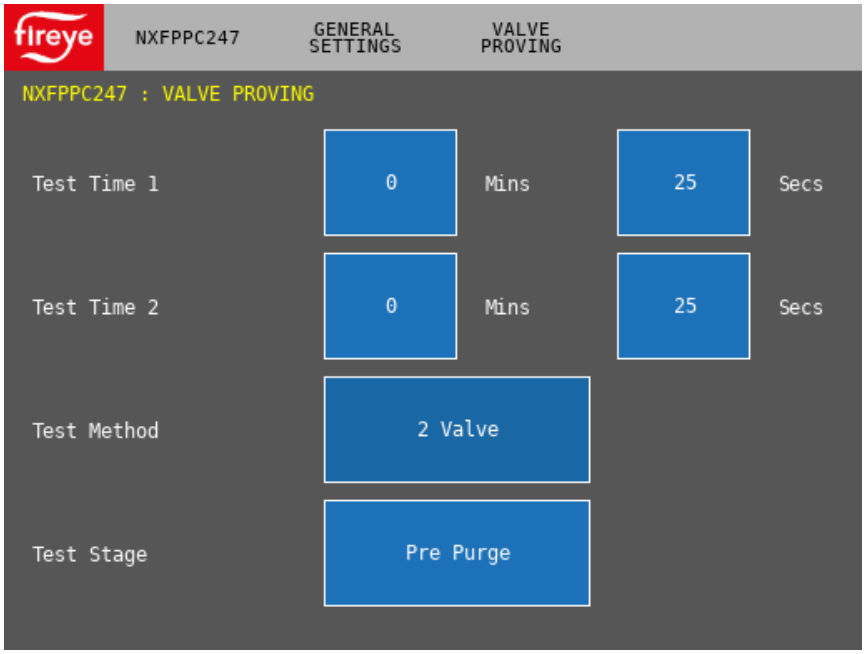
With the NXD410TS, burner control options are set from the BURNER CNTRL SETUP menu. This is where flame safeguard options, timings and other settings are made.





With the NXTSD507HD and NXTSD512HD, go to the menu GENERAL SETTINGS → BURNER CONTROL for all settings except for valve proving. For valve proving, go to the menu GENERAL SETTINGS → VALVE PROVING.





COMMISSIONING

Importance of Proper Commissioning

One of the main benefits of a parallel positioning system is that precise control of the fuel-air ratio can be ensured at any firing rate. These systems are sold on the benefits of the lower operating costs and the ability to meet strict emissions standards, but the actual results from installing such a system really depend upon the quality of commissioning.

Methods of Process Control

The firing rate of a burner falls under the category of process control. With any process, there is always a process value as well as a setpoint. The process value is another way to refer to the actual output of the process, while the setpoint is the desired value to reach.

One of the most basic methods of process control is known as proportional control. With proportional control, the output is at the maximum at a certain level below the setpoint, and it is reduced linearly toward no output as the process value gets closer to the setpoint. At setpoint, there is no output at all. The main issue with proportional control is that in theory, you can never reach the setpoint — you can only get infinitely closer.

To deal with this limitation, two additional components were added to the proportional component to create PID control. PID stands for proportional, integral and derivative. These three components are added together to create an output that can be tuned to control a setpoint and can dynamically react to any situation to maintain that setpoint. Most parallel-positioning systems are going to be controlled using PID control.

Ability to Maintain Setpoint

Burners that use on/off or staging control to maintain a setpoint will have an issue with frequent overshooting of the setpoint. This is a necessity because tight control of the setpoint is not possible due to the fixed burner outputs, and to shut off at the setpoint would lead to high cycling (and wear) on the equipment. The key to acceptable performance with these systems is to balance an acceptable amount of cycling with an acceptable amount of setpoint overshoot.

Burners that have proportional control or PID control have an advantage in that they can modulate their output to react to the setpoint. This will allow cycling to be greatly reduced or eliminated, while also offering much better control of the setpoint at the same time. Even with a linkage burner, this type of control can save a lot of money in operational costs over an on/off or staging burner.

Parallel positioning control offers an additional benefit that modulating linkage burners do not. With a linkage burner, only the low– and high fire positions can be accurately set with regards to gas input. Any point in between will follow the curve of the linkage, which is not going to be linear. Sometimes a linkage burner will allow some curve characterization, but this does not approach the level of linearity that the parallel-positioning servos can provide. The gas input of any point entered during commissioning can be assured to be accurate, and any point in between will be linear to the two closest points. The more points entered during commissioning, the more accurate this curve will be.

Effectiveness of PID Control

Successfully using PID control requires that the output requested is accurately deployed into the process. The PID control will receive feedback in the form of the process value and is expecting a certain amount of response. When the output is linear and accurately reflecting the command of the PID control, the process can be tuned to run smoothly in most cases. If the output is not linear, it is likely that the PID control will never run well, regardless of the tuning. This is because the output requested will manifest as unknown and unreliable amounts in the process. A PID control simply cannot be tuned to run with an output that is not linear – this is a basic expectation of a PID control.

Commissioning a System Properly

In order to properly commission a system to work well with a PID control, it is necessary to accurately measure the fuel flow at both low and high fire and to calculate the required fuel flows at all intermediate tuning points. This is a simple linear calculation. If the low fire fuel flow is 5000 SCFH and the high fire fuel flow is 20000 SCFH, mid-fire would be 12500 SCFH. While commissioning each point, the fuel servos are trimmed to match these fuel flow numbers, and the air-influenced servos (air damper and VSD) are trimmed to provide the desired combustion numbers.

For gas fuels, if a fuel flow meter is not available to measure all combustion curve points, isolating the burner as the only appliance and then clocking the incoming gas meter is another way that fuel flow can be measured. Clocking the meter at low and high fire will be necessary to verify the flow at those points, while also measuring the burner head pressures as a reference. Using Bernoulli's principle of flow and pressure, the approximate burner head pressure at each combustion curve point can be calculated. During commissioning, the fuel servos are then trimmed to the calculated burner head pressure measurements instead of to fuel flow at the intermediate points. Note that this method will not be as accurate as using a fuel flow meter, but it is better than not attempting to make any measurement of fuel flow with regards to creating a linear combustion curve.

For gas fuels, a spreadsheet (*Nexus Commissioning Worksheet for Gas Fuels*) is available from Fireye to assist with calculating the servo positions at each step of commissioning. Measured or calculated fuel flow is entered, as well as burner head pressure measurements. Targets positions for the servos at ten combustion points from low to high fire are provided. The fuel servo positions should then be trimmed to match the fuel flow or burner head pressure for that point, and the air-influenced servo positions should be trimmed to meet desired combustion numbers.

Effects of Turndown on Burner PID Control

Each burner is going to have a maximum turndown. This is expressed as a ratio that indicates how much lower that the low fire is compared to the high fire output. If a burner has a high turndown ratio, there will be less burner cycling since the output can be reduced further when the process value is too high, instead of shutting the burner off.

PID control is expecting that the output of a process can be reduced to zero at any point in time. The controls do not consider that a burner output cannot be reduced below the low fire point without the burner shutting off. Shutting a burner off is generally to be avoided since it can a significant amount of time for a burner to transition from standby mode into normal operation due to the purge times as well as flame establishing periods.

Upon periods of low demand, this is where a burner will cycle. If the burner is running at the lowest output and the process value is still rising, the burner will eventually overshoot enough to shut down. At this point the burner is going to operate exactly as an on/off or staged burner would, and the same balance of overshooting the setpoint and cycling must be found.

Summary

While PID control may not be the perfect solution due to turndown limitations, it works quite well in most burner applications when the burner is commissioned properly. It is when commissioning is done with no reference to the gas input that problems can develop and the PID control itself is usually blamed for this. If the commissioning is not done well in the first place, there is no amount of PID control tuning that will ever make the burner run well. Even if it can be made to run reasonably well, it will a less efficient process overall and will cost more to operate in the long run.

The best way to address this is to use a fuel flow meter as a commissioning tool, or to permanently install on for each burner. For gas fuels, in-line fuel flow meters often only need a single tapping and a straight run of piping to install, and this tapping can be specified during installation. Upon commissioning, simply isolate the gas line, remove the plug and install the meter. Remove and re-plug the tapping upon completion. Using a fuel flow meter can also save a lot of time during commissioning by making the process more structured and repeatable.

The ability to control the process will only be as good as the efforts made during commissioning.

Nexus Commissioning Worksheet for Gas Fuels

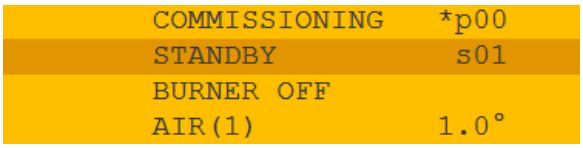
There is a worksheet called *Nexus Commissioning Worksheet for Gas Fuels* (available on Fireye website) that makes setting up a combustion control curve on gas fuels easier. This worksheet goes through each point step-by-step and calculates target positions to help take the guesswork out of setting up a curve. Ten points are used to reduce complexity while still creating a strong curve. The worksheet is also a good archive of a burner startup.

The worksheet is a Microsoft Excel macro-enabled workbook (.xlsm extension). When opened, a warning will appear stating that macros are disabled, and will give the option to enable. Note that macros must be enabled in order to use this worksheet.

Commissioning Mode

WARNING: Never attempt to commission a burner without a combustion analyzer monitoring the stack emissions. Only qualified service technicians that understand the principles of combustion, burner controls and instrumentation use should attempt to commission a burner.

The method used to commission the NXF4000 and PPC4000 is largely the same. The steps shown will apply to both controls unless the text indicates that the step is specific to either control using a bold preface.

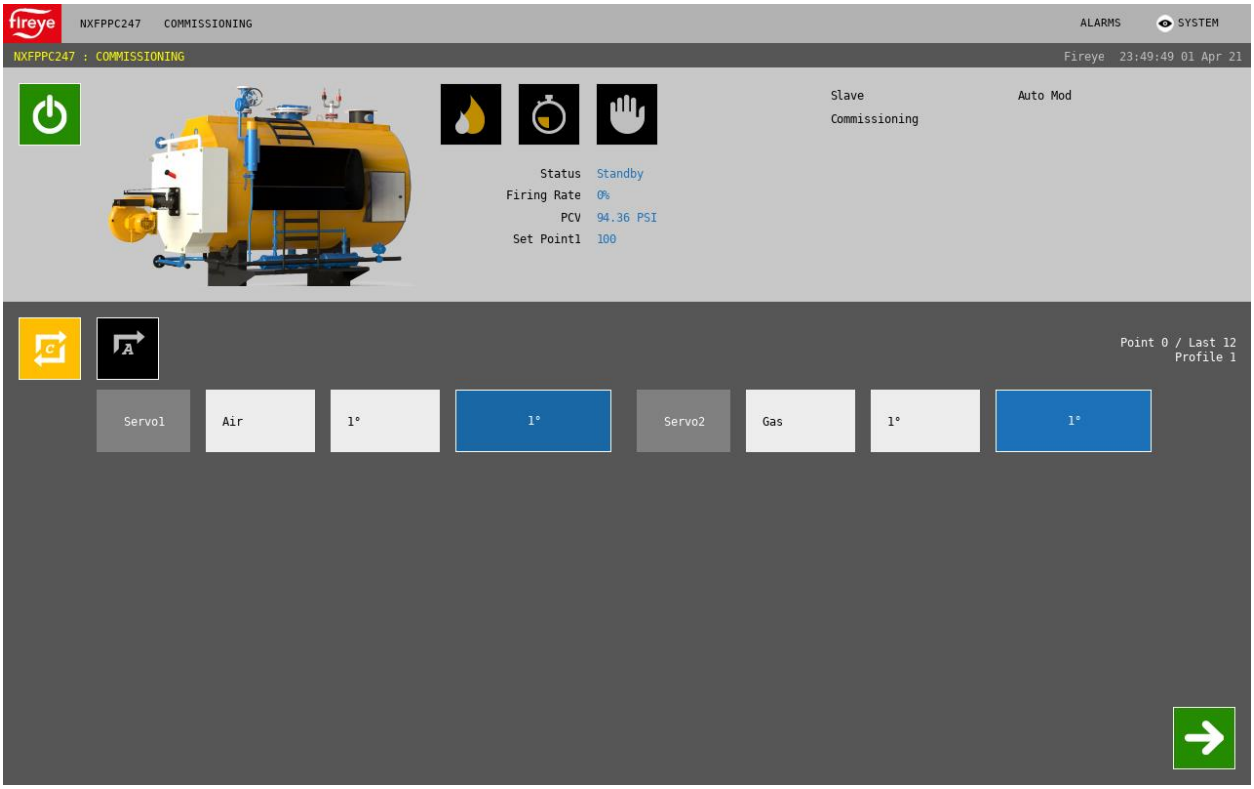


With the NXD410TS, enter commissioning mode by pressing the C-MODE quick key, then entering the C-MODE passcode. After entering commissioning mode, the background will switch to yellow.

To change the servo or VFD positions, bring the desired servo or VFD to the second line and press the MODIFY/SAVE quick key to modify as with any other value. The servo or VFD position will only move once the MODIFY/SAVE quick key is pressed to confirm the value.

With the NXTSD507HD and NXTSD512HD, go to the menu COMMISSIONING. Touch the C-MODE quick key, then enter the COMMISSIONING passcode. The servo and VFD positions will appear on the bottom panel and the current point (Point 0) will show on the upper right of the bottom panel.

To change the servo or VFD positions, touch the blue number entry box to enter the desired value.



NXF4000: The display will also show the current state, which will be STANDBY.

PPC4000: Will not show the state since that is controlled by the external flame safeguard.

Setting p00 (Standby)

p00 can now be set. This is the standby position. At this point only servos can be moved, any VFD will be off and so these positions can't be changed. This is because the VFD is not expected to be operating during standby. It is generally advised to close all servos as much as possible at p00. With the NXD410TS, the asterisk (*) to the left of the point number indicates that the point can be confirmed. With the NXTSD507HD and NXTSD512HD, the point can be confirmed only if the NEXT quick key (green arrow at lower right of bottom panel) is displayed. Once adjustments are complete, confirm the point with the NEXT quick key. The NXTSD507HD and NXTSD512HD will both display a yellow banner START BURNER TO SELECT PROFILE if a profile input is not active at this time.

At this point, the burner is in standby during commissioning mode because the burner on/off switch is not on.

NXF4000: Once the burner on/off switch is set, the burner sequence will start and p01 can be commissioned.

PPC4000: The display will initially read NO PROFILE SELECTED while waiting for the external flame safeguard to begin the burner sequence. Once that sequence starts, p01 can be commissioned.

Setting p01 (Purge)

The air-influencing servos should all be set to their maximum positions to allow for the best purge. The VFD should be set to a sufficient speed to allow the proper air changes and to save on energy.

Set the positions in the same manner as in the previous step. Note that when setting the VFD, the feedback may not exactly match what is entered. For example, if the target position entered is 80.0%, the feedback may show the VFD position as 79.9%. This is due to the tolerance set.

COMMISSIONING	*p01
AIR(1)	90.0°
GAS(2)	1.0°
FAN(VFD1)	79.9%

If the feedback from the VFD is not wired properly, or if the VFD is not configured properly, the feedback may never match the target and the asterisk will not appear beside P01 (NXD410TS) or the NEXT quick key will not be visible (NXTSD507HD and NXTSD512HD). This means that the current point will not be able to be confirmed until the issue is resolved. Jumping the 4-20mA output to the feedback (as is done with the training units) for a particular VFD can confirm a connection or configuration issue quickly.

NXF4000: Once the purge position p01 is set, press the NEXT quick key to confirm. After purging for the prepurge duration, ignition position p02 can be commissioned.

PPC4000: The external flame safeguard will send the command to travel to the high fire purge position and will be waiting for feedback. An example of this is the text M-8 LIMIT OPEN on a BurnerLogix. How long the flame safeguard will wait for this feedback before locking out varies by model.

When the flame safeguard is traveling to the purge position, it is a good practice to activate the CHECK/RUN switch (or equivalent) to put the flame safeguard in check mode while setting p01, to avoid this lockout.

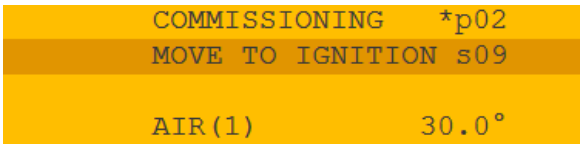
To put the BurnerLogix into check mode, slide the switch on the botton of the chassis to the CHECK position. Note that the BurnerLogix by default will generally allow enough time to set the purge positions on the servos and VFD.

To put the BurnerPRO into check mode, wait until the LEDs indicate that the control is moving the actuator to the purge position. This is indicated by the open damper LED and close damper LED alternating. At that time, hold the POWER/RESET button down until the alarm LED changes from green to amber. The BurnerPRO is now holding at the purge position in check mode. Note that the BurnerPRO by default will likely lockout during commissioning if not placed into check mode.

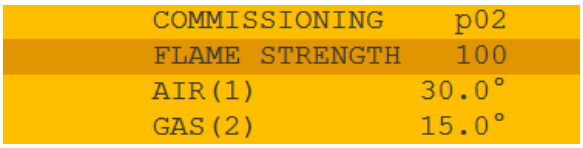
If the flame safeguard does lock out at any point during commissioning, it is possible to restart the process without exiting commissioning mode and restarting. When the flame safeguard locks out, the PPC4000 will return to the previously defined p00 position. Once the flame safeguard has been reset, an asterisk will appear to the left of p00 indicating that commissioning can be restarted by pressing the NEXT key.

Once the purge position p01 is set, press the NEXT quick key to confirm. The NXTSD507HD and NXTSD512HD will both display a yellow banner MOVING TO POSITION P02 as the control purges, before settling on p02 and allowing changes. Take the flame safeguard out of check mode if applicable. After purging for the prepurge duration, ignition position p02 can be commissioned.

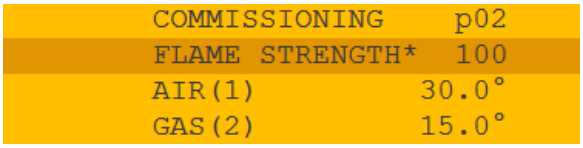
Setting p02 (Ignition)



NXF4000: This is where the ignition positions are entered. Note that ignition will not actually occur until this point is confirmed using the NEXT quick key. Set the servo positions to a place where ignition is likely to occur. After ignition, the control can be placed into check mode to allow these positions to be fine-tuned before proceeding to p03 and the configuration of the automatic operation curve. Note that this position does not have to be the same as the eventual low fire (p03) position – it can be higher if the burner has trouble lighting off at very low turndown positions.

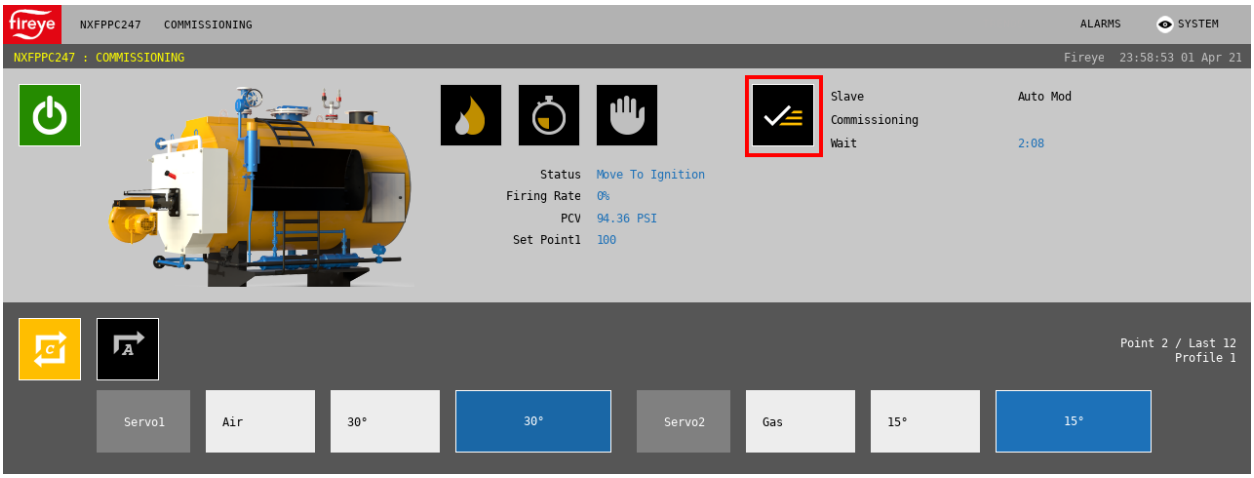


Once the positions are set, press the NEXT quick key. The NXTSD507HD and NXTSD512HD will both display a yellow banner WAITING TO GO TO AUTO. After a short wait, the ignition, pilot and upstream gas valve (if applicable to the chosen profile) outputs will energize and the status will change to PTFI. The display will also show the flame strength.

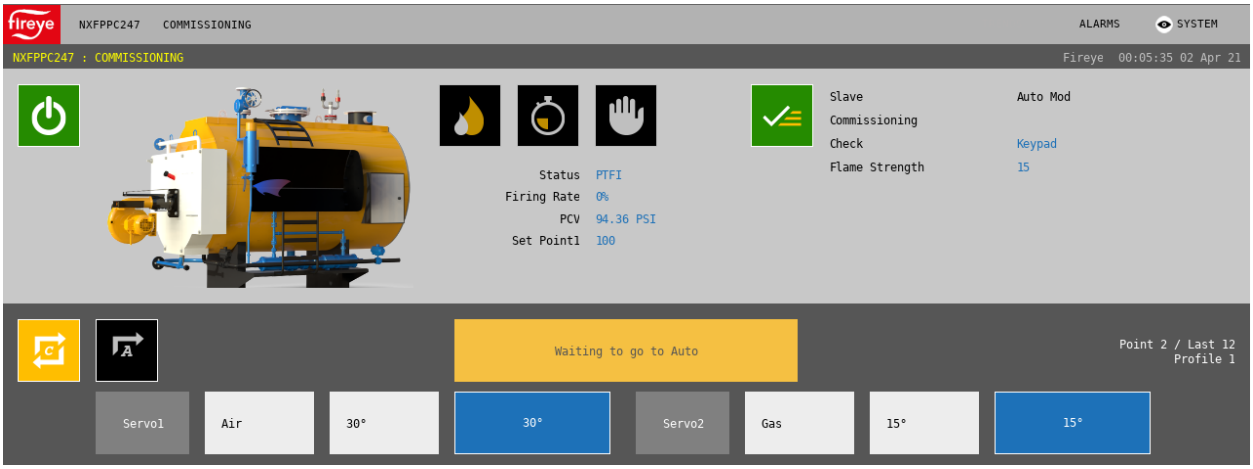


Within the period of PTFI (15 seconds at the most), press the CHECK/RUN quick key to put the control into check mode. This will allow adjustment of the ignition position while the pilot is active. With the NXD410TS, this is indicated by an asterisk following the text FLAME STRENGTH.

The CHECK/RUN quick key with the NXTSD507HD and NXTSD512HD is shown below:



The NXTSD507HD and NXTSD512HD when check mode is active (CHECK/RUN quick key in green):



To confirm p02, exit check mode using the CHECK/RUN quick key and allow PTFI to complete. The NXF4000 will transition to MOVE TO LOW FIRE and allow p03 (first user defined point) to be commissioned. The NXTSD507HD and NXTSD512HD will both display a yellow banner MOVING TO POSITION P02 as the control purges.

If the control is not put into check mode at all, the status will change from ignition to PTFI, pilot, MTFI and MFEP in the normal progression before going into auto and allowing commissioning of p03.

PPC4000: The external flame safeguard will send the command to travel to the low fire ignition position and will be waiting for feedback. An example of this is the text M-D LIMIT OPEN on a BurnerLogix. How long the flame safeguard will wait for this feedback before locking out varies by model.

When the flame safeguard is traveling to the ignition position, it is a good practice to activate the CHECK/RUN switch (or equivalent) to put the flame safeguard in check mode while setting p02, to avoid this lockout.

To put the BurnerLogix into check mode, slide the switch on the botton of the chassis to the CHECK position. Note that the BurnerLogix by default will generally allow enough time to set the ignition positions on the servos and VFD.

To put the BurnerPRO into check mode, wait until the LEDs indicate that the control is moving the actuator to the ignition position. This is indicated by the open damper LED and close damper LED alternating in the same manner as they did when traveling to the purge position. At that time, hold the POWER/RESET button down until the alarm LED changes from green to amber. The BurnerPRO is now holding at the pre-ignition position in check mode. Note that the BurnerPRO by default will likely lockout during commissioning if not placed into check mode.

Once the ignition position p02 is set, press the NEXT quick key to confirm. Take the flame safeguard out of check mode if applicable. The flame safeguard will transition into auto (release to modulate) but the PPC4000 will again allow adjustment of p02 (indicated by the asterisk returning to the left of the point number). This is due to the fact that the ignition position is likely to need adjustment after the initial light-off and the PPC4000 does not offer check mode as does the NXF4000.

Once p02 has been confirmed for the second time, the PPC4000 will transition to p03 (first user defined point).

Set High Fire Rate (Gas Fuels)

This step applies to both the NXF4000 and PPC4000. The control is now ready to commission p03, which is the low fire position. Before setting p03, however, it is important that the gas regulator is set at the high fire position. This is the position where the gas butterfly valve delivers the maximum amount of gas to the burner. The reason that this is done is to avoid having to recommission all the points if it is discovered at the high fire setting that rate (burner output) can't be achieved. It is also good practice to commission a burner to open the fuel valve all the way at high fire. If this is not done, any inadvertent action leading to the fuel valve opening further could cause the burner to over fire.

The easiest way to check the high fire rate is to use a fuel flow meter. If that is not available, the gas meter can be clocked to estimate the fuel flow when the fuel type is a gas. In order to clock the gas meter, the burner must be isolated, so it is the only appliance using gas during the test.

Basic formula to clock the meter (Imperial units):

1. Determine the pressure factor based upon the inlet gas pressure and the atmospheric and base pressure at the current location. The formula is:

   Pressure Factor = (Inlet Pressure + Atmospheric Pressure) ÷ Base Pressure

   If not known, use 14.16psi for atmospheric pressure and 14.73 for base pressure.

   Example: (2psi + 14.16 psi) ÷ 14.73psi = 1.097

2. Use a stopwatch to time how long a certain volume of gas takes to measure on the meter. Measure enough gas to have confidence in the accuracy of the time as well as the accuracy of the volume measured. Select a dial that is moving slow enough for accurate measurement (such as 100-foot dial).

3. Multiply the cubic feet that were clocked by 3600. This converts the cubic feet to cubic feet per hour (3600 seconds in an hour).

   Example: 100 cubic feet x 3600 = 360,000 cubic feet per hour

4. Divide the cubic feet per hour by the time clocked.

   Example: 360,000 ft^3/h ÷ 30 seconds = 12,000

5. Multiply by the pressure factor calculated in step 1.

   Example: 12,000 x 1.097 = 13,164

6. Multiply by the BTU factor of natural gas at the current location. If not known, use 1050 BTU.

   Example: 13,164 x 1050 BTU = 13,822,200 BTU/h (aka 13822 MBH)

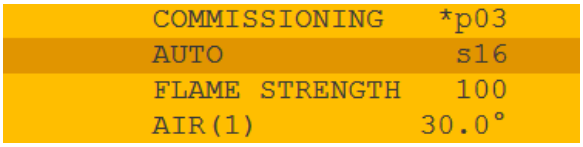
While in p03, slowly move each servo (and VFD, if applicable) a small amount at a time, keeping watch on the combustion analyzer to ensure safe combustion. When moving, always lead with the air servo and/or VFD to keep combustion on the lean side. Use caution not to press the next key and confirm p03 at high fire. If this is done inadvertently, exit commissioning mode and erase the profile, then start commissioning again.

Once the gas butterfly valve is at the maximum desired open position, clock the meter or consult the fuel flow meter. Adjust the gas regulator slowly as needed to adjust the measured fuel flow until the output matches the burner rating. Remember to adjust the air servo and/or VFD as necessary while adjusting the gas regulator. After the regulator has been confirmed to be at the correct setting, slowly reverse the servos back toward what will be the actual low fire setting. Check the analyzer as this is done. Lead with the gas servo to keep combustion on the lean side as the firing rate is lowered.

If the load is lost during this step, simply restart the burner and enter commissioning mode again. The servos will drive to the last position in memory for all points. p00 through p02 will need to be confirmed but the positions will be retained from the previous attempt at commissioning. At p03, the burner will return to the last point entered during commissioning. If this is not desired, the profile itself can be erased. This will erase the point memory requiring all points from p00 and up to be re-entered.

Setting p03 (Low Fire)

p03 is the low fire position. This can be set to be different from the ignition position if necessary. Some burners light off at a higher position than low fire, and this ability to have a different ignition and low fire position offers increased efficiency.



Since the gas regulator has been set already to make rate at the high fire position (see previous step), set the gas servo position based upon where the turndown can be verified, either by a fuel flow meter or by clocking the meter. It is important to check that the expected turndown is being delivered.

NXF4000: Once p03 is set, there are two options. If p03 will be the only commissioned point (burner only runs at low fire), then press the C-MODE quick key to exit commissioning and the control will transition to the MOVE TO LOW FIRE state and will be under automatic control. Note that with only one user commissioned point, the control will never go to the AUTO state since operating at p03 triggers the MOVE TO LOW FIRE state. If additional points will be added, press NEXT to move to p04.

PPC4000: Once p03 is set, there are two options. If p03 will be the only commissioned point (burner only runs at low fire), then press the C-MODE quick key to exit commissioning and the control will transition to the AUTO state and will be under automatic control. Note that with only one user commissioned point, the control will not modulate. If additional points will be added, press NEXT to move to p04.

If the revert to pilot function will be used with the flame safeguard (using the BurnerLogix with the YP138 programmer, for example), the ignition position p02 and low fire position p03 must be the same. This is because when revert to pilot is initiated, the flame safeguard returns to PTFI and sends the drive to low fire signal to the actuators (for ignition position). While in the AUTO state, the PPC4000 will interpret this as a command to move to low fire, and it will move to p03. Once revert to pilot is lifted and the flame safeguard enters MTFI, the servos will be at the p03 position. This differs from a new cycle where the servos would be at the p02 position.

Setting p04 to High Fire

Additional points from p04 up to p23 can be added as desired. There is no rule as to how many points can be added. For firmware revision 4.3 and earlier, at least one of the servos or VFD must be moved at least 0.1º to confirm a new point. Beginning with firmware revision 4.4, no change is necessary to add a new point. This can be useful for adding placeholders that can be used when in Adjust Ratio mode later. Adding a point without any change does not affect the linearity calculation of the firing rate.

The *Nexus Commissioning Worksheet for Gas Fuels* recommends ten user defined points, from p03 to p12. If a fuel flow meter is not present, the worksheet can calculate target manifold pressure readings for each point based upon the manifold pressure measured at high fire. The worksheet also calculates target positions for each servo and VFD that serve as guidelines for actual servo/VFD position entry that should be based upon instrumentation (fuel flow and analyzer).

When following the worksheet, the intention for each servo is as follows:

- **GAS:** Adjust to match the target fuel flow or burner head pressure. Do not make any adjustments to the gas regulator as this was already set for high fire to make rate.
- **AIR:** Trim the air servo to provide the desired numbers (NOx, O2% and CO) on the analyzer as per burner manufacturer recommendations.
- **VFD:** Trim the VFD linearly according to the target positions on the chart.

It is recommended that the VFD positions are simply set to be linear from low fire to high fire, and that the air servo is used to trim to the desired combustion numbers. This will also make O_2 trim control work better (if enabled) since O_2 trim can control the air servo, but not the VFD.

Once the servos and VFD are set for the current point, there are two choices. If the current point is the high fire point, press C-MODE to confirm the commissioned curve and immediately transition to AUTO. If another point is desired, press NEXT to enter the next point. If NEXT is pressed accidentally when the current point is the high fire point, simply add another point and then press C-MODE. There will be an additional point in the curve, but it can be removed later if commissioning mode is started again and C-MODE pressed at the correct point.

Firing Rate Linearity

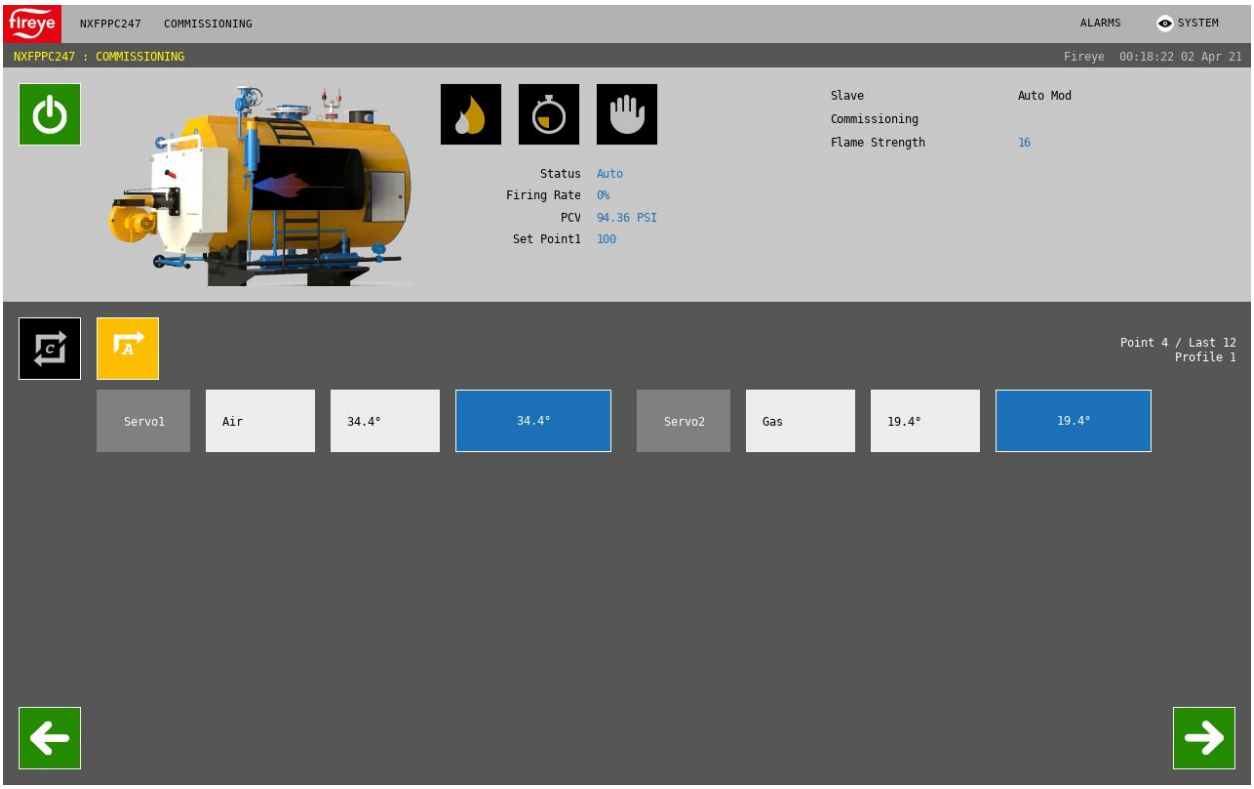
After commissioning, the firing rate will be linear from 0% to 100% across the commissioned points. For example, if ten points are commissioned (high fire is p12), then 50% would be between p07 and p08. It is important to ensure that the position of the fuel servo is linear across the points so that the firing rate will accurately reflect the output, and so the PID can function as well as possible. See *Importance of Proper Commissioning* section for addition details.

ADJUST EXISTING CURVE

The same method is used to adjust an existing curve on the NXF4000 and PPC4000. To enter the adjust ratio mode with the NXD410TS, press the C-MODE quick key and enter the ADJUST RATIO passcode. The display background color will change to indicate that the unit is in the adjust ratio mode.

ADJUST RATIO	a04
AUTO	s16
FLAME STRENGTH	100
AIR(1)	28.4°

With the NXTSD507HD and NXTSD512HD, go to the menu COMMISSIONING. Touch the ADJUST RATIO quick key, then enter the ADJUST RATIO passcode. The servo and VFD positions will appear on the bottom panel and the current point will show on the upper right of the bottom panel.



Once the burner is in the automatic state, use the LEFT and RIGHT quick keys to change which point is being adjusted. On the NXD410TS, these points will be referred to as a03…a23 instead of as p03…p23 while in this mode. Once the control has moved to the desired point the servo and VFD positions can be modified in the same manner as when commissioning. When finished adjusting, press the C-MODE or ADJUST RATIO quick key to return to automatic operation.

With the NXD410TS, it is also possible to enter the adjust ratio mode while the burner is already running. Simply press the C-MODE quick key and then enter either the ADJUST RATIO or C-MODE passcode.

Only p03 through the high fire point can be adjusted using this method. p00, p01 and p02 can't be adjusted, and points can't be added or deleted.

Method to Adjust p00-p02 or to Add Points

Commissioning mode can be reopened on a control that has already been commissioned. Doing so does not erase the current commissioning. Any points changed and saved using the MODIFY/SAVE key will be retained. The control will automatically move to the previously stored positions and then those can be modified or reconfirmed.

If it is desired to remove points, simply exit commissioning mode early by pressing the C-MODE quick key to confirm the current point as the last. This can also be done on p00 through p02 if adjustments are only being made to those points. If it is desired to add points, continue commissioning by pressing the NEXT quick key after adjusting the point that was previously the last point.

It is also possible to enter commissioning mode with no previous curve memory (fresh start). With NXD410TS, go to the PROFILE SETUP menu, choose the applicable profile, then choose YES for ERASE PROFILE. With the NXTSD507HD and NXTSD512HD, go to the menu SYSTEM SETTINGS → PROFILES, go to the tab for the applicable profile, then touch the trash icon and confirm the operation to erase. Using this option will require that commissioning is completed as described in the previous section, as it will render the control as not commissioned for the selected profile.

CONFIGURING O_2 TRIM

WARNING: It is the responsibility of the commissioning and operating personnel to ensure that the trim limits selected do not allow a hazardous combustion condition to occur. In the event of an O_2 probe failure, the commissioned curve will be followed, without any trim.

See *PARAMETERS* section for more details on specific O_2 trim parameters, including setting level alarms or lockouts.

O_2 monitoring or trim control can be enabled by connecting either the NXCESO2 or FXCESO2 (with FXO2TRIM-1 interface) probe to the NXF4000 or PPC4000. There are many options available, but the basic concept is that the air or fuel servo can be trimmed automatically to hold a target O_2 reading that is defined during commissioning. The O_2 probe can also be used in a monitor-only capacity. Whether controlling or monitoring, the O_2 probe can also issue O_2 level alarms or lockouts as well as offering flue gas temperature monitoring and level alarms. When an inlet temperature sensor is connected to a sensor input, efficiency values can also be calculated.

Connecting O_2 Probe

After connecting the probe, check the information screen to verify that the probe is reading approximately 20.9% in a free air state. With the NXD410TS, this is done by touching the INFO quick key and scrolling. With the NXTSD507HD and NXTSD512HD, go to the menu INFORMATION, then to the O2 tab.

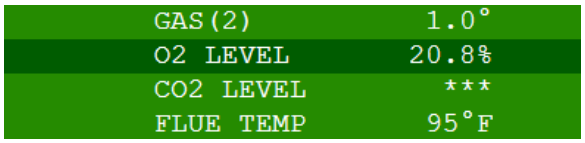
A free air state is a state free of combustion. If there is no reading (***), verify that the wiring is correct to both the 24VDC and Modbus connections. See the *WIRING* section for additional detail. If the reading is not near 20.9%, perform a calibration to set the free air state to 20.9%. Note that calibration is only to reference the current reading to 20.9%, to provide scaling of the raw signal. It is not necessary to recalibrate unless the free air reading begins to deviate from 20.9%. The free air reading will typically lower from 20.9% as the O_2 probe ages.

Before calibrating, start by purging the NXF4000 or external flame safeguard in check mode for around 15 minutes, to set up a free air condition. While the purge is active and after some time has elapsed to clear the stack, run the calibration command to the O_2 probe.

To calibrate using the NXD410TS, navigate to O2 SETUP → CALIBRATE NOW. The status of calibration will be reported, and the status should read DONE when complete. With the NXTSD507HD and NXTSD512HD, go to the menu GENERAL SETTINGS → O2, then to the CALIBRATION tab. Touch START for the CALIBRATE parameter. The status will read LAST RESULT O2 CALIBRATION COMPLETE when finished.

O_2 Monitor Mode

O_2 monitoring mode can be activated when trimming is not required. This mode is also automatically activated for any profiles where control is not required, when O_2 control mode is enabled for any other profile. Monitor mode will display the O_2 probe reading as well as the stack temperature on the user interface.



In monitoring mode, the level alarms for O_2 and stack temperature can be set per profile. This allows monitoring and alarming without full trim control. When an inlet temperature sensor is connected to a sensor input, efficiency can be calculated while in monitoring mode.

O_2 Control Mode

O_2 control mode can be activated for any combination of the available four profiles. It is possible to have multiple different fuels profiles, but to only activate O_2 control mode on certain ones. A typical example of this would be to implement O_2 control mode with natural gas, but not with oil. The profiles that are not enabled for control will operate in O_2 monitor mode.

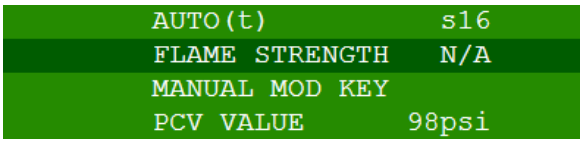
O_2 control mode can be set up to trim either the fuel or air servo. When trimming using the fuel servo, a much smaller trim range is used since combustion typically has an air to fuel ratio of around 10:1. Trimming the fuel servo will also affect the output of the connected burner. **For these reasons, it is suggested that the air servo is selected as the servo to use for trimming.**

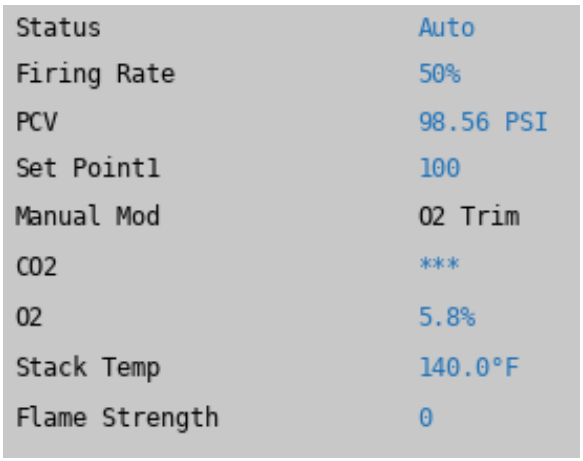
There are multiple ways that O_2 control mode can be commissioned. The first method is to have the O_2 probe connected and reading during the initial commissioning. Set the O2 OPERATION (NXD410TS) or O2 MODE (NXTSD507HD and NXTSD512HD) parameter to CONTROL before commissioning starts to capture O_2 targets during the initial commissioning.

Each profile that will be subject to O_2 control must have a fuel type selected. With the NXD410TS, the is done using the ASSIGNMENT parameter as well as the FUEL TYPE(1…4) parameters. With the NXTSD507HD and NXTSD512HD, go to the menu GENERAL SETTINGS → O2 and choose the CONTROL tab. Select the ASSIGNED PROFILES, then go to the PROFILES tab to select the FUEL TYPE using the PROFILE 1…4 sub tabs.

The current O_2 reading that is captured while confirming any user defined point (p03 and up to the last point) will be set as the target O_2 for that point. **It is very important that enough time is given to ensure that the O_2 reading that is shown on the keypad is a stable reading. The target O_2 values in memory can't be directly edited.**

Once the curve is confirmed and C-MODE is pressed, the control will transition to AUTO. If O_2 trim control has been properly activated, the NXD410TS display will show (t) following AUTO to indicate that trim is active. The NXTSD507HD and NXTSD512HD will show the text O2 TRIM below the setpoint on any overview or status screen, or to the right of the text TRACK MOD if track modulation is used. This confirms that O_2 control mode is active.





A different method is used to commission O_2 control mode on an NXF4000 or PPC4000 that has already been commissioned without O_2 targets in place. To do so, reactivate commissioning mode and step the control through all the existing points, while also capturing O_2 targets using the method described above. The current O_2 reading captured when a curve point is confirmed will be the O_2 target for that point. It is very important that at least one adjustment involving the MODIFY/SAVE key or number entry is performed at each user defined point (p03 and up to the last point). The value must undergo a change to capture the O_2 target, even if the value is then changed back to the original value. This allows the control to capture the target O_2 for each point. As with the first method, it is very important that enough time is given to ensure that the O_2 reading that is shown on the keypad is a stable reading.

Adjust ratio mode can also be used to enter target O_2 values. Ensure that the O2 CONTROL mode is selected before entering adjust ratio mode and the O_2 target setpoints will be saved. As with the method used in commissioning mode, a change must be made at every curve point to capture all the O_2 target values. Every point must have an O_2 target saved for trim setup to be completed. An existing curve point can also be edited in adjust ratio mode by making a change to one of the servos or VFD, and a new O_2 target will be saved.

Note that while in commissioning mode or in adjust ratio mode, active O_2 trimming will be temporarily disabled.

For all methods it is advised to use a portable combustion analyzer for independent verification of O_2 values during commissioning. Note that the readings between the O_2 probe and combustion analyzer will likely be different as the O_2 probe measures “wet” O_2 while the typical combustion analyzer measures “dry” O_2.

Setting Level Alarms

The O2 reading at low and high fire can be monitored to fall within a band. If the O2 value falls outside of this band, an alarm or a lockout can be issued. This alarm or lockout can also be annunciated out as line voltage through a user output (NXF4000 only).

In addition. the flue gas temperature at low and high fire can be monitored to fall within a band as well. If the temperature falls outside of this band, an alarm or a lockout can be issued. This alarm or lockout can also be annunciated out as line voltage through a user output (NXF4000 only).

The low and high monitoring setpoints are set per profile, so each profile can be customized with different level alarms.

Level alarms for O_2 or stack temperature can also be set. The parameter O2 LEVEL ALARM determines what action should be taken when a level alarm is reported. The setpoints for high and low O_2 and stack temperatures can be set using the various O_2 setpoints that are individually set by profile. The options for an O_2 level alarm are to issue a warning but keep running with trim disabled or lockout the control. O_2 level alarms can also be globally disabled (not used). O_2 level alarms are deviations from the target O_2 levels, not absolute values.

O_2 level alarms are generated with some rules to avoid nuisance alarms:

1. The O_2 level drops below the absolute value of 0.5% O2 for 30 seconds.
2. The O_2 level drops below the low alarm limit for 2 minutes.
3. The O_2 levels drops below twice the low alarm level for 30 seconds.
4. The O_2 level rises above the high alarm limit for 2 minutes.
5. The O_2 level rises above twice the high alarm limit of 30 seconds.
6. The O_2 level alarm timer is reset to 0 when the actual O_2 level returns to within the acceptable zone.

See *PARAMETERS* section for additional details on each parameter.

Efficiency Calculations

If an inlet temperature sensor is connected to one of the sensor inputs, all the necessary data is available, and an efficiency calculation can be shown on the keypad. Additional parameters such as fuel type, heat loss percentage and turndown ratio can all be entered to make this calculation more accurate.

See *PARAMETERS* section for additional details on each parameter.

Setting Trim Limits

When setting up the combustion curve, determine how far above and below (in degrees) the air servo can move at various firing rates, without disrupting combustion. Use these observations to determine how to set the trim limits.

O_2 trim limits (expressed in degrees) are derived from the parameters TRIM LIMIT, TRIM LIMIT RATIO and the current firing rate of the burner. Care should be exercised when selecting these values. The trim limit applies to both CW and CCW directions and is a deviation from the commissioned position – the servo can move in either direction. The effective range of motion is twice the trim limit, with the commissioned position in the middle of travel. The trim limit values must be selected as to not reach the mechanical stop at either end of the trimmed servo travel.

With the NXD410TS, the TRIM LIMIT in the O2 SETUP menu parameter determines if the default value of 0.1° will be used (DEFAULT) or if a separate value will be entered per profile (MANUAL). If set to MANUAL, there will be a parameter TRIM LIMIT(1…4) for each profile. The default value for this parameter will be 2.0°. Note that if the TRIM LIMIT parameter is changed from DEFAULT to MANUAL, the new value for DEFAULT will be the last value from when set to MANUAL, if it is changed back to DEFAULT. **It is suggested that this parameter is set to MANUAL and trim limits are actively entered.** With the NXTSD507HD and NXTSD512HD, the TRIM LIMIT parameter is found in the GENERAL SETTINGS → O2 menu, under the CONTROL tab. The parameter is

named TRIM LIMIT MODE. The actual trim limits when in MANUAL are under the PROFILES tab by profile, under the name TRIM LIMIT.

Whether the default is used or if manually entered, the trim limit is part of the equation to determine how much trim can be applied in either direction to the servo position at low fire. Since smaller movement of the servo will result in more significant changes in the air/fuel ratio at low firing rates, the trim limit ratio is used to allow for larger trim limits as the firing rate increases to high fire.

The TRIM LIMIT RATIO parameter determines how much additional trim can be applied at high fire over low fire. If the trim limit is set to 3.0° and the trim limit ratio is set to 3, the maximum trim at high fire would be ±9.0°. The maximum trim at any intermediate firing rate will follow a linear path, so at 50% firing rate the maximum trim would be ±6.0°. With the NXD410TS, this parameter is found in the O2 SETUP menu. With the NXTSD507HD and NXTSD512HD, this parameter is found in the GENERAL SETTINGS → O2 menu, under the CONTROL tab.

The following formula is used to determine the maximum trim at any firing rate:

$$\text{LIMIT} = \text{TRIM LIMIT} \times \left(\left(\left(\text{TRIM LIMIT RATIO} - 1 \right) \times \frac{\text{FIRING RATE}}{100} \right) + 1 \right)$$

The tables below show how the trim limit is a progressively increasing number from low fire to high fire (from the formula previously described):

TRIM LIMIT RATIO = 3 **TRIM LIMIT = 2.0°**	
FIRING RATE	**TRIM LIMT**
LOW FIRE	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°
HIGH FIRE	6.0°

TRIM LIMIT RATIO = 3 **TRIM LIMIT = 3.0°**	
FIRING RATE	**TRIM LIMT**
LOW FIRE	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°
HIGH FIRE	9.0°

TRIM LIMIT RATIO = 4 **TRIM LIMIT = 3.0°**	
FIRING RATE	**TRIM LIMT**
LOW FIRE	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°
HIGH FIRE	12.0°

There is typically a large (example 10:1) ratio between air and fuel in any combustion system. If selecting fuel as the trimming servo, trim limits should be selected to allow only enough movement to achieve the desired target. Any movement will have a much larger effect.

It is advised to begin by only setting a couple of key parameters and leaving the rest at the default settings. After some observation, if the performance is not adequate, additional parameters can then be adjusted. It is always best to be as conservative as possible when making combustion changes.

The first parameter that must be set is TRANSPORT DELAY. With the NXD410TS, this is in the O2 SETUP menu. With the NXTSD507HD and NXTSD512HD, go to the menu GENERAL SETTINGS → O2, then to the CONTROL tab. Set this parameter to an accurate setting by noting how long it takes for a change in servo position to be recognized as a change in the O_2 value, while at low fire. This affects the calculations by noting how long the NXF4000 or PPC4000 should expect feedback to take.

The second parameter that must be set is TRIM TYPE. For both user interfaces, it is in the same menu as TRANSPORT DELAY. **It is suggested to set TRIM TYPE to AIR. This is due to the higher concentration of air in the combustion process. If the fuel servo is used to trim, any movement will be magnified so it could be harder to control.**

It is also suggested to set the TRIM I-GAIN (integral) for the selected profile to 0. Only add integral if the trim function has trouble reaching the trim setpoint. A lower integral value will be more conservative and is a good place to start. Each profile has an individual TRIM I-GAIN setting.

TRIM P-GAIN will determine how quickly trim is added but won't change the trim limit. For example, if the trim limit for the firing rate is 8.0°, a proportional setting of 10% may change the servo position by 0.3° when the O_2 is 1.0% off of the target. If the proportional setting was changed to 100% (10x more), the same servo position would change by approximately 3.0° when the O_2 is off target by 1.0%. **It is suggested to begin with the default TRIM P-GAIN setting and only increase if the control is not trimming fast enough. Always try increasing the proportional gain slightly before modifying the trim limit parameters.** Each profile has an individual TRIM P-GAIN setting.

HEAT LOSS, TURNDOWN RATIO and FUEL TYPE(1…4) are used with the efficiency calculation. Efficiency is only calculated when an inlet temperature sensor is connected and properly configured. HEAT LOSS can be set from 0.0% to 9.9% and indicates how much heat is lost through the boiler shell at high fire. The TURNDOWN RATIO parameter is used to scale the heat loss linearly when the firing rate approaches low fire. FUEL TYPE changes the efficiency formula used.

The parameter O2 FAULT ALARM determines what action should be taken when an alarm is reported by the O_2 probe. These alarms can be due to many causes – the code reported should be checked against those listed in the bulletin for the specific O_2 probe fitted. The options for an O_2 probe alarm are to issue a warning but keep running with trim disabled or lockout the control.

See *PARAMETERS* section for additional details on each parameter.

Suggested Starting Parameters

Below is a table showing some good starting values while setting up trim. These values are conservative and will allow observation of trim operation. If trimming is not enough to reach the O_2 target setpoints, and it is safe to do so, increase the trim limits and/or the proportional gain and see if trimming performs better. Slowly repeat the process to ensure that the settings do not result in too much trimming.

NXD410TS	NXTSD507HD and NXTSD512HD	VALUE
O2 SETUP → TRIM TYPE	GENERAL SETTINGS → O2 → CONTROL → TRIM TYPE	AIR
O2 SETUP → TRIM LIMIT RATIO	GENERAL SETTINGS → O2 → CONTROL → TRIM LIMIT RATIO	1
O2 SETUP → TRIM LIMIT	GENERAL SETTINGS → O2 → CONTROL → TRIM LIMIT MODE	MANUAL
O2 SETUP → TRIM LIMIT(1)	GENERAL SETTINGS → O2 → PROFILES → PROFILE 1 → TRIM LIMIT	2.0°
O2 SETUP → TRIM P-GAIN(1)	GENERAL SETTINGS → O2 → PROFILES → PROFILE 1 → TRIM P-GAIN	10%
O2 SETUP → TRIM I-GAIN(1)	GENERAL SETTINGS → O2 → PROFILES → PROFILE 1 → TRIM I-GAIN	0%

Section 7: Troubleshooting

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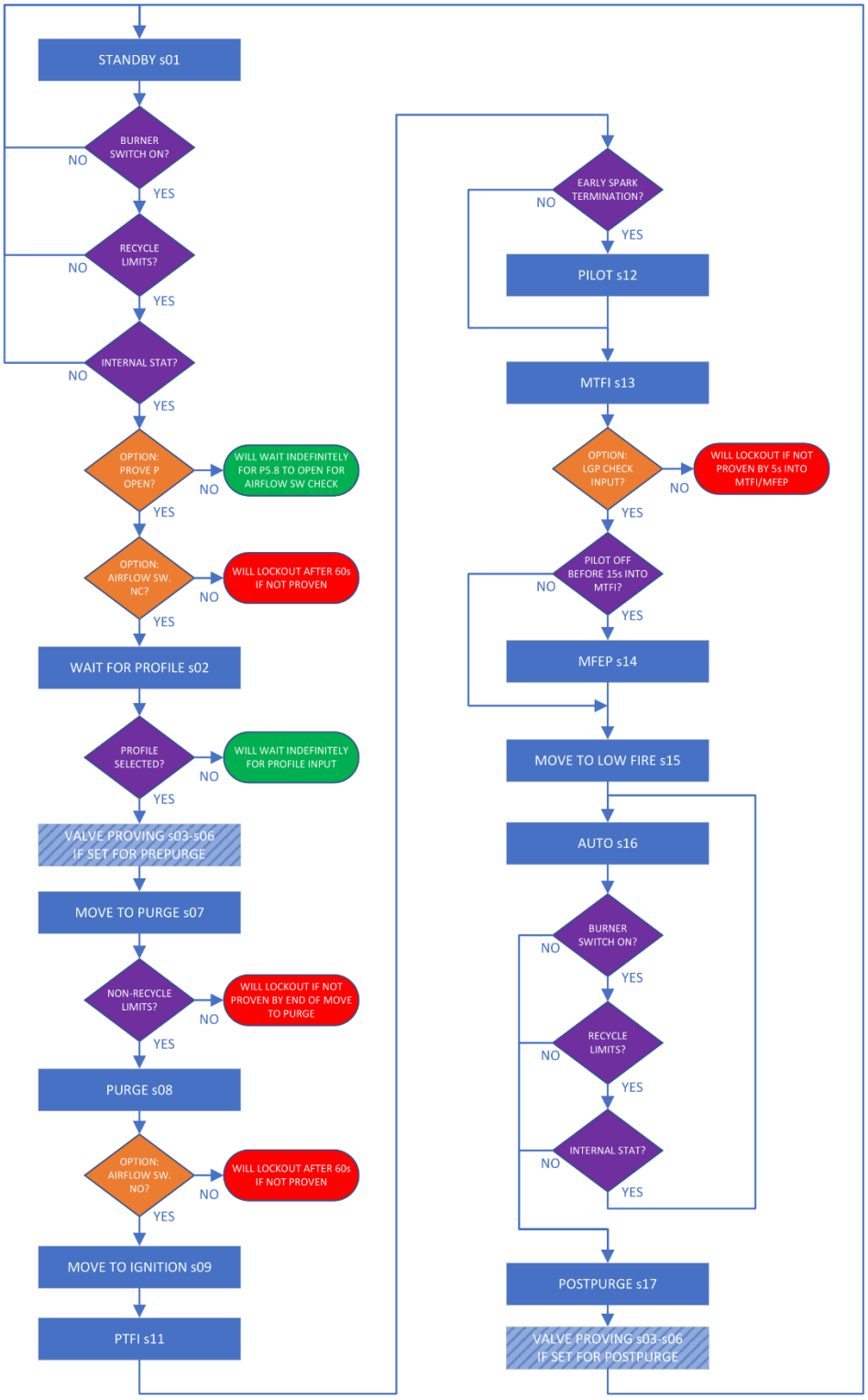
SEQUENCE OF OPERATION

State Listing NXF4000

State	Message		Description
s00	POST	s00	Power on self-test. State only appears upon the initial application of power.
s01	STANDBY	s01	Burner is in off condition and the servos are in the p00 position.
s02	WAIT FOR PROFILE	s02	Once the profile is selected and the pre-conditions for start-up are satisfied the NXF4000 turns on the blower.
s03	VALVE PROVING	s03	The first step in valve proving is evacuation, where the downstream gas valve is opened to evacuate the test chamber.
s04	VALVE PROVING	s04	The second step in valve proving is the evacuation test, where the closure of the upstream valve is checked by making sure the test chamber doesn't pressurize.
s05	VALVE PROVING	s05	The third test in valve proving is the fill, where the upstream gas valve is opened to pressurize the test chamber.
s06	VALVE PROVING	s06	The fourth and final test in valve proving is the pressurization test, where the downstream gas valve is checked by making sure the test chamber stays pressurized.
s07	MOVE TO PURGE	s07	Command is sent to the AIR servo and/or VFD drive to move to the p01 position.
s08	PURGE	s08	The AIR servo and/or VFD remain in the purge position for the purge duration.
s09	MOVE TO IGNITION	s09	Command is sent to all servos and/or VFD drive to move to the p02 position.
s11	PTFI	s11	Pilot trial for ignition. Both ignition and pilot outputs are on during MTFI.
s12	PILOT	s12	Pilot stabilization time. PTFI will transition to PILOT once ignition turns off (early spark termination, depends on settings).
s13	MTFI	s13	Main trial for ignition. Both pilot and main outputs are on during MTFI.
s14	MFEP	s14	Main flame establishing period. MTFI will transition to MFEP once pilot turns off (depends on settings).
s15	MOVE TO LOW FIRE	s15	This is the initial state after MTFI/MFEP. This will be displayed any time p03 is the current position (including low fire hold).
s16	AUTO	s16	Modulation can occur to satisfy demand.
s17	POSTPURGE	s17	A loss of demand commences a controlled shutdown and transition back to the standby state (s01).
s18	LOCKOUT	s18	There is an active lockout that needs to be addressed and reset.

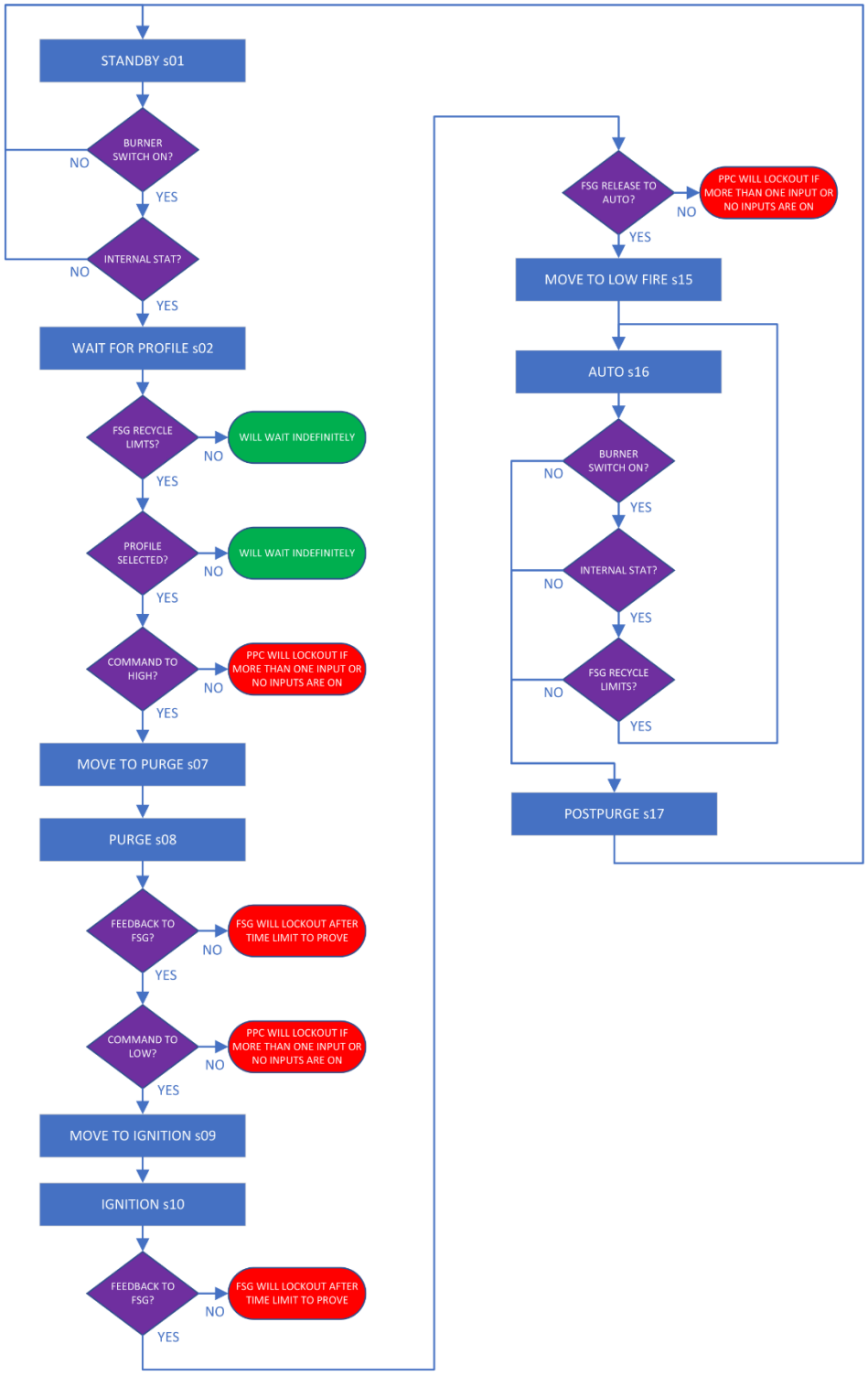
State Flow Chart NXF4000



State Listing PPC4000

State	Message	Description
s00	POST s00	Power on self-test. State only appears upon the initial application of power.
s01	STANDBY s01	Burner is in off condition and the servos are in the p00 position.
s02	WAIT FOR PROFILE s02	Waits for the fuel select input to begin the sequence.
s07	MOVE TO PURGE s07	Flame safeguard is sending command to drive to the high fire purge position.
s08	PURGE s08	Sends feedback to the flame safeguard that the servos and/or VFD are all at the purge position.
s09	MOVE TO IGNITION s09	Flame safeguard is sending command to drive to the low fire ignition position.
s10	IGNITION s10	Sends feedback to the flame safeguard that the servos and/or VFD are all at the ignition position.
s15	MOVE TO LOW FIRE s15	This will be displayed for the first 10 seconds after the flame safeguard releases modulation to allow stabilization. This is also displayed whenever low fire hold is applied or revert to pilot is enabled in the flame safeguard.
s16	AUTO s16	Modulation can occur to satisfy demand.
s17	POSTPURGE s17	A loss of demand commences a controlled shutdown and transition back to the standby state (s01).
s18	LOCKOUT s18	There is an active lockout that needs to be addressed and reset.

State Flow Chart PPC4000

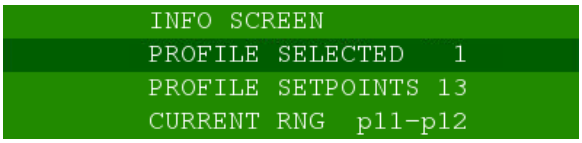


INFORMATION SCREENS NXD410TS

The information screen is accessible from the INFO quick key. This screen shows diagnostic information about the inputs, sensors, software and more. This is also where burner cycles and hours can be viewed. The whole list is can navigated in either direction using either the UP or DOWN quick keys. Pressing the INFO quick key again exits back to the same screen being viewed prior to accessing the INFO screen.

Current Operating Status

The first section shows the current status/state as well as the selected profile, how many commissioned points exist in the profile and which points in the profile the current firing rate resides. In the example shown, the current range of p11-p12 indicates that the servo positions are calculated to be between those commissioned for p11 and p12 since the firing rate does not land evenly on one commissioned point.

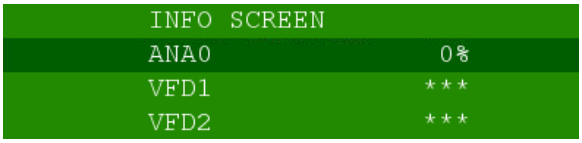


Servo Diagnostics

Following the operating status, the information screen shows servo diagnostic information. Servo firmware is identified by checksum, which is a four hexadecimal digit number. This helps identify the age of a servo as well as the firmware that it is running. The current servo position in angular degrees is also shown.

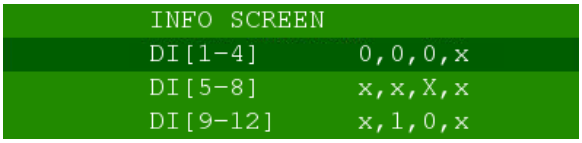
Analog Output Diagnostics

The user-defined analog output values can be checked at this area of the information screen. If the analog output is not available, *** will be displayed for the value. This is the case for the VFD1 and VFD2 outputs when the NXCESVFD card is not fitted. The current output will be shown in percent, with 0% indicating 4mA output and 100% indicating 20mA output.



Digital Input Diagnostics

The current value of the digital inputs can be checked at this area of the information screen. The state of the inputs can be determined whether the input is programmed or not. Each line shows up to four digital inputs, separated by commas as shown in the example.



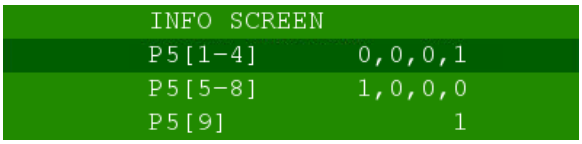
If the input is not programmed, the state will be indicated by a lowercase x when no voltage is present, and by an uppercase X when voltage is present.

If the input is programmed for any function, the state will be indicated by a 0 when no voltage is present, and by a 1 when voltage is present.

Other digital inputs, such as OPERATING CONTROL (P15.4) for the NXF4000, or HIGH (P15.2), LOW (P15.3) and AUTO (P15.4) for the PPC4000, also have their status indicated by a 0 for off and a 1 for on.

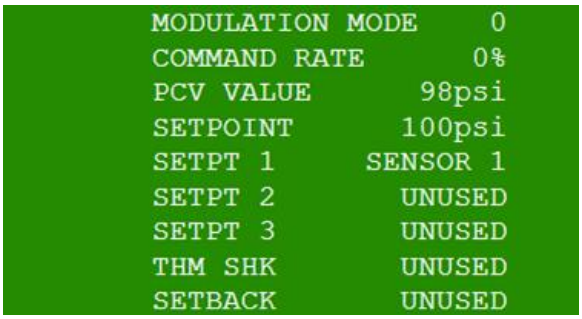
Digital Output Diagnostics

The current value of the digital outputs can be checked at this area of the information screen. The state of the outputs is indicated by a 0 for off and a 1 for on. Each line shows up to four digital outputs, separated by commas as shown in the example.



Modulation Diagnostics

The current modulation mode indicates the current source being used for the firing rate. The following list indicates the sources by number:

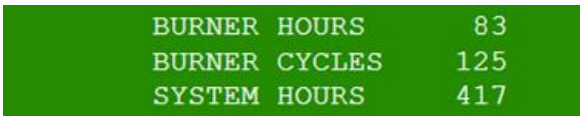


- 0 = AUTO, based on setpoint
- 1 = Low fire hold from digital input
- 2 = Manual modulation from keypad
- 3 = From lead/lag master
- 4 = Low fire hold from keypad
- 5 = Operating in standby water mode
- 6 = Thermal shock active
- 7 = Hold due to low stack temperature
- 8 = Purge hold is active
- 9 = Track modulation is active

The current modulation rate is also shown here, in percent from 0% to 100%. The current PCV (process control variable) is also shown, which is the controlling sensor that the PID firing rate is based upon. The current setpoint is also shown, as well as the sensor assignments for setpoints 1, 2, 3, thermal shock and setback.

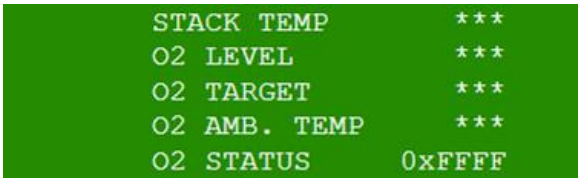
Operating Statistics

The next section of the information screen shows typical operating statistics. These include burner hours, which indicate how many complete hours the fuel valves have been opened, the burner cycles, which indicate how many times the fuel valves have been opened, and the system hours, which indicates how many complete hours the NXF4000 or PPC4000 have been powered.

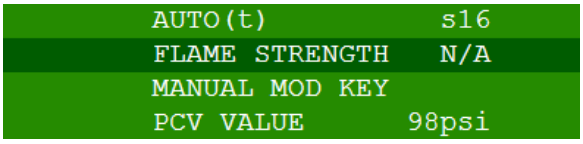


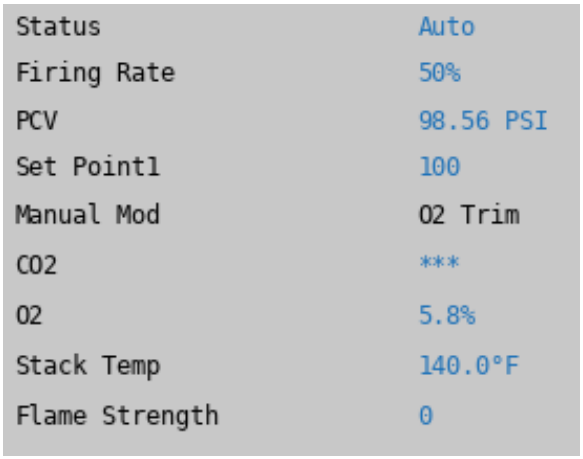
O_2 Trim Diagnostics

The current values operating values from the O_2 probe are shown in this section of the information screen. If the O_2 probe is not used, the values will be represented by ***.



O2 LEVEL shows the current O_2 reading whether O_2 trim is disabled, in monitoring or in control mode. O2 TARGET shows the current O_2 target while in control mode. If this is showing 0.0%, O_2 control has not been properly commissioned. See COMMISSIONING section for additional details. If O_2 control is enabled and working properly, the NXD410TS HOME screen will show AUTO(t) instead of AUTO. The NXTSD507HD or NXTSD512HD will show the text O2 TRIM below the setpoint on all overview and status panels. If track modulation is used, this will appear to the right of the text TRACK MOD.





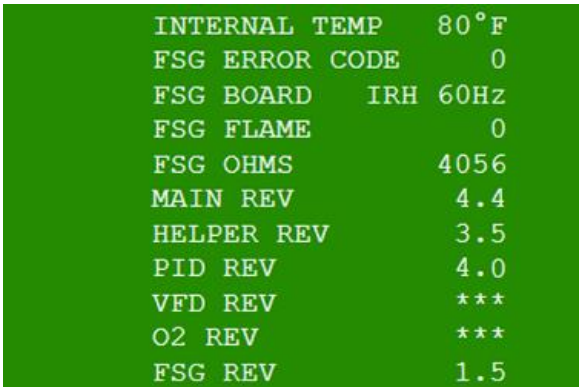
O2 STATUS shows the hexadecimal status code for the O_2 probe. See Fireye bulletins *NXCESO2-1001* (NXCESO2 probe) or *FXCESO2-1001* (FXCESO2 probe with FXO2TRIM-1 interface) for a full description of the status codes as well as more information in general about the O_2 probes.

Sequencing Diagnostics

The current sequencing state (SEQUENCING on information screen) indicates the current status of the control in the peer-to-peer sequencing network. The following list indicates the reasons by number:

- 0 = Sequencing is not enabled (status is disabled)
- 1 = Slave control
- 2 = Master control
- 3 = Transition from disabled → slave
- 4 = Transition from disabled → master
- 5 = Transition from slave → disabled
- 6 = Transition from master → disabled
- 7 = Transition from slave → master
- 8 = Transition from master → slave

Controller Diagnostics



The last section of the information screen shows controller diagnostics. Information pertaining to the FSG board (add-on card amplifier) is not shown with the PPC4000.

The current status of the FSG amplifier can help troubleshoot flame detection issues. The FSG ERROR CODE parameter will display 0 for no error, and any other value for an error code. If this parameter indicates an error code, the add-on card amplifier likely needs replacement.

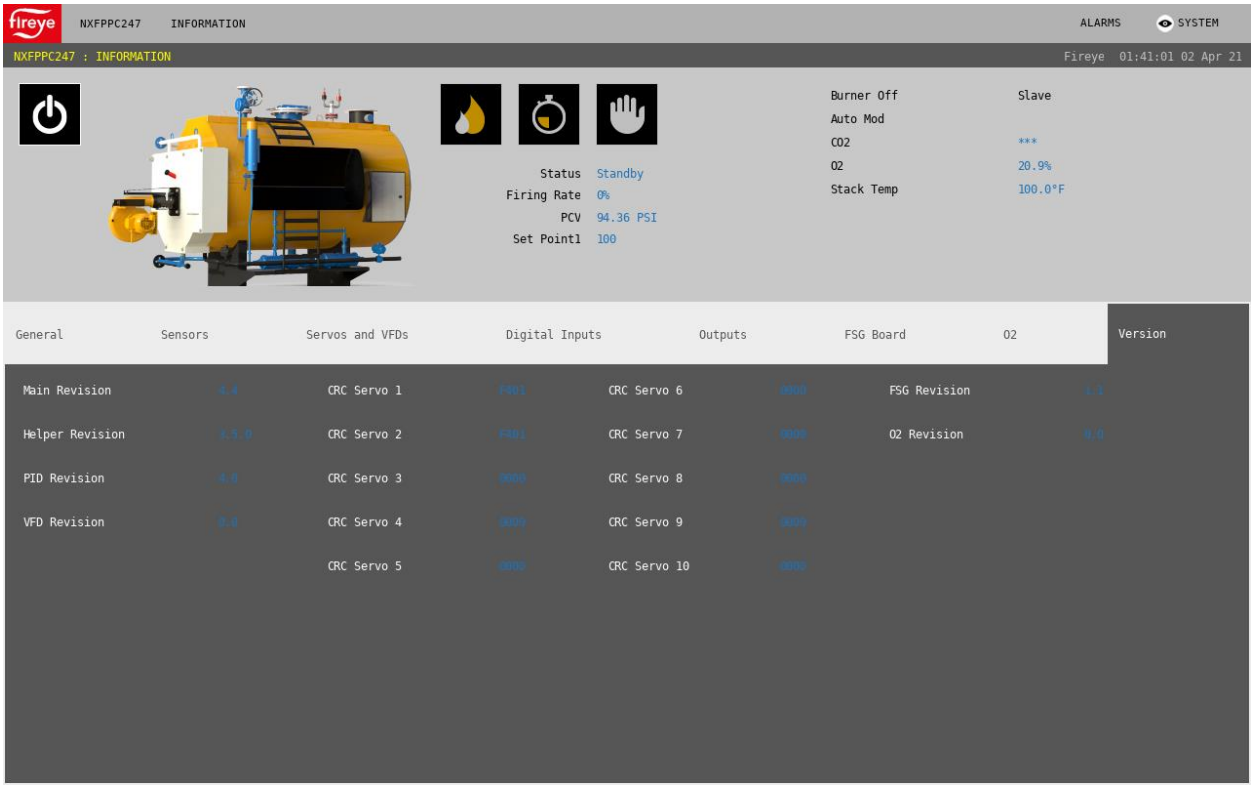
The type of amplifier card is indicated by the parameter FSG BOARD, and this can be viewed to verify that the amplifier is installed at all or that the correct scanner is being used. The current frequency of the line voltage is shown as well.

FSG FLAME shows the current flame signal from 0 to 100. FSG OHMS is a raw value showing the flame resistance. This value can be useful when troubleshooting intermittent scanner issues.

The final several lines on the information screen show the firmware revisions for the various processors connected to the control. If a processor is not connected (VFD card not fitted, for example), the is indicated by ***.

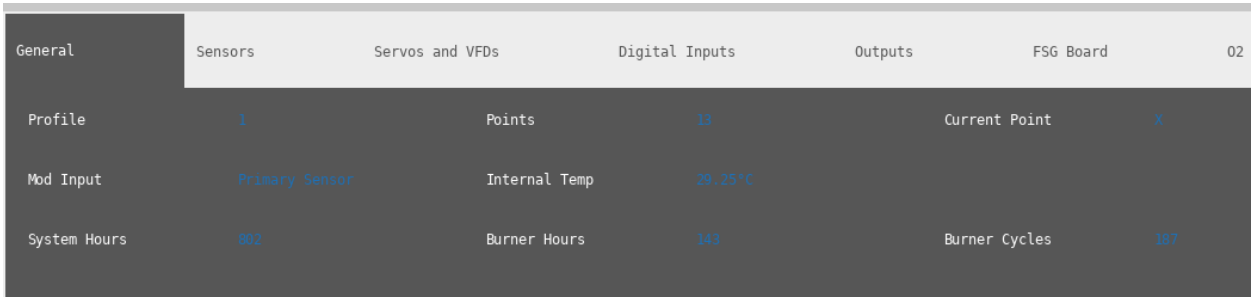
INFORMATION SCREENS NXTSD507HD AND NXTSD512HD

The information screen is accessible by going to the menu INFORMATION. This screen has multiple tabs that groups information.



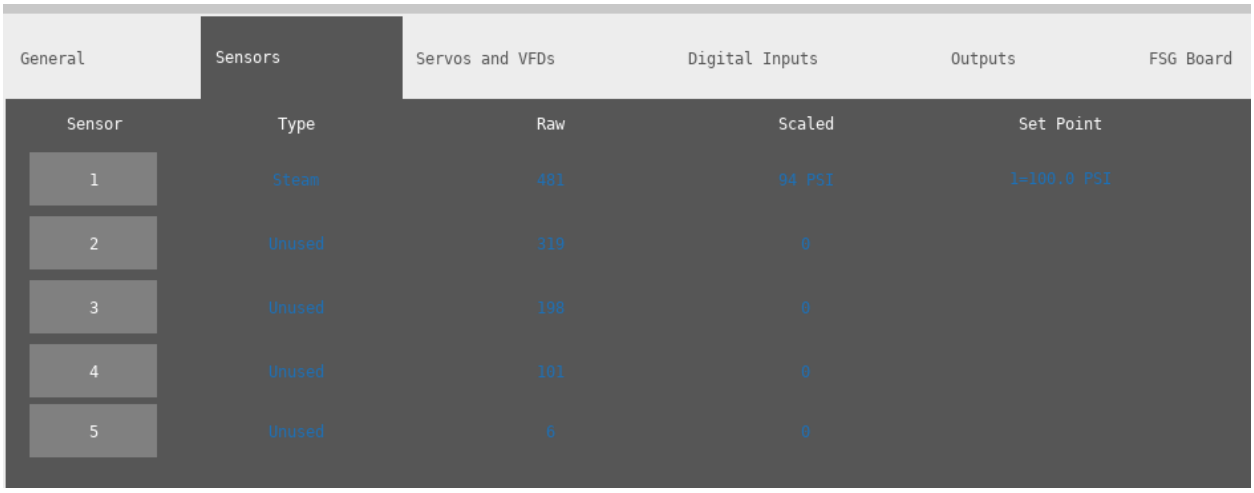
General Tab

The GENERAL tab shows basic operating information, such as current profile, burner hours, burner cycles, etc.



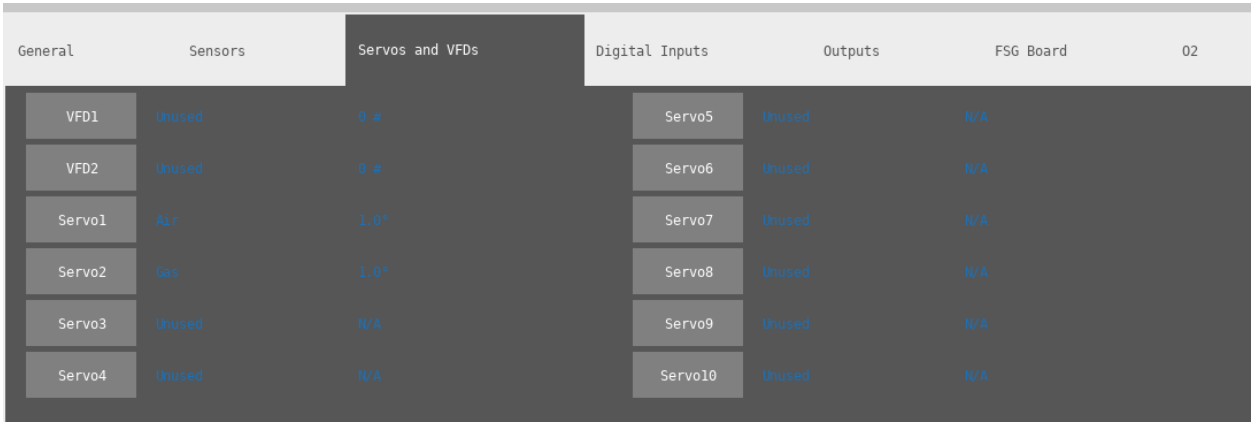
Sensors Tab

The SENSORS tab shows the current configuration of each sensor, as well as the raw and scaled values of each.



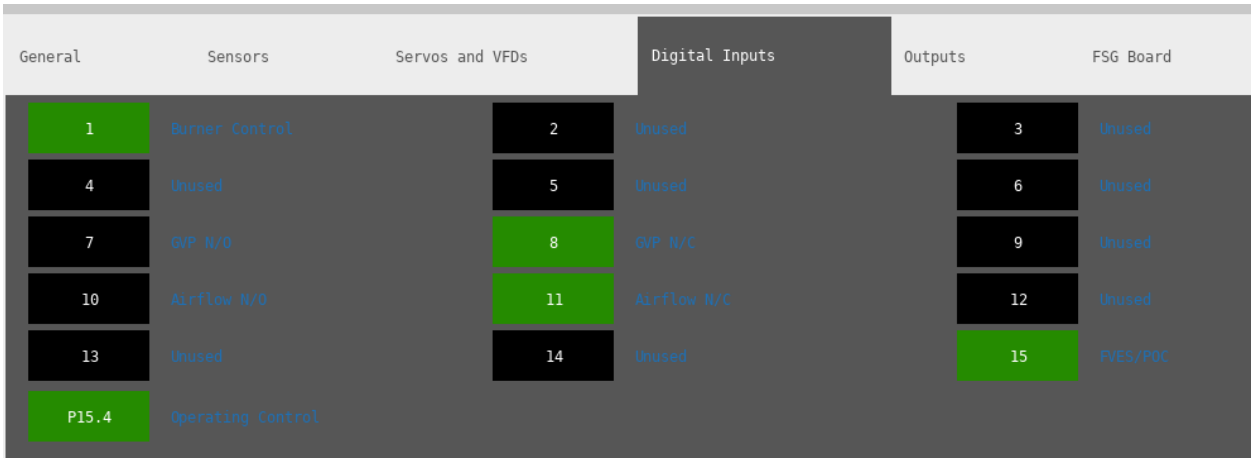
Servos and VFDs Tab

The SERVOS AND VFDS tab shows the current configuration of each servo or VFD, as well as the current position.



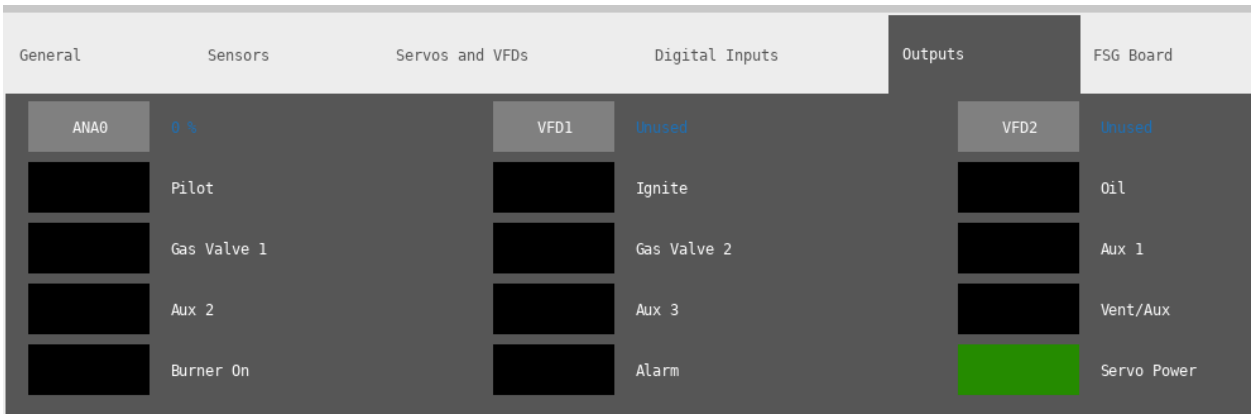
Digital Inputs Tab

The DIGITAL INPUTS tab shows the current configuration of digital input. It also shows the digital input number with a black background when off and a green background when on. This helps troubleshoot issues with digital inputs.



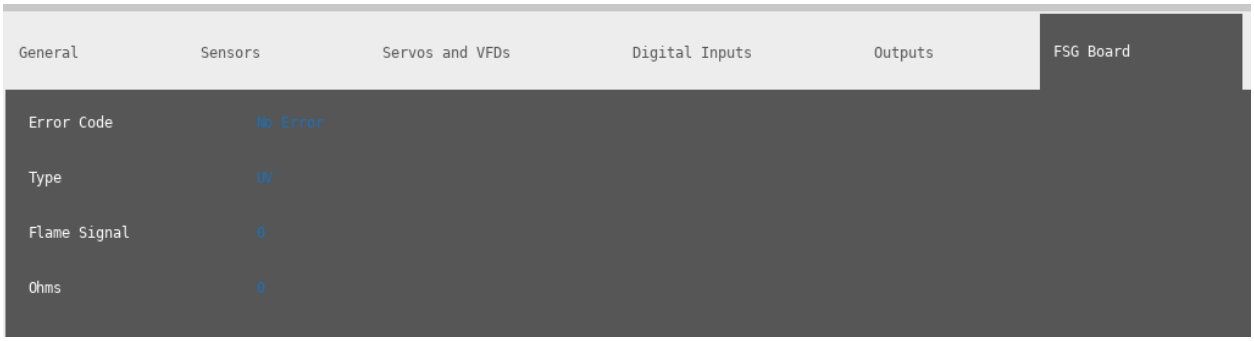
Outputs Tab

The OUTPUTS tab shows the current configuration of the analog and user outputs. It also shows the current analog values of analog outputs, or the current on/off state of the user outputs. As with the digital inputs, the user outputs show a black background when off and a green background when on.



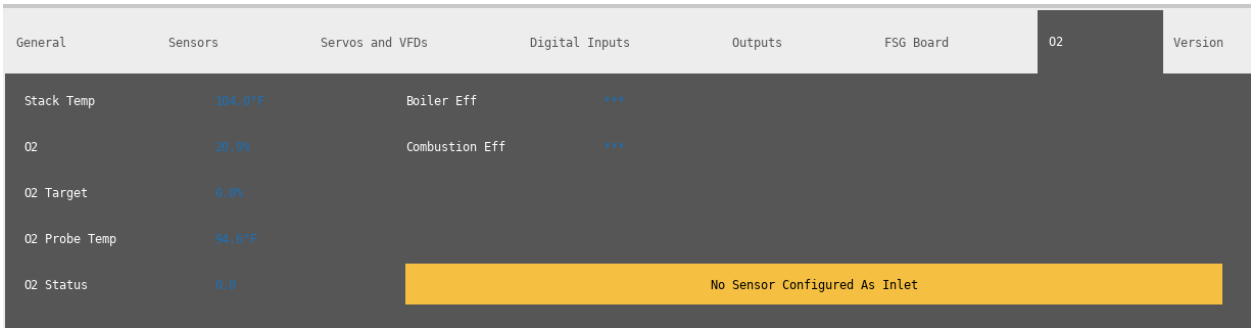
FSG Board

The FSG BOARD tab shows diagnostic information for the FSG board. This only applies to the NXF4000 as the PPC4000 uses as external flame safeguard.



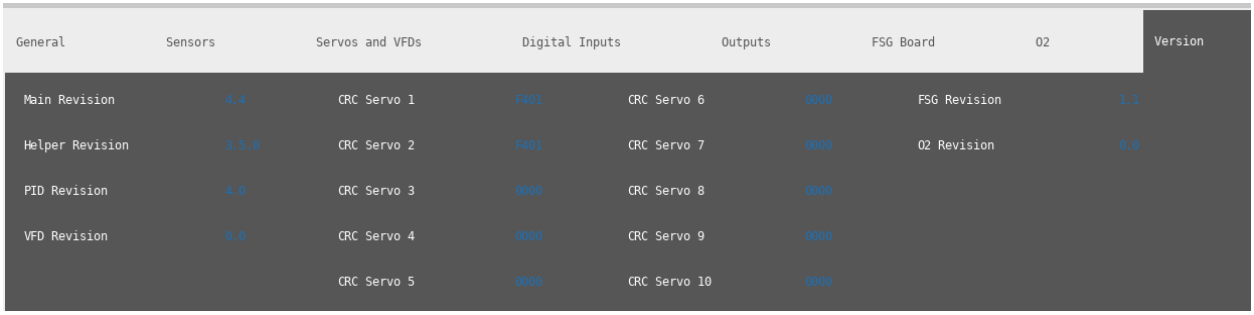
O2

The O2 tab shows diagnostic information for the O_2 probe. It also offers warning messages in a yellow background to help troubleshoot common issues.



Version

The VERSION tab shows revision information for all connected devices.



SCENARIOS

Different troubleshooting scenarios are described in this section.

Improper VFD Feedback

When commissioning with the NXD410TS, the asterisk (*) beside the current point number indicates that the current commanded positions and actual positions agree. With the NXTSD507HD and NXTSD512HD, the visibility of the NEXT quick key indicates the same thing. When either is the case, the point can either be further modified as needed or NEXT can be pressed to proceed to the next point.

With servos, it is rare that feedback doesn't match the command since Modbus is used and all the setup and communication is handled behind the scenes. The same Modbus connection automatically handles the command and receives the feedback, in the proper format. One of the scenarios that could cause the feedback to mismatch the command with a servo would be a physical blockage of the damper. This would result in a servo-specific lockout that would lead to resolving the blockage.

With a VFD, the command and feedback are independent 4-20mA channels. Each connects to the VFD, one to an analog input (command to VFD) and one to an analog output (feedback from the VFD). It is also possible to use an encoder for feedback instead of getting it from the VFD's analog output.

If the VFD is not configured correctly across all parameters, the 4-20mA feedback may not match the command. When this happens, the control will appear to get stuck during commissioning as the asterisk will not appear, since the commanded VFD position does not match the feedback. What is seen on the screen during commissioning is the VFD feedback.

An easy way to confirm that this is the case is to connect the analog output from the NXF4000 or PPC4000 (signal to VFD) to the analog input for feedback. The result is a short wire jumper from one terminal to the other. This simulates perfect feedback from the VFD. Note that since the analog output and input already share a common ground, no ground connections need to be jumpered. If this connection results in the feedback matching the command closely, verify the VFD configuration as that is the source of the improper feedback. See the WIRING section for example configuration parameters for the ABB ACS550 and ABB ACS580 VFDs (available from Fireye).

Always make sure that the analog output from the VFD represents the running frequency or rpm and does not simply mirror the analog input.

Keypad Keys Stuck

If the NXF4000 or PPC4000 is not configured to use the keypad keys for burner control, low fire hold, auto/manual or lead/lag, they may still be activated by a user Modbus connection. If building automation sets one of these keys on or off, they will be activated and forced into duty despite being programmed as unused. If the building automation connection is active, this should not present a problem. If the connection is turned off, however, the last command sent will continue to be respected and in non-volatile, meaning that it will persist through a power cycle.

If the control will not start and there is no apparent reason for that, enable the use of the keypad keys (set all to USED from UNUSED under the KEYPAD SETUP menu), and then toggle each on and off to see if this resolves the problem. Note that this step is only necessary if a user Modbus connection had been previously made and then disconnected, resulting in a condition where the control will not restart.

This scenario only applies when using the NXD410TS user interface.

Can't Move to Next Point During Commissioning

If the NXF4000 or PPC4000 will not advance to the next point during commissioning after touching NEXT, make a small adjustment to one of the servo channels. This servo channel can then be set back to the initial position. Try touching NEXT again and see if the situation is resolved. The most likely reason for this is when recommissioning an existing curve after O_2 control mode is enabled.

This procedure will set the curve point as being a valid curve point. While this is not normally necessary, there are situations where a curve point may not register as being valid if no changes have been made, such as when setting O_2 target setpoints.

Can't Change Sensor Units

Units can universally be changed from Metric to Imperial. Metric units used are ºC, mBar and Bar, while Imperial units used are ºF and psi. Since this is a global setting, it is not possible to have some units in Metric with others in Imperial units.

In order to change units, all the sensors must be set to UNUSED. If any sensor is set to a type, the units will not be able to be changed. Note that when a sensor is set back to a type, all associated setpoints will have to be set again as they will return to their defaults.

Can't Change PTFI or MTFI to Desired Setting

Both PTFI and MTFI show split values in the BURNER CNTRL SETUP (NXD410TS) or GENERAL SETTINGS → BURNER CONTROL (NXTSD507HD and NXTSD512HD) menus. The setting of one affects the setting of the other. This is because not all combinations would make sense.

With the PTFI setting, the first number shown is how long the ignition output is active during PTFI, while the second is how long PTFI lasts in total. If the first number is less than the second, this indicates that early spark termination is used. This is usually desired in applications where the spark may be registered as a flame signal, causing the control to pass PTFI without a pilot. Using early spark termination will solve this issue.

With the MTFI setting, the first number shown is how long the ignition output is active during the fixed 15 second MTFI/MFEP period. If early spark termination is used, this must be set to a 0. If it is not set to a 0, the PTFI parameter will only show options with matching times (i.e. 5/5 and 10/10). Once MTFI is set to an option with a 0 for the first time, the PTFI parameter will show all available options, including those offering early spark termination.

The second MTFI number is how long the pilot output is active during MTFI/MFEP. If this is set to any value less the 15, the control will transition from MTFI to MFEP once the pilot output turns off.

Stuck Servo Lockouts

If the lockout code indicates a stuck servo, check to see if the green LED under the servo cover is illuminated. Also try moving the servo using the manual movement buttons. If the LED is not on and the servo does not move using the manual movement buttons, try holding down both CW and CCW for two seconds, then releasing one. If the servo doesn't drive then repeat the process again, releasing the other button. This lockout is typically caused by a servo being driven out of range of the feedback potentiometer, and this method is used to try to get the servo back into range. Once the servo is between 1.0° and 99.9°, the lockout should clear and the servo should operate properly.

Parameter Dependencies

Some parameters have dependencies on other parameters. This can cause a parameter to automatically adjust to account for the parameter with the dependency or can change which values are available to set a parameter to.

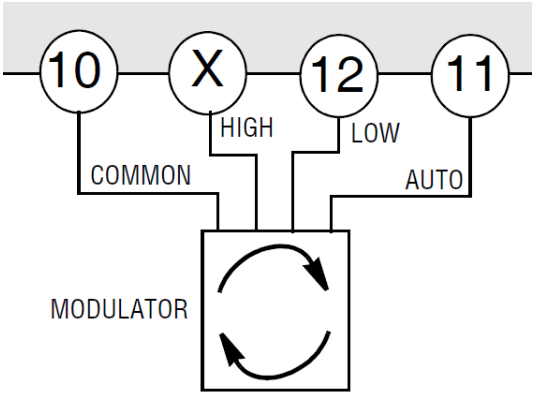
An example of this is the relationship between the different setpoint parameters. The setpoint can only be set to a value that is less than the high marginal alarm, after the cut-out setting is added. For example, if the high marginal alarm is set to 120psi, and the cut-out is set to 7psi, then the highest that the setpoint could be set for is 113psi. This is 120psi less 7psi. To set it to a higher value, either the high marginal alarm setting would need to be increased, or the cut-out would need to be decreased. When using the NXD410TS, the upper and lower boundaries available will automatically roll over with the UP and DOWN arrows while MODIFY/SAVE is active. With the NXTSD507HD and NXTSD512HD, the boundaries are displayed on the numeric entry pop-up.

PPC4000 Check Wiring Lockouts

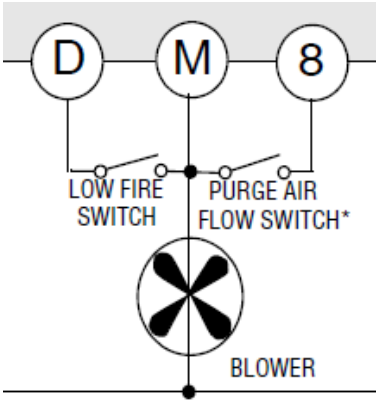
Most flame safeguards were originally intended to control a linear actuator (modulating motor). The actuator takes signals from the flame safeguard to go to the minimum (low fire), maximum (high fire) or auto (free to modulate). In turn, the actuator then relays back to the flame safeguard if the commanded position has been reached. This closed loop design provides safety to make sure that the actuator is doing what the flame safeguard needs it to do. Once in auto, an external controller can modulate the actuator to maintain the setpoint.

The PPC4000 interfaces to these same inputs and outputs to appear to the flame safeguard as a linear actuator. An easy way to understand this is to realize that in the standard burner bill of materials, an entire PPC4000 parallel positioning system replaces one linear actuator.

For a flame safeguard to be compatible, it must always provide one of three command outputs to the actuator. It cannot provide more than one simultaneously, and there can never be any time with none of the outputs active. If more than one or no outputs are active, a CHECK WIRING lockout will occur. These outputs must share a common terminal that allows line voltage to be switched, or they must provide line voltage outputs to be compatible with the PPC4000.

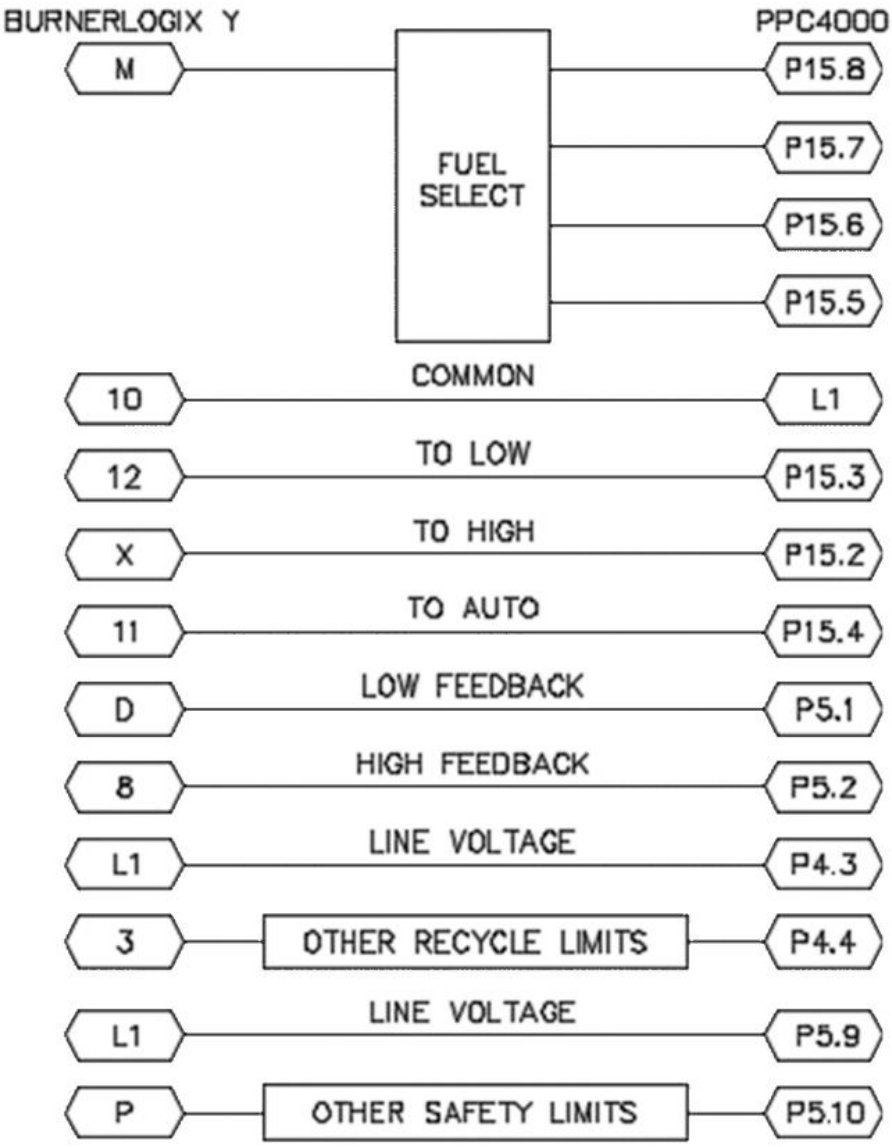


Commands from FSG to PPC4000



Feedback from PPC4000 to FSG

The complete wiring between the PPC4000 and the flame safeguard is very simple. A sample of the minimum interface between a BurnerLogix and the PPC4000 is shown in the figure to the right. See the *WIRING* section for full descriptions of each terminal. See *APPENDIX A* for a full sample connection diagram of a PPC4000 system with a BurnerLogix Y or BurnerPRO.



Example wiring interface from BurnerLogix to PPC4000

Invalid Parameter Errors on NXTSD507HD and NXTSD512HD

A persistent error that shows the device name followed by ".2319", such as "NXFPPC247.2319" and an error message reading "Device status: Invalid parameter value." indicates that the date and time need to be properly set. This is because the touchscreen is trying to write a date that is older than is allowed by the NXF4000 or PPC4000. An NXF4000 or PPC4000 running firmware version 4.4 must have a date that is on or after January 1, 2020.

No Buttons to Commission p00 on NXTSD507HD or NXTSD512HD with NXF4000

When using the NXTSD507HD or NXTSD512HD, there may be a situation during commissioning p00 where the buttons and indicators for servo positions do not appear. With these touchscreens, a profile needs to be selected for commissioning to be possible. Make sure that there is voltage on one of the profile select inputs to resolve this issue. If the fuel selection switch gets power from the blower output, change this so that the fuel selection switch gets direct line power.

PPC4000 Stays in Standby Despite Call for Heat Present

If the PPC4000 stays in standby despite there being a call for heat (either in track modulation mode or when using a sensor), check that none of the profile select inputs have voltage. The PPC4000 begins its sequence when voltage is received on a profile select input, so it will not be able to exit standby if there is already voltage on one of these inputs. The voltage for the profile select input should be sourced from the blower output of the flame safeguard to ensure that voltage can only be received on the profile select inputs after the PPC4000 has already sent the call for heat to the flame safeguard.

Sequence of events:

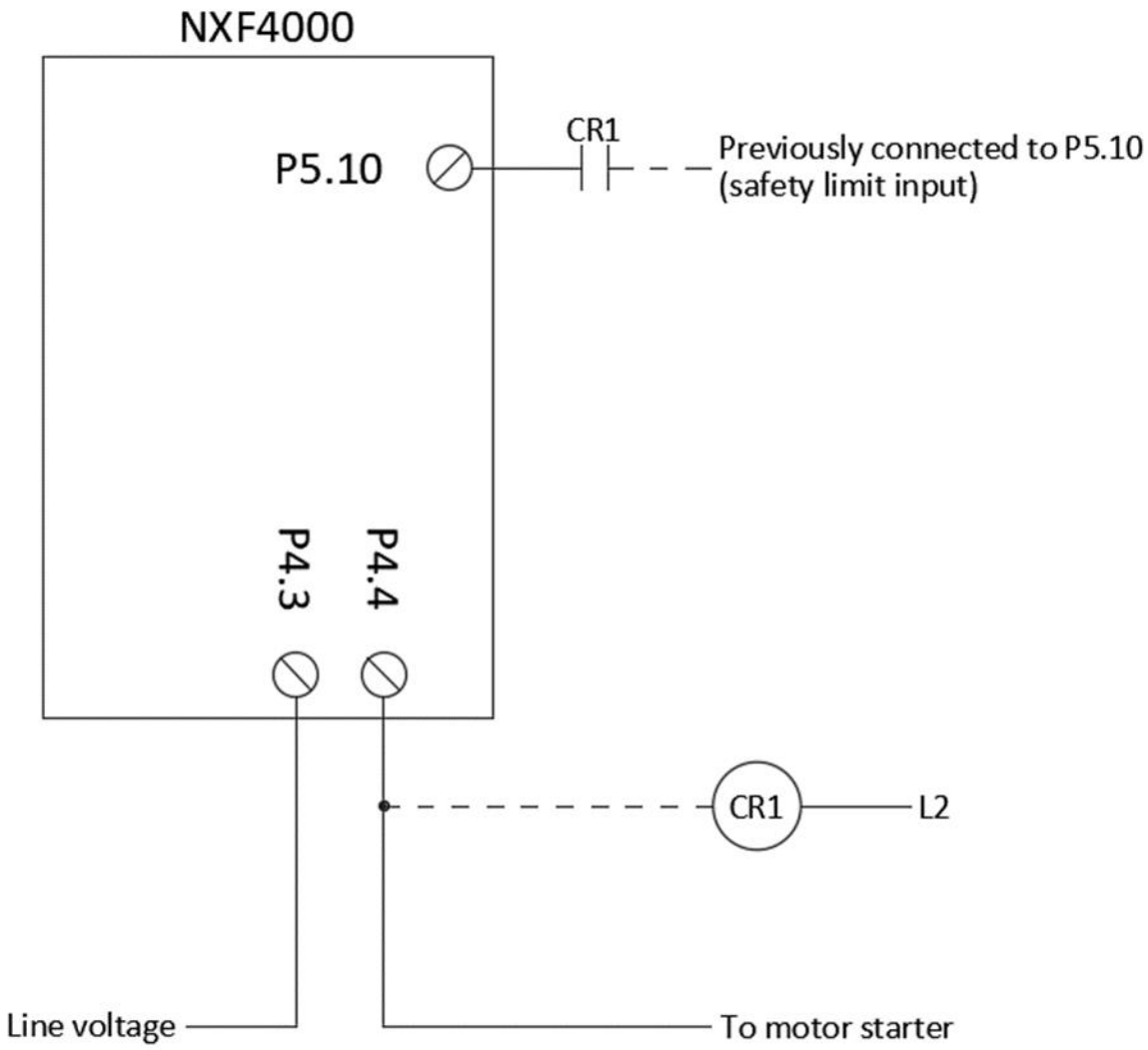
1. PPC4000 closes OCRC relay contact, sending voltage to FSG call for heat input (terminal 3 on a BurnerLogix).
2. FSG starts blower to begin cycle (terminal M on a BurnerLogix).
3. Voltage from blower output goes through profile select switch to and voltage is sent to one of the profile select inputs on the PPC4000 to initiate the PPC4000 to move the servos based on signals from the FSG.
4. FSG sends voltage signals to the PPC4000 to drive to purge, drive to ignition or release to automatic control and the PPC4000 sends feedback to the FSG when required to indicate that the commanded positions were reached. This is identical to how a linear actuator would interface with the FSG.

Nuisance e101 Lockouts with NXF4000

e101 lockouts can occur when extraneous voltage is measured on terminal P5.10 on the NXF4000. This terminal is the input for the safety limit string. Even low voltages in the range of 2V-5V can trigger these nuisance lockouts. If the source of the voltage can't be determined and removed (possibly by rearranging the order of the safety limit string), a relay can be used to break this signal whenever there is not a call for heat.

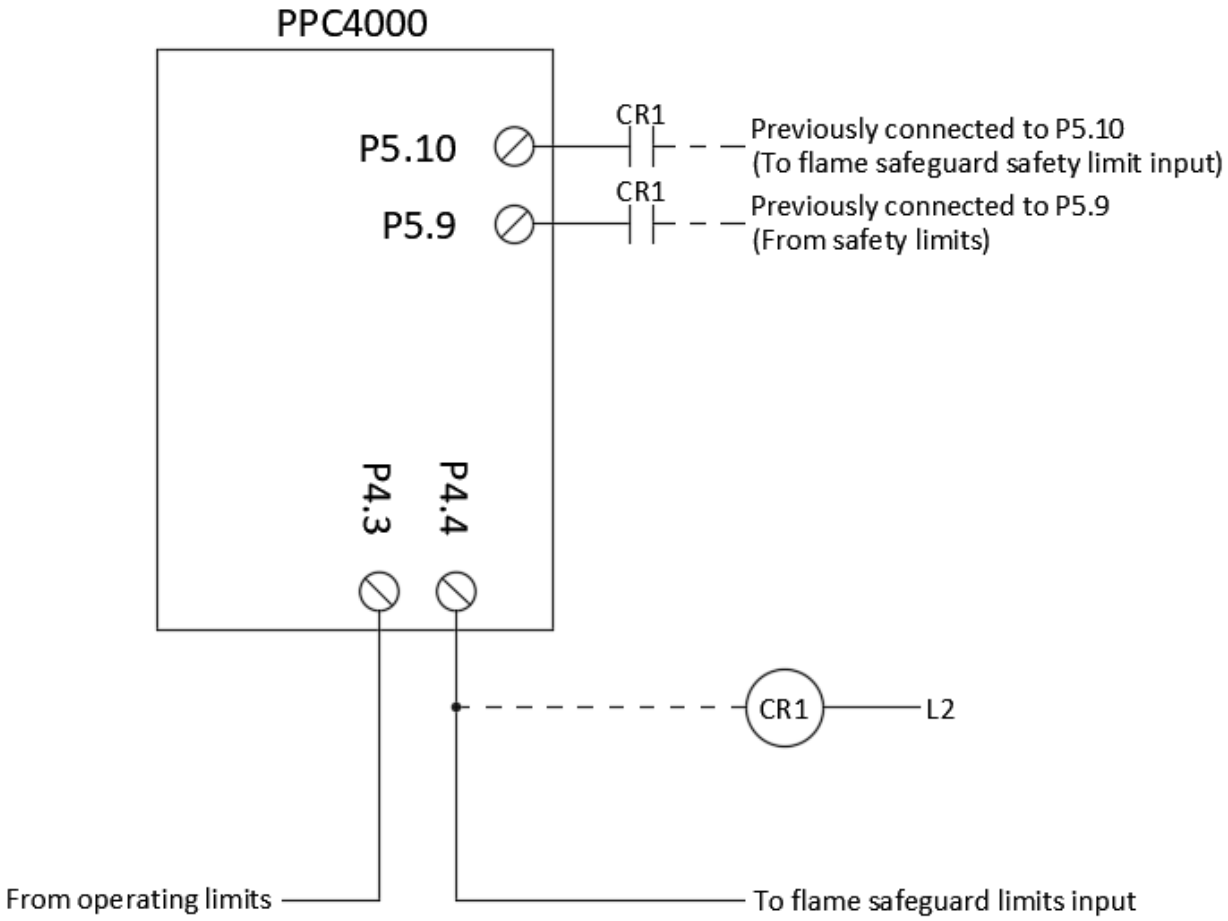
If connecting the coil of the relay to P4.4 does not resolve the issue, connect the relay coil instead to P5.1 and program the following parameters:

`USER OUTPUT SETUP → USER OUTPUT 1 → USE = ON OFF STATE`
`USER OUTPUT SETUP → USER OUTPUT 1 → ASSIGNMENT = 4,3,2,1`
`USER OUTPUT SETUP → USER OUTPUT 1 → ON STATE = WAIT FOR PROFILE`
`USER OUTPUT SETUP → USER OUTPUT 1 → OFF STATE = POST PURGE`



Nuisance e101 Lockouts with PPC4000

e101 lockouts can occur when extraneous voltage is measured on terminals P5.9 and/or P5.10 on the PPC4000. These terminals are the contacts for the safety limit (running interlock) to the flame safeguard. This allows the FSG to lockout when the PPC4000 is in lockout. Even low voltages in the range of 2V-5V can trigger these nuisance lockouts. If the source of the voltage can't be determined and removed (possibly by rearranging the order of the safety limit string), a relay can be used to break these signals whenever there is not a call for heat.



LOCKOUT CODES

Code	Display	Description	Action
e1	NXF4000 FAULT PPC4000 FAULT	ARM CPU self-test	Reset control and replace NXF4000 or PPC4000 if lockout continues to occur
e2		ARM CPU code CRC	
e3	Z BOARD FAULT	NXF4000 or PPC4000 cannot communicate with the Z board (internal daughter board)	
e4	SAFETY RELAY ON	Internal relay is on when it should be off	Check wiring then reset control and replace NXF4000 or PPC4000 if lockout continues to occur
e5	SAFETY RELAY OFF	Internal relay is off when it should be on	
e6	RELAY 8 ON	Internal relay is on when it should be off, check for back fed voltage	
e7	RELAY 8 OFF	Internal relay is off when it should be on	
e8	RELAY D ON	Internal relay is on when it should be off, check for back fed voltage	
e9	RELAY D OFF	Internal relay is off when it should be on	
e10	NXF4000 FAULT PPC4000 FAULT	Unused	n/a
e11	INVALID PROFILE	The user is supplying line voltage to more than one of the following: P15.5, P15.6, P15.7, P15.8 (multiple profiles selected simultaneously)	Check wiring
e12	HIGH TEMPERATURE	Internal temperature is above 80ºC	Check cooling 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, P15.3, P15.4 (multiple position commands)	Check wiring
e14		User has not connected one or more of the following terminals: P15.2, P15.3, P15.4 (no position command)	
e15	NO AIR SERVO	The user has no servo named AIR in the current profile	Name one servo in current profile AIR
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	NXF4000 FAULT PPC4000 FAULT	Unused	n/a
e19	SENSOR 1 MARGINAL	SENSOR 1 has reached user defined marginal setting	Alarm based on user setpoint
e20	SENSOR 1 MARGINAL	SENSOR 1 has reached user defined marginal setting	
e21	SENSOR 2 MARGINAL	SENSOR 2 has reached user defined marginal setting	
e22	SENSOR 2 MARGINAL	SENSOR 2 has reached user defined marginal setting	
e23	SENSOR 2 MARGINAL	SENSOR 2 has reached user defined marginal setting	
e24	SENSOR 3 MARGINAL	SENSOR 3 has reached user defined marginal setting	
e25	SENSOR 3 MARGINAL	SENSOR 3 has reached user defined marginal setting	
e26	SENSOR 3 MARGINAL	SENSOR 3 has reached user defined marginal setting	
e27	SENSOR1 HIGH LIMIT	SENSOR 1 has reached user defined limit setting	Lockout based on user setpoint or inoperative sensor
e28	SENSOR1 HIGH LIMIT	SENSOR 1 has reached user defined limit setting	
e29	SENSOR2 HIGH LIMIT	SENSOR 2 has reached user defined limit setting	

Code	Display	Description	Action
e30	SENSOR2 HIGH LIMIT	SENSOR 2 has reached user defined limit setting	Lockout based on user setpoint or inoperative sensor
e31	SENSOR2 HIGH LIMIT	SENSOR 2 has reached user defined limit setting	
e32	SENSOR3 HIGH LIMIT	SENSOR 3 has reached user defined limit setting	
e33	SENSOR3 HIGH LIMIT	SENSOR 3 has reached user defined limit setting	
e34	SENSOR3 HIGH LIMIT	SENSOR 3 has reached user defined limit setting	
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	
e37	SENSOR2 UNDER RNG	SENSOR 2 input is under 2mA	
e38	SENSOR2 OVER RNG	SENSOR 2 input is over 22mA	
e39	SENSOR3 UNDER RNG	SENSOR 3 input is under 2mA	
e40	SENSOR3 OVER RNG	SENSOR 3 input is over 22mA	
e41	Z BOARD	Z board (internal daughter board) internal error	Reset control and replace NXF4000 or PPC4000 if lockout continues to occur
e42			
e43	NXF4000 FAULT PPC4000 FAULT	NXF4000 or PPC4000 internal error	
e44	O2 FAULT	Internal communications error	Replace O_2 probe
e45			
e46			
e47		O_2 is not communicating with the NXF4000 or PPC4000	Check wiring, swap Modbus polarity, add termination resistor (200 ohm)
e48		O_2 probe is reporting that the O_2 level is below the user configured minimum	This could be normal operation
e49		O_2 probe is reporting that the O_2 level is above the user configured minimum	
e50		O_2 probe is reporting that the stack temperature is below configured minimum	
e51		O_2 probe is reporting that the stack temperature is above the user configured maximum	
e52		Undefined O_2 probe fault	Replace O_2 probe
e53			
e54		O_2 thermocouple is disconnected or defective	Check thermocouple for breakage or replace if necessary
e55		O_2 stack temperature is above the user configurable temperature or thermocouple is defective	Temperature probe has exceeded its maximum range of 482ºC (900ºF)
e56		O_2 stack temperature is below 0ºC or thermocouple is defective (read error)	Check thermocouple for breakage or replace if necessary
e57		O_2 ambient temperature sensor read error	Replace O_2 probe
e58		O_2 probe temperature is above 85ºC	Temperature in probe has exceeded 85ºC (185ºF), check or replace cooling fan
e59		O_2 probe temperature is below -25ºC	Temperature in probe is below -25ºC (-13ºF)
e60		O_2 probe CPU CRC error	Replace O_2 probe
e61		O_2 probe CPU RAM error	
e62		O_2 probe CPU self-test error	
e63		The 24V supply to the O_2 probe is undervoltage	Check wiring, measure supply voltage at the probe (should be 18VDC-30VDC)

Code	Display	Description	Action
e64	O2 FAULT	The 24V supply to the O_2 probe is overvoltage	Check wiring, measure supply voltage at the probe (should be 18VDC-30VDC)
e65		O_2 probe 12V supply open	Replace O_2 probe
e66		O_2 probe 12V supply low	
e67		O_2 probe 12V supply high	
e68		O_2 probe unexpected calibration fault	Replace O_2 probe cartridge
e69		O_2 probe stuck	
e70		O_2 probe calibration needed	Run calibration from O2 SETUP menu
e71		O_2 probe heater shorted	Replace O_2 probe cartridge
e72		O_2 probe heater open	
e73		O_2 probe pump short	
e74		O_2 probe pump open	
e75		O_2 probe Nernst cell short	
e76		O_2 probe Nernst cell open	
e77		O_2 probe conversion timeout	
e78		O_2 probe low voltage	
e79		O_2 probe too cold	
e80		O_2 probe too hot	
e81		O_2 probe air calibration	Calibration in progress
e82		O_2 probe heater calibration	
e83		O_2 probe comm busy	Replace O_2 probe
e84		O_2 probe comm fault	
e85		O_2 probe sensor warming up	Normal operation after powering up
e86		O_2 probe sensor in standby	O_2 probe forced to standby during inactivity
e87	NXF4000 FAULT PPC4000 FAULT	Unused	n/a
e88		NXF4000 or PPC4000 internal error	Reset control and replace NXF4000 or PPC4000 if lockout continues to occur
e89	NOT COMMISSIONED	User has less than 3 points in the current profile	Recommission current profile
e90	NXF4000 FAULT PPC4000 FAULT	FRAM chip may be bad	Reset control and replace NXF4000 or PPC4000 if lockout continues to occur
e91		Helper CPU may not be programmed	
e92		Unused	n/a
e93		The main and helper CPUs are not communicating or clock error	Reset control and replace NXF4000 or PPC4000 if lockout continues to occur
e94		Helper CPU internal error 1	
e95		Helper CPU internal error 2	
e96		Helper CPU internal error 3	
e97		Helper CPU internal error 4	
e98		The main and helper CPUs are not communicating	
e99	NXF4000 FAULT PPC4000 FAULT	Helper CPU ROM CRC is not correct	Reset control and replace NXF4000 or PPC4000 if lockout continues to occur

Code	Display	Description	Action
e100	NXF4000 FAULT PPC4000 FAULT	Helper CPU optocoupler input pin stuck-at-fault	Reset control and replace NXF4000 or PPC4000 if lockout continues to occur
e101		Helper CPU optocoupler input pin to pin short	
e102		Helper CPU is not running	
e103		Unused	n/a
e104...e121		NXF4000 or PPC4000 internal error	Reset control and replace NXF4000 or PPC4000 if lockout continues to occur
e122	SERVO 1 LOST	Communications to the servo has stopped	Check servo address selection, check wiring, add 200-ohm resistor, replace servo
e123	SERVO 2 LOST		
e124	SERVO 3 LOST		
e125	SERVO 4 LOST		
e126	SERVO 5 LOST		
e127	SERVO 6 LOST		
e128	SERVO 7 LOST		
e129	SERVO 8 LOST		
e130	SERVO 9 LOST		
e131	SERVO 10 LOST		
e132...e141	NXF4000 FAULT PPC4000 FAULT	Unused	n/a
e142	SERVO 1 STUCK	Expected shaft movement does not equal measured shaft movement	Excessive torque, servo hitting hard stop, defective servo
e143	SERVO 2 STUCK		
e144	SERVO 3 STUCK		
e145	SERVO 4 STUCK		
e146	SERVO 5 STUCK		
e147	SERVO 6 STUCK		
e148	SERVO 7 STUCK		
e149	SERVO 8 STUCK		
e150	SERVO 9 STUCK		
e151	SERVO 10 STUCK		
e152...e161	NXF4000 FAULT PPC4000 FAULT	Unused	n/a
e162	SERVO 1 ERROR	Servo has detected an internal fault	Replace servo
e163	SERVO 2 ERROR		
e164	SERVO 3 ERROR		
e165	SERVO 4 ERROR		
e166	SERVO 5 ERROR		
e167	SERVO 6 ERROR		
e168	SERVO 7 ERROR		
e169	SERVO 8 ERROR		
e170	SERVO 9 ERROR		
e171	SERVO 10 ERROR	Servo has detected an internal fault	Replace servo

Code	Display	Description	Action
e172...e181	NXF4000 FAULT PPC4000 FAULT	Unused	n/a
e182	SERVO 1 VOLTAGE	Voltage supply to servo is above 33V	Excessive voltage to servo or defective servo
e183	SERVO 2 VOLTAGE		
e184	SERVO 3 VOLTAGE		
e185	SERVO 4 VOLTAGE		
e186	SERVO 5 VOLTAGE		
e187	SERVO 6 VOLTAGE		
e188	SERVO 7 VOLTAGE		
e189	SERVO 8 VOLTAGE		
e190	SERVO 9 VOLTAGE		
e191	SERVO 10 VOLTAGE		
e192...e201	NXF4000 FAULT PPC4000 FAULT	Unused	n/a
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		
e204	SERVO 3 VOLTAGE		
e205	SERVO 4 VOLTAGE		
e206	SERVO 5 VOLTAGE		
e207	SERVO 6 VOLTAGE		
e208	SERVO 7 VOLTAGE		
e209	SERVO 8 VOLTAGE		
e210	SERVO 9 VOLTAGE		
e211	SERVO 10 VOLTAGE		
e212...e221	NXF4000 FAULT PPC4000 FAULT	Unused	n/a
e222	SERVO 1 OFF RATIO	Servo may have exceeded its torque capacity	Excessive torque, servo hitting hard stop, defective servo
e223	SERVO 2 OFF RATIO		
e224	SERVO 3 OFF RATIO		
e225	SERVO 4 OFF RATIO		
e226	SERVO 5 OFF RATIO		
e227	SERVO 6 OFF RATIO		
e228	SERVO 7 OFF RATIO		
e229	SERVO 8 OFF RATIO		
e230	SERVO 9 OFF RATIO		
e231	SERVO 10 OFF RATIO		
e232...e241	NXF4000 FAULT PPC4000 FAULT	Unused	n/a
e242		NXF4000 or PPC4000 internal 24V supply overvoltage	Reset control and replace NXF4000 or PPC4000 if lockout continues to occur
e243		NXF4000 or PPC4000 internal 24V supply undervoltage	

Code	Display	Description	Action
e244	NXF4000 FAULT PPC4000 FAULT	NXF4000 or PPC4000 internal 5V supply overvoltage	Reset control and replace NXF4000 or PPC4000 if lockout continues to occur
e245		NXF4000 or PPC4000 internal 5V supply undervoltage	
e246		Main processor failure	
e247			
e248			
e249		External watchdog timer malfunction	
e250		NXF4000 or PPC4000 internal error	
e251	SENSOR4 UNDER RNG	Sensor 4 is under 2mA	Defective sensor or check wiring
e252	SENSOR4 OVER RNG	Sensor 4 is over 22mA	
e253	SENSOR5 UNDER RNG	Sensor 5 is under 2mA	
e254	SENSOR5 OVER RNG	Sensor 5 is over 22mA	
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 1 is moving too slow to meet timeout	Check VFD for proper setup (ramp times)
e257	VFD2 OFF RATIO	VFD input 2 is moving too slow to meet timeout	
e258	VFD COMM FAULT 1	VFD board is missing or CPU is not programmed	Replace VFD board
e259	VFD COMM FAULT 2	VFD board communication problem	
e260	VFD1 MISSING	VFD was commissioned to current profile but is not available	Replace VFD board or remove VFD from profile
e261	VFD2 MISSING	VFD was commissioned to current profile but is not available	
e262	NXF4000 FAULT PPC4000 FAULT	Unused	n/a
e263			
e264			
e265			
e266	VFD BOARD FAULT	VFD board CPU error	Replace VFD board
e267			
e268			
e269			
e270			
e271			
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			
e275			
e276		VFD board has not been calibrated	
e277		VFD board CPU error	
e278	VFD2 INPUT BELOW 4mA	VFD 2 input is less than 2 mA	Defective input or check wiring

Code	Display	Description	Action
e279	VFD BOARD FAULT	VFD board CPU error	Replace VFD board, if problem persists reset control and replace NXF4000 or PPC4000 if lockout continues to occur or PPC4000
e280		VFD board communication problem	
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	
e283	P0 NOT COMMISSIONED	p00 not commissioned	Commission the p00 servo positions
e284	MAIN CPU FAULT 1	NXF4000 or PPC4000 main CPU timing error	Reset control and replace NXF4000 or PPC4000 if lockout continues to occur
e285	MAIN CPU FAULT 2		
e286	MAIN CPU FAULT 3		
e287	MAIN CPU FAULT 4		
e288	MAIN CPU FAULT 5		
e289	MAIN CPU FAULT 6		
e290	MAIN CPU FAULT 7		
e291	LESS THAN 2 SERVOS	Less than two servos have been assigned to the current profile	Assign at least two servos to the profiles being used
e292	UNIT TEMP SENSORS	The two internal temperature sensors disagree by more than 6ºC	Reset control and replace NXF4000 or PPC4000 if lockout continues to occur
e293	NOT COMMISSIONED	Profile was erased when profile name was changed	Recommission profile or restore from backup
e294...e318	NXF4000 FAULT PPC4000 FAULT	Unused	n/a
e319	NO SENSOR-SETPT DATA	Stored “sensor data” is corrupted	Pressing RESET will restore factory default values, replace NXF4000 or PPC4000 if lockout continues to occur
e320	NO SERVO SETUP DATA	Stored “servo data” is corrupted	
e321	NO DIG I/P DATA	Stored “di data” is corrupted	
e322	NO PASSCODE DATA	Stored “passcode data” is corrupted	
e323	NO P0 DATA	Stored “p0 data” is corrupted	
e324	NO PROFILE1 DATA	Stored “profile 1 data” is corrupted	
e325	NO PROFILE2 DATA	Stored “profile 2 data” is corrupted	
e326	NO PROFILE3 DATA	Stored “profile 3 data” is corrupted	
e327	NO PROFILE4 DATA	Stored “profile 4 data” is corrupted	
e328	NO PROFL SETUP DATA	Stored “profile setup data” is corrupted	
e329	NO KEYPAD SETUP DATA	Stored “keypad setup data” is corrupted	
e330	NO KEY STATES DATA	Stored “key states data” is corrupted	
e331	NO THERML SHOCK DATA	Stored “thermal shock data” is corrupted	
e332	NO FAULT HISTRY DATA	Stored “fault history data” is corrupted	
e333	NO SETBACK DATA	Stored “setback data” is corrupted	
e334	NO COMM SETUP DATA	Stored “communication data” is corrupted	
e335	NO SEQUENCING DATA	Stored “sequencing data” is corrupted	
e336	NO O2 SETUP DATA	Stored “o2 setup data” is corrupted	
e337	NO ADJUSTED O2 DATA	Stored “adjusted o2 data” is corrupted	
e338	NO ANALOG OUT DATA	Stored “analog out data” is corrupted	

Code	Display	Description	Action
e339	NO VFD SETUP DATA	Stored “vfd setup data” is corrupted	Pressing RESET will restore factory default values, replace NXF4000 or PPC4000 if lockout continues to occur
e340	NO VFD PROFILE1 DATA	Stored “vfd profile 1 data” is corrupted	Pressing RESET will restore factory default values, replace NXF4000 or PPC4000 if lockout continues to occur
e341	NO VFD PROFILE2 DATA	Stored “vfd profile 2 data” is corrupted	
e342	NO VFD PROFILE3 DATA	Stored “vfd profile 3 data” is corrupted	
e343	NO VFD PROFILE4 DATA	Stored “vfd profile 4 data” is corrupted	
e344	NO BURNER DATA	“Burner Info data” is corrupted (FSG only)	
e345	NO FSG SETUP DATA	“FSG Setup data” is corrupted (FSG only)	
e346	NO FSG DI DATA	“FSG DI data” is corrupted (FSG only)	
e347	NO VALVE PROV DATA	“Valve Proving data” is corrupted (FSG only)	
e348	NO USER OUTPUT DATA	“User Output data” is corrupted (FSG only)	
e349	NO CO SETUP DATA	“co setup data” is corrupted (Future use)	
e350...e368	NXF4000 FAULT PPC4000 FAULT	Unused	n/a
e369		“sensor data” is corrupted	Pressing RESET will restore values from stored memory, replace NXF4000 or PPC4000 if lockout continues to occur
e370		“servo data” is corrupted	
e371		“di data” is corrupted	
e372		“passcode data” is corrupted	
e373		“p0 data” is corrupted	
e374		“profile 1 data” is corrupted	
e375		“profile 2 data” is corrupted	
e376		“profile 3 data” is corrupted	
e377		“profile 4 data” is corrupted	
e378		“profile setup data” is corrupted	
e379		“keypad setup data” is corrupted	
e380		“key states data” is corrupted	
e381		“thermal shock data” is corrupted	
e382		“fault history data” is corrupted	
e383		“setback data” is corrupted	
e384		“communication data” is corrupted	
e385		“sequencing data” is corrupted	
e386		“o2 setup data” is corrupted	
e387		“adjusted o2 data” is corrupted	
e388		“analog out data” is corrupted	
e389		“vfd setup data” is corrupted	
e390		“vfd profile 1 data” is corrupted	
e391		“vfd profile 2 data” is corrupted	
e392		“vfd profile 3 data” is corrupted	
e393		“vfd profile 4 data” is corrupted	

Code	Display	Description	Action
e394	NXF4000 FAULT PPC4000 FAULT	"Burner Info data" is corrupted	Pressing RESET will restore values from stored memory, replace NXF4000 or PPC4000 if lockout continues to occur
e395		"FSG Setup data" is corrupted	
e396		"FSG DI data" is corrupted	
e397		"Valve Proving data" is corrupted	
e398		"User Output data" is corrupted	
e399		"CO Setup data" is corrupted (Future use)	
e400...e418		Unused	n/a
e419	CANNOT MOVE TO PURGE	Cannot move to PURGE (P1) in allotted time	Check SERVO SPEED parameter or change programmed position
e420	NXF4000 FAULT PPC4000 FAULT	Manual move button pressed on servo 1	Inspect servo for physical button obstruction under the cover
e421		Manual move button pressed on servo 2	
e422		Manual move button pressed on servo 3	
e423		Manual move button pressed on servo 4	
e424		Manual move button pressed on servo 5	
e425		Manual move button pressed on servo 6	
e426		Manual move button pressed on servo 7	
e427		Manual move button pressed on servo 8	
e428		Manual move button pressed on servo 9	
e429		Manual move button pressed on servo 10	
e430	FVES OPEN i01	FVES open on DI 1	Fuel valve end switch (POC) input open when it should be closed
e431	FVES OPEN i02	FVES open on DI 2	
e432	FVES OPEN i03	FVES open on DI 3	
e433	FVES OPEN i04	FVES open on DI 4	
e434	FVES OPEN i05	FVES open on DI 5	
e435	FVES OPEN i06	FVES open on DI 6	
e436	FVES OPEN i07	FVES open on DI 7	
e437	FVES OPEN i08	FVES open on DI 8	
e438	FVES OPEN i09	FVES open on DI 9	
e439	FVES OPEN i10	FVES open on DI 10	
e440	FVES OPEN i11	FVES open on DI 11	
e441	FVES OPEN i12	FVES open on DI 12	
e442	FVES OPEN i13	FVES open on DI 13	
e443	FVES OPEN i14	FVES open on DI 14	
e444	FVES OPEN i15	FVES open on DI 15	
e445	UNUSED	Unused	n/a
e446	FVES CLOSED i01	FVES closed on DI 1	Fuel valve end switch (POC) input closed when it should be open
e447	FVES CLOSED i02	FVES closed on DI 2	
e448	FVES CLOSED i03	FVES closed on DI 3	

Code	Display	Description	Action
e449	FVES CLOSED i04	FVES closed on DI 4	Fuel valve end switch (POC) input closed when it should be open
e450	FVES CLOSED i05	FVES closed on DI 5	
e451	FVES CLOSED i06	FVES closed on DI 6	Fuel valve end switch (POC) input closed when it should be open
e452	FVES CLOSED i07	FVES closed on DI 7	
e453	FVES CLOSED i08	FVES closed on DI 8	
e454	FVES CLOSED i09	FVES closed on DI 9	
e455	FVES CLOSED i10	FVES closed on DI 10	
e456	FVES CLOSED i11	FVES closed on DI 11	
e457	FVES CLOSED i12	FVES closed on DI 12	
e458	FVES CLOSED i13	FVES closed on DI 13	
e459	FVES CLOSED i14	FVES closed on DI 14	
e460	FVES CLOSED i15	FVES closed on DI 15	
e461	UNUSED	Unused	n/a
e462	LOST P INPUT	Non-Recycle input (P5.10) is open	Check wiring, non-recycle limits for trips requiring manual reset
e463	NXF4000 FAULT PPC4000 FAULT	Start of FSG only faults	n/a
e464	PILOT RELAY ON	Internal relay is on when it should be off, check for back fed voltage	Check wiring then reset control and replace NXF4000 or PPC4000 if lockout continues to occur
e465	IGNITE RELAY ON	Internal relay is on when it should be off, check for back fed voltage	
e466	OIL RELAY ON	Internal relay is on when it should be off, check for back fed voltage	
e467	GV1 RELAY ON	Internal relay is on when it should be off, check for back fed voltage	
e468	GV2 RELAY ON	Internal relay is on when it should be off, check for back fed voltage	
e469	GV3 RELAY ON	Internal relay is on when it should be off, check for back fed voltage	
e470	USER RELAY 1 ON	Internal relay is on when it should be off, check for back fed voltage	
e471	USER RELAY 2 ON	Internal relay is on when it should be off, check for back fed voltage	
e472	USER RELAY 3 ON	Internal relay is on when it should be off, check for back fed voltage	
e473	PILOT RELAY OFF	Internal relay is off when it should be on	
e474	IGNITION RELAY OFF	Internal relay is off when it should be on	
e475	OIL RELAY OFF	Internal relay is off when it should be on	
e476	GV1 RELAY OFF	Internal relay is off when it should be on	
e477	GV2 RELAY OFF	Internal relay is off when it should be on	
e478	GV3 RELAY OFF	Internal relay is off when it should be on	
e479	USER RELAY 1 OFF	Internal relay is off when it should be on	
e480	USER RELAY 2 OFF	Internal relay is off when it should be on	
e481	USER RELAY 3 OFF	Internal relay is off when it should be on	
e482	FSG BOARD COMMS	FSG board internal communication not working	Check mounting of FSG board, or replace FSG board
e483	FSG BOARD INCORRECT	FSG board is not compatible	Replace FSG board with compatible model

Code	Display	Description	Action
e484	FSG SELF-CHECK1	FSG board CPU tests not completing on time	Check mounting of FSG board, or replace FSG board
e485	FSG SELF-CHECK2		
e486	FSG SELF-CHECK3	FSG board CPU detected a specific error	See INFO screen to get FSG specific error code, replace FSG board if lockout continues
e487	FSG ROM CRC	FSG CPU fails CRC ROM check	Replace FSG board
e488	FSG 120 OHM RESISTOR	Too many Fault Region hits	Replace external resistor with 120 ohms
e489	UNUSED	Unused	n/a
e490	FALSE FLAME	Flame detected for more than 60 seconds in Standby	Determine cause of false flame, replace scanner if necessary
e491	FLAME FAIL OIL FOG	Flame failure from oil fog algorithm	
e492	FLAME FAIL	Normal flame failure from lack of flame detection	Check if flame is present, test and replace scanner if necessary
e493	FORCED i01	Forced lockout on DI 1	Lockout due to user defined programming of digital input
e494	FORCED i02	Forced lockout on DI 2	
e495	FORCED i03	Forced lockout on DI 3	
e496	FORCED i04	Forced lockout on DI 4	
e497	FORCED i05	Forced lockout on DI 5	
e498	FORCED i06	Forced lockout on DI 6	
e499	FORCED i07	Forced lockout on DI 7	
e500	FORCED i08	Forced lockout on DI 8	
e501	FORCED i09	Forced lockout on DI 9	
e502	FORCED i10	Forced lockout on DI 10	
e503	FORCED i11	Forced lockout on DI 11	
e504	FORCED i12	Forced lockout on DI 12	
e505	FORCED i13	Forced lockout on DI 13	
e506	FORCED i14	Forced lockout on DI 14	
e507	FORCED i15	Forced lockout on DI 15	
e508	UNUSED	Unused	n/a
e509	INVALID SENSOR DATA	Bounds checking error data structure 1	Reset control and replace NXF4000 or PPC4000 if lockout continues to occur
e510	INVALID SERVO DATA	Bounds checking error data structure 2	
e511	INVALID DIG IP DATA	Bounds checking error data structure 3	
e512	INVALID PCODE DATA	Bounds checking error data structure 4	
e513	INVALID P0 DATA	Bounds checking error data structure 5	
e514	INVALID PROF 1 DATA	Bounds checking error data structure 6	
e515	INVALID PROF 2 DATA	Bounds checking error data structure 7	
e516	INVALID PROF 3 DATA	Bounds checking error data structure 8	
e517	INVALID PROF 4 DATA	Bounds checking error data structure 9	
e518	INVALID PROFILE DATA	Bounds checking error data structure 10	
e519	INVALID KEYPAD DATA	Bounds checking error data structure 11	

Code	Display	Description	Action
e520	INVALID KEY ST DATA	Bounds checking error data structure 12	Reset control and replace NXF4000 or PPC4000 if lockout continues to occur
e521	INVALID TH SHK DATA	Bounds checking error data structure 13	
e522	INVALID FAULT DATA	Bounds checking error data structure 14	
e523	INVALID SETBACK DATA	Bounds checking error data structure 15	
e524	INVALID COMM DATA	Bounds checking error data structure 16	
e525	INVALID SEQ DATA	Bounds checking error data structure 17	
e526	INVALID O2 DATA	Bounds checking error data structure 18	
e527	INVALID ADJ O2 DATA	Bounds checking error data structure 19	
e528	INVALID ANALOG DATA	Bounds checking error data structure 20	
e529	INVALID VFD DATA	Bounds checking error data structure 21	
e530	INVALID VPROF 1 DATA	Bounds checking error data structure 22	
e531	INVALID VPROF 2 DATA	Bounds checking error data structure 23	
e532	INVALID VPROF 3 DATA	Bounds checking error data structure 24	
e533	INVALID VPROF 4 DATA	Bounds checking error data structure 25	
e534	INVALID BURNER DATA	Bounds checking error data structure 26	
e535	INVALID FSG DATA	Bounds checking error data structure 27	
e536	INVALID FSG DI DATA	Bounds checking error data structure 28	
e537	INVALID V-PROV DATA	Bounds checking error data structure 29	
e538	INVALID USER OP DATA	Bounds checking error data structure 30	
e539	NXF4000 FAULT PPC4000 FAULT	Bounds checking error data structure 31	
e540		Bounds checking error data structure 32	
e541		Bounds checking error data structure 33	
e542		Bounds checking error data structure 34	
e543		Bounds checking error data structure 35	
e544		Bounds checking error data structure 36	
e545		Bounds checking error data structure 37	
e546		Bounds checking error data structure 38	
e547		Bounds checking error data structure 39	
e548		Bounds checking error data structure 40	
e549		Bounds checking error data structure 41	
e550		Bounds checking error data structure 42	
e551		Bounds checking error data structure 43	
e552		Bounds checking error data structure 44	
e553		Bounds checking error data structure 45	
e554		Bounds checking error data structure 46	
e555		Bounds checking error data structure 47	
e556		Bounds checking error data structure 48	

Code	Display	Description	Action
e557	NXF4000 FAULT PPC4000 FAULT	Bounds checking error data structure 49	Reset control and replace NXF4000 or PPC4000 if lockout continues to occur
e558	VALVE PROVING TEST 2	Failed valve proving test at conclusion of test time 2 (evacuation test)	Check integrity of gas train with manual leak testing before operating appliance
e559	VALVE PROVING TEST 4	Failed valve proving test at conclusion of test time 4 (pressurization test)	
e560	AIRFLOW ON	Airflow is on when it should be off	Airflow switch stuck on during the airflow switch test (should be off), check that VFD has enough time to fully stop before a new cycle
e561	AIRFLOW OFF	Airflow is off when it should be on	Airflow switch is not proving airflow, check fan operation
e562	OBSOLETE SEQ DATA	Sequencing data was copied from an older revision control	Reconfigure sequencing data
e563	RUN CHECK TIMEOUT	User left unit in CHECK mode over two hours	Reset control to resume normal operation
e564	SERVO 1 NOT CW	Servo violates commissioning rules	Run commissioning process again
e565	SERVO 2 NOT CW		
e566	SERVO 3 NOT CW		
e567	SERVO 4 NOT CW		
e568	SERVO 5 NOT CW		
e569	SERVO 6 NOT CW		
e570	SERVO 7 NOT CW		
e571	SERVO 8 NOT CW		
e572	SERVO 9 NOT CW		
e573	SERVO 10 NOT CW		
e574	SERVO 1 NOT CCW		
e575	SERVO 2 NOT CCW		
e576	SERVO 3 NOT CCW		
e577	SERVO 4 NOT CCW		
e578	SERVO 5 NOT CCW		
e579	SERVO 6 NOT CCW		
e580	SERVO 7 NOT CCW		
e581	SERVO 8 NOT CCW		
e582	SERVO 9 NOT CCW		
e583	SERVO 10 NOT CCW		

Section 8: Modbus

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DESCRIPTION

A Modbus RTU data server is available using RS-485. See *WIRING* section for additional detail on how to connect to building automation, a PLC or a SCADA system.

The baud rate and node address are adjustable from the COMMUNICATION SETUP menu. Note that the node address is shared with the peer-to-peer sequencing Modbus network, so they will both be the same as the UNIT ADDRESS parameter. See *PARAMETERS* section for additional details on each parameter.

The NXTSD507HD and NXTSD512HD both connect to the user Modbus port for communication. When using one of these touchscreens, a Modbus TCP/IP server is made available for connection to building automation, a PLC or a SCADA system. See Fireye bulletin *TSD-4001* for additional details and mapping.

The Modbus server uses function code 3 for all reads and function code 6 for all writes. **The address format shown begins with address 0 – this corresponds to 40001 using 4x-style addressing.**

Gain describes how much to multiply the data. A gain of x1 means no manipulation is possible while a gain of x10 means that the Modbus representation of the data will be x10 (i.e. 900 indicates 90.0). The format shows the data type:

- S16/U16 – signed or unsigned 16-bit integer (signed if value could be negative)
- U16 bits – the bits of the 16-bit unsigned integer represent binary data
- U32 – unsigned 32-bit integer, spans two words (for values that may exceed 65535)
- Float – IEEE 754 single-precision float, spans two words
- String – Two ASCII characters per word, total number of characters shown
- S8/U8 – signed or unsigned 8-bit byte (signed if value could be negative)

If the value is a byte type (S8/U8) then additional information will be provided as to whether the data is in the upper (bits 8-15) or lower (bits 0-7) byte of the Modbus address. There are several addresses that pack two bytes of related data into a single Modbus address (i.e. sensor type and sensor range).

The last column indicates whether the point is read-only (R) or read/write (RW). Note that the writable points with "keypad" in the description will write to the keypad button or percent (manual modulation) with the same function. This means that if a keypad button is commanded via Modbus, it can be toggled back manually on the keypad. If the Modbus write is continuous, changing the command on the keypad will be quickly overridden. Button commands are also retentive through a power cycle.

If a Modbus data point is only available with a certain firmware release, this will be noted in bold with the required firmware indicated.

MAPPING

Address	Description	Gain	Format	Type
0	current operational state (see *ENUMERATIONS*)	x1	S16/U16	R
1	flame signal value (NXF4000 only)	x1	S16/U16	R
2	operational hour counter	x1	U32	R
4	burner running hours counter	x1	U32	R
6	burner cycle counter	x1	U32	R
8	current modulation rate	x1	S16/U16	R
9	current modulation reason mode (see *ENUMERATIONS*)	x1	S16/U16	R
10	current internal temperature Celsius	x10	S16/U16	R
11	current profile commission point	x1	S16/U16	R
12	current calculated CO2 value	x1	S16/U16	R
13	controller type *0 = PPC4000, 1 = NXF4000*	x1	S16/U16	R
14	current profile	x1	S8/U8 lower byte	R
14	burner control *bit 8 = low fire, bit 9 = high fire, bit 10 = auto*	x1	S8/U8 upper byte	R
15	total number of commissioned points in current profile	x1	S16/U16	R
16	current profile commissioned points range	x1	S16/U16	R
17	current digital input values (see *ENUMERATIONS*)	x1	U16 bits	R
21	current VFD 1 position	x1	S16/U16	R
22	commanded VFD 1 position	x1	S16/U16	R
23	current VFD 2 position	x1	S16/U16	R
24	commanded VFD 2 position	x1	S16/U16	R
25	current running efficiency	x10	S16/U16	R
26	O_2 trim process control variable value	x10	S16/U16	R
29	current running combustion efficiency	x10	S16/U16	R
35	O_2 probe status *(see bulletin NXCESO2-1001)*	x1	S16/U16	R
36	O_2 probe stack temperature (ºC)	x4	S16/U16	R
37	O_2 probe ambient temperature (ºC)	x16	S16/U16	R
38	O_2 probe O_2 level	x100	S16/U16	R
51	ADC calibration constant for sensor 1/2/3 calculations	x1	S16/U16	R

Address	Description	Gain	Format	Type
56	Z processor firmware major revision (hex)	x1	S16/U16	R
57	Z processor firmware minor revision (hex)	x1	S8/U8 lower byte	R
57	hold off reason (see *ENUMERATIONS*)	x1	S8/U8 upper byte	R
59	raw A2D measurement of sensor 1 *((((this value ÷ register 51) – 0.2) ÷ 0.8) x sensor range) + sensor minimum*	x1	S16/U16	R
60	raw A2D measurement of sensor 2 *((((this value ÷ register 51) – 0.2) ÷ 0.8) x sensor range) + sensor minimum*	x1	S16/U16	R
61	raw A2D measurement of sensor 3 *((((this value ÷ register 51) – 0.2) ÷ 0.8) x sensor range) + sensor minimum*	x1	S16/U16	R
65	raw A2D measurement of sensor 4 *(((((this value - 77) ÷ 336) – 0.2) ÷ 0.8) x sensor range) + sensor minimum*	x1	S16/U16	R
66	raw A2D measurement of sensor 5 *(((((this value - 77) ÷ 336) – 0.2) ÷ 0.8) x sensor range) + sensor minimum*	x1	S16/U16	R
75	servo 1 command	x1	S8/U8 lower byte	R
75	servo 1 data length	x1	S8/U8 upper byte	R
76	servo 1 speed	x1	S16/U16	R
77	servo 1 position	x1	S16/U16	R
79	servo 1 current position	x1	S16/U16	R
84	servo 2 command	x1	S8/U8 lower byte	R
84	servo 2 data length	x1	S8/U8 upper byte	R
85	servo 2 speed	x1	S16/U16	R
86	servo 2 position	x1	S16/U16	R
87	servo 2 commanded position	x1	S16/U16	R
88	servo 2 current position	x1	S16/U16	R
93	servo 3 command	x1	S8/U8 lower byte	R
93	servo 3 data length	x1	S8/U8 upper byte	R
94	servo 3 speed	x1	S16/U16	R
95	servo 3 position	x1	S16/U16	R
96	servo 3 commanded position	x1	S16/U16	R
97	servo 3 current position	x1	S16/U16	R
102	servo 4 command	x1	S8/U8 lower byte	R
102	servo 4 data length	x1	S8/U8 upper byte	R
103	servo 4 speed	x1	S16/U16	R

Address	Description	Gain	Format	Type
104	servo 4 position	x1	S16/U16	R
105	servo 4 commanded position	x1	S16/U16	R
106	servo 4 current position	x1	S16/U16	R
111	servo 5 command	x1	S8/U8 lower byte	R
111	servo 5 data length	x1	S8/U8 upper byte	R
112	servo 5 speed	x1	S16/U16	R
113	servo 5 position	x1	S16/U16	R
114	servo 5 commanded position	x1	S16/U16	R
115	servo 5 current position	x1	S16/U16	R
120	servo 6 command	x1	S8/U8 lower byte	R
120	servo 6 data length	x1	S8/U8 upper byte	R
121	servo 6 speed	x1	S16/U16	R
122	servo 6 position	x1	S16/U16	R
123	servo 6 commanded position	x1	S16/U16	R
124	servo 6 current position	x1	S16/U16	R
129	servo 7 command	x1	S8/U8 lower byte	R
129	servo 7 data length	x1	S8/U8 upper byte	R
130	servo 7 speed	x1	S16/U16	R
131	servo 7 position	x1	S16/U16	R
132	servo 7 commanded position	x1	S16/U16	R
133	servo 7 current position	x1	S16/U16	R
138	servo 8 command	x1	S8/U8 lower byte	R
138	servo 8 data length	x1	S8/U8 upper byte	R
139	servo 8 speed	x1	S16/U16	R
140	servo 8 position	x1	S16/U16	R
141	servo 8 commanded position	x1	S16/U16	R
142	servo 8 current position	x1	S16/U16	R
147	servo 9 command	x1	S8/U8 lower byte	R
147	servo 9 data length	x1	S8/U8 upper byte	R
148	servo 9 speed	x1	S16/U16	R

Address	Description	Gain	Format	Type
149	servo 9 position	x1	S16/U16	R
150	servo 9 commanded position	x1	S16/U16	R
151	servo 9 current position	x1	S16/U16	R
156	servo 10 command	x1	S8/U8 lower byte	R
156	servo 10 data length	x1	S8/U8 upper byte	R
157	servo 10 speed	x1	S16/U16	R
158	servo 10 position	x1	S16/U16	R
159	servo 10 commanded position	x1	S16/U16	R
160	servo 10 current position	x1	S16/U16	R
167	current digital output values (see *ENUMERATIONS*) **firmware 4.4+**	x1	U16 bits	R
170	FSG board type (see *ENUMERATIONS*) (NXF4000 only)	x1	S16/U16	R
172	profile 1 minimum modulation	x1	S16/U16	R
172	profile 2 minimum modulation	x1	S16/U16	R
173	profile 3 minimum modulation	x1	S16/U16	R
173	profile 4 minimum modulation	x1	S16/U16	R
180	controller revision string	x1	String (8)	R
184	helper CPU major revision number (hex)	x1	S16/U16	R
185	helper CPU minor revision number (hex)	x1	S16/U16	R
186	VFD CPU minor revision number (hex)	x1	S8/U8 lower byte	R
186	VFD CPU major revision number (hex)	x1	S8/U8 upper byte	R
187	FSG CPU minor revision number (hex)	x1	S8/U8 lower byte	R
187	FSG CPU major revision number (hex)	x1	S8/U8 upper byte	R
191	current active error number	x1	S16/U16	R
192	total number of errors detected	x1	S16/U16	R
193	lockout history 1 operation state (see *ENUMERATIONS*)	x1	S8/U8 lower byte	R
193	lockout history 1 profile position	x1	S8/U8 upper byte	R
194	lockout history 1 error code (see *ENUMERATIONS*)	x1	S16/U16	R
195	lockout history 1 sec	x1	S8/U8 lower byte	R
195	lockout history 1 min	x1	S8/U8 upper byte	R
196	lockout history 1 hour	x1	S8/U8 lower byte	R

Address	Description	Gain	Format	Type
196	lockout history 1 date	x1	S8/U8 upper byte	R
197	lockout history 1 month	x1	S8/U8 lower byte	R
197	lockout history 1 day	x1	S8/U8 upper byte	R
198	lockout history 1 year	x1	S16/U16	R
199	lockout history 2 operation state (see *ENUMERATIONS*)	x1	S8/U8 lower byte	R
199	lockout history 2 profile position	x1	S8/U8 upper byte	R
200	lockout history 2 error code (see *ENUMERATIONS*)	x1	S16/U16	R
201	lockout history 2 sec	x1	S8/U8 lower byte	R
201	lockout history 2 min	x1	S8/U8 upper byte	R
202	lockout history 2 hour	x1	S8/U8 lower byte	R
202	lockout history 2 date	x1	S8/U8 upper byte	R
203	lockout history 2 month	x1	S8/U8 lower byte	R
203	lockout history 2 day	x1	S8/U8 upper byte	R
204	lockout history 2 year	x1	S16/U16	R
205	lockout history 3 operation state (see *ENUMERATIONS*)	x1	S8/U8 lower byte	R
205	lockout history 3 profile position	x1	S8/U8 upper byte	R
206	lockout history 3 error code (see *ENUMERATIONS*)	x1	S16/U16	R
207	lockout history 3 sec	x1	S8/U8 lower byte	R
207	lockout history 3 min	x1	S8/U8 upper byte	R
208	lockout history 3 hour	x1	S8/U8 lower byte	R
208	lockout history 3 date	x1	S8/U8 upper byte	R
209	lockout history 3 month	x1	S8/U8 lower byte	R
209	lockout history 3 day	x1	S8/U8 upper byte	R
210	lockout history 3 year	x1	S16/U16	R
211	lockout history 4 operation state (see *ENUMERATIONS*)	x1	S8/U8 lower byte	R
211	lockout history 4 profile position	x1	S8/U8 upper byte	R
212	lockout history 2 error code (see *ENUMERATIONS*)	x1	S16/U16	R
213	lockout history 4 sec	x1	S8/U8 lower byte	R
213	lockout history 4 min	x1	S8/U8 upper byte	R
214	lockout history 4 hour	x1	S8/U8 lower byte	R

Address	Description	Gain	Format	Type
214	lockout history 4 date	x1	S8/U8 upper byte	R
215	lockout history 4 month	x1	S8/U8 lower byte	R
215	lockout history 4 day	x1	S8/U8 upper byte	R
216	lockout history 4 year	x1	S16/U16	R
217	lockout history 5 operation state (see *ENUMERATIONS*)	x1	S8/U8 lower byte	R
217	lockout history 5 profile position	x1	S8/U8 upper byte	R
218	lockout history 5 error code (see *ENUMERATIONS*)	x1	S16/U16	R
219	lockout history 5 sec	x1	S8/U8 lower byte	R
219	lockout history 5 min	x1	S8/U8 upper byte	R
220	lockout history 5 hour	x1	S8/U8 lower byte	R
220	lockout history 5 date	x1	S8/U8 upper byte	R
221	lockout history 5 month	x1	S8/U8 lower byte	R
221	lockout history 5 day	x1	S8/U8 upper byte	R
222	lockout history 5 year	x1	S16/U16	R
223	lockout history 6 operation state (see *ENUMERATIONS*)	x1	S8/U8 lower byte	R
223	lockout history 6 profile position	x1	S8/U8 upper byte	R
224	lockout history 6 error code (see *ENUMERATIONS*)	x1	S16/U16	R
225	lockout history 6 sec	x1	S8/U8 lower byte	R
225	lockout history 6 min	x1	S8/U8 upper byte	R
226	lockout history 6 hour	x1	S8/U8 lower byte	R
226	lockout history 6 date	x1	S8/U8 upper byte	R
227	lockout history 6 month	x1	S8/U8 lower byte	R
227	lockout history 6 day	x1	S8/U8 upper byte	R
228	lockout history 6 year	x1	S16/U16	R
229	lockout history 7 operation state (see *ENUMERATIONS*)	x1	S8/U8 lower byte	R
229	lockout history 7 profile position	x1	S8/U8 upper byte	R
230	lockout history 7 error code (see *ENUMERATIONS*)	x1	S16/U16	R
231	lockout history 7 sec	x1	S8/U8 lower byte	R
231	lockout history 7 min	x1	S8/U8 upper byte	R
232	lockout history 7 hour	x1	S8/U8 lower byte	R

Address	Description	Gain	Format	Type
232	lockout history 7 date	x1	S8/U8 upper byte	R
233	lockout history 7 month	x1	S8/U8 lower byte	R
233	lockout history 7 day	x1	S8/U8 upper byte	R
234	lockout history 7 year	x1	S16/U16	R
235	lockout history 8 operation state (see *ENUMERATIONS*)	x1	S8/U8 lower byte	R
235	lockout history 8 profile position	x1	S8/U8 upper byte	R
236	lockout history 8 error code (see *ENUMERATIONS*)	x1	S16/U16	R
237	lockout history 8 sec	x1	S8/U8 lower byte	R
237	lockout history 8 min	x1	S8/U8 upper byte	R
238	lockout history 8 hour	x1	S8/U8 lower byte	R
238	lockout history 8 date	x1	S8/U8 upper byte	R
239	lockout history 8 month	x1	S8/U8 lower byte	R
239	lockout history 8 day	x1	S8/U8 upper byte	R
240	lockout history 8 year	x1	S16/U16	R
241	lockout history 9 operation state (see *ENUMERATIONS*)	x1	S8/U8 lower byte	R
241	lockout history 9 profile position	x1	S8/U8 upper byte	R
242	lockout history 9 error code (see *ENUMERATIONS*)	x1	S16/U16	R
243	lockout history 9 sec	x1	S8/U8 lower byte	R
243	lockout history 9 min	x1	S8/U8 upper byte	R
244	lockout history 9 hour	x1	S8/U8 lower byte	R
244	lockout history 9 date	x1	S8/U8 upper byte	R
245	lockout history 9 month	x1	S8/U8 lower byte	R
245	lockout history 9 day	x1	S8/U8 upper byte	R
246	lockout history 9 year	x1	S16/U16	R
247	lockout history 10 operation state (see *ENUMERATIONS*)	x1	S8/U8 lower byte	R
247	lockout history 10 profile position	x1	S8/U8 upper byte	R
248	lockout history 10 error code (see *ENUMERATIONS*)	x1	S16/U16	R
249	lockout history 10 sec	x1	S8/U8 lower byte	R
249	lockout history 10 min	x1	S8/U8 upper byte	R
250	lockout history 10 hour	x1	S8/U8 lower byte	R

Address	Description	Gain	Format	Type
250	lockout history 10 date	x1	S8/U8 upper byte	R
251	lockout history 10 month	x1	S8/U8 lower byte	R
251	lockout history 10 day	x1	S8/U8 upper byte	R
252	lockout history 10 year	x1	S16/U16	R
255	engineering units *0 = English, 1 = metric*	x1	S16/U16	R
257	sensor 1 type (see *ENUMERATIONS*)	x1	S8/U8 lower byte	R
257	sensor 1 range (see *ENUMERATIONS*)	x1	S8/U8 upper byte	R
258	sensor 2 type (see *ENUMERATIONS*)	x1	S8/U8 lower byte	R
258	sensor 2 range (see *ENUMERATIONS*)	x1	S8/U8 upper byte	R
259	sensor 3 type (see *ENUMERATIONS*)	x1	S8/U8 lower byte	R
259	sensor 3 range (see *ENUMERATIONS*)	x1	S8/U8 upper byte	R
260	sensor 4 type (see *ENUMERATIONS*)	x1	S8/U8 lower byte	R
260	sensor 4 range (see *ENUMERATIONS*)	x1	S8/U8 upper byte	R
261	sensor 5 type (see *ENUMERATIONS*)	x1	S8/U8 lower byte	R
261	sensor 5 range (see *ENUMERATIONS*)	x1	S8/U8 upper byte	R
262	setpoint 1 use *0 = unused, 1 = sensor 1*	x1	S8/U8 lower byte	R
262	setpoint 1 limit type *0 = deviation, 1 = absolute*	x1	S8/U8 upper byte	R
263	setpoint 1 integral	x1	S8/U8 lower byte	R
263	setpoint 1 derivative	x1	S8/U8 upper byte	R
264	setpoint 1 value	x1	S16/U16	R
265	setpoint 1 cut in	x1	S16/U16	R
266	setpoint 1 cut out	x1	S16/U16	R
268	setpoint 1 high margin limit	x1	S16/U16	R
269	setpoint 1 high alarm limit	x1	S16/U16	R
270	setpoint 2 use *0 = unused, 1 = sensor 1, 2 = sensor 2*	x1	S8/U8 lower byte	R
270	setpoint 2 limit type *0 = deviation, 1 = absolute*	x1	S8/U8 upper byte	R
271	setpoint 2 integral	x1	S8/U8 lower byte	R
271	setpoint 2 derivative	x1	S8/U8 upper byte	R

Address	Description	Gain	Format	Type
272	setpoint 2 value	x1	S16/U16	R
273	setpoint 2 cut in	x1	S16/U16	R
274	setpoint 2 cut out	x1	S16/U16	R
276	setpoint 2 high margin limit	x1	S16/U16	R
277	setpoint 2 high alarm limit	x1	S16/U16	R
278	setpoint 3 use *0 = unused, 3 = sensor 3*	x1	S8/U8 lower byte	R
278	setpoint 3 limit type *0 = deviation, 1 = absolute*	x1	S8/U8 upper byte	R
279	setpoint 3 integral	x1	S8/U8 lower byte	R
279	setpoint 3 derivative	x1	S8/U8 upper byte	R
280	setpoint 3 value	x1	S16/U16	R
281	setpoint 3 cut in	x1	S16/U16	R
282	setpoint 3 cut out	x1	S16/U16	R
284	setpoint 3 high margin limit	x1	S16/U16	R
285	setpoint 3 high alarm limit	x1	S16/U16	R
335	valve proving test time 1 (NXF4000 only)	x5	S8/U8 lower byte	R
335	valve proving test time 2 (NXF4000 only)	x5	S8/U8 upper byte	R
336	valve proving test duration (NXF4000 only) *0 = prepurge, 1= postpurge*	x1	S8/U8 lower byte	R
336	valve proving test method (NXF4000 only) *0 = 2-valve, 1 = 3-valve NO, 2 = 3-valve NC*	x1	S8/U8 upper byte	R
346	PCV sensor value	x1	String (22)	R
357	measured value	x1	String (22)	R
400	sensor 1 value **firmware 4.4+**	x10	S16/U16	R
401	sensor 2 value **firmware 4.4+**	x10	S16/U16	R
402	sensor 3 value **firmware 4.4+**	x10	S16/U16	R
403	sensor 4 value **firmware 4.4+**	x10	S16/U16	R
404	sensor 5 value **firmware 4.4+**	x10	S16/U16	R
480	profile 1 name (see *ENUMERATIONS*)	x1	S8/U8 lower byte	R
480	profile 1 max modulation	x1	S8/U8 upper byte	R
481	profile 2 name (see *ENUMERATIONS*)	x1	S8/U8 lower byte	R
481	profile 2 max modulation	x1	S8/U8 upper byte	R

Address	Description	Gain	Format	Type
482	profile 3 name (see *ENUMERATIONS*)	x1	S8/U8 lower byte	R
482	profile 3 max modulation	x1	S8/U8 upper byte	R
483	profile 4 name (see *ENUMERATIONS*)	x1	S8/U8 lower byte	R
483	profile 4 max modulation	x1	S8/U8 upper byte	R
900	recycle (NXF4000 only) *0 = no, 1 = yes*	x1	S8/U8 lower byte	R
900	PTFI time (see *ENUMERATIONS*) (NXF4000 only)	x1	S8/U8 upper byte	R
901	MTFI time (see *ENUMERATIONS*) (NXF4000 only)	x1	S8/U8 lower byte	R
901	intermittent pilot (NXF4000 only) *0 = no, 1 = yes*	x1	S8/U8 upper byte	R
902	FFRT time (NXF4000 only) *0 = 1s, 1 = 2s, 2 = 3s, 3 = 4s*	x1	S8/U8 lower byte	R
902	profile selected *0 = digital input, 1-4 = profile 1-4 via keypad*	x1	S8/U8 upper byte	R
903	FSG prove air flow (NXF4000 only) *0 = no, 1 = yes*	x1	S16/U16	R
905	post purge time (NXF4000 only)	x1	S16/U16	R
1000	reset command	x1	S16/U16	RW
1001	keypad control off/on *0 = off, 1 = on*	x1	S16/U16	RW
1002	keypad control low fire *0 = off, 1 = on*	x1	S16/U16	RW
1003	keypad control lead/lag *0 = off, 1 = on*	x1	S16/U16	RW
1004	keypad control auto/manual *0 = off, 1 = on*	x1	S16/U16	RW
1009	force analog 0 output (set use to MODBUS) **firmware 4.4+** *400 = 4mA, 2000 = 20mA*	x1	S16/U16	RW
1010	force VFD 1 output (set use to MODBUS) **firmware 4.4+** *400 = 4mA, 2000 = 20mA*	x1	S16/U16	RW
1011	force VFD 2 output (set use to MODBUS) **firmware 4.4+** *400 = 4mA, 200 = 20mA*	x1	S16/U16	RW
1012	force user output 1 (NXF4000 only) (set use to MODBUS) **firmware 4.4+** *0 = off, 1 = on*	x1	S16/U16	RW
1013	force user output 2 (NXF4000 only) (set use to MODBUS) **firmware 4.4+** *0 = off, 1 = on*	x1	S16/U16	RW
1014	force user output 3 (NXF4000 only) (set use to MODBUS) **firmware 4.4+** *0 = off, 1 = on*	x1	S16/U16	RW
1017	keypad manual modulation rate	x1	S16/U16	RW

Address	Description	Gain	Format	Type
1199	setpoint 1 value	x1	S16/U16	RW
1200	setpoint 1 cut in	x1	S16/U16	RW
1201	setpoint 1 cut out	x1	S16/U16	RW
1209	setpoint 2 value	x1	S16/U16	RW
1210	setpoint 2 cut in	x1	S16/U16	RW
1211	setpoint 2 cut out	x1	S16/U16	RW
1219	setpoint 2 value	x1	S16/U16	RW
1220	setpoint 2 cut in	x1	S16/U16	RW
1221	setpoint 2 cut out	x1	S16/U16	RW

ENUMERATIONS

Address	Enumerations
Address 0: current operational state **Address 193:** lockout history 1 operation state **Address 199:** lockout history 2 operation state **Address 205:** lockout history 3 operation state **Address 211:** lockout history 4 operation state **Address 217:** lockout history 5 operation state **Address 223:** lockout history 6 operation state **Address 229:** lockout history 7 operation state **Address 235:** lockout history 8 operation state **Address 241:** lockout history 9 operation state **Address 247:** lockout history 10 operation state	0 = SYSTEM STARTUP 1 = STANDBY 2 = WAIT FOR PROFILE 3 = GAS VALVE PROVE1 4 = GAS VALVE PROVE2 5 = GAS VALVE PROVE3 6 = GAS VALVE PROVE4 7 = MOVE TO PURGE 8 = PURGE 9 = MOVE TO IGNITION 10 = IGNITION 11 = PTFI 12 = PILOT 13 = MTFI 14 = MFEP 15 = MOVE TO LOW FIRE 16 = AUTO 17 = POST PURGE 18 = LOCKOUT
Address 9: current modulation reason mode	0 = Main Sensor 1 = Digital Input for Auto/Man (manual modulation) 2 = Keypad Auto/Man (manual modulation) 3 = Sequencing Slave 4 = Low Fire Hold 5 = Standby Water 6 = Thermal Shock 7 = Low Stack 8 = High Fire Hold 9 = Track Modulation
Address 17: current digital input values	Bit 0 = digital input 1 Bit 1 = digital input 2 Bit 2 = digital input 3 Bit 3 = digital input 4 Bit 4 = digital input 5 Bit 5 = digital input 6 Bit 6 = digital input 7 Bit 7 = digital input 8 Bit 8 = digital input 9 Bit 9 = digital input 10 Bit 10 = digital input 11 (NXF4000 only) Bit 11 = digital input 12 (NXF4000 only) Bit 12 = digital input 13 (NXF4000 only) Bit 13 = digital input 14 (NXF4000 only) Bit 14 = digital input 15 (NXF4000 only) Bit 15 = input P15.4 operating control (NXF4000 only)
Address 57: hold off reason	0 = No Hold Off 1 = Outdoor Temperature High 2 = Thermal Shock

Address	Enumerations	
Address 167: current digital output values	NXF4000	PPC4000
	Bit 0 = P5.7 pilot Bit 1 = P5.6 ignition Bit 2 = P5.8 oil valve Bit 3 = P5.4 gas valve 1 Bit 4 = P5.3 user output 3 Bit 5 = P5.2 user output 2 Bit 6 = P5.1 user output 1 Bit 7 = P4.3/P4.4 fan output Bit 8 = P4.1/P4.2 alarm relay Bit 9 = P5.9 vent valve Bit 10+ = unused	Bit 0 = unused Bit 1 = unused Bit 2 = unused Bit 3 = unused Bit 4 = P5.3 common feedback Bit 5 = P5.2 damper open high feedback Bit 6 = P5.1 damper closed ignition feedback Bit 7 = P4.3/P4.4 OCRC relay Bit 8 = P4.1/P4.2 alarm relay Bit 9 = P5.9/p5.10 safety limit relay Bit 10+ = unused
Address 170: FSG board type	0 = FSG SCANNER NONE 1 = FSG SCANNER IR HIGH 2 = FSG SCANNER DC 3 = FSG SCANNER UV 6 = FSG SCANNER IR LOW	
Address 194: lockout history 1 error code **Address 200:** lockout history 2 error code **Address 206:** lockout history 3 error code **Address 212:** lockout history 4 error code **Address 218:** lockout history 5 error code **Address 224:** lockout history 6 error code **Address 230:** lockout history 7 error code **Address 236:** lockout history 8 error code **Address 242:** lockout history 9 error code **Address 248:** lockout history 10 error code	1-2 = NXF4000 FAULT OR PPC4000 FAULT 3 = Z BOARD FAULT 4 = SAFETY RELAY ON 5 = SAFETY RELAY OFF 6 = RELAY 8 ON 7 = RELAY 8 OFF 8 = RELAY D ON 9 = RELAY D OFF 10 = NXF4000 FAULT OR PPC4000 FAULT 11 = INVALID PROFILE 12 = HIGH TEMPERATURE 13 -14 = CHECK WIRING 15 = NO AIR SERVO 16 = NO FUEL SERVO 17 = INVALID SETPOINT 18 = NXF4000 FAULT OR PPC4000 FAULT 19-20 = SENSOR 1 MARGINAL 21-23 = SENSOR 2 MARGINAL 24-26 = SENSOR 3 MARGINAL 27-28 = SENSOR1 HIGH LIMIT 29-31 = SENSOR2 HIGH LIMIT 32-34 = SENSOR3 HIGH LIMIT 35 = SENSOR1 UNDER RNG 36 = SENSOR1 OVER RNG 37 = SENSOR2 UNDER RNG 38 = SENSOR2 OVER RNG 39 = SENSOR3 UNDER RNG 40 = SENSOR3 OVER RNG 41-42 = Z BOARD INTERNAL FAULT 43-45 = NXF4000 FAULT OR PPC4000 FAULT	

Address	Enumerations
Address 194: lockout history 1 error code **Address 200:** lockout history 2 error code **Address 206:** lockout history 3 error code **Address 212:** lockout history 4 error code **Address 218:** lockout history 5 error code **Address 224:** lockout history 6 error code **Address 230:** lockout history 7 error code **Address 236:** lockout history 8 error code **Address 242:** lockout history 9 error code **Address 248:** lockout history 10 error code	46-86= O2 FAULT 87-88 = NXF4000 FAULT OR PPC4000 FAULT 89 = NOT COMMISSIONED 90-121 = NXF4000 FAULT OR PPC4000 FAULT 122 = SERVO 1 LOST 123 = SERVO 2 LOST 124 = SERVO 3 LOST 125 = SERVO 4 LOST 126 = SERVO 5 LOST 127 = SERVO 6 LOST 128 = SERVO 7 LOST 129 = SERVO 8 LOST 130 = SERVO 9 LOST 131 = SERVO 10 LOST 132-141 = NXF4000 FAULT OR PPC4000 FAULT 142 = SERVO 1 STUCK 143 = SERVO 2 STUCK 144 = SERVO 3 STUCK 145 = SERVO 4 STUCK 146 = SERVO 5 STUCK 147 = SERVO 6 STUCK 148 = SERVO 7 STUCK 149 = SERVO 8 STUCK 150 = SERVO 9 STUCK 151 = SERVO 10 STUCK 152-161 = NXF4000 FAULT OR PPC4000 FAULT 162 = SERVO 1 ERROR 163 = SERVO 2 ERROR 164 = SERVO 3 ERROR 165 = SERVO 4 ERROR 166 = SERVO 5 ERROR 167 = SERVO 6 ERROR 168 = SERVO 7 ERROR 169 = SERVO 8 ERROR 170 = SERVO 9 ERROR 171 = SERVO 10 ERROR 172-181 = NXF4000 FAULT OR PPC4000 FAULT 182 = SERVO 1 VOLTAGE 183 = SERVO 2 VOLTAGE 184 = SERVO 3 VOLTAGE 185 = SERVO 4 VOLTAGE 186 = SERVO 5 VOLTAGE 187 = SERVO 6 VOLTAGE 188 = SERVO 7 VOLTAGE 189 = SERVO 8 VOLTAGE 190 = SERVO 9 VOLTAGE 191 = SERVO 10 VOLTAGE 192-201 = NXF4000 FAULT OR PPC4000 FAULT 202 = SERVO 1 VOLTAGE

Address	Enumerations
Address 194: lockout history 1 error code **Address 200:** lockout history 2 error code **Address 206:** lockout history 3 error code **Address 212:** lockout history 4 error code **Address 218:** lockout history 5 error code **Address 224:** lockout history 6 error code **Address 230:** lockout history 7 error code **Address 236:** lockout history 8 error code **Address 242:** lockout history 9 error code **Address 248:** lockout history 10 error code	203 = SERVO 2 VOLTAGE 204 = SERVO 3 VOLTAGE 205 = SERVO 4 VOLTAGE 206 = SERVO 5 VOLTAGE 207 = SERVO 6 VOLTAGE 208 = SERVO 7 VOLTAGE 209 = SERVO 8 VOLTAGE 210 = SERVO 9 VOLTAGE 211 = SERVO 10 VOLTAGE 212-221 = NXF4000 FAULT OR PPC4000 FAULT 222 = SERVO 1 OFF RATIO 223 = SERVO 2 OFF RATIO 224 = SERVO 3 OFF RATIO 225 = SERVO 4 OFF RATIO 226 = SERVO 5 OFF RATIO 227 = SERVO 6 OFF RATIO 228 = SERVO 7 OFF RATIO 229 = SERVO 8 OFF RATIO 230 = SERVO 9 OFF RATIO 231 = SERVO 10 OFF RATIO 232-250 = NXF4000 FAULT OR PPC4000 FAULT 251 = SENSOR4 UNDER RNG 252 = SENSOR4 OVER RNG 253 = SENSOR4 UNDER RNG 254 = SENSOR4 OVER RNG 255 = NOT COMMISSIONED 256 = VFD1 OFF RATIO 257 = VFD2 OFF RATIO 258 = VFD COMM FAULT 1 259 = VFD COMM FAULT 2 260 = VFD1 MISSING 261 = VFD2 MISSING 262-265 = NXF4000 FAULT OR PPC4000 FAULT 266-271 = VFD BOARD FAULT 272 = VFD1 INPUT BELOW 4mA 273-277 = VFD BOARD FAULT 278 = VFD2 INPUT BELOW 4mA 279-280 = VFD BOARD FAULT 281 = CHECK VFD1 INPUT 282 = CHECK VFD2 INPUT 283 = P0 NOT COMMISSIONED 284 = MAIN CPU FAULT 1 285 = MAIN CPU FAULT 2 286 = MAIN CPU FAULT 3 287 = MAIN CPU FAULT 4 288 = MAIN CPU FAULT 5 289 = MAIN CPU FAULT 6 290 = MAIN CPU FAULT 7 291 = LESS THAN 2 SERVOS

Address	Enumerations
Address 194: lockout history 1 error code **Address 200:** lockout history 2 error code **Address 206:** lockout history 3 error code **Address 212:** lockout history 4 error code **Address 218:** lockout history 5 error code **Address 224:** lockout history 6 error code **Address 230:** lockout history 7 error code **Address 236:** lockout history 8 error code **Address 242:** lockout history 9 error code **Address 248:** lockout history 10 error code	292 = UNIT TEMP SENSORS 293 = NOT COMMISSIONED 294 = INVALID PRROFILE NAME 295 = LGP/FUEL SUPPLY 296-318 = NXF4000 FAULT OR PPC4000 FAULT 319 = NO SENSOR-SETPT DATA 320 = NO SERVO SETUP DATA 321 = NO DIG I/P DATA 322 = NO PASSCODE DATA 323 = NO P0 DATA 324 = NO PROFILE1 DATA 325 = NO PROFILE2 DATA 326 = NO PROFILE3 DATA 327 = NO PROFILE4 DATA 328 = NO PROFL SETUP DATA 329 = NO KEYPAD SETUP DATA 330 = NO KEY STATES DATA 331 = NO THERML SHOCK DATA 332 = NO FAULT HISTRY DATA 333 = NO SETBACK DATA 334 = NO COMM SETUP DATA 335 = NO SEQUENCING DATA 336 = NO O2 SETUP DATA 337 = NO ADJUSTED O2 DATA 338 = NO ANALOG OUT DATA 339 = NO VFD SETUP DATA 340 = NO VFD PROFILE1 DATA 341 = NO VFD PROFILE2 DATA 342 = NO VFD PROFILE3 DATA 343 = NO VFD PROFILE4 DATA 344 = NO BURNER DATA 345 = NO FSG SETUP DATA 346 = NO FSG DI DATA 347 = NO VALVE PROV DATA 348 = NO USER OUTPUT DATA 349 = NO CO SETUP DATA 350-418 = NXF4000 FAULT OR PPC4000 FAULT 419 = CANNOT MOVE TO PURGE 420-429 = NXF4000 FAULT OR PPC4000 FAULT 430 = FVES OPEN i01 431 = FVES OPEN i02 432 = FVES OPEN i03 433 = FVES OPEN i04 434 = FVES OPEN i05 435 = FVES OPEN i06 436 = FVES OPEN i07 437 = FVES OPEN i08 438 = FVES OPEN i09 439 = FVES OPEN i10

Address	Enumerations
Address 194: lockout history 1 error code **Address 200:** lockout history 2 error code **Address 206:** lockout history 3 error code **Address 212:** lockout history 4 error code **Address 218:** lockout history 5 error code **Address 224:** lockout history 6 error code **Address 230:** lockout history 7 error code **Address 236:** lockout history 8 error code **Address 242:** lockout history 9 error code **Address 248:** lockout history 10 error code	440 = FVES OPEN i11 441 = FVES OPEN i12 442 = FVES OPEN i13 443 = FVES OPEN i14 444 = FVES OPEN i15 446 = FVES CLOSED i01 447 = FVES CLOSED i02 448 = FVES CLOSED i03 449 = FVES CLOSED i04 450 = FVES CLOSED i05 451 = FVES CLOSED i06 452 = FVES CLOSED i07 453 = FVES CLOSED i08 454 = FVES CLOSED i09 455 = FVES CLOSED i10 456 = FVES CLOSED i11 457 = FVES CLOSED i12 458 = FVES CLOSED i13 459 = FVES CLOSED i14 460 = FVES CLOSED i15 462 = LOST P INPUT 463 = NXF4000 FAULT OR PPC4000 FAULT 464 = PILOT RELAY ON 465 = IGNITE RELAY ON 466 = OIL RELAY ON 467 = GV1 RELAY ON 468 = GV2 RELAY ON 469 = GV3 RELAY ON 470 = USER RELAY 1 ON 471 = USER RELAY 2 ON 472 = USER RELAY 3 ON 473 = PILOT RELAY OFF 474 = IGNITE RELAY OFF 475 = OIL RELAY OFF 476 = GV1 RELAY OFF 477 = GV2 RELAY OFF 478 = GV3 RELAY OFF 479 = USER RELAY 1 OFF 480 = USER RELAY 2 OFF 481 = USER RELAY 3 OFF 482 = FSG BOARD COMMS 483 = FSG BOARD INCORRECT 484 = FSG SELF-CHECK1 485 = FSG SELF-CHECK2 486 = FSG SELF-CHECK3 487 = FSG ROM CRC 488 = FSG DC WIRING LOOP 489 = UV SELF CHECK FAIL 490 = read FLAME 491 = FLAME FAIL OIL FOG

Address	Enumerations
Address 194: lockout history 1 error code **Address 200:** lockout history 2 error code **Address 206:** lockout history 3 error code **Address 212:** lockout history 4 error code **Address 218:** lockout history 5 error code **Address 224:** lockout history 6 error code **Address 230:** lockout history 7 error code **Address 236:** lockout history 8 error code **Address 242:** lockout history 9 error code **Address 248:** lockout history 10 error code	492 = FLAME FAIL 493 = FORCED i01 494 = FORCED i02 495 = FORCED i03 496 = FORCED i04 497 = FORCED i05 498 = FORCED i06 499 = FORCED i07 500 = FORCED i08 501 = FORCED i09 502 = FORCED i10 503 = FORCED i11 504 = FORCED i12 505 = FORCED i13 506 = FORCED i14 507 = FORCED i15 509 = INVALID SENSOR DATA 510 = INVALID SERVO DATA 511 = INVALID DIG IP DATA 512 = INVALID PCODE DATA 513 = INVALID P0 DATA 514 = INVALID PROF 1 DATA 515 = INVALID PROF 2 DATA 516 = INVALID PROF 3 DATA 517 = INVALID PROF 4 DATA 518 = INVALID PROFILE DATA 519 = INVALID KEYPAD DATA 520 = INVALID KEY ST DATA 521 = INVALID TH SHK DATA 522 = INVALID FAULT DATA 523 = INVALID SETBACK DATA 524 = INVALID COMM DATA 525 = INVALID SEQ DATA 526 = INVALID O2 DATA 527 = INVALID ADJ O2 DATA 528 = INVALID ANALOG DATA 529 = INVALID VFD DATA 530 = INVALID VPROF 1 DATA 531 = INVALID VPROF 2 DATA 532 = INVALID VPROF 3 DATA 533 = INVALID VPROF 4 DATA 534 = INVALID BURNER DATA 535 = INVALID FSG DATA 536 = INVALID FSG DI DATA 537 = INVALID V-PROV DATA 538 = INVALID USER OP DATA 539-557 = NXF4000 FAULT OR PPC4000 FAULT 558 = VALVE PROVING TEST 2 559 = VALVE PROVING TEST 4 560 = AIRFLOW ON

Address	Enumerations
Address 194: lockout history 1 error code **Address 200:** lockout history 2 error code **Address 206:** lockout history 3 error code **Address 212:** lockout history 4 error code **Address 218:** lockout history 5 error code **Address 224:** lockout history 6 error code **Address 230:** lockout history 7 error code **Address 236:** lockout history 8 error code **Address 242:** lockout history 9 error code **Address 248:** lockout history 10 error code	561 = AIRFLOW OFF 562 = OBSOLETE SEQ DATA 563 = RUN CHECK TIMEOUT 564 = SERVO 1 NOT CW 565 = SERVO 2 NOT CW 566 = SERVO 3 NOT CW 567 = SERVO 4 NOT CW 568 = SERVO 5 NOT CW 569 = SERVO 6 NOT CW 570 = SERVO 7 NOT CW 571 = SERVO 8 NOT CW 572 = SERVO 9 NOT CW 573 = SERVO 10 NOT CW 574 = SERVO 1 NOT CCW 575 = SERVO 2 NOT CCW 576 = SERVO 3 NOT CCW 577 = SERVO 4 NOT CCW 578 = SERVO 5 NOT CCW 579 = SERVO 6 NOT CCW 580 = SERVO 7 NOT CCW 581 = SERVO 8 NOT CCW 582 = SERVO 9 NOT CCW 583 = SERVO 10 NOT CCW
Address 257: sensor 1 type	0 = UNUSED 1 = WATER 2 = STEAM 3 = TRACK
Address 258: sensor 2 type	0 = UNUSED 1 = WATER 2 = STEAM 4 = STANDBY
Address 259: sensor 3 type	0 = UNUSED 1 = WATER 2 = STEAM 3 = INLET 4 = OUTDOOR 5 = STACK
Address 260: sensor 4 type	0 = UNUSED 1 = INLET 2 = FLAME SIGNAL
Address 261: sensor 5 type	0 = UNUSED 1 = INLET

Address	Enumerations	
Address 257: sensor 1 range	Sensor type STEAM	Sensor type WATER
	0 = Unused 1 = 0 to 1030 mBar (0 to 15psi) 2 = 0 to 2070 mBar (0 to 30psi) 3 = 0 to 13.8 Bar (0 to 200psi) 4 = 0 to 20.7 Bar (0 to 300psi) 5 = -1013 - 1720mBar (-14.7 to 25psi)	0 = Unused 1 = 0 to 176°C (32 to 350°F) 2 = 0 to 400°C (32 to 752°F)
Address 258: sensor 2 range	Sensor type STEAM	Sensor type WATER Sensor type STANDBY
	0 = Unused 1 = 0 to 1030 mBar (0 to 15psi) 2 = 0 to 2070 mBar (0 to 30psi) 3 = 0 to 13.8 Bar (0 to 200psi) 4 = 0 to 20.7 Bar (0 to 300psi) 5 = -1013 - 1720mBar (-14.7 to 25psi)	0 = Unused 1 = 0 to 176°C (32 to 350°F) 2 = 0 to 400°C (32 to 752°F)
Address 259: sensor 3 range	Sensor type STEAM	Sensor type WATER Sensor type STANDBY Sensor type OUTDOOR Sensor type STACK Sensor type INLET
	0 = Unused 1 = 0 to 1030 mBar (0 to 15psi) 2 = 0 to 2070 mBar (0 to 30psi) 3 = 0 to 13.8 Bar (0 to 200psi) 4 = 0 to 20.7 Bar (0 to 300psi) 5 = -1013 - 1720mBar (-14.7 to 25psi)	0 = Unused 1 = 0 to 176°C (32 to 350°F) 2 = 0 to 400°C (32 to 752°F)
Address 260: sensor 4 range	Sensor type INLET	Sensor type FLAME SIGNAL
	0 = Unused 1 = -45 to 149°C (-50 to 300°F) 2 = -40 to 60°C (-40 to 140°F) 3 = 0 to 176°C (32 to 350°F)	0 = 4-20mA
Address 261: sensor 5 range	Sensor type INLET	
	0 = Unused 1 = -45 to 149°C (-50 to 300°F) 2 = -40 to 60°C (-40 to 140°F) 3 = 0 to 176°C (32 to 350°F)	
Address 480: profile 1 name **Address 481:** profile 2 name **Address 482:** profile 3 name **Address 483:** profile 4 name	0 = NONE 1 = GAS 2 = WAS 3 = FUE 4 = COG 5 = SOL 6 = OIL 7 = HVY 8 = GAS1 9 = GAS2 10 = OIL1 11 = OIL2	

Address	Enumerations
Address 900: PTFI time	0 = 5/5 (Ignition = 5 seconds, Pilot = 5 seconds) 1 = 5/15 (Ignition = 5 seconds, Pilot = 15 seconds) 2 = 10/10 (Ignition = 10 seconds, Pilot = 10 seconds) 3 = 3/6 (Ignition = 3 seconds, Pilot = 6 seconds) 4 = 3/8 (Ignition = 3 seconds, Pilot = 8 seconds) 5 = 3/13 (Ignition = 3 seconds, Pilot = 13 seconds) 6 = 5/10 (Ignition = 5 seconds, Pilot = 10 seconds)
Address 901: MTFI time	0 = 0/5 (Ignition = 0 seconds, Pilot = 5 seconds) 1 = 0/10 (Ignition = 0 seconds, Pilot = 10 seconds) 2 = 0/15 (Ignition = 0 seconds, Pilot = 15 seconds) 3 = 3/5 (Ignition = 3 seconds, Pilot = 5 seconds) 4 = 10/10 (Ignition = 10 seconds, Pilot = 10 seconds) 5 = 10/15 (Ignition = 10 seconds, Pilot = 15 seconds) 6 = 0/3 (Ignition = 0 seconds, Pilot = 3 seconds)

OTHER PROTOCOLS

Other protocols are available by connecting the MB485ETH-CG Communication Gateway to the user Modbus connection. The NXF4000 or PPC4000 can provide the operating power for the MB485ETH-CG and only requires 30mm (1.25in) of DIN rail space for mounting.

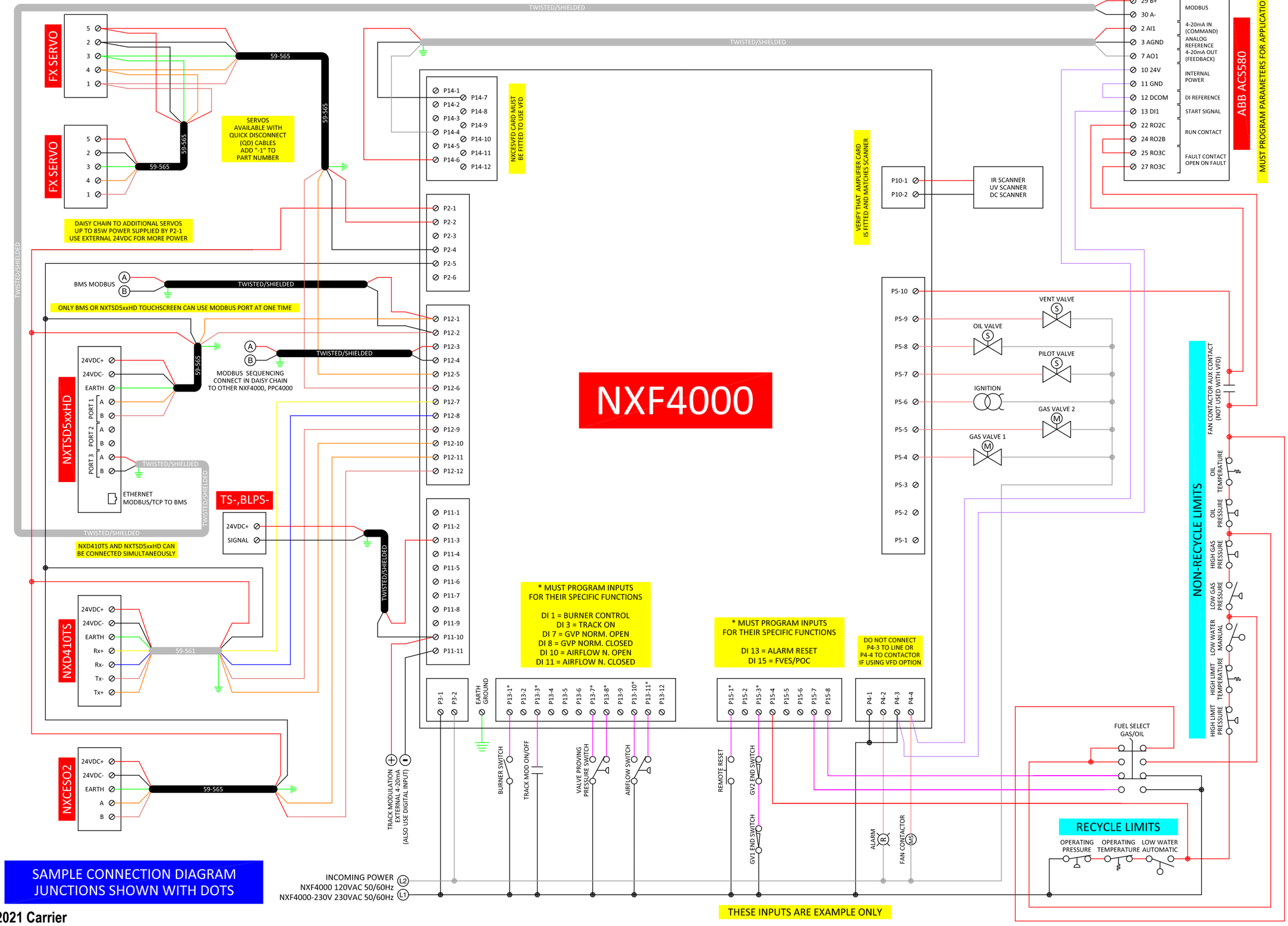
The MB485TH-CG supports the following protocols:

- BACnet/IP
- BACnet MS/TP
- Ethernet/IP
- Modbus TCP/IP

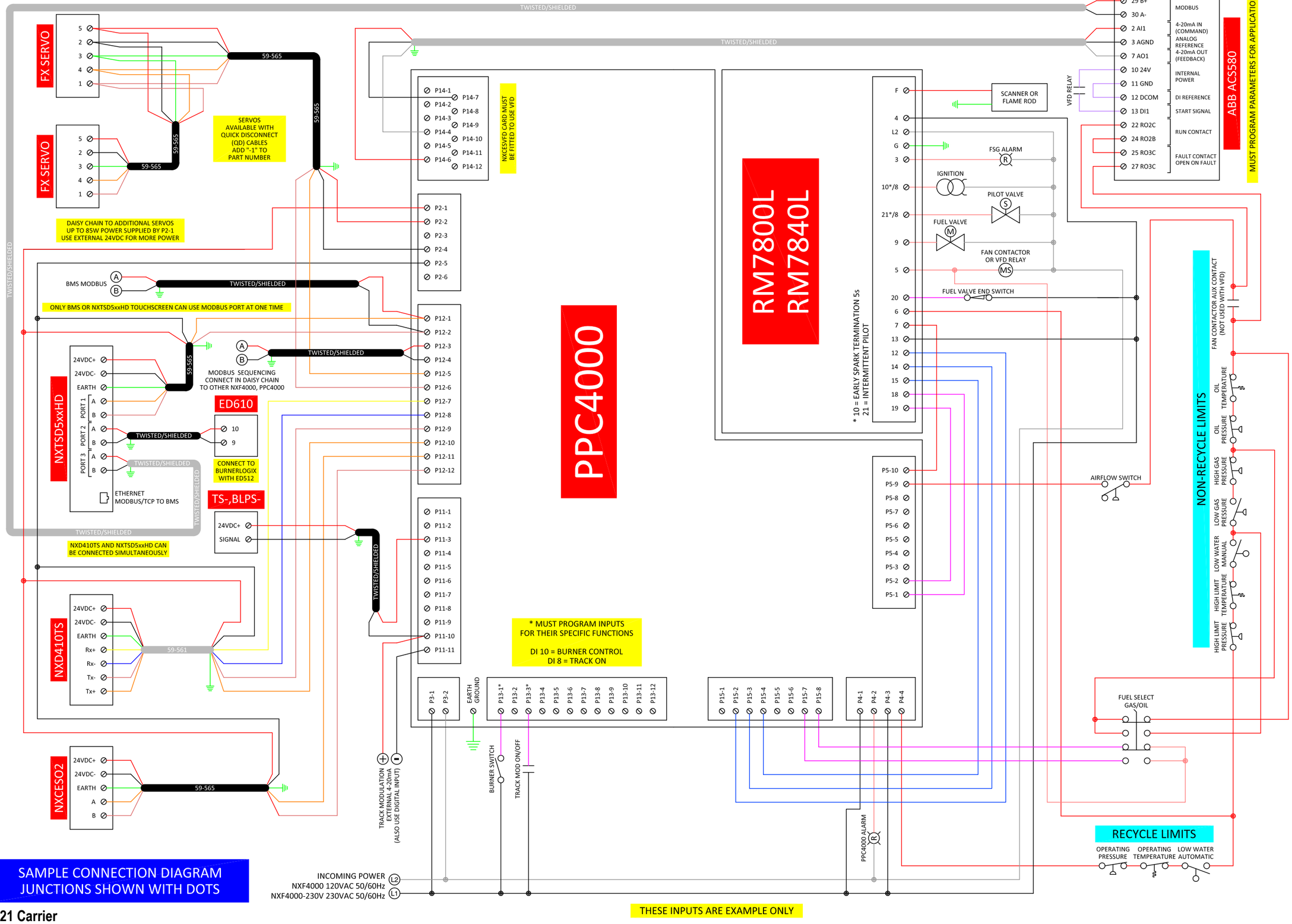
The MB485ETH-CG is easy to configure using any web browser. Any Fireye product that offers a user Modbus connection can be connected and converted, allowing one MB485ETH-CG to convert many different controls in one installation.

See Fireye bulletin *CG-1001* for additional details on wiring, mapping and configuration.

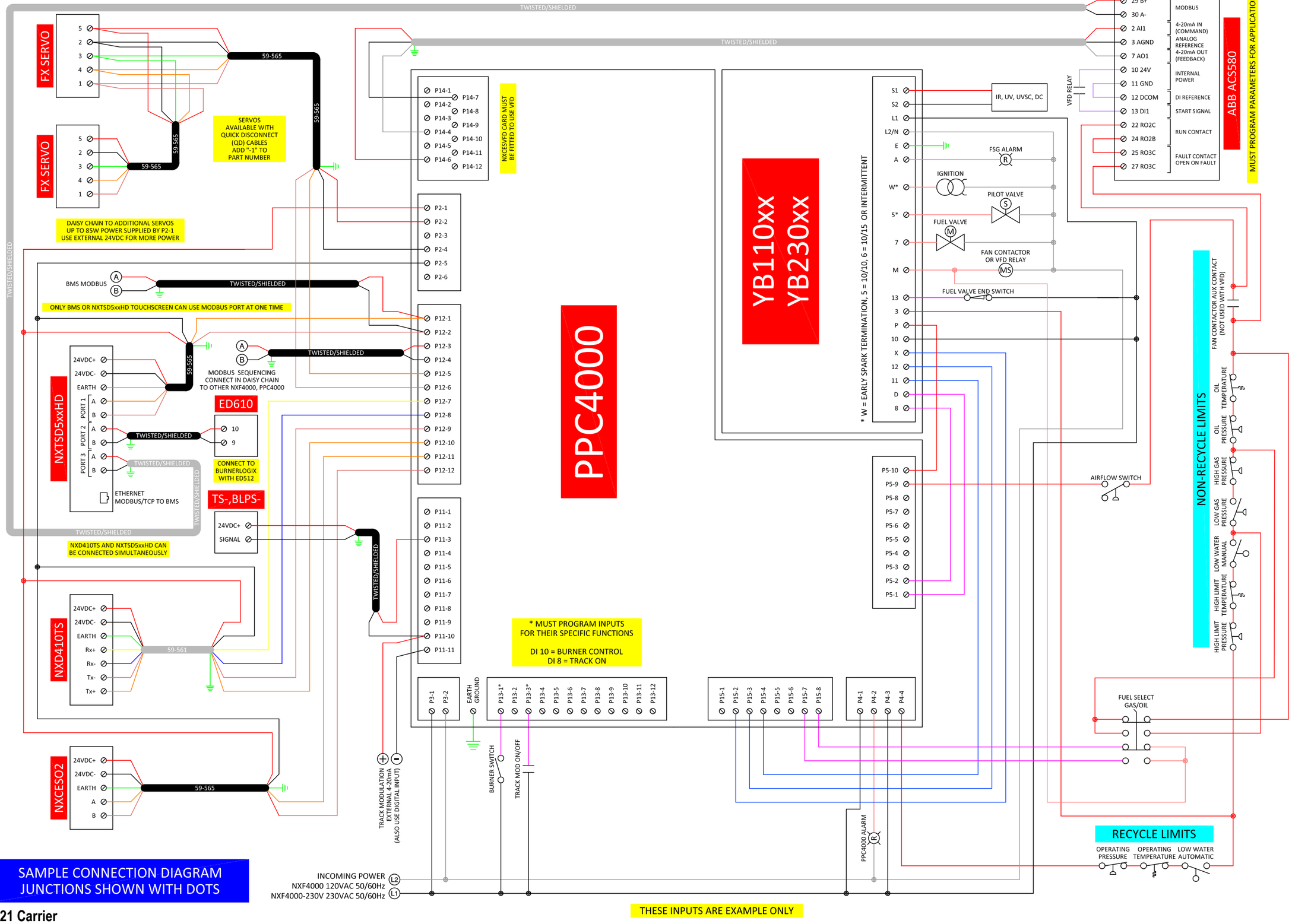
Sample Connection Diagram: NXF4000 (revised 11/2021)



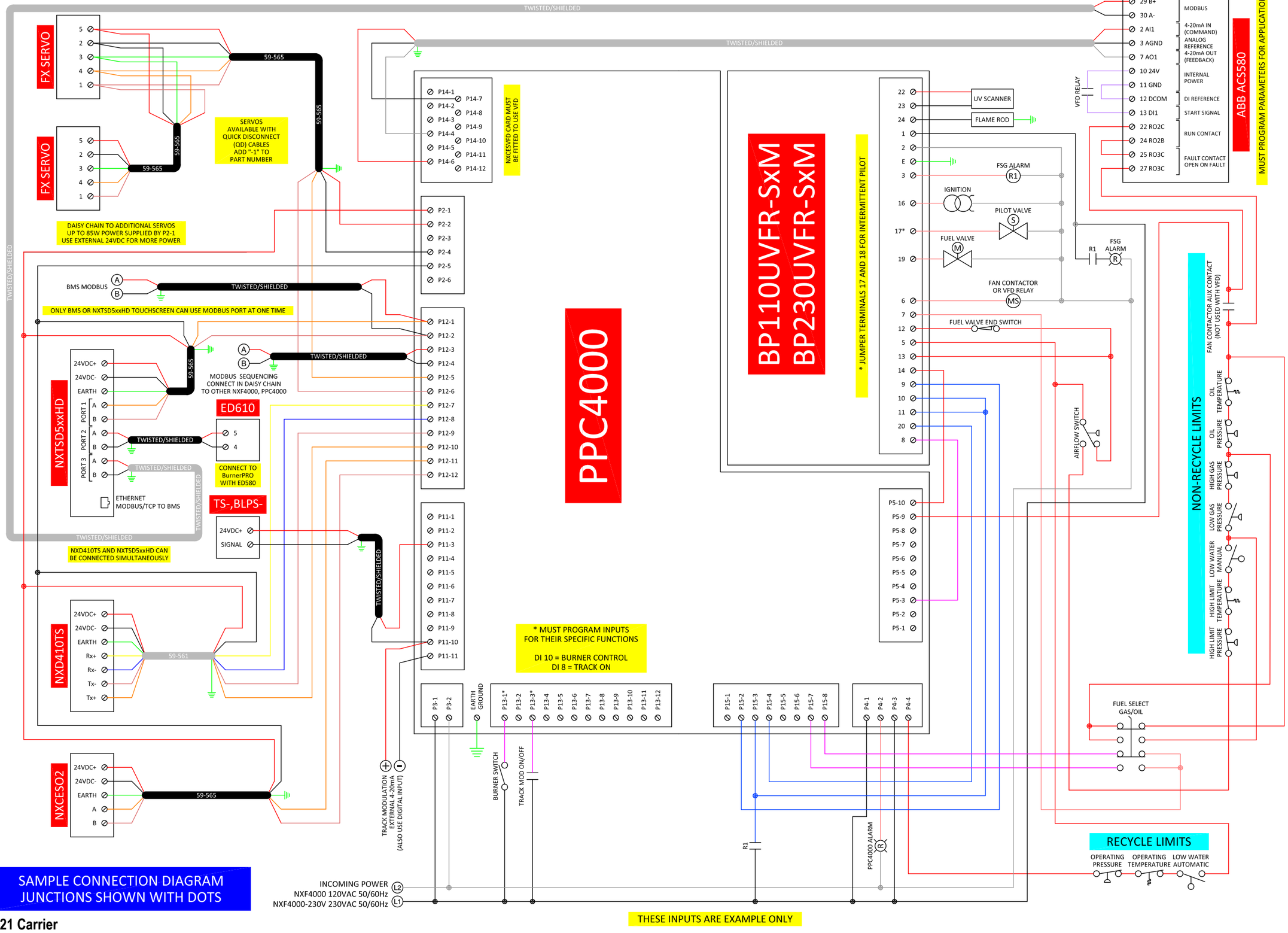
Sample Connection Diagram: PPC4000 to 7800 SERIES (revised 11/2021)



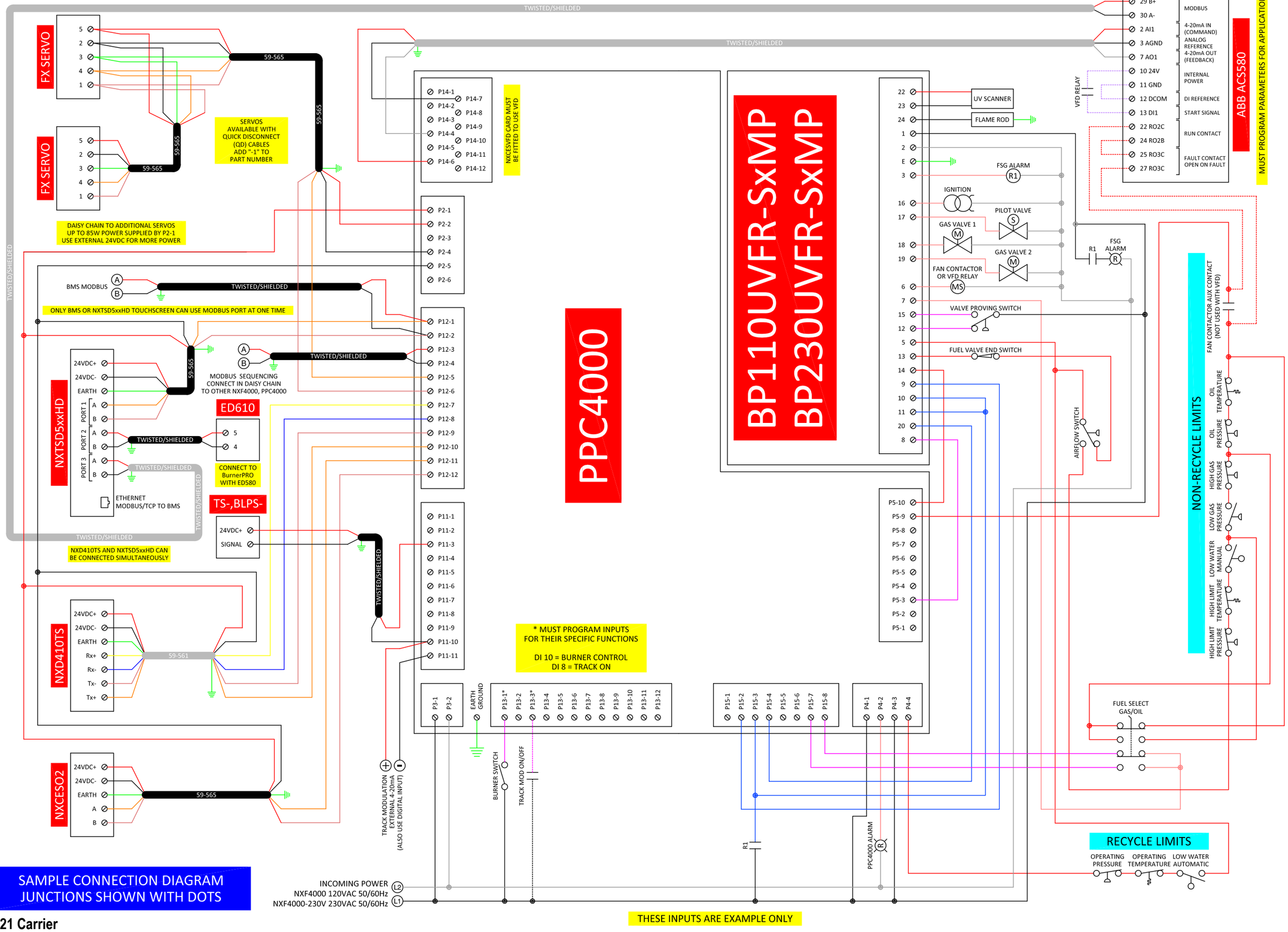
Sample Connection Diagram: PPC4000 to BurnerLogix (revised 11/2021)



Sample Connection Diagram: PPC4000 to BurnerPRO (revised 11/2021)



Sample Connection Diagram: PPC4000 to BurnerPRO with Valve Proving (revised 11/2021)



Sample Connection Diagram: PPC4000 to FLAME MONITOR (revised 11/2021)