1. 2704CP FURNACE ATMOSPHERE CONTROLLER/PROG2

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1. **2704CP Furnace Atmosphere Controller/Prog**

1.1 **INTRODUCTION**

The 2704CP Furnace Atmosphere Controller/Programmer is a fully programmable controller suitable for precision control of temperature, carbon potential, dewpoint and oxygen in atmosphere heat treatment applications. It may be supplied with the following clone files:

<table>
<thead>
<tr>
<th>Clone File Name</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>27CP-CXX-V1.xx.UIC</td>
<td>carbon potential only</td>
</tr>
<tr>
<td>27CP-DXX-V1.xx.UIC</td>
<td>dewpoint only</td>
</tr>
<tr>
<td>27CP-OXX-V1.xx.UIC</td>
<td>oxygen only</td>
</tr>
<tr>
<td>27CP-CTX-V1.xx.UIC</td>
<td>carbon potential plus temperature</td>
</tr>
<tr>
<td>27CP-DTX-V1.xx.UIC</td>
<td>dewpoint plus temperature</td>
</tr>
<tr>
<td>27CP-OTX-V1.xx.UIC</td>
<td>oxygen plus temperature</td>
</tr>
<tr>
<td>27CP-CTP-V1.xx.UIC</td>
<td>carbon potential plus temperature programmer</td>
</tr>
<tr>
<td>27CP-DTP-V1.xx.UIC</td>
<td>dewpoint plus temperature programmer</td>
</tr>
<tr>
<td>27CP-OTP-V1.xx.UIC</td>
<td>oxygen plus temperature programmer</td>
</tr>
</tbody>
</table>

These files are included in the iTools CD. iTools is the software which may be used for configuration of 2000 series instruments.

The order code for your controller is identified on a label fixed to the side of the instrument. This can be checked against the explanation of the order code given at the end of this supplement.

Instrument views shown in this handbook are typical but may vary in detail depending on the clone file loaded or the state of certain parameters.

1.1.1 **Related Handbooks**

For further details not described in this supplement please refer to the following handbooks where this symbol is shown 📘:-

- 2704 Installation and Operation Handbook Part No. HA026502
- 2704 Engineering Handbook Part No. HA026933
- iTools User Handbook Part No. HA026179
- I/O Expander Handbook Part No. HA026893

All handbooks are available on the Eurotherm web site www.eurotherm.co.uk.

Select Documentation → Document Library DATABASE → Keyword (eg 2704) → Choose the handbook and DOWNLOAD. The documents are in pdf format.
1.2 WHAT IS CARBON POTENTIAL CONTROL

Carburizing may be used to provide a hard surface to steel after it has been formed. It is produced by placing the steel in a furnace with a carbon atmosphere and holding it at a temperature of between about 800 and 1100°C for a period of time.

As the carbon is absorbed into the steel the carbon potential controller will admit a carbon rich gas from an endothermic generator or air into the furnace atmosphere to maintain the desired carbon potential setpoint.

Carbon potential cannot be measured directly and so must be inferred using other measurements. The most common of these uses a Zirconia probe.

1.2.1 Zirconia Probe

The zirconia probe actually measures the oxygen content and generates a mV signal based on the ratio of oxygen concentration between the reference air side of the probe (outside the furnace) and the amount of oxygen actually inside the furnace. The temperature and the CO content of the furnace atmosphere are also measured and from all of these measurements the carbon content can be calculated. Each manufacturer of zirconia probes may use a different algorithm for calculating the carbon content and the 2704CP controller may be configured for the type in use.

1.2.2 Dewpoint

In this application the zirconia probe measures the actual dewpoint of the gas. For both oxygen and dewpoint measurement the CO level of the sample gas is assumed to be constant at 40%. The dewpoint is then directly related to the carbon content. An increasing dewpoint represents a decreasing carbon content.

The diagram below shows a typical 2704CP applied to the control of temperature and carbon in a furnace.

![Figure 1-1: Temperature/Carbon Control Loop](image_url)
1.2.3 Sooting Alarm and Probe Burn Off

Because of the harsh atmosphere in the furnace the probe can become contaminated. When this occurs the 2704CP initiates an alarm and this can turn on a solenoid to admit air down the ceramic tube of the probe. The air on the heated surface creates an intense burning action which cleans the tip of the probe. The burn off can also be initiated at regular intervals by the 2704CP controller and the duration of the admittance of the air can also be set.

1.3 TYPICAL FUNCTION BLOCK DIAGRAM

The block diagram below shows a simplified overview of the carbon potential controller when integrated with temperature programmer.

![Typical Furnace Atmosphere Controller/Programmer Block Diagram](image)

**Figure 1-2: Typical Furnace Atmosphere Controller/Programmer Block Diagram**
1.4 INSTALLATION

The 2704CP Furnace Atmosphere Controller/Programmer should be installed as described in Chapter 2 of the Installation and Operation Handbook.

**WARNING**

You must ensure that the controller is correctly configured for your application. Incorrect configuration could result in damage to the process being controlled, and/or personal injury. It is your responsibility, as the installer, to ensure that the configuration is correct. See 2704 Engineering Handbook for details.

1.5 WIRING CONNECTIONS

Before proceeding further, please read Appendix B, Safety and EMC information, in the above handbooks.

This controller has the following configuration depending on the order code:

- Temperature control loop, 50 single profile programs, four events
- Zirconia control loop (Carbon, Dewpoint, Oxygen)
- Toolkit functions including mathematical calculations, combination logic, real time clock, timer function
- Dual relay (part no. AH025246U002) or DC control output module (part no. AH025728U003) fitted in slot 1 provides temperature control output
- Dual relay output module (part no. AH025246U002) fitted in slot 3 provides programmer event outputs
- Dual relay output module (part no. AH025246U002) fitted in slot 4 provides time proportion outputs for both gas and air
- Analogue input module (part no. AH025728U002) fitted in slot 5 to provide dc retransmission
- Dual analogue input module (part no. AH026359) fitted in slot 6 provides temperature and probe input for the Zirconia sensor
- Optional communications module fitted in slot H
- Standard toolkit functions

The following connection diagrams are shown for the above configuration.
1.5.1 Controller Connections to Plant Devices

The furnace thermocouple measures the temperature of the furnace.
The probe thermocouple measures the temperature at the zirconia probe.
The probe thermocouple input and probe mV input are not isolated from each other, although they are isolated from all other I/O.

Figure 1-3: Controller Terminals

Note
Thermocouple negative connected to 6D
Probe positive connected to 6D
1.5.2 IO Expander Connections to Plant Devices

See IO Expander Handbook for further details.

![IO Expander Terminals Diagram]

Figure 1-4: IO Expander Terminals
1.6 TEMPERATURE/ZIRCONIA CONTROL

Switch on the controller. After a brief self-test sequence, during which the controller displays
the software version number, you will see an overview display. The display shown below is
the overview for a temperature/carbon controller/programmer. The displays and operating
procedures for carbon, dewpoint and oxygen are basically the same. Differences are
highlighted where applicable.

![Temperature/Carbon Display](image)

**Figure 1-5: Temperature/Carbon Display**

1.6.1 To Change Temperature Setpoint

From the above view the parameter value which can be changed is indicated by a flashing
underline.

Press `▲` or `▼` to increase or decrease the temperature setpoint.

1.6.2 To Select Auto or Manual Operation (Temperature)

From the above view, press `MAN`. AUT on the Overview display will change to MAN.

The Output Power will be shown with a flashing underline.

Press `▲` or `▼` to increase or decrease the output power.

1.6.3 To Change Carbon Setpoint

From the above view press `loop` to select between the temperature loop and the carbon loop.

The carbon setpoint parameter will be shown with the flashing underline.

Press `▲` or `▼` to increase or decrease the carbon potential setpoint.

1.6.4 To Select Auto or Manual Operation (Carbon)

From the above view, repeat 1.6.2. for the carbon loop.
1.6.5 To Select Alternative Overviews

Press \( \text{LOOP} \).

The views below show examples of alternative overview displays with each press of \( \text{LOOP} \).

**Temperature**

Shows a summary of the temperature control loop

Press \( \text{SP} \) to scroll through the list of commonly used parameters promoted to the bottom section of the display. These are:

- **Target SP**: Setpoint when the programmer is in Reset. Alterable in Auto.
- **Target OP**: Output demand signal Alterable in Manual.

Any parameter preceded by \( \text{SP} \) may be changed.

**Temperature Trend**

Shows a time/temperature graph of the process

Press \( \text{SP} \) to scroll through the list of commonly used parameters. These are:

- **Target SP**: Setpoint when the programmer is in Reset. Alterable in Auto.
- **Target OP**: Output demand signal Alterable in Manual.
- **Timebase**: To set the time axis.

**Carbon/Dewpoint/Oxygen**

Shows a summary of the carbon or dewpoint or oxygen control loops depending on the variable. Units are %CP for carbon (as shown), °F or °C for dewpoint, PPM for oxygen

Press \( \text{SP} \) to scroll through the list of commonly used parameters. These are:

- **Target SP**: Setpoint when the programmer is in Reset. Alterable in Auto.
- **Target OP**: Output demand signal Alterable in Manual.
Carbon/Dewpoint/Oxygen Trend

Shows a trend chart for carbon potential, dewpoint or oxygen measured values depending on the variable being controlled.

Press \(\text{[+]}\) to scroll through the list of commonly used parameters. These are:-

- **Target SP**: Setpoint when the programmer is in Reset. Alterable in Auto
- **Target OP**: Output demand signal. Alterable in Manual
- **Timebase**: To set the time axis

SUMMARY (Mimic)

A time/temperature chart showing the furnace temperature during a running program.

Press \(\text{[+]}\) to scroll through the list of commonly used parameters. These are all read only:-

- **Temp Target**: Temperature to which the programmer is heading
- **Carbon Target**: Carbon potential to which the programmer is heading
- **Prog Dos**: State of the digital outputs in the current segment

### 1.6.6 Alarm Messages

If alarms occur an alarm message, in the format shown below, will be shown across the overview display. Acknowledge as instructed. Any further alarms will also need to be acknowledged before the overview can be seen.

- \(\text{[+]}\) alternates for an unacknowledged alarm

**Alarm source** ➔ **Sensor Fault ?** ➔ **FurnaceTC** ➔ **Press \(\text{[+]}\) to Ack**

**Instruction**

For an un-latched alarm this message disappears when the alarm condition is no longer present

**Figure 1-6: Alarm Message Banner**
### 1.6.7 Operator Buttons

<table>
<thead>
<tr>
<th>Button</th>
<th>Description</th>
</tr>
</thead>
</table>
| AUTO | Auto/Manual button | When pressed, this toggles between automatic and manual mode:  
- If the controller is in automatic mode ‘AUT’ is displayed  
- If the controller is in manual mode, ‘MAN’ is displayed  
In manual mode the output power of either the temperature or carbon loops can be adjusted by the operator. |
| LOOP | Loop select button | Each press selects a different overview display  
The overview name is shown in the banner at the top of the display |
| PROG | Programmer button | This button is only applicable if the programmer version is supplied  
- Press once to display a pop up window  
The pop up window will remain for approximately 6 seconds and during this period:  
- Press PROG again to RUN a program  
- Press PROG again to HOLD a program  
- Press PROG again to toggle between RUN & HOLD  
- Press PROG and hold for two seconds to reset |
| Page | Page button | Press to select the Page Header ‘Menu’. |
| Scroll | Scroll button | Press to select a new parameter from the page heading.  
If held down it will continuously scroll through the parameters. |
| Down | Down button | Press to decrease an analogue value, or to change the state of a digital value |
| Up | Up button | Press to increase an analogue value, or to change the state of a digital value |

![Operator Buttons Diagram](image)

Figure 1-7: Operator Buttons
1.7 CARBON CONTROL

1.7.1 Carbon Control User Screen
This is a customised screen which displays information about the carbon control loop.

To access this view:-

<table>
<thead>
<tr>
<th>Do This</th>
<th>This Is The Display You Should See</th>
<th>Additional Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. From any display press [^] as many times as necessary to access the page header menu</td>
<td>SUMMARY</td>
<td>This view is available at access level 1. For further information on Access Levels see the Engineering Handbook.</td>
</tr>
<tr>
<td>2. Press [^] or [^] to scroll to ‘CARBON’</td>
<td>PROGRAM RUN</td>
<td></td>
</tr>
<tr>
<td></td>
<td>PROGRAM EDIT</td>
<td></td>
</tr>
<tr>
<td></td>
<td>ALARMS</td>
<td></td>
</tr>
<tr>
<td></td>
<td>CARBON</td>
<td></td>
</tr>
<tr>
<td></td>
<td>HIGH Z CAL</td>
<td></td>
</tr>
<tr>
<td></td>
<td>ACCESS</td>
<td></td>
</tr>
</tbody>
</table>

This view is available at access level 1.

For further information on Access Levels see the Engineering Handbook.

3. Press \[^] to display information about the carbon loop.

4. Press \[^] to scroll through the list of commonly used parameters promoted to the bottom section of the display.

These are:-

- **Local Carbon SP**
  - Carbon setpoint when the programmer is in Reset.
  - Alterable in Auto

- **Internal %CO Val**
  - This value is used in the calculation for the probe.
  - It is normally set to 40% but can be changed in level 3

- **%CO Input Select**
  - Select between Internal and Remote

- **Remote %CO Val**
  - Read only

- **Clean Frequency**
  - To set the time between cleans

- **Clean Duration**
  - To set the time taken for the clean

- **High Z SP (kohm)**
  - Set point to define probe impedance failure

- **Sooting Alarm**
  - Select between Disabled and Enabled

Any parameter preceded by \[^] may be changed.
1.8 DEWPOINT CONTROL

1.8.1 Dewpoint Control User Screen

This is a customised screen which displays information about the dewpoint control loop.

To access this view:-

<table>
<thead>
<tr>
<th>Do This</th>
<th>This Is The Display You Should See</th>
<th>Additional Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. From any display press [ \text{ } ] as many times as necessary to access the page header menu</td>
<td></td>
<td>This view is available at access level 1. For further information on Access Levels see the Engineering Handbook.</td>
</tr>
<tr>
<td>2. Press [ \text{ A } ] or [ \text{ V } ] to scroll to ‘DEWPOINT’</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

3. Press \[ \text{ C } \] to display information about the dewpoint loop.

4. Press \[ \text{ C } \] to scroll through the list of commonly used parameters promoted to the bottom section of the display.

These are:-

- **Target SP**
  - Dewpoint setpoint when the programmer is in Reset.
  - Alterable in Auto
  - If the SP is set to the Low Limit the outputs are set to zero
  - Internal %H Val
    - This value is used in the calculation for the probe.
    - It is normally set to 40% but can be changed in level 3
  - %H Input Select
    - Select between Internal and Remote
  - Remote %H Val
    - Read only
  - High Z SP(kohm)
    - Set point to define probe impedance failure
  - Admit Gas SP
    - To set the level of the admittance gas
  - Any parameter preceded by \[ \text{ c118 } \] may be changed

Zirconia control PV
Target SP
The admittance temperature of the endothermic gas from the generator must be greater than a set value to prevent damage.
In the 2704CP this value is pre-set to 1850°F, 1010°C
1.9 OXYGEN CONTROL

1.9.1 Oxygen Control User Screen

This is a customised screen which displays information about the oxygen control loop.

To access this view:-

<table>
<thead>
<tr>
<th>Do This</th>
<th>This Is The Display You Should See</th>
<th>Additional Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. From any display press as many times as necessary to access the page header menu</td>
<td>SUMMARY PROGRAM RUN PROGRAM EDIT ALARMS OXYGEN HIGH Z CAL ACCESS</td>
<td>This view is available at access level 1. For further information on Access Levels see the Engineering Handbook.</td>
</tr>
<tr>
<td>2. Press ▲ or ▼ to scroll to ‘OXYGEN’</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Press ▼ to display information about the oxygen loop.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Press ▼ to scroll through the list of commonly used parameters promoted to the bottom section of the display.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

These are:-

- **Target SP**  
  Oxygen setpoint when the programmer is in Reset.
  Alterable in Auto
  If the SP is set to the Low Limit the outputs are set to zero

- **Probe kohm**  
  Probe resistance. Read only

- **High Z SP(kohm)**  
  Set point to define probe impedance failure

- **Min Cal Temp**  
  Minimum calibration temperature

- **Admit Gas SP**  
  To set the level of the admittance gas

Any parameter preceded by ♦ may be changed
## 1.10 PROBE IMPEDANCE

When the output impedance of a zirconia probe increases above a certain level, it indicates that the performance of the probe has deteriorated, and should be replaced. The 2704CP controller has the ability to measure the impedance of the sensor connected to its input, and in conjunction with User Alarms an alarm strategy created to alert the operator.

### 1.10.1 To Calibrate High Impedance Input

<table>
<thead>
<tr>
<th>Do This</th>
<th>This Is The Display You Should See</th>
<th>Additional Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. With the probe disconnected, place a shorting link across the input terminals 6A and 6D</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. From any display press as many times as necessary until the ‘HIGH Z CAL’ page header is displayed.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Press to select sub-headers</td>
<td><img src="image" alt="Calibrate the Low Point" /></td>
<td></td>
</tr>
<tr>
<td>4. Press again to edit ‘Enable Cal’</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Press or to ‘On’</td>
<td>Press + as directed to start the zero point calibration.</td>
<td>When this has been completed the ‘On’ message reverts to ‘Off’</td>
</tr>
<tr>
<td>6. Press to scroll to ‘Start Zero Cal’</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. Press or to ‘On’</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
1.10.2 Alarm Inhibition
Zirconia probes have an extremely high impedance at lower temperatures. For this reason the probe temperature measurement is used to inhibit alarms at temperatures below 850°C.

1.10.3 Impedance Measurement Filter
The probe impedance measurement is inherently noisy. The 2704CP uses a Toolkit block to apply internal filtering to the input.

---

8. Remove the shorting link and replace with a calibration resistor value approximately 30KΩ.

9. Scroll back to ‘Cal High(kohm)’ and use ▲ or ▼ to enter the same value as the calibration resistor.

---

10. Press ▼ to scroll to ‘High Z SP(kohm)’.

11. Press ▼ to select subheaders.

12. Remove the calibration resistor and re-connect the probe.

13. Press ▼ again to scroll to ‘Enable Cal’.

14. Press ▲ or ▼ to ‘Off’.

---

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1.1.02 Alarm Inhibition
Zirconia probes have an extremely high impedance at lower temperatures. For this reason the probe temperature measurement is used to inhibit alarms at temperatures below 850°C.

1.1.03 Impedance Measurement Filter
The probe impedance measurement is inherently noisy. The 2704CP uses a Toolkit block to apply internal filtering to the input.
1.11 SETPOINT PROGRAMMER

This section describes how to create, edit and run programs in controllers fitted with this option.

The programmer has two setpoint profiles for temperature and carbon, connected to control loops 1 and 2 respectively. Digital inputs are available for Run, Reset and Hold on IO expander inputs 1, 2 or 3. Run and Reset are also available on controller terminals D6 and D7. Four digital event outputs are pre-configured – more can be added by the user (see Engineering Handbook). Event outputs 1 and 2 are available on terminals 3A and 3C. Event 3 is available on D4 and event 4 is wired to start a probe clean cycle.
1.11.2 **Programmer Type**

The programmer type is configured as Time to Target. Each segment consists of a **single duration parameter** and a set of **target values** for the profiled variables.

1. The **duration** specifies the time that the segment takes to change the profiled variables from their current values to the new targets.
2. A **dwell** type segment is set up by leaving the target setpoint at the previous value.
3. A **Step** type segment is set up by setting the segment time to zero.

The operating descriptions which follow are specific to the 2704CP clone files. For a general description of operation refer to the 2704 Installation or Engineering Handbooks.

1.11.3 **To Select, Run, Hold or Reset a Program**

Press the **PROG** button. A banner appears.

Press **PROG** button to select the program number to be run.

Press **PROG** button to select Run. In run the programmer varies the setpoint in accordance with the profile set in the active program.

Press **PROG** button again to Hold the program if required. In hold the programmer is frozen at its current point. In this state you can make temporary changes to program parameters such as a target setpoint, ramp rates and dwells. Such changes can only be made in the current or subsequent segments and will only remain effective until the end of the currently running segment, when they will be overwritten by the stored program values.

Press **PROG** button again to Reset the program. In reset the programmer is inactive and the controller behaves as a standard controller, with the setpoint determined by the raise/lower buttons.

A list of parameters available for a running program is available under the page header PROGRAM RUN. Refer to section 1.10.12.

External run, reset or hold inputs are available on the IO Expander. If this has been supplied and wired to external buttons then the program may be operated from these buttons.
1.11.4 To Create or Edit a Program

The programmer parameters are grouped under page headings in exactly the same way as other parameters.

<table>
<thead>
<tr>
<th>Do This</th>
<th>This Is The Display You Should See</th>
<th>Additional Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. From any display press [ ] as many times as necessary to access the page header menu</td>
<td>SUMMARY</td>
<td>This is access level 1 view</td>
</tr>
<tr>
<td>2. Press [ ] or [ ] to select ‘PROGRAM EDIT’</td>
<td>PROGRAM RUN</td>
<td></td>
</tr>
<tr>
<td>3. Press [ ] to display sub-headers</td>
<td>PROGRAM EDIT</td>
<td></td>
</tr>
<tr>
<td>4. Press [ ] to select parameters for the overall program</td>
<td>ALARMS</td>
<td></td>
</tr>
<tr>
<td>5. Press [ ] again to edit the value of any parameter</td>
<td>CARBON</td>
<td></td>
</tr>
<tr>
<td>6. Press [ ] or [ ] to change the value</td>
<td>HIGH Z CAL</td>
<td></td>
</tr>
<tr>
<td></td>
<td>ACCESS</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The following table shows the full list of parameters in this page together with a description of their functions.

The following table shows the full list of parameters in this page together with a description of their functions.
### 1.11.5 PROGRAM EDIT (Program Page) Parameters

<table>
<thead>
<tr>
<th>Parameter Name</th>
<th>Parameter Description</th>
<th>Value</th>
<th>Default</th>
</tr>
</thead>
<tbody>
<tr>
<td>Program Number</td>
<td>Selects the program number to be edited.</td>
<td>1 to 50</td>
<td>1</td>
</tr>
<tr>
<td>Hbk Mode</td>
<td>Holdback mode</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>None = no holdback</td>
<td></td>
<td>Per Segment</td>
</tr>
<tr>
<td></td>
<td>Per prog = applied over the whole program</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Per seg = active in every segment</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Temp HBk Type</td>
<td>Holdback type for Temperature program</td>
<td></td>
<td>Off</td>
</tr>
<tr>
<td></td>
<td>These are deviations between SP and PV</td>
<td></td>
<td>Fine Lo</td>
</tr>
<tr>
<td></td>
<td>Fine and course holdback allows two levels of holdback to be</td>
<td></td>
<td>Fine Hi</td>
</tr>
<tr>
<td></td>
<td>applied to different segments.</td>
<td></td>
<td>Fine Band</td>
</tr>
<tr>
<td></td>
<td>Off, Fine Lo, Fine Hi, Fine Band, Course Lo, Course Hi, Course</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Band</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Temp FineHBk</td>
<td>Fine holdback value for the Temperature program</td>
<td></td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Display range</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Temp CoarseHBk</td>
<td>Course holdback value for the Temperature program</td>
<td></td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Display range</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The above two parameters are only displayed if Hbk Mode = Per Segment. They are repeated for the carbon loop.

<table>
<thead>
<tr>
<th>Parameter Name</th>
<th>Parameter Description</th>
<th>Value</th>
<th>Default</th>
</tr>
</thead>
<tbody>
<tr>
<td>Program Cycles</td>
<td>The number of times a program repeats.</td>
<td>Cont. to 999</td>
<td>Cont.</td>
</tr>
<tr>
<td>End Action</td>
<td>Defines the action in the end segment.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Dwell - the program will dwell indefinitely at the</td>
<td>Dwell</td>
<td></td>
</tr>
<tr>
<td></td>
<td>conditions set in the end segment.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Reset - the program will reset to the start</td>
<td>Reset</td>
<td></td>
</tr>
<tr>
<td></td>
<td>conditions.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Program Name</td>
<td>Displays the name of the program</td>
<td></td>
<td>Program 1</td>
</tr>
</tbody>
</table>

---

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### 1.11.6 To Set Up Each Segment of a Program

<table>
<thead>
<tr>
<th>Do This</th>
<th>This Is The Display You Should See</th>
<th>Additional Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. From any display press to access the page header menu.</td>
<td><strong>PROGRAM RUN</strong>&lt;br&gt;<strong>PROGRAM EDIT</strong>&lt;br&gt;<strong>ALARMS</strong>&lt;br&gt;<strong>CARBON</strong>&lt;br&gt;<strong>HIGH Z CAL</strong>&lt;br&gt;<strong>ACCESS</strong></td>
<td>This is access level 1 view</td>
</tr>
<tr>
<td>2. Press or to select ‘PROGRAM EDIT’</td>
<td><strong>PROGRAM RUN</strong>&lt;br&gt;<strong>PROGRAM EDIT</strong>&lt;br&gt;<strong>ALARMS</strong>&lt;br&gt;<strong>CARBON</strong>&lt;br&gt;<strong>HIGH Z CAL</strong>&lt;br&gt;<strong>ACCESS</strong></td>
<td></td>
</tr>
<tr>
<td>3. Press to show sub-headers</td>
<td><strong>PROGRAM RUN</strong>&lt;br&gt;<strong>PROGRAM EDIT</strong>&lt;br&gt;<strong>ALARMS</strong>&lt;br&gt;<strong>CARBON</strong>&lt;br&gt;<strong>HIGH Z CAL</strong>&lt;br&gt;<strong>ACCESS</strong></td>
<td></td>
</tr>
<tr>
<td>4. Press or  (if necessary) to select ‘Segment’</td>
<td><strong>PROGRAM RUN</strong>&lt;br&gt;<strong>PROGRAM EDIT</strong>&lt;br&gt;<strong>ALARMS</strong>&lt;br&gt;<strong>CARBON</strong>&lt;br&gt;<strong>HIGH Z CAL</strong>&lt;br&gt;<strong>ACCESS</strong></td>
<td></td>
</tr>
<tr>
<td>5. Press to show segment parameters</td>
<td><strong>Program Number</strong>: 1&lt;br&gt;<strong>Segment Number</strong>: 1&lt;br&gt;<strong>Segment Type</strong>: Profile&lt;br&gt;<strong>Temp Target</strong>: 450.0&lt;br&gt;<strong>Carbon Target</strong>: 0.13&lt;br&gt;<strong>Prog DO Values</strong>:</td>
<td>If the program exists, the segment details are displayed</td>
</tr>
<tr>
<td>6. Press or to scroll up or down the list of parameters</td>
<td><strong>Program Number</strong>: 2&lt;br&gt;<strong>Segment Number</strong>: 1&lt;br&gt;<strong>Segment Type</strong>: Profile&lt;br&gt;<strong>Temp Target</strong>: 450.0&lt;br&gt;<strong>Carbon Target</strong>: 0.13&lt;br&gt;<strong>Prog DO Values</strong>:</td>
<td></td>
</tr>
<tr>
<td>7. Press again to edit the selected parameter</td>
<td><strong>Program Number</strong>: 2&lt;br&gt;<strong>Segment Number</strong>: 1&lt;br&gt;<strong>Segment Type</strong>: Profile&lt;br&gt;<strong>Temp Target</strong>: 450.0&lt;br&gt;<strong>Carbon Target</strong>: 0.13&lt;br&gt;<strong>Prog DO Values</strong>:</td>
<td>If the program selected is new, confirm as instructed on the display</td>
</tr>
<tr>
<td>8. The value or state of a parameter prefixed by can be changed using or</td>
<td><strong>Program Number</strong>: 2&lt;br&gt;<strong>Segment Number</strong>: 1&lt;br&gt;<strong>Segment Type</strong>: Profile&lt;br&gt;<strong>Temp Target</strong>: 450.0&lt;br&gt;<strong>Carbon Target</strong>: 0.13&lt;br&gt;<strong>Prog DO Values</strong>:</td>
<td>Create Prg: 2?&lt;br&gt;Cancel ←→ OK</td>
</tr>
</tbody>
</table>

**Tip**: A back and forward scroll is available by holding down and pressing or respectively

Alternatively, press to return to the highlighted bar and use or
Program Number
Segment Number 2
Segment Type Profile
Temp Target 450.0
Carbon Target 0.13
Prog DO Values

9. Press \( \uparrow \) to scroll to and edit the 'Segment Number'

10. Press \( \uparrow \) or \( \downarrow \) to choose the 'segment number'

11. Press \( \uparrow \) to scroll to and edit the 'Segment Type'

12. Press \( \uparrow \) or \( \downarrow \) to change the segment type

13. Press \( \uparrow \) to scroll to and edit 'Temp Target'

14. Press \( \uparrow \) or \( \downarrow \) to set the target value

15. Press \( \uparrow \) to scroll to and edit 'Carbon Target'

16. Press \( \uparrow \) or \( \downarrow \) to set the target value

17. Press \( \uparrow \) to scroll to and edit 'Prog DO Values'

18. Press \( \uparrow \) or \( \downarrow \) to turn each program event output on or off in turn

19. Repeat the above steps for all required segments

If the segment selected is new, confirm as instructed on the display.
Not applicable to segment 1

Program Number
Segment Number 2
Segment Type Profile
Temp Target 450.0
Carbon Target 0.13
Prog DO Values

Create Seg 2? ▼ ▲
Cancel OK

Up to 100 segments are available per program

The choices are:-
Profile
Go Back
End Segment
See the Program Edit Parameter tables for an explanation

Program Number
Segment Number 2
Segment Type Profile
Temp Target 450.0
Carbon Target 0.13
Prog DO Values

The target temperature for the segment can be set between the upper and lower limits of the temperature range pre-set in configuration level.
0 – 1200°C by default

Program Number
Segment Number 2
Segment Type Profile
Temp Target 450.0
Carbon Target 1.13
Prog DO Values

The target carbon for the segment can be set between the upper and lower limits of the carbon range pre-set in configuration level.
0 – 1.40 by default

Program Number
Segment Number 2
Segment Type Profile
Temp Target 450.0
Carbon Target 1.13
Prog DO Values

Up to four digital outputs can be set to operate in each segment. If the IO Expander is being used these outputs switch relays to operate external devices.
□ = Off in the selected segment
■ = On in the selected segment
Further Segments

Up to 100 segments can be set up in any program. Scroll back to ‘Segment Number’ and select the next segment. Then repeat the procedure above.

The following table gives a summary of all parameters which appear in the Program Edit list.
### 1.11.7 PROGRAM EDIT (Segment) Parameters

These parameters allow you to set up each segment in the program.

<table>
<thead>
<tr>
<th>Parameter Name</th>
<th>Parameter Description</th>
<th>Value</th>
<th>Default</th>
</tr>
</thead>
<tbody>
<tr>
<td>Program Number</td>
<td>Selects the program number to be edited</td>
<td>1 to 50</td>
<td></td>
</tr>
<tr>
<td>Segment Number</td>
<td>Selects the segment number to be edited</td>
<td>1 to 100</td>
<td></td>
</tr>
<tr>
<td>Segment Type</td>
<td>Segment type</td>
<td>Profile</td>
<td>Profile</td>
</tr>
<tr>
<td></td>
<td>Profile = a segment which has a time period</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>End Segment = the last segment in the program (press ( ) to confirm)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Go Back = repeat part of program. Not shown for segment 1.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Temp Target</td>
<td>The temperature which the program is heading for in the selected segment</td>
<td>Temp lo limit to Temp hi limit</td>
<td>0 –1200°C</td>
</tr>
<tr>
<td>Temp HBk Type</td>
<td>Temperature holdback type</td>
<td>Off</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Not shown if Segment Type = End Segment</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>A full description of holdback is given in Note 1 after this table</td>
<td></td>
<td></td>
</tr>
<tr>
<td>The following parameters depend on the type of variable. This may be Carbon, Dewpoint or Oxygen control</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Carbon/Oxygen/ Dewpoint Target</td>
<td>The Carbon Potential/ Oxygen/Dewpoint value which the program is heading for</td>
<td>PSP2 lo limit to PSP2 hi limit</td>
<td>0</td>
</tr>
<tr>
<td>Carbon/Oxygen/ Dewpoint Dwell Time</td>
<td>The time for which the temperature will remain at its current value</td>
<td>hrs:mins:secs</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Only appears if 'Carbon/Oxygen/Dewpoint Type' = 'Dwell'</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Carbon/Oxygen/ Dewpoint HBk Type</td>
<td>Holdback type for the application in use</td>
<td>Off</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Not shown if Segment Type = End Segment</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>A full description of holdback is given in Note 1 after this table</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
The final two parameters apply to any segment for any variable Temperature, Carbon, Oxygen or Dewpoint

<table>
<thead>
<tr>
<th>Prog DO Values</th>
<th>Sets programmer event outputs on or off</th>
<th>Off/On in the selected segment</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Segment Name</td>
<td>Allows a user defined name to be chosen from a stored name in User Text - (Set in INSTRUMENT User Text – configuration mode only)</td>
<td>Default Text to 50:Usr 50</td>
<td>Default Text</td>
</tr>
</tbody>
</table>
Note 1  **Holdback Type** defines how holdback operates. It may apply when:

- The PV is below the SP by a pre-set value (Lo),
- The PV is above the SP by a pre-set value (Hi)
- The PV is below or above the SP by a pre-set value (Band).

In addition two levels of holdback are available per profile setpoint, per program. These are defined as ‘Fine’ and ‘Course’.

**Holdback** freezes the program if the process value does not track the setpoint by an amount which can be set by the user.

During a period when the setpoint is changing it indicates that the process value is lagging the setpoint by more than a pre-set amount and that the program is waiting for the process to catch up.

During a period when the setpoint is constant it will freeze the time if the difference between SP and PV exceeds pre-set limits.

In both cases it guarantees the correct time period for the product.

Holdback (PROGRAM EDIT Program page) may be configured in three modes:

- OFF - holdback does not operate
- Applied to the complete program. Holdback operates the same way in every segment
- To each individual segment. A different holdback type can be applied to each segment

**Example:**

Holdback, operating in each segment, is often used in a temperature control application as detailed below:

During a ‘ramp up’ period the holdback type may be set to deviation low. If the Process Value lags the programmed rate of rise, holdback will stop the program until the PV catches up. This prevents the set program from entering the next segment until the PV has attained the correct temperature.

---

**Figure 1-10: Effect of Holdback to Produce Guaranteed soak**

---

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1.11.8 To Edit A Running Program

From time to time it may be necessary to make temporary changes to the currently running program, for example, to change the target setpoint or to add time to a segment. The current running program can only be edited under the following conditions:

- The program must be put into ‘Hold’
- Changes to the currently running segment are temporary and apply only to the current run
- Permanent changes should be made in the ‘PROGRAM EDIT’ pages, see previous section.
- Other programs can be created or edited when another program is running

1.11.8.1 Example: To Change Current Segment Time or Target Setpoint

Place the program in ‘Hold’. Then:-

<table>
<thead>
<tr>
<th>Do This</th>
<th>This Is The Display You Should See</th>
<th>Additional Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Select the ‘PROGRAM RUN (Temp SP)’ page</td>
<td>SUMMARY PROGRAM RUN PROGRAM EDIT ALARMS CARBON HIGH Z CAL ACCESS General Temp Carbon</td>
<td>This is access level 1 view</td>
</tr>
<tr>
<td>2. Press ▲ to select the list of parameters for the running temperature program.</td>
<td>Seg Time Rem 0:35:00 Temp 260</td>
<td></td>
</tr>
<tr>
<td>3. Press ▼ to edit ‘Seg Time Rem’</td>
<td>Temp Target 260 Temp HBk Appl No</td>
<td></td>
</tr>
<tr>
<td>4. Press ▲ or ▼ to increase or decrease the time remaining in the current segment</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Press ▼ to scroll to ‘Temp Target’</td>
<td>Seg Time Rem 0:35:00</td>
<td>Temp Target can be set between the high and low limits set in configuration level, see Engineering Handbook</td>
</tr>
<tr>
<td>6. Press ▲ or ▼ to change the value</td>
<td>Temp 260 Temp Target 260 Temp HBk Appl No</td>
<td></td>
</tr>
</tbody>
</table>

Now place the programmer in Run.
## 1.11.9 Run Parameters

### General Page

<table>
<thead>
<tr>
<th>Table Number:</th>
<th>These parameters show the state of a running program. All parameters are available at Level 1. To hide parameters refer to the Engineering Handbook</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.11.9.</td>
<td>PROGRAM RUN (General Page)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Parameter Name</th>
<th>Parameter Description</th>
<th>Value</th>
<th>Default</th>
</tr>
</thead>
<tbody>
<tr>
<td>Program Status</td>
<td>Shows the status of the program</td>
<td>Run</td>
<td>Reset</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Hold</td>
<td></td>
</tr>
<tr>
<td>Prog Cycles Rem</td>
<td>Remaining number of cycles before the program is complete</td>
<td>1 to 999</td>
<td>Only shown if 'Prog Cycles' &gt; 1</td>
</tr>
<tr>
<td>Total Segments</td>
<td>Number of segments in the running program</td>
<td>0 to 100</td>
<td>R/O</td>
</tr>
<tr>
<td>Segment Number</td>
<td>The number of the current segment</td>
<td>1 to 100</td>
<td></td>
</tr>
<tr>
<td>Segment Type</td>
<td>The current segment type</td>
<td>Profile</td>
<td>R/O</td>
</tr>
<tr>
<td></td>
<td></td>
<td>End Segment</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Go Back</td>
<td></td>
</tr>
<tr>
<td>Segment Name</td>
<td>A user defined name for the current segment</td>
<td>Default or</td>
<td>R/O</td>
</tr>
<tr>
<td></td>
<td></td>
<td>from User</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Text</td>
<td></td>
</tr>
<tr>
<td>Seg Time Rem</td>
<td>Time remaining in the current segment</td>
<td>h:m:s</td>
<td></td>
</tr>
<tr>
<td>End Action</td>
<td>The state set in the end segment</td>
<td>Dwell</td>
<td>R/O</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Reset</td>
<td></td>
</tr>
<tr>
<td>Prog Reset DO</td>
<td>The state of the digital events in reset</td>
<td>□□□□□</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>□□□□□</td>
<td></td>
</tr>
</tbody>
</table>

| □□□□□ = Off/On in the segment |
Temp Page

Table Number: 1.11.9.

These parameters show the state of the temperature parameters in a running program. All parameters are available at Level 1. To hide parameters refer to the Engineering Handbook. The current program and segment is shown in the upper right hand corner of the display.

<table>
<thead>
<tr>
<th>Parameter Name</th>
<th>Parameter Description</th>
<th>Value</th>
<th>Default</th>
</tr>
</thead>
<tbody>
<tr>
<td>Seg Time Rem</td>
<td>Time remaining in the current segment</td>
<td>hrs:mins:secs</td>
<td></td>
</tr>
<tr>
<td>Temp</td>
<td>The current temperature</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Temp Target</td>
<td>The current target temperature</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Temp SP HBk Appl</td>
<td>Holdback applied in the current segment</td>
<td>No, Yes</td>
<td>R/O</td>
</tr>
</tbody>
</table>

Carbon, Oxygen or Dewpoint Page

If the variable being controlled is Carbon Potential, Oxygen or Dewpoint a separate page is available which list the running parameters for this variable. The type of variable depends on the particular clone file loaded.

The parameters are the same as those listed above for temperature but the term temperature is replaced by the name of the variable (carbon, oxygen or dewpoint).
1.12 ACCESS

In normal operation the controller will start up in Level 1. This gives access to parameters which have been described in previous sections. In certain cases, for example when commissioning the controller, it may be necessary to gain access to further parameters.

1.12.1 To Select Access Level 3

<table>
<thead>
<tr>
<th>Do This</th>
<th>This Is The Display You Should See</th>
</tr>
</thead>
</table>
| 1. From any display press as many times as necessary until the ‘ACCESS’ page header is displayed | PROGRAM RUN  
PROGRAM EDIT  
ALARMS  
CARBON  
HIGH Z CAL  
ACCESS |
| 2. Press to select ‘Access Level’ | Access Level  
Level 1 |
| 3. Press or to select the required access level. E.g. ‘Level 3’ | Access Level  
Level 3  
Enter Passcode  
PASS |
| 4. Press or to enter the passcode. | Access Level  
Level 3  
Enter Passcode  
PASS |
| 5. When the correct passcode is entered the display momentarily changes to PASS, then back to the start level to confirm correct entry. | Access Level  
Level 3  
Enter Passcode  
PASS |

Additional Notes:
- The default passcode of a new controller is 3 to enter level 3. If a new passcode has been previously entered it will be in the form 0 to 9999.
- If an incorrect passcode is entered, the display returns to 0.
- Note: In the special case that the passcode has been configured as ‘None’, the display will blink momentarily when Level 3 is selected and Level 3 will be entered immediately.
1.13 ALARMS

The following alarms have been configured:

<table>
<thead>
<tr>
<th>Name</th>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Admit Gas</td>
<td>Full scale high event</td>
<td>Triggered when the temperature measured by the probe exceeds a set value (default 760°C for carbon). Delay 10 seconds</td>
</tr>
<tr>
<td>High Impedance</td>
<td>Full scale high</td>
<td>Alarm to indicate probe failure</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Delay 10 seconds</td>
</tr>
<tr>
<td>High Z Inhibit</td>
<td>Full scale high event</td>
<td>Inhibits the High Impedance alarm when the probe temperature is below 800°C</td>
</tr>
<tr>
<td>Sooting Alarm</td>
<td>Full scale high</td>
<td>Triggered by the zirconia probe sooting alarm</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Delay 10 seconds</td>
</tr>
<tr>
<td>Recovery Fault</td>
<td>Full scale high</td>
<td>Triggered by the zirconia status</td>
</tr>
</tbody>
</table>

1.13.1 To Activate/Deactivate Alarms

Any of the above alarms may be activated or deactivated in operating Level 3. The following example deactivates the High Z Inhibit alarm:

3. Select the ‘ALARMS’ page

4. Press ▲ or ▼ to select the alarm sub-headings

5. Press ▲ or ▼ to scroll to ‘High Z Inhibit’

6. Press ▲ or ▼ to select the list of parameters for this alarm

7. Press ▲ or ▼ to scroll to ‘Inhibit’

8. Press ▲ or ▼ to edit to ‘Inhibit’

9. Press ▲ or ▼ to select ‘Yes’
## 1.14 ORDERING CODE

<table>
<thead>
<tr>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>11</th>
<th>12</th>
<th>13</th>
<th>14</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Controller Type</td>
<td>2704CP</td>
<td>2704</td>
<td>Standard</td>
<td>2704CPF</td>
<td>2704</td>
<td>Profibus</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Supply Voltage</td>
<td>VH</td>
<td>85-264 Vac</td>
<td>VL</td>
<td>20-29 Vac/dc</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Controller Function</td>
<td>CXX</td>
<td>Carbon</td>
<td>DXX</td>
<td>Dewpoint</td>
<td>OXX</td>
<td>Oxygen</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Furnace Control Sensor</td>
<td>X</td>
<td>Unconfigured</td>
<td>N</td>
<td>Type K</td>
<td>R</td>
<td>Type R</td>
<td>B</td>
<td>Type S</td>
<td>B</td>
<td>Type B</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Temp Control Output</td>
<td>XX</td>
<td>Not Fitted</td>
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<td>% Oxygen</td>
<td>OP</td>
<td>PPM Oxygen</td>
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<td>DR</td>
<td>Drayton</td>
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<td>Type K</td>
<td>N</td>
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1.14.1 Ordering Code for the IO Expander

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