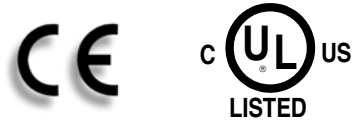


# NEXUS EXPANSION INTERFACE AND EXPANDED BURNER CONTROL SYSTEM



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## DESCRIPTION

The Fireye Nexus™ Integrated Controller is a microprocessor based, Flame Safeguard and Parallel Positioning combustion controller built into one compact, user configurable package.

By the addition of a Nexus Expansion Interface (P/N NX280HW) many additional features can be provided to expand the functions of the standard Nexus system. The Interface is a multi functional device and can allow features such as O<sub>2</sub> measurement, display and Trim, display of CO<sub>2</sub>, exhaust temperature and efficiency, variable frequency control for the combustion air blower, additional output channels (for Servo Motors) and analogue inputs / outputs to be incorporated into the control system.

O<sub>2</sub> and exhaust temperature measurement is provided via the NX280HW Expansion Interface by using an NX280PK zirconium oxide “in situ” fast response, exhaust probe. This presents continuous information on O<sub>2</sub>, CO<sub>2</sub>, exhaust temperature and efficiency onto the Nexus NX550 vacuum fluorescent display. (In addition all displayed information can be retransmitted to ComFire Windows based software).

Application of NX280ATI software further enhances the system capabilities, providing a “one key press”, automatically calibrating, full Trim function. This allows the system to have user selectable target values for O<sub>2</sub> assigned for each of the programmed fuel - air ratio points throughout the firing range of the burner. In addition each of the four fuel profiles can have differing sets of O<sub>2</sub> target values programmed according to customer requirements.

Use of NX280VSD software automatically provides the required signals and monitoring via the NX280HW Expansion Interface to control a variable speed drive (inverter) on the combustion air blower. These inputs and outputs are configured to provide all that is required to accurately position and monitor blower motor speed (or frequency) in concert with fuel and air servo motors. Optimum combustion is maintained at all times and continuously checked for correct feedback response. Use of the NX280VSD software allows the benefits of precise blower control, optimized burner turn-down, large electrical energy savings and reduced noise levels to be utilized.

Up to 4 analogue outputs and 4 analogue inputs are provided on the NX280HW Expansion Interface. Any system value can be assigned as an output analogue value (4 to 20mA), while any field device signal (4 to 20mA) can be connected to the system for display on the Nexus NX550 (and retransmission to ComFire Windows based software). All inputs zero, span and alarm levels can be set within the Nexus controller e.g. steam flow, gas flow, oil flow etc.

The NX280HW Expansion Interface can accept connections for one additional Servo Motor making the total control capability of a fully expanded Nexus system to six channels (five Servo Motors and one variable speed control output).



## Table of Contents

This bulletin (NEX-1002) describes the installation, commissioning, operation and maintenance of the NX280HW, NX280PK, NX280ATI, NX280VSD, expansion systems for use with the Fireeye Nexus control system. It may be used in conjunction with the following other technical bulletins:- NEX-1001 - Nexus integrated burner control system NEX-1501 - ComFire combustion analysis tool user manual

Description .....	1
Technical Specifications .....	3
Approvals .....	3
Safety Information .....	5
Installation of the NX280HW Expansion Module .....	6
Link Selection NX280HW Expansion Module .....	7
Wiring NX280HW and Field Connections .....	7
Installation Guidelines NX280PK O2 Probe .....	13
Option Parameters and Setting Up.....	15
Variable Speed Drive Description of Operation .....	26
Faults and Fault Finding .....	29
Engineers Key .....	35
Troubleshooting .....	39
Expansion Unit Layout NX280HW .....	41



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## TECHNICAL SPECIFICATIONS

### General

Supply Voltage:	120/230 VAC
Power Consumption:	Approx. 20VA
Supply Frequency:	50/60Hz
Ambient Temperature Range:	32 -140°F (0 to 60°C)
Maximum Connected Load:	2000 VA
Control Unit Protection Category:	Indoor: Unit must be mounted in a NEMA12, IP40 enclosure Outdoor: Unit must be mounted in a NEMA4, IP54 enclosure The unit must be situated in a clean environment according to EN6730-1
Unit Dimensions:	7.7" w x 11.3" h x 3.0" tall
Weight:	8.0 lbs (3.5kg)
Type of Display:	2 line 20 character dot-matrix vacuum fluorescent

### Servo Motor Control

Type:	AC up/down with feedback potentiometer.
Max. Number of Setpoints Per Profile	24 including close, purge and ignition
Positioning Accuracy:	0.1°
Response Time to Positioning Error:	15s for +/- 1.0°, 1s for +/- 5.0°
Maximum Motor Current:	150mA rms
Maximum Motor Voltage:	250VAC rms
Motor Speed Range:	10s/90° to 60s/90°
Potentiometer Feedback Voltage:	+ 5Vdc for pot with full range travel +15Vdc for 340° pot with 90° travel (selected using a link)
Potentiometer Resistance Range:	1 to 5K ohms @ 5V 3 to 15K ohms @15V

### Relay Outputs

#### Alarms

Type:	On-off relay, de-energize for off.
Maximum Current:	2A rms (pilot duty) / 4A rms (power factor > 0.6)
Maximum Voltage:	250VAC rms
Maximum voltage:	250VAC rms

#### Communications Interface

2-wire RS485 plus ground, with termination resistor selected using a link.  
See NX1501 communications manual for details.

#### External Display Interface

Interface Fireeye specific

#### Approvals

UL 372 Primary Safety Controls for Gas and Oil Fired Appliances  
Classification in accordance with EN298: F/T/L/L/J/B



Tested in accordance with the Gas Appliance Directive (GAD 90/396 EEC), encompassing the following standards:

- ENV1954, Internal and external behavior of safety related electronic parts
- EN298, Automatic gas burner control systems for gas burners and gas burning appliances with or without fans
- EN60730-1, Automatic electrical controls for household and similar use
- EN230, Monobloc oil burners - safety, control and regulation devices and safety times

## SAFETY INFORMATION



**WARNING:** The equipment in this manual is capable of causing property damage, severe injury or death. It is the responsibility of the owner or user to ensure that the equipment described herein is installed, operated and commissioned in compliance with the requirements of all national and local legislation which may prevail.

When this equipment is mounted on a burner/boiler, due regard must be given to the requirements of that appliance.

**Before attempting to install, commission or operate this equipment, all relevant sections of this document must be read and fully understood. If in doubt about any requirements consult the supplier. Installation, commissioning or adjusting of this product MUST be carried out by suitably trained engineers or personnel qualified by training and experience.**

The manufacturer of this equipment accepts no liability for any consequences resulting from the inappropriate, negligent or incorrect installation, commissioning or adjustment of operating parameters of the equipment.

This equipment **MUST** only be mounted on to burners as detailed in the contracted specification. The supplier must approve any change in the specification in writing.

Control panels **MUST NOT** be left uncovered while power is on. If it is essential to do so while rectifying faults, only personnel qualified by training and experience should be involved.

The time any covers are off must be kept to a minimum and warning notices **MUST** be posted.

Before attempting any work on this equipment, the electrical supplies **MUST** be isolated.

Safety interlocks **MUST NOT** be removed or over-ridden. Any faults detected **MUST** be corrected before the unit is operated.



**CAUTION:** Some versions of this equipment contain a lithium battery.

*Note: The manufacturer of this equipment has a policy of continual product improvement and reserves the right to change the specifications of the equipment and the contents of this manual without notice.*



**WARNING:** Explosion of fire hazard can cause property damage, severe injury or death. To prevent possible hazardous burner operation, verification of safety requirements and interlocks must be performed each time a control is installed on a burner.

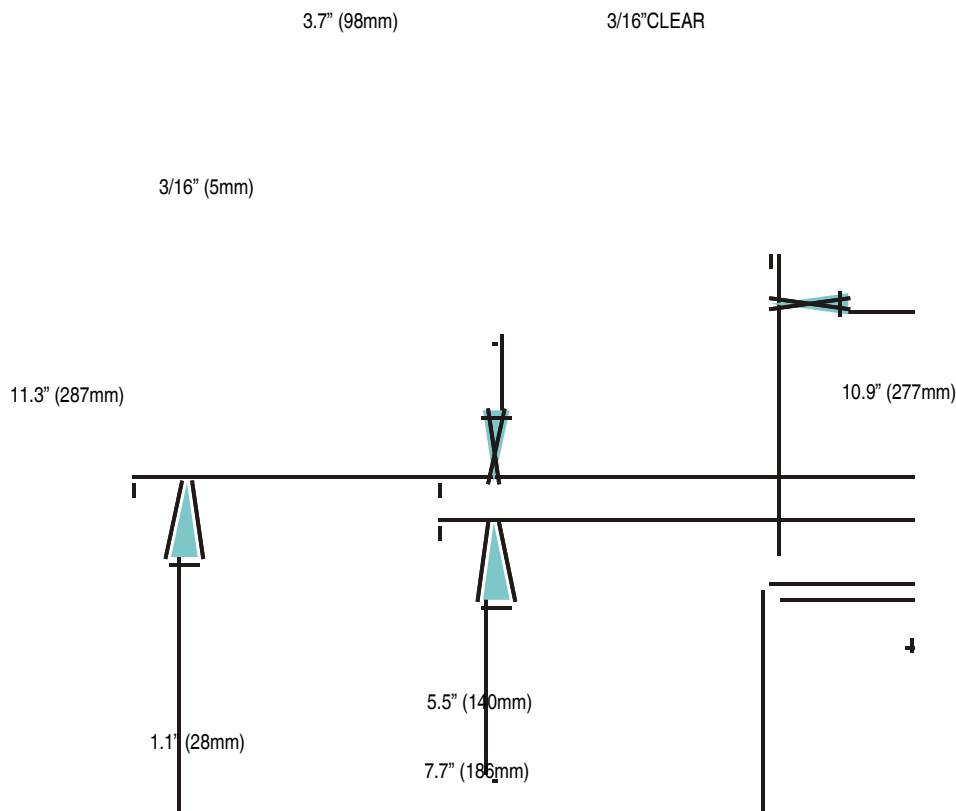
## INSTALLATION NX280HW EXPANSION INTERFACE

This section contains basic installation information concerning choice of enclosure and servo-motor environment, wiring specification and connection details.



**CAUTION:** Read these instructions carefully and ensure you fully understand the product requirements. Failure to follow them could damage the product or cause a hazardous condition. Check the ratings given in these instructions to ensure the product is suitable for your application. After installation is complete, check the product operation is as described in these instructions.

FIGURE 1. Mounting the NX280HW expansion unit



The NX280HW expansion unit is designed to be fitted inside the burner control cabinet. The cabinet should have a minimum protection level of NEMA 12, IP40 for indoor use or NEMA4, IP54 for outdoor use.

The unit should be mounted so that the circuit board within it is vertical, to maximize cooling efficiency. A clearance is required of a least 3" (80mm) above and 1" (25mm) below and at the sides of the controller enclosure.

The ambient operating temperature range of the equipment is 32-140°F (0 to 60°C). The unit must be installed in a clean environment, according to EN6730-1.

## LINK SELECTION (NX280HW EXPANSION UNIT)

The optional NX280HW expansion unit has a number of option selection switch/links, in addition to the supply voltage selection. The function and settings of each link or switch are described here, it is important to ensure all settings are in the correct position before power is applied.

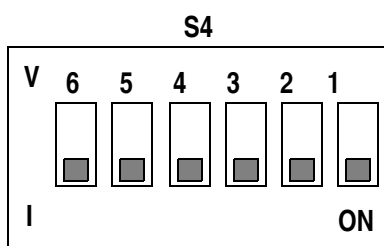
### Power supply voltage (NX280HW expansion unit)

**The expansion unit must be set for the correct supply voltage.**

The supply voltage is selected via a switch on the circuit board. The possible supply voltages are shown below, together with the necessary fuse rating. The correct fuse (type and rating) must be fitted; failure to do so may result in damage to the unit.

SUPPLY VOLTAGE (V)	SWITCH POSITION	FUSE
115	115	800 Anti-Surge
230	230	400 Anti-Surge

### Analogue Inputs (NX280HW Expansion Unit) Switch 4



Switch 4 has 6 dipswitches marked 1 through 6 which need to be configured for the following functions:

**S4-1:** RS485 serial communication termination resistor. ONLY required "ON" for long communications wire run (try in "OFF" position first).

**S4-2:** Must be "OFF" when servo is driven from the expansion module.

**S4-3 thru S4-6:** Are dedicated to the auxiliary analog inputs and can be selected for voltage (V) or current (I).

**S4-3:** Selects input type for Input 1, Terminal PM14.

**S4-4:** Selects input type for Input 2, Terminal PM13.

**S4-5:** Selects input type for Input 3, Terminal PM12.

**S4-4:** Selects input type for Input 4, Terminal PM10.

## WIRING



**CAUTION: Disconnect the power supply before beginning installation to prevent electrical shock, equipment and/or control damage. More than one power supply disconnect may be involved.**

**Wiring must comply with all applicable codes, ordinances and regulations.**

**Wiring, where required, must comply with NEC, Class 1 (Line Voltage) wiring.**

**Loads connected to the Controller must not exceed those listed in the specifications as shown in this manual.**

**All external controls connected to this unit must be listed or recognized by authorities who have jurisdiction for the specific purpose for which they are used.**

**Maximum connected load must not exceed 2000VA**

The enclosure **MUST** be mounted within a burner cabinet or similar and **MUST** be earthed to the overall enclosure to ensure safe and reliable operation.

The clamping bars on the control unit perform only an earth function and do not provide strain relief, the signal cable shields only connect at the clamping bar. Secure all cables carried in conduit at both ends using a suitable anchorage method in the cabinet.



**CAUTION: HAZARDOUS VOLTAGES MUST BE ISOLATED BEFORE SERVICE WORK IS CARRIED OUT.**

For UL approval, all single conductor wiring should be TEW, AWM or MTW within the cabinet. Conductors to be pulled through conduit should be THHN or TFFN. The maximum wire size that the wiring base will accept is a single 16 AWG. Should multiple conductors be required on a single terminal, an interposing terminal strip will be required.

For multi-conductor shielded requirements, use multiple conductor braid shielded cable similar to Belden 8735 for 3 conductor application, or Belden 9939 (3 conductor), 9940 (4 conductor), 9942 (6 conductor).

For CE approval, all cabling operating above 50V must be multi-strand single core PVC insulated 16/0.2mm and should meet the requirements of I.E.C. 227 or I.E.C. 225.

Do not use a green/yellow conductor for any purpose other than earth.

To comply with EMC requirements, wire the control unit using the specified cable sizes and shield connections. Clamp all signal cable shields to earth using the clamping bars provided on the control unit. Connect all cable shields to earth at the control unit end only, with the exception of the cables that connect the display and pressure sensors.

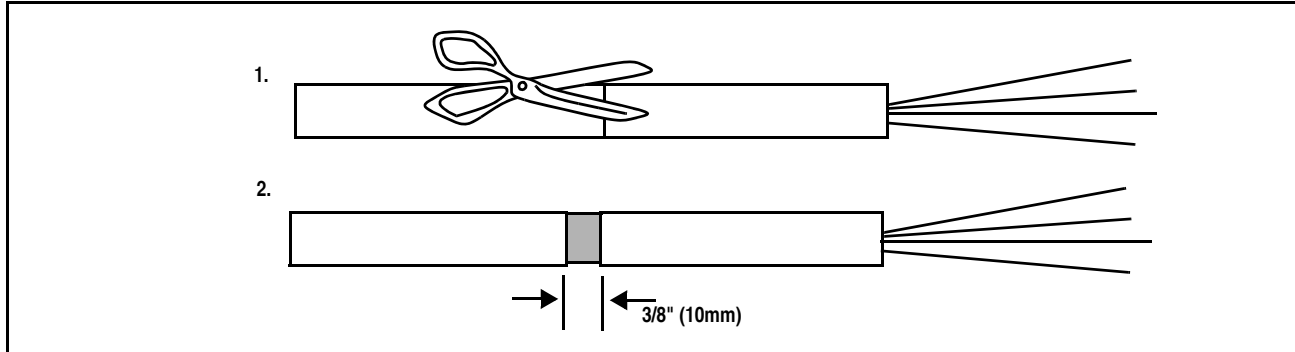
The equipment described in this manual has been tested for compliance to the UL Standards and CE Directives listed in the section headed “approvals”.

However, once connected to a burner and other associated controls, it is the responsibility of the installer to ensure the complete installation meets the requirements of the UL Standard and/or CE Directives relevant to the particular installation.

#### Using the cable clamp:

Clamping bars are provided on the control unit for termination of cable screens where necessary. The cable should be prepared by cutting around the outer sleeve, taking care not to damage the shield (1). Pull the sleeving apart to expose  $3/8"$  (10mm) of the screen (2). Slide the exposed length of shield between the clamping bars (3). Refer to figure 7.

FIGURE 2.

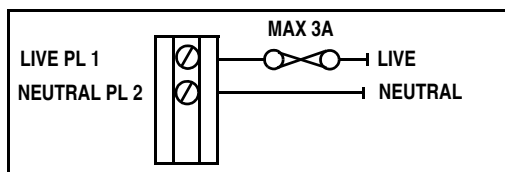


#### Ground Connection

Make the ground connection to the unit(s) using the earth stud(s) provided. Ensure that a good electrical connection is made both between the unit(s) and the burner panel and between the burner panel and earth. Where necessary, scrape any paint away from connection points and use shake-proof washers to obtain a reliable electrical connection. Always use the largest cross-sectional area earth wire possible.



### LIVE and Neutral Supply (NX280HW expansion unit)



The LIVE and NEUTRAL supplies must be connected using multi-strand single conductor PVC insulated 16, 18, 20 AWG, 600V 90°C (16/.02) wire. The live connection should be fused with a maximum rating of 3A. Wiring should comply with all applicable codes, ordinances and regulations

and where required, must comply with NEC Class 1 (line voltage) wiring.

### Oxygen probe connection (NX280HW expansion unit)

The NX280HW Expansion Interface is designed to directly interface to the NX280PK oxygen probe, which allows the unit to monitor flue oxygen and temperature. The NX280HW is then connected to the Nexus controller via an RS485 communication cable or directly to an NX550 display via a shielded cable connection.

The cabling between the NX280HW Expansion Interface and the NX280PK oxygen probe consists of the following specifications:

#### CABLE

#### SPECIFICATION

##### Probe Heater Cable

- **Max. voltage in use 48VAC**
- 2 PVC insulated conductors covered by a copper mesh screen and grey sheath.
- Conductors, blue and red twisted.
- Each conductor consists of 16, 18, 20 AWG (16/0.2) tinned copper stranded conductors covered by PVC.
- Resistance per conductor 40 milli-ohms/3 feet.
- Max. working voltage 440V r.m.s.
- Max. cable length 60 feet between units.

##### Probe Cell Signal Cable

- **Max. voltage in use < 15VDC**
- Each conductor consists of 22 AWG (7/0.2mm) tinned copper stranded conductors covered by PVC.
- Overall copper mesh shield.
- Outer sheath PVC.
- Resistance per conductor 92 milli-ohms/3 feet.
- Max. working voltage 440V r.m.s.
- Max. cable length 60 feet between units.

##### Heater and Flue

- **Max. voltage in use <15VDC**

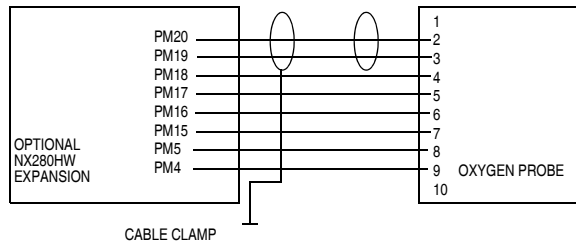
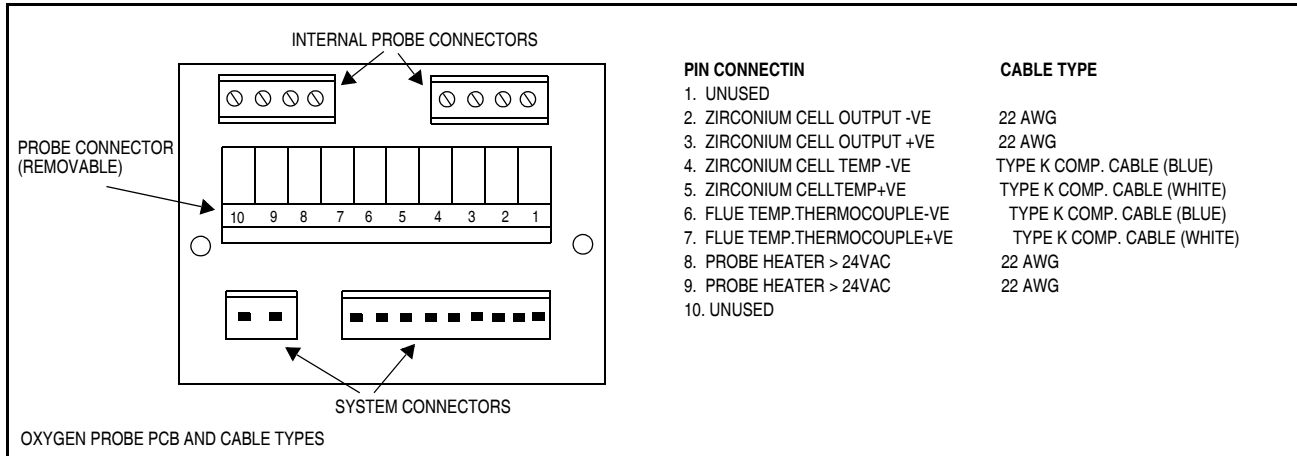
##### Thermocouple Compensation Cable

- 2 PVC insulated conductors (blue and white) covered by a red PVC sheath.
- Each core consists of 16, 18 AWG (7/0.2mm) stranded conductors covered by PVC.
- Type compensating cable Probe transformer secondary cable.

##### Probe Transformer Secondary Cable

- **Max. voltage in use 48VAC**
- Single core stranded conductor 22AWG 7/30 (0.34mm<sup>2</sup>) UL style 1007.
- O.D. 1/8".

### OXYGEN PROBE TO CONTROLLER CONNECTION

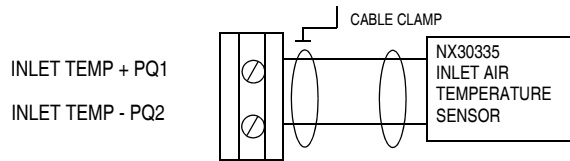


After ensuring all connectors are correctly fitted, secure the probe cap on the probe. The heater supply must be connected using overall shielded 2 conductor 16, 18, 20 AWG, 16/0.2mm PVC insulated cable.

The oxygen cell output must be connected using overall shielded 2 conductor 16, 18, 20 AWG, 16/0.2mm PVC insulated cable.

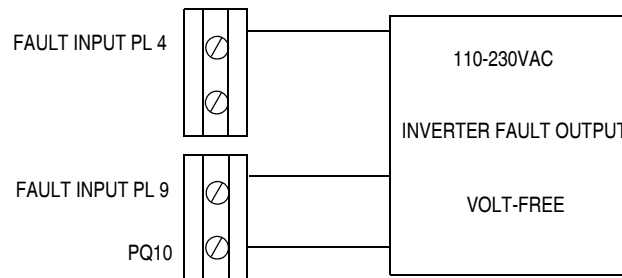
Both thermocouple connections must be made using type K compensating cable.

#### Inlet temperature sensor (NX280HW expansion unit)



The expansion unit allows direct connection of an inlet temperature sensor. The cabling between the units is via an overall shielded 2 conductor 16, 18, 20 AWG, 16/0.2mm PVC insulated cable.

#### Inverter fault signal option (NX280HW expansion unit)

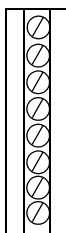


The inverter fault signal may be connected either as a 110 - 230Vac signal to terminal PL 4 or if a volt-free output from the inverter is available across PQ 9 & 10. In both cases the presence of a signal will cause the fault to be indicated.

The signal must be connected using multi-strand single conductor PVC insulated 22 AWG - 7/0.2mm wire.

### Analogue Outputs (NX280HW expansion unit)

ANALOGUE 1 OUTPUT + PQ13  
 ANALOGUE 1 OUTPUT + PQ14  
 ANALOGUE 2 OUTPUT + PQ15  
 ANALOGUE 2 OUTPUT + PQ16  
 ANALOGUE 3 OUTPUT + PQ17  
 ANALOGUE 3 OUTPUT + PQ18  
 ANALOGUE 4 OUTPUT + PQ19  
 ANALOGUE 4 OUTPUT + PQ20



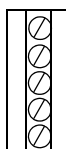
The analogue output cabling for each output must be overall shielded 2-conductor PVC insulated 22 AWG - 7/0.2mm. Since these cables may be run in conduit with high voltage wiring, its voltage rating must exceed the maximum voltage carried by any other cable in the same conduit.

If the unit is being used to control a variable speed drive the signal to the inverter must be connected to output 4.

Connect the cable shield(s) to the expansion unit by use of the clamping bar.

### Analogue Inputs (NX280HW expansion unit)

ANALOGUE 4 INPUT PM10  
 ANALOGUE INPUT COMM PM11  
 ANALOGUE 3 INPUT PM12  
 ANALOGUE 2 INPUT PM13  
 ANALOGUE 1 INPUT PM 14

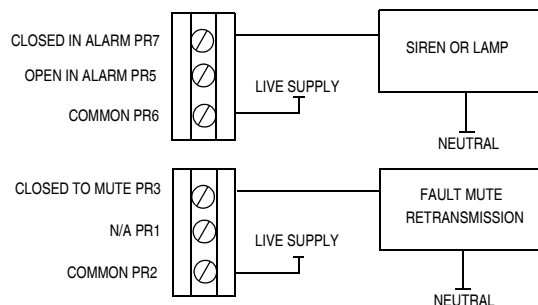


The analogue input cabling for each input must be overall shielded 2-conductor PVC insulated 22 AWG - 7/0.2mm. If the inputs are connected to a 'single location' it is acceptable to use an overall shielded multiconductor PVC insulated 22 AWG - 7/0.2mm cable. Since these cables may be run in conduit with high voltage wiring, its voltage rating must exceed the maximum voltage carried by any other cable in the same conduit.

If the unit is being used to control a variable speed drive the inverter feedback signal must be connected to input 4 and the input configured to operate as a current input.

Connect the cable shield(s) to the expansion unit by use of the clamping bar.

### Alarm Relay Outputs/Re-Set (Fault Mute) Function



These are provided to add an external siren or lamp for indication of a limit condition on a variable measured by the NX280HW expansion unit and to retransmit the fault mute 'function'. The relay will operate for limits [L50 to L54, L56 to L60 & L67 - L70].

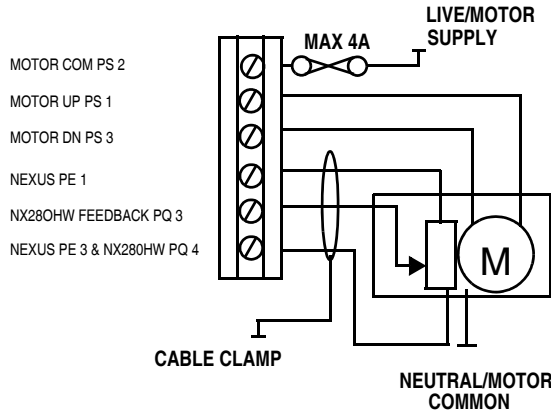
The retransmission of the Fault Mute function may be required if in a fault develops within the inverter and a manual fault mute is required it may be added to the NEXUS fault mute function, removing the need for a separate fault mute.

### Auxiliary Damper (NX280HW expansion unit)



**CAUTION:** The auxiliary damper output must not be used for controlling the main F.D. damper.

*NOTE:* Auxiliary damper remains closed during the purge cycle.



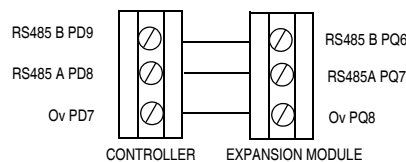
**PLEASE NOTE** the potentiometer connection is made to both the main and expansion units.

The auxiliary damper output should be connected using multi-strand single conductor PVC insulated 16, 18, 20 AWG 16/0.2mm wire. The connections to the motor should be made via its switched inputs, so that the internal micro-switches prevent the motor being damaged if it is driven to either end of its travel. The motor supply must be fused to protect the unit and the motor, ensure the fuse rating is selected to suit the current rating of the triac output option fitted.

Motor feedback potentiometer cabling must be wired using two overall shielded 2-conductor PVC insulated 22 AWG - 7/0.2mm. The potentiometer supply is from the main Nexus unit PE 1 & 3 while the feedback is via the optional NX280HW expansion unit PQ 3 & 4. This will require the 0v connection at the servomotor to have two connections and also connect the main unit and optional NX280HW expansion unit 0v lines together. Since these cables may be run in conduit with the motor drive wiring, the voltage rating must exceed the maximum voltage carried by any other cable in the same conduit.

Connect the shields with the use of the clamping bar. Make all connections at the servo-motor first. **Incorrect connection may damage or destroy the motor potentiometer.**

#### RS485 Expansion unit interconnection detail



The cabling for this interconnection must be overall shielded 3-conductor PVC insulated 7/0.2mm. Since this cable may be run in conduit with high voltage wiring, its voltage rating must exceed the maximum voltage carried by any other cable in the same conduit. Note Nexus connections are shown on the left.

Connect the cable shield(s) to the NEXUS unit by use of the clamping bar.

#### Final Checks

Before applying power, make the following checks:

- The unit(s) supply voltage is correctly set.
- All other link positions are correct.
- The fuse(s) are of the correct type and value.
- All wiring and connections have been made according to the specifications detailed in this chapter.
- Before applying power to the unit ensure that the probe heater output is not attempting to drive into a short circuit by checking between terminals PN4 and PN5 using a resistance meter. The expected resistance with an oxygen probe fitted should be greater than 15 Ohms.
- Enclosure lid(s) are fitted, before applying power to the unit(s).

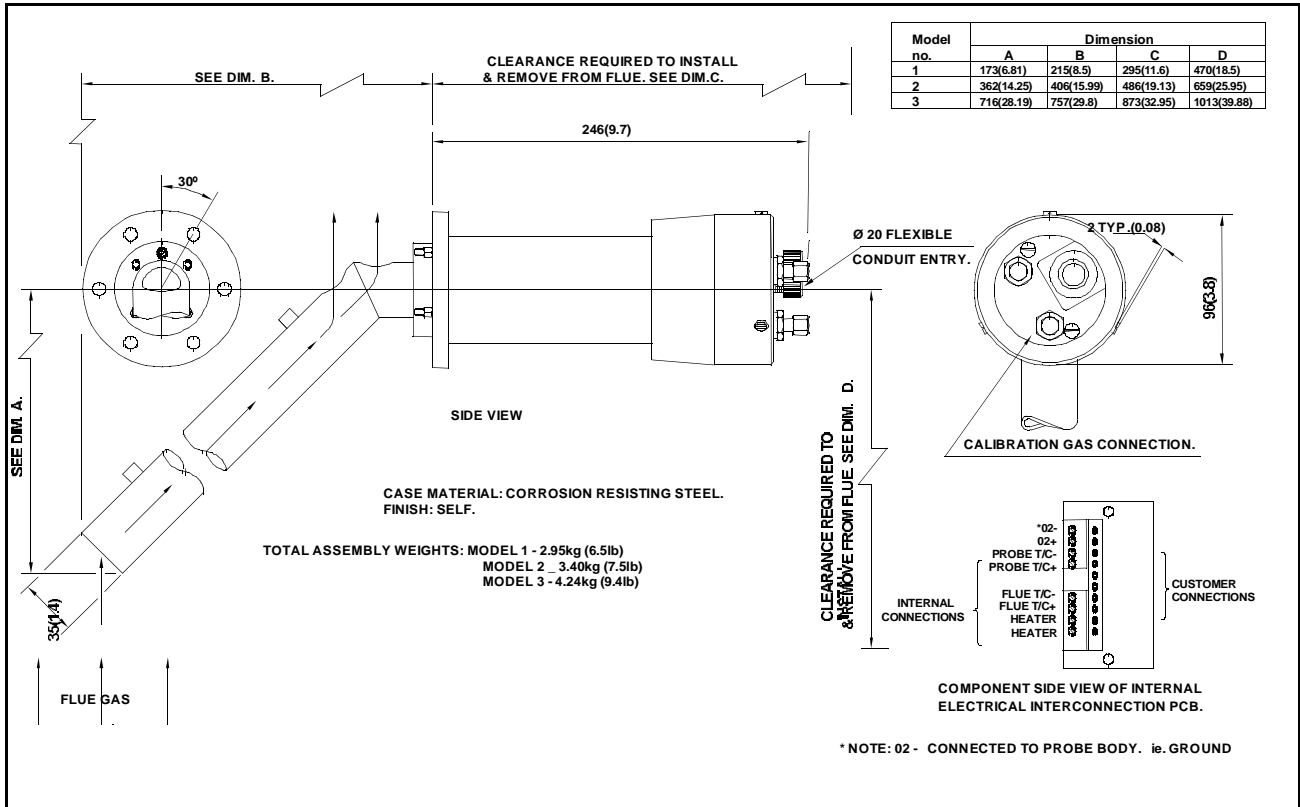


# INSTALLATION GUIDELINES NX280PK O2 PROBE

## Oxygen Probe Description

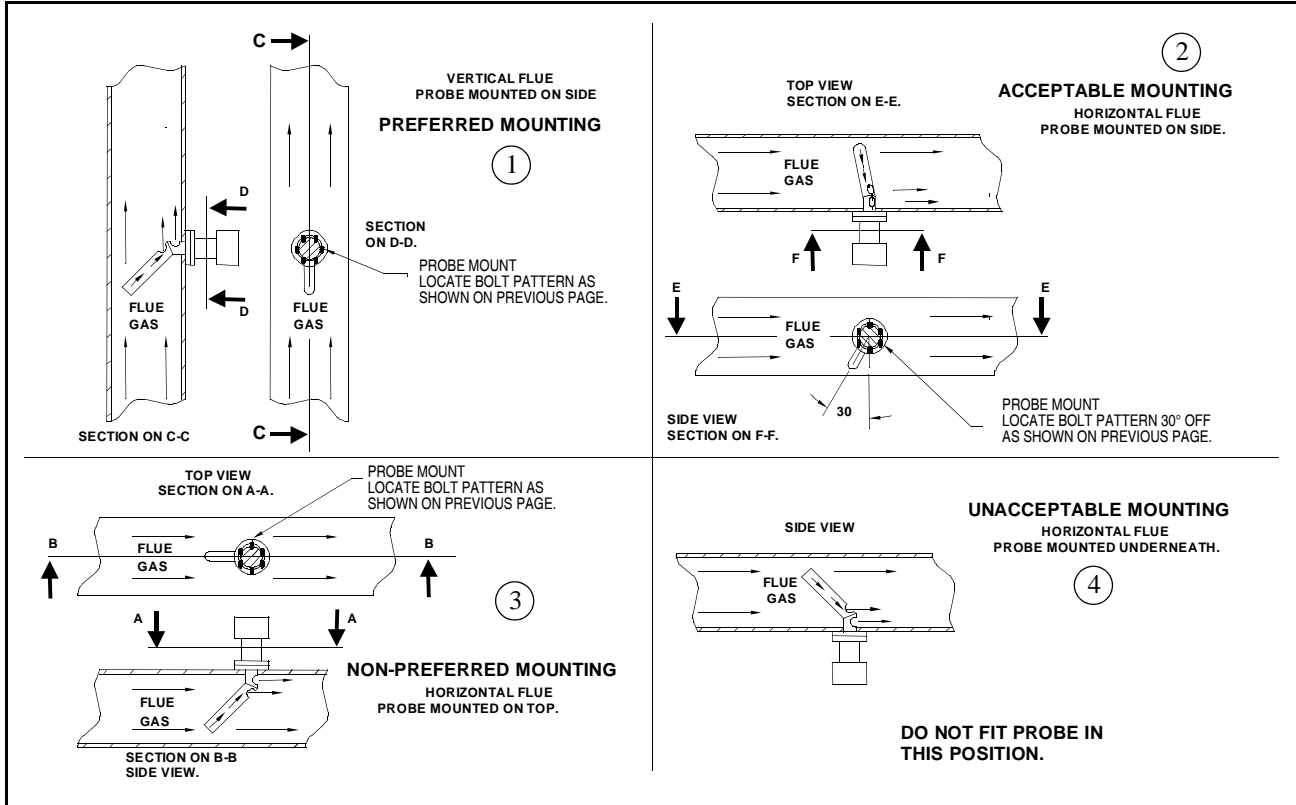
The oxygen trim or monitoring function via the NX280HW Expansion Interface is designed to be used with a Fireye NX-280PK oxygen probe kit. This probe offers fast, accurate response and good reliability when mounted in accordance with the guidelines in this section.

The probe is available in three different sizes. With the standard being the smallest flue diameter of approximately 12" (300mm) to 40" (1000mm).



## Mounting the Oxygen Probe

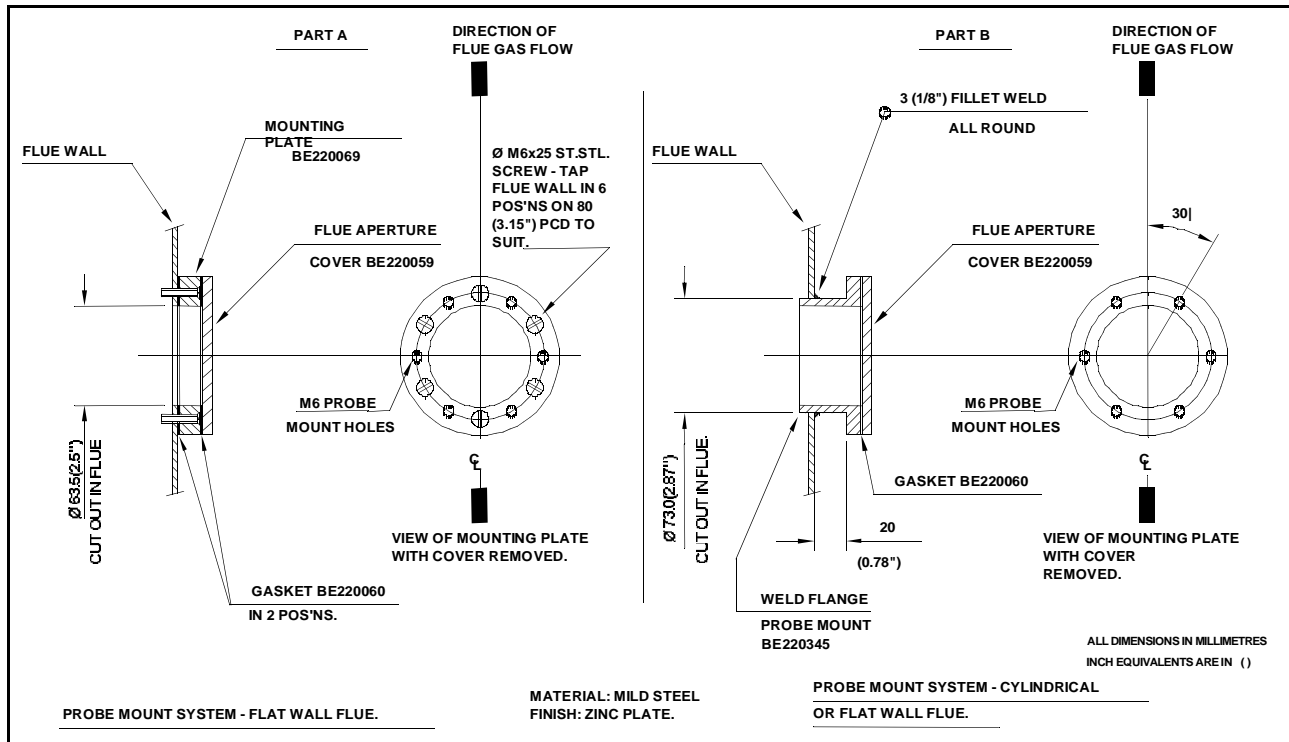
The probe must be mounted in a manner which ensures that the flue gases pass into the gas tube at its open end and out of the tube at the flange end. Furthermore, if possible, the flange should be vertical with the gas tube angled downwards to ensure that particulate does not build up within the sample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



There are two types of flanges available (see the drawing on next page). With either flange the vertical centre line of the flange shown on the drawing should correspond to the gas flow direction. The weld flange shown in part 8 is included as a standard part with NX280PK probe kit.

6 stainless steel socket cap screws are provided for probe attachment.

The probe flange temperature must be maintained at the temperature of the flue wall by repacking or adding lagging which may have been removed to mount the probe. Sulfate condensation will occur if the flue wall of an oil fired boiler falls below approximately 260° F. The sulfate problem does not occur in gas fired installations, but vapor may cause problems due to condensation if the temperature of the flue gas falls below 212° F. The maximum flue gas temperature is 1022° F.



The probe end cap carries a removable flexible conduit fitting to enable probe replacement without wiring. The 2 hexagonal caps visible on the probe rear face are there to cover the calibration gas port and the sample gas port. The latter is merely a tube that passes directly into the flue to enable gas samples to be drawn or flue temperatures to be taken using other instrumentation. Both ports must be kept sealed during normal operation for safety and accurate performance.

## OPTION PARAMETERS

Only those additional options available (via Nexus Controller) when using the NX280HW - Expansion Interface are described below.

Option parameters are accessed in the same method as described in the main Nexus bulletin NEX-1001 and also described below:

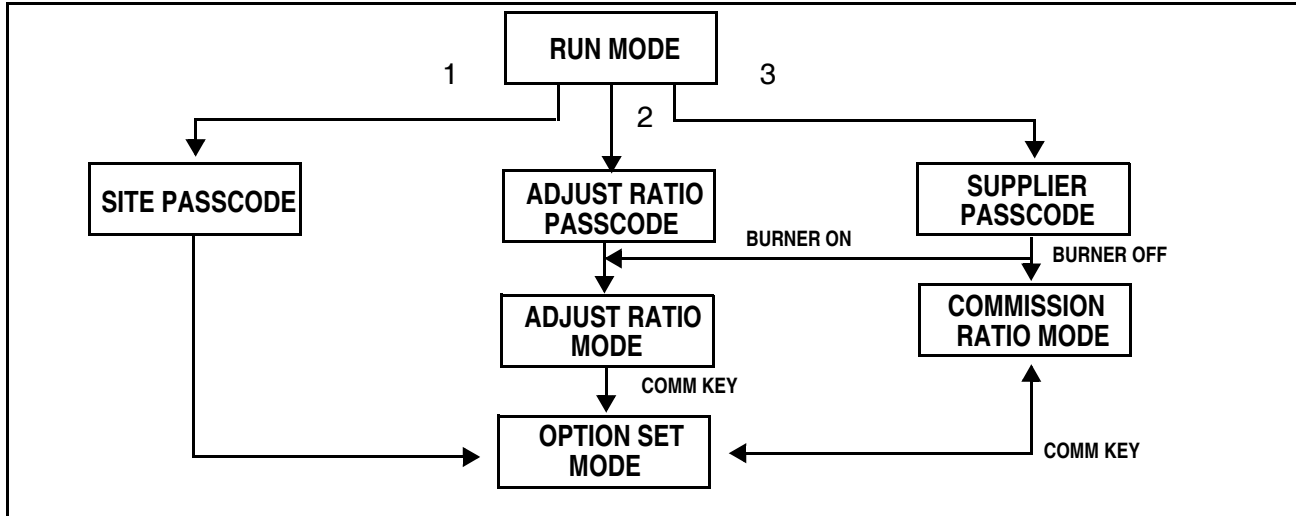


**WARNING:** While the unit is in commissioning mode or adjust ratio mode certain safety checks cannot be performed by the NX1000 and therefore the safety of the system operation is the sole responsibility of the commissioning engineer. Do not allow the fuel to accumulate in the combustion chamber for longer than a few seconds without igniting, an explosive mixture could result. If a flame failure occurs at any point the unit will not attempt a restart until the fault is cleared and will perform any selected postpurge and prepurge, before moving to the ignition position.

### General

If any settings in the unit are to be changed, it is necessary to enter a commission mode. Three passcodes are available for this purpose.

1. Site passcode - allows adjustment of some option parameters.
2. Adjust ratio passcode - allows adjustment of some option parameters and entry to adjust ratio mode.
3. Supplier passcode - allows entry to all commissioning modes.



### Commissioning Data

#### Option parameters

Option parameters contain information about the configuration of the burner and the boiler. Option parameters may be adjusted in *option set mode*, but it may not be possible to adjust all of them if the burner is on.

#### Profile Setpoints

Setpoints contain information about required motor positions. There are four tables of setpoints (or four profiles), which may be visualized using the diagram below:

GAS POSITION (°)	AIR 1 POSITION (°)	AIR 2 POSITION (°)		OIL POSITION (°)	AIR 2 POSITION (°)	AIR 1 POSITION (°)
2.1	2.2	1.9	CLOSE (P00)	1.7	2.2	1.9
89.5	87.3	88.9	PURGE (P01)	90.1	87.3	88.9
24.6	22.4	30.6	INGNITION (P02)	10.6	22.4	28.7
21.3	25.6	25.8	LOW FIRE (P03)	10.6	25.6	28.7
76.8	70.3	85.6	HIGH FIRE (PXX)	50.2	70.3	83.5

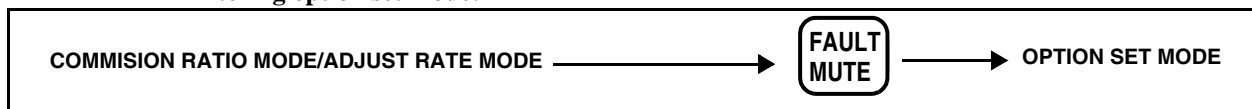
Up to 24 setpoints may be entered for each profile, including close, purge, and ignition. New setpoints may be entered in *commission ratio mode*. Existing setpoints may be modified in *adjust ratio mode* or *commission ratio mode*.

#### Option Set Mode

##### Description:

Option set mode is used for changing the values of option parameters. If the burner is on, it may not be possible to adjust all of the option parameters.

##### Entering option set mode:



To enter option set mode, enter commission ratio mode or adjust ratio mode and press the key labelled **FAULT MUTE (MODE)**.

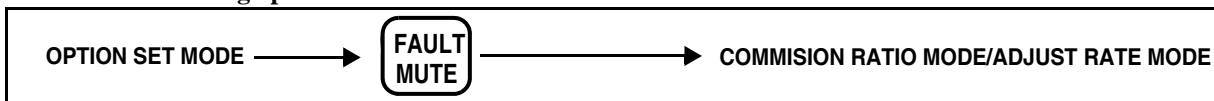
In commission mode the display will flash **COM**.



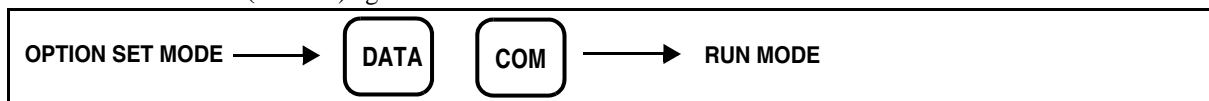
### Using option set mode:

- Use the **LEFT/RIGHT** scroll keys to point the select arrow at the option number on the top line of the display and use the **UP/DOWN** scroll keys to display the option parameter to be changed.
- Then use the **LEFT/RIGHT** scroll keys to point the select arrow at the option value and use the **UP/DOWN** keys to change the value of the option parameter.
- If the value has been changed, the value will flash. Press the key labelled **COM (ENTER)** to store the new value.

### Leaving option set mode:



To exit option set mode and return to commission ratio or adjust ratio mode, press the key labelled **FAULT (MODE)** again.



To exit option set mode and return to run mode, press the key labelled **DATA (RUN)** and then **COM (ENTER)**.

## OPTION PARAMETER LISTING

*NOTE: If an option parameter is marked with \*, it is not possible to adjust its value using the site passcode. The option parameters marked with \* can only be adjusted in the commissioning mode after entering the supplier passcode. If using the supplier passcode and it is still not possible to adjust the value of an option parameter, the burner must be turned off first.*

### Option 0.7, 0.8 - Expansion Module Passcodes\*

These passcodes enable the various functions available from the Expansion Module. Depending on the required operation, passcodes are available for O<sub>2</sub> Trim, variable speed Inverter/Auxilliary Damper Enable, or all of the above. Contact Fireye for the appropriate passcodes, the Serial Number of the Nexus Controller will be required.

### Option 14.0 - Inverter/auxiliary damper enable (0 / 1)\*

### Options 14.1 to 14.4 - Inverter/auxiliary damper select per fuel/profile (0 - 3)\*



**CAUTION: The auxiliary damper output must not be used for controlling the main F.D. damper, the error time for this output and the inverter control is 3 seconds not 1 second as for all servomotor outputs.**

It is possible to select an inverter and/or an auxiliary damper if the optional NX280HW expansion unit is fitted and enabled for variable speed/auxiliary damper control.

If option 14.0 is set to 1, it is possible to select an inverter and or an auxiliary damper per fuel/profile using option 14.1 - 14.4.

**0** - Inverter speed control disabled.

**1** - Inverter speed control enabled for relevant fuel/profile.

**2** - Auxiliary damper control enabled for relevant fuel/profile.

**3** - Inverter and auxiliary damper enabled for relevant fuel/profile.

### Option 14.5 - Inverter control accuracy (0 / 1)\*

This parameter affects the inverter connected to the unit.

**0** - Low accuracy (normal setting).

Control will be performed to within approximately (0.45Hz for a 0-50Hz system).

*NOTE: When using the high accuracy setting, the unit may have difficulty with controlling the speed of the inverter. If this occurs, use the low accuracy setting for reliable operation.*



**Option 14.6 - Inverter error tolerance (0 / 1)\***

This option parameter affects the inverter connected to the unit.

**0** - Small tolerance (normal setting). The unit will perform a non-volatile lockout if the inverter positioning error exceeds  $\pm 30$  for 15 seconds or  $\pm 55$  for 3 second (units conform to those seen on the display).

**1** - Large tolerance. The unit will perform a non-volatile lockout if the inverter positioning error exceeds  $\pm 55$  for 3 seconds (units conform to those seen on the display).

*NOTE: Only use the large tolerance setting if an inverter error of up to 55 will not cause unsafe combustion.*

**Option 14.7 - Inverter closed loop gain (15 - 125%)\***

This option parameter affects all inverters connected to the unit.

For normal operation, use 100%. If the inverter control is unstable, reducing this value has the effect of damping the inverter's response as its speed approaches its setpoint.

**Option 14.8 - Inverter stop time (0 - 100 seconds)\***

Determines the minimum time between a burner shutdown and subsequent start-up. Set this parameter to give the inverter sufficient time to stop before the burner restarts. This parameter will increase the time the burner is held in status 5.

**Option 20.0 - Oxygen probe select (0 - 2)\***

This option parameter allows the oxygen probe function to be selected.

**0** - No probe selected. The oxygen level display will not be available.

**1** - FIREYE oxygen probe for monitoring or trim with no pre-purge test.

**2** - FIREYE oxygen probe for monitoring or trim with a pre-purge test. If the measured oxygen level is less than 18.0% at the end of the pre-purge period, F76 is given and oxygen trim will be disabled.

**Option 20.1 - Oxygen probe calibration offset value (0 - 999)\***

This option parameter is only available if option 20.0 is non zero.

This option parameter must be set to the calibration offset value specified with the probe supplied.

**Option 20.2 - Oxygen probe calibration gain value (0 - 999)\***

This option parameter is only available if option 20.0 is non zero.

This option parameter must be set to the calibration gain value specified with the probe supplied.

**Option 20.3 - Oxygen probe calibration gas concentration (0.00 - 9.99%)\***

This option parameter is only available if option 20.0 is non zero. This option parameter must be set to the percentage oxygen concentration of the calibration gas used if the probe is to be calibrated using a reference gas (see option parameter 20.6). The range of this parameter is **0.00 - 9.99%**.

**Option 20.4 - Flue and inlet sensor temperature units (0 - 1)\***

This option parameter is only available if option 20.0 is non zero. This option parameter must be set to select the units for display of both temperatures on either °C or °F. Please note that temperature limits **MUST** be set in the correct units.

**Option 20.5 - Oxygen input function (0/1)\***

This option parameter can only be set above 1 if option 20.0 is non zero. Using this option parameter, it is possible to configure the oxygen input for a monitoring function or trim function. The two functions are explained below:

**0** - Monitor only. The oxygen value on the optional NX280HW expansion unit is only used to provide a display of the measured oxygen level.

**1** - Closed loop trim. The oxygen value on the optional NX280HW expansion unit is used to provide both a display of the measured oxygen level and a feedback signal for closed loop trim control function of the NEXUS Integrated Burner Controller.

### **Option 20.6 - Oxygen probe calibrate enable (0 - 2)\***

This option parameter is only available if option 20.0 is non zero.

This option parameter must be used when calibrating the FIREYE oxygen probe. There are three possible values:

**0** - No calibrate. This is the normal operating condition, where the probe is used to measure the oxygen concentration in the flue.

**1** - Calibrate in air. The probe will be calibrated for 'offset' at the normal atmospheric oxygen concentration.

**2** - Calibrate in reference gas. The probe will be calibrated for 'gain' in a reference gas with a nominal oxygen concentration of 3.0%.

Once this calibration has been successfully completed the values in 20.1 and 20.2 will be automatically updated.

### **Option 20.7 - Boiler transport delay (5 - 60 seconds)\***

This parameter is only available if option 20.5 has been set for closed loop oxygen trim.

Boiler transport delay is the time taken for 'gas' to travel from the burner to the oxygen probe. This delay varies with burner fire rate.

In order for the oxygen trim control loop to be stable, this parameter must be set accurately to the transport delay of the boiler **when at low fire**. This option may be set between **5** and **60** seconds inclusive.

- To measure the transport delay, ignite the burner and enter adjust ratio mode. Select the low fire setpoint and allow time for the flue oxygen reading to settle. Once the oxygen reading is steady, make a step change to the fuel/air ratio and start a timer. When the measured oxygen reading begins to change, stop the timer. Set the option parameter to the recorded timer value in seconds.
- Automatic trim commissioning (option 20.9) will set this automatically. However the value must be checked by the engineer.

### **Option 20.8 - Reset oxygen trim profile (0/1)\*.**

This option parameter allows the previously learned trim profile to be reset. If the option is set to 1 any learned profile currently held in memory will be reset and the trim drives will return to their commissioned positions for the corresponding modulation position. Once the profile has been reset this option parameter will automatically be reset to 0.

### **Option 20.9 - Automatic trim commissioning (0 / 1)\***

**0** - Not selected.

**1** - Automatic trim commissioning will be performed under the following conditions:

- An oxygen probe is fitted and fully operational
- The unit is in adjust ratio with the burner firing a single fuel only
- A hydrocarbon ratio has been entered for the current fuel (see option parameters 26.5 - 26.8).

### **Option 23.0 - Trim limit default (0/1)\***

#### **Options 23.1 to 23.4 - Trim limits (0.0 - 25.0)\***

Option 23.0 is only available if option 20.5 (oxygen input function) has been set for closed loop oxygen trim.

It is possible for the system to trim the air or fuel drives up to a maximum deviation of  $\pm 25.0\%$  of the total air or fuel flow for the chosen trim drives.

If option 23.0 is set to 0, the default trim limit will be  $\pm 5.0\%$  for all profile selections. Option parameters 23.1 to 23.4 will not be available.

If option 23.0 is set to 1, it is possible to individually adjust the trim limit for each profile selection using option parameters 23.1 to 23.4. The trim limit may be adjusted from 0.0% (no trim) up to a maximum of  $\pm 25.0\%$  (maximum allowable trim).

**It is the responsibility of the commissioning engineer to ensure the trim limit set will not allow a hazardous combustion condition to occur.**

**Options 24.1 to 24.4 - Trim integral gain (0.0 - 99.9%)\***

Options 24.1 to 24.4 are only available if option 20.5 (oxygen input function) has been set for closed loop oxygen trim.

In order for the oxygen trim control loop to be stable, the integral gain must be set correctly. Options 24.1 to 24.4 allow the integral gain to be set individually for each profile combination to any value between 0.0 and 99.9%. As a general recommendation, the integral gain should be initially set to 15.0%.

If the burner is firing, it is only possible to make an adjustment to the option parameter which relates to the selected profile. If the burner is not firing, the integral gain for any profile selection may be adjusted.

**Option 25.0 - Trim proportional gain default (0/1)\***

**Options 25.1 to 25.4 - Trim proportional gain (0.0 - 99.9%)\***

Options 25.0 to 25.4 are only available if option 20.5 (oxygen input function) has been set for closed loop oxygen trim.

If oxygen trim proportional gain is not required for any profile selection, set option parameter 25.0 to **0**.

If oxygen trim proportional gain is required, set option parameter 25.0 to **1**. Option parameters 25.1 to 25.4 will then become available. Options 25.1 to 25.4 allow the loop gain to be set individually for each profile selection to any value between 0.0 and 99.9%.

**Option 26.0 - Inlet temperature sensor (0 - 2)\***

This option parameter is only available if option 20.0 (oxygen input select) is not set to zero. The option may be set as shown below:

**0** - Inlet temperature sensor not fitted.

**1** - Inlet temperature sensor fitted and connected to PQ1-2. Calculated burner **gross** efficiency will be displayed if the calorific value, hydrocarbon ratio and flow values have been entered for the fuel that is firing. Efficiency will not be displayed when firing multiple fuel combinations.

**2** - Inlet temperature sensor fitted and connected to PQ1-2. Calculated burner **net** efficiency will be displayed if the calorific value, hydrocarbon ratio and flow values have been entered for the fuel that is firing. Efficiency will not be displayed when firing multiple fuel combinations.

**Options 26.1 to 26.4 - Calorific values of fuels/profiles 1 to 4 respectively (0.0 - 99.9)**

These option parameters are only available if option 26.0 (inlet temperature sensor) is not set to zero.

If a display of calculated burner efficiency is required, the calorific value of the required fuels must be entered. May be set between **0.0** and **99.9 MJkg<sup>-1</sup>** inclusive.

A display of burner efficiency is not available when firing multiple fuel combinations.

**Options 26.5 to 26.8 - Hydrocarbon ratios of each fuel respectively (0.00 - 9.99)**

These option parameters are only available if option 26.0 (inlet temperature sensor) is not set to zero.

If a display of calculated burner efficiency is required, the hydrocarbon ratios for the required fuels must be entered. May be set between 0.0 and 9.99 inclusive, where the value entered is the hydrocarbon ratio x 10. For example, for a hydrocarbon ratio of 0.157, a value of 1.57 should be entered.

Display of burner efficiency is not available when firing multiple fuel combinations.

The table below shows the calorific values and hydrocarbon ratios of several common fuels. These values should be used as a guide only. Gross calorific values should be used for display of gross efficiency.

FUEL	GROSS CALORIFIC VALUE	NET CALORIFIC VALUE	HYDROCARBON RATIO (x10)
GAS	52.8	47.6	3.20
LIGHT OIL	45.6	42.8	1.57
MEDIUM OIL	43.1	40.8	1.35
HEAVY OIL	42.9	40.5	1.28

**Option 26.9 - Boiler radiated heat loss (0.0 - 9.9%)**

This option parameter is only available if option 26.0 (inlet temperature sensor) is not set to zero.

For accurate calculation of boiler gross efficiency, this option parameter must be set to the heat lost through the shell of the boiler at high fire as a percentage of the burner's output at high fire. The range of this parameter is **0.0 to 9.9%**.

**Option 27.0 - Flue temperature alarm select (0/1)\***

This option parameter is only available if option 20.0 is non zero.

If option 27.0 is set to 0, the flue temperature high and low alarms are disabled.

If option 27.0 is set to 1, the flue temperature high and low alarms are enabled and option parameters 27.1 to 28.4 become available.

**Options 27.1 to 27.4 - Flue temperature low alarm values (0 - 999)\***

Using option parameters 27.1 to 27.4, it is possible to set a different flue temperature low alarm value for each profile combination. Each option parameter may be set to any value between 0 and 999 inclusive. The temperature units should be set with respect to option parameter 20.4.

If the burner is firing, it is only possible to make an adjustment to the option parameter which relates to the selected profile. If the burner is not firing, the low alarm value for any profile selection may be adjusted.

When the flue temperature drops below the low alarm value for the selected profile, a fault number will appear.

**Options 28.1 to 28.4 - Flue temperature high alarm values (0 - 999)\***

Using option parameters 28.1 to 28.4, it is possible to set a different flue temperature high alarm value for each profile selection. Each option parameter may be set to any value between 0 and 999 inclusive. The temperature units should be set with respect to option parameter 20.4.

If the burner is firing, it is only possible to make an adjustment to the option parameter which relates to the selected profile. If the burner is not firing, the high alarm value for any profile selection may be adjusted.

When the flue temperature rises above the high alarm value for the selected profile combination, a fault number will appear. See Fault Code Listing L59.

**Option 29.0 - Oxygen alarm select (0 - 2)\***

Option parameter 29.0 is only available when option 20.0 (oxygen input select) is not set to zero and the optional NX280HW expansion unit is fitted.

Since the oxygen alarm values relate to the oxygen setpoint values, oxygen setpoint values must first be entered in adjust ratio mode.

**0 - Alarms disabled.** Oxygen low and high alarms are disabled.

**1 - Alarms enabled, no non-volatile lockout.** Oxygen low and high alarms are enabled and option parameters 29.1 to 32.4 will become available. If an alarm value is exceeded, a fault number will appear but no non-volatile lockout will occur.

**2 - Alarms enabled with non-volatile lockout.** Oxygen low and high alarms are enabled and option parameters 29.1 to 32.4 will become available. If an alarm value is exceeded, a fault number will appear and a non-volatile lockout will occur.

**Options 29.1 to 29.4 - Oxygen low alarm values at low fire (0.0 - 99.9%)\*****Options 30.1 to 30.4 - Oxygen low alarm values at high fire (0.0 - 99.9%)\*****Options 31.1 to 31.4 - Oxygen high alarm values at low fire (0.0 - 99.9%)\*****Options 32.1 to 32.2 - Oxygen high alarm values at high fire (0.0 - 99.9%)\***

Using option parameters 29.1 to 30.4, it is possible to set different oxygen alarm values at high fire and low fire for each profile.

At firing positions other than high and low fire, the alarm limit is interpolated between the two points. For example, if the oxygen limit has been entered as 5% of setpoint at low fire and 10% of setpoint at high fire, the limit at mid fire will be 7.5%.

The alarm limits may set to any value between **0.0 and 99.9%**, where the value entered relates to a **percentage deviation** from each oxygen setpoint in the firing range.

If the burner is firing, it is only possible to make an adjustment to the option parameters which relate to the selected profile. If the burner is not firing, the alarm values for any profile selection may be adjusted.

An oxygen low alarm will be caused by one or more of the following events:

- The level drops below 0.5% O<sub>2</sub> for 30 seconds
- The level drops below the low alarm limit for 2 minutes
- The level drops below twice the low alarm limit for 30 seconds

An oxygen high alarm will be caused by one or more of the following events:

- The level rises above the high alarm limit for 2 minutes
- The level rises above twice the high alarm limit for 30 seconds

#### Options 36.0 to 39.3 - 4-20mA output functions



**CAUTION: These 4-20mA outputs must not be used for any safety related function except when used in conjunction with a 4-20mA feedback for controlling an inverter.**

These option parameters determine the function of each 4-20mA output on the optional NX280HW expansion unit (if fitted). Output 4 parameters will be available even if an inverter is connected but the output will operate as set to interface to the inverter, irrespective of the values entered in option parameters 39.x.

The table below details each option parameter.

OPTION PARAMETER	OUTPUT	DESCRIPTION
36.0	OUT 1	THIS OPTION PARAMETER RELATES TO OUTPUT TERMINALS PQ13-14
37.0	OUT 2	THIS OPTION PARAMETER RELATES TO OUTPUT TERMINALS PQ15-16
38.0	OUT 3	THIS OPTION PARAMETER RELATES TO OUTPUT TERMINALS PQ17-18
39.0	OUT 4	THIS OPTION PARAMETER RELATES TO OUTPUT TERMINALS PQ19-20

Depending on the values of option parameters 36.0, 37.0, 38.0 and 39.0 (see table above), it is possible to transmit one of the variables from the list below as a 4-20mA signal:

- 0 - No function. The output will transmit 0mA.
- 1 - Modulation rate (4mA when not modulating).
- 2 - Boiler pressure/temperature measured value.
- 3 - Boiler pressure/temperature setpoint.
- 4 - Calculated efficiency.
- 5 - Inlet temperature.
- 6 - Flue temperature.
- 7 - Oxygen level.
- 8 - CO<sub>2</sub> level.
- 9 - Gas pressure.

10 - Modulation rate master signal for twin burner slaving. If the burner is modulating, the unit outputs a 4-20mA modulation rate signal. Otherwise, the unit outputs 0mA. The slave burner should have its auxiliary modulation input configured for remote tracking (see option parameter 03.3).

When output functions 2 to 9 are used, the output zero and span values must be entered. The option parameters determining zero and span values are detailed below:

OPTION PARAMETER	ZERO	SPAN
36.0	36.1	36.2
37.0	37.1	37.2
38.0	38.1	38.2
39.0	39.1	39.1

**NOTE:** If output 4 is already configured for use with an inverter, the inverter function will take precedence.

#### Options 40.0 to 43.4 - 4-20mA input functions



**CAUTION:** These 4-20mA inputs must not be used for any safety related function except when used in conjunction with a 4-20mA output for controlling an inverter and NXVSD codes.

These option parameters determine the function of each 4-20mA input on the optional NX280HW expansion unit (if fitted), including the selection of limits. Input 4 will not be available if the optional NX280HW expansion unit is being used to control an inverter.

The table below details each option parameter.

OPTION PARAMETER	INPUT	DESCRIPTION
40.0	AUX 1	THIS OPTION PARAMETER RELATES TO INPUT TERMINAL PM14
41.0	AUX 2	THIS OPTION PARAMETER RELATES TO INPUT TERMINAL PM13
42.0	AUX 3	THIS OPTION PARAMETER RELATES TO INPUT TERMINAL PM12
43.0	AUX 4	THIS OPTION PARAMETER RELATES TO INPUT TERMINAL PM10

In each case above the common (O) connection for the inputs is PM11. Depending on the values of option parameters 40.0, 41.0, 42.0 & 43.0 (see table above), it is possible to set decimal point position and alarm levels for each 4-20mA input signal if required:

If the inputs are selected, the decimal point position, input zero and span values must be entered and if require the limit level.

**0** - Input not used

**1** - Auxiliary input values displayed with no decimal place

**2** - Auxiliary input values displayed with 1 decimal place

**3** - Auxiliary input values displayed with 2 decimal places

The option parameters determining these values are detailed below:

INPUT NUMBER	OPTION PARAMETER	ZERO	SPAN	LIMIT
1	40.0	40.1	40.2	40.3
2	41.0	41.1	41.2	41.3
3	42.0	42.1	42.2	42.3
4	43.0	43.1	43.2	43.3

**NOTE:** If input 4 is already configured for use with an inverter, the inverter function will take precedence.

## COMMISSIONING O2 TRIM SYSTEM

For the oxygen trim system to function correctly, the following information must be programmed:

1. Option parameters
2. Flow values and O2 setpoints

The Nexus system automatically calculates the flow values and stores them against each of the programmed fuel air ratio points and measured O2 values at those points, using the automatic trim commissioning procedure (enabled in Option Parameter 20.9).

If the automatic trim commissioning is performed, the engineer **MUST CHECK THAT THE VALUES ENTERED ARE VALID AND SAFE AFTER COMPLETION**. Additionally, the oxygen probe calibration should be checked before and after the procedure since the results are highly dependent on measurements taken using the probe. Entering option parameters with the burner off, enter commission mode (see section Option Parameters and setting up). To get the trim operational it is necessary to set up the following option parameters:

1. Calibration - Enter zero calibration numbers supplied with the Nexus NX280PK (Option 20.1).
2. Calibration - Enter span calibration numbers supplied with the Nexus NX280PK (Option 20.2).
3. Lead drive - The lead drive will also select which drive will be moved to achieve trim (options 05.X).
4. Trim gain - To improve stability of the control (options 24.X, 25.X).
5. Trim limits - To impose limits on the amount of trim applied (options 23.X).
6. Transport delay - Enter an initial time (e.g. 15 secs.) After automatic trim procedure Nexus will automatically set a precise measured time here (Option 20.7).
7. Trim enable - To turn trim on (Option 20.9).

Before proceeding to enter the oxygen setpoints for each profile, a few points relating to the oxygen trim option should be considered.

### Using adjust ratio mode to enter oxygen setpoints and flow values manually



**WARNING: When using the adjust ratio mode, it is not possible for the unit to check drive positions at all times. It is therefore the responsibility of the engineers to check that the motors and valves are responding correctly.**

To adjust an oxygen setpoint or enter an air flow value in the firing range, use the following procedure. The manual calculation of the values to be entered here is covered in the next section.

1. Enter adjust ratio mode.
2. Enable oxygen trim by setting option parameter 20.5 to 1.
3. Press the RIGHT /LEFT keys to position cursor and use the UP/DOWN keys to select the desired setpoint (A04 for example). The system will modulate to the selected setpoint. Each push of the UP/DOWN cursor will move to the next profile point.
4. Wait for the number in the display to be illuminated steadily e.g. A04. This means that the drives have arrived at the selected setpoint.
5. The display will show "o2" to indicate that the system is expecting an oxygen setpoint to be entered for the current profile setpoint. Use the Mode Key to toggle between servo positions, option parameters and oxygen setpoint value in percentage oxygen.
6. Press the RIGHT /LEFT keys to position cursor and use the UP/DOWN keys to adjust the oxygen setpoint as necessary. The **ENTER** indicator will start flashing to indicate that a change has been made.
7. If the new oxygen setpoint value is wanted, press the **ENTER** key. The value will be stored in memory.
8. If the new oxygen setpoint value is not wanted or an adjustment is not required, press the **NEXT** key to return to the value stored in memory.





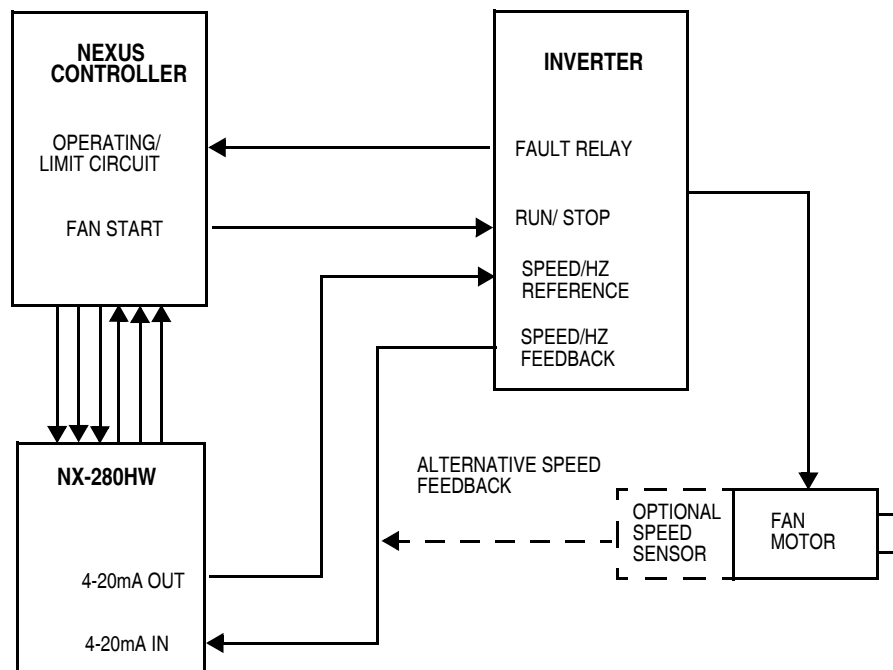
9. Press the top left quadrant key to illuminate its indicator, and then press the key once again. The top left display will now show "FLO" to indicate that the system is expecting a flow value for the current profile setpoint to be entered. The top right display will show the air flow value, represented as a percentage of the air flow when the drives are at the **HIGH FIRE** position.
10. Press the top right quadrant key and use the UP/DOWN keys to adjust the flow value as necessary. The **ENTER** indicator will start flashing to indicate that a change has been made.
11. If the new flow value is not wanted or an adjustment is not required, press the **NEXT** key to return to the value stored in memory.
12. If it is necessary to adjust another setpoint in the firing range, repeat the above procedure from step 3.

## VARIABLE SPEED DRIVE DESCRIPTION OF OPERATION

### System configuration

The Nexus unit uses a 4-20mA output on the Expansion Interface NX-280HW as a speed or frequency reference signal to the inverter. A matching 4-20mA input is used to monitor a feedback signal from the inverter, representing the actual speed or frequency of the motor.

In addition to the 4-20mA signals, the Nexus system provides the motor start signal. The fault relay of the inverter must be connected into the operating (on-off) circuit of the burner, so that if the relay breaks the burner will be shut down. Alternatively the fault relay of the inverter can be connected to one of the safety/ auxiliary inputs on the Nexus control to force a burner lockout in the event of an inverter drive failure.



### Description of control method

During start up of the burner and before the drives move to purge, Nexus moves all motors to their minimum positions and outputs a current of 4mA to the inverter drive. The unit waits for the inverter stop time (set in Options and the minimum time between a stop and restart of the drive), and then monitors the feedback signals of all drives and compares them to the values which were stored in memory at commission time. If the values do not match the ones in memory, a positioning fault is given and the unit performs a safety shutdown.

If the test is successful, the unit moves all motors to their maximum positions and outputs a current of 20mA to the inverter drive. As the drives' feedback signals increase, the response time is measured for later use in the control algorithm during modulation. Once the drives' feedback signal has stopped changing, the unit again performs a comparison with the values that were stored in memory at commission time. If the values do not match those in memory, a positioning fault is given and the unit performs a safety shutdown.

These tests prove the control circuit to the inverter and help to guard against control parameters being changed on the inverter, which may affect the safety of the burner.

If the inverter is not performing correctly, start-up may be unreliable. If the burner start-up is successful, the unit will control the frequency of the inverter during modulation. A closed loop method is employed, where adjustments to the speed reference signal are made based on the value of the feedback signal.

If the feedback signal from the drive is lost during a run condition (i.e. the loop current drops below 3.5mA) Nexus will perform a safety shutdown.

### **Setting up the inverter for use with Nexus**

Nexus will work with most inverters which meet the following criteria:

- 4-20mA speed / frequency reference input
- 4-20mA speed / frequency feedback output
- Remote run/stop command
- Fault relay for internal (inverter) and external (motor) faults

### **Analogue inputs and outputs**

The analogue inputs and outputs (i.e. the 4-20mA reference and feedback signals) on the inverter should be configured in the following way:

- 4-20mA signal (this may be an option parameter and/or a board jumper)
- Speed reference input
- Speed reference output
- Minimum frequency 0Hz for 4mA signal
- Maximum reference frequency as required (nominally 50Hz) for 20mA signal
- Maximum feedback frequency same as reference for 20mA signal
- No filtering (time constant = 0.0) and no rate limiting

### **Digital inputs and outputs**

The digital inputs and outputs (i.e. the RUN/STOP and FAULT signals) on the inverter should be configured in the following way:

- RUN/STOP from external input (NOT inverter keyboard)
- RUN/STOP active high (i.e. energize to start)
- FAULT relay set for internal inverter fault or motor over temperature/current
- FAULT relay energized during normal operation (i.e. loss of power breaks circuit)

### **Control characteristics**

- The control characteristics of the inverter should be configured in the following way:
- Acceleration and deceleration time approximately 25 - 40 seconds, must be the same
- Straight line (linear) acceleration between reference points
- Motor to coast to a stop when RUN signal is removed
- No critical frequencies
- DC braking may be needed if motor deceleration is not linear

### **Motor characteristics**

The characteristics of the motor connected to the inverter should be entered into the inverter's option parameter list as follows:

- Motor nominal voltage, power, current and frequency (see motor plate)
- Motor current and temperature limits
- U/F ratio. Use the "SQUARED" option for fans and pumps.
- Motor slip ratio

### Setting up Nexus for use with an inverter drive

In order to use an inverter drive with a 4-20mA interface, an NX-280HW expansion interface must be installed and the NX-280VSD software installed into the Nexus controller. Various additional options will be added to standard Nexus configurations by using the software. A full list of option numbers and their functions will be issued with the software. The following steps must then be taken:

- Enter option set mode.
- Enter commission mode. Look at the display for the drive mapped to the inverter output (e.g. air damper 2). The display should show 0 for a feedback signal of 4mA and 999 for a feedback signal of 20mA. If the display is flashing "LO", the feedback signal is less than 3.5mA or the polarity of the wiring is reversed. If the display is flashing "HI", the feedback signal is more than 21.0mA or the polarity of the wiring is reversed. In both these cases, check the wiring and/or the option parameters on the inverter.
- Monitor the reference signal from the NX-280HW. With the inverter drive selected, the UP key should increase the current gradually up to 20mA and the DOWN key should decrease the current gradually down to 4mA.
- For the rest of the commissioning procedure, treat the inverter drive in the same way as a motor. The inverter drive has a closed position (4mA), a purge position (20mA), an ignition position and up to 20 profile positions.

## FAULTS AND FAULT FINDING

### The Fault Display

The unit carries out a number of internal and external checks during operation. If a fault is found, a fault number is used to identify the type of problem. A list of fault numbers may be found later in this chapter.

Depending on the type of fault, the unit may perform a non-volatile lockout of the burner and activate the alarm relay.

### Fault Description

Many of the faults detected and displayed by the unit will cause a non-volatile lockout of the burner. Other faults will be displayed as a warning but operation of the burner will not be affected.

Each fault number is prefixed on the full function display by a letter. This letter describes the status of the fault:

- F** - This means that a fault has occurred and is still present.  
The fault may be internal or external to the unit.
- C** - This means that a fault did occur but has now cleared.
- L** - This means a limit has occurred and is still present.

For example:

**F60** - Means fault 60 has occurred and still exists.

**L43** - Means limit 43 has occurred and still exists.

**C73** - Means fault or alarm limit 73 has occurred but has subsequently been rectified.  
This is known as a cleared fault.

### What to do when a fault occurs

To cancel the alarm relay, briefly press the **FAULT MUTE** key on the display, with no display connected a separate **FAULT MUTE** 'switch' will be available.

Use the right quadrant key to view the **FAULT NUMBER** and look up the fault number(s) shown to discover why the fault occurred.

If faults or limits are present and either the alarm or limit relay is closed, press the **FAULT MUTE** key to mute the alarm (open the relay).

If the faults, which cause a non-volatile lockout, are still present when the alarm is muted, the alarm will operate again when the alarm clears to indicate to the operator that the unit may be restarted.

Once all faults have cleared hold down the **FAULT MUTE** key for approximately three seconds to remove the faults and re-start the burner.

The function of the **FAULT MUTE** key may also be achieved using the **FAULT MUTE** input.

### Non-volatile lockout

If power is removed from the unit while a fault is still present, the fault will be stored in non-volatile memory. When power is restored to the unit, the fault number will still be present and it will be necessary to remove the fault before restarting the burner.

### Fault subsets

As an aid to fault finding, most faults also have a fault subset which gives additional information about the type of fault or what the burner was doing when the fault occurred, these are only available using the full function display or via ComFire windows communication software. Where applicable, the subsets are given in the fault listing in chart.



## Full Fault listing – (covers all Nexus and Nexus expanded function faults)

● = LED ON    ○ = LED OFF

NO	DISPLAY	NAME	DESCRIPTION
	A B C D E F G		
F1	●○○○○○○○	Fuel 1 motor incorrect position	A drive positioning fault has occurred, which will cause a safety shutdown of the burner. This fault has occurred for one of the following reasons:
F2	○●○○○○○○○	Fuel 2 motor incorrect position	1. During close position prove, when a drive stops at a position which is outside the close set position by more than five degrees.
F3	●●○○○○○○○	Air damper 1 incorrect position	2. During purge position prove, when a drive stops at a position which is outside the purge set position by more than five degrees.
F4	○○●○○○○○○○	Air damper 2 incorrect position	3. During pre-purge, ignition or post-purge, when a drive moves from its set-point.  4. During modulation, when a drive is not at its correct setpoint as defined by the commissioned fuel/air ratio for the selected profile. A drive is defined as having moved from its setpoint if its positional error is more than 1° for 15s, or more than 5° for 1s. For positional errors between 1° and 5°, the detection time is variable between 15s and 1s.  Note: Only the selected fuel motor and the air damper motor are checked. The other fuel motor is ignored.  Subset: burner status
F5	●○●○○○○○○○	Fuel 1 motor illegal speed	1. Before the pre-purge starts, all required drives are moved from their lowest positions (closed setpoints) to their highest positions (purge setpoints).
F6	○●●○○○○○○○	Fuel 2 motor illegal speed	2. During this time, a speed measurement is made for each drive.
F7	●●●○○○○○○○	Air damper 1 illegal speed	These faults will occur if a drive is outside the allowable speed range of 10s/90° to 60s/90°. Is the POT SUPPLY link set for the correct voltage?
F8	○○○●○○○○○○○	Air damper 2 illegal speed	Subset: measured speed (s/90°).
F9	●○○●○○○○○○○	Flame not detected	The flame detector did not register the presence of a flame when it should be present.
F10	○●●●○○○○○○○	Flame detected	The flame detector registered the presence of a flame when it should not be present or when the shutter (if selected) was closed.  Subset: burner status
F11	●●○●○○○○○○○	SW1 air pressure not detected	The air pressure switch failed to register air pressure when it should be present, or both the “flow” and “no flow” inputs are at the same state.  Subset: burner status
F12	○○●●○○○○○○○	SW1 air pressure detected	The air pressure switch registered air pressure when it should not be present (Subset: 1), or the air pressure switch registered air pressure for more than 3 minutes after the burner was turned off (Subset: 2).
F13	●○●●○○○○○○○	SW2 air pressure not detected	The air pressure switch failed to register air pressure when it should be present, or both the “flow” and “no flow” inputs are at the same state.  Subset: burner status
F14	○●●●○○○○○○○	SW2 air pressure detected	The air pressure switch registered air pressure when it should not be present (subset: 1), or the air pressure switch registered air pressure for more than 3 minutes after the burner was turned off (Subset: 2).



NO	DISPLAY	NAME	DESCRIPTION
	A B C D E F G		
F15	●●●●○○○	Valve proving fault	The measured gas pressure was not correct during the gas valve proving test. <i>(Subset: value prove status)</i>
F16	○○○○●○○	Gas pressure limit	The measured gas pressure is outside the operating limits (subset: valve prove status), or the gas pressure sensor is not responding correctly <i>Subset: 10.</i> See option parameter 2.0 for details on changing the operating limits.
F17	●○○○○●○○	Forced lockout	A high level on an auxiliary input has forced a lockout.
F18	○●○○○●○○	Not enough setpoints entered	A fuel/air ratio profile has been selected which does not have at least four setpoints commissioned. Use commission ratio mode to enter more setpoints. <i>Subset: fuel code</i>
F19	●●○○○●○○	CPU board voltage reference	The CPU board has an incorrect on-board reference level. <i>Subset: measured reference, where 512 = 2.5V</i>
F20	○○●○○●○○	Potentiometer supply incorrect	The unit has detected that the supply voltage to the potentiometers is too high or too low. Is the potentiometer supply voltage selection link installed? Are the potentiometers wired correctly? <i>Subset: expected potentiometer voltage (5/15)</i>
F21	●○●○○●○○	Burner input	The burner inputs (FUEL 1 SEL, FUEL 2 SEL, FAULT MUTE, AUX 1 to AUX 5, FLOW or NO FLOW [for either airflow sensor]) are not responding correctly. <i>Subset: faulty input (1-512)</i>
F22	○●●○○●○○	Forced lockout gas firing	A forced lockout has occurred due to the removal of the high level on auxiliary input configured to provide this function, when the unit is firing on gas.
F23	●●●○○●○○	Forced lockout oil firing	A forced lockout has occurred due to the removal of the high level on auxiliary input configured to provide this function, when the unit is firing on oil.
F24	○○○●●○○	Forced lockout gas during modulation	A forced lockout has occurred due to the removal of the high level on auxiliary input configured to provide this function, when the unit is modulating on gas.
F25	●○○○●●○○	Shutdown relay	The safety shutdown relay is not responding correctly. <i>Subset: required state (0 - off, 1 - on)</i>
F26	○●○○●●○○	Gas valve 1 relay	The main gas valve 1 relay is not responding correctly. <i>Subset: required state (0 - off, 1 - on)</i>
F27	●●○○●●○○	Gas valve 2 relay	The main gas valve 2 relay is not responding correctly. <i>Subset: required state (0 - off, 1 - on)</i>
F28	○○●●●○○	Pilot valve relay	The pilot valve relay is not responding correctly. <i>Subset: required state (0 - off, 1 - on)</i>
F29	●○●●●○○	Vent valve relay	The vent valve relay is not responding correctly. <i>Subset: required state (0 - off, 1 - on)</i>
F30	○●●●●○○	Ignition transformer relay	The ignition transformer relay is not responding correctly. <i>Subset: required state (0 - off, 1 - on)</i>
F31	●●●●●○○	Oil valve relay	The oil valve relay is not responding correctly. <i>Subset: required state (0 - off, 1 - on)</i>
F32	○○○○○●○	Auxiliary relay	The auxiliary relay is not responding correctly. <i>Subset: required state (0 - off, 1 - on)</i>



NO	DISPLAY	NAME	DESCRIPTION
	A B C D E F G		
F33	●○○○○●○	Gas Proof of Closure	The gas (main 2) valve proof of closure signal is not responding correctly.
F34	○●○○○○●○	Oil Proof of Closure	The oil valve proof of closure signal is not responding correctly.
F35	●●○○○○●○	Calibration	The calibration data could not be read. The unit will not perform a safety shut-down but instead will use default calibration values. This means that potentiometer and sensor inputs may be inaccurate. <i>Subset: +1 - zero data, +2 - checksum incorrect</i>
F36	○○●○○●○	Commissioning data checksum	The commissioning data memory on the CPU board has been corrupted. • Erase all option parameters and fuel/air ratio setpoints. • Contact supplier. <i>Subset: page number</i>
F37	●○●○○●○	RAM test	The main memory on the CPU board has malfunctioned. • Interrupt power to the unit.
F38	○●●○○●○	Program memory checksum	The program memory on the CPU board has been corrupted. • Interrupt power to the unit.
F39	●●●○○●○	Microprocessor clock	The timing reference on the CPU board is incorrect. • Is option parameter 1.1 set for the correct frequency? • Is the on-site frequency incorrect? • Use a filtered uninterruptable power supply if the voltage supply is excessively noisy. <i>Subset: expected frequency (50/60Hz)</i>
F40	○○○●○○●	Single fuel only allowed	An attempt has been made to select a gas profile when an oil profile has been already commissioned, or vice versa. • Choose a different profile selection. • Erase the existing profile <i>Subset: selected fuel code</i>
F41	●○○●○○●	Boiler safety limit exceeded	The boiler's measured value has exceeded the pressure/temperature safety limit, or the Fireye pressure/temperature sensor is not responding correctly. <i>Subset: 1 - sensor feedback &lt; 1V, 2 - sensor feedback &gt; 5V, 3 - sensor failed during test, 4 - safety limit exceeded</i>
L42	○●○○●○○	Forced shutdown from digital input	The burner has been forced into a shutdown situation from the digital inputs, (operates alarm relay 2). This could be used to indicate low water level. <i>Subset: auxiliary input number</i>
L43	●●○○●○○	Forced limit alarm from digital input	The burner has been forced into a limit alarm situation from the digital inputs, (operates alarm relay 2). This could be used to indicate high water level. <i>Subset: auxiliary input number</i>
F44	○○●●○○●	Auxiliary digital input fault	A digital input is faulty. Look for a short between two inputs.
F46		Spare	
F47		Spare	
F48		Spare	
F49		Spare	
F50	○●○○○○●	Oxygen probe heater fault	The probe heater has not heated to the correct temperature within 15 minutes of system power up. • Is the probe heater wiring correct? • Is the probe cell thermocouple wiring correct? <i>Subset: O2 probe status</i>
F51	●●○○○○●	Probe calibration fault	The probe calibration data is invalid. • Enter the calibration data supplied with the probe. • Calibrate the probe using air and reference gas.



NO	DISPLAY							NAME	DESCRIPTION
	A	B	C	D	E	F	G		
L52	○	○	●	○	●	●	○	Oxygen low limit alarm	The oxygen level measured value is below the oxygen setpoint low alarm value for the current profile.
L53	●	○	●	○	●	●	○	Oxygen high limit alarm	The oxygen level measured value has exceeded the oxygen setpoint high alarm value for the current profile.
L55	●	●	●	○	●	●	○	Trim limit alarm	The trim drive has reached the allowed maximum deviation limit.
F56	○	○	○	●	●	●	○	Oxygen probe purge check	The measured value from the oxygen probe was less than 18.0% at the end of pre-purge. Trim is disabled. <i>Subset: Oxygen level x 10</i>
F57	●	○	○	●	●	●	○	Auto trim commissioning fault	The measured oxygen level exceeded 15.0% during auto trim commissioning. The burner is shutdown. <i>Subset: Last auto trim commission setpoint</i>
L58	○	●	○	●	●	●	○	Flue temperature low alarm value exceeded	The measured flue temperature is below the low alarm value for the current profile, or the flue thermocouple is faulty.
L59	●	●	○	●	●	●	○	Flue temperature high alarm value exceeded	The measured flue temperature has exceeded the high alarm value for the current profile.
L/ F60	○	○	●	●	●	●	○	Remove unit fault	The communication from the remote unit is faulty. <ul style="list-style-type: none"> <li>• Check wiring between units</li> <li>• Check supply to remote unit</li> <li>• Check fuse in remote unit</li> <li>• Check IC11 (CU 221616) is correct with all pins inserted into the socket</li> </ul> <i>Subset: 1 = ESP not responding, &gt;1 = contact supplier</i>
F61	●	○	●	●	●	●	○	Var. speed incorrect position	A drive positioning fault has occurred, which will cause a non-volatile lockout of the burner. This fault has occurred for one of the following reasons: <ul style="list-style-type: none"> <li>• During close position prove, when a drive stops at a position which is outside the close set position by more than five degrees.</li> </ul>
F62	○	●	●	●	●	●	○	Aux. damper position fault	<ul style="list-style-type: none"> <li>• During purge position prove, when a drive stops at a position which is outside the purge set position by more than five degrees.</li> <li>• During pre-purge, ignition or post-purge, when a drive moves from its setpoint.</li> <li>• During modulation, when a drive is not at its correct setpoint as defined by the commissioned fuel/air ratio for the selected profile.</li> <li>• Reference error on expansion unit or communications error (L60) between units.</li> </ul> <p>A drive is defined as having moved from its setpoint if its positional error is more than 1° for 15s, or more than 5° for 1s. For positional errors between 1° and 5°, the detection time is variable between 15s and 1s.</p> <p>Inverter error tolerance during modulation is defined by option parameter 14.6. Frequent positioning faults are usually caused by one of the following problems:</p> <ul style="list-style-type: none"> <li>• Worn, dirty or unsuitable (e.g. wire-wound) potentiometers used for servomotors feedback.</li> <li>• Unsuitable lead drive selection - two adjacent profile points having a small change in lead drive position and a large change by a non-lead drive.</li> </ul> <p>Note: Only the selected fuel motor and the aux damper motor are checked. The other fuel motor is ignored.</p> <i>Subset: Burner status</i>
F63	●	●	●	●	●	●	○	Var. speed drive illegal speed	The specified drive is outside the allowable speed range of 10s/90° to 60s/90°. If the drive is an inverted, adjust the acceleration and deceleration times accordingly. Before the pre-purge starts, all required drives are moved from their lowest positions (closed set points) to their highest positions (purge setpoints).

NO	DISPLAY							NAME	DESCRIPTION
	A	B	C	D	E	F	G		
F64	○	○	○	○	○	○	●	Aux. damper drive illegal speed	<p>During this time, a speed measurement is made for each drive. These faults will occur if a drive is outside the allowable speed range of 10s/90° to 60s/90°.</p> <ul style="list-style-type: none"> <li>• Is the POT SUPPLY link set for the correct voltage.</li> <li>• Is the wiring correct?</li> <li>• Has the triac output failed?</li> </ul> <p><i>Subset: measured speed (s/90°).</i></p>
F65	●	○	○	○	○	○	●	Inverter generated fault	Fault generated from auxiliary input on expansion unit (PL4), no non-volatile lockout.
F66	○	●	○	○	○	○	●	Drive selection fault	Selected profile requires drive which is not available, check option parameters 1.3, 14.x and expansion unit passcodes 0.7 & 0.8.
L67	●	●	○	○	○	○	●	Aux 1 Limit	The 4-20mA auxiliary input signal is above the limit set by the corresponding option parameter. Its value is displayed on EK 87.
L68	○	○	●	○	○	○	●	Aux 2 Limit	The 4-20mA auxiliary input signal is above the limit set by the corresponding option parameter. Its value is displayed on EK 88.
L69	●	○	●	○	○	○	●	Aux 3 Limit	The 4-20mA auxiliary input signal is above the limit set by the corresponding option parameter. Its value is displayed on EK 89.
L70	○	●	●	○	○	○	●	Aux 4 Limit	The 4-20mA auxiliary input signal is above the limit set by the corresponding option parameter. Its value is displayed on EK 90.
F76	○	○	●	●	○	○	●	Secondary flame sensor input fault	The flame sensor input is not responding correctly. If the fault persists for 23 hours, the burner will be shutdown.
F77	●	○	●	●	○	○	●	Secondary non-volatile lock-out relay fault	A secondary fault has occurred with the main 1, main 2, pilot, vent or non-volatile lock-out relays. If the fault persists for 23 hours, the burner will shutdown. <i>Subset: +1 - non-volatile lockout, =2 - main1, =4 - main2, =8 -pilot, =16 -vent.</i>
F78	○	○	●	●	○	○	●	Secondary program memory checksum fault	A fault has occurred with the program memory on the CPU board. If the fault persists for 23 hours, the burner will shutdown. • Contact supplier.
F79	●	●	●	●	○	○	●	Secondary watchdog fault	A fault has occurred with the CPU watchdog. If the fault persists for 23 hours, the burner will shutdown. • Contact supplier.



## The Engineer's Key

The engineer's key is accessed via a hidden key on the display, it is located under the Fireye Logo. With the use of the engineer's key it is possible to read the values of internal system variables and external input and output states. It is also possible to see the values of fault subsets (refer to fault listings for details) in order to obtain more detailed information about a fault which has occurred. This provides an excellent diagnostic tool for the engineer to review operation of input devices, get more information on causes of failures as well as status checks on the controller.

When using the engineer's key it is not possible to change any parameters. Therefore, it is not possible to affect the operation of the burner.

Press the key once to review subset, again to see EK numbers and again to revert back to normal display. Note, after 30 seconds of non-use the display will automatically revert back to normal display.

### After pressing the Engineer's Key twice:

- The display will show the EK number and status or value.
- Use the UP/DOWN keys to scroll through or change the displayed EK number.
- Press the Fireye logo at any time or leave for 30 seconds to return to normal display model functions.

Engineers key full listing (applies for Nexus and Nexus with expanded functions)		
NO	NAME	DESCRIPTION
EK1	Digital Input 3 (oil select)	Shows the state of each input. Where: 0 = OFF 1 = ON
EK2	Digital Input 2 (gas select)	
EK3	Digital Input C	
EK4	Digital Input D	
EK5	Digital Input E	
EK6	Digital Input 1	
EK7	Digital Input A	
EK8	Digital Input B	
EK9	"Flow" input	
EK10	"No Flow" input	
EK11	Burner select input	
EK 12	Digital Input 4 (Primary "flow")	
EK 13	Digital Input 5 (Primary "flow")	
EK15	Track modulation input	0 - Not tracking PE21 input 1 - Tracking PE21 input
EK16	Warming limit	0 - Measured value above warming limit, burner free to modulate 1 - Measured value below warming limit, burner held at low fire if the unit is in auto or sequencing mode.
EK17	Setpoint 1/2	Indicates which setpoint the unit is currently operating from.
EK18	Boiler status	0 - Burner will not fire because the temperature/pressure measured value has exceeded the high control value. 1 - Burner will fire because the temperature/pressure measured value has fallen below the low control value.
EK19	Confirm to adjust	0 - Unit not in commission mode or unit is in commission mode and drives moving to setpoints. 1 - Unit in commission mode and drives may be adjusted using the UP/DOWN keys.



**Engineers key full listing (applies for Nexus and Nexus with expanded functions)**

NO	NAME	DESCRIPTION
EK20	Drive moved	0 - Unit not in commission mode or unit is in commission mode and drives have not been moved using the UP/DOWN keys. 1 - Unit in commission mode and drives have been moved using the UP/DOWN keys.
EK21	Positions proved	0 - Drives have stopped moving, ready for position prove test. 1 - Ready for position prove test but drives still moving.
EK22	Fault alarm	0 - Fault alarm relay off. 1 - Fault alarm relay on.
EK23	Serial communications status	+1 - Toggles on message received +2 - Serial communications passcode correct, or in commission ratio mode +4 - Boiler sequencing passcode correct
EK24	Boiler sequencing status	0 - Boiler sequencing inactive 1 - Boiler held off via sequence control 2 - Boiler in standby via sequence control. 3 - Boiler modulating via sequence control. 4 - Boiler is lead via sequence control
EK25	Burner status	Status of the start-up sequence. Refer to Nexus bulletin NEX-1001 for details.
EK26	Valve prove status	Status of the valve proving sequence. Refer to Nexus bulletin NEX-1001 for details.
EK27	Selected profile	0 - No profile selected. 1 - Gas profile 1. 2 - Oil profile 1. 3 - Gas profile 2. 4 - Oil profile 2.
EK28	Setpoints entered	The number of fuel/air setpoints entered for the current profile, where: 0 - No setpoints entered. 1 - Close setpoint only. 2 - Close and purge setpoints. 3 - Close, purge and ignition. 4 - Close, purge, ignition and low fire. 5 thru 24 -etc.
EK29	Commission status	Current commissioning mode, where: 0 - Normal run mode. 1 - Adjust ratio mode. 2 - Commission ratio mode.
EK30	Commission profile	The expected commission ratio profile, where: 1 - Gas profile 1. 2 - Oil profile 1. 3 - Gas profile 2. 4 - Oil profile 2.
EK31	Commission setpoint	The current commission ratio setpoints: 0 - Closed setpoint. 1 - Purge setpoint. 2 - Ignition setpoint. 3 - Low fire setpoint. 4 thru 24 - profile setpoints
EK32	Number of commission setpoints	The number of setpoints entered in the current commission ratio session: 0 - No setpoints entered. 1 - Close setpoint only. 2 - Close and purge setpoints. 3 - Close, purge and ignition. 4 thru 24 - profile setpoints.



Engineers key full listing (applies for Nexus and Nexus with expanded functions)		
NO	NAME	DESCRIPTION
EK33	Modulation mode	The current modulation mode: 0 - Auto mode. 1 - Manual from external limit. 2 - Manual from keyboard. 3 - Boiler sequencing control. 4 - Low fire hold.
EK35	Shutdown profile setpoint	When the unit performs a safety shutdown, this shows the number of the profile setpoint nearest to the last modulation position.
EK36	Flame sensor signal value	Signal value received from the flame sensor input. Value based on Signal Maximum 35 Threshold 5
EK37	Measured gas pressure (mBar)	Measured pressure from gas pressure sensor (sensor must be enabled and gas must be selected).
EK38	Valve close time $t_{test}$ (s)	Time for which each half of the valve prove test will be conducted (refer to Nexus bulletin NEX-1001 for details). This time counts down to zero during stages 2 and 4 of the valve prove test.
EK39	Gas pressure change ( $P_{test}$ )	Maximum pressure drop/rise allowed during the valve prove test (refer to Nexus bulletin NEX-1001 for details).
EK40	Modulation rate	Current percentage modulation rate (based on lead drive position), where: 0 - Low fire (or burner off) 100 - High fire.
EK 41	Nearest setpoint	The number of the profile setpoint which is nearest to the current lead drive position.
EK42	Drives at setpoint	Represents which drives are currently at their setpoints, where: 0 - All drives are at their setpoints and not moving. NON-ZERO - One or more drives are not at their setpoints.
EK43	Potentiometer supply voltage (V)	The measured potentiometer supply voltage.
EK44	Voltage reference error (V)	The error between the measured voltage reference and the calibrated value.
EK45	Gas motor setpoint (°)	Setpoint for each motor, in angular degrees
EK46	Oil motor setpoint (°)	
EK47	Air damper 1 motor setpoint (°)	
EK48	Air damper 2 motor setpoint (°)	
EK49	Gas motor error (°)	
EK50	Oil motor error (°)	
EK51	Air damper 1 motor error (°)	
EK52	Air damper 2 motor error (°)	
EK53	Gas motor response speed (s/90°)	The measured time taken (in secs.) for each motor to move over 90°.
EK54	Oil motor response speed (s/90°)	
EK55	Air damper response sp. (s/90°)	
EK56	Air damper 2 response sp. (s/90°)	
EK60	Manufacture day	Date of manufacture/test of CPU board.
EK61	Manufacture month	
EK62	Manufacture year	
EK63	Software issue	Currently installed software issue.
EK64	CPU board hardware issue	
EK65	CPU board serial no. (low 3 digits)	The 6-digit CPU board serial number.
EK66	CPU board serial no. (high 3 digits)	This serial number is required to obtain the boiler sequencing and/or serial data communications passcodes.



**Engineers key full listing (applies for Nexus and Nexus with expanded functions)**

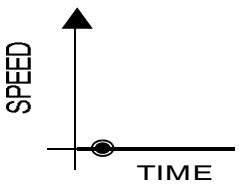
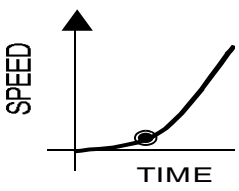
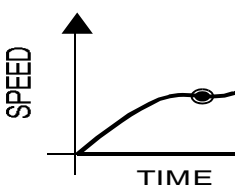
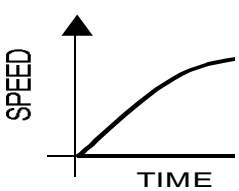
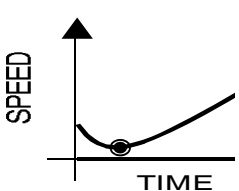
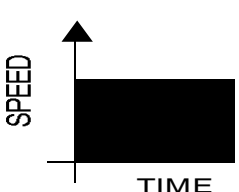
NO	NAME	DESCRIPTION
EK67	Average modulation	
EK68	Adjust ratio counter	The number of times adjust ratio mode has been used.
EK69	Commission ratio counter	The number of times commission ratio has been used.
EK71	O2 probe heater power output * optional NX280HW expansion unit must be fitted	Power output to the probe heater (0-100%)
EK72	O2 probe status * optional NX280HW expansion unit must be fitted	+1 - Offset fault +2 - Gain fault +4 - Heater fault +8 - Cell mv too high +16 - Oxygen level <18% during pre-purge
EK73	O2 trim status * optional NX280HW expansion unit must be fitted	0 - O2 trim working, or +1 - no expansion unit fitted +2 - Option 20.0 not 1 or 2, or option 20.5 not 1, or option 20.8 not 0 or trim not selected via aux input or trim not selected via serial comms +4 - O2 setpoints or flow values incorrect +8 - Option 20.6 not 0 +16 - Not modulating +32 - In commission mode +64 - Probe faulty (see EK72) +128 - Passcode for trim incorrect
EK74	O2 trim operative * optional NX280HW expansion unit must be fitted	0 - O2 trim disabled or inoperative 1 - O2 trim enabled and operative
EK75	Oxygen probe cell temperature (°C) * optional NX280HW expansion unit must be fitted	Temperature of oxygen cell, nominal 650°C. F50 will be generated if outside the window 600°C (after 15 minutes of power on) to 700°C
EK76	Oxygen error (%)	Error between O2 measured value and O2 setpoint
EK77	Trim deviation (% flow)	Deviation in air flow imposed by trim (-25 to +25%)
EK78	Excess air (%)	Excess combustion air at the current firing position
EK79	Oxygen setpoint (%)	Current oxygen setpoint. This is only available if trim is enabled and working.
EK80	Instantaneous fuel flow	Calculated fuel flow for currently selected profile. This is only available on single fuel profiles which have all flow values entered.
EK81	Inverter setpoint	Inverter speed setpoint (0 – 999)
EK82	Auxiliary damper motor setpoint (°)	Setpoint, in angular degrees
EK83	Inverter error	Inverter speed error (0 – 999)
EK84	Auxiliary damper motor error (°)	How far motor is from its setpoint, in angular degrees
EK85	Inverter drive response speed	The measured time taken in seconds for the inverter to move from zero speed to 50/60Hz.
EK86	Auxiliary damper motor response speed (s/90°)	The measured time taken (in secs.) for drive to move over 90°.
EK87	Auxiliary analogue input 1	Auxiliary analogue input range as selected by option parameter 40.x.
EK88	Auxiliary analogue input 2	Auxiliary analogue input range as selected by option parameter 41.x.
EK89	Auxiliary analogue input 3	Auxiliary analogue input range as selected by option parameter 42.x.
EK90	Auxiliary analogue input 4	Auxiliary analogue input range as selected by option parameter 43.x.



## Troubleshooting

PROBLEM	POSSIBLE CAUSE	SUGGESTED ACTION
Oxygen display not available	No expansion unit connected. Probe calibration values not entered correctly. Probe installed incorrectly.	Check for correct interconnection. Re enter values (options 20.1,20.2) Check wiring.
No inlet temperature display	No expansion unit connected Option 26.0 has not been set.	Check for correct interconnection. Set to 1 or 2.
Inlet or flue temperature display flashes 'Hi'	Inlet air temperature sensor / O2 probe not installed and wired correctly.	Check wiring to connector PM & PQ.
No efficiency display or efficiency incorrect.	No oxygen display. No inlet temperature display. No calorific value for the current fuel been entered into 26.X? Have flow values been entered for the current fuel combination?	See 'No oxygen display' See 'No inlet temperature display' Enter the value for the fuel in use. Enter the flow values (See Fault Code Listing L59)
Oxygen display shows '---'	Burner off. Transport delay not expired. Probe not heated up yet.	Not a fault. Not a fault. Check EK85 - must be above 600°C to work.
Oxygen trim will not work	Trim is not operative.  Boiler just fired up. Probe calibration values not entered correctly. Probe not heated up yet. Probe installed incorrectly. Set to monitor only. Probe in calibration. Trim being reset. Trim limits set to 0.0% of flow. Trim integral gain set to zero. Commissioning data missing.	Use EK25 to decide if trim is operative. If trim is not operative, use EK53 to find out why. Check that option 20.0 =1 or 2. Wait for the boiler transport time (after ignition). Wait for modulation. Re enter values (options 20.1, 20.2) Check EK85 - must be above 600°C to work. Check wiring. Check option parameter 20.5 set to 1. Check option parameter 20.6 set to 0. Check option parameter 20.8 set to 0. Check option parameters 23.X. Check option parameters 24.X are non zero. Check oxygen and flow values been entered for all profile points in the firing range.

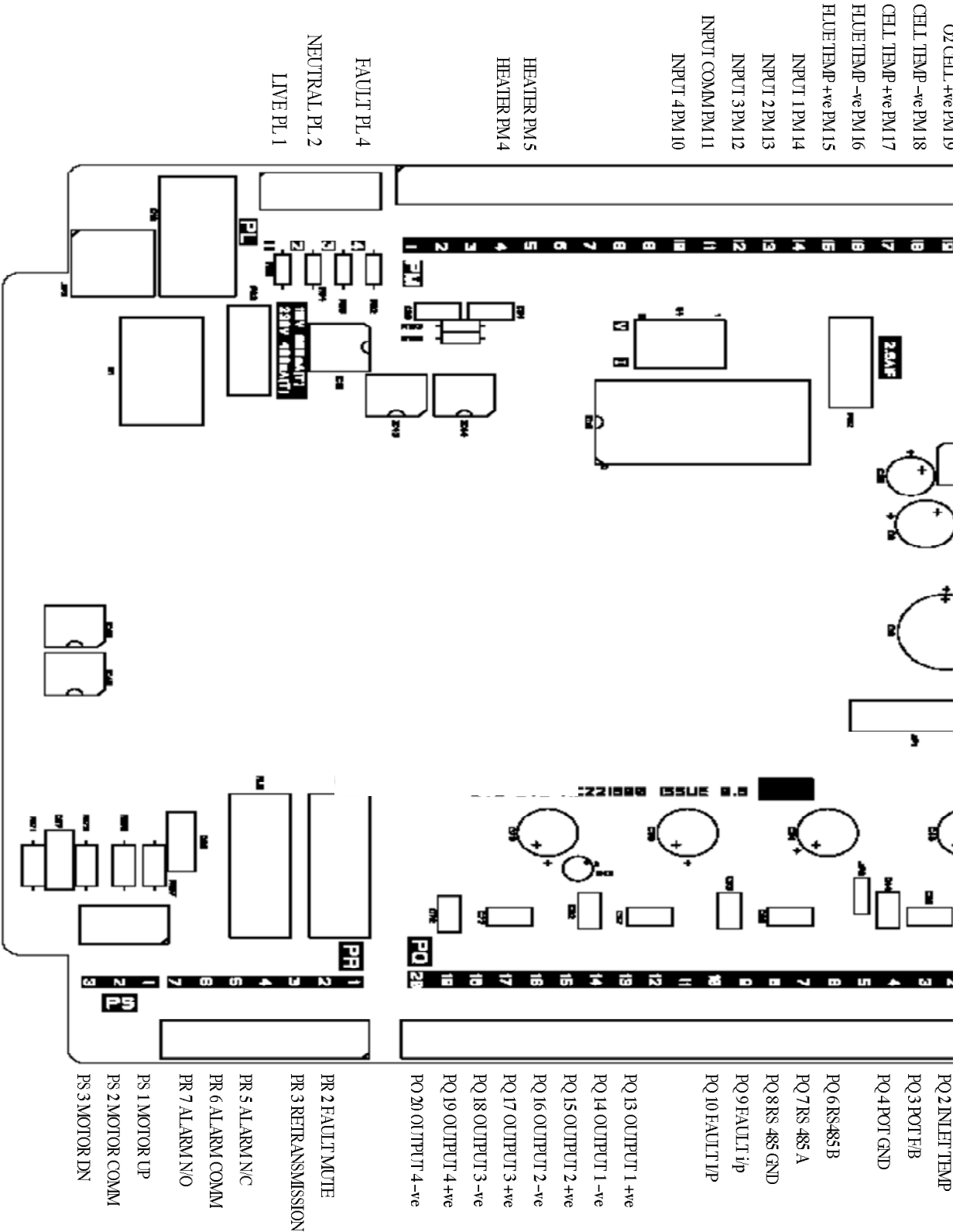
### Troubleshooting inverter problems

PROBLEM	POSSIBLE CAUSE	SUGGESTED ACTION
	<ul style="list-style-type: none"> <li>Inverter does not start because it does not receive a RUN signal.</li> </ul>	<ul style="list-style-type: none"> <li>Ensure that the inverter receives the RUN signal from the Nexus controller at the correct time.</li> </ul>
	<ul style="list-style-type: none"> <li>Inverter has a slow start.</li> <li>Late RUN signal.</li> <li>Non-linear output from inverter or inverter's PID is enabled</li> </ul>	<ul style="list-style-type: none"> <li>Ensure that the inverter's slow start feature is disabled.</li> <li>Ensure that the inverter receives the RUN signal from the Nexus controller at the correct time.</li> <li>Check that the inverter's output is selected to be linear, and that the inverter's own PID loop is <b>disabled</b>.</li> </ul>
	<ul style="list-style-type: none"> <li>Current limit reached</li> <li>Noise</li> </ul>	<ul style="list-style-type: none"> <li>Slow down the inverter by increasing its acceleration / deceleration time settings.</li> <li>Check cable screens.</li> </ul>
	<ul style="list-style-type: none"> <li>Current limit reached.</li> <li>Non-linear output from inverter or inverter's PID is enabled.</li> </ul>	<ul style="list-style-type: none"> <li>Slow down the inverter by increasing its acceleration / deceleration time settings.</li> <li>Check that the inverter's output is selected to be linear, and that the inverter's own PID loop is <b>disabled</b>.</li> </ul>
	<ul style="list-style-type: none"> <li>Fan failed to stop before restart.</li> </ul>	<ul style="list-style-type: none"> <li>Increase the inverter stop time by increasing option parameter 14.8 on the Nexus.</li> </ul>
	<ul style="list-style-type: none"> <li>Control is unstable</li> </ul>	<ul style="list-style-type: none"> <li>Adjust option parameters 14.5 &amp; 14.7 on the Nexus to reduce accuracy &amp; slow down control response.</li> </ul>

In extreme cases, it may be necessary to increase the inverter error tolerance to prevent safety shut-downs caused by positioning faults (set option 14.6 = 1). **This must only be done if an inverter error of  $\pm 55$  will not cause unsafe combustion.**



### Expansion Unit Layout





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**NOTES**



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**NOTES**



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## NOTICE

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

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