

Installation, Operation and Maintenance Instructions

Controller Manual

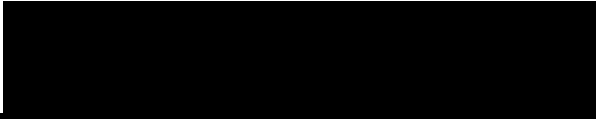
3216 Controller

3216 Controller

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.

1.0	3216 Controller	4
1.1	PID control	4
1.2	3216P1	4
1.3	3216P5	4
1.4	Operation	4
1.4.1	Controller Layout	4
1.4.2	Keys	5
1.5	Quick Start Guide	5
1.5.1	Operation as a simple controller	5
1.5.2	Changing the Setpoint	5
1.5.3	Using the Controller	5
1.5.4	Understanding User Levels	6
1.6	Setting up the Controller	7
1.6.1	Maximum Output Power	7
1.6.2	Customer ID	7
1.6.3	Units	7
1.6.4	Language	7
1.6.5	Scrolling Text	7
1.6.6	Customer Calibration	8
1.6.7	Holdback	9
1.7	Programming	10
1.7.1	Creating a Program	10
1.7.2	Program Number (3216P5 Only)	10
1.7.3	Ramp Units	10
1.7.4	Dwell Units	10
1.7.5	Holdback	10
1.7.6	Ramp Rate	10
1.7.7	Target Setpoint	10
1.7.8	Dwell Time	10
1.7.9	Running a Program	11
1.7.10	Program Status	11
1.7.11	Process Value	11
1.7.12	PSP, Segment Type and Number	11
1.8	Controller Options	14
1.8.1	Digital Communications - RS232	14



1.8.2 Digital Communications - RS485 14
1.8.3 Comms Address 14
1.8.4 Alarm Option 15
1.9 Temperature Controller Replacement 15
1.10 3216 Controller Navigation Diagram 15

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



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

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:
Page and Scroll		<ul style="list-style-type: none">• Return to the Home Menu• Acknowledge an alarm if activated.• Reset a program after the program has ended.
Arrow Keys		The arrow keys are used individually to adjust the selected parameters and in 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.

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

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




TIP

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

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).

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.

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.

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

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  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  until the display shows PROG <PROGRAM NUMBER.> Select the program number.




1.7.3 Ramp Units

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




1.7.4 Dwell Units

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


1.7.5 Holdback

See section 1.6. Press scroll  until the display shows H.BACK <Program Holdback>: If a holdback value is required, use the up  down  to enter the required value or select "OFF" if no holdback is required.

1.7.6 Ramp Rate



Press scroll  until the display shows RMP.1 <Ramp Rate 1>: Using the up  down  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  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  until the display shows DWELL. 1 <DWELL TIME 1>: Enter the time to dwell at "Target SP 1". If the dwell segment is not required, use the down  to select OFF, which is below the Zero value.

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

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

A program will end in one of two ways, either revert to the control 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.

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

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  until the display shows WRK.OP <WORKING OUTPUT POWER>. This shows the power being used as a percentage.

Time Remaining





Press scroll  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  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 , down  together, the "HLD" indicator will turn off and the "Run" indicator will flash, indicating the program is on hold. When the program is started again by pressing the up , down  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

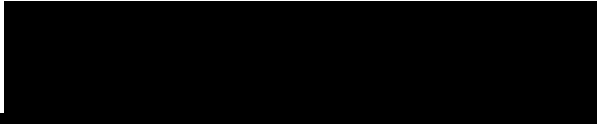
Alarms are used to alert the operator when a pre-set level has been exceeded or a function error has occurred such as a sensor break. They are indicated by a scrolling message on the display and a flashing red ALM (Alarm) indicator. The alarm may also switch an output – usually a relay to allow external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

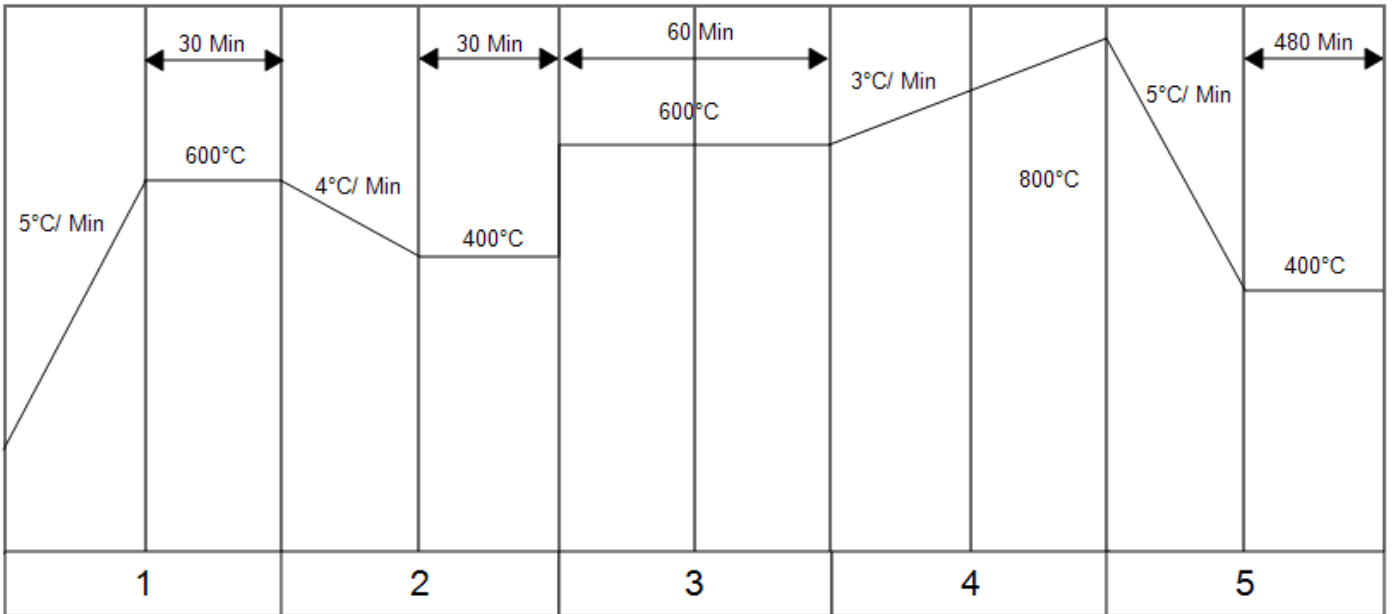
Note: The alarm indicator may seem to be permanently on when viewed from above. When an alarm is active the indicator should only be flashing, to confirm this, the controller must be viewed directly from the front.



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 3>. 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.



Segment

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

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.

Product end of cable female (25-pin) 9-pin			RS232 Cable: product to PC	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

1.8.2 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

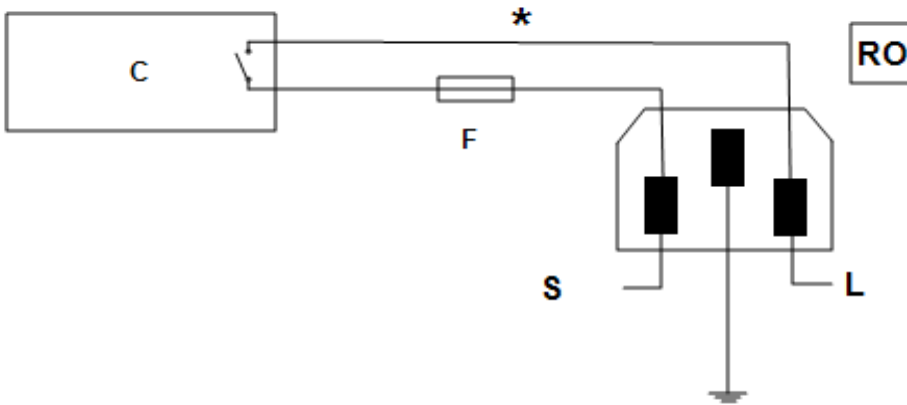
1.8.3 Comms Address

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:



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 Temperature Controller Replacement

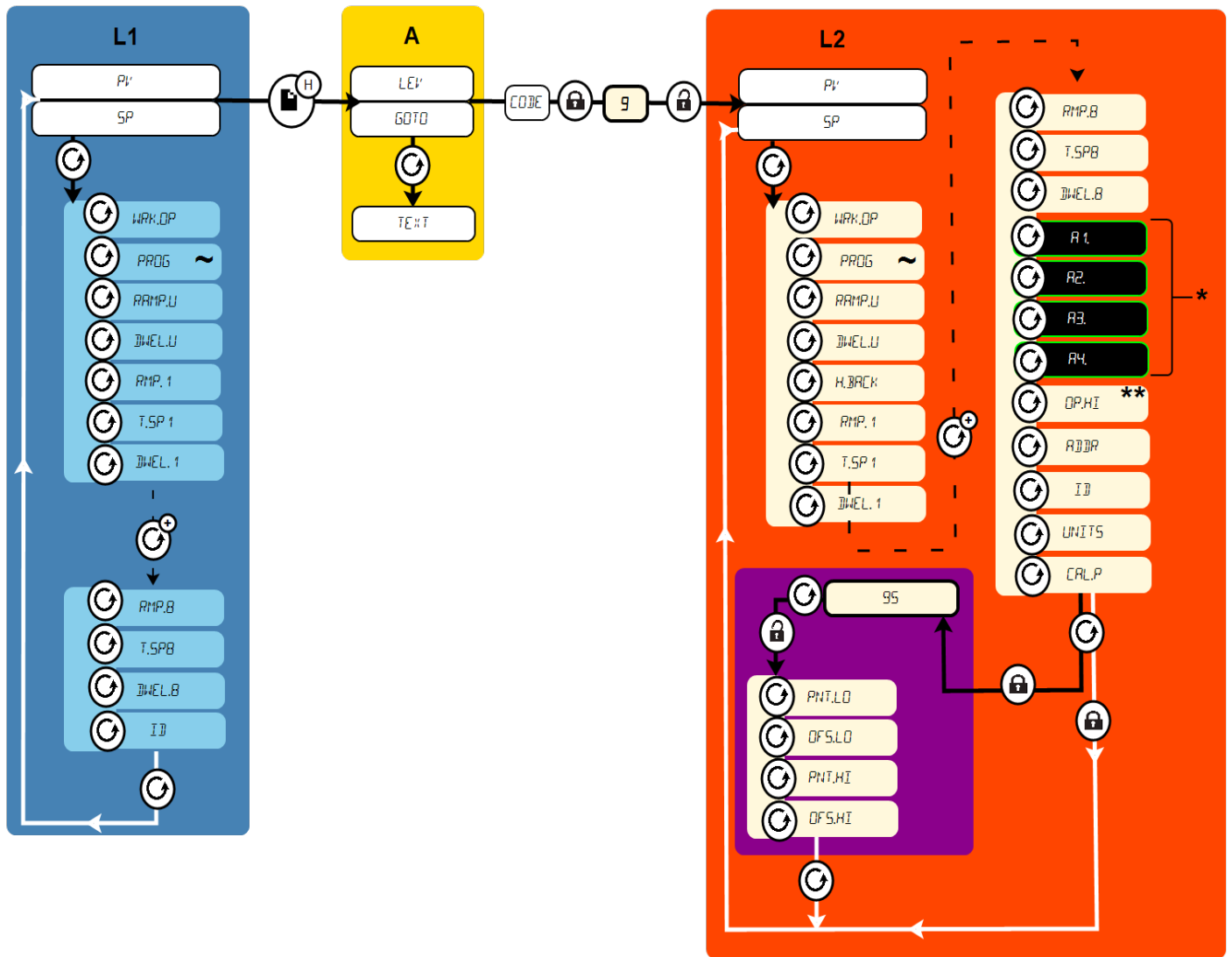


Before handling the controller: wear an anti-static wrist strap or otherwise avoid any possibility of damage to the unit by static electricity. Refer to the detailed instructions supplied with the replacement controller.

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
A	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

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.

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

Carbolite Gero Service

Telephone: + 44 (0) 1433 624242

Fax: +44 (0) 1433 624243

Email: ServiceUK@carbolite-gero.com

Carbolite Gero Ltd,

Parsons Lane, Hope, Hope Valley,
S33 6RB, England.

Telephone: + 44 (0) 1433 620011

Fax: + 44 (0) 1433 621198

Email: Info@carbolite-gero.com

www.carbolite-gero.com

CARBOLITE
GERO 30-3000°C

Copyright © 2021 Carbolite Gero Limited