## 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 3216 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 3216P1

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

1.3 3216P5

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

1.4 Operation

1.4.1 Controller Layout

<table>
<thead>
<tr>
<th>Key</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Power Output Indicator</td>
</tr>
<tr>
<td>B</td>
<td>Alarm Indicator</td>
</tr>
<tr>
<td>C</td>
<td>Remote Indicator (when configured)</td>
</tr>
<tr>
<td>D</td>
<td>Page</td>
</tr>
<tr>
<td>E</td>
<td>Scroll</td>
</tr>
<tr>
<td>F</td>
<td>Down</td>
</tr>
<tr>
<td>G</td>
<td>Up</td>
</tr>
<tr>
<td>H</td>
<td>Measurement Temperature</td>
</tr>
<tr>
<td>I</td>
<td>Setpoint Temperature (SP)</td>
</tr>
<tr>
<td>J</td>
<td>Hold Indicator</td>
</tr>
<tr>
<td>K</td>
<td>Run Indicator</td>
</tr>
</tbody>
</table>
### 1.4.2 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:
    - Return to the Home Menu
    - Acknowledge an alarm if activated.
    - Reset a program after the program has ended.

- **Page and Scroll**
  - 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.

### 1.5 Quick Start Guide

#### 1.5.1 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).

#### 1.5.2 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.

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.
1.5.3 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>

1.5.4 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

<table>
<thead>
<tr>
<th>Operator LEVEL 1</th>
<th>Supervisor LEVEL 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>home display</td>
<td>home display</td>
</tr>
<tr>
<td>Programming</td>
<td>Programming</td>
</tr>
<tr>
<td>Program Status</td>
<td>Program Status</td>
</tr>
<tr>
<td></td>
<td>Alarms (if configured)</td>
</tr>
<tr>
<td></td>
<td>Current Transformer Input (if configured)</td>
</tr>
</tbody>
</table>
1.0 3216 Controller

| Comms (if configured) | Controller Setup | Customer Calibration |

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

### 1.6 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 1.5.

#### 1.6.1 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, see section 1.0.

#### 1.6.2 Customer ID

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

Press scroll ▼ 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.

#### 1.6.3 Units

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

<table>
<thead>
<tr>
<th>Mnemonic</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>NONE</td>
<td>No units (Default °C)</td>
</tr>
<tr>
<td>°C</td>
<td>Celsius</td>
</tr>
<tr>
<td>°F</td>
<td>Fahrenheit</td>
</tr>
<tr>
<td>°K</td>
<td>Kelvin</td>
</tr>
<tr>
<td>PERC</td>
<td>% (shows °C value)</td>
</tr>
</tbody>
</table>
1.6.4 Language

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

1.6.5 Scrolling Text

If at any time the scrolling text is not required.
Press and hold the page for three seconds until “GOTO” is displayed.
Press scroll until the display shows. TEXT <ENABLE/ DISABLE SCROLLING TEXT>

Use the up ▲ and down ▼ keys to select ON or OFF.

1.6.6 Customer Calibration

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

Dual Offset

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

Press scroll until the display shows CAL.P (Enter Calibration Code) Use the up ▲ down ▼ keys to enter the password code. (Calibration Pass Code = 95). When the correct password has been entered the display will show PNT.LO. If the wrong pass code is entered the display will revert to zero pass code, until the correct pass code is entered.

When the correct pass code is entered and PNT.LO (Adjust Low Point) is displayed. Use the up ▲ and down ▼ keys to enter the Low Temperature Point, which you want to apply an Offset.

Press scroll until the display shows OFS.LO (Adjust Low Offset). Use the up ▲ and down ▼ keys to enter the amount Offset you want to apply to the Low Temperature Point.

Press scroll until the display shows PNT.HI (Adjust High Point). Use the up ▲ and down ▼ keys to enter the High Temperature Point, which you want to apply an Offset.

Press scroll until the display shows OFS.HI (Adjust High Offset). Use the up ▲ and down ▼ keys to enter the amount Offset you want to apply the High Temperature Point.

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

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

Caution! - Do not make PNT.LO and PNT.HI the same value as the controller will not work correctly and could cause the product to overheat.

1.6.7 Holdback
If the temperature ramp rate of the program is quicker than the product can achieve, the program will wait until the temperature of the product catches up.

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

The holdback will only apply once per segment, therefore when control has been re-established, the holdback will not apply again to that segment, even if the product temperature goes outside the holdback band.

Holdback can only be accessed in supervisor level (level 2) by scrolling with the scroll keys until the display shows H.BACK <PROGRAM HOLDBACK>: Use the up ▲ and down ▼ keys to select the required Holdback value.

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

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

1.7.1 Creating a Program

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

Note: A currently active program cannot be altered. Go into 'Reset' mode before starting to create or modify a program.

1.7.2 Program Number (3216P5 Only)

Press scroll \( \uparrow \) until the display shows PROG <PROGRAM NUMBER.> Select the program number.

1.7.3 Ramp Units

Press scroll \( \uparrow \) until the display shows RAMP.U <Ramp Units>: Use the up \( \uparrow \) down \( \downarrow \) to select the Ramp Units of Hour, Min or Seconds.

1.7.4 Dwell Units

Press scroll \( \uparrow \) until the display shows DWEL.U <Dwell Units>: Use the up \( \uparrow \) down \( \downarrow \) to select the Dwell Units of Hour or Min.

1.7.5 Holdback

see section 1.6. Press scroll \( \uparrow \) until the display shows H.BACK <Program Holdback>: If a holdback value is required, use the up \( \uparrow \) down \( \downarrow \) to enter the required value or select “OFF” if no holdback is required.

1.7.6 Ramp Rate

Press scroll \( \uparrow \) until the display shows RMP.1 <Ramp Rate 1>: Using the up \( \uparrow \) down \( \downarrow \) enter the value for the first ramp rate depending on the Ramp Units selected. If the Ramp segment is not required select “OFF”.

1.7.7 Target Setpoint

Press scroll \( \uparrow \) until the display shows T.SP 1 <Target SP 1>: Enter the temperature that you want the product to ramp up to using “Ramp rate 1”.

If “Ramp Rate 1” has been set to “OFF”. The product will Heat/ Cool directly to the Target SP.

1.7.8 Dwell Time

Press scroll \( \uparrow \) until the display shows DWELL. 1 <DWELL TIME 1>: Enter the time to dwell at “Target SP 1”. If the dwell segment is not required, use the down \( \downarrow \) to select OFF, which is below the Zero value.

This Process is repeated for each of the 8 segments of the program.
If not all the segments are used for a program, the Ramp & Dwell of each of the subsequent segments should be set to OFF.

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

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

### 1.7.9 Running a Program

If using the 3216P5 controller press scroll to display PROG <PROGRAM NUMBER>. Select the required Program Number before operating a Program.

Table below shows the key presses to operate a program.

<table>
<thead>
<tr>
<th>Operation</th>
<th>Action</th>
<th>Indication</th>
</tr>
</thead>
<tbody>
<tr>
<td>To RUN a program</td>
<td>Press and quickly release ▲ +▼</td>
<td>Indicator – RUN = ON Scrolling Display – Current Program state</td>
</tr>
<tr>
<td>To HOLD a program</td>
<td>Press and quickly release ▲ +▼</td>
<td>Indicator – RUN = Flashing Scrolling Display – Program Hold</td>
</tr>
<tr>
<td>To RESET a program</td>
<td>Press and hold ▲ +▼ for more than 1 second</td>
<td>Indicator – RUN = OFF Scrolling Display - None</td>
</tr>
<tr>
<td></td>
<td>Program Ended</td>
<td>Indicator – RUN = OFF Scrolling Display - None</td>
</tr>
<tr>
<td>To RESET a program after it has completed</td>
<td>Press and hold ▲ +▼ for more than 1 second or press and quickly release Ack</td>
<td>Indicator – RUN = OFF Scrolling Display - None</td>
</tr>
</tbody>
</table>

### 1.7.10 Program Status

While the program is operating in level 1 or level 2, the home display shows two values at any one time:

**1.7.11 Process Value**

The upper display shows the current temperature of the product.

**1.7.12 PSP, Segment Type and Number**

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

Additional information can be obtained using the scroll key while the program is operating.
**Working Output Power**

From the home display, press scroll \( \uparrow \) until the display shows WRK.OP <WORKING OUTPUT POWER>. This shows the power being used as a percentage.

**Time Remaining**

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

**Program Review**

Further presses of scroll \( \uparrow \) will reveal the settings of the current program operating. These parameters are locked, while the program is operating.

**Program Hold with Holdback**

If a holdback value has been set (see section 1.6) and the program goes into a hold state, the red “HLD” indicator will light, until the current temperature catches up.

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

**Power Failure**

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

Press the “ACK” function to acknowledge this message, press the “ACK” function again to reset the program.

**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 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 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.
Program Example

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

1. Press scroll until the display shows RAMP.U <SP RAMP UNITS>. Select MIN.
2. Press scroll until the display shows DWELL.U <DWELL UNITS>. Select MIN.
3. Press scroll until the display shows RMP.1 <RAMP RATE 1>. Select 5
4. Press scroll until the display shows T.SP1 <TARGET SP 1>. Select 600
5. Press scroll until the display shows DWEL.1 <DWELL TIME 1>. Select 30
6. Press scroll until the display shows RMP.2 <RAMP RATE 2>. Select 4
7. Press scroll until the display shows T.SP2 <TARGET SP 2>. Select 400
8. Press scroll until the display shows DWEL.2 <DWELL TIME 2>. Select 30
9. Press scroll until the display shows RMP.3 <RAMP RATE 3>. Select OFF
10. Press scroll until the display shows T.SP3 <TARGET SP 3>. Select 600
11. Press scroll until the display shows DWEL.3 <DWELL TIME 3>. Select 60
12. Press scroll until the display shows RMP.4 <RAMP RATE 4>. Select 3
13. Press scroll until the display shows T.SP4 <TARGET SP 4>. Select 800
14. Press scroll until the display shows DWEL.4 <DWELL TIME 4>. Select OFF
15. Press scroll until the display shows RMP.5 <RAMP RATE 5>. Select 5
16. Press scroll until the display shows T.SP5 <TARGET SP 5>. Select 400
17. Press scroll until the display shows DWEL.5 <DWELL TIME 5>. Select 480
18. Press the ACK function to return to the home display.
19. Press the up ▲ and down ▼ keys together, to operate the program.
### 1.8 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.

#### 1.8.1 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.

<table>
<thead>
<tr>
<th>Product end of cable female (25-pin) 9-pin</th>
<th>RS232 Cable: product to PC</th>
<th>Computer end of cable 9-pin (25-pin) male</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rx (2) 3</td>
<td>3</td>
<td>2 Rx</td>
</tr>
<tr>
<td>Tx (3) 2</td>
<td>2</td>
<td>3 Tx</td>
</tr>
<tr>
<td>Com (7) 5</td>
<td>5</td>
<td>7, 8 Com</td>
</tr>
</tbody>
</table>

#### 1.8.2 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:

<table>
<thead>
<tr>
<th>Product end of cable female (25-pin) 9-pin</th>
<th>RS485 Cable: product to PC</th>
<th>Computer end of cable 9-pin (25-pin) female</th>
</tr>
</thead>
<tbody>
<tr>
<td>- (2) 3</td>
<td>3</td>
<td>2 Rx</td>
</tr>
<tr>
<td>+ (3) 2</td>
<td>2</td>
<td>3 Tx</td>
</tr>
<tr>
<td>Com (7) 5</td>
<td>5</td>
<td>7, 8 Com</td>
</tr>
</tbody>
</table>

#### 1.8.3 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.

1.8.4 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:

![Diagram](image-url)

<table>
<thead>
<tr>
<th>Key</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>Temperature Controller</td>
</tr>
<tr>
<td>F</td>
<td>Fuse (2A)</td>
</tr>
<tr>
<td>S</td>
<td>Supply</td>
</tr>
<tr>
<td>L</td>
<td>Load</td>
</tr>
<tr>
<td>*</td>
<td>Normally open relay contacts</td>
</tr>
<tr>
<td>RO</td>
<td>Relay Output 240V 2A MAX</td>
</tr>
</tbody>
</table>

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 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.

1.10 3216 Controller Navigation Diagram

The following diagram details how to navigate to the various menu options within the 3216 Controller. At each option, values can be set using the arrow keys.
L1 Level 1

Press the Scroll Key

Hold the Page key for 3 seconds

L2 Level 2

Press the Scroll Key multiple times

Locked - password required

Access

* If configured

Unlocked

** Do not raise the power limit (if accessible) above the design level for the product

~ Multiple Program Only

Black = Progress

Dashed = Through multiple menus

White = Return
2.0 2132 Controller

2.1 Description

The 2132 Controller is made by Eurotherm, and is fitted and configured by Carbolite Gero for immediate use. It is a digital instrument with PID control algorithms.

The 2132 Controller features:

- Easy use as a simple temperature controller, where on setting the required temperature the controller immediately attempts to reach and maintain it.
- A ramp-to-setpoint feature, which may be used to limit the heating (or cooling).
- A timer function which allows for heating for a predetermined time, either from start or from reaching temperature; or alternatively for delaying the start of heating.
- An alarm output which may be used in conjunction with the timer, for example to give an audible alarm at the end of the timing period.

2.2 2132 Controller Operation

2.2.1 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.
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 \( \square \) allows access to parameter lists within the controller.

A single press of the page key \( \square \) displays the temperature units, normally set to °C; further presses reveal the lists indicated in the navigation diagram. See section 3.4.

The scroll key \( \square \) 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 \( \square \) 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 \( \square \) and scroll \( \square \) together, or wait for 45 seconds.

The down \( \downarrow \) and up \( \uparrow \) keys are used to alter the setpoint or other parameter values.

### 2.2.3 Basic Operation

Normally no operator action is required other than entering the setpoint, as the controller starts to control on being switched on, as described above.

### 2.2.4 Altering the Setpoint

With the display at 'Home', showing the measured temperature, press down \( \downarrow \) or up \( \uparrow \) once to display the setpoint; press again or hold down to adjust it. The display returns to the measured temperature when no key is pressed for 0.5 seconds.
2.0 2132 Controller

2.2.5 Stopping and Starting Control

It is possible to stop and start the controller without altering the setpoint. Press scroll until the legend 'm-A' (manual/ auto) appears. In this controller, manual means OFF and auto means ON. Press down ▼ or up ▲ once to show the current on/ off state: 'mAn' for OFF and 'Auto' for ON. Press down ▼ or up ▲ to change between manual and auto (off and on) as required.

Note that timer modes 1 & 3 set the controller to 'mAn' at the end of the timing period. If the controller unexpectedly does not control it may be in manual, possibly as the result of previous use of the timer function.

2.2.6 Altering the Ramp Rate

It is only possible to limit the rate of heating by setting a ramp rate if the timer feature is not in use.

To enable direct setting of the ramp rate, first ensure that the 'StAt' parameter and 'dwEll' parameter are both set to OFF (see sections 2.3.1 and 2.3.2).

Press scroll until 'SPrr' (setpoint ramp rate) is displayed. Use down ▼ or up ▲ to display and adjust the value.

The ramp rate sets the maximum rate of heating or cooling in degrees per minute. A value of OFF cancels the ramp rate, allowing heating and cooling at the maximum rate. When this feature is in use, there is a “working setpoint” which can be viewed at any time by scrolling to 'w.SP' and pressing ▼ or ▲.

Fig 1 and fig 2 indicate the possible difference between operating without and with a ramp-to-setpoint value (depending on the load and the value used).

![Fig 1 - control without ramp-to-setpoint](image1)

![Fig 2 - control with ramp-to-setpoint](image2)

2.3 Operating with the Timer

This controller can be used as a process timer allowing timed heating or timed delay, according to the options in the table. There are 5 timer modes, but 2 of them are affected by whether the setpoint ramp rate feature is being used, making 7 entries in
the table. The table also shows the status of the timer light on the controller. A visual impression of the different modes is given in fig 3.
<table>
<thead>
<tr>
<th>Timer Mode</th>
<th>Description</th>
<th>Timer Light</th>
</tr>
</thead>
<tbody>
<tr>
<td>mode 1</td>
<td>The timer starts timing when the actual temperature is within 1 °C of the setpoint. At the end of the timing period, control switches off (i.e. goes into Manual) to allow cooling and 'End' flashes on the display.</td>
<td>On while temperature is reaching setpoint. On during the timing period. Off from the end of the timing period.</td>
</tr>
<tr>
<td>mode 2</td>
<td>The timer starts timing when the actual temperature is within 1 °C of the setpoint. At the end of the timing period, control remains on, maintaining the setpoint temperature and 'End' flashes on the display.</td>
<td>On while temperature is reaching setpoint. On during the timing period. Off from the end of the timing period.</td>
</tr>
<tr>
<td>mode 3, with SPrr off</td>
<td>The timer starts timing immediately. At the end of the timing period, control switches off (i.e. goes into Manual) to allow cooling and 'End' flashes on the display.</td>
<td>On during the timing period. Off from the end of the timing period.</td>
</tr>
<tr>
<td>mode 3, with SPrr active</td>
<td>The timer starts timing when the working setpoint is within 1 °C of the setpoint. At the end of the timing period, control switches off (i.e. goes into Manual) to allow cooling and 'End' flashes on the display.</td>
<td>On during the timing period. Off from the end of the timing period.</td>
</tr>
<tr>
<td>mode 4, with SPrr off</td>
<td>The timer starts timing immediately. At the end of the timing period, control remains on, maintaining the setpoint temperature and 'End' flashes on the display.</td>
<td>On during the timing period. Off from the end of the timing period.</td>
</tr>
<tr>
<td>mode 4, with SPrr active</td>
<td>The timer starts timing when the working setpoint is within 1 °C of the setpoint. At the end of the timing period, control remains on, maintaining the setpoint temperature and 'End' flashes on the display.</td>
<td>On during the timing period. Off from the end of the timing period.</td>
</tr>
<tr>
<td>mode 5</td>
<td>The timer starts timing immediately and control starts at the end of the timing period. There is no 'End' condition in this mode.</td>
<td>On during the timing period. Off from the end of the timing period.</td>
</tr>
</tbody>
</table>
2.3.1 Setting the Timer Mode

Scroll to 'tm.OP'; use ▲ or ▼ to view and alter the mode. The mode shows as 'OPt.1' to 'OPt.5'. It is not possible to alter the mode while the timer is operating; if the mode cannot be altered, scroll to the 'StAt' parameter and set its value to OFF.

2.3.2 Setting the Time Period

Method 1

Scroll to 'tmr' (time remaining). Use ▲ or ▼ to view the remaining time; the units are always in minutes. Use ▲ or ▼ to set or alter the time. Setting 'tmr' automatically activates the timer; the 'm-A' parameter changes to 'Auto' and the 'StAt' parameter changes to run.

Note that the 'tmr' display shows 0 (zero) during the last minute of timing and also shows 0 when the time has expired. The timer light indicates whether timing is still in progress.

Method 2

Scroll to 'dwEll' and use ▲ or ▼ to set the timing duration. The advantage of method 2 is that 'dwEll' need only be set once if repeated use of the same time period is required.

Scroll to 'StAt' and use ▲ or ▼ to set the parameter value to run. This copies the dwell time into 'tmr' and activates the timer as in method 1.

2.3.3 Running with the Timer

Once the timer is activated by method 1 or 2 above, the control sequence depends on the 'Timer' mode, as previously given in the table. Fig 3 gives another representation of the timer action.
2.3.4 Stopping the Timer

To stop the timer at any time while it is operating, change the 'StAt User Calibration' parameter to OFF. This is the same as reducing 'tmr' to zero. The controller then acts as though it has reached the end of the time period.

2.3.5 End of Time Period

Modes 1 and 3: heating stops at the end of timing; the 'm-A' parameter changes to 'mAn'.

Modes 2 and 4: heating continues at the end of timing; the 'm-A' parameter remains at 'Auto'.

Mode 5: heating starts at the end of the timing period; the 'm-A' parameter remains at 'Auto'.

In modes 1 to 4 the alarm message 'End' flashes on the display at the end of timing; the 'StAt' parameter remains at run.

In mode 5 there is no 'End' message; the 'StAt' parameter changes to OFF at the end of timing.

2.3.6 Cancelling the Alarm

To acknowledge (cancel) the 'End' alarm, press page and scroll together; the 'StAt' parameter changes to OFF.

Alternatively cancel the alarm by directly changing the 'StAt' parameter from run to OFF.
2.3.7 Program Example

To heat up at 10 °C per minute to 500 °C; to hold at 500 °C for 1 hour; then to allow to cool down.

(This example uses timing mode 1, as on the first row of the timer table, but also includes the use of ramp rate).

To create this program

1. Start with display at home; use arrow keys to alter the setpoint to 500.
2. Press scroll until 'sp.rr' shows; use arrow key to set value to 10 (if you do not want to limit the ramp rate, ignore this step or set the value to OFF)
3. Press scroll until 'tm.op' shows; use arrow key to set value to opt.1
4. Press scroll until 'dwell' shows; use arrow key to set value to 60

To operate this program

5. Press scroll until 'stat' shows; use arrow key to set value to run
   - heating starts when run is set;
   - timing starts when the working setpoint reaches 499 °C;
   - heating stops 61* minutes later and 'End' flashes on the display.
6. Cancel 'End' by pressing page and scroll together.

* note that the timer runs for an extra minute, when tmr has counted down to zero; allow for this when testing the system with short durations such as 1 or 2 minutes.

2.4 Altering Power Limit

Overview

Depending on the furnace or oven model the power limit parameter OP.Hi (Output High) may be accessible or hidden.

For silicon carbide heated furnaces the parameter is accessible to allow for compensation for element ageing. In wire-heated chamber or tube furnaces, reducing the power limit is a convenient method of improving control at low temperatures, as outlined below.

The power limit may be set to zero to permit demonstration of the controls without heating.

In many models the power limit setting depends on the supply voltage; usually the furnace or oven manual contains details: if in doubt, contact Carbolite Gero for advice.

The power limit parameter does not apply to the over-temperature controller, if fitted.

Altering the value

Press page [ until oP (output list) is displayed. Press scroll [ until OP.Hi (Output High) is displayed. Press down [ or up [ once to display the value of OP.Hi and write down the value. To alter the value, use down [ or up [.

Note: setting the value to zero prevents the furnace or oven from heating.
Caution: Do not increase the power limit value to a value above the design level for the oven or furnace model, or to a value above that correctly calculated for silicon carbide elements. The heating elements could burn out, or other damage could be caused.

Control at Low Temperatures
If a product is to be used at temperatures much lower than its design maximum, control stability can often be improved by reducing the power limit. Remember to make a record of the original setting before altering the power limit.

Example: It is desired to operate a 1200 °C furnace at 300 °C. The normal control settings can be expected to cause excessive overshoot as the furnace reaches temperature. If the power limit OP.Hi is normally set to 100%, try a setting of 40%. This should greatly reduce the overshoot. (There is no firm calculation rule to get this example setting of 40% – experimentation may be required to achieve a good result. Avoid power limits below approximately 30% – control accuracy is reduced at such levels.)

Depending on the furnace or oven model the power limit parameter OP.Hi (Output High) may be accessible or hidden.

For silicon carbide heated furnaces the parameter is accessible to allow for compensation for element ageing. In wire-heated chamber or tube furnaces, reducing the power limit is a convenient method of improving control at low temperatures, as outlined above.

The power limit may be set to zero to permit demonstration of the controls without heating.

In many models the power limit setting depends on the supply voltage; usually the furnace or oven manual contains details: if in doubt, contact Carbolite Gero for advice.

User Calibration
The controller is calibrated for life at manufacture against known reference sources, but there may be sensor errors or other system errors. User calibration allows compensation for such errors and this controller allows for a user 2-point calibration. This setting is password protected to avoid accidental alteration.

Page to iP, scroll to CAL.P and use up ▲ to alter the password. The password is 3. If the correct password is entered, the display shows PASS. Scroll to CAL and use up ▲ or down ▼ to observe the setting FACt (factory values, as manufactured) or USEr (user values). Change to USEr.

NOTE: before checking the calibration of the controller, or of the complete system, remember to reset the controller to factory calibration values by setting the CAL.P parameter to FACt.

To enter a user calibration, scroll to each of the following parameters in turn and set the desired values.

Pnt.L low temperature for which an offset is to be entered
OFS.L offset value for the low temperature
Pnt.H high temperature for which an offset is to be entered
OFS.H offset value for the high temperature
Example: the controller reads 3 °C low at 400 °C and 5 °C low at 1000 °C. The parameter values should be Pnt.L=400, OFS.L=3, Pnt.H=1000, OFS.H=5.
Negative or positive values can be entered: if the controller is reading high, negative offsets would be appropriate.
Fig 4 gives a graphical representation of the 2-point calibration.

2.5 Audible Alarm
If an audible alarm is supplied for use with the timer function, then it is normally configured to sound at the 'End' condition and to go off when the alarm is acknowledged as given in section 2.3.6.
It is not feasible to cover all possible alarm features which may be included by customer special order, within this manual.

2.6 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.
2.7 Navigation Diagram

- **Home List**
  - 20.0
  - °C
  - OP
  - w.SP
  - m - A
  - SPrr
  - tm.OP
  - tm
  - dwell
  - stAt

- **Input List**
  - ip
  - CAL.P
  - CAL
  - Pnt.L
  - OFS.L
  - Pnt.H
  - OFS.H

- **Output List**
  - oP
  - OP.Hi
  - ACCS
  - code

- **Access List**
  - for factory access to lists and parameters not available to the operator

- **Notes**
  - measured temperature; use ▲ / ▼ to access setpoint
  - output power, read only
  - present only if SPrr in use
  - manual/Auto
    - mAn = off
    - Auto = on
  - setpoint ramp rate OFF or value
  - timer mode
  - time remaining
  - dwell time for timer
  - timer status run or OFF

**Additional Notes**
- Power limit setting, if present
- User 2 - point calibration
3.0 2132 Over-Temperature Controller Description (if fitted)

3.1 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.

3.2 Operation

3.2.1 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.
3.2.2 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 \( \text{Page} \) allows access to parameter lists within the controller.

A single press of the page key \( \text{Page} \) displays the temperature units, normally set to °C; further presses reveal the lists indicated in the navigation diagram. See section 3.4.

The scroll key \( \text{Scroll} \) 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 \( \text{Scroll} \) 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 \( \text{Page} \) and scroll \( \text{Scroll} \) together, or wait for 45 seconds.

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

3.2.3 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 \( \text{Scroll} \) twice view the present temperature as measured by the over-temperature controller. Press it twice, the first press shows the temperature units (°C).

3.2.4 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.

3.2.5 Resetting the Over-Temperature Alarm

To acknowledge the alarm press scroll \( \text{Scroll} \) and page \( \text{Page} \) 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.

3.2.6 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.
3.3 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 3.2.

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

3.4 Navigation Diagram

<table>
<thead>
<tr>
<th>HL</th>
<th>Home List</th>
<th>Page Key</th>
<th>Black = Progress</th>
</tr>
</thead>
<tbody>
<tr>
<td>OTSP</td>
<td>Over-Temperature Setpoint</td>
<td>Scroll Key</td>
<td>Dashed = Through to other options</td>
</tr>
<tr>
<td>AL</td>
<td>Access List</td>
<td>!</td>
<td>For factory access to list and parameters not available to the operator.</td>
</tr>
</tbody>
</table>
4.0 Operation

4.1 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.

4.2 3-Zone Control Methods

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

(A) Back to back thermocouples
(B) Retransmission of Setpoint using Broadcast Communications.
(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.

Please note that 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 using Broadcast communications**

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.

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 (unless edited). To make this adjustment, enter 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 subtract 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.
# Service Record

<table>
<thead>
<tr>
<th>Engineer Name</th>
<th>Date</th>
<th>Record of Work</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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</tbody>
</table>
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.

For preventive maintenance, repair and calibration of all furnace and oven products, please contact:

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