Novatech CONTROLS PTY. LTD.

Water Vapour Transmitter

Model 1735
Technical Manual

February 2022

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The product described in this manual and products for use with it are subject to continuous developments and improvement. All information of a technical nature and particulars of the product and its use (including the information in this manual) are given by Novatech in good faith. However, it is acknowledged that there may be errors or omissions in this manual. A list of details of any amendments or revisions to this manual can be obtained upon request from Novatech Controls Technical Enquiries. Novatech Controls welcome comments and suggestions relating to the product and this manual.

All correspondence should be addressed to: -

Technical Enquiries
Novatech Controls Pty Ltd
309 Reserve Road,
Cheltenham
Victoria 3192
Australia

Tel: +61 3 9585 2833
Fax: +61 3 9585 2844
Email: info@novatech.com.au
Website: https://www.novatech.com.au/

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Important Notice Regarding
1231 Probe Option - FIL-3

WARNING: The only identifiable standard for flame arresters for general use is British Standard BS EN 12874:2001. British Standard BS EN 12874:2001 refers to an operating environment up to 150 Degrees Centigrade.

The FIL-3 device optionally fitted to 1231 Heated Zirconia Probes (the “Probes" or "Probe") operate in an environment considerably greater than 150 Degrees Centigrade.

Therefore, we know of no Australian, British, European or USA standard applicable to flame arresters or their testing above 150 degrees Centigrade. Consequently, the FIL-3 device cannot be certified as a safety device.

The probe is only one of several potential sources of ignition. Extreme care is required when using the probes during the start-up processes of a combustion appliance.

The Novatech Burner Interlock Relay facility, which is a standard part of the Novatech transmitter, is designed to be wired to the main safety shut-off fuel valves in a way that can shut down the probe heater when the fuel valves are closed.

The risk of ignition of flammable gas mixture at the hot end of the Probe can only be minimised by correct use, maintenance and operation of the FIL-3 device. The user of the FIL-3 device is responsible for verification and maintenance and correct use and operation of the FIL-3 device.

THE USER AGREES THAT IT USES THE PROBE AND THE FIL-3 DEVICE AT ITS SOLE RISK. NOVATECH CONTROLS PTY LTD, TO THE FULL EXTENT PERMITTED BY LAW, GIVES NO WARRANTIES OR ASSURANCES AND EXCLUDES ALL LIABILITY (INCLUDING LIABILITY FOR NEGLIGENCE) IN RELATION TO THE PROBE AND THE FIL-3 DEVICE.

The user must ensure that it correctly follows all instructions in relation to the Probe and FIL-3 device, correctly understands the specifications of the Probe and FIL-3 device and ensures that the Probe and FIL-3 device are regularly inspected and maintained.

FIL-3 equipped Probes should be inspected at least once a year for corrosion and more frequently if there is any reason to suspect that corrosion may have occurred.

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1. Important Notices

This manual is a complete version of the 1735 Water Vapour Transmitter product manual. It is intended to be used by technical personal that are qualified to install, commission, service and calibrate electronic industrial control equipment. A separate Operators Manual is also supplied with the transmitter intended to be used as a reference for basic operation once the device is commissioned. Both manuals are supplied with each transmitter and are also available to download at the Novatech Controls website.

https://www.novatech.com.au/products/1735/

Please read the safety information below before connecting power to the transmitter.

1.1 Cautions

CAUTION 1

The probe heater is supplied with MAINS VOLTAGE. This supply has electrical shock danger to maintenance personnel. Always isolate the transmitter before working with the probe.
The EARTH wire (green) from a heated probe must ALWAYS be connected to earth.

CAUTION 2

Combustion or atmosphere control systems can be dangerous. Burners must be mechanically set up so that in the case of equipment failure, the system cannot generate explosive atmospheres. This danger is normally avoided with flue gas trim systems by adjustment so that in the case of failure the appliance will not generate CO in excess of 400ppm in the flue. The CO level in the flue should be measured with a separate CO instrument, normally an infrared or fuel cell type.

CAUTION 3

The oxygen probe is heated to over 700°C (1290°F) and is a source of ignition. Since raw fuel leaks can occur during burner shutdown, the transmitter has an interlocking relay that removes power from the probe heater when the main fuel shut-off valve power is off. If this configuration does not suit or if it is possible for raw fuel to come into contact with a hot oxygen probe then the Model 1735 transmitter with a heated probe will not be safe in your application.
An unheated probe can be utilised in such applications; however, the oxygen readings are valid only above 650°C (1200°F).

CAUTION 4

The reducing oxygen signal from the transmitter and the associated alarm relay can be used as an explosive warning or trip. This measurement assumes complete combustion. If incomplete combustion is possible then this signal will read less reducing and should not be used as an alarm or trip. A true excess combustibles analyser, normally incorporating a catalyst or thermal conductivity bridge, would be more appropriate where incomplete combustion is possible.
Also read the probe electrical shock caution in the probe heater interlock caution in chapter 4.8

CAUTION 5

FIL-3 filter. If the optional FIL-3 has been fitted to the 1231 probe in this installation, please read the Important Notice regarding probe option FIL-3 on the previous page

CAUTION 6

The heater is supplied from the mains power directly, and the temperature is controlled at 720°C (1330°F). The outside of the process end of the probe can get to temperatures that are dangerous to touch. Wear insulating gloves when handling a probe that has been on.

1.2 Warning Symbols

Danger, high voltage. Risk of electrical shock.

Caution hot surface.

Caution, risk of danger. See additional information in the manual.

1.3 Acid Dew Point

Acid dew point is the temperature at a given pressure, at which specific gaseous acid vapours suspended in a gas mixture will saturate and begin to condense and form liquid acid.

Flue gasses from the combustion of coal, natural gas, fossil fuels and other sulphur-bearing fuels are comprised primarily of carbon dioxide (CO_2), water vapour (H_2O), excess oxygen (O_2) and nitrogen (N_2). There are also trace amounts of other gasses including carbon monoxide (CO), nitrogen oxides (NO_X) and sulphur oxides (SO_2 & SO_3). Sulphur Trioxide (SO_3) combines with water vapour to form sulphuric acid (H_2SO_4)

$$SO_3 + H_2O = H_2SO_4$$

The acid dew point temperature depends on the levels of sulphur oxides present in the flue gas. It generally lies in the range 100-150°C

To maximise the efficiency of industrial combustion processes, economizers are used to recover heat from the hot flue gasses before they are emitted into the atmosphere. If the flue gas temperature drops below the acid dew point temperature then liquid acid will form inside of the ducts resulting in sulphuric acid corrosion, so-called low-temperature corrosion.

1.3.1 Predicting the Sulphuric Acid Dew Point Temperature

By knowing the composition of the flue gas, sulphuric acid dew point temperature can be predicted with reasonable accuracy using mathematical equations.

NOTE: The acid dew point calculations are only a prediction of acid dew point as there is no comprehensive method for calculation.

The key issues related to accurately predicting sulphuric acid dew point;

- The concentration of H_2SO_4 depends on the SO_3 conversion rate, that being the percentage of SO_2 that further reacts and oxidises to form SO_3. Since SO_3 concentration cannot be directly measured, this must be approximated, and it can vary from as low as 1% up to ~6% in different processes. An assumed conversion rate of 2% is considered a safe medium, however this value can be adjusted in the Commissioning Menu (see chapter 7.2.28 Acid Dew Point Calculation for Direct Fired Applications)
- Experimental acid dew point data for several flue gas compositions exist, but there are significant discrepancies in the data collected making evaluation of predictive models difficult to assess. New data and updated correlation models are made available periodically which may alter the currently accepted models in the future.

There are several widely published equations that can be used to predict acid dew point, the equation used in this transmitter to predict sulphuric acid dew point is given below;

$$1000/T = 2.276 - 0.02943\log_e(P_{\mathrm{H_2O}}) - 0.0858\log_e(P_{\mathrm{SO_3}}) + 0.0062\log_e(P_{\mathrm{H_2O}})\log_e(P_{\mathrm{SO_3}})$$

T - sulphuric acid dew point temperature in °C
$P_{\mathrm{H_2O}}$ - partial pressure water vapour in mmHG
$P_{\mathrm{SO_3}}$ - partial pressure sulphur trioxide in mmHG

The above formula for predicated acid dewpoint temperature is estimated to be within 9 degrees Celsius when compared to published measured data.

Reference: Verhoff F H, Banchero J T, Predicting dew points of flue gases, Chem. Eng. Prog. 70 (8), 1974, 71–72.

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The Novatech 1735 Water Vapour Transmitter is designed for measuring moisture in drying and baking applications, where the drying temperature is above the maximum limit of conventional relative humidity sensors (which are limited to 130-150°C) or a more robust sensor is preferred. The transmitter signal can be used with a conventional controller to improve the efficiency of industrial drying or baking applications, as well as to optimise the quality of the product being dried or baked.

2.1 Dryer Modes of Operation

There are several methods that the 1735 Water Vapour Transmitter can use to calculate water vapour:

Mode	Option in Commissioning Menu 4	1231 oxygen probe installed	Second probe installed	RGS temp sensor
1	Indirect Fired, Single Zone	Yes	No	No
2	Indirect Fired, Two Zones	Yes	**1231**	No
3	Direct Fired, Fixed Combustion	Yes	No	No
4	Direct Fired, Single Probe	Yes	No	**Yes**
5	Direct Fired, Refrigerated Gas	Yes	No	No
6	Direct Fired, Probe + RGS	Yes	**RGS-17**	**Yes**
7	Directly Fired, External Dry Oxygen	Yes	No	No
8	Directly Fired Two Zone, External Dry Oxygen	Yes	**1231**	No

1. Indirectly Heated Dryers and Ovens, Single Zone

The in-situ 1231 probe measures the oxygen content within the drying chamber and calculations are performed to determine how much of the air space is taken up by water vapour.

For indirectly heated dryers or ovens, an oxygen probe and transmitter are all that is required. The oxygen probe uses ambient air as a reference gas.

2. Indirectly Heated Dryers and Ovens, Two Zones

Two independent in-situ 1232 probes measure oxygen content at two points within the drying chamber to calculate water vapour for each zone.

The 1735 Transmitter can be configured to independently display and retransmit water vapour for each individual zone on separate channels for comparison or redundancy. Both oxygen probes use ambient air as a reference gas.

3. Directly Heated Dryers and Ovens with Constant Combustion

If the dryer or oven has a fixed combustion system (fixed firing rate), where the reduction of oxygen due to combustion is constant. In this application a reference gas sensor may not be necessary to condition reference gas from within the dryer.

The dryer or oven oxygen level can be assumed as a fixed value and entered into the transmitter during commissioning. The water vapour percentage is measured by gravimetric methods to calculate the correct initial setting.

NOTE: The next two methods for calculating water vapour utilize gas extracted from the dryer which is conditioned and used as the reference gas for the oxygen probe. While these two methods reduce the number of oxygen probes required to obtain a water vapour measurement in a direct fired application, the process of extracting gas requires sampling and conditioning equipment additional to the 1735 Transmitter.

It is not recommended that process gas be used as reference gas for the 1231 in-situ oxygen probe unless it has been cleaned of any process related residue, otherwise it may adversely affect the accuracy of readings and significantly reduce the operational life of the probe.

4. Directly Heated Dryers and Ovens, Single Probe Differential Measurement Using Extracted and Ambient Cooled Process Gas

Used in a system where a single in-situ oxygen probe is used to calculate water vapour by simultaneously extracting process gas from the dryer and cooling this to ambient temperature to produce a cool but saturated reference gas.

This cooled gas is used in place of ambient air as the oxygen probe reference gas allowing the probe to measure the difference in oxygen concentration between the wet process gas in the dryer and the cooled process gas. By measuring the process gas temperature, the water vapour percentage of the process can be calculated.

5. Directly Heated Dryers and Ovens, Single Probe Differential Measurement Using Extracted and Refrigerated Process Gas

Used in a system where a single in-situ oxygen probe is used to calculate water vapour by simultaneously extracting process gas from the dryer and actively refrigerating this to 0°C to produce a reference gas.

The same as the previous method this reference gas is used in place of ambient air as the oxygen probe reference gas to measure the difference in oxygen concentration between the wet process gas in the dryer and the cooled process gas. By cooling to a known temperature, a separate temperature sensor is not required, and by knowing the water vapour concentration in the reference gas it is possible to calculate the water vapour in the dryer.

6. Directly Heated Dryers and Ovens, Two Oxygen Sensors to Measure Wet and Dry Oxygen Concentration

The recommend method for measuring water vapour where dryers or ovens use direct fired combustion. Because the combustion oxygen can vary, two oxygen sensors are required to calculate water vapour.

In this mode the transmitter uses an in-situ 1231 oxygen probe to measure the wet gas oxygen level in the dryer and a second RGS-17 Reference Gas Sensor to read the dry gas. The dry measurement of oxygen in the dryer or oven is measured after removing most of the water vapour. A temperature sensor is used to measure the temperature of the gas as it enters the RGS-17 to compensate for the moisture remaining in the gas stream.

7. Directly Heated Dryers and Ovens Using an External Dry Oxygen Measurement by Means of a Scaled 4-20mA Signal

In this mode two oxygen sensors are still used to calculate water vapour similar to the previous method, however it may be preferred to use a separate technology or system to measure the dry oxygen content in the dryer or oven rather than the RGS-17 Reference Gas Sensor.

A 1231 in-situ oxygen probe is still used read the wet gas oxygen level in the dryer and a third-party oxygen sensor is used to read the dry gas, which is scaled 0-25% dry oxygen and fed into the transmitter as a 4-20mA signal.

8. Directly Heated Dryers and Ovens Using an External Dry Oxygen Measurement by Means of a Scaled 4-20ma Signal, Two Zones

This mode is identical to the above method, but extends the functionality to use a second 1231 in-situ oxygen probe for a second independent zone.

The dry oxygen reading, which is fed into the transmitter as a 4-20mA signal is used for both zones. Each zone can be independently displayed and retransmitted on separate channels for comparison or redundancy.

2.2 The 1735 Transmitter Hardware

The 1735 Water Vapour transmitter has been designed as a successive replacement for the model 1635 water vapour transmitter. It has been designed to replicate all the functions of the previous model, as well as introduce a number of major improvements in its speed, accuracy and user operation.

The device has been designed to meet standards regarding EMC emissions and immunity.

It is possible to use the 1735 Transmitter to measure the water vapour content in ovens, drying kilns and combustion appliances at temperatures up to 900°C (1650°F) and the measurement can be displayed as –

Water Vapour %
Dew Point
Mixing Ratio
Specific Humidity
Relative Humidity
Absolute Humidity

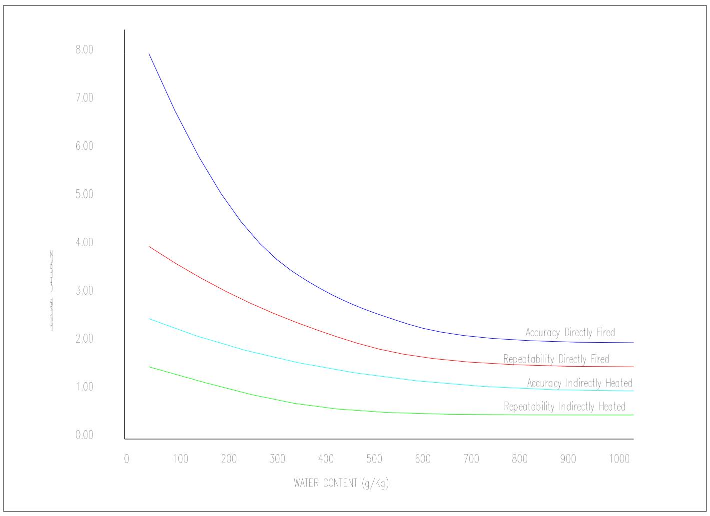
Features include: -

Inputs
Two zirconia oxygen probes, heated or unheated
Oxygen range from 10^{-30} to 100%
Dryer thermocouple, field selectable as type K or, J
Main flame established safety interlock (for heated probes only)
Purge pressure or flow switch

Outputs
Two linearized 4-20mA or 0-20mA DC isolated outputs, maximum load 1000Ω
The output function and the range are field selectable
Common alarm relay
Three other alarm relays with selectable functions

Digital Interface
RS-232 or two wire RS-485 MODBUS™ for connection to a computer/DCS/PLC for diagnostics of the transmitter, probe or combustion process.

Display
Multi font graphical display
Large font characters for the oxygen on the top line
Selectable lower line items for the secondary display functions. i.e. Dew point, Water vapour second probe
Alarm display mode that shows the time of the alarm, the acceptance time and the time that the alarm was cleared of up to 4000 alarm events



Accuracy & Repeatability of 1735 Water Vapour % Transmitter Readings

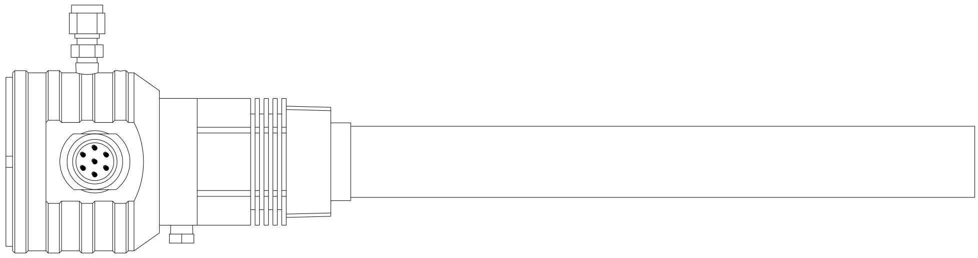
2.3 Series 1230 Oxygen Probes & Sensors

Novatech Controls Series 1230 Oxygen Probes and sensors employ state-of-the-art zirconia sensors and advanced materials, which provide the following benefits:

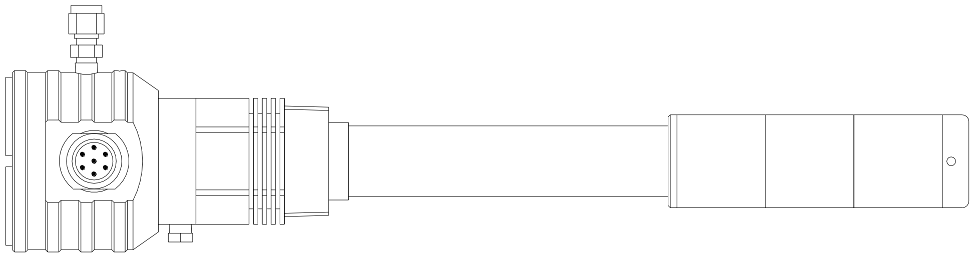
- Improved control due to fast response time to typically less than four seconds
- Cost-efficient design provides improved reliability
- Longer-life probes with greater resistance to corrosion from sulphur and zinc contaminants in flue gas
- Low cost allows maintenance by replacement
- Reduced probe breakage due to greater resistance to thermal shock and mechanical damage during installation and start-up

Series 1230 probe or sensors are simple to install and maintain. All models provide direct measurement of oxygen level. On-line automatic calibration check is available if required. Probes or sensors may be used with Novatech oxygen transmitters and some model transmitters from other manufacturers.

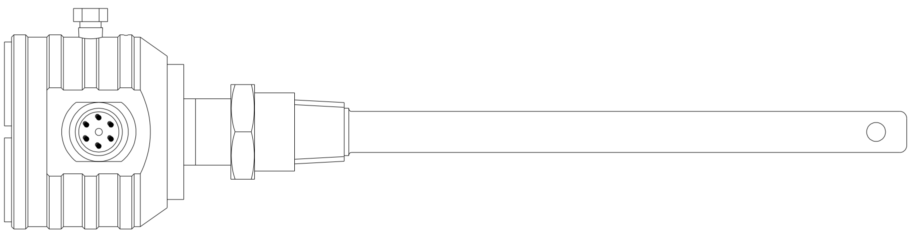
All Novatech oxygen probe or sensors are designed and manufactured to exacting standards of performance and reliability. Series 1230 probe or sensors are the result of extensive research and development by Novatech, industry and government agencies. Novatech Controls provides application and after sales support for oxygen probes, sensors and transmitters, worldwide.



Model 1231 Heated Oxygen Probe



Model 1231 Heated Oxygen Probe with Filter

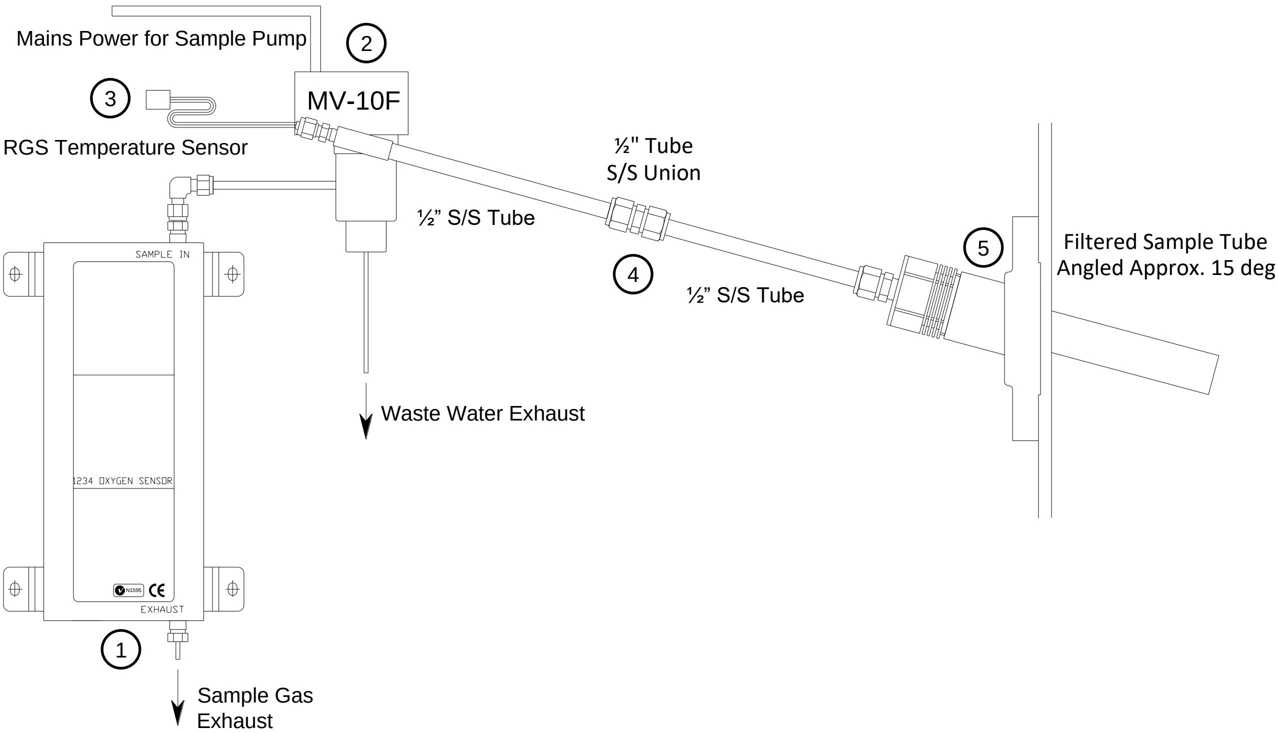


Model 1232 Unheated Oxygen Probe

2.4 The Reference Gas Sensor (RGS-17)

The RGS-17 Reference Gas Sensor is the name given to the system of components required to take a second reference oxygen sample used to calculate Water Vapour in direct fired applications with variable combustion. It consists of;

1. Model 1234 Oxygen Sensor
2. MV-10F mains voltage sample pump with attached moisture trap
3. RGS solid-state temperature sensor with termination block
4. Stainless steel condenser tube – supplied in two pieces with unions
5. Sample tube



RGS-17 Reference Gas Sensor

Not shown on the diagram above is the cable connecting the 1234 oxygen sensor and RGS temperature sensor to the 1735 transmitter.

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3.1 Hardware Specifications

3.1.1 Transmitter Specifications

Number of Oxygen Probes:	1 or 2
Water Vapour Range:	0 to 100%
Dew Point Range:	-50 to 100°C
Mixing Ratio Range:	0 to 10,000g/kg
Specific Humidity Range:	0 to 1,000g/kg
Relative Humidity Range:	0.0 to 100%
Absolute Humidity	0 to 1000g/m^3
Oxygen Range:	1 x 10^{-30} to 100%
Oxygen Accuracy:	±1% of actual measured oxygen value with a repeatability of ±0.5% of the measured value
Thermocouple Types:	Type K and J
Temperature Accuracy:	±2°C
Analog Outputs:	0-20mA or 4-20mA field selectable Active Outputs

(WARNING: DO NOT LOOP POWER OUTPUTS. Use only passive receivers for commissioning and testing. The use of loop powered receivers will damage the output)

Output Load:	1000 ohm max
Alarm Relays:	4
Alarm Relay Contacts:	2A 240VAC, 2A 30VDC Reinforced insulation when used with mains voltage

(WARNING: Do not use both mains voltage and low voltage connections to adjacent alarm contacts)

Mains Voltage Supply:	100 to 240VAC 50/60 Hz Reinforced insulation
Overvoltage:	Category II (IEC60364-4-443)
Power:	5 Watts for controller plus probe power 530W max., 25% duty cycle each probe on 240VAC 110W max., 100% duty cycle each probe on 110VAC 576W (2.4A) max
Environmental Rating:	Operating Temperature -25°C to 55°C Relative Humidity 5% to 95% (non-condensing)
Altitude	2000m Maximum
Degree of Protection:	IP65 IP54 with internal reference air pump
Case Size:	315mm (12.4") wide, 190mm (7.5") high, 110mm (4.3") deep
Case Weight:	3 Kg (6.6 lbs.)

WARNING: All signal level connections onto the transmitter must be treated as safety extra-low voltage (SELV) as defined in the standard IEC61140. Double insulation must be used when connecting these terminals to systems that might carry high voltage.

3.1.2 Series 1230 Probes Specifications

MODEL	1231 Heated Probe	1232 Unheated Probe
Application	In-situ probe Process gasses below 900°C (1650°F) Refer to note 1	In-situ probe Process gasses above 700°C (1290°F)
Temperature Range	0 to 900°C. Refer to note 2 (32 to 1650°F)	Stainless Steel: 700°C to 1000°C (1290°F to 1830°F) Alumina Ceramic: 700°C to 1400°C (1290°F to 2550°F)
Length	Standard Lengths: 250 mm (10") 350 mm (14") 500 mm (20") 750 mm (30") 1000 mm (40") 1500 mm (60")	Standard Lengths: 500 mm (20") 750 mm (30") 1000 mm (40")
Outer Sheath Material	316 Grade Stainless Steel standard (Inconel with all Inconel wetted parts optional)	253MA Grade Stainless Steel standard (Alumina Ceramic optional)
Process Connection	1½" BSPT or NPT	¾" BSPT or NPT
Electrical Connection	Weatherproof plug-in connector or optional screw terminals. The plug connector can be supplied with the cable.	
Cable	Order a specific length with the transmitter	
Filter	Removable sintered titanium alloy particulate filter 30-micron standard, optional 15-micron available. Refer to note 2	Not Available
Heater	Yes	No
Thermocouple	K, integral	None or R, integral as standard (K, integral by special request).
Response Time	Typically < 4 seconds	Typically < 1 second
Head Temperature	-25 to 100°C (-15 to 210°F) with weatherproof connector -25 to 150°C (-15 to 300°F) with screw terminals	
Reference Gas	Ambient air, 50 to 150 cc/min (3 to 9 scim). Pump can be supplied with the transmitter	
Ref Air Connection	¼" tube	Integral air-line in probe cable. Barbed fitting to 3/16" ID PVC tube
Calibration Check Gas Connection	⅛" NPT female	⅛" NPT female
Weight	2 kg (4.4 lb) plus 165 g (5.8 oz) / 100mm (4") length	1 kg (2.2 lb) plus 100g (3.5oz) / 100mm (4") length

Notes:

1. Care must be taken to avoid contact with explosive or inflammable gases with 1231 heated probes and 1234 oxygen sensors when hot. Novatech transmitters have built in safety protection.
2. Process gas temperature must be below 800°C if the filters are fitted.

Please contact factory for corrosives other than sulphur or zinc. We can provide test materials to try in your atmosphere.

3.1.3 Model 1234 Sampling Sensor Specifications

Application	Sampling Sensor Used in RGS-17 Reference Gas Sensor
Range of Measurement	1ppm to 100% Oxygen
Accuracy	±1%
Process Connection	¼" NPT female, inlet and outlet
Electrical Connection	Weatherproof plug-in connector or optional screw terminals. The plug connector can be supplied with the cable.
Cable	Order a specific length with the transmitter
Heater	Yes
Sample Flow Rate	1 to 5 litres per minute (2 to 10scfh)
Differential Pressure	80 to 800 mmWG (3 to 30inWG)
Thermocouple	K, integral
Response Time	Typically <1 second
Reference Gas	n/a
Dimensions	300 x 125 x 85 mm (11.81" x 4.92" x 3.46") HxWxD
Weight	2.2 kg (4.8 lb)

3.1.4 Probe Ordering Information

When ordering an oxygen probe please specify the following required options:

1. Probe to be heated or unheated
2. Probe insertion length (from process end of mounting thread to probe sensing tip)
3. Mounting thread for the process connection, BSP or NPT (for size of thread refer to specifications).
4. Lagging extension length, if required.
5. Electrical Connection Type.
6. Outer Sheath Material, if not specified will assume 316 stainless steel
7. For model 1231 heated probe state filter type if required. If not specified will assume no filters
8. For model 1232 unheated probe, state thermocouple type. If not specified will assume R-type.

For a list of options for the above requirements refer to the appropriate probe specification tables in the previous section.

3.2 Operational Specifications

3.2.1 Output Options for Analog Output Channel #1

	Indirect fired, Single zone	Indirect fired, 2 zone	Direct fired, Fixed oxygen	Direct fired, Probe + RGS	Direct fired, External dry oxygen	Direct fired, 2 zone, External dry oxygen
Water Vapour 1	√	√	√	√	√	√
Dew Point 1	√	√	√	√	√	√
Mixing Ratio 1	√	√	√	√	√	√
Specific Humidity 1	√	√	√	√	√	√
Dryer Temperature	√		√		√	√
Relative Humidity	√		√		√	√
Absolute Humidity	√		√		√	√
Probe 1 Oxygen	√	√	√	√	√	√
Probe 2 Oxygen		√		√		√
Acid Dew Point			√	√	√	√
No Output	√	√	√	√	√	√

3.2.2 Output Options for Analog Output Channel #2

	Indirect fired, Single zone	Indirect fired, 2 zone	Direct fired, Fixed oxygen	Direct fired, Probe + RGS	Direct fired, External dry oxygen	Direct fired, 2 zone, External dry oxygen
Water Vapour 1	√		√	√	√	
Water Vapour 2		√				√
Dew Point 1	√		√	√	√	
Dew Point 2		√				√
Mixing Ratio 1	√		√	√	√	
Mixing Ratio 2 2		√				√
Specific Humidity 1	√		√	√	√	
Specific Humidity 2		√				√
Dryer Temperature	√		√		√	√
Relative Humidity	√		√		√	√
Absolute Humidity	√		√		√	√
Probe 1 oxygen	√	√	√	√	√	√
Probe 2 oxygen		√		√		√
Acid Dew Point			√	√	√	√
No output	√	√	√	√	√	√

3.2.3 Scaling of Analog Outputs Channel #1 and Channel #2

Process Variable	Min FS Range	Max Range
Water Vapour	20%	0 to 100%
Dew Point	20°C	-50 to 100°C
Mixing Ratio	200g/Kg	0 to 10,000g/kg
Specific Humidity	50g/Kg	0 to 1,000g/kg
Relative Humidity	5%	0 to 100%
Absolute Humidity	50g/m^3	0 to 1,000g/m^3
Probe 1 Oxygen	1.0%	0.0 to 25.0%
Probe 2 Oxygen*	1.0%	0.0 to 25.0%
Sulphuric Acid Dew Point	10°C	200°C

* Probe 2 Oxygen is only available if the second oxygen probe is enabled.

Output Channel 2 is independently isolated and separately scaled with the same options as analog Output Channel 1. For configurations in which one zone water vapour is calculated both channels transmit Water Vapour, Dew Point, Mixing Ratio and Specific Humidity based on that single zone. For configurations where two zone water vapour is calculated Channel 1 outputs process variables related to zone 1 and Channel 2 outputs process variables related to zone 2.

3.2.4 Local Display of Process Variables

Process Variable	Range	Notes
Water Vapour	0 to 100%	*Zone 1 is displayed always, Zone 2 also displayed if the transmitter is configured for dual zone.*
Dew Point	-50 to 100°C	
Mixing Ratio	0 to 10,000g/Kg	
Specific Humidity	0 to 1,000g/kg	
Dryer Temperature	-30 to 1400°C (2550°F)	*Requires a Dryer TC*
Relative Humidity	0.0 to 100.0%	
Absolute Humidity	0 to 1000g/m^3	
Ambient Temperature	-25 to 80°C	
Ambient Relative Humidity	5 to 95%	
RGS Temperature	-25 to 100°C	*Requires an RGS Sensor*
Runtime	>10 years (hours and minutes)	
Service Date	Day/Month/Year	
Probe Temperature	-30 to 1400°C (2550°F)	*Probe 1 is displayed always, Probe 2 also displayed if the transmitter is configured with two oxygen probes*
Probe EMF	-40 to 1350mV	
Probe Impedance	0.0 to 300.0kohm	
Probe Oxygen	1x10^{-30}% to 100%	
Flue Pressure	-1 to 3 Atm	
Sulphuric Acid Dew Point	0 to 200°C	
External Dry Oxygen	0 to 25%	*Modes that use Ext Dry Oxygen*

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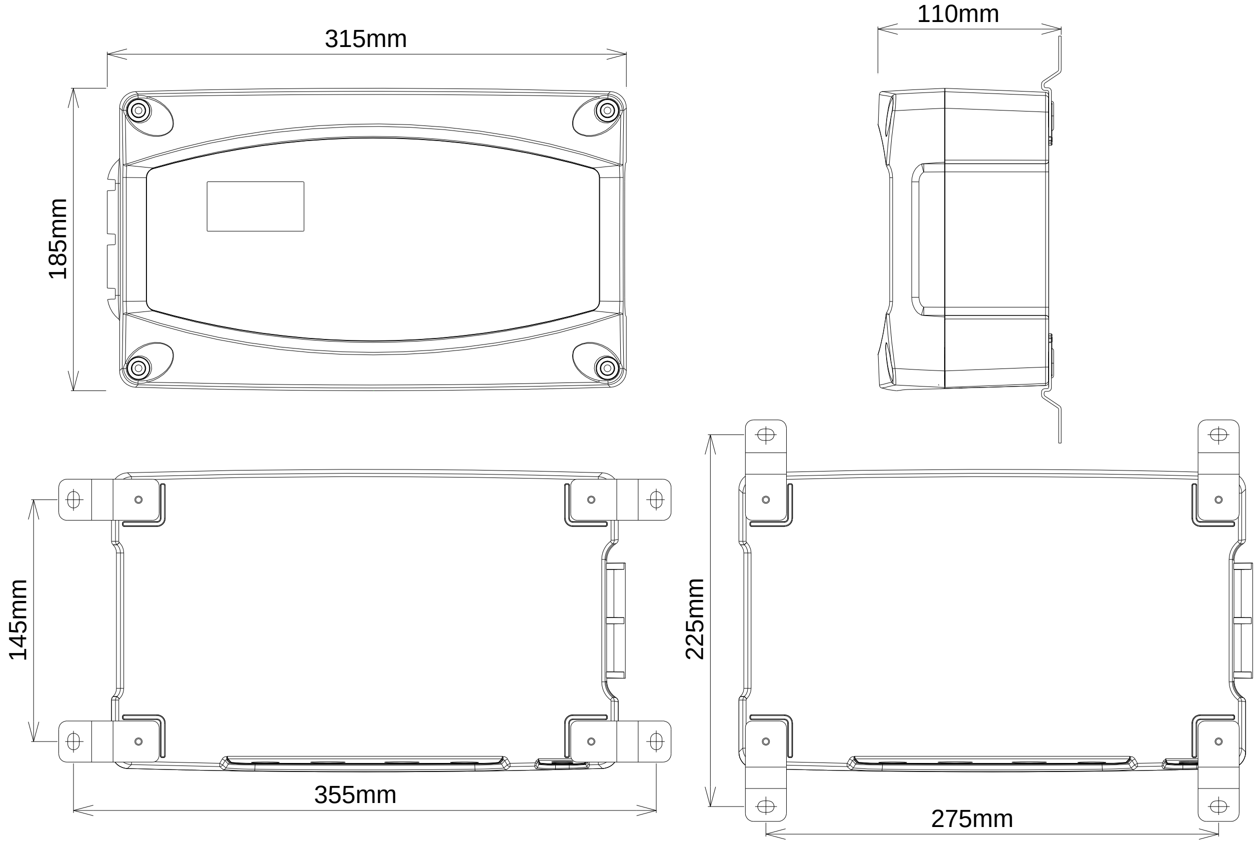
4.1 Mounting the Transmitter

Surface mount the transmitter case on to a flat surface or bracket, using the four mounting brackets provided. The transmitter should never be mounted so that it is directly expose to the sun or rain. Always leave at least 10cm of clearance around the four sides of the case.

Make sure the ambient temperature is below 55°C, and that the radiated heat from furnaces and boilers is kept to a minimum. There should be adequate ventilation to maintain ambient temperature.

Install the cables through cable glands. There are 4 holes cut in the base of the transmitter case; 2x 17mm & 2x 21mm. Use a sharp knife to cut away the covering film for only the glands that are needed.
NOTE: ALWAYS LEAVE THE UNUSED GLAND HOLES SEALED.

Ensure that the electrical connection complies with the local electrical requirements. (see chapter 4.7 Electrical Connections)



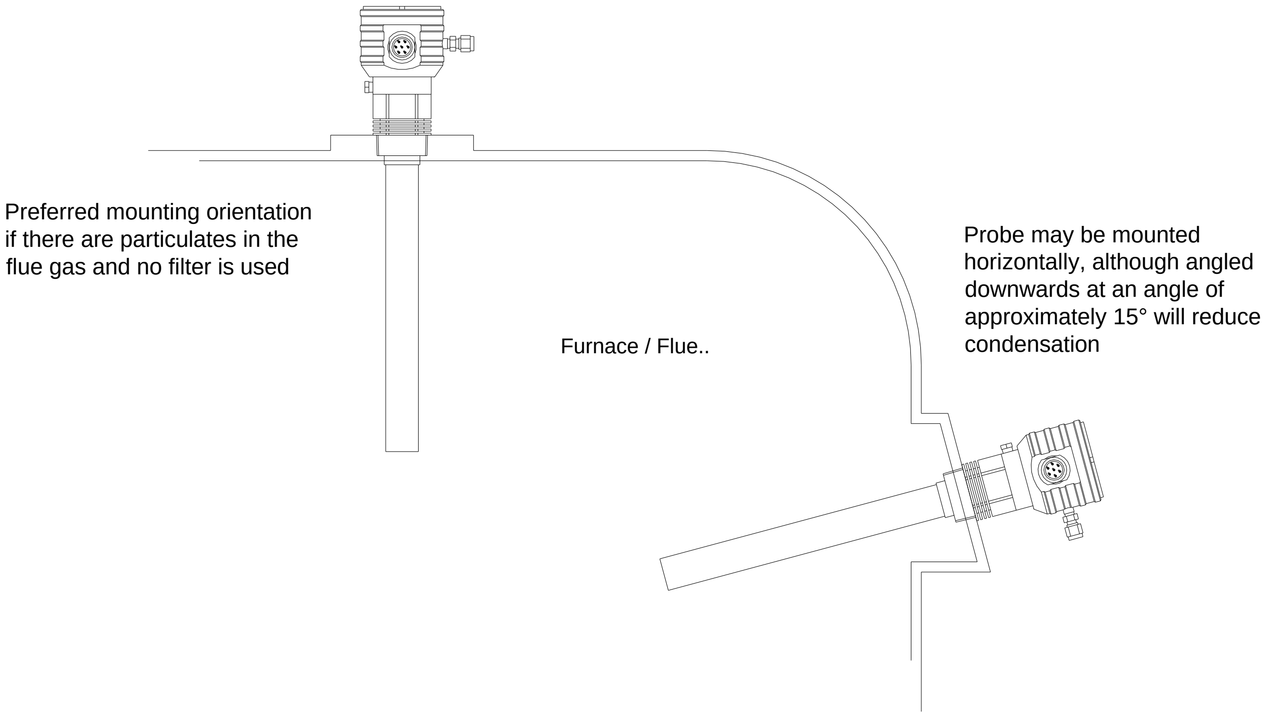
Case Mounting Dimensions

4.2 Installing a 1231 Oxygen Probe

Weld a BSP or NPT socket to the flue in a suitable position for flue gas sensing. For the correct size of socket refer to probe data in chapter 3.1.3. The closer to the source of combustion the smaller will be sensing lag time, allowing better control.

The probe has a typical response time of less than four seconds, so most of the delay time is normally the transit time of the gas from the point of combustion to the point of sensing.

Probes can be mounted at any angle. However, if the probe is to be mounted on a vertical duct wall, it is better to angle the probe (approx. 15°) down to avoid process condensation inside the cold end of the probe. If there are any particulates in the flue gas, a filter can be omitted by pointing the probe vertically downwards. Otherwise the transmitter can be configured to automatically purge the filters, or they can be replaced periodically.



Oxygen Probe Mounting

CAUTION

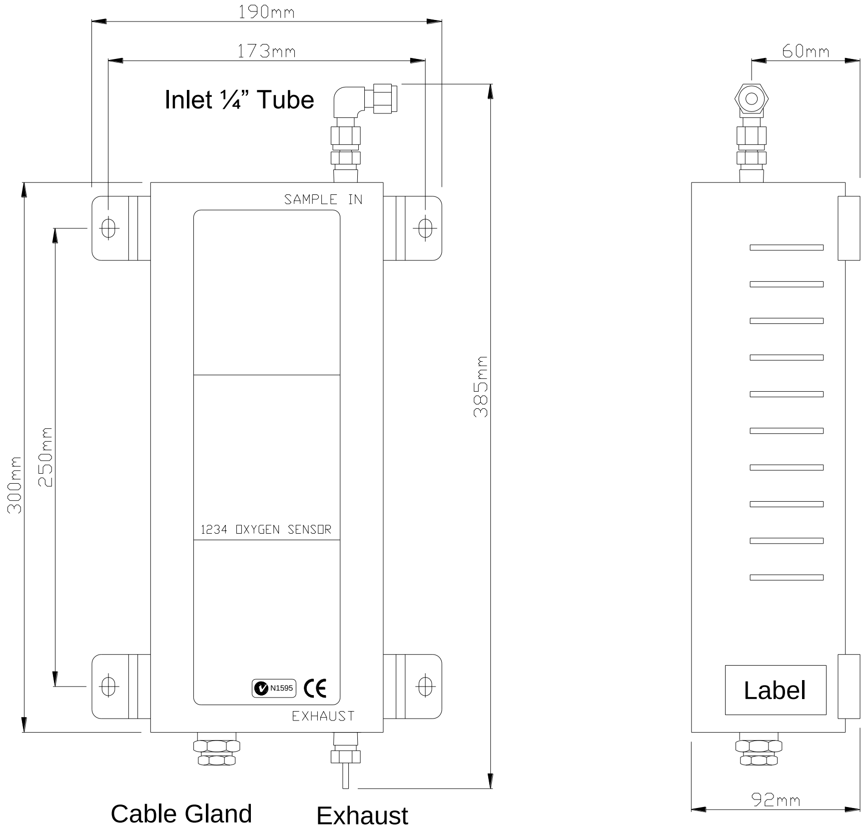
It is important that there is no air in leakage upstream of the oxygen sensing point otherwise there will be a high oxygen reading.

If the probe is to be installed on a bend in the flue, it is best located on the outer circumference of the bend to avoid dead pockets of flue gas flow. While the standard 1231 probe with a 'U' length of 250 mm (10") will suit most low temperature flue applications, it is occasionally necessary to have a longer probe with the sensing tip in the centre of the flue gas stream.

Although it is rare, occasionally a probe may sense oxygen vastly differently from the average reading in the flue gas. If it occurs, then the probe should be moved, or a longer probe installed. This phenomenon is normally caused by stratification of the flue gas.

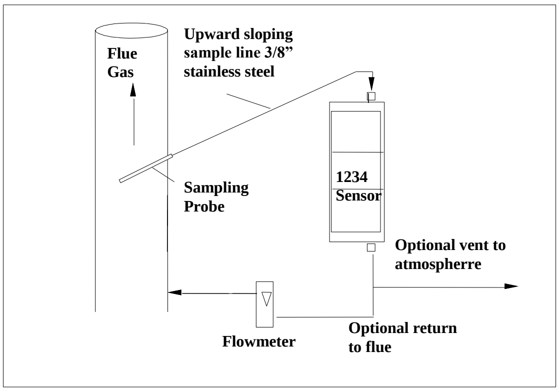
4.3 Installing a 1234 Oxygen sensor

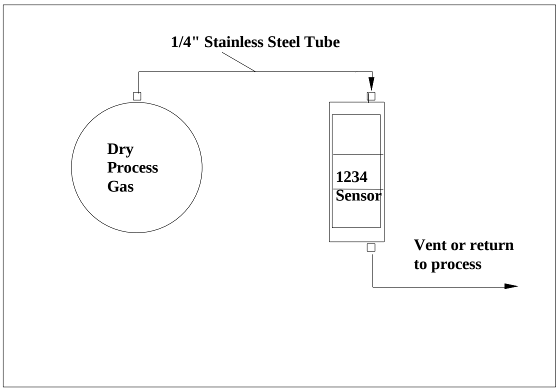
Mounting - Screw the 1234 Oxygen Sensor to a wall or similar surface with the piping connections at the top.



1234 Sensor Mounting Dimensions

Sample Piping - Connect the gas sample piping to the "sample in" port. If the process, boiler, kiln or furnace has a positive pressure, no suction will be required. If the sample is under a negative pressure, connect a pump to the "inlet" port. The flow rate should be within the range of 1 to 5 litres/minute (2 to 10 scfh).





4.4 Installing the Auxiliary Thermocouple

Weld a ½ inch BSP mounting socket to the flue within about 300mm (12"), and upstream of the oxygen probe. The thermocouple should be of similar length to the oxygen probe to prevent flue temperature distribution errors.

The thermocouple should be connected to terminals 7 & 8. These terminals will not be available for an auxiliary thermocouple if a second probe has been installed.

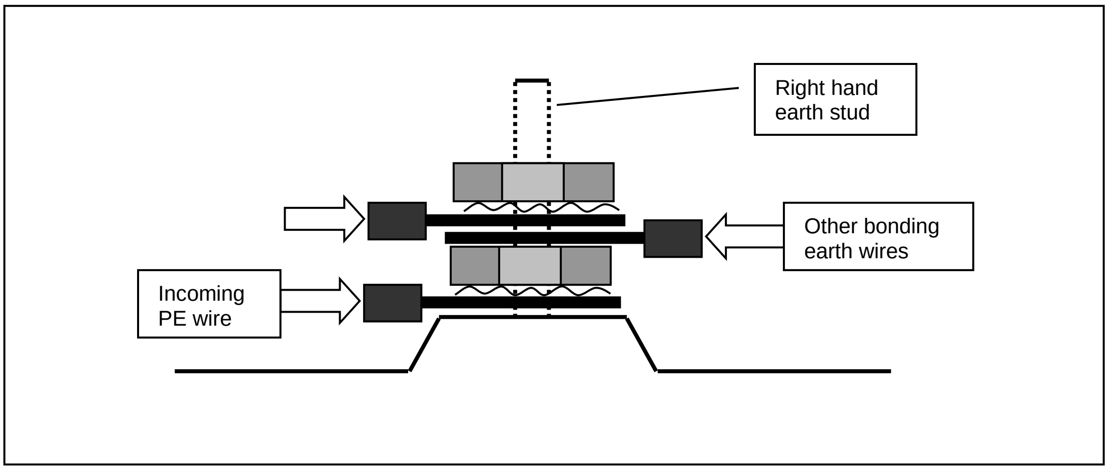
4.5 Shield Connections

All external wiring to the transmitter should be shielded. Do not connect shields at the field end. Simply clip off and insulate. There are two M4 earth screw terminals available in the 1735 transmitter. An extra terminal strip may be required to connect all shields together. This should be supplied by the installer.

4.6 Earth Connection (PE)

The PE (protective earth) input connection must be made to the earth stud on the right-hand side of cabinet. The PE input connection must be the first connection onto the earth stud and it must be secured by a separate nut and spring washer. All other earth connections (bonding connections) can be made on either of the two earth studs in the base of the cabinet.

The transmitter MUST be securely earthed.

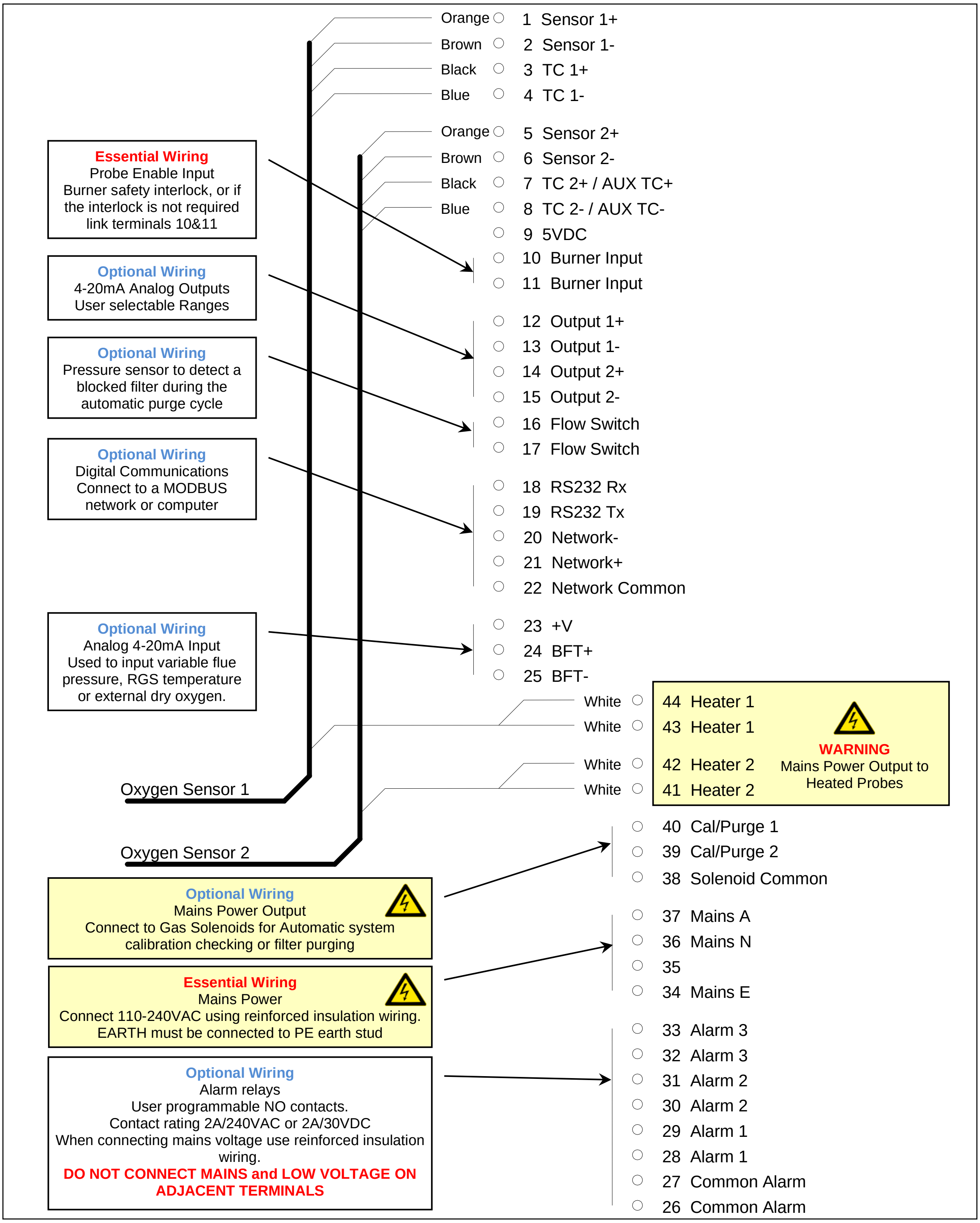


Assembly of the PE and bonding connections on the earth stud

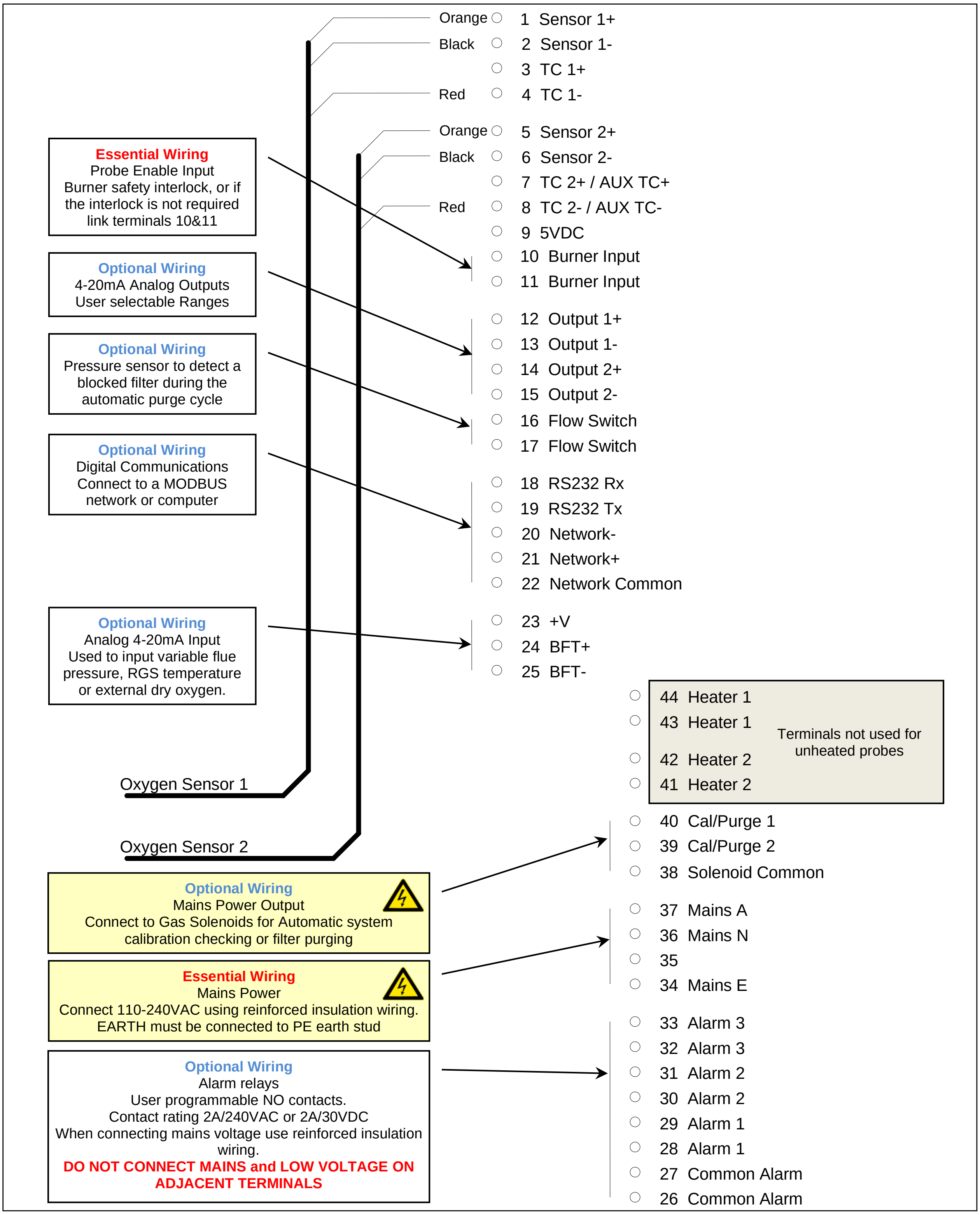
4.7 Electrical Connections

All wiring should comply with local electrical codes. The printed circuit boards are fully floating above earth. The incoming safety earth (PE) must be connected to the primary earth stud in the right-hand side of the base cabinet.
The local fuse for the mains power supply, the isolation switch and the supply wiring must all comply with the electrical safety codes and must only be installed by qualified technicians.

All earth and shield connections should be connected to the earth screws inside the case.



Connection Diagram for 1735 Transmitter and one or two 1231 / 1234 Heated Sensors



Connection Diagram for 1735 Transmitter and one or two 1232 Unheated Probes

- The mains power must be either 100/110VAC or 220/240VAC with a mains frequency of 50 or 60Hz
- The supply circuit must be fused to at least 10Amps and have a dual pole isolation switch within easy access of the oxygen transmitter. The isolation switch must be marked as the isolation switch for this equipment. It is recommended that a separate isolation switch be used for each transmitter so that a transmitter can be serviced individually.
- The power supply cables must be supplied and installed according to local regulations
- The earth connection must comply with the local regulations must have a current carrying capability equal or greater than the supply fuse current rating
- The earth connection must be connected to the primary earth stud inside the transmitter on the right-hand side
- All other bonded earth connections from the external wiring must be connected to the primary earth stud

All operations relating the electrical wiring and installation must be carried out by qualified persons in accordance with the safety regulations and the wiring rules.

NOTE: The power switch in the transmitter can be used to turn off the transmitter. There must be an approved isolation device installed to provide complete isolation of the mains power to the transmitter. The mains wiring terminal must not be used as a disconnect device.

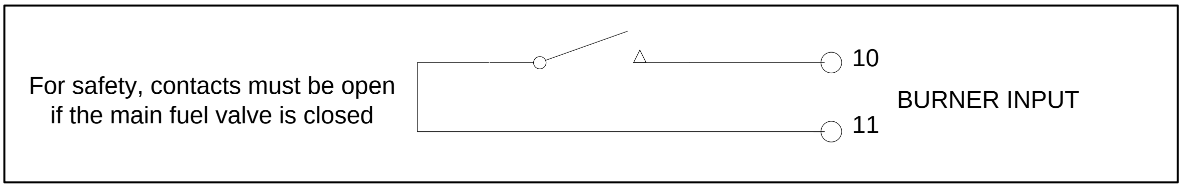
4.8 Heater Interlock Relays

CAUTION

Explosion protection for heated probes is achieved by switching the power to the probe heater off whenever the main fuel valve is closed.

The principle of safety is that if the main fuel valve is open then main flame has been established. With this primary source of ignition on, the probe heater can be safely switched on. The most dangerous situation is if fuel leaks into the combustion appliance when the fuel valve is closed. When power is removed from the main fuel valve the heater should also be switched off.

To achieve this protection, connect a main fuel valve voltage free contact to the 'BURNER INPUT' terminals 10 & 11. When the main fuel valve is open, the voltage free contact should be closed. For installations where there is no risk of explosion, connect a link between terminals number 10 & 11.

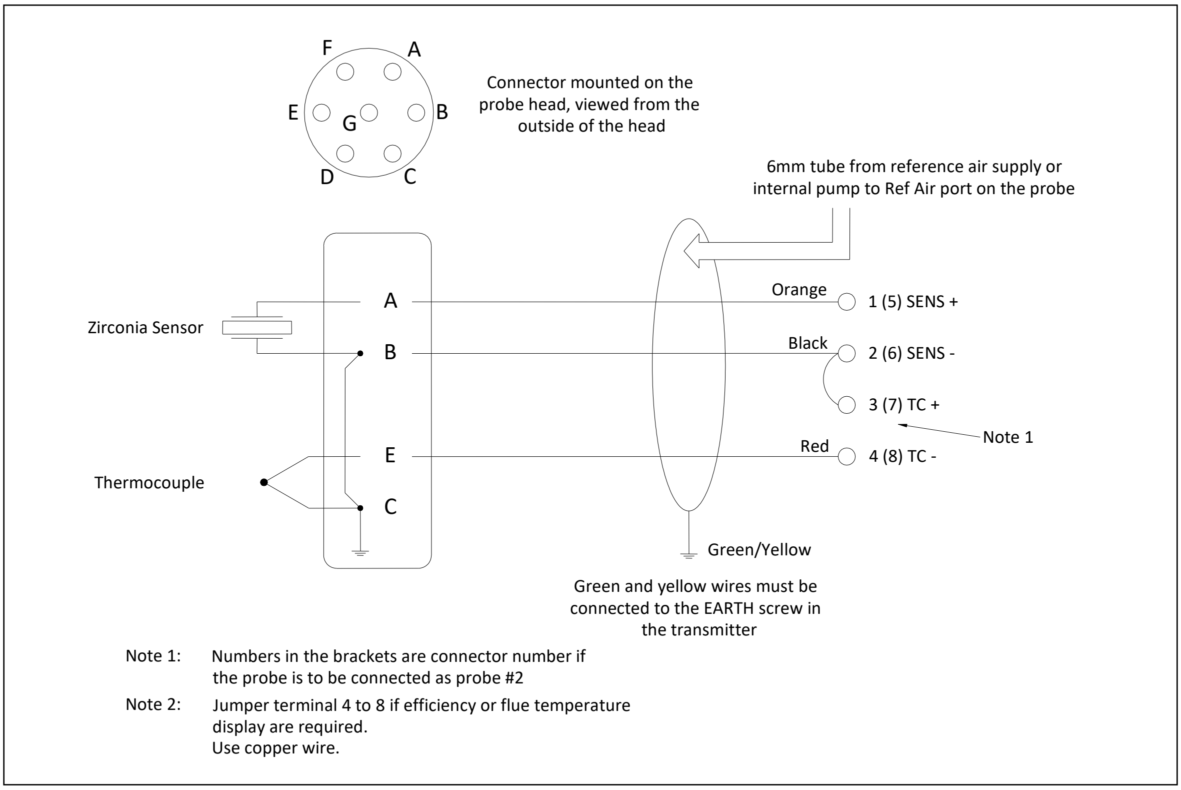


Heater Supply Interlock Connection for Heated Probes

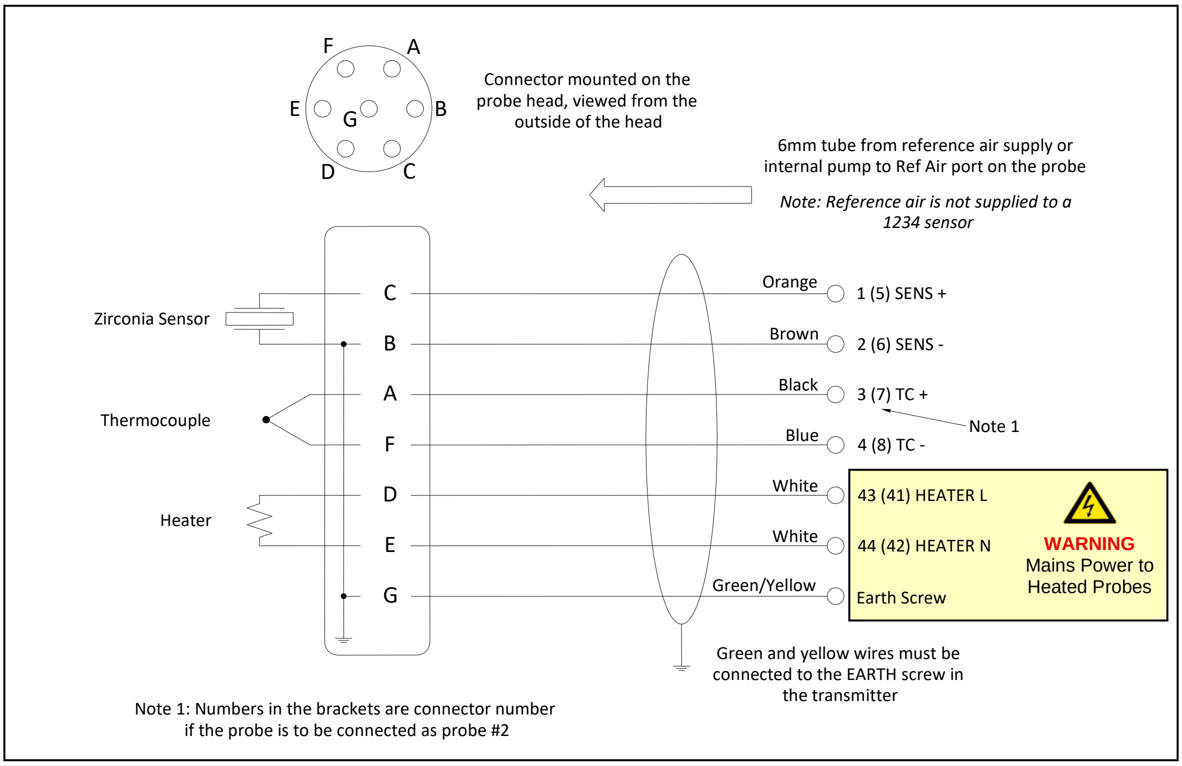
If a safety interlock is not required, a wire must be connected between terminals 10 &11 to enable –
- The heaters on heated probes
- Process alarms
- Auto-purge and auto-cal checking
- Run time timer

4.9 Connecting an Oxygen Probe Cable

Connect the probe lead as shown in the following drawings. Unheated probe leads have integral reference air tube. An adaptor has been supplied to connect this tube to quarter inch flexible PVC tubing, from the air pump or reference air supply.



Connection of Probe Cable for Unheated Probes Models 1232.

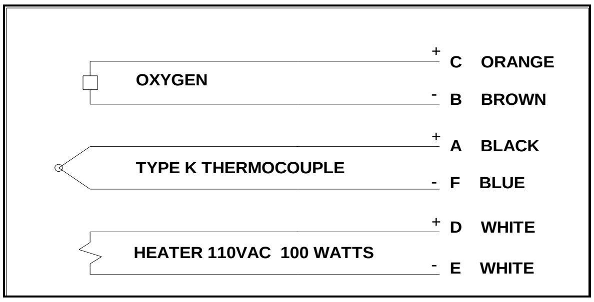


Connection of Probe Cable for Heated Probes Model 1231 and 1234.

4.10 Connecting a 1234 Sensor Cable

The 1234 will either be supplied with a weather proof connector or direct cable wiring.
If the 1234 has a weather proof connector, it will have been supplied with a cable that is already terminated with a matching plug. The other end of the cable can then be terminated in the 1735 transmitter as shown in the 1231 / 1234 wiring diagram on the previous page

If the 1234 has been supplied without the weather proof connector, remove the cover of the 1234 and connect the wires to the connectors on the circuit board as shown below.



Connecting a 1234 Sensor Cable

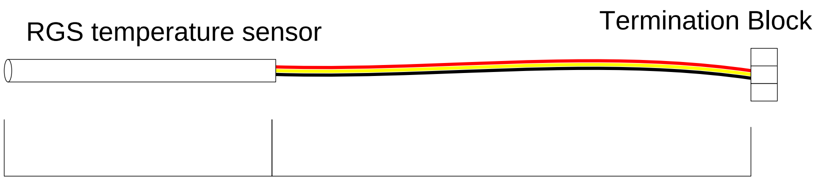
4.11 Connecting the Auxiliary Thermocouple (optional)

For 1231 heated probes, the auxiliary thermocouple must be a separate TC with the junction isolated from earth, mounted near to and upstream of the oxygen probe. It can be either a K, J, R or S type thermocouple. It is optional. If the auxiliary temperature or combustion efficiency is not to be displayed or transmitted, then an auxiliary thermocouple is not necessary.

The thermocouple should be connected to terminals 7 & 8. These terminals will not be available for an auxiliary thermocouple if a second probe has been installed.

4.12 Connecting the RGS temperature sensor (optional)

When the RGS is used with the 1735 a temperature sensor is fitted into the end of the sample tube. The sensor must be connected in the 1735 transmitter to the terminals 23, 24 and 25 as shown.



Wiring Guide to 1735 Transmitter

red	Terminal 23 (V+)
yellow	Terminal 24 (BFT+)
black	Terminal 25 (BFT-)

Connecting the RGS temperature sensor

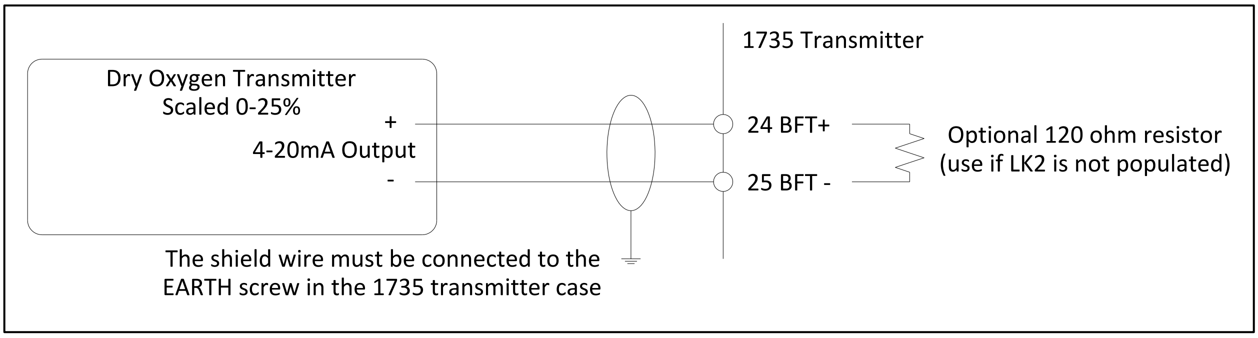
4.13 Connecting the Output Channels

The two 4-20mA DC analog output channels are capable of driving into a 1000Ω load. The output terminals are 12 & 13 for Output Channel 1, and 14 & 15 for Output Channel 2.

4.14 Connecting the External Dry Oxygen Input

If an External Dry Oxygen signal is to be connected to the 1735 transmitter it must output an isolated 4–20mA signal scaled 0–25% dry oxygen.

Before connecting ensure the link LK2 (bottom left hand side of the 1730-1 PCB, under the shield) is shorted using a 0.1" jumper. If LK2 is not populated on the PCB then the same can be achieved by inserting a 120Ω resistor across the input terminals 24 & 25.



See also chapter 7.2.5 Dry O_2 Sample Delay.

NOTE: The BFT input on terminals 24&25 can be used for either Variable Flue Pressure or External Dry Oxygen, but not both simultaneously.

4.15 Connecting the Alarms

A common alarm, which should be connected for all installations initiates on alarm functions described below. Three additional alarm relays are available for selectable functions as listed in chapter 9.3. Each relay has normally open contacts. The contacts will open in alarm condition. Relays are connected as follows:

Relay	Terminal Numbers
Common Alarm	26 & 27
Alarm 1	28 & 29
Alarm 2	30 & 31
Alarm 3	32 & 33

Common Alarms All of the following conditions will cause a common alarm -

- Probe 1 / Probe 2 Heater Fail
- Probe 1 / Probe 2 High Impedance
- Probe 1 / Probe 2 TC Open Circuit
- Aux TC Open Circuit
- Ref Air Pump Fail
- Ref Air Pump Overload
- BBRAM Fail
- Alarm Log Fail
- ADC Calibration Fail
- Output 1 / Output 2 Failure
- Heater 1 / Heater 2 SSR Failure
- Heater SSR Leakage
- Probe 1 / Probe 2 Filter Blocked
- Gas 1 / Gas 2 Calibration Error

Alarms can be accepted by pressing the ALARM ∆ button (viewing the alarm messages) and then the ENTER button.

Alarm Relay 2 to 4 Select any one or all of the following for each relay. See chapter 9. Alarms

- High Oxygen 1 / Oxygen 2
- Low Oxygen 1 / Oxygen 2
- Very Low Oxygen 1 / Oxygen 2
- Oxygen Deviation
- Probe 1 / Probe 2 Temperature Low
- Calibration Check 1 / Check 2 in Progress
- Probe 1 / Probe 2 Purge in Progress

In addition, any of the selections that are removed from the common alarm relay can be added to relays two to four.

4.16 Connecting the Automatic Purge and Calibration Check System

CAUTION
The purge and calibration solenoid valves are supplied with mains voltage. This supply has electrical shock danger to maintenance personnel. Always isolate the transmitter before working with the purge and calibration solenoid valves.

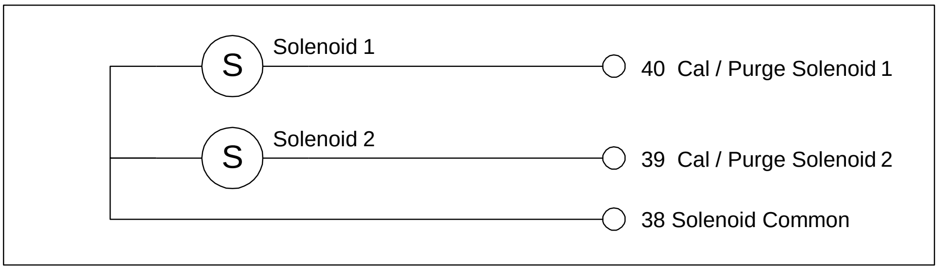
The on-line auto purge and calibration check system is optional. For details on its operation see chapters 4.22, 4.23 and chapter 11.

To automatically sense a blocked probe filter, a flow switch should be installed in the ‘purge’ line to the probe ‘CAL’ port. It should be adjusted so that it energises just below the purge flow with new or clean filters installed. The flow switch contacts should be connected to terminals 16 & 17 (FLOW SW).

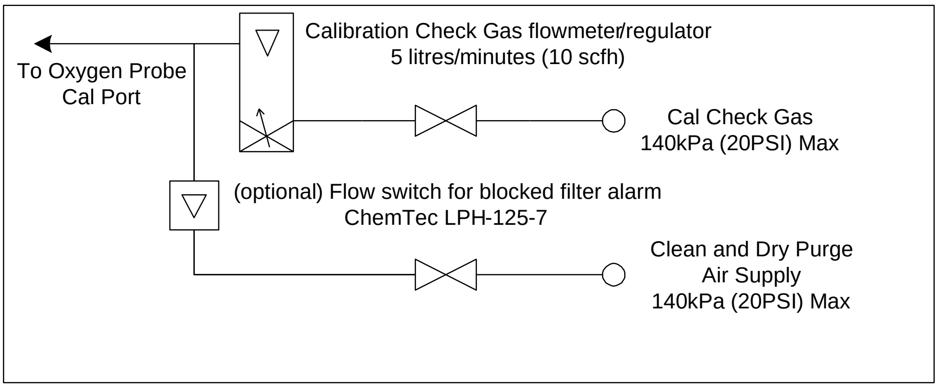
If the filter is still blocked or partly blocked after an auto purge cycle, the flow switch will not energise and will therefore cause a ‘Probe1 (2) Filter Blocked’ alarm.

After installation the purge/cal system should be tested thoroughly for leaks. Any leaks can cause significant errors if the flue is at negative pressure. If the flue is at positive pressure, an outward leak can cause corrosion in the purge/cal system piping and fittings.

If probe/filter purging is required but a “Probe1 (2) Filter Blocked” alarm is not required, do not install the flow switch but link terminals 16 &17.



Automatic Purge & Calibration check System Wiring Schematic



Automatic Purge & Calibration check System Piping Schematic

4.17 Connecting Reference Air

For 1234 sensors, no reference air connection is required.

For oxygen probes, a 1/4” tube connector on the transmitter should be connected via a nylon, copper or stainless-steel tube to the ‘REF’ connector on the probe.

If two probes are being used, a “T” fitting must be supplied to provide reference air supply to both probes.

4.18 Connecting the Transmitter to a MODBUS™ network

The transmitter can be networked to other transmitters and to a network master. The network uses the transmitter's RS485 port. Up to 31 transmitters can be connected to the network, and can be interrogated by the Network Master.

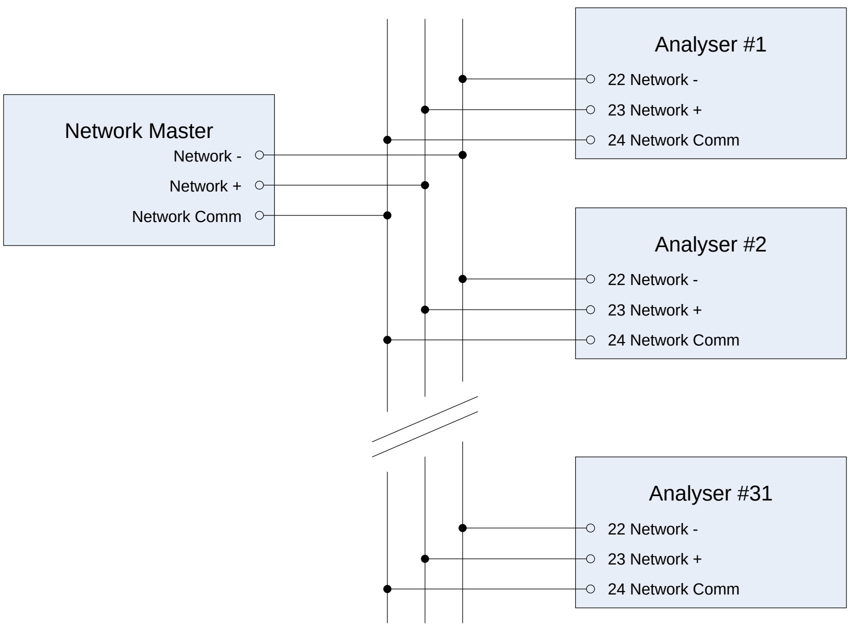
NOTE: Hardware Protocol Selection
The communications port of the 1735 can be configured to communicate on either RS232 or RS485. If the transmitter is to be used on a MODBUS network, the 1735 transmitter must be set to RS485. For further details see chapter 7.2.30 Communications Port Options.

NOTE: Terminating Resistor
There is a terminating 100Ω resistor fitted to the 1730-1 PCB. Link LK3 (TERM), in the bottom left-hand corner of the PCB, is used to connect the terminating resistor. Link LK3 must be removed on all transmitters except the transmitter on the end of the network line. If the network line from the transmitters is taken from the middle of the transmitter network string, a terminating resistor should be enabled with LK3 at each end of the network line.

The MODBUS™ protocol of the network is –

Baud Rate	19,200
Parity	Even
Stop Bits	1
RS485	2-wire (half-duplex)
Mode	RTU (binary mode)

For more details see Appendix 3.



Network Connections

4.19 Connecting Power

Before commissioning the probe, sensor or transmitter, read the CAUTION paragraphs at the front of this manual. The green & yellow EARTH wire MUST be connected to earth.

4.20 Commissioning - Run Mode

When the transmitter is turned on it will go to *Run Mode*. The top line of the display will now display the prime humidity measurement in large writing. If the probe or sensor temperature is not above 650°C (1200°F), a "Probe Low Temperature" message is flashed on the lower line. The probe or sensor temperature can be checked on the lower line of the display.

4.21 Probe or Sensor Calibration

The zirconia sensor provides an absolute measurement of oxygen partial pressure. There are no calibration adjustments, apart from 'Probe 1 Offset', for the probe. The zirconia sensor EMF is either correct or it needs to be replaced. To check that the probe is functioning correctly, first check that the high impedance alarm, 'Probe 1 (2) High Impedance', is not active. The actual impedance can be displayed on the lower line. It should be less than 9 KΩ at 720°C (1320°F).

Once it has been established that the impedance is normal, the offset may be set using the millivolt value marked on the oxygen probe. See chapter 6.4.1 Probe 1 Offset. The probe offset can be tested on site. A small flow of air must be admitted to both the 'REF' and 'CAL' ports when testing the probe offset. If the probe is in the process, the air must fully purge the probe sensor without interference from the process gas sample. Novatech probes can easily achieve this with or without a probe filter and a gas flow of only 1 to 5 litres/minute (2-10scfh) for a 1231 probe and up to 20 litres/minute (40scfh) for an unheated probe. When a stable oxygen reading has been achieved, read the 'Probe EMF'. Enter this value into the Setup Menu function #01 for the probe 1 (Setup Menu function #02 for the second probe if it is installed).

4.22 Filter Purging

Purging probe filters is controlled from the GAS / PURGE buttons on the transmitter when in Run Mode. If 'Automatic' has been selected in either 'Sol. 1 Auto/Man' or 'Sol. 2 Auto/Man' in Commissioning Menu function #21 or #30, pressing the respective GAS / PURGE button will start the automatic cycle. Pressing the button again will cancel the auto purge cycle. If 'Automatic' was not enabled, the solenoid will only stay open for as long as the button is pressed. Gradually adjust the purge air supply regulator, increasing the pressure until sufficient flow is obtained to clear the filter. This is best checked with a dirty filter after a period of operation, by withdrawing the probe from service and watching any build up on the filter being blown off at the set pressure. Normally 30kPa (5 psi) is adequate but the air pressure may be set as high as 100kPa (15 psi).

4.23 Calibration Gas Check

If the installation has a filter purge facility, set this up first. Refer to the previous paragraph. Press the GAS 1 / PURGE 1 or GAS 2 / PURGE 2 button while in Run Mode to obtain a reasonable flow through the calibration check gas flow meter. If air is being used as a calibration check gas, use the air from the regulator for filter purge. Then, when setting up a gas for calibration checking, set the pressure from the calibration gas cylinder so that it is the same as the pressure set on the air regulator. Then the setting on the rotameter / flow regulator will be the same as that for the airflow. The flow required is 1 to 5 litres/minute (2 to 10scfh) for a 1231 probe and up to 20 litres/minute (40scfh) for an unheated probe.

Air is not the best gas for calibration checking on a zirconia sensor. The output of a zirconia sensor with air on both sides of the sensor is zero millivolts. It is better to choose a gas value which provides a reasonable output from the sensor and which is near to the process oxygen level. A cylinder with 2% oxygen in nitrogen is a commonly used calibration gas. The maximum pressure on the calibration check gas cylinder regulators is 100kPa (15 psi).

Note: If a dual zone dryer type was selected in Commissioning Menu function #04, 'Cal Gas 2' must be connected to probe 2.

4.24 Dust in the Flue Gas

For heated probes the preferred method of mounting for dust-laden applications is facing vertically downwards with the filter removed. Probes can also be mounted horizontally with no filter with some dusts. An occasional automatic back purge is helpful in this case.

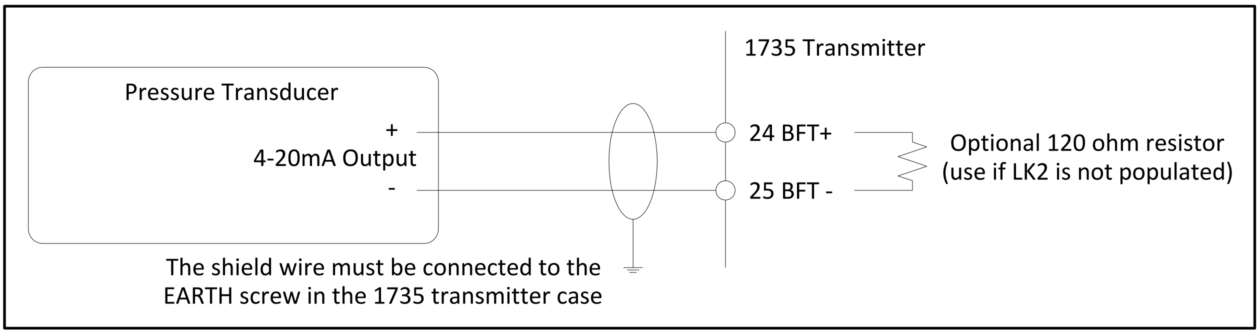
Normally heated probes are supplied with filters for applications with particulates in the process gas. The probe response time should be tested when the probe is first installed, and then regularly until it remains constant for a significant period. Filter purging should be set up on the time periods determined by these tests. To test the probe response time, use a stopwatch to obtain the time for a probe to achieve a 63 % change from one reading to another. If a probe filter blocks completely in a short period of time, then there is no option but to use the probe without the filter. A trial probe with filter can be installed to test whether a filter blockage is likely to occur.

4.25 Connecting a Pressure Transducer

If the process gas pressure varies more than 4" WG and therefore requires automatic compensation, connect a pressure transducer as shown below.

Place a link across LK2, near to the input terminals 24 & 25. **If the link is not populated**, you can achieve the same thing connecting a 120Ω resistor across the two terminals.

A change in pressure of 4" WG will cause a change in the calculated oxygen reading of approximately 1%.



There are no calibration adjustments for the zero or span of the pressure transducer input.

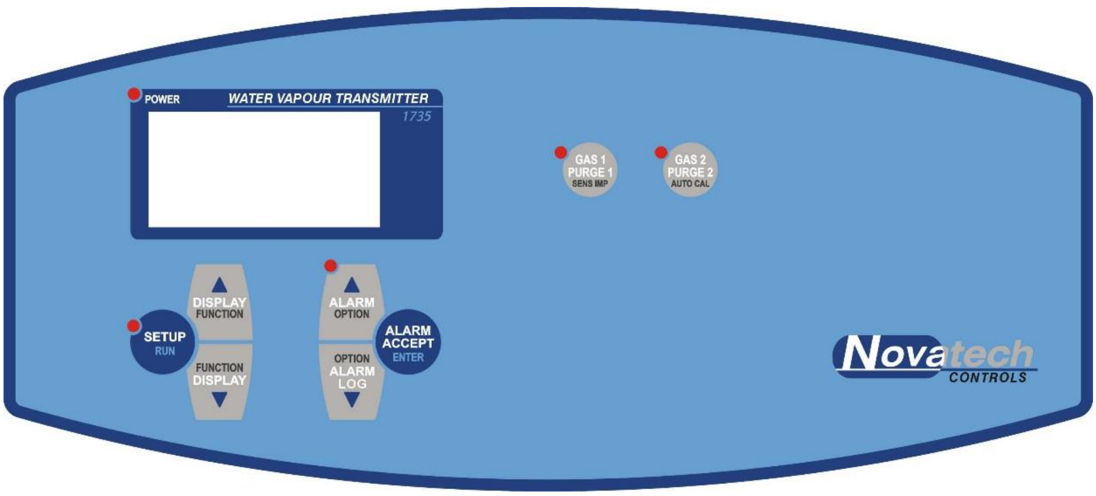
Set the transducer scale range in the Commissioning Menu - See chapter 7.2.10 Transmitter Output Channel 1 & 2. The pressure can be displayed on the lower line by enabling the corresponding option. See chapter 6.4.2 Lower Line Items

NOTE: The BFT input on terminals 24/25 can be used for either Variable Flue Pressure or External Dry Oxygen, but not both simultaneously.

The 1735 Water Vapour Transmitter has a graphic display, 8 buttons and 5 LED indicators to show the status of the transmitter.

All of the buttons have multiple functions, depending on what is currently on the display. As a general starting point, the larger white text on the button is the function while the transmitter is in the ***Run Menu*** and the smaller black text on the button is the function in the ***Setup / Commissioning / Calibration Menus***.

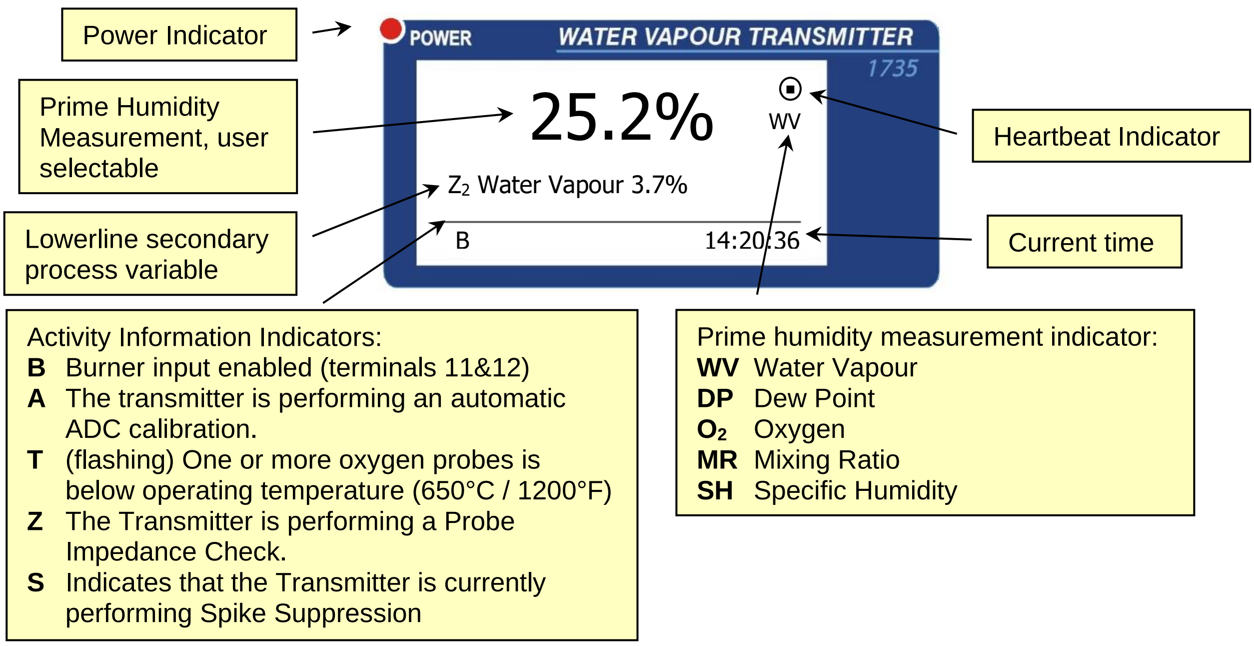
When the transmitter is sitting idle it will revert to Run Mode, in which standard information relating to the process appears on the screen. In order to configure the transmitter, the operator must access Setup Menu. This is achieved by pressing, and in some cases holding down the SETUP button (see chapters 6, 7 8). The transmitter will return back to the Run Mode when the SETUP button is pressed again or after a period of 60 seconds of inactivity.



The front panel of the model 1735 Water Vapour Transmitter

5.1 Run Mode Display

In Run Mode the 1735 Transmitter shows the prime measurement in large characters at the top of the display and a user selectable lower line in smaller characters below. Other items on the display include the activity heartbeat indicator in the top right corner, a row of single letter action indicators in the bottom left corner and the current time in the bottom right corner.



In the Setup Menu the display is replaced with an interactive menu driven interface. While in the Setup Menu all other functions of the transmitter including reading inputs, calculation of process variables, checking of alarm conditions and retransmitting will continue to operate as normal.

5.2 Top Line Display

The top line of the display shows the Prime Humidity Measurement in large writing. The units are selectable from the following Zone 1 items:

Process Variable		Display format
Water Vapour	(WV)	##.# %
Dew Point	(DP)	##.# °C (°F)
Probe Oxygen	(O_2)	See the table below
Mixing Ratio	(MR)	# g/Kg or #.# Kg/Kg
Specific Humidity	(SH)	# g/Kg

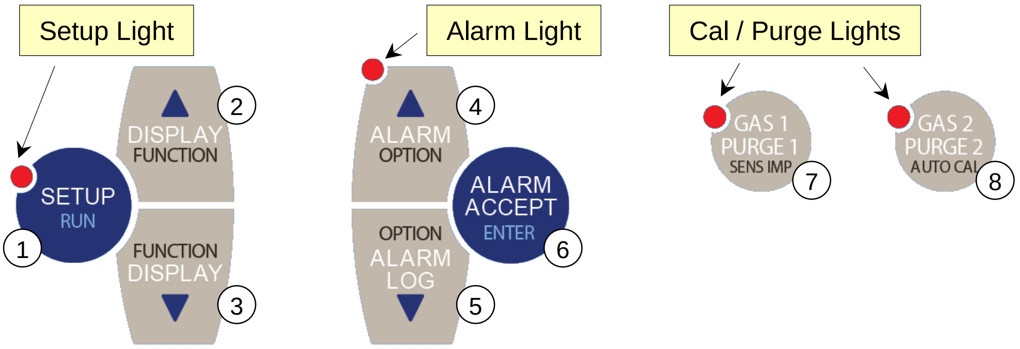
The selection is made in the Commissioning Menu function #04, see chapter 7.2.6 Top Line Display for details.

If oxygen is selected for the top line the transmitter will show the oxygen in % format between 100% down to 0.1%. Below of this range the oxygen will be shown in scientific format.

Range	Display format
30.0% to 100.0%	###.# % (1 digit after the decimal)
1.00% to 29.99%	##.## % (2 digits after the decimal)
0.100% to 0.999%	0.### % (3 digits after the decimal)
< 0.100ppm	scientific notation (#.## x 10$^{-\#\#}$ %)

5.3 Keypad

There are 8 buttons built into the label on front panel of the 1735 Transmitter. The button functions are written in BLACK and WHITE to identify the function of the button in either Run Mode or the Setup Menu system.



	Button Text	Run Mode (white text)	Setup Menu (black/blue text)
1	SETUP / RUN	Enter Setup Menu	Return to Run Mode
2	DISPLAY / FUNCTION ∆	DISPLAY NEXT LOWER LINE ITEM	NEXT FUNCTION
3	DISPLAY / FUNCTION ∇	Display last Lower line Item	Previous function
4	ALARM / OPTION ∆	Next alarm	Next / increment option
5	ALARM / OPTION ∇	Previous alarm	Previous / decrement option
6	ALARM ACCEPT / ENTER	Acknowledge displayed alarm	Save current option
7	GAS 1 PURGE 1 / SENS IMP	Gas 1 / Purge 1 manual activate	Check Probe impedance
8	GAS 2 PURGE 2 / AUTO CAL	Gas 2 / Purge 2 manual activate	Manually perform device calibration

5.3.1 Keypad in Run Mode

After the transmitter is powered on and has completed the initial start-up procedure it will enter the Run Mode. In this mode the top line of the display will show the prime humidity measurement selected for Zone 1. The other button functions are –

SETUP / RUN

By pressing this button once from Run Mode, the transmitter will enter the Setup Menu system. In the Setup Menu the function of each of the buttons is reassigned. Pressing the SETUP / RUN button a second time while in the Setup Menu will return the transmitter to the Run Mode. If the transmitter is left idle in the Setup Menu for more than 60 seconds it will automatically return to Run Mode.

DISPLAY ∆ / DISPLAY ∇

The display buttons are used to scroll the lower line up and down through the variety of measurements that are available on the lower line. For a complete list of options see chapter 6.4.2 Lower Line Items.

ALARM ∆

If there is either a new alarm or an active alarm the ALARM ∆ button can be pressed to examine the alarm status. The Alarm Light will be flashing if there is a new alarm or steady if there is an existing alarm. For more details on the ALARM MODE and buttons see chapter 9. Alarms. The Setup Light will flash slowly to show that the transmitter is now in the alarm display mode.

ALARM ∇

When the transmitter is displaying active alarms (the ALARM ∆ button has been pressed), the ALARM ∆ button and ALARM ∇ button allow the operator to examine the date / time of the alarm and the date / time that the alarm was acknowledged.

If the transmitter was in Run Mode when this button is pressed it will go into the alarm log display mode. See chapter 9. Alarms for more details.

ALARM ACCEPT

Press this button to acknowledge the currently displayed alarm (See chapter 9. Alarms).

GAS 1 / PURGE 1   GAS 2 / PURGE 2

These two buttons are used to operate the gas / purge solenoids. When the transmitter is in the manual cal / purge mode (Commissioning Menu function #21 and #30) the solenoid will be activated for as long as the button is pressed. When the transmitter is in the auto cal / purge mode the automatic cal / purge cycle is started. The cycle can be stopped by pressing the same button again.

5.3.2 Keypad in the Setup / Commissioning / Calibration Menu

NOTE: Access to the Commissioning Menu and Calibration Menu can be disabled by switching OFF the corresponding slider on DIP switch SW1 on the 1730 Main PCB. In order to enter either Commissioning Menu or Calibration Menu, the corresponding DIP switch SW1 on the 1730-1 PCB must be turned on.

From Run Mode, if the SETUP / RUN button is pressed once, the transmitter will display the Setup Menu. If the SETUP / RUN button is pressed and held for 2 seconds, the transmitter will display the **Commissioning Menu**. If the SETUP / RUN button is pressed and held for 4 seconds, the transmitter will display the **Calibration Menu**.

The following functions are then available in all of the above modes.

SETUP / RUN

Pressing this button while in the Setup / Commissioning / Calibration Menu will return the transmitter to the Run Mode.

FUNCTION ∆ / FUNCTION ∇

These two buttons allow for the selection of the menu function. A function summary table is found at the start of each chapter for Setup Menu, Commissioning Menu and Calibration Menu.

OPTION ∆ / OPTION ∇

These two buttons allow for modifying the option for the selected function. A list/range of options for each function is found in the function summary table at the start of each chapter for the Setup Menu, Commissioning Menu and Calibration Menu.

ENTER

This button applies/updates the currently displayed option and stores the value in non-volatile memory to be retrieved on device start up. If this button is not pressed before changing to a new function then the previous option will be retained.

SENS IMP

When this button is pressed the transmitter will measure the impedance of oxygen probe(s) attached to the transmitter. If the burner is not enabled (terminals 10 & 11) or the probe temperature is below 700°C (1292°F) impedance checking will not be performed. During impedance checking a 'Z' will be seen in the bottom left hand corner of the display.

AUTO CAL

When this button is pressed the transmitter will calibrate the analog output channels that are set to auto calibration (see chapter 10. Instrument Calibration). This is performed by directing the output current away from the output terminals (terminals 12 & 13 and 14 & 15) back to an analogue input to the transmitter in order to calculate a zero and span calibration factor for each of the output channels.

During this process normal output to the analog channels will be interrupted sending the outputs open circuit.

This chapter describes the functions available in the Setup Menu on the 1735 Water Vapour Transmitter.

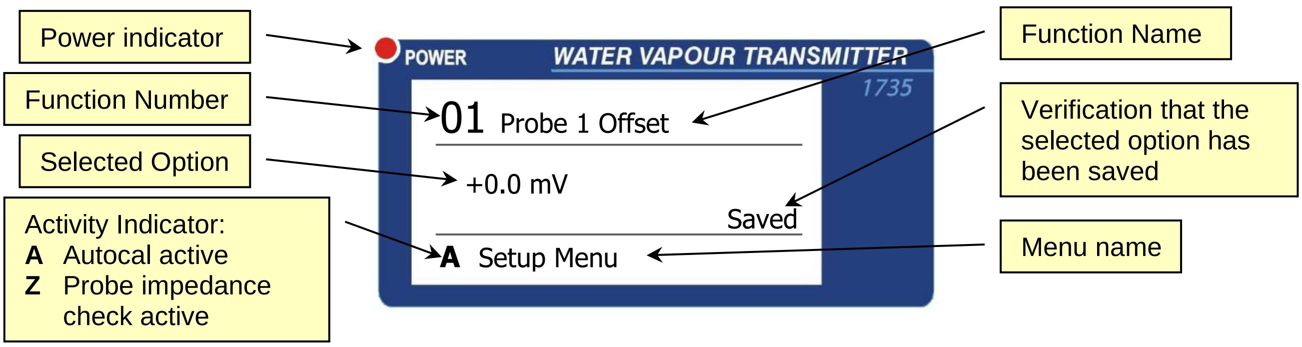
The Setup Menu is mode is accessed from Run Mode by pressing the SETUP button momentarily so the words 'Setup Menu' appear at the bottom of the display. The transmitter will return to the Run Mode when the SETUP button is pressed again or after 60 seconds of keypad inactivity.

6.1 Function Summary Table

The following table shows a summary of Setup Menu functions:

Menu #	Function Description	Range	Default value
01	Probe 1 Offset	±6.0mV	0.0mV
02	Probe 2 Offset	±6.0mV	0.0mV
03	Lower Line Items	See SETUP function #3 for details (chapter 5.2.2)	
04	Damping Factor	No Damping to 5 Minutes	5 seconds
05	Spike Suppression	Disabled to 5 mins	Disabled
06	Spike Trip Level	5mV to 100mV	10mV

6.2 Setup Menu Display



6.3 Changing Menu Options

The purpose of having an interactive Setup Menu is to allow for configuration of the transmitter using the graphical display and keypad.

Once an option is changed and entered using the ENTER button that value immediately becomes active. The device configuration and calibration are stored into the non-volatile memory and will be retained permanently even if the device does not have power.

To reset the transmitter configuration to factory default settings, see chapter 10.2 Cold Start.

To change an option in the Setup Menu system:

1. Enter the Setup Menu by pressing the SETUP / RUN button once. The Setup Light will come on and the display will have the format shown below. The operations of the buttons are now the operations written in WHITE on the keypad. The menu name is written at the bottom of the display.
2. While in the Setup Menu the required function can be selected by using the FUNCTION ∆ and FUNCTION ∇ buttons. The options available for that function can be seen by using the OPTION ∆ and OPTION ∇ buttons.
3. When the required option is on the display press the ENTER button to save that value.

When finished, press the SETUP / RUN button to return to the Run Mode.

6.4 Setup Menu Functions

6.4.1 Probe 1 Offset

Options: ±6.0mV in 0.1mV increments.
Default: 0.0mV

Each Novatech oxygen probe has an offset calibration value printed on a tag that is attached to the probe when it is dispatched. To achieve the most accurate measurement of oxygen the offset value must be entered into this setup function with the same polarity as it is printed on the label. For a healthy probe the offset value should be within ±1.0mV

NOTE: An offset of 1.0mV will change the oxygen reading by approximately 1% oxygen when the probe is in ambient air. However, as the process oxygen measurement drops, this offset will have a diminishing effect. At a process gas oxygen concentration of 2%, the 1.0mV offset error will only change the reading by 0.1% oxygen. If in any doubt about the correct offset value, set it to 0.0mV.

The function 'Probe 2 Offset' will only appear if the transmitter has been configured for 2 oxygen probes.

6.4.2 Lower Line Items

This function allows the operator to change the items that are available to be displayed on the lower line of the transmitter in Run Mode. If the word "Enabled" appears on the display for a selected lower line option, the measurement will be available to be shown on the display in the Run Mode by scrolling through the list using the DISPLAY Δ and DISPLAY ∇ buttons.

Each individual lower line measurement can be enabled or disabled by pressing the ENTER button.

	OPTIONS:				
1	Temperature, Probe #1	*	16	Zone 2 Specific Humidity	*
2	Temperature, Probe #2	*	17	Dryer Temperature	*
3	Sensor EMF, Probe #1	*	18	Relative Humidity	*
4	Sensor EMF, Probe #2	*	19	Absolute Humidity	*
5	Sensor Impedance, Probe #1	*	20	Ambient Temperature	
6	Sensor Impedance, Probe #2	*	21	RGS Sensor Temperature	
7	Oxygen, Probe #1	*	22	Ambient Relative Humidity	
8	Oxygen, Probe #2	*	23	External Dry Oxygen	
9	Zone 1 Water Vapour	*	24	Flue Pressure	
10	Zone 2 Water Vapour	*	25	Sulphuric Acid Dew Point	
11	Zone 1 Dew Point	*	26	Runtime	
12	Zone 2 Dew Point	*	27	Service Date	
13	Zone 1 Mixing Ratio	*	28	Analog Output 1 4-20mA	
14	Zone 2 Mixing Ratio	*	29	Analog Output 2 4-20mA	
15	Zone 1 Specific Humidity				

NOTE: An asterisk (*) on the end of the line identifies the item is enabled by default after a COLD-START.

NOTE: The options may be different to those shown above depending on the selections for the top line display in the Commissioning Menu.

6.4.3 Oxygen Factor

Options: No Damping
2 to 10 Seconds in 1 second increments
10 to 30 Seconds in 5 second increments
30 / 45 / 60 / 90 Seconds
2 / 3 / 4 / 5 Minutes
Default: 5 seconds

The Oxygen measurement can be damped by averaging successive readings from the probe. This can be used to smooth out minor fluctuations in the process gas level and should improve the stability of the readings of the system. The larger the number selected here, the more successive readings are averaged and the smoother the measurement will be.

The damping factor is not applied to the Probe EMF and Probe Temperature values used to calculate oxygen, but to the oxygen value itself. The pre-damped oxygen value is not displayed or retransmitted via digital or analog outputs, when damping is enabled the damped oxygen value is shown on the local display as well as being retransmitted via digital or analog outputs.

The damped Oxygen value is also used in the calculations of all other process variables including Water Vapour, Dew Point, Mixing Ratio and Specific Humidity. By enabling damping on oxygen, all process variables will be similarly damped.

6.4.4 Spike Suppression

Options: Disabled
15 / 30 / 60 Seconds
2 / 3 / 4 / 5 Minutes
Default: Disabled

This function allows the operator to automatically suppress the spikes in EMF caused by moisture condensing inside the probe in high humidity processes.

Due to the high levels of moisture in some environments it is not unusual to experience condensation build-up on the inner and outer sheath of the probe. When this occurs, the condensation will often drip back onto the hot sensing area of the probe causing rapid thermal expansion which causes the probe to read incorrect levels for some period of time.

This menu allows the operator to set the maximum duration of time that the analyser can automatically suppress these condensation related spikes.
In normal operation a value of ~2 minutes is acceptable

6.4.5 Spike Trip Level

Options: 5mV to 100mV in 1mV increments
Default: 10mV

NOTE: This menu is only visible if spike suppression is enabled in the previous menu.

This function sets the instantaneous jump in probe EMF that indicates that a condensation related spike is interfering with normal readings.

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7. Commissioning Menu

This chapter describes the functions available in the Commissioning Menu on the 1735 Water Vapour Transmitter.

To Access the Commissioning Menu;

- Ensure the DIP switch SW1-2 on the main PCB is in the ON position
- From Run Mode, press and hold the Setup button for approximately 2 seconds until the words “Commissioning Menu” appears at the bottom of the display.

When the transmitter is in the Commissioning Menu the Setup Light will be on and the words “Commissioning Menu” will be shown at the bottom of the display. The transmitter will return to the Run Mode when the SETUP button is pressed again or after 60 seconds of keypad inactivity.

Changing options in the Commissioning Menu is the same as the Setup Menu. See chapter 6.3 Changing Menu Options

7.1 Function Summary Table

The following table shows a summary of Commissioning Menu functions:

Menu #	Function Description	Range	Default value
01	Internal Clock Date		
02	Internal Clock Time		
03	Service Date		
04	Heater Dryer Type	see chapter 7.2.3 Heater Dryer Type	Indirect Fired
05	Probe 2 Input	Oxygen Probe/Dryer TC	Disabled
06	Dry O_2 Sample Delay	No Delay	600 seconds (10 mins)
07	Top Line Display	see chapter 7.2.6 Top Line Display	Water Vapour %
08	Probe 1 Type	1231 / 1234 Heated or 1232 Unheated	1231 / 1234 Heated
09	Probe 2 Type		1231 / 1234 Heated
10	Probe 1 TC Type	K or J Type	K-Type
11	Probe 2 TC Type	K or J Type	K-Type
12	Fixed Combustion O2	0.1% - 21.0%	5.0%
13	Transmitter Output Channel 1	see chapter 7.2.10 Transmitter Output Channel 1 & 2	Water Vapour 1
14	Transmitter Zero Channel 1		0 %
15	Transmitter Span Channel 1		100 %
16	Transmitter Output Channel 1		Water Vapour 1
17	Transmitter Zero Channel 2		0 %
18	Transmitter Span Channel 2		100 %
19	Flue Pressure Units	Inches WG, mm WG, kPa, PSI	Inches WG
20	Flue Pressure Input	Fixed or Variable	Fixed
21	Flue Pressure Value	-1 to 3 Atm	0 Inches WG
22	Flue Pressure Input Zero	-1 to 3 Atm	0 Inches WG
23	Flue Pressure Input Span	-1 to 3 Atm	100 Inches WG
24	Temperature Units	Celsius / Fahrenheit	Celsius
25	Cal Freezes Outputs	Enabled / Disabled	Enabled
26	Solenoid 1 Operation	Disabled/Calibration Gas / Purge	Disabled
27	Solenoid 1 Auto / Manual	Automatic / Manual	Manual

Menu #	Function Description	Range	Default value
28	Solenoid 1 Start Time	00:00 to 23:45	00:00 (midnight)
29	Solenoid 1 Period	1 minute – 7 days	1 hour
30	Solenoid 1 Duration	1 – 90 seconds	30 seconds
31	Solenoid 1 Post Freeze	5 – 300 seconds	60 seconds
32	Oxygen Content Cal Gas 1	0.1 – 20.9%	8.0%
33	Max Cal Gas 1 Positive Error	0.1% to 3.0%	0.5%
34	Max Cal Gas 1 Negative Error	0.1% to 3.0%	0.2%
35	Solenoid 2 Operation	Disabled/Calibration Gas / Purge	Disabled
36	Solenoid 2 Auto / Manual	Automatic / Manual	Manual
37	Solenoid 2 Start Time	00:00 – 23:45	00:00 (midnight)
38	Solenoid 2 Period	1 minute – 7 days	1 hour
39	Solenoid 2 Duration	1 – 90 seconds	30 seconds
40	Solenoid 2 Post Freeze	5 – 300 seconds	60 seconds
41	O2 Content Calibration Gas 2	0.1% to 20.9%	8.0%
42	Max Cal Gas 2 Positive Error	0.1% to 3.0%	0.5%
43	Max Cal Gas 2 Negative Error	0.1% to 3.0%	0.2%
44	Process Alarm 1	see chapter 7.2.23 Process Alarms	
45	Process Alarm 1 Delay		
46	Process Alarm 2		
47	Process Alarm 2 Delay		
48	Process Alarm 3		
49	Process Alarm 3 Delay		
50	Process Alarm 4		
51	Process Alarm 4 Delay		
52	Alarm Relay 1 Function	see chapter 9. Alarms	
53	Alarm Relay 2 Function		
54	Alarm Relay 3 Function		
55	Common Relay Function		
56	Accept Relay Hold	Enabled / Disabled	Enabled
57	Z-Test Frequency	see chapter 7.2.27 Probe Impedance Test Options	Daily
58	Z-Test Start Time		11:30
59	Z-Test Post Freeze		Automatic
60	Fuel SO_2 Level	1ppm to 15.0%	0.5%
61	SO_3 Conversion Rate	0.1 to 6.0%	2.0%
62	Reference Air Pump	Internal / External	Internal
63	Internal Pump Voltage	1.5v to 5.0v	5v
64	Reference Air RH %	0 to 80%	55%
65	Serial Interface	RS-232 / RS-485	RS-485
66	Serial Baud Rate	2400 – 115200 bps	19200bps
67	Serial Parity	Even / Odd / No Parity	Even Parity
68	Modbus Address	Disabled or 1 – 246	Disabled
69	Clear Alarm Log	Clear / Don't Clear	Don't Clear

7.2 Commissioning Menu Functions

7.2.1 Internal Date / Time

The date and time are used in the transmitter to run time-based operations such as impedance readings and gas calibration checks. The correct date and time should be entered by pressing and holding the OPTION ∆ and OPTION ∇ buttons. The date and time will change faster the longer the button is held.

7.2.2 Service Date

The service date can be used to keep a record of when a probe was changed. The Runtime timer which keeps a track of the hours and minutes that the transmitter and probe has been operating is reset when the service date is changed.

The service date and the runtime timer can be displayed as lower line items in Run Mode.

7.2.3 Heater Dryer Type

The most important selection in the commissioning of the 1735 Transmitter is the selection of the dryer heater type. The options are –

Mode	Description	1231 oxygen probe installed	Second probe installed	RGS temp sensor
1	Indirect Fired, Single Zone	Yes	No	No
2	Indirect Fired, Two Zones	Yes	**1231**	No
3	Direct fired, Fixed Combustion	Yes	No	No
4	Direct fired, Single Probe	Yes	No	**Yes**
5	Direct fired, Refrigerated Gas	Yes	No	No
6	Direct fired, 2 probes + Temp. sensor	Yes	**RGS-17**	**Yes**
7	Directly fired, external dry oxygen sensor	Yes	No	No
8	Directly fired, external dry oxygen sensor, two zones	Yes	**1231**	No

For a detailed explanation of the modes of operation see chapter 2.1 Dryer Modes of Operation

7.2.4 Probe 2 Input

Options: Disabled / Oxygen Probe
Dryer TC K-Type / Dryer TC J-Type
Default: Disabled

If the transmitter is configured in a dryer mode that only requires a single oxygen probe second probe input can be configured as a dryer TC to calculate Dryer Relative Humidity, or as a second standard oxygen sensor for unrelated system monitoring.

7.2.5 Dry O_2 Sample Delay

Options: No Delay
1 to 10 Seconds in 1 second increments
10 to 60 Seconds in 5 second increments
60 / 75 / 90 Seconds
120 to 600 Seconds in 60 second increments
Default: No Delay

For systems that use an external dry oxygen input via the 4-20mA input there may be some gas transport lag between the oxygen reading from the in-situ oxygen probe and the sample of the oven / dryer gas taken through the sample gas dryer. This item enables a time delay to be placed on the wet oxygen value used to calculate Water Vapour

7.2.6 Top Line Display

Options: Water Vapour / Dew Point / Oxygen
Mixing Ratio / Specific Humidity
Default: Water Vapour

The top line of the transmitter can be configured to display one of five prime humidity process variables. In addition to being displayed in large text on the top line of the transmitter display this variable is also used for configuring process alarms.

7.2.7 Probe 1 & 2 Type

Options: 1231 / 1234 Heated
1232 Unheated
Default: 1231 / 1234 Heated

The probe type function allows the selection between a heated probe and an unheated probe. Heater control and heater related alarms will be disabled if unheated probe type is selected.

Probe 2 will only be available for dryer modes requiring two oxygen probes or if the second oxygen probe has been enabled as an additional oxygen sensor.

7.2.8 Probe 1 & 2 Thermocouple Type

Options: K-Type / J-Type
Default: K-Type

The thermocouple in the Novatech 1231/1234 heated probes are always K type. Other thermocouple options are made available for special installations.

Probe 2 TC Type will only be available for dryer modes requiring two oxygen probes or if the second oxygen probe has been enabled as an additional oxygen sensor.

7.2.9 Fixed Combustion Oxygen

Options: 0.1% to 21.0% in 0.1% increments
Default: 5.0%

In dryers where the reduction of oxygen due to the combustion is constant, it is not necessary to use an RGS-17 Dry Oxygen reference gas sensor.

The value of oxygen to be entered is determined by removing any wet product from the dryer, and having the combustion at the normal level. Read the oxygen on the lower line of the display. Alternatively, a gravimetric test of the dryer of oven water vapour level will allow the operator to set the 'Combustion O_2' level so that the percent water vapour reading is correct. Ambient air must already have been supplied to the 'Ref. Air' input to the probe.

7.2.10 Transmitter Output Channel 1 & 2

The 1735 Transmitter has two fully configurable 4-20mA analog outputs. The channels are configured independently to output one of several calculated values.

If the transmitter is configured for two zone operation, channel 2 will output zone 2 process variables where applicable, otherwise it will output zone 1 process variables.

Output	Zero	Span	Step	Min Span	Default
Water Vapour	0 to 80%	20 to 100%	5%	20%	0 to 100%
Dew Point	-50 to 80°C	-30 to 100°C	5°C	20°C	-25 to 100°C
Mixing Ratio	0g/Kg to 9.8 Kg/Kg	200g/Kg to 10Kg/Kg	100g/kg	200g/kg	0 to 1Kg/Kg
Specific Humidity	0 to 950g/kg	50 to 1,000g/kg	10g/kg	50k/kg	0 to 1,000g/Kg
Dryer Temperature *	0 to 350°C	50 to 400°C	1°C	50°C	0 to 200°C
Relative Humidity *	0 to 95%	5 to 100 %	1%	5%	0 to 20%
Absolute Humidity *	0 to 950g/m^3	50 to 1,000g/m^3	1g/m^3	50g/m^3	0 to 500g/m^3
Probe 1 Oxygen	0 to 24%	1 to 25%	1%	1%	0 to 20%
Probe 2 Oxygen **	0 to 24%	1 to 25%	1%	1%	0 to 20%
No Output					

* Only available if Dryer TC is installed ** Only available in dual probe mode

The zero and span of the selected output are set in the following two menus (Commissioning Menu functions #14 & #15 for Output Channel 1 and Commissioning Menu functions #17 & #18 for Output Channel 2).

7.2.11 Flue Pressure Units

Options: Inches WG / mm WG / kPa / PSI / Atm
Default: Inches WG

The units that the flue pressure will be displayed and scaled by.

7.2.12 Flue Pressure Input Units and Value

Options: Fixed or Variable
Default: Fixed

The 1735 Transmitter is capable of fixed or variable input pressure compensation in the calculation of oxygen from -1 Atm to +3 Atm relative to ambient. If the probe is running in a pressurised environment this value should be set to allow for accurate oxygen measurement.

If the flue pressure is constant then select 'Fixed' in Commissioning Menu function #20 and enter the fixed value into function #21. If the pressure varies then flue pressure transducer may be needed to automatically compensate for variation. (See chapter 4.25 Connecting a Pressure Transducer). If a pressure transducer is being used, select 'Variable' in Commissioning Menu function #20 and set the range of the transducer using a zero and span value in functions #22 and #23.

7.2.13 Temperature Units

Options: Celsius or Fahrenheit
Default: Celsius

The display on the transmitter can be changed to show temperature scaled in either Celsius or Fahrenheit.

7.2.14 Calibration Freezes Outputs

Options: Enabled or Disabled
Default: Enabled

During gas calibration checks it may be required that the analog outputs remain frozen at their last reading. When cal freezes is enabled both analog outputs remain frozen until the entire calibration cycle has completed.

7.2.15 Solenoid 1 & 2 Operation

Options: Disabled / Calibration Gas / Purge
Default: Disabled

The two solenoid outputs can be individually configured to perform gas calibration check or probe purge.

7.2.16 Solenoid 1 & 2 Automatic / Manual

Options: Manual or Automatic
Default: Manual

When set to automatic the solenoid will perform a pre-programmed gas calibration or purge cycle when the function is triggered. When set to manual the solenoid is controlled purely from the corresponding button on the front of the case.

When set to automatic the calibration check or the purge cycle can be started by pressing the corresponding button on the front of the case. It can be stopped by pressing the same button again.

The Commissioning Menu functions #26 to #34 relating to Solenoid 1 will vary depending on the solenoid mode of operation selected in function #26 & #27. Likewise, the Commissioning Menu functions #35 to #43 relative to Solenoid 2 will vary depending on the solenoid mode of operation selected in function #35 & #36.

7.2.17 Solenoid 1 & 2 Start Time

Options: 00:00 to 23:45 in 15 minute increments
Default: 00:00 (midnight)

For automating gas calibration or purge events a start time is specified to allow precise control over the timing of such events. Starting at this specified time, the next gas calibration or purge event will occur in successive intervals from this time.

7.2.18 Solenoid 1 & 2 Period

Options: No Timered
1 to 5 Minutes in 1 minute increments
10 / 15 / 20 / 30 Minutes
1 / 2 /3 / 4 / 6 / 8 / 12 Hours
1 to 7 Days in 1 day increments
Default: 1 Hour

This option specifies the period between automatic gas calibration or purge events. For periods less than 24 hours the period is divisible into 24 hours forcing scheduling of events to occur at the same time each day between 1 minute and 7 days.

The 'No Timed' option accessible by scrolling the option below 1 minute allows for pre-configured solenoid cycles that are only triggered manually via the keypad.

7.2.19 Solenoid 1 & 2 Duration

Options: 1 to 90 Seconds in 1 second increments
Default: 30 Seconds

Duration of time that an automatic gas calibration or purge event energises the solenoid

7.2.20 Solenoid 1 & 2 Post Freeze

Options: 5 to 300 Seconds in 5 seconds increments
Default: 60 Seconds

Duration of time the transmitter waits before resuming live readings following a gas calibration or purge event. (See also chapter 7.2.15 Solenoid 1 & 2 Operation)

7.2.21 Oxygen Content Calibration Gas 1 & 2

Options: 0.1% to 21.0% in 0.1% increments
Default: 8.0%

When configured as a gas calibration check solenoid this value specifies the oxygen content of the calibration gas.

7.2.22 Maximum Calibration Gas 1 & 2 Positive / Negative Error

Options: 0.1% to 3.0% in 0.1% increments
Default: 0.5% (Positive Error) 0.2% (Negative Error)

Specifies the maximum positive & negative error levels used during the gas calibration check.
If the difference between the specified oxygen content and the measured process gas exceed these thresholds, a gas calibration error alarm will be triggered immediately.

7.2.23 Process Alarms

Although the 1735 Transmitter is capable of calculating a number of different process variables such as Water Vapour, Dew Point etc, only one of these process variables is deemed to be the 'prime' process variable which will be used to set process alarms. The prime process variable is selected on the top line display (Chapter 7.2.6).

There are four independent process alarms; each one individually set using the OPTION Δ / OPTION ∇ buttons. From the default 'disabled' position, by pressing the OPTION Δ button the alarm condition becomes process variable exceeding threshold, by pressing the OPTION ∇ button the alarm condition becomes process variable is below threshold.

The operator may configure any combination of alarm thresholds which can then be used to drive the three alarm relay outputs. By pressing OPTION Δ / OPTION ∇ the alarm threshold is increased/decreased. The disabled option is positioned between the minimum excess threshold and the minimum deficit threshold.

Each Process Alarm also has an associated alarm delay which can be set between 0 and 200 seconds. This delay time corresponds to the delay between the process alarm condition being met, and the process alarm actively triggering.

For dryer modes with two zones, each of the four process alarm thresholds applies separately for both zone 1 and zone 2. The process alarm thresholds however can be configured individually for each zone as trigger options for the three programmable alarm relays.

For example, assume Top Line display is set to Water Vapour and the system has two zones. Process Alarm 1 could be set to Water Vapour < 75%. Alarm Relay 2 could be set to trigger if Zone 1 Water Vapour < 75%, and Alarm Relay 3 could be set to trigger of Zone 2 Water Vapour < 75%. Alternatively, one Alarm Relay could be set to trigger if either zone Water Vapour < 75%.

7.2.24 Alarm Relay 1, 2 and 3 Function

There are 4 user configurable alarm relays. Any of the relays can be configured to be triggered on the following alarm conditions. In addition, any of the alarm conditions that are disabled from the common alarm relay can also be configured to trigger these 3 relays. Multiple selections can be made.

Process Alarms

Zone 1 Process Alarm 1	Zone 2 Process Alarm 4**
Zone 1 Process Alarm 2	Probe 1 Temperature Low
Zone 1 Process Alarm 3	Probe 2 Temperature Low*
Zone 1 Process Alarm 4	Calibration 1 In Progress
Zone 2 Process Alarm 1**	Calibration 2 In Progress
Zone 2 Process Alarm 2**	Purge 1 In Progress
Zone 2 Process Alarm 3**	Purge 2 In Progress

* Only available if a second oxygen probe is enabled

** Only available if the transmitter is configured in a two-zone mode

7.2.25 Common Alarm Relay Function

The common alarm relay can be configured to be triggered on any of the following:

Instrument Alarms	
Probe 1 Heater Fail	ADC Calibration Fail
Probe 2 Heater Fail*	Output 1 Fail
Probe 1 High Impedance	Output 2 Fail
Probe 2 High Impedance*	Heater 1 SSR Fail
Probe 1 Thermocouple Open Circuit	Heater 2 SSR Fail*
Probe 2 Thermocouple Open Circuit*	Heater SSR Leakage
Dryer Thermocouple Open Circuit	RGS Sensor Failed
Reference Air Pump Fail	Probe 1 Filter Blocked
Reference Air Pump Overload	Probe 2 Filter Blocked*
BBRAM Fail	Gas 1 Calibration Error
Alarm Log Fail	Gas 2 Calibration Error*

* Are only available in dual probe mode

All of the items in this list are selected as the default setting. Any of these items can be disabled from the common alarm by pressing the ENTER button, and they will then appear on the list in the other alarm relays.

7.2.26 Accepted Alarm Relay Hold

Options: Enabled or Disabled
Default: Enabled

When an Alarm Relay is configured to trigger on a particular alarm state, the relay will remain energised while the alarm state is clear, and will de-energise when the alarm state is active. There are however two other states in which the alarm may find itself where the function of the alarm relay may depend on the installation.

An alarm that has been acknowledged via the keypad, but is still present is classed as 'accepted', while an alarm which has triggered, then the alarm state has cleared before it was acknowledged is classed as 'self-cleared'. While in the 'accepted' state, the function of the alarm relay can be altered with this setting

Alarm state	Enabled	Disabled
No alarm condition	Closed circuit	Closed circuit
New alarm	Open circuit	Open circuit
All alarms accepted	Open circuit	Closed circuit
Alarms self-cleared	Closed circuit	Closed circuit

To enable backward compatibility with the 1635 series transmitter, set this to Enabled.

7.2.27 Probe Impedance Test Options

Probe Impedance testing (abbreviated to Z-Test) provides an indication of the oxygen sensor rate of response and overall health. The 1735 Water Vapour Transmitter automatically checks probe impedance at fixed intervals and raises an alarm if the impedance value is above a set threshold.

Z-Test Frequency

Options: Daily, Every 2 Days, Every 4 Days, Monday, Tuesday, Wednesday, Thursday, Friday, Saturday, Sunday, Disabled, Default Settings
Default: Daily

Z-Test Start Time

Options: 00:00 to 23:45 in 15 minute increments
Default: 11:30

The time of day that the automatic impedance test is scheduled to occur

After each impedance test is completed, the next impedance test is scheduled to occur at an interval set by this menu. By setting the Z-Test Frequency to 'Default Settings' this will alter both the Z-Test frequency and Z-Test Start Time to check probe impedance daily at 11:30am.

Note, it is possible to disable automatic impedance testing by setting this menu to 'disabled'. If automatic impedance testing is disabled it is necessary to manually perform impedance tests using the local keypad at regular intervals to monitor probe health.

Z-Test Post Freeze

Options: Automatic, No Freeze, 5, 10, 15, 20, 30, 45, 60, 90, 120, 150, 180 Seconds
Default: Automatic

Following an impedance test the sensor requires a period of time to return to stable reading. This time varies greatly depending on the process and age of the probe. By default, the transmitter automatically calculates post-freeze time based on probe impedance, however this freeze time can be manually overridden using this menu.

7.2.28 Acid Dew Point Calculation for Direct Fired Applications

These two menu items set the values used for the calculation of predicted sulphuric acid dew point for direct fired applications that involve combustion of fuels that contain sulphur. Please refer to chapter 1.3 Acid Dew Point

NOTE: These options are disabled if the heater dryer type is set to indirect fired. See chapter 7.2.3 Heater Dryer Type

	Function	Options
60	Fuel SO_2 Level	1ppm to 15.0% in varying increments Default: 0.5%
61	SO_3 Conversion Rate	0.1% to 6.0% in 0.1% increments Default: 2.0%

The first menu sets the concentration of sulphur dioxide (SO_2) in the flue emission gasses, the second menu sets the percentage of SO_2 that further reacts and oxidises to form sulphur trioxide (SO_3).

Acid Dew Point calculations can be disabled by setting the Fuel SO_2 Level to 0.

7.2.29 Reference Air Pump Options

Normally the reference air is supplied from the transmitter using the internal pump. The pump will be a model MP-24 or a model CM-15. The default options are to use an Internal MP-24 pump at 2.00v.

	Function	Options
62	Reference Air Pump	External or Internal
63	Internal Pump Voltage	MP-24 select 2.00v, CM-15 select 3.5v
64	Reference Air RH%	If external is selected, set the RH level. (5% if instrument air is used)

7.2.30 Communications Port Options

The 1735 Transmitter has a serial communications port available at terminals 18 to 22. The default protocol is for RS-232 running at 19,200 baud rate with 8 bits, even parity and 1 stop bit.

	Function	Options
65	Serial Interface	Disabled / RS-232 / RS-485 (Use RS-485 for MODBUS)
66	Serial Baud Rate	2400, 4800, 9600, 19200, 38400, 57600, 115200 (RS-232 up to 19200 only)
67	Serial Parity	Even, Odd or No Parity
68	MODBUS Address	Set the MODBUS address for this device between 1 and 246. 0 is to disable the MODBUS

7.2.31 Alarm Log Clearing

Every alarm that is instigated internally in the transmitter or as a process level is recorded in the alarm log with the activation time, accepted time and the cleared time. The last 4000 events will be recorded and then the oldest alarms will be dropped off as new ones occur. If you would like to delete the log recording use the OPTION buttons to select CLEAR and press the ENTER button. The message “Alarm Log Cleared” will be displayed.

This chapter describes the functions available in the Calibration Menu on the transmitter. For specific information about calibrating the transmitter see chapter 10. Instrument Calibration.

To Access the Calibration Menu;

- Ensure the DIP switch SW1-3 on the main PCB is in the ON position
- From Run Mode, press and hold the Setup button for approximately 4 seconds until the words "Calibration Menu" appears at the bottom of the display.

When the transmitter is in the Calibration Menu the Setup Light will be on and the words "Commissioning Menu" will be shown at the bottom of the display. The transmitter will return to the Run Mode when the SETUP button is pressed again or after 60 seconds of keypad inactivity.

Changing options in the Calibration Menu is the same as the Setup Menu. See chapter 6.3 Changing Menu Options.

8.1 Function Summary Table

The following table shows a summary of Calibration Menu functions:

Menu #	Function Description	Range	Default value
01	Reference Voltage 1, 50mV	40.00 to 60.00mV	47.14mV
02	Reference Voltage 2, 200mV	180.00 to 210.00mV	182.24mV
03	Reference Voltage 3, 1200mV	1150.0 to 1250.0mV	1221.8mV
04	Reference Voltage 4, 2500mV	2400.0 to 2550.0mV	2489.2mV
05	Output Channel 1, Calibration	Auto Calibrated / Manual Calibrated / Set 4mA / Set 20mA	Auto Calibrated
06	Output Channel 1, 4mA Trim	3.00 to 5.00mA	4.00mA
07	Output Channel 1, 20mA Trim	19.00 to 21.00mA	20.00mA
08	Output Channel 2, Calibration	Auto Calibrated / Manual Calibrated / Set 4mA / Set 20mA	Auto Calibrated
09	Output Channel 2, 4mA Trim	3.00 to 5.00mA	4.00mA
10	Output Channel 2, 20mA Trim	19.00 to 21.00mA	20.00mA
11	Ambient Temperature Sensor Offset	-10.0°C to 10.0°C	0.0°C
12	Low Oxygen Cal 1	80.0% to 120.0%	100.0%
13	Low Oxygen Cal 2	80.0% to 120.0%	100.0%
14	Transmitter Output Select	4-20mA / 0-20mA / 4-20mA over-scale limit / 0-20mA over-scale limit	4-20mA
15	Transmitter Output Limiting	Hold 0mA / Hold 4mA / Hold 20mA	Hold 20mA
16	Mains Voltage Detection Override	Automatic / 220/240 / 110/120	Automatic
17	Mains Frequency Detection Override	Automatic / 50Hz / 60Hz	Automatic
18	Heater SSR Selection	Normal Heater1 <-> Heater2 Heaters <-> CalPurge	Normal
19	SSR Fail Protection	Enabled / Disabled	Enabled
20	BFT Input Z-Trim	Disabled 0.00% to 2.00%	Disabled
21	Burner Temp O/Ride	Enabled / Disabled	Disabled
22	Ref Pump Cycling	Always On / Cycle Above xx°C (where xx is ranged 30-55°C)	Cycle Above 35°C

8.2 Calibration Menu Functions

8.2.1 Reference Voltages

The calibration of the analogue inputs is based on the voltage of a temperature compensated voltage reference integrated circuit. There are 4 voltages generated from the standard reference voltage. They will vary by about 1% from one transmitter to another but can be trimmed by setting the actual voltages into Calibration Menu functions #01 to #04.

8.2.2 Output Channel 1 and 2 Calibration

Options: Auto Calibrated / Manually Calibrated
Calibrate 4mA / Calibrate 20mA
Default: Auto Calibrated

The analog 4-20mA output calibration can be set either Auto or Manual.
If Auto Calibrated is selected the transmitter will go through an output calibration cycle when the power is turned on or when the AUTO CAL button is pressed in Setup Mode. This will divert the outputs back to the input and automatically set the 4mA and 20mA calibration.
If Manually Calibrated is selected then the 4mA and 20mA calibration must be set in the next two functions.
For the full explanation see chapter 10.1.2 Calibration of the Outputs

8.2.3 Ambient Temperature Calibration

The ambient temperature measurement is used as the cold junction temperature for the thermocouple measurements. Use an independent temperature sensor to measure the temperature inside the transmitter case near the screw terminal #1. Enter this temperature into the calibration function 11 by using the OPTION buttons and then the ENTER button.

8.2.4 Low Oxygen Calibration

Options: 80.0% to 120.0% in 0.1% increments
Default: 100.0%

The low oxygen calibration factors can be used to fine tune the oxygen calculation at low oxygen readings. It will not affect the measurement at 20.9%. They are included to allow oxygen probes made by other manufacturers to be used on a Novatech transmitter. The default is 100% but can be set to between 80 and 120%.

8.2.5 Transmitter Output Scale

Options: 0-20mA / 4-20mA
0-20mA over-scale limit / 4-20mA over-scale limit
Default: 4-20mA

The transmitter is capable of driving the outputs to ~24mA for loads <700 ohms and by default the transmitter will allow the transmitter outputs to transmit out of range (below 4mA or above 20mA) if the process variable scaling is also out of range. To prevent the transmitter outputs from retransmitting out of range set this option to either '0-20mA over-scale limit' or '4-20mA over-scale limit'

8.2.6 Transmitter Output Limiting

Options: Hold 0mA (for 0-20mA Transmitter Output Scaling)
Hold 4mA (for 4-20mA Transmitter Output Scaling)
Hold 20mA
Default: Hold 0mA / Hold 4mA

The oxygen probes used in the calculation of all process variables cannot provide an accurate measurement for oxygen until they reach their operating temperature of 650°C (1200°F). If an oxygen probe is below operating temperature, or if the probe thermocouple has been detected as open circuit then the transmitter is unable to calculate a valid reading for any process variable that uses oxygen as part of its formula.
While the transmitter has no valid process variable the analog outputs are held at this nominated level until a valid reading can be made. The default is to set the output to 20mA.

8.2.7 Mains Voltage Detection

Options: Automatic / 220-240V / 110-127V
Default: Automatic

Options: Automatic / 50Hz / 60Hz
Default: Automatic

The default setting for the 1735 Transmitter is that it will automatically detect the mains voltage and frequency in order to correctly power the probe heaters. If there is any uncertainty in this detection system the automatic voltage detection can be overridden and manually set.

8.2.8 Heater SSR Select

Options: Normal / Heater1 <-> Heater2 / Heaters <-> CalPurge
Default: Normal

In the event of one of the heater solid state relays (SSR) failing in single probe mode, this option can be used to swap the functions of the various powered relay outputs.

Warning, this option requires altering the wiring inside the transmitter. It is not recommended that you make changes to this function unless absolutely necessary.

Refer to the table below for details:

Mode	Heater 1 Solenoid	Heater 2 Solenoid	Cal / Purge 1 Sol	Cal / Purge 2 Sol
Normal	Heater 1	Heater 2	Cal / Purge 1	Cal / Purge 2
Heater1 <-> Heater2	Heater 2	Heater 1	Cal / Purge 1	Cal / Purge 2
Heaters <-> CalPurge	Cal / Purge 1	Cal / Purge 2	Heater 1	Heater 2

8.2.9 SSR Fail Protection

Options: Enabled or Disabled
Default: Enabled

The transmitter continuously monitors the high voltage outputs on the solid-state relays that power the probe and purge/cal solenoids. If it detects that any solenoids are not switching off correctly then it mechanically isolates all high voltage outputs in order to protect the instrument. This feature can be switched off by setting the SSR fail protection to disabled.

Note: It is recommended that you leave this enabled unless you are experiencing problems with the leakage detection system.

8.2.10 BFT Input Z-Trim

Options: Disabled, or Enabled 0.01% to 2.00%
Default: Disabled

This option allows for adjustment of the calibration of the 4-20mA BFT input used in some modes for external dry oxygen. Due to electronic attenuation on some transmitters, the high end of the 4-20mA input may read low, and this trim factor can be used to adjust accordingly. It should be set at the factory, and alteration may require special calibration equipment.

8.2.11 Burner Temp Override

Options: Disabled, or Enabled
Default: Disabled

The mains power to the two probe heaters and purge/cal solenoids is switched through the electromechanical 'burner' relay. In addition to being used to disable the probe heaters as part of the burner interlock safety system, this relay can also be de-energised by the 1735 transmitter to protect a probe from burning out in the event of a failure in the probe temperature controller.

In normal operation the burner interlock is de-energised if any heated probe exceeds 735°C (1355°F) as this may indicate an electronic fault in the transmitter temperature controller or feedback loop. In certain applications where heated probes are used in a process that exceeds 735°C, to use the purge/cal solenoids at temperatures above 735°C this override option must be set to enabled.

WARNING: by enabling the burner temperature override, the operator acknowledges that in the unlikely event of a probe heater solid-state relay short-circuit, the normal temperature protection will be disabled resulting in the probe heater burning out.

8.2.12 Ref Pump Cycling

Options: Always On, or Cycle Above 30°C to 55°C in 5°C increments
Default: Cycle Above 35°C

The internal reference air pump is used to move a small volume of atmospheric air to the reference side of the oxygen sensor to allow for the continuous accurate measurement of oxygen concentration in the process gas relative to ambient. If an oxygen probe is used without a reference air pump then the oxygen on the reference side of the sensor will 'stagnate' and result in drift in the EMF output of the sensor.

The reference air pump is a small mechanical diaphragm pump located inside the transmitter case. As the temperature inside the case heats up, the expected lifespan of the pump will reduce. In order to maximise the life of the pump the transmitter can cycle the reference air pump to reduce its overall use.

Once the internal case temperature exceeds the pump cycle threshold, the reference air pump will run for 30 seconds on, then 30 seconds off. This is enough to prevent the atmospheric air on the reference side of the sensor from stagnating.

The 1735 Water Vapour Transmitter has 4 alarm relays, a built-in alarm annunciator and an alarm log. When an alarm occurs, the Alarm Light will flash. To find out what the alarm is, press the ALARM Δ button.

When the ALARM Δ button has been pressed, the transmitter goes into the Alarm Display Mode. In this mode some of the buttons take on a different function.

Button text	Run Mode	Alarm Mode
SETUP / RUN	*	Return to Run Mode
DISPLAY / FUNCTION Δ	*	Next alarm
DISPLAY / FUNCTION ∇	*	Last alarm
ALARM / OPTION Δ	Enter Alarm Display Mode	Alarm activated time
ALARM / OPTION ∇	Enter Alarm Log Mode	Alarm acknowledged time
ALARM ACCEPT / ENTER	*	Acknowledge alarm
GAS 1 PURGE 1 / SENS IMP	*	*
GAS 2 PURGE 2 / AUTO CAL	*	*

* This button is not used in the Alarm Display Mode

The common alarm relay is intended to monitor faults within the transmitter and the probe. The other three alarm relays relate to the process gas. The actions of all four relays can be configured using the Commissioning Menu.

If one of the alarm events is removed from the common alarm using Commissioning Menu function #49, then this alarm event can be programmed for one of the other 3 alarm relays.

When the Alarm Mode has been entered, the Setup Light flashes once a second. The transmitter will return to Run Mode if the SETUP / RUN button is pressed a second time, or after 60 seconds of keypad inactivity.

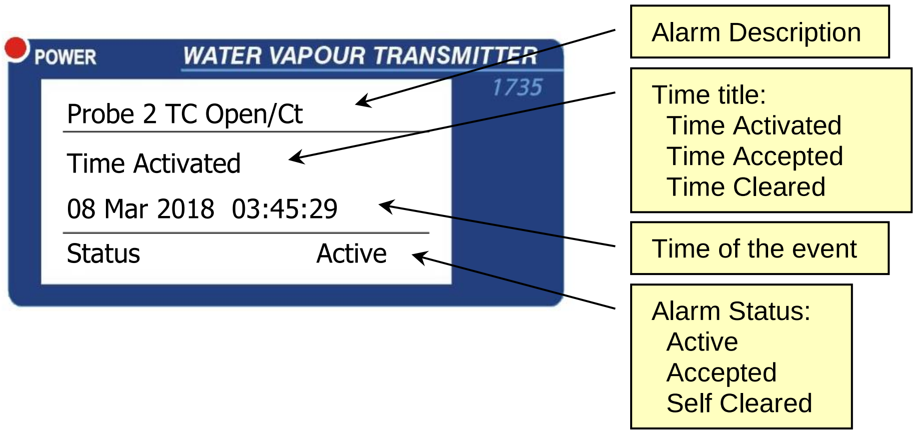
All relays have fail-safe alarm contacts. That is –

When the transmitter is powered off the contacts are open circuit
When the transmitter is powered on but there are no alarms the contacts will be closed
When there is a current unaccepted alarm event the contacts will be open circuit
When there is a current accepted alarm event the state of the contacts will depend on the selection in the Commissioning Menu #56. See chapter 7.2.26 Accepted Alarm Relay Hold.

All alarms drive the alarm light on the front door.

The light will be off if there are no alarms current
The light will flash if there is a current alarm that has not been acknowledged
The light will be on steady if there are current alarm(s) that have not been cleared
The light will flash faster as more alarms occur

9.1 Checking and Accepting an Alarm



When a new alarm occurs, either a process alarm or an alarm that will appear in the common alarm list, the Alarm Light will flash quickly.

To check the cause of the alarm –

1. Press the ALARM Δ button. This will put the transmitter into the current alarm mode. The Setup Light will flash.
2. The alarm screen will appear displaying the cause of the alarm on the top line.
3. Press the ALARM ACCEPT button to accept the alarm.
4. Press the OPTION Δ button to see the next active alarm or the OPTION ∇ button to see the previous active alarm.
5. When all the new alarms have been ACCEPTED the Alarm Light will stop flashing.
6. Accept each alarm and then press the SETUP / RUN button to return to the Run Mode

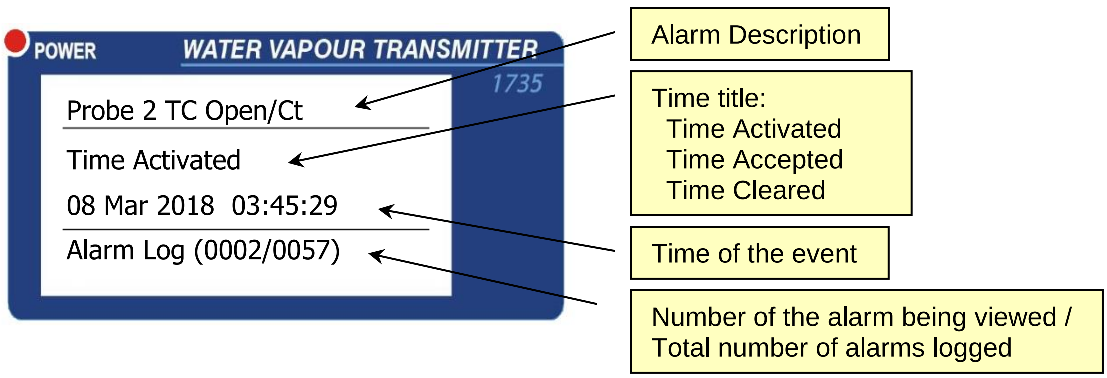
9.1.1 Current Alarms

To view the alarms that are still current press the ALARM Δ button from the Run Mode and then use the ALARM Δ and ALARM ∇ buttons to view all alarms. Use the DISPLAY Δ and DISPLAY ∇ buttons to view the Time Activated and the Time Accepted of each alarm.

9.1.2 Alarm Log

The alarm log keeps a record of the alarm events after the cause of the alarm has been cleared. It will hold a record of up to 4000 alarm events and will be retained even with the transmitter power off.

To view all the alarms that have occurred in the alarm log press the ALARM ∇ button from the Run Mode. The display will look like this:



Use the OPTION ∆ and OPTION ∇ to scroll through the alarm events that have been saved in the alarm log. The alarm event will be transferred to the alarm log when the alarm has been cleared.

The alarms are stored in the alarm log in chronological order. However, it may be seen that the current alarm number will skip some numbers. These numbers have been reserved for alarm events that are still current. When the alarm cause has been removed, these alarm events will be transferred to the alarm log.

9.2 Common Alarms

The cause of events that trigger the common alarms are described below, along with some suggestions on what might be the appropriate response to these alarms. If the alarm cannot be resolved using the directions below then the fault may be with the transmitter itself. If you believe this is the case then please contact your supplier to discuss further testing or repair options.

It is assumed that an appropriately qualified technician will carry out the testing, the probes, transmitters and cabling may contain active mains power. Please disconnect all wiring to the probe before performing any electrical tests.

1. 'Probe 1 Heater Fail'
2. 'Probe 2 Heater Fail'

Alarm Trigger: This alarm indicates that the heated oxygen probe has failed to reach the minimum operational temperature of 650°C (1200°F) within a normal time period of 20 minutes.

In normal operation, it is expected that a heated probe will reach a minimum operating temperature of 650°C in less than 20 minutes once the burner relay is enabled. If it does not reach this temperature within the given time, either because the heater is faulty, or the probe is experiencing significant cooling due to process gas airflow then this alarm will be triggered.

Response to Alarm: Use a digital multimeter to test the probe heater and confirm whether it is open-circuit. Check the fuses FS2 and FS3 inside the transmitter and confirm neither are open-circuit. Test to see whether there is significant cooling to the probe caused by the process which may result in the probe temperature dipping below 650°C (1200°F).

3. 'Probe 1 High Impedance'
4. 'Probe 2 High Impedance'

Alarm Trigger: Oxygen probe electrode failure. The transmitter monitors the health of the oxygen sensor by periodically testing the sensor's internal impedance. The impedance will naturally vary from ~0.2kΩ when new and settle at 2kΩ - 5kΩ during its operational lifetime. As the sensor reaches the end of its operational lifespan the impedance will begin to increase more rapidly and once it exceeds 8kΩ the response rate of the sensor will be too slow for use.

Response to Alarm: Replace the probe. Contact your local distributor to discuss refurbishment options for your old probe.

5. 'Probe 1 TC Open Circuit'
6. 'Probe 2 TC Open Circuit'

Alarm Trigger: The Probe thermocouple is reading open-circuit.

NOTE: For heated probes, the heater is switched off when the thermocouple is open circuit.

Response to Alarm: Use a digital multimeter to test the thermocouple contacts on the probe and confirm whether it is open-circuit. Check any terminations for the thermocouple wires from the cable inside the transmitter. Check for any physical damage to the probe cable.

7. 'Dryer TC Open Circuit'

Alarm Trigger: The dryer thermocouple is reading open-circuit.

This alarm will only trigger for configurations where the Dryer TC is enabled. If the Dryer TC is not being used this alarm can easily be suppressed by disabling the Dryer TC. See chapter 7.2.4 Probe 2 Input

Response to Alarm: Use a digital multimeter to test the dryer TC and confirm whether it is open-circuit. Check any terminations for the Dryer TC cabling inside the transmitter and at any other termination points. Check for any physical damage to the dryer TC cable.

8. 'Ref Air Pump Fail'

Alarm Trigger: The reference air pump in the transmitter has failed. The transmitter has an internal reference air pump for supplying ambient air to the reference side of the oxygen probe. The transmitter monitors the current being drawn by this pump to detect for failures.

This alarm corresponds to the current being drawn by the pump being abnormally low, indicating the pump is no longer present.

Response to Alarm: Check the wiring on the pump for any broken wires. Check the connector CN8 to the reference pump is fully inserted. Replace the reference air pump.

9. 'Reference Air Pump Overload'

Alarm Trigger: Refer to the first paragraph of the alarm trigger description for 'Ref Air Pump Fail' above.

This alarm corresponds to the current being drawn by the pump being abnormally high. The pump is disabled to protect the drive circuitry from damage.

Response to Alarm: Check the pump for any signs of physical damage. Replace the reference air pump.

10. 'BBRAM Fail'

Alarm Trigger: The BBRAM is an internal component that maintains the date and time. If this device fails then the device loses its ability to accurately set and maintain time. This will affect time-related functions such as automatic purges which will no longer trigger at the set time.

Response to Alarm: Contact your supplier for replacement options.

11. 'Alarm Log Fail'

Alarm Trigger: The internal memory device responsible for storing both the device calibration and alarm log has failed. If this occurs then the device will run using default settings.

Response to Alarm: Contact your supplier to arrange for the device to be repaired.

12. 'ADC Calibration Fail'

Alarm Trigger: The analog to digital converter has been found to fall outside the normal calibration specifications. In this case the probe heaters will automatically be turned off and the device will be unable to read inputs or re-transmit calculated process variables.

Response to Alarm: Contact your supplier to arrange for the device to be repaired.

13. 'Output 1 Failure'
14. 'Output 2 Failure'

Alarm Trigger: The digital to analogue and voltage isolator circuit has been found to fall outside the normal calibration specifications. This check is only performed when the AUTO CAL button is pressed. See chapter 10.1.2 Calibration of the Outputs

Response to Alarm: If you are not using both outputs simultaneously you may be able to disable the failed output and use the second output instead. Check for any loop powered/active receivers or diagnostics devices that may have caused the failure. Contact your supplier to arrange for the device to be repaired.

15. 'Heater 1 SSR Failure'
16. 'Heater 2 SSR Failure'

Alarm Trigger: One of the heater power control devices (SSR) has been found to have failed.

Response to Alarm: See chapter 8.2.8 Heater SSR Select.

17. 'Heater SSR Leakage'

Alarm Trigger: One of the heater power control devices (SSR) has been found to have failed, but the transmitter cannot determine which one or ones have failed.

Response to Alarm: See chapter 8.2.8 Heater SSR Select

18. 'RGS Sensor Failed'

Alarm Trigger: The transmitter has determined that a RGS temperature sensor is required for operation, but has failed to detect a valid input.

Response to Alarm: Check that the RGS Temperature sensor is correctly installed as described in Chapter 4.12. Test the voltage output on the terminals marked BFT+ / BFT-, it should correspond to ~10mV per 1°C.

19. ‘Probe 1 Filter Blocked’
20. ‘Probe 2 Filter Blocked’

Alarm Trigger: The alarm is caused by a blocked probe filter. This test is only performed when automatic purging of the probe is selected. See chapter 11. Gas Calibration Check and Purge. This alarm will not reset until the next purge cycle. The cycle can be initiated manually or automatically.

Response to Alarm: Check the probe filter. If the purge system does not require an alarm this can be disabled by linking across terminals 16 & 17 on the main board.

21. ‘Gas 1 Calibration Error’
22. ‘Gas 2 Calibration Error’

Alarm Trigger: At the end of an automatic gas calibration check cycle the oxygen reading was outside the values set in the Commissioning Menu #26 to 28 (#35 to 37). This alarm will not reset until the next calibration check cycle. The cycle can be initiated manually or automatically.

Response to Alarm: Check the gas calibration system for air leaks, certified gas concentration and flow rates.

9.3 Selectable Process Alarms

The Alarm Relays 1, 2 and 3 are generally used to transmit a process related alarm event. Any or all of the following functions can be selected for each relay.
The trip levels and the delay times are set is in the Commissioning Menu.

23. Zone 1 Process Alarm 1
24. Zone 1 Process Alarm 2
25. Zone 1 Process Alarm 3
26. Zone 1 Process Alarm 4

The measured process variable level on the indicated zone has been below the trip level shown in Commissioning Menu function #44 for longer than the delay time shown in function #45.

27. Zone 2 Process Alarm 1
28. Zone 2 Process Alarm 2
29. Zone 2 Process Alarm 3
30. Zone 2 Process Alarm 4

31. ‘Probe 1 Temperature Low’
32. ‘Probe 2 Temperature Low’

The probe temperature is below 650°C (1200°F). Below this temperature the oxygen sensor cannot make a valid reading therefore all process variables related to oxygen are invalid. If the probe heater has been enabled for more than 20 minutes and the temperature is less than 650°C (1200°F) a ‘Probe # Heater Fail’ alarm will occur.

NOTE: The ‘Probe # Temperature Low’ relay function is used with unheated probes to indicate oxygen reading is invalid (the probe is below 650°C / 1200°F), in case the process temperature falls below this level. With heated probes this relay will be de-energised while the probe is heating up from ambient, making the contacts open circuit.

33. ‘Cal 1 in Progress’
34. ‘Cal 2 in Progress’

A calibration check is occurring, either manual or automatic mode.

35. ‘Purge 1 in Progress’
36. ‘Purge 2 in Progress’

A probe purge is occurring, either manual or automatic mode.

9.4 Alarm Relay Options

The three Alarm Relays (relays 1 to 3) are user programmable. The relay action will depend on the selections made in the Commissioning Menu functions #52 to #54.

The relay contacts are all designed to be "Fail Safe". That is, they are

- open when the transmitter power is off
- closed when the transmitter is powered on and there is NOT an alarm condition
- open when an alarm occurs

The contact will close circuit again (relay energised) when the alarm condition is acknowledged.

Choose to have the relays react to any or all of the following alarms or warnings –

Zone 1 Process Alarm 1	Alarm
Zone 1 Process Alarm 2	Alarm
Zone 1 Process Alarm 3	Alarm
Zone 1 Process Alarm 4	Alarm
Zone 2 Process Alarm 1	Alarm
Zone 2 Process Alarm 2	Alarm
Zone 2 Process Alarm 3	Alarm
Zone 2 Process Alarm 4	Alarm
Probe 1 Temperature Low	Warning
Probe 2 Temperature Low	Warning
Calibration check on probe 1 in Progress	Warning
Calibration check on probe 2 in Progress	Warning
Purge on probe 1 in Progress	Warning
Purge on probe 2 in Progress	Warning

In addition to the above process alarms that can activate the process alarm relays, any of the common alarm relay events that have been taken off the common alarm list in Commissioning Menu function #55 will appear on the process alarm relay lists in function #52 to #54.

10.1 Calibration Summary

The 1735 Water Vapour Transmitter has a self-calibration and diagnostic system built into the hardware and software. Once the reference voltages have been set into memory the self-calibration system maintains the calibration of the transmitter. An automatic update of the zero and span is done every minute.
The 4-20mA outputs can be automatically calibrated with the press of the AUTO CAL button or manually fine-tuned.
One entry for each probe offset is required to optimise the calibration of the oxygen measurement although an automatic system calibration check can be programmed into the transmitter using certified gasses.

10.1.1 Calibration of the Inputs

The calibration of the analogue inputs is based on the voltage of a temperature compensated voltage reference integrated circuit. There are 4 voltages generated from the standard reference voltage. They will vary by about 1% from one transmitter to another but can be trimmed by setting the actual voltages into Calibration Menu functions #01 to #04.

The calibration should be done 30 minutes or more after the instrument has been on, approximately once every year. The calibration constants are retained in battery backed memory unless a 'COLD START' is performed. See chapter 10.2 Cold Start.
Connect a 3 ½ digit multimeter negative lead to the test point marked 'COM' in the centre of the 1730-1 PCB (labelled 'V-REFS'). Measure the four voltages on the test point marked 1 to 4 with the positive lead of the multimeter. Enter the measured values in the Calibration Menu functions #1 to 4. Whenever new values are entered, the D/A Section should be re-calibrated. See chapter 10.1.1 Calibration of the Inputs.

10.1.2 Calibration of the Outputs

The easiest way to calibrate the outputs is to select 'Auto Calibrated' in Calibration Menu functions #5 and 8. If this is selected the outputs will be directed away from the output terminals and back into an analogue input of the transmitter. The outputs are then tested and a zero and span calibration factor is recorded.
If a more accurate calibration is required select 'Manually Calibrated' in Calibration Menu functions #5 and 8. This will inhibit the automatic calibration system overwriting the calibration factors. However, the zero and span factors will need to be manually set. To set the calibration factors use the following steps for each output:

1. Select Calibration Menu function #05 (function #08 for Output 2), press the OPTION ∆ button to set the option to 'Calibrate 4mA'. Press the ENTER button.
2. Press the FUNCTION ∆ button to navigate to Calibration Menu function #06 (function #09 for Output 2), set this value 4.00mA using the OPTION ∆ / OPTION ∇ buttons. Press the ENTER button.
3. Measure the actual output current with a digital multimeter.
4. Use the OPTION ∆ / OPTION ∇ buttons to adjust the value on the display to match the reading on the digital multimeter. Press ENTER to save changes.
5. The output on the digital multimeter should now read 4.00mA. If desired, this value can be fine-tuned until exactly 4.00mA is read on the digital multimeter. Remember to press the ENTER key after each adjustment to the calibration
6. Press the FUNCTION ∇ to navigate back to Calibration Menu function #5 and press the OPTION ∆ button to set the option to 'Calibrate 20mA'. Press the ENTER button.
7. Press the FUNCTION ∆ button to navigate to Calibration Menu function #07 (function #10 for Output 2), set this value to 20.00mA using the OPTION ∆ / OPTION ∇ buttons. Press the ENTER button
8. Measure the actual output current with a digital multimeter.
9. Use the OPTION ∆ / OPTION ∇ buttons to adjust the value on the display to match the reading on the digital multimeter. Press ENTER to save changes.
10. The output on the digital multimeter should now read 20.00mA. Like before, the value can be fine-tuned as required.

11. Press the FUNCTION ∇ button to navigate back to Calibration Menu function #05 and press the OPTION ∆ button twice to select 'Manually Calibrated'. Press the ENTER button.

10.1.3 Probe Calibration

There is only one calibration factor for the calibration of the oxygen probe. This is the sensor offset, and it is written on a tag attached to every probe.

Use the FUNCTION buttons to navigate to Setup Menu #01 (or Setup Menu #02 for probe 2) and then use the OPTION buttons to set the value to the value written on the tag. If in doubt the best option is to set the offset to 0.0mV as this will only produce an error of around 0.1% oxygen in a combustion application for a 1mV error in the offset value.

For information on checking the probe and transmitter system with a certified gas see chapter 11. Gas Calibration Check and Purge.

10.2 Cold Start

The purpose of the Cold Start function is to return all of the configuration on the transmitter back to the factory default values. There are several reasons why a Cold Start may be necessary

1. After a firmware upgrade, if the update requires changes to the menu functions then the transmitter will automatically perform a Cold Start.
2. The transmitter will automatically force a Cold Start when the power is turned on and the configuration / calibration factors are found to be corrupted. The device configuration and device calibration are stored in separate blocks of memory and the device can detect corruption and factory reset one or both parts as necessary.
3. A Cold Start can be manually performed if the operator wants to reset the transmitter back to the default factory configuration. See chapter 10.2.1 Forcing a Cold Start.
4. Resetting the calibration factors back to the default values. See chapter 10.2.2 Resetting the Calibration Factors.

10.2.1 Forcing a Cold Start

The cold start can be initiated by following these steps:

1. Turn the transmitter power off.
2. Use a fine point or screw driver to set the DIP switch SW1-1 on the 1730 main PCB to ON. The switch is at the bottom of the 1730-1 PCB, accessible through the window in the shield.
3. Turn the transmitter back on.
4. You will be prompted to select 'Reset' or 'Cancel' to the prompt 'Reset Calibration Data?'. Press the DISPLAY ∆ button to reset the calibration factors and the configuration data or the ALARM ∆ key to only reset the configuration of the transmitter.
5. Turn off the Cold Start switch when prompted by 'Turn off C/Start Switch'.

If the calibration factors have been reset, follow the instructions in chapter 10.1 to recalibrate the transmitter. If only the configuration has been reset it is also important to check items that will affect the transmitter outputs, number of probes, the serial communications, the solenoid configuration and other items.

10.2.2 Resetting the Calibration Factors

If it is required to reset the calibration factors, follow the instructions in the previous section and select 'Reset' when prompted to 'Reset Calibration Data?'.

11. GAS CALIBRATION CHECK AND PURGE

The Novatech oxygen sensor that is used in the Novatech oxygen probe is extremely predictable, stable and reliable. For this reason, the calibration of a Novatech oxygen system does not require the use of calibration gases. However, all Novatech oxygen probes have a built-in gas connection that does allow the accuracy of the probe to be checked in-situ. This chapter describes the operation of this gas checking system.

The 1735 has a timer and solenoid driving system that can be configured to admit a certified calibration gas into the probe or an air supply to purge the probe filters through the gas connection. Both the calibration gas and the filter purge gas must be piped to the port on the probe labelled "CAL".

There are two mains voltage solenoids drivers in the 1735 Transmitter. They can be used for any combinations of gas checking and probe filter purging. The only limitation is that if the transmitter is in dual probe mode, then solenoid #1 must be wired and plumbed to the probe #1 and solenoid #2 must be wired and plumbed to probe #2.

The transmitter can also be configured to be in a MANUAL or AUTOMATIC purge and gas check mode.

Menu	Description	Options			
22 (31)	Solenoid 1 (2) Operation	Disabled / Calibration Gas / Purge	√	√	√
23 (32)	Solenoid 1 (2) Auto / Manual	Automatic / Manual	√	√	√
24 (33)	Solenoid 1 (2) Start Time	00:00 to 23:45		√	√
25 (34)	Solenoid 1 (2) Period	1 hour – 7 days		√	√
26 (35)	Solenoid 1 (2) Duration	1 – 90 seconds		√	√
27 (36)	Solenoid 1 (2) Post Freeze	5 – 300 seconds		√	√
28 (37)	Oxygen Content Cal Gas 1 (2)	0.1 – 20.9%			√
29 (38)	Max Cal Gas 1 (2) Positive Error	0.1% to 3.0%			√
30 (39)	Max Cal Gas 1 (2) Negative Error	0.1% to 3.0%			√

Available if 'Solenoid Operation' is set to either 'Calibration Gas' or 'Purge'

Available if 'Solenoid Operation' is set to 'Purge' and 'Automatic'

Available if 'Solenoid Operation' is set to 'Calibration Gas' and 'Automatic'

11.1 Purge

For processes that have particulate present in the gas stream, probe filters are necessary and should be back-purged with sufficient frequency to avoid blocked filters.
Select 'Purge' in function #20 (29) and 'Automatic' in function #30 and then set the times in function #22 (31) to #25 (34). The outputs can be frozen during purging if selected in Commissioning Menu function #19.
A flow switch can be wired to terminals 16 and 17. If the flow is not sufficient at the end of the purge cycle to close the contacts of the flow switch a 'Probe 1 (2) Filter Blocked' alarm is generated. If a flow switch is not being used a short circuit should be placed across terminals 16 and 17 to suppress the 'Probe 1 (2) Filter Blocked' alarm.

11.2 Calibration Gas

If it is required to automatically check the oxygen probe and transmitter on line, select 'Calibration Gas' in the Configuration Menu function #26 (#35) and 'Automatic' in the Configuration Menu function #27(#36) and then set the times in function #28 to #31 (#37 to 40) and the gas levels in function #32 to #34 (#41 to #43).

If the oxygen content read by the probe during a Gas Calibration Check does not fall within the tolerances set in the Configuration Menu items above, a 'Gas Calibration Error' alarm will be generated.

If the transmitter has 'Automatic' selected in Calibration Menu #27 (#36) and one of the GAS / PURGE buttons is pressed in Run Mode, the automatic cycle will be started and the alarms will be checked. The cycle can be stopped at any time by pressing the same button during the cycle.

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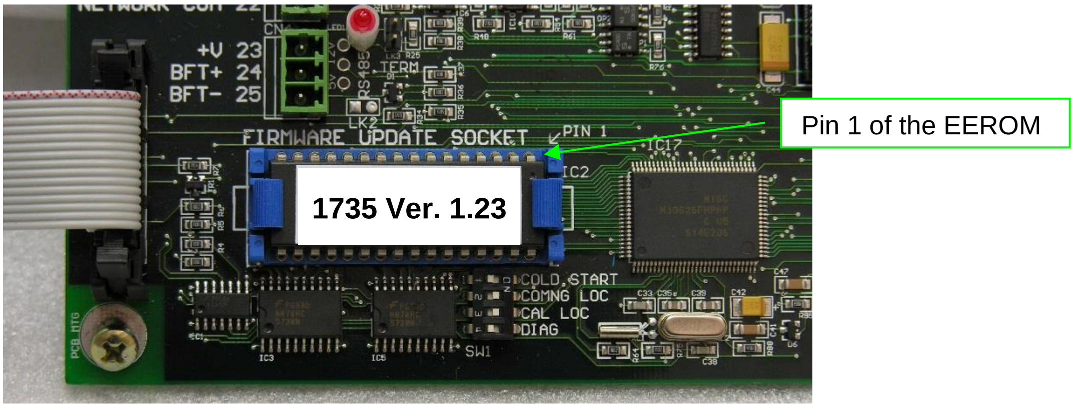
The firmware for the 1730 series transmitters is programmed directly into the microprocessor during manufacture. It can be upgraded to a newer version using the 'firmware update socket' on the main PCB.

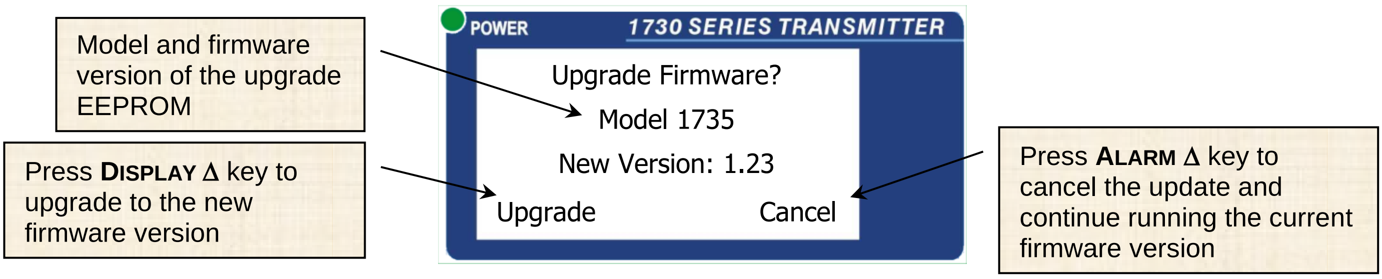
If an upgrade is to be made to the software it will be supplied in a 32 pin EEPROM IC type 29F010B. To do the upgrade, use the following steps:

1. **Turn the power off to the transmitter using the power switch on the board**
2. Remove the hose from the reference air pump (if fitted)
3. Unplug the reference air DC power lead (if fitted)
4. Undo the two M4 screws at the top and bottom of the main shield
5. Remove the earth screw from the main shield on the right-hand side of the cabinet
6. Lift out the main shield around the cable glands
7. If the socket has the quick release ejectors, fold out the two wings of the blue socket labelled "FIRMWARE UPGRADE SOCKET". Plug the 29F010B into the socket.

WARNING: Be very careful not to bend any of the pins of the EEPROM. If the EEPROM does not have all the pins correctly plugged into the socket during upgrade the EEPROM may be damaged and the upgrade process will not work.
Note also the direction of the EEROM. Pin 1 is identified by a small dot on the EEPROM. This dot MUST be oriented in the top right-hand corner of the socket as indicated by the arrow on the board and the diagram.



8. While the power is still turned OFF, press and hold the DISPLAY ∇ and the ALARM LOG ∇ buttons. Turn on the analyser holding down the two buttons.
9. If the message "Invalid EEPROM, Unable to Upgrade" is displayed, turn the power off again and check the pins of the EEPROM and that it was in the correct direction.
10. If the display looks like the following image, press the DISPLAY Δ button to load the upgrade software



NOTE: While the firmware is being upgraded it is essential that the power is not turned off otherwise the programme will be corrupted and will not be recoverable.

11. Once the transmitter has upgraded the firmware, it will automatically reset and begin normal initialisation. The version of the firmware is shown on the startup screen.
12. Turn the transmitter power off.
13. Unplug the EEPROM by pressing out the wings of the blue upgrade socket. Keep the EEPROM in a safe place. The same EEPROM can be used to upgrade any number of transmitters as required.
14. Replace the main shield and secure it with the three screws.
15. Reconnect the reference air pump hose and plug (if fitted).
16. Turn the power back on.

NOTE: The transmitter may perform an automatic COLD START after the upgrade. The words 'Cold Start' will be shown on the display in step 14 if the cold start has been performed. The calibration will NOT be changed but the configuration may have been changed.

The Novatech 1735 Water Vapour Transmitter has proved an extremely reliable instrument. The trouble shooting guide here is based on an analysis of the potential problem that may occur after many years of operation in the field. A current list of problems and solutions can be found on the Novatech web site at www.novatech.com.au when any are identified.

13.1 First Approach

The probe will not heat up.
Turn the power off, remove and check 2 x 20mm glass fuses. If either of them is blown, check the probe heater resistance between the two white wires that come from the probe. It should be 110 +/- 15 ohms, and both wires should be open circuit to earth. If not, replace the probe.
Is the 'B' shown on the bottom left hand corner of the display? If not, check that the burner is enabled with either a link between terminals 10&11, BURNER INPUT, or is enabled with a connection to a voltage-free contact from the main fuel valve to these terminals.

The display is blank and there is no backlight on.
Measure the power supply voltages at the test points labelled COMM and +5v at the right-hand side of the main PCB 1730-1. It should be 5 +/- 0.15v.
Turn off the power and remove the main shield. Check that the plug-in fuse FS1 has not blown. It should only be replaced with a 1A, 250v fuse if it has blown.
Is the mains power being supplied to terminals 36&37 and is it between 85 and 265VAC? If may be necessary to replace the switch-mode power supply, PS5, APC-5S.

An 'ADC Calibration Fail' alarm has occurred.
Turn the transmitter off and remove the main shield. Turn the transmitter back on and measure the voltages on the 'ACom' test points. With the negative lead on the centre terminal the other 2 terminals should measure 12 +/-0.3v. If not, replace the small DC-DC converter PS4.

An 'Output 1 (2) Failure' alarm has occurred.
Turn the transmitter off and remove the main shield. Turn the transmitter back on and measure the voltages on the 'D1com' test points. With the negative lead on the centre terminal the other 2 terminals should measure 12 +/-0.3v. If not, replace the small DC-DC converter PS4.

A 'Heater 1 (2) Failure' alarm has occurred.
The software has found that the SSR4 has failed. If only one probe is being used and you need to gets the transmitter back working quickly, use the CALIBRATION menu function 18, Heater SSR Select, to change the heater output terminals. See chapter 8.2.8 Heater SSR Select.

A 'BBRAM Fail' alarm has occurred
Replace the BBRAM, MEM1 on the 1730-1 main PCB.

13.2 Detailed Fault Analysis

The 1735 transmitter has a Diagnostics Mode built into the software. This mode allows detailed analysis of the hardware of the transmitter, but does require a level of competence in electronics.

The Diagnostics Mode is selectable by turning the 'Diagnostics' DIP switch to ON and then turn on the power.

There is a separate Diagnostics Mode Manual available that describes its use. Ask Novatech for more details.

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ZIRCONIA OXYGEN SENSOR OUTPUT (mV)
PROBE TYPE 1231, SENSOR TYPE 1234

OXYGEN %	**Probe EMF @ 720°C (1320°F)**	**OXYGEN %**	**Probe EMF @ 720°C (1320°F)**
20.95	0	10.0	15.930
20.5	0.517	9.5	17.033
20.0	1.046	9.0	18.196
19.5	1.589	8.5	19.426
19.0	2.147	8.0	20.730
18.5	2.719	7.5	22.120
18.0	3.306	7.0	23.607
17.5	3.911	6.5	25.204
17.0	4.533	6.0	26.930
16.5	5.173	5.5	28.808
16.0	5.834	5.0	30.867
15.5	6.515	4.5	33.145
15.0	7.219	4.0	35.695
14.5	7.947	3.5	38.590
14.0	8.700	3.0	41.940
13.5	9.481	2.5	45.913
13.0	10.292	2.0	50.797
12.5	11.134	1.5	57.135
12.0	12.011	0.9	66.182
11.5	12.925	0.4	82.168
11.0	13.881	0.2	99.518
10.5	14.881	0.1	114.347

'K' Type TC 29.965 mV @ 720°C (1320°F)

These tables are based on the Nernst equation:

$$EMF = \frac{T \log_e(O_2/20.95)}{-46.421}$$ Where *T* is temperature° K

ZIRCONIA OXYGEN PROBE OUTPUT (mV)
PROBE TYPE 1232

	TEMPERATURE °C (°F)								
OXYGEN %	**600 (1110)**	**700 (1290)**	**800 (1470)**	**900 (1650)**	**1000 (1830)**	**1100 (2010)**	**1200 (2190)**	**1300 (2370)**	**1400 (2550)**
20	0.873	0.973	1.073	1.173	1.273	1.373	1.473	1.573	1.673
19.5	1.349	1.504	1.658	1.813	1.967	2.122	2.276	2.431	2.585
19	1.838	2.048	2.259	2.469	2.680	2.890	3.100	3.311	3.521
18.5	2.339	2.607	2.875	3.143	3.411	3.679	3.947	4.215	4.483
18	2.855	3.182	3.509	3.835	4.162	4.489	4.816	5.143	5.470
17.5	3.385	3.772	4.160	4.547	4.935	5.323	5.710	6.098	6.485
17	3.930	4.380	4.830	5.280	5.730	6.180	6.630	7.080	7.530
16.5	4.491	5.006	5.520	6.034	6.549	7.063	7.578	8.092	8.606
16	5.070	5.651	6.231	6.812	7.393	7.973	8.554	9.135	9.715
15.5	5.667	6.316	6.965	7.614	8.263	8.913	9.562	10.211	10.860
15	6.284	7.004	7.723	8.443	9.163	9.882	10.602	11.322	12.042
14.5	6.922	7.714	8.507	9.300	10.093	10.885	11.678	12.471	13.263
14	7.582	8.450	9.318	10.187	11.055	11.923	12.792	13.660	14.528
13.5	8.266	9.212	10.159	11.106	12.052	12.999	13.946	14.892	15.839
13	8.976	10.004	11.032	12.060	13.087	14.115	15.143	16.171	17.199
12.5	9.713	10.826	11.938	13.051	14.163	15.276	16.388	17.500	18.613
12	10.481	11.682	12.882	14.082	15.283	16.483	17.684	18.884	20.084
11.5	11.282	12.574	13.866	15.158	16.450	17.742	19.034	20.326	21.618
11	12.118	13.506	14.893	16.281	17.669	19.057	20.445	21.833	23.220
10.5	12.993	14.481	15.969	17.457	18.945	20.433	21.921	23.409	24.897
10	13.911	15.504	17.097	18.690	20.283	21.876	23.469	25.063	26.656
9.5	14.875	16.579	18.283	19.986	21.690	23.394	25.097	26.801	28.504
9	15.892	17.712	19.533	21.353	23.173	24.993	26.813	28.633	30.453
8.5	16.967	18.911	20.854	22.797	24.740	26.684	28.627	30.570	32.513
8	18.108	20.182	22.255	24.329	26.403	28.477	30.551	32.625	34.698
7.5	19.322	21.535	23.747	25.960	28.173	30.386	32.599	34.812	37.025
7	20.619	22.981	25.342	27.704	30.065	32.427	34.788	37.150	39.511
6.5	22.013	24.534	27.056	29.577	32.098	34.619	37.140	39.661	42.182
6	23.519	26.212	28.906	31.600	34.293	36.987	39.680	42.374	45.067
5.5	25.155	28.036	30.917	33.798	36.679	39.560	42.442	45.323	48.204
5	26.948	30.035	33.121	36.207	39.293	42.380	45.466	48.552	51.639
4.5	28.930	32.243	35.557	38.870	42.183	45.496	48.810	52.123	55.436
4	31.145	34.712	38.279	41.846	45.413	48.980	52.547	56.115	59.682
3.5	33.657	37.512	41.366	45.221	49.076	52.930	56.785	60.640	64.494
3	36.557	40.743	44.930	49.117	53.303	57.490	61.677	65.864	70.050
2.5	39.986	44.565	49.145	53.724	58.304	62.883	67.463	72.042	76.622
2	44.183	49.243	54.303	59.364	64.424	69.484	74.544	79.604	84.665
1.5	49.594	55.274	60.954	66.634	72.314	77.994	83.674	89.354	95.034
1	57.221	63.774	70.327	76.881	83.434	89.988	96.541	103.094	109.648
0.5	70.258	78.305	86.351	94.398	102.445	110.491	118.538	126.584	134.631
0.2	87.493	97.514	107.534	117.554	127.575	137.595	147.616	157.636	167.657
Thermocouple mV									
'K' Type	24.905	29.129	33.275	37.326	41.276	45.119	48.838	52.410	-
'J' Type	33.102	39.132	45.494	51.877	57.953	63.792	69.553	-	-
'R' Type	5.583	6.743	7.950	9.205	10.506	11.850	13.228	14.629	16.040
'S' Type	5.239	6.275	7.345	8.449	9.587	10.757	11.951	13.159	14.373
'N' Type	20.613	24.527	28.455	32.371	36.256	40.087	43.846	47.513	-

These tables are based on the Nernst equation:

$$EMF = \frac{T \log_e(O_2/20.95)}{-46.421}$$ Where *T* is temperature° K

Thermocouple information from NIST ITS-90 data tables

The Novatech 1735 Transmitter has the ability to work as a Modbus slave node on serial RS-232 or 3-wire RS-485 via RTU mode transmissions. By accessing information stored in the input and holding registers it is possible to access runtime variables, alarm conditions and modify the device configuration.

The implementation of the Modbus protocol is limited to the specific command set relevant to reading and writing register variables. Attempting to send unrecognised commands will result in appropriate error responses

MODBUS™ Functions Supported:-
0x03: Read Holding Registers
0x04: Read Input Registers
0x06: Write Single Holding Register
0x08: (return query data – for loopback testing)
0x10: Write Multiple Holding Registers
0x16: Mask Write Holding Register
0x17: Read/Write Multiple Holding Registers
0x2B: Encapsulated Interface (read device information)
0x41: Special Instruction Function

Serial Configuration

The serial configuration for the slave device is accessed in the Commissioning Menu of the transmitter. Default settings are highlighted in bold.

Baud Rate	2400, 4800, 9600, **19200**, 38400, 57600, 115200
Parity	**Even**, Odd, None
Stop Bits	1
Interface	RS-485, **RS-232**

All holding register addresses contain a single 16 bit value, however some variables span multiple holding registers to yield a single 32 bit variable.

When reading register values be aware that the byte order of data within registers may differ from that of the target system.

Modbus Protocol

The Modbus over serial line protocol defines a messaging system for master/slave communications. Only one master device may be connected to any network with one or several slave nodes.
In unicast mode, the master initiates communication with a specific slave node by sending a request message. The slave processes the request and returns a reply message containing the requested information or a confirmation that the request was fulfilled.

Modbus requests are transmitted as a formed request frame with a CRC for data integrity checking. The frame for each request and reply type will vary somewhat, but will always have the basic structure described below:

1 byte	1 byte	up to 255 bytes	2 bytes
slave address	function code	data	checksum

Detailed information regarding the implementation of the Modbus protocol can be obtained from the website of the Modbus Organisation.
http://www.modbus-ida.org

Internal Representation of Dates & Alarm Status

The transmitter stores all dates as an unsigned 32bit count of seconds elapsed since 1-Jan 2004.
Alarm status is stored as an integer value:

0	clear	2	active
1	self cleared	3	acknowledged

1735 Transmitter Modbus Input Register Table for firmware v1.35 and newer

Group	Reg	Description	Bits	Type
Probe 1 Runtime Data	0	Water Vapour %	32	floating point
	2	Dew Point	32	floating point
	4	Mixing Ratio	32	floating point
	6	Specific Humidity	32	floating point
	8	Oxygen %	32	floating point
	10	EMF mV	32	floating point
	12	Temperature degC	32	floating point
	14	Temperature Open Ct Flag	16	boolean
	15	Temperature Low Flag	16	boolean
	16	Impedance kOhms	32	floating point
	18	Power Output	16	unsigned integer
Probe 2 Runtime Data	19	Water Vapour %	32	floating point
	21	Dew Point	32	floating point
	23	Mixing Ratio	32	floating point
	25	Specific Humidity	32	floating point
	27	Oxygen %	32	floating point
	29	EMF mV	32	floating point
	31	Temperature degC	32	floating point
	33	Temperature Open Ct Flag	16	boolean
	34	Temperature Low Flag	16	boolean
	35	Impedance kOhms	32	floating point
	37	Power Output	16	unsigned integer
Current Alarm Status	73	Heater 1 Fail Alarm	16	unsigned integer
	74	Heater 2 Fail Alarm	16	unsigned integer
	75	Probe 1 Hi Impedance	16	unsigned integer
	76	Probe 2 Hi Impedance	16	unsigned integer
	77	Probe 1 Thermocouple Open Ct	16	unsigned integer
	78	Probe 2 Thermocouple Open Ct	16	unsigned integer
	79	Dryer Thermocouple Open Tc	16	unsigned integer
	80	Reference Air Pump Fail	16	unsigned integer
	81	Reference Air Pump Overload	16	unsigned integer
	82	Battery Backup RAM Failure	16	unsigned integer
	83	Internal Alarm Log Memory Failure	16	unsigned integer
	84	Internal ADC Fail	16	unsigned integer
	85	Internal DAC Output 1 Fail	16	unsigned integer
	86	Internal DAC Output 2 Fail	16	unsigned integer
	87	Heater 1 SSR Relay Fail	16	unsigned integer
	88	Heater 2 SSR Relay Fail	16	unsigned integer
	89	Heater SSR Leaking	16	unsigned integer
	90	Probe 1 Blocked	16	unsigned integer
	91	Probe 2 Blocked	16	unsigned integer
	92	Gas 1 Calibration Error	16	unsigned integer
	93	Gas 2 Calibration Error	16	unsigned integer
	94	Zone 1 Process Alarm 1	16	unsigned integer
	95	Zone 1 Process Alarm 2	16	unsigned integer
	96	Zone 1 Process Alarm 3	16	unsigned integer
	97	Zone 1 Process Alarm 4	16	unsigned integer
	98	Zone 2 Process Alarm 1	16	unsigned integer
	99	Zone 2 Process Alarm 2	16	unsigned integer
	100	Zone 2 Process Alarm 3	16	unsigned integer
	101	Zone 2 Process Alarm 4	16	unsigned integer
Last Alarm User Acknowledged Time	162	Heater 1 Fail Alarm	32	unsigned integer
	164	Heater 2 Fail Alarm	32	unsigned integer
	166	Probe 1 Hi Impedance	32	unsigned integer
	168	Probe 2 Hi Impedance	32	unsigned integer
	170	Probe 1 Thermocouple Open Ct	32	unsigned integer
	172	Probe 2 Thermocouple Open Ct	32	unsigned integer
	174	Dryer Thermocouple Open Tc	32	unsigned integer
	176	Reference Air Pump Fail	32	unsigned integer
	178	Reference Air Pump Overload	32	unsigned integer
	180	Battery Backup RAM Failure	32	unsigned integer
	182	Internal Alarm Log Memory Failure	32	unsigned integer
	184	Internal ADC Fail	32	unsigned integer
	186	Internal DAC Output 1 Fail	32	unsigned integer
	188	Internal DAC Output 2 Fail	32	unsigned integer
	190	Heater 1 SSR Relay Fail	32	unsigned integer
	192	Heater 2 SSR Relay Fail	32	unsigned integer
	194	Heater SSR Leaking	32	unsigned integer
	196	Probe 1 Blocked	32	unsigned integer
	198	Probe 2 Blocked	32	unsigned integer
	200	Gas 1 Calibration Error	32	unsigned integer
	202	Gas 2 Calibration Error	32	unsigned integer
	204	Zone 1 Process Alarm 1	32	unsigned integer
	206	Zone 1 Process Alarm 2	32	unsigned integer
	208	Zone 1 Process Alarm 3	32	unsigned integer
	210	Zone 1 Process Alarm 4	32	unsigned integer
	212	Zone 2 Process Alarm 1	32	unsigned integer
	214	Zone 2 Process Alarm 2	32	unsigned integer
	216	Zone 2 Process Alarm 3	32	unsigned integer
	218	Zone 2 Process Alarm 4	32	unsigned integer

Group	Reg	Description	Bits	Type
Analyser Runtime Data	38	Dryer TC Temperature	32	floating point
	40	Dryer TC Open Ct Flag	16	boolean
	41	Relative Humidity	32	floating point
	43	Absolute Humidity	32	floating point
	45	RGS Temperature	16	signed integer
	46	External Dry Oxygen	32	floating point
	48	Sulphuric Acid Dew Point	32	floating point
	50	4-20mA Outputs Frozen	16	boolean
	51	Ambient Temperature	16	signed integer
	52	Maximum Ambient Temperature	16	signed integer
	53	Reference Air Oxygen	32	floating point
	55	Burner Runtime Minutes	32	unsigned integer
	57	Burner On Time Minutes	32	unsigned integer
Event Times	59	Current Date & Time	32	unsigned integer
	61	Next Purge/Cal 1 Time	32	unsigned integer
	63	Next Purge/Cal 2 Time	32	unsigned integer
	65	Next Probe Impedance Check	32	unsigned integer
Relay Status	67	Relay 1 Status	16	boolean
	68	Relay 2 Status	16	boolean
	69	Relay 3 Status	16	boolean
	70	Common Relay Status	16	boolean
	71	Mains Voltage	16	unsigned integer
	72	Mains Frequency	16	unsigned integer
	102	DAC Output 1 mA	16	unsigned integer
	103	DAC Output 2 mA	16	unsigned integer
Last Alarm Active Time	104	Heater 1 Fail Alarm	32	unsigned integer
	106	Heater 2 Fail Alarm	32	unsigned integer
	108	Probe 1 Hi Impedance	32	unsigned integer
	110	Probe 2 Hi Impedance	32	unsigned integer
	112	Probe 1 Thermocouple Open Ct	32	unsigned integer
	114	Probe 2 Thermocouple Open Ct	32	unsigned integer
	116	Dryer Thermocouple Open Tc	32	unsigned integer
	118	Reference Air Pump Fail	32	unsigned integer
	120	Reference Air Pump Overload	32	unsigned integer
	122	Battery Backup RAM Failure	32	unsigned integer
	124	Internal Alarm Log Memory Failure	32	unsigned integer
	126	Internal ADC Fail	32	unsigned integer
	128	Internal DAC Output 1 Fail	32	unsigned integer
	130	Internal DAC Output 2 Fail	32	unsigned integer
	132	Heater 1 SSR Relay Fail	32	unsigned integer
	134	Heater 2 SSR Relay Fail	32	unsigned integer
	136	Heater SSR Leaking	32	unsigned integer
	138	Probe 1 Blocked	32	unsigned integer
	140	Probe 2 Blocked	32	unsigned integer
	142	Gas 1 Calibration Error	32	unsigned integer
	144	Gas 2 Calibration Error	32	unsigned integer
	146	Zone 1 Process Alarm 1	32	unsigned integer
	148	Zone 1 Process Alarm 2	32	unsigned integer
	150	Zone 1 Process Alarm 3	32	unsigned integer
	152	Zone 1 Process Alarm 4	32	unsigned integer
	154	Zone 2 Process Alarm 1	32	unsigned integer
	156	Zone 2 Process Alarm 2	32	unsigned integer
	158	Zone 2 Process Alarm 3	32	unsigned integer
	160	Zone 2 Process Alarm 4	32	unsigned integer
Last Alarm State Cleared Time	220	Heater 1 Fail Alarm	32	unsigned integer
	222	Heater 2 Fail Alarm	32	unsigned integer
	224	Probe 1 Hi Impedance	32	unsigned integer
	226	Probe 2 Hi Impedance	32	unsigned integer
	228	Probe 1 Thermocouple Open Ct	32	unsigned integer
	230	Probe 2 Thermocouple Open Ct	32	unsigned integer
	232	Dryer Thermocouple Open Tc	32	unsigned integer
	234	Reference Air Pump Fail	32	unsigned integer
	236	Reference Air Pump Overload	32	unsigned integer
	238	Battery Backup RAM Failure	32	unsigned integer
	240	Internal Alarm Log Memory Failure	32	unsigned integer
	242	Internal ADC Fail	32	unsigned integer
	244	Internal DAC Output 1 Fail	32	unsigned integer
	246	Internal DAC Output 2 Fail	32	unsigned integer
	248	Heater 1 SSR Relay Fail	32	unsigned integer
	250	Heater 2 SSR Relay Fail	32	unsigned integer
	252	Heater SSR Leaking	32	unsigned integer
	254	Probe 1 Blocked	32	unsigned integer
	256	Probe 2 Blocked	32	unsigned integer
	258	Gas 1 Calibration Error	32	unsigned integer
	260	Gas 2 Calibration Error	32	unsigned integer
	262	Zone 1 Process Alarm 1	32	unsigned integer
	264	Zone 1 Process Alarm 2	32	unsigned integer
	266	Zone 1 Process Alarm 3	32	unsigned integer
	268	Zone 1 Process Alarm 4	32	unsigned integer
	270	Zone 2 Process Alarm 1	32	unsigned integer
	272	Zone 2 Process Alarm 2	32	unsigned integer
	274	Zone 2 Process Alarm 3	32	unsigned integer
	276	Zone 2 Process Alarm 4	32	unsigned integer

1735 Transmitter Modbus Holding Register Table for firmware v1.35 and newer

Group	Reg		Description	Bits	Type
Analyser Calibration & Configuration	0	00	50mV Reference Voltage	32	unsigned integer
	2	02	200mV Reference Voltage	32	unsigned integer
	4	04	1200mV Reference Voltage	32	unsigned integer
	6	06	2500mV Reference Voltage	32	unsigned integer
	8	08	Dryer Type	16	unsigned integer
	9	09	Probe 2 Input Type	16	unsigned integer
	10	0A	Fixed Combustion Oxygen	16	unsigned integer
	11	0B	Service Date	16	unsigned integer
	12	0C	Probe 1 Type	16	unsigned integer
	13	0D	Probe 1 TC Type	16	unsigned integer
	14	0E	Probe 1 Offset	16	signed integer
	15	0F	Probe 2 Type	16	unsigned integer
	16	10	Probe 2 TC Type	16	unsigned integer
	17	11	Probe 2 Offset	16	signed integer
	18	12	Flue Pressure Units	16	unsigned integer
	19	13	Flue Pressure Value	16	signed integer
	20	14	Temperature Units	16	unsigned integer
	21	15	Top Line Item	16	unsigned integer
	22	16	Lower Line Items	64	bitmask
	26	1A	Reference Air Pump	16	unsigned integer
	27	1B	Reference Pump Voltage	16	unsigned integer
	28	1C	Reference Air RH%	16	unsigned integer
	29	1D	Oxygen Damping Factor	16	unsigned integer
	30	1E	Ambient Temperature Offset	16	signed integer
	31	1F	Transmitter 4-20mA / 0-20mA Select	16	unsigned integer
	32	20	Transmitter Output Limiting for Low Temp	16	unsigned integer
	33	21	Manual Mains Voltage Select	16	unsigned integer
	34	22	Manual Mains Frequency Select	16	unsigned integer
	35	23	Freeze 4-20mA Outputs during cal	16	unsigned integer
	36	24	Accepted Alarm Relay Active Hold	16	unsigned integer
Transmitter 1 Configuration	37	25	Transmitter 1 Output	16	unsigned integer
	38	26	Transmitter 1 Zero (Water Vapour)	16	unsigned integer
	39	27	Transmitter 1 Zero (Dew Point)	16	unsigned integer
	40	28	Transmitter 1 Zero (Mixing Ratio)	16	unsigned integer
	41	29	Transmitter 1 Zero (Specific Humidity)	16	unsigned integer
	42	2A	Transmitter 1 Zero (Dryer Temp)	16	unsigned integer
	43	2B	Transmitter 1 Zero (Relaitve Humidity)	16	unsigned integer
	44	2C	Transmitter 1 Zero (Absolute Humidity)	16	unsigned integer
	45	2D	Transmitter 1 Zero (Probe 1 Oxygen)	16	unsigned integer
	46	2E	Transmitter 1 Zero (Probe 2 Oxygen)	16	unsigned integer
	47	2F	Transmitter 1 Zero (Acid Dew Point)	16	unsigned integer
	48	30	Transmitter 1 Span (Water Vapour)	16	unsigned integer
	49	31	Transmitter 1 Span (Dew Point)	16	unsigned integer
	50	32	Transmitter 1 Span (Mixing Ratio)	16	unsigned integer
	51	33	Transmitter 1 Span (Specific Humidity)	16	unsigned integer
	52	34	Transmitter 1 Span (Dryer Temp)	16	unsigned integer
	53	35	Transmitter 1 Span (Relaive Humidity)	16	unsigned integer
	54	36	Transmitter 1 Span (Absolute Humidity)	16	unsigned integer
	55	37	Transmitter 1 Span (Probe 1 Oxygen)	16	unsigned integer
	56	38	Transmitter 1 Span (Probe 2 Oxygen)	16	unsigned integer
	57	39	Transmitter 1 Span (Acid Dew Point)	16	unsigned integer
	58	3A	Transmitter 1 4-20mA Cal Mode	16	unsigned integer
	59	3B	Transmitter 1 4mA Trim	16	unsigned integer
	60	3C	Transmitter 1 20mA Trim	16	unsigned integer

Group	Reg	Description	Bits	Type
Transmitter 2 Configuration	61	Transmitter 2 Output	16	unsigned integer
	62	Transmitter 2 Zero (Water Vapour)	16	unsigned integer
	63	Transmitter 2 Zero (Dew Point)	16	unsigned integer
	64	Transmitter 2 Zero (Mixing Ratio)	16	unsigned integer
	65	Transmitter 2 Zero (Specific Humidity)	16	unsigned integer
	66	Transmitter 2 Zero (Dryer Temp)	16	unsigned integer
	67	Transmitter 2 Zero (Relative Humidity)	16	unsigned integer
	68	Transmitter 2 Zero (Absolute Humidity)	16	unsigned integer
	69	Transmitter 2 Zero (Probe 1 Oxygen)	16	unsigned integer
	70	Transmitter 2 Zero (Probe 2 Oxygen)	16	unsigned integer
	71	Transmitter 2 Zero (Acid Dew Point)	16	unsigned integer
	72	Transmitter 2 Span (Water Vapour)	16	unsigned integer
	73	Transmitter 2 Span (Dew Point)	16	unsigned integer
	74	Transmitter 2 Span (Mixing Ratio)	16	unsigned integer
	75	Transmitter 2 Span (Specific Humidity)	16	unsigned integer
	76	Transmitter 2 Span (Dryer Temp)	16	unsigned integer
	77	Transmitter 2 Span (Relaive Humidity)	16	unsigned integer
	78	Transmitter 2 Span (Absolute Humidity)	16	unsigned integer
	79	Transmitter 2 Span (Probe 1 Oxygen)	16	unsigned integer
	80	Transmitter 2 Span (Probe 2 Oxygen)	16	unsigned integer
	81	Transmitter 2 Span (Acid Dew Point)	16	unsigned integer
	82	Transmitter 2 4-20mA Cal Mode	16	unsigned integer
	83	Transmitter 2 4mA Trim	16	unsigned integer
	84	Transmitter 2 20mA Trim	16	unsigned integer
Process Alarms Configuration	85	Process Alarm 1 Threshold	16	unsigned integer
	86	Process Alarm 1 Delay	16	unsigned integer
	87	Process Alarm 2 Threshold	16	unsigned integer
	88	Process Alarm 2 Delay	16	unsigned integer
	89	Process Alarm 3 Threshold	16	unsigned integer
	90	Process Alarm 3 Delay	16	unsigned integer
	91	Process Alarm 4 Threshold	16	unsigned integer
	92	Process Alarm 4 Delay	16	unsigned integer
Alarm Relays	93	Alarm Relay 2 Options	64	bitmask
	97	Alarm Relay 3 Options	64	bitmask
	101	Alarm Relay 4 Options	64	bitmask
	105	Common Relay Mask Options	64	bitmask
Solenoid 1 Configuration	109	Solenoid 1 Operation (Cal/Purge)	16	unsigned integer
	110	Solenoid 1 Auto/Man	16	unsigned integer
	111	Solenoid 1 Start Time	16	unsigned integer
	112	Solenoid 1 Period	16	unsigned integer
	113	Solenoid 1 Purge/Cal Duration	16	unsigned integer
	114	Solenoid 1 Post P/C Freeze	16	unsigned integer
	115	Solenoid 1 Calibration Gas Content	16	unsigned integer
	116	Solenoid 1 Calibration Gas Positive Error	16	unsigned integer
	117	Solenoid 1 Calibration Gas Negative Error	16	unsigned integer
Solenoid 2 Configuration	118	Solenoid 2 Operation (Cal/Purge)	16	unsigned integer
	119	Solenoid 2 Auto/Man	16	unsigned integer
	120	Solenoid 2 Start Time	16	unsigned integer
	121	Solenoid 2 Period	16	unsigned integer
	122	Solenoid 2 Purge/Cal Duration	16	unsigned integer
	123	Solenoid 2 Post P/C Freeze	16	unsigned integer
	124	Solenoid 2 Calibration Gas Content	16	unsigned integer
	125	Solenoid 2 Calibration Gas Positive Error	16	unsigned integer
	126	Solenoid 2 Calibration Gas Negative Error	16	unsigned integer

0x41 Special Instruction Function

This command allows you to interact with the transmitter allowing access to functionality that would otherwise only be accessible via the keypad. The request length will vary from one command to the next depending on what arguments are required. Requests are formed the same as other Modbus requests:

1 byte	1 byte	1 byte	0 - 4 bytes	2 bytes
slave address	command code	function code	arguments	checksum

Function Code	Command	Arguments
0x01	Accept All Active Alarms	none
0x02	remote set key down	1 byte keymask
0x03	remote reset key down	1 byte keymask
0x04	Initiate Probe Impedance Check	none
0x05	Set Internal Clock	4 byte rtc*

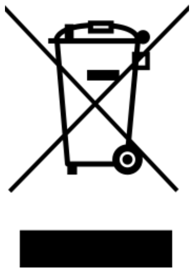
* date expressed as seconds since 1-Jan 2004

keymask	
0x01	option down
0x02	option up
0x04	setup
0x08	function down
0x10	function up
0x20	purge/cal 1 key
0x40	purge/cal 2 key
0x80	enter

Instructions for Disposal by Users

The Waste from Electrical and Electronic Equipment (WEEE) EU Directive aims to reduce the amount of WEEE going to landfill.

The symbol shown below is on the product or on its packaging, which indicates that this product must not be disposed of with other waste. Instead, it is the user's responsibility to separate their waste electrical and electronic equipment and hand it over to a designated collection point for the disposal of.



To further reduce waste to landfill, the steel and aluminium parts of probes/sensors may be separated and handed to a metals recycler.

The separate collection and recycling of your waste equipment at the time of disposal will help to conserve natural resources and ensure that it is recycled in a manner that protects human health and the environment. For more information about where you can drop off your waste equipment for recycling, please contact your local city office or your general waste disposal service.

DECLARATION OF CONFORMITY

Application of Council Directives: 2004/108/EC
2006/95/EC
2011/65/EU with 2015/863 amendment

Standards to which conformity is declared:

EN61010-1:2010	Safety Requirements for Electrical Equipment for Measurement, Control and Laboratory Use.
EN50270:1999	Electromagnetic Compatibility – Electrical Apparatus for the Detection and Measurement of Combustible Gases, Toxic Gases or Oxygen
CFR47 FCC Part 15, Subpart B (Class A)	Electromagnetic Compatibility - Radiated and Conducted Emissions
AS60529:2004	Degree of Protection Provided By Enclosures (IP Code)

This product is manufactured in Australia under ISO9001:2015 quality systems and ISO14001:2015 environmental certification.

Manufacturer's name: ***Novatech Controls Pty Ltd***

Manufacturer's address: *309 Reserve Road*
Cheltenham VIC 3192
AUSTRALIA

Type of equipment: *Oxygen Transmitter*

Model Number: *1730 Series Transmitter*
1231 Oxygen Probe
1232 Oxygen Probe
1234 Oxygen Sensor

I hereby declare that the equipment specified herein conforms to the above directive(s) and standards(s) in 2021.

Full Name: **Douglas Rice**
Position: **R & D Manager**