

Type2 Oxygen probe system for Nexus NX6100 and PPC6000





1. Introduction

This supplement is intended to be additional information to that contained in the standard Nexus Installation and Commissioning Bulletin. This document details the wiring configurations for the Type2 Oxygen probe system. The Type2 component system will replace the original system by March 31st, 2017.

The Type2 probe system employs a probe controller and trim interface, model NXO2TRIM, with probe models NX6083-1, NX6083-2 and NX6083-3.



CAUTION

- Unlike the NXO2INT, which is Line voltage supplied, the NXO2TRIM only requires CANbus power 24V. Connection of Line voltages to the NXO2TRIM will damage the product beyond repair.
- The interconnection system between the NXO2TRIM and the NXPk224455-56-57 probes is considerably different to the wiring system between the NXO2INT and the NXO2PK-x probe

Installation and Wiring.

1.1 Installation.

1.1.1 Oxygen probe.

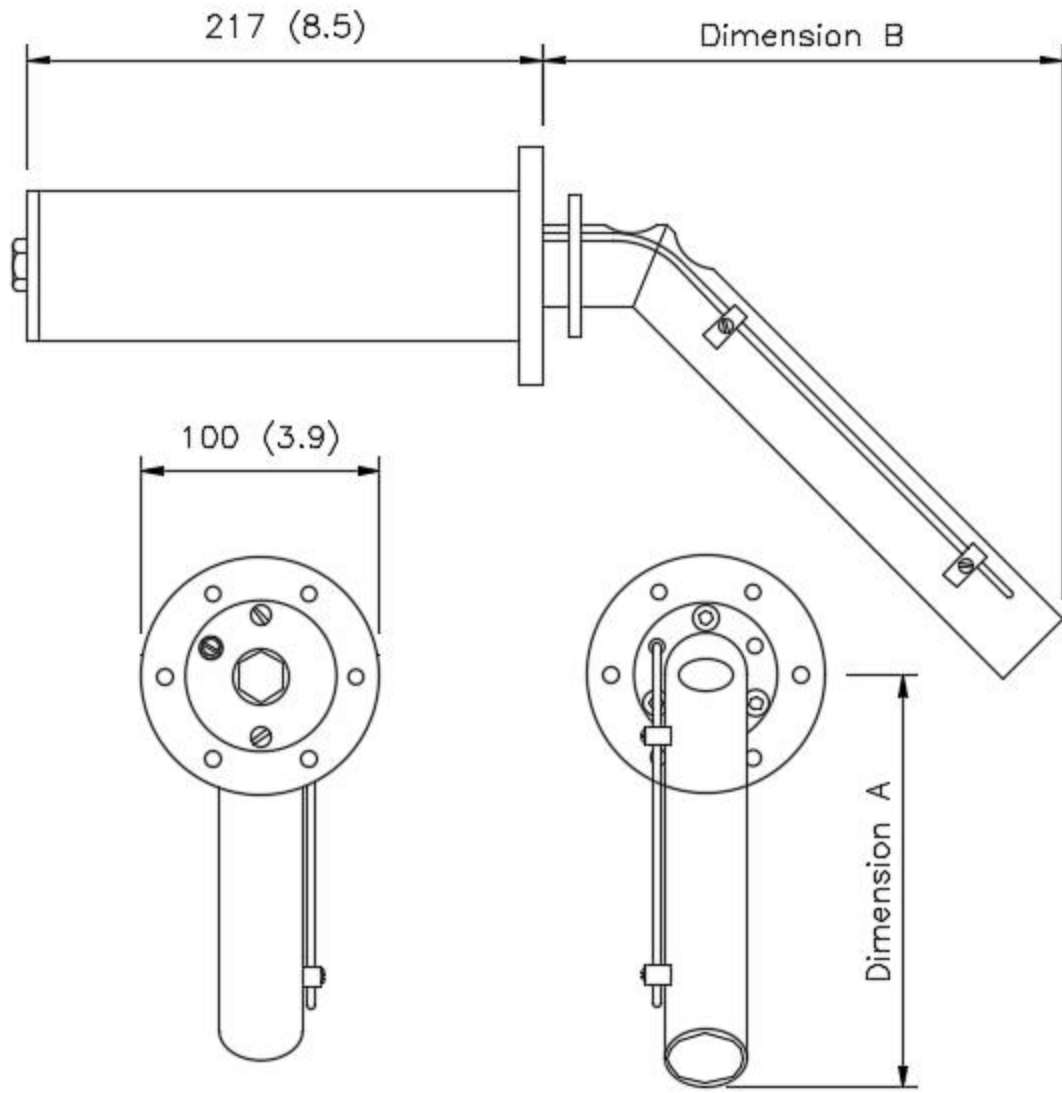
The NXPk224455-56-57 oxygen probe is available in the same sample tube lengths as the NXO2PK probes and is designed for use with the existing mounting flange system.

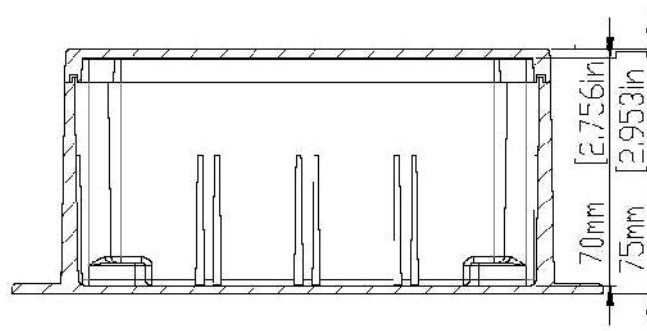
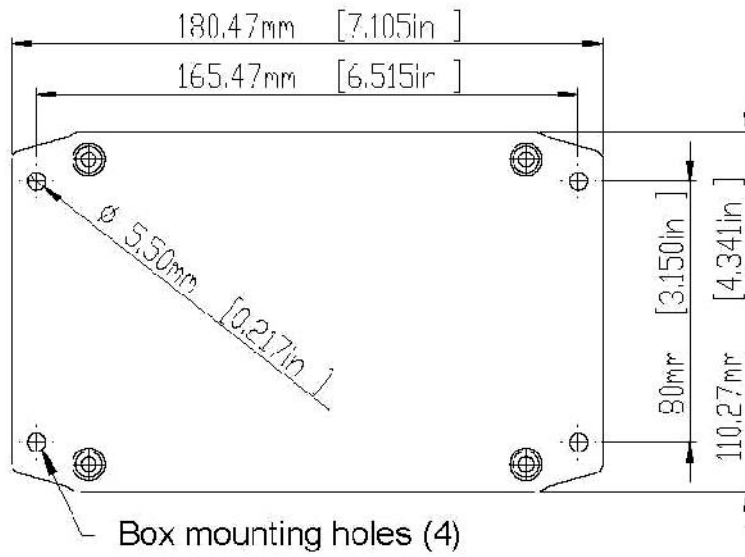
1.1.2 Oxygen probe interface.

The NXO2TRIM oxygen trim interface enclosure has different dimensions and mounting points, compared to the original design. The following drawing gives the dimensional information and the details required to fix the interface to a wall or panel surface.



Model No.	Dimension A	Dimension B	Weight
6083/1	173mm (6.8")	215mm (8.5")	2.4kg (5.3lb)
6083/2	362mm (14.3")	406mm (16.0")	2.9kg (6.4lb)
6083/3	716mm (28.2")	757mm (31.4")	3.6kg (7.9lb)





Tolerances : $\pm 0.3\text{mm}$ ($\pm 0.012\text{in}$)

1.2 Wiring



- Read this document in conjunction with the product bulletin NEX-6101 & PPC6000
- 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.
- Ensure the maximum total load on the CANbus cabling (servo-motors, display etc) is within the specifications for the cable being used.
- This equipment **MUST NOT** be directly connected to any part of a SELV circuit.

WIRING INSTALLATION MUST BE CARRIED OUT BY A COMPETENT ELECTRICIAN AND IS SUBJECT TO I.E.E. WIRING REGULATIONS (BS 7671:1992) AND/OR LOCAL STANDARDS, WHICH MAY PREVAIL.

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

The main controller **MUST** be mounted within a 'burner cabinet' or similar panel and **MUST** be earthed to the overall enclosure to ensure safe and reliable operation using the largest cross-sectional area green/yellow earth wire available. **Do not use a green/yellow conductor for any purpose other than earth.** The metal body of all other component parts **MUST** be connected to earth using a green/yellow conductor.

To comply with EMC requirements, the controller and any optional units must be wired using the specified cable sizes, and screen connections, observing any maximum cable length limitations. Cabinet designers **MUST** ensure that Line voltage and Extra Low Voltage (ELV) cables are segregated within the burner cabinet, distribution panels and conduits.

The manufacturer of this equipment recommends the use of bootlace ferrules on all wire ends, as a "best practice".

**Bootlace
Ferrules**



All cabling that is required to operate at above 50V must be multi-strand single core, PVC insulated, at least 0.5 mm² (20 AWG) and should meet the requirements of I.E.C. 227 or I.E.C. 225.



Secure all cables carried in conduit at both ends using a suitable anchorage method in the cabinet.

Connect all signal cable 'braid' screens to earth using the screen termination clamps provided on the controller. Connect all cable screens to earth at the controller only, unless stated otherwise in this section.

The equipment described in this manual has been tested for compliance to the CE directives listed in the section headed 'Approvals'. However, once connected to a burner and other associated control devices, it is the responsibility of the installer to ensure the complete installation meets the requirements of the CE or other local codes/directives relevant to the particular installation.

1.3 NXO2TRIM terminal designation and wiring requirements

1.3.1 Wire specification and interconnection.

The electrical connection between the Nexus series controller must be to the CANbus 4-core screen cable specification in the main product manual, NEX-6101 or PPC-6001. Connect the CAN cable 'braid' screen at the controller, using the screen termination clamps provided at the controller.

Terminate the 'braid' screen for all other connections in the NXO2TRIM enclosure at ring terminal point.

Incorrect connection or application of excess voltage will damage or destroy the devices being connected.

The electrical cable specification for connections between the NXO2TRIM and NX6083-X probe must be as follows:

Cable function	Specification
Cell heater and O ₂ measurement.	Max Voltage in use 14V d.c. <ul style="list-style-type: none">6-core cable with each core 16/0.2mm (20 AWG) and with overall braided screen. Cable covered in PVC sheath.Resistance per core 40 milliohms/metre.Maximum working voltage 440V rms.<u>Maximum length between the probe and controller is 10m (33ft).</u>
Flue gas temperature measurement.	Max Voltage in use 5V d.c. <ul style="list-style-type: none">Type 'K' compensating cable.2-core PVC insulated cable with 7/0.2mm (24awg) conductors, covered in overall PVC sheath.

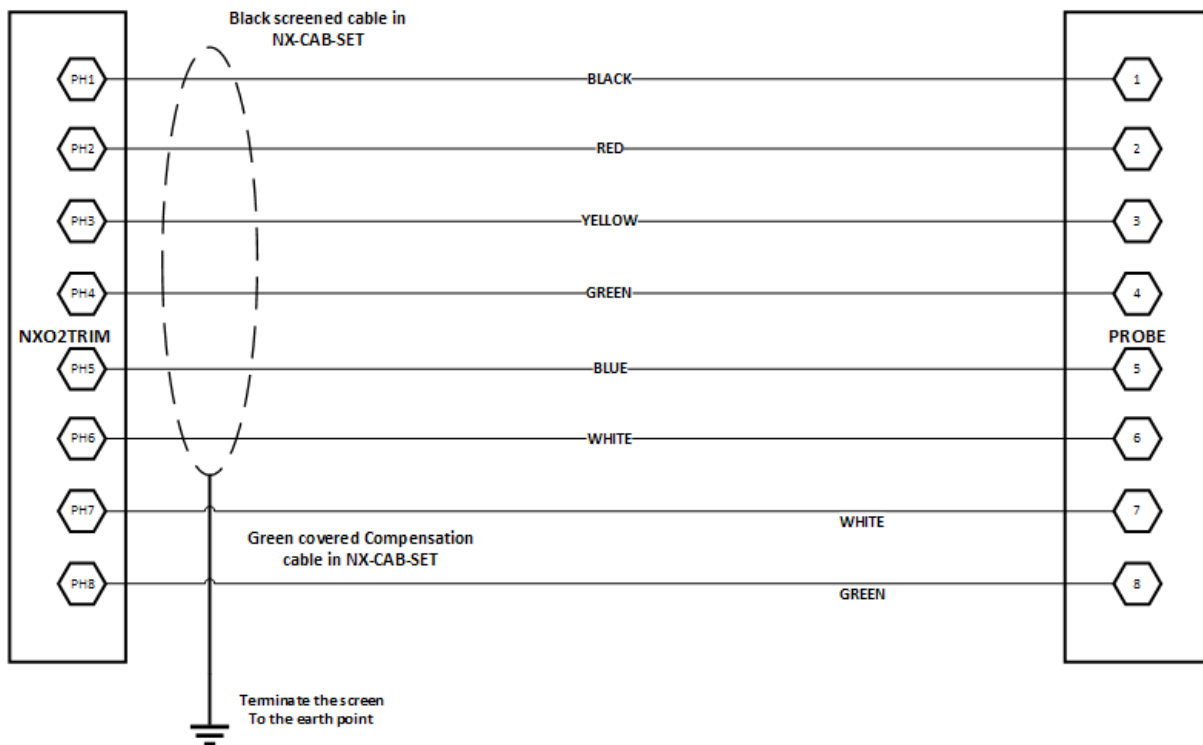
1.3.2 Terminal connections and layout.

Terminal No.	Module	Function	Voltage Rating
PG1	O2 Trim Interface	CAN 24Vac Supply	24 – 32Vac
PG2	O2 Trim Interface	CAN 24Vac Supply	24 – 32Vac
PG3	O2 Trim Interface	CAN + (High)	0-5V
PG4	O2 Trim Interface	CAN – (Low)	0-5V
PG5	O2 Trim Interface	GND (4-20mA Input 0V)	0V
PG6	O2 Trim Interface	4-20mA Input 1 (CO Signal +)	0-5V
PG7	O2 Trim Interface	4-20mA Input 2 (O2 Signal +)	0-5V
PG8	O2 Trim Interface	4-20mA Input 3 (N/A)	0-5V
PG9	O2 Trim Interface	GND (4-20mA Input 0V)	0V
PH1	O2 Trim Interface	Probe 1 (Black)	0-14V
PH2	O2 Trim Interface	Probe 2 (Red)	0-14V
PH3	O2 Trim Interface	Probe 3 (Yellow)	0-14V
PH4	O2 Trim Interface	Probe 4 (Green)	0-14V
PH5	O2 Trim Interface	Probe 5 (Blue)	0-14V
PH6	O2 Trim Interface	Probe 6 (White)	0-14V
PH7	O2 Trim Interface	Flue gas thermocouple White	0-5V
PH8	O2 Trim Interface	Flue gas thermocouple Green	0-5V

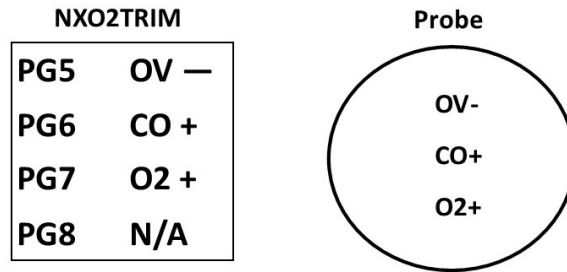
The connection scheme between the NXO2TRIM and NX6083-X is by direct connection, terminal1 to 1, 2 to 2 and so on up to terminal 8. See the reference to PH above.

NXO2TRIM to NX6083-x Oxygen Probe

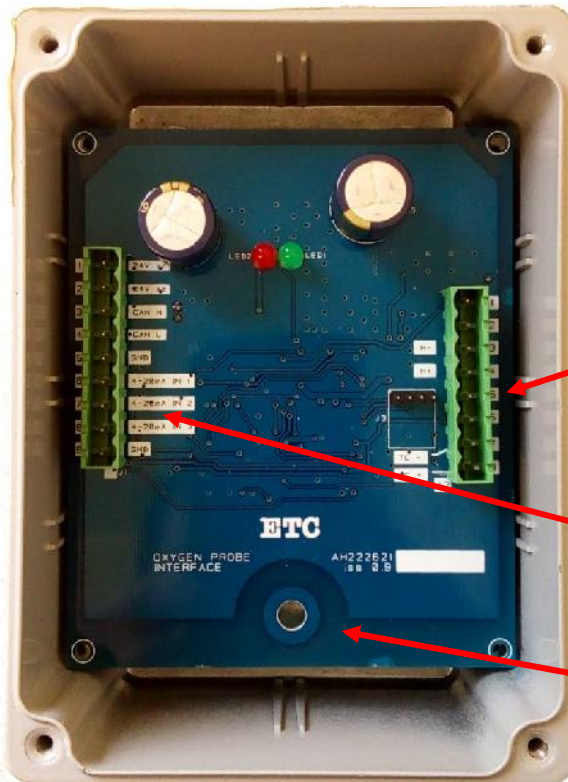
No screen connection at the probe.
Trim the screen back to the outer insulation.



Third Party Probe Connections



Internal view of NXO2TRIM.



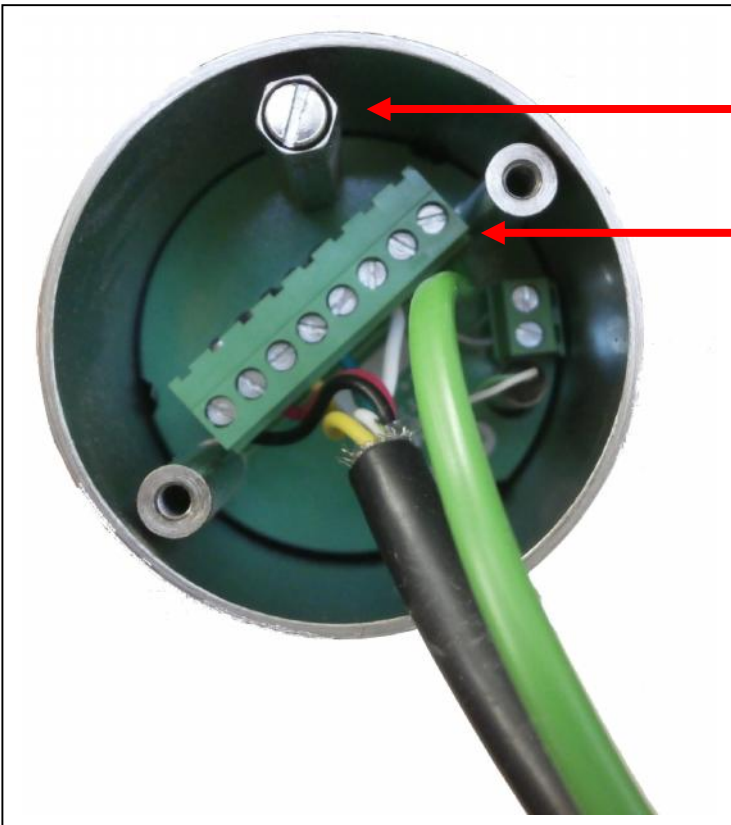
Probe connection terminals.
PH1 to PH8

CAN and 4-20mA connection
terminals PG1 to PG8

Ring terminal point for screen
termination.

Do not Connect 120Vac NXO2TRIM is 24Vac supplied

View of NXPk224455-56-57 oxygen probe terminals.



Calibration port.

Removable terminal block

NOTE: There is no screen termination point. The screen in the 6-way cable must be cut short to the PVC outer cover.



2. Commissioning and Calibration process.

There are no changes to the Commissioning and Calibration process when using the Type2 Oxygen probe system. A card with Calibration data will be provided with every new probe in a similar way to that for NXO2PK probe.

Refer to bulletin NEX-6101 or PPC6001 for all processes.

Commissioning Oxygen Trim



WARNING

- Use extreme care when entering flow values and oxygen set points. Incorrect setting of either could cause a hazardous situation to occur, and serious injury or death could result.
- If the flow values and oxygen set points have been up-loaded it is essential that the combustion is verified at each firing position.
- If using automatic oxygen trim commissioning it is the sole responsibility of the commissioning engineer to ensure the values calculated by the system are correct and will not cause a hazardous condition to occur.

In order for the oxygen trim system to function correctly, the following information must be entered:

1. Enter the appropriate option parameters from 30.0 to 42.6 as required.

With the burner off, enter commission mode (See section 5 of the PPC-6001 and NEX-6101 bulletins). To get the trim operational it is only necessary to address all option parameters

with the  symbol

Refer to options 30.0 thru 42.6 inclusive for details of parameters that may be entered.

2. Flow values and O2 set points. The flow and O2 values may be entered manually by the engineer (option 34.5), or the system can automatically calculate the values and enter them itself by using automatic trim commissioning (option 30.9).

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 depend highly upon measurements taken using the probe.

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

- ◆ No trim is applied which would require a drive to move above its high fire position or below its low fire position.
- ◆ The flow for each profile position must be entered to ensure correct operation. The flow can either be measured for each profile position or calculated as a percentage with respect to the flow at high fire.



Using adjust ratio mode to modify an existing oxygen profile manually, follow steps 1 -12 listed below.



CAUTION

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

To adjust an oxygen set point 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 (See section 5.6).
2. Ensure oxygen trim is set to monitor only 30.5 = 0.
3. Use the scroll keys to select the desired set point and move up and/or down (A4 for example). The system will modulate to the selected set point and the number displayed will flash to indicate that the drives are modulating.
4. Wait for the number in the display to be illuminated steadily. This means that the drives have arrived at the selected set point.
5. The display will allow scrolling sideways to show flow and 'O2' in addition to the servo-motor positions to indicate that the system is expecting a flow value and an oxygen set point to be entered for the current profile set point. **To check the current oxygen measured value use the engineer's key EK44.**
6. Once the oxygen value is shown on the display use the scroll keys to position the '>' pointing to the 'O2' value use the UP/DOWN keys to adjust the oxygen setpoint as necessary. The display will start flashing to indicate that a change has been made.
7. If the new oxygen set point value is wanted, press the ENTER key. The value will be stored in memory.
8. If the new oxygen set point value is not wanted or an adjustment is not required, press the **NEXT** key to return to the value stored in memory.
9. Once the flow value is shown on the display use the scroll keys to position the '>' pointing to the 'FLO' value use the UP/DOWN keys to adjust the flow value as necessary. The display will show the air flow value, represented as a percentage of the air flow when the drives are at the **HIGH FIRE** position. The display will start flashing to indicate that a change has been made.
10. 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.
11. If it is necessary to adjust another set point in the firing range, repeat the above procedure from step 3.



12. After modifying an existing O2 trim profile, use Option 30.8 to reset the feed forward function. See option 30.8 for details.

 **Option 30.0 – Oxygen probe interface serial number LV3**

Each CANbus device connected to the system has a unique serial number allocated to it during production testing. This number cannot be changed and is used to uniquely identify each device.

When the system is in commissioning mode the serial number of all the connected devices is read by the NX6100 and displayed as a 'list' to allow the selection of the relevant serial number unit to be made.

Scrolling the list in an upward direction will scroll through all oxygen probe interface options available until '0, nothing' is displayed. Enter this value to disconnect the specified device from any hardware.

Scrolling the list in a downward direction will stop when the currently selected item is displayed, and the value will stop flashing.

The display will show type information for each device present (such as 'O2 probe'), but the commissioning engineer should be aware of which serial number device is being used for which function.

 **Option 30.1 - Oxygen probe calibration offset value (0 – 999) LV3**

This option parameter is only available if option 30.0 is non-zero.

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

When using another manufacturer's O2 probe with a 4-20mA signal for O2 value, enter the O2 value for 4.0mA in this option parameter. Example 0% O2 = 000.

 **Option 30.2 - Oxygen probe calibration gain value (0 – 999) LV3**

This option parameter is only available if option 30.0 is non-zero.

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

When using another manufacturer's O2 probe with a 4-20mA signal for the O2 value, enter the O2 value for 20.0mA in this option parameter. Example 21% O2 = 210.

NOTE: If the value of 30.1 and 30.2 are both below 300, the NX6100 will utilize the analog input on the NXO2TRIM terminals PG6(+)/PG5(-) to determine the O2 signal.

Option 30.3 - Oxygen probe calibration gas concentration (0.00 – 9.99%) LV3

This option parameter is only available if option 30.0 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 30.6). The range of this parameter is 0.00 - 9.99%.



Option 30.4 – Flue and inlet sensor temperature units (0 – 1) LV3

This option parameter is only available if option 30.0 is non zero.

This option parameter must be set to select the units for display of both temperatures on either °C or °F.

Option parameter 30.4 value	Meaning
0	°C. The temperature value will be displayed in °C.
1	°F. The temperature value will be displayed in °F.

Please note that temperature limits MUST be set in the correct units.

If a 4-20mA input is used for O2 signal, a NXIATS is required to calculate efficiency in conjunction with a K type thermocouple measuring flue temperature, connected to the appropriate inputs in the NX02TRIM .



Option 30.5 - Oxygen input function (0/1) LV3

This option parameter can only be set above 1 if option 30.0 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:

Option parameter 30.5 value	Meaning
0	Monitor only. The oxygen value is only used to provide a display of the measured oxygen level.
1	Closed loop trim. The oxygen value is used to provide both a display of the measured oxygen level and a feedback signal for closed loop trim control function of the NX6100 series control.

Option 30.6 - Oxygen probe calibrate enable (0 – 2) LV3

This option parameter is only available if option 30.0 is non-zero.

This option parameter must be used when calibrating the oxygen probe.

There are three possible values:

Option parameter 30.6 value	Meaning
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 the level specified in option parameter 30.3 (typically 3.0%).

Once this calibration has been successfully completed the values in 30.1 and 30.2 will be automatically updated.



O 2

Option 30.7 - Boiler transport delay (5 – 60 seconds) LV3

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 set point 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. As soon as 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 30.9) will attempt to set this automatically. However the value must be checked by the engineer.

Option 30.8 - Reset oxygen trim profile (0/1) LV3

During full automatic operation, the O2 trim system will learn and store the percentage of trim applied to various firing rates. This provides a "feed forward" aspect to O2 trim. If any changes to target O2 values are made after the system has been in operation, the trim profile must be reset so as to not apply previous trim feed forward. A new trim profile will be learned as the burner modulates. Only the trim profile is affected. The Oxygen set points and flow values are not changed.

This option parameter allows the 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 30.9 – Automatic trim commissioning (0 / 1) LV3

The unit is able to automate the manual calculation procedures (option parameter 34.5), automatically calculating and entering flow values, oxygen trim set points, and boiler transport delay. The automatic commissioning procedure will only work if the following conditions are met:

- Option parameter 30.9 (automatic trim commissioning) is set to 1
- 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 35.1 — 35.4).

The auto commissioning procedure will usually take between 10 and 30 minutes (depending on number of set points), and is performed by the unit as follows:

1. Beginning with high fire, the unit moves the drives to each point in the firing range. **The display will show O2.**
2. When the measured oxygen reading settles, the unit stores the measured oxygen reading as the new oxygen set point.
3. The drives are moved to the next position directly below high fire (Ph-1) and wait for the oxygen to stabilize.



4. The unit moves the air drives up to the point above the current set point, leaving the fuel drive in the same position. **The display will show 'Flow calc An + 1'.**
5. When the new oxygen reading settles, the unit calculates and stores the new flow value. If the oxygen reading exceeds 15.0% during this stage, the unit shuts the burner down with F77.
6. When the unit has completed the low fire point, the measured boiler transport delay (at low fire) is stored in option parameter 30.7. Option parameter 30.5 (oxygen trim enable) is set to zero.
7. You must use "adjust ratio" mode to confirm each position from P3 (low fire) to Ph (high fire). If the flow values appear reasonable (about 4 to 6% change at each position) once you have finished, setting option 30.5 to 1 will enable O2 trim. There is a one-minute delay after exiting commissioning mode before trim will enable. If the flow values are unreasonable, they may be adjusted manually by placing the cursor to the "FLO" position and using the up/down arrows set the desired flow value. Using EK44 verify the O2 levels at each position and adjust to match if required. EK46 will help troubleshoot O2 trim issues.

BEFORE ENABLING TRIM, USE ADJUSTS RATIO MODE TO MANUALLY CHECK THE CALCULATED FLOW VALUES, OXYGEN SETPOINTS AND TRANSPORT DELAY. THE LOW FIRE PERCENTAGE FLOW VALUE SHOULD CONFORM APPROXIMATELY TO THE TURN-DOWN RATIO OF THE BURNER.

SUMMARY

To perform automatic trim commissioning, follow the procedure below:

1. If the probe is new, enter the offset and gain values in option parameters 30.1 and 30.2 which are supplied with the probe. To re-calibrate the probe refer to section 8.
2. Enter adjust ratio mode (See section 5).
3. Enable automatic trim commissioning by setting option parameter 30.9 to 1.
4. Wait for procedure to finish.
5. Check that the O₂, flow and transport delay values are sensible. Use EK44 for O2 value.
6. Check calibration of the oxygen probe.
7. Confirm setup using "adjust ratio" mode.

NOTE: If the boiler shuts off for any reason during automatic commissioning, the sequence will continue when the boiler re-starts.

Option parameter 30.9 value	Meaning
0	Not selected.
1	Perform automatic trim characterization. The control will attempt to characterize the burner profile by calculating flow values and selecting oxygen set points to match the currently commissioned points. Automatic trim commissioning will be performed under the following conditions: <ul style="list-style-type: none">• An oxygen probe is fitted and fully operational• The control is in adjust ratio mode.• A hydrocarbon ratio has been entered for the current fuel (see option parameters 35.1 – 35.4).



Option 31.0 - Limit Modulation Range (0 to 1) LV3

By default, the control modulates the burner between the set-points P_3 (low fire) and P_h (high fire), where P_h is the last set-point entered in commission ratio mode. If oxygen trim is fitted, it is not possible for any drive position to be trimmed lower than point P_3 (low fire) or higher than point P_h (high fire). Basically, you can't take fuel or air off at low fire, and you can't add fuel or air at high fire.

This option parameter allows the engineer to overcome this limitation in one of two ways. First the modulation range of the burner can be limited so that the burner may only modulate between points P_4 (one set-point above low fire) and P_{h-1} (one set-point below high fire). Since oxygen trim is not affected by this limitation, each drive may be trimmed between the points P_3 and P_h . This means that it is not possible to over-fire or under-fire the burner but a degree of trim may still be achieved at high and low fire. Note that this option may reduce the turn down of the boiler.

Another option, allows the control to adaptively adjust the modulation rate so that the required amount of trim can be applied. The turn down of the boiler will not normally be limited because the high and low fire positions of the trimmed drives will still be attained.

Option parameter 31.0 value	Meaning
0	Modulation not limited. Burner modulates from P_3 to P_h . Oxygen trim works over full range from P_3 to P_h , but may not be able to apply trim at high fire, or low fire – depending on trim direction. The burner always modulates to the desired modulation rate, which may limit the system's ability to maintain the desired oxygen value.
1	Normal modulation range limited to P_4 to P_{h-1} always. Oxygen trim works over full range from P_3 to P_h , and can apply extra trim at low and high fire – limited by P_3 and P_h . This setting is useful when there is extra capacity (usually air flow) available for the burner, but otherwise it will reduce the turn-down ratio of the boiler.

0 2 → Options 31.1 to 31.4 - Trim Type for profiles 1 to 4 (0 to 2) LV3

These option parameters determine which drive will be trimmed (Air or Fuel) in profiles 1 to 4. These parameters are used together with the parameters entered in option parameters 2.0 to 2.9 to determine which drives are trimmed, and in which direction.

Parameter	Meaning
31.1	Trim Type for profile 1
31.2	Trim Type for profile 2
31.3	Trim Type for profile 3
31.4	Trim Type for profile 4

Parameter value in 31.X	Meaning
0	No Trim. Do not apply oxygen trim when running on this profile.
1	Air Trim. Trim 'Air' drives when running on this profile (see option parameters 2.0 to 2.9.)
2	Fuel Trim. Trim 'Fuel' drives when running on this profile (see option parameters 2.0 to 2.9.)



O 2 → **Option 32.0 - Trim limit default (0/1) LV3**

0 = Default Trim Limit of $\pm 5\%$
1 = Enables options 32.1 to 32.4

O 2 → **Options 32.1 to 32.4 - Trim limits (0.0 – 25.0) LV3**

Option 32.0 is only available if option 30.5 (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 32.0 is set to 0, the default trim limit will be $\pm 5.0\%$ for all profile selections. Option parameters 32.1 to 32.4 will not be available.

If option 32.0 is set to 1, it is possible to individually adjust the trim limit for each profile selection using option parameters 32.1 to 32.4. 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 in the event of an oxygen probe failure. Where oxygen is to be considered safety critical, option parameters 31.X should be used to setup a second oxygen monitor. When a second oxygen monitoring system is used, the oxygen can be considered fail-safe, and the trim limits can be set up to 50% instead of 25%.

O 2 → **Options 33.1 to 33.4 - Trim integral gain (Default 10%) LV3**

Options 33.1 to 33.4 are only available if option 30.5 (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 33.1 to 33.4 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 10.0%. This value must be set above 0.0 for the system to apply trim.

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

Option 34.0 - Trim proportional gain (0/1) LV3

Options 34.1 to 34.4 - Trim proportional gain (0.0 – 99.9%) LV3

Options 34.0 to 34.4 are only available if option 30.5 (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 34.0 to **0**.

If oxygen trim proportional gain is required, set option parameter 34.0 to **1**. Option parameters 34.1 to 34.4 will then become available. Options 34.1 to 34.4 allow the loop gain to be set individually for each profile selection to any value between 0.0 and 99.9%.

Oxygen trim proportional gain is not normally required.



Option 34.5 - Calculating and entering the flow values manually LV3

If the flow values are to be calculated manually, the procedure below must be followed.

Enter Adjust Ratio Mode with oxygen trim **disabled** as outlined above.

1. Select the high fire position. This will cause the display to show A(n), where n is the number of the high fire profile point.
2. Wait until the oxygen reading has stabilized, the value can be viewed using the engineer's key.
3. Record the **excess air** value at location x in the table. For single fuel profiles, this value may be found using the Engineer's Key parameter EK48 (provided the hydrocarbon ratio has been entered into the appropriate option parameter (35.1 - 35.4) for this fuel). For multiple fuel profiles, **Refer to NOTE under section Options 35.1 to 35.4.**
4. Select the profile position immediately below high fire. This will cause the display to show A(n -1).
5. Wait until the oxygen reading has stabilized and record the **excess air** value at location a₁ in the table
6. Move air dampers 1 and 2 (if fitted) **up** until they stop, so that they are at the set point immediately above the current position. **Do not press enter.**
7. Wait until the oxygen reading has stabilized, then record the **excess air** value at location b₁ in the table, relating to the current profile position
8. Repeat the above for all other profile positions including low fire (profile position A3), recording each time the values at locations a and b in the table. When extra air is added at P3, the time taken before the flue oxygen reading starts to increase should be measured and entered into option parameter 30.7.
9. After completing the table for all Excess Air values a and b, complete the Excess Air + 100 column, by adding 100 (i.e. $y = x + 100$, $c = a + 100$ and $d = b + 100$).
10. Complete the Ratio column by dividing c by d (i.e. $e = c/d$).
11. Complete the Airflow column by multiplying e by the previous value of f (i.e. $f_x = e_x f_{x-1}$).
12. If the system will be applying trim to the fuel, the fuel flow column must be completed. This is achieved by multiplying the airflow at each point by the ratio of excess air + 100 at high fire divided by the excess air + 100 at the actual point (i.e. $g_x = f_x(y/c_x)$).

Example of table completed for A10 (high fire) to A8. In practice, the table must be filled out down to A3 (low fire).

Profile position	Excess Air		Ex. Air + 100 $y = x + 100$ $c = a + 100$ $d = b + 100$		Ratio	Airflow	Fuel flow
High fire = A10	x	10	y	110	-----	99.9%	99.9%
1 = A9	a ₁	8	c ₁	108	$e_1 = c_1/d_1$	$f_1 = e_1 (99.9)$	$g_1 = f_1 (y/c_1)$
	b ₁	33	d ₁	133	0.812	81.1%	82.6%



Profile position	Excess Air		Ex. Air + 100 $y = x + 100$ $c = a + 100$ $d = b + 100$		Ratio	Airflow	Fuel flow
2 = A8	a_2	9	c_2	109	$e_2 = c_2/d_2$	$f_2 = e_2 (f_1)$	$g_2 = f_2 (y/c_2)$
	b_2	20	d_2	120	0.908	73.7%	74.4%

Table: Flow calculation table

Profile position	Excess Air		Ex. Air + 100 $y = x + 100$ $c = a + 100$ $d = b + 100$		Ratio	Airflow	Fuel flow
High fire = A	x		y				
1 = A	a_1		c_1		$e_1 = c_1/d_1$	$f_1 = e_1 (99.9)$	$g_1 = f_1 (y/c_1)$
	b_1		d_1				
2 = A	a_2		c_2		$e_2 = c_2/d_2$	$f_2 = e_2 (f_1)$	$g_2 = f_2 (y/c_2)$
	b_2		d_2				
3 = A	a_3		c_3		$e_3 = c_3/d_3$	$f_3 = e_3 (f_2)$	$g_3 = f_3 (y/c_3)$
	b_3		d_3				
4 = A	a_4		c_4		$e_4 = c_4/d_4$	$f_4 = e_4 (f_3)$	$g_4 = f_4 (y/c_4)$
	b_4		d_4				
5 = A	a_5		c_5		$e_5 = c_5/d_5$	$f_5 = e_5 (f_4)$	$g_5 = f_5 (y/c_5)$
	b_5		d_5				
6 = A	a_6		c_6		$e_6 = c_6/d_6$	$f_6 = e_6 (f_5)$	$g_6 = f_6 (y/c_6)$
	b_6		d_6				
7 = A	a_7		c_7		$e_7 = c_7/d_7$	$f_7 = e_7 (f_6)$	$g_7 = f_7 (y/c_7)$
	b_7		d_7				
8 = A	a_8		c_8		$e_8 = c_8/d_8$	$f_8 = e_8 (f_7)$	$g_8 = f_8 (y/c_8)$
	b_8		d_8				
9 = A	a_9		c_9		$e_9 = c_9/d_9$	$f_9 = e_9 (f_8)$	$g_9 = f_9 (y/c_9)$
	b_9		d_9				
10 = A	a_{10}		c_{10}		$e_{10} = c_{10}/d_{10}$	$f_{10} = e_{10} (f_9)$	$g_{10} = f_{10} (y/c_{10})$
	b_{10}		d_{10}				
11 = A	a_{11}		c_{11}		$e_{11} = c_{11}/d_{11}$	$f_{11} = e_{11} (f_{10})$	$g_{11} = f_{11} (y/c_{11})$
	b_{11}		d_{11}				
12 = A	a_{12}		c_{12}		$e_{12} = c_{12}/d_{12}$	$f_{12} = e_{12} (f_{11})$	$g_{12} = f_{12} (y/c_{12})$
	b_{12}		d_{12}				
13 = A	a_{13}		c_{13}		$e_{13} = c_{13}/d_{13}$	$f_{13} = e_{13} (f_{12})$	$g_{13} = f_{13} (y/c_{13})$
	b_{13}		d_{13}				
14 = A	a_{14}		c_{14}		$e_{14} = c_{14}/d_{14}$	$f_{14} = e_{14} (f_{13})$	$g_{14} = f_{14} (y/c_{14})$
	b_{14}		d_{14}				



Profile position	Excess Air		Ex. Air + 100 $y = x + 100$ $c = a + 100$ $d = b + 100$		Ratio	Airflow	Fuel flow
15 = A	a ₁₅	b ₁₅	c ₁₅	d ₁₅	$e_{15} = c_{15}/d_{15}$	$f_{15} = e_{15} (f_{14})_{15}$	$g_{15} = f_{15} (y/c_{15})$
16 = A	a ₁₆	b ₁₆	c ₁₆	d ₁₆	$e_{16} = c_{16}/d_{16}$	$f_{16} = e_{16} (f_{15})$	$g_{16} = f_{16} (y/c_{16})$
17 = A	a ₁₇	b ₁₇	c ₁₇	d ₁₇	$e_{17} = c_{17}/d_{17}$	$f_{17} = e_{17} (f_{16})$	$g_{17} = f_{17} (y/c_{17})$
18 = A	a ₁₈	b ₁₈	c ₁₈	d ₁₈	$e_{18} = c_{18}/d_{18}$	$f_{18} = e_{18} (f_{17})$	$g_{18} = f_{18} (y/c_{18})$
19 = A	a ₁₉	b ₁₉	c ₁₉	d ₁₉	$e_{19} = c_{19}/d_{19}$	$f_{19} = e_{19} (f_{18})$	$g_{19} = f_{19} (y/c_{19})$
20 = A	a ₂₀	b ₂₀	c ₂₀	d ₂₀	$E_{20} = c_{20}/d_{20}$	$f_{20} = e_{20} (f_{19})$	$g_{20} = f_{20} (y/c_{20})$



Option 35.0 – Inlet temperature sensor serial number LV3

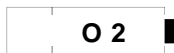
Each CANbus device connected to the system has a unique serial number allocated to it during production testing. This number cannot be changed and is used to uniquely identify each device.

When the system is in commissioning mode the serial number of all the connected devices is read by the NX6100 or PPC6000 and displayed as a 'list' to allow the selection of the relevant serial number unit to be made.

Scrolling the list in an upward direction will scroll through all temperature sensor options available until 'nothing' is displayed. Enter this value to disconnect the specified device from any hardware.

Scrolling the list in a downward direction will stop when the currently selected item is displayed, and the value will stop flashing.

The display will show type information for each device present (such as 'air temp'), but the commissioning engineer should be aware of which serial number device is being used for which function.



Options 35.1 to 35.4-Hydrocarbon ratios of each fuel respectively (0.00 – 9.99) LV3

If a display of calculated burner efficiency, or 'automatic trim commissioning' is required, the hydrocarbon ratios for the required fuels must be entered. These 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.

Note: When firing multiple fuels, the mixture between the fuels fired may vary across the firing range of the burner. When this happens, the effective hydrocarbon ratio and calorific value of the fuel combination



will change. The accuracy of the calculated efficiency and the 'automatic trim commissioning' procedure will be adversely affected by this. It maybe that these functions should not be used, in which case these values should be entered as zero.



Options 35.5 to 35.8-Calorific values of fuels/profiles 1 to 4 respectively (0.0 – 99.9) LV3

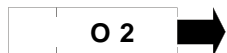
These option parameters are only available if option 35.0 (inlet temperature sensor) is not set to zero.

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⁻¹** inclusive.

Note: When firing multiple fuels, the mixture between the fuels fired may vary across the firing range of the burner. When this happens, the effective hydrocarbon ratio and calorific value of the fuel combination will change. The accuracy of the calculated efficiency and the 'automatic trim commissioning' procedure will be adversely affected by this. It maybe that these functions should not be used, in which case these values should be entered as zero.

The following table shows the calorific values and hydrocarbon ratios of several common fuels. These values should be used as a guide only. If the display is required to show gross efficiency in addition to entering the gross calorific values a non-zero value for the boiler radiated heat loss **MUST** be entered.

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 35.9 - Boiler radiated heat loss (0.0 – 9.9%) LV3

This option parameter is only available if option 35.0 (inlet temperature sensor) is not set to zero.

If this option parameter is set to zero the unit will calculate the net efficiency, if non-zero it will calculate gross efficiency.

For accurate calculation of boiler gross efficiency, this option parameter must be set to the value of 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 36.0 - Flue temperature alarm select (0/1) LV3

This option parameter is only available if option 30.0 is non zero.

If option 36.0 is set to **0**, the flue temperature high and low alarms are disabled.

If option 36.0 is set to **1**, the flue temperature high and low alarms are enabled and option parameters 36.1 to 36.4 and 37.1 to 37.4 become available.

Options 36.1 to 36.4 - Flue temperature low alarm values (0 – 999)

LV3



Using option parameters 36.1 to 36.4, 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 30.4.

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

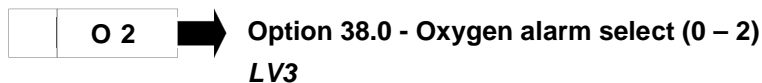
When the flue temperature drops below the low alarm value for the selected profile, a fault number will appear.

Options 37.1 to 37.4 - Flue temperature high alarm values (0 – 999) LV3

Using option parameters 37.1 to 37.4, 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 30.4.

If the burner is firing, it is only possible to make an adjustment to the option parameter that 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.





CAUTION

This parameter is not required, but highly recommended.

Option parameter 38.0 is only available when option 30.5 (oxygen input select) is not set to zero and the optional oxygen probe interface unit is connected.

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

Option parameter 38.0 value	Meaning
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 38.1 to 41.4 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 38.1 to 41.4 will become available. If an alarm value is exceeded, a fault number will appear and a non-volatile lockout will occur.



- | | | |
|----------------------------------|---|--|
| <input type="text" value="O 2"/> | ➔ | Options 38.1 to 38.4 - Oxygen low alarm values at low fire (0.0 – 99.9%) LV3 |
| <input type="text" value="O 2"/> | ➔ | Options 39.1 to 39.4 - Oxygen low alarm values at high fire (0.0 – 99.9%) LV3 |
| <input type="text" value="O 2"/> | ➔ | Options 40.1 to 40.4 - Oxygen high alarm values at low fire (0.0 – 99.9%) LV3 |
| <input type="text" value="O 2"/> | ➔ | Options 41.1 to 41.4 - Oxygen high alarm values at high fire (0.0 – 99.9%) LV3 |

Using option parameters 38.1 to 41.4, 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 set point at low fire and 10% of set point 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 set point in the firing range.

If the burner is firing, it is only possible to make an adjustment to the option parameters that 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% O₂ 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

When 2 probes are used the low alarm will also be caused by the following event:

- The difference between the oxygen values exceeds the value set in option parameter 42.4 for two (2) minutes.



3. Fault code and EK data.

There are no changes to the Oxygen probe system fault codes.

There is one change that will be observed in the EK data. The EK72 value, Oxygen Probe Cell Temperature, will be higher for the NXPk224455-56-57 oxygen probe. The normal value will be **820 °C.** (1,508°F)

Refer to bulletin NEX-6101 or PPC-6001 for all fault codes and EK descriptions.



4. Specifications and Approvals.

4.1 NXO2TRIM Oxygen Probe Interface

Supply voltage (CANbus)	26 Vac \pm 15%
Power consumption	Approximately 10 VA
Supply frequency	50/60 Hz \pm 5%
Ambient temperature range	0 to 60 °C
Protection category	IP65.
Unit dimensions	160 x 110 x 75 mm deep
Weight	(6.29 x 4.3 x 2.9 in deep) 0.6 kg
Interface to NX6100 or PPC-6000 series.	Fireeye specific CANbus.
Interface to oxygen probe.	Fireeye specific.
Oxygen sensor heater supply.	24 Vac nominal
Oxygen sensor temperature set point.	820 °C (1,508 °F)
Oxygen measurement accuracy	\pm 1% of value.
Auxiliary Inputs:	
Type	4– 20mA.
Input impedance	220 Ω
Pre-assignment	O ₂ , CO
Flue gas temperature input:	
Type	Type-K thermocouple.
Measurement range	0-540 °C (1000 °F)
Flue temperature accuracy	\pm 2 °C (35.6 °F)



4.2 NX6083-x Flue Gas Temperature and Oxygen probe

Ambient temperature range	0 to 70 °C (0 to 158 °F)
Protection category	IP20.
Maximum flue temperature	600 °C (1,112 °F)
Oxygen Measurement:	
Type	Zirconia oxide cell,
Range	1 – 21% Oxygen.
Response.	5s
Time constant.	Less than 15s for 63% change.
Flue Gas Temperature Measurement	Type K thermocouple
Calibration:	
Reference gas concentration	Ambient air at 20.9% O ₂
Recommended calibration gas concentration	3% O ₂ in Nitrogen
Reference and Calibration gas flow rate	350 cc/min
Filter and flame arrestor	4 – 7 micron sintered stainless steel.
Filter pressure drop	50 – 100 mm water gauge.
Filter replacement pressure	150 mm water gauge.
Unit Weight	2.5 – 4.5 kg (type dependent) 5.5 – 9.9 lb (type dependant)

4.3 Approvals

Europe: Tested in accordance with the **Gas Appliances Regulation (EU) 2018/426 (GAR)** including the following standards:

EN298-2012, **EN12067-2**

Australia: Approved for use by AGA.
Relevant Standards: EN298-2012, AS4625, AS 4630.

North America:
UL approved.



Functional Safety Certification: EN61508-2010. Suitable for inclusion in a S.I.L. 3 loop.

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.

WARRANTIES

FIREYE guarantees for *one year from the date of installation or 18 months from date of manufacture* of its products to replace, or, at its option, to repair any product or part thereof (except lamps and photocells) which is found defective in material or workmanship or which otherwise fails to conform to the description of the product on the face of its sales order. **THE FOREGOING IS IN LIEU OF ALL OTHER WARRANTIES AND FIREYE MAKES NO WARRANTY OF MERCHANTABILITY OR ANY OTHER WARRANTY, EXPRESS OR IMPLIED.** Except as specifically stated in these general terms and conditions of sale, remedies with respect to any product or part number manufactured or sold by Fireeye shall be limited exclusively to the right to replacement or repair as above provided. In no event shall Fireeye be liable for consequential or special damages of any nature that may arise in connection with such product or part.



FIREYE
3 Manchester Road
Derry, New Hampshire 03038 USA
www.Fireeye.com

NXP2244
July 24, 2019
Supersedes April 3, 2019