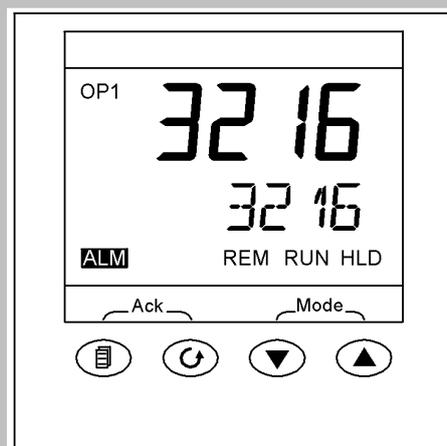


CARBOLITE[®]

IGERO 30-3000°C

Operating Instructions

Temperature Controller



Type 3216CC

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 3216CC 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 3216CC - Controller

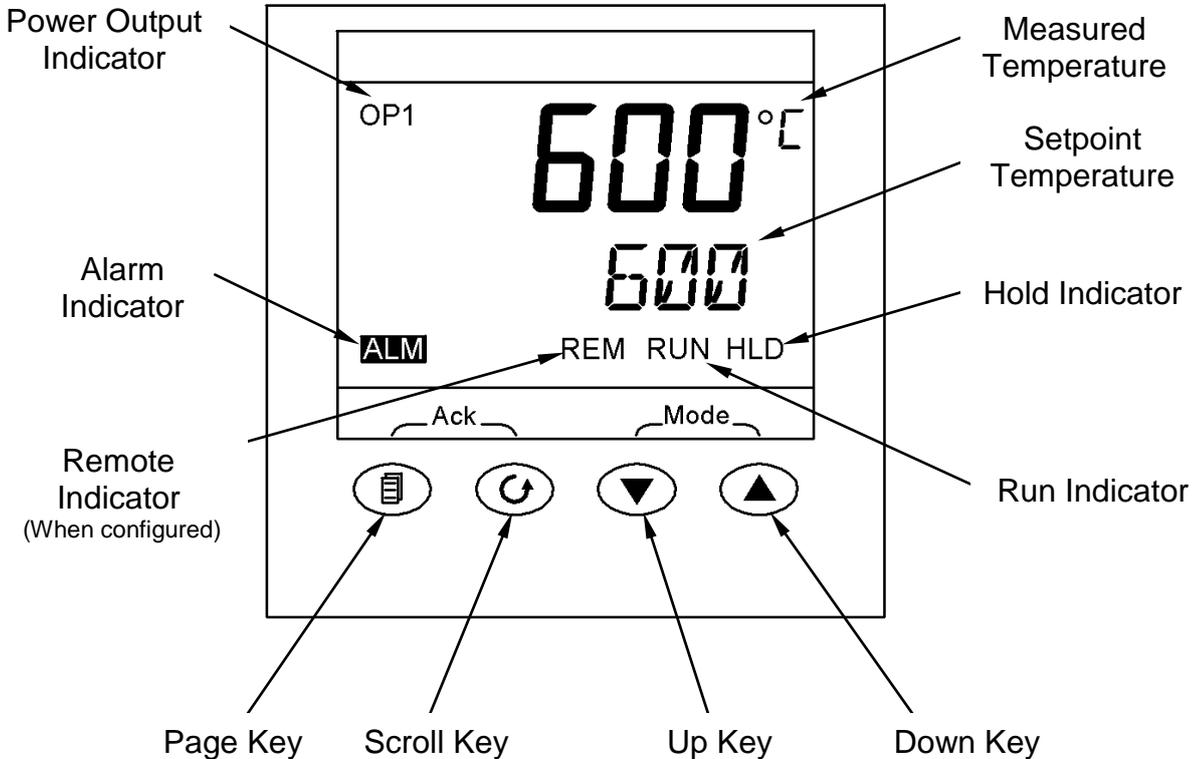
The 3216CC is a digital temperature controller which uses PID algorithms to give excellent temperature control when properly set. This controller can only be used as a simple temperature controller, it cannot be programmed.

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 timer end. • Acknowledge an alarm if activated.
Arrow Keys U λ	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 U or Down λ 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. *WRK.OP* <WORKING OUTPUT>

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 || for 3 seconds.
2. The display will show *LEU 1 GOTO*
3. Release the page Key
4. Press the UpU or Down λ to choose *LEU 2* (level 2)
5. Press the Up U or Down λ to enter the code (Level 2 Code = 9).

If the correct code is entered, the display show the level 2 home display.

If an incorrect code is entered the display reverts back to Level 1 home display

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 λ to select **LEVEL 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
	Timer
	Timer Status
	Alarms (if configured)
	Current Transformer Input (if configured)
	Comms (if configured)
	Controller setup (if configured)
	Customer Calibration (if configured)

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 \leftarrow and use Up \uparrow 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 Set Point Ramp Rate (3216CC only)

To control the rate at which the temperature rises to setpoint, the SP.RATE function is used.

Before setting the ramp rate, it is advisable to set the setpoint to a low value, preferably 0°C (see section 3.2). Once the ramp rate has been set the required setpoint can be entered from the home menu. Doing so will activate the ramp rate, which can be identified with the run indicator showing on the bottom of the display. While the ramp rate is active the working setpoint will be shown on the lower temperature display (This is the setpoint, set by the ramp rate).

When the process temperature has reached the setpoint value at the given ramp rate, the run indicator will turn off and the instrument will control at the required Setpoint temperature. Any further modifications to set point will cause the ramp rate to be activated and the instrument to control as described above.

NOTE: Ensure timer configuration is set to 'NONE' (Section 5.1) to use the setpoint ramp rate feature without any timer functions.

Press scroll \leftarrow until the display shows *SP.RATE <SETPOINT RATE LIMIT>*. Using Up \uparrow and Down \downarrow select the ramp rate required, in °C/Min.

To check the Setpoint during ramping press the Up \uparrow or Down \downarrow once.

To cancel the ramp rate, the *SP.RATE <SETPOINT RATE LIMIT>* must be set to *OFF*.

4.2 Maximum Output Power Setting

Press scroll \leftarrow until the display shows *OP.HI <OUTPUT HIGH>*. Using Up \uparrow and Down \downarrow 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.

4.3 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 \leftarrow until the display shows *ID <CUSTOMER ID>*. Using the Up \uparrow Down \downarrow enter your own identification number. This can range from 1-9999.

4.4 Units

Press scroll \leftarrow until the display shows *UNITS <DISPLAY UNITS>*. Using the Up \uparrow or Down \downarrow 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>	%

4.5 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.

5 Timer

5.1 Setting the Timer

A timer can be configured to operate in four different modes. These can be selected in level 2 (supervisor level) using the *TM.CFG* parameter as:-

- None
- Dwell Timer
- Delayed switch on timer
- Soft start timer

None

The timer is turned off, no timer configurations are available, the instrument works as a simple set point controller.

Press scroll \leftarrow until the display shows *TM.CFG <TIMER CONFIGURATION>*. Using the Up \uparrow Down \downarrow select *NONE*.

5.2 Dwell Timer

A dwell timer is used to control a process at a fixed temperature for a defined period. At the end of the time period the controller will switch off the output power to the elements.

Press scroll \leftarrow until the display shows *T.M.C.F.G* \langle *TIMER CONFIGURATION* \rangle . Using the Up \uparrow Down \downarrow select *dWELL*

When Dwell parameter is selected, the Timer resolution (*T.M.RES*), Time duration (*DWELL*), Timer threshold (*THRES*) functions become available.

Press scroll \leftarrow until the display shows *T.M.RES* \langle *TIME RESOLUTION* \rangle . Use the Up \uparrow Down \downarrow to select the timer units in *MIN* or *HOURS*.

Press scroll \leftarrow until the display shows *DWELL* \langle *SET TIME DURATION* \rangle . Use the Up \uparrow Down \downarrow to enter the time duration required.

Press scroll \leftarrow until the display shows *THRES* \langle *TIMER THRESHOLD* \rangle . Use the Up \uparrow Down \downarrow to select the temperature threshold that you require the timer to start at.

The threshold value is $\pm n$ around the setpoint (n =threshold value).

Example: If the set point is set to 800°C and the timer threshold is set to 2, after the timer is activated will not start until the process value reaches 798°C if ramping up or 802°C if it is cooling.

Note: If the threshold is set to *OFF*, the timer will either; start to count down as soon as it is activated with the mode keys or if a ramp rate has been set (see section 4.1), the timer will start as soon as the ramp reaches the set point. (See Section 6.1)

5.3 Delayed Switch On Timer

The delayed switch on timer is used to switch on the output power to the elements after a set time period.

Press scroll \leftarrow until the display shows *T.M.C.F.G* \langle *TIMER CONFIGURATION* \rangle . Using the Up \uparrow Down \downarrow select *dELAY*

When delay parameter is selected, the Timer resolution (*T.M.RES*), Time duration (*DWELL*), functions become available.

Press scroll \leftarrow until the display shows *T.M.RES* \langle *TIME RESOLUTION* \rangle . Use the Up \uparrow Down \downarrow to select the timer units in *MIN* or *HOURS*.

Press scroll \leftarrow until the display shows *DWELL < SET TIME DURATION >*. Use the Up U Down \rightarrow to enter the time duration required, before the output power switches on.

5.4 Soft Start Timer

The soft start timer is used to start a process at a reduced setpoint and power. The soft start setpoint is used as a threshold only and is not a control point.

Example:	Main Setpoint	= 800°C
	Max power limit	= 75% (This maybe set at the factory)
	Soft Start Setpoint	= 600°C (Threshold)
	Soft Start Power Limit	= 50% (Cannot be set above max power Limit)

When the timer is running the maximum power is controlled by the Soft Start Setpoint of 600°C and the Soft Start Power limit of 50%, this will continue until the timer ends or the PV (Process value) exceeds the Soft Start Setpoint.

When the timer ends or the PV exceed the Soft Start Setpoint the instrument will start to control using the main Setpoint of 800°C and the Max Power Limit of 75%.

Press scroll \leftarrow until the display shows *TM.CFG <TIMER CONFIGURATION>*. Using the Up \uparrow Down \downarrow select *SF.ST*

When Soft Start parameter is selected, the Timer resolution (*TM.RES*), Time duration (*DWELL*), Soft Start Setpoint (*SS.SP*) and Soft Start Power Limit (*SS.PWR*) functions become available.

Press scroll \leftarrow until the display shows *TM.RES <TIME RESOLUTION>*. Use the Up \uparrow Down \downarrow to select the timer units in *MIN* or *HOURS*.

Press scroll \leftarrow until the display shows *DWELL <SET TIME DURATION>*. Use the Up \uparrow Down \downarrow to enter the time duration required, before the output power switches on.

Press scroll \leftarrow until the display shows *SS.SP <SOFT START SETPOINT>*. Use the Up \uparrow Down \downarrow to enter the soft start setpoint.

Press scroll \leftarrow until the display shows *SS.PWR <SOFT START POWER LIMIT>*. Use the Up \uparrow Down \downarrow to enter the soft start power limit.

6 Running a Timer

Run. This starts the timer.

Hold. This stops the timer at the elapsed time. It will start again from the elapsed time when Run is selected again.

Reset. This sets the timer back to zero. It can be run again from this state.

End cannot be set – it occurs automatically when the timer has counted down to zero.

Acknowledge any timer after a timer has timed out using ACK function (see section 2.2) by pressing the || < simultaneously.

6.1 Dwell Timer

Operation	Action	Indication
To RUN Timer	Press and quickly release U + λ	Indicator – RUN = On Scrolling Display – <i>TIMER RUNNING</i>
To HOLD timer	Press and quickly release U + λ	Indicator – RUN = Flashing Scrolling Display – <i>TIMER HOLD</i>
To switch off Timer / Cancel	Press and Hold U + λ for more than 1 second	Indicator – RUN = Off Scrolling Display – <i>None</i> Static Text - <i>OFF</i>
To return to home after reset	Press and Hold U + λ for more than 1 second	Indicator – RUN = Off Display – <i>A-M <LOOP MODE-- AUTO MANUAL OFF></i> Use the Up U Down λ to select <i>AUTO</i>
	Timer Ended	Indicator – RUN = Off Scrolling Text – <i>Timer End</i> Static Text - <i>OFF</i>
To re-RUN Timer	Press and quickly release U + λ	Indicator – RUN = On Scrolling Display – <i>TIMER RUNNING</i>
To RESET timer and return to home menu after timer end	Press and quickly release Ack <	Indicator – RUN = Off Scrolling Display - <i>None</i>
	Press and Hold U + λ for more than 1 second	Indicator – RUN = Off Display – <i>A-M <LOOP MODE-- AUTO MANUAL OFF></i> Use the Up U Down λ to select <i>AUTO</i>

Power Failure While Using Dwell Timer

If there is a power failure while the timer is running and the power is subsequently restored the timer will reset and the static text will display “OFF” until the U + λ keys are pressed to re-run the timer.

Running Dwell Timer with Ramp Rate

Set the ramp rate as outlined in section 4.1

Set the dwell time as outlined in section 5.2

When the timer is set to run with a set ramp rate, the timer will not start to count down until the setpoint has been reached with the ramp, at which time the timer will begin time count down.

The scrolling display will indicate “timer running” and the run indicator will be illuminated while the ramp rate is active and during the timer count down, after which the display will indicate the instrument has switched off power to the elements (see table 6.1), and the run indicator will switch off.

Running Dwell Timer with Ramp Rate & Threshold

Set the ramp rate as outlined in section 4.1

Set the dwell time as outlined in section 5.2

Set the threshold as outlined in section 5.2

When the timer is set to run with a set ramp rate and threshold, the timer will not start to count down until the process temperature has reached the threshold value (see example section 5.2)

The scrolling display will indicate “timer running” and the run indicator will be illuminated while the ramp rate is active, while the process value is reaching the threshold value and during the timer count down, after which the display will indicate the instrument has switched off power to the elements (see table 6.1).

6.2 Delayed Switch On Timer

Operation	Action	Indication
To RUN Timer	Press and quickly release U + λ	Indicator – RUN = On Scrolling Display – <i>TIMER RUNNING</i> Static Text - <i>OFF</i>
To HOLD timer	Press and quickly release U + λ	Indicator – RUN = Flashing Scrolling Display – <i>TIMER HOLD</i> Static Text - <i>OFF</i>
To switch off Timer / Cancel	Press and Hold U + λ for more than 1 second	Indicator – RUN = Off Scrolling Display – <i>None</i> Static Text - <i>OFF</i>
To return to home menu. After Resetting timer.	Press and Hold U + λ for more than 1 second	Indicator – RUN = Off Display – <i>A-M <LOOP MODE - AUTO MANUAL OFF></i> Use the Up U Down λ to select <i>AUTO</i>
	Timer Ended	Indicator – RUN = Off Scrolling Text – <i>Timer End</i>
To re-RUN Timer	Press and quickly release U + λ	Indicator – RUN = On Scrolling Display – <i>TIMER RUNNING</i> Static Text – <i>OFF</i>

Running Delay Timer with Ramp Rate

Set the ramp rate as outlined in section 4.1
Set the delay time as outlined in section 5.3

When ramp rate is active with a Delay timer the run indicator serves two functions:

- Indicates timer is running
- Indicates ramp rate is active

This means that when the timer has timed out the run indicator will still be illuminated if the ramp rate is still active and will continue to be illuminated until the ramp reaches setpoint, at which time it will switch off.

A characteristic of these combinations of parameters is that the scrolling text will continue to indicate timer running when the timer has timed out. Checking whether the timer has timed out or not, can be done with the T.REMN function.

The delay timer with ramp rate will function as outlined in the table above with the addition of the functions in the following table.

Delay timer with ramp rate functions

	Timer Ended When ramp rate active	Indicator – RUN = On - <i>if ramp rate active</i> Scrolling Text – <i>TIMER RUNNING</i>
To HOLD timer	Press and quickly release U + λ	Indicator – RUN = Flashing Scrolling Display – <i>TIMER HOLD</i> Static Text - <i>OFF</i>
To switch off Timer / Cancel	Press and Hold U + λ for more than 1 second	Indicator – RUN = On - <i>if ramp rate active</i> Scrolling Display – <i>None</i> Static Text - <i>OFF</i>
To re-RUN Timer	Press and quickly release U + λ	Indicator – RUN = On Scrolling Display – <i>TIMER RUNNING</i> Static Text – <i>OFF</i>

Power Failure While Using Delay Timer

If there is a power failure while the timer is running and the power is subsequently restored the timer will reset and will re-run from the power on time.

6.3 Soft start Timer

Operation	Action	Indication
To RUN Timer	Press and quickly release U + λ	Indicator – RUN = On Scrolling Display – <i>TIMER RUNNING</i> Static Text - <i>OFF</i>
To HOLD timer	Press and quickly release U + λ	Indicator – RUN = Flashing Scrolling Display – <i>TIMER HOLD</i> Static Text - <i>OFF</i>
To switch off Timer / Cancel	Press and Hold U + λ for more than 1 second	Indicator – RUN = Off Scrolling Display – <i>None</i> Static Text - <i>OFF</i>
	Timer Ended	Indicator – RUN = Off Scrolling Text – <i>TIMER END</i>

Running Soft Start Timer

When the soft start timer is set to run, the scrolling display will indicate “timer running” and the set point temperature, not the soft start set point.

Power Failure While Using Soft Start Timer

If there is a power failure while the timer is running and the power is subsequently restored the timer will reset and will re-run from the power on time.

Ramp Rate with Soft Start Timer

It is not recommended that the ramp rate function be used with a soft start timer.

Note: If the temperature is already above the threshold when the timer is set to run the timer will time out immediately.

Time Remaining

The time remaining of any timer mode can be checked at any time while a timer is active.

To view the time remaining, press scroll \leftarrow until the display shows *T.REMN <TIME REMAINING>*.

Note: The time remaining can be modified at any time while the count down timer is running, by pressing, the Up \cup Down λ while the time remaining function is active.

6.4 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.

7 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 Gero.

7.1 Digital Communications – RS232

If the RS232 option is supplied, then the furnace is fitted with one sub miniature 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

7.2 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 7.1.

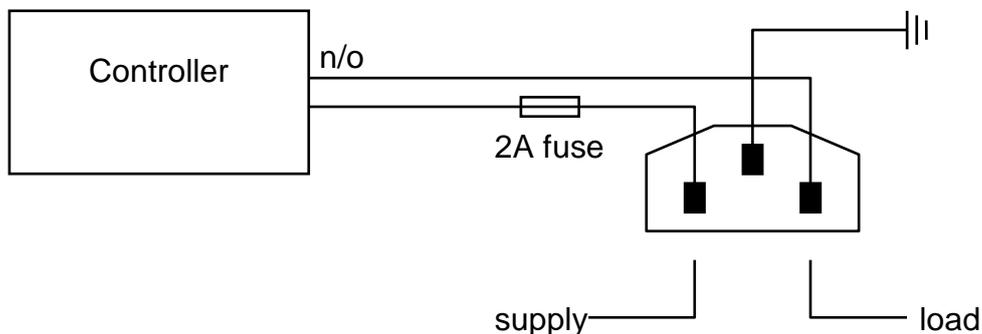
7.3 Comms Address

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 \leftarrow until the *ADDR (ADDRESS)* parameter is displayed. Use the Up \uparrow / Down \downarrow to select the address value.

7.4 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:

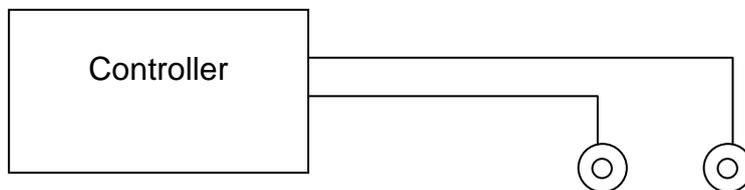


The purpose of the 2 amp fuse is to guard against the connection of a mains supply to the panel plug.

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

7.5 Remote Input and Output (Analogue Communications)

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

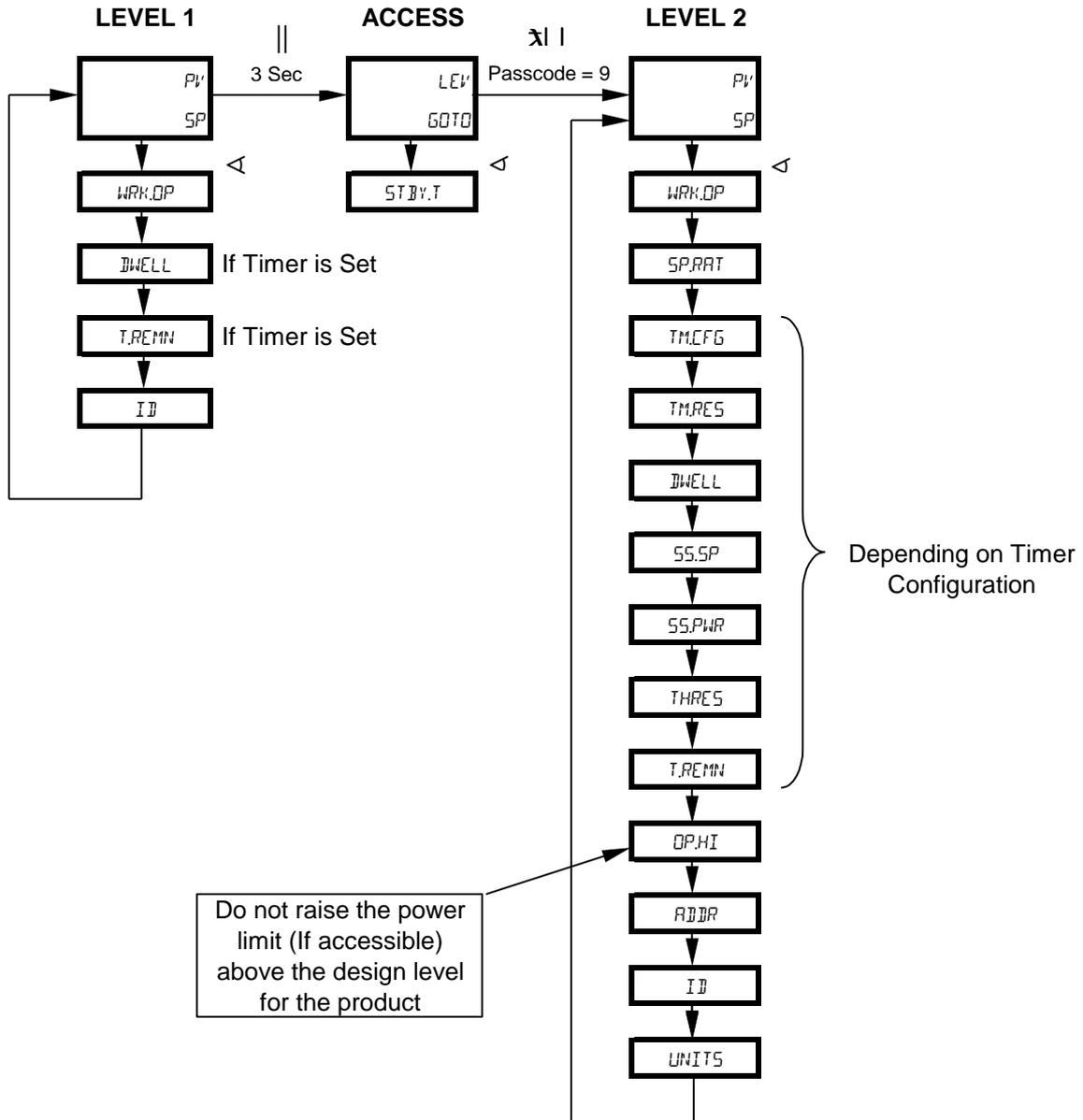


Controller configuration depends on customer requirements.

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.

8 Navigation Diagram

8.1 3216CC



9 Controller Fault

9.1 Fault Code Diagnostic Table

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

10 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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