NXF4000
SETUP AND COMMISSIONING
BASIC COURSE

Revised August 2021

Section 1

COURSE INTRODUCTION

Course introduction

What the course covers

A basic introduction to the NXF4000 will be followed by hands-on commissioning of an NXF4000 using training units and a basic application template. All the steps required for a setting up and commissioning this application will be covered. A sample wiring schematic from the “NXF4000 Wiring Application Guide” will be used as a guide for where to connect sensors and inputs.

Time will be provided for each participant to setup and commission a training unit for additional hands-on experience. Since training units will be shared among participants, it is suggested that each person is given an opportunity to set up different parameters and commission different points during the process.

Course introduction

Training units

The NXF4000 training units used have all the necessary digital inputs and analog inputs wired to the main control. Additionally, the digital outputs normally used to control the blower, ignition and fuel valves are connected to status LEDs. Other features such as flame signal have the option to be automated to allow commissioning a profile using the two connected servos. An NXCESVFD card is also installed with simulated feedback, allowing for a VFD to be added to any profile.

Section 2

BURNER CONTROL BASICS

Burner control basics

Traditional burner control

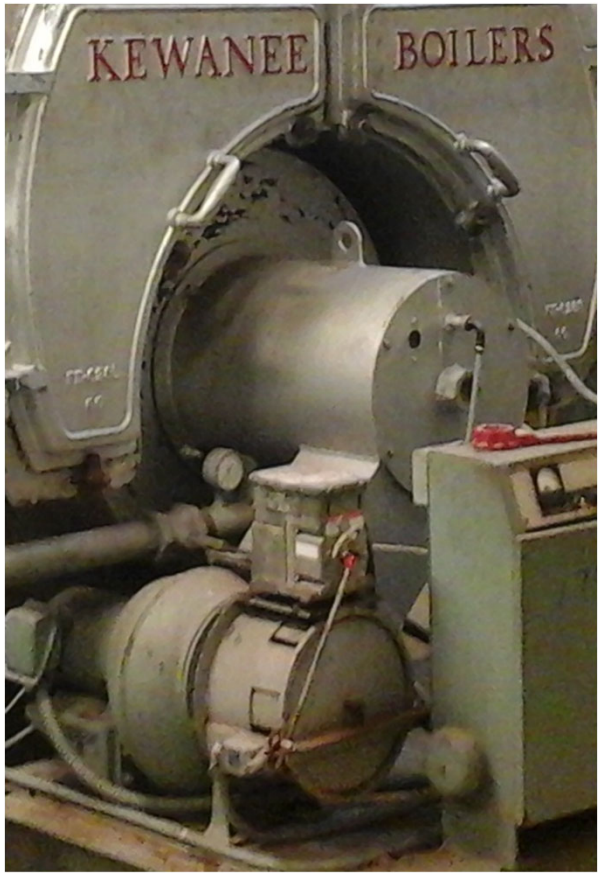
The most basic form of burner control is on/off. When automatic burner controls became available, this was the best available control technology. Over time, modulation was possible with the advent of the proportional slide wire control and the modulating motor. This type of control is known as single-point, or linkage control. This is because only one motor can safely be controlled by the slide wire output.

Burner control basics

Linkage burner control

Linkage burners link the air damper and fuel valves together through a common linkage. They maintain a fixed relationship through the firing range.

Linkage burners can only be set up accurately on low-fire and high-fire. Any firing rate in between is subject to the position of the linkage and may not be optimal. During commissioning all intermediate firing rates must be checked for safe combustion. Another issue with linkage is the hysteresis that occurs from the tolerances or “slop” present in the linkage mechanisms and can vary while modulating up or down due to where the tension is present on the linkage.



Burner control basics

Slide wire control

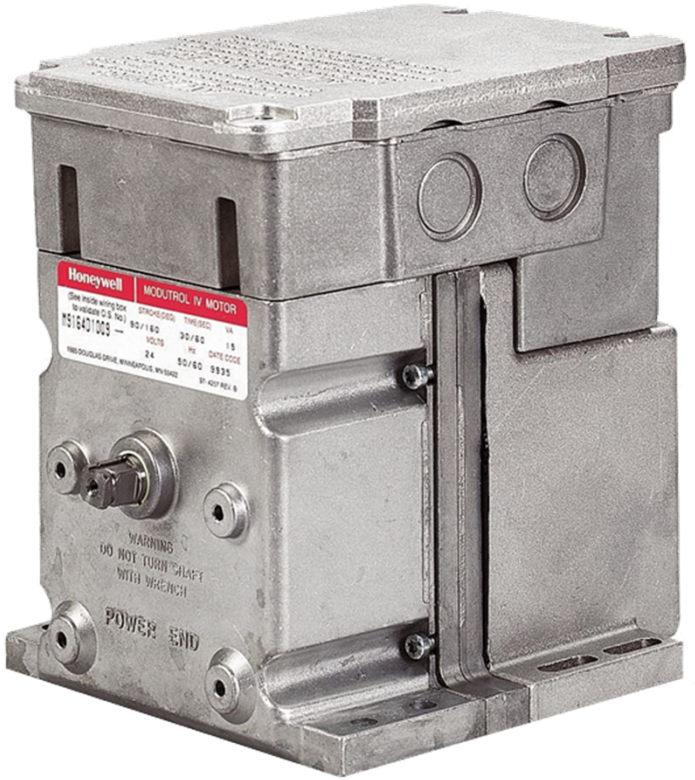
For the technology of the time, slide wire control was revolutionary. It is a mechanical system that creates a proportional output of 0 to 135 ohms based upon the setpoint and actual value. This resistance output is then connected to a modulating motor. The setpoint and the proportional gain are set using springs. These are presented to the user on a printed legend. As such, the slide wire can't control too precisely since the actual setpoint is never known. Additionally, with only proportional control it can be hard to reach the setpoint at times as there is no way to account for changing load conditions.

Burner control basics

Modulating motors

The typical 0-135ohm modulating motors that are used are directly connected to the slide wire controls. The motors can be directed to the high and low positions as needed through the flame safeguard for purge and ignition and are connected to the slide wire control through a relay when the automatic run state is reached.

These motors run open-loop (no feedback) and do not have fine resolution. This means that while the motor may have a span of 90 angular degrees, this may only result in 20 or fewer different steps of modulation. This is due to the inherent design of the motor and slide wire control.



Burner control basics

Parallel positioning burners

Parallel positioning burners allow the air and the fuel to each be individually controlled by a servo at each designated firing rate. Additional servos for FGR and/or sliding head position can also be incorporated. This allows for a true characterized combustion curve through the entire firing rate. Instead of using wrenches to adjust a linkage, commissioning is done via an operator interface. The servos used are closed loop with much more precision than the typical modulating motor, with 900 steps of resolution over 90 angular degrees. This also eliminates all the hysteresis during firing rate changes.

Slide wire control is replaced by intelligent PID control. The slide wire lack of resolution is addressed by the PID control.

As technology has evolved, the shortcomings of linkage burners and slide wire control have been amplified by changing efficiency and emissions initiatives. Although linkage may still be the lower cost option initially, over the life of the burner these inefficiencies will result in a linkage burner costing more to operate and maintain than if it were a parallel positioning burner.

Burner control basics

Reasons to use an NXF4000 in your burner

While upgrading or replacing an existing linkage burner to a burner with an NXF4000 control system may incur a high initial cost, it is important to realize that the initial capital costs for equipment and labor will be a one-time expense and will end up having the lowest impact over the life of the burner.

The largest expense when operating a burner is energy. This can be both fuel and electricity. Parallel positioning allows greatly increased efficiency during operation as well as the ability to take full advantage of the burner turndown for all fuels. This results in savings that can be measured quickly. In addition, the affinity laws for fans and pumps state that at 80% flow only half of the electricity is used, so using a combustion air VFD can also save a lot when commissioned to take advantage of this.

The last large expense over the life of a burner is maintenance. The superior diagnostic capabilities of a parallel positioning system as well as the increase in efficient operation both ensure that maintenance costs will drop significantly over a similar linkage burner.

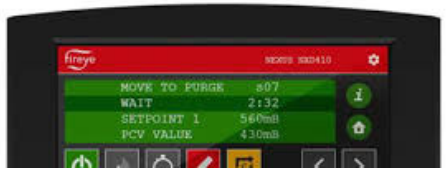
Section 3

NXF4000 INTRODUCTION

NXF4000 introduction

What is the NXF4000

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.



NXF4000 introduction

Capabilities of the NXF4000

Due to its versatility, the NXF4000 is a great choice for most applications. Three different amplifiers can be fitted so any application using a UV scanner, IR scanner or a Fireye integrated scanner is supported. The flame safeguard supports either an interrupted or intermittent pilot and allows other settings to be adjusted such as purge times, airflow switch check, recycle operation, PTFI timings, MTFI timings and flame failure response time.

For installations subject to continuous operation while using a UV scanner, there is a 24-hour recycle option that will cause the unit to recycle after 23 hours and 59 minutes of operation. This is to check if the UV scanner still detects a flame during the cycle (runaway scanner).

NXF4000 introduction

Capabilities of the NXF4000

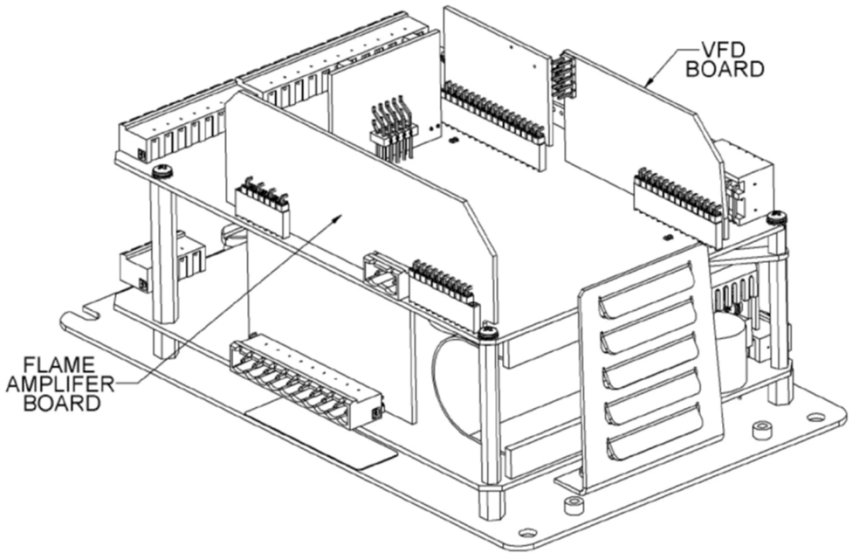
The PPC4000 is a related control that uses the same accessories and has most of the same options. The only difference is that the PPC4000 does not have an integrated flame safeguard – an external flame safeguard is used. Some configurations that are outside of the scope of the NXF4000 but can be designed using the PPC4000 are listed below:

- **Flame rod:** Use a PPC4000 with YB110 and YP1xx programmer or BP110UVFRSx(M)(P)
- **UV and flame rod simultaneously:** Use a PPC4000 with BP110UVFR-Sx(M)(P)
- **Expanded annunciation:** Use a PPC4000 with YB110, YP1xx programmer and YZ300 annunciator
- **Ultraviolet self-check:** Use a PPC4000 with YB110UVSC and YP1xx programmer
  - Note that self-checking is possible with the NXF4000 by using either the 48PT2 infrared scanner or one of the Fireye integrated scanners.

NXF4000 introduction

NXF4000 form factor

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.



NXF4000 introduction

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.

NXF4000 introduction

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.

The PPC4000 and PPC4000-230V are related products that are designed to work with an external flame safeguard (such as the Fireye BurnerLogix or BurnerPRO). These controls interface with the external flame safeguard in the same manner as a single-point actuator but allow full parallel positioning control. All accessories for the NXF4000 are compatible with the PPC4000 except for the amplifier cards (not needed without a flame safeguard function).

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

NXF4000 introduction

Four available profiles

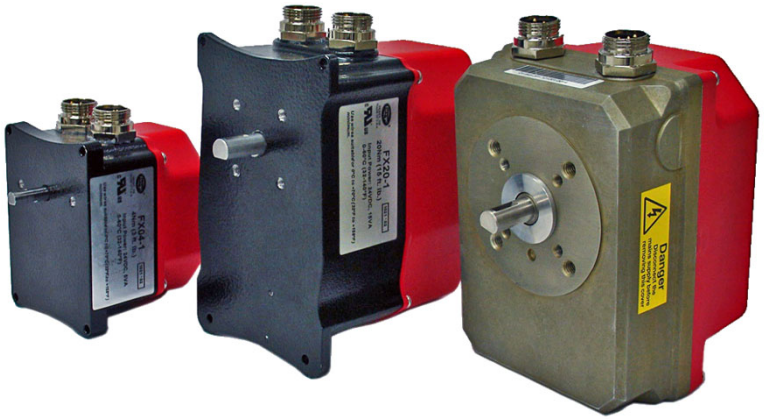
The NXF4000 is best-in-class with support for **four different profiles**. The most common application for this is to offer a dual-fuel burner with a VFD bypass option, so each fuel can have a unique profile with and without VFD bypass. **Each of these profiles can have up to 24 points**.

There are different fuel train options so that any fuel can use the gas valve or oil valve outputs as needed. There are also different gas profile options to allow for the upstream valve to open with the pilot output or to open simultaneously with the downstream gas valve.

NXF4000 introduction

FX series

There are three sizes of servo available with the FX series: 4Nm (3 ft.-lb.), 20Nm (15 ft.-lb.) and 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 60W of power for the servos which is enough for the typical application, but an external 24VDC power supply can be used if more power is needed for additional servos.



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.

NXF4000 introduction

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), has an IP40 rating and is intended to be panel mounted.

This is the standard interface.

NXF4000 introduction

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.** Additional features from these displays are a Modbus TCP/IP server, VNC remote monitoring capability and support for a custom language editor. These displays are 24VDC (powered from the NXF4000), has an IP67 rating and is intended to be panel mounted.

NXF4000 introduction

Minimum system needs

The following shows the minimum requirements for a working NXF4000 system:

1. **CONTROL:** NXF4000 or NXF4000-230V
2. **TERMINAL BLOCKS:** 60-3004
3. **INTERFACE:** NXD410 or NXD410TS or NXTSD507HD or NXTSD512HD
4. **AMPLIFIER:** NXCESIR or NXCESUV or NXCESDC
5. **SERVOS:** ANY TWO FX04/20/50 or ANY ONE FX04/20/50 **WITH** NXCESVFD

Additionally, any connecting cables for the interface and servos are required, as well as the accompanying scanner for the chosen amplifier.

NXF4000 introduction

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 (two- or three-valve), airflow switch (with change-of-state verification), fuel valve end switch and more. Additionally, the inputs can be used to create a first-out annunciator by tapping into each connection on the limit string. Any loss of safety limit will create a unique lockout indicating the input that is not on before the control issues general safety limit lockout.

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

NXF4000 introduction

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.

NXF4000 introduction

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. Additionally, connected analog inputs can be monitored for high values and alarms for these can be directed to the user-assignable outputs.

NXF4000 introduction

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.

NXF4000 introduction

Thermal shock or warming

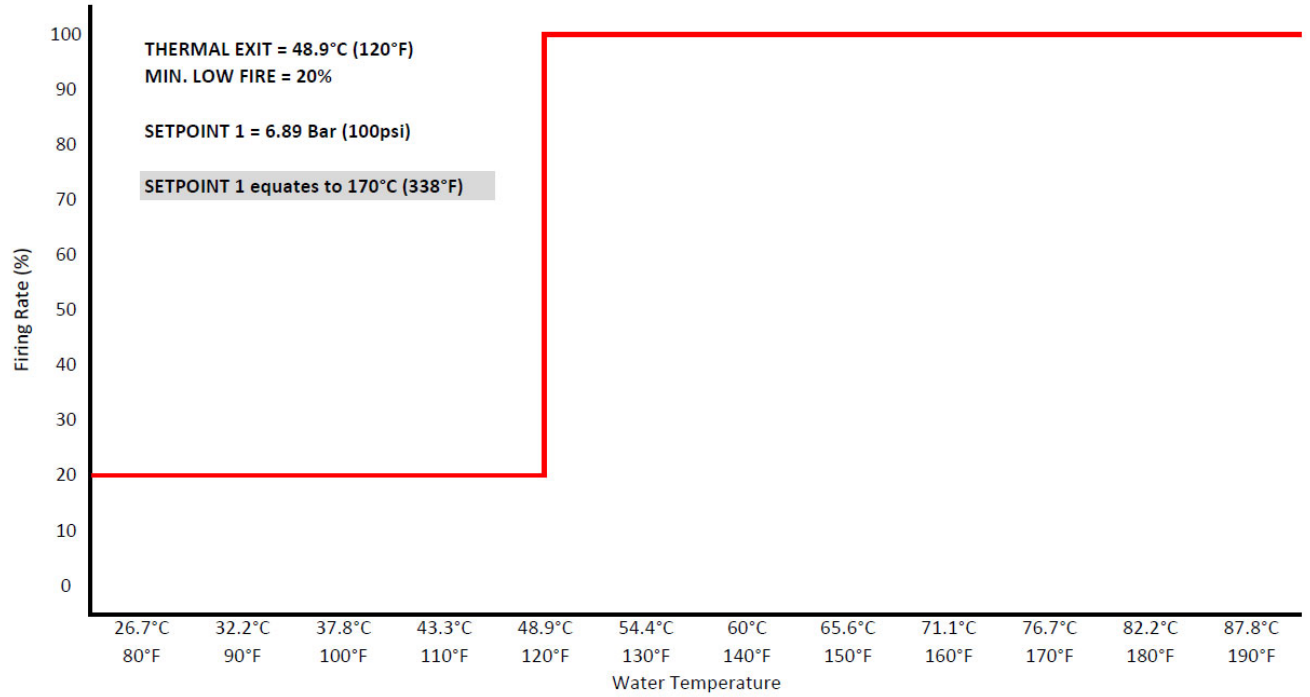
Typically used with a steam boiler, this involves checking the temperature upon start-up. Depending upon the setup options chosen, modulation will be restricted by temperature or will gradually increase in steps as the temperature increases. To use this feature, a sensor is chosen and the desired algorithm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

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

NXF4000 introduction

Thermal shock via temperature hold

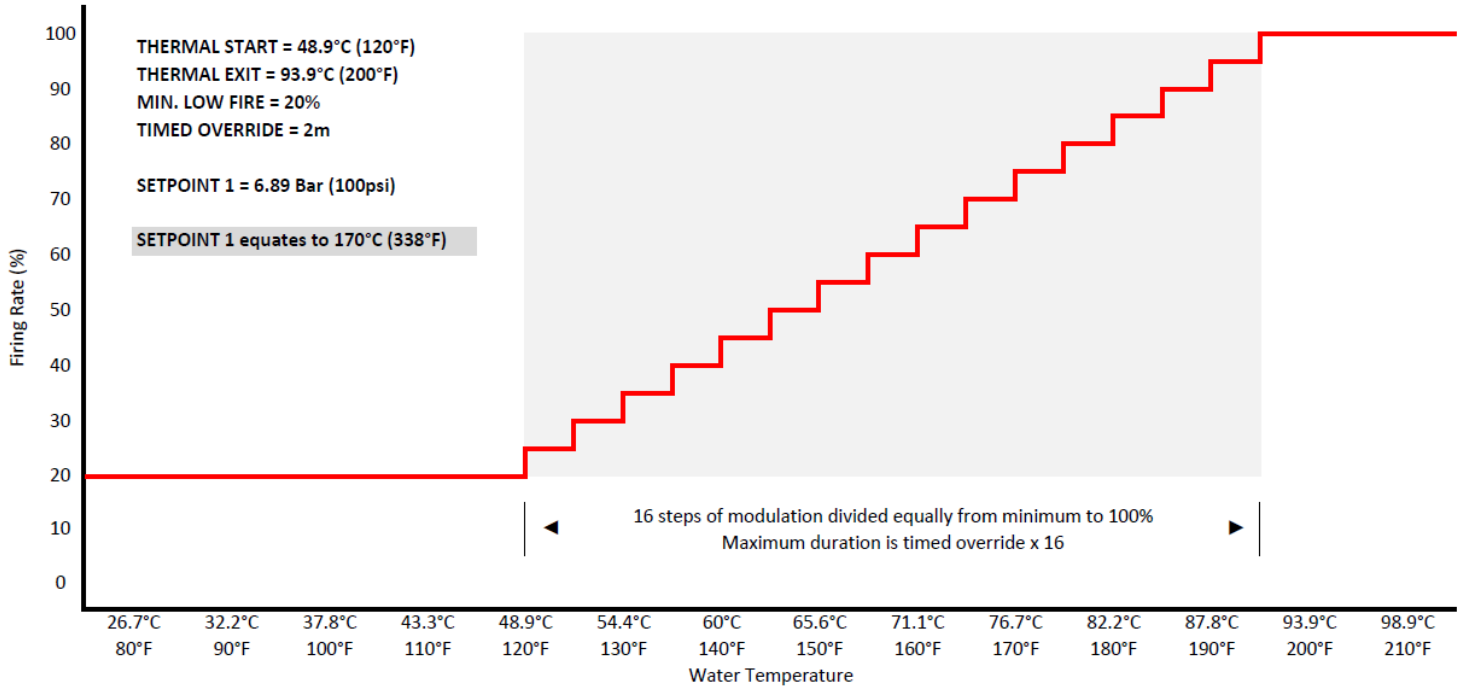
Using this method, a setpoint is selected that will allow modulation to begin. At any temperature below that setpoint, the burner will modulate only at the selected firing rate.



NXF4000 introduction

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.



NXF4000 introduction

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.

NXF4000 introduction

Peer-to-peer sequencing

Up to six NXF4000 (or PPC4000) controls can be connected with 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.

NXF4000 introduction

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.

NXF4000 introduction

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 the burner control switch is turned off, a low fire shutdown will also occur. For this reason, it is advised to connect the burner control switch to a dedicated digital input instead of leaving it in the general recycle limit string.

If a general recycle limit input or non-recycle limit input loses voltage, the control will shut the burner down immediately regardless of the firing rate.

NXF4000 introduction

NXCESO2 oxygen probe

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 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”).

NXF4000 introduction

NXCESO2 oxygen probe

The operating temperature range is 0°C to 60°C (32°F to 140°F). An optional ambient air temperature sensor (FXIATS-1) can also be added (connected to NXF4000) to allow for efficiency calculations to be made.

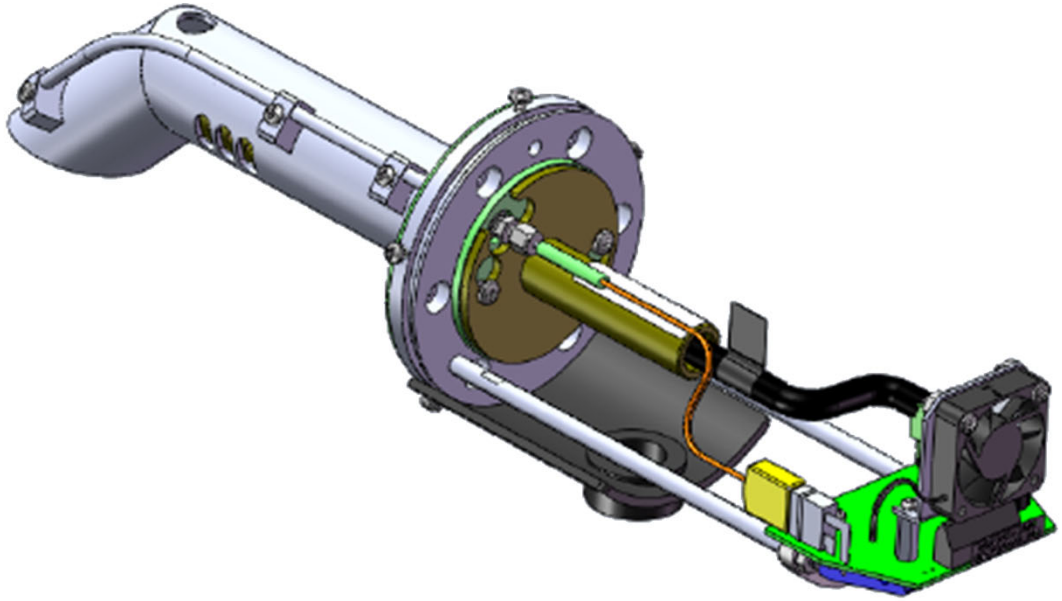
The NXCESO2 probe connects to the NXF4000 using a Modbus connection. The required connections are 24VDC power (sourced from the NXF4000) and Modbus. The same cabling used for the servos is used to connect the NXCESO2 to the NXF4000.

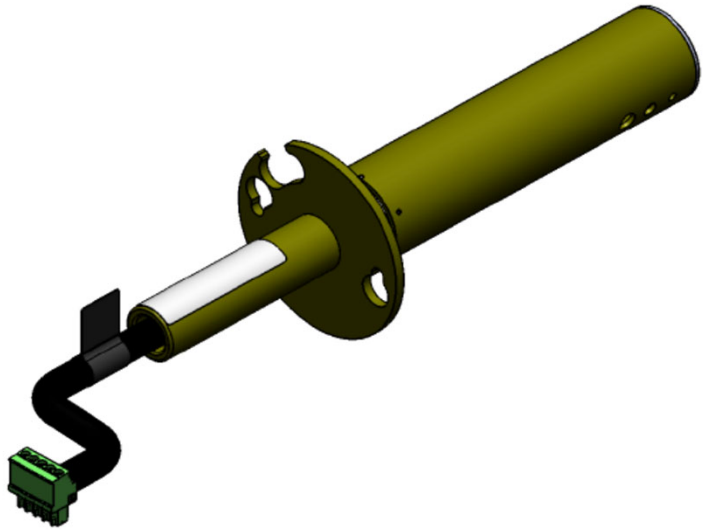
Since the NXCESO2 uses Modbus to communicate with the NXF4000, it is also available for standalone use with other Modbus control systems.

NXF4000 introduction

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.





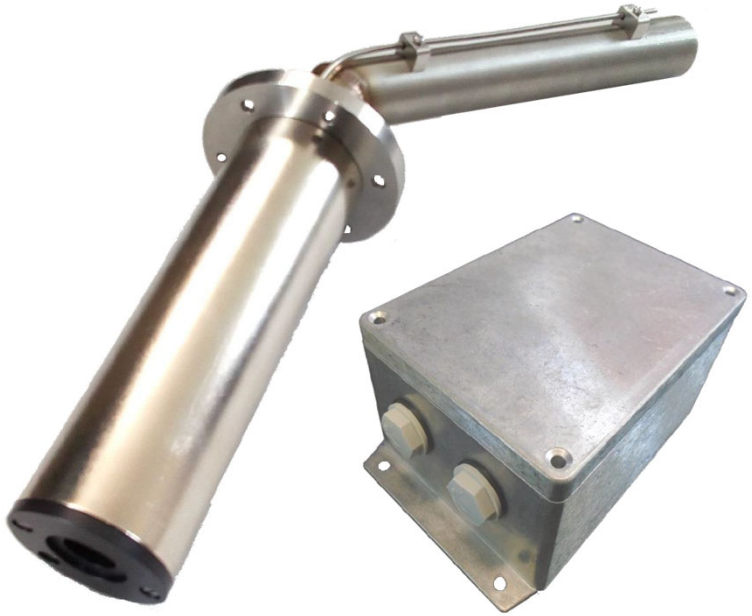
NXF4000 introduction

FXCESO2 with FXO2TRIM-1 oxygen probe

The Fireye FXCES02 zirconia oxide probe when connected to the 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 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.

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



NXF4000 introduction

FXCESO2 with FXO2TRIM-1 oxygen probe

The operating temperature range for the FXO2TRIM-1 interface is 0°C to 60°C (32°F to 140°F). An optional ambient air temperature sensor (FXIATS-1) can also be added (connected to NXF4000) to allow for efficiency calculations to be made.

The FXCESO2 probe connects to the FXO2TRIM-1 interface using a CAN bus connection. Special cable must be used (available from Fireye) for this connection and has a limit of 10m (33’). In turn, the FXO2TRIM-1 connects to the NXF4000 using a Modbus connection. The required connections are 24VDC power (sourced from the NXF4000) and Modbus. The same cabling used for the servos is used to connect the FXO2TRIM-1 to the NXF4000.

NXF4000 introduction

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.

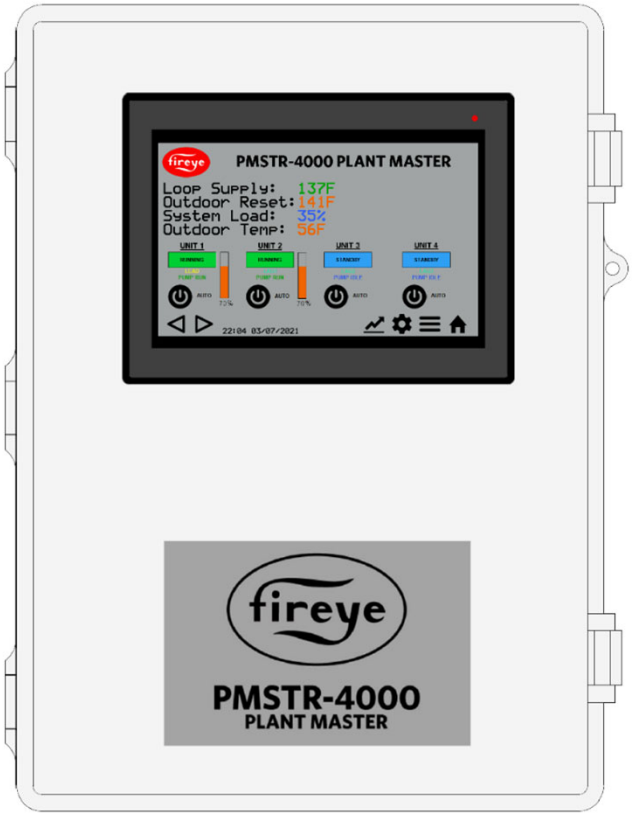
If CONTROL is chosen, the system will trim the O_2 level automatically using the trim channel chosen. Trim limits and PID gains are set to tune trim control. If an O_2 limit is reached the choice can be made either to issue a warning and disable trim, or to lockout immediately.

Commissioning O_2 trim is straightforward. If CONTROL mode is active during commissioning and the probe is connected and working, the probe reading at each commissioned point will be saved as the O_2 target for that point. The selected servo will trim in both directions up to the limits that are entered for the different parameters.

NXF4000 introduction

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.



NXF4000 introduction

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.

NXF4000 introduction

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

NXF4000 introduction

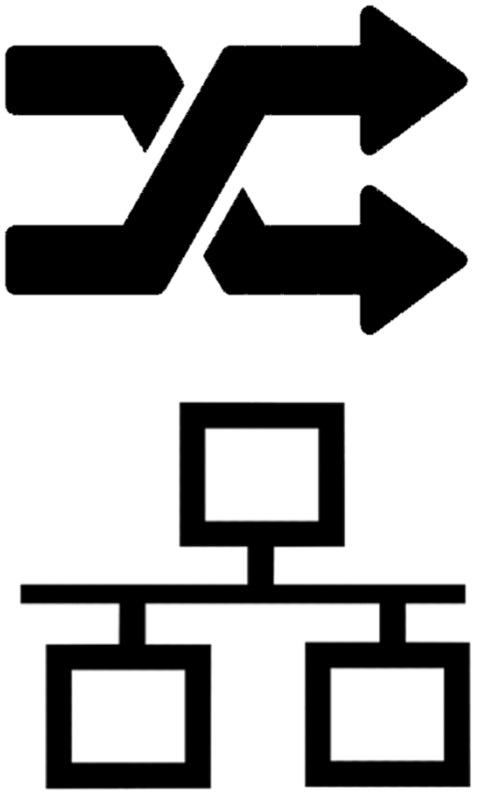
Plant master energy savings

- 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

NXF4000 introduction

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



NXF4000 introduction

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

NXF4000 introduction

Standard 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.

NXF4000 introduction

Backup/restore via 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.

Section 4

SYSTEM DESIGN

System design

Internal 24VDC power supply

The NXF4000 has an internal power supply that can power most accessories that will be connected:

- NXD410TS interface
- NXTSD507HD or NXTSD512HD enhanced interface
- NXCESO2 or FXCESO2/FXO2TRIM-1 O_2 trim interface
- External temperature or pressure sensor
- 85W available for servos

System design

Servo power requirements

Up to ten servos can be connected, and up to four can be used with any specific profile. The wiring examples in the *NXF4000 Wiring Application Guide* show five servos connected with the last two receiving power from an external power supply. The internal power supply for the servos can supply up to 85W of power, so the need for an external power supply entirely depends upon the power requirements of the connected servos. The power requirements are as follows:

- **FX04: 7.5W**
- **FX20: 35W**
- **FX50: 38W**

Even though only four can be used with one profile, enough power must be present for all connected as servos from idle profiles may need to move at any time (typically to the home position).

System design

Servo power example

If there were three FX04 and two FX20 servos in a system:

FX04 servos: 7.5W x 3 = 22.5W

FX20 servos: 35W x 2 = 70W

Total requirement: 22.5W + 70W = 92.5W

This is in excess of the available 85W. The two options in this scenario would be:

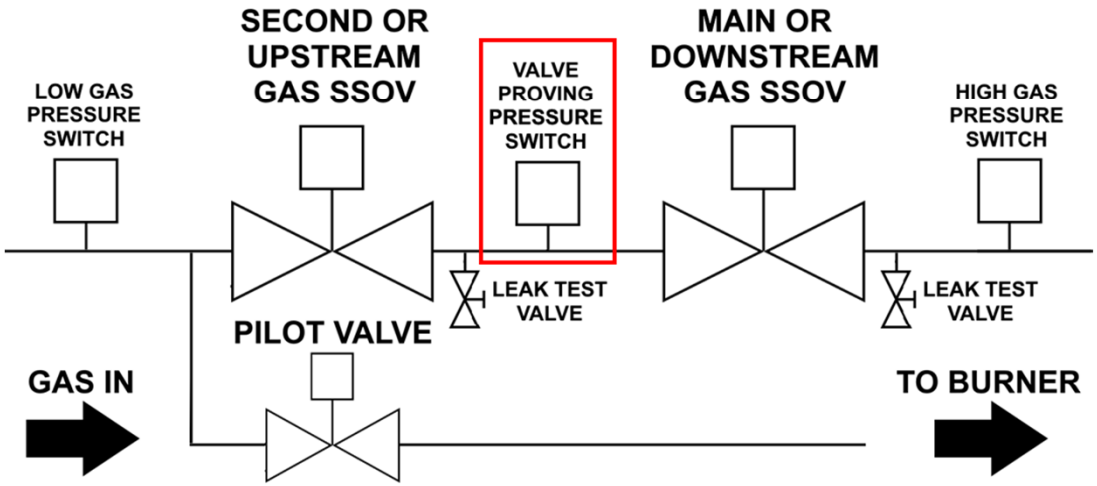
1. Put all five servos on an external 120W power supply.
2. Put the three FX04 servos and one FX20 servo on the internal power supply and put the remaining FX20 servo on an external 85W power supply.

When using an external power supply, the common references are tied together and the power to the servos is directed through a 24VDC relay controlled by the NXF4000. This is so that the NXF4000 can power cycle the servos when needed.

System design

Valve proving

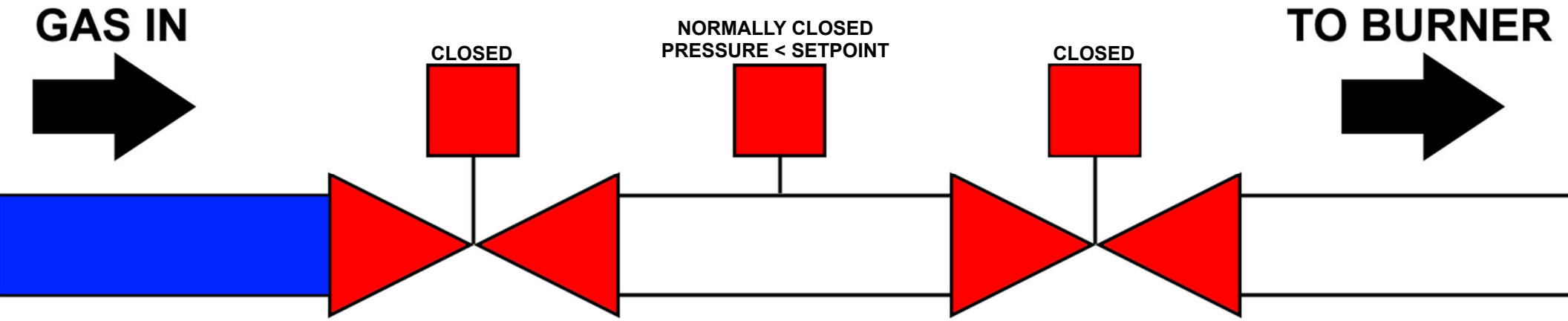
Valve proving is an option that uses a gas pressure switch to stage the safety shutoff valves and monitor the state of the gas pressure in between. This allows a leaking valve to be detected instead of just venting to the atmosphere. EN 676, NFPA 85, FM and GE GAP allow a valve proving system to be used in place of a vent valve. Both the normally open and normally closed terminals of the gas pressure switch are connected to digital inputs.



System design

Valve proving method

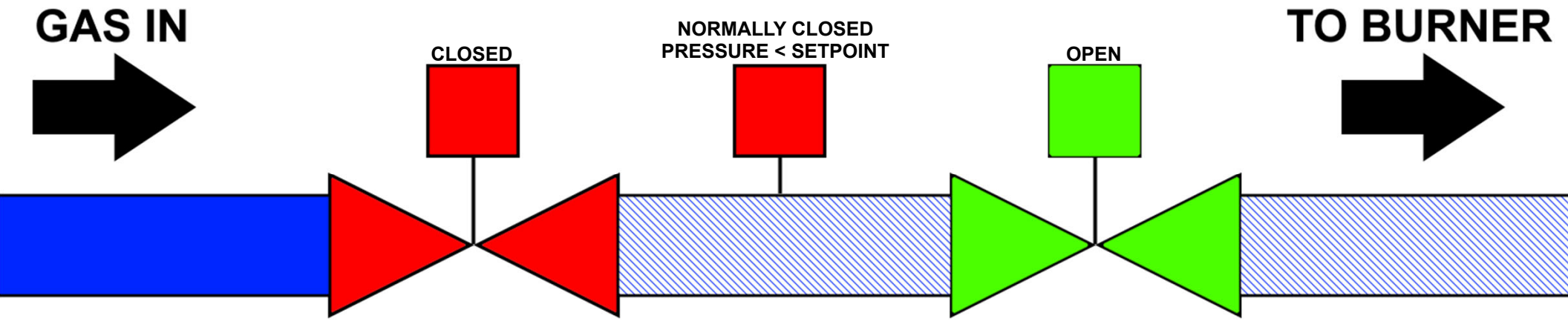
Valve proving can be programmed to occur either at the beginning of the sequence (before the prepurge) or at the end of the sequence (after postpurge). In either case, the valve proving test consists of the same steps. In the following diagrams, blue represents gas is present, red indicates the valve 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.



System design

Valve proving evacuation (GAS VALVE PROVE1)

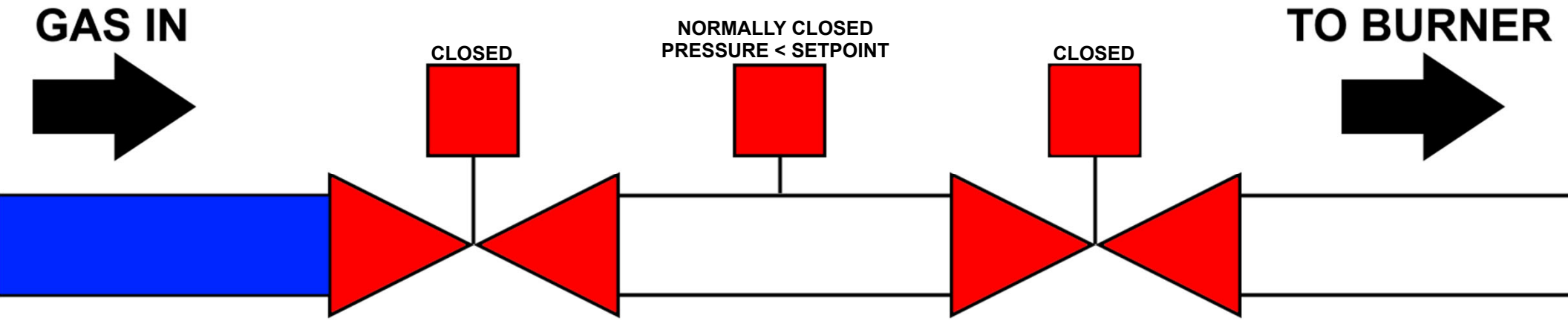
The first step is the evacuation. The downstream valve is opened so any gas that was present in between the valves is evacuated into the combustion chamber (to be then evacuated during prepurge). The length of time the valve remains open is three seconds.



System design

Valve proving evacuation test (GAS VALVE PROVE2)

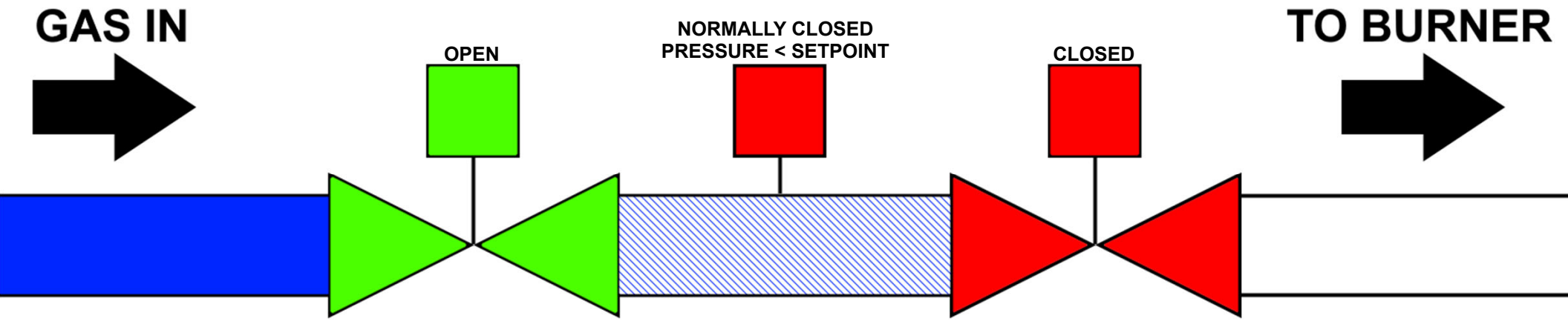
Following the evacuation, a test is performed for a set amount of time to ensure that the gas pressure switch remains in the normally closed state. This time period is adjustable and has a default of 25 seconds. If the test fails, the flame safeguard will lockout. This lockout indicates that the upstream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



System design

Valve proving pressurization (GAS VALVE PROVE3)

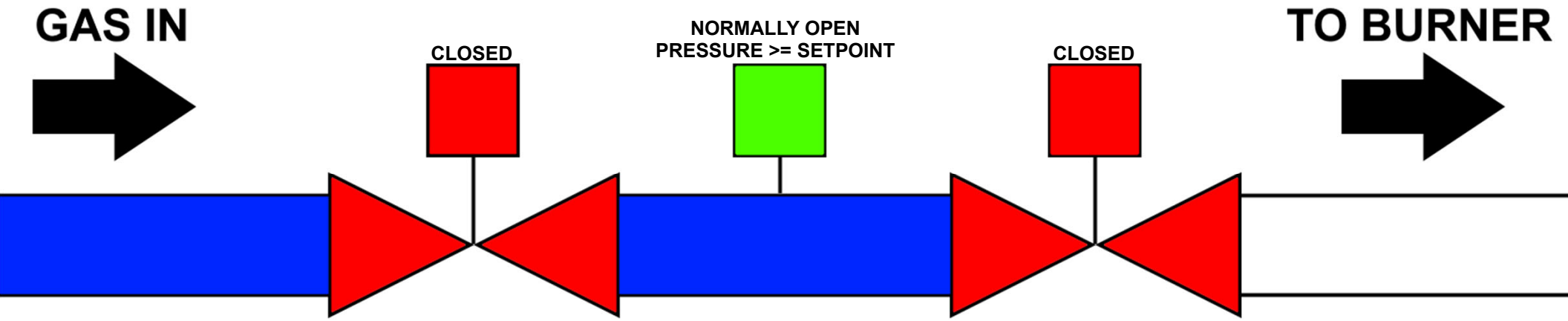
After the evacuation test is passed, the upstream gas valve opens for an adjustable period (normally around five seconds) to pressurize the space between the safety shutoff valves. The length of time the valve remains open is three seconds.



System design

Valve proving pressurization test (GAS VALVE PROVE4)

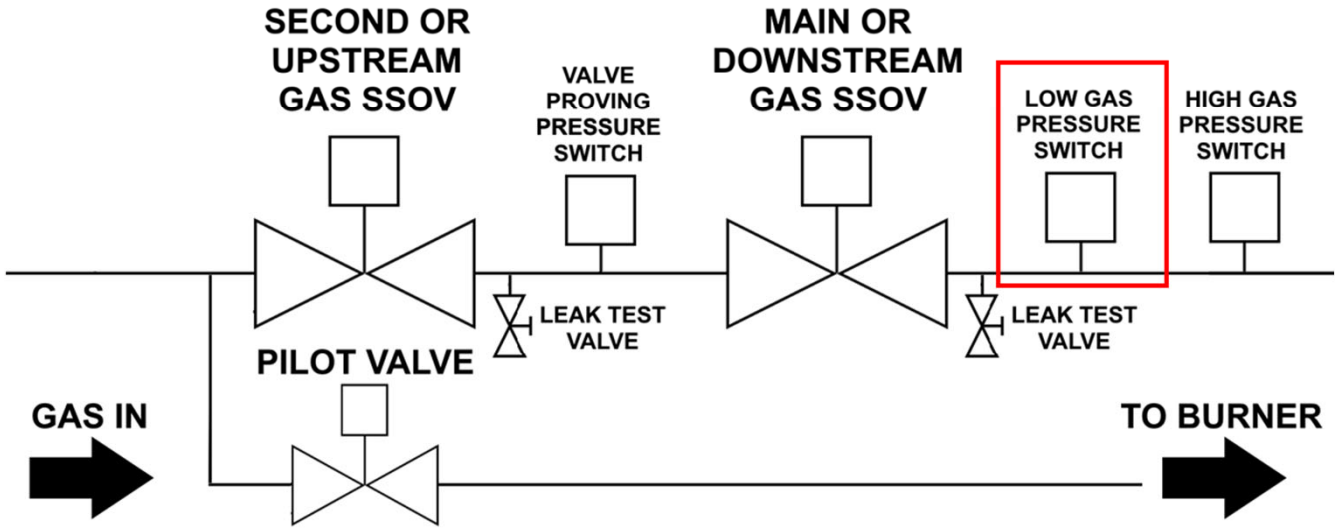
Following the pressurization, a test is performed for a set amount of time to ensure that the gas pressure switch changes to the normally open state. This time period is adjustable and has a default of 25 seconds. If the test fails, the flame safeguard will lockout. This lockout indicates that the downstream valve may be leaking since the space in between is losing pressure.



System design

Low gas pressure switch located after downstream gas valve (LGP CHECK)

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.



System design

Proof of closure (FVES)

Gas valves may have a mechanical switch that is adjusted to provide independent verification that the valve is physically closed. If debris or some other impediment would cause the valve not to fully close (thereby leaking gas by), the switch will not indicate that the valve is closed.

This feature is known by various names:

- Proof of closure (POC)
- Fuel valve end switch (FVES)
- Closed position indication (CPI)

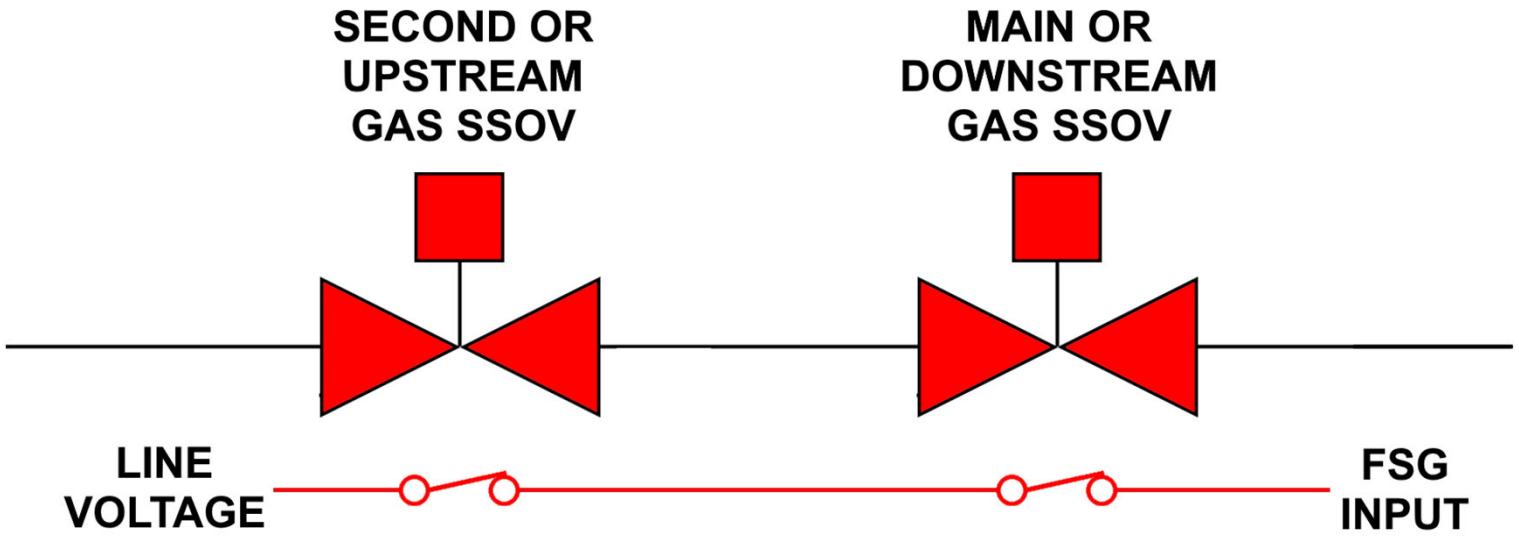
The switch is wired so that there is continuity when the valve is closed. Checking for the fuel valve end switch closures require connecting all the fuel valve end switches in series and connecting to a digital input. More than one input can be programmed for this function if desired (to separate by fuel).

By most codes, a proof of closure switch should not be field-adjustable.

System design

Proof of closure example

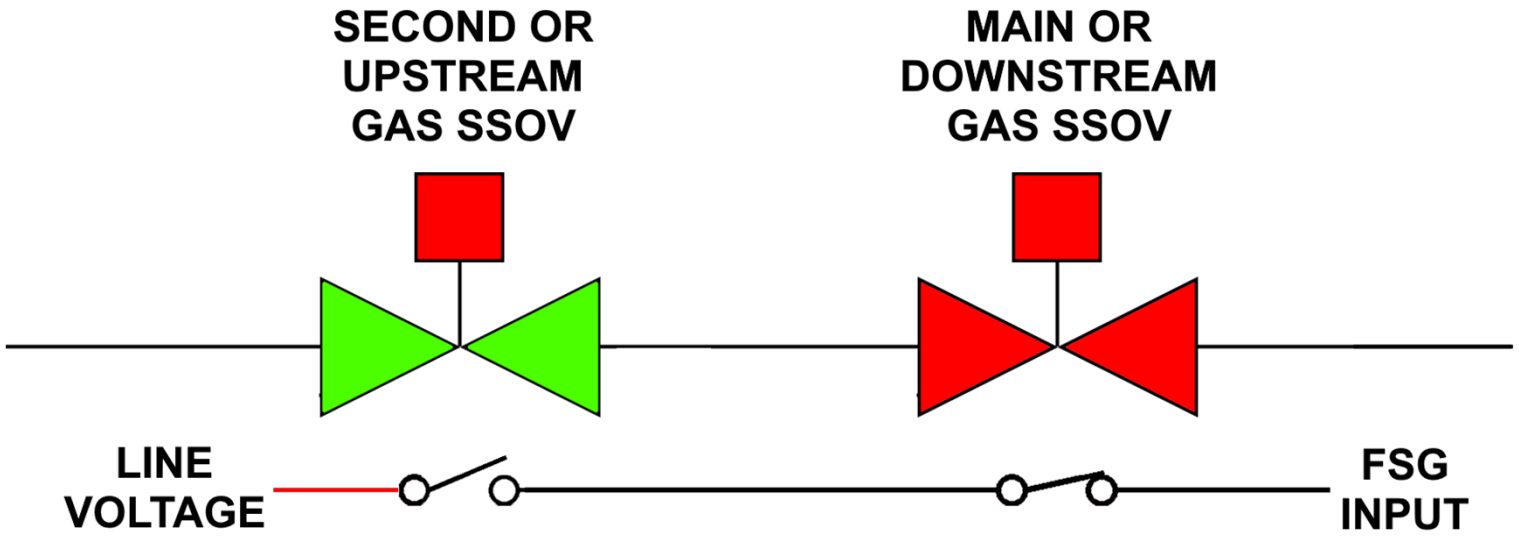
In the diagram below, both valves are closed as indicated by the red color. Line voltage can pass through both proof of closure switched into the digital input, indicating that it is safe to begin the startup sequence.



System design

Proof of closure example

If one of the valves is not closed either due to the wrong command or a physical blockage to the valve seat, the proof of closure input will not receive voltage. In this example, there is a blockage to the upstream valve seat (indicated by the green color) while it is being commanded off. This would result in the NXF4000 locking out.



System design

Airflow switch check

The airflow switch can be removed from the general non-recycle limit string and connected to dedicated digital inputs. When this is done, a switch check is performed prior to startup to ensure that the switch changes states. Both the normally open and normally closed terminals of the gas pressure switch are connected to digital inputs.

If the airflow switch is left in the general non-recycle limit string, there is a parameter in BURNER SETTINGS (PROVE P OPEN) that requires that terminal P5.10 loses voltage when in standby, to indicate that the airflow switch has changed states.

Section 5

WIRING

Wiring

Terminals

All the wiring is done on removable terminal blocks. The terminal blocks are available as a separate part and can be ordered as needed (part 60-3004). Each terminal block has a dedicated number (i.e., P13) and the individual terminal on the specific block is indicated as an index (i.e., P13.1). Each terminal block has a different number of terminals and/or terminal pitch. This prevents connecting a terminal block into the wrong header.

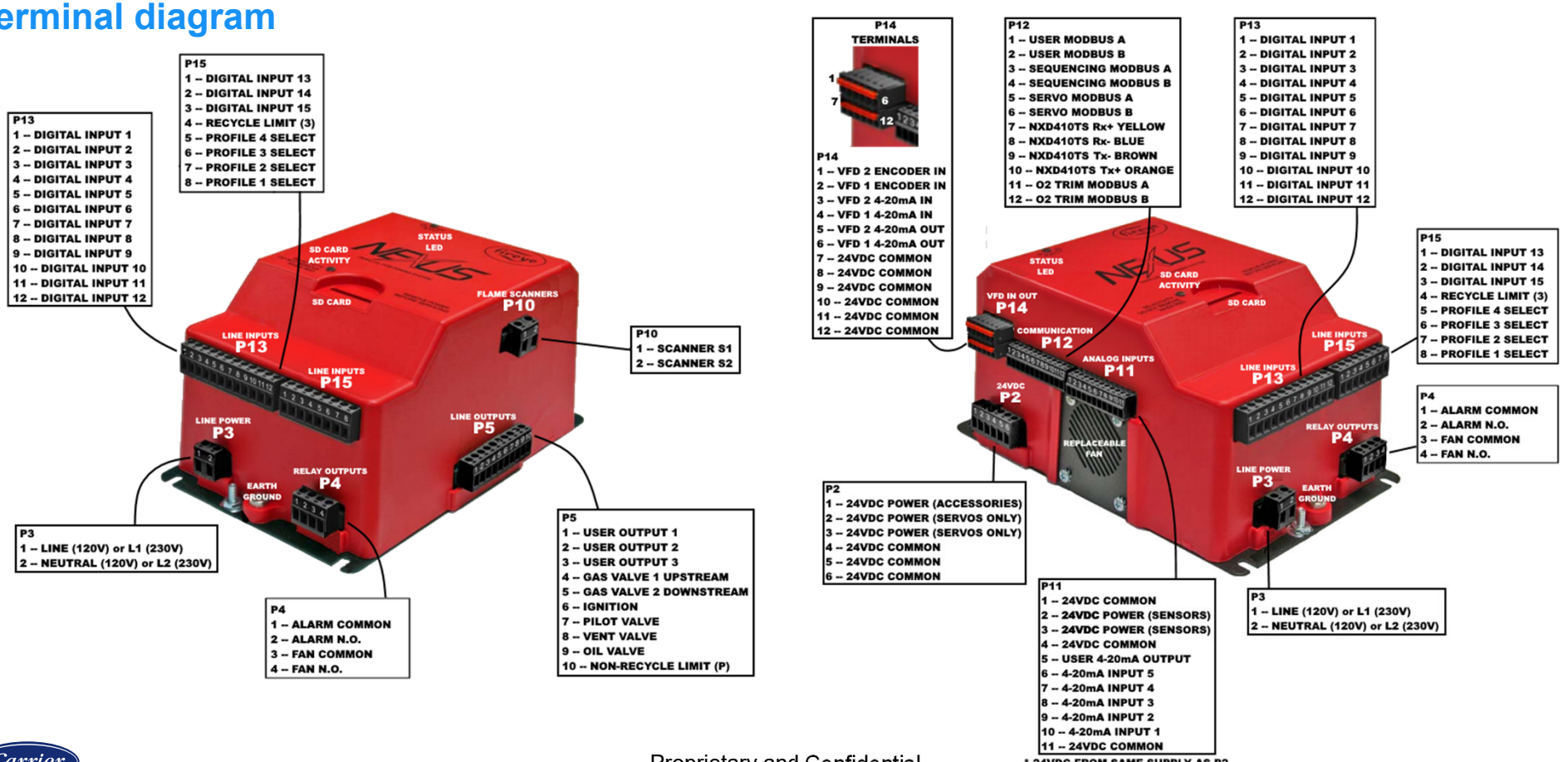
Wiring

Terminal blocks

Position	Description
P2	6-position terminal block, labeled (screw terminals 5.08mm)
P3	2-position terminal block, labeled (screw terminals 7.62mm)
P4	4-position terminal block, labeled (screw terminals 5.08mm)
P5	10-position terminal block, labeled (screw terminals 5.08mm)
P10	2-position terminal block, labeled (screw terminals 7.62mm)
P11	11-position terminal block, labeled (screw terminals 3.5mm)
P12	12-position terminal block, labeled (screw terminals 3.5mm)
P13	12-position terminal block, labeled (screw terminals 5.08mm)
P14	6-position/2-row terminal block, labeled (spring terminals 3.5mm)
P15	8-position terminal block, labeled (screw terminals 5.08mm)

Wiring

Terminal diagram



Wiring

Terminal descriptions

Terminal block and number	Description
P2.1	24VDC power out (do not use for servos)
P2.2	24VDC power out (use for servos, power cycles on certain lockouts)
P2.3	24VDC power out (use for servos, power cycles on certain lockouts)
P2.4	0VDC common
P2.5	0VDC common
P2.6	0VDC common
P3.1	L1 line voltage in
P3.2	L2 neutral in
P4.1	Alarm relay common
P4.2	Alarm relay normally open
P4.3	Blower relay common

Wiring

Terminal descriptions

Terminal block and number	Description
P4.4	Blower relay normally open
P5.1	User relay output 1
P5.2	User relay output 2
P5.3	User relay output 3
P5.4	Upstream gas valve
P5.5	Downstream gas valve
P5.6	Ignition
P5.7	Pilot valve
P5.8	Oil valve
P5.9	Vent valve
P5.10	Non-recycle limit input (safety limit input) **Legacy name – P input**

Wiring

Terminal descriptions

Terminal block and number	Description
P10.1	Scanner S1
P10.2	Scanner S2
P11.1	0VDC common
P11.2	24VDC power out
P11.3	24VDC power out
P11.4	0VDC common
P11.5	User analog output 4-20mA
P11.6	Sensor 5 analog input 4-20mA
P11.7	Sensor 4 analog input 4-20mA
P11.8	Sensor 3 analog input 4-20mA
P11.9	Sensor 2 analog input 4-20mA

Wiring

Terminal descriptions

Terminal block and number	Description
P11.10	Sensor 1 analog input 4-20mA
P11.11	0VDC common
P12.1	BMS or enhance interface Modbus RTU (A)
P12.2	BMS or enhance interface Modbus RTU (B)
P12.3	Peer-to-peer sequencing Modbus RTU (A)
P12.4	Peer-to-peer sequencing Modbus RTU (B)
P12.5	Servo secure communication Modbus RTU (A)
P12.6	Servo secure communication Modbus RTU (B)
P12.7	Interface Rx+
P12.8	Interface Rx-
P12.9	Interface Tx-

Wiring

Terminal descriptions

Terminal block and number	Description
P12.10	Interface Tx+
P12.11	O_2 trim secure communication Modbus RTU (A)
P12.12	O_2 trim secure communication Modbus RTU (B)
P13.1	Line voltage digital input 1
P13.2	Line voltage digital input 2
P13.3	Line voltage digital input 3
P13.4	Line voltage digital input 4
P13.5	Line voltage digital input 5
P13.6	Line voltage digital input 6
P13.7	Line voltage digital input 7
P13.8	Line voltage digital input 8

Wiring

Terminal descriptions

Terminal block and number	Description
P13.9	Line voltage digital input 9
P13.10	Line voltage digital input 10
P13.11	Line voltage digital input 11
P13.12	Line voltage digital input 12
P14.1	VFD1 4-20mA output
P14.2	VFD2 4-20mA output
P14.3	VFD1 4-20mA feedback input
P14.4	VFD2 4-20mA feedback input
P14.5	VFD1 encoder feedback input
P14.6	VFD2 encoder feedback input
P14.7	0VDC common

Wiring

Terminal descriptions

Terminal block and number	Description
P14.8	0VDC common
P14.9	0VDC common
P14.10	0VDC common
P14.11	0VDC common
P14.12	0VDC common
P15.1	Line voltage digital input 13
P15.2	Line voltage digital input 14
P15.3	Line voltage digital input 15
P15.4	Recycle limit input **Legacy name – 3 input**
P15.5	Line voltage profile 4 select input
P15.6	Line voltage profile 3 select input

Wiring

Terminal descriptions

Terminal block and number	Description
P15.7	Line voltage profile 2 select input
P15.8	Line voltage profile 1 select input

Wiring

Wiring application guides

For this course, we will use diagram NXF4000-4 from the *NXF4000 Wiring Application Guide* which is available at the Fireye website (www.fireye.com) in the “Service Guide” section of the NXF4000 home page. This section also contains many other helpful documents.

NXF4000 Wiring Application Guide

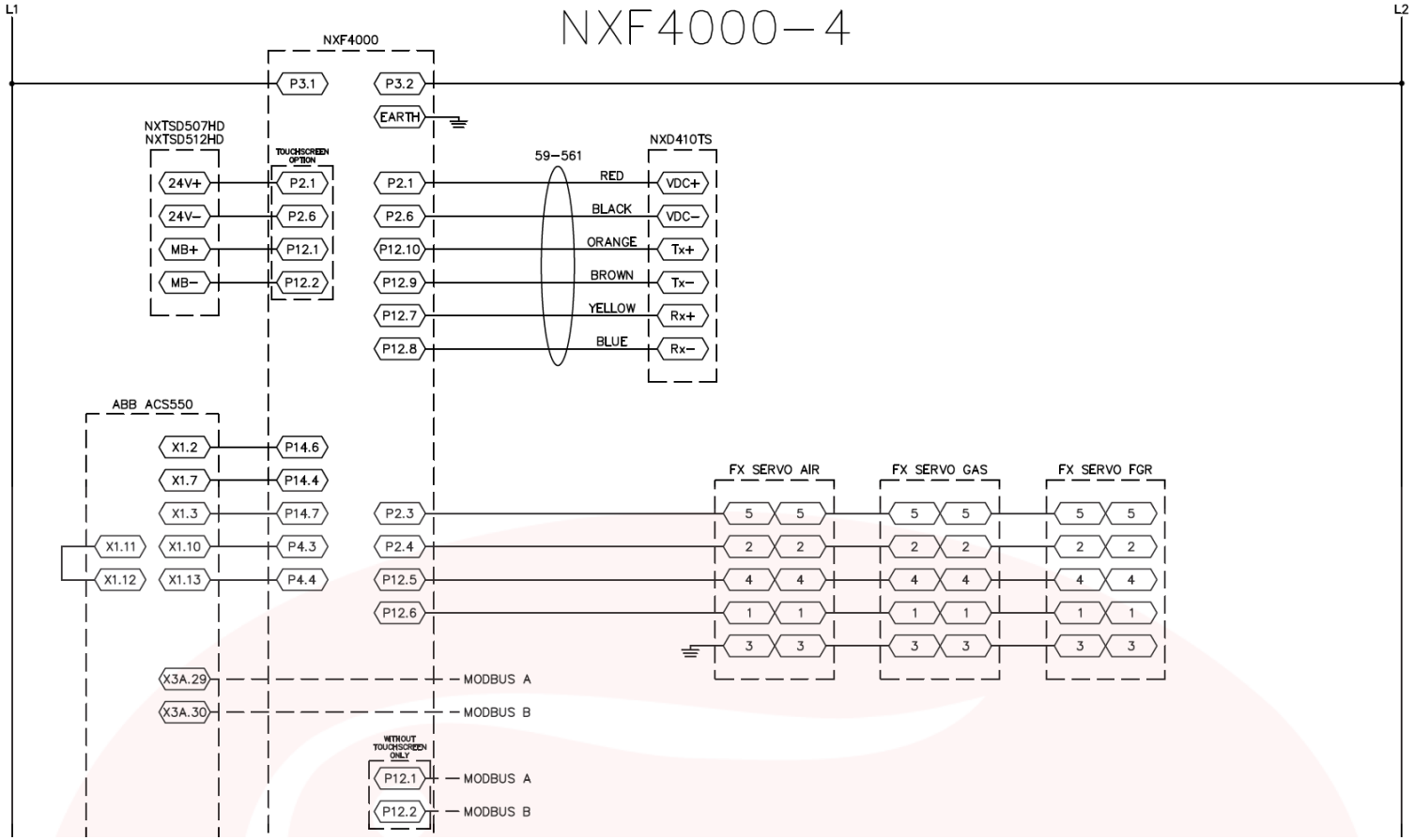
April 6, 2020

WIRING DIAGRAMS BY FEATURE

Diagram Number	User Interface	O_2	VFD	VFD Bypass	Dual Fuel
NXF4000-1	NXD410	---	---	---	---
NXF4000-2	NXD410TS	---	---	---	---
NXF4000-3	NXD410	---	ACS550	---	---
NXF4000-4	NXD410TS	---	ACS550	---	---
NXF4000-5	NXD410	---	ACS550	Yes	---
NXF4000-6	NXD410TS	---	ACS550	Yes	---

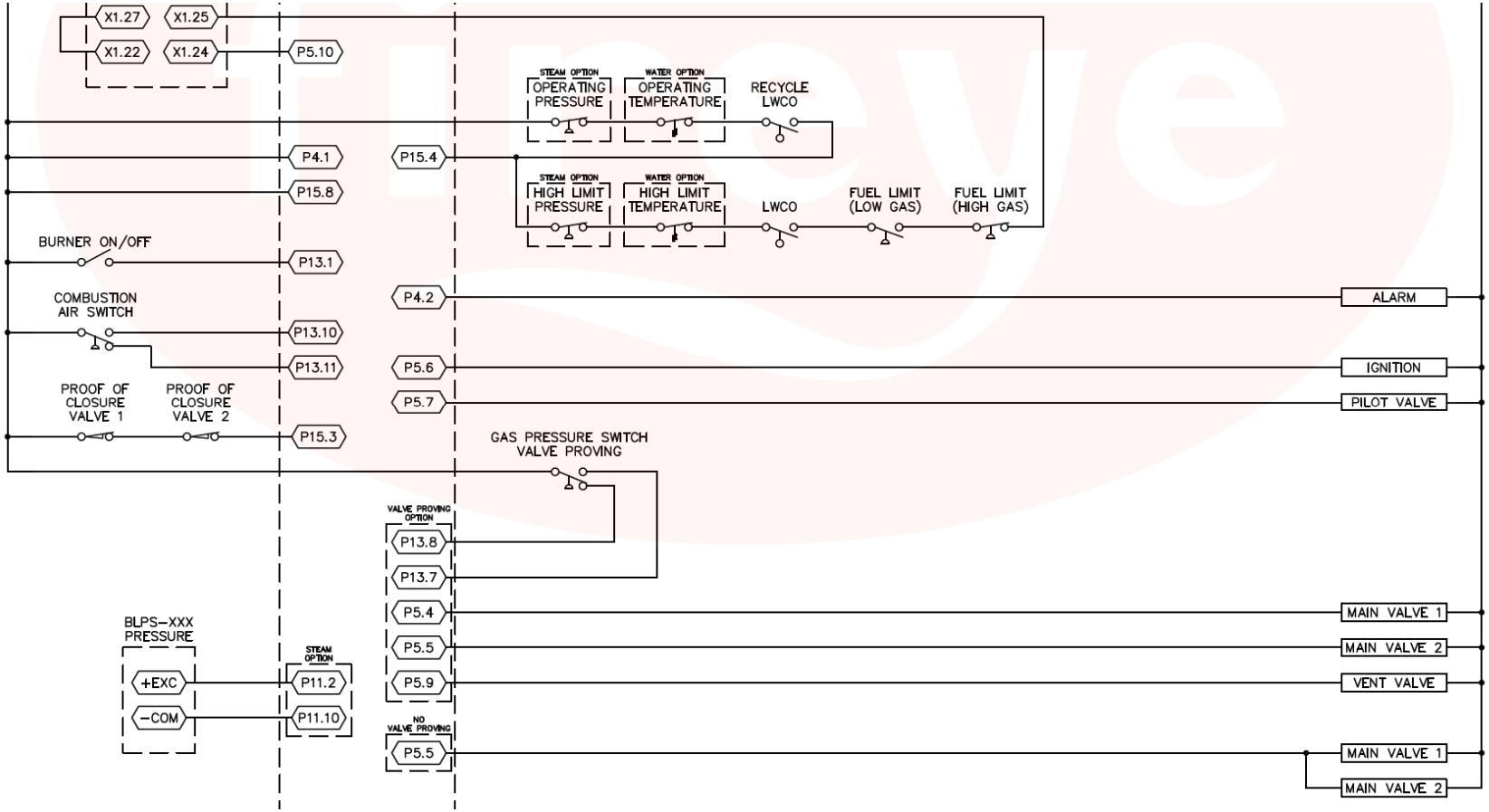
Wiring

1/3


NXF4000–4
L1
L2
NXF4000
P3.1
P3.2
EARTH
NXTSD507HD
NXTSD512HD
TOUCHSCREEN OPTION
24V+
24V–
MB+
MB–
P2.1
P2.6
P12.1
P12.2
59–561
RED
BLACK
ORANGE
BROWN
YELLOW
BLUE
NXD410TS
VDC+
VDC–
Tx+
Tx–
Rx+
Rx–
P2.1
P2.6
P12.10
P12.9
P12.7
P12.8
ABB ACS550
X1.2
X1.7
X1.3
X1.11
X1.10
X1.12
X1.13
P14.6
P14.4
P14.7
P4.3
P4.4
P2.3
P2.4
P12.5
P12.6
FX SERVO AIR
FX SERVO GAS
FX SERVO FGR
X3A.29
X3A.30
MODBUS A
MODBUS B
WITHOUT TOUCHSCREEN ONLY
P12.1
P12.2
MODBUS A
MODBUS B

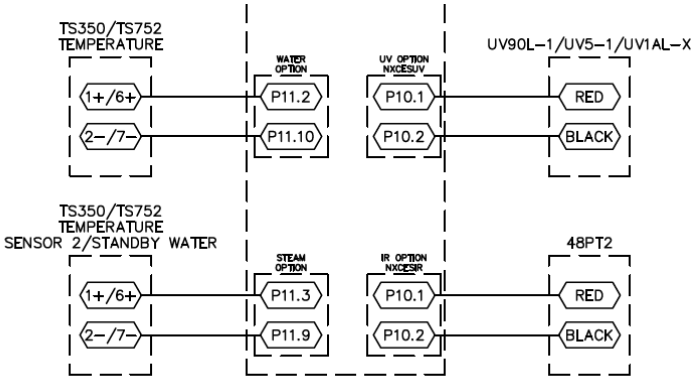
Wiring

2/3


X1.27
X1.25
X1.22
X1.24
P5.10
STEAM OPTION
OPERATING PRESSURE
WATER OPTION
OPERATING TEMPERATURE
RECYCLE LWCO
P4.1
P15.4
P15.8
STEAM OPTION
HIGH LIMIT PRESSURE
WATER OPTION
HIGH LIMIT TEMPERATURE
LWCO
FUEL LIMIT (LOW GAS)
FUEL LIMIT (HIGH GAS)
BURNER ON/OFF
P13.1
P4.2
ALARM
COMBUSTION AIR SWITCH
P13.10
P13.11
P5.6
IGNITION
P5.7
PILOT VALVE
PROOF OF CLOSURE VALVE 1
PROOF OF CLOSURE VALVE 2
P15.3
GAS PRESSURE SWITCH VALVE PROVING
VALVE PROVING OPTION
P13.8
P13.7
P5.4
MAIN VALVE 1
P5.5
MAIN VALVE 2
P5.9
VENT VALVE
BLPS-XXX PRESSURE
STEAM OPTION
+EXC
P11.2
-COM
P11.10
NO VALVE PROVING
P5.5
MAIN VALVE 1
MAIN VALVE 2

Wiring

3/3


TS350/TS752
TEMPERATURE
1+/6+
2-/7-
WATER OPTION
P11.2
P11.10
UV OPTION NXCESUV
P10.1
P10.2
UV90L-1/UV5-1/UV1AL-X
RED
BLACK
TS350/TS752
TEMPERATURE
SENSOR 2/STANDBY WATER
1+/6+
2-/7-
STEAM OPTION
P11.3
P11.9
IR OPTION NXCESIR
P10.1
P10.2
48PT2
RED
BLACK

Section 6

INTERFACE

Interface

NXD410TS

The NXD410TS interface is a 4.3” touchscreen that is used for operation, monitoring and commissioning of the NXF4000.

The touchscreen 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 NXD410TS contains virtual “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 specific 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.

Interface

NXTSD507HD and NXTSD512HD

The NXTSD507HD interface has a 7” touchscreen while the NXTSD512HD interface has a 12” touchscreen. Both are used for operation, monitoring and commissioning of the NXF4000.

Each of these interfaces can be used instead of or in conjunction with the NXD410TS. These interfaces offer a graphical interface as opposed to a text-based interface. Additional features such as multi-device support, local alarm/event log, remote VNC viewing and additional language support are some of the enhancements offered with this upgrade.

A Modbus TCP/IP server is offered as standard for PLC/SCADA/BMS connectivity.

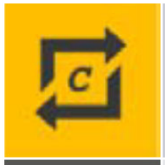
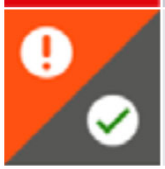
Interface

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.

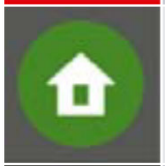
Interface

Quick keys

Button	Key Name	Description
	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.
	ADJUST SETPOINT	Used to go to the setpoint screen for the currently active setpoint.
	RESET	Allows reset of non-volatile lockout.
	CHECK/RUN FAULT HISTORY	Normally used to access fault history information. If BURNER CNTRL SETUP → ENABLE RUN/CHECK is set to YES and the current state has support for check mode this button will toggle check mode.

Interface

Quick keys

Button	Key Name	Description
	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.
	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.

Interface

Quick keys

Button	Key Name	Description
	UP 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. Holding down the key will result in continuous scrolling, and the speed of scrolling will increase the longer the keys are held down. This makes it quicker to enter a setting that is far from the current entry.
	DOWN NXD410TS	
	BACK/ESC NXD410TS	Used to move back through the menu options. This will abandon any changes being made if MODIFY is active.
	NEXT/ENTER NXD410TS	Used to move forward through the menu options. This also confirms a point during commissioning and moves to the next point.

Interface

Quick keys

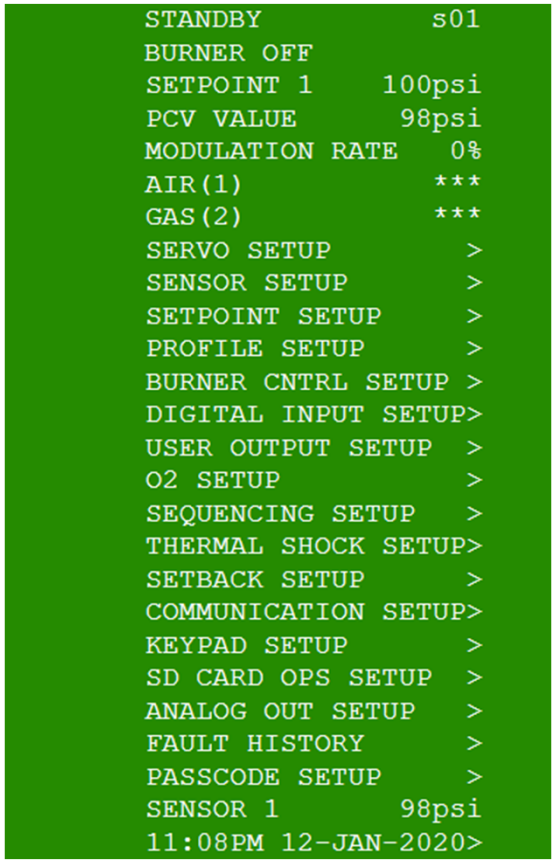
Button	Key Name	Description
	C-MODE NXTSD507HD NXTSD512HD	Used to go to the Commissioning or Adjust Ratio mode. The mode entered depends upon the passcode used and whether the burner is firing at the time. While in Commissioning Mode or Adjust Ratio mode, this button is also used to exit Commissioning or Adjust Ratio mode.
	ADJUST SETPOINT 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.
	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).

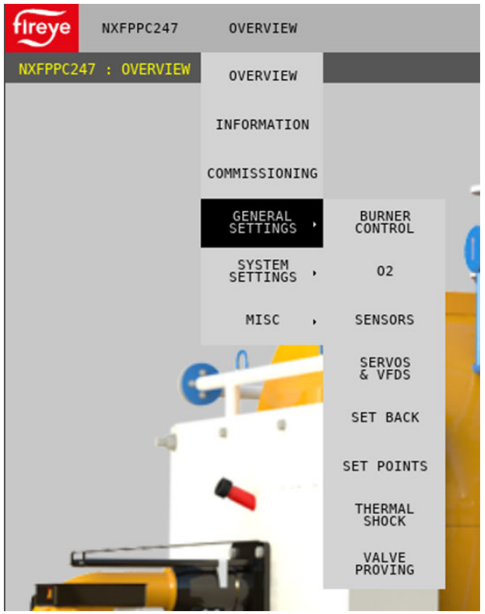
Interface

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.

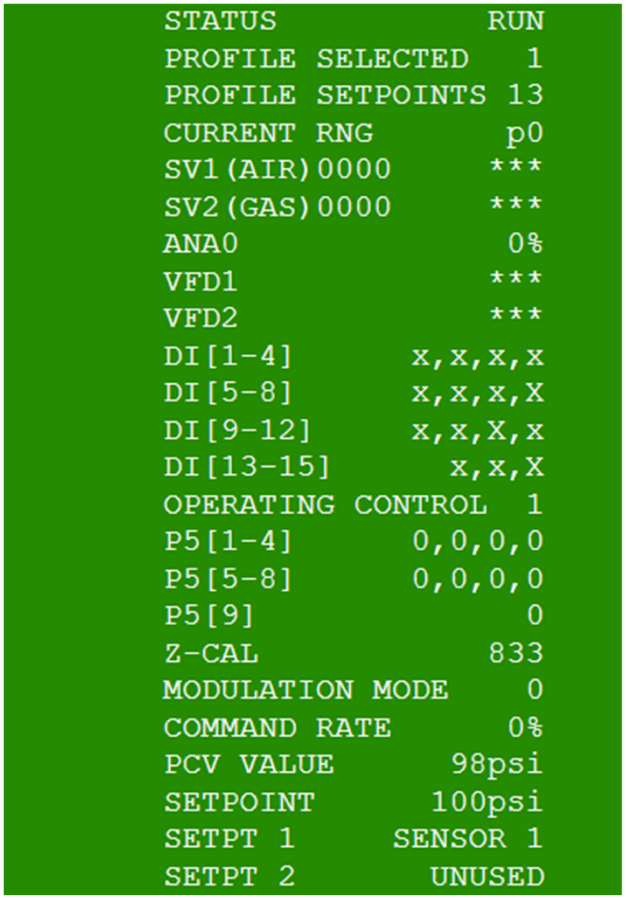


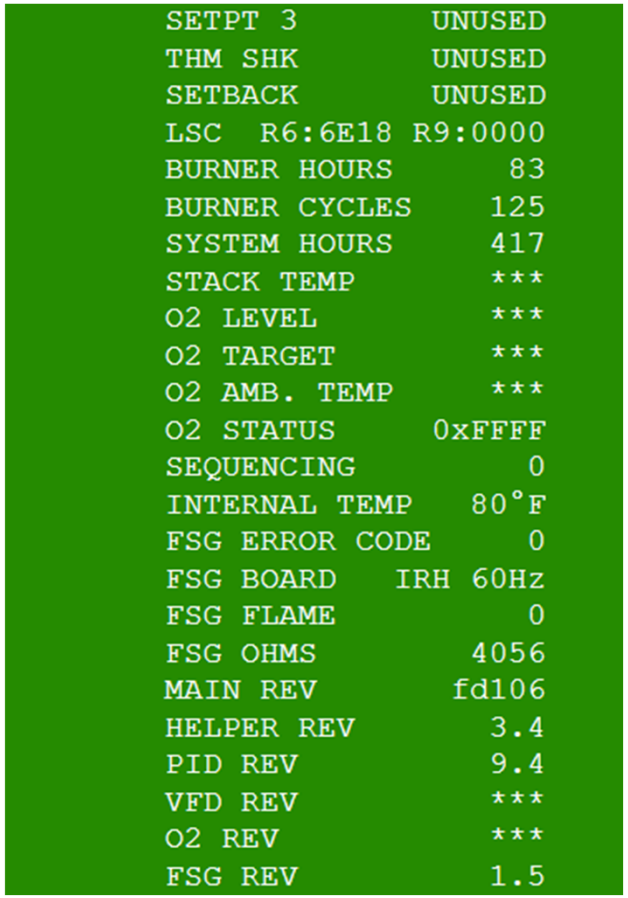


Interface

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.

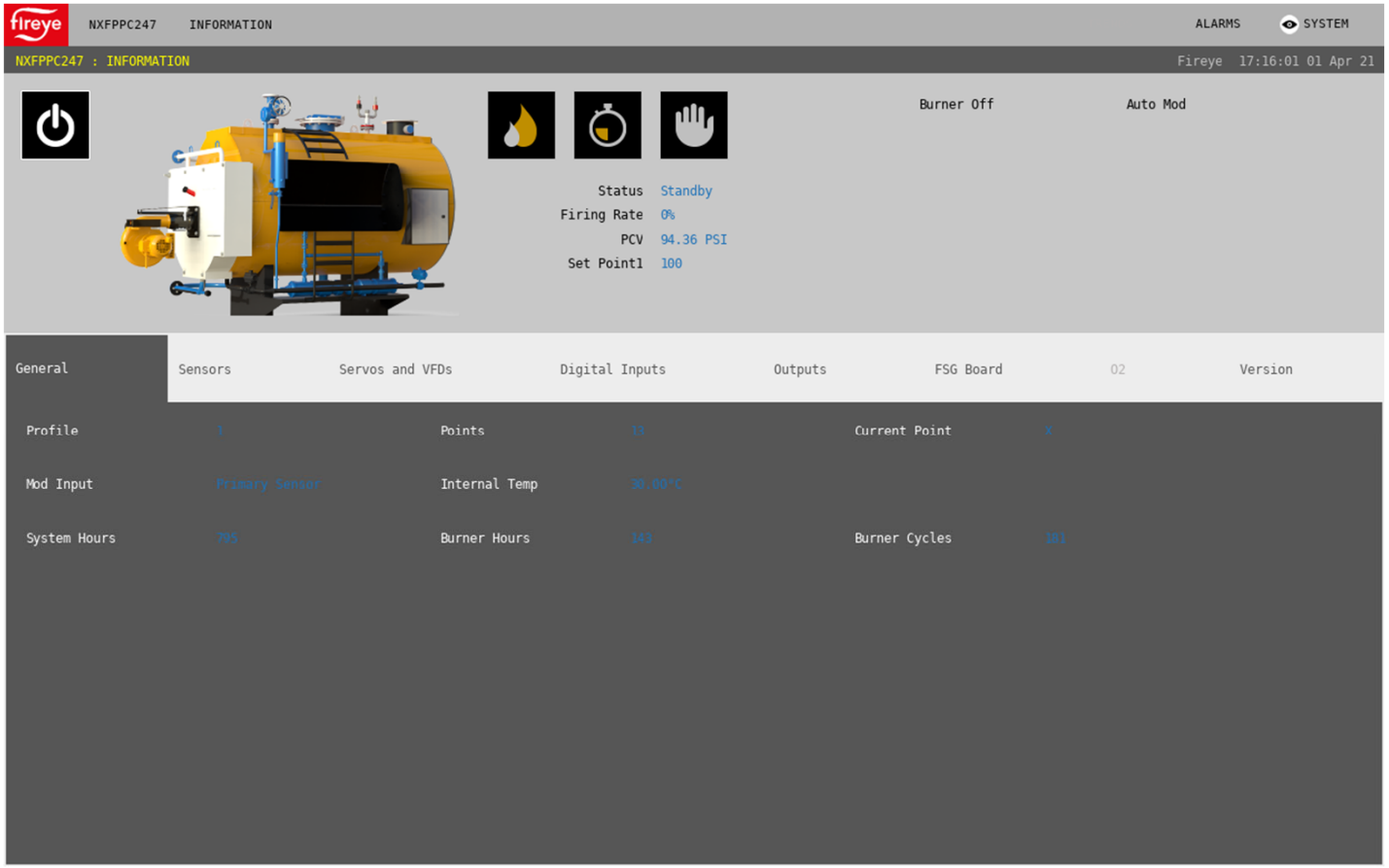




Interface

Information 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.



Interface

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.

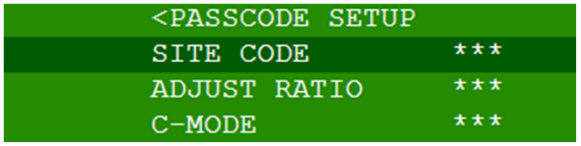
Level	Passcode	Access Allowed
SITE	154 (this is default, can be changed)	SETPOINT SETUP SEQUENCING SETUP
ADJUST RATIO	256 (can't be changed)	SETPOINT SETUP SEQUENCING SETUP O2 SETUP PROFILE SETUP (erasing profiles only) Adjust ratio mode
C-MODE	903 (can't be changed)	Full access (no restrictions)

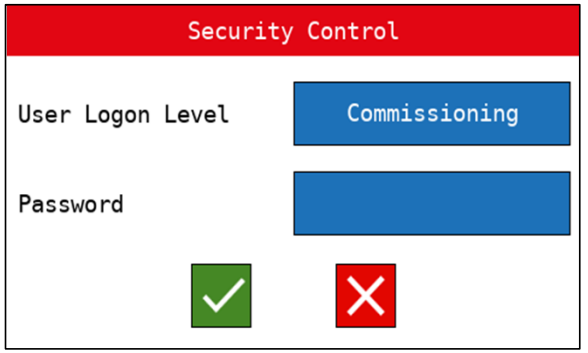
Interface

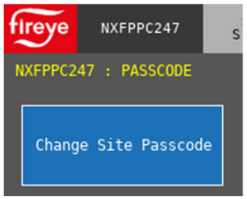
Security

With the NXD410TS, the PASSCODE SETUP screen will automatically appear when it is necessary to enter the passcode. Use the arrows and MODIFY/SAVE to enter the passcode.

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.





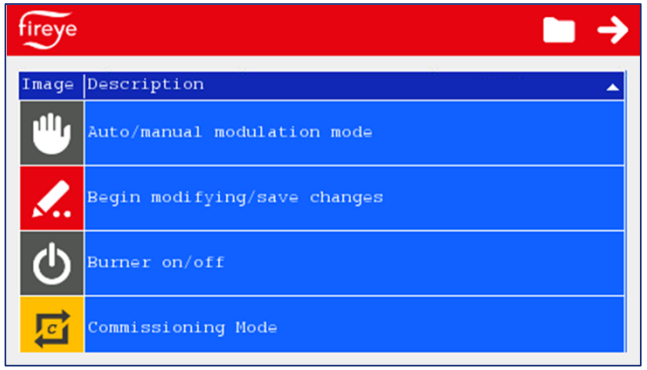


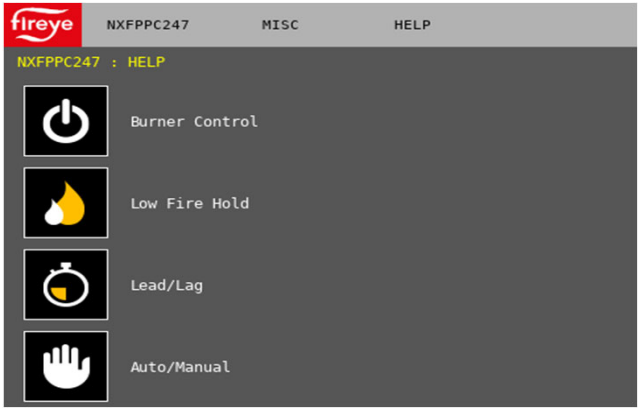
Interface

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.



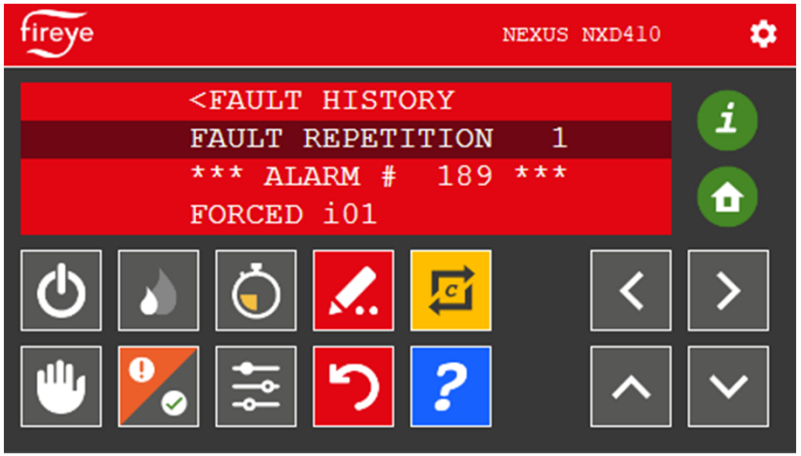


Interface

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.



Interface

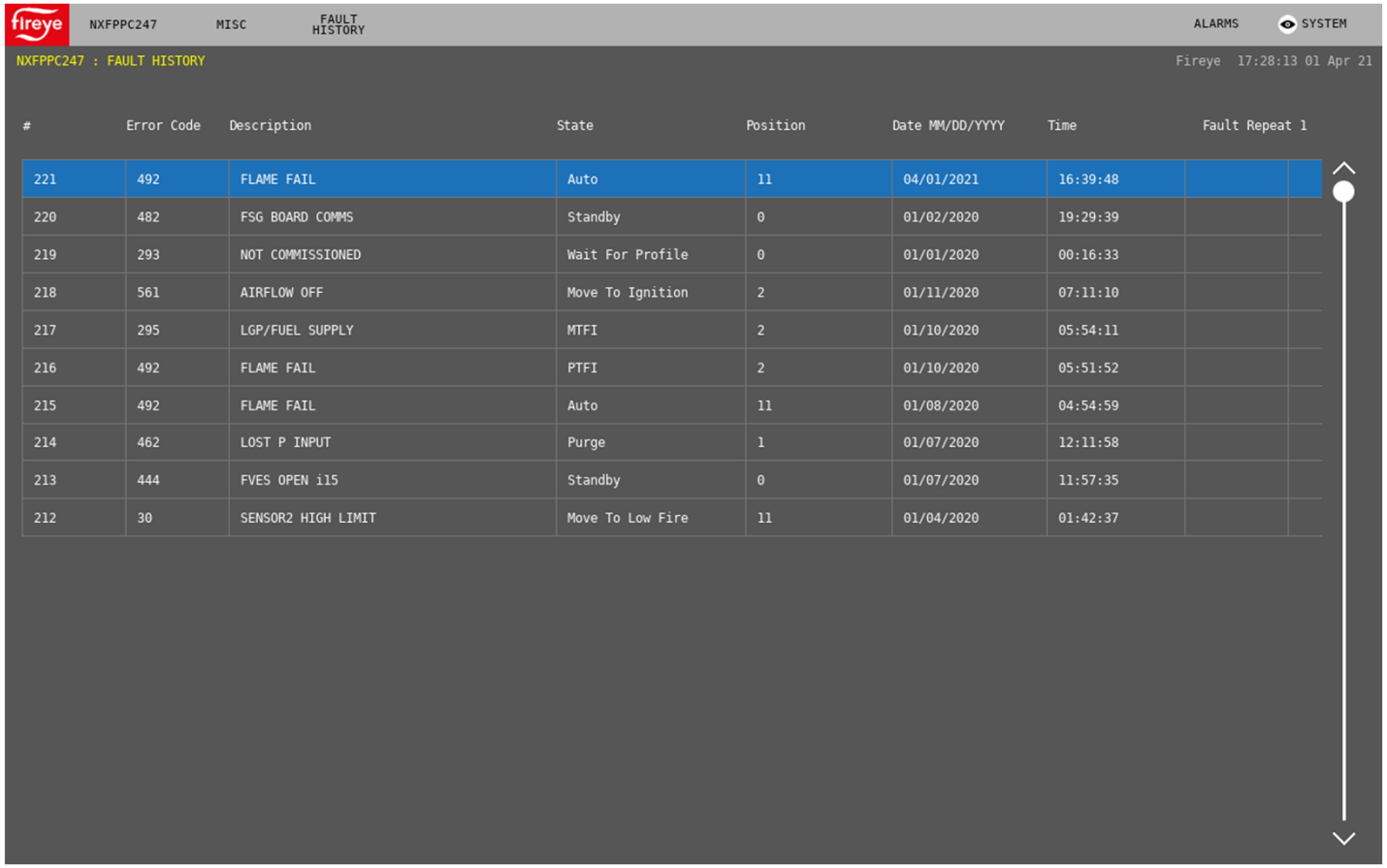
Lockout and fault history

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.

Interface

Lockout and fault history

Choosing MISC. → FAULT HISTORY in the drop-down menu will display the fault history contained in the NXF4000 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	

Interface

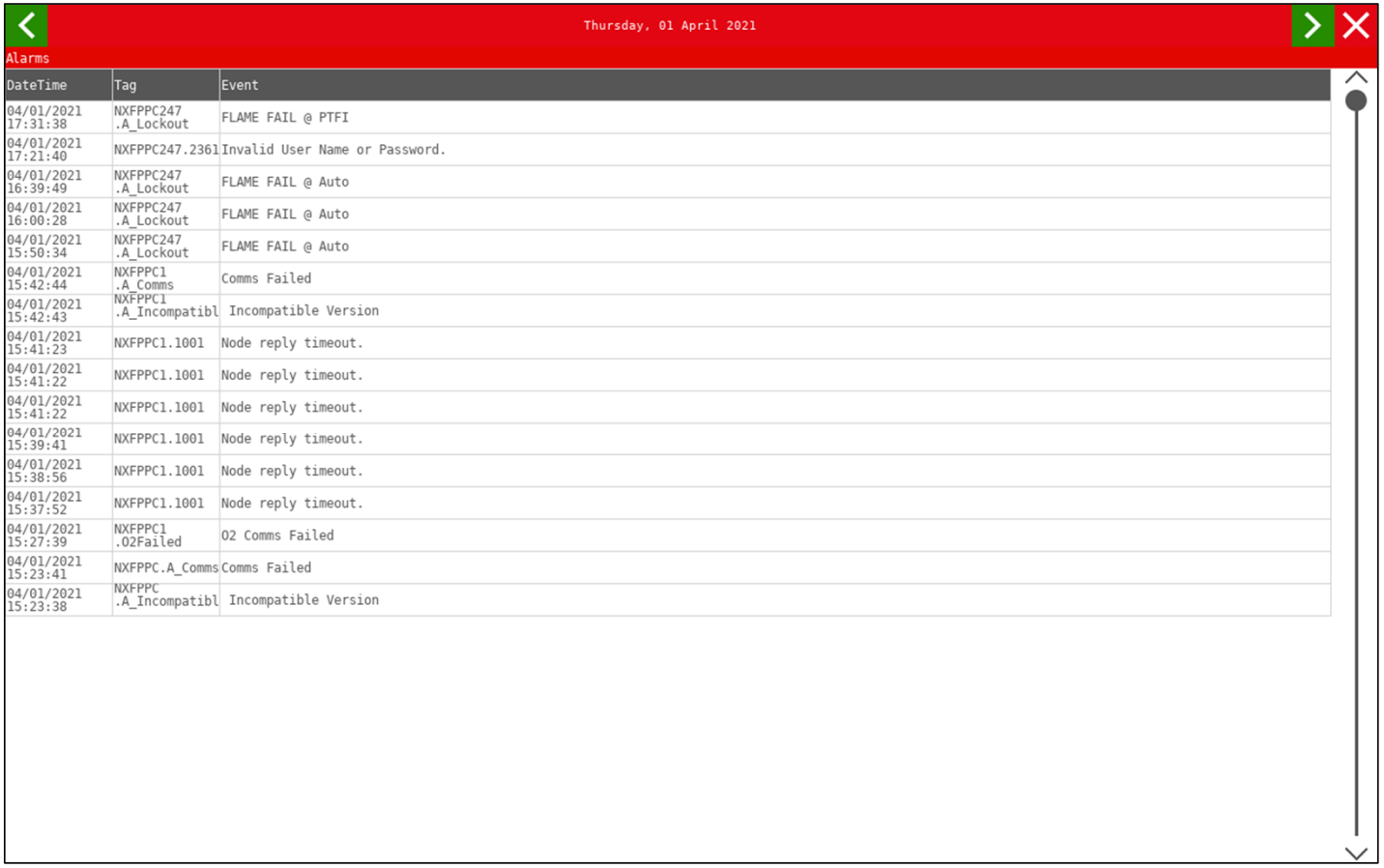
Lockout and fault history

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 limit of the previous ten. Choose ALARMS → ACTIVE to see the currently active alarms.

Interface

Lockout and fault history

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



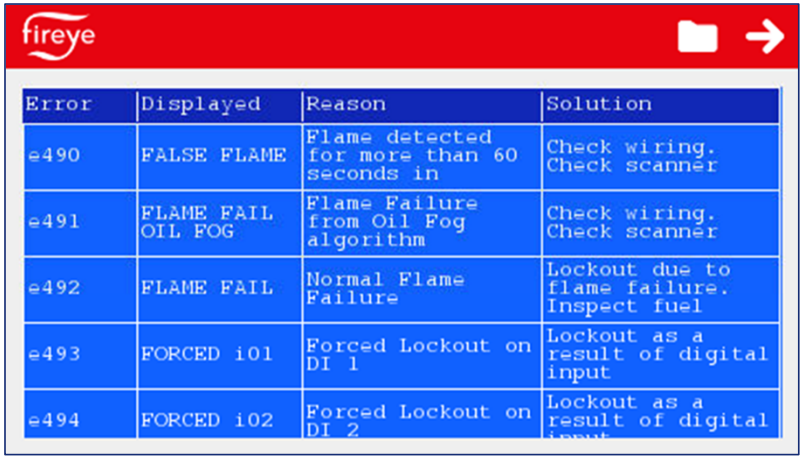
DateTime	Tag	Event
04/01/2021 17:31:38	NXFPPC247 .A_Lockout	FLAME FAIL @ PTFI
04/01/2021 17:21:40	NXFPPC247.2361	Invalid User Name or Password.
04/01/2021 16:39:49	NXFPPC247 .A_Lockout	FLAME FAIL @ Auto
04/01/2021 16:00:28	NXFPPC247 .A_Lockout	FLAME FAIL @ Auto
04/01/2021 15:50:34	NXFPPC247 .A_Lockout	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

Interface

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. 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.



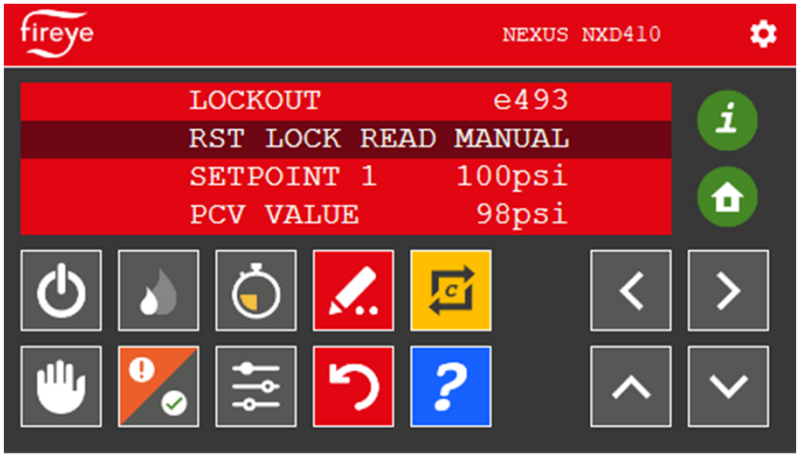
Error	Displayed	Reason	Solution
e490	FALSE FLAME	Flame detected for more than 60 seconds in	Check wiring. Check scanner
e491	FLAME FAIL OIL FOG	Flame Failure from Oil Fog algorithm	Check wiring. Check scanner
e492	FLAME FAIL	Normal Flame Failure	Lockout due to flame failure. Inspect fuel
e493	FORCED i01	Forced Lockout on DI 1	Lockout as a result of digital input
e494	FORCED i02	Forced Lockout on DI 2	Lockout as a result of digital

Interface

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 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.



Status	Lockout
Firing Rate	0%
PCV	94.36 PSI
Set Point1	100
Lockout	e89
NOT COMMISSIONED	
Reset Locked	
Auto Mod	

Interface

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.

Interface

Language support

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.

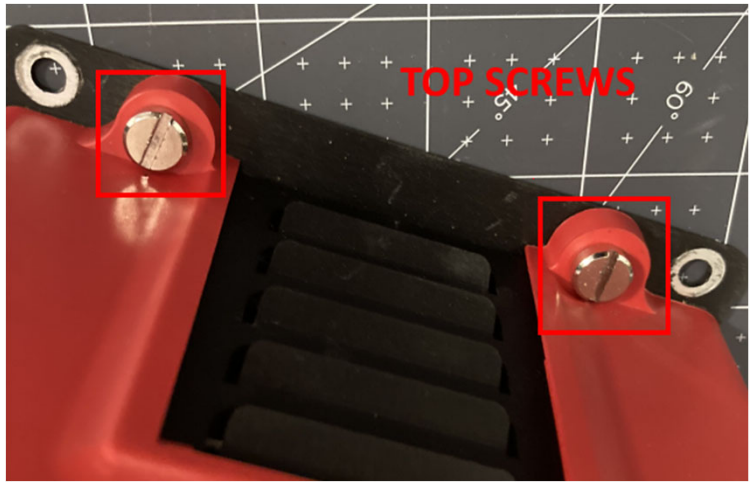
Section 7

HARDWARE CHECKING

Hardware checking

Removing the cover

To check that the proper add-on cards are fitted, remove each terminal block from the NXF4000. Then loosed the three captive slotted screws that hold the cover on. **These screws will remain attached to the cover.** Once the cover is loose, it can be carefully lifted off. Make sure that none of the terminal blocks are catching on the cover and that the SD card has been removed. Note that the ground does not need to be removed.

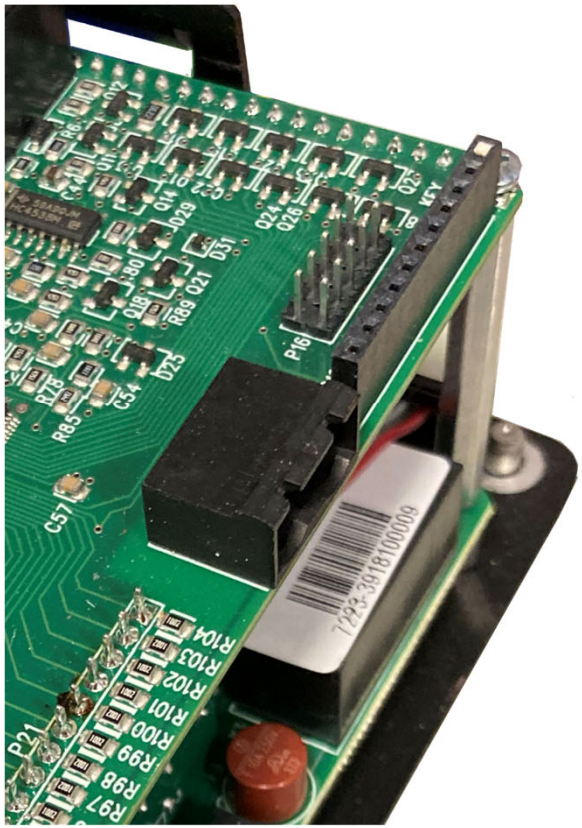


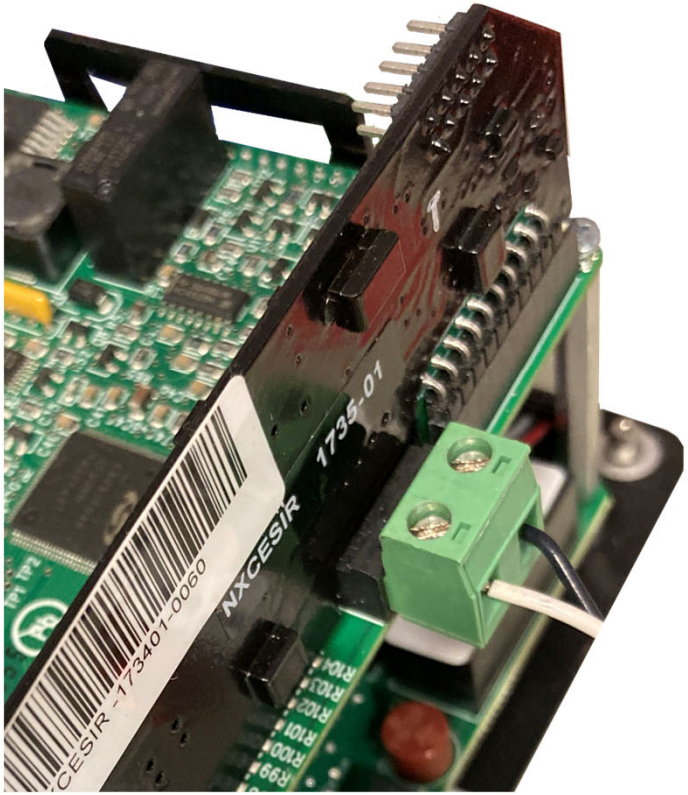
Hardware checking

Amplifiers

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

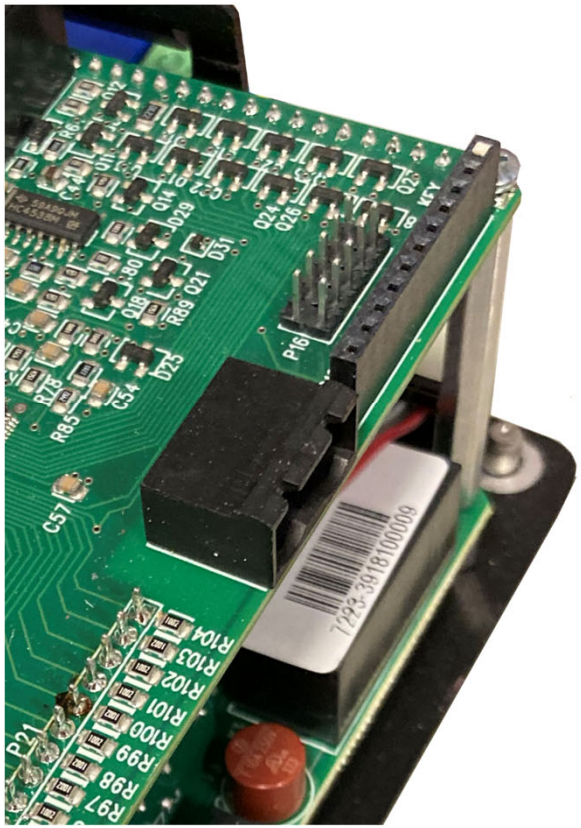


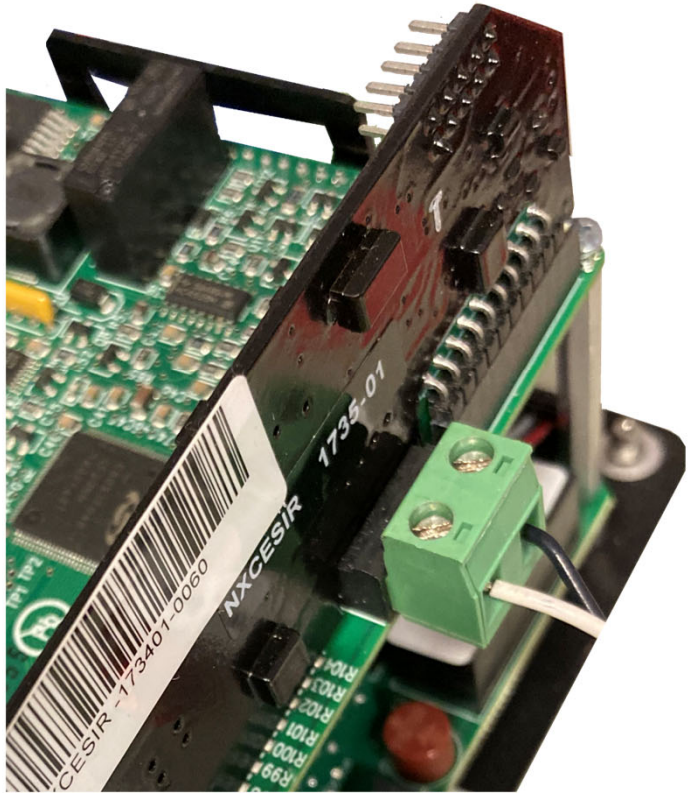


Hardware checking

Mounting

Make sure the power is off when removing or replacing the amplifier card. Make sure that all pins are fully seated in both pin headers. It is possible to seat the ten front pins properly and have the rear two pins not insert into the rear header – this will result in a flame failure since these rear pins carry the flame signal.

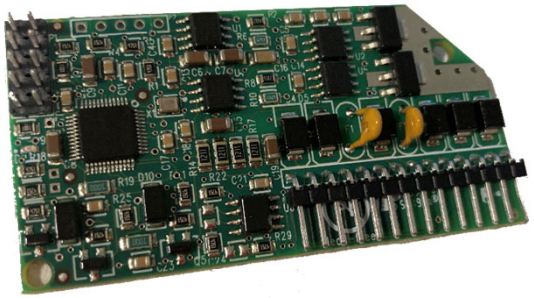


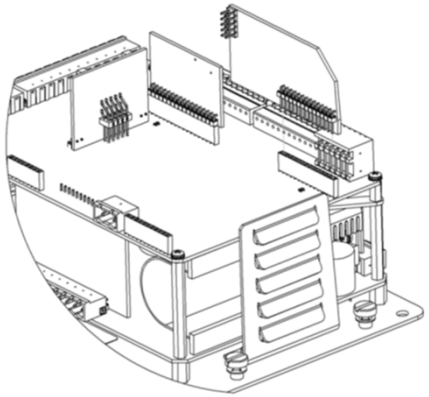


Hardware checking

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.



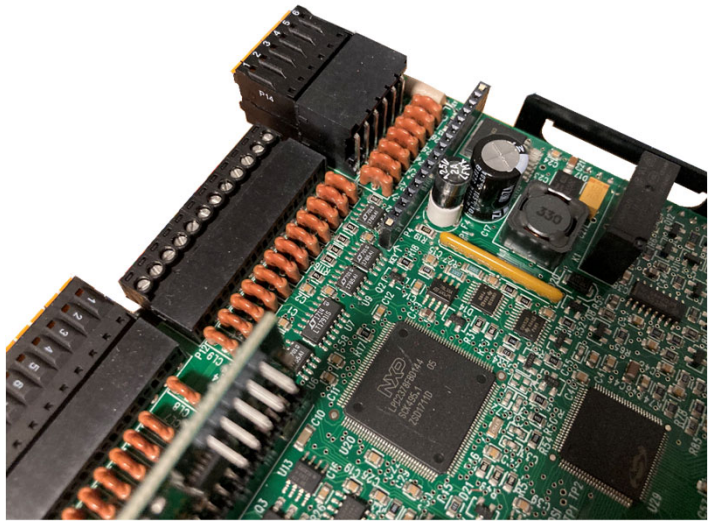


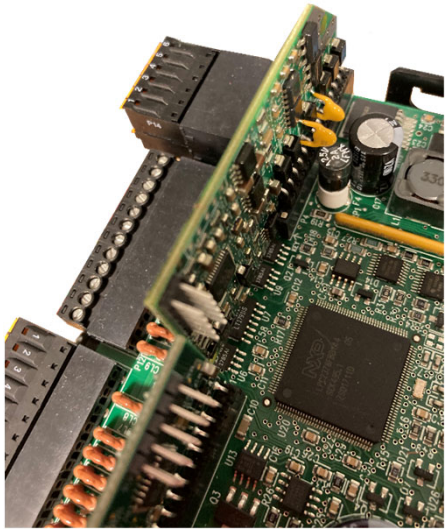
The NXCESVFD offers interfaces for up to two VFDs with either encoder feedback or with 4-20mA feedback from the VFD. The analog outputs from any unused channels can be used as user-assignable analog outputs.

Hardware checking

VFD add-on card NXCESVFD

The add-on card mounts in a similar manner to the amplifier add-on card.





For the exercise, power down the NXF4000 and disconnect each terminal block. Remove the plastic cover and find the NXCESVFD and the NXCESUV/NXCESIR amplifier cards. Remove and replace each card, then replace cover and terminal blocks.

Hardware checking

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.

Hardware checking

ABB ACS550

Fireye offers for sale ACS550 drives from 5HP to 200HP in 230VAC, 460VAC or 600VAC form. The drives are packaged in NEMA 12 enclosures with fused disconnects, motor overload relay and an LCD keypad. A contactor bypass package with a Hand-Off-Auto switch is also offered.

These VFDs are programmed at the factory with all the settings needed to work properly with the NXF4000. The only thing to do in the field is to properly wire between the devices. If the installation is a retrofit, it may be necessary to properly commission the VFD as well (check motor insulation and enter motor nameplate data).

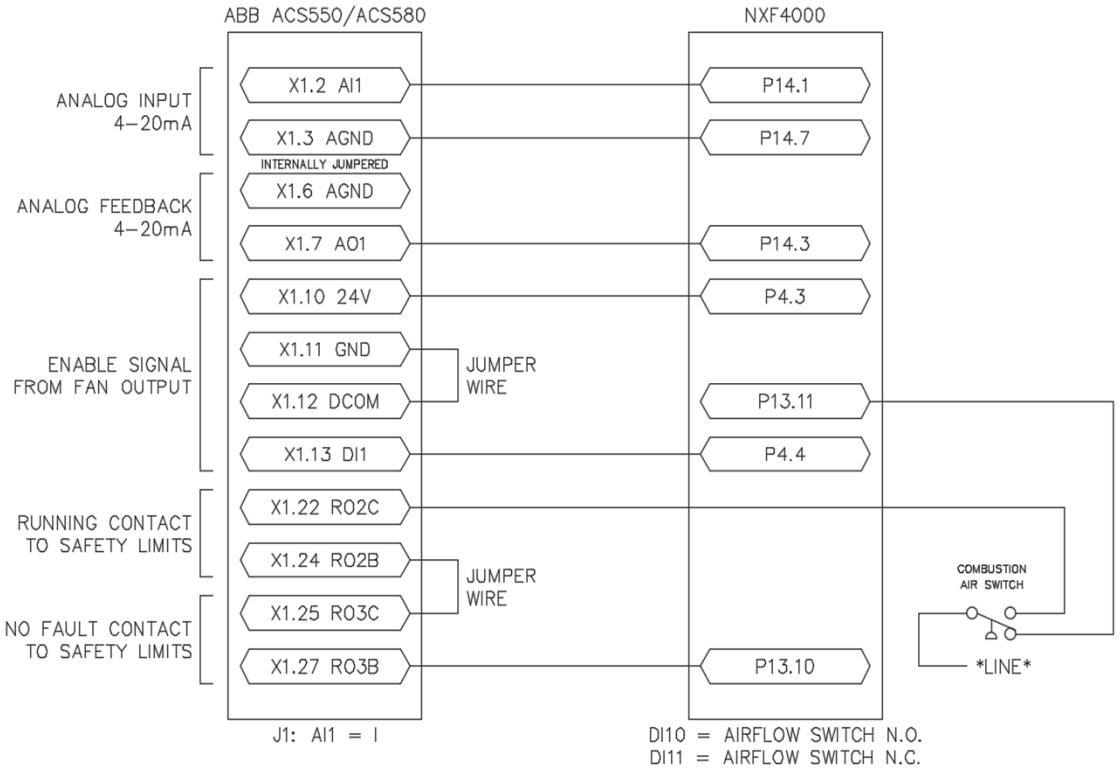
Fireye also offers ACS550 drives unpackaged (loose) for any application, including pumps and fans.

All ACS550 wiring and parameters are available in the *NXF-4100* bulletin for quick setup.

***Fireye will be transitioning from ACS550 to ACS580 mid-2021**

Hardware checking

ABB ACS550/ACS580 wiring example



Hardware checking

VFD 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 NXF400 and the VFD are hard-wired. This allows for a couple of different options to be used to supply the feedback.

Hardware checking

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 would lockout based upon an airflow interlock safety fault.

Hardware checking

Encoder feedback

If required for the installation, an external encoder can be mounted to the motor shaft to provide the feedback to the NXF4000. If this option is used, the 4-20mA signal from the NXF4000 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 NXF4000. The encoder is third-party device separate from the VFD or the NXF4000.

Hardware checking

Encoder selection

The encoder selected must have an **open-collector** output type. The NXF4000 has an internal pull-up resistor to work with this signal and uses 24VDC power to the encoder.

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 NXF4000 input.

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.

Hardware checking

Encoder selection

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 scale value (NXF4000 parameter ENCODER COUNTS):

(Motor RPM x CPR) / 60

ENCODER COUNTS can be set from 300 to 5000.

The table below shows the CPR range that can be used for different motor RPMs based on the formula above:

Motor RPM	NXF4000/PPC4000 Usable CPR Range
1750	11 to 171
3500	6 to 85

Hardware checking

Encoder mounting options

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 several 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.

Hardware checking

Encoder examples

Here are some examples of encoders from EPC (Encoder Products Company, www.encoders.com):

Model 775 low-profile (1.375”)

Model 25T

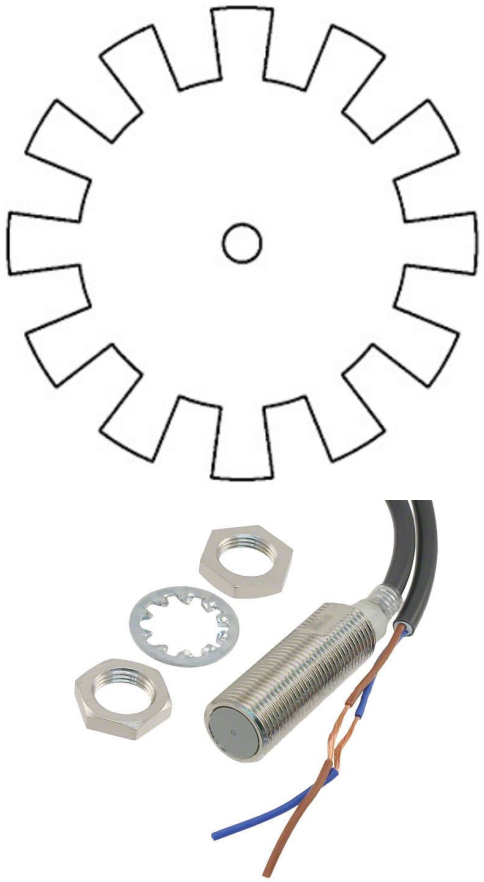
Model 702 motor mounted

Hardware checking

Speed wheel option

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.

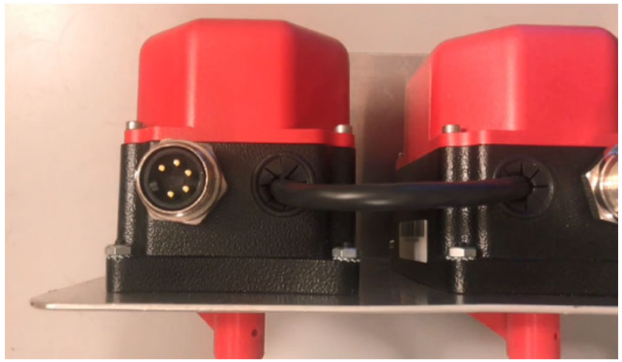
If using the speed wheel option, fabricate the wheel so that the inductive proximity sensor can be mounted close enough to pick up each tooth clearly. These speed wheels will typically mount on the tail shaft of the motor where it connects to the rear bearing, while the inductive proximity sensor threaded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

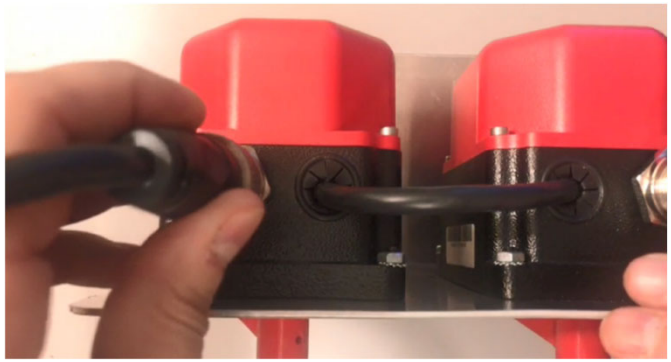


Hardware checking

FX servos

The FX servos can either be wired in a point-to-point (daisy chain) method using a four-conductor cable made up of two pairs (Fireye part number 59-565 recommended, sold by the foot) or “-1” variants of the FX servos can be ordered with quick-disconnect (QD) fittings. QD cables are sold in various lengths (i.e., 59-565-6 or 59-565-40, indicating 6’ or 40’ respectively). QD cables can also be made from bulk 59-565 cable and loose QD plugs which can be added in the field, making it possible to create cables of any length. Cables should be kept to a maximum of 200 feet to avoid voltage drop on the 24VDC power.



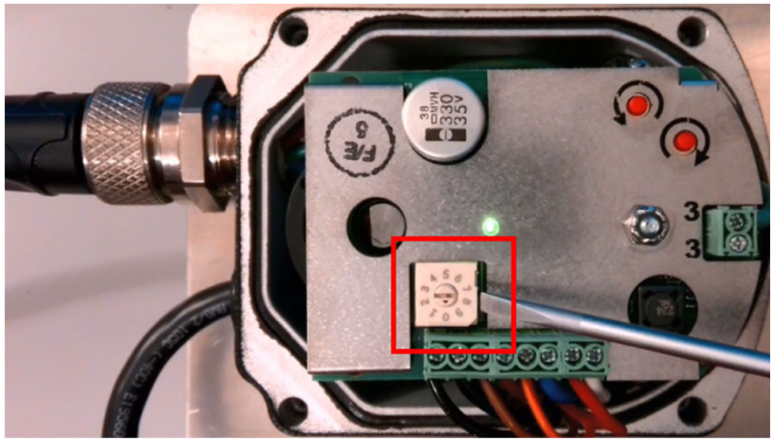


Hardware checking

FX servo addressing

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 this is the address that a new servo will have assigned.

Replacing a servo only requires that the address is set to match the one being replaced, then power cycled to apply. Since the servos use Modbus, it is important that each address is used only once, or communication errors will occur.

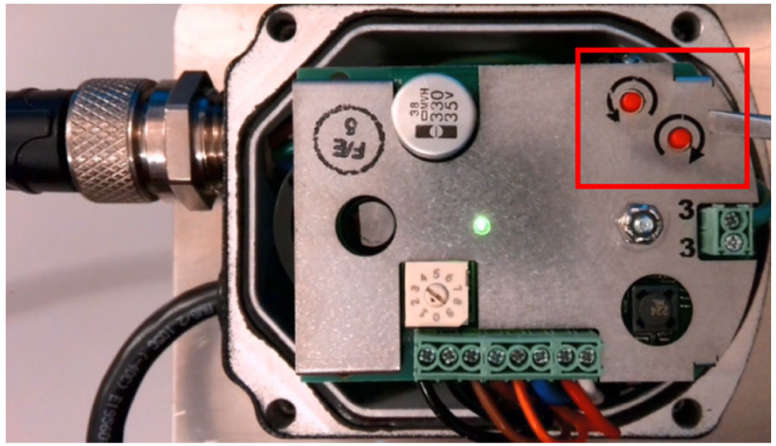


For the exercise, check that the AIR servo is addressed to 1 and that the GAS servo is addressed to 2.

Hardware checking

FX servo initial positioning

The FX servos have manual movement buttons located under the cover. The servo can be moved clockwise or counter-clockwise/anti-clockwise. 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.



For the exercise, first power up the unit. Then use the manual movement buttons to make sure each servo will go from 1° to 100° to simulate testing actual movement. Leave the servo at what will be the fully closed position (1°).

Section 8

PRE-COMMISSIONING SETUP

Pre-commissioning setup

Hands-on setup

Begin here and follow these steps to complete a hands-on setup of the NXF4000. This section and the next (Commissioning) will outline all the necessary steps to complete this task.

Power up the training units, making sure that the Recycle Limits or Call For Heat switch is in the Off position, and that the FVES/POC switch is in the Auto position. This should avoid creating any lockouts when the unit is first powered.

Pre-commissioning setup

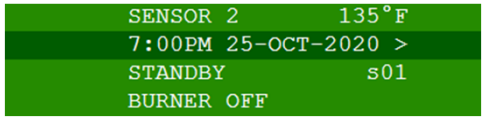
Set the real-time clock

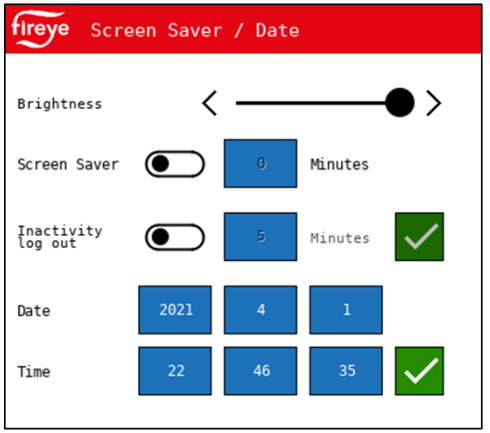
The real-time clock should be set so that any time-stamped alarms will display the correct time.

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.

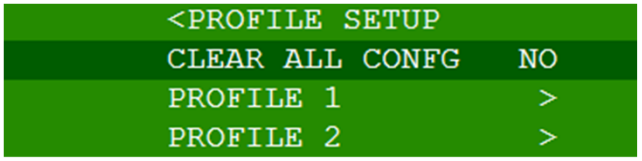
The real-time clock is also be used for setback functions.





Pre-commissioning setup

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.

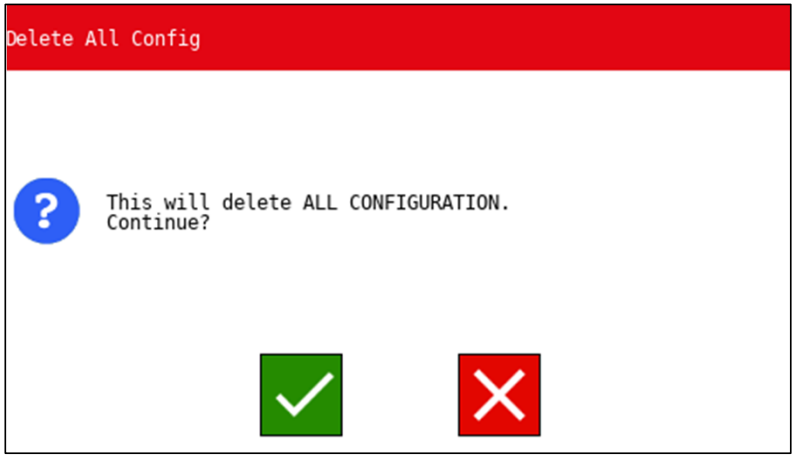
If the burner has already been commissioned and it is desired to keep the parameters only, it is possible to erase just the profiles as well.

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.

Pre-commissioning setup

Erasing existing configurations

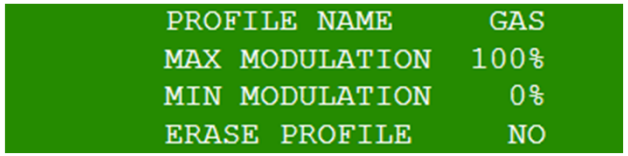
With the NXTSD507HD and NXTSD512HD, go to the menu SYSTEM SETTINGS → PROFILES. Navigate to the ALL CONFIG tab and touch the trash icon to erase. A confirmation pop-up will appear before proceeding.



Pre-commissioning setup

Create a new profile

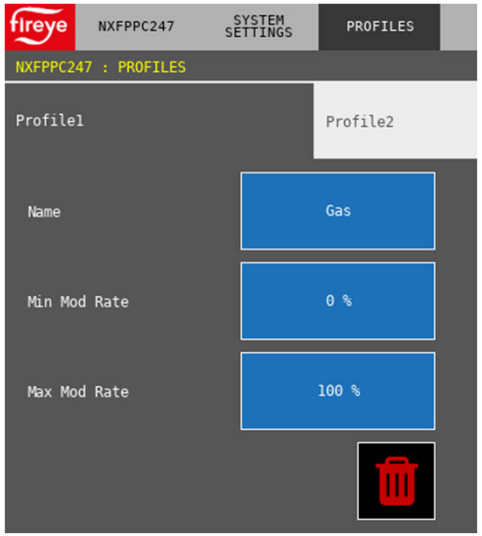
To create a new profile with the NXD410TS, navigate to PROFILE SETUP → PROFILE 1 then hit the NEXT quick key.



Pre-commissioning setup

Create a new profile

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



Pre-commissioning setup

Create a new profile

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, shown in the table on the right.

Each profile name is associated with one of four sequence charts that show how the outputs are energized for that fuel choice.

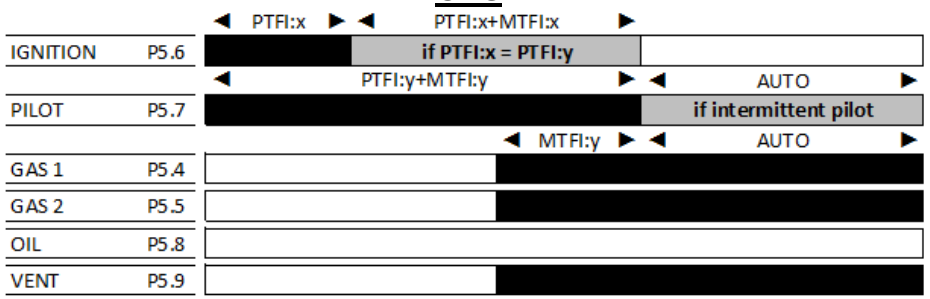
NAME	DESCRIPTION
GAS	Natural gas
WAS	Waste oil
FUE	Generic fuel oil
COG	Coke oven gas
SOL	Solid fuel
OIL	Light oil
HVY	Heavy oil
GAS1	Natural gas
GAS2	Natural gas
OIL1	Light oil
OIL2	Light oil

Pre-commissioning setup

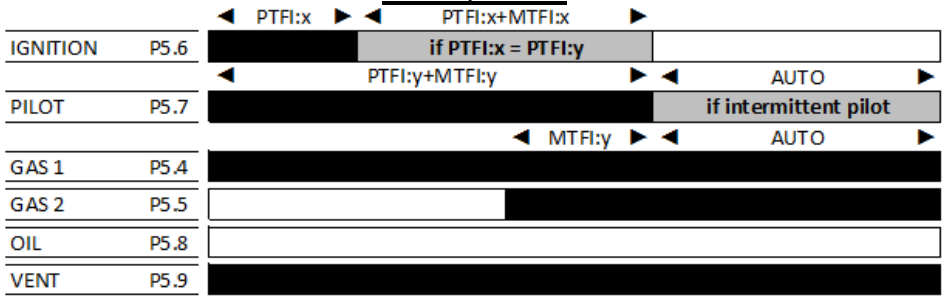
Profile sequence charts

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.

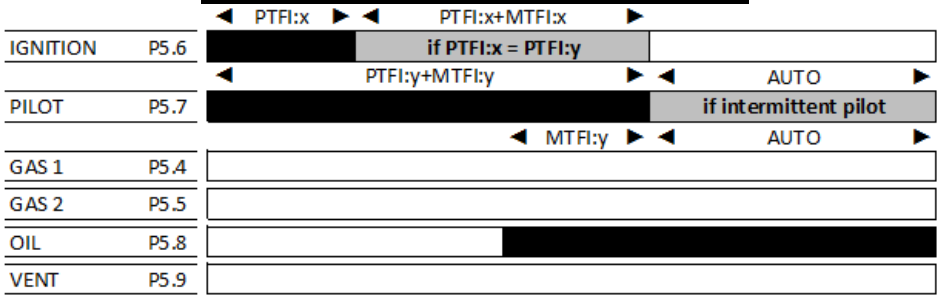
GAS



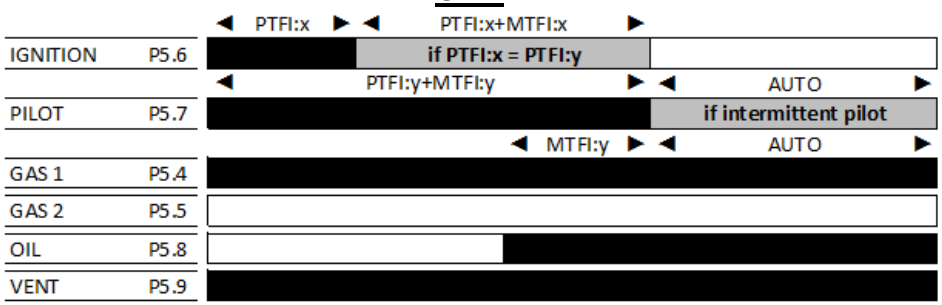
GAS1, GAS2



OIL, WAS, FUE, COG, SOL, HVY, OIL1



OIL2



Pre-commissioning setup

Create a new profile

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.

For the exercise, configure PROFILE 1 with the name GAS.

Pre-commissioning setup

Discover servos

For this step to work, make sure that the NXF4000 is not in lockout.

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 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.

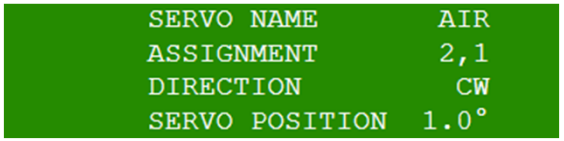
For the exercise, run a servo search and troubleshoot until two servos are found with the addresses 1 and 2.

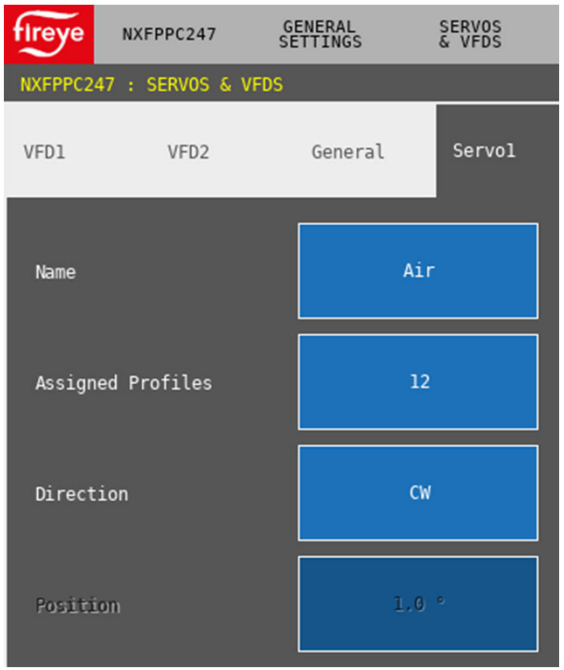
Pre-commissioning setup

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.





Pre-commissioning setup

Set up servos

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.

For the exercise, configure SERVO 1 with the name AIR. Configure SERVO 2 with the name GAS. Assign both so that they can be used with profile 1.

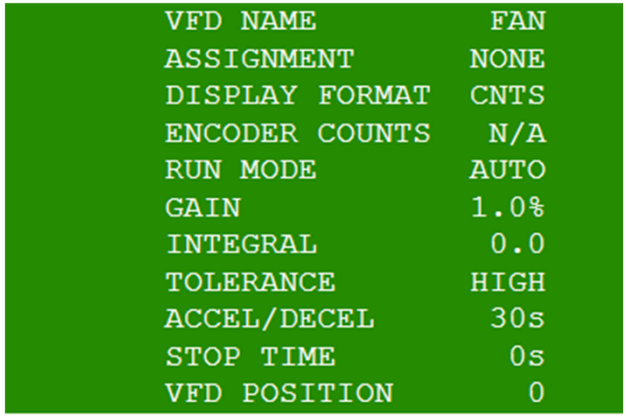
Pre-commissioning setup

Set up VFD

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 shortly after it is enabled.

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.

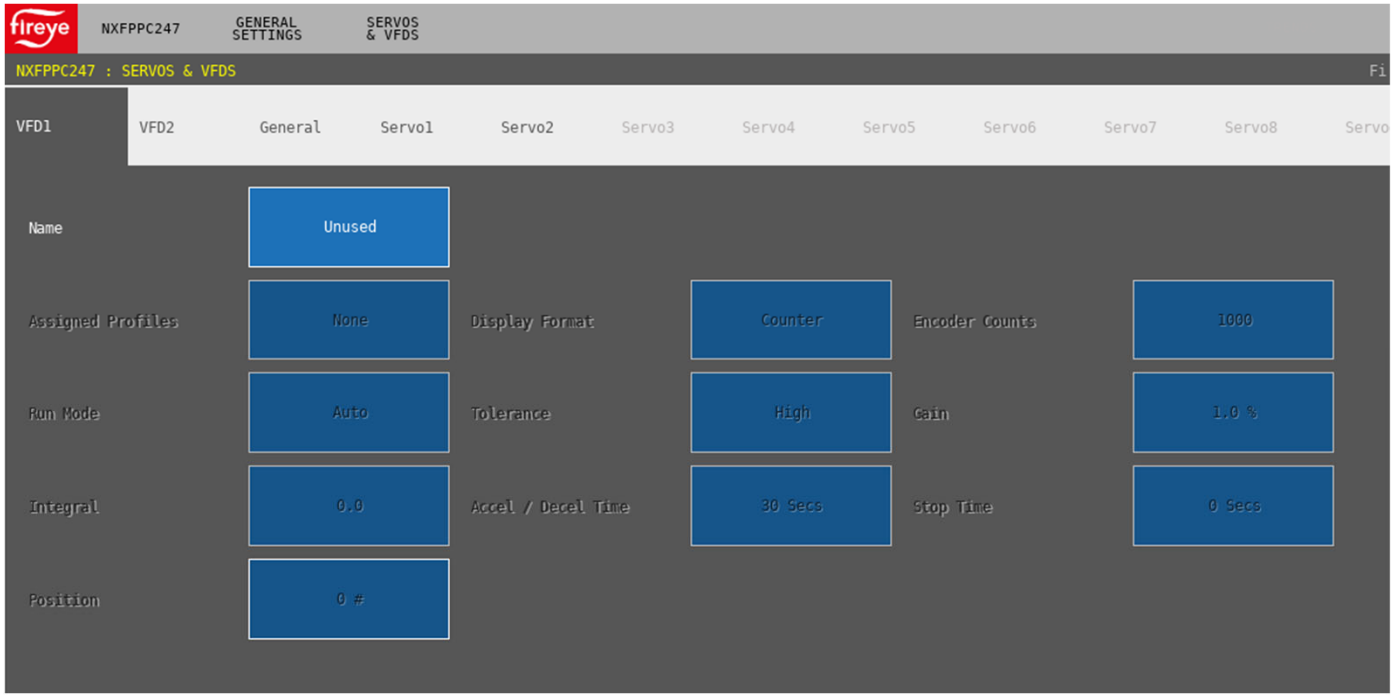
With the NXD410TS, the VFD channels can be configured from the SERVO SETUP menu. There is a menu for both VFD1 and VFD2.



Pre-commissioning setup

Set up VFD

With the NXTSD507HD and NXTSD512HD, go to the menu GENERAL SETTINGS → SERVOS & VFDS. Each VFD will have a separate tab.



Pre-commissioning setup

Set up VFD

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.

NOTE: The VFD channels can also be used with industrial actuators that accept a 4-20mA command and provide 4-20mA feedback.

For the exercise, configure VFD 1 with the name FAN. Set the display format to %FS.

Pre-commissioning setup

VFD parameters

Once a name has been selected, the following setup options are presented:

- **ASSIGNMENT:** Which profiles this VFD is used with.
- **DISPLAY FORMAT:** Choose between **CNTS** (counts), **ENCOD** (encoder) or **%FS** (percent).
  - **CNTS**: Used with 4-20mA, shows the feedback as 0-1000 (ex. 30Hz = 500 for 60Hz max).
  - **ENCOD**: Used with an encoder, shows the feedback as 0-1000 as described above.
  - **%FS**: Used with 4-20mA, shows the feedback as 0-100% (ex. 30Hz = 50% for 60Hz max).
- **ENCODER COUNTS**: This is where the number calculated from the encoder scaling formula **(Motor RPM x CPR) / 60** is entered. The allowed range is 300 to 5000.

Pre-commissioning setup

VFD parameters

- **RUN MODE:** Choose between **AUTO** and **MANUAL**. The default is AUTO.
  - **AUTO:** The NXF4000 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 will only issue the setpoint. This is not recommended as it may lead to lockouts from failure to reach the required positions.
- **GAIN:** This is the proportional gain for the internal PID for the VFD. This can be set from 1% to 100%. This only needs to be adjusted if the VFD is reacting too fast or too slow for satisfactory operation. The default is 1%
- **INTEGRAL:** This is the integral for the internal PID for the VFD. This can be set from 0.0 (disabled) up to 100.0 in 0.1 increments. This only needs to be adjusted if the VFD is having trouble reaching the desired speed. The default is 0.0.

Pre-commissioning setup

VFD parameters

- **TOLERANCE:** Sets the allowable deviation from the target speed. This is based upon a normalized range of 0-1000 for the 0-60Hz speed range. Falling outside of this tolerance range will result in a lockout. Choose between **LOW** and **HIGH**. The default is HIGH.
  - **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.
- **ACCEL/DECEL:** This is the time it takes to ramp from 0Hz to full speed (60Hz). Lengthening this time is normally one way to solve tolerance errors. The range can be set from 0 to 255 seconds. The default is 30 seconds.
- **STOP TIME:** This is the time that the NXF4000 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 range can be set from 0 to 100 seconds. The default is 0 seconds.

Pre-commissioning setup

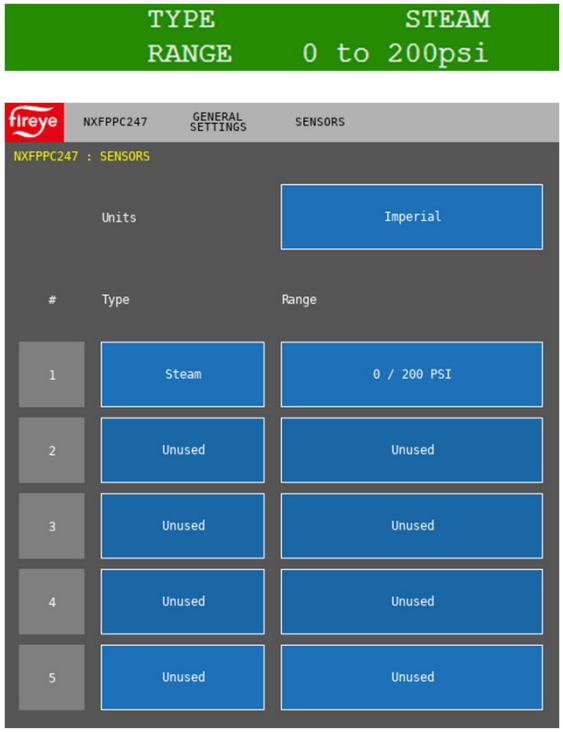
Set up sensors

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



For the exercise, configure SENSOR 1 as type STEAM. Choose the range 0 to 200psi.

Pre-commissioning setup

Available sensor ranges

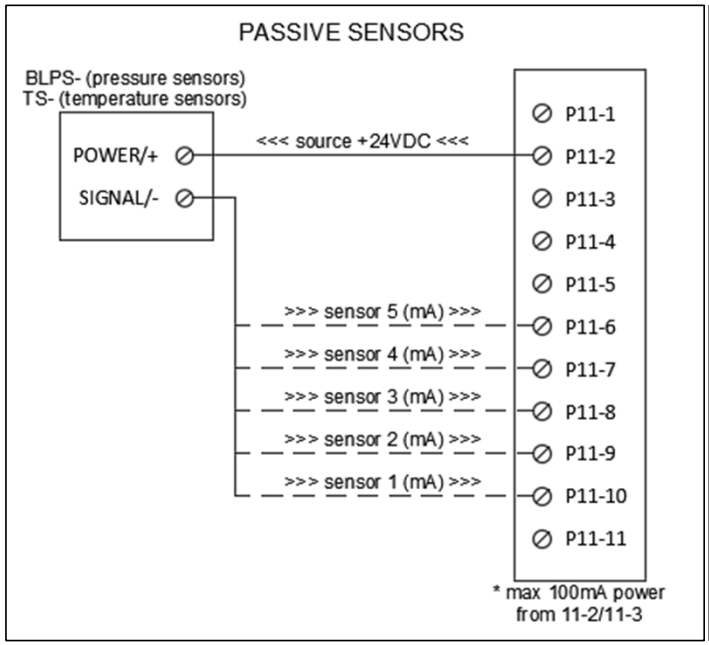
Sensor	Type	Minimum	Maximum
BLPS-15	Pressure	0 mb (0 psi)	1030 mb (15 psi)
BLPS-25	Pressure	-1013 mb (-14.7 psi)	1720 mb (25 psi)
BLPS-30	Pressure	0 mb (0 psi)	2070 mb (30 psi)
BLPS-200	Pressure	0 Bar (0 psi)	13.8 Bar (200 psi)
BLPS-300	Pressure	0 Bar (0 psi)	20.7 Bar (300 psi)
TS350-2*,-4*,-8*	Temperature	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)

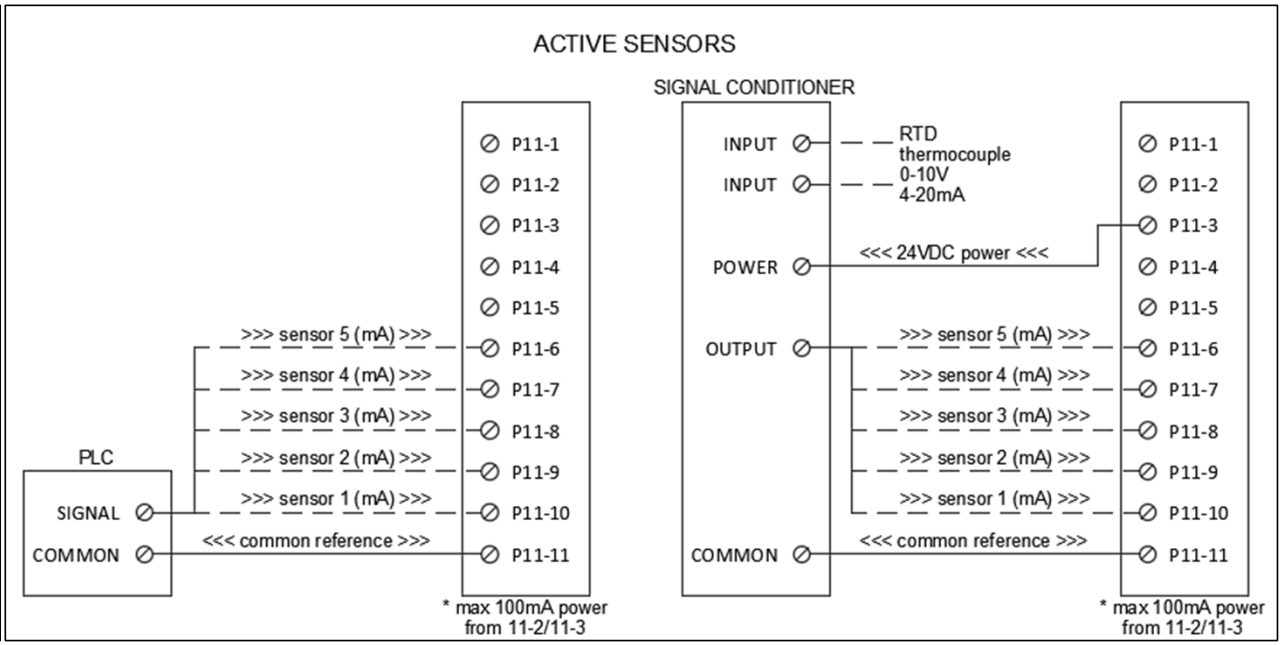
* -- indicates length of insertion probe

Pre-commissioning setup

Sensor wiring

Sensors can be wired either passive or active. Fireye sensors are passively wired (loop powered) but external 4-20mA signals are often actively wired.





Pre-commissioning setup

Set up setpoint

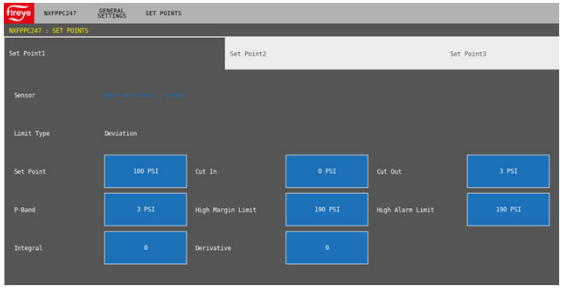
With the NXD410TS, setpoints are set up from the SETPOINT SETUP menu. With the NXTSD507HD and NXTSD512HD, go to the menu GENERAL SETTINGS → SET POINTS. Each setpoint has a separate tab.

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.

For the exercise, configure SETPOINT 1 to use sensor 1.

SETPOINT to 100psi
CUT OUT to 3psi
P-BAND to 10psi

SENSOR USED	1
LIMIT TYPE	DEV
SETPOINT	100psi
CUT IN	0psi
CUT OUT	3psi
P-BAND	10psi
HIGH MARGNL	190psi
HIGH LIMIT	190psi
INTEGRAL	0
DERIVATIVE	0



Pre-commissioning setup

Setpoint options

- **LIMIT TYPE:** Fixed to DEV. This means that the CUT IN and CUT OUT settings reference a deviation from the setpoint.
- **CUT IN:** This is the point where the burner will turn back on if it is off on stat limit. This is always subtracted from the setpoint. Example: If the setpoint is 100psi and the cut in is 3psi, the burner would come back on when the process value dropped below 97psi (100psi – 3psi).
- **CUT OUT:** This is the point where the burner will turn off on the stat limit. This is always added to the setpoint. Example: If the setpoint is 100psi and the cut out is 7psi, the burner would shut down when the process value rose above 107psi (100psi + 7psi).
- **P-BAND:** This is the proportional band for modulation. If the setpoint is 100psi and the proportional band is 10psi, the firing rate would be 100% at 90psi or less, and 0% at 100psi or more. At any point in between the firing rate would be in ratio. Example: At 92.5psi the firing rate would be 75% and at 97.5psi the firing rate would be at 25%. Note that if integral and/or derivative are enabled, these will also affect the firing rate since all three terms are added together to determine the firing rate.

Pre-commissioning setup

Setpoint options

- **HIGH MARGNL:** This is the high “marginal” limit. At this setpoint or higher, the alarm output will be energized but the burner will continue to run. This is intended to be a warning prior to the lockout high limit.
- **HIGH LIMIT:** This is the lockout high limit. At this setpoint or higher, the alarm output will be energized, and the burner will lockout.
- **INTEGRAL:** This is a time-based variable that monitors the difference between the setpoint and process value and makes corrections to the firing rate. How quickly this occurs is based upon this setting. A lower value is more aggressive, and a higher value is less aggressive. A setting of 0 disables this function. A setting of 1 corresponds to an integral of 12 seconds and a setting of 100 corresponds to 1200 seconds.
- **DERIVATIVE:** This is a time-based variable that monitors the rate of change and makes corrections to the firing rate to prevent overshooting either up or down. How quickly this correction lasts is based upon this setting. A higher value will correct longer than a lower value. A setting of 0 disables this function. A setting of 1 corresponds to a duration of 12 seconds and a setting of 100 corresponds to 1200 seconds.

Pre-commissioning setup

Digital inputs

Digital inputs are programmed from the DIGITAL INPUT SETUP menu. There are 15 available digital inputs. There are many different options that can be selected for each input.

For the exercise, the following slides will show the required digital inputs to be set up. This is based upon the notes from the *NXF4000 Wiring Application Guide*.

Note that for the inputs used are just an example, other inputs can be used for the same functions.

Pre-commissioning setup

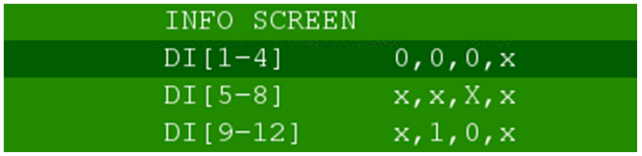
Verify digital inputs

With the NXD410TS, navigate to the INFO screen on the keypad. Scroll until the DI status is shown.

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.

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.

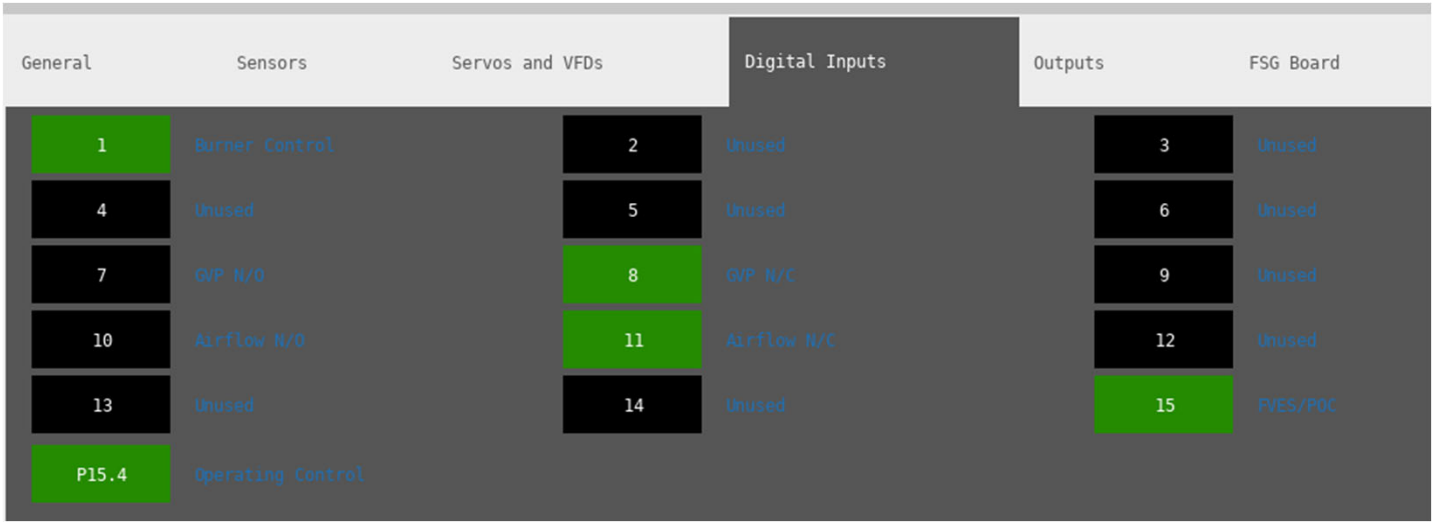


Pre-commissioning setup

Verify digital inputs

With the NXTSD507HD and NXTSD512HD, go to the menu INFORMATION, then to the tab DIGITAL INPUTS. The fill of the input is black when off, and green when on.

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.



Pre-commissioning setup

Verify digital inputs

The training units one or more of the following switches:

- Airflow OPEN/CLOSE/AUTO
- FVES OPEN/CLOSE/AUTO
- GAS PRESSURE SWITCH (VALVE PROVING) OPEN/CLOSE/AUTO
- DIGITAL INPUT 1 ON/OFF
- DIGITAL INPUT 2 ON/OFF
- DIGITAL INPUT 3 ON/OFF
- RESET ON/OFF

Toggle the switches/buttons on the trainer to check which digital input turns on and off for each function. If applicable, note which input is connected to the remote reset pushbutton for later programming.

Pre-commissioning setup

Digital input 1

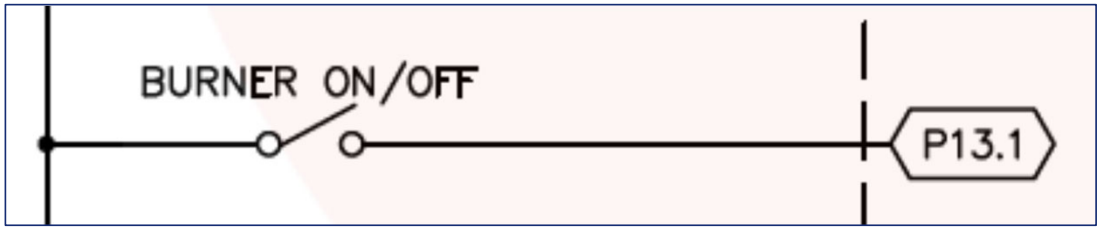
Digital input 1 is used for the Burner On/Off switch. This must be programmed as:

DIGITAL INPUT SETUP → DI 1 → USE = BURNER CONTROL

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

DIGITAL INPUT SETUP → DI 1 → ACTION = AND

With the NXTSD507HD and NXTSD512HD, this is programmed as:



For the exercise, program DI1.

Pre-commissioning setup

Digital inputs 7 and 8

Digital inputs 7 and 8 are used for valve proving. Configuring the digital inputs for this function also implicitly enables valve proving. This must be programmed as:

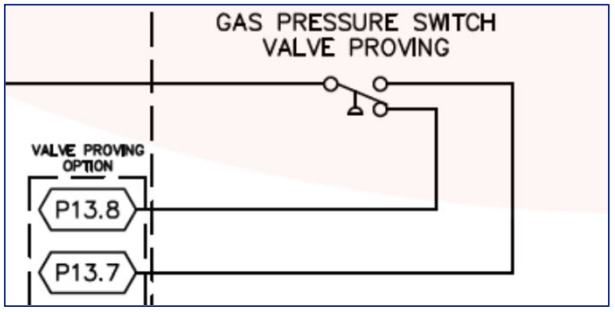
DIGITAL INPUT SETUP → DI 7 → USE = GVP NORM. OPEN

DIGITAL INPUT SETUP → DI 7 → ASSIGNMENT = 1

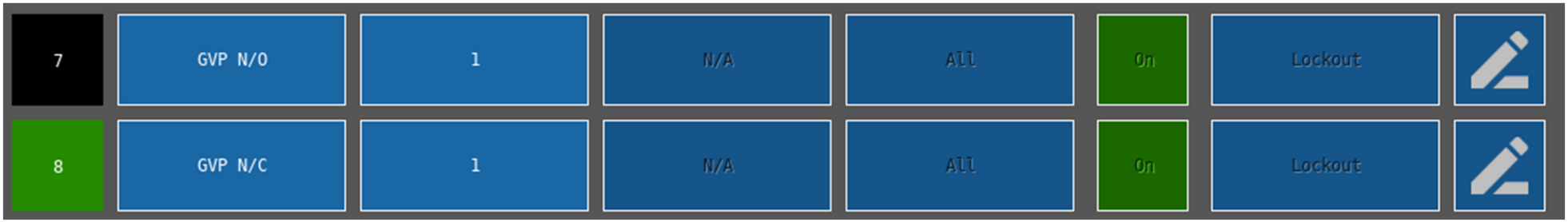
DIGITAL INPUT SETUP → DI 8 → USE = GVP NORM. CLOSED

DIGITAL INPUT SETUP → DI 8 → ASSIGNMENT = 1

With the NXTSD507HD and NXTSD512HD, this is programmed as:



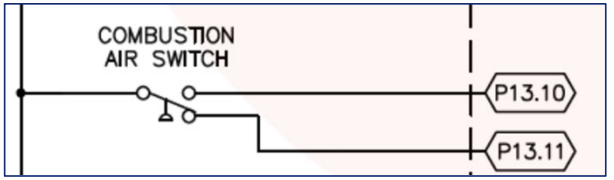
For the exercise, program DI7 and DI8.



Pre-commissioning setup

Digital inputs 10 and 11

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 must be programmed as:



For the exercise, program DI10 and DI11.

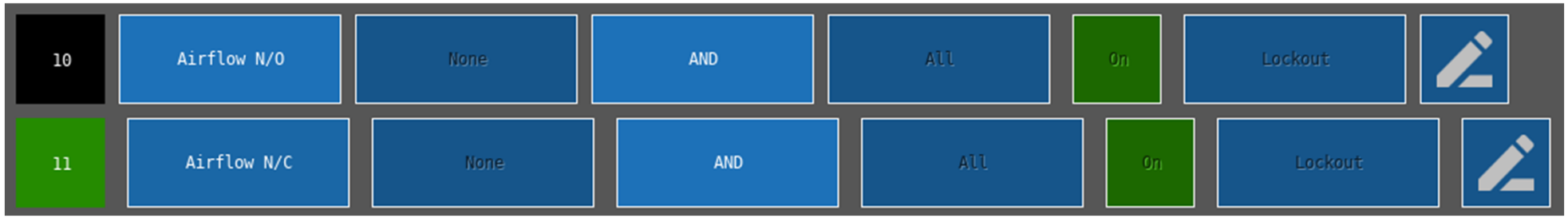
DIGITAL INPUT SETUP → DI 10 → USE = AIRFLOW N. OPEN

DIGITAL INPUT SETUP → DI 10 → ACTION = AND

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

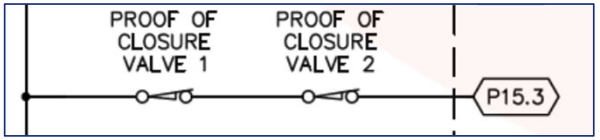
DIGITAL INPUT SETUP → DI 11 → ACTION = AND

With the NXTSD507HD and NXTSD512HD, this is programmed as:



Pre-commissioning setup

Digital input 15



Digital input 15 is used for the fuel valve end switches (proof of closure). This must be programmed as:

DIGITAL INPUT SETUP → DI 15 → USE = FVES/POC

DIGITAL INPUT SETUP → DI 15 → ASSIGNMENT = 1

For the exercise, program DI15.

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.

With the NXTSD507HD and NXTSD512HD, this is programmed as:

Pre-commissioning setup

Remote reset

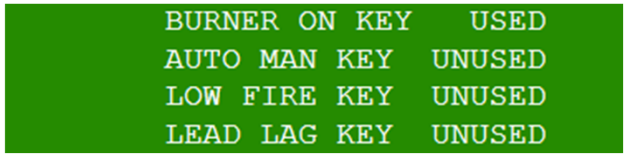
Based upon the techniques used to set up the previous digital inputs, set up the appropriate input for the remote reset pushbutton already wired on the training unit. Recall the digital input test done earlier with the INFO screen.

Pre-commissioning setup

Set up keypad

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. 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.

This step only applies when the NXD410TS is used. These keys are always enabled on the NXTSD507HD and NXTSD512HD.



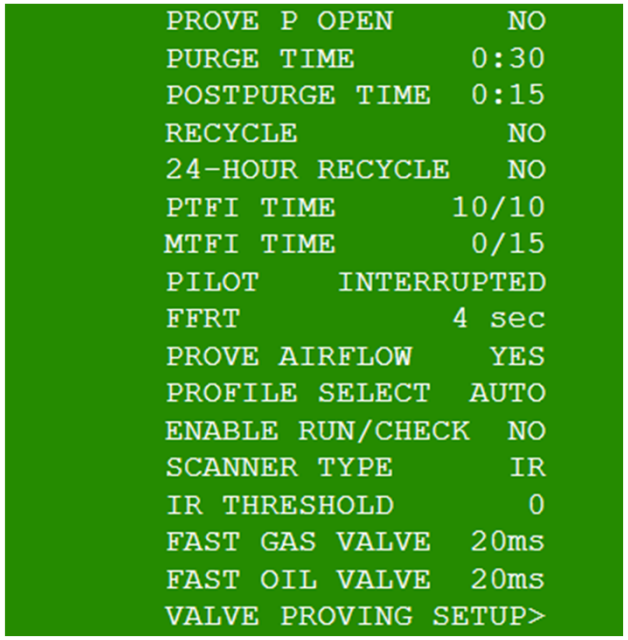
For the exercise, configure the BURNER ON KEY, AUTO MAN KEY and LOW FIRE KEY to be used.

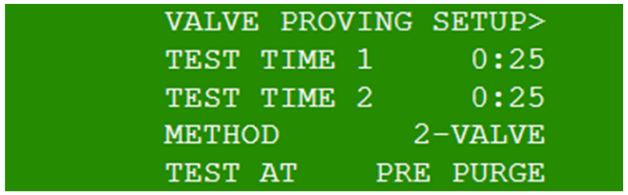
***** QUESTION *****
How could digital input 2 be configured so that it can also trigger low fire hold, in addition to the keypad button?

Pre-commissioning setup

Set up burner 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.

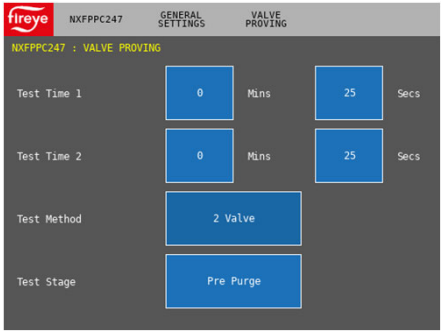




Pre-commissioning setup

Set up burner control

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.



Pre-commissioning setup

Burner control options

- **PROVE P OPEN:** Choices are NO or YES. If YES, terminal P5.10 must be open before a burner sequence can start.
- **PURGE TIME and POSTPURGE TIME:** This sets the purge or postpurge time. This can be set from 0 to 60 minutes in five second intervals.
- **RECYCLE:** Choices are NO or YES. If NO, losing terminal P5.10 during burner operation will result in a lockout. If YES, the burner will initiate a new burner cycle.
- **24-HOUR RECYCLE:** Choices are NO or YES. If NO, the burner will not count time during a cycle. If YES, the burner will initiate a new burner cycle at 23:59 into the current cycle. Choose YES if the scanner type used is UV.
- **PTFI TIME:** Choices are 10/10, 5/15, 5/10, 5/5, 3/6, 3/8 or 3/13. The first number is how long the ignition output P5.6 is active, the second is how long the pilot output P5.7 is active (it is also the PTFI duration). If the first number is less than the second, that is known as “early spark termination”.

Pre-commissioning setup

Burner control options

- **MTFI TIME:** Choices are 10/15, 10/10, 3/5, 0/15, 0/10, 0/5 or 0/3. The first number is how long the ignition output P5.6 is active during MTFI, the second is how long the pilot output P5.7 is active during MTFI. If early spark termination is being used the first number must be 0. If intermittent pilot is active the second number doesn't matter.
- **PILOT:** Choices are INTERRUPTED or INTERMITTENT. This is a global setting that affects all profiles. If interrupted, the pilot output P5.7 is only active during PTFI and partially into MTFI as programmed. If intermittent, the pilot output P5.7 is active from the beginning of PTFI until the end of the burner cycle (always on).
- **FFRT:** Choices are 1s, 2s, 3s or 4s. FFRT is the flame failure response time, which is the time required for the control to de-energize the main fuel shutoff valve(s) in the event of a loss of flame. Please consult local codes to determine the required setting.
- **PROVE AIRFLOW:** Choices are NO or YES. If YES, the normally open and normally closed positions of the airflow switch will be monitored independently using digital inputs.

Pre-commissioning setup

Burner control options

- **PROFILE SELECT:** Choices are AUTO, 1, 2, 3 or 4. If the setting is AUTO, the dedicated line voltage inputs P15.5 to P15.8 are used to select the profile. Otherwise, the chosen profile is forced to be used and will override the digital inputs.
- **ENABLE RUN/CHECK:** Choices are NO or YES. If YES, the CHECK/RUN quick key will be active and able to be used for two hours. If any key is pressed during that period, the two-hour counter will reset. Check mode is used to hold the control in a state to help with troubleshooting.
- **SCANNER TYPE:** Shows the current amplifier that is fitted. Additional parameters related to the scanner may be shown.
- **FAST GAS/OIL VALVE:** This sets the controls reaction time to a power disruption to minimize disruptions. This is set depending upon the fuel valves used. This can be set from 20ms to 150ms in 2ms increments.

Pre-commissioning setup

Burner control valve proving options

- **TEST TIMES:** This determines how long the valve proving tests last. Test time 1 is the test for the upstream gas valve and test time 2 is the test for the downstream gas valve. The fill and evacuation cycles are fixed at 5 seconds. This can be set from 5 seconds to 21 minutes in five second intervals.
- **METHOD:** Choices are 2-VALVE or 3-VALVE (NO). This determines whether or not a normally open vent valve is fitted in between the upstream and downstream gas valves.
- **TEST AT:** Choices are PREPURGE or POSTPURGE. This determines if the valve proving test is done before the prepurge or after the postpurge cycle.

Section 9

COMMISSIONING

Commissioning

Initial switch states

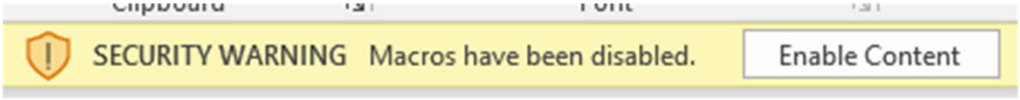
To prepare for commissioning, set the following switch states:

Switch	State
Recycle Limits or Call For Heat	ON
Non-Recycle Limits or Limits	ON
FVES/POC	AUTO
Airflow Switch	AUTO
GPS or Valve Proving	AUTO
Flame Signal	AUTO
Flame Type	type of amplifier card
Digital Input 1 (Burner Control Switch)	ON
Burner Control Switch on keypad	OFF

Commissioning

Worksheet

There is a worksheet available on the Fireye website (www.fireye.com) called *Nexus Commissioning Worksheet for Gas Fuels* that makes setting up a combustion control curve on gas fuels easier. This worksheet goes through each point step-by-step and calcu lates 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.

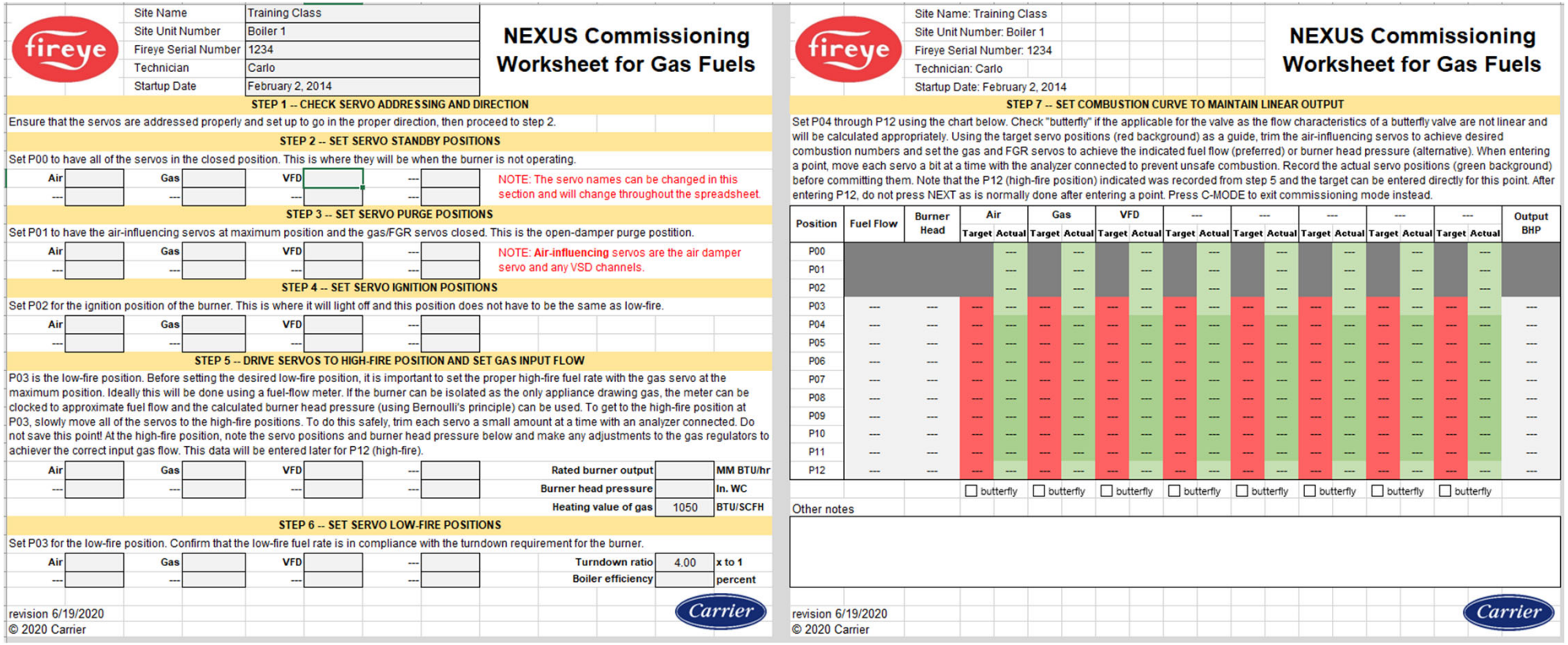


The worksheet is a Microsoft Excel macro-enabled workbook (.xlsm extension). When opened, a warning will appear stating that macros are disabled, and will give the option to enable. Note that macros must be enabled in order to use this worksheet.

For the exercise, there will be screen shots from the actual worksheet in lieu of filling out an actual worksheet.

Commissioning

Worksheet



Site Name	Training Class
Site Unit Number	Boiler 1
Fireye Serial Number	1234
Technician	Carlo
Startup Date	February 2, 2014

NEXUS Commissioning Worksheet for Gas Fuels

STEP 1 -- CHECK SERVO ADDRESSING AND DIRECTION

Ensure that the servos are addressed properly and set up to go in the proper direction, then proceed to step 2.

STEP 2 -- SET SERVO STANDBY POSITIONS

Set P00 to have all of the servos in the closed position. This is where they will be when the burner is not operating.

Air	Gas	VFD	---
---	---	---	---

NOTE: The servo names can be changed in this section and will change throughout the spreadsheet.

STEP 3 -- SET SERVO PURGE POSITIONS

Set P01 to have the air-influencing servos at maximum position and the gas/FGR servos closed. This is the open-damper purge postition.

Air	Gas	VFD	---
---	---	---	---

NOTE: **Air-influencing** servos are the air damper servo and any VSD channels.

STEP 4 -- SET SERVO IGNITION POSITIONS

Set P02 for the ignition position of the burner. This is where it will light off and this position does not have to be the same as low-fire.

Air	Gas	VFD	---
---	---	---	---

STEP 5 -- DRIVE SERVOS TO HIGH-FIRE POSITION AND SET GAS INPUT FLOW

P03 is the low-fire position. Before setting the desired low-fire position, it is important to set the proper high-fire fuel rate with the gas servo at the maximum position. Ideally this will be done using a fuel-flow meter. If the burner can be isolated as the only appliance drawing gas, the meter can be clocked to approximate fuel flow and the calculated burner head pressure (using Bernoulli's principle) can be used. To get to the high-fire position at P03, slowly move all of the servos to the high-fire positions. To do this safely, trim each servo a small amount at a time with an analyzer connected. Do not save this point! At the high-fire position, note the servo positions and burner head pressure below and make any adjustments to the gas regulators to achiever the correct input gas flow. This data will be entered later for P12 (high-fire).

Air	Gas	VFD	---		
---	---	---	---	---	---
				Rated burner output	MM BTU/hr
				Burner head pressure	In. WC
				Heating value of gas: 1050	BTU/SCFH

STEP 6 -- SET SERVO LOW-FIRE POSITIONS

Set P03 for the low-fire position. Confirm that the low-fire fuel rate is in compliance with the turndown requirement for the burner.

Air	Gas	VFD	---		
---	---	---	---	---	---
				Turndown ratio: 4.00	x to 1
				Boiler efficiency	percent

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Site Name:	Training Class
Site Unit Number:	Boiler 1
Fireye Serial Number:	1234
Technician:	Carlo
Startup Date:	February 2, 2014

NEXUS Commissioning Worksheet for Gas Fuels

STEP 7 -- SET COMBUSTION CURVE TO MAINTAIN LINEAR OUTPUT

Set P04 through P12 using the chart below. Check "butterfly" if the applicable for the valve as the flow characteristics of a butterfly valve are not linear and will be calculated appropriately. Using the target servo positions (red background) as a guide, trim the air-influencing servos to achieve desired combustion numbers and set the gas and FGR servos to achieve the indicated fuel flow (preferred) or burner head pressure (alternative). When entering a point, move each servo a bit at a time with the analyzer connected to prevent unsafe combustion. Record the actual servo positions (green background) before committing them. Note that the P12 (high-fire position) indicated was recorded from step 5 and the target can be entered directly for this point. After entering P12, do not press NEXT as is normally done after entering a point. Press C-MODE to exit commissioning mode instead.

Position	Fuel Flow	Burner Head	Air		Gas		VFD		---		---		---		Output BHP
			Target	Actual	Target	Actual	Target	Actual	Target	Actual	Target	Actual	Target	Actual	
P00				---		---		---		---		---		---	
P01				---		---		---		---		---		---	
P02				---		---		---		---		---		---	
P03	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
P04	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
P05	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
P06	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
P07	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
P08	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
P09	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
P10	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
P11	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
P12	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
			☐ butterfly		☐ butterfly		☐ butterfly		☐ butterfly		☐ butterfly		☐ butterfly		

Other notes

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Commissioning

Step 1 – Check servo addressing, direction and range of motion

STEP 1 -- CHECK SERVO ADDRESSING AND DIRECTION			
Ensure that the servos are addressed properly and set up to go in the proper direction, then proceed to step 2.			

The servos have already been set up during the pre-commissioning setup, but it is a good practice to verify that everything is correct before going into commissioning mode.

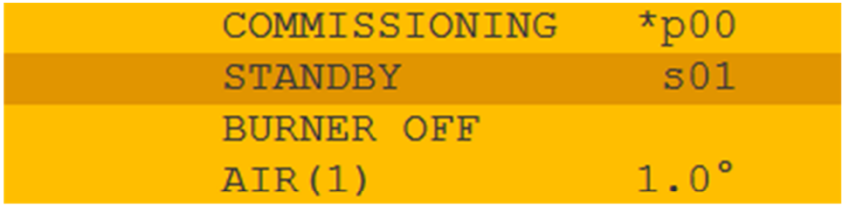
For the exercise, use a cursory check to verify that the proper direction and addressing of the servos has been done.

Commissioning

Step 2 – Set servo standby positions

STEP 2 -- SET SERVO STANDBY POSITIONS								
Set P00 to have all of the servos in the closed position. This is where they will be when the burner is not operating.								
Air		Gas		VFD		---		NOTE: The servo names can be changed in this section and will change throughout the spreadsheet.
---		---		---		---		

The first thing to do in step 2 is to follow the note (red text), and type in the actual servo names. In this application, servo 1 is named AIR, servo 2 is named GAS and VFD1 is named FAN, so those names can be entered to replace the standard names if desired.



With the NXD410TS, the next step is to enter commissioning mode by pressing the C-MODE quick key. After entering commissioning mode, the background will switch to yellow and P00 can be set. The asterisk (*) to the left of the point number indicates that the point can be confirmed. 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.

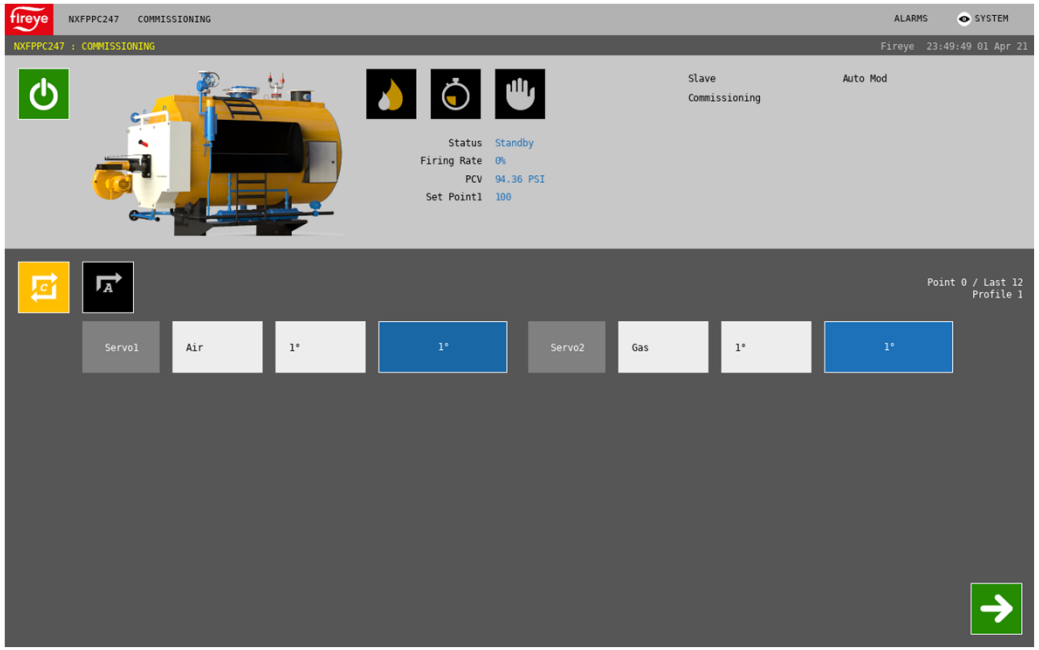
step 2 continues

Commissioning

Step 2 (continued)

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.



step 2 continues

Commissioning

Step 2 (continued)

Note that the VFD does not allow a standby setting. This is because the VFD is not expected to be operating during standby. Once the air and gas servo positions are set to the standby positions (typically 1.0° or 99.9° depending upon rotation direction), record the positions into the worksheet and then press the NEXT quick key to move to the next point (P01).

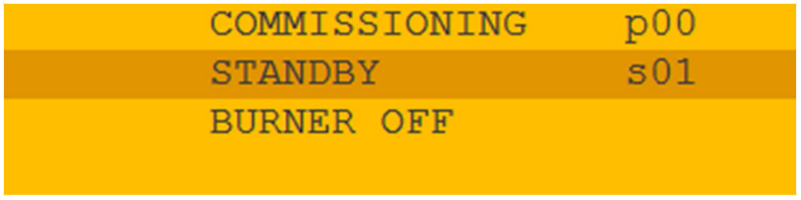
STEP 2 -- SET SERVO STANDBY POSITIONS								
Set P00 to have all of the servos in the closed position. This is where they will be when the burner is not operating.								
AIR	1.0	GAS	1.0	FAN		---		NOTE: The servo names can be changed in this section and will change throughout the spreadsheet.
---		---		---		---		

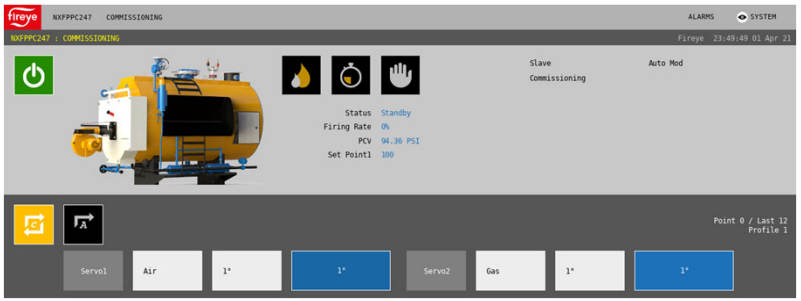
For the exercise, enter commissioning mode and put in values for the standby position.

Commissioning

Step 3 – Set purpose positions

At this point, the burner is in standby during commissioning mode because the burner on/off switch is not on. Once the burner on/off switch is set, P01 can be commissioned. 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.





STEP 3 -- SET SERVO PURPOSE POSITIONS							
Set P01 to have the air-influencing servos at maximum position and the gas/FGR servos closed. This is the open-damper purge postition.							
AIR		GAS		FAN		---	
---		---		---		---	

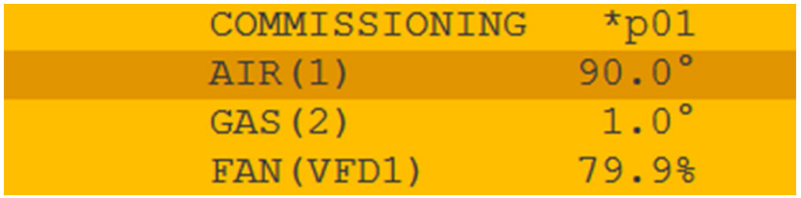
NOTE: **Air-influencing** servos are the air damper servo and any VSD channels.

step 3 continues

Commissioning

Step 3 (continued)

Set the positions in the same manner as in step 2. 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.



NEXT quick key, lower right corner, NXTSD507HD and NXTSD512HD

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.

To troubleshoot, jump the 4-20mA output to the feedback (as is done with the training units). If the feedback is then close to the correct value, this confirms that there is an issue either with the VFD configuration, wiring between the VFD and the NXF4000 or both.

Commissioning

Step 3 (continued)

Once the purge positions are set, record them into the worksheet and then press the NEXT quick key to move to the next point (P02).

STEP 3 -- SET SERVO PURGE POSITIONS								
Set P01 to have the air-influencing servos at maximum position and the gas/FGR servos closed. This is the open-damper purge postition.								
AIR	90.0	GAS	1.0	FAN	79.9	---		NOTE: **Air-influencing** servos are the air damper servo and any VSD channels.
---		---		---		---		

For the exercise, put in values for the purge position.

Commissioning

Step 4 – Set ignition position

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.

STEP 4 -- SET SERVO IGNITION POSITIONS							
Set P02 for the ignition position of the burner. This is where it will light off and this position does not have to be the same as low-fire.							
AIR		GAS		FAN		---	
---		---		---		---	

step 4 continues

Commissioning

Step 4 (continued)

Once the positions are set, press the NEXT quick key. After a short wait, the ignition, pilot and upstream gas valve (if applicable to the chosen profile) outputs will energize. The display will also show the flame strength.

COMMISSIONING	p02
FLAME STRENGTH	100
AIR(1)	30.0°
GAS(2)	15.0°

Within the period of PTFI press the CHECK/RUN quick key to put the control into CHECK MODE. This allows adjustment of the ignition position. This is indicated by an asterisk before the flame strength.

COMMISSIONING	p02
FLAME STRENGTH*	100
AIR(1)	30.0°
GAS(2)	15.0°

To confirm P02, exit check mode using the CHECK/RUN quick key and allow PTFI to complete. Record the servo and VFD positions in the worksheet.

For the exercise, put in values for the ignition position, then press the CHECK/RUN key during PTFI.

STEP 4 -- SET SERVO IGNITION POSITIONS							
Set P02 for the ignition position of the burner. This is where it will light off and this position does not have to be the same as low-fire.							
AIR	30.0	GAS	15.0	FAN	49.9	---	
---		---		---		---	

Commissioning

Step 5 – Record high fire rate from the low fire position

The recommended option for step 5 may seem a little unusual but the purpose of this is to ensure that the proper amount of gas is being delivered from the gas regulator before adjustments need to be made. The intention is to avoid having to recommission all the points prior to high fire.

Entering the rated burner output, burner head pressure at high fire and heating value of the gas will help the calculations of the target positions to be more accurate.

STEP 5 -- DRIVE SERVOS TO HIGH-FIRE POSITION AND SET GAS INPUT FLOW

P03 is the low-fire position. Before setting the desired low-fire position, it is important to set the proper high-fire fuel rate with the gas servo at the maximum position. Ideally this will be done using a fuel-flow meter. If the burner can be isolated as the only appliance drawing gas, the meter can be clocked to approximate fuel flow and the calculated burner head pressure (using Bernoulli's principle) can be used. To get to the high-fire position at P03, slowly move all of the servos to the high-fire positions. To do this safely, trim each servo a small amount at a time with an analyzer connected. Do not save this point! At the high-fire position, note the servo positions and burner head pressure below and make any adjustments to the gas regulators to achiever the correct input gas flow. This data will be entered later for P12 (high-fire).

AIR		GAS		FAN		---		Rated burner output		MM BTU/hr
---		---		---		---		Burner head pressure		In. WC
								Heating value of gas	1050	BTU/SCFH

step 5 continues

Commissioning

Step 5 (continued)

For more detail as to why this method is a good practice, refer to the document on the Fireye website (www.fireye.com) titled *Importance of Proper Commissioning of a Parallel-Positioning System*. This can be found using the search bar or on the NXF4000 home page under “Service Guide”. The same information can also be found in Fireye bulletin *NXF-4100*.

One of the concerns about using this method is that losing the load during commissioning can result in a lot of lost work and time spent. With the NXF4000, if a servo or VFD position at any point has been committed to memory using the MODIFY/SAVE quick key, the control will remember that point. For example, if P00 through P06 have been commissioned, and the load is lost while commissioning P07, the control will stay in commissioning mode and go to standby. Once the load returns, the control will resume commissioning from P00 but all that needs to be done is to confirm the existing points. The control will automatically travel to the points already in memory.

step 5 continues

Commissioning

Step 5 (continued)

When tuning any point in the automatic combustion curve, it is very important to make small adjustments in sequence to each servo and VFD. Always monitor the combustion analyzer while adjusting. Keep combustion on the lean side (more air) as this offers more safety.

When adjusting, use caution to not press the NEXT quick key to confirm P03, since these positions are temporary. Once the desired high fire servo position has been reached on the gas servo, confirm the fuel flow using the flow meter or by clocking the meter and adjust the gas regulator to confirm that the burner is at rate. At this point, the burner can be walked back down to the actual low fire position for the next step. In either case, record the high fire servo and VFD positions as these will be used again for the last commissioned point.

STEP 5 -- DRIVE SERVOS TO HIGH-FIRE POSITION AND SET GAS INPUT FLOW									
AIR	80.0	GAS	60.0	FAN	100.0	---		Rated burner output	20.00	MM BTU/hr
---		---		---		---		Burner head pressure	7.00	In. WC
								Heating value of gas	1050	BTU/SCFH

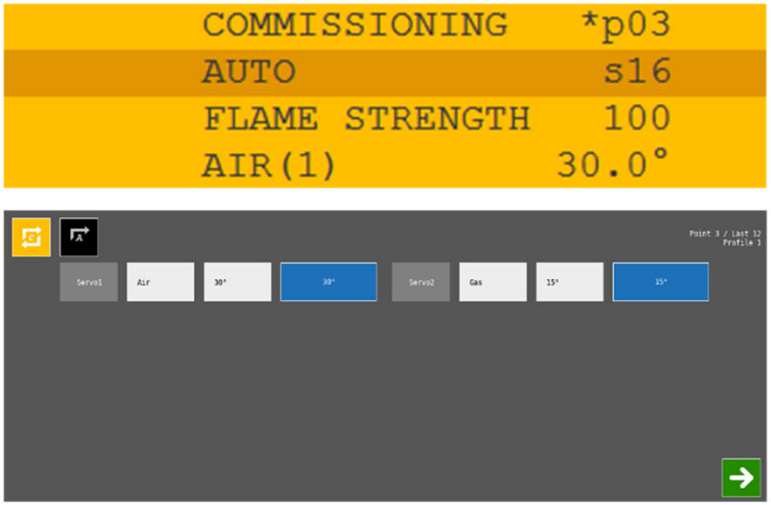
For the exercise, simulate going to the high fire position in P03 and clocking the meter. Then go back to where low fire would actually be and simulate clocking the meter again for turndown verification.

Commissioning

Step 6 – Set the actual low fire position

P03 is the actual low fire position. This can be set to be different from the ignition position if necessary. Since the gas regulator has been set already to make rate at the high fire servo position recorded, set the gas servo position based upon where the turndown can be verified, either by a fuel flow meter or by clocking the meter. Once the positions are set, record them in the worksheet and then press the NEXT quick key to move to P04.

The turndown ratio is entered in this step to help the calculations of the target positions to be more accurate. The boiler efficiency can be entered if output BHP calculations are desired.



For the exercise, enter values for the low fire position.

STEP 6 -- SET SERVO LOW-FIRE POSITIONS									
Set P03 for the low-fire position. Confirm that the low-fire fuel rate is in compliance with the turndown requirement for the burner.									
AIR	22.0	GAS	12.0	FAN	60.0	---		Turndown ratio	4.00	x to 1
---		---		---		---		Boiler efficiency	85	percent

Commissioning

Step 7 – Set the combustion curve from low fire to high fire

STEP 7 -- SET COMBUSTION CURVE TO MAINTAIN LINEAR OUTPUT

Set P04 through P12 using the chart below. Check "butterfly" if the applicable for the valve as the flow characteristics of a butterfly valve are not linear and will be calculated appropriately. Using the target servo positions (red background) as a guide, trim the air-influencing servos to achieve desired combustion numbers and set the gas and FGR servos to achieve the indicated fuel flow (preferred) or burner head pressure (alternative). When entering a point, move each servo a bit at a time with the analyzer connected to prevent unsafe combustion. Record the actual servo positions (green background) before committing them. Note that the P12 (high-fire position) indicated was recorded from step 5 and the target can be entered directly for this point. After entering P12, do not press NEXT as is normally done after entering a point. Press C-MODE to exit commissioning mode instead.

Position	Fuel Flow	Burner Head	AIR		GAS		FAN		---		---		---		---		---		Output BHP
			Target	Actual	Target	Actual	Target	Actual	Target	Actual	Target	Actual	Target	Actual	Target	Actual	Target	Actual	
P00				1.0		1.0		---		---		---		---		---		---	
P01				90.0		1.0		79.9		---		---		---		---		---	
P02				30.0		15.0		49.9		---		---		---		---		---	
P03	4762	0.44	22.0	22.0	12.0	12.0	60.0	60.0	---	---	---	---	---	---	---	---	---	---	127.0
P04	6349	0.78	28.4	---	17.3	---	64.4	---	---	---	---	---	---	---	---	---	---	---	169.3
P05	7937	1.22	34.9	---	22.7	---	68.9	---	---	---	---	---	---	---	---	---	---	---	211.6
P06	9524	1.75	41.3	---	28.0	---	73.3	---	---	---	---	---	---	---	---	---	---	---	253.9
P07	11111	2.38	47.8	---	33.3	---	77.8	---	---	---	---	---	---	---	---	---	---	---	296.2
P08	12698	3.11	54.2	---	38.7	---	82.2	---	---	---	---	---	---	---	---	---	---	---	338.6
P09	14286	3.94	60.7	---	44.0	---	86.7	---	---	---	---	---	---	---	---	---	---	---	380.9
P10	15873	4.86	67.1	---	49.3	---	91.1	---	---	---	---	---	---	---	---	---	---	---	423.2
P11	17460	5.88	73.6	---	54.7	---	95.6	---	---	---	---	---	---	---	---	---	---	---	465.5
P12	19048	7.00	80.0	80.0	60.0	60.0	100.0	100.0	---	---	---	---	---	---	---	---	---	---	507.8
			☐ butterfly		☐ butterfly		☐ butterfly		☐ butterfly		☐ butterfly		☐ butterfly		☐ butterfly		☐ butterfly		

step 7 continues

Commissioning

Step 7 (continued)

The chart shown provides target servo positions intended to help create a 10-point linear curve. 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 (NO_x, O_2% and CO) on the analyzer as per burner manufacturer recommendations.
- **VFD:** Trim the VFD linearly according to the target positions on the chart. There is no need to deviate from this as the AIR servo can be used to trim the combustion air. This simplifies the choice of which channel to trim and makes operation smoother.

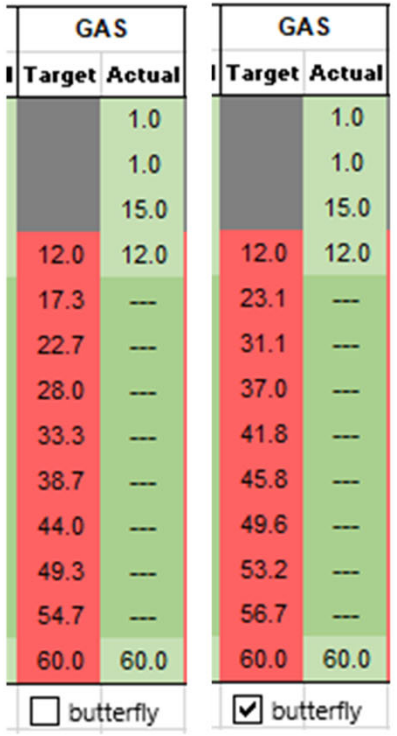
Note that the target positions are just guidelines and may or may not accurately reflect the actual final servo and VFD positions.

step 7 continues

Commissioning

Step 7 (continued)

Note that there is a check box at the bottom of each column labeled “butterfly”. Check this if the servo is connected to a butterfly valve as this changes the calculations to match the flow characteristics of a butterfly valve.



GAS	
Target	Actual
	1.0
	1.0
	15.0
12.0	12.0
17.3	---
22.7	---
28.0	---
33.3	---
38.7	---
44.0	---
49.3	---
54.7	---
60.0	60.0
☐ butterfly	

GAS	
Target	Actual
	1.0
	1.0
	15.0
12.0	12.0
23.1	---
31.1	---
37.0	---
41.8	---
45.8	---
49.6	---
53.2	---
56.7	---
60.0	60.0
☑ butterfly	

step 7 continues

Commissioning

Step 7 (continued) – P4 through P11

For each point from P04 through P11, enter slowly move each servo and VFD sequentially to reach the target positions, taking caution to always keep the combustion lean while traveling and monitoring the combustion analyzer. Make adjustments to these positions according to the guidelines described for each type of servo and then record the actual positions entered into the worksheet. After each intermediate point is finished, press the NEXT quick key to move to the next point. It is possible to confirm a point with no changes if the NEXT key is inadvertently touched twice. This can't be reversed, so if this is done simply add an extra point and continue. The final curve will not be functionally affected but will have an additional intermediate point.

For the exercise, estimate good positions for P4 through P11. It is not necessary to actually fill out the spreadsheet as there is no feedback from a combustion analyzer to guide the process.

AIR		GAS		FAN	
Target	Actual	Target	Actual	Target	Actual
	1.0		1.0		---
	90.0		1.0		79.9
	30.0		15.0		49.9
22.0	22.0	12.0	12.0	60.0	60.0
28.4	28.4	23.1	23.1	64.4	64.2
34.9	34.9	31.1	31.1	68.9	68.7
41.3	41.3	37.0	37.0	73.3	73.0
47.8	47.8	41.8	41.8	77.8	77.6
54.2	54.2	45.8	45.8	82.2	82.0
60.7	60.7	49.6	49.6	86.7	86.6
67.1	67.1	53.2	53.2	91.1	91.0
73.6	---	56.7	---	95.6	---
80.0	80.0	60.0	60.0	100.0	100.0
☐ butterfly		☑ butterfly		☐ butterfly	

step 7 continues

Commissioning

Step 7 (continued) – P12

There is a different procedure when entering the last point. For this example, that is P12. Since points can entered all the way to P23, there needs to be a way to indicate which point is the last one being entered. To confirm the last point, the C-MODE quick key is pressed instead of the NEXT quick key. This will put the unit immediately into automatic modulation without shutting down, and the combustion curve will be online using the internal PID or external modulation signal as configured.

In the event that the NEXT quick key is inadvertently pressed, an extra point will be added but the C-MODE key can then be pressed on this new point. This will not functionally affect the combustion curve but will show an additional point as having been configured.

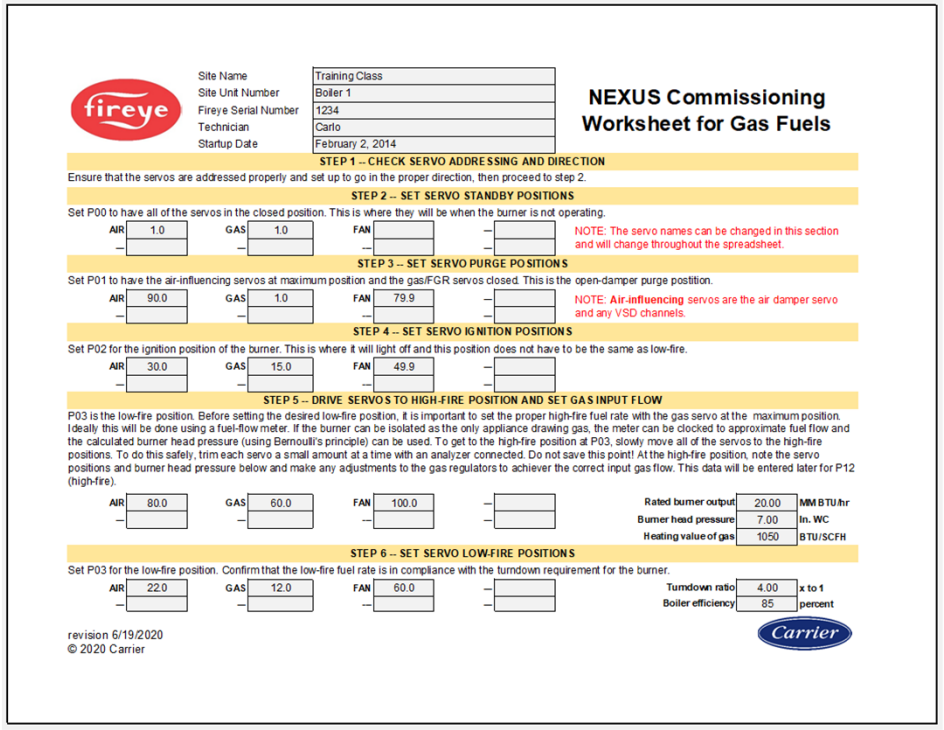
For the exercise, make P12 the last curve point. Touch C-MODE instead of NEXT after entering P12 points.

AIR		GAS		FAN	
Target	Actual	Target	Actual	Target	Actual
	1.0		1.0		---
	90.0		1.0		79.9
	30.0		15.0		49.9
22.0	22.0	12.0	12.0	60.0	60.0
28.4	28.4	23.1	23.1	64.4	64.2
34.9	34.9	31.1	31.1	68.9	68.7
41.3	41.3	37.0	37.0	73.3	73.0
47.8	47.8	41.8	41.8	77.8	77.6
54.2	54.2	45.8	45.8	82.2	82.0
60.7	60.7	49.6	49.6	86.7	86.6
67.1	67.1	53.2	53.2	91.1	91.0
73.6	73.6	56.7	56.7	95.6	95.5
80.0	80.0	60.0	60.0	100.0	100.0
☐ butterfly		☑ butterfly		☐ butterfly	

Commissioning

Printing worksheet

The worksheet is designed to print neatly onto two pages.



Site Name	Training Class
Site Unit Number	Boiler 1
Fireye Serial Number	1234
Technician	Carlo
Startup Date	February 2, 2014

NEXUS Commissioning Worksheet for Gas Fuels

STEP 1 -- CHECK SERVO ADDRESSING AND DIRECTION

Ensure that the servos are addressed properly and set up to go in the proper direction, then proceed to step 2.

STEP 2 -- SET SERVO STANDBY POSITIONS

Set P00 to have all of the servos in the closed position. This is where they will be when the burner is not operating.

AIR	GAS	FAN	—
1.0	1.0		

NOTE: The servo names can be changed in this section and will change throughout the spreadsheet.

STEP 3 -- SET SERVO PURGE POSITIONS

Set P01 to have the air-influencing servos at maximum position and the gas/FGR servos closed. This is the open-damper purge position.

AIR	GAS	FAN	—
90.0	1.0	79.9	

NOTE: **Air-influencing** servos are the air damper servo and any VSD channels.

STEP 4 -- SET SERVO IGNITION POSITIONS

Set P02 for the ignition position of the burner. This is where it will light off and this position does not have to be the same as low-fire.

AIR	GAS	FAN	—
30.0	15.0	49.9	

STEP 5 -- DRIVE SERVOS TO HIGH-FIRE POSITION AND SET GAS INPUT FLOW

P03 is the low-fire position. Before setting the desired low-fire position, it is important to set the proper high-fire fuel rate with the gas servo at the maximum position. Ideally this will be done using a fuel-flow meter. If the burner can be isolated as the only appliance drawing gas, the meter can be clocked to approximate fuel flow and the calculated burner head pressure (using Bernoulli's principle) can be used. To get to the high-fire position at P03, slowly move all of the servos to the high-fire positions. To do this safely, trim each servo a small amount at a time with an analyzer connected. Do not save this point! At the high-fire position, note the servo positions and burner head pressure below and make any adjustments to the gas regulators to achieve the correct input gas flow. This data will be entered later for P12 (high-fire).

AIR	GAS	FAN	—
80.0	60.0	100.0	

Rated burner output	20.00	MM BTU/hr
Burner head pressure	7.00	In. WC
Heating value of gas	1050	BTU/SCFH

STEP 6 -- SET SERVO LOW-FIRE POSITIONS

Set P03 for the low-fire position. Confirm that the low-fire fuel rate is in compliance with the turndown requirement for the burner.

AIR	GAS	FAN	—
22.0	12.0	60.0	

Turndown ratio	4.00	x to 1
Boiler efficiency	85	percent

revision 6/19/2020
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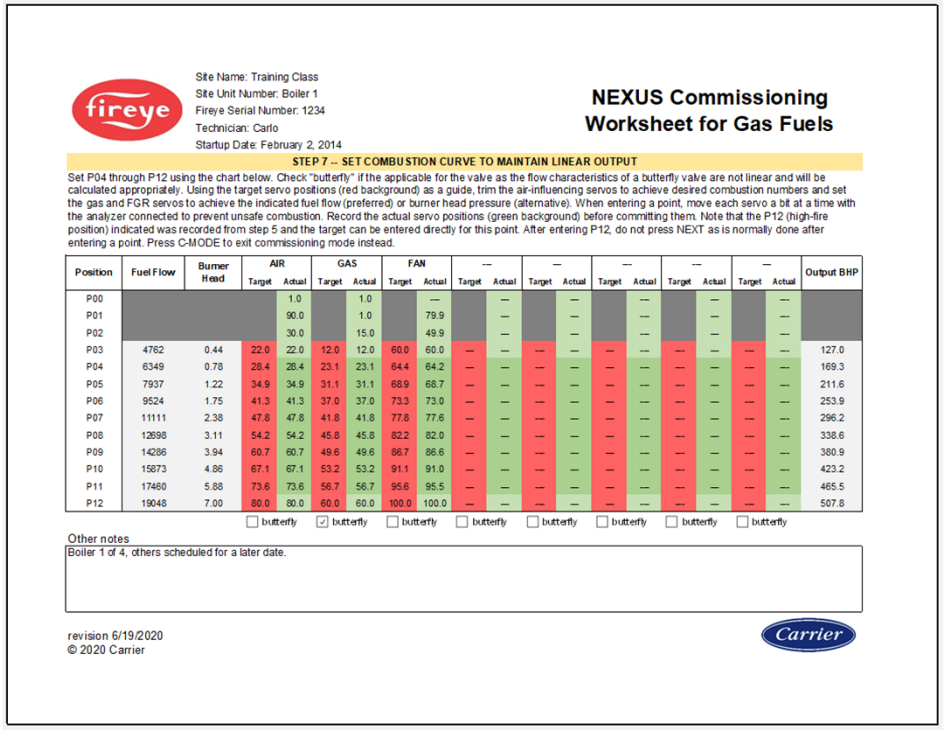

Site Name: Training Class
Site Unit Number: Boiler 1
Fireye Serial Number: 1234
Technician: Carlo
Startup Date: February 2, 2014

NEXUS Commissioning Worksheet for Gas Fuels

STEP 7 -- SET COMBUSTION CURVE TO MAINTAIN LINEAR OUTPUT

Set P04 through P12 using the chart below. Check "butterfly" if the applicable for the valve as the flow characteristics of a butterfly valve are not linear and will be calculated appropriately. Using the target servo positions (red background) as a guide, trim the air-influencing servos to achieve desired combustion numbers and set the gas and FGR servos to achieve the indicated fuel flow (preferred) or burner head pressure (alternative). When entering a point, move each servo a bit at a time with the analyzer connected to prevent unsafe combustion. Record the actual servo positions (green background) before committing them. Note that the P12 (high-fire position) indicated was recorded from step 5 and the target can be entered directly for this point. After entering P12, do not press NEXT as is normally done after entering a point. Press C-MODE to exit commissioning mode instead.

Position	Fuel Flow	Burner Head	AIR		GAS		FAN		---		—		—		—		Output BHP
			Target	Actual	Target	Actual	Target	Actual	Target	Actual	Target	Actual	Target	Actual	Target	Actual	
P00				1.0		1.0		—		—		—		—		—	
P01				90.0		1.0		79.9		—		—		—		—	
P02				30.0		15.0		49.9		—		—		—		—	
P03	4762	0.44	22.0	22.0	12.0	12.0	60.0	60.0	—	—	—	—	—	—	—	—	127.0
P04	6349	0.78	28.4	28.4	23.1	23.1	64.4	64.2	—	—	—	—	—	—	—	—	169.3
P05	7937	1.22	34.9	34.9	31.1	31.1	68.9	68.7	—	—	—	—	—	—	—	—	211.6
P06	9524	1.75	41.3	41.3	37.0	37.0	73.3	73.0	—	—	—	—	—	—	—	—	253.9
P07	11111	2.38	47.8	47.8	41.8	41.8	77.8	77.6	—	—	—	—	—	—	—	—	296.2
P08	12698	3.11	54.2	54.2	45.8	45.8	82.2	82.0	—	—	—	—	—	—	—	—	338.6
P09	14286	3.94	60.7	60.7	49.6	49.6	86.7	86.6	—	—	—	—	—	—	—	—	380.9
P10	15873	4.86	67.1	67.1	53.2	53.2	91.1	91.0	—	—	—	—	—	—	—	—	423.2
P11	17460	5.88	73.6	73.6	56.7	56.7	95.6	95.5	—	—	—	—	—	—	—	—	465.5
P12	19048	7.00	80.0	80.0	60.0	60.0	100.0	100.0	—	—	—	—	—	—	—	—	507.8
				☐ butterfly		☑ butterfly		☐ butterfly		☐ butterfly		☐ butterfly		☐ butterfly		☐ butterfly	

Other notes

Boiler 1 of 4, others scheduled for a later date.

revision 6/19/2020
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Commissioning

Summary

This exercise showed one method that can be used to organize the commissioning process. The intention of the worksheet is to improve the quality of commissioning to result in a linear output, as well as to help structure how to address each of the servos and VFDs. The process of entering the servo and VFD positions is the same no matter what organization method is used to commission.

For additional profiles, simply change the selected profile input and commission the new profile using the same procedure. Each profile can be individually backed up and restored to a different profile to copy the combustion curve points, so that the curve will only need to be confirmed by running the burner through the points. This is an easy way to derive a VFD bypass curve from a VFD curve.

Section 10

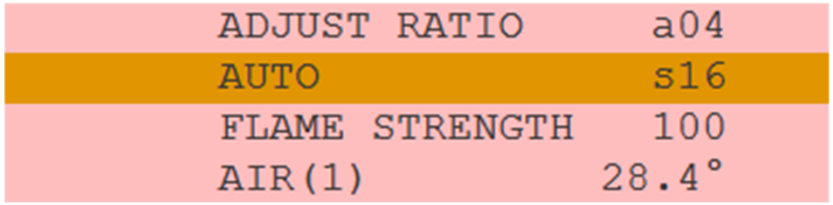
ADJUSTING CURVE

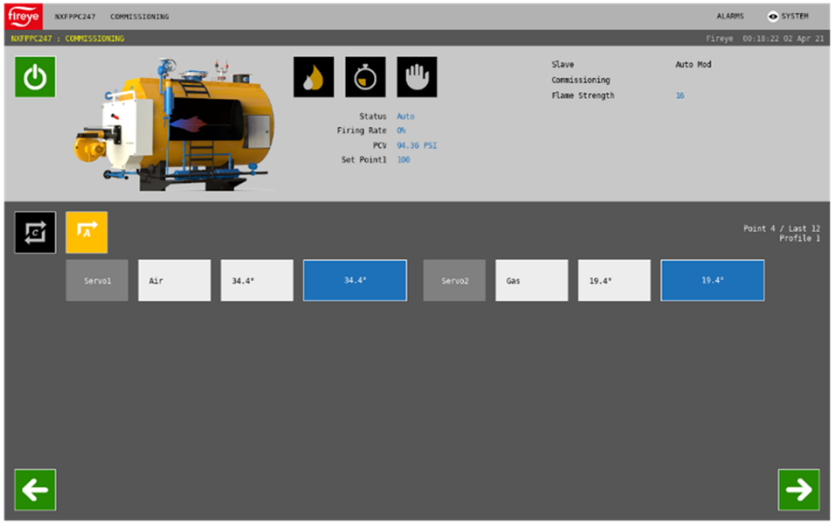
Adjusting curve

Method to adjust current curve

It is possible to adjust an existing curve. Only P03 through the last commissioned point can be adjusted. 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.

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.





Adjusting curve

Method to adjust current curve

Once the burner is in the automatic state, use the LEFT and RIGHT quick keys to change which point is being adjusted. These points will be referred to as A03… instead of as P03… 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 making adjustments, press the C-MODE quick key to return to automatic operation.

It is 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.

Since points without any change from the previous point can be added during commissioning, “placeholder” points can be used if it is anticipated that adjustments via the adjust ratio process will be used later.

For the exercise, enter ADJUST RATIO mode and make some modifications to P03 through P12 as if making tuning adjustments to an existing install.

Adjusting curve

Method to adjust P00 through 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 or number entry boxes 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, reenter commissioning mode and walk through the existing points until the desired last point is reached. Exit commissioning mode at this point by pressing the C-MODE quick key to confirm it as the last. Reentering commissioning mode can also be done to adjust P00 through P02. 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.

Adjusting curve

Erase existing curve memory

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.

Section 11

OPERATION

Operation

Burner states of operation

State	Message on interface	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	The NXF4000 sends a command 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.

Operation

Burner states of operation

State	Message on interface	Description
s09	MOVE TO IGNITION s09	The NXF4000 commences the ignition sequence by commanding the servos to the P02 position.
s11	PTFI s11	Pilot trial for ignition. The outputs that are energized depends upon the profile and timings selected.
s12	PILOT s12	Pilot stabilization time.
s13	MTFI s13	Main trial for ignition. The duration of the ignition and pilot outputs being energized into this state depends upon the timings selected.
s14	MFEP s14	Main flame establishing period.
s15	MOVE TO LOW FIRE s15	After MFEP, the servos are moved to the P03 position prior to the state changing to auto (s16).
s16	AUTO s16	Modulation can occur to satisfy demand.
s17	POSTPURGE s17	The NXF4000 commences a controlled shutdown and transition back to the standby state (s01).
s18	LOCKOUT s18	The NXF4000 has an active lockout that needs to be addressed.

Operation

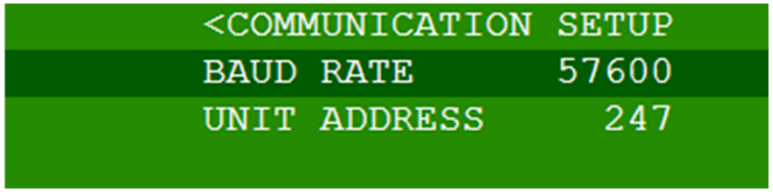
Track modulation

If the sensor 1 input is configured for the type TRACK, the 4-20mA input will take a direct firing rate to modulate the NXF4000. When this option is used, a digital input must also be assigned as TRACK ON. This is the accompanying remote enable signal. Note that the internal PID is not used when track modulation is active, but the limits will still shut the burner down.

Operation

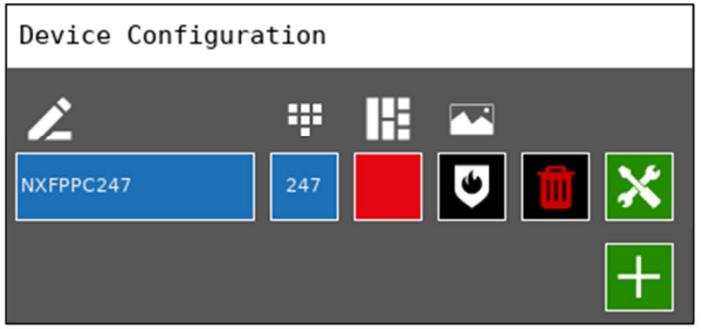
Modbus

The Modbus RTU connection available on terminals P12.1 and P12.2 has some configuration parameters that can be changed from the COMMUNICATION SETUP menu. The baud rate can be set to 4800, 9600, 19200, 38400 or 57600. The unit address can be set from 1 to 247. The data bits, parity and stop bits are fixed to 8,N,1.



The NXTSD507HD and NXTSD512HD touchscreens use this connection and are set up to communicate to the default address of 247 at baud rate 57600. Since these interfaces use the available Modbus RTU output, they offer a Modbus TCP/IP server as an alternate source of Modbus connection for the BMS, PLC or SCADA. Refer to the bulletin for those interfaces for more detail.

If the NXTSD507HD and NXTSD512HD do not connect to the NXF4000, login to the screen using the Admin user. Go to the menu SYSTEM → OPTIONS, then touch the folder icon to display the page MISCELLANEOUS. Touch DEVICE CONFIGURATION. Touch the TRASH icon for the displayed device, then touch the ADD (plus sign) icon. If the device is connected to one of the Modbus serial ports, it will be automatically discovered and added.



Operation

Adjusting setpoints

To adjust the setpoint, use the ADJUST SETPOINT quick key to access the setpoint menu. This can also be accessed from the home screen by scrolling down to the SETPOINT SETUP menu.

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.

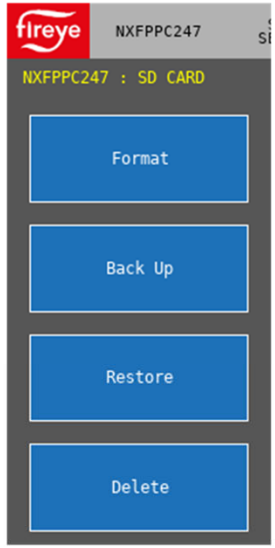
This quick key only exists on the NXD410TS.

Operation

SD card

The NXF4000 has an on-board SD card reader and ships with an SD card inserted. Any SD card* formatted with the FAT32 file system can be used. The NXF4000 also has the ability to format the SD card.

When the SD card is inserted, the menu will jump to the SD CARD OPS SETUP line of the home screen. 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.



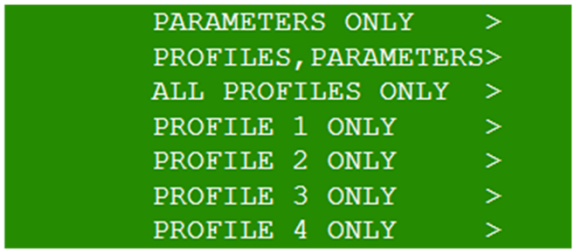
* 32GB and lower have been confirmed to work

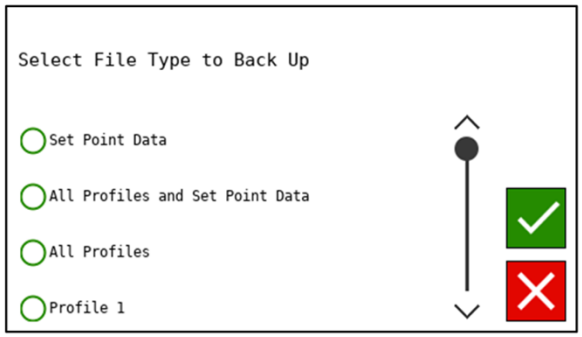
Operation

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.





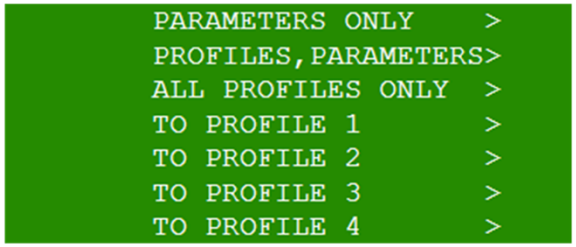
All the backup files will have a different extension depending upon the type of file. The default name will be based upon the time and date set in the control but can be changed to a different name if the SD card is inserted into a PC (will still be recognized). Note that a backup can only be done when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

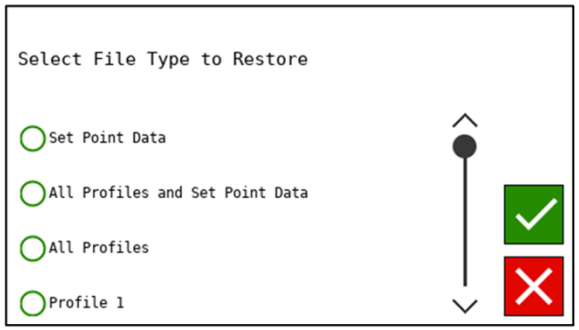
Operation

Restore

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.



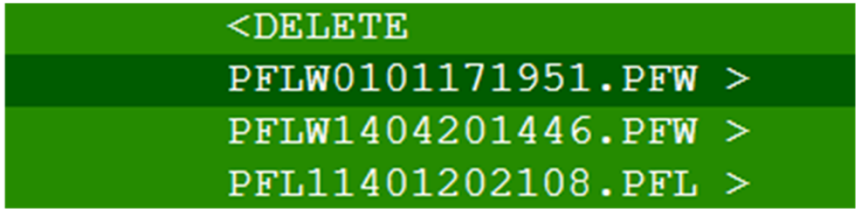


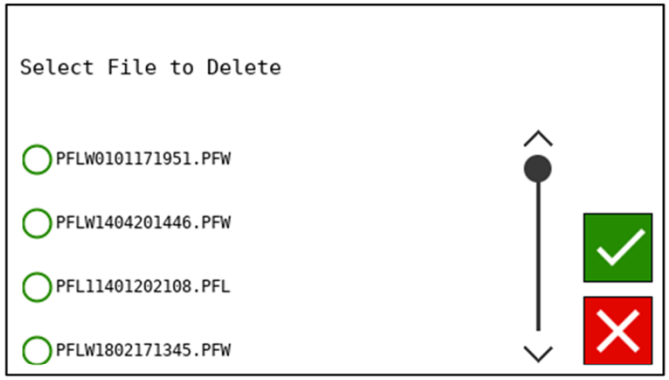
Once an option is chosen all available backup files are shown so the one to restore can be selected. If the backup file is invalid (corrupted or from an incompatible firmware or model such as the PPC4000), this will be indicated. Note that restoring can only be done when the control is in the standby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

Operation

Delete and Format

When DELETE is selected, all of 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.





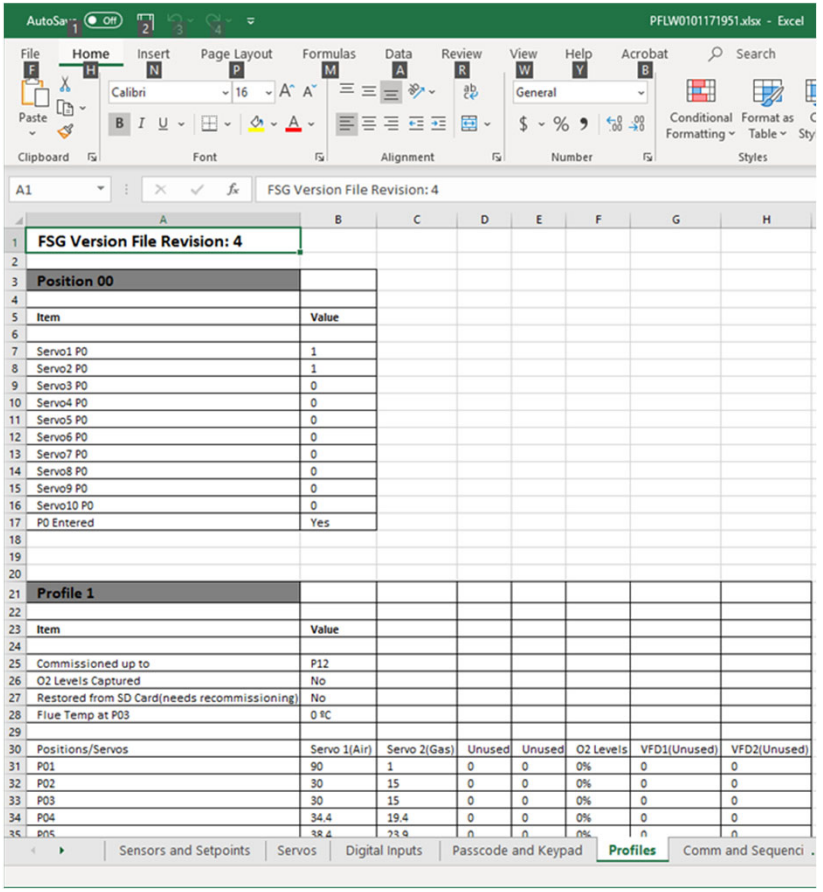
Choosing FORMAT will format the SD card using the compatible FAT32 file system. Note that formatting will result in the loss of all current files on the SD card and the action can't be reversed.

Operation

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). Download the newest version available. 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.

The files can’t be edited and put back on the SD card. The Excel format is only for viewing. The actual files on the SD card are in a binary format and can’t be modified outside of the commissioning process.



	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

THANK YOU