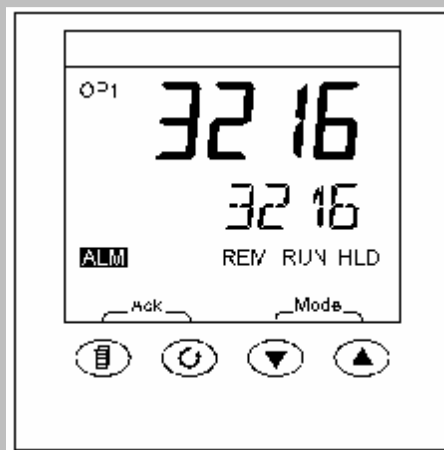




Operating Instructions

Temperature Controller



Type 3216 | P1 P5

English

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1 Introduction to the Controller and Manual

1.1 Using This Manual

This manual aims to explain how to set up and operate the Eurotherm 3216 series of controllers; it must be read in conjunction with the product main manual.

Due to the complex nature of furnace or oven control the use of technical terms throughout this manual is unavoidable. Explanations of these terms can be found in the 'Glossary of Terms' at the back of this manual.

This manual covers the operation of:

1.1.1 3216P1 - Controller/Programmer

The 3216P1 is a digital temperature controller which uses PID algorithms to give excellent temperature control. This controller can store and run a single program of 8 ramp/dwell segments. The 3216P1 can also be used as a simple temperature controller.

1.1.2 3216P5 - Controller/Programmer

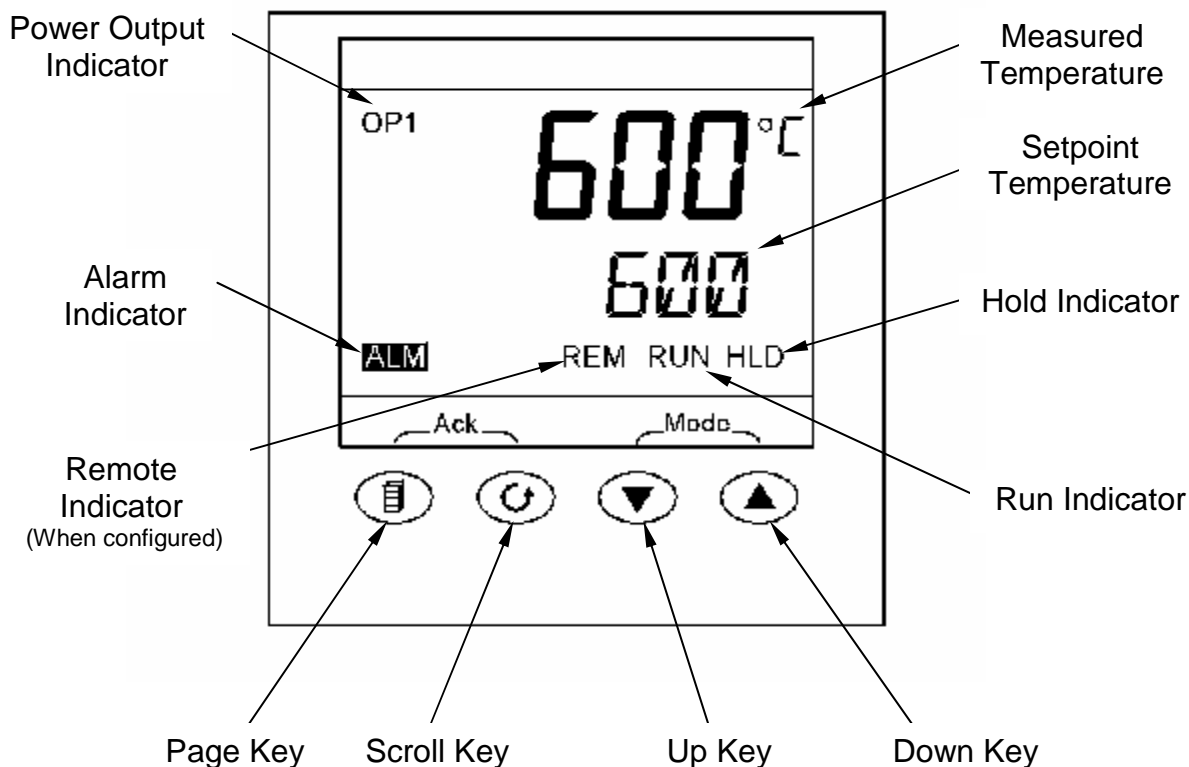
The 3216P5 is a digital temperature controller which uses PID algorithms to give excellent temperature control. This controller can store up to 5 programs of 8 ramp/dwell segments. The 3216P5 can also be used as a simple temperature controller.

1.2 PID Control







The 3216 series of controllers use PID (Proportional Integral Derivative) temperature control. This type of control uses a complex mathematical control system to adjust the power being sent to the elements and to hold the furnace or oven at the desired temperature.

2 Basic Operation

2.1 Controller Layout (Home Display)



2.2 Keys

Page Key 	The <i>Page</i> key is used to access level 2 when held down for 3 seconds.
Scroll Key 	The <i>Scroll</i> key is used to scroll through the parameters.
ACK Page + Scroll  + 	When pressed simultaneously the <i>ACK</i> function is used to: <ul style="list-style-type: none"> • Return to the Home Menu. • Acknowledge an alarm if activated. • Reset a program after the program has ended
Arrow Keys  + 	The arrow keys are used individually to adjust the selected parameters and in combination to run a program

Note: If a parameter is selected and no further action is taken, the display will time out and revert back to the home display in its working level after approximately 1 minute

3 Quick Start Guide

3.1 Operation as a simple controller

When switched on, the controller goes through a short test routine and then shows the measured temperature (PV = Process Value) in the upper part of the display, and below it, the set temperature (Set Point).

3.2 Changing the Set Point

Press Up \triangle or Down ∇ to select the required SP. If the SP is higher than the measured temperature, the OP1 indicator will illuminate in the top left corner of the display, indicating that the controller is calling for power (giving an output).

The controller will immediately attempt to reach the set temperature and then maintain it.

3.3 Using The controller

The parameters in the controller are first shown by a short code (mnemonic). After 5 Seconds a description of the parameter will scroll once along the display and then revert back to the mnemonic. The scrolling text can be interrupted at any time by a single press of any of the buttons, but will not scroll again until the parameter is returned to. In this manual the mnemonic will be shown first, followed by the scrolling text in brackets;

e.g. *PRG* <PROGRAM NUMBER>

3.4 Understanding User Levels

There are two user levels in the controller; Level 1(Operator) and Level 2 (Supervisor).

Level 1 (Operator) is for the day to day operation of the controller. These parameters are not protected by a security code.

Level 2 (Supervisor) provides access to additional parameters. Access to these is protected by a security code

To Enter Level 2



1. Press and hold the page key \square for 3 seconds.
2. The display will show *LEU 1 GOTO*
3. Release the page Key
4. Press the Up \triangle or Down ∇ to choose *LEU 2* (level 2)
5. Press the Up \triangle or Down ∇ to enter the code (Level 2 Code = 9).

If the correct code is entered, *PASS* should momentarily be displayed and then revert to the level 2 home display (See Section 5.3)

If an incorrect code is entered the display reverts back to Level 1 home display (See Section 5.3)

When level 2 operations have been completed, the supervisor must return to Level 1 either manually or by 'power cycling', there is no time out function.

To Return to Level 1



1. Press and hold the page Key 
2. Press Down  to select **LEU 1**

It is not necessary to enter a code when going from a higher level to a lower level
When level 1 is selected, the display reverts to the home display (See Section 2.1)

Table showing parameters accessible in level 1 and Level 2

Operator LEVEL 1	Supervisor LEVEL 2
Home display	Home Display
Programming	Programming
Program Status	Program Status
	Alarms (if configured)
	Current Transformer Input (if configured)
	Comms (if configured)
	Controller setup
	Customer Calibration

TIP

If while navigating the controller a parameter has been passed or you need to access parameters which would be at the end of a scroll list, press and hold Scroll  and use Up  to return to a previous parameter.

4 Setting up the controller

Before using the controller (or during its lifetime) certain parameters may have to be set, depending on specific requirements. To do this the controller must be set to supervisor level (Level 2) see section 3.4

4.1 Maximum Output Power Setting

Press scroll \curvearrowright until the display shows *OP.HI* <OUTPUT HIGH>. Using Up \triangle and Down ∇ select the output power required as a percentage.

Depending on the furnace or oven model, the maximum output power setting OPHi may be accessible or locked.

For Silicon Carbide heated furnaces, the parameter is accessible to allow compensation for element ageing. Refer to the product manual for details.

In many models the maximum output power setting depends on the supply voltage, refer to the product manual for details.

4.2 Customer ID.

A furnace or oven identification number can be entered if required. This maybe used to identify one of many units, for production or quality control systems.

Press scroll \curvearrowright until the display shows *ID* <CUSTOMER ID>. Using the Up \triangle Down ∇ enter your own identification number. This can range from 1-9999.

4.3 Units

Press scroll \curvearrowright until the display shows *UNITS* <DISPLAY UNITS>. Using the Up \triangle or Down ∇ select the required units.

Mnemonic	Description
<i>NONE</i>	No units (Default °C)
<i>°C</i>	Celsius
<i>°F</i>	Fahrenheit
<i>°K</i>	Kelvin
<i>PERC</i>	%

4.4 Language

The scrolling text on the 3216 can be shown in different languages, this can only be set at the factory and therefore must be specified at the time of placing an order.

4.5 Scrolling Text

If at any time the scrolling text is not required.

Press and hold the Page \square for three seconds until "GOTO" is displayed

Press Scroll \curvearrowright until the display shows. *TEXT <ENABLE/DISABLE SCROLLING TEXT>*
Use the Up \triangle Down ∇ to select *ON* or *OFF*

4.6 Customer Calibration

The 3216 series of controllers are calibrated for life at manufacture, there may however be sensor or other system errors, which affect the accuracy of the measured temperature. Customer calibration can be used to compensate for these errors.

Dual Offset

Dual point calibration uses two offset values at two corresponding temperatures; this changes the calibration linearly as the temperature increases or decreases.

Press scroll \curvearrowright until the display shows *CAL.P (ENTER CALIBRATION CODE)* Use Up \triangle Down ∇ to enter the password code. (Calibration Pass Code = 95). When the correct password has been entered the display will show *PNT.LO*. If the wrong pass code is entered the display will revert to zero pass code, until the correct pass code is entered.

When the correct pass code is entered and *PNT.LO (ADJUST LOW POINT)* is displayed. Use Up \triangle Down ∇ to enter the Low Temperature Point, which you want to apply an Offset.

Press scroll \curvearrowright until the display shows *OFF.LO (ADJUST LOW OFFSET)*. Use Up \triangle Down ∇ to enter the amount Offset you want to apply to the Low Temperature Point.

Press scroll \curvearrowright until the display shows *PNT.HI (ADJUST HIGH POINT)*. Use Up \triangle Down ∇ to enter the High Temperature Point, which you want to apply an Offset.

Press scroll \curvearrowright until the display shows *OFF.HI (ADJUST HIGH OFFSET)*. Use the Up \triangle Down ∇ to enter the amount Offset you want to apply the High Temperature Point.

Once the calibration details have been entered, press scroll \curvearrowright until the display shows the next required parameter or return to the home list. The calibration data will now be protected by the pass code. To edit the data the above procedure must be followed.

Single Offset

If a constant offset is required across the temperature range, set the required “High Point” (*PNT.HI*) and “Low Point” (*PNT.LO*) to the required values (not the same), then set the “low Offset” (*OFFS.LO*) and “High Offset” (*OFFS.HI*) to the same value.



Caution! - Do not make *PNT.LO* and *PNT.HI* the same value as the controller will not work correctly and could cause your furnace or oven to overheat.

4.7 Holdback

If the temperature ramp rate of the program is quicker than the furnace or oven can achieve, the program will wait until the temperature of the furnace or oven catches up.

e.g. If a Holdback value of 10 is set and the program is set to ramp to a setpoint of 600°C, the program will reach 600°C, then go into an hold state; the hold indicator will light until the furnace or oven temperature reaches 590°C, the program will then continue to control again.

The hold back will only apply once per Segment, therefore when control has been re-established, the hold back will not apply again to that segment, even if the furnace or oven temperature go outside the hold back band.

Holdback can only be accessed in supervisor level (level 2) by scrolling with the Scroll \curvearrowright until the display shows *H.BACK <PROGRAM HOLD BACK>*: Use the Up \triangle Down ∇ to select the required Hold Back value.

If a multi programmer is used, each program can have its own Holdback value assigned to it.

Note: When a Holdback is set, each segment used must have a Ramp Rate assigned to it, in order for it to be recognised by the program.

5 Programming

5.1 Creating a Program

Programs can be created in level 1 or level 2 of the 3216 P1 and 3216P5. Each program contains 8 Ramp/Dwell pairs.

Note:

A currently active program cannot be altered. Go into reset mode before starting to create or modify a program

Program Number (3216 P5 Only)

Press scroll \curvearrowright until the display shows *PROG <PROGRAM NUMBER.>* Select the program number.

Ramp Units

Press scroll \curvearrowright until the display shows *RAMP.U* <*RAMP UNITS*>: Use the Up \triangle Down ∇ to select the Ramp Units of *Hour, Min or Seconds*.

Dwell Units

Press Scroll \curvearrowright until the display shows *DWELL.U* <*DWELL UNITS*>: Use the Up \triangle Down ∇ to select the Dwell Units of *Hour or Min*.

Holdback (See section 4.7)

Press Scroll \curvearrowright until the display shows *H.BACK* <*PROGRAM HOLD BACK*>: If a Holdback value is required, use the Up \triangle Down ∇ to enter the required value or select "OFF" if no holdback is required.

Ramp Rate

Press Scroll \curvearrowright until the display shows *RMP.1* <*RAMP RATE 1*>: Using the Up \triangle Down ∇ enter the value for the first ramp rate depending on the Ramp Units selected. If the Ramp segment is not required select "OFF".

Target Setpoint

Press Scroll \curvearrowright until the display shows *T.SP 1* <*TARGET SP 1*>: Enter the temperature that you want the unit to ramp up to using "Ramp rate 1".

If "Ramp Rate 1" has been set to "OFF". The unit will Heat/Cool directly to the Target SP.

Dwell Time

Press Scroll \curvearrowright until the display shows *DWELL. 1* <*DWELL TIME 1*>: Enter the time to dwell at "Target SP 1". If the dwell segment is not required, use the Down ∇ to select OFF, which is below the Zero value.

This Process is repeated for each of the 8 segments of the program.

If not all the segments are used for a program, the Ramp & Dwell of each of the subsequent Segments should be set to OFF.

A program will end in one of two ways, either revert to the control Set Point or dwell at the temperature set in the last segment used. When a program finishes on a dwell and the dwell time expires the temperature will revert to the control setpoint.

Note: Before running a program ensure that the control set point is set to Zero to avoid unexpected heating at the end of the program.

5.2 Running a Program

If using the 3216P5 controller Press Scroll \curvearrowright to display *PROG <PROGRAM NUMBER>* select the required Program Number before running a Program.

Table below shows the key presses to run a program

Operation	Action	Indication
To RUN a program	Press and quickly release $\triangle + \nabla$	Indicator – RUN = On Scrolling Display – <i>Current Program state</i>
To HOLD a program	Press and quickly release $\triangle + \nabla$	Indicator – RUN = Flashing Scrolling Display – Program Hold
To RESET a program	Press and Hold $\triangle + \nabla$ for more than 1 second	Indicator – RUN = Off Scrolling Display - <i>None</i>
	Program Ended	Indicator – RUN = Off Scrolling Text – Program End
To RESET a program after it has completed	Press and Hold $\triangle + \nabla$ for more than 1 second Or Press and quickly release Ack $\square + \curvearrowright$	Indicator – RUN = Off Scrolling Display - <i>None</i>

5.3 Program Status

While the program is running in level 1 or level 2, the Home Display shows two values at any one time:

Process Value

The upper display shows the measured temperature of the furnace (PV).

PSP, Segment Type and Number

The lower display continually alternates between the programs current set value (Program SP = PSP) and scrolling text, indicating the current status of the program whether RAMP or DWELLING followed by the segment number.

Additional information can be obtained using the scroll \curvearrowright key while the program is running.

Working Output Power

From the home display, press Scroll \curvearrowright until the display shows *WRK.OP <WORKING OUTPUT POWER>* This shows the power being used as a percentage.

Time Remaining

Press scroll \curvearrowright until the display shows *T.REMN <TIME REMAINING>*. This shows the dwell time remaining for the current segment. There is no value for “Ramp Time Remaining” therefore when the program is ramping the dwell time set will be shown and will only begin to count down when the ramp has finished.

Program Review

Further presses of scroll \curvearrowright will reveal the settings of the current program running. These parameters are locked, while the program is running.

Program Hold with Holdback

If a holdback value has been set (see Programming section 4.7) and the program goes into a hold state, the red “HLD” indicator will light, until the “PV” catches up.

If while in this condition the program itself is put into “Hold” by pressing the Up \triangle , Down ∇ together, the “HLD” indicator will turn off and the “Run” indicator will flash, indicating the program is on hold. When the program is started again by pressing the up \triangle , down ∇ together, the “Run “ indicator will stop flashing and show continually and the “HLD” indicator will light, if the “PV” has not caught up with the program.

Power Failure

If there is a power failure while the program is running and the power is subsequently restored, the scrolling text will read *<POWER FAIL - PROGRAM RESET>*.

To acknowledge this message and to reset the program Press “ACK” function

Alarms

Alarms are used to alert the operator when a pre-set level has been exceeded or a function error has occurred such as a sensor break. They are indicated by a scrolling message on the display and a flashing red ALM (Alarm) indicator. The alarm may also switch an output – usually a relay to allow external devices to be operated when an alarm occurs. Alarms only operate if they have been configured and are dependant on customer requirements.

How to Acknowledge an alarm will depend on the type of latching which has been configured. A non-latched alarm will reset itself when the alarm condition is removed. A latched alarm requires acknowledgement with the “ACK” Function (Section 2.2) before it is reset.

If an alarm has been activated the red “ALM” indicator will light and the scrolling text will indicate the type of alarm.

To Acknowledge an alarm and cancel the “ALM” indicator, press ACK function.

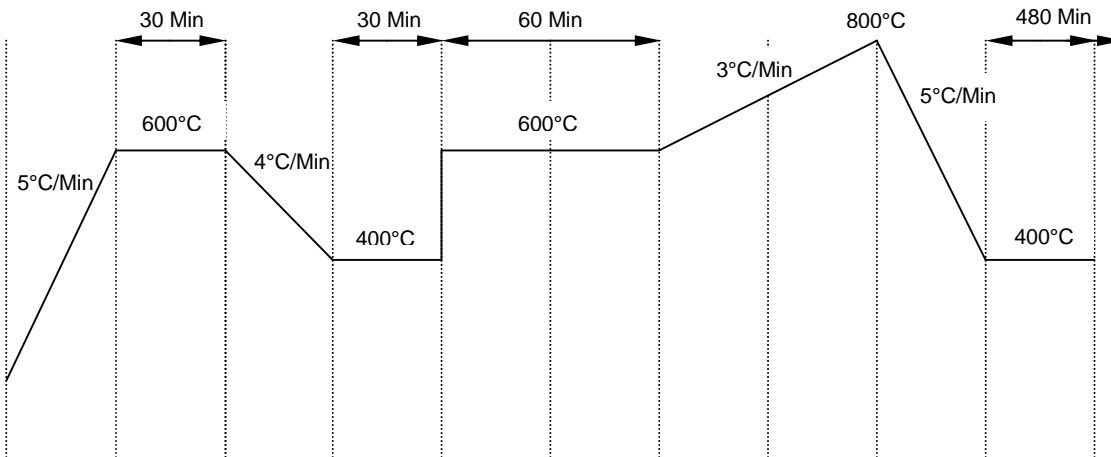
Note:

The alarm indicator may seem to be permanently on when viewed from above. When an alarm is active the indicator should only be flashing, to confirm this, the controller must be viewed directly from the front.

5.4 Program Example

The following sequence of entries creates and runs the program shown graphically below.

1. Press Scroll until the display shows *RAMP.U <SP RAMP UNITS>*. Select *MIN.*
2. Press Scroll until the display shows *DWELL.U <DWELL UNITS>*. Select *MIN.*
3. Press Scroll until the display shows *RMP.1 <RAMP RATE 1>*. Select *5*
4. Press Scroll until the display shows *T.SP1 <TARGET SP 1>*. Select *600*
5. Press Scroll until the display shows *DWEL.1 <DWELL TIME 1>*. Select *30*
6. Press Scroll until the display shows *RMP.2 <RAMP RATE 2>*. Select *4*
7. Press Scroll until the display shows *T.SP2 <TARGET SP 2>*. Select *400*
8. Press Scroll until the display shows *DWEL.2 <DWELL TIME 2>*. Select *30*
9. Press Scroll until the display shows *RMP.3 <RAMP RATE 3>*. Select *OFF*
10. Press Scroll until the display shows *T.SP3 <TARGET SP 3>*. Select *600*
11. Press Scroll until the display shows *DWEL.3 <DWELL TIME 3>*. Select *60*
12. Press Scroll until the display shows *RMP.4 <RAMP RATE 4>*. Select *3*
13. Press Scroll until the display shows *T.SP4 <TARGET SP 4>*. Select *800*
14. Press Scroll until the display shows *DWEL.4 <DWELL TIME 4>*. Select *OFF*
15. Press Scroll until the display shows *RMP.5 <RAMP RATE 5>*. Select *5*
16. Press Scroll until the display shows *T.SP5 <TARGET SP 5>*. Select *400*
17. Press Scroll until the display shows *DWEL.5 <DWELL TIME 5>*. Select *480*
18. Press the ACK function to return to the home display (section 2.2).
19. Press the Up \triangle , Down ∇ together, to run the program.



Segment 1	Segment 2	Segment 3	Segment 4	Segment 5
RMP.1 = 5°C/Min T.SP1 = 600°C DWEL.1 = 30 Min	RMP.1 = 4°C/Min T.SP1 = 400°C DWEL.1 = 30 Min	RMP.1 = OFF T.SP1 = 600°C DWEL.1 = 60 Min	RMP.1 = 3°C/Min T.SP1 = 800°C DWEL.1 = OFF	RMP.1 = 5°C/Min T.SP1 = 400°C DWEL.1 = 480 Min

6 Options

Because options can be ordered in a variety of combinations and for a variety of purposes, exact instructions are not given here. The full Eurotherm manual may be required to determine customer parameter settings. To reveal or hide parameters in the controller it is necessary to go into configuration modes and enter a security codes. Please consult Carbolite.

6.1 Digital Communications – RS232

If the RS232 option is supplied, then the furnace is fitted with one subminiature D-socket connected to the controller communications (comms) module. RS232 is suitable for direct connection to a personal computer (PC), using a “straight through” cable as follows (the linked pins at the computer end are recommended but may not be necessary). The cable is usually 9-pin at the furnace end and 9-pin at the computer, but other alternatives are shown in parentheses.

Furnace end of cable female 9-pin (25-pin)	RS232 Cable: furnace to PC	Computer end of cable 9-pin (25-pin) male
Rx 3 (2)	_____	3 (2) Tx
Tx 2 (3)	_____	2 (3) Rx
Com 5 (7)	_____	5 (7) Com
		7,8 (4,5) Link together
		1,4,6 (6,8,20) Link together

6.2 Digital Communications – RS485

If an RS485 option is supplied, then the furnace is fitted with two sub-miniature D-sockets. Connection between products is by “straight” cable as follows:

female 9-pin (25-pin)	RS485 cable: furnace to furnace	9-pin (25-pin) female
- 3 (2)	_____	3 (2) -
+ 2 (3)	_____	2 (3) +
Com 5 (7)	_____	5 (7) Com

If a boxed KD485 RS485 to RS232 converter is supplied, then the connection cable from furnace to KD485 should be a “straight” cable, the same as the furnace-to-furnace cable. The connection between the KD485 and the PC should be a “crossover” cable, the same as the Furnace to PC cable in section 6.1.

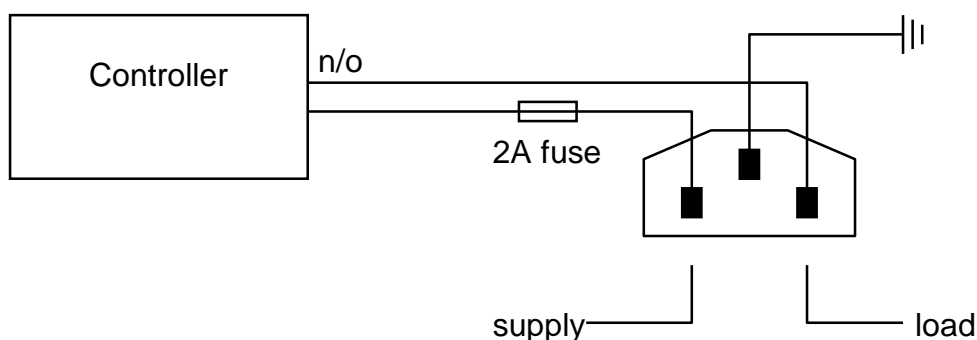
6.3 Comms Address

Typically the comms address is set to 1, but this can be changed. In the case of RS485 and multiple instruments it is necessary to set different addresses.

To change the address value access the level 2 list. In level 2 press the scroll key \curvearrowright until the *ADDR (ADDRESS)* parameter is displayed. Use the Up \triangle Down ∇ to select the address value.

6.4 Alarm Option

When an alarm board is fitted with free contacts for customer use, the contacts are taken to a panel plug on the control panel, wired as indicated:

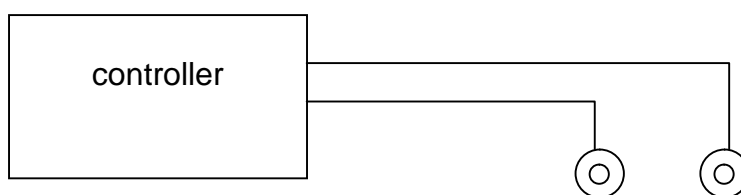


The purpose of the 2 amp fuse is to guard against the connection of a mains supply to the panel plug.

The instrument configuration, and parameters available to the operator, depend on the customer requirements.

6.5 Remote Input and Output (Analogue Communications)

When analogue communications are fitted, the contacts are taken to Insulated terminal sockets on the control panel.



Controller configuration depends on customer requirements.

Remote input (when specified) may be switched on and off using the Alternative Setpoint Enable parameter in the controller home list, if this was made available for a particular application. Remote output does not require switching on and off.

7 Navigation Diagrams

8 Controller Fault

8.1 Fault Code Diagnostic Table

Error Code	Explanation	Actions
5.br	Temperature sensor failure	Replace the Furnace or Oven Temperature Sensor

9 Glossary of Terms

Process Value (PV)	The actual temperature of the furnace or oven.	°C
Setpoint (SP)	The target temperature the furnace or oven is trying to reach.	°C
SP Ramp Rate	The speed at which the furnace or oven is allowed to heat up or cool down.	°C/Min
Control Setpoint	The temperature that can be directly set into the controller using the Up and Down keys	-
Element	The heating device used in the furnace or oven.	-
Thermocouple	The temperature-measuring device used in the furnace or oven.	-
PID	Proportional Integral Derivative: the control system used by the controller.	-
Overtemperature (O/T)	The condition which a furnace or oven may enter if part of the main control circuit fails.	-
Overtemperature Protection	A system to prevent the product or process being damaged if it has gone into an overtemperature condition.	-
Ramp/Dwell Pairs	A Program is split up into segments, each segment Contains a Ramp and a dwell.	-
Program	A sequence of stored Parameters set by the operator, which will run automatically when started.	-
Latched Alarm	Will hold the alarm condition once it has been detected.	-
Non-Latching Alarm	Will reset itself when the alarm condition is removed.	-
Power Cycling	The Power to the controller is turned off and then back on.	-

*For preventive maintenance, repair and calibration of all Furnace
and Oven products, please contact:*

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