INTRODUCTION TO THE NXF4000

PR-00-2-0500-0-008-A

The basics

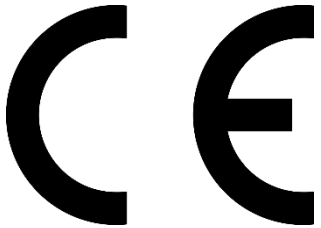
NXF4000 description

The NXF4000 is a parallel positioning system with an integrated flame safeguard. This is the only controller that you need to both monitor the flame and control the channels of combustion.

Approvals

Many worldwide listings

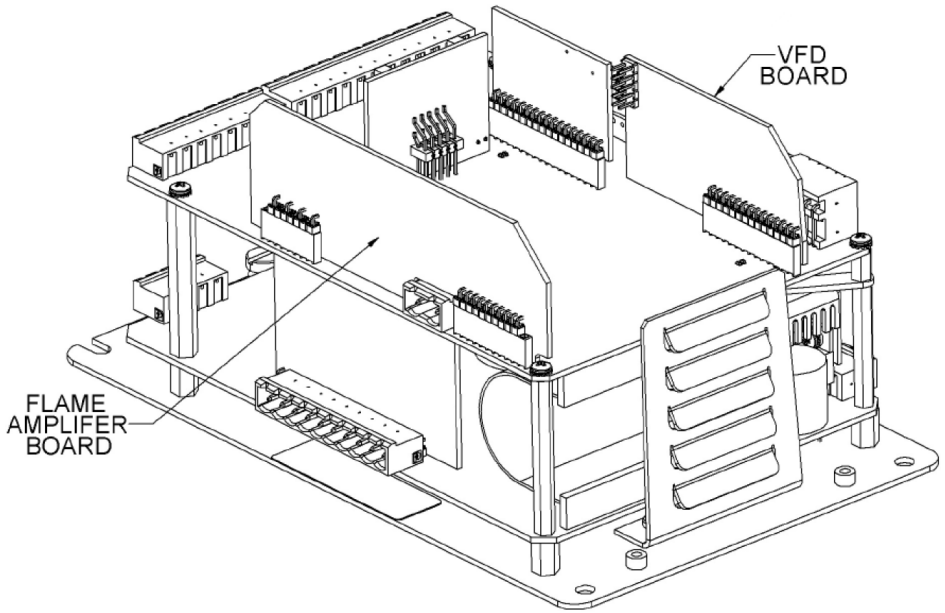
The NXF4000, PPC4000 and accessories are approved by use by many of the leading listing agencies worldwide. Selection charts are available in the product documentation to verify the listings for any part number.



Form factor

Size

The NXF4000 occupies a small footprint in the combustion encloser. The unit measures approximately 200mm x 130mm (8” x 5”) on the back panel and has a height of 100mm (4”). Electrical connections are made to removable terminal blocks. Add-on cards are fitted within the footprint onto the main circuit board, so no additional space is required.



Control	Dimensions
Fireye NXF4000	203.2mm x 127mm x 101.6mm 8” x 5” x 4”
Fireye NX6100	210mm x 125mm x 80mm 8.27” x 4.92” x 3.15”
Siemens LMV3	230mm x 135mm x 60mm 9.06” x 5.31” x 2.36”
Siemens LMV5	250mm x 200mm x 82.5mm 9.84” x 7.87” x 3.25”
Honeywell SLATE (base only)	180mm x 155mm x 135mm 7.09” x 6.1” x 5.31”

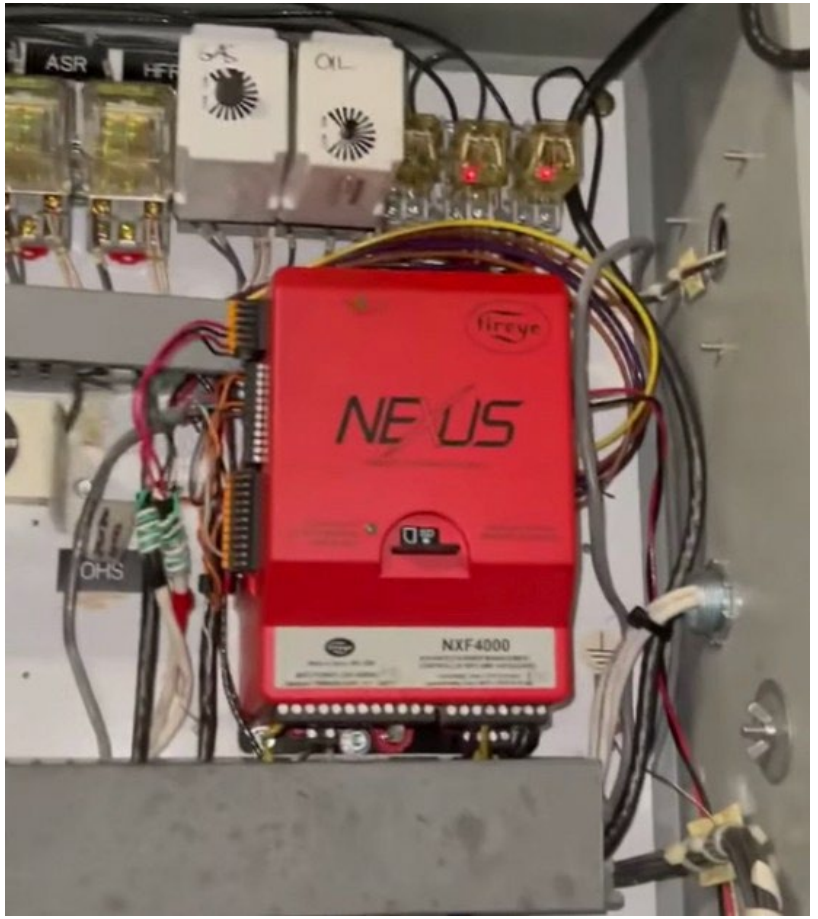
Operating temperature

Replaceable fan

The NXF4000 has an operating temperature range of 0°C to 60°C (32°F to 140°F). The integrated cooling fan is a replaceable part so long life can be ensured in high heat environments. The fan is internally controlled by the internal NXF4000 temperature. If the fan were to run constantly the design life is over three years.

Form factor

NXF4000 application photos



Varieties

Input voltage

- Only two models of NXF4000 are available – 110/120VAC and 230/240VAC input power. Agency approvals vary for each based upon the needs for the market they are directed towards. All accessories are compatible with controls of either voltage.

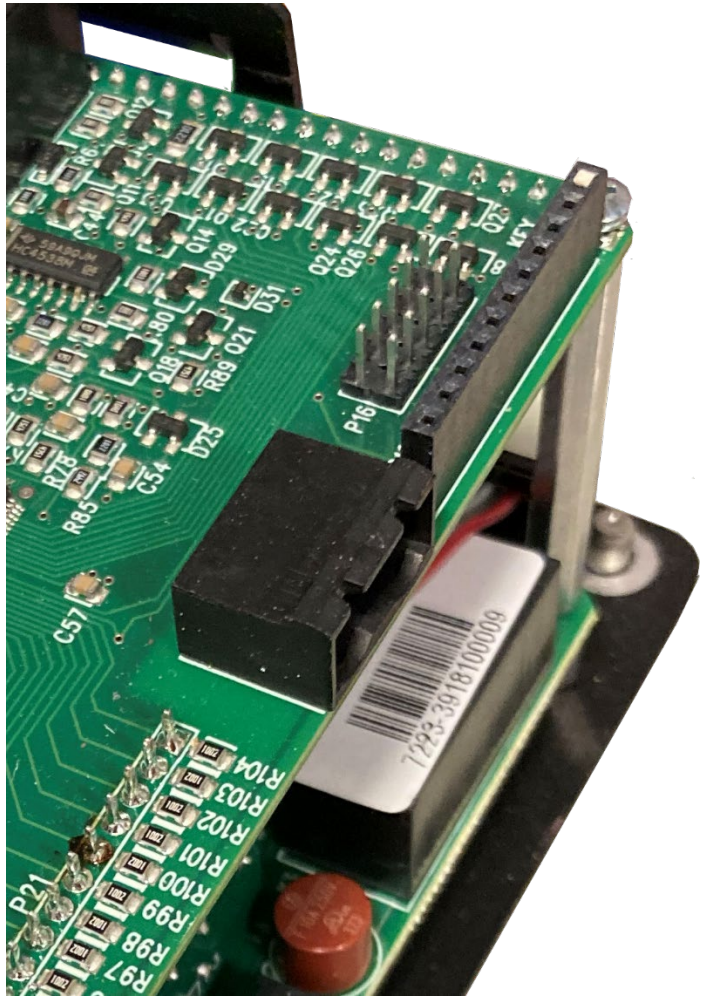
Fireye Part Number	FM APPROVED	c UL us LISTED	c RU us	CE	DIN DVGW	DIN Geprüft
Control						
NXF4000		X		X		X
NXF4000-230V				X		X

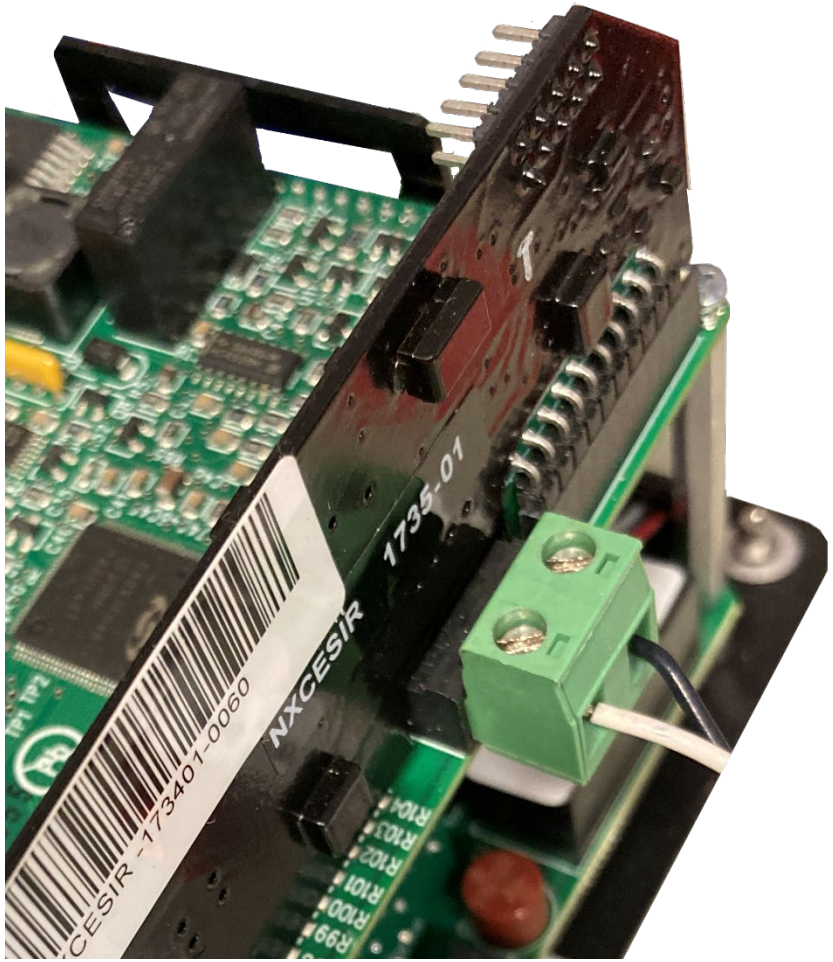
Amplifier options

Three choices

Three amplifier options are available via add-on card:

- **UV amplifier (NXCESUV)** allows use of any Fireye low-voltage UV scanners (UV1AL, UV90L, UV5)
- **IR amplifier (NXCESIR)** allows use of the Fireye 48PT2 IR scanner
- **DC amplifier (NXCESDC)** allows use of certain Fireye Phoenix or InSight integrated scanners





UV scanners

UV1AL

The UV1AL series scanners are designed for front mounting which may allow the scanner to obtain a clearer view of the flame. The UV1AL comes with either a 0.915m (3') or 1.83m (6') TC-ER rated cable attached. The UV1AL has a ½" NPT female thread for mounting directly to a sight pipe.

UV1AL

The UV1AL, UV90L and UV5 ultra-violet flame scanners are non-self-checking and should be applied only to burners that cycle a minimum of once per 24 hours.

A parameter exists in the NXF4000 called 24-HOUR OPERATION that will cycle the control after 23:59 of continuous run time.

UV scanners

UV90L

The UV90L series scanners are designed for front and lateral (90°) mounting which may allow the scanner to obtain a clearer view of the flame. The UV90L provides a field wired terminal block.

UV90L (Cable purchased separately)

The UV1AL, UV90L and UV5 ultra-violet flame scanners are non-self-checking and should be applied only to burners that cycle a minimum of once per 24 hours.

A parameter exists in the NXF4000 called 24-HOUR OPERATION that will cycle the control after 23:59 of continuous run time.

UV scanners

UV5

The UV5 series scanners are designed for front and lateral (90°) mounting which may allow the scanner to obtain a clearer view of the flame. The UV5 provides a detachable 2m (80”) UL rated cable.

UV5

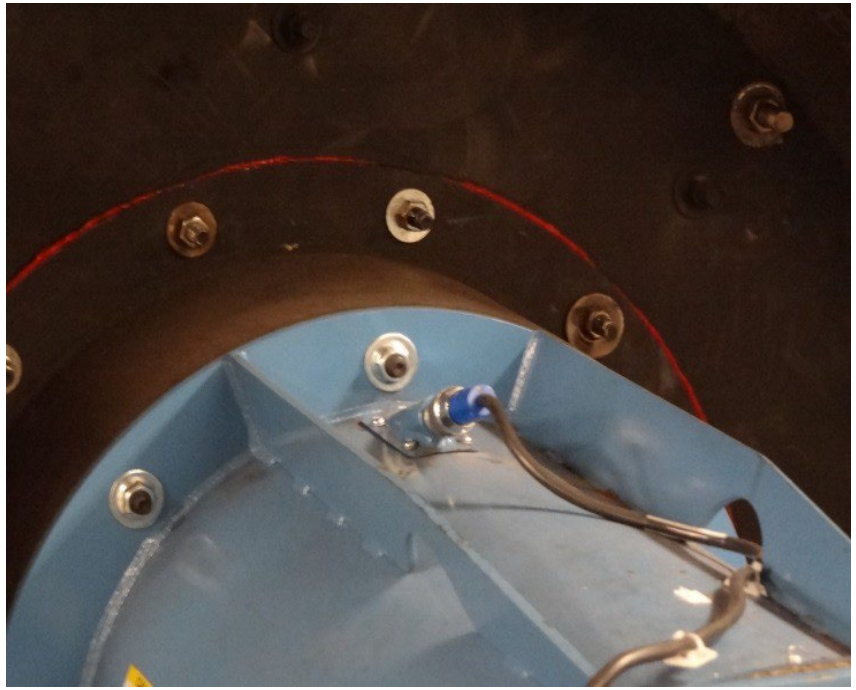
The UV1AL, UV90L and UV5 ultra-violet flame scanners are non-self-checking and should be applied only to burners that cycle a minimum of once per 24 hours.

A parameter exists in the NXF4000 called 24-HOUR OPERATION that will cycle the control after 23:59 of continuous run time.

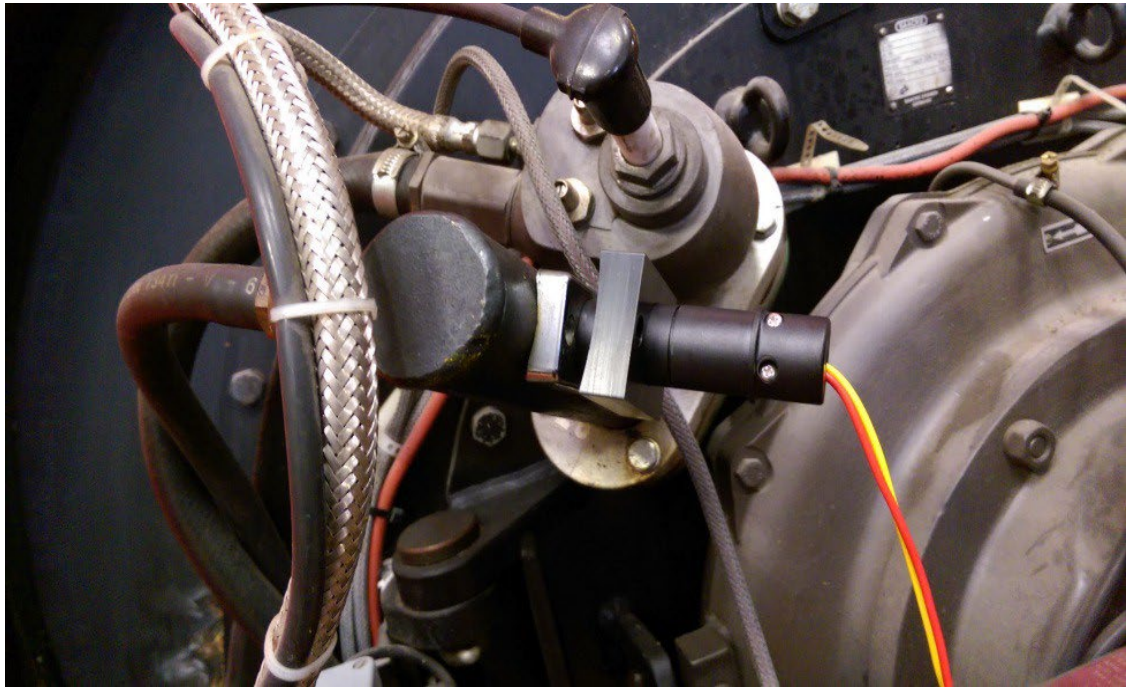
UV scanners

UV scanner application photos

UV1AL



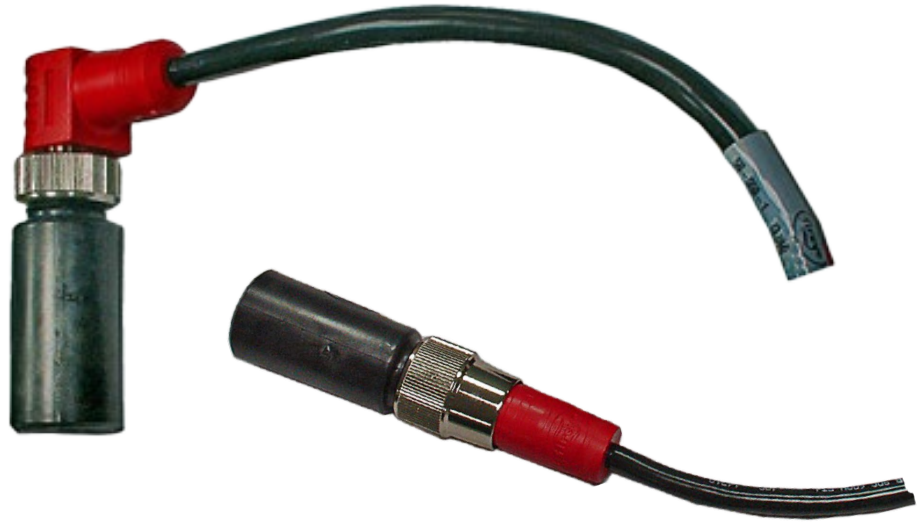
UV90L



IR scanners

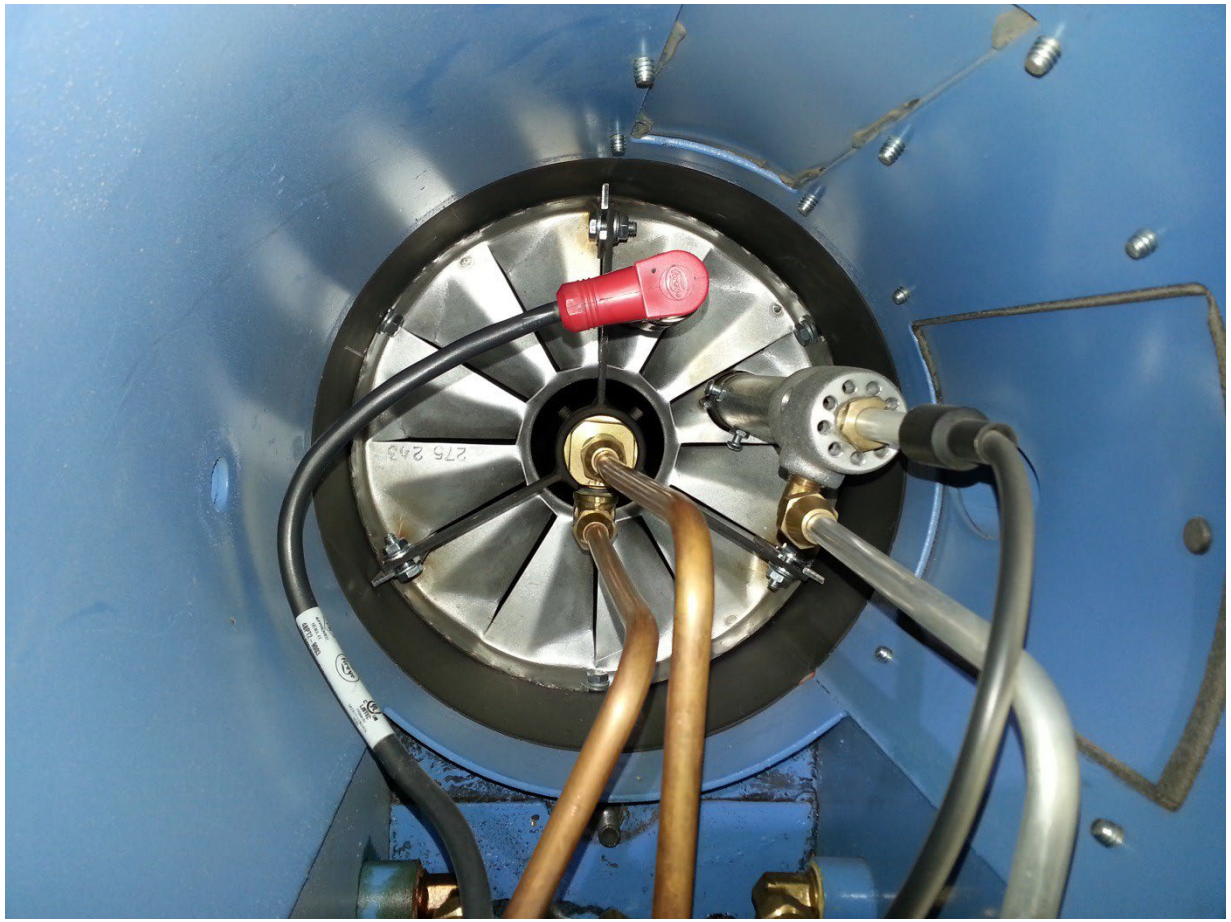
48PT2

The 48PT2 infrared scanner is offered in ½” NPT mounting in both straight mount or 90 degree mounting options. An attached 1.22m (4’) or 2.44m (8’) molded TC-ER cable provides the connection to the scanner. Use of this scanner is recommended for any application that will run for more than 24 hours continuously as the IR technology is inherently self-checking.



IR scanners

IR scanner application photos



Phoenix scanners (85UVF, 85IRF)

Overview

The Phoenix 85 series offer self-check models for detecting either ultraviolet or infrared radiation. Flame profiles can be programmed, including background flame.

- 8-pin quick disconnect (QD) connector
- 24VDC powered
- Voltage-free flame relay (fault relay internally wired in series) with additional voltage-free fault relay
- 4-20mA analog output for flame signal
- Keypad setup with LEDs for flame indication
- Class I, Div 2 (groups A, B, C, D) and ATEX hazardous area classification

InSight scanners (95UV, 95IR, 95DS)

Overview

The InSight scanners offer self-check models available for detecting either ultraviolet radiation, infrared radiation or both in one unit. Flame profiles can be programmed, including background flame.

- 12-pin quick disconnect (QD) connector
- 24VDC powered
- Voltage-free flame relay (fault relay internally wired in series) with additional voltage-free fault relay
- 4-20mA analog output for flame signal
- Keypad with display for monitoring and programming
- Inputs to select file (profile) to use – four available
- Modbus communication
- Class I, Div 2 (groups A, B, C, D) hazardous area classification
- ATEX hazardous area classification with proper housing

InSight II scanners (95DSS3)

- Overview
- The Insight II 95DSS3 scanner can detect both ultraviolet and infrared radiation in one unit. Flame profiles can be programmed, including background flame. There are additional connectivity options for displays and remote viewing and data collection.

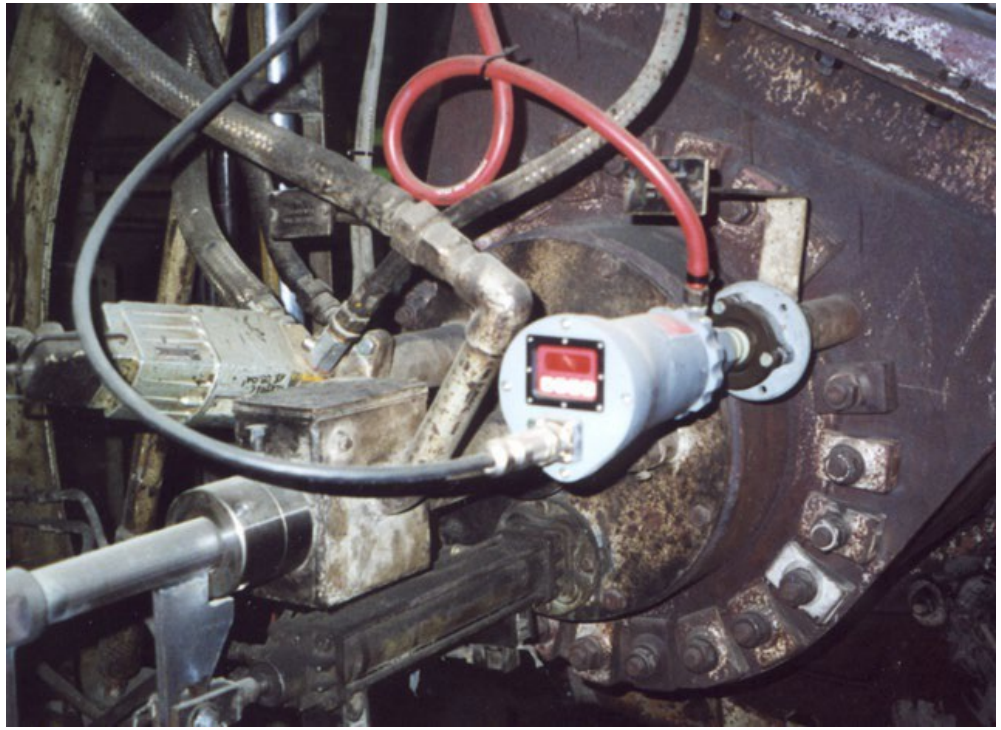
- 8-pin and 12-pin quick disconnect (QD) connectors
- 24VDC powered
- Two voltage-free flame relays (fault relay internally wired in series) with additional voltage-free fault relay
- Two 4-20mA analog outputs for flame signal and flame quality
- Inputs to select file (profile) to use – four available
- Modbus communication
- Class I, Div 2 (groups A, B, C, D) hazardous area classification
- ATEX hazardous area classification with proper housing

Integrated scanners

Integrated scanner application photos

Phoenix

InSight



Profiles

Four available profiles

The NXF4000 is best-in-class with support for four different profiles. The most common application for this is to offer a dual-fuel burner with a VFD bypass option, so each fuel can have a unique profile with and without VFD bypass. Each of these profiles can have up to 24 points.

- **Natural gas with VFD**
- **Light oil with VFD**
- **Natural gas on bypass**
- **Light oil on bypass**

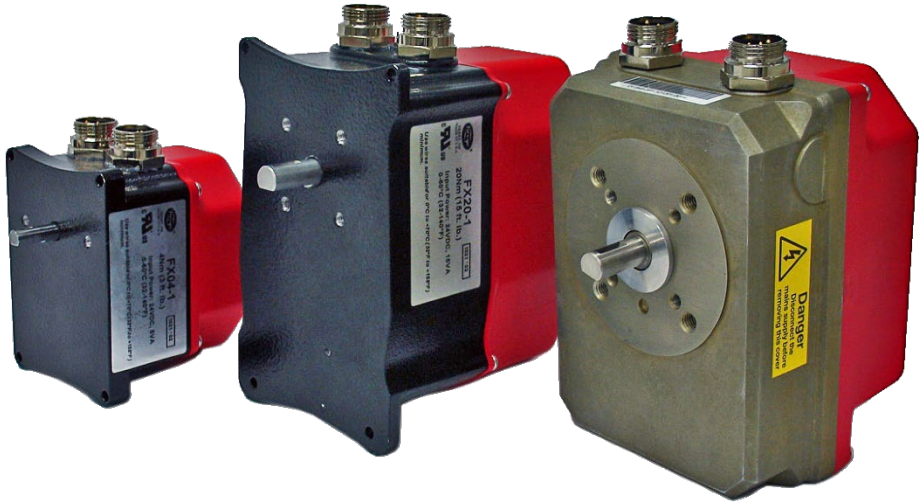
Control	Profiles	User curve points per profile
Fireye NXF4000	4	1 to 21
Fireye NX6100	4	1 to 21
Siemens LMV3	1 or 2 (model dependent)	9
Siemens LMV5	2	2 to 15
Honeywell SLATE	2	3 to 24
Autoflame Mk8	4	5 to 20
Autoflame Mini Mk8	2	5 to 20
Lamtec BT300	1 or 2 (model dependent)	10

Servos

FX series

There are three sizes of servo available with the FX series:

- 4Nm (3 ft.-lb.)
- 20Nm (15 ft.-lb.)
- 50Nm (37 ft.-lb.)



Each of these is 24VDC powered and operates using Modbus wiring to the NXF4000 on a secure transmission line. The NXF4000 provides up to 85W of power for the servos which is enough for most typical applications.

Internal servo power, no external power supplies needed for most applications

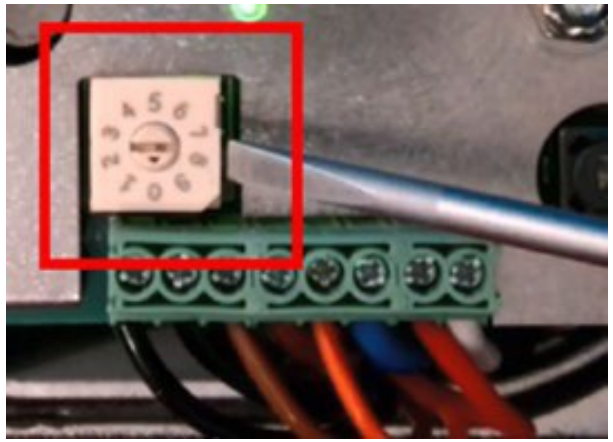
Secure Modbus communication for easy wiring

Servos

FX series

There is also an option for servos with quick-disconnect (QD) cables. Using the QD cables makes it easier to service a burner if the servos need to be quickly disconnected for maintenance.

Addressing the servos is done using a rotary switch making switching out a servo quick and easy.



Servos

Up to ten servos

The NXF4000 can support up to ten connected servos, with up to four active on any profile. The minimum requirement is two servos or one servo with a VFD.

Control	Max servos	Servos per profile	Servo communication
Fireye NXF4000	10	4	Modbus
Fireye NX6100	10	10	CAN
Siemens LMV3	2 or 3 (model dependent)	2	Analog
Siemens LMV5	6	5	CAN
Honeywell SLATE	4	4	Modbus
Autoflame Mk8	4	4	Analog
Autoflame Mini Mk8	3	3	Analog
Lamtec BT300	2 or 3 (model dependent)	2	Analog

Servos

FX series other features

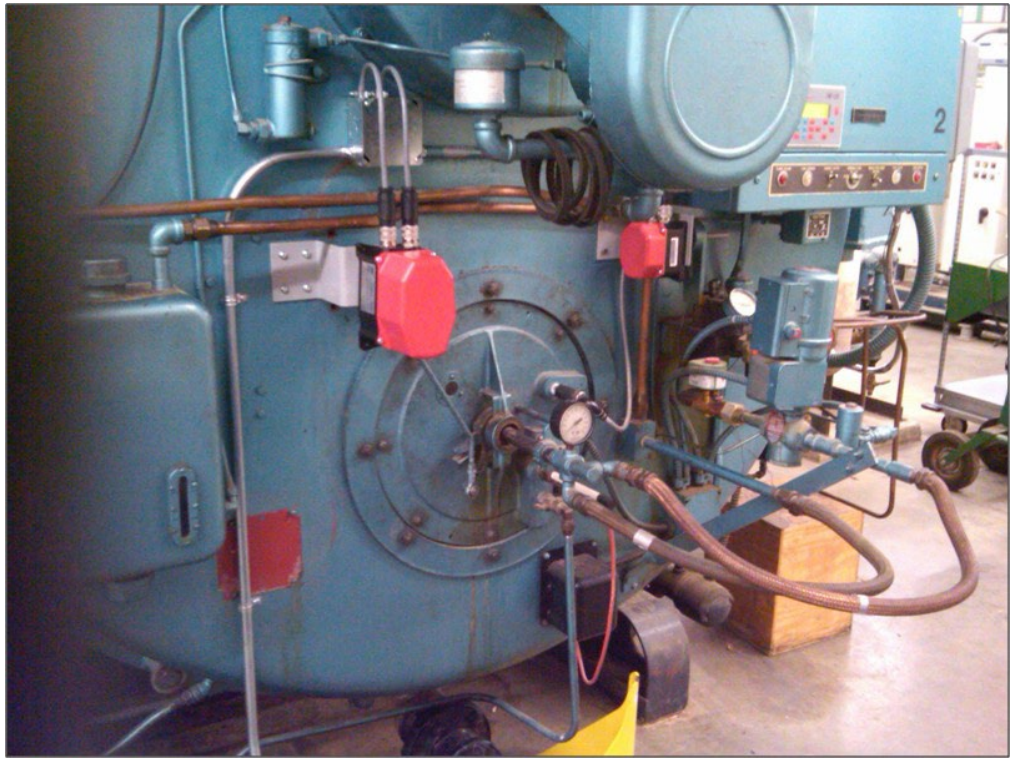
- Stepper motor control offers 0.1 angular degree of accuracy
- 99.9 angular degrees of rotation
- Variable speeds of full-stroke movement from 30 to 120 seconds
- D-type shafts
- CW or CCW rotation with manual movement buttons under the cover to ease setup
- NEMA 4X, IP65 rated

Servos

Servo application photos

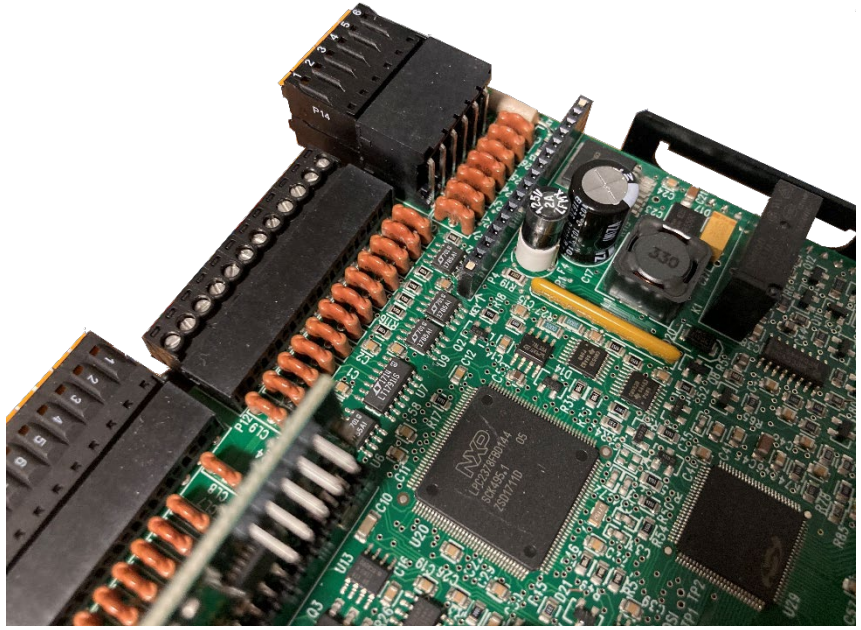
FX50

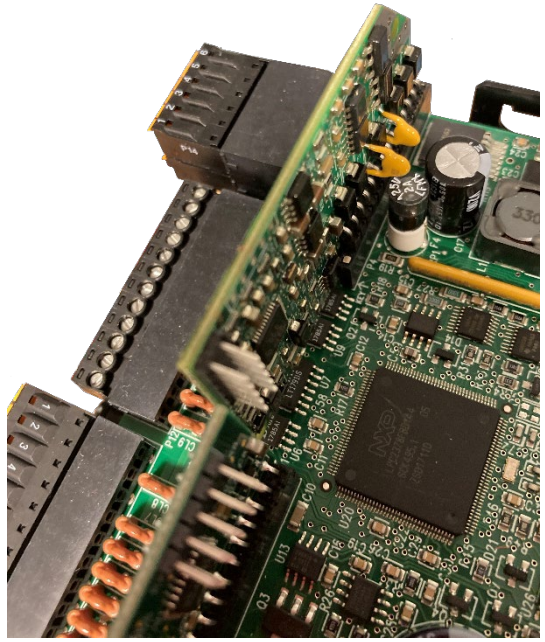
FX04/FX20



VFD

- Up to two VFDs
- The NXF4000 can support up to two connected VFDs using the NXCESVFD add-on card. This card mounts in a similar manner to the amplifier card. Each VFD is controlled from a 4-20mA signal and must feedback must be provided either from the VFD 4-20mA output (programmed to indicated running frequency) or from an external encoder or speed wheel.





Interface options

4.3” touchscreen

The NXD410TS touchscreen is the next generation standard interface to allow for commissioning, monitoring and operating the NXF4000. The display is a 4.3” touchscreen with a four-line text terminal and virtual function keys. Onboard help files link to lockout codes to help with troubleshooting and there is alternate language support for Simplified Chinese. The display is 24VDC (powered from the NXF4000) and has an IP40 rating.

Interface options

7” and 12” touchscreen

The NXTSD507HD (7”) and NXTSD512HD (12”) touchscreens are upgrade options that allow for commissioning, monitoring and operating the NXF4000. These can be used in addition to or instead of the NXD410 or NXD410TS. These displays are 24VDC (powered from the NXF4000) and have an IP67 rating.

These screens can be used for configuration and commissioning, not just monitoring

Interface options

7” and 12” touchscreen

- Modbus TCP/IP server for BMS communications
- VNC server for remote viewing over network
- Language editor to customize text
- Ability to connect multiple devices to one screen
- Compatible with NXF4000, PPC4000, BurnerLogix, BurnerPRO and ABB ACS550 VFDs

Minimum system

Components

Satisfy the requirements from each column to assemble a working system:

Control (need one)	Amplifier (need one)	Interface (need at least one)	Servos and VFD (need at least two)
NXF4000 NXF4000-230V	NXCESIR NXCESUV NXCESDC	NXD410TS NXTSD507HD NXTSD512HD	FX04 FX20 FX50 NXCESVFD
Terminal block kit 60-3004 is sold separately	Scanner is sold separately	It is possible to connect one NXD410TS in tandem with one of the other options	Only one NXCESVFD can be fitted so another servo is also required

Additional connection cables may be required as well.

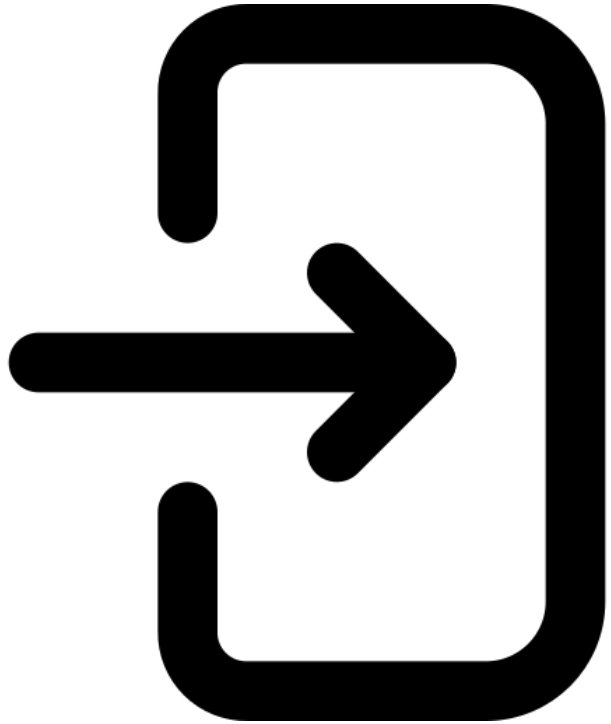
Digital inputs

Flexible line voltage inputs

There are 15 available line voltage inputs that can each be user assigned for a variety of options. Dedicated inputs can be used for special functions such as:

- Valve proving
- Airflow switch with change-of-state verification)
- Fuel valve end switch

Inputs can also be read over Modbus for further processing or annunciation.



Analog inputs

4-20mA sensor inputs

There are five 4-20mA analog inputs used for connecting field sensors. The most common uses are for connecting the control sensor (steam/pressure or hot water/temperature) and for connecting the standby water sensor (temperature). When configuring a sensor, the list of available functions and sensor ranges are presented. A remote 4-20mA modulation signal can also be used directly if the control is set for “track” modulation.

Analog inputs

Available sensor ranges

Sensor	Type	Minimum	Maximum
BLPS-15	Pressure	0 mb (0 psi)	1030 mb (15 psi)
BLPS-25	Pressure	-1013 mb (-14.7 psi)	1720 mb (25 psi)
BLPS-30	Pressure	0 mb (0 psi)	2070 mb (30 psi)
BLPS-200	Pressure	0 Bar (0 psi)	13.8 Bar (200 psi)
BLPS-300	Pressure	0 Bar (0 psi)	20.7 Bar (300 psi)
TS350-2*,-4*,-8*	Temperature	0°C (32°F)	176°C (350°F)
TS752-2*,-4*,-8*	Temperature	0°C (32°F)	400°C (752°F)
FXIATS-140	Temperature	-40°C (-40°F)	60°C (140°F)

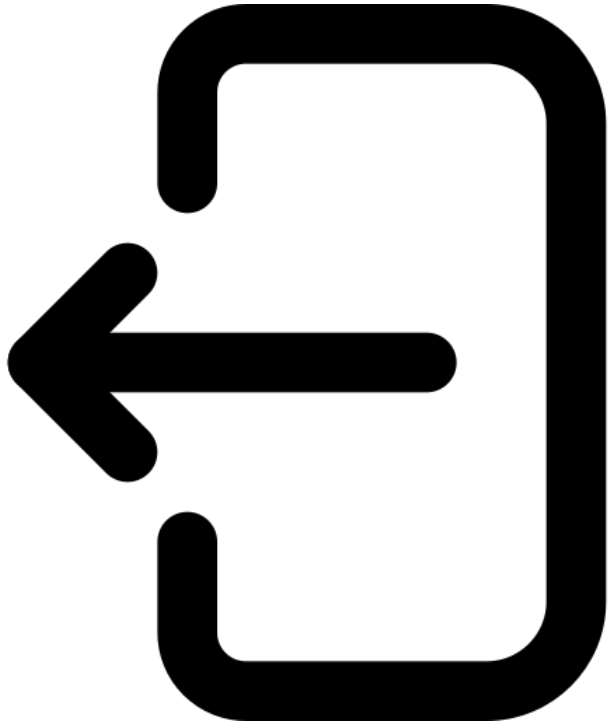
* indicates length of insertion probe

Digital outputs

User-assignable line voltage outputs

There are three user-assignable line voltage outputs available. These can be set with different on and off assignments so that they can be used for sending status to a BMS or PLC system. They can also be used to control other accessories such as pumps or valves.

These outputs can also be directly controlled via a remote PLC using Modbus.



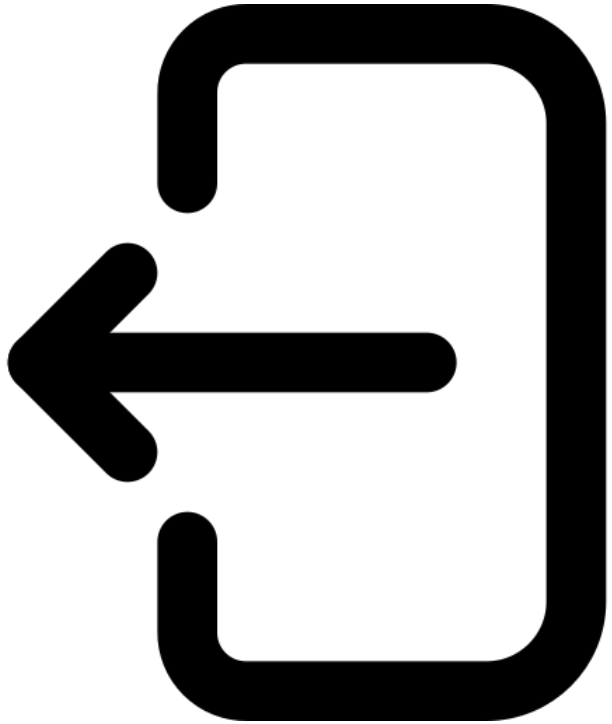
Analog outputs

User-assignable 4-20mA outputs

There is one user-assignable 4-20mA analog output available. This can be set for a variety of different uses such as to retransmit an analog input or to indicate the modulation rate or a servo position.

If an NXCESVFD card is fitted, any unused analog outputs from there can also be used in this manner. This means that up to three analog outputs may be available.

These outputs can also be directly controlled via a remote PLC using Modbus.

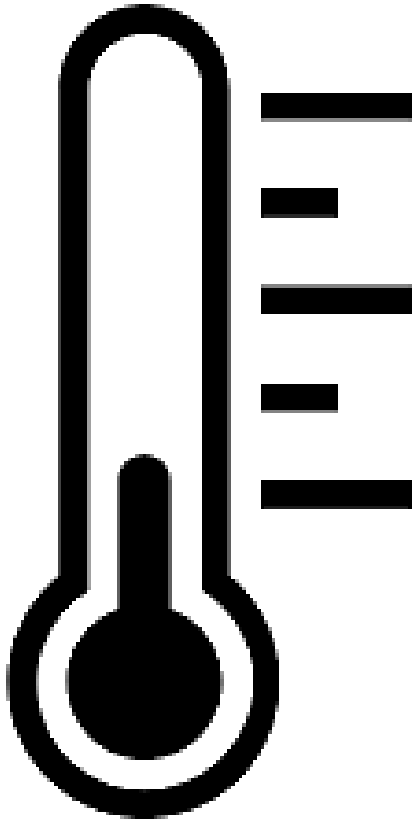


Additional features

Thermal shock or warming

Typically used with a steam boiler, this involves checking the temperature upon start-up. Depending upon the setup options chosen, modulation will be restricted by temperature or will gradually increase in steps as the temperature increases. To use this feature, a sensor is chosen and the desired algorithm and setpoints are entered.

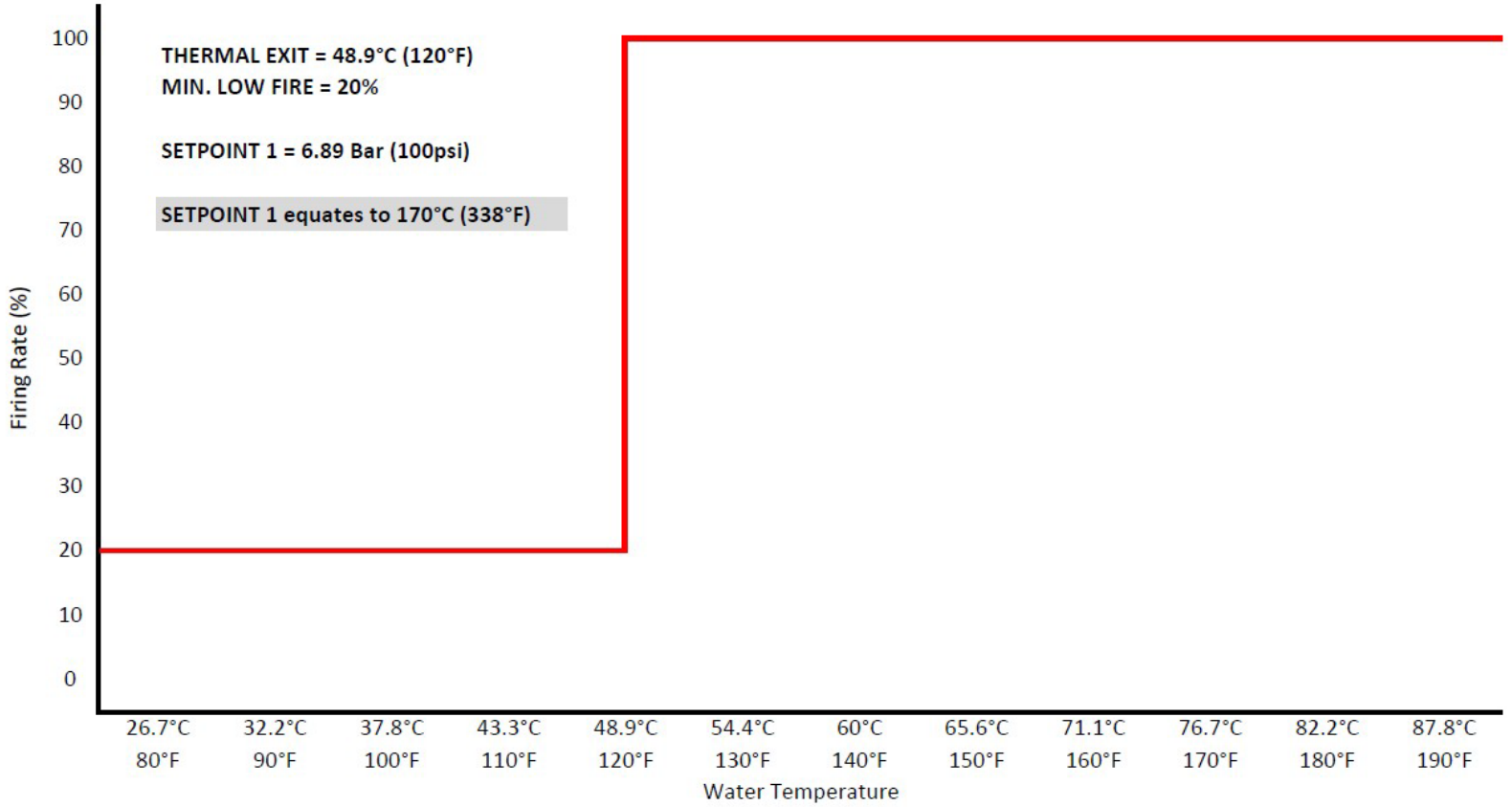
This feature can also be used with a steam sensor although this method is not recommended.



Additional features

Thermal shock via temperature hold

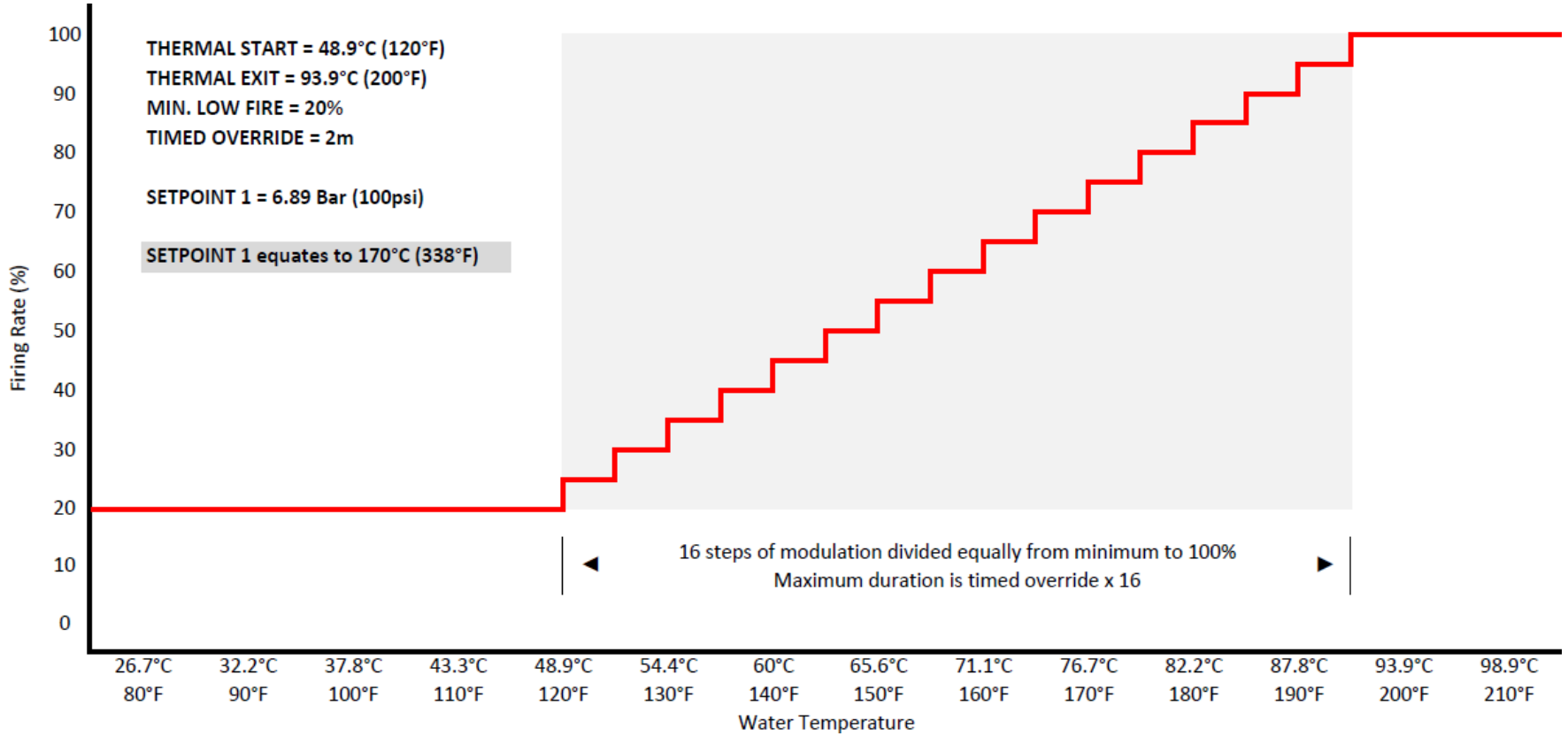
Using this method, a setpoint is selected that will allow modulation to begin. At any temperature below that setpoint, the burner will modulate only at the selected firing rate.



Additional features

Thermal shock via segmentation

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.



Additional features

Hot standby

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 boiler is kept ready to produce usable steam quickly when it is needed again.

Hot standby can be activated if there is a standby water temperature sensor connected. There also needs to be a control scheme in place, such as peer-to-peer sequencing or track modulation. When track modulation is used a digital input must be assigned to enable the control. Hot standby can occur if a lag boiler in peer-to-peer sequencing is idle or if the digital input for track modulation is not made.

When standby mode is active, the unit will operate to maintain the desired water setpoint instead of the usual pressure setpoint. Any other functions such as thermal shock will still apply before modulation will occur.

Additional features

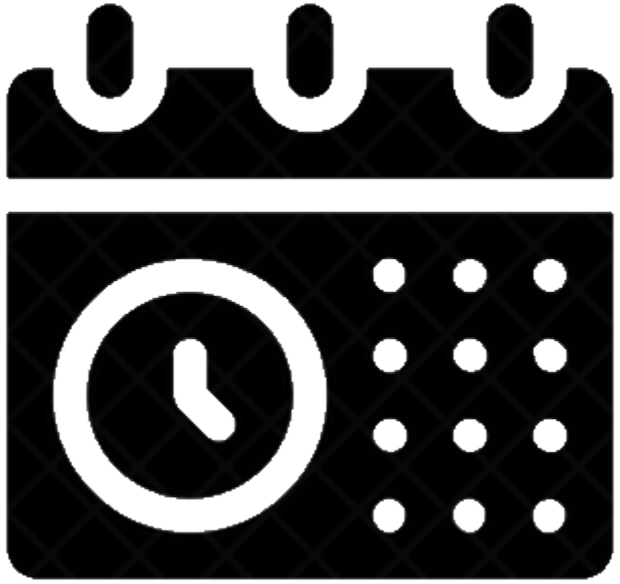
Peer-to-peer sequencing

Up to six NXF4000 (or PPC4000) controls can be connected using a dedicated Modbus connection for peer-to-peer sequencing. One control is selected to be the lead control by using either the interface or by using a digital input. The lead control will determine when to bring lag controls online based upon the total number of slaves as well as the on and off points entered. Each on and off point also has an associated delay timer to ensure that the on or off condition lasts for a minimum duration.

Hot standby can be enabled for any lag boiler controlled by this sequencing so that a minimum water temperature is maintained.

Additional features

Real-time clock



The NXF4000 contains a real time clock that is used to record fault history and implement the setback schedule. To operate properly, the real time clock should be checked and set correctly.

The NXF4000 maintains the last ten lockouts in the non-volatile fault history. This can be accessed at any time and the interface will automatically show the fault history page or a link to the fault history whenever a lockout occurs.

The setback function allows choosing a setback setpoint with a time to begin and end the setback period. There is an action for each day whether to use the setback all day, not use the setback at all, or to follow the time-of-day schedule as set. Additionally, if setback is used digital inputs can be programmed to override the setback or to implement the setback with priority.

Additional features

Assured low fire cutoff

When being controlled using the internal PID control and stat, the firing rate will be reduced to low fire before entering postpurge and ending the burner cycle.

If a limit input is the cause of the shutdown, the control will shut the burner down immediately regardless of the firing rate.

Oxygen trim

NXCESO2

The Fireye NXCES02 zirconium dioxide probe is designed to be used with the NXF4000 and provides continuous oxygen concentration readings allowing the NXF4000 to trim the air or fuel servo to obtain optimum combustion efficiency. The NXCESO2 probe connects to the NXF4000 using a Modbus connection. The required connections are 24VDC power (sourced from the NXF4000) and Modbus.

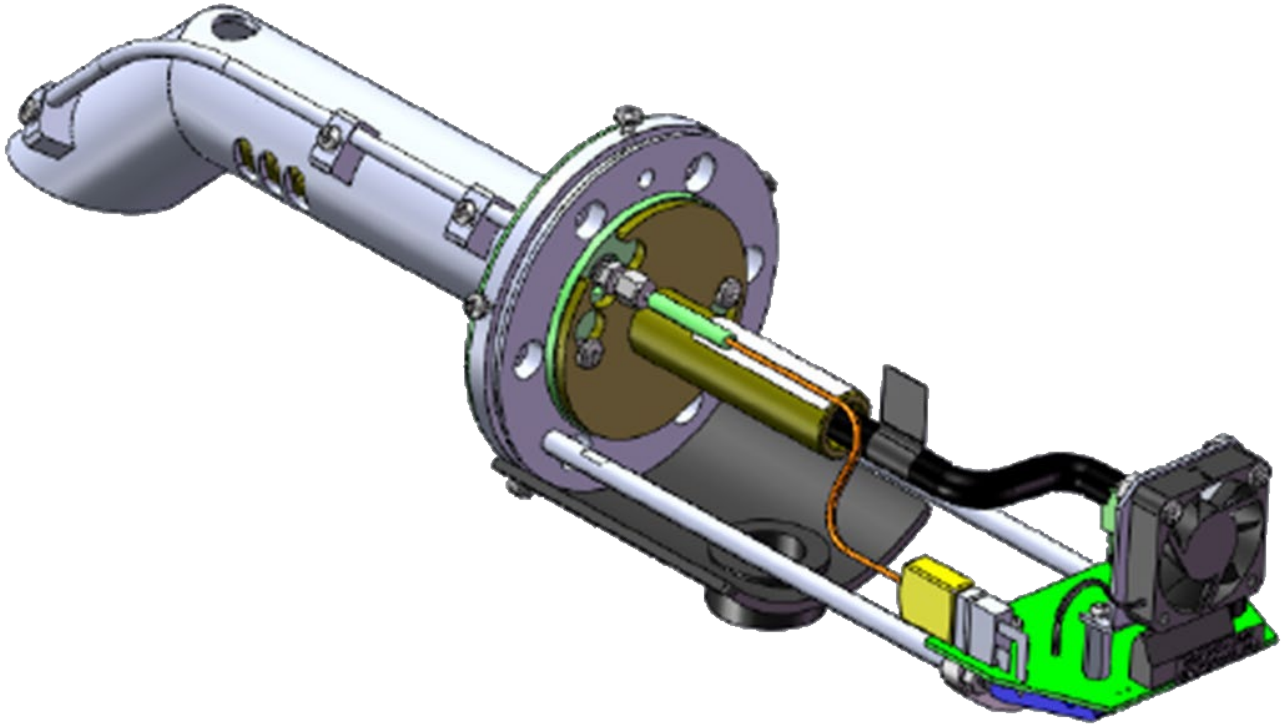
The NXCESO2 incorporates a type K thermocouple to measure flue temperatures up to 426°C (800°F).

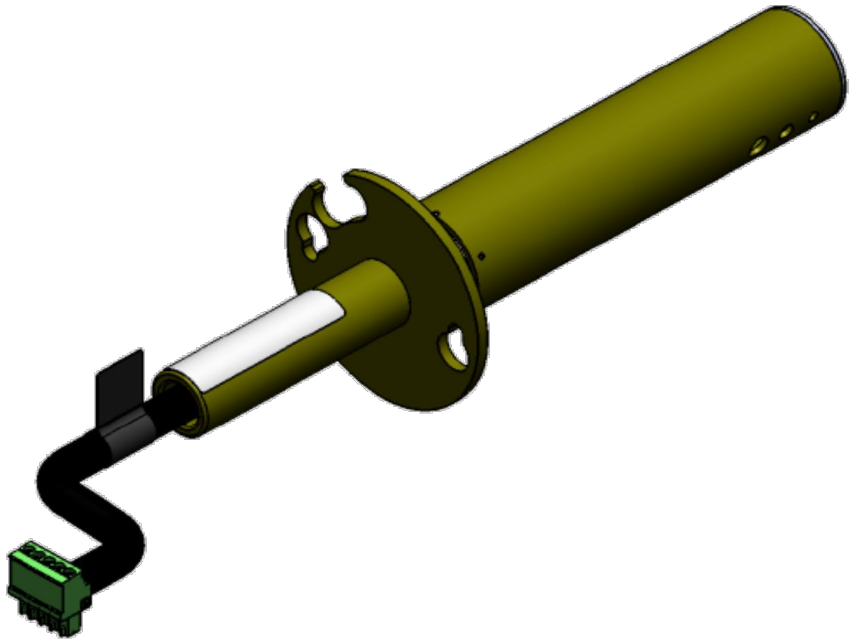
Two insertion depths are available: 216mm (8.5”) and 407mm (16”).

Oxygen trim

NXCESO2 removable probe

The probe assembly in the NXCESO2 is easily removed for service or replacement. This eliminates the need to remove the probe assembly from the stack.





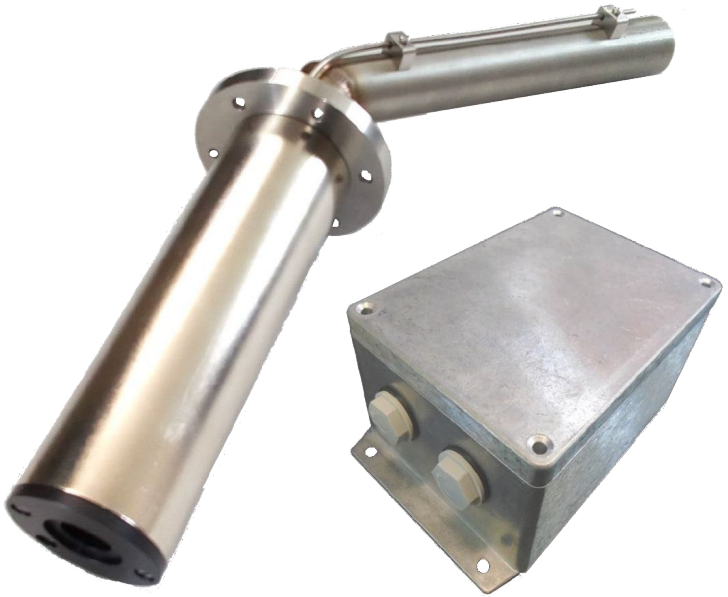
Oxygen trim

FXCESO2 with FXO2TRIM-1

The Fireye FXCES02 zirconia oxide probe and FXO2TRIM-1 interface is an alternative to the NXCESO2 for industrial applications where the operating temperature is in excess of 85°C (185°F). The FXO2TRIM-1 interface connects to the NXF4000 using a Modbus connection. The required connections are 24VDC power (sourced from the NXF4000) and Modbus.

The FXCESO2 incorporates a type K thermocouple to measure flue temperatures up to its maximum temperature rating of 600°C (1112°F). This higher range is due to the remote mounting of the electronics in the FXO2TRIM-1 interface.

Three insertion depths are available: 215mm (8.5”), 406mm (16”) and 757mm (31.4”).



Use this probe for higher ambient temperature locations

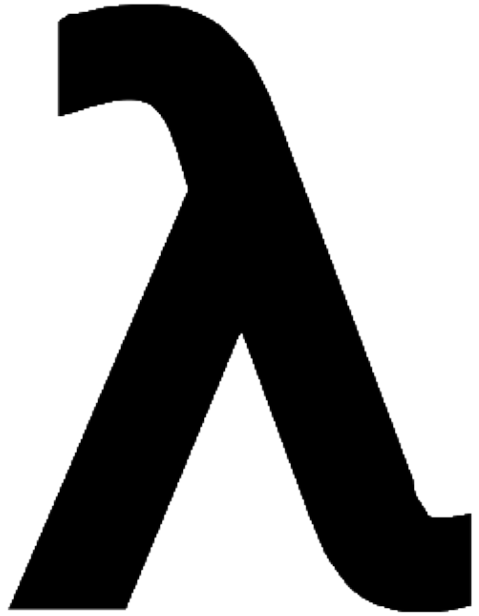
Oxygen trim

Control modes

If oxygen trim is enabled, there are two control modes: MONITOR and CONTROL.

If MONITOR is chosen, the O_2 level will be monitored and displayed on the top level of the interface. O_2 limits and flue temperature limits are still monitored, and alarms are still issued.

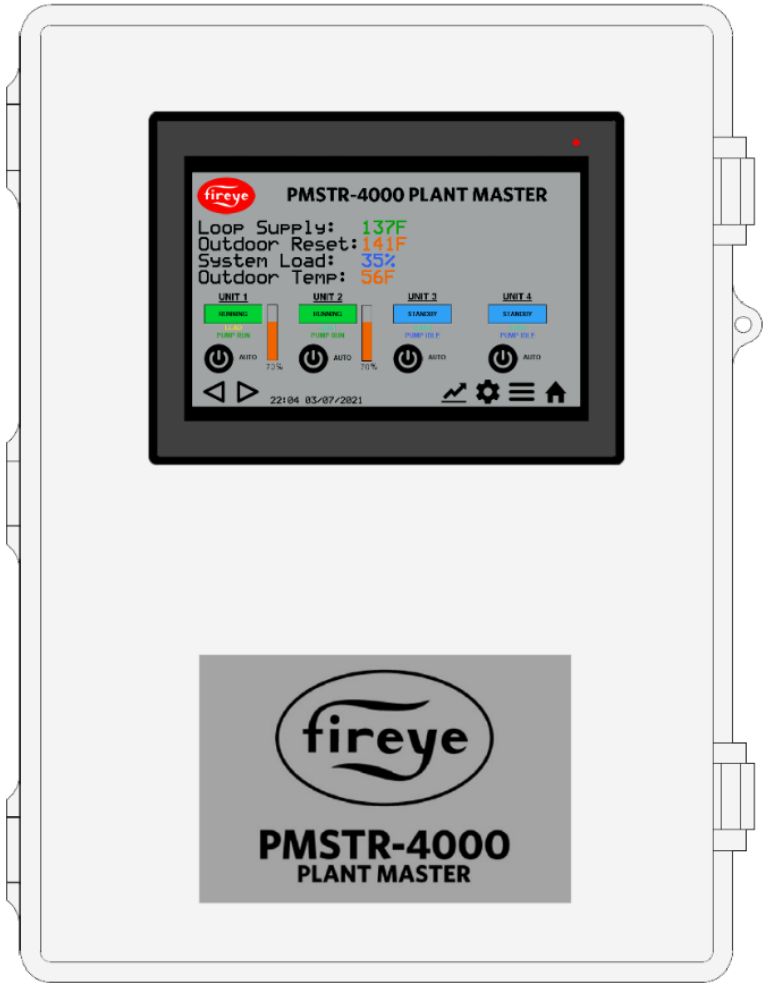
If CONTROL is chosen, the system will trim the O_2 level automatically using the trim channel chosen. Trim limits and PID gains are set to tune trim control. If an O_2 limit is reached the choice can be made either to issue a warning and disable trim, or to lockout immediately.



Plant Master

PMSTR-4000 description

The PMSTR-4000 Plant Master provides centralized 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.



Plant Master

Differences from peer-to-peer connection

Up to six NXF4000 and/or PPC4000 controls can be connected for lead/lag sequencing without a master panel.

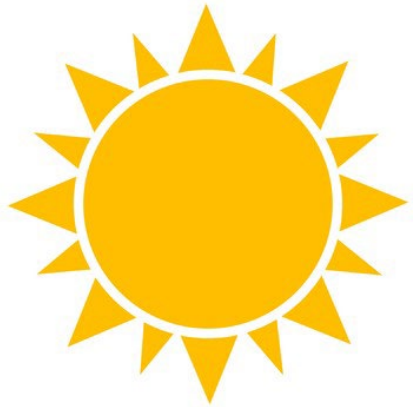
Some of the differences between peer-to-peer and plant master control are:

- Peer-to-peer uses the lead control's sensor for PID control instead of centralized sensor
- Peer-to-peer requires manual lead control selection instead of automatic rotation
- Plant master works with up to eight controls instead of six
- Plant master has additional options such as pump control, outside air setpoint reset, etc.

Plant Master

Options and features

- Works with steam or hot water systems
- Can connect to up to eight NXF4000 and/or PPC4000 controls
- Remote setpoint
- Outdoor temperature setpoint reset
- Warm weather shutdown
- Time-of-day schedule functionality
- Pump control with feedback alarms
- Real-time PV-SP trend
- Modbus TCP/IP interface
- Modbus RTU (RS232 or RS485) interface



Plant Master

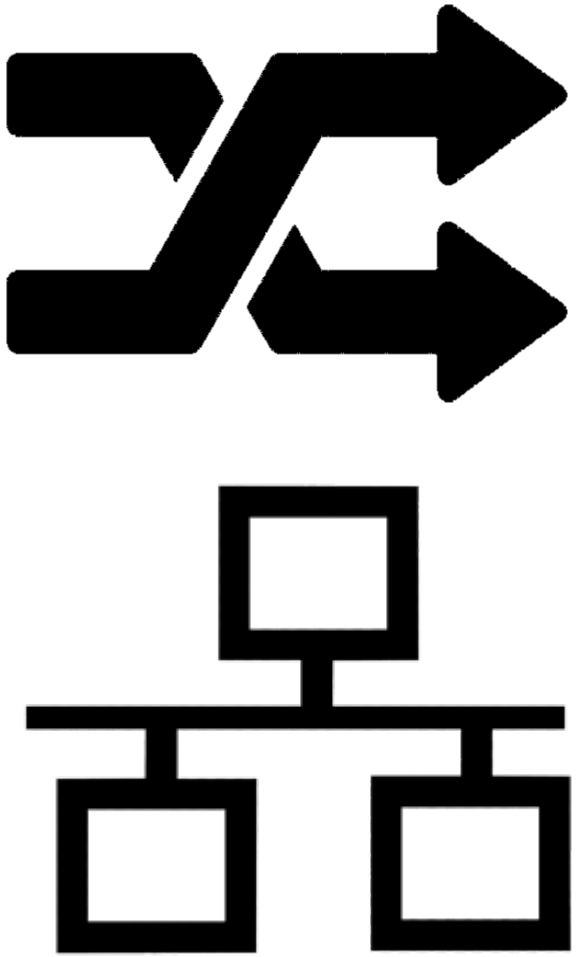
Savings

- Unique algorithm determines how many units to operate to maximize efficiency
- Automatic lead rotation promotes even operating hours over time
- Pump control with timers reduces wasted electrical usage
- Connection to building management is available
- Time-of-day occupancy settings can be used to adjust setpoints or disable/enable system
- Operating parameters and setpoints are adjustable so operation can be fine-tuned to the installation

Plant Master

Redundancy

- Failure backup via automatic lead change when a control is locked out or isn't communicating
- "Watchdog" timers in each control to revert to local load demand and enable upon loss of communication
- Local features such as thermal shock and hot standby can still be used



Plant Master

- Specifications
- Polycarbonate enclosure is IP66 (NEMA 4X) rated
- External dimensions of 270mm x 370mm (10.64 in. x 14.59 in.) with a depth of 151mm (5.92 in.)
- 7” touchscreen interface with a resolution of 800x480 pixels
- 100-240VAC 45-65Hz input power
- UL508A listed enclosed industrial control panel for United States and Canada

Modbus

Modbus RTU interface

The NXF4000 offers a Modbus RTU interface for communication to a BMS or PLC. When the NXTSD507HD or NXTSD512HD touchscreens are optioned, these use the Modbus connection and so a Modbus TCP/IP server is offered as a replacement.

All operating data can be monitored using the Modbus connection. In addition, commands can be sent to activate the local interface keys such as burner on/off, auto/manual, low fire hold and manual fire rate. Setpoints can be written as well.

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

Backup/restore

SD card interface

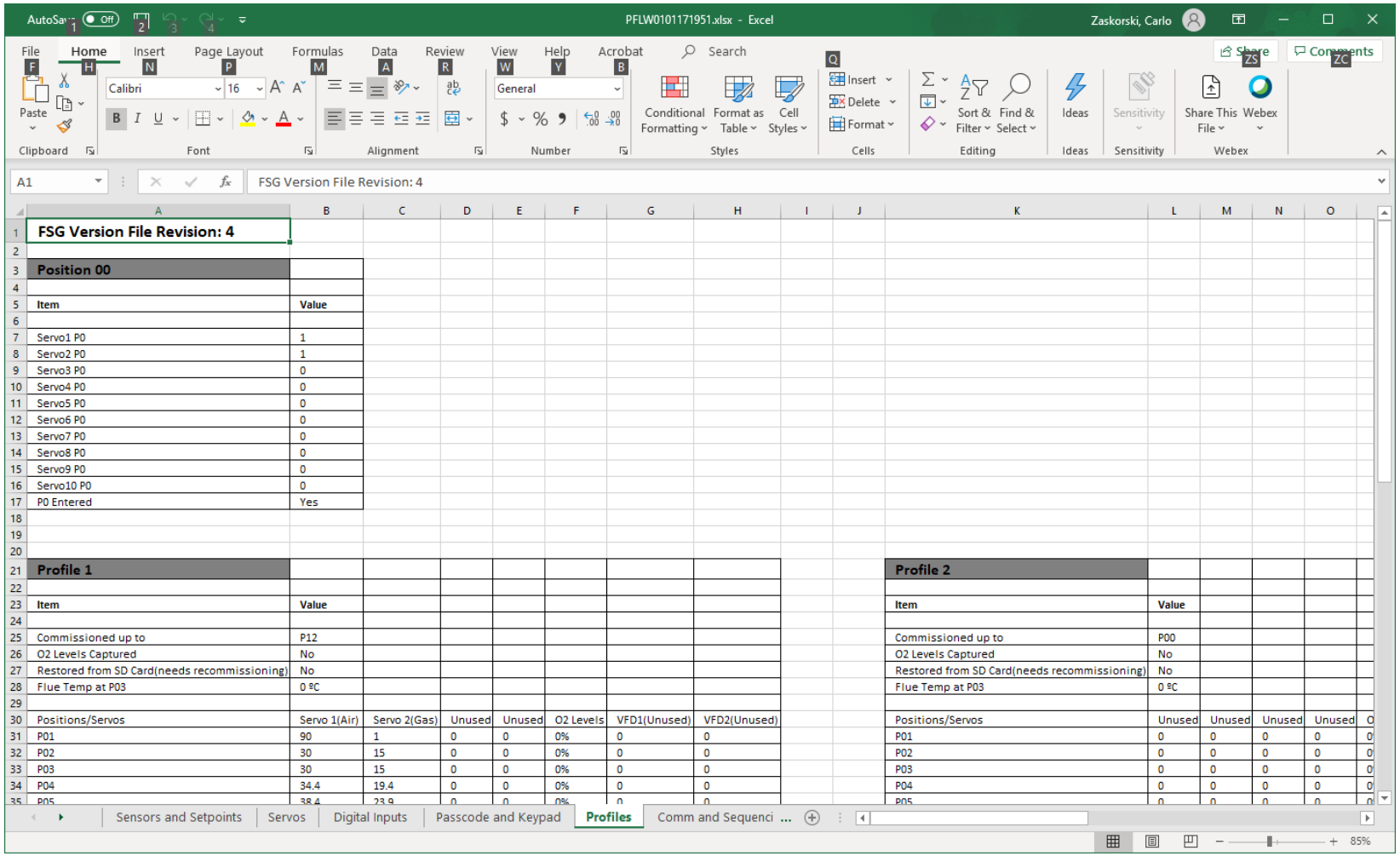
The NXF4000 has a built-in SD card reader that can be used to backup profiles, parameters or both. Each unit also ships with an SD card. This makes it easy to back up site configurations as well as to migrate settings from one unit to another.

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 2.3” 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.

It is recommended to use an SD card that is 32GB or less and formatted to the FAT32 file system. It is recommended to use the FORMAT option when a new SD card is inserted into the NXF4000 for the first time.

Backup/restore

Excel backup file



FSG Version File Revision: 4

Position 00

Item	Value
Servo1 P0	1
Servo2 P0	1
Servo3 P0	0
Servo4 P0	0
Servo5 P0	0
Servo6 P0	0
Servo7 P0	0
Servo8 P0	0
Servo9 P0	0
Servo10 P0	0
P0 Entered	Yes

Profile 1

Item	Value
Commissioned up to	P12
O2 Levels Captured	No
Restored from SD Card(needs recommissioning)	No
Flue Temp at P03	0 ºC

Positions/Servos	Servo 1(Air)	Servo 2(Gas)	Unused	Unused	O2 Levels	VFD1(Unused)	VFD2(Unused)
P01	90	1	0	0	0%	0	0
P02	30	15	0	0	0%	0	0
P03	30	15	0	0	0%	0	0
P04	34.4	19.4	0	0	0%	0	0
P05	38.4	23.9	0	0	0%	0	0

Profile 2

Item	Value
Commissioned up to	P00
O2 Levels Captured	No
Restored from SD Card(needs recommissioning)	No
Flue Temp at P03	0 ºC

Positions/Servos	Unused	Unused	Unused	Unused	O
P01	0	0	0	0	0
P02	0	0	0	0	0
P03	0	0	0	0	0
P04	0	0	0	0	0
P05	0	0	0	0	0

Conclusion

Full-featured parallel positioning

- The NXF4000 is a full-featured parallel positioning system that rivals any other in the same class. It also offers many unique features such as support for four profiles and peer-to-peer sequencing that most competing products don't support.
- For applications where the NXF4000 does not fit for technical reasons, the related PPC4000 product may be able to be used with an external flame safeguard. The BurnerLogix and BurnerPRO flame safeguards offer support for many additional configurations (flame rod and UV self-check, for example) that the NXF4000 may not support.

- Support for four profiles
- Peer-to-peer sequencing
- PPC4000 available for use with external flame safeguard
- Common accessories with PPC4000
- Simple menus and intuitive

interface Easy to retrofit

THANK YOU