Novatech CONTROLS PTY. LTD.

Carbon Controller

Model 1734
Technical Manual

October 2013

TABLE OF CONTENTS

This manual describes the controller firmware version 1.06, October 2013

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
Web site: http://www.novatech.com.au/

Novatech Controls or their authorised dealers should carry out all maintenance and service on the product. Novatech Controls can accept no liability whatsoever for any loss or damage caused by service or maintenance by unauthorised personnel. This manual is intended only to assist the reader in the use of the product, and therefore Novatech Controls shall not be liable for any loss or damage whatsoever arising from the use of any information or particulars in, or any error or omission in, this manual, or any incorrect use of the product.

1. IMPORTANT NOTICE

This manual is intended as a supplement to the 1734 Operators Manual. It is intended to be used by technical personal that are qualified to install, commission, service and calibrate electronic industrial control equipment.

CAUTION

Please note that if this equipment is not installed and used in the manner described in this manual then the safety protection provided by the equipment may be impaired.

This page has been intentionally left blank.

2.1 The 1734 Carbon Controller

The Novatech 1734 Carbon Controller provides in-situ measurement and closed loop control for one or two carbon probes in furnace and gas generators with temperatures up to 1400°C. The controller provides local indication of carbon percentage and oxygen, plus numerous other related measurements.

Within the same process either one or two probes can be controlled providing average and/or individual probe readings. The controller provides two isolated 4-20mA outputs, 4 normally closed configurable relay outputs and digital communications via MODBUS™. Alarms are displayed at the controller and the relay contacts can be configured to activate remote alarm devices. Using unheated Novatech zirconia oxygen probes the analyser also provides automatic probe filter purging.

The model 1734 carbon controller is based on the well known model 1634 controller. It includes a number of hardware and software improvements such as a graphic display, larger characters, faster microprocessor, simplified set up menu, alarm logging, faster probe heater control and more accuracy in the calculation of carbon.

The 1734 Carbon Controller has a variety of user-selectable functions. The device is configured locally using a menu driven interface and the local keypad & display. For a description of the configuration process refer to Chapter 6. Setup Mode

Features include:-

Inputs
Two unheated Novatech zirconia carbon / oxygen probes
Carbon range up to 2.0%
Oxygen range from 10^{-30} to 100%
Furnace or auxiliary thermocouple, field selectable as type K, J, R, S or N
Purge pressure or flow switch

Outputs
Two linearised 4-20mA or 0-20mA DC isolated outputs, max. 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/PCL for diagnostics of the controller, probe or combustion process.

Display
Multi font graphical display
Large character display for carbon on the top line
Selectable lower line items for the secondary display functions. ie Probe temperature, carbon 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

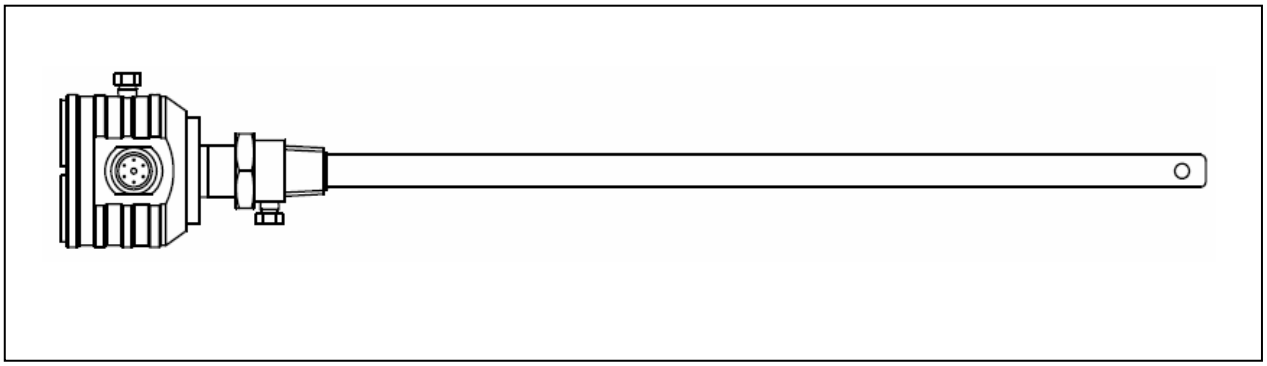
2.2 Series 1230 Carbon Probes & Sensors

Novatech series 1230 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 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 carbon level. Probes or sensors may be used with Novatech carbon controllers and some model transmitters from other manufacturers.

All Novatech carbon and 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, transmitters and controllers worldwide.



Model 1232 Unheated Probe

2.3 Warning Symbols

Danger, high voltage. Risk of electrical shock.

Caution hot surface.

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

2.4 Carbon Feedback Controller

As well as calculating the carbon level in a furnace the 1734 controller can also be configured to control the furnace carbon level with feedback. The required set point is entered in COMMISSIONING menu 32.

There are four carbon control feedback methods build in to the 1734 controller as follows;

2.4.1 Simple ON/OFF Solenoid Control

A small bypass line around the main enrichment control valve on the furnace can be installed with an on/off solenoid. In 'ON/OFF control' the solenoid will be turned on if the process carbon is below the set point, and off if the carbon is above the set point. Select either 'ON/OFF control ' or 'Proportional ON/OF' control.

Connect the mains voltage solenoid to Heater 1 Solenoid (terminals 41 & 42).

2.4.2 Proportional ON/OFF Solenoid Control

If a proportional control mode has been selected, set the sensitivity of the control system with the proportional band in COMMISSIONING menu 33 and with the cycle time in menu 36 The smaller the proportional band number, the larger the output valve adjustment reaction will be to an atmosphere change.

Set the 'Cycle Time' value to match the 1734 controller to the furnace. Keep the time as long as possible (maintaining smooth control) to reduce the wear on the control valve.

Connect the mains voltage solenoid to Heater 1 Solenoid (terminals 41 & 42).

2.4.3 Proportional 4-20mA Control

Proportional 4-20mA control requires a 4-20mA control valve to be connected to the output channel 2 (terminals 14 & 15). This control mode allows entry of both the proportional band and the integral time constant (COMMISSIONING menu 33 and 34).

2.4.4 Floating Control

Floating control requires a motor driven control valve with both up and down drive terminals. The up drive should be connected to terminal 44 and the down drive to terminal 42, with the common on terminal 41.

Floating inherently does not have an integral setting but COMMOSSIONING menu 33 has a setting for the proportional band, menu 35 has a setting for the dead band and menu 37 is used to set the 'Actuate time'.

Set the 'Actuate Time' value to match the 1734 controller to the furnace. Keep the time as long as possible (maintaining smooth control) to reduce the wear on the control valve. The wear on an up/down motor can be reduced by increasing the 'Dead Band'.

When the above menu items have been configured for the furnace, adjust the 'Set Point' in COMMISSIONING menu 32 to the desired carbon level in the furnace. The 'Carbon Set Point' can be displayed on the lower line of the 1734 (see Lower Line Items in chapter 6.3.03)

This page has been intentionally left blank.

3.1 Hardware Specifications

3.1.1 Controller Specifications

Number of carbon probes:	2 maximum
Carbon range:	up to 2.0%
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, J, R, S & N
Temperature accuracy:	±2°C
Analogue outputs:	0-20mA or 4-20mA field selectable Active outputs (Do NOT loop power these outputs)
Output load:	1000 ohm max
Alarm relays:	4
Alarm relay contacts:	2A/240VAC, 2A/30VDC

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

Mains voltage supply: Overvoltage:	100 to 240VAC, -6 +10%, 50/60 Hz Category II (IEC60364-4-443)
Power:	5W for controller
Fuses:	3A, fast blow, 250v, 20x5mm (heater fuses, 2 of) 1A, slow blow, 250v, microfuse (PCB mtg fuse, 1 of)
Environmental Rating: Altitude	Operating Temperature -25°C to 55°C Relative Humidity 5% to 95% (non-condensing) 2000m maximum
Degree of Protection:	IP65 IP54 with internal reference air pump
Case Size:	260mm (10.2”) wide, 160mm (6.3”) high, 90mm (3.5”) deep
Weight:	3 Kg (6.6 lbs.)

WARNING: All signal level connections onto the controller 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 Probe Useable Lengths (‘U’ Lengths)

1232
500 mm (20”)
750 mm (30”)
1000 mm (40”)
1500mm (60”)

Probe insertion length is measured from process end of mounting thread to probe sensing tip.

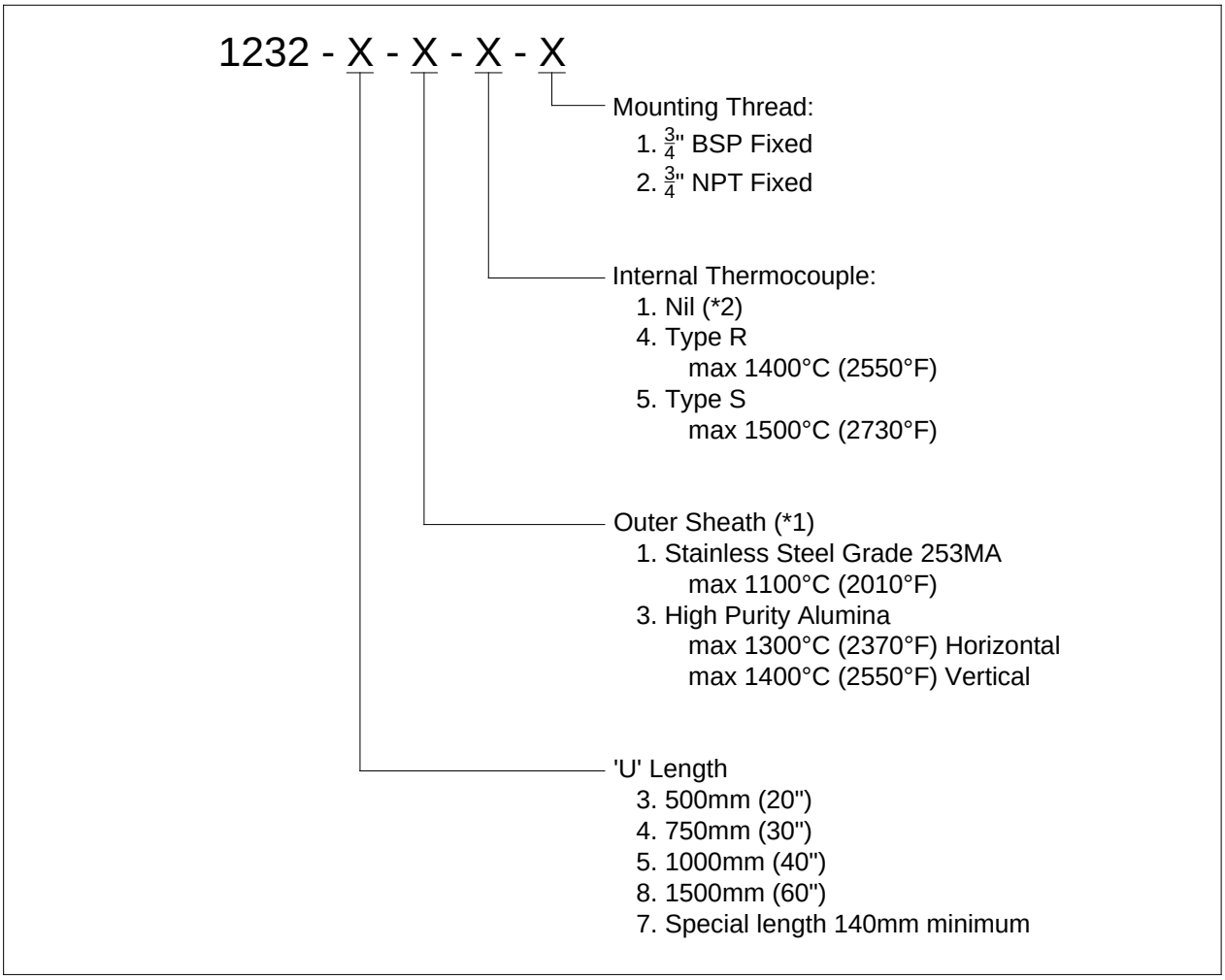
3.1.3 Carbon Probes Specifications

MODEL	**1232**
Application	Furnace temperatures above 700°C (1290°F) with no contaminants. eg. natural gas, light oils
Temperature Range	700 to 1400°C (1290 to 2550°F)
Length	500, 750, 1000, 1500 mm (20”, 30”, 40”, 60”)
Process Connection	¾" BSP 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 controller
Heater	No
Thermocouple	Integral R or S or no TC
Response Time	Typically < 1 sec
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 controller.
Ref Air Connection	Integral air line in probe cable. Barbed fitting to 3/16" ID PVC tube.
Purge Air Connection	1/8" NPT female
Weight	1 kg (2.2 lb) plus 100g / 100 mm (3.5oz / 4”) length

3.1.4 Carbon Probe Model Selection Guide

Unheated probes for clean gases-temperature range 700-1400°C (1290-2550°F).

The model number for the 1232 probe has the following designation:



*Note: (1) A standard oxygen probe for carburising furnaces, has a 253 MA sheath.
(2) For applications up to 1200°C it may be more economical to use a separate type “K” or “N” thermocouple than the internal “R” thermocouple. It is important that a separate thermocouple senses the same temperatures as the Oxygen probe tip.

3.1.5 Probe Purge

Novatech probes and controllers provide a ready method of connecting on-line and automatic probe filter purge facility.

Dirty furnace gas applications often require the back purge facility to keep a probe sensor free from blockage. The purge solenoid valve can be operated manually or automatically from a 1734 controller.

The external components required for automatic / manual purging are:

- A mains voltage (240 or 110 VAC) purge solenoid valve
- A Pressure regulator, 0 to 100 kPa (0 to 15 PSI)
- A purge pressure switch, 0 to 35 kPa (0 to 5 psi), to test for filter blockage.

The user should supply:

- A 100 kPa (15 psi) clean and dry instrument air supply when filter purging is required.

3.2 Operational Specifications

Range of outputs:

Function	Minimum	Maximum	Min Step
Carbon #1 / Carbon #2	0%	0.1 to 1.5%	0.1%
Average Carbon	0%	0.1 to 1.5%	0.1%
Probe EMF	0 to 1400mV	100 to 1500mV	100mV
Probe TC Temperature	0 to 1500°C	1000 to 1600°C	100°C
Probe Oxygen	0 to 99%	1 to 100%	0.1%
Reducing Oxygen	0 to $1x10^{-30}$%	0 to 100%	1 decade
Auxiliary TC Temperature	0 to 1500°C	100 to 1600°C	100°C
No output	Disables the output		

Local display, lower line secondary display items:

Function	Range
Probe #2 Carbon	0.000% to 2.000%
Average Carbon	0.000% to 2.000%
Probe #1 EMF	-30 to 1500mV
Probe #2 EMF	-30 to 1500mV
Probe #1 TC Temperature	Up to 1760°C (3200°F) in °C or °F
Probe #2 TC Temperature	Up to 1760°C (3200°F) in °C or °F
Probe #1 Sensor Impedance	0 to 300k Ω
Probe #2 Sensor Impedance	0 to 300k Ω
Probe #1 Oxygen	$1x10^{-30}$ to 100%
Probe #2 Oxygen	$1x10^{-30}$ to 100%
Auxiliary Temperature	Up to 1760°C (3200°F) in °C or °F
Ambient Temperature	-20° to 70°C (-5° to 125°F) in °C or °F
Ambient Relative Humidity	5 to 95%
Controller Set Point	0.1 to 2.0%
Controller Run Time	
Service Date	
4-20mA Output Channel 1	0.00 to 24.00mA
4-20mA Output Channel 2	0.00 to 24.00mA

This page has been intentionally left blank.

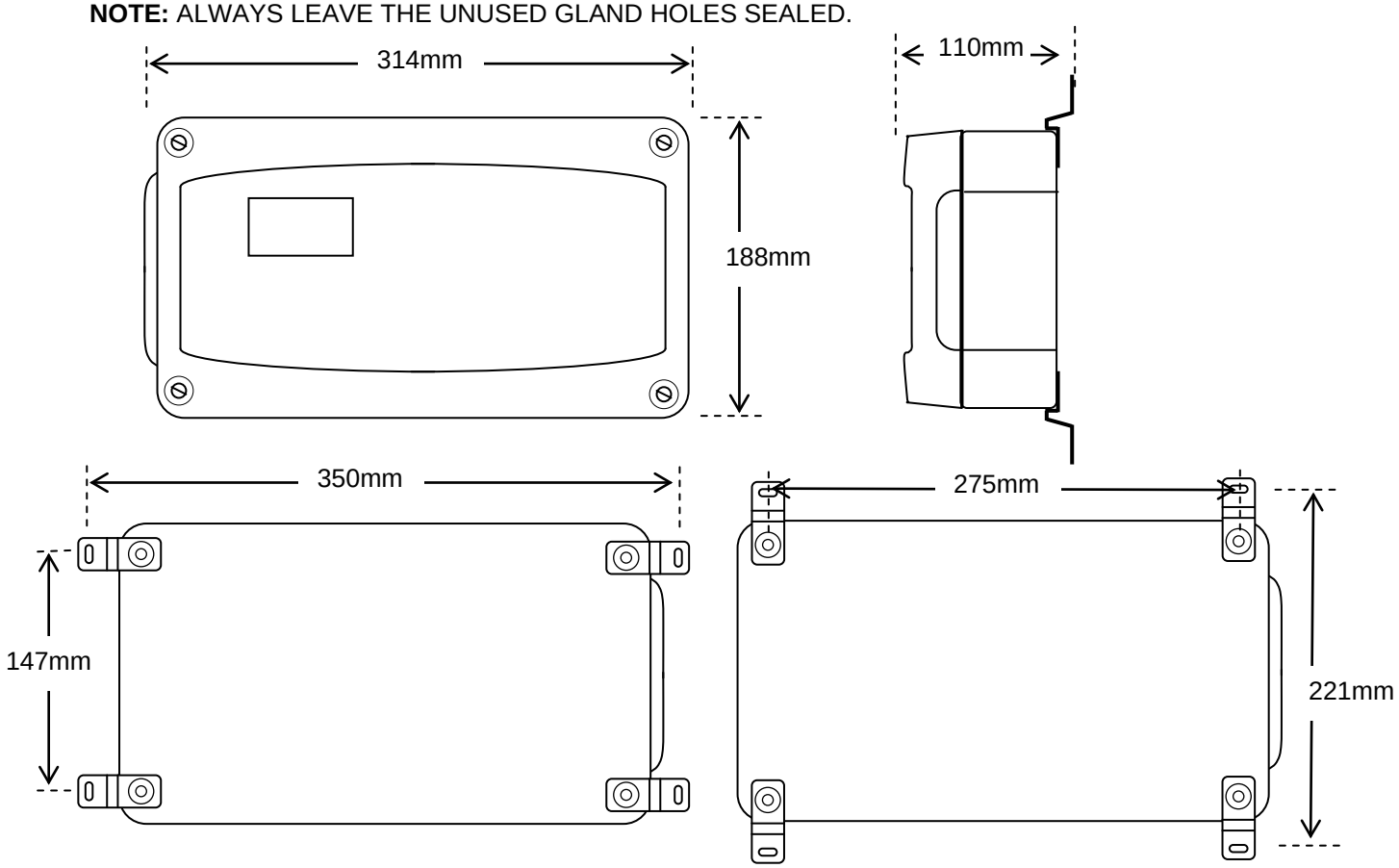
4.1 Mounting the Controller

Surface mount the controller case on to a flat surface or bracket, using the four mounting brackets provided. The controller 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 temperature of the case is below 55°C, and that the radiated heat from furnaces and boilers is kept to a minimum.

Install the cables through cable glands. There are 4 holes cut in the base of the controller 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.



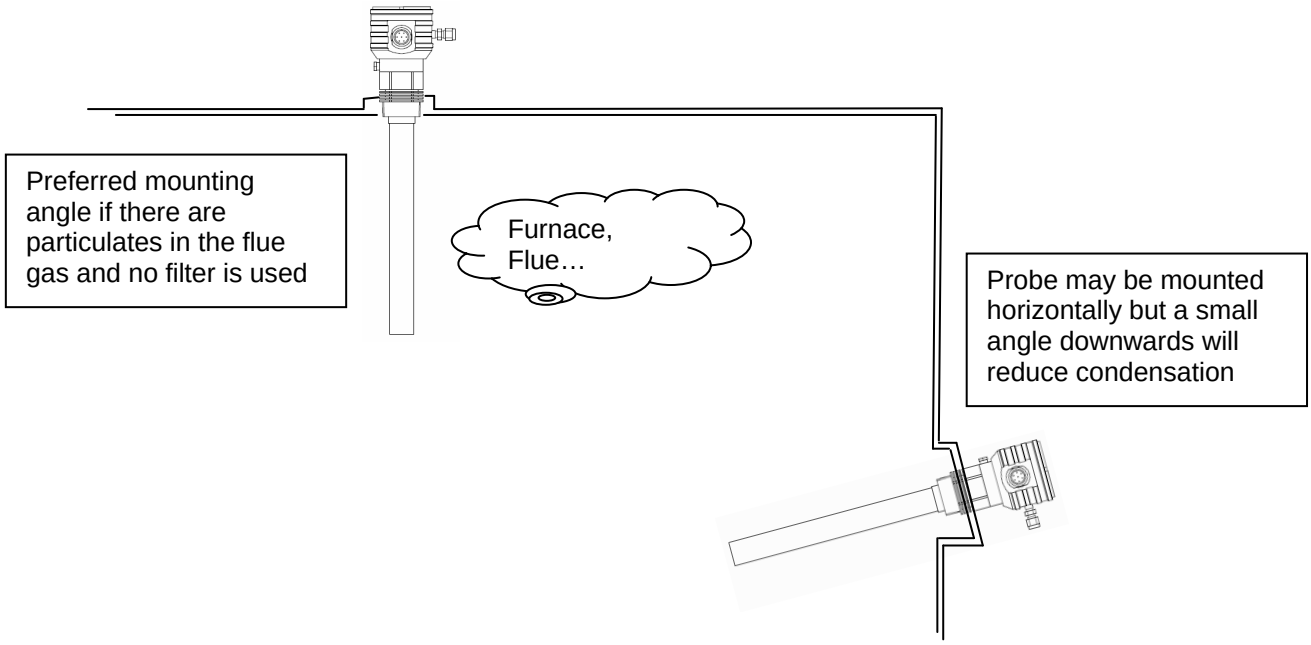
Case Mounting Dimensions

4.2 Installing a Carbon 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. Try to place the carbon probe in a position where it is sensing a representative gas in the furnace. (i.e. Not to close to the endo injection port).

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 installing a probe into a hot environment, slide the probe in slowly to avoid thermal shock to the internal ceramic parts. If the flue gas is 900°C, it should take approximately ten minutes to install a 1,000 mm probe, moving it in about 50 mm steps.



Oxygen Probe Mounting

CAUTION

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

4.3 Installing the Auxiliary Thermocouple

Weld a 1/2 inch BSP mounting socket to the flue within about 300 mm (12”), and upstream of the carbon 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.

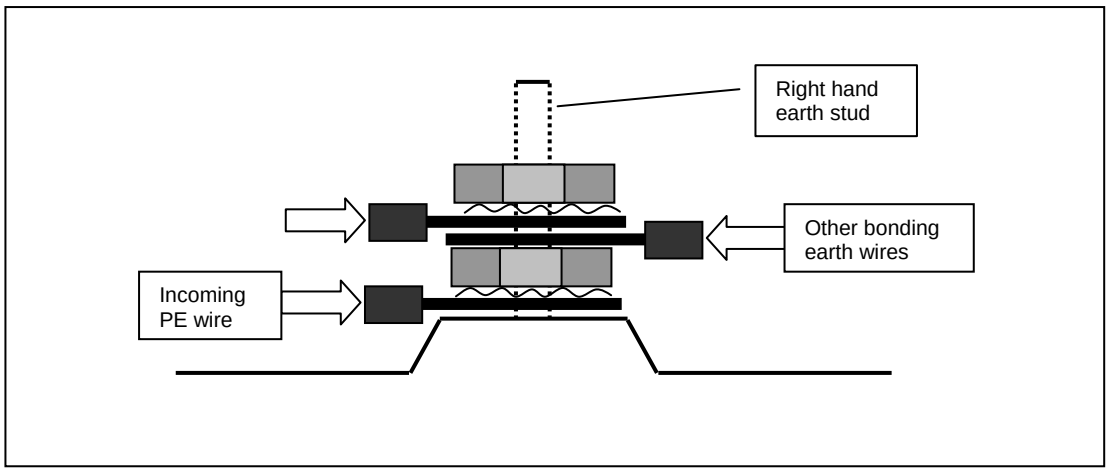
4.4 Shield Connections

All external wiring to the 1734 controller 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 1734 controller. An extra terminal strip may be required to connect all shields together. This should be supplied by the installer.

4.5 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.

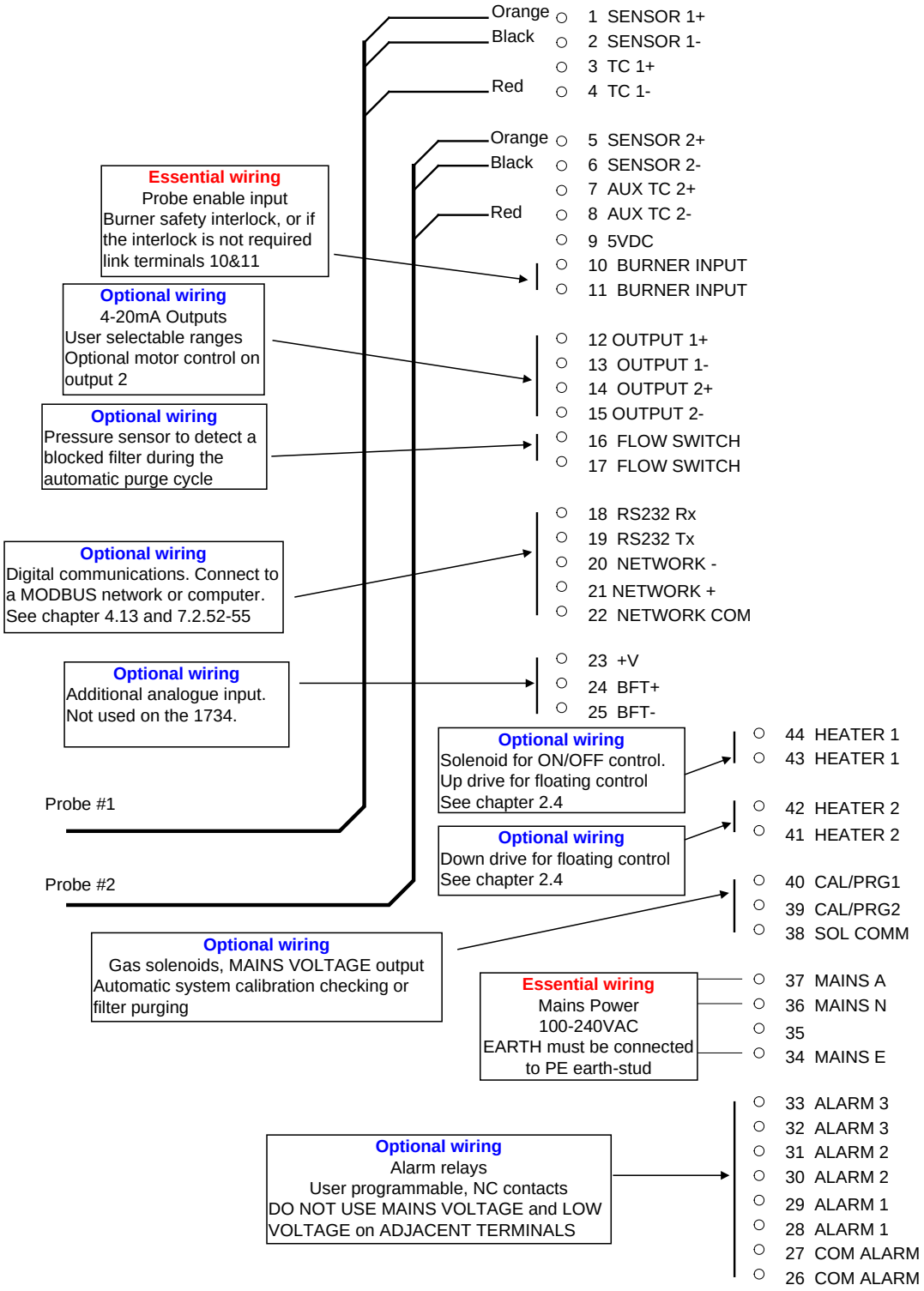
The controller MUST be securely earthed.



Assembly of the PE and bonding connections on the earth stud

4.6 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.



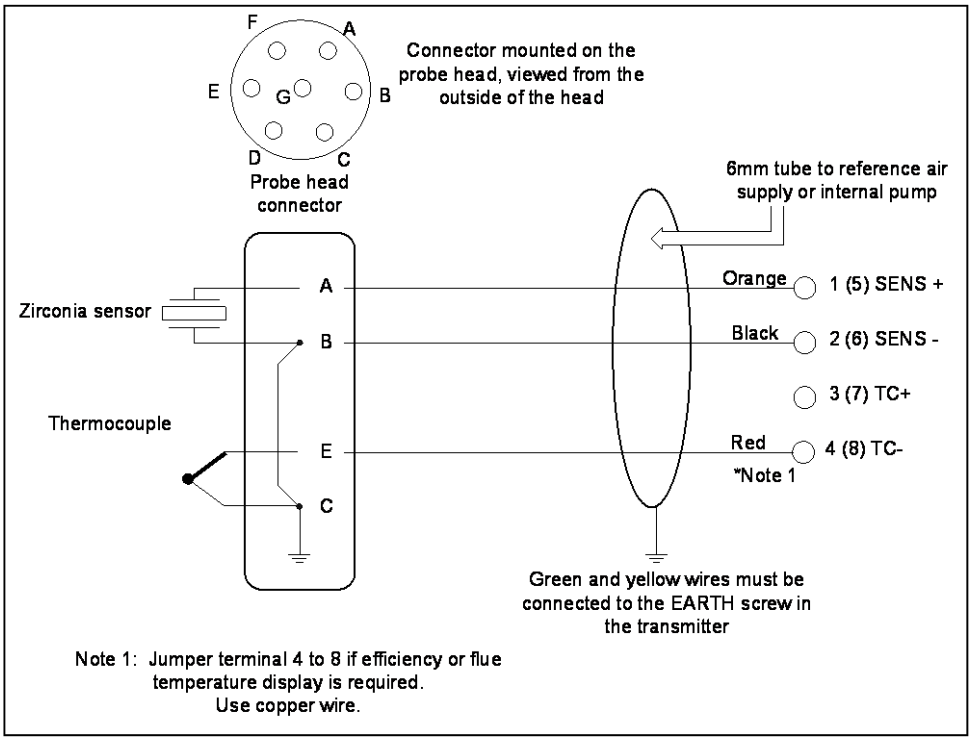
Connection Diagram for 1734 Controller and one or two 1232 Unheated Probes

- 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 carbon controller. 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 controller so that a controller 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 controller 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.

4.7 Connecting an 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 1232 Probe.

4.8 Connecting the Auxiliary Thermocouple (optional)

For applications that require an additional temperature to be transmitted or displayed, a thermocouple can be connected to terminals 7 & 8. This is only possible if only one probe is being used.
It can be any one of types J, K, R, S or N. It is optional.

4.9 Connecting the Output Channels

The two 4-20mA DC output channels are capable of driving into a 1000Ω load. The output terminals are 12 & 13 for channel 1, and 14 & 15 for channel 2. Channel 2 will not be available if "Prop + Integral 4020" has been chosen in COMMISSIONING menu 31.

4.10 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 9.2. 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 1/2 Heater Fail
Probe 1/2 High Impedance
Probe 1/2 TC Open Circuit
Aux TC Open Circuit
Ref Air Pump Fail
Ref Air Pump Overload
BBRAM Fail
Alarm Log Fail
ADC Calibration Fail
4-20mA Output 1/2 Failure
Heater 1/2 SSR Failure
Heater SSR Leakage
Probe 1/2 Filter Blocked

The watchdog timer is a special alarm. There will not be an alarm message displayed, but the controller will reset.

Any alarms that are on the common alarm can be removed from the common alarm by pressing the enter button. They will then be available on the other alarm relays.

Alarms can be accepted by pressing the alarm button (viewing the alarm messages).

Alarm relay 1 to 3 Select any one or all of the following for each relay. Refer to Chapter 9.
In addition, any of the selections that are removed from the common alarm relay can be added to relays one to three.

Low Carbon 1/2
High Carbon 1/2
Carbon Deviation High
Probe 1/2 Temperature Low
Probe 1/2 Purge in Progress
Carbon 1/2 Invalid Low
Carbon 1/2 Invalid High
Carbon 1/2 Invalid Temp

4.11 Connecting the Automatic Purge System

CAUTION

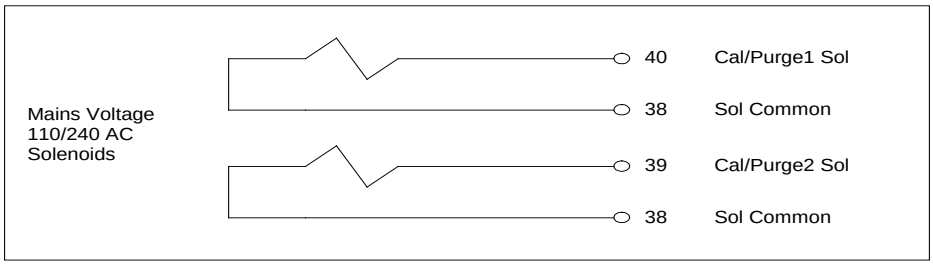
The purge solenoid valves are supplied with mains voltage. This supply has electrical shock danger to maintenance personnel. Always isolate the controller before working with the purge and calibration solenoid valves.

The on-line auto purge check system is optional. For details on its operation see Chapters 4.17, 4.18

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 System Wiring Schematic

4.12 Connecting Reference Air

For carbon / oxygen probes, a 1/4" tube connector on the controller 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.

4.13 Connecting the Controller to a MODBUS™ Network

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

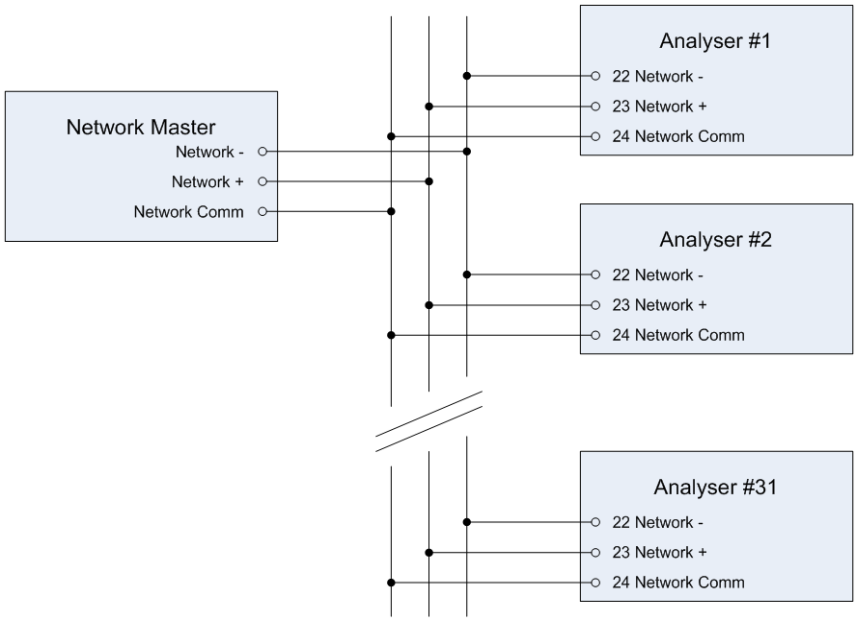
NOTE: Hardware Protocol Selection
The communications port of the 1734 can be configured to communicate on either RS232 or RS485. If the controller is to be used on a MODBUS network, the 1734 controller must be set to RS485. For further details see Chapter 7.2.52-55, Communications Port Options.

NOTE: Terminating Resistor
There is a terminating 100 ohm 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 controllers except the controller on the end of the network line. If the network line from the controllers is taken from the middle of the controller 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	None
Stop	Bits 1
RS485	Half Duplex
Mode	RTU (binary mode)

For more details see Appendix 5.



Network Connections

4.14 Connecting Power

The power input terminals are –

34	Earth
35	N/C
36	Mains Neutral
37	Mains Active

The 1734 controller automatically detects the mains voltage and frequency, so there is no mains voltage selection necessary.
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. See chapter 4.5 for the drawing.

The controller MUST be securely earthed.

4.15 Commissioning - Run Mode

When the controller is turned on it will go to the RUN mode. The SET-UP/RUN button will toggle between the two modes. The upper line of the display will now read 'Probe 1 Carbon %'. If the probe or sensor temperature is not above 650°C (1200°F), a "Probe Low Temperature" message is flashed on the lower line, and the "T" will be flashed in the lower LH corner of the display. The probe or sensor temperature can be checked on the lower line of the display.

4.16 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 6.3 Function 1. *Probe 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 (120 to 600 scfm) for a 1231 probe and up to 20 litres/minute (2400scfm) for an unheated probe. When a stable oxygen reading has been achieved, read the 'Probe EMF'. Enter this value into the set-up menu #1 for the probe 1 (set-up #2 for the second probe if it is installed).

4.17 Filter Purging

Purging probe filters is controlled from the 'GAS/PURGE' buttons on the controller when in 'RUN' mode. If 'Automatic' has been selected in either 'Sol. 1 Auto/Man' or 'Sol. 2 Auto/Man' in Commissioning Menus 21 or 26, pressing the 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 30 kPa (5 psi) is adequate but the air pressure may be set as high as 100 kPa (15 psi).

For unheated probes with no filter, carbon build up in the end of the probe does not present a problem unless the carbon, when settled, is not porous. Allow the carbon in the process to build up on the probe. It will form a porous layer, slowing the response time. To avoid mechanical abrasion of the electrode material, pack 'SAFFIL' or equivalent alumina based ceramic fibre in the sensing holes to protect the electrode. Do not use silica based ceramic fibres such as 'KAOWOOL', which can attack the electrode at high temperatures. Once the carbon has built up the response time of the probe will be slower.

Probes can also be mounted horizontally with no filter. An occasional automatic back purge is helpful in this case.

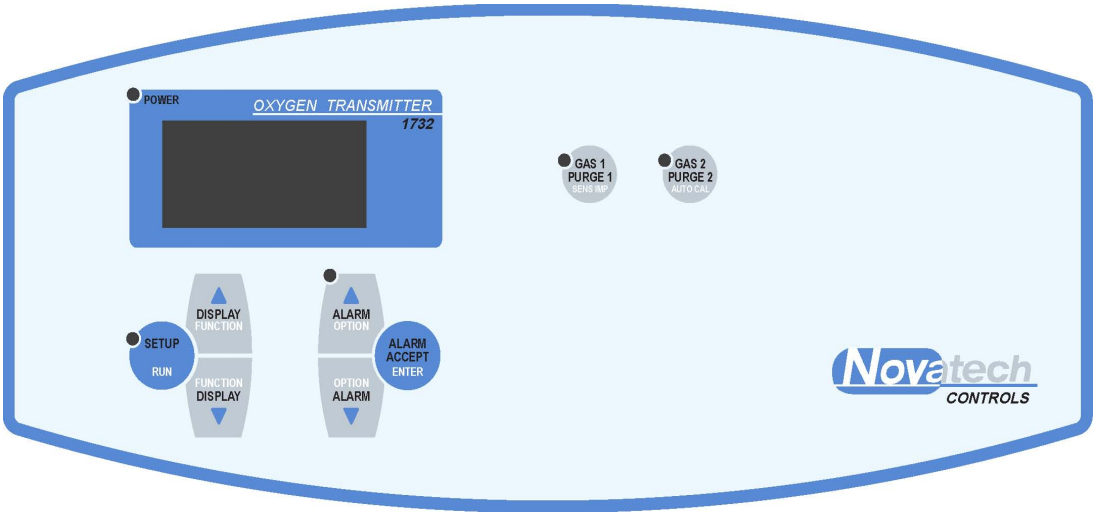
This page has been intentionally left blank.

5. DISPLAY AND KEYPAD

Operator interaction with the carbon controller is done through a graphical display and 8 keys on the front of the case. The five LED indicators are used to show the status of the controller and to alert the operator of any errors.

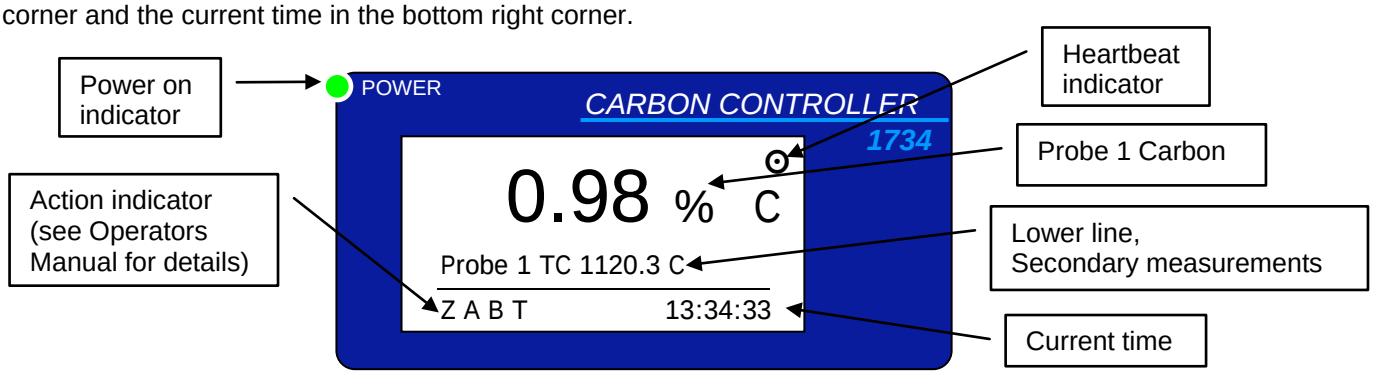
Each of the keys has a dual function;
The BLACK text printed on the key is the function while the controller is in the RUN mode
The WHITE text printed on the key is the function in one of the three configuring menus, (SETUP, COMMISSIONING and CALIBRATION)

The menu driven modes are accessed by pressing, and in some cases holding down, the SETUP key (see Chapters 6, 7 and 8 for details of these modes). The controller will return to the RUN mode when the SETUP key is pressed again, or if 60 seconds has elapsed since the last key was pressed.



5.1 Graphical Display

In RUN mode the 1734 shows the first carbon probe 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 SETUP mode the RUN display is replaced with a menu driven interface. All other functions of the controller (reading, calculating and transmitting etc) aside from the keypad and display will continue to operate as normal.

5.2 Carbon and Oxygen Display Units

The measurement of carbon is shown as the main and largest value on the display. It is shown with 2 decimal places as #.## %.
The measured oxygen content displayed on the Lower line is shown in either %, parts per million (ppm) or in scientific notation.
The format of the oxygen display changes to maintain the best resolution for the measurement.

Range	Display format
30.0 to 100.0%	##.#%
1.00 to 29.99%	##.##%
0.100 to 0.999%	#.###%
< 0.100%	scientific notation (#.## x $10^{-\#\#}$ %)

5.3 Keypad

There are eight keys built into the decal on the outside of the door of the 1734 controller. The key functions are written in BLACK and WHITE to identify the function of the key in either RUN mode or SETUP mode.

Key text	RUN mode (WHITE text)	SETUP mode (BLACK text)
SETUP / RUN	Enter SETUP mode	Return to RUN mode
DISPLAY / FUNCTION UP	Display Next Lower Line Item	Next Function
DISPLAY / FUNCTION DOWN	Display Prev. Lower Line Item	Previous Function
ALARM / OPTION UP	Next Alarm	Next / Increment Option
ALARM / OPTION DOWN	Previous Alarm	Previous / Decrement Option
ALARM ACCEPT / ENTER	Acknowledge Displayed Alarm	Save Current Option
GAS 1 PURGE 1 / SENS IMP	Gas 1 / Purge 1 manual activate	Check Probe impedance
GAS 2 PURGE 2 / AUTO CAL	Gas 2 / Purge 2 manual activate	Manually Activate Output Calibration

5.3.1 Keypad in RUN mode

When the controller is turned on and has completed its start-up procedure, it will enter RUN mode and enable the keypad. The key functions in this mode are as follows;

SETUP / RUN key
Pressing this key will put the controller into one of the menu-driven SETUP, COMMISSIONING or CALIBRATION modes (see Chapters 6, 7 and 8 for details). The function of all the keys will then change to the functions that they have in the SETUP mode.

DISPLAY UP / DOWN keys
The display keys 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 6.3 Function 03. *Lower Line Items*.

ALARM UP key
If there is either a new alarm or an active alarm the ALARM UP key 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 keys see Chapter 9, Alarms. The SETUP light will flash slowly to show that the controller is now in the alarm display mode.

ALARM DOWN key
When the controller is displaying active alarms (the ALARM UP key has been pressed), the ALARM DOWN key and the ALARM UP key allow the operator to examine the date / time of the alarm and the date / time that the alarm was acknowledged.
If the controller was in RUN mode when this key is pressed it will go into the alarm log display mode. See Chapter 9 for more details.

ALARM ACCEPT key
The ALARM ACCEPT key is used to accept a new alarm (see Chapter 9, Alarms).

GAS 1 / PURGE 1 and GAS 2 / PURGE 2 keys
These two keys are used to turn on the gas / purge solenoids. When the controller is in the manual cal / purge mode (Commissioning functions #21 and 30) the solenoid will be activated for as long as the key is pressed. When the controller is in the auto cal / purge mode the automatic purge cycle is started. The cycle can be stopped by pressing the same key again.

5.3.2 Keypad in SETUP / COMMISSIONING / CALIBRATION modes

NOTE: In order to enter either COMMISSIONING or CALIBRATION modes, the corresponding DIP switch on the 1730-1 PCB must be turned on.

From RUN mode, if the SETUP / RUN key is pressed once, the controller will go into the SETUP mode.

From RUN mode, if the SETUP / RUN key is pressed and held for 2 seconds, the controller will go into the COMMISSIONING mode.

From RUN mode, if the SETUP / RUN key is pressed and held for 4 seconds, the controller will go into the CALIBRATION mode.

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

SETUP / RUN key
Pressing the SETUP / RUN key while in any of the set up modes will return the controller to the RUN mode.

FUNCTION up and FUNCTION down keys
These two keys allow for the selection of the setup function. A function summary table is found at the start of the relevant SETUP, COMMISSIONING or CALIBRATION mode chapter.

OPTION up and OPTION down keys
These two keys allow for changing 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 the relevant SETUP, COMMISSIONING or CALIBRATION mode chapter.

ENTER key
The ENTER key sets the currently displayed option and stores the value in non-volatile memory to be retrieved on device start up. If the ENTER key is not pressed when a new option is chosen, the previous option will be retained.

Probe impedance key
When this key is pressed the controller will measure the impedance of oxygen sensor(s) attached to the controller. 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. A ‘Z’ will be seen in the bottom left hand corner of the display as the test is performed.

Auto calibrate key
When this key is pressed the controller will calibrate the analogue output channels that are set to auto calibration (see Chapter 10). 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 controller in order to calculate a zero and span calibration factor for each of the output channels.
During this process normal output to the analogue channels will be interrupted sending the outputs to zero mA.

This page has been intentionally left blank.

This chapter describes the functions available when the SETUP mode is entered on the controller.

The SETUP mode is mode is accessed by pressing the SETUP key momentarily so the words 'Setup Mode' appear at the bottom of the display. The controller will return to the RUN mode when the SETUP key is pressed again or 60 seconds after the last key press.

6.1 Function Summary Table

When the controller is in the SETUP mode the SETUP light will be on and the words "Setup Menu" will be shown at the bottom of the display.
The following table shows the SETUP functions:

Menu #	Function name	Range	Default value
01	Probe 1 Offset	-6.0 to +6.0mV	0.0mV
02	Probe 2 Offset	-6.0 to +6.0mV	0.0mV
03	Lower Line Items	See Chapter 6.3 Function 03.	
04	Damping Factor	No Damping to 10 Samples	5 Samples
05	Process Alarms	Enabled / Disabled	Disabled
06	Carbon Controller	See Chapter 7.2 Function 31.	
07	Carbon Set Point	0.01 to 2.00%	1.2%
08	High Carbon Alarm	0.01 to 2.00% **	1.5%
09	High Carbon Alarm Delay	0 to 200 seconds **	20 seconds
10	Low Carbon Alarm	0.01 to 2.00% **	0.35%
11	Low Carbon Alarm Delay	0 to 200 seconds **	20 seconds
12	Carbon Deviation Alarm	0.01 to 2.00% **	2.0%
13	Carbon Deviation Alarm Delay	0 to 200 seconds **	30 seconds

** These menus are display only in the SETUP menu. To change these values refer to the CALIBRATION menu

6.2 Changing Options

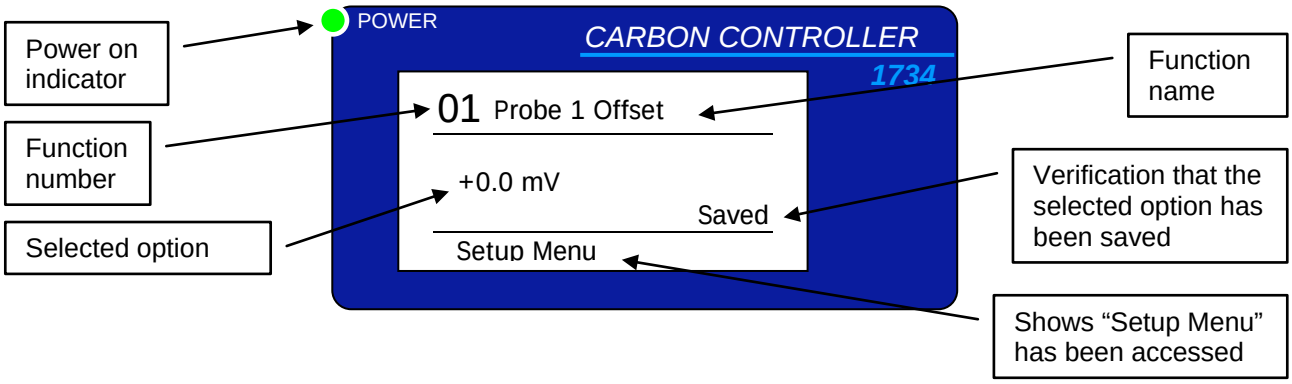
The purpose of having a menu driven SETUP mode is to allow for configuration of the controller using the graphical display and keypad.
Once an option is changed and entered using the ENTER key that value immediately becomes active. It is also stored into the non-volatile memory within the BBRAM and will be loaded again at device start-up. To reset the controller configuration defaults see Chapter 10.2, Cold Start.

To change an option in the SETUP menu system:

1. Select the SETUP mode by pressing the SETUP / RUN key once. The SETUP light will come on and the display will have the format shown below. The operations of the keys are now the operations written in WHITE on the keypad. The menu name is written at the bottom of the display.
2. When the SETUP mode has been selected the required function can be found by using the FUNCTION UP and FUNCTION DOWN keys.
   The options available for that function can be seen by using the OPTION UP & OPTION DOWN keys.
3. When the required option is on the display press the ENTER key to save that value.

When finished, press the SETUP / RUN key to return to the RUN mode.

6.3 Setup Mode Functions



01 & 02. Probe 1/2 Offset

Each Novatech probe has an offset calibration value printed on a tag that is attached to the probe when it is dispatched. To achieve accurate measurement the offset value must be entered with the same polarity as it is printed on this label. 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 reduced affect. 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 controller has been configured for 2 probes. (see Chapter 04. Number of *Probes*)

03. Lower Line Items

This function allows the operator to change the items that are available to be displayed on the lower line of the controller 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 UP and DISPLAY DOWN keys.
A lower line measurement can be "Enabled" or disabled by pressing the ENTER key.

	Option	Enabled as Default
1	Probe 2 Carbon %	*
2	Average Carbon %	*
3	Probe 1 TC Temperature	*
4	Probe 2 TC Temperature	*
5	Probe 1 EMF mV	*
6	Probe 2 EMF mV	*
7	Probe 1 Sensor Impedance	*
8	Probe 2 Sensor Impedance	*
9	Probe 1 Oxygen %	
10	Probe 2 Oxygen %	*
11	Auxiliary TC Temperature	
12	Ambient Temperature	
13	Ambient Relative Humidity	
14	Controller Set Point	
15	Burner Run Time	
16	Service date	

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

04. Damping Factor

The carbon measurement can be damped by averaging successive readings from the probe. This will smooth out fluctuations in the process gas level and will slow down the reaction time of the controller. The larger the number selected here, the more successive readings are averaged and the smoother the measurement will be.
The damped oxygen value is also used in the calculation of all other parameters that are based on the oxygen value.

05. Process Alarms

This function allows the operator to enable and disable process alarms. The process alarm menu functions will also be hidden if the process alarms are disabled. (See also Chapter 7.2 Function 38. *Process Alarms*)

06 & 07. Carbon Controller & Carbon Set Point

NOTE: In the SETUP menu the carbon controller selection and set point are accessible for quick configuration. For more complete configuration of proportional control or floating control refer to the carbon control menus in the COMMISSIONING menu.

The 1734 Carbon Controller can enter a carbon set point and control feedback devices based on the carbon readings. See Chapter 2.4 and Chapter 7.2 Function 31. *Carbon Controller* for further details.

08 – 11. High / Low Carbon Alarm and Delay

NOTE: In the SETUP menu the process alarm functions are locked and cannot be modified. To make changes to the process alarm thresholds and delays, see Chapter 7. Commissioning Mode.

As well as enabling or disabling all process alarms, each alarm can be individually disabled. This is done by scrolling the alarm threshold option down as far as it can go until the word ‘disabled’ is displayed, then saving the value.

12 & 13. Carbon Deviation Alarm and Delay

NOTE: See note on previous chapter regarding the changing of alarm thresholds & delays.
These process alarms require the comparison of two oxygen probes and will only become available if dual probe mode is enabled.

If process alarms are enabled each probe will be treated separately and will trigger its own set of process alarms when a threshold is exceeded for longer than the delay time.
The delay time is included to avoid nuisance alarms which may occur if the process is undergoing transitions. In order to trigger a process alarm the oxygen must exceed the threshold for a time exceeding the delay time. For instant response this can be set to zero or ‘no delay’.

This page has been intentionally left blank.

This chapter describes the functions available when the COMMISSIONING mode is entered on the controller.

The COMMISSIONING mode is accessed by pressing and holding the SETUP key for approximately 2 seconds until the words “Commissioning Menu” appears at the bottom of the display. The controller will return to the RUN mode when the SETUP key is pressed again or 60 seconds after the last key press.

Changing options in the COMMISSIONING mode is the same as the SETUP mode. See Chapter 6.2, Changing Options.

7.1 Function Summary Table

When the controller is in the COMMISSIONING mode the SETUP light will be on and the words “Commissioning Menu” will be shown the bottom of the display.
The following table shows the COMMISSIONING menu functions:

Menu #	Function name	Range	Default value
01	Internal Clock Date	-	
02	Internal Clock Time	-	
03	Service Date	-	
04	Number of Probes	Single / Dual Probe	Single Probe
05	Probe 1 Type	1231 / 1234 Heated or 1232 Unheated	1232 Unheated
06	Probe 2 Type		
07	Probe 1 TC Type	K, J, R, S or N Types	R-Type
08	Probe 2 TC Type		
09	Auxiliary TC Type	K, J, R, S, N, Disabled	Disabled
10	Controller Output Channel 1	See Chapter 10 – 15. Controller Output Channel.	Probe 1 Carbon %
11	Controller Zero Channel 1		0%
12	Controller Span Channel 1		1.5%
13	Controller Output Channel 1		Probe 1 Carbon %
14	Controller Zero Channel 2		0%
15	Controller Span Channel 2		1.5%
16	Process Pressure Units	Inches WG, mm WG, kPa, PSI	Inches WG
17	Process Pressure Value	-1 to 3 Atm	0 Inches WG
18	Generator Gas	Methane/Propane/Nitro-Methanol	Methane
19	Furnace CO%	0-100%	23%
20	Temperature Units	Celsius / Fahrenheit	Celsius
21	Auto Purge Solenoid 1	Enabled/Disabled	Disabled
22	Purge 1 Start Time	00:00 to 23:45	00:00 (midnight)
23	Purge 1 Period	1 minute – 7 days	24 Hours
24	Purge 1 Duration	1 – 90 seconds	30 Seconds
25	Purge 1 Post Freeze	5 – 300 seconds	60 Seconds
26	Auto Purge Solenoid 2	Enabled/Disabled	Disabled
27	Purge 2 Start Time	00:00 – 23:45	00:00 (midnight)
28	Purge 2 Period	1 minute – 7 days	24 Hours
29	Purge 2 Duration	1 – 90 seconds	30 Seconds
30	Purge 2 Post Freeze	5 – 300 seconds	60 Seconds
31	Carbon Controller	See Chapter 7.2 Function 31.	
32	Carbon Set Point	0.1 to 2.0%	1.2%

Menu #	Function name	Range	Default value
33	Proportional Band	0.01 to 2.00%	0.5%
34	Integral Time Constant	0 to 1000 seconds	100 seconds
35	Dead Band	0.001 to 0.1%	0.01%
36	Cycle Time	1 to 100 seconds	30 seconds
37	Actuate Time	1 to 100 seconds	60 seconds
38	High Carbon Alarm	0.01 to 2.00%	2.5%
39	High Carbon Alarm Delay	0 to 200 seconds	10 seconds
40	Low Carbon Alarm	0.01 to 2.00%	10.0%
41	Low Carbon Alarm Delay	0 to 200 seconds	60 seconds
42	Carbon Deviation Alarm	0.01 to 2.00%	2.0%
43	Carbon Deviation Alarm Delay	0 to 200 seconds	30 seconds
44	Alarm Relay 1 Function	See Chapter 9	
45	Alarm Relay 2 Function		
46	Alarm Relay 3 Function		
47	Common Relay Function		
48	Accept Relay Hold	Enabled / Disabled	Enabled
49	Reference Air Pump	Internal / External	Internal
50	Internal Pump Voltage	1.5 to 5.0v	2.0v
51	Reference Air RH %	0 to 80%	55%
52	Serial Interface	RS-232 / RS-485	RS-232
53	Serial Baud Rate	9600 – 57600 bps	19200bps
54	Serial Parity	Even / Odd / No Parity	Even Parity
55	MODBUS Address	1 – 246	Disabled (0)
56	Clear Alarm Log	Clear / Don't Clear	Don't Clear

7.2 Commissioning Mode Functions

01 & 02. Internal Date / Time

The date and time are used in the controller 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 UP & DOWN keys. The date and time will change faster the longer the OPTION key is held.

03. 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 controller 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.

04. Number of Probes

The 1734 controller can operate in single or dual probe mode. By selecting single probe, all dual probe options and alarms will be disabled and second probe options hidden from the user.
If you are using the controller as a single probe device you should set the number of probes to 'single probe' to disable all probe 2 alarms and display items.

05 & 06. Probe 1 & 2 Type

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

07 & 08. Probe 1 & 2 Thermocouple Type

The thermocouple type can be set to K, J, R, S or N. The thermocouple in the Novatech 1232 unheated probes are available in R type or S type. Other thermocouple options are made available for special installations.

09. Auxiliary Thermocouple Type

When the controller is operating as a single probe mode, the probe 2 thermocouple input (terminals 7&8) is used as an auxiliary thermocouple input. In dual probe mode this option is unavailable.
Use of an auxiliary thermocouple allows for basic monitoring of temperature as well as enabling the calculation of combustion efficiency. The thermocouple type can be set to K, J, R or S.

10 – 15. Controller Output Channel 1 & 2

The 1734 controller has two fully configurable 4-20mA analogue outputs. The channels can be configured independently to output one of several calculated values.
The following outputs are available on channel #1:

Output	Zero	Span	Step	Min Span	Default
Probe 1 Carbon %	0%	0.1 to 1.5%	0.1%	0.1%	0 to 1.5%
Average Carbon % **	0%	0.1 to 1.5%	0.1%	0.1%	0 to 1.5%
Probe 1 EMF	0 to 1400mV	100 to 1500mV	100mV	100mV	0 to 100mV
Probe 1 TC Temperature	0 to 1500°C	100 to 1600°C	100°C	100°C	0 to 1300°C
Probe 1 Oxygen %	0 to 99%	1 to 100%	0.1%	1%	0 to 25%
Reducing Oxygen 1 exp	+2 to -28	0 to -30	1	2 decades	-1 to 30
Aux TC Temperature *	0 to 1500°C	100 to 1600°C	100°C	100°C	0 to 1300°C
No Output	-	-	-	-	-

** Only available in dual probe mode. * Only available in single probe mode.

The following outputs are available on channel #2:

Output	Zero	Span	Step	Min Span	Default
Probe 1 Carbon % *	0%	0.1 to 1.5%	0.1%	0.1%	0 to 1.5%
Probe 2 Carbon % **	0%	0.1 to 1.5%	0.1%	0.1%	0 to 1.5%
Average Carbon % **	0%	0.1 to 1.5%	0.1%	0.1%	0 to 1.5%
Probe 1 EMF *	0 to 1400mV	100 to 1500mV	100mV	100mV	0 to 100mV
Probe 2 EMF **	0 to 1400mV	100 to 1500mV	100mV	100mV	0 to 100mV
Probe 1 TC Temperature *	0 to 1500°C	100 to 1600°C	100°C	100°C	0 to 1300°C
Probe 1 TC Temperature **	0 to 1500°C	100 to 1600°C	100°C	100°C	0 to 1300°C
Probe 1 Oxygen % *	0 to 99%	1 to 100%	0.1%	1%	0 to 25%
Probe 1 Oxygen % **	0 to 99%	1 to 100%	0.1%	1%	0 to 25%
Reducing Oxygen 1 exp. *	+2 to -28	0 to -30	1	2 decades	-1 to 30
Reducing Oxygen 2 exp. **	+2 to -28	0 to -30	1	2 decades	-1 to 30
Aux TC Temperature *	0 to 1500°C	100 to 1600°C	100°C	100°C	0 to 1300°C
No Output	-	-	-	-	-

** Only available in dual probe mode. * Only available in single probe mode.

The zero and span of the selected output are set in the following two menus (functions 11&12 and 14&15).

16 & 17. Process Pressure Units and Value

The 1734 controller is capable of fixed pressure compensation in the calculation of oxygen from -1 Atm to +3 Atm. If the probe is running in a pressurised environment this value should be set to allow for accurate oxygen measurement.

18 & 19. Generator Gas & Furnace CO%

Select the source of the gas in the furnace. Options are Methane CH_4, Propane C_3H_8, or Nitrogen-Methanol. If the last option is selected then the percentage carbon monoxide present in the furnace must be entered in menu 19

20. Temperature Units

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

21 & 26. Automatic Purge Solenoid 1 & 2

When enabled the solenoid will perform a pre-programmed timed purge cycle. When set to manual the solenoid is controlled directly from the corresponding key on the front of the case. When set to automatic the purge cycle can be started by pressing the corresponding key on the front of the case. It can be stopped by pressing the same key again.

22 & 27. Purge 1 & 2 Start Time

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

23 & 28. Purge 1 & 2 Period

This option specifies the period between automatic 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 Operation' option accessible by scrolling the option below 1 minute allows for pre-configured solenoid cycles to be triggered manually via the keypad, but without the automatic scheduling.

24 & 29. Purge 1 & 2 Duration

Duration of time that an automatic purge event energises the solenoid

25 & 30. Purge 1 & 2 Post Freeze

Duration of time the controller waits before resuming live readings following a purge event.

31. Carbon Controller

The 1734 Carbon Controller is capable of controlling the carbon atmosphere of a furnace. There are four feedback methods for controlling the furnace; the first one 'ON/OFF' is the simplest and commonly used. The next three require a more sophisticated control valve and commissioning. See chapter 2.4 for more details.

32. Carbon Set Point

Available if any carbon control method is selected in COMMISSIONING menu 31 above. This is the carbon percentage that the 1734 controller will maintain when the controller is enabled.

33. Proportional Band

Available if one of the two carbon control proportional methods or 'Floating Control' is selected in COMMISSIONING menu 31 above. This item provides an adjustment on the sensitivity of the control action. The smaller the proportional band the larger the output valve adjustment reaction will be to an atmospheric change.

34. Integral Time Constant

Available if the Carbon Controller is set to '4-20mA Proportional' Control method in COMMISSIONING menu 31 above. This number controls the rate of integral windup in the controller while the process variable is within the proportional band. The larger this number the slower the integral action of the controller

35. Dead Band

Available if the Carbon Controller is set to 'Floating Control' Control method in COMMISSIONING menu 31 above. This menu provides an adjustable process error range over which the valve will not be adjusted.

36. Cycle Time

Available if the Carbon Controller is set to 'Proportional ON/OFF' control method in COMMISSIONING menu 31 above. This is the time over which the control vale will go through an on and an off cycle.

37. Actuate Time

Available if the Carbon Controller is set to 'Floating Control' control method in COMMISSIONING menu 31 above. This is the time over which the control vale will go through an on and an off cycle.

38 – 43.Process Alarms

The carbon measurements are continuously monitored by the controller for process alarm conditions (Process alarms must be enabled in the Set up menu). The limits and the alarm time delays are configurable for the Very Low Oxygen alarm, Low Oxygen alarm, High Oxygen alarm and the Oxygen Deviation alarm.

44 – 46. Alarm Relay 1, 2 and 3 Function

There are 3 user configurable alarm relays. Any of the 3 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	
Carbon 1 Low	Carbon 1 Invalid Low
Carbon 2 Low **	Carbon 2 Invalid Low **
Carbon 1 High	Carbon 1 Invalid High
Carbon 2 High **	Carbon 1 Invalid High
Carbon Deviation	Carbon 2 Invalid High **
Probe 1 Temperature Low	Carbon 1 Invalid Temp
Probe 2 Temperature Low **	Carbon 2 Invalid Temp **
Purge 1 In Progress	
Purge 2 In Progress **	

** Are only available in dual probe mode.

The 'invalid' alarm conditions indicate that the calculated and displayed carbon value is not valid according to environmental limiting equations. The value is still displayed for continuity reasons.

47. 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	Alarm Log 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
Auxiliary Thermocouple Open Circuit	Probe 1 Filter Blocked
Reference Air Pump Fail	Probe 2 Filter Blocked **
Reference Air Pump Overload	

** 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 key, and they will then appear on the list in the other alarm relays.

48. Operation of the Alarm Relays when an Alarm is Accepted

An option is available to in the commissioning menu to change the operation of the alarm relay when an alarm has been accepted. The states for the alarm relay contacts are shown in the following table –

Alarm State	**Accepted Relay – Hold Enabled**	**Accepted Relay – Hold 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

The default setting is 'Enabled' after a cold start. This state makes the 1734 react to alarms in the same way as the earlier model 1634 controller.

49 - 51. Reference Air Pump Options

Normally the reference air is supplied from the controller using the internal pump. The pump will be a model MP-24 or a model CM-15. The default option is 5.00v.

	Function	**Options**
49	Reference Air Pump	External or Internal
50	Internal Pump Voltage	Pump voltage setting, between 2.5 and 5.00 in 0.25v steps
51	Reference Air RH%	If external is selected, set the RH level. (5% if instrument air is used)

52 – 55. Communications Port Options

The 1734 controller 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**
52	Serial Interface	RS-232 or RS-485 (Use RS-485 for MODBUS)
53	Serial Baud Rate	9600, 19200, 38400, 57600 (RS-232 up to 19200 only)
54	Serial Parity	Even, Odd or No Parity
55	MODBUS Address	Set the MODBUS address for this device between 1 and 246. 0 is to disable the MODBUS

56. Alarm Log Clearing

Every alarm that is instigated internally in the controller 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 select CLEAR in SETUP step 64 by using the OPTION keys and press the ENTER key. The message "Alarm Log Cleared" will be displayed.

8. CALIBRATION MODE

This chapter describes the functions available when the CALIBRATION mode is selected on the controller. For specific information about calibrating the controller see Chapter 10, Instrument Calibration.

The CALIBRATION mode is accessed by pressing and holding the SETUP key for approximately 4 seconds until the words “Calibration Menu” appears at the bottom of the display. The controller will return to the RUN mode when the SETUP key is pressed again or 60 seconds after the last key press.

Changing options in the CALIBRATION mode is the same as the SETUP mode. See Chapter 6.2 Changing Options.

8.1 Function Summary Table

When the controller is in the CALIBRATION mode the SETUP light will be on and the words “Commissioning Menu” will be at the bottom of the display. The following table shows the CALIBRATION menu functions:

Menu #	Function name	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	Controller Output Select	4-20mA / 0-20mA	4-20mA
15	Controller Output Limiting	Hold 0mA / Hold 20mA Disabled	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

8.2 Calibration Mode Functions

01 – 04. 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 controller to another but can be trimmed by setting the actual voltages into CALIBRATION menu functions #1 to 4. These voltages should be measured and the reference voltage entries in the menu checked every year.

05 – 10. Output Channel 1 and 2 Calibration

The output 4-20mA calibration can be set either AUTOMATICALLY (default) or MANUALLY.
If Auto Calibrated is selected the controller 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.

11. 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 controller case near the screw terminal #1. Enter this temperature into the calibration function 11 by using the OPTION keys and then the ENTER key.

12 & 13. Low Oxygen Calibration

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 controller. The default is 100% but can be set to between 80 and 120%.

14. Controller Output Scale

The controller outputs can be configured to either 4-20mA or 0-20mA.

15. Controller Output Limiting

If the carbon reading is invalid the output can be made to be set to either 0/4mA (low scale) or 20mA (full scale). An invalid reading is when the probe temperature is below 650°C (1200°F) or the probe thermocouple has been detected as open circuit. The default is to set the output to 20mA but the function can also be disabled.

16 & 17. Mains Voltage Detection

The default setting for the 1734 controller is that it will automatically detect the mains voltage and frequency in order to correctly drive the probe heaters. If there is any uncertainty in this detection system the voltage can be forced to 220-240 or 100-127, and the frequency can be set to 50 or 60Hz.

18. Heater SSR Fault Correction

In the event of one of the heater solid state relays (SSR) failing in single probe mode, the heater drive output can be swapped to the HEATER 2 output. Select “Heater 1<-> Heater 2”.
If you are running in dual probe mode but not using the calibration gas or purge solenoid outputs the solenoid outputs can be swapped to the 2 heater outputs. Select “Heaters <-> CalPurge”.
The default setting is “Normal”.

The 1734 has 4 alarm relays and a built in alarm annunciator.

If an alarm occurs, the ALARM light will flash. To find out what the alarm is, press the ALARM up key.

When the ALARM up key has been pressed, the controller goes into the alarm display mode. In this mode some of the keys take on a special function.

Key Text	RUN mode	ALARM mode
SETUP / RUN	*	Return to RUN mode
DISPLAY / FUNCTION up	*	Next alarm
DISPLAY / FUNCTION down	*	Last alarm
ALARM / OPTION up	Enter ALARM display mode	Alarm activated time
ALARM / OPTION down	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 key is not used in the ALARM mode

The common alarm relay is used to monitor faults within the controller and the probe. The other three alarm relays relate to the process gas. All relays have user defined actions.

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 until the SETUP key is pressed to return the controller to RUN mode.

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

When the controller is turned off the contacts are open circuit
When the controller is 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 #50. See Chapter 7.2 Function 44, Operation of the alarm relay when an alarm is accepted.

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 Common Alarms

The events that drive the common alarm are –

1. ‘Probe 1 Heater Fail’
2. ‘Probe 2 Heater Fail’

A heated probe (model 1231/1234) has been turned on for more than 20 minutes but is still not up to 650°C (1200°F) or the probe temperature falls below 650°C.

3. ‘Probe 1 High Impedance’
4. ‘Probe 2 High Impedance’

Oxygen probe or electrode failure. The sensor has a high impedance measurement. Replace the probe. This alarm is inhibited when the probes are less than 650°C (1200°F).

5. ‘Probe 1 TC Open Circuit’
6. ‘Probe 2 TC Open Circuit’
Probe thermocouple is open circuit. The heater in heated probes will switch off.

7. ‘Aux TC Open Circuit’
The AUX thermocouple is open circuit. If the thermocouple is not needed, select “Disabled” in COMMISSIONING menu function #9, “Aux TC Type” or place a short circuit between terminals 7 & 8.

8. ‘Ref Air Pump Fail’
The reference air pump in the controller has been either unplugged or has gone open circuit (<20mA). Replace the reference air pump.

9. ‘Ref Air Pump Overload
The reference air pump in the controller has stalled and is drawing in excess of 300mA. The controller will attempt to restart the pump every minute for 1 second. Replace the reference air pump.

10. ‘ADC Calibration Fail’
The analogue to digital converter has been found to fall outside the normal calibration specifications. In this case the probe heater will automatically be turned off.

11. ‘Alarm Log Fail’
The alarm history is kept in an EEROM. This alarm will be raised if this memory device fails.

12. ‘Output 1 Failure’
13. ‘Output 2 Failure’
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.

14. ‘Heater 1 SSR Failure’
15. ‘Heater 2 SSR Failure’
One of the heater power control devices (SSR) has been found to have failed. See Chapter 8.2 Function 18. *Heater SSR fault correction*.

16. ‘Heater SSR Leakage’
One of the heater power control devices (SSR) has been found to have failed but the controller cannot determine which one(s) has failed.

17. ‘Probe 1 Filter Blocked’
18. ‘Probe 2 Filter Blocked’
Blocked probe filter. This test is only performed when automatic purging of the probe is selected. This alarm will not reset until the next purge cycle. The cycle can be initiated manually or automatically.

19. ‘BBRAM Fail’
All of the setup options are held in the battery backed memory (BBRAM). This is the battery shaped device at the bottom centre of the 1730-1 PCB labelled MEM1. This alarm will occur when this device fails and will need to be replaced.

9.2 Selectable Process Alarms

The alarm relays 1, 2 and 3 are generally used to transmit a gas related alarm event. Any or all of the following functions can be selected for each relay. In addition, any of the common alarms that have been de-selected from the common alarm relay can be selected to activate the process alarm relays 1 to 3.

The trip levels and the delay times are set is in the COMMISSIONING menu.

NOTE: The process alarms will only be activated if they are enabled in the SETUP function 6. See Chapter 6.3 Function 5. *Process Alarms*

20. 'Carbon 1 Low'
21. 'Carbon 2 Low'

The measured carbon level on the indicated probe has been below the trip level shown in COMMISSIONING menu function #38 for longer than the delay time shown in function #39.

22. 'Carbon 1 High'
23. 'Carbon 2 High'

The measured carbon level on the indicated probe has been above the trip level shown in COMMISSIONING menu function #40 for longer than the delay time shown in function #41.

24. 'Carbon Deviation'

The difference between the carbon level measured on probe #1 and the carbon level measured on probe #2 is greater than the trip level shown in COMMISSIONING menu function #44 for longer than the delay time shown in function #45.

25. 'Probe 1 Temperature Low'
26. 'Probe 2 Temperature Low'

The probe temperature is under 650°C (1200°F). The oxygen reading is therefore invalid. If the probe heater has been on 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.

27. 'Purge 1 in Progress'
28. 'Purge 2 in Progress'

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

29. 'Carbon 1 Invalid Low'
30. 'Carbon 2 Invalid Low'
31. 'Carbon 1 Invalid High'
32. 'Carbon 2 Invalid High'

The carbon within the process may not be valid due to the probe EMF resulting in a carbon potential that is above/below the maximum carbon potential for the temperature of the process

33. 'Carbon 1 Invalid Temp'
34. 'Carbon 2 Invalid Temp'

The carbon within a process may not be valid due to the process temperature being below the minimum temperature of the carbon potential equation.

9.3 Alarm Relay Options

The three process alarm relays (relays 1 to 3) are user defined. The relay action will depend on the selections made in the COMMISSIONING menu functions #45 to #48.

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

- open when the controller power is off
- closed when 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 –

Carbon 1 Low	Alarm
Carbon 2 Low	
Carbon 1 High	
Carbon 2 High	
Carbon Deviation High	
Probe 1 Temperature Low	Warning
Probe 2 Temperature Low	
Purge 1 in Progress	
Purge 2 in Progress	
Carbon 1 Invalid Low	
Carbon 2 Invalid Low	
Carbon 1 Invalid High	
Carbon 2 Invalid High	
Carbon 1 Invalid Temp	
Carbon 2 Invalid temp	

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 #49 will appear on the process alarm relay lists in function #46 to #48.

10.1 Calibration Summary

The 1734 carbon controller 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 controller. 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 key 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 controller 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 controller to another but can be trimmed by setting the actual voltages into CALIBRATION menu functions #1 to 4.

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 1/2 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 10.1.2.

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 controller. 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 #5 (8) and set the option to 'Calibrate 4mA'.
2. Use the FUNCTION up key to go to function #6 (9).
3. Set this to 4.00mA and press the ENTER key.
4. Measure the actual output current with a digital multimeter.
5. Use the OPTION keys to set the option to the value read on the digital multimeter and press ENTER.
6. The output should go to 4.00mA. The value in function #6 (9) can be fine tuned if necessary.
7. Go back to function #5 (8) and select 'Calibrate 20mA'.
8. Go up to function #7 (10) and set the option value to 20.00mA.
9. Measure the actual output current with a digital multimeter.
10. Use the OPTION keys to set the option to the value read on the digital multimeter and press ENTER.
11. The output should go 20.00mA. The value in function #7 (10) can be fine tuned if necessary.
12. Go back to function #5 (8) and select 'Calibrate 4mA' again and check that the output is still set to 4.00mA. If it is not exactly 4.00mA the value in function #6 (9) can be trimmed again.
13. Go back to function #5 (8) and select 'Manually Calibrated'.

10.1.3 Probe Calibration

There is only one calibration factor for the calibration of the carbon / oxygen probe. This is the sensor offset, and it is written on a tag attached to every probe.
Use the FUNCTION keys to go to SETUP menu #1 (2) and then use the OPTION keys 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 because this will only produce an error of around 2% in the carbon reading in a heat treatment application for a 1mV error in the offset value.

10.2 Cold Start

The intention of the cold start function of the controller is to return all of the configuration set up back to the default values. There are 3 parts to the cold start:

1. If a software upgrade is installed and the changes require a change to the menu functions then the controller will automatically do a cold start. The controller will also do a cold start when the power is turned on and the configuration / calibration factors are found to be corrupted. It will only reset either the configuration values or the calibration values if either of them is found to be corrupted.
2. A cold start can be forced if the operator wants to reset the controller back to the default set up. See Chapter 10.2.1, Forcing a Cold Start.
3. 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 controller power off.
2. Use a fine point or screw driver to turn the COLD START switch on. The switch is at the bottom of the 1730-1 PCB, accessible through the window in the shield.
3. Turn the controller back on.
4. You will be prompted to select 'Reset' or 'Cancel' to the prompt 'Reset Calibration Data?'. Press the DISPLAY up key to reset the calibration factors and the configuration data or the ALARM up key to only reset the configuration of the controller.
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 controller. If only the configuration has been reset it is also important to check items that will affect the controller 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. SOFTWARE UPGRADES

The software for the 1734 controller is contained in memory inside the microprocessor integrated circuit (IC). The controller therefore does not require an external memory IC for the software. Provision has been made to enable the software to be upgraded in the field without the use of a computer.

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

1. Turn the power off to the controller at the power switch
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. Fold out the two wings of the blue socket labelled "FIRMWARE UPGRADE SOCKET". Plug the 29F010B into the socket. ***Carefully note the direction of the IC. Pin 1 is identified on the PCB and pin 1 on the IC has a small round indentation next to the pin.***
8. Hold down the DISPLAY down and the ALARM LOG keys and then turn on the power
9. Release the keys when the message "Verifying the EEROM" will be shown. The controller is confirming that the new firmware is valid.
10. After the EEROM has been read and confirmed this message will be shown:

Upgrade Firmware?
Model 1734
New Version: 1.##
Upgrade Cancel

11. Press the DISPLAY up key to 'Upgrade' the firmware.
12. Press the ALARM up key to cancel the upgrade and continue the start up of the current firmware.

Upgrading Firmware.
Analyser will reset itself in approx. 15 seconds. Do not turn off the power

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.

13. When the controller has upgraded the firmware it will start up the normal initialisation. The version of the firmware is shown on the start up screen.
14. Turn the controller power off.
15. Unplug the EEROM by pressing out the wings of the blue upgrade socket. Keep the EEROM in a safe place. It can be used to upgrade any number of controllers as required.
16. Replace the main shield and secure it with the three screws.
17. Reconnect the reference air pump hose and plug (if fitted).
18. Turn the power back on.

NOTE: The controller may do 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.

This page has been intentionally left blank.

The Novatech carbon controller 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.

12.1 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 100 and 240VAC? If may be necessary to replace the switch mode power supply, PS5, APC-5S.

An 'ADC Calibration Fail' alarm has occurred.
Turn the controller off and remove the main shield. Turn the controller 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 controller off and remove the main shield. Turn the controller 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 controller back working quickly, use the CALIBRATION menu function 18, Heater SSR Select, to change the heater output terminals. See Chapter 8.2 Function 18. *Heater SSR fault correction*.

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

12.2 Detailed Fault Analysis

The 1734 controller has a diagnostics mode built into the software. This mode allows detailed analysis of the hardware of the controller, 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.

This page has been intentionally left blank.

13.1 Controller Maintenance

The 1734 controller has several hardware checking systems that confirm the correct operation of the controller and raise an alarm if there is a fault detected. Because of this system, the controller only requires periodic maintenance. Novatech recommends an annual check of the controller.

The annual check should include the following items –

1. Measure and record the reference voltages, and check that the correct voltages are set in the calibration menu
2. Check that the reference air flow from the port on the bottom of the controller case is between 100 and 300cc/m
3. Check for contamination and potential blockage of the reference air filter that is mounted on the bottom of the controller case
4. If an external burner interlock has been connected (terminals 10 & 11), check that if one of the wires is disconnected the probe heater is disabled (1231 probes only)
5. Check the integrity of the cable. Particularly check the main power supply cable and the probe cable for any damage.
6. Check the integrity of the earth connections in the controller

13.2 Cleaning

The 1734 controller is made in an IP54 / IP65 rated diecast case. It is painted with a tough ripple finish power coating to maintain a clean look. However, if it is necessary to clean the case use either a warm soapy water solution or an isopropyl alcohol.

A build up of dust on or around the controller should be removed before the cabinet door is opened.
If there is a build up of dust inside the cabinet check the door o-ring seal for damage and replace it if necessary.

Take care when wiping the display window to avoid scratching the surface.

If the filters of the probe (if fitted) become blocked, use an ultrasonic cleaner with a few drops of household detergent. If the filters cannot be cleaned this way replace the sintered filters.

13.3 Replacement parts

The following list identifies field replaceable parts –

Stock Number	Description
18020	1730-1 Main PCB
18021	1730-2 Display PCB
14021	CM-15 Reference air pump
14105	Fuse - M205 3.15A 250V fuse (pack of 5)
14093	Instruction manual
18064	EEROM 173x firmware
11040	FIL-230 Titanium sintered filter, 30um
11041	FIL-215 Titanium sintered filter, 15um

14. INDEX

APPENDIX 1, TABLES FOR ENDOTHERMIC ATMOSPHERES

Millivolt Readings for Endothermic Atmosphere Generated from
Methane (Natural Gas) and containing approximately 20% ($CO + CO_2$)

Carbon %	Temperature °C 800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090
0.30	-	1051	1053	1055	1057	1059	1061	1063	1065	1067	1069	1071	1073	1075	1077	1079	1081	1083	1085	1087	1089	1091	1093	1095	1098	1100	1102	1104	1106	1108
0.35	1057	1059	1061	1063	1065	1067	1069	1071	1073	1075	1077	1079	1082	1084	1086	1088	1090	1092	1094	1096	1099	1101	1103	1105	1107	1110	1112	1114	1116	1118
0.40	1064	1066	1068	1070	1073	1075	1077	1079	1081	1083	1085	1087	1089	1092	1094	1096	1098	1100	1103	1105	1107	1109	1111	1114	1116	1118	1121	1123	1125	1127
0.45	1071	1073	1075	1077	1079	1081	1084	1086	1088	1090	1092	1094	1097	1099	1101	1103	1105	1108	1110	1112	1114	1117	1119	1121	1124	1126	1128	1131	1133	1135
0.50	1077	1079	1081	1083	1085	1088	1090	1092	1094	1096	1099	1101	1103	1105	1108	1110	1112	1114	1117	1119	1121	1124	1126	1128	1131	1133	1135	1138	1140	1143
0.55	1082	1084	1087	1089	1091	1093	1095	1098	1100	1102	1104	1107	1109	1111	1114	1116	1118	1121	1123	1125	1128	1130	1132	1135	1137	1140	1142	1144	1147	1149
0.60	1087	1089	1092	1094	1096	1098	1101	1103	1105	1108	1110	1112	1114	1117	1119	1122	1124	1126	1129	1131	1133	1136	1138	1141	1143	1146	1148	1151	1153	1155
0.65	1092	1094	1096	1099	1101	1103	1106	1108	1110	1113	1115	1117	1120	1122	1124	1127	1129	1132	1134	1136	1139	1141	1144	1146	1149	1151	1154	1156	1159	1161
0.70	1096	1099	1101	1103	1106	1108	1110	1113	1115	1117	1120	1122	1125	1127	1129	1132	1134	1137	1139	1142	1144	1147	1149	1152	1154	1157	1159	1162	1164	1167
0.75	1101	1103	1105	1108	1110	1112	1115	1117	1119	1122	1124	1127	1129	1132	1134	1136	1139	1141	1144	1146	1149	1151	1154	1156	1159	1162	1164	1167	1169	1172
0.80	1105	1107	1109	1112	1114	1117	1119	1121	1124	1126	1129	1131	1133	1136	1138	1141	1143	1146	1148	1151	1153	1156	1159	1161	1164	1166	1169	1171	1174	1177
0.85	1109	1111	1113	1116	1118	1120	1123	1125	1128	1130	1133	1135	1138	1140	1143	1145	1148	1150	1153	1155	1158	1160	1163	1166	1168	1171	1173	1176	1179	1181
0.90	1112	1115	1117	1119	1122	1124	1127	1129	1132	1134	1137	1139	1142	1144	1147	1149	1152	1154	1157	1160	1162	1165	1167	1170	1173	1175	1178	1180	1183	1186
0.95	1116	1118	1121	1123	1126	1128	1130	1133	1135	1138	1140	1143	1146	1148	1151	1153	1156	1158	1161	1164	1166	1169	1171	1174	1177	1179	1182	1185	1187	1190
1.00	-	1122	1124	1127	1129	1132	1134	1137	1139	1142	1144	1147	1149	1152	1154	1157	1160	1162	1165	1167	1170	1173	1175	1178	1181	1183	1186	1189	1191	1194
1.05	-	-	-	-	1132	1135	1137	1140	1143	1145	1148	1150	1153	1155	1158	1161	1163	1166	1168	1171	1174	1176	1179	1182	1184	1187	1190	1193	1195	1198
1.10	-	-	-	-	-	-	1141	1143	1146	1148	1151	1154	1156	1159	1161	1164	1167	1169	1172	1175	1177	1180	1183	1185	1188	1191	1194	1196	1199	1202
1.15	-	-	-	-	-	-	-	-	1149	1152	1154	1157	1160	1162	1165	1168	1170	1173	1176	1178	1181	1184	1186	1189	1192	1195	1197	1200	1203	1206
1.20	-	-	-	-	-	-	-	-	-	-	1158	1160	1163	1165	1168	1171	1174	1176	1179	1182	1184	1187	1190	1193	1195	1198	1201	1204	1206	1209

Millivolt Readings for Endothermic Atmosphere Generated from
Propane and containing approximately 20% ($CO + CO_2$)

Carbon %	Temperature °C 800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090
0.30	-	1044	1046	1048	1050	1052	1053	1055	1057	1059	1061	1063	1065	1067	1069	1071	1073	1075	1077	1079	1081	1083	1085	1087	1089	1091	1093	1096	1098	1100
0.35	1050	1052	1054	1056	1058	1060	1062	1064	1066	1068	1070	1072	1074	1076	1078	1080	1082	1084	1086	1088	1091	1093	1095	1097	1099	1101	1103	1106	1108	1110
0.40	1058	1060	1062	1064	1066	1068	1070	1072	1074	1076	1078	1080	1082	1084	1086	1088	1090	1092	1095	1097	1099	1101	1103	1105	1108	1110	1112	1114	1117	1119
0.45	1064	1066	1068	1070	1072	1074	1076	1078	1081	1083	1085	1087	1089	1091	1093	1095	1098	1100	1102	1104	1106	1109	1111	1113	1115	1118	1120	1122	1124	1127
0.50	1070	1072	1074	1076	1078	1080	1083	1085	1087	1089	1091	1093	1095	1098	1100	1102	1104	1107	1109	1111	1113	1116	1118	1120	1122	1125	1127	1129	1132	1134
0.55	1075	1078	1080	1082	1084	1086	1088	1090	1093	1095	1097	1099	1101	1104	1106	1108	1110	1113	1115	1117	1120	1122	1124	1127	1129	1131	1134	1136	1138	1141
0.60	1080	1083	1085	1087	1089	1091	1094	1096	1098	1100	1102	1105	1107	1109	1112	1114	1116	1118	1121	1123	1125	1128	1130	1132	1135	1137	1140	1142	1144	1147
0.65	1085	1087	1090	1092	1094	1096	1098	1101	1103	1105	1108	1110	1112	1114	1117	1119	1121	1124	1126	1128	1131	1133	1136	1138	1140	1143	1145	1148	1150	1153
0.70	1090	1092	1094	1096	1099	1101	1103	1105	1108	1110	1112	1115	1117	1119	1122	1124	1126	1129	1131	1134	1136	1138	1141	1143	1146	1148	1151	1153	1156	1158
0.75	1094	1096	1098	1101	1103	1105	1108	1110	1112	1115	1117	1119	1122	1124	1126	1129	1131	1134	1136	1138	1141	1143	1146	1148	1151	1153	1156	1158	1161	1163
0.80	1098	1100	1102	1105	1107	1109	1112	1114	1116	1119	1121	1124	1126	1128	1131	1133	1136	1138	1141	1143	1145	1148	1150	1153	1155	1158	1160	1163	1166	1168
0.85	1102	1104	1106	1109	1111	1113	1116	1118	1121	1123	1125	1128	1130	1133	1135	1137	1140	1142	1145	1147	1150	1152	1155	1157	1160	1162	1165	1168	1170	1173
0.90	1105	1108	1110	1112	1115	1117	1120	1122	1124	1127	1129	1132	1134	1137	1139	1142	1144	1147	1149	1152	1154	1157	1159	1162	1164	1167	1169	1172	1175	1177
0.95	1109	1111	1114	1116	1118	1121	1123	1126	1128	1131	1133	1135	1138	1140	1143	1145	1148	1150	1153	1156	1158	1161	1163	1166	1168	1171	1174	1176	1179	1181
1.00	-	1115	1117	1120	1122	1124	1127	1129	1132	1134	1137	1139	1142	1144	1147	1149	1152	1154	1157	1159	1162	1165	1167	1170	1172	1175	1178	1180	1183	1186
1.05	-	-	-	-	1125	1128	1130	1133	1135	1138	1140	1143	1145	1148	1150	1153	1155	1158	1161	1163	1166	1168	1171	1174	1176	1179	1181	1184	1187	1189
1.10	-	-	-	-	-	-	1134	1136	1139	1141	1144	1146	1149	1151	1154	1156	1159	1162	1164	1167	1169	1172	1175	1177	1180	1183	1185	1188	1191	1193
1.15	-	-	-	-	-	-	-	-	1142	1144	1147	1149	1152	1155	1157	1160	1162	1165	1168	1170	1173	1176	1178	1181	1183	1186	1189	1192	1194	1197
1.20	-	-	-	-	-	-	-	-	-	-	1150	1153	1155	1158	1160	1163	1166	1168	1171	1174	1176	1179	1182	1184	1187	1190	1192	1195	1198	1201

Nitrogen Content of Gas Mixture 40%, Balance Methanol Products
Liquid Methanol Supply Rate 0.9307 litres per cubic metre of Nitrogen
CO% in furnace: 19.5

Carbon %	Temperature °C																															
	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090
0.30	-	1053	1055	1057	1059	1061	1063	1065	1067	1069	1071	1073	1075	1077	1079	1081	1083	1085	1088	1090	1092	1094	1096	1098	1100	1102	1105	1107	1109	1111
0.35	1059	1061	1063	1065	1067	1069	1072	1074	1076	1078	1080	1082	1084	1086	1088	1090	1093	1095	1097	1099	1101	1103	1106	1108	1110	1112	1115	1117	1119	1121
0.40	1067	1069	1071	1073	1075	1077	1079	1081	1083	1085	1088	1090	1092	1094	1096	1099	1101	1103	1105	1107	1110	1112	1114	1116	1119	1121	1123	1126	1128	1130
0.45	1073	1075	1077	1079	1082	1084	1086	1088	1090	1092	1095	1097	1099	1101	1104	1106	1108	1110	1113	1115	1117	1119	1122	1124	1126	1129	1131	1133	1136	1138
0.50	1079	1081	1083	1085	1088	1090	1092	1094	1096	1099	1101	1103	1106	1108	1110	1112	1115	1117	1119	1122	1124	1126	1129	1131	1133	1136	1138	1141	1143	1145
0.55	1084	1087	1089	1091	1093	1095	1098	1100	1102	1105	1107	1109	1111	1114	1116	1118	1121	1123	1126	1128	1130	1133	1135	1137	1140	1142	1145	1147	1150	1152
0.60	1089	1092	1094	1096	1098	1101	1103	1105	1108	1110	1112	1115	1117	1119	1122	1124	1126	1129	1131	1134	1136	1139	1141	1143	1146	1148	1151	1153	1156	1158
0.65	1094	1096	1099	1101	1103	1106	1108	1110	1113	1115	1117	1120	1122	1125	1127	1129	1132	1134	1137	1139	1142	1144	1147	1149	1151	1154	1157	1159	1162	1164
0.70	1099	1101	1103	1106	1108	1110	1113	1115	1117	1120	1122	1125	1127	1129	1132	1134	1137	1139	1142	1144	1147	1149	1152	1154	1157	1159	1162	1164	1167	1170
0.75	1103	1105	1108	1110	1112	1115	1117	1119	1122	1124	1127	1129	1132	1134	1137	1139	1141	1144	1146	1149	1152	1154	1157	1159	1162	1164	1167	1169	1172	1175
0.80	1107	1109	1112	1114	1116	1119	1121	1124	1126	1129	1131	1134	1136	1138	1141	1143	1146	1149	1151	1154	1156	1159	1161	1164	1166	1169	1172	1174	1177	1180
0.85	1111	1113	1116	1118	1120	1123	1125	1128	1130	1133	1135	1138	1140	1143	1145	1148	1150	1153	1155	1158	1161	1163	1166	1168	1171	1174	1176	1179	1182	1184
0.90	1114	1117	1119	1122	1124	1127	1129	1132	1134	1137	1139	1142	1144	1147	1149	1152	1154	1157	1160	1162	1165	1167	1170	1173	1175	1178	1181	1183	1186	1189
0.95	1118	1120	1123	1125	1128	1130	1133	1135	1138	1140	1143	1145	1148	1151	1153	1156	1158	1161	1164	1166	1169	1171	1174	1177	1179	1182	1185	1187	1190	1193
1.00	-	1124	1126	1129	1131	1134	1136	1139	1141	1144	1147	1149	1152	1154	1157	1159	1162	1165	1167	1170	1173	1175	1178	1181	1183	1186	1189	1191	1194	1197
1.05	-	-	-	-	1135	1137	1140	1142	1145	1147	1150	1153	1155	1158	1160	1163	1166	1168	1171	1174	1176	1179	1182	1184	1187	1190	1193	1195	1198	1201
1.10	-	-	-	-	-	-	1143	1146	1148	1151	1153	1156	1159	1161	1164	1167	1169	1172	1175	1177	1180	1183	1185	1188	1191	1194	1196	1199	1202	1205
1.15	-	-	-	-	-	-	-	-	1152	1154	1157	1159	1162	1165	1167	1170	1173	1175	1178	1181	1184	1186	1189	1192	1195	1197	1200	1203	1206	1208
1.20	-	-	-	-	-	-	-	-	-	-	1160	1163	1165	1168	1171	1173	1176	1179	1181	1184	1187	1190	1192	1195	1198	1201	1204	1206	1209	1212

Nitrogen Content of Gas Mixture 45%, Balance Methanol Products
Liquid Methanol Supply Rate 0.7364 litres per cubic metre of Nitrogen
CO% in furnace: 17.9

Carbon %	Temperature °C																															
	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090
0.30	-	1057	1059	1061	1063	1065	1067	1069	1071	1073	1075	1077	1079	1082	1084	1086	1088	1090	1092	1094	1096	1099	1101	1103	1105	1107	1110	1112	1114	1116
0.35	1063	1065	1067	1069	1072	1074	1076	1078	1080	1082	1084	1086	1088	1091	1093	1095	1097	1099	1102	1104	1106	1108	1110	1113	1115	1117	1119	1122	1124	1126
0.40	1071	1073	1075	1077	1079	1081	1083	1085	1088	1090	1092	1094	1096	1099	1101	1103	1105	1108	1110	1112	1114	1117	1119	1121	1124	1126	1128	1131	1133	1135
0.45	1077	1079	1081	1083	1086	1088	1090	1092	1094	1097	1099	1101	1103	1106	1108	1110	1113	1115	1117	1120	1122	1124	1127	1129	1131	1134	1136	1138	1141	1143
0.50	1083	1085	1087	1090	1092	1094	1096	1098	1101	1103	1105	1108	1110	1112	1115	1117	1119	1122	1124	1126	1129	1131	1133	1136	1138	1141	1143	1146	1148	1151
0.55	1088	1091	1093	1095	1097	1100	1102	1104	1107	1109	1111	1114	1116	1118	1121	1123	1125	1128	1130	1133	1135	1137	1140	1142	1145	1147	1150	1152	1155	1157
0.60	1093	1096	1098	1100	1103	1105	1107	1110	1112	1114	1117	1119	1121	1124	1126	1129	1131	1133	1136	1138	1141	1143	1146	1148	1151	1153	1156	1158	1161	1163
0.65	1098	1100	1103	1105	1107	1110	1112	1115	1117	1119	1122	1124	1127	1129	1131	1134	1136	1139	1141	1144	1146	1149	1151	1154	1156	1159	1161	1164	1167	1169
0.70	1103	1105	1107	1110	1112	1114	1117	1119	1122	1124	1127	1129	1131	1134	1136	1139	1141	1144	1146	1149	1151	1154	1156	1159	1162	1164	1167	1169	1172	1175
0.75	1107	1109	1112	1114	1116	1119	1121	1124	1126	1129	1131	1134	1136	1139	1141	1144	1146	1149	1151	1154	1156	1159	1161	1164	1167	1169	1172	1174	1177	1180
0.80	1111	1113	1116	1118	1121	1123	1125	1128	1130	1133	1135	1138	1140	1143	1145	1148	1151	1153	1156	1158	1161	1163	1166	1169	1171	1174	1177	1179	1182	1185
0.85	1115	1117	1120	1122	1125	1127	1129	1132	1134	1137	1139	1142	1145	1147	1150	1152	1155	1157	1160	1163	1165	1168	1170	1173	1176	1178	1181	1184	1186	1189
0.90	1118	1121	1123	1126	1128	1131	1133	1136	1138	1141	1143	1146	1149	1151	1154	1156	1159	1162	1164	1167	1169	1172	1175	1177	1180	1183	1185	1188	1191	1194
0.95	1122	1124	1127	1129	1132	1134	1137	1140	1142	1145	1147	1150	1152	1155	1158	1160	1163	1165	1168	1171	1173	1176	1179	1182	1184	1187	1190	1192	1195	1198
1.00	-	1128	1130	1133	1135	1138	1141	1143	1146	1148	1151	1153	1156	1159	1161	1164	1167	1169	1172	1175	1177	1180	1183	1185	1188	1191	1194	1196	1199	1202
1.05	-	-	-	-	1139	1141	1144	1147	1149	1152	1154	1157	1160	1162	1165	1168	1170	1173	1176	1178	1181	1184	1187	1189	1192	1195	1198	1200	1203	1206
1.10	-	-	-	-	-	-	1147	1150	1153	1155	1158	1160	1163	1166	1168	1171	1174	1177	1179	1182	1185	1187	1190	1193	1196	1199	1201	1204	1207	1210
1.15	-	-	-	-	-	-	-	-	1156	1158	1161	1164	1166	1169	1172	1175	1177	1180	1183	1185	1188	1191	1194	1197	1199	1202	1205	1208	1211	1213
1.20	-	-	-	-	-	-	-	-	-	-	1164	1167	1170	1172	1175	1178	1181	1183	1186	1189	1192	1194	1197	1200	1203	1206	1209	1211	1214	1217

Nitrogen Content of Gas Mixture 50%, Balance Methanol Products
Liquid Methanol Supply Rate 0.6025 litres per cubic metre of Nitrogen
CO% in furnace: 16.3

Carbon %	Temperature °C																															
	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090
0.30	-	1062	1064	1066	1068	1070	1072	1074	1076	1078	1080	1082	1084	1086	1089	1091	1093	1095	1097	1099	1102	1104	1106	1108	1110	1113	1115	1117	1119	1122
0.35	1068	1070	1072	1074	1076	1078	1080	1082	1085	1087	1089	1091	1093	1095	1098	1100	1102	1104	1107	1109	1111	1113	1116	1118	1120	1123	1125	1127	1130	1132
0.40	1075	1077	1079	1081	1083	1086	1088	1090	1092	1094	1097	1099	1101	1103	1106	1108	1110	1113	1115	1117	1119	1122	1124	1126	1129	1131	1134	1136	1138	1141
0.45	1081	1084	1086	1088	1090	1092	1095	1097	1099	1101	1104	1106	1108	1111	1113	1115	1118	1120	1122	1125	1127	1129	1132	1134	1137	1139	1141	1144	1146	1149
0.50	1087	1089	1092	1094	1096	1099	1101	1103	1105	1108	1110	1112	1115	1117	1119	1122	1124	1127	1129	1131	1134	1136	1139	1141	1144	1146	1149	1151	1154	1156
0.55	1093	1095	1097	1100	1102	1104	1106	1109	1111	1114	1116	1118	1121	1123	1125	1128	1130	1133	1135	1138	1140	1143	1145	1148	1150	1153	1155	1158	1160	1163
0.60	1098	1100	1102	1105	1107	1109	1112	1114	1117	1119	1121	1124	1126	1129	1131	1134	1136	1138	1141	1143	1146	1148	1151	1153	1156	1159	1161	1164	1166	1169
0.65	1102	1105	1107	1110	1112	1114	1117	1119	1122	1124	1126	1129	1131	1134	1136	1139	1141	1144	1146	1149	1151	1154	1156	1159	1162	1164	1167	1169	1172	1175
0.70	1107	1109	1112	1114	1117	1119	1121	1124	1126	1129	1131	1134	1136	1139	1141	1144	1146	1149	1151	1154	1157	1159	1162	1164	1167	1170	1172	1175	1177	1180
0.75	1111	1114	1116	1118	1121	1123	1126	1128	1131	1133	1136	1138	1141	1143	1146	1148	1151	1154	1156	1159	1161	1164	1167	1169	1172	1175	1177	1180	1183	1185
0.80	1115	1118	1120	1123	1125	1128	1130	1133	1135	1138	1140	1143	1145	1148	1150	1153	1156	1158	1161	1163	1166	1169	1171	1174	1177	1179	1182	1185	1187	1190
0.85	1119	1122	1124	1126	1129	1132	1134	1137	1139	1142	1144	1147	1149	1152	1155	1157	1160	1162	1165	1168	1170	1173	1176	1178	1181	1184	1187	1189	1192	1195
0.90	1123	1125	1128	1130	1133	1135	1138	1140	1143	1146	1148	1151	1153	1156	1159	1161	1164	1167	1169	1172	1175	1177	1180	1183	1185	1188	1191	1194	1196	1199
0.95	1126	1129	1131	1134	1136	1139	1142	1144	1147	1149	1152	1155	1157	1160	1162	1165	1168	1171	1173	1176	1179	1181	1184	1187	1190	1192	1195	1198	1201	1203
1.00	-	1132	1135	1137	1140	1143	1145	1148	1150	1153	1156	1158	1161	1164	1166	1169	1172	1174	1177	1180	1182	1185	1188	1191	1194	1196	1199	1202	1205	1207
1.05	-	-	-	-	1143	1146	1149	1151	1154	1156	1159	1162	1164	1167	1170	1173	1175	1178	1181	1183	1186	1189	1192	1195	1197	1200	1203	1206	1209	1211
1.10	-	-	-	-	-	-	1152	1155	1157	1160	1163	1165	1168	1171	1173	1176	1179	1182	1184	1187	1190	1193	1195	1198	1201	1204	1207	1210	1212	1215
1.15	-	-	-	-	-	-	-	-	1160	1163	1166	1169	1171	1174	1177	1179	1182	1185	1188	1191	1193	1196	1199	1202	1205	1207	1210	1213	1216	1219
1.20	-	-	-	-	-	-	-	-	-	-	1169	1172	1175	1177	1180	1183	1186	1188	1191	1194	1197	1200	1202	1205	1208	1211	1214	1217	1220	1223

Nitrogen Content of Gas Mixture 55%, Balance Methanol Products
Liquid Methanol Supply Rate 0.4922 litres per cubic metre of Nitrogen
CO% in furnace: 14.6

Carbon %	Temperature °C																															
	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090
0.30	-	1067	1069	1071	1073	1075	1077	1079	1081	1083	1086	1088	1090	1092	1094	1096	1099	1101	1103	1105	1108	1110	1112	1114	1117	1119	1121	1124	1126	1128
0.35	1073	1075	1077	1079	1081	1083	1086	1088	1090	1092	1094	1097	1099	1101	1103	1106	1108	1110	1113	1115	1117	1119	1122	1124	1126	1129	1131	1134	1136	1138
0.40	1080	1082	1084	1087	1089	1091	1093	1095	1098	1100	1102	1105	1107	1109	1111	1114	1116	1118	1121	1123	1126	1128	1130	1133	1135	1137	1140	1142	1145	1147
0.45	1086	1089	1091	1093	1095	1098	1100	1102	1105	1107	1109	1112	1114	1116	1119	1121	1123	1126	1128	1131	1133	1135	1138	1140	1143	1145	1148	1150	1153	1155
0.50	1092	1095	1097	1099	1102	1104	1106	1109	1111	1113	1116	1118	1120	1123	1125	1128	1130	1132	1135	1137	1140	1142	1145	1147	1150	1152	1155	1157	1160	1162
0.55	1098	1100	1102	1105	1107	1110	1112	1114	1117	1119	1121	1124	1126	1129	1131	1134	1136	1139	1141	1144	1146	1149	1151	1154	1156	1159	1161	1164	1167	1169
0.60	1103	1105	1108	1110	1112	1115	1117	1120	1122	1124	1127	1129	1132	1134	1137	1139	1142	1144	1147	1149	1152	1155	1157	1160	1162	1165	1167	1170	1173	1175
0.65	1108	1110	1112	1115	1117	1120	1122	1125	1127	1130	1132	1135	1137	1140	1142	1145	1147	1150	1152	1155	1157	1160	1163	1165	1168	1170	1173	1176	1178	1181
0.70	1112	1114	1117	1119	1122	1124	1127	1129	1132	1134	1137	1139	1142	1144	1147	1150	1152	1155	1157	1160	1163	1165	1168	1170	1173	1176	1178	1181	1184	1187
0.75	1116	1119	1121	1124	1126	1129	1131	1134	1136	1139	1141	1144	1146	1149	1152	1154	1157	1159	1162	1165	1167	1170	1173	1175	1178	1181	1183	1186	1189	1192
0.80	1120	1123	1125	1128	1130	1133	1135	1138	1141	1143	1146	1148	1151	1153	1156	1159	1161	1164	1167	1169	1172	1175	1177	1180	1183	1186	1188	1191	1194	1197
0.85	1124	1127	1129	1132	1134	1137	1139	1142	1145	1147	1150	1152	1155	1158	1160	1163	1166	1168	1171	1174	1176	1179	1182	1185	1187	1190	1193	1196	1198	1201
0.90	1128	1130	1133	1135	1138	1141	1143	1146	1148	1151	1154	1156	1159	1162	1164	1167	1170	1172	1175	1178	1181	1183	1186	1189	1192	1194	1197	1200	1203	1206
0.95	1131	1134	1137	1139	1142	1144	1147	1150	1152	1155	1158	1160	1163	1166	1168	1171	1174	1176	1179	1182	1185	1187	1190	1193	1196	1199	1201	1204	1207	1210
1.00	-	1137	1140	1143	1145	1148	1150	1153	1156	1158	1161	1164	1167	1169	1172	1175	1177	1180	1183	1186	1189	1191	1194	1197	1200	1203	1205	1208	1211	1214
1.05	-	-	-	-	1149	1151	1154	1157	1159	1162	1165	1167	1170	1173	1176	1178	1181	1184	1187	1189	1192	1195	1198	1201	1204	1206	1209	1212	1215	1218
1.10	-	-	-	-	-	-	1157	1160	1163	1165	1168	1171	1174	1176	1179	1182	1185	1187	1190	1193	1196	1199	1202	1204	1207	1210	1213	1216	1219	1222
1.15	-	-	-	-	-	-	-	-	1166	1169	1171	1174	1177	1180	1183	1185	1188	1191	1194	1197	1199	1202	1205	1208	1211	1214	1217	1220	1222	1225
1.20	-	-	-	-	-	-	-	-	-	-	1175	1177	1180	1183	1186	1189	1191	1194	1197	1200	1203	1206	1209	1211	1214	1217	1220	1223	1226	1229

Nitrogen Content of Gas Mixture 60%, Balance Methanol Products
Liquid Methanol Supply Rate 0.4017 litres per cubic metre of Nitrogen
CO% in furnace: 13.1

Carbon %	Temperature °C																															
	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090
0.30	-	1072	1074	1076	1078	1080	1082	1085	1087	1089	1091	1093	1096	1098	1100	1102	1104	1107	1109	1111	1114	1116	1118	1120	1123	1125	1127	1130	1132	1135
0.35	1078	1080	1082	1084	1087	1089	1091	1093	1095	1098	1100	1102	1104	1107	1109	1111	1114	1116	1118	1121	1123	1125	1128	1130	1133	1135	1137	1140	1142	1145
0.40	1085	1087	1089	1092	1094	1096	1098	1101	1103	1105	1108	1110	1112	1115	1117	1119	1122	1124	1127	1129	1131	1134	1136	1139	1141	1144	1146	1149	1151	1154
0.45	1091	1094	1096	1098	1101	1103	1105	1108	1110	1112	1115	1117	1119	1122	1124	1127	1129	1132	1134	1136	1139	1141	1144	1146	1149	1151	1154	1156	1159	1162
0.50	1097	1100	1102	1104	1107	1109	1111	1114	1116	1119	1121	1124	1126	1128	1131	1133	1136	1138	1141	1143	1146	1148	1151	1153	1156	1159	1161	1164	1166	1169
0.55	1103	1105	1108	1110	1112	1115	1117	1120	1122	1124	1127	1129	1132	1134	1137	1139	1142	1144	1147	1150	1152	1155	1157	1160	1162	1165	1168	1170	1173	1176
0.60	1108	1110	1113	1115	1118	1120	1122	1125	1127	1130	1132	1135	1137	1140	1142	1145	1148	1150	1153	1155	1158	1161	1163	1166	1168	1171	1174	1176	1179	1182
0.65	1113	1115	1117	1120	1122	1125	1127	1130	1132	1135	1137	1140	1143	1145	1148	1150	1153	1156	1158	1161	1163	1166	1169	1171	1174	1177	1179	1182	1185	1187
0.70	1117	1120	1122	1125	1127	1130	1132	1135	1137	1140	1142	1145	1147	1150	1153	1155	1158	1161	1163	1166	1169	1171	1174	1177	1179	1182	1185	1187	1190	1193
0.75	1121	1124	1126	1129	1131	1134	1136	1139	1142	1144	1147	1149	1152	1155	1157	1160	1163	1165	1168	1171	1173	1176	1179	1181	1184	1187	1190	1192	1195	1198
0.80	1125	1128	1130	1133	1136	1138	1141	1143	1146	1149	1151	1154	1156	1159	1162	1164	1167	1170	1173	1175	1178	1181	1183	1186	1189	1192	1194	1197	1200	1203
0.85	1129	1132	1134	1137	1139	1142	1145	1147	1150	1153	1155	1158	1161	1163	1166	1169	1171	1174	1177	1180	1182	1185	1188	1191	1193	1196	1199	1202	1205	1208
0.90	1133	1135	1138	1141	1143	1146	1149	1151	1154	1157	1159	1162	1165	1167	1170	1173	1176	1178	1181	1184	1187	1189	1192	1195	1198	1201	1203	1206	1209	1212
0.95	1136	1139	1142	1144	1147	1150	1152	1155	1158	1160	1163	1166	1168	1171	1174	1177	1179	1182	1185	1188	1191	1193	1196	1199	1202	1205	1208	1210	1213	1216
1.00	-	1142	1145	1148	1150	1153	1156	1158	1161	1164	1167	1169	1172	1175	1178	1180	1183	1186	1189	1192	1194	1197	1200	1203	1206	1209	1212	1215	1217	1220
1.05	-	-	-	-	1154	1157	1159	1162	1165	1167	1170	1173	1176	1178	1181	1184	1187	1190	1193	1195	1198	1201	1204	1207	1210	1213	1216	1218	1221	1224
1.10	-	-	-	-	-	-	1163	1165	1168	1171	1174	1176	1179	1182	1185	1188	1190	1193	1196	1199	1202	1205	1208	1211	1213	1216	1219	1222	1225	1228
1.15	-	-	-	-	-	-	-	-	1171	1174	1177	1180	1183	1185	1188	1191	1194	1197	1200	1202	1205	1208	1211	1214	1217	1220	1223	1226	1229	1232
1.20	-	-	-	-	-	-	-	-	-	-	1180	1183	1186	1189	1191	1194	1197	1200	1203	1206	1209	1212	1215	1218	1221	1223	1226	1229	1232	1235

Nitrogen Content of Gas Mixture 65%, Balance Methanol Products
Liquid Methanol Supply Rate 0.3244 litres per cubic metre of Nitrogen
CO% in furnace: 11.4

Carbon %	Temperature °C																															
	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090
0.30	-	1078	1080	1083	1085	1087	1089	1091	1094	1096	1098	1100	1103	1105	1107	1110	1112	1114	1116	1119	1121	1124	1126	1128	1131	1133	1135	1138	1140	1143
0.35	1084	1086	1089	1091	1093	1095	1098	1100	1102	1105	1107	1109	1112	1114	1116	1119	1121	1123	1126	1128	1131	1133	1136	1138	1140	1143	1145	1148	1150	1153
0.40	1091	1094	1096	1098	1101	1103	1105	1108	1110	1112	1115	1117	1120	1122	1124	1127	1129	1132	1134	1137	1139	1142	1144	1147	1149	1152	1154	1157	1159	1162
0.45	1098	1100	1103	1105	1107	1110	1112	1114	1117	1119	1122	1124	1127	1129	1132	1134	1137	1139	1142	1144	1147	1149	1152	1154	1157	1159	1162	1165	1167	1170
0.50	1104	1106	1109	1111	1113	1116	1118	1121	1123	1126	1128	1131	1133	1136	1138	1141	1143	1146	1148	1151	1153	1156	1159	1161	1164	1166	1169	1172	1174	1177
0.55	1109	1112	1114	1117	1119	1121	1124	1126	1129	1131	1134	1137	1139	1142	1144	1147	1149	1152	1154	1157	1160	1162	1165	1168	1170	1173	1176	1178	1181	1184
0.60	1114	1117	1119	1122	1124	1127	1129	1132	1134	1137	1139	1142	1145	1147	1150	1152	1155	1158	1160	1163	1166	1168	1171	1174	1176	1179	1182	1184	1187	1190
0.65	1119	1122	1124	1127	1129	1132	1134	1137	1139	1142	1145	1147	1150	1152	1155	1158	1160	1163	1166	1168	1171	1174	1176	1179	1182	1185	1187	1190	1193	1196
0.70	1123	1126	1129	1131	1134	1136	1139	1141	1144	1147	1149	1152	1155	1157	1160	1163	1165	1168	1171	1173	1176	1179	1182	1184	1187	1190	1193	1195	1198	1201
0.75	1128	1130	1133	1135	1138	1141	1143	1146	1149	1151	1154	1157	1159	1162	1165	1167	1170	1173	1175	1178	1181	1184	1187	1189	1192	1195	1198	1201	1203	1206
0.80	1132	1134	1137	1140	1142	1145	1147	1150	1153	1155	1158	1161	1164	1166	1169	1172	1175	1177	1180	1183	1186	1188	1191	1194	1197	1200	1202	1205	1208	1211
0.85	1136	1138	1141	1143	1146	1149	1151	1154	1157	1160	1162	1165	1168	1170	1173	1176	1179	1182	1184	1187	1190	1193	1196	1198	1201	1204	1207	1210	1213	1216
0.90	1139	1142	1145	1147	1150	1153	1155	1158	1161	1163	1166	1169	1172	1175	1177	1180	1183	1186	1189	1191	1194	1197	1200	1203	1206	1209	1211	1214	1217	1220
0.95	1143	1145	1148	1151	1154	1156	1159	1162	1164	1167	1170	1173	1176	1178	1181	1184	1187	1190	1193	1195	1198	1201	1204	1207	1210	1213	1216	1219	1221	1224
1.00	-	1149	1152	1154	1157	1160	1163	1165	1168	1171	1174	1176	1179	1182	1185	1188	1191	1193	1196	1199	1202	1205	1208	1211	1214	1217	1220	1223	1226	1228
1.05	-	-	-	-	1160	1163	1166	1169	1172	1174	1177	1180	1183	1186	1189	1191	1194	1197	1200	1203	1206	1209	1212	1215	1218	1221	1223	1226	1229	1232
1.10	-	-	-	-	-	-	1169	1172	1175	1178	1181	1183	1186	1189	1192	1195	1198	1201	1204	1207	1209	1212	1215	1218	1221	1224	1227	1230	1233	1236
1.15	-	-	-	-	-	-	-	-	1178	1181	1184	1187	1190	1193	1195	1198	1201	1204	1207	1210	1213	1216	1219	1222	1225	1228	1231	1234	1237	1240
1.20	-	-	-	-	-	-	-	-	-	-	1187	1190	1193	1196	1199	1202	1205	1208	1210	1213	1216	1219	1222	1225	1228	1231	1234	1237	1240	1244

The Novatech 1734 controller 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 controller. Default settings are highlighted in bold.

Baud Rate	9600, **19200**, 38400, 57600
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 controller 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

1734 Controller Modbus Input Register Table for firmware v1.01

	Reg	Description	Bits	Type
Probe 1 Runtime Data	0	Carbon Potential %	32	floating point
	2	Oxygen %	32	floating point
	4	EMF mV	32	floating point
	6	Temperature degC	32	floating point
	8	Impedance kOhms	32	floating point
	10	Thermocouple Open Ct Flag	16	boolean
	11	Temperature Low Flag	16	boolean
	12	Temperature Below 725	16	boolean
	13	Carbon Invalid Hi	16	boolean
	14	Carbon Invalid Lo	16	boolean
	15	Heater 1 Output	16	unsigned integer
Probe 2 Runtime Data	16	Carbon Potential %	32	floating point
	18	Oxygen %	32	floating point
	20	EMF mV	32	floating point
	22	Temperature degC	32	floating point
	24	Impedance kOhms	32	floating point
	26	Thermocouple Open Ct Flag	16	boolean
	27	Temperature Low Flag	16	boolean
	28	Temperature Below 725	16	boolean
	29	Carbon Invalid Hi	16	boolean
	30	Carbon Invalid Lo	16	boolean
	31	Heater 2 Output	16	unsigned integer

	Reg	Description	Bits	Type
Analyser Runtime Data	32	Auxilliary TC Temperature degC	32	floating point
	34	Auxilliary TC Open Ct Flag	16	boolean
	35	4-20mA Outputs Frozen	16	boolean
	36	Ambient Temperature	16	signed integer
	37	Maximum Ambient Temperature	16	signed integer
	38	Average Carbon	32	floating point
	40	Reference Air Oxygen	32	floating point
	42	Burner Runtime Minutes	32	unsigned integer
	44	Burner On Time Minutes	32	unsigned integer
Event Times	46	Current Date & Time	32	unsigned integer
	48	Next Purge/Cal 1 Time	32	unsigned integer
	50	Next Purge/Cal 2 Time	32	unsigned integer
	52	Next Probe Impedance Check	32	unsigned integer
Relay Status	54	Relay 1 Status	16	unsigned integer
	55	Relay 2 Status	16	unsigned integer
	56	Relay 3 Status	16	unsigned integer
	57	Common Relay Status	16	unsigned integer
	58	Mains Power	16	unsigned integer
	59	Mains Frequency	16	unsigned integer
	84	4-20mA Output 1	16	unsigned integer
	85	4-20mA Output 2	16	unsigned integer

	Reg	Description	Bits	Type
Current Alarm Status	60	Heater 1 Fail Alarm	16	unsigned integer
	61	Heater 2 Fail Alarm	16	unsigned integer
	62	Probe 1 Hi Impedance	16	unsigned integer
	63	Probe 2 Hi Impedance	16	unsigned integer
	64	Probe 1 Thermocouple Open Ct	16	unsigned integer
	65	Probe 2 Thermocouple Open Ct	16	unsigned integer
	66	Auxilliary Thermocouple Open Tc	16	unsigned integer
	67	Reference Air Pump Fail	16	unsigned integer
	68	Reference Air Pump Overload	16	unsigned integer
	69	Battery Backup RAM Failure	16	unsigned integer
	70	Internal Alarm Log Memory Failure	16	unsigned integer
	71	Internal ADC Fail	16	unsigned integer
	72	Internal DAC Output 1 Fail	16	unsigned integer
	73	Internal DAC Output 2 Fail	16	unsigned integer
	74	Heater 1 SSR Relay Fail	16	unsigned integer
	75	Heater 2 SSR Relay Fail	16	unsigned integer
	76	Heater SSR Leaking	16	unsigned integer
	77	Probe 1 Blocked	16	unsigned integer
	78	Probe 2 Blocked	16	unsigned integer
	79	Carbon 1 Low	16	unsigned integer
	80	Carbon 2 Low	16	unsigned integer
	81	Carbon 1 High	16	unsigned integer
	82	Carbon 2 High	16	unsigned integer
	83	Carbon Deviation	16	unsigned integer
Last Alarm User Acknowledged Time	134	Heater 1 Fail Alarm	32	unsigned integer
	136	Heater 2 Fail Alarm	32	unsigned integer
	138	Probe 1 Hi Impedance	32	unsigned integer
	140	Probe 2 Hi Impedance	32	unsigned integer
	142	Probe 1 Thermocouple Open Ct	32	unsigned integer
	144	Probe 2 Thermocouple Open Ct	32	unsigned integer
	146	Auxilliary Thermocouple Open Tc	32	unsigned integer
	148	Reference Air Pump Fail	32	unsigned integer
	150	Reference Air Pump Overload	32	unsigned integer
	152	Battery Backup RAM Failure	32	unsigned integer
	154	Internal Alarm Log Memory Failure	32	unsigned integer
	156	Internal ADC Fail	32	unsigned integer
	158	Internal DAC Output 1 Fail	32	unsigned integer
	160	Internal DAC Output 2 Fail	32	unsigned integer
	162	Heater 1 SSR Relay Fail	32	unsigned integer
	164	Heater 2 SSR Relay Fail	32	unsigned integer
	166	Heater SSR Leaking	32	unsigned integer
	168	Probe 1 Blocked	32	unsigned integer
	170	Probe 2 Blocked	32	unsigned integer
	172	Carbon 1 Low	32	unsigned integer
	174	Carbon 2 Low	32	unsigned integer
	176	Carbon 1 High	32	unsigned integer
	178	Carbon 2 High	32	unsigned integer
	180	Carbon Deviation	32	unsigned integer

	Reg	Description	Bits	Type
Last Alarm Active Time	86	Heater 1 Fail Alarm	32	unsigned integer
	88	Heater 2 Fail Alarm	32	unsigned integer
	90	Probe 1 Hi Impedance	32	unsigned integer
	92	Probe 2 Hi Impedance	32	unsigned integer
	94	Probe 1 Thermocouple Open Ct	32	unsigned integer
	96	Probe 2 Thermocouple Open Ct	32	unsigned integer
	98	Auxilliary Thermocouple Open Tc	32	unsigned integer
	100	Reference Air Pump Fail	32	unsigned integer
	102	Reference Air Pump Overload	32	unsigned integer
	104	Battery Backup RAM Failure	32	unsigned integer
	106	Internal Alarm Log Memory Failure	32	unsigned integer
	108	Internal ADC Fail	32	unsigned integer
	110	Internal DAC Output 1 Fail	32	unsigned integer
	112	Internal DAC Output 2 Fail	32	unsigned integer
	114	Heater 1 SSR Relay Fail	32	unsigned integer
	116	Heater 2 SSR Relay Fail	32	unsigned integer
	118	Heater SSR Leaking	32	unsigned integer
	120	Probe 1 Blocked	32	unsigned integer
	122	Probe 2 Blocked	32	unsigned integer
	124	Carbon 1 Low	32	unsigned integer
	126	Carbon 2 Low	32	unsigned integer
	128	Carbon 1 High	32	unsigned integer
	130	Carbon 2 High	32	unsigned integer
	132	Carbon Deviation	32	unsigned integer
Last Alarm State Cleared Time	182	Heater 1 Fail Alarm	32	unsigned integer
	184	Heater 2 Fail Alarm	32	unsigned integer
	186	Probe 1 Hi Impedance	32	unsigned integer
	188	Probe 2 Hi Impedance	32	unsigned integer
	190	Probe 1 Thermocouple Open Ct	32	unsigned integer
	192	Probe 2 Thermocouple Open Ct	32	unsigned integer
	194	Auxilliary Thermocouple Open Tc	32	unsigned integer
	196	Reference Air Pump Fail	32	unsigned integer
	198	Reference Air Pump Overload	32	unsigned integer
	200	Battery Backup RAM Failure	32	unsigned integer
	202	Internal Alarm Log Memory Failure	32	unsigned integer
	204	Internal ADC Fail	32	unsigned integer
	206	Internal DAC Output 1 Fail	32	unsigned integer
	208	Internal DAC Output 2 Fail	32	unsigned integer
	210	Heater 1 SSR Relay Fail	32	unsigned integer
	212	Heater 2 SSR Relay Fail	32	unsigned integer
	214	Heater SSR Leaking	32	unsigned integer
	216	Probe 1 Blocked	32	unsigned integer
	218	Probe 2 Blocked	32	unsigned integer
	220	Carbon 1 Low	32	unsigned integer
	222	Carbon 2 Low	32	unsigned integer
	224	Carbon 1 High	32	unsigned integer
	226	Carbon 2 High	32	unsigned integer
	228	Carbon Deviation	32	unsigned integer

1734 Controller Modbus Holding Register Table for firmware v1.06

	Reg	Description	Bits	Type
Analyser Calibration & Configuration	0	50mV Reference Voltage	32	unsigned integer
	2	200mV Reference Voltage	32	unsigned integer
	4	1200mV Reference Voltage	32	unsigned integer
	6	2500mV Reference Voltage	32	unsigned integer
	8	Single/Dual Probe	16	boolean
	9	Service Date	16	unsigned integer
	10	Probe 1 Type	16	unsigned integer
	11	Probe 1 TC Type	16	unsigned integer
	12	Probe 1 Offset	16	signed integer
	13	Probe 2 Type	16	unsigned integer
	14	Probe 2 TC Type	16	unsigned integer
	15	Probe 2 Offset	16	signed integer
	16	Aux TC Type	16	unsigned integer
	17	Flue Pressure Units	16	unsigned integer
	18	Flue Pressure Value	16	signed integer
	19	Temperature Units	16	unsigned integer
	20	Lower Line Items	64	bitmask
	24	Reference Air Pump	16	unsigned integer
	25	Reference Air Pump Voltage	16	unsigned integer
	26	Reference Air RH%	16	unsigned integer
	27	Oxygen Damping Factor	16	unsigned integer
	28	Ambient Temperature Offset	16	signed integer
	29	Transmitter 4-20mA / 0-20mA Select	16	unsigned integer
	30	Transmitter Output Limiting for Low Ten	16	unsigned integer
	31	Manual Mains Voltage Select	16	unsigned integer
	32	Manual Mains Frequency Select	16	unsigned integer
Transmitter 1 Configuration	33	Transmitter 1 Output	16	unsigned integer
	34	Transmitter 1 Zero (Probe 1 EMF)	16	unsigned integer
	35	Transmitter 1 Zero (Probe 1 TC Temp)	16	unsigned integer
	36	Transmitter 1 Zero (Probe 1 Oxygen)	16	unsigned integer
	37	Transmitter 1 Zero (Reducing O2 1)	16	unsigned integer
	38	Transmitter 1 Zero (Auxilliary TC Temp)	16	unsigned integer
	39	Transmitter 1 Span (Probe 1 Carbon)	16	unsigned integer
	40	Transmitter 1 Span (Average Carbon)	16	unsigned integer
	41	Transmitter 1 Span (Probe 1 EMF)	16	unsigned integer
	42	Transmitter 1 Span (Probe 1 TC Temp)	16	unsigned integer
	43	Transmitter 1 Span (Probe 1 Oxygen)	16	unsigned integer
	44	Transmitter 1 Span (Reducing O2 1)	16	unsigned integer
	45	Transmitter 1 Span (Auxilliary TC Temp)	16	unsigned integer
	46	Transmitter 1 4-20mA Cal Mode	16	unsigned integer
	47	Transmitter 1 4mA Trim	16	unsigned integer
	48	Transmitter 1 20mA Trim	16	unsigned integer

	Reg		Description	Bits	Type
Transmitter 2 Configuration	49	31	Transmitter 2 Output	16	unsigned integer
	50	32	Transmitter 2 Zero (Probe 1 EMF)	16	unsigned integer
	51	33	Transmitter 2 Zero (Probe 1 TC Temp)	16	unsigned integer
	52	34	Transmitter 2 Zero (Probe 1 Oxygen)	16	unsigned integer
	53	35	Transmitter 2 Zero (Reducing O2 1)	16	unsigned integer
	54	36	Transmitter 2 Zero (Auxilliary TC Temp)	16	unsigned integer
	55	37	Transmitter 2 Span (Probe 1 Carbon)	16	unsigned integer
	56	38	Transmitter 2 Span (Average Carbon)	16	unsigned integer
	57	39	Transmitter 2 Span (Probe 1 EMF)	16	unsigned integer
	58	3A	Transmitter 2 Span (Probe 1 TC Temp)	16	unsigned integer
	59	3B	Transmitter 2 Span (Probe 1 Oxygen)	16	unsigned integer
	60	3C	Transmitter 2 Span (Reducing O2 1)	16	unsigned integer
	61	3D	Transmitter 2 Span (Auxilliary TC Temp)	16	unsigned integer
	62	3E	Transmitter 2 4-20mA Cal Mode	16	unsigned integer
	63	3F	Transmitter 2 4mA Trim	16	unsigned integer
	64	40	Transmitter 2 20mA Trim	16	unsigned integer
Process Alarms Configuration	65	41	Enable Process Alarms	16	boolean
	66	42	High Carbon Alarm	16	unsigned integer
	67	43	High Carbon Alarm Delay	16	unsigned integer
	68	44	Low Carbon Alarm	16	unsigned integer
	69	45	Low Carbon Alarm Delay	16	unsigned integer
	70	46	Carbon Deviation Alarm	16	unsigned integer
	71	47	Carbon Deviation Alarm Delay	16	unsigned integer
Alarm Relays	72	48	Alarm Relay 1 Options	64	bitmask
	76	4C	Alarm Relay 2 Options	64	bitmask
	80	50	Alarm Relay 3 Options	64	bitmask
	84	54	Common Relay Options	64	bitmask
Solenoid 1	88	58	Solenoid 1 Auto/Man	16	unsigned integer
	89	59	Solenoid 1 Start Time	16	unsigned integer
	90	5A	Solenoid 1 Period	16	unsigned integer
	91	5B	Solenoid 1 Purge/Cal Duration	16	unsigned integer
	92	5C	Solenoid 1 Post P/C Freeze	16	unsigned integer
Solenoid 2	93	5D	Solenoid 2 Auto/Man	16	unsigned integer
	94	5E	Solenoid 2 Start Time	16	unsigned integer
	95	5F	Solenoid 2 Period	16	unsigned integer
	96	60	Solenoid 2 Purge/Cal Duration	16	unsigned integer
	97	61	Solenoid 2 Post P/C Freeze	16	unsigned integer
Carbon Control 1	98	62	Control Mode	16	unsigned integer
	99	63	Carbon Set Point	16	unsigned integer
	100	64	Proportional Band	16	unsigned integer
	101	65	Dead Band	16	unsigned integer
	102	66	Integral Time Constant	16	unsigned integer
	103	67	Cycle Time	16	unsigned integer
	104	68	Actuate Time	16	unsigned integer
Carbon Control 2	105	69	Control Mode	16	unsigned integer
	106	6A	Carbon Set Point	16	unsigned integer
	107	6B	Proportional Band	16	unsigned integer
	108	6C	Dead Band	16	unsigned integer
	109	6D	Integral Time Constant	16	unsigned integer
	110	6E	Cycle Time	16	unsigned integer
	111	6F	Actuate Time	16	unsigned integer

a0x41 Special Instruction Function

This command allows you to interact with the controller 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

Declaration of Conformity

Application of Council Directives:

89/336/EEC (92/31/EEC)
72/23/EEC

Standards to which conformity is declared:

EN550011.1:1995 (ISM, Group 1, Class B)
EN55014:1995 (Clause 4.2)
EN50082-2 (Industrial)
EN61010-1
AS61000.4.5:1999
IEC-68-2-2
IEC-68-2-3
AS1099.2.6

Manufacturer's name: Novatech Controls Pty Ltd

Manufacturer's address: 309 Reserve Road
Cheltenham, Victoria 3192
Australia

Type of equipment: Oxygen Transmitter
Equipment Class: ISM, Group 1, Class B

Model Number: 1730 Series Transmitter
1231 Oxygen Probe

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

Full Name: **Fraser Chapman**

Position: **R & D Manager**