

## Installation, Operation and Maintenance Instructions

### Controller Manual

### CC-T1 Controller

## CC-T1 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.

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## 1.0 Introduction

The CC-T1 is a touchscreen temperature controller developed by Carbolite Gero.

It uses PID (Proportional Integral Derivative) algorithms to adjust the heating power and control the temperature within the product.

Users navigate through the controller by pressing on-screen buttons, and set values and parameters by pressing on fields within the screen. When alphanumerical values (names, passwords, times) are required, the on-screen keyboard will appear.

### 1.1 Features

The CC-T1 features:

- 10 individual program slots with up to 24 configurable segments
- Program scheduling with real-time clock
- Data logging to USB stick (all data is recorded in a **.csv** file format)
- Ethernet connections
- 3 password protected user levels to control access to functionality
- Can be used as a programmer or simple temperature controller
- Built-in over-temperature protection (optional)
- Regional language options:
  - English
  - German
  - French
  - Italian
  - Spanish
  - Chinese (Simplified)
  - Russian
  - Japanese

## 1.2 Technical Terms

Due to the complex nature of temperature control, this manual uses technical terms. Here is a list of some of the terms used within this manual, alongside their explanation:

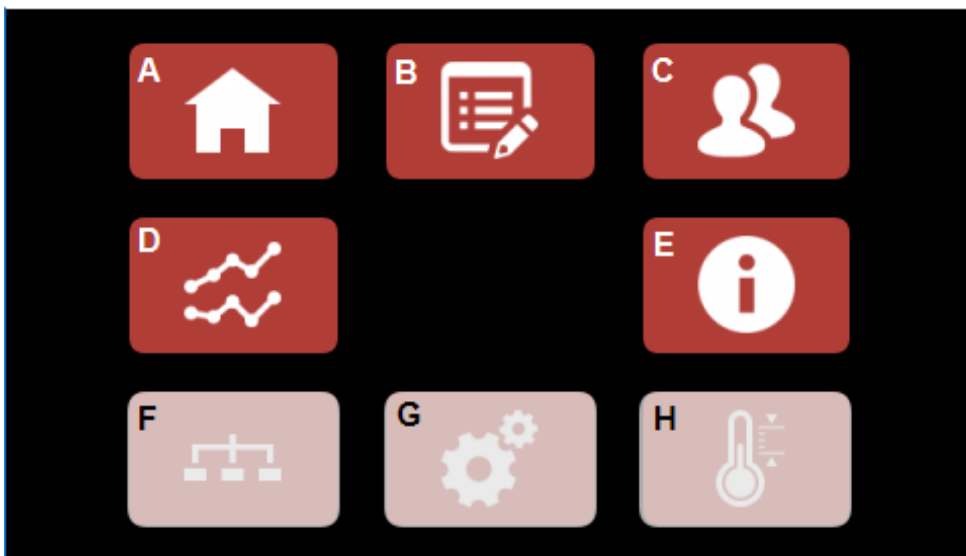
Term	Description
Setpoint	The target temperature the furnace or oven is trying to reach (°C)
Over-Temperature Protection	A system to prevent the product or process being damaged if the temperature has increased above a temperature specified by the user (over-temperature setpoint). Power to the heating elements is stopped until either the temperature of the product drops below the over-temperature setpoint, or the user manually increases the over-temperature setpoint
Over-Temperature Setpoint	The temperature at which the over-temperature protection system triggers
Heating element	The electrically powered heating device used within the product (furnace or oven)
Thermocouple	A thermoelectric device for measuring temperature
PID	Proportional Integral Derivative - the mathematical control system used by the controller
Program	A series of instructions that tell the controller how to behave. A program is divided into sections called "segments"
Segment	A section of a program. A program can have 24 individual segments. There are 6 different segment types that can be configured. The segments define how the controller behaves when a program reaches that segment. The last segment of a program must always be an "End" type
Holdback	Used when running a program. Holdback is the amount (in °C / °F / K) by which the programmed setpoint can run ahead of the actual measured temperature before holdback operates and prevents the program from progressing until the actual temperature catches up. This can be applied to either heating, cooling or both, depending on the "Holdback Type" set by the user
Ramp Rate	The amount of degrees (°C / °F / K) the temperature should increase per second, minute or hour (dependant on "Ramp Units")
Ramp Units	Used to define whether the temperature should increase at <b>X</b> °C per second, <b>X</b> °C per minute or <b>X</b> °C per hour

## 2.0 Navigation

The CC-T1 has numerous buttons and fields designed to be operated with your finger.

- When a button is pressed it will be outlined in white to show that the controller has registered your input (if using a stylus, then buttons are not typically highlighted when pressed)
- When a field is pressed it may:
  - Open a keyboard for entering alphanumerical values
  - Open a pop-up window with more options



















**Note:** If using a stylus or pointer to operate the CC-T1, **ALWAYS** ensure that it is blunt to avoid damaging the screen.



A	To Home screen
B	To Programming screen
C	To Login screen
D	To Data Logging screen
E	To Information screen
F	To Communications screen
G	To Settings screen
H	To Offset-Calibration screen

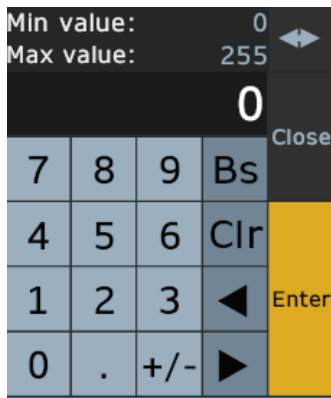
*Navigation Screen: Operator User Level*

**Note:** Any options that are unavailable will be greyed out (see options " F, G and H" in the screenshot above). Some options are only available when logged in at specific user levels.

Icon	Function	Icon	Function
	Return to Navigation screen		To Set Maintenance Reminder screen
	To Over-Temperature Protection screen (if fitted)		Maintenance Reminder
	Over-Temperature Alarm icon (displays when the Over-Temperature alarm is triggered)		To Program Select screen
	Return to previous screen		To Program Edit screen
	Forward		To Schedule Program screen
	Back		Run program
	Accept / Yes		Pause Program
	Close / No		More information
	Reset		Cycle Countdown
	Start Manual data logging		Press on a field to enter a value
	Stop Manual data logging		USB stick inserted
	To Data Logging Settings screen		Data logging in progress
	Heating Element Temperature (Cascade Control only)		

## 2.1 On-Screen Keyboards

Various on-screen numerical and alphanumeric keyboards are available to input values into the CC-T1.




*Numeric Keyboard*



*Alphanumeric Keyboard*



*Numeric Time/Date Keyboard*

Bs	Backspace - delete a value to the left of the cursor
Clr (Clear)	Remove any values already input
Esc	Escape
Up	Increase the selected value by 1
Down	Decrease the selected value by 1
Enter	Confirm and apply the input values
Close	Close the keyboard
Cap	Switch between capital and lowercase characters
Shift	Switch between capital and lowercase, and additional characters (!&@# etc.)
Clear	Remove all values already input into the keyboard
Space	Add a space into a value
Delete	Delete a value to the right of the cursor
AM/PM	Select the time of day (values after 12 pm are displayed in 24 hour time format)
	Press to align the keyboard to either the left or right of the screen

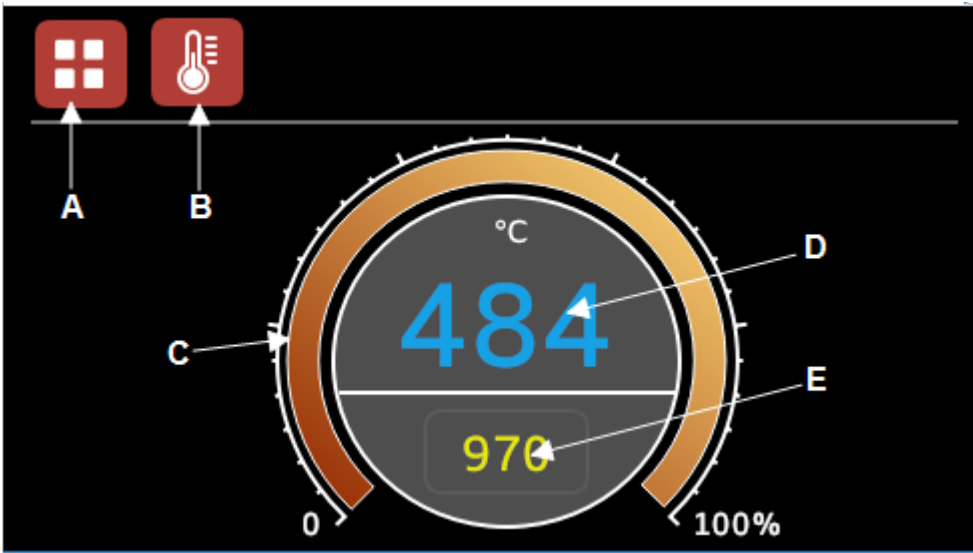
### 3.0 Start Up

When you turn on the product, the touchscreen will show the initial loading screen.



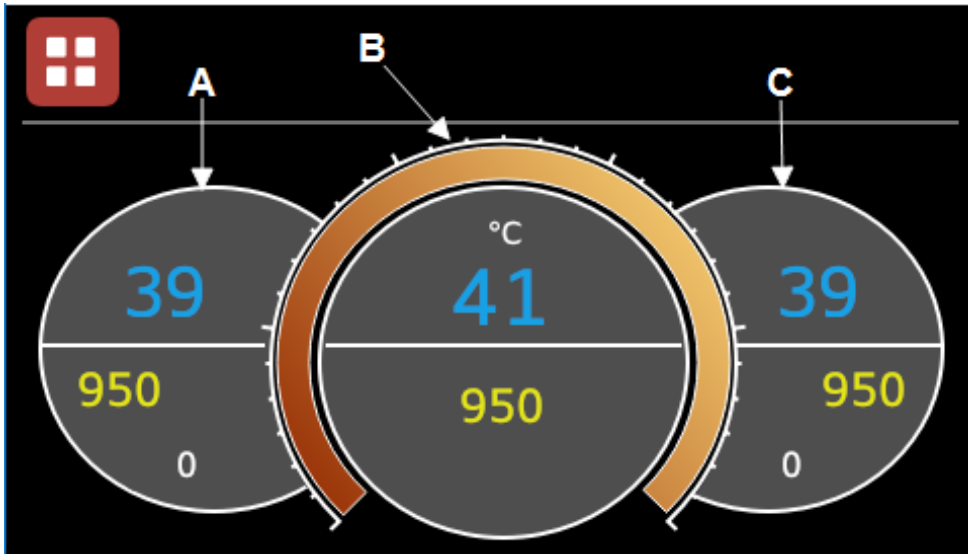
After the initial loading screen, the **Home** screen will appear.

**Note:** If your product is configured for multiple heated zones, you will first see an overview of all the available zones. You can choose to focus upon a particular zone by pressing on it. Three small icons will appear above the main display to indicate which controller you are viewing.



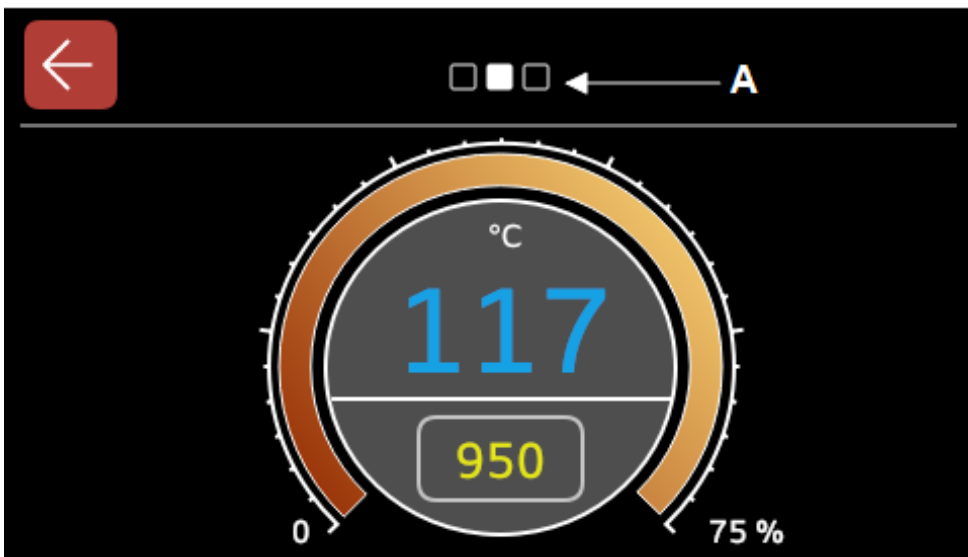
A	Return to Navigation screen
B	To Over-Temperature Protection screen (if fitted)
C	Power Output Indicator
D	Actual Temperature
E	Setpoint Temperature

Home Screen (Single Zone)



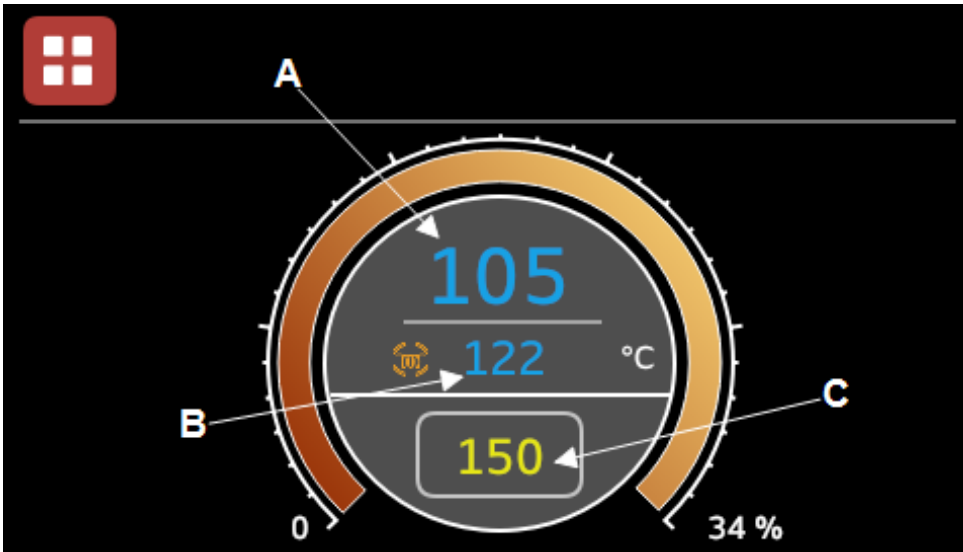
A	Left Controller
B	Main Controller
C	Right Controller

Home Screen (3-Zone Overview)



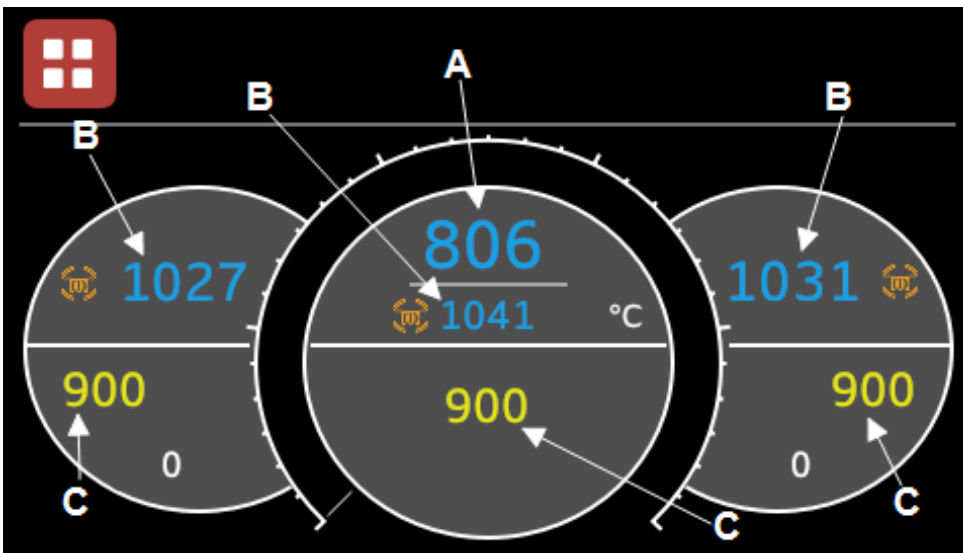
A	Indicates which controller the display is focused upon (left, right or main)
---	------------------------------------------------------------------------------

Home Screen (3-Zone, Main Controller View)



Home Screen (Single Zone Cascade Control)

A	Load Temperature
B	Heating Element Temperature
C	Setpoint



Home Screen (3-Zone Cascade Control)

**Note:** Cascade Control versions of the CC-T1 function in the same way as the standard version described throughout this manual. Any additional functionality is detailed in see section 7.0.

- Press the "Return to Navigation screen" button to access other controller functionality:







*Navigation Screen: Admin User Level*

## 4.0 User Levels

There are 4 user levels within the CC-T1. These user levels control access to functionality within the controller via permissions.

The default user level is **Operator**.

	<b>Operator</b>
	<b>Supervisor</b>
	<b>Admin</b>
	<b>Service</b> - Only used by Carbolite Gero personnel

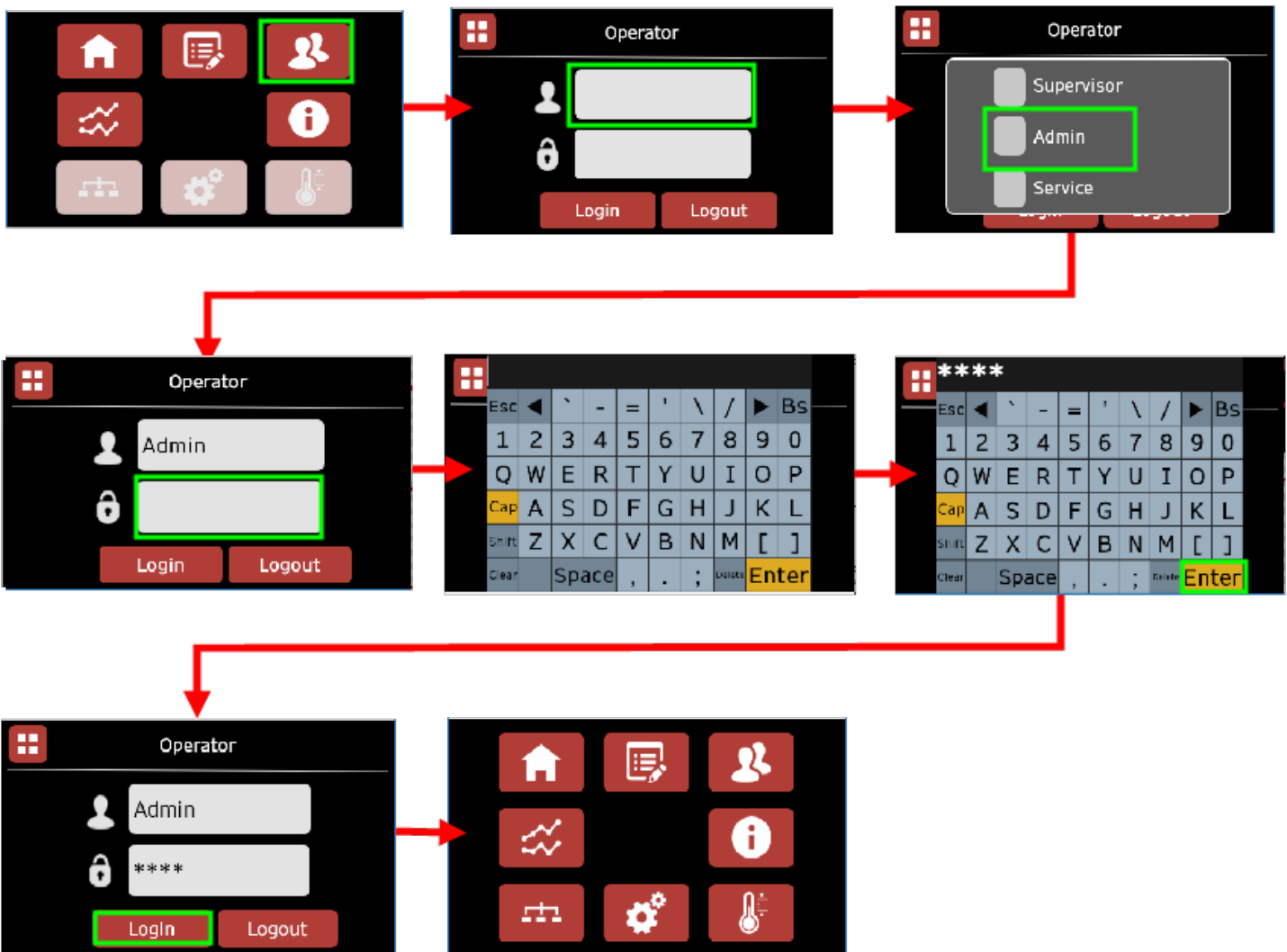
Functionality	Permissions			
Login / Change User Level	Green	Blue	Orange	Red
Access Home Screen	Green	Blue	Orange	Red
Change Setpoint (including Over-Temperature Setpoint)	Green	Blue	Orange	Red
Run Pre-configured Programs	Green	Blue	Orange	Red
Edit / Create Programs		Blue	Orange	Red
Edit Controller Language, Date, and Time Settings			Orange	Red
Edit Controller Settings			Orange	Red
Manage Serial Communications (if fitted)			Orange	Red
Access to Offset-Calibration settings			Orange	Red
Set Manual Data Logging	Green	Blue	Orange	Red
Download Manually Logged Data	Green	Blue	Orange	Red
Set Automatic Data Logging		Blue	Orange	Red
Edit Data Logging Settings			Orange	Red
Access Configuration and Hardware Settings				Red



## 4.1 Changing User Level

To change user level:

1. Go to the **Login** screen
2. Select your desired user level by pressing the upper field. A pop-up window will appear giving you the option of "Supervisor", "Admin", or "Service". The window will close automatically when you have selected your user level
3. Press the lower field to open the keyboard
4. Enter the password for the selected user level
5. Press "Enter"
6. Press "Login", and you will be returned to the **Navigation** screen



*Changing User Level*

## 4.2 User Level Passwords

All passwords are case-sensitive.

User	Password
Supervisor	<b>7N4C</b>
Admin	<b>3X6B</b>
Service	Please contact Carbolite Gero Service for any operations that require controller calibration or software updates

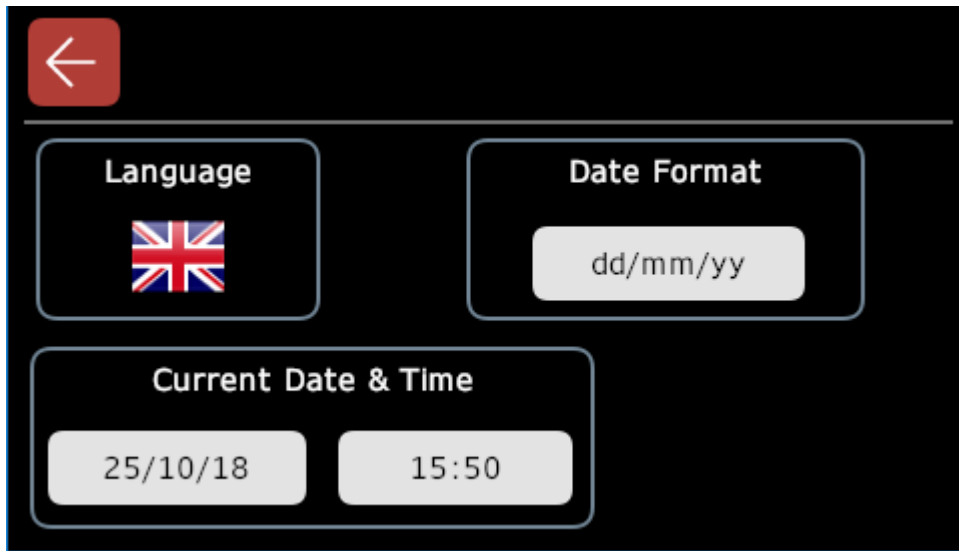
To return to the default user level (Operator), go to the **Login** screen and press the "Logout" button.

**Note:** If your product is switched off, the CC-T1 will return to the Operator user level.



## 5.0 Regional Settings

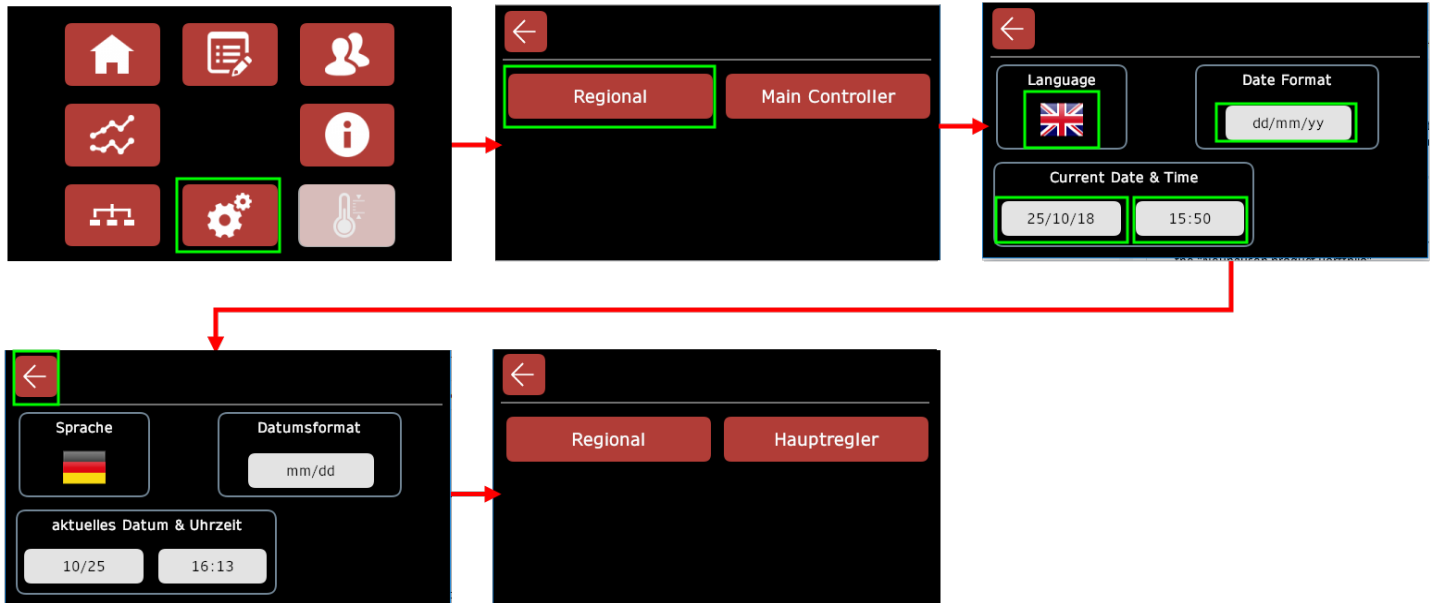
To effectively use the CC-T1 controller, you will need to set the time, date and language.



*Regional Settings Screen*

To do this:

1. Go to the **Login** screen and log in as "Admin"
2. Go to the **Settings** screen and press the "Regional" button
3. Press on the flag icon to scroll through the available languages. Keep pressing until you reach the language you desire. The CC-T1 is available in:
  - English
  - German
  - French
  - Italian
  - Spanish
  - Chinese (Simplified)
  - Russian
  - Japanese
4. Press on the "Date Format" field until you reach your desired date format e.g. **dd/mm/yy, mm/dd** etc.
5. Press on the "Current Date & Time" fields to open the on-screen keyboard, and type in the current date and time
6. Once completed, press the "back" button twice to return to the **Navigation** screen



*Setting the Time, Date and Language*

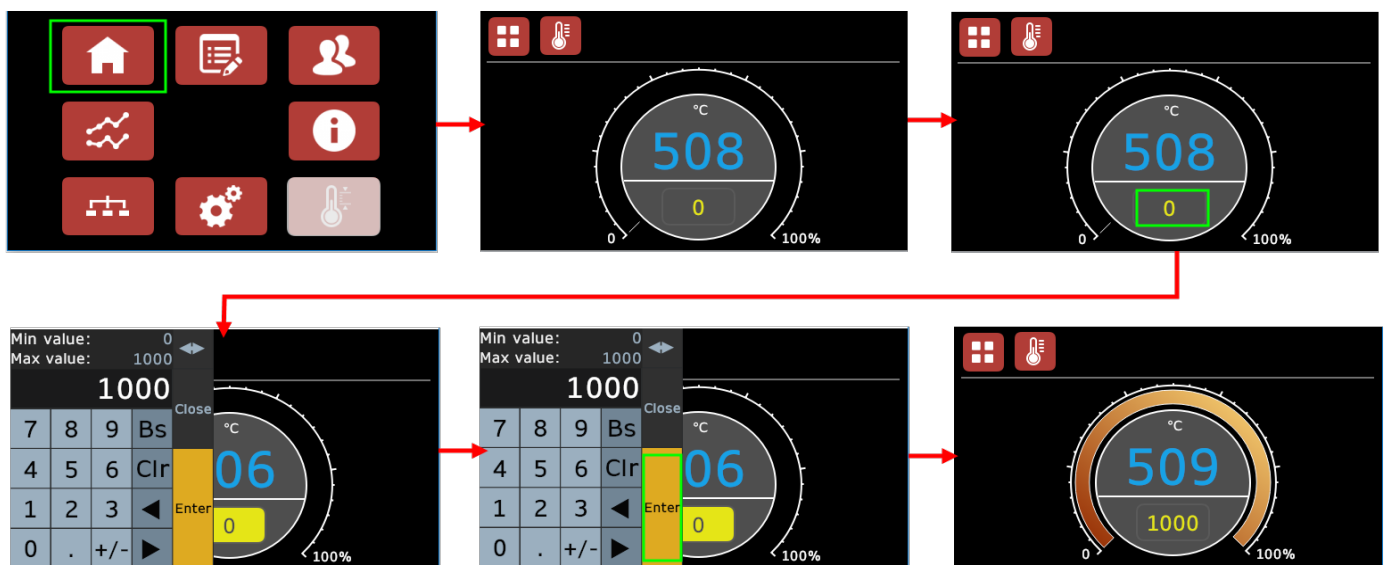


## 6.0 Simple Temperature Control

The CC-T1 can be used as a programmer or as a simple temperature controller. The controller has been configured so that it cannot heat above the maximum stated temperature for the product you have purchased.

To set a setpoint temperature:

1. Go to the **Home** screen
2. Press on the small yellow number on the lower part of the display. This will open the on-screen keyboard
3. Type in the temperature you wish the product to reach
4. Press "Enter" to close the keyboard
5. The product will then begin to heat (or stop heating, depending on the temperature you have set). The "Power Output Indicator" will show the amount of power being used by the heating elements in order to achieve the setpoint



*Setting a Setpoint Temperature*

### 6.1 Setpoint Trim (Multiple-Zone Configuration Only)

If the main controller is set to retransmit its setpoint to the end-zone controllers (see the **Controller Settings** section of this manual for information on setpoint retransmission), then you will have the option of configuring a setpoint trim value on each of the available end-zones.

The setpoint trim value ensures that the end-zone controller setpoint is maintained at a defined number of degrees (°C /°F / K) away from the main controller setpoint, up to a maximum of **-50** or **+50**.

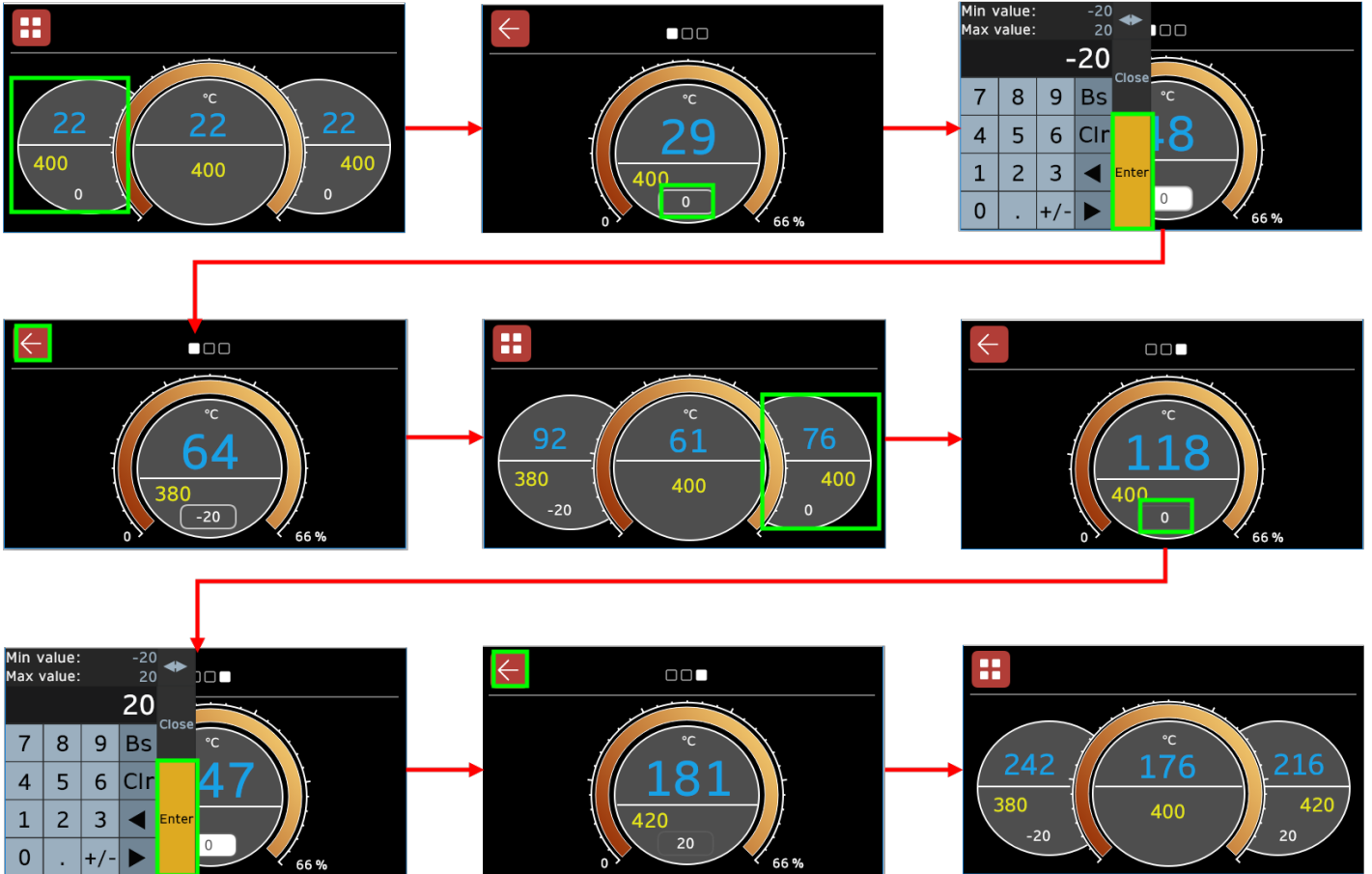
For example:

- The main controller setpoint is set at 700°C
- The end-zone controllers have a setpoint trim value of -20
- The end-zone controllers will adjust their setpoints to 680°C
- If the user then changes the main controller setpoint to 1000°C, the end-zone controller setpoints will automatically adjust to 980°C

If your controller is configured for 3-zone use, it is possible to set different setpoint trim values on each of the end-zone controllers.

To do this:

1. Go to the **Home** screen to see the overview of all available controllers
2. Press on the end-zone controller display to see more detail
3. Press on the white number (trim value) beneath the setpoint value
4. Input the desired setpoint trim value
5. Press "Enter" to confirm. The end-zone controller setpoint will adjust accordingly



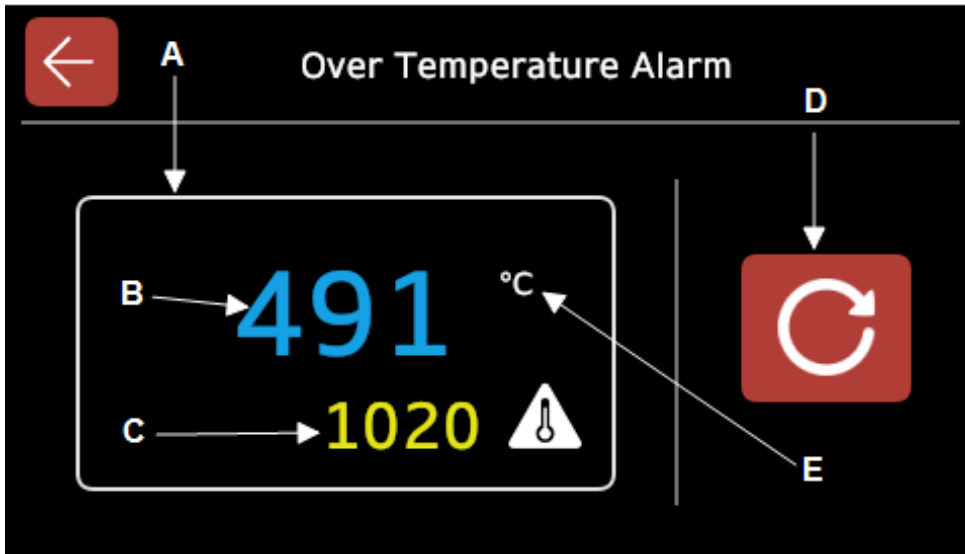
*Configuring Setpoint Trim Values on End-Zone Controllers*



## 6.2 Over-Temperature Protection (if fitted)

The CC-T1 can be fitted and configured to include over-temperature protection.

If over-temperature protection is fitted, the "Over-Temperature Protection" button will be visible on the **Home** screen. This will allow the user to access the **Over-Temperature Protection** screen and set an over-temperature setpoint.



A	Box (flashes red when alarm triggered)
B	Actual Temperature
C	Over-Temperature set-point
D	Reset button
E	Temperature Units (°C, °F, K)

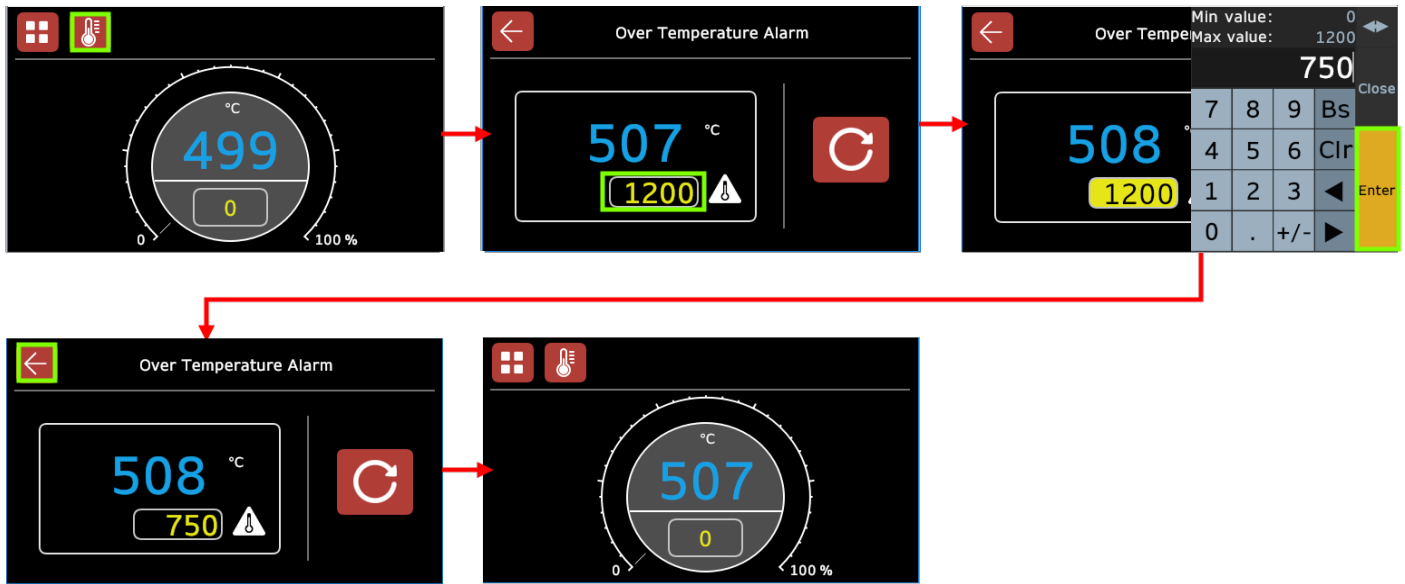
*Over-Temperature Protection Screen*

To set an over-temperature setpoint:

1. Press the "Over-Temperature Protection" button on the **Home** screen
2. Press on the small yellow numbers on the lower part of the display. This will open the on-screen keyboard
3. Type in the desired temperature
4. Press "Enter"

**Note:** If the product reaches this temperature, the over-temperature alarm will be triggered and the power to the heating elements will be stopped, preventing the product from heating until the temperature drops below the over-temperature setpoint value.

Press the "Back" button to return to the **Home** screen.



*Setting an Over-Temperature Setpoint*

### 6.2.1 Over-Temperature Alarm

If the temperature of the product increases above the over-temperature setpoint, the over-temperature alarm will be triggered and the user will be automatically taken to the **Over-Temperature Protection** screen.

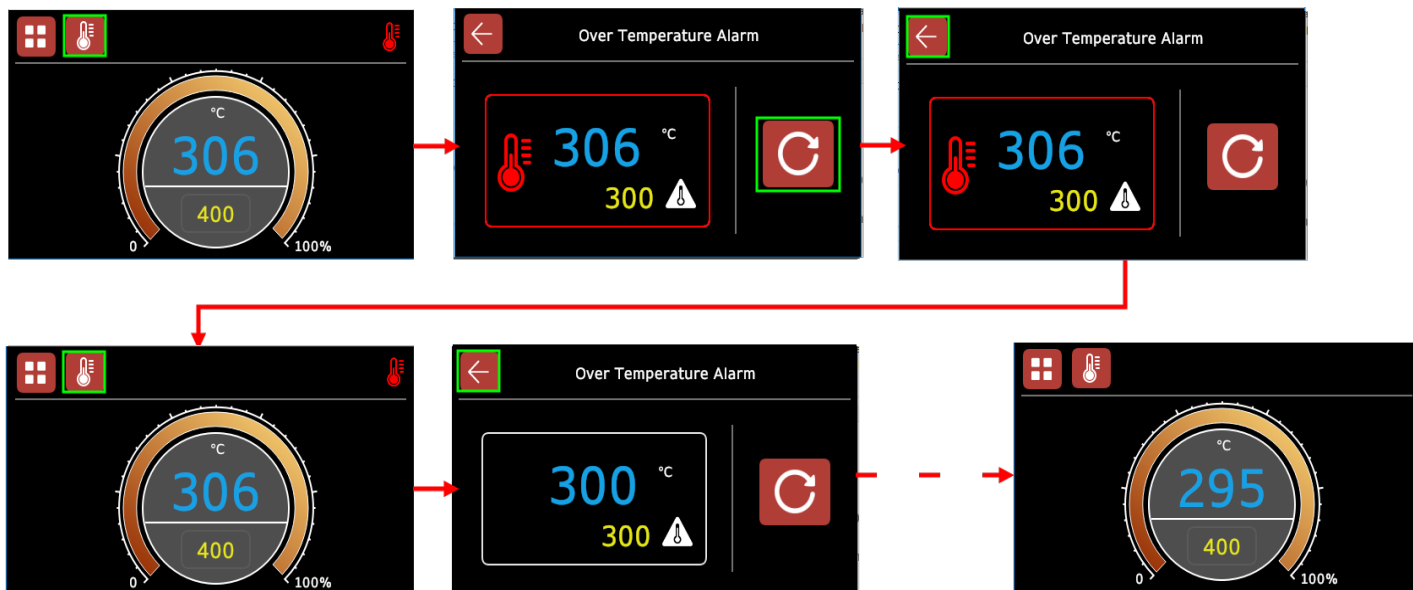
On all other screens, an "over-temperature alarm" icon will appear at the top of the screen to notify the user that the controller is now in an alarm state. The icon will flash until the over-temperature alarm is acknowledged.

The icon will remain on-screen until the temperature drops below the over-temperature setpoint and the over-temperature alarm has been reset and acknowledged.

To reset and acknowledge the over-temperature alarm:

1. Go to the **Over-Temperature Protection** screen. The box around the actual temperature and the over-temperature setpoint will be flashing red
2. Press the "Reset" button to acknowledge the alarm, and the box will stop flashing
  - If the alarm is acknowledged, but the temperature of the product is still above the over-temperature setpoint, then the box will remain red to indicate that the controller is still in an "alarm state", and the over-temperature alarm icon will remain on all other screens
  - If the alarm is acknowledged and the temperature of the product has dropped below the over-temperature setpoint, then the controller is no longer in an "alarm state", the red box will vanish, the over-temperature alarm icon will vanish from other screens, and the product will continue heating normally

The product will not continue to heat again until the actual temperature drops below the over-temperature setpoint.



*Resetting the Over-Temperature Alarm and Waiting for the Product to Cool*

## 7.0 Cascade Control

In standard products the main thermocouple is positioned closer to the heating elements, so the temperature measured may be a few degrees higher than the actual temperature around the material being heated (the load) within the main heated zone. For customers whose processes require a very high degree of accuracy, cascade control is a more precise method of temperature control.

### 7.1 Principles of Cascade Control

Within the controller there are two circuits that communicate with one another, known as "loops", and each loop is connected to its own thermocouple. The Load Loop measures the temperature as close to the load as possible, and the Heating Element Loop measures the temperature of the heating elements.

The operator sets the desired setpoint of the load which prompts the Load Loop to request heat from the Heating Element Loop. The Heating Element Loop responds by applying power to the heating elements.

As the temperature of the load nears the desired setpoint, the Load Loop will signal to the Heating Element Loop that less heat is required to achieve the setpoint, and the controller will adjust the amount of power supplied to the heating elements in order to achieve accurate control of the load temperature.

### 7.2 Cascade Control Operation

The operation of the CC-T1 with optional cascade control follows the same principles as the standard model, however there are some visual differences to screens. The Home screen displays actual temperature readings for both control loops. The temperature of the load is always at the top the screen, and the temperature of the heating elements is displayed below, beside the orange heating element temperature icon.

The heating element temperatures displayed will be significantly higher / lower than the load setpoint and will increase / decrease in line with the power demand.

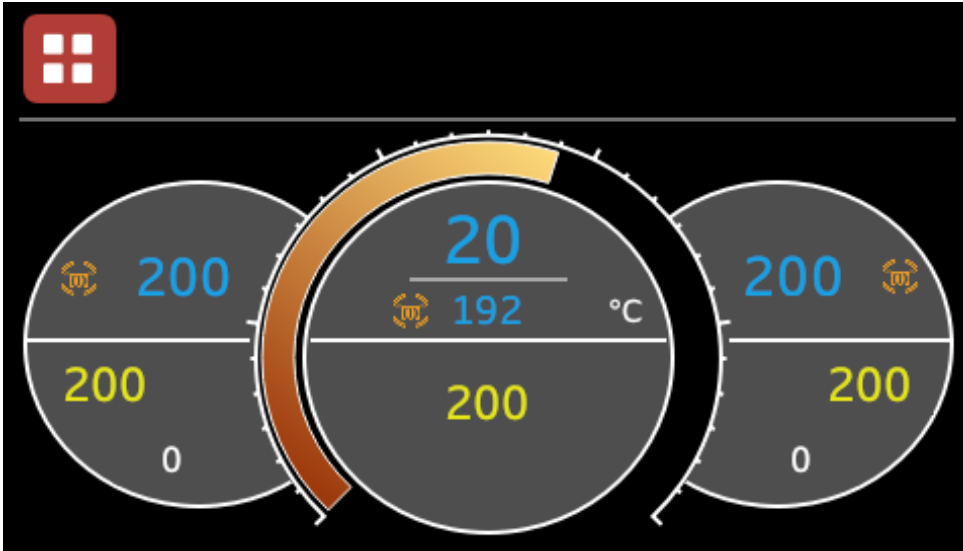
**Note:** In 3-Zone products, each heated zone has its own thermocouple which measures the temperature of the heating elements. The fourth thermocouple is the dedicated load thermocouple and is typically located in the central heated zone; thus, only the central heated zone shows both the load temperature and the heating element temperature. The endzones display only their respective heating element temperature.

### 7.3 Operation with Cascade Thermocouple Removed

If the Load Thermocouple is removable, leave it in the furnace or oven chamber whenever possible. Operating the product 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.

It is possible to operate the furnace when the probe thermocouple is outside of the heated zone, however the operator must set the Trim parameter value to **0** on the Cascade Controller Settings screen (see section 15.0).

The Home screen display will show the heating element loop temperatures as expected, however the load temperature displayed will be closer to ambient.



3-Zone Cascade Control with Cascade Thermocouple removed from Heated Zone

**Note:** The probe thermocouple must not be disconnected as this will register as a sensorbreak, and the controller will stop the product from heating.

### 7.4 Trim Values

The Trim value sets the maximum difference allowed between the load temperature and the heating element temperature. The "Trim" is applied as a  $\pm$  percentage value, so if the parameter is set at "10", the heating element temperature cannot be any higher or lower than 10% of the maximum temperature of the product.

Maximum Temperature of Product (°C)	Recommended Trim Value (%)
300	10
800	7
1200	5
>1200	2

**Note:** The values above are guidelines based on typical use. If a dense volume of material is to be heated, a higher Trim value is recommended.

Please see section 15.0 for instructions on how to adjust Trim values.

## 7.5 Sensorbreak

### 7.5.1 Control Thermocouple

If a thermocouple becomes disconnected, or fails, the controller will display the "Sensorbreak" error message, indicating that the thermocouple is unable to read a temperature.

The controller will automatically switch to display a "high point" value i.e. the maximum temperature the product is configured to achieve, and further heating will be prevented.

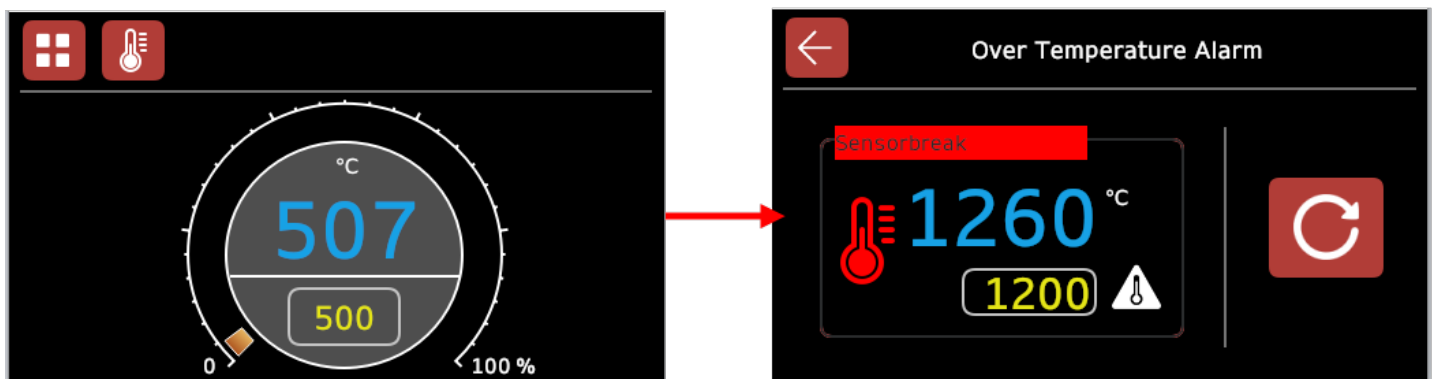
**Note:** If any alarm relay outputs are configured, then the icons for these will also appear on-screen



*Control Thermocouple Sensorbreak Error Display*

### 7.5.2 Over-Temperature Thermocouple (if fitted)

If an over-temperature controller is fitted and the thermocouple becomes disconnected, or fails, then the controller will go into an over-temperature alarm state. This is triggered because the thermocouple reading automatically defaults to the "high point" parameter, which will always be above the maximum value for the over-temperature setpoint. It is possible to acknowledge the alarm, but the product will not continue heating until the thermocouple is reconnected or replaced.



*Over-Temperature Thermocouple Sensorbreak Error Display*



## 8.0 Offset Calibration

After prolonged use the controller and/or thermocouple could require recalibration. A quick check using an independent thermocouple and temperature indicator should be made from time to time to determine whether full calibration is required.

For some processes the difference of just a few degrees can have negative implications, so it is highly important that temperature readings are as accurate as possible.

**Note:** All independent thermocouples and indicators should be calibrated and tested prior to use to avoid incorrect calibration of your Carbolite Gero product.

### 8.1 Single-Point Calibration

When using an independent thermocouple and temperature indicator, the difference between the readings on the product controller and the readings shown by the independent temperature indicator should be considered the potential offset value.

This method can also be applied if the user wishes to measure the temperature at a particular position of interest within the product, e.g. by their load / samples. The difference between the temperature read by the control thermocouple and the independent thermocouple by their samples could be calculated as the offset value.

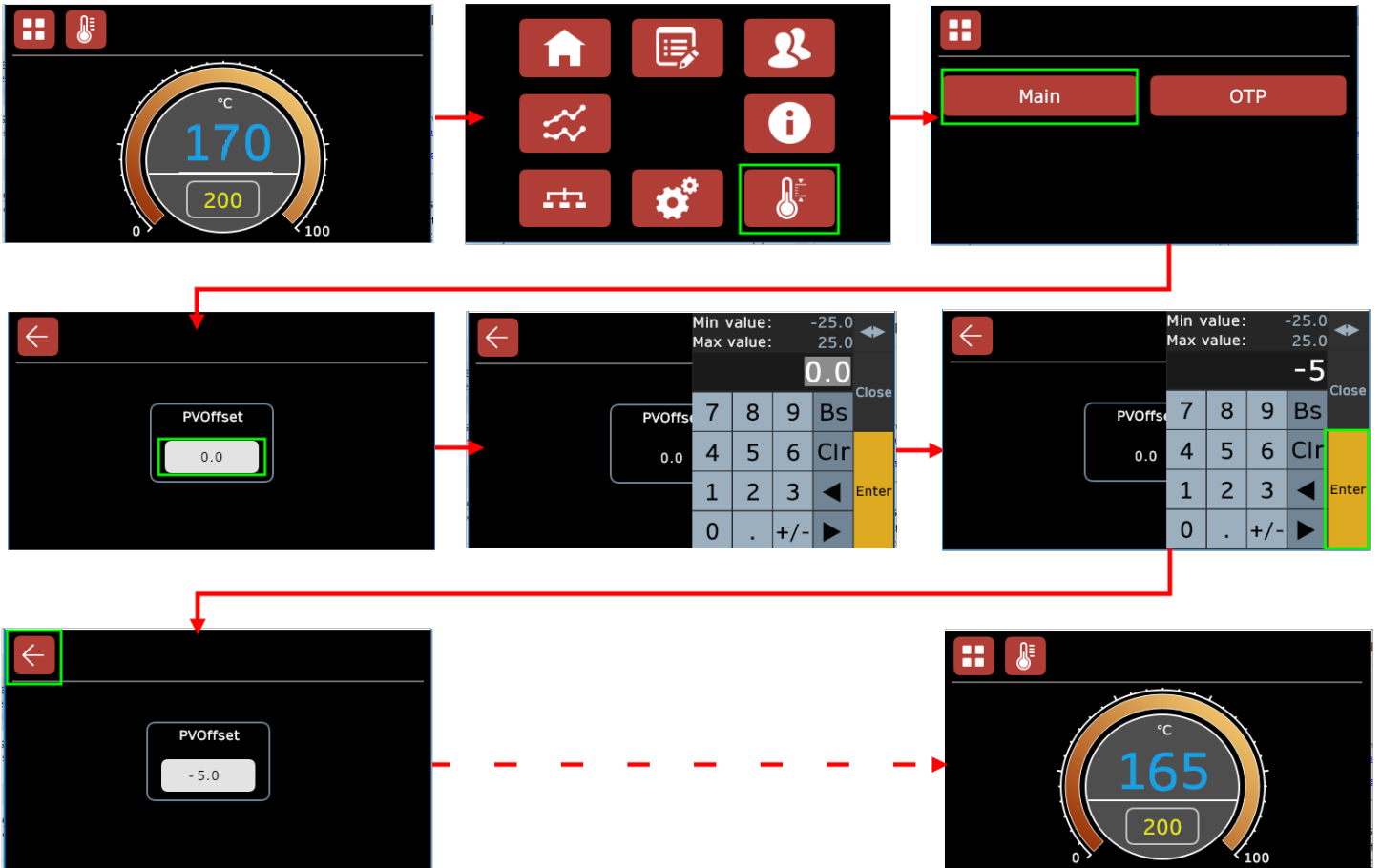
#### For example:

If the controller is displaying a temperature of 1080°C, and the independent thermocouple reads 1075°C, this means that the control thermocouple in the product is reading an extra 5°C. This would make the offset value **-5**, as the controller needs to display a temperature 5°C less than what it is currently displaying.

You can use the offset calibration function to adjust the temperature displayed on the controller so that it gives a more accurate reading to a maximum of **-25** or **+25**.

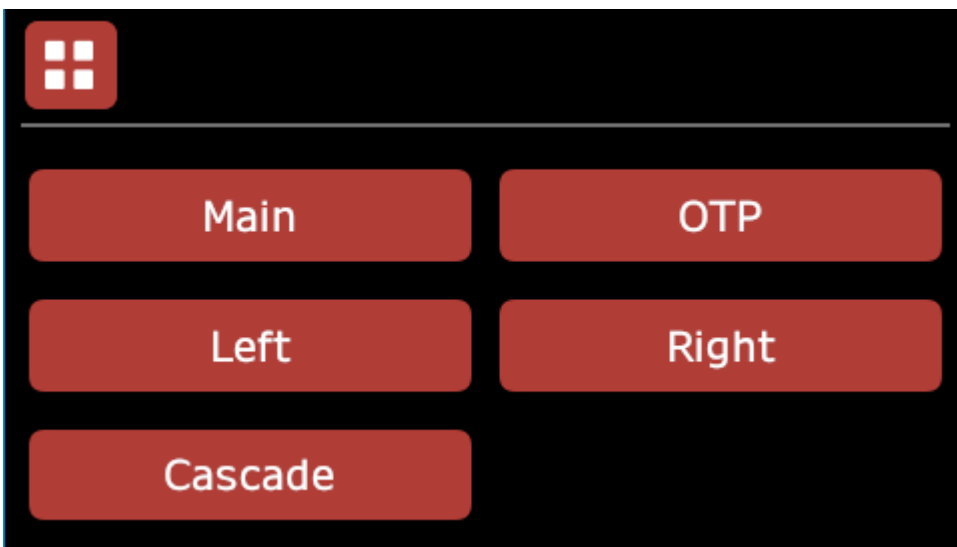
To do this:

- Go to the **Offset Calibration** screen from the **Navigation** screen
- Select the controller to which you want to apply an offset value
- Press on the "PVOffset" field to open up the keyboard
- Type your desired offset value
- Press "Enter"
- Return to the **Home** screen to view the amended temperature readings



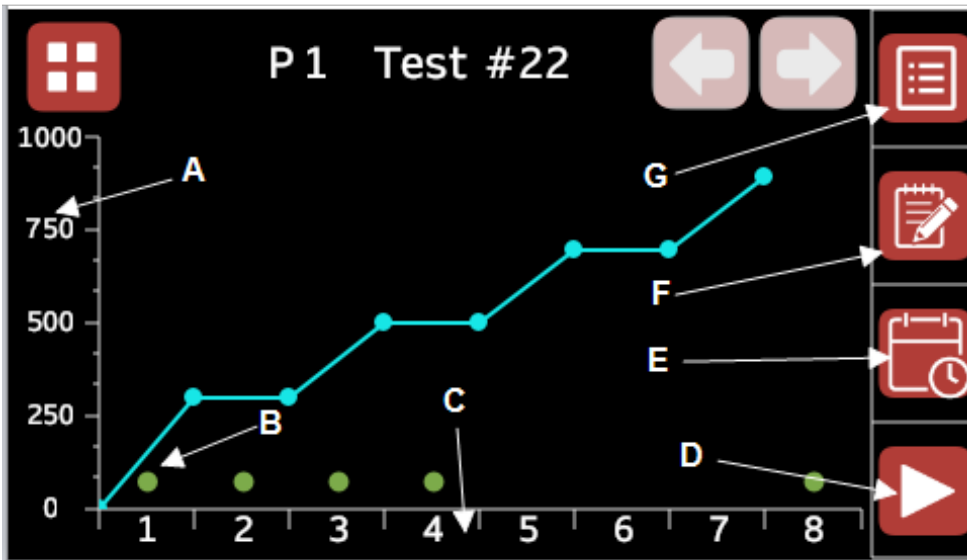
Setting an Offset Value

**Note:** Offset calibration values can be applied to all available controllers, including those configured for products with multiple heated zones. The relevant buttons will appear on the **Offset Calibration** screen.



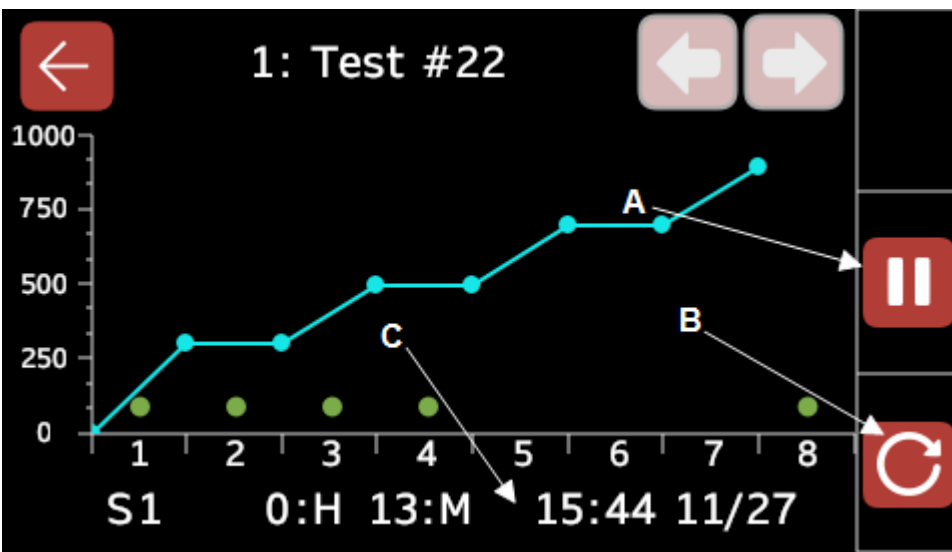
Offset Calibration Screen (3-Zone Configuration with Cascade Control and Over-Temperature Protection)

## 9.0 Programming



A	Temperature
B	Event Indicators
C	Segments
D	Start Program
E	Schedule Program
F	Edit Program
G	Program Select

Programming Screen when Logged in as "Supervisor" or "Admin"



A	Pause Program
B	Reset Program
C	Estimated completion details

Programming Screen when a Program is Running

**Note:** If previewing a longer program, the two arrow buttons at the top of the screen become enabled, allowing the user to scroll through the program overview.

## 9.1 Running a Program



To run a pre-configured program:

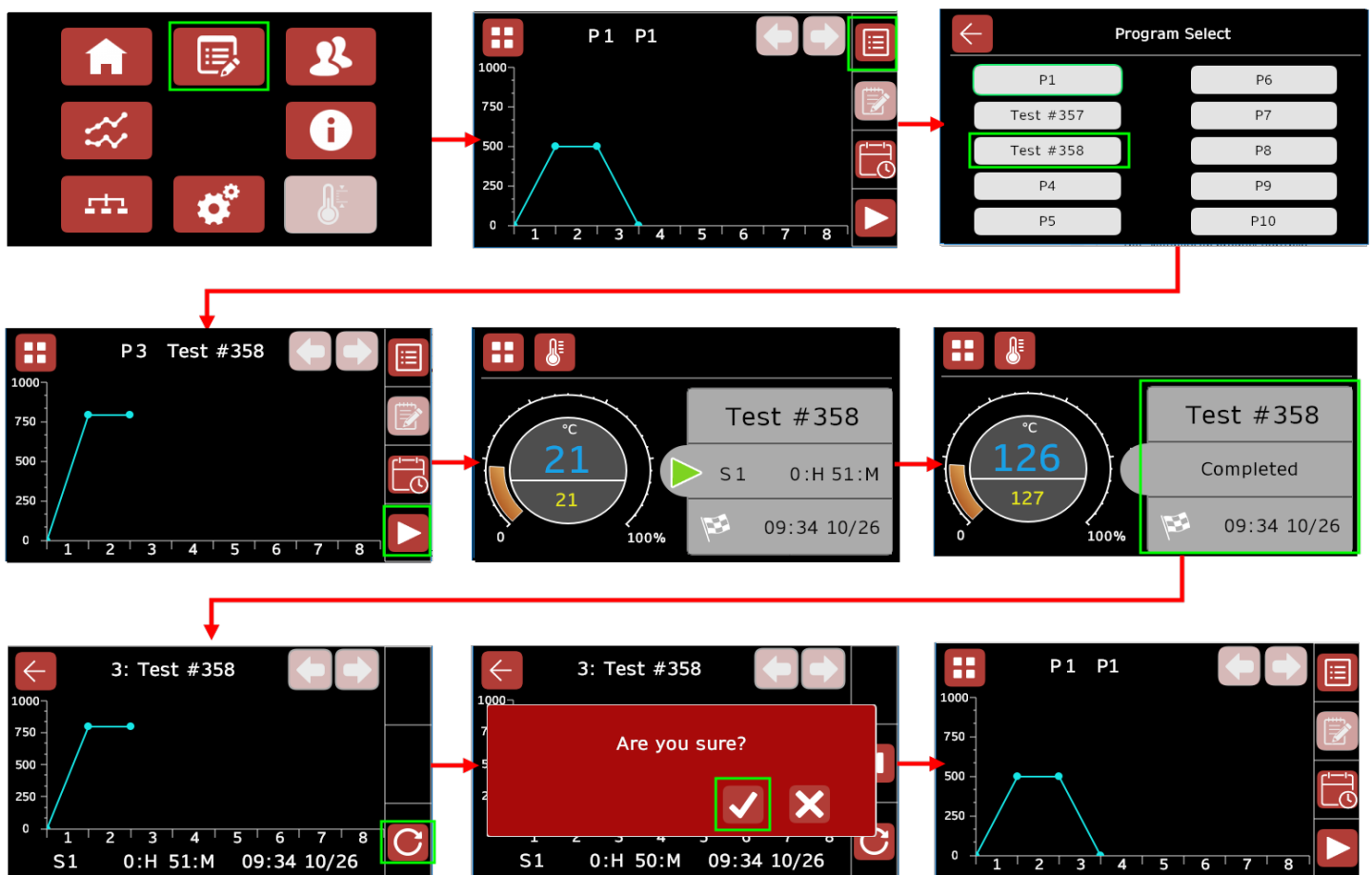
1. Go to the **Programming** screen
2. Press on the "Program Select" button to open the **Program Select** screen

3. Choose a program from the list. Once you have pressed on a program, you will be returned to the **Programming** screen
4. Press the "Start Program" button to run the program. The **Programming** screen will change to indicate that the program is running
5. You will be taken to the **Home** screen. Here you can view the program status and estimated completion time/date

**Note:** The estimated completion time will display a maximum of 500 hours, regardless of whether the program exceeds this duration. This estimate does not factor in the effect of holdback within a program.

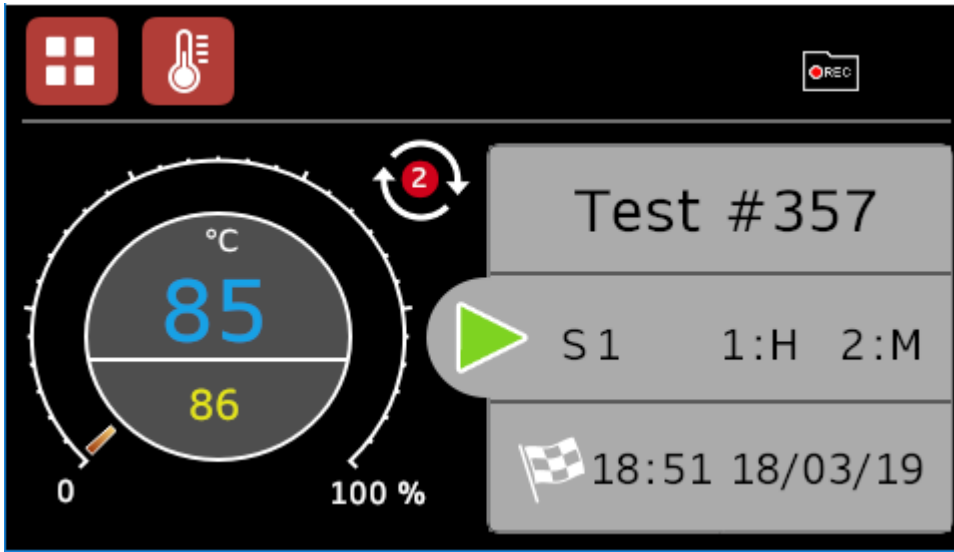
6. When the program has completed, press on the grey area on the right hand side of the screen to quickly return to the **Programming** screen
7. Press the "Reset" button to exit the program
8. A pop-up window will appear asking "Are you sure?". Press the tick button to reset

**Note:** If a program has been set to reset on completion, you should not have to perform step 6

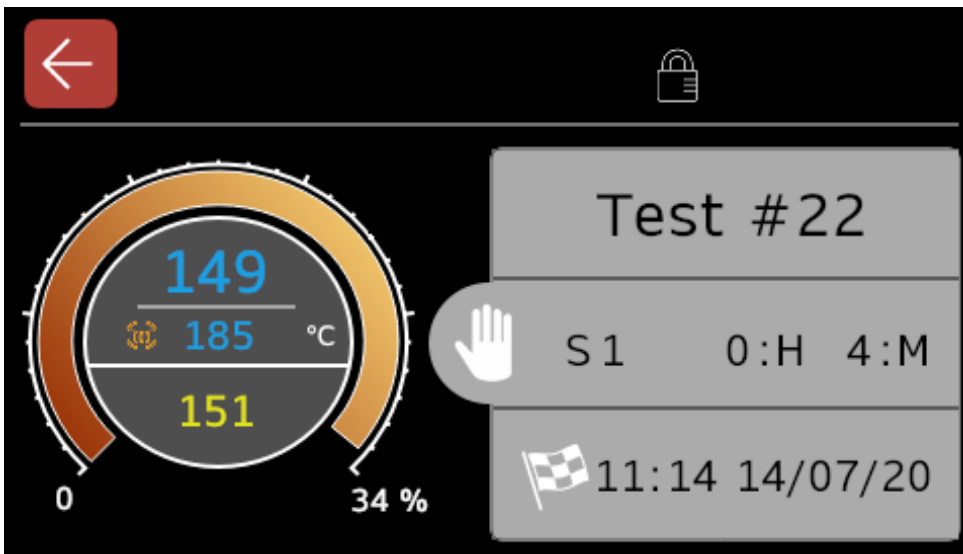


Running a Program (Single-Zone)

If a program is configured to run for two or more cycles, then the "Cycle Countdown" icon will appear on the **Home** screen, displaying the number of program cycles remaining.



*Running a Program with 2 Cycles Remaining*

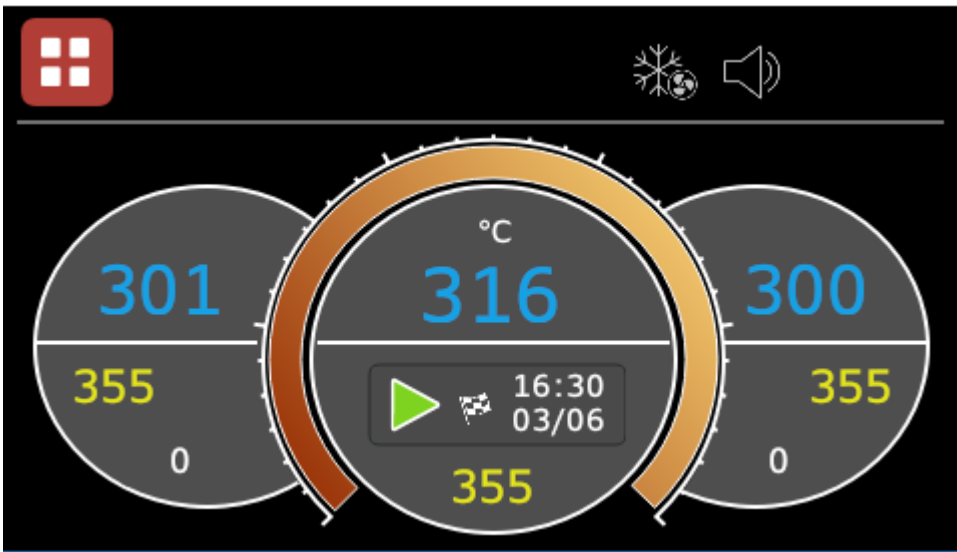


*Running a Program with Cascade Control*

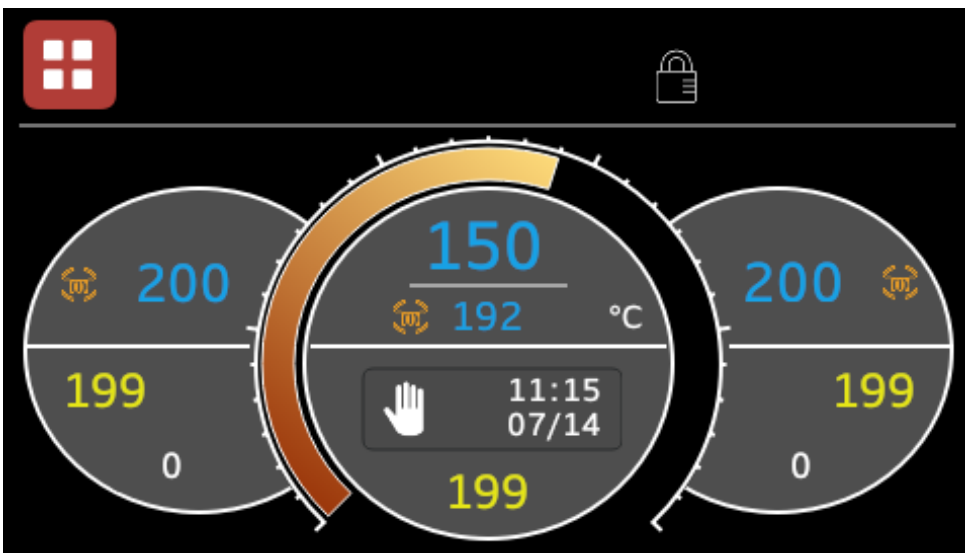
**Note:** If your controller is configured for use with multiple heated zones, when you run a program, you will automatically be taken to the **Home** screen display for the main controller. Pressing the back button will take you to an overview of all controllers.

The main controller follows the program. If the "Retransmit" parameter is set to "On" in the **Controller Settings** screen, any additional controllers will follow the program setpoint. If the "Retransmit" parameter is set to "Off", the additional controllers can be used independently as simple temperature controllers.

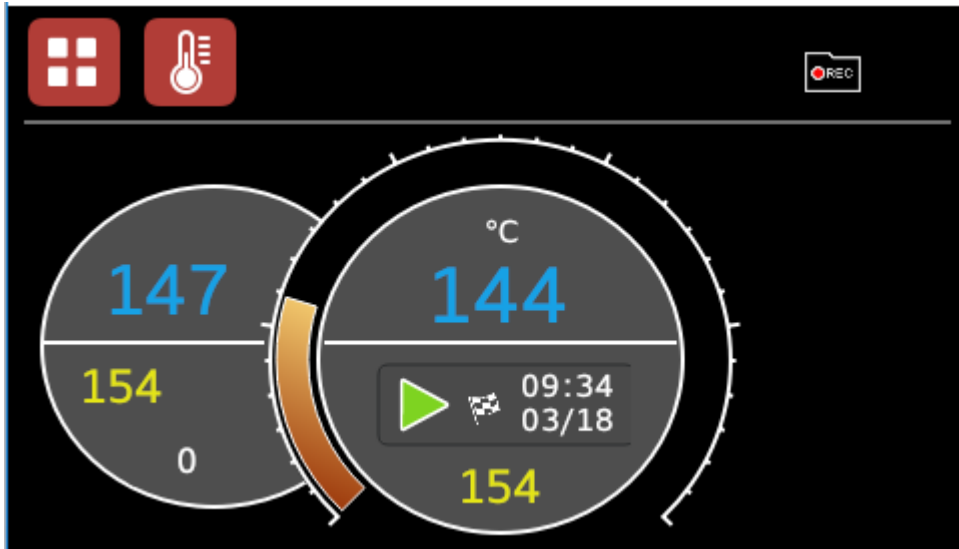
Please refer to the "Controller Settings" section of this manual for more information on setpoint retransmission in multiple-zoned products.



*3-Zone Configuration: Overview of All Controllers*



*3-Zone Configuration with Cascade Control*



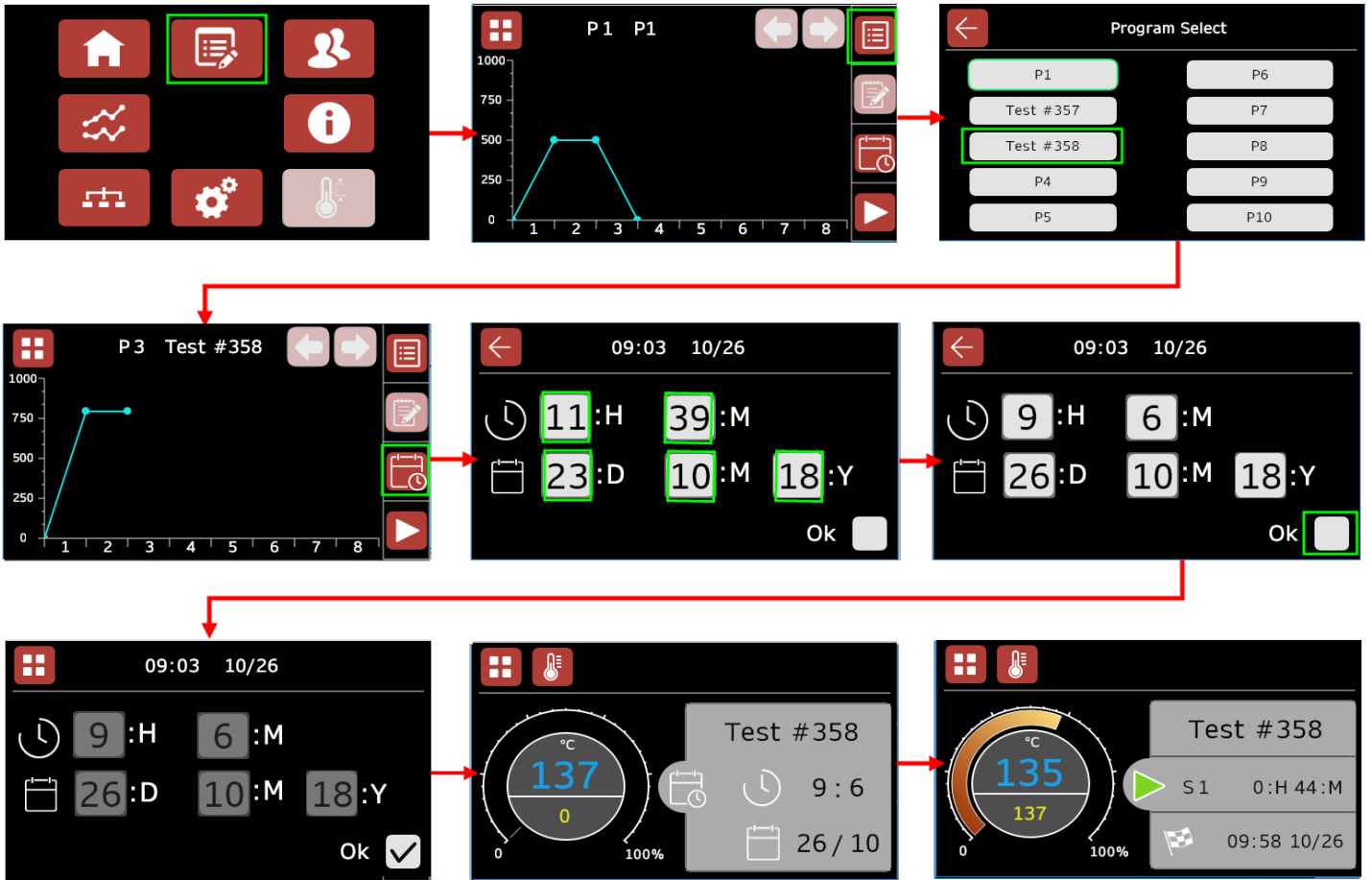
2-Zone Configuration: Overview of All Controllers

## 9.2 Scheduling a Program



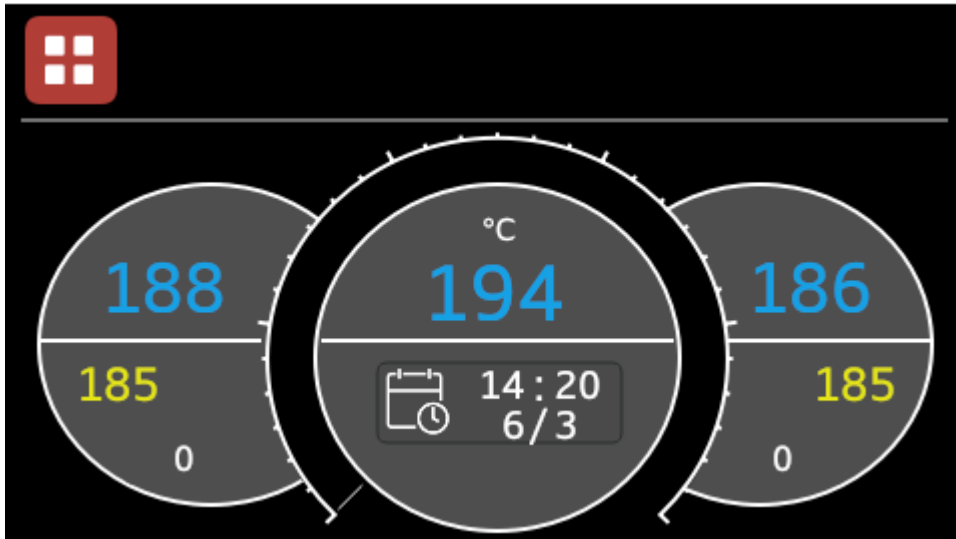
To schedule a program:

1. Go to the **Programming** screen and select the program you wish to schedule from the **Program Select** screen
2. Press the "Schedule Program" button to open the **Schedule Program** screen
3. Press on the grey fields to open the on-screen keyboard, then input the time and date that you wish the program to start running
4. Select "Ok" to confirm
5. Navigate to the **Home** screen to view the status of the scheduled program
6. The program will start running at the scheduled time and date



Scheduling a Program (Single-Zone)

**Note:** If your product is configured for multiple heated zones, when you schedule a program and navigate to the **Home** screen, you will see an overview of all controllers, including program scheduling information. Pressing on the main controller display will show more details, as seen on the single-zone version.



*Schedule Program (3-Zone Overview)*

### 9.3 Creating a Program



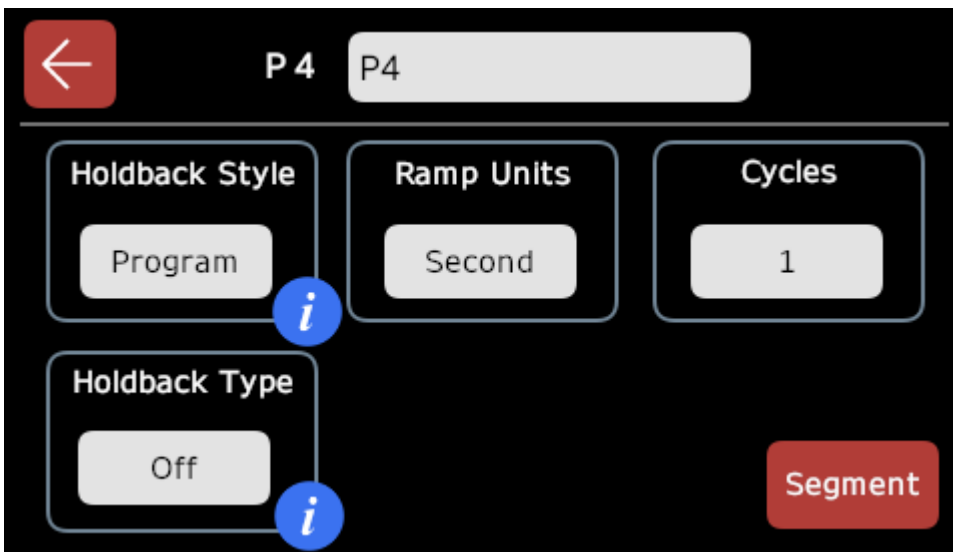
**Note:** To create or edit a program, you must first be logged in at the **Supervisor** or **Admin** user level. See the "User Levels" section for instructions on how to change user level.

**Note:** To edit a program, select an existing program and follow the same method as described for creating a program.

To create a program:

1. Go to the **Programming** screen
2. Press the "Program Select" button to open the **Program Select** screen
3. Choose an empty program slot and you will be returned to the **Programming** screen
4. Press the "Program Edit" button to open the **Global Program Edit** screen and begin creating the program

### 9.3.1 Global Program Edit Screen




*Global Program Edit Screen*

Firstly, you will need to set parameters that will apply to the entire program. The following table describes the parameters and their potential use:


Parameter	Description/ Use
Program Name	You can customise the program name, by pressing in the field at the top of the screen (maximum of 10 characters)
Holdback Style	Used to define whether the same holdback settings should apply for the entire program, or whether they can be defined for each individual segment <ul style="list-style-type: none"> <li>• If the "Program" style is selected, you will be able to set parameters for "Holdback Type", "Holdback Value", "Ramp Units" and "Program Cycles"</li> <li>• If the "Segment" style is selected, you will only be able to set parameters for "Ramp Units" and "Program Cycles" on the <b>Global Program Edit</b> screen</li> </ul>
Holdback Type	Used to define the Holdback Type for the entire program <ul style="list-style-type: none"> <li>• Off – holdback does not operate</li> <li>• Low – holdback operates only during heating</li> <li>• High – holdback operates only during cooling</li> <li>• Band – holdback operates during both heating and cooling</li> </ul>
Holdback Value	Sets the number of degrees (°C / °F / K) by which the program can run ahead of the actual temperature before holdback operates and prevents further heating or cooling (only visible when a holdback type is selected)
Ramp Units	Used to define whether the ramp units are °C per second, °C per minute, or °C per hour.

	(This logic also applies to controllers configured to display °F or K)
Program Cycles	How many times the program is set to run (with a minimum value of 1). If the program is set to run for 2 or more cycles, the "Cycle Countdown" icon will appear on the <b>Home</b> screen, displaying the number of program cycles remaining


**Note:** If a value has a blue "More Information" icon beside it, pressing on it will open a screen explaining that value.



### Holdback Style

Holdback prevents the program setpoint from running 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 actual temperature, before holdback operates. When holdback is operating, this icon  will flash.

*More Information: Holdback Style*



### Holdback Type

Holdback type can be set to one of the following:

- \* Off = holdback does not operate
- \* Low = holdback operates only during heating
- \* High = holdback operates only during cooling
- \* Band = holdback operates during both heating & cooling

*More Information: Holdback Type*

### 9.3.2 Segment Edit Screen



*Segment Edit Screen for "Rate" Segment Type*

1. When you have set all the parameters on the **Global Program Edit** screen, press the "Segment" button to open the **Segment Select** screen and start editing the individual segments within the program
2. Press on a segment section to open the edit screen for that segment
3. On the **Segment Edit** screen for each segment, press the "Segment Type" button to open a pop-up window showing all the possible segment types
4. Select the segment type. This will then unlock further parameters relevant to your chosen segment type
5. To set values, press on the grey fields. Some fields may require multiple presses to toggle values on or off, others will open a keyboard when nominal values are required.



*Segment Type Selection Screen*

The following table details the parameter options for each segment type:

Segment Type	Parameters	Description/ Use
End	Event Output (optional)	Select an "event" to occur during that segment e.g. turn on a solenoid valve, turn on a fan etc.
	Program End	Select how you want the program to end: <ul style="list-style-type: none"> <li>• <b>Dwell</b> - maintain the temperature achieved by the previous segment until the user manually intervenes to reset the program</li> <li>• <b>Reset</b> - stop the program automatically and return to basic controller mode</li> <li>• <b>Track</b> - if using iTools software to set programs, you will have the option of "Track". The CC-T1 does not support this parameter, and it should not be used with any Carbolite Gero product.</li> </ul>
Rate	Event Output (optional)	Select an "event" to occur during that segment e.g. turn on a solenoid valve, turn on a fan etc.
	Target Setpoint	The desired temperature the controller should reach for that segment
	Ramp Rate	The amount of degrees (°C /°F / K) the temperature should increase per second/minute/hour (dependent on "Ramp Units" parameter set at the <b>Program Edit</b> screen
Time	Event Output (optional)	Select an "event" to occur during that segment e.g. turn on a solenoid valve, turn on a fan etc.
	Time to Target	The desired time (in hours, minutes and seconds) that the user wants the controller to take to reach the desired setpoint
	Target Setpoint	The desired temperature the controller should reach for that segment
Dwell	Event Output (optional)	Select an "event" to occur during that segment e.g. turn on a solenoid valve, turn on a fan etc.
	Duration	The length of time (in hours, minutes and seconds) that the controller should maintain the temperature achieved by the previous segment in the program
Step	Event Output (optional)	Select an "event" to occur during that segment e.g. turn on a solenoid valve, turn on a fan etc.
	Target Setpoint	The desired temperature the controller should reach for that segment

Call	Call Cycles	Select how many times the called program should run before moving onto the next segment of the current program
	Call Program	Select a different program to run when the current program reaches the "Call" segment <div style="border: 1px solid black; padding: 5px; margin-top: 10px;"> <p><b>Note:</b> You can only call a program that is higher in the program slot sequence than the current program, e.g. if you are creating a program in program slot "P4", you can only call programs 5-10; you cannot call programs 1, 2, or 3.</p> </div>

**Note:** When the "Holdback" parameter is set to "Segment" on the **Global Program Edit** screen, the "Holdback Type" and "Holdback Value" parameters will appear on the **Segment Edit** screen, in addition to the values in the table above.

6. When you have set the parameters within a segment, press the "Back" button to return to the graph view, and select the next segment. You can configure up to **24** segments per program. Two arrow keys are enabled when the third segment within the program has been set. These keys allow the user to navigate to and from the next set of available segments
7. When you have finished configuring your program, press the "Back" button to return to the **Programming** screen. Your program will now be available to all users on the **Program Select** screen



Creating a Program for a Product with 2 Program Segment Outputs Configured

## 9.4 Editing a Program

To edit a program you have already configured:

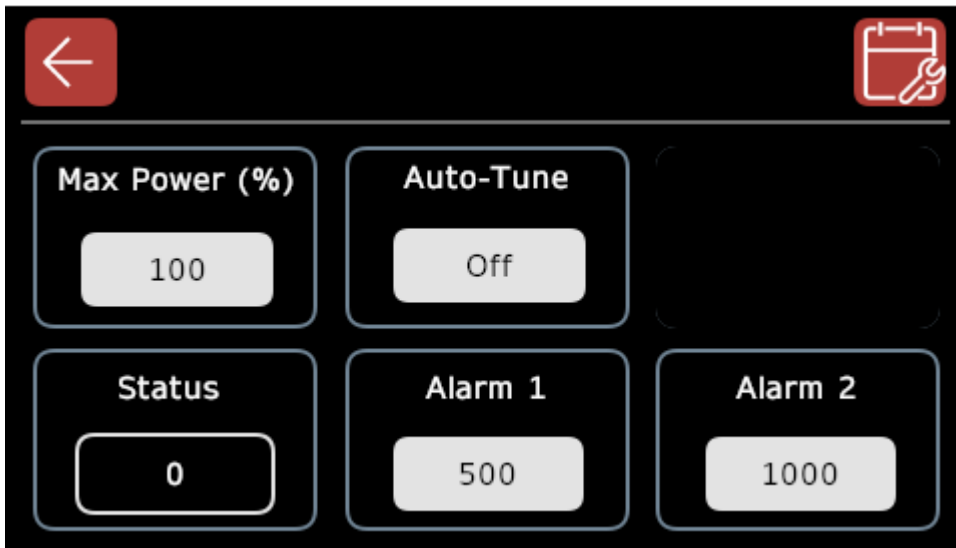
1. Go to the **Programming** screen
2. Press the "Program Select" button to open the **Program Select** screen
3. Press on the program you want to edit and you will be returned to the **Programming** screen
4. Press on the "Program Edit" button, and follow the method as described in the "Creating a Program" section of this manual

## 10.0 Alarm Relays (optional)

The CC-T1 has two available relays (electrically operated switches) that are used to control additional features and components, such as door locks, solenoid valves, fans and audible alarms; they can also be used to control external equipment if necessary.

Relays can be set to trigger during a particular point in a program (referred to as a program segment output) or when the product reaches a specific temperature:

- If a product is fitted with a door lock, this can be linked to a relay. The user can input a temperature at which the relay will trigger, e.g. if the temperature increases above 200°C lock the door. The door will remain locked until the temperature drops below 200°C. The alarm trigger temperatures can be set on the **Controller Settings** screen:









*Controller Settings Screen with 2 Alarms Configured*

**Note:** The Alarm 1 and/or Alarm 2 parameters are only available on the **Controller Settings** screen if you have ordered the alarm relay option.

The CC-T1 can be configured to have a maximum of:

- 2 x Program segment outputs (event output)  
**or**
- 2 x Alarm relays  
**or**
- 1x Program segment output and 1x Alarm relay

**Important:** If you did not order any program segment outputs, or you have ordered the CC-T1 with 2 alarm relays, then the "Event Output" parameter within the **Segment Edit** screen will be greyed out when creating or editing a program.

Icon	Relay
	Solenoid Valve
	Exhaust Fan
	Door Lock
	Cooling Fan
	Audible Alarm
	Relay (customer specified)

## 11.0 Data Logging

The data logging function allows users to log the setpoint, actual temperature, relay status, and download test data from the CC-T1 to a **.csv** file.

**Note:** To initiate data logging, always ensure that you have a formatted USB stick inserted into the control panel before the product is switched on.

There are two methods of data logging, automatic and manual:

- **Automatic** data logging can only be used when a program is running. Data logging ends automatically when the program completes or is reset
- **Manual** data logging can be used if a program is running, or the CC-T1 is being used as a simple temperature controller

### 11.1 USB Requirements

**IMPORTANT:** Any USB stick used with the CC-T1 **must be formatted in FAT32**, and be **no bigger than 32GB**.

It is recommended that the USB stick has an activity light to indicate when it is in use. For optimum results when data logging, the USB stick should be formatted between each logging session. Having any additional files on the USB stick prior to data logging could cause corruption, loss of data, and poor screen performance.

### 11.2 Data Logging Settings

The user can determine what information is to be recorded by amending the data logging settings.

**Note:** If your product has multiple heated zones, the data logging settings will apply to all configured controllers.

**Note:** The user must be logged in as "Supervisor" or "Admin" in order to change settings.

To change the data logging settings:

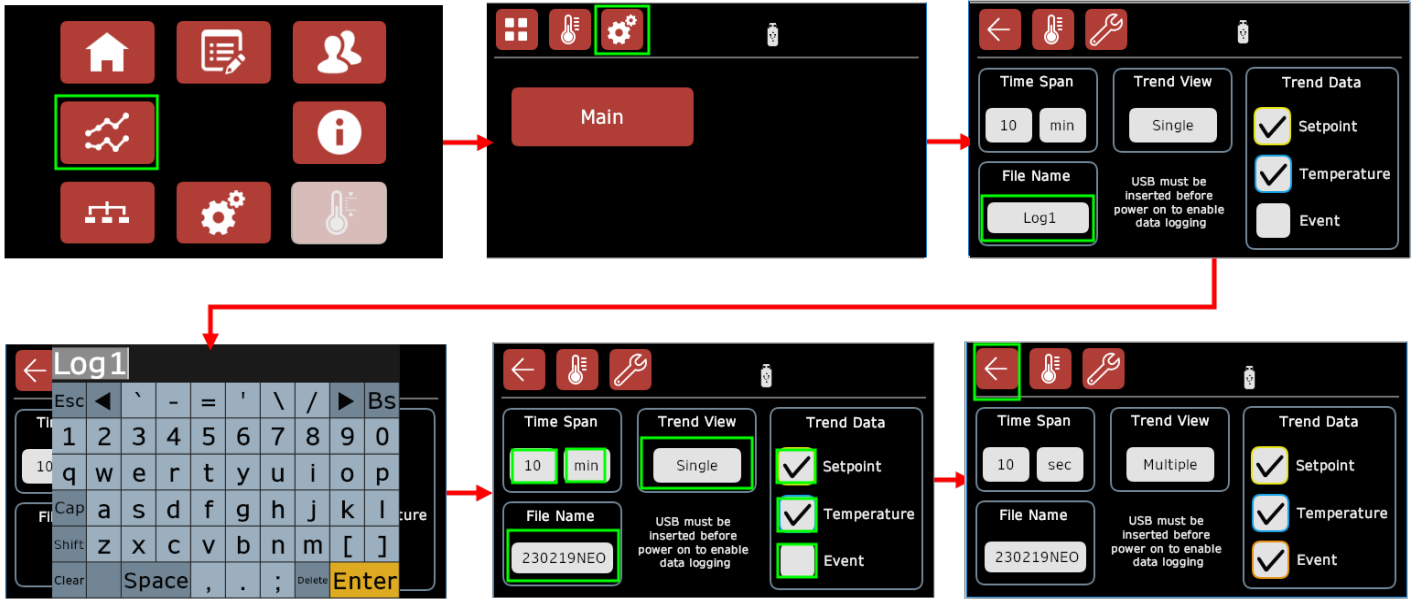
1. Go to the **Data Logging** screen
2. Press the "Settings" button to open the **Data Logging Settings** screen

The following table shows the available parameters:

Parameter	Description
Time Span	<p>The amount of elapsed time shown on the data logging graph.</p> <ul style="list-style-type: none"> <li>• <b>min</b> = minutes</li> <li>• <b>sec</b> = seconds</li> </ul> <p><b>Note:</b> The CC-T1 logs data every 10 seconds, so if the "Time Span" parameter is set to "10 min", there will be 60 log points displayed on the graph.</p>
Trend View	<ul style="list-style-type: none"> <li>• <b>Single</b> = All recorded data is shown on one graph</li> <li>• <b>Multiple</b> = Each piece of "Trend Data" is shown on its own individual graph</li> </ul>
File Name	<p>Allows the user to customise the file name of the <b>.csv</b> file to be downloaded.</p> <p><b>Warning:</b> Only use alphanumerical characters in the log file name. Any "special characters" (e.g. &amp;!_#) may cause errors when the log file is downloaded to a computer.</p>
Trend Data	<p>Allows the user to choose which data to record:</p> <ul style="list-style-type: none"> <li>• Setpoint</li> <li>• Temperature</li> <li>• Event (relay status)</li> </ul>

3. Once you have set the parameters, press the "Back" button to return to the **Data Logging** screen

**Note:** If a user with "Operator" permissions is scheduled to perform the data logging, it is recommended that you now logout to prevent any unwanted amendments to the data logging settings.



Changing the Data Logging Settings

## 11.3 Recording Data

**Note:** When recording data from products with multiple heated zones, if you select "Automatic" or "Manual" data logging for one controller, the same option will be applied to all other existing controllers.

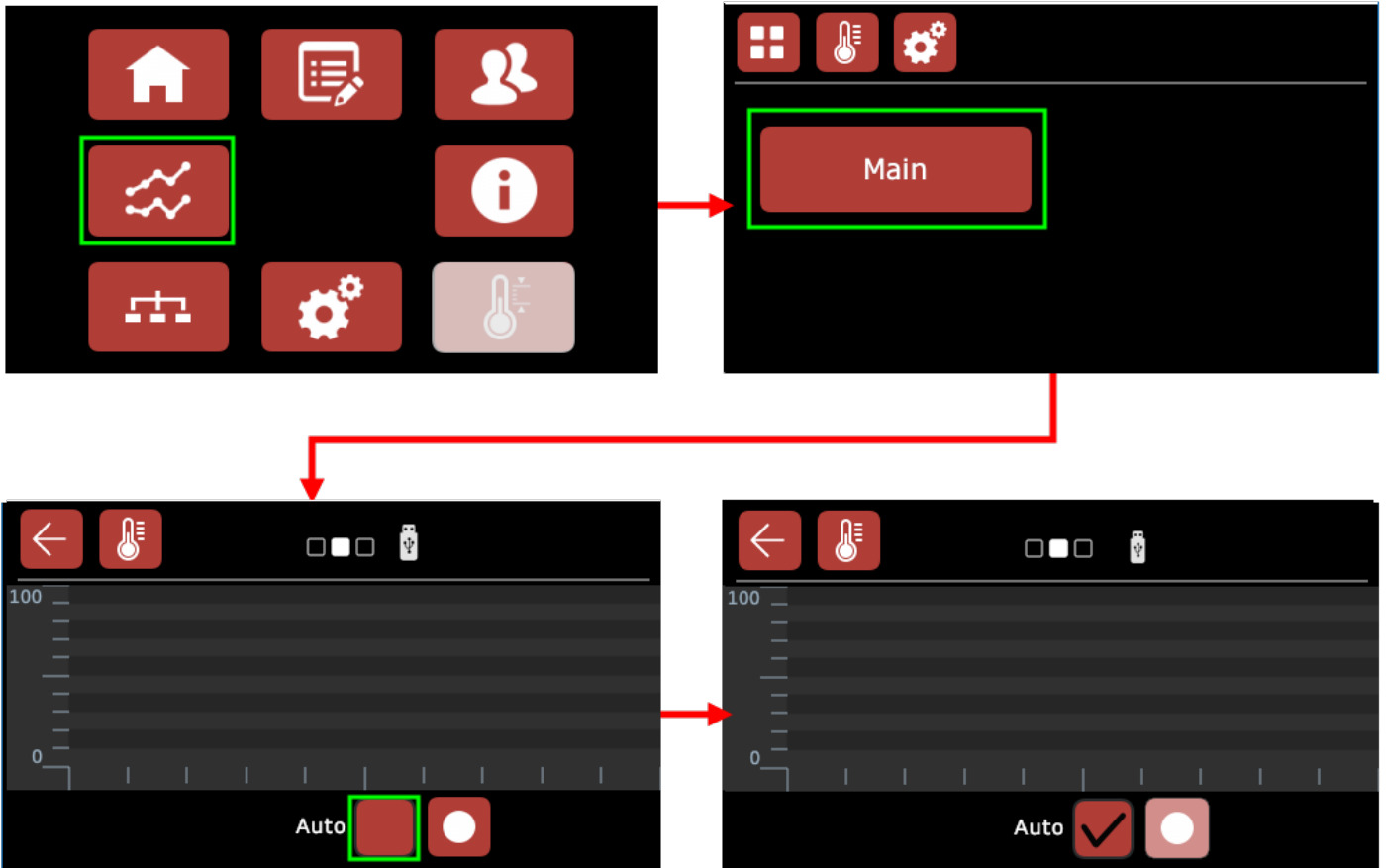
### 11.3.1 Automatic Data Logging



Automatic data logging only functions when a program is running. The logging starts when the program starts, and ends when the program is reset.

To log data automatically:

1. Login at the "Supervisor" or "Admin" user level
2. Go to the **Data Logging** screen
3. Press the "Main" button to go to the **Data Logging View** screen
4. Press the field next to "Auto" and a tick should appear. Manual data logging is now disabled and you can now logout of the "Supervisor" or "Admin" user level if required
5. Go to the **Programming** screen and run, or schedule, the program you wish to record. The data will now be automatically recorded



Setting Automatic Data Logging - User Level: Admin

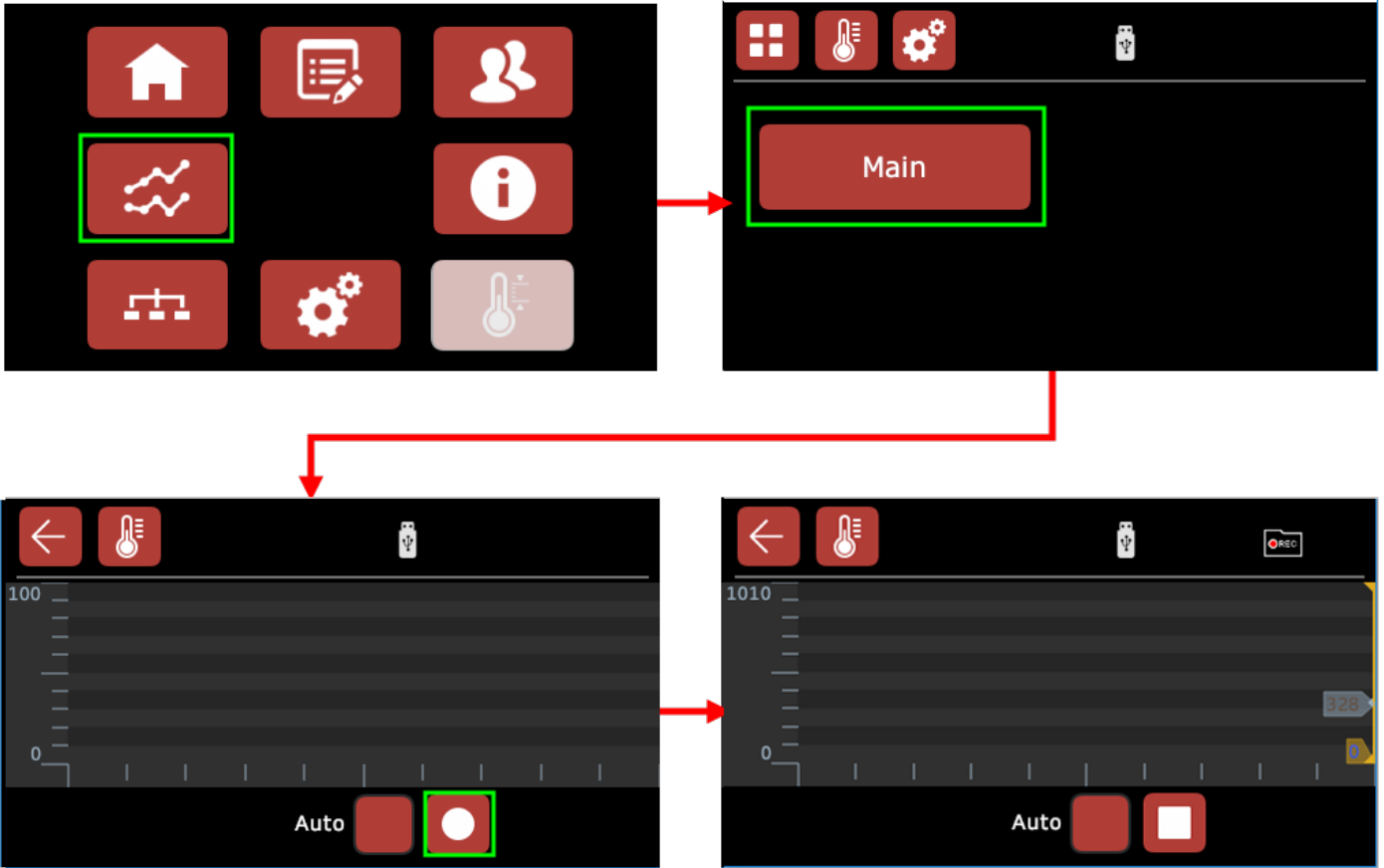
### 11.3.2 Manual Data Logging



Manual data logging can be used at any time, by any user level, when a program is running, or if the CC-T1 is being used as a simple temperature controller.

To log data manually:

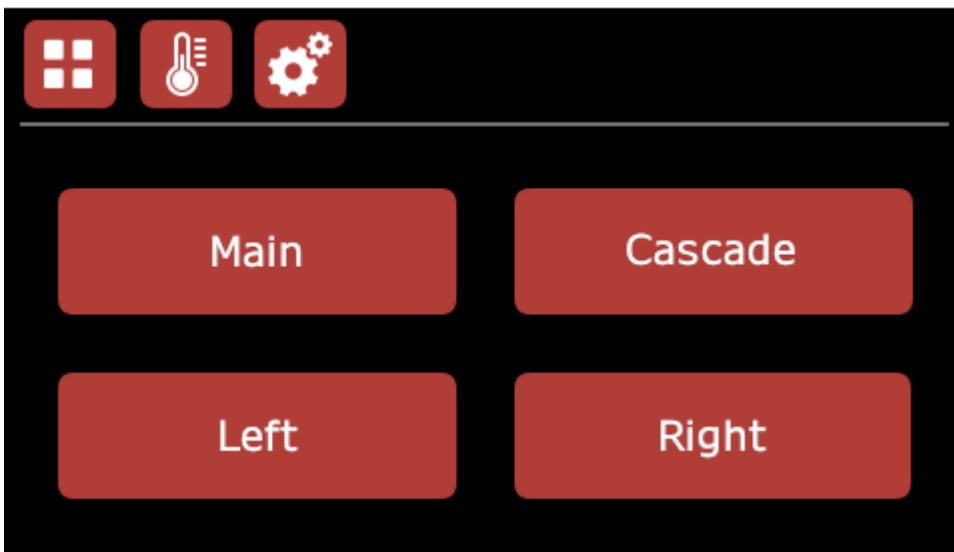
1. Go to the **Data Logging View** screen
2. Press the "Record Start/Stop" button. The symbol on the button will change from a circle to a square to indicate that data logging is in progress.
3. To stop data logging, press the "Record Start/Stop" button again. The symbol on the button will change from a square back to a circle



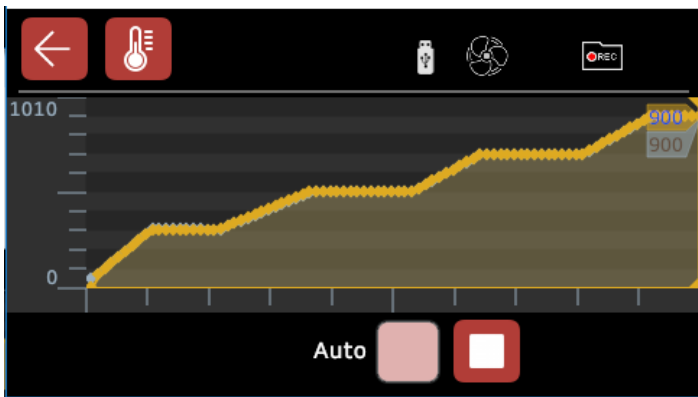
Setting Manual Data Logging - User Level: Operator

### 11.3.3 Data Logging Graph Views

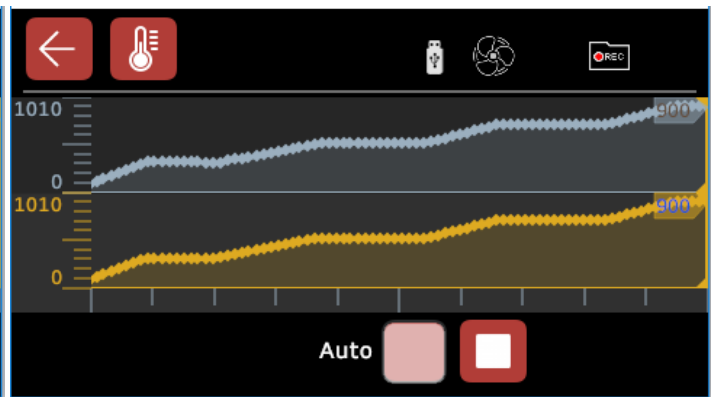
Pressing on any controller button on the **Data Logging** screen will take you to the graph view for that controller. Depending on the settings you have applied, the view can differ.



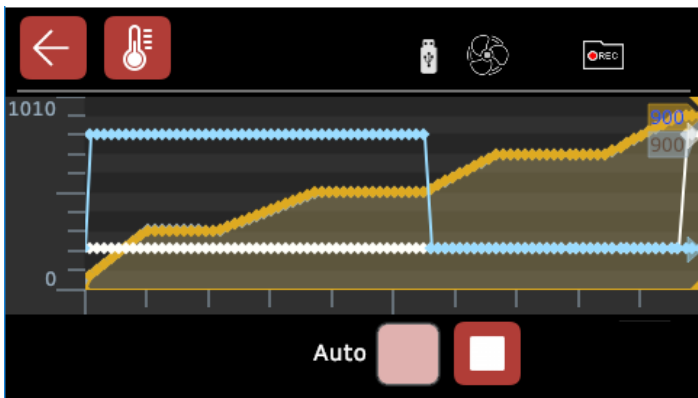
Data Logging Screen: 3-Zone Configuration with Cascade Control



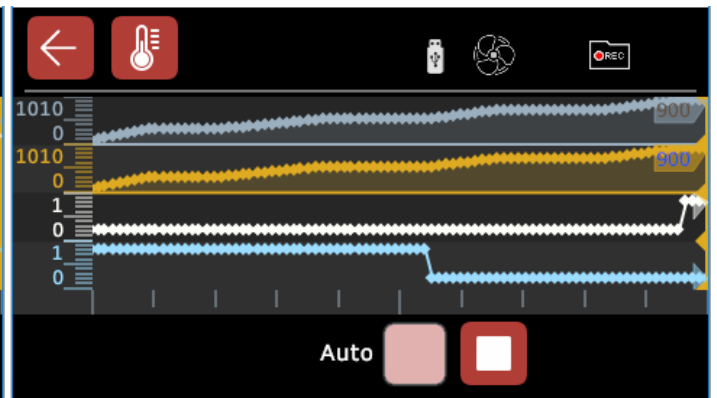
*Single View*  
 Trend Data: Setpoint, Temperature



*Multiple View*  
 Trend Data: Setpoint, Temperature



*Single View*  
 Trend Data: Setpoint, Temperature, Event



*Multiple View*  
 Trend Data: Setpoint, Temperature, Event

### 11.4 Downloading Data to USB

Data is logged directly to a **.csv** file on the USB stick **every 2 minutes**.

The Carbolite Gero USB stick will flash to indicate when data is being written to the **.csv** file. Once data logging has completed, you can remove the USB stick from the product.

**Note:** The controller will not store any recorded data between sessions.

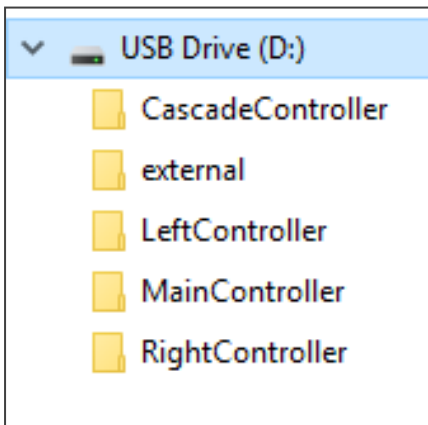
### 11.5 Opening Logged Data

The CC-T1 exports logged data in a comma separated file format (**.csv**), which can be opened on various operating systems using standard spreadsheet software.

**Note:** The following instructions and screenshots depict a Windows 10 operating system with Office 365 installed. Other versions of Windows and Microsoft Office may vary in appearance.

To access the data once it has been downloaded to the USB stick:

1. Remove the USB stick from the product
2. Insert the USB stick into a computer
3. Open the file structure. You will see a number of folders. Within each folder there will be the logged data in the form of a **.csv** file. Depending on the configuration of your CC-T1, some files may not contain data



4. It is recommended that you copy these folders and save them to a secure location on your computer. Format the USB stick to remove this data before using the USB stick for subsequent data logging
5. Double-click on the **.csv** file to open the data

	A	B	C	D	E	F	G	H	I	J	K	L	M
1	Date	Time	Main_Controller_PV	QF	Main_Controller_Working_SP	QF	Running_Program_Data.Event1	QF	Running_Program_Data.Event2	QF	Running_Program_Data.ProgramNumber	QF	Running_Program_Data
2	04/09/2019	08:17:28	67.45353699	0		0	0	0	0	0	0	4	0
3	04/09/2019	08:17:28	67.45353699	0		0	0	0	0	0	0	4	0
4	04/09/2019	08:17:38	67.41897583	0		0	0	0	0	0	0	4	0
5	04/09/2019	08:17:48	67.37454987	0	68.37878418	0	1	0	0	0	0	4	0
6	04/09/2019	08:17:58	67.44515991	0	70.08670044	0	1	0	0	0	0	4	0
7	04/09/2019	08:18:08	67.87723541	0	71.81544495	0	1	0	0	0	0	4	0
8	04/09/2019	08:18:18	68.74770355	0	73.36714935	0	1	0	0	0	0	4	0
9	04/09/2019	08:18:28	70.23947906	0	75.06465149	0	1	0	0	0	0	4	0
10	04/09/2019	08:18:38	72.28106689	0	76.78298187	0	1	0	0	0	0	4	0
11	04/09/2019	08:18:48	74.50041962	0	78.3451004	0	1	0	0	0	0	4	0
12	04/09/2019	08:18:58	77.15731812	0	80.07384491	0	1	0	0	0	0	4	0
13	04/09/2019	08:19:08	79.83393097	0	81.79217529	0	1	0	0	0	0	4	0
14	04/09/2019	08:19:18	82.15437317	0	83.3438797	0	1	0	0	0	0	4	0
15	04/09/2019	08:19:28	84.49856567	0	85.06221008	0	1	0	0	0	0	4	0
16	04/09/2019	08:19:38	86.47621155	0	86.77012634	0	1	0	0	0	0	4	0
17	04/09/2019	08:19:48	88.24125671	0	88.48845673	0	1	0	0	0	0	4	0

**Note:** Columns headed **QF**, **QF\_1** etc. contain zero values and can be ignored or deleted.

## 12.0 Ethernet Connections

If you want to monitor functions, create programs or load any existing programs into the CC-T1 via Eurotherm's iTools Engineering Studio software, you will first need to establish a connection between the controller and the computer. This can be achieved via ethernet.

Each controller module within the CC-T1 has its own IP address. Depending on the configuration of your product, you may have all, or just a subset of the following:

Controller Module	IP Address
Cascade (cascade control option only)	192.168.111.221
Main	192.168.111.222
Over-Temperature (if fitted)	192.168.111.223
Left End Zone (3-zone models only)	192.168.111.224
Right End Zone (3-zone models only)	192.168.111.225

You can use an Ethernet-to-USB adapter to connect a product directly to a single computer (see section 13.0).

**Note:** Ethernet-to-USB adapters must be configured with IP addresses **different** to those of the controller modules in order to establish a successful iTools connection.

Alternatively, you can connect a product to an existing ethernet network to enable remote access.

**Important:** Because the IP addresses of the controller modules are preconfigured and cannot be changed, if you wish to connect a CC-T1 controller to an ethernet network, the use of an additional ethernet router is required to enable the user to identify the correct product.

A preconfigured router can be ordered from Carbolite Gero, to be connected between the product and the ethernet network.

Separate connection instructions are provided with the router. Please contact your organisation's IT department for assistance during setup.

## 13.0 Connecting via Ethernet to USB Adapter

An ethernet to USB adapter creates a single direct connection between a product and a computer. The product can only be monitored and controlled locally from that device.

If it is necessary to monitor a product remotely, an ethernet router is required.

Before connecting to the product, ensure that the ethernet to USB adapter has been configured with an appropriate IP address. Contact your IT specialist for assistance.

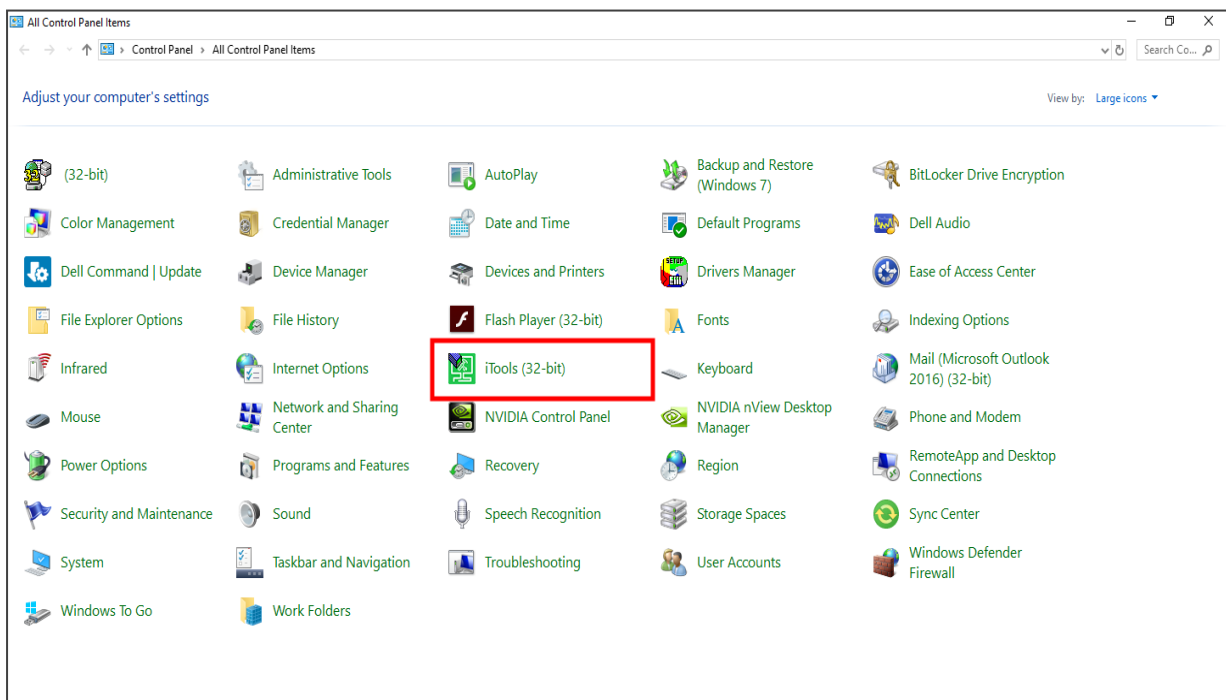
**Note:** Ethernet-to-USB adapters must be configured with IP addresses **different** to those of the controller modules in order to establish a successful iTools connection. Do not use IP address 192.168.111.100. For a list of controller IP addresses, see section 12.0.

### 13.1 Making a Connection via iTools

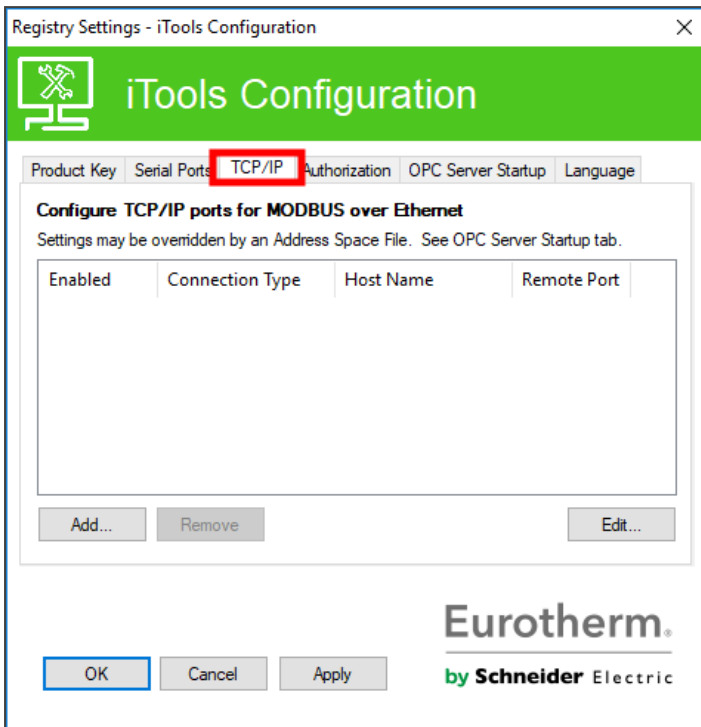
**Note:** To make a connection via iTools, you will first have to input the IP addresses of each controller module within the CC-T1 set up, into the iTools configuration settings.

To do this:

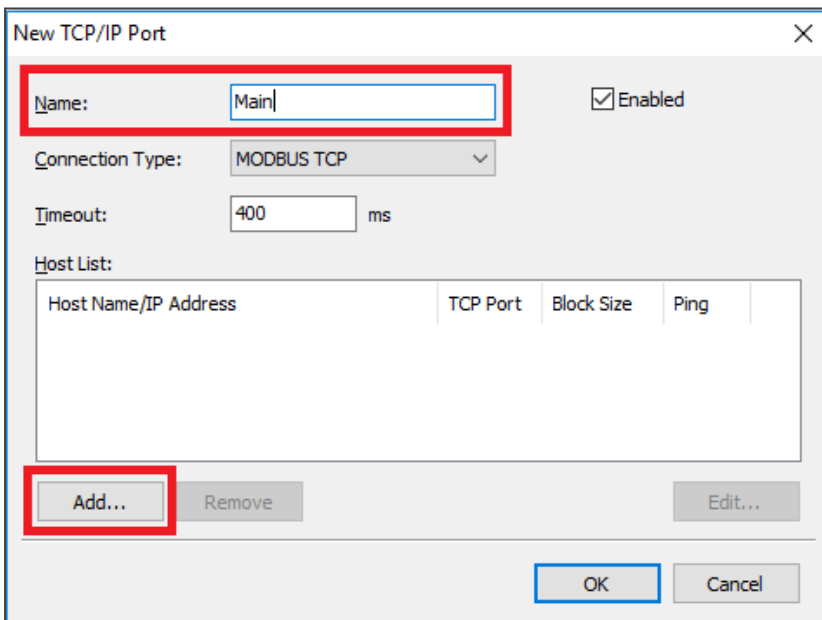
1. From the Control Panel of your computer, open **iTools (32-bit)**. The **Registry Settings - iTools Configuration** window will open



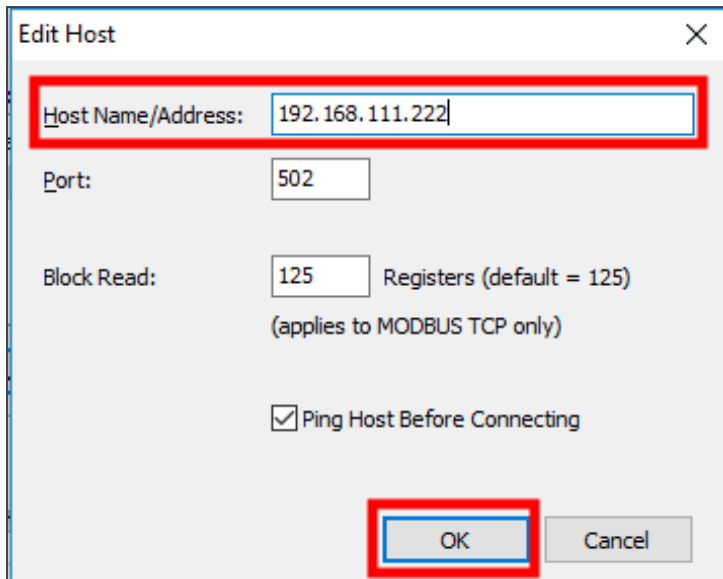
2. Select the **TCP/IP** tab and click **Add...**. The **New TCP/IP Port** window will open



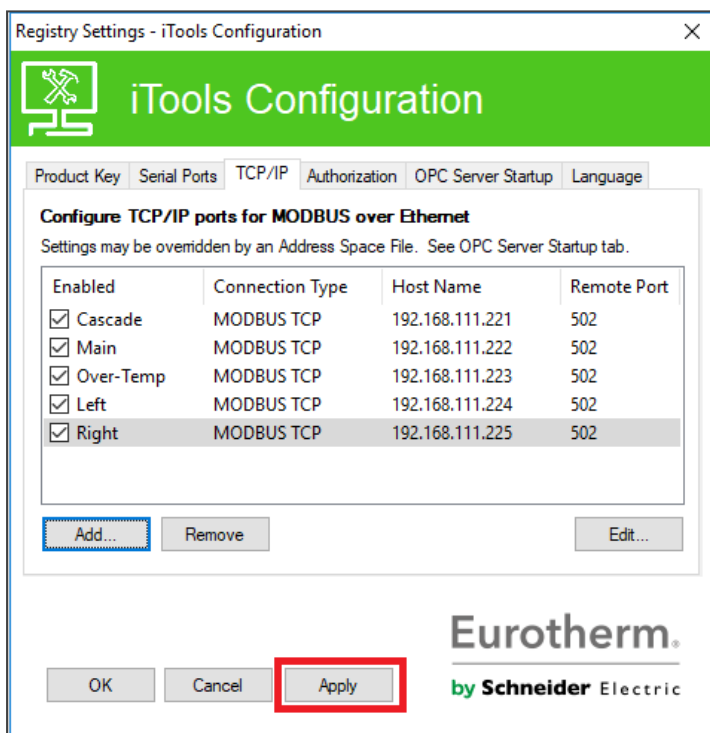
3. Name your new connection port; for this example, the connections have been named after their respective controller modules



4. Click **Add...**
5. In the **Host Name/Address** field, type the IP address for the controller module you want to add



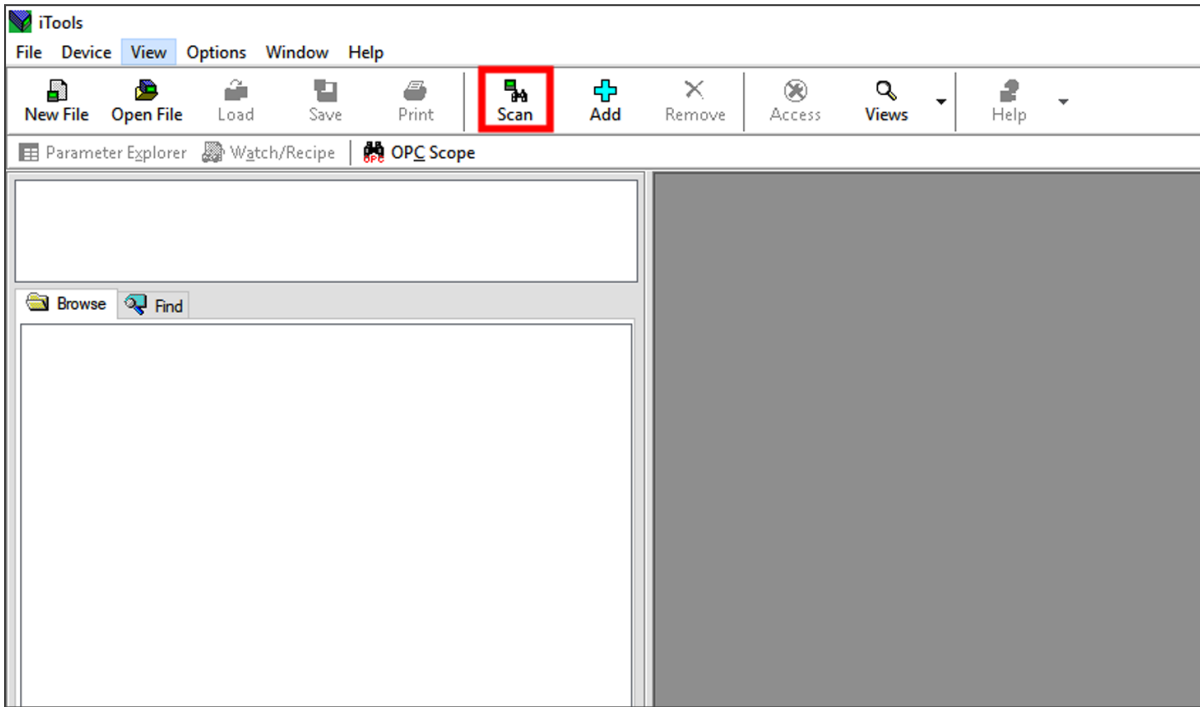
6. Click **OK**
7. Repeat these steps for each controller module you wish to connect to



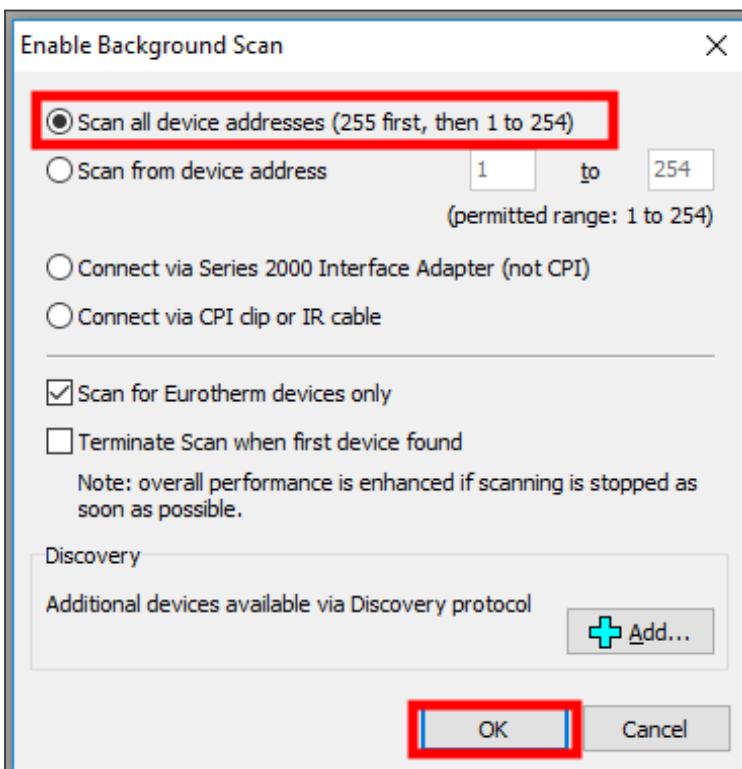
8. Click **Apply** and close the window

### 13.2 Establishing A Connection

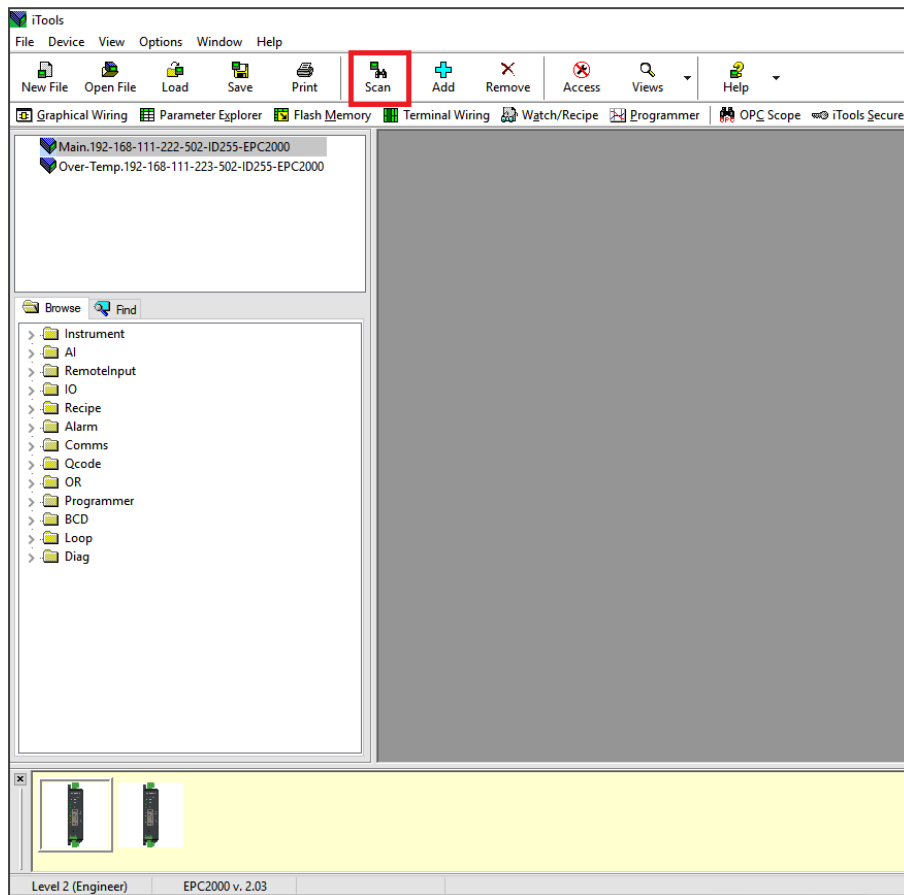
1. Open **iTools Engineering Studio** on your computer
2. Click the **Scan** button on the top toolbar



3. The **Enable Background Scan** window will pop up. Ensure the **Scan all device addresses (255 first, then 1 to 254)** and **Scan for Eurotherm devices only** options are selected, then click **OK**



4. The software will automatically find any controller modules connected via ethernet. If you want to stop the scan prematurely, click the **Scan** button again. The example below shows a single-zone unit with over-temperature protection connected via ethernet:

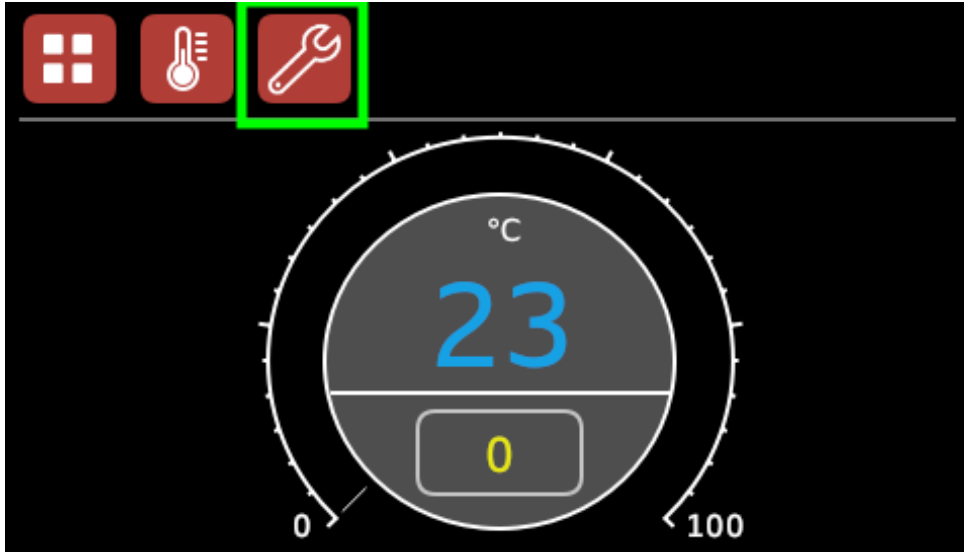


You can now access the CC-T1 controller via iTools.

## 14.0 Maintenance Reminder

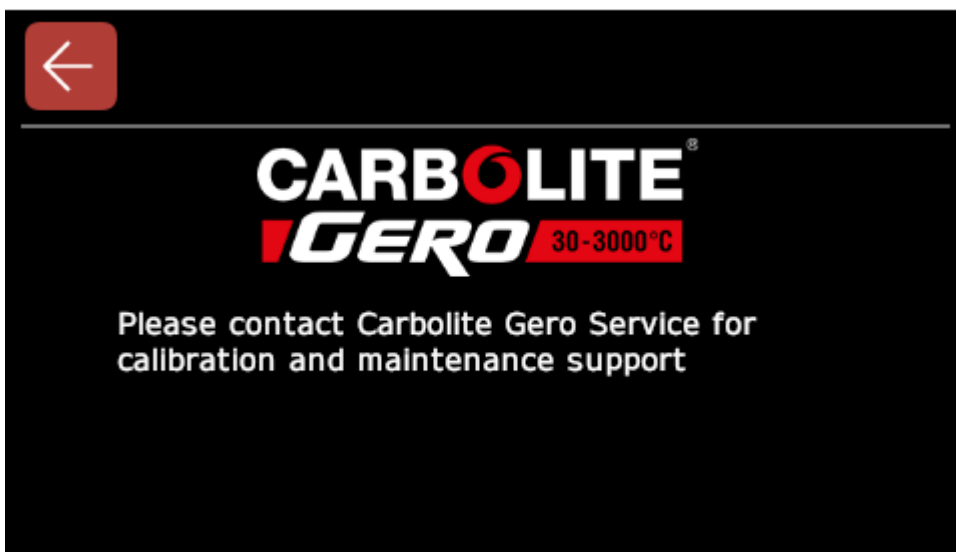


If the following icon appears on-screen, this indicates that a "Maintenance Reminder" has been scheduled:



*Maintenance Reminder Icon on the Home Screen*

Pressing on the "Maintenance Reminder" icon will open the following screen:



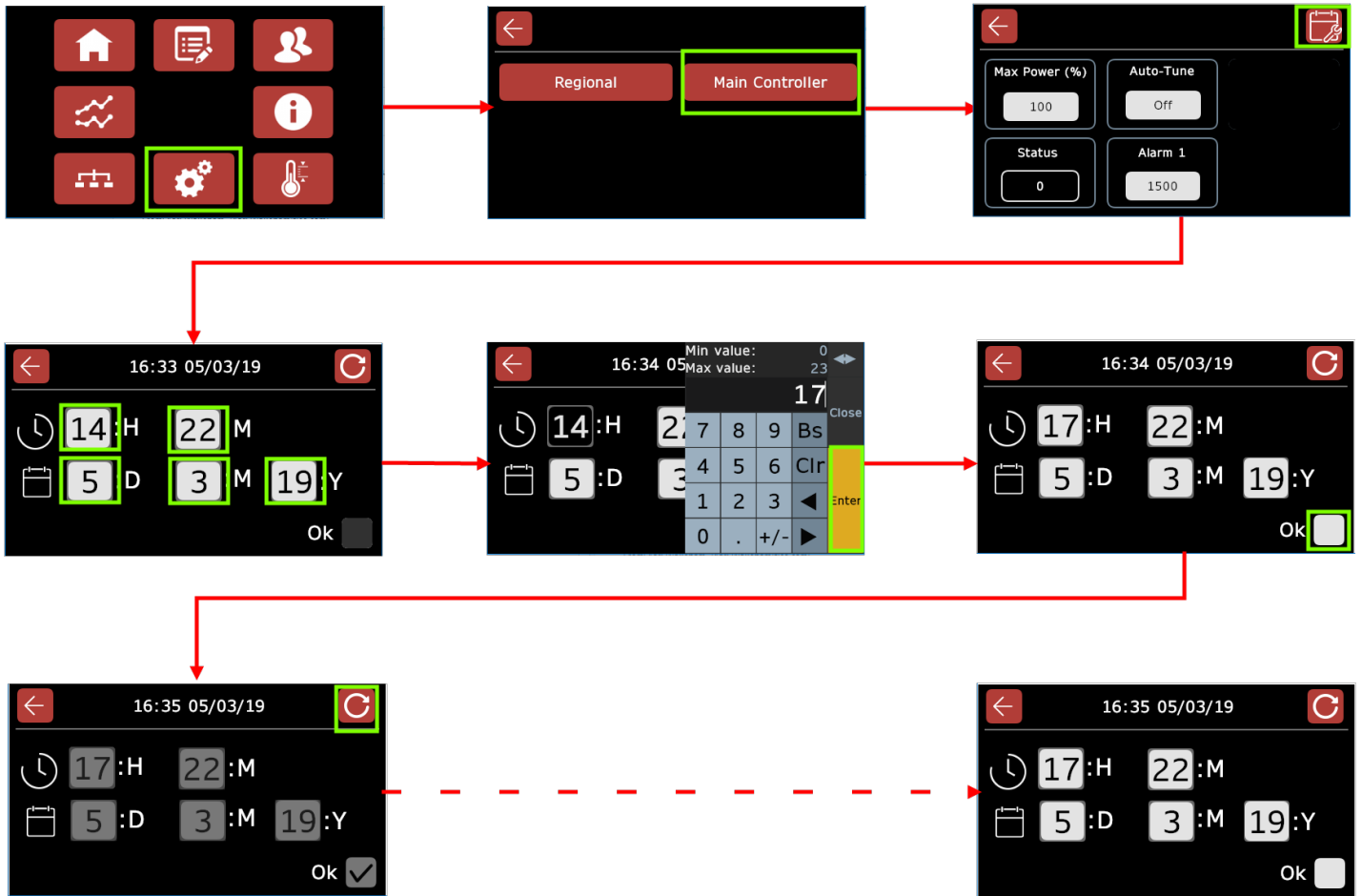
*Maintenance Reminder Message*

Users logged in at "Admin" level can set and reset this reminder to appear at a particular time or disable it as required.

To do this:

1. Go to the **Settings** screen
2. Press the "Main Controller" button
3. Press the "Set Maintenance Reminder" icon
4. Press in the fields to set the desired time and date
5. Press "Ok" to confirm
6. The reminder icon will now appear at the scheduled time and date

7. You can reset the reminder by pressing the reset button in the top right hand corner of the **Set Maintenance Reminder** screen. Doing this will prevent the reminder from appearing until it is next scheduled




*Setting the Maintenance Reminder*

## 15.0 Controller Settings

For each controller set up on the product, there is an additional menu that contains the following parameters:

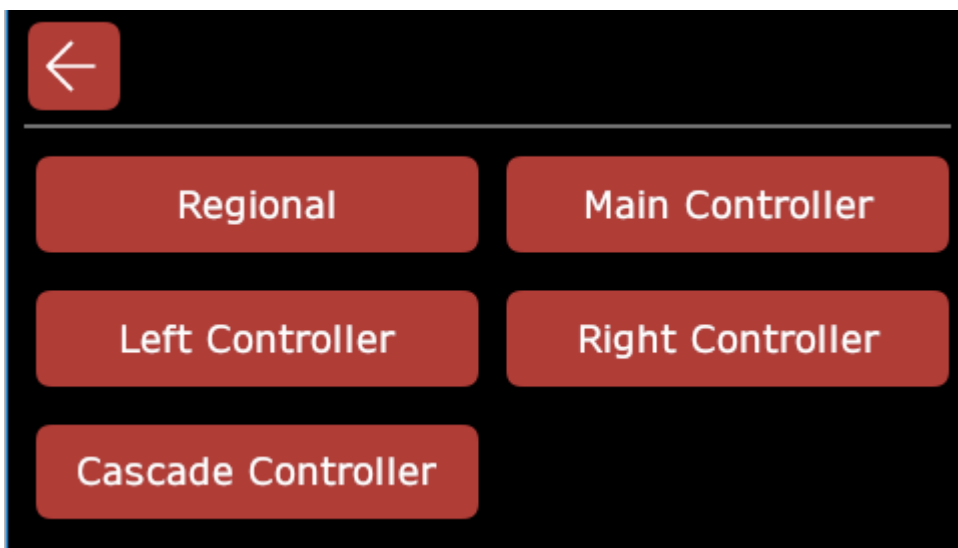
Parameter	Description/Use
Max Power (%)	<p>Used to adjust the amount of power delivered by the heating elements of the product.</p> <p>Depending on the design of the product and the voltage of the intended power supply, the Max Power (%) value may be adjusted in order to protect the heating elements from overloading and unnecessary wear.</p> <p>For multiple-zoned products, the maximum power output setting can be adjusted for each individual temperature controller.</p> <div style="border: 1px solid black; padding: 5px;"> <p><b>Note:</b> This parameter is not available on the Cascade Control Settings screen.</p> </div>
Auto-Tune	<p>Used to refine the PID terms within the controller and optimise the temperature control for the product if it is to be used outside of the normal operating temperature range.</p> <div style="border: 1px solid black; padding: 5px;"> <p><b>Note:</b> This parameter is not available on the Cascade Control Settings screen.</p> </div>
Status	<p>Indicates the error status of the controller as a numerical value. If the Status value is anything but <b>0</b> (normal), please contact Carbolite Gero Service for assistance.</p>
Retransmit (3-zone configuration only)	<p>If the Retransmit value is set to:</p> <ul style="list-style-type: none"> <li>• <b>On</b> - the <b>Left</b> and <b>Right</b> controllers (end zones) will follow the set-point of the <b>Main</b> controller. This is referred to as control method <b>B</b> in the "Operation" section of your product manual</li> <li>• <b>Off</b> - the <b>Left</b> and <b>Right</b> controllers (end zones) can be set independently of the <b>Main</b> controller. This is referred to as control method <b>C</b> in the "Operation" section of your product manual</li> </ul> <div style="border: 1px solid black; padding: 5px;"> <p><b>Tip:</b> If the retransmit parameter is switched <b>on</b> when a program is running, the end zones will follow the program. If retransmit is switched <b>off</b> when a program is running, then the end zones can be used as independent controllers regardless of the program.</p> </div> <div style="border: 1px solid black; padding: 5px;"> <p><b>Note:</b> If a 3-zone product is configured with cascade control, it is recommended that the Retransmit parameter is always set to <b>On</b>.</p> </div>

Alarm 1/2 (if configured)	If any alarm relays have been configured, use this parameter to set the temperature at which these relays will activate.
Trim (Cascade Controller Only)	Used to set the maximum difference allowed between the load temperature and the heating element temperature (see section 7.0). The "Trim" is applied as a $\pm$ percentage value, so if the parameter is set at "10", the heating element temperature cannot be any higher or lower than 10% of the maximum temperature of the product. For example: If a product has a maximum temperature of 1000°C, and the setpoint is set to 800°C with a Trim value of 10, the heating element temperature must be within the range of 700°C and 900°C.
	Press this button to access the <b>Maintenance Reminder</b> screen, where you can set a date and time for an on-screen reminder to appear when your product is due for a service check

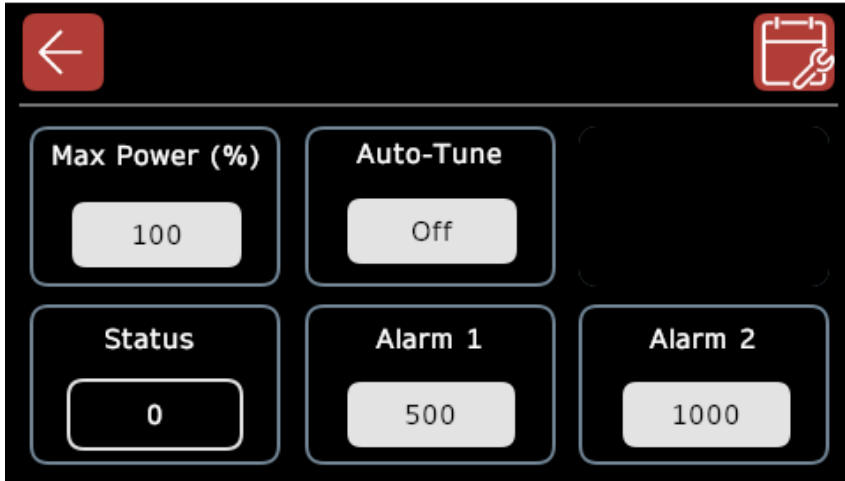
To access these parameters:

1. Go to the **Login** screen and log in as "Admin"
2. Go to the **Settings** screen and press the "Main" button

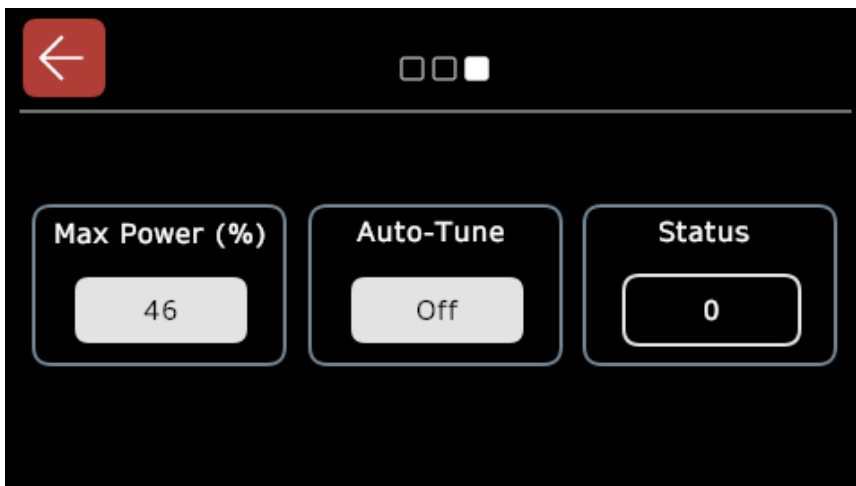
**Note:** If your controller is configured for multiple heated zones or cascade control operation, you will also have the option of adjusting the settings for these controllers.



*Settings Screen Showing all Possible Controllers*



Main Controller Settings



Right/Left Controller Settings



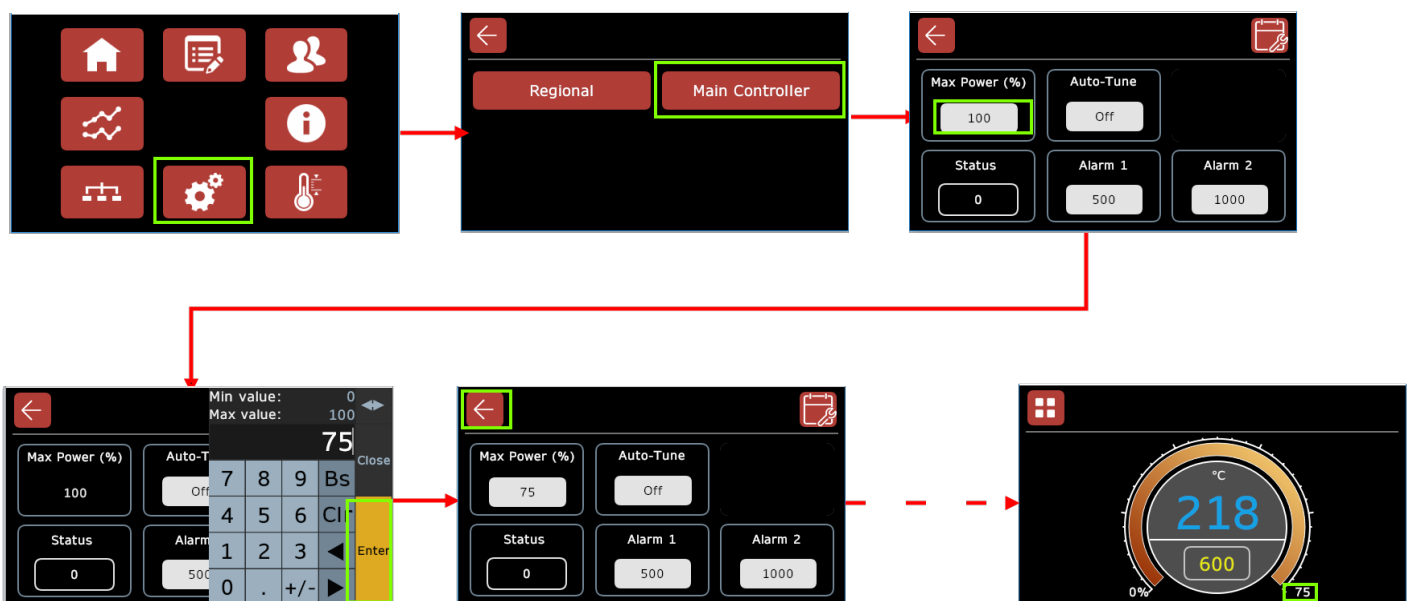
Cascade Controller Settings



## 15.1 Adjusting the Maximum Power Output Settings

To adjust the power settings:

1. Navigate to the settings screen for the controller you wish to adjust
2. Press on the "Max Power %" field. A numeric keyboard will open allowing you to input values between 0-100 (%). This refers to a percentage of the total power output the product was designed to achieve. Please refer to the "Power Settings" section of your product manual for specific details
3. Once you have set the new maximum power output, the "Power Output Indicator" on the **Home** screen will update to show the new maximum value



*Adjusting the Maximum Power Output Setting*

## 15.2 Using Auto-Tune to Optimise Temperature Control

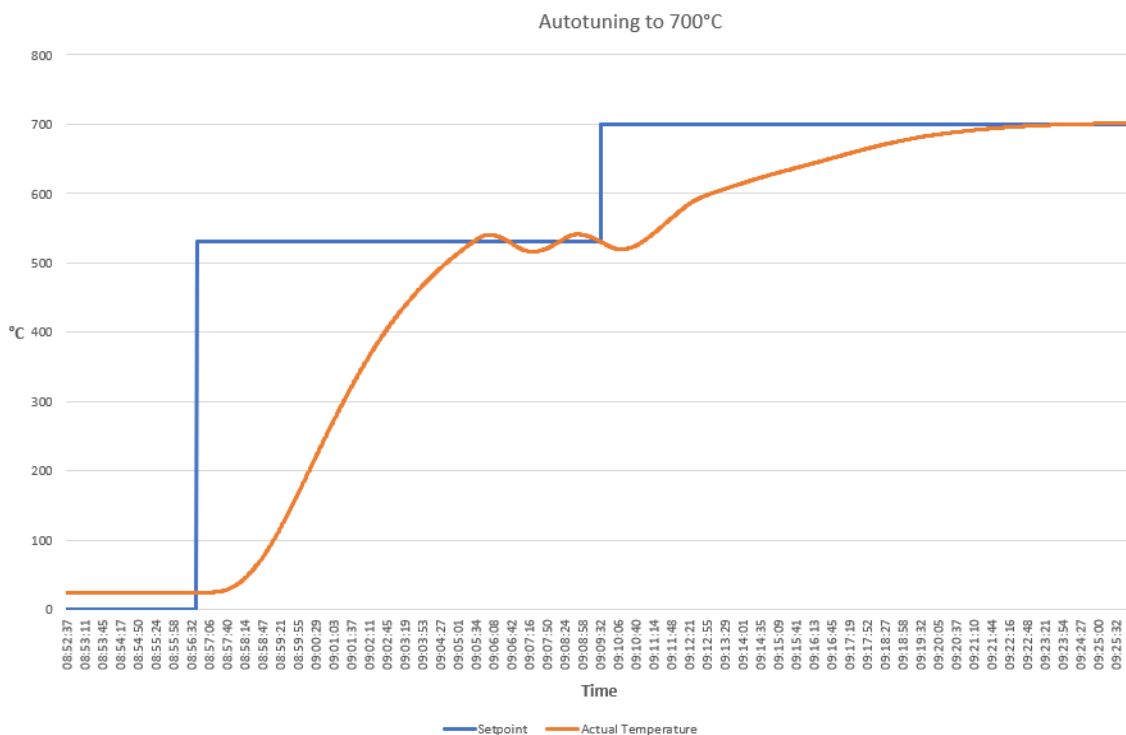
All Carbolite Gero products are preconfigured for optimum performance when used within their normal expected operating temperature range.

Depending on the intended application, it may be necessary for the product to be used outside of this normal range, in which case some tuning may be required in order to optimise the PID controls within the temperature controller e.g. if a high temperature product is to be used at a significantly lower temperature than it was originally designed for, or if a particularly heavy sample/load is to be heated.

**Note:** The following instructions are intended for use on single-zone products. Please contact Carbolite Gero Service for assistance if it is necessary to auto-tune a product with multiple heated zones or cascade control fitted.

To use the Auto-Tune function:

1. Ensure that the product is cold (at ambient temperature) before proceeding
2. On the **Home** screen, set the setpoint temperature to 0°C
3. Navigate to the settings screen for the main controller
4. Press the "Auto-Tune" button to switch the auto-tune parameter from "Off" to "On". The auto-tune function will now go into stand-by mode for 30 seconds
5. Before the stand-by mode period lapses, navigate to the **Home** screen and set the product setpoint to the temperature you wish to optimise the product for e.g. 400°C
6. The controller will remain in stand-by mode for a few minutes. The power output indicator on the **Home** screen will illuminate when the product begins the auto-tuning cycle:
  - The controller heats until it is within a few degrees (°C / °F / K) of the programmed setpoint
  - The controller then cuts off power to the heating elements
  - The controller allows the temperature to overshoot the target setpoint
  - When the temperature drops below the point at which the controller stopped heating, it turns the power to the heating elements back on
  - The controller will then allow the temperature to undershoot (not reach the target setpoint)
  - The controller analyses the information it received from the overshoot and undershoot scenarios, and calculates new PID terms that will optimise temperature control for the new temperature range
  - The new PID terms are applied, and the controller then heats as normal until it reaches the target setpoint, then maintains that setpoint



*Graphical Example of Autotuning a Product to 700°C*

7. When the auto-tuning cycle is complete, the "Auto-Tune" parameter on the controller settings screen will return to "Off"

**Tip:** If you are tuning to optimise the controller for low temperature use, the output power ("Max Power (%)") value can be reduced before auto-tune is used. Output power can be returned to a higher value if the product is subsequently required to operate at higher temperatures.

### 15.3 Power Cycling

In the event of a power cycle (power to the controller is switched off, then back on again):

- If the CC-T1 was being used as a simple temperature controller, it will continue to control at the last configured setpoint once power is restored.
- If the CC-T1 was running a program, the program will resume from the point at which it was interrupted once power is restored.

## **16.0 Controller Replacement**

Please contact Carbolite Gero Service for assistance.





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](mailto: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](mailto:Info@carbolite-gero.com)

[www.carbolite-gero.com](http://www.carbolite-gero.com)

**CARBOLITE**  
**GERO** 30-3000°C

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