

### Installation, Operation and Maintenance Instructions

#### Controller Manual

#### 3508P1 Controller + 3216CC End Zone Controllers

## 3508P1 Controller + 3216CC End Zone

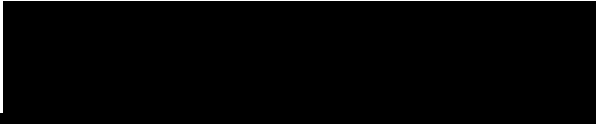
## Contents

This manual is for guidance on the use of the Carbolite Gero product specified on the front cover. This manual should be read thoroughly before unpacking and using the furnace or oven. The model details and serial number are shown on the back of this manual. Use the product for the purpose for which it is intended.

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## **1.0 3508 Controller**

### **1.1 PID control**

This controller uses PID (Proportional Integral Derivative) temperature control. This type of control uses a complex mathematical control system to adjust the heating power and achieve the desired temperature.

### **1.2 3508P1**

The 3508P1 is a digital temperature controller which uses PID algorithm to give excellent temperature control when properly set. This controller can store and operate a single program of up to 20 segments. The 3508P1 can also be used as a simple temperature controller.

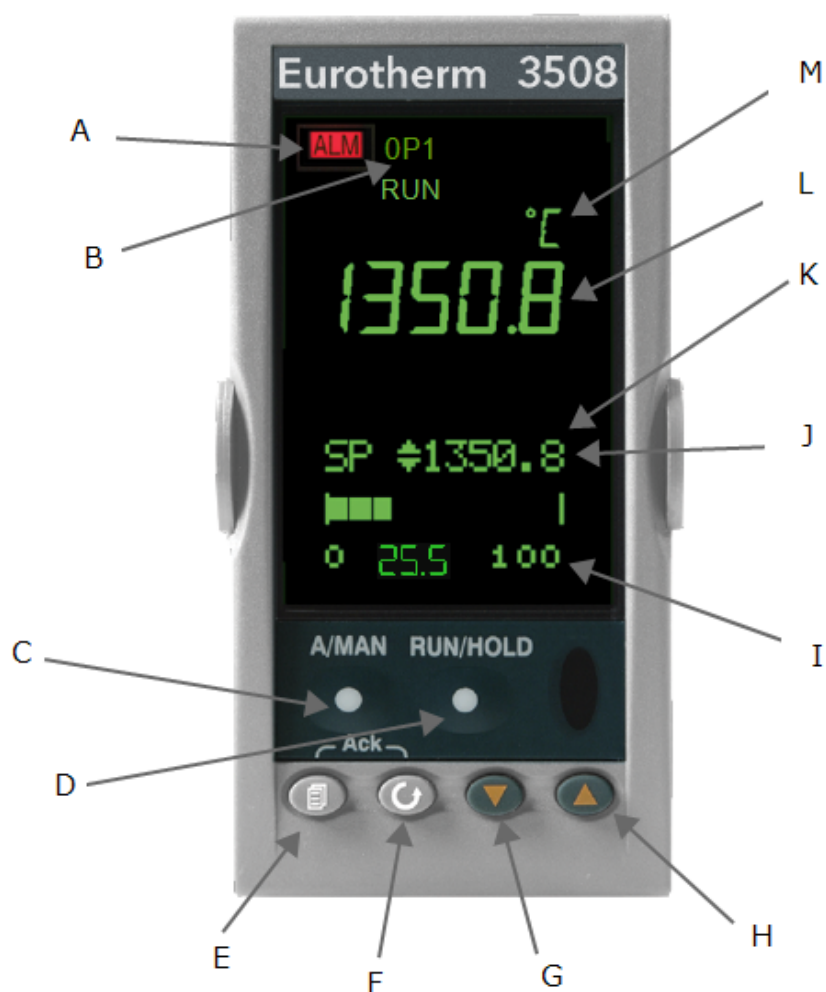
### **1.3 3508P10**

The 3508P10 is a digital controller which uses PID algorithms to give excellent temperature control when properly set. This controller can store 10 programs of up to 50 segments each. Programs can be operated individually or linked by a Call parameter as sub-programs or to form single long programs. The 3508P10 can also be used as a simple temperature controller.

### **1.4 3508P25**

The 3508P25 is a digital temperature controller which uses PID algorithms to give excellent temperature control when properly set. This controller has a maximum of 500 segments or 25 programs; each program has a maximum of 50 segments. For example 3508P25 could store 10 programs with 50 segments or 25 programs with 20 segments. Programs can be operated individually or linked by a Call parameter as sub-programs or to form single long programs. The 3508P25 can also be used as a simple temperature controller.

### 1.5 Basic Operation









Key	
A	Alarm Indicator
B	Power Output Indicator
C	Not Used
D	Runs, Holds, Resets the current program
E	Page
F	Scroll
G	Down
H	Up
I	Power Output Percentage
J	Program Setpoint Temperature (PSP) when a program is running
K	Setpoint Temperature (SP) when basic controlling
L	Measurement Temperature

M	Measurement Units
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### 1.5.1 Controller Layout

#### 1.5.2 Keys

A/ Man	-	Disabled
RUN/ HOLD	-	Runs, Holds or Resets the current program. Hold down for 3 seconds to Reset.
Page Key		Scrolls through the page headings. Hold down for 3 seconds to access further levels, pass codes are required.
Scroll Key		Scrolls through parameters listed on pages.
Arrow Keys		Adjust parameter values.
Page and Scroll together		Press together to return to the home display or to acknowledge an alarm.
Page and Up together		Press together quickly to scroll back up the page headings.
Scroll and Up together		Press together quickly to scroll back up a parameter list.
Pressing any other combination of keys together has no effect.		

Note: If no keys are pressed for 1 minute, the display returns to Home.



## 1.6 Quick Start Guide

### 1.6.1 Operation as a simple controller

When switched on the controller goes through a short test routine and then shows the measured temperature. Below it, the setpoint temperature (SP) and percentage of power output.

The controller will immediately attempt to reach the set temperature and maintain it. This will cause the product to heat as quickly as possible which may not be appropriate where the product contains sensitive ceramic components. For products with ceramic components, e.g. a tube furnaces fitted with a long ceramic work tube, use the ramp rate feature set with a low heating rate such as 5°C per minute (300°C per hour), to prevent damage.

### 1.6.2 Changing the Setpoint

Press up  or down  to select the required SP. If the SP is higher than the measured temperature, the OP1 indicator will illuminate at the top of the display, indicating that the product is heating.

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

This will cause the product to heat as quickly as possible which may not be appropriate where the product contains sensitive ceramic components. For products with ceramic components, e.g. a tube furnaces fitted with a long ceramic work tube, use the ramp rate feature set with a low heating rate such as 5°C per minute (300°C per hour), to prevent damage.

### 1.6.3 Resetting the programmer

To reset the programmer to simple controller mode, press RUN/HOLD for 2 seconds.

#### **Operating the current program**

- To avoid unwanted heating at the end of a program, set the SP temperature to zero before operating a program.
- Ensure the programmer is reset to simple controller mode before starting a program by pressing RUN/HOLD for 2 seconds.
- To start the program, press RUN/HOLD twice, RUN will light up on the display.

The displayed Program Setpoint (PSP) follows ramps, dwells and steps as the program runs. The SP temperature of the controller does not apply when a program is operating.

- To pause the program, press RUN/HOLD.
- To stop the program and return to simple controlling (reset), press RUN/HOLD for 2 seconds.

When the program ends, the programmer will either:

- Automatically reset to operation as a simple controller.
- Dwell at the last temperature of the program (with the RUN indicator flashing), until the operator presses RUN/HOLD for 2 seconds to manually reset, or presses RUN/HOLD once to restart the program.
- Turn power to the elements down to zero.





### 1.6.4 Understanding User Levels

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

Level 1 (Operator) is for the day-to-day operation of the controller is not protected by a security code. There are 3 pages at this level. Page 1, Customer Identity, can only be altered in level 2. Page 2 shows the current program status. Page 3 is for writing and viewing programs.



Level 2 (Supervisor) requires a security code to enter, but once enable, provides access to additional parameters. A further 4 pages are accessible in this level as follows; Home , Customer identity, Control Output Hi percentage, Units.

To Enter Level 2:

1. Press and hold page  for 3 seconds. The display will show "Access Goto Level 1"
2. Press up  to select level 2. After a short pause the display will show "Access Pass code".
3. Press up  or down  to enter the pass code. Pass is momentarily displayed. After a short pause the display will return to home, the controller is now in level 2.

When Level 2 operations have been completed the supervisor must return to Level 1 manually. It is not necessary to enter a code when going from a higher level to a lower level.




To Return to Level 1:

1. Press and hold page  for 3 seconds. The display will show "Access Goto Level 2."
2. Press down  to go to level 1. After a short pause the display will revert to home, the controller is now in level 1.

## 1.7 Setting Up 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 2, see "Controller Navigation Diagrams".

### 1.7.1 Maximum output power setting

Press page  until "Control Output Hi" is displayed. Press up  or down  to adjust the value.


Depending on the product model, the maximum power output setting may be accessible or locked.

For silicon carbide heated products the parameter is accessible to allow compensation for element ageing.




In many models the maximum power output setting depends on the electrical supply voltage.

### 1.7.2 Customer ID.

A product identity number can be entered if required. This may be used to identify one of many units, for production or quality control systems.

Press page  until "Customer Identity" is displayed. Press up  or down  to select a number.

### 1.7.3 Units

Press page  until "Units" is displayed. Press up  or down  to select:

C	Celsius
F	Fahrenheit
K	Kelvin

### 1.7.4 Language

The text on the 3508 Controller 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.

## 1.8 Programming

### 1.8.1 Programming Notes

Programs can be created in Level 1 or Level 2 of the 3508 Controller.

For the P10 and P25, new programs can be created while the current program is operating.

To avoid unwanted heating at the end of a program, set the controller setpoint temperature to zero before operating a program.

All new unused programs show only 1 segment of type 'End'.

The minimum number of segments for a program is 2. The second being an 'End' type.

Ramp-to-setpoint control. To achieve this, create a two segment program. Set the first segment type as 'Rate' or 'Time'. Set the second segment type 'End' type 'Dwell'.

For the P10 and P25, programs can be linked together using a 'Call' segment. However, a lower number program can not be called and a program can not be ended with a call segment.

A program can be ended in four ways:

1. With 'End' segment set to S.OP the power to the elements is turned down to 0%, no matter what the 'Setpoint' temperature is.
2. With 'End' segment set to 'Reset' and the 'Setpoint' temperature turned down to zero, power to the elements will be 0%. To do this set the 'Setpoint' temperature to the minimum possible. For type B thermocouples this will be below zero.
3. With the 'End' segment set to 'Reset'. The controller will try to reach and maintain the 'Setpoint' temperature in place before the program started.
4. With the 'End' segment set to 'Dwell'. The controller will dwell at the 'PSP' of the last segment ("RUN" indicator flashes), until it is reset.

To reduce the number of segments in a program, change the last required segment to an 'End' type.

You will be asked to press  to cancel or  for OK.





To cancel all segments in a program, change the first segment to an 'End' type.

To alter parameters or segments of an operating program, this program must be held or reset. Press RUN/ HOLD to pause the program, or press RUN/ HOLD for 2 seconds to reset.

### 1.8.2 Holdback

Holdback can be used to prevent the program from operating ahead of the actual heating or cooling.

The holdback value is the amount, in degrees, by which the program setpoint can run ahead of the measured temperature before holdback operates. The value applies to a whole program.





To set the value press page  twice, press scroll  until 'Holdback Value' appears and press up  or down  to set.

Holdback can be used in 'Rate', 'Time' and 'Step' segments.

- For 'Rate' and 'Time' segments holdback will operate during the segment.
- For a 'Step' segment holdback delays continuation to the next segment until the step target is reached.

The 'Holdback Type' can be set as follows:

• Low	Applies to heating only
• High	Applies to cooling only
• Band	Applies to both heating and cooling
• Off	Holdback is switched off

To set the holdback type, press page  twice, then press scroll  until the display shows 'Holdback Type' for each segment and press up  or down  to set.

The default setting for holdback is 'OFF'.

### 1.8.3 Wait Segments

Wait prevents the program proceeding to the next segment, in a similar way to holdback, until the selected 'Wait-For' parameter has been met. There are 5 'Wait For' parameters. The first 4 only work if there are configured inputs to the controller.





1. PrgIn1 Wait until Input 1 is true
2. PrgIn2 Wait until Input 2 is true
3. PrgIn 1&2 Wait until Inputs 1 AND 2 are true
4. PrgIn 1or2 Wait until Inputs 1 OR 2 is true
5. PVWaitIP Wait until the measured temperature reaches a threshold value before continuing. It can operate in one of 4 ways:
  1. 'Abs Hi' Wait until the measured temperature is greater than or equal to a value 'WaitVal' set for that segment.
  2. 'Abs Lo' Wait until the measured temperature is less than or equal to a value 'WaitVal' set for that segment.

3. 'Dev Hi' Wait until the measured temperature exceeds a fixed\* threshold by an amount 'WaitVal' set for that segment.
4. 'Dev Lo' Wait until the measured temperature drops below a fixed\* threshold by an amount 'WaitVal' set for that segment.




\* The fixed threshold used by deviation parameters is set in the configuration level of the programmer and if required should be requested when purchasing a product from Carbolite Gero.

### 1.8.4 Program Cycling



The 'Cycles' parameter sets the number of times the program will operate. The default setting is 1 cycle.

To change the number of cycles, press page  twice, then press scroll  until the display shows 'Prog Cycles', then press up  to set a finite number of cycles up to 999. Or press down  to set cycling to continuous.




### 1.8.5 Creating a Program

From the home display, press page  three times to get to the programming page, the display will show "ProgEdit   1".



#### Program number

On P10 or P25 models press up  or down  to select a new program number. The display will show that new programs have only one segment.



#### Holdback Value

Press scroll  until the display shows 'Holdback Value". If required: Press up  or down  to set a value. This value will be used in any segment where a 'Holdback Type' is set.

#### Ramp Units




These apply to Rate segments only. Press scroll until the display shows 'Ramp Units'. Press up  or down  to select the ramp units of degrees per Hour, Min or Sec.

#### Number of program cycles




Press scroll  until the display shows 'Cycles'. Press up  or down  to select more than one cycle.

Now create all the segments for your program, finishing with an 'End' segment. When parameters for each segment have been entered the display goes to the next segment number.


#### Segment Type

Press scroll  until the display shows 'Segment Type'. Press up  or down  to select 'Rate', 'Time', 'Dwell', 'Step', 'Wait', 'GoBack', 'Call' or 'End'.

### Holdback Type

Press scroll  until the display shows 'Holdback Type'. If required, press up  or down  to select 'Off', 'Low', 'High' or 'Band'.




### Target Setpoint (Visible only for Rate, Time and Step segments)

Press scroll  until the display shows 'Target SP'. Press up  or down  to set a value.




### Ramp Rate (Visible only for Rate segments)

Press scroll  until the display shows 'Ramp Rate'. Press up  or down  to set the number of degrees per 'Ramp Unit' as set above.



### Duration (Visible only for Time and Dwell segments)

Press scroll  until the display shows 'Duration'. Press up  or down  to set a value.

### Wait For (Visible only for Wait segments)

Press scroll  until the display shows 'Wait For'. Press up  or down  to select: PrgIn1, PrgIn2, PrgIn1In2, PrgIn1orIn2, PVWaitIP.




### GoBack to segment number (visible only for GoBack segments)

Press scroll  until the display shows 'GoBack Seg'. Press down  to select a segment number to go back to.


### GoBack Cycles (visible only for GoBack segments)

Press scroll  until the display shows 'GoBack Cycles'. Press up  or down  to set a value.





### Call Cycles (Visible only for call segments)

Press scroll  until the display shows 'Call Cycles'. Press up  or down  to set a value.

### End Type (Visible only for End segments)

Press scroll  until the display shows 'End Type'. Press up  or down  to select: 'Reset', 'Dwell' or 'SafeOp'.

#### 1.8.6 Running a Program

The current program can be started from the home display by pressing RUN/HOLD or by pressing page  once, then scroll  once (twice for P10 and P25), then press up  or down  to change the status to 'Run'.

### 1.8.7 To pause (hold) a program

Press RUN/HOLD

or

Press page  until 'Program Status Reset' appears

Press scroll  until the cursor moves to 'Reset'

Press up  or down  to select 'Hold'


RUN/HLD will be displayed


### 1.8.8 To stop and reset a program

Press and hold RUN/HOLD

or

Press page  until 'Program Status Reset' appears

Press scroll  until the cursor moves to 'Reset'

Press up  or down  to select 'Reset'

### 1.8.9 To run a different program (P10 and P25)

To select a program


Press page  until 'Program Status Reset' appears

Press scroll  then up  or down  to select a program number

To operate the program

Press RUN/HOLD

or

Press scroll  until the cursor moves to 'Reset'

Press up  or down  to select 'Run'


Run will be displayed

### 1.8.10 Program Status


While a program is operating the home display shows 3 values:

- Top: Measured temperature
- Centre: Program Setpoint (PSP)
- Bottom: Power output percentage

To see more detail:


Press page  once to go to the program status page. The top and centre values from the home page remain on the display. The lower half of the screen now shows:

- Current program number (P10 and P25 only)
- Current segment number
- Time remaining for that segment

Further presses of the scroll  key while a program is operating will reveal additional information:

 Status. This can be changed to 'Hold', 'Reset' or 'Run' by pressing up  or down 


 Program Setpoint (PSP)

 Current Segment Type. 'Step' and 'Call' segments are instant, so are only flashed on the screen, unless holdback is operating on that segment.

 Target Setpoint

 Segment Rate For 'Rate', 'Time' and 'Step' segments only

 Cycles left

 Program Time Left

#### 1.8.11 Program Hold with Holdback

If a holdback value has been set and the program goes into a hold state, the green HLD indicator will flash until the measured temperature catches up.

While in this condition, the program itself is put into hold by pressing the RUN/HLD button, the 'HLD' indicator will stop flashing and remain on with the 'RUN' indicator. When the program is started again by pressing the RUN/HLD button, the 'HLD' indicator will flash again if the measured temperature has not caught up with the program.

Programming note: For P10 and P25 models, other programs can be created or changed whilst the current program is operating.

#### 1.8.12 Power Failure Recovery

If there is a power interruption to the controller during a program, when power is restored the controller pauses the program, then ramps the temperature back up to the current program setpoint (PSP) before continuing the program.

- Power failure during ramp segments: The ramp rate will be that of the current ramp segment.
- Power failure during dwell segments: The ramp rate will be that of the previous ramp segment. If a previous ramp segment does not exist, then the dwell will continue at the current measured temperature.
- Power failure during time-to-target segments: The ramp rate will be that of the current segment. The ramp rate is maintained, but the time remaining is recalculated.

If there is a power interruption while controlling to setpoint, when power is restored the controller automatically calls for maximum power.

### 1.8.13 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 flashing red ALM (Alarm) indicator. The alarm may also switch an output – usually a relay to allow external devices to operate when an alarm occurs. Alarms only operate if they have been configured and are dependent 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 before it is reset.

If an alarm has been activated, the red 'ALM' indicator will flash and the text will indicate the type of alarm.

To acknowledge an alarm and cancel the 'ALM' indicator, press  and  together.

### 1.8.14 Program Example 1

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

1. Turn the controller SP down to '0' by pressing down .
2. Press page  until 'Prog Segments Used' is displayed. On P10 or P25 models press up  or down  to select a new program number, (a program with only 1 segment).
3. Press scroll  until 'Holdback Value' is displayed. Default '0' degrees.
4. Press scroll  until 'Ramp Units' is displayed. Press up  or down  to set to 'Min'
5. Press scroll  until 'Cycles' is displayed. Default '1'
6. Press scroll  until 'Segment 1' is displayed
7. Press scroll  until 'Segment Type' is displayed. Press up  or down  to select 'Rate'
8. Press scroll  until 'Holdback Type' is displayed. Default 'Off'
9. Press scroll  until 'Target SP' is displayed. Press up  or down  to set to '400' degrees.
10. Press scroll  until 'Ramp Rate' is displayed. Press up  or down  to set to '5.0' degrees per minute.

Repeat steps 6 to 10 for 4 more segments. Set 'Holdback' to the default 'Off'. Enter the following parameters and values:












Segment Type Dwell Duration '30:00.0' minutes

Segment Type Step Target SP '600' degrees

Segment Type Dwell Duration '30:00.0' minutes

Segment Type Time Target SP '200' degrees, Duration '2:00:0' hours

Finish the program with an 'End' segment:

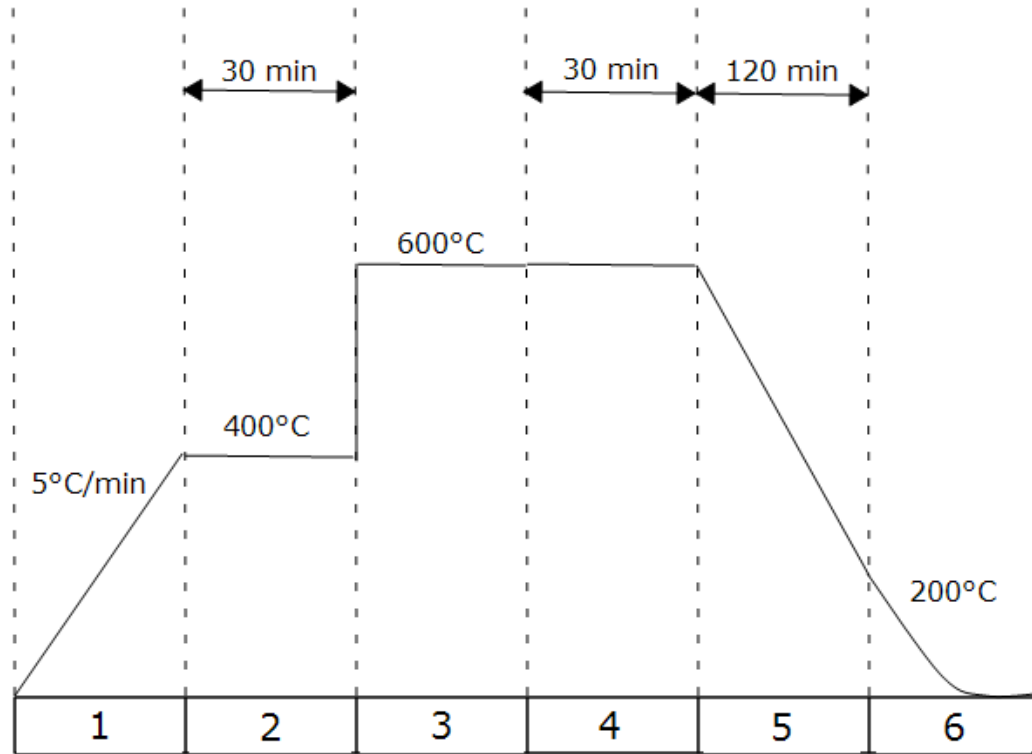
11. Press scroll  until 'Segment Type' is displayed. Press up  or down  to select 'End'
12. Press scroll  until 'End Type' is displayed. Press up  or down  to select 'Reset'
13. Press page  and scroll  together to return to the home display.  
To run the program either press RUN/HOLD or:
14. Press page  until 'Program Status' is displayed
15. Press scroll  until the cursor moves to the program status of 'Reset'
16. Press  to select 'Run'.

**Time Display Examples**

10:05:3 Min/Sec/10th Sec

21:10:05 Hour/Min/Sec




196:10 Hour/Min















Segment					
1	2	3	4	5	6
Type 'Rate'	Type 'Dwell'	Type 'Step'	Type 'Dwell'	Type 'Time'	Type 'End'
Target 400°C	Duration 30 min	Target 600°	Duration 30 min	Target 200°	End Type 'Reset'
Rate 5.0°/Min				Time 120 min	

1.8.15 Program Example 2

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












1. Turn the 'Setpoint' to '0' by pressing down ▼
2. Press page  until 'Prog Segments Used' is displayed. On P10 and P25 models press up ▲ or down ▼ to select a new program number, (a program with only 1 segment).
3. Press scroll  until 'Holdback Value' is displayed. Press up ▲ or down ▼ to set to '5' degrees
4. Press scroll  until 'Ramp Units' is displayed. Press up ▲ or down ▼ to set to 'Min'

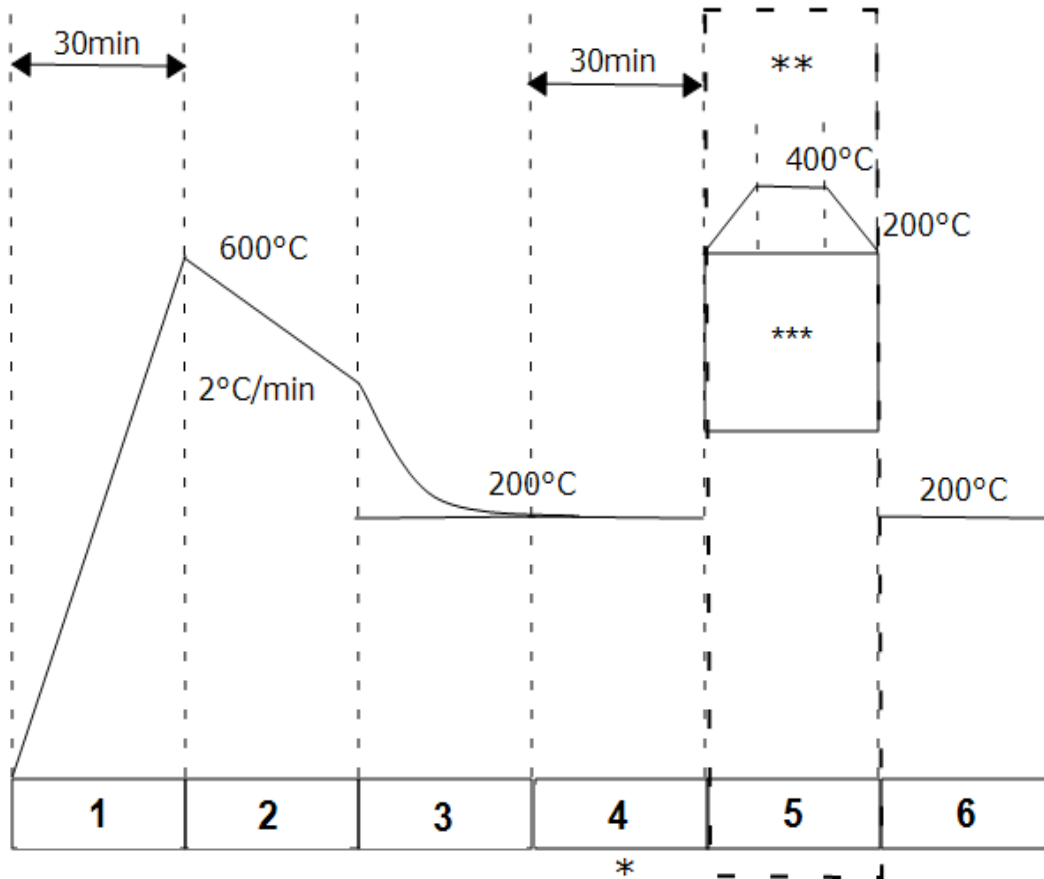
5. Press scroll  until 'Cycles' is displayed. Default '1'
6. Press scroll  until 'Segment 1' is displayed
7. Press scroll  until 'Segment Type' is displayed. Press up  or down  to select 'Time'
8. Press scroll  until 'Holdback Type' is displayed. Default 'Off'
9. Press scroll  until 'Target SP' is displayed. Press up  or down  to set to '600' degrees
10. Press scroll  until 'Duration' is displayed. Press up  or down  to set to '30:00.0' minutes

Repeat steps 6 to 10 for 4 more segments. Enter the following parameters and values:  
 Note: Call segments are not available on single program models.

Segment Type Rate	Target SP '400' degrees. Ramp Rate '2.0' degrees per minute
Segment Type Step	Target SP '200' degrees
Segment Type Dwell	Holdback 'High'. Duration '30:00.0' minutes
Segment Type Call	Call Prog 'next number'. Call Cycles '2'

Finish the program with an End segment:

11. Press scroll  until 'Segment Type' is displayed. Press up  or down  to select 'End'
  12. Press scroll  until 'End Type' is displayed. Press up  or down  to select 'Dwell'
- Repeat the sequence to create a short program '3' as suggested in the diagram.
13. Press page  and scroll  together to return to the home display  
 To operate the program either press RUN/HOLD or
  14. Press page  until 'Program Status' is displayed
  15. Press scroll  until the cursor moves to the program status of 'Reset'
  16. Press  to select 'Run'



Segment					
1	2	3	4	5	6
Type 'Time'	Type 'Rate'	Type 'Step'	Type 'Dwell'	Type 'Call'	Type 'End'
Target 600°C	Target 400°C	Target 200°C	Duration 30 min	Call prog 3	End Type 'Dwell'
Duration 30min	Rate 2°C/min		H back type 'High'	Call cycles 2n	
			* Segment 4 'Holdback Value' 5°C	** P10 and P25 only	
				*** Program 3 Example	

## 1.9 Controller Options

As 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 controllers it is necessary to go into configuration mode, a security code is needed. Please consult Carbolite Gero.

### 1.9.1 Digital Communications - RS232

If the RS232 option is supplied, the furnace is fitted with one sub-miniature D-socket connected to the controller 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.

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

### 1.9.2 Digital Communications - RS485

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

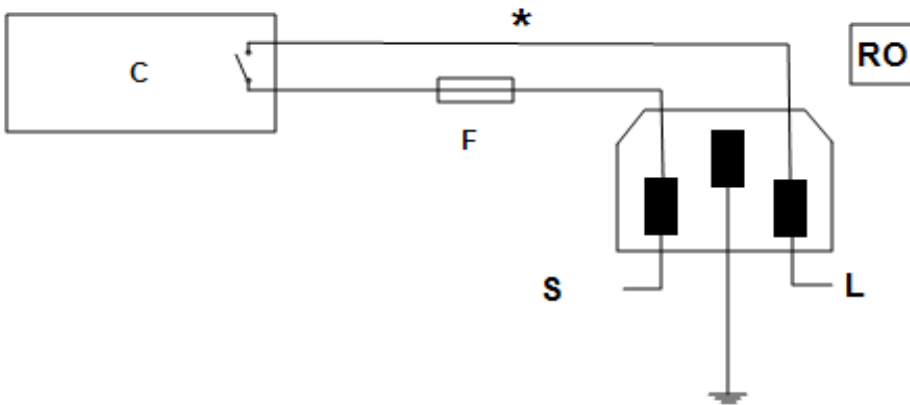
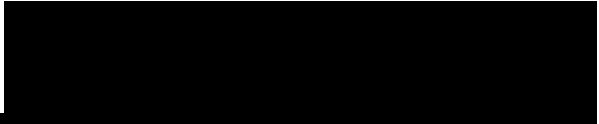
Product end of cable female (25-pin) 9-pin			<b>RS485 Cable: product to PC</b>	Computer end of cable 9-pin (25-pin) female		
-	(2)	3	=====	3	(2)	Tx
+	(3)	2	=====	2	(3)	Rx
Com	(7)	5	_____	5	(7)	Com

### 1.9.3 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 page key until the COMMS parameter is displayed. Press up ▲ down ▼ to select the address value.

### 1.9.4 Alarm Option

When an alarm board is fitted, which consists of a relay with voltage free contacts, for operator use, the contacts are taken to a panel plug on the control panel, wired as indicated:



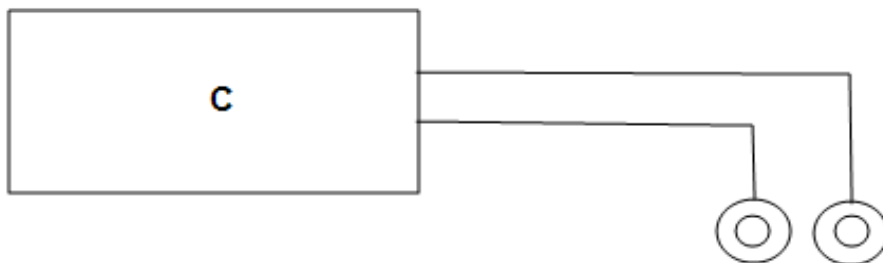
Key	
C	Temperature Controller
F	Fuse (2A)
S	Supply
L	Load
*	Normally open relay contacts
RO	Relay Output 240V 2A MAX

The purpose of the 2 amp fuse is to break the circuit to prevent overloading on the circuit due to high voltage.

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

#### 1.9.5 Remote Input and Output (Analogue Communications)

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



Key	
C	Controller

Controller configuration depends on customer requirements.

Remote input (when specified) may be switched on and off using the remote setpoint enable parameter in the controller level 2, if this was made available for a particular application. In level 2 press page until 'REM SP Enable' is displayed, press up or down to select SP1 (the normal controller setpoint) or SP2 (the remote input setpoint), 'SPX' will appear in the top left corner of the display.

Remote output does not require switching on and off.

#### 1.9.6 Program segment output

When the customer requirement is for program segment output, an extra parameter is revealed in the PROG list. For each program segment, after the segment type and settings, the parameter EVENT OUTS appears. This has values on and off. If the value

is set to on, then the relay closes during the segment and a small 1 appears in the top left of the screen.

If more than one program segment output is fitted, then there are extra boxes depending on how many event outputs there are.

## 1.10 Temperature Controller Replacement



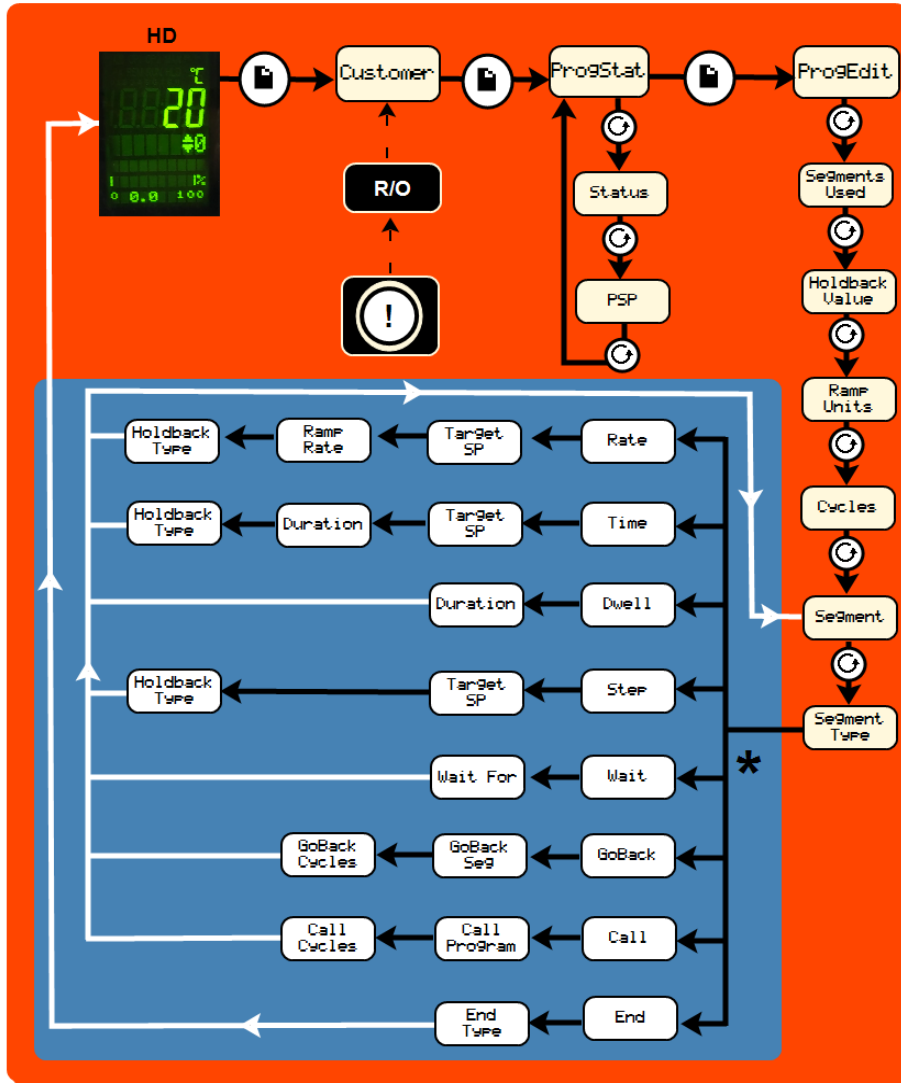
Before handling the controller: wear an anti-static wrist strap or otherwise avoid any possibility of damage to the unit by static electricity. Refer to the detailed instructions supplied with the replacement controller.

Ease apart the two lugs at the side; grip the instrument and withdraw it from its sleeve; push in the replacement.

## 1.11 Controller Navigation Diagrams

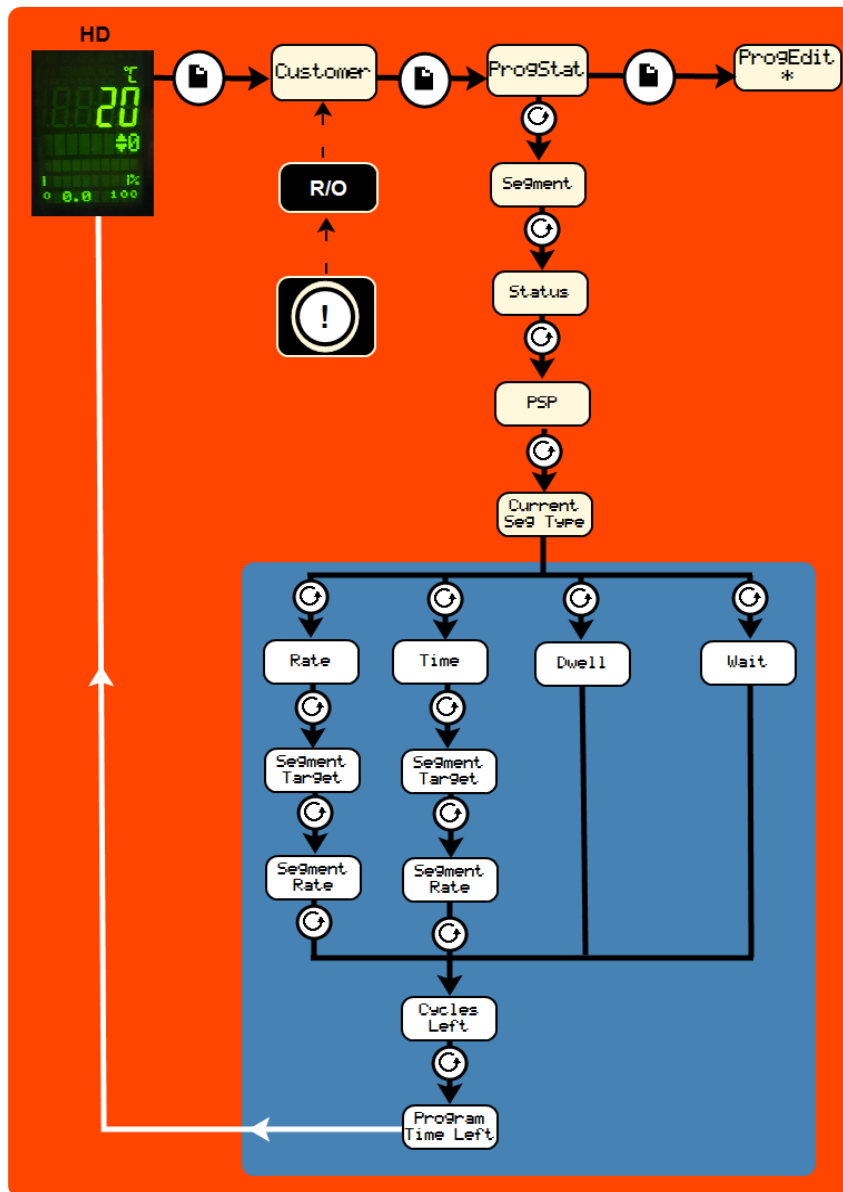
The following diagrams detail how to navigate to the various menu options within the 3508 Controller. At each option, values can be set using the arrow keys.

### 1.11.1 Operator Level 1 - No Program Running



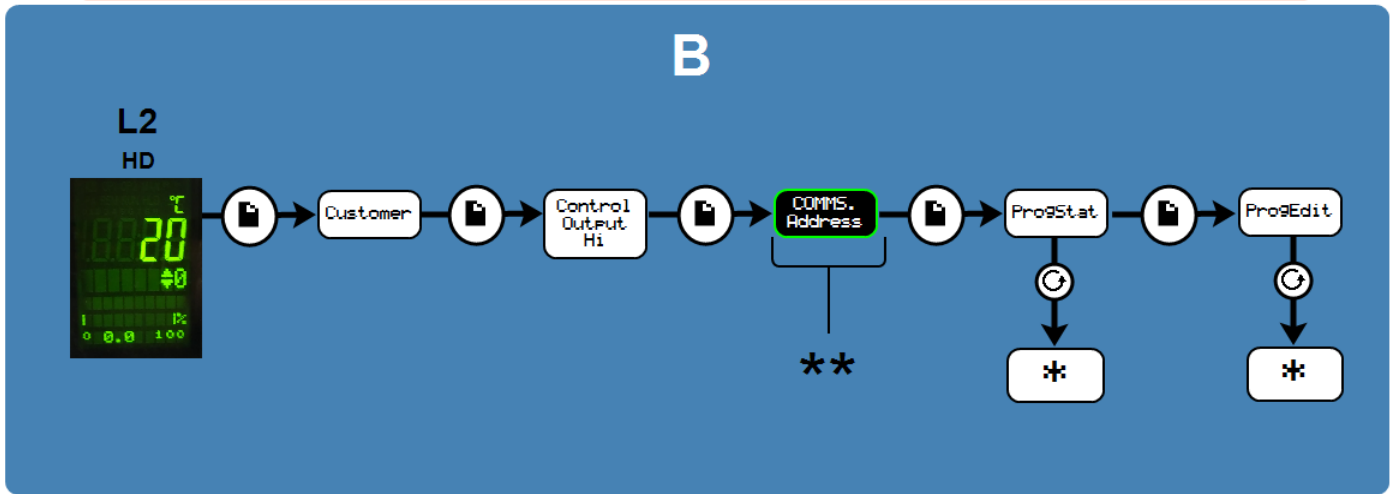
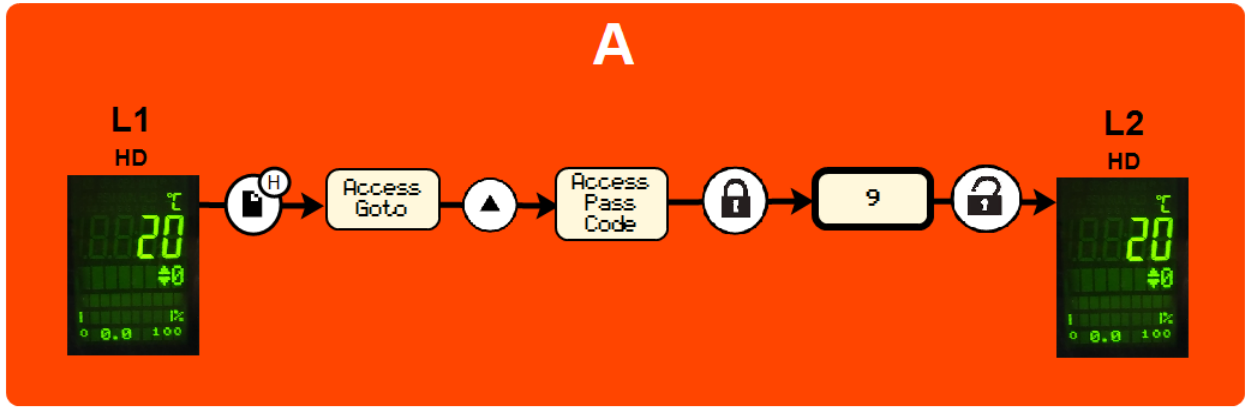
<b>HD</b>	Home Display	!	Controller identity when using more than one controller
<b>R/O</b>	Read Only	→	Black = Progress
	Page Key	→	White = Return
	Scroll Key	*	Visible Parameters depend on the Segment Type

1.11.2 Operator Level 1 - Program Running



HD	Home Display	!	Controller identity when using more than one controller
R/O	Read Only	→	Black = Progress
	Page Key	→	White = Return
	Scroll Key	*	See previous diagram: Operator Level 1- No Program Running

### 1.11.3 Supervisor Level 2



A	To enter Level 2		Scroll Key
B	Level 2		Locked before Pass Code entered
L1	Level 1 Home Display		Unlocked
L2	Level 2 Home Display		Black = Progress
	Page Key		See previous diagram: <b>Operator Level 1- No Program Running</b>
	Hold Page Key for 3 seconds		If configured
	Arrow Key		

## **2.0 3508 Dual Loop Cascade Control (if fitted)**

### **2.1 Principle of Cascade Control**

When cascade control is fitted, the Load Loop 3508 senses the temperature of the workload, and the Element Loop 3508 senses the element temperature. Depending on the oven or furnace model, the Load Thermocouple may be in a fixed position, or may be movable. The Element Thermocouple is fixed in a predetermined position near the heating elements. The Load Thermocouple should be placed as near as possible to the work to be heated.

The Load Loop communicates with the Element Loop, calling for heat according to the load temperature and the current program or set point. The Element Loop regulates the heat according to element temperature and the requests from the Load Loop.

The element temperature could, in principle, vary between the furnace or oven maximum and minimum, regardless of the working temperature of the load. In practice, the cascade control system is configured to limit the element temperature to a band around the load temperature, typically of  $\pm 10\%$  of the set-point temperature.

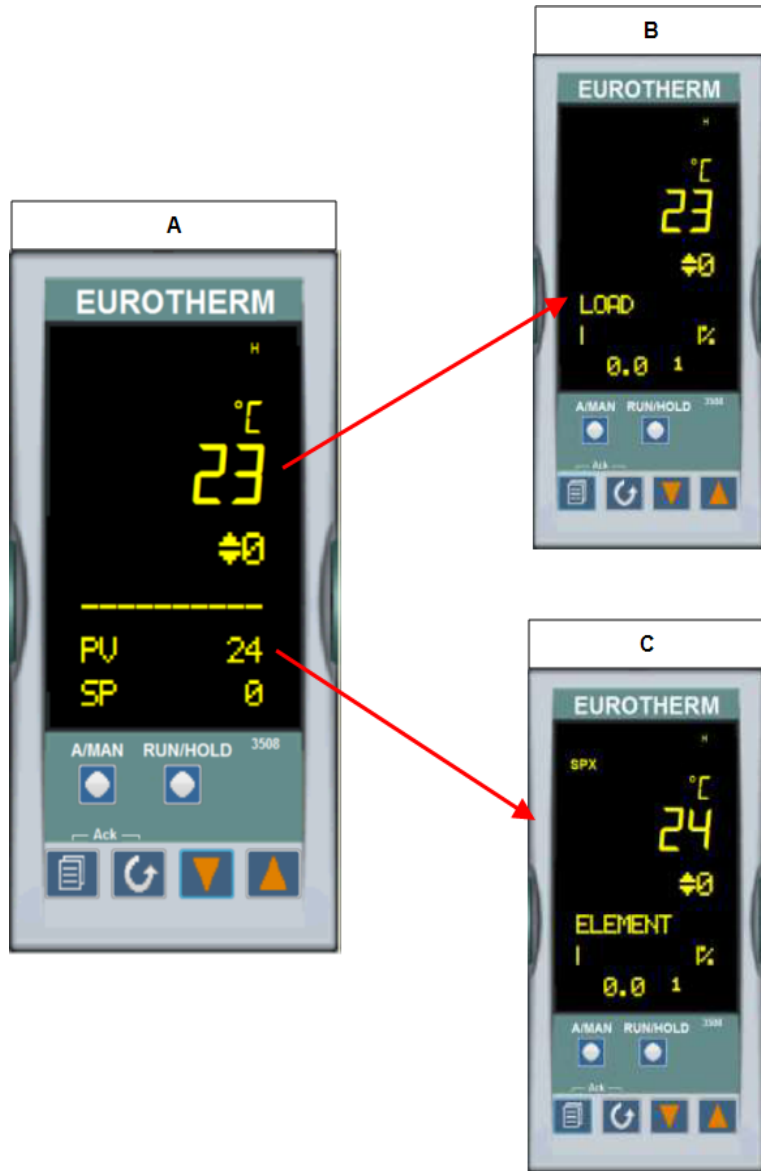
The set point of the load loop, shown at the top of the display, can be adjusted by the operator. The Element Loop, shown at the bottom of the display, should not be adjusted by the operator & will automatically regulate the element temperature to achieve the Load set temperature.

In a three-zone furnace for which the "three zone cascade" option has been ordered the centre zone is a 3508 Dual Loop & separate end zone controls are fitted. The operator sets the Load loop set point on the 3508 centre zone. The end zone controllers work automatically & need no adjustment by the operator.

### **2.2 Operation of Cascade Control**

The operator may ignore all the complications of the system, and program the Load Loop according to the standard instructions for that controller. The home display shows the load loop at the top of the display and the Element loop at the bottom. By pressing the page key, separate views of load and element loops will be shown.

Key	
A	Home Display View
B	Load Loop View
C	Element Loop View



The Element Loop should never be adjusted. Note that the elements usually run at a higher temperature than the load.

Because the details of the customer's cascade application (in particular the nature of the load) are generally not known, the feed forward parameter (FF Trim) is made easily accessible in level 2 (Refer to instrument operating instructions). Its default setting is 2%. If overshoot of the load temperature occurs – often a problem at low temperatures – then FF Trim can be reduced in order to limit the amount of overshoot. However, if FF trim is reduced too much, the load may not reach the desired temperature. If the load does not reach the desired temperature or is slow in the final stages, FF Trim can be increased: a maximum of 10% is suggested.



*Feed Forward View*

When attempting to control at very low temperatures it can become a problem to achieve stable control because of excessive power being supplied during heating. The available power can be limited using the power limit parameter OP.Hi, make a note of the original settings before adjusting. For power settings please refer to the fuse and power section at the back of the manual. If the parameter is normally set to 100%, try initially setting it to 50% to improve stability. Avoid settings below 40% where possible (though some furnaces require low settings for reasons unconnected with cascade control).



*Power Limit View*

## 2.3 Bypassing Cascade Control

This applies where the Control Thermocouple is a removal probe (e.g. in a tube furnace), or where for other reasons it may be required to operate the furnace or oven directly from the Element Loop.

To operate without Cascade Control the load thermocouple has to remain connected at all time; or a link has to be made across the thermocouple input connections.

## 2.4 3508P1 Element Loop (Loop 2)

In these circumstances the Element Controller is configured with the local/remote parameter, accessible in level 2 (Refer to instrument operating instructions).

To switch cascade control on or off. In Level 2, press Scroll until the display shows L-r.

Using the up ▲ down ▼ set:

- *SP2* = cascade control on
- *SP1* = cascade control off

The top left hand side of the screen will show *SPX* when *SP2* is enabled. The instrument operates as an independent Programmer/Controller when L-r is set to *SP1*. To return to cascade control, change the L-r parameter to *SP2*. Also note that cooling at low temperatures takes longer per degree than it does at high temperatures.

## 2.5 Caution



If the Load Thermocouple is removable, leave it in the furnace or oven chamber whenever possible. Operating with the Cascade Control active and with the Load Thermocouple in an unheated position (such as lying on the work bench) may cause the furnace or oven to heat up to its maximum temperature, wasting power and possibly shortening element life.

## 2.6 Over-Temperature Control

Where over-temperature control is fitted, it normally protects against failure of the control system or of a component such as a power control relay. The over-temperature controller must be set at a level higher than the greatest element temperature, typically 15 °C above maximum.

If the working temperature is less than the maximum temperature, then it may be possible to set the over-temperature limit as follows:

$$\text{working temperature} + (\text{maximum temperature} \times \text{FF}/100) + 15 \text{ °C}$$

where FF is the Feed Forward percent parameter value (e.g. 10)

Example: for working at 800 °C in a 1200 °C product, the over-temperature limit could be set to  $800+120+15=935$ .

## 2.7 Cascade Control Switch (optional)

It is possible for cascade control functionality to be switched on or off as required, via a dedicated switch on the control panel.

### **When cascade control is switched OFF:**

- The controller will continue to function as a standard 3508 controller.
- If the cascade thermocouple is unplugged, the display will show a sensorbreak error, however this will not stop the controller from functioning.

### **When cascade control is switched ON:**

- The controller will function as a standard 3508 cascade controller.
- If the cascade thermocouple is unplugged, the display will show a sensorbreak error and the controller will stop functioning.

## 3.0 3216CC Controller

### 3.1 3216CC

The 3216CC Controller 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.

### 3.2 PID control

This controller uses PID (Proportional Integral Derivative) temperature control. This type of control uses a complex mathematical control system to adjust the heating power and achieve the desired temperature.



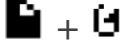

## 3.3 Operation

### 3.3.1 Controller Layout



Key	
A	Power Output Indicator
B	Alarm Indicator
C	Remote Indicator (when configured)
D	Page
E	Scroll
F	Down
G	Up
H	Run Indicator
I	Hold Indicator
J	Setpoint Temperature (SP)
K	Measurement Temperature

### 3.3.2 Keys

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

## 3.4 Quick Start Guide

### 3.4.1 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 desired temperature (Setpoint).

### 3.4.2 Changing the Setpoint

Press Up  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 setpoint and then maintain it.

This will cause the product to heat as quickly as possible which may not be appropriate where the product contains sensitive ceramic components. For products with ceramic components, e.g. a tube furnaces fitted with a long ceramic work tube, use the ramp rate feature set with a low heating rate such as 5°C per minute (300°C per hour), to prevent damage.

### 3.4.3 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. PROG <PROGRAM NUMBER>

### 3.4.4 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 this level 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 up  or down  to choose LEu 2 (level 2)
5. Press the up  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.

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 switching the instrument off and back on. 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 Controller Layout)

#### Table showing parameters accessible in level 1 and Level 2

Operator LEVEL 1	Supervisor LEVEL 2
home display	home display
	Programming
	Program Status
	Alarms (if configured)
	Current Transformer Input (if configured)
	Comms (if configured)
	Controller set up (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  and use up  to return to a previous parameter.

### 3.5 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).

#### 3.5.1 Setpoint Ramp Rate

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 3.4). 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 setpoint will cause the ramp rate to be activated and the instrument to control as described above.



NOTE: Ensure timer configuration is set to 'none' (see section 3.6) to use the setpoint ramp rate feature without any timer functions.

##### 3.5.1.1 Setting Setpoint Ramp Rate



In supervisor level (level 2).

Press scroll  until the display shows SP.Rate <setpoint rate limit>. Using up  and down  select the ramp rate required, in °C/ Min.

##### 3.5.1.2 Running with Ramp Rate


Press the up  and down  keys at the same time to activate the ramp rate. The "Run" indicator will illuminate and the scrolling text will read <RAMPING> to show the ramp rate is active. The ramp rate will then start from the current process temperature.

When the ramp reaches the setpoint temperature, the "Run" indicator will turn off and the instrument will maintain control at the setpoint.

To put the ramp rate into a hold condition, press the up  and down  keys and release. The "Run" indicator will flash and the scrolling text will read <HOLD> to show the ramp rate is on hold.

To cancel the ramp rate, press and hold the up ▲ and down ▼ keys until the "Run" indicator turns off.

### 3.5.2 Maximum Output Power


Press scroll  until the display shows OP.HI <OUTPUT HIGH>. Use the up ▲ and down ▼ keys to select the output power required as a percentage. Once the setting is made, turn the instrument switch off and on to power cycle the temperature controller. Depending on the furnace or oven model, the maximum output power setting OP.Hi may be accessible or locked.

For silicon carbide heated furnaces, the parameter is accessible to allow compensation for element ageing.


In many models the maximum output power setting depends on the supply voltage.

### 3.5.3 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  until the display shows ID <CUSTOMER ID>. Use the up ▲ and down ▼ keys to enter your own identification number. This can range from 1-9999.

### 3.5.4 Units

Press scroll  until the display shows UNITS <DISPLAY UNITS>. Use the up ▲ or down ▼ keys to select the required units.

Mnemonic	Description
NONE	No units (Default °C)
°C	Celsius
°F	Fahrenheit
°K	Kelvin
PERC	% (shows °C value)

### 3.5.5 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.

## 3.6 Timer

### 3.6.1 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 setpoint controller.




Press scroll  until the display shows TM.CFG <TIMER CONFIGURATION>. Using the up  down  select NONE.




### 3.6.2 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  until the display shows TM.CFG <TIMER CONFIGURATION>. Using the up  down  select Dwell.

When Dwell parameter is selected, the Timer resolution (TM.RES), Time duration (DWELL) and Timer Threshold (THRES) functions become available.

Press scroll  until the display shows TM.RES < Time resolution >. Use the up  down  to select the timer units in Min or Hours.

Press scroll  until the display shows DWELL < SET TIME DURATION >. Use the up  down  to enter the time duration required.

Press scroll  until the display shows THres < TIMER THRESHOLD >. Use the up  down  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 setpoint is set to 800 °C and the timer threshold is set to 2, after the timer is activated it 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 3.5.1 ), the timer will start as soon as the ramp reaches the setpoint. (see section 3.7.1)



### 3.6.3 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  until the display shows TM.CFG <TIMER CONFIGURATION>. Using the up  down  select dELY.

When delay parameter is selected, the Timer Resolution (TM.RES) and Time Duration (DWELL) functions become available.

Press scroll  until the display shows TM.RES < Time Resolution >. Use the up  down  to select the timer units in Min or Hours.

Press scroll  until the display shows DWELL < SET TIME DURATION >. Use the up  down  to enter the time duration required before the output power switches on.

#### 3.6.4 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 may be 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 current temperature exceeds the Soft Start Setpoint.




When the timer ends or the current temperature exceeds 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  until the display shows TM.CFG <TIMER CONFIGURATION>. Using the up  down  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  until the display shows TM.RES < Time resolution >. Use the up  down  to select the timer units in minutes or hours.



Press scroll  until the display shows DWELL < SET TIME DURATION >. Use the up  down  to enter the time duration required, before the instrument starts to control using the main setpoint and max power.

Press scroll  until the display shows SS.SP < Soft Start Setpoint >. Use the up  down  to enter the Soft Start Setpoint.



Press scroll  until the display shows SS.PWR < Soft Start Power Limit >. Use the up  down  to enter the Soft Start Power Limit.

### 3.7 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 operated 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 3.3.2) by pressing the  and  simultaneously.

### 3.7.1 Dwell Timer

Operation	Action	Indication
To RUN Timer	Press and quickly release ▲ + ▼	Indicator – RUN = ON Scrolling Display – Timer Running
To HOLD timer	Press and quickly release ▲ + ▼	Indicator – RUN = Flashing Scrolling Display – Timer Hold
To switch off Timer / Cancel	Press and hold ▲ + ▼ for more than 1 second	Indicator – RUN = OFF Scrolling Display – None Static Text - OFF
To return to home after reset	Press and hold ▲ + ▼ for more than 1 second	Indicator – RUN = OFF Display – A-M <LOOP MODE- AUTO MANUAL OFF>  Use the up ▲ or down ▼ to select AUTO
	Timer Ended	Indicator – RUN = OFF Scrolling Text – Timer End Static Text - OFF
To re-RUN Timer	Press and quickly release ▲ + ▼	Indicator – RUN = ON Scrolling Display – Timer Running
To RESET timer and return to home menu after timer end	Press and quickly release Ack  + 	Indicator – RUN = OFF Scrolling Display - None
	Press and hold ▲ + ▼ for more than 1 second	Indicator – RUN = OFF Display – A-M <LOOP MODE- AUTO MANUAL OFF>  Use the up ▲ down ▼ to select <i>Auto</i>

### 3.7.2 Power Failure While Using Dwell Timer

If there is a power failure while the timer is operating and the power is subsequently restored, the timer will reset and the static text will display "OFF" until the ▲ + ▼ keys are pressed to re-run the timer.

### 3.7.3 Running Dwell Timer with Ramp Rate

Set the ramp rate as outlined in section 3.5.1

Set the dwell time as outlined in section 3.6.2.

When the timer is set to operate 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 section 3.7.7), and the run indicator will switch off.

### 3.7.4 Running Dwell Timer with Ramp Rate & Threshold

Set the ramp rate as outlined in section 3.5.1.











Set the dwell time as outlined in section 3.6.2.

Set the threshold as outlined in section 3.6.3.

When the timer is set to operate 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 3.6.3).

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 section 3.7.1).

### 3.7.5 Delayed Switch on Timer

Operation	Action	Indication
To RUN Timer	Press and quickly release  + 	Indicator – RUN = ON Scrolling Display – Timer Running Static Text - OFF
To HOLD timer	Press and quickly release  + 	Indicator – RUN = Flashing Scrolling Display – Timer Hold Static Text - OFF
To switch off Timer / Cancel	Press and hold  +  for more than 1 second Indicator – RUN = Off	Scrolling Display – None Static Text - OFF
To return to home menu. After Resetting timer	Press and hold  +  for more than 1 second	Indicator – RUN = Off Display – A-M <LOOP MODE-AUTO MANUAL OFF>  Use the up  or down  to select <i>Auto</i>

	Timer Ended	Indicator – RUN = OFF Scrolling Text – Timer End
To re-RUN Timer	Press and quickly release ▲ + ▼	Indicator – RUN = ON Scrolling Display – Timer Running Static Text – OFF

### 3.7.6 Running Delay Timer with Ramp Rate

Set the ramp rate as outlined in section 3.5.1.

Set the delay time as outlined in section 3.6.3.

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. (see section 3.7.12)

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

### 3.7.7 Delay timer with ramp rate functions

	Timer Ended When ramp rate active	Indicator – RUN = ON - if ramp rate active Scrolling Text – Timer Running
To HOLD timer	Press and quickly release ▲ + ▼	Indicator – RUN = Flashing Scrolling Display – Timer Hold Static Text - OFF
To switch off Timer / Cancel	Press and hold ▲ + ▼ for more than 1 second	Indicator – RUN = ON - if ramp rate active Scrolling Display – None Static Text - OFF
To re-RUN Timer	Press and quickly release ▲ + ▼	Indicator – RUN = ON Scrolling Display – Timer Running Static Text – OFF

### 3.7.8 Power Failure While Using Delay Timer

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

### 3.7.9 Soft start Timer

Operation	Action	Indication
To RUN Timer	Press and quickly release ▲ + ▼	Indicator – RUN = ON Scrolling Display – Timer Running Static Text - OFF
To HOLD timer	Press and quickly release ▲ + ▼	Indicator – RUN = Flashing Scrolling Display – Timer Hold Static Text - OFF
To switch off Timer/Cancel	Press and hold ▲ + ▼ for more than 1 second	Indicator – RUN = OFF Scrolling Display – None Static Text - OFF
	Timer Ended	Indicator – RUN = OFF Scrolling Text – Timer End Running Soft Start Timer

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

### 3.7.10 Power Failure While Using Soft Start Timer

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

### 3.7.11 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 operate, the timer will time out immediately.

### 3.7.12 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  until the display shows T.REMN <TIME REMAINING>.

Note: The time remaining can be modified at any time while the count down timer is operating by pressing the up ▲ or down ▼ key while the time remaining function is active.

### 3.7.13 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 (see section 3.3.2) before it is reset.

If an alarm has been activated the red “ALM” indicator will illuminate 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.

## 3.8 Controller Options

As 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 controllers it is necessary to go into configuration mode, a security code is needed. Please consult Carbolite Gero.

### 3.8.1 Digital Communications - RS232

If the RS232 option is supplied, the furnace is fitted with one sub-miniature D-socket connected to the controller 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.

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

### 3.8.2 Digital Communications - RS485

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

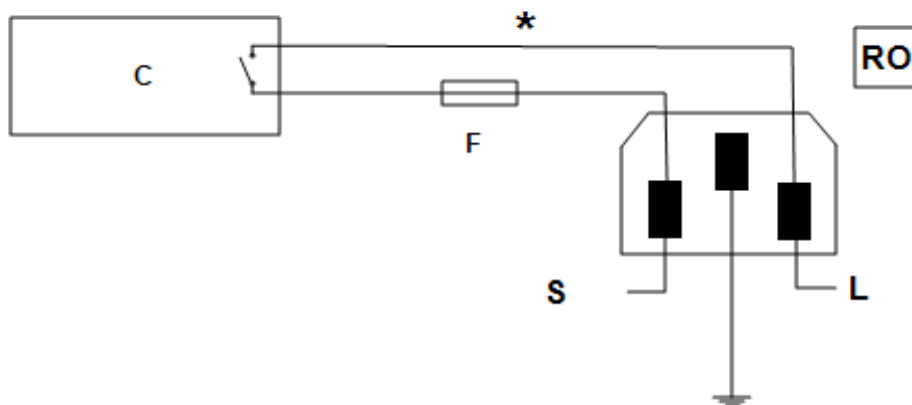
Product end of cable female (25-pin) 9-pin			RS485 Cable: product to PC	Computer end of cable 9-pin (25-pin) female		
-	(2)	3		3	(2)	Tx
+	(3)	2		2	(3)	Rx
Com	(7)	5		5	(7)	Com

### 3.8.3 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 page key until the COMMS parameter is displayed. Press up ▲ down ▼ to select the address value.

### 3.8.4 Alarm Option

When an alarm board is fitted, which consists of a relay with voltage free contacts, for operator use, the contacts are taken to a panel plug on the control panel, wired as indicated:



Key	
C	Temperature Controller
F	Fuse (2A)
S	Supply
L	Load
*	Normally open relay contacts
RO	Relay Output 240V 2A MAX

The purpose of the 2 amp fuse is to break the circuit to prevent overloading on the circuit due to high voltage.

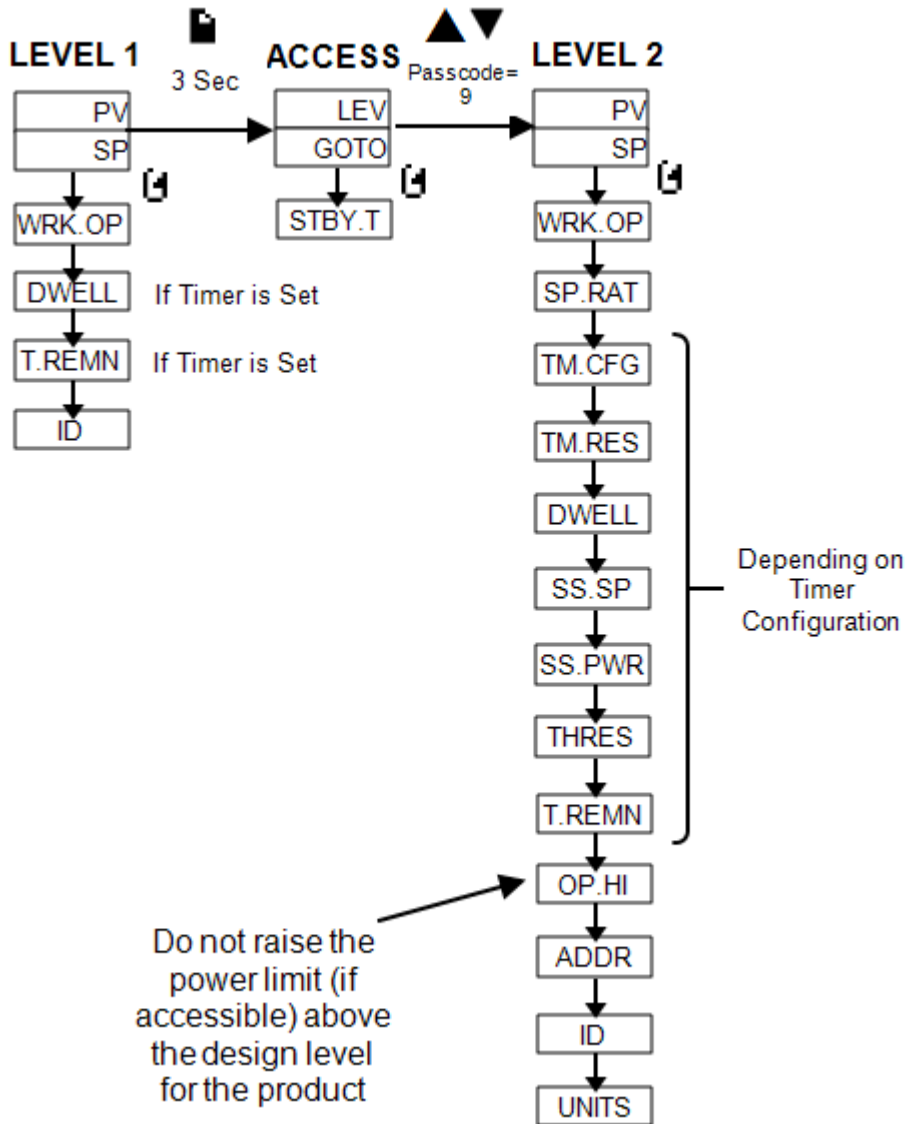
The instrument configuration and parameters available to the operator depend on the customer requirements.



Before handling the controller: wear an anti-static wrist strap or otherwise avoid any possibility of damage to the unit by static electricity. Refer to the detailed instructions supplied with the replacement controller.

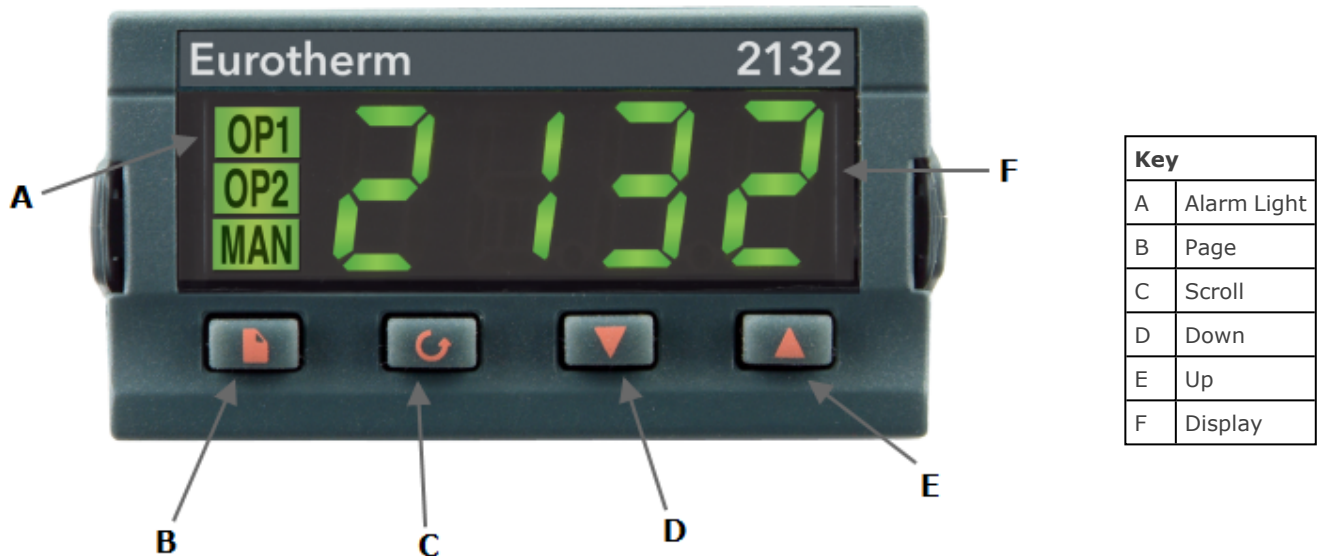
Ease apart the two lugs at the side; grip the instrument and withdraw it from its sleeve; push in the replacement.

### 3.9 3216CC Navigation Diagram



## 4.0 2132 Over-Temperature Controller Description (if fitted)

### 4.1 Description



This over-temperature controller is fitted and supplied ready to use by Carbolite Gero. It is a digital instrument with a latching alarm, requiring no additional panel controls. The controller features easy setting of over-temperature setpoint and reading of current temperature by the over-temperature sensor.

## 4.2 Operation

### 4.2.1 Controls

Most Carbolite Gero products are fitted with an instrument switch which cuts off power to the controller and other parts of the control circuit.

To operate the controller, power must be supplied to the product and the instrument switch must be on. If a time switch is included in the product circuit, this must be in the 'ON' position.


When an over-temperature condition occurs, the controller cuts the power to a contactor, which in turn cuts power to the heating elements. Power is not restored until the controller is 'reset'.


Some components will operate after the over-temperature feature isolates the power supply e.g. cooling fans will continue to operate, provided that there is a power supply to the product. In some cases the product may not do so, if other options (such as a door switch) are fitted.


### 4.2.2 Operation

When switched on, the controller lights up, goes through a short test routine and then displays the measured temperature or the over-temperature setpoint.

The page key  allows access to parameter lists within the controller.

A single press of the page key  displays the temperature units, normally set to °C; further presses reveal the lists indicated in the navigation diagram.



The scroll key  allows access to the parameters within a list. Some parameters are display-only; others may be altered by the operator.

A single press of the scroll key  in the 'Home' list displays the temperature units; further presses reveal the parameters in the current list indicated in the navigation diagram.

To return to the 'Home' list at any time, press page  and scroll  together, or wait for 45 seconds.

The down  and up  keys are used to alter the setpoint or other parameter values.

### 4.2.3 Over-Temperature Operation

Use down  and up  to alter the over-temperature setpoint. This should normally be set a little above the working temperature (for example 15 °C above). The product is supplied with the over-temperature set at 15 °C above the furnace or oven maximum working temperature.

Press scroll  twice view the present temperature as measured by the over-temperature controller. Press it twice, the first press shows the temperature units (°C).

### 4.2.4 Over-Temperature Alarm

If an over-temperature condition occurs, the OP2 indicator flashes and an alarm message 2FSH also flashes, alternating with the setpoint. Power to the heating elements is disconnected.

### 4.2.5 Resetting the Over-Temperature Alarm

To acknowledge the alarm press scroll  and page  together.

If the alarm is acknowledged while there is still an over-temperature condition, the OP2 indicator stops flashing but continues to glow. The 2FSH alarm continues to flash until the over-temperature condition is cleared (by the temperature falling), when normal operation resumes.

If the alarm is acknowledged when the temperature has dropped (or after the over-temperature setpoint has been raised) so that the over-temperature condition no longer exists, then the furnace or oven immediately resumes normal operation.

### 4.2.6 Sensor Break

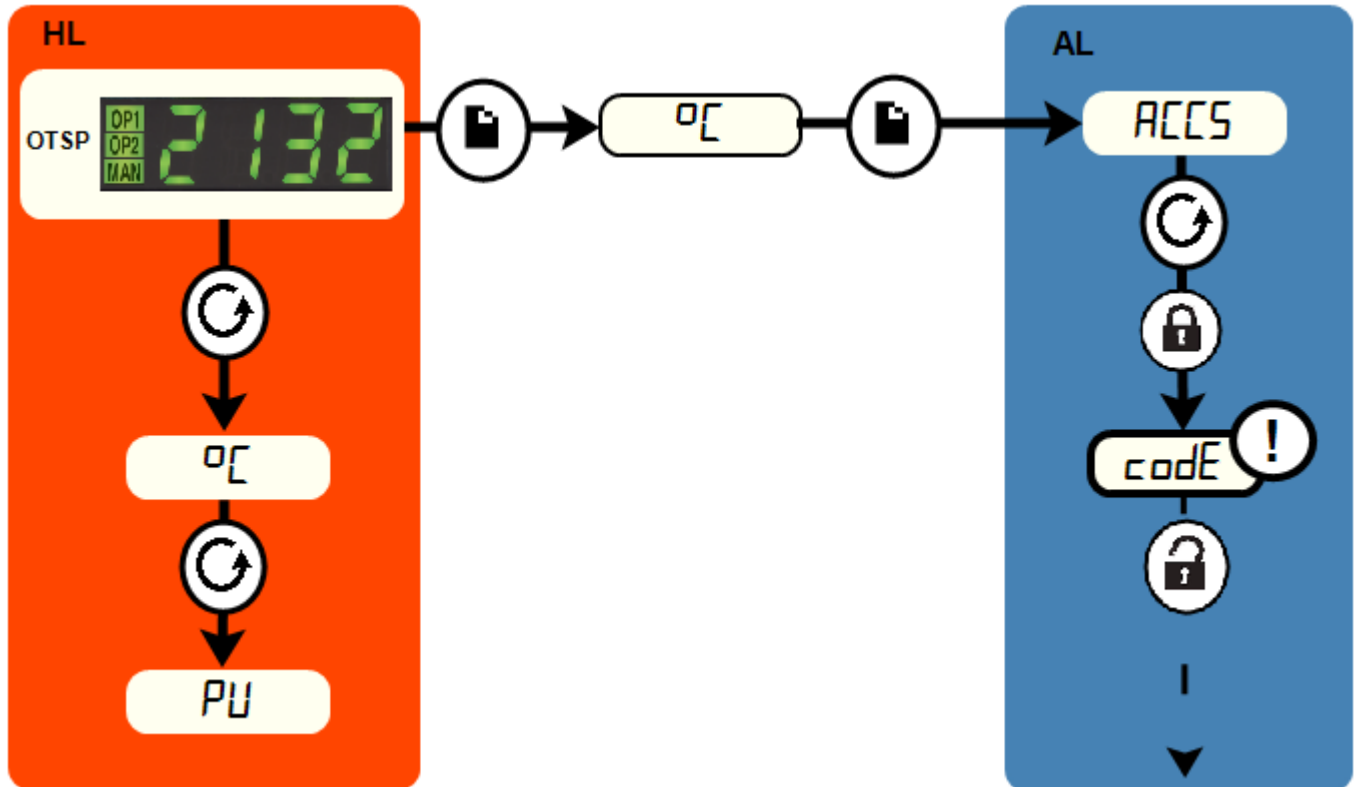
The over-temperature cut-out system also operates if the over-temperature control thermocouple breaks or becomes disconnected. The message S.br flashes where the measured temperature is normally displayed.

### 4.3 Audible Alarm

If an audible alarm is supplied for use with the over-temperature controller, it is normally configured to sound on over-temperature condition and to stop sounding when the alarm is acknowledged as given in section 4.2.

Note: the alarm may sound during controller start-up.

### 4.4 Navigation Diagram



<b>HL</b>	Home List		Page Key	→	Black = Progress
<b>OTSP</b>	Over-Temperature Setpoint		Scroll Key		Dashed = Through to other options
<b>AL</b>	Access List		For factory access to list and parameters not available to the operator.		

## 5.0 Operation

### 5.1 Control Method

Set the three temperature controllers to the desired setpoints. The setting and operation of the end zone controllers depends on the 3-zone control options selected when the product was ordered. These options are described in the 3-zone control methods section.

**Note:** Despite its vertical orientation, the heated zones of the KVZ model are labelled to correspond with the relevant control module on the CC-T1 touchscreen controller display (Left, Main, Right).

### 5.2 3-Zone Control Methods

There are three different control options (A, B & C).

- (A) Back to back thermocouples
- (B) Retransmission of Setpoint
- (C) Independent control

The models listed in this manual are designed to achieve an extended uniform temperature zone, through use of three control zones, rather than achieving different temperatures in each zone.

For A & B, the control zones are linked so that they all follow the centre zone controller in a master-slave approach

**Note:**

- Option A is **NOT** applicable when using the CC-T1 controller
- Option B is **NOT** applicable when using the Eurotherm 2132 End Zone Controller

#### A. Back-to-Back Thermocouples

This is the most commonly supplied option. The centre zone of the tube furnace is controlled directly by the centre zone temperature controller. The two end zone thermocouples are wired in opposition to the centre zone reference thermocouple. If the temperatures of the centre and end zones are the same then 0°C will be displayed on the end zone controllers. If the end zone temperatures are either higher or lower than the centre zone, the end zone controller will display the difference in temperature (higher = positive value, lower = negative value).

It is best practice to set the setpoint of the two end zone controllers to zero. Alternatively, a small temperature difference (offset) can be created by setting a non-zero value, for example to compensate for heat losses at the end or where using a gas

flow. However, the sum of the centre zone controller setpoint and the end zone controller offset MUST NOT exceed the furnace maximum temperature.

**To alter the setpoint with the display showing the Home screen, press Down  or Up  once to display the setpoint and then press again or hold down to adjust it. The display returns to the measured temperature when no key is pressed for a short period of time.**

Sometimes a furnace using this type of control does not cool down because the end zones lose heat first and therefore the end zone controllers try to compensate for this by switching on the end zone elements, preventing the furnace from cooling.

## **B. Retransmission of Setpoint**

Three independent thermocouples are connected to three controllers. The three controllers are linked together and the centre zone controller communicates the desired setpoint to the end zone controllers. If the centre zone controller is set to a setpoint or is running a program, the end zone controllers will automatically follow.

For products with the CC-T1 controller, please refer to the separate CC-T1 controller manual for details on enabling and disabling setpoint retransmission.

For other products, additional communication modules are fitted in the controllers. The communication between the controllers of the Eurotherm 3000 series is known as Broadcast communications. It is possible to switch off the linked control and allow the controllers to work independently. In the level 2 menu of the end zone controllers (see controller operating instruction), scroll to L-r. Where the end zone controller is a 3216 use the  up  down buttons and select NO. Where the end zone controller is a 3508 use the  up  down buttons to select SP1, (SP1 = Local, and SP2 = Remote). There is no need to alter the centre zone controller.

It is possible to set an offset (local trim) between the centre and end zone controllers. This can be either a positive or negative difference from the centre zone temperature. Once entered, this offset will always be added to, or subtracted from, the retransmitted setpoint temperature.

For products with the CC-T1 controller, please refer to the separate CC-T1 controller manual for details on how to set an offset trim.

To make this adjustment on other controllers, enter the level 2 menu of the end zone controllers (see controller operating instruction), scroll to LOC.T (local trim) and use the  up  down buttons to enter the desired positive or negative value. This will then be added to, or subtracted from, the end zone set temperature. There is no need to alter the centre zone controller.

### **C. Independent Control**

The three controllers are completely independent. Note that it is not possible to maintain very different temperatures in the three zones because of heat transfer between the zones. The models listed in this manual are designed to achieve an extended uniform temperature zone by the use of three control zones rather than achieving different temperatures in each zone.





ProductLabel

The products covered in this manual are only a small part of the wide range of ovens, chamber furnaces and tube furnaces manufactured by Carbolite Gero for laboratory and industrial use. For further details of our standard or custom built products please contact us at the address below, or ask your nearest stockist.

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