1. SUPPLEMENT 2704VC VACUUM FURNACE CONTROLLER 2

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1. Supplement 2704VC Vacuum Furnace Controller

1.1 INTRODUCTION

The 2704 Furnace Vacuum Controller is shipped pre-configured with any one of four clone files as shown in the following table:-

1.	27VC-VXX mB-V1.XX.UIC	2704 vacuum only controller, units in mBar, version 1. UIC is the extension for the file used in iTools
2.	27VC-VXX torr-V1.XX.UIC	2704 vacuum only controller, units in torr, version 1. UIC is the extension for the file used in iTools
3.	27VC-VTX mB-V1.XX.UIC	2704 vacuum + temperature programmer, units in mBar, version 1. UIC is the extension for the file used in iTools
4.	27VC-VTX torr-V1.XX.UIC	2704 vacuum + temperature programmer, units in torr, version 1. UIC is the extension for the file used in iTools

When fitted with files 1 or 2 (VXX) the controller is used to control the vacuum pump down sequence of a furnace. Three vacuum inputs are provided – two for high and low vacuum gauges, and a third input which may be used for backing or backfill pressure. Switching between the low and high vacuum gauges is automatic and bumpless. Four setpoint outputs in the controller can be used to turn on or off external devices such as vacuum gauges. A total of six are available using the IO expander. Each setpoint has independent on/off values.

When fitted with files 3 or 4 (VTX) the vacuum control is combined with a temperature setpoint programmer which can store up to 50 setpoint profiles.

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

1.1.1 Related Handbooks

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

- The general vacuum control function block is described in the 2704 Engineering Handbook, part no. HA026933 issue 3.0. It is also available as a supplement part no. HA027186.
- 2704 Installation and Operation Handbook Part No. HA026502
- IO Expander Handbook Part No. HA026893
- iTools User Handbook Part No. HA026179

1.2 TEMPERATURE/VACUUM CONTROLLER BLOCK DIAGRAM

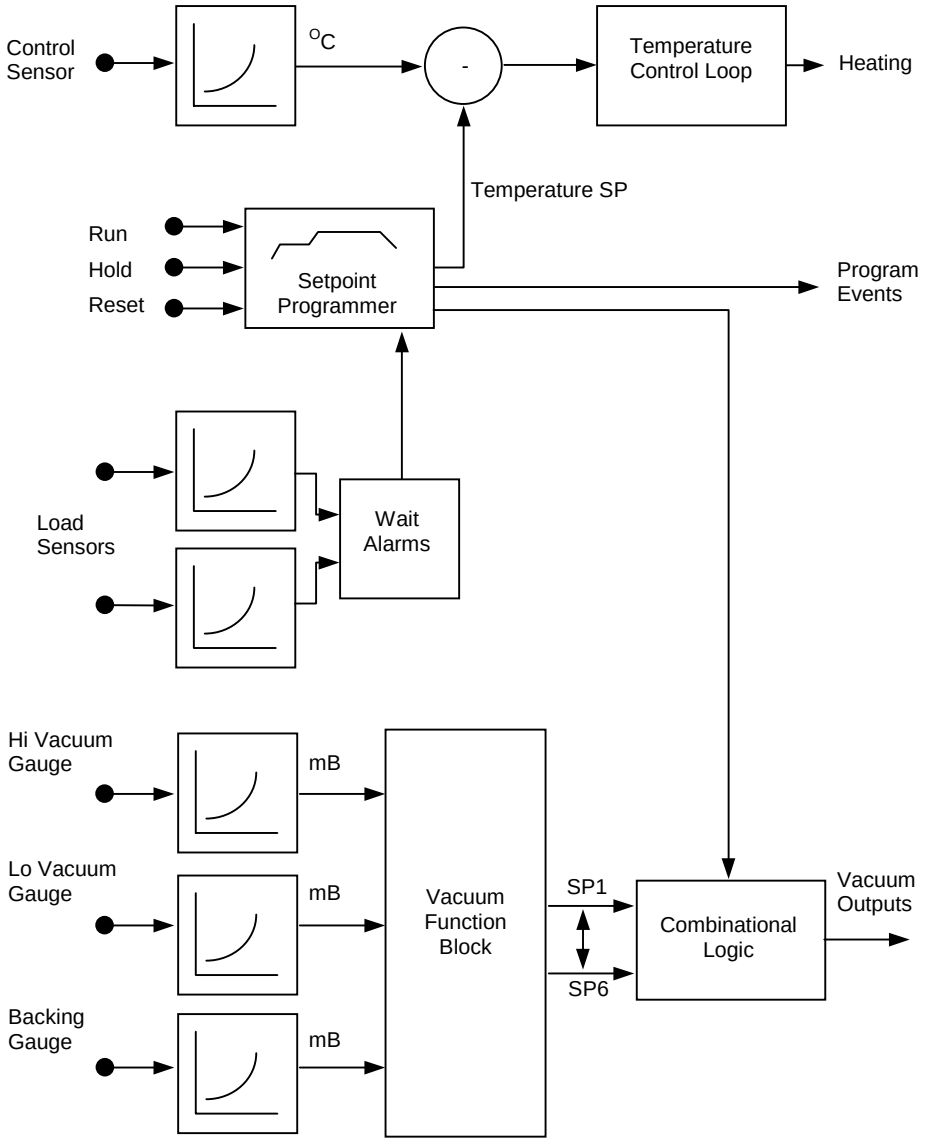


Figure 1-1: Typical Controller Block Diagram

1.3 INSTALLATION

The 2704 Vacuum Furnace controller 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.

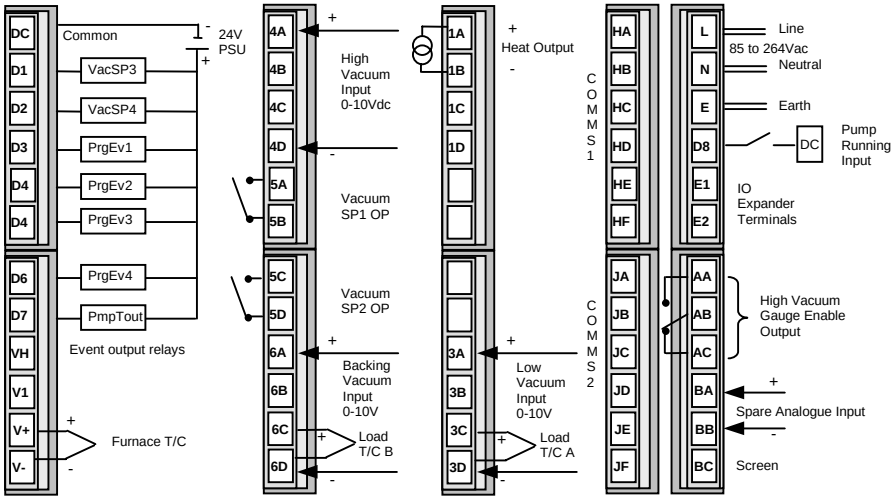
1.4 WIRING CONNECTIONS

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

This controller has the following configuration:-

- One control loop, 50 single profile programs, four events (VTX version only)
- DC control output module fitted in slot 1 providing heating control (VTX version only)
- Dual analogue input module fitted in slot 3 to provide 0-10V low vacuum gauge input and Load A thermocouple
- Analogue input module fitted in slot 4 to provide 0-10V high vacuum gauge input
- Dual relay module fitted in slot 5 to provide vacuum setpoint 1 and 2 outputs
- Dual analogue input module fitted in slot 6 to provide 0-10V backing gauge vacuum input and Load B thermocouple
- Optional EIA-232 communications module fitted in slot H
- Standard toolkit functions
- Thermocouple types are defaulted to type K
- Relay output for Hi-vacuum enable
- Six vacuum setpoint outputs

1.4.1 Controller Connections to Plant Devices



The Furnace thermocouple measures the temperature of the furnace

Load T/C A & B measure the temperature of the load in up to two different places. These values are compared in two deviation user alarms against the current setpoint to produce Wait A & B events. Wait events are used to provide guaranteed soak segments when running a setpoint program. See also section 1.7.6. note 3.

The Load Thermocouple input and Vacuum Measurement input are not isolated from each other, although they are isolated from all other I/O. These two signals should be isolated in the gauge.

Figure 1-2: Controller Terminals

The process inputs for the vacuum block are connected to terminals 3A & 3D (low vacuum), 4A & 4D (high vacuum) and 6A & 6D (backing vacuum) on the controller. Setpoint outputs 1 & 2 are wired to module outputs 5A & 5C on the controller. Setpoint outputs 3 & 4 are wired to digital IO points 1 and 2 on the controller. Vacuum setpoints 3 to 6 are wired to relay outputs on the IO expander.

The roughing timeout is wired to digital IO point 7 and a pump running digital input is wired from digital 8. The high vacuum enable output is connected to the AA relay.

1.4.2 IO Expander Connections to Plant Devices

☞ See IO Expander Handbook for further details.

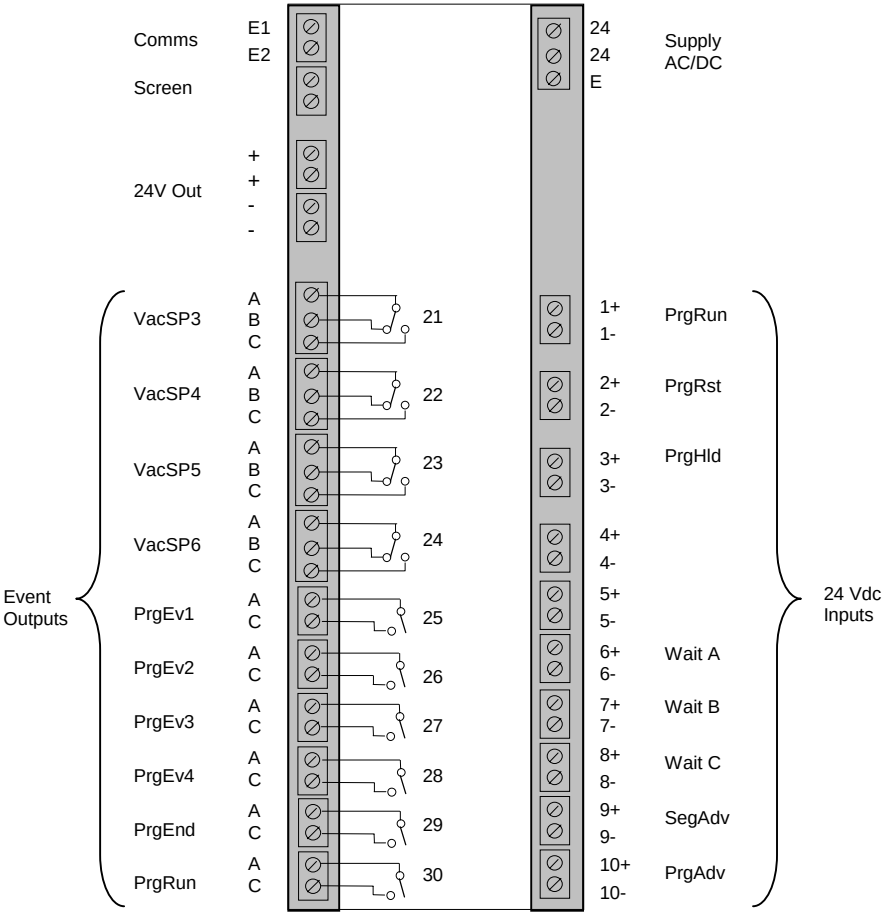


Figure 1-3: IO Expander Terminals

1.5 VACUUM 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 vacuum only controller.

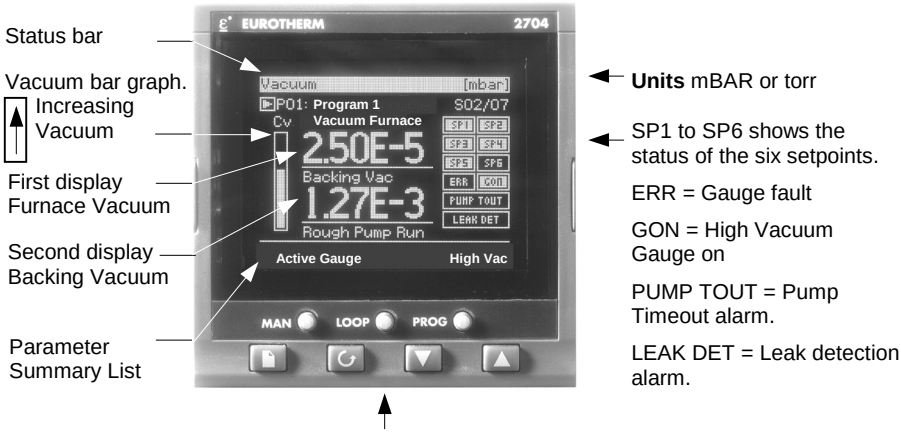


Figure 1-4: Vacuum Display

1.5.1 Alarm Messages

If alarms are present at switch on 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.

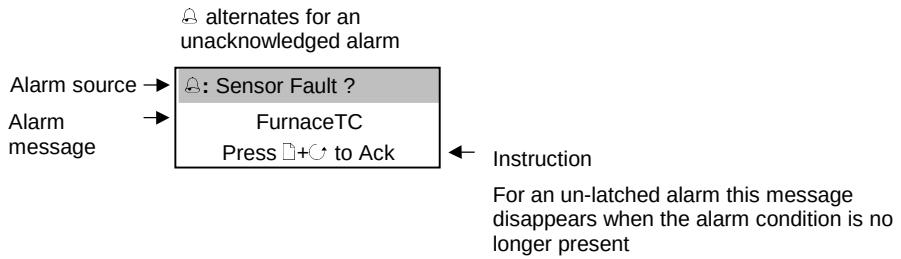
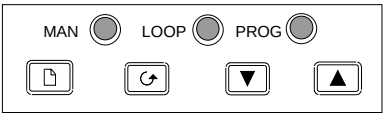


Figure 1-5: Alarm Message Banner

1.5.2 Operator Buttons



AUTO	Auto/Manual button This button is only applicable if the temperature control clone file is loaded	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 the temperature loop 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 temperature control clone file is loaded	• 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 button	Press to select the Page Header 'Menu'.
	Scroll button	Press to select a new parameter from the page heading. If held down it will continuously scroll through the parameters.
	Down button	Press to decrease an analogue value, or to change the state of a digital value
	Up button	Press to increase an analogue value, or to change the state of a digital value

Figure 1-6: Operator Buttons

1.5.3 To Change Vacuum Overview Displays

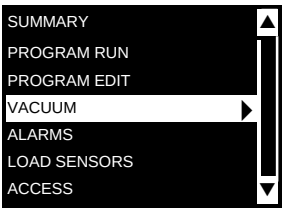
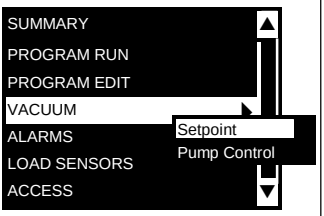
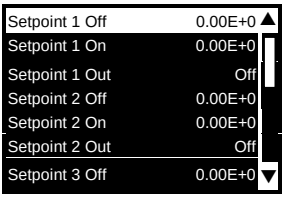
Two overview displays are provided. The first, which is the default display, is shown in Figure 1-4. The second is shown in Figure 1-7.

To switch between them press LOOP

Figure 1-7: Vacuum Overview

1.5.4 To Set Vacuum Setpoints

Six setpoint outputs are provided which can be used to turn on and off vacuum gauges or other external devices. The on/off points are independently settable giving a controlled hysteresis value. For further information see Setpoints section in the Engineering Handbook or supplement HA027186.

Do This	This Is The Display You Should See	Additional Notes
1. From any display press [page] as many times as necessary to access the page header menu 2. Press [▲] or [▼] to select **'VACUUM'**		This view is for the temperature/vacuum controller.
3. Press [↵] to display sub-headers 4. Press [▲] or [▼] to scroll to **'Setpoint'**		
5. Press [↵] to display vacuum setpoint parameters 6. Press [↵] again to edit the selected parameter 7. Press [▲] or [▼] to change the value		In this view only Setpoint 6 value can be changed. The output status of the other setpoints is off and is read only

Setpoint Off	The output will turn off at the value set for the parameter
Setpoint On	The output will turn on at the value set for the parameter
Setpoint Out	Current state of the setpoint output 'On' or 'Off'

i

By default Setpoint 1 & 2 are active on High Vacuum Gauge

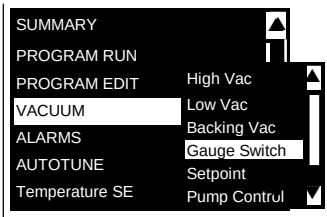
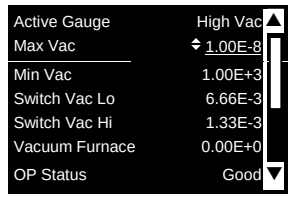
Setpoint 3 is active on Low Vacuum Gauge

Setpoint 4 is active on Backing Vacuum Gauge

These can all be changed in configuration level

1.5.5 To Set The Switchover Region Between Gauges

Gauge switchover allows the chamber vacuum measurement to transfer from one gauge to another in a controlled (bumpless) way. To set the switchover region it is necessary to enter Access Level 3. The procedure for this is given in the Engineering Handbook together with further information on Gauge Switchover.

Do This	This Is The Display You Should See	Additional Notes
Access the **VACUUM (Gauge Switch)** page using the procedure described in the previous section		This view is Access Level 3 and for the vacuum only controller.
5. Press [↵] to display gauge switchover parameters 6. Press [▲] or [▼] to scroll to the selected parameter 7. Press [↵] again to edit the selected parameter 8. Press [▲] or [▼] to change the value of the selected parameter		

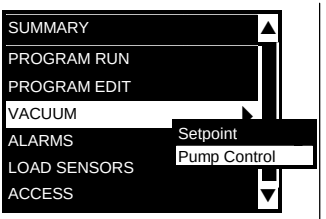
Active Gauge	is a read only parameter which shows the currently selected gauge
Max Vac	sets a high limit for the vacuum range
Min Vac	sets a low limit for the vacuum range
Switch Vac Lo	sets the point at which the low vacuum gauge begins to transfer to the high vacuum gauge
Switch Vac Hi	sets the point at which the low vacuum gauge ceases to contribute to the vacuum reading. After this value the vacuum is read totally by the high vacuum gauge
Vacuum Furnace	is a read only parameter showing the current value of the furnace vacuum as read by the low or high vacuum gauges
Op Status	is read only and indicates that the working gauge is 'Good' or 'Bad' A gauge may be bad, for example, if it is out of range or the input is open circuit. If one input is bad the PV will take the value of the good input to try tp allow the process to continue.

1.5.6 To Set The Roughing Pump Timeout

When starting the chamber the roughing pump is run to get the chamber down to an initial level before the high vacuum pump is started. If a level of vacuum is not reached in a time (both of which are settable by the user) then the roughing pump timeout status is set.

The roughing pump timeout can be configured such that the vacuum measurement used for the timeout can be either the low vacuum gauge or the backing vacuum gauge (default).

When the roughing pump is started the **PUMP TOUT** (Figure 1-4) indicator flashes and continues to flash until the timeout is complete. If at the end of the timeout the required vacuum level is not reached the indicator stays permanently on.

Do This	This Is The Display You Should See	Additional Notes
Access the **VACUUM (Pump Control)** page using the procedure described in the previous section		This view is Access level 1 and for the vacuum only controller.
5. Press [↻] to display Pump Control parameters 6. Press [▲] or [▼] to scroll to the selected parameter 7. Press [↻] again to edit the selected parameter 8. Press [▲] or [▼] to change the value of the selected parameter		

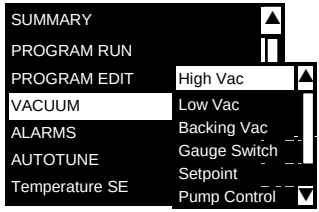
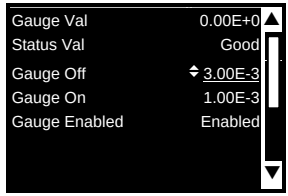
Pump Running	is a read only parameter showing pump running Yes/No	Level 1
R Pump TimeOut	sets the time out for the roughing pump in hrs:min:sec	Level 3
R Pump TimeRem	read only time remaining, in hrs:min:sec, for the roughing pump to achieve the set level	Level 1
R Pump SP	to set the vacuum level which the roughing pump must reach in set the time out	Level 1
R Pump Status	read only parameter showing pump timed out in the set time – Good/Bad	Level 3

1.5.7 To Set The High Vacuum Enable Setpoint

It is generally required to ensure that power is not turned on to the high vacuum gauge until the vacuum reaches a pre-determined level. An enable signal is provided using the AA relay output. This relay changes when the vacuum reaches a level set by the parameter 'Gauge On', and changes back when the vacuum level reaches the value set by the parameter 'Gauge Off'.

If the gauge 'status' is determined by the controller to be 'Bad' a fault output will be set and 'Sensor Break' displayed.

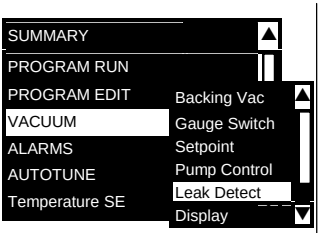
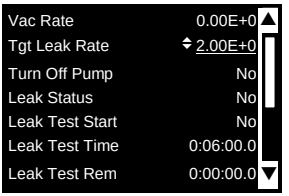
To set the high vacuum enable setpoint it is necessary to enter Access Level 3. The procedure for this is given in the Engineering Handbook.

Do This	This Is The Display You Should See	Additional Notes
Access the **VACUUM (High Vac)** page using the procedure described in the previous section		This view is Access Level 3 and for the vacuum only controller.
1. Press [↻] to display High Vacuum gauge parameters 2. Press [▲] or [▼] to scroll to the selected parameter 3. Press [↻] again to edit the selected parameter 4. Press [▲] or [▼] to change the value of the selected parameter		Table a-10 in the Vacuum Supplement Part No. HA027186 shows the full list of parameters in this page

1.5.8 Leak Detection

Vacuum chamber leaks are typically categorised into two areas, virtual leaks and real leaks. A virtual leak is a decrease in vacuum caused by outgassing of the workpiece and the chamber material/gaskets, etc. Therefore, in order for a leak to be detected, the reduction in vacuum must be monitored over a period of time with the pumps turned off. If there is a real leak the vacuum will continue to reduce, whereas if a virtual leak is present the vacuum will appear to decrease at a constant rate but then level off to give a steady vacuum reading.

To set leak detection it is necessary to enter Access Level 3. The procedure for this is given in the Engineering Handbook.

Do This	This Is The Display You Should See	Additional Notes
Access the **VACUUM (Leak Detect)** page using the procedure described in the previous section		This view is Access Level 3 and for the vacuum only controller.
1. Press [↻] to display High Vacuum gauge parameters 2. Press [▲] or [▼] to scroll to the selected parameter 3. Press [↻] again to edit the selected parameter 4. Press [▲] or [▼] to change the value of the selected parameter		

Vac Rate	read only parameter showing the current rate of change of vacuum
Tgt Leak rate	set this value to the required leak rate
Turn Off Pump	read only parameter showing the status of the pump On/Off
Leak Status	read only parameter leak detected No/Yes
Leak test Start	to start the test
Leak Test Time	to set the time period for the leak test
Leak Time Rem	read only parameter leak time remaining

1.6 TEMPERATURE CONTROL

When the controller is loaded with clone files, VTX, the 2704VC vacuum controller integrates both temperature and vacuum control functions into one unit.

Switch on the controller. After a brief self-test sequence, during which the controller displays the software version number, you will see the default overview display (Vacuum).

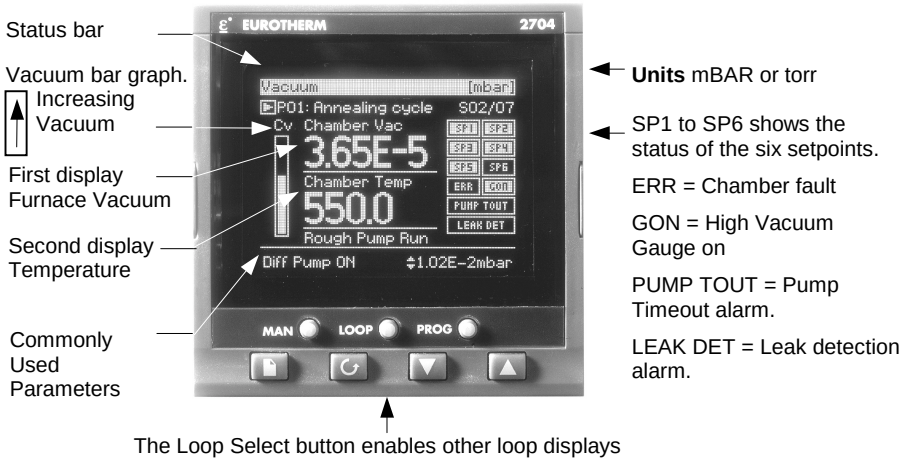


Figure 1-8: Vacuum Display

1.6.1 Commonly Used Parameters

The lower section of the display contains a number of commonly used parameters.

To scroll through these press

A parameter preceded by ⇕ may be altered using ▲ or ▼

In the Vacuum overview the parameters are:-

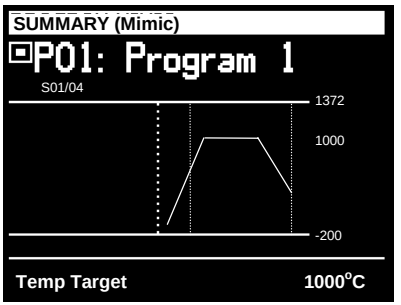
- Temp Local SP — Furnace temperature setpoint when programmer in Reset
- Temperature WSP — Current working setpoint (read only)
- Temp Target — Temperature which the programmer is heading for (read only)
- Time Remaining — Time remaining to end of program (read only)

1.6.2 To Select Different Operator Views

Press LOOP button.

The following views are displayed with each press:-

SUMMARY (Mimic)

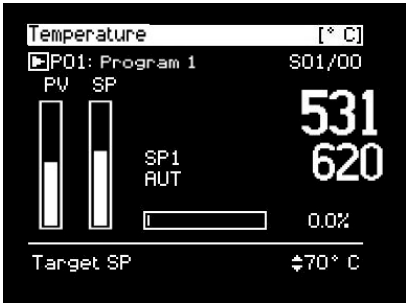


A time/temperature chart showing the furnace temperature during a running program

Press to scroll through the list of commonly used parameters. These are all read only:-

Temp Target	Temperature to which the programmer is heading
Temp Dwell Time	Time in current segment
Prog Dos	State of the digital outputs in the current segment

Temperature

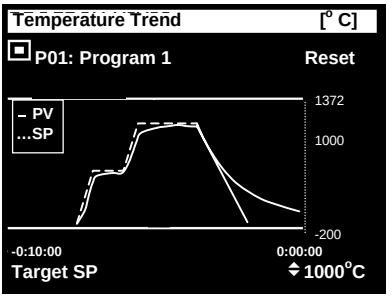


Shows a summary of the temperature control loop

Press 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

Temperature Trend

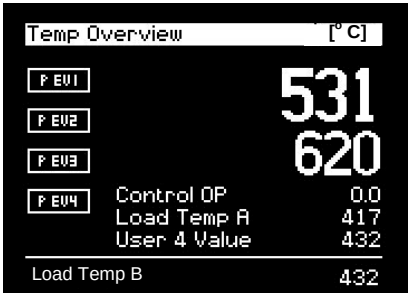


Shows a time/temperature graph of the process

Press  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

Temperature Overview

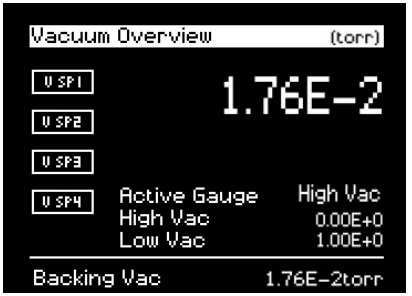


Shows an overview of all three temperature inputs

One commonly used parameter is available:-

Temp Local SP	The setpoint when the programmer is in Reset

Vacuum Overview



Shows an overview of vacuum setpoints and gauge measurements

One commonly used parameter is available:-

Backing Vac	The current value of the backing vacuum. Read only

1.6.3 To Change the Value of the Local Setpoint

From the overview displays, scroll to 'Temp Local SP' using

Press ▲ or ▼ to raise or lower the value.

Note: A parameter value preceded by ⬍ indicates that it can be changed

1.6.4 To Select Auto or Manual Operation

The temperature controller has two basic modes of operation:

- **Automatic Mode** in which the control output is automatically adjusted to maintain the process value at the setpoint .
- **Manual Mode** in which you can adjust the output independently of the setpoint.

The Auto/Manual button can only be operated from the 'Temperature' or the 'Temperature Trend' overview. Press the Loop Select button to select this view, then press **AUTO/MAN** to toggle between auto and manual.

When the controller is in **AUTO**, 'AUT' will be displayed on the page. The parameter summary list (lower readout) will default to the **Target SP** which can be changed as described above.

When the controller is in **MANUAL**, 'MAN' will be displayed on the page. The parameter summary list (lower readout) will default to the **Output Power**. The output power can now be changed using ▲ or ▼.

1.7 TEMPERATURE SETPOINT PROGRAMMER

The programmer has one setpoint profile for temperature, and is connected to control loop 1.

Digital inputs are available for Run, Reset and Hold on IO expander inputs 1, 2 or 3.

Four programmer event outputs are pre-configured in the controller, which are duplicated in the IO expander to provide a relay outputs.

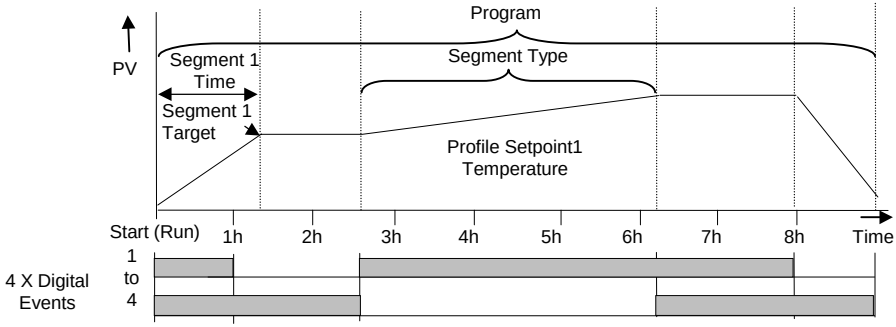


Figure 1-9: Example of a Temperature Profile

1.7.1 To Select, Run, Hold or Reset a Program

Press PROG button. A banner appears →

Press ▲ or ▼ 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 again to toggle between Run and Hold.

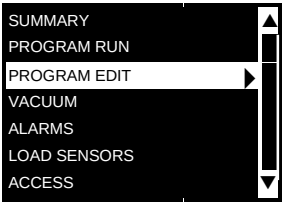
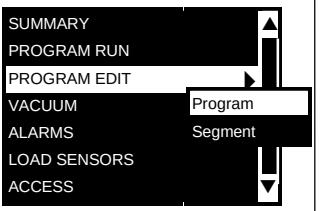
Press and hold PROG button for 2 seconds to Reset the program. In reset the programmer is inactive and the controller behaves as a standard controller, with the setpoint determined by the raise/lower buttons.

☞ A list of parameters available for a running program is available under the page header PROGRAM RUN. Refer to the Engineering or Operation Handbook

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.

1.7.2 To Create or Edit a Program

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

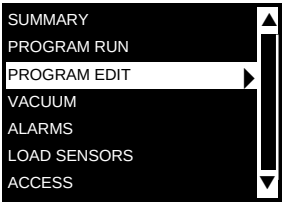
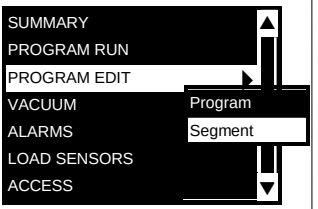
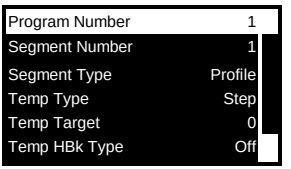
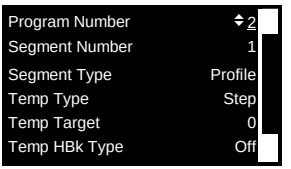
Do This	This Is The Display You Should See	Additional Notes
1. From any display press [D] as many times as necessary to access the page header menu 2. Press [▲] or [▼] to select **'PROGRAM EDIT'**		This is access level 1 view
3. Press [↵] to display sub-headers		
4. Press [↵] to select parameters for the overall program 5. Press [▲] or [▼] to change the value		

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

1.7.3 PROGRAM EDIT (Program Page) Parameters

Table Number: 1.7.3.	These parameters affect the overall program. All parameters are available at Level 1. To hide parameters refer to the Engineering Handbook		PROGRAM EDIT (Program Page)
Parameter Name	**Parameter Description**	**Value**	**Default**
Program Number	Selects the program number to be edited.	1 to 50	1
Hbk Mode See also Note 2 in section 1.7.7.	Holdback mode None = no holdback Per prog = applied over the whole program Per seg = active in every segment	 None Per Program Per Segment	Per Segment
Temp HBk Type Only displayed if Per Program configured	Holdback type for Temperature program These are deviations between SP and PV Fine and course holdback allows two levels of holdback to be applied to different segments.	Off Fine Lo Fine Hi Fine Band Course Lo Course Hi Course Band	Off
Temp FineHBk	Fine holdback value for the Temperature program	Display range	0
Temp CoarseHBk	Course holdback value for the Temperature program	Display range	0
The above two parameters are only displayed if Hbk Mode = Per Segment			
Rate Units	Rate units	Per Second Per Minute Per Hour	
Program Cycles	The number of times a program repeats.	Cont. to 999	Cont.
End Action	Defines the action in the end segment. Dwell - the program will dwell indefinitely at the conditions set in the end segment. Reset - the program will reset to the start conditions.	 Dwell Reset	
Program Name	Displays the name of the program		Program 1

1.7.4 To Set Up Each Segment of a Program

Do This	This Is The Display You Should See	Additional Notes
1. From any display press [D] to access the page header menu. 2. Press [▲] or [▼] to select '**PROGRAM EDIT**'		This is access level 1 view
3. Press [↺] to show sub-headers 4. Press [▲] or [▼] (if necessary) to select **'Segment'**		
5. Press [↺] to show segment parameters 6. Press [▲] or [▼] to scroll up or down the list of parameters	**Select a Program** 	If the program exists, the segment details are displayed
7. Press [↺] again to edit the selected parameter 8. The value or state of a parameter prefixed by ⇕ can be changed using [▲] or [▼]		→If the program selected is new, confirm as instructed on the display Create Prg: 2? [D]→Cancel [↺]→OK

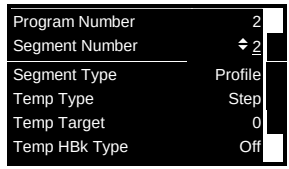
Tip ☺ A back and forward scroll is available by holding down [↺] and pressing [▲] or [▼] respectively

Alternatively, press [D] to return to the highlighted bar and use [▲] or [▼]

Set Up a Segment

9. Press [C] to scroll to and edit the **'Segment Number'**

10. Press [▲] or [▼] to choose the **'segment number'**



If the segment selected is new, confirm as instructed on the display.

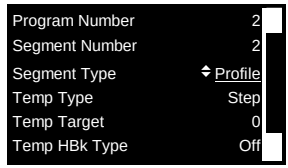
Not applicable to segment 1

Create Seg 2?
□→Cancel ↻→OK

Up to 100 segments are available per program

11. Press [C] to scroll to and edit the **'Segment Type'**

12. Press [▲] or [▼] to change the segment type



The choices are:-

Profile

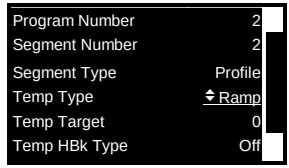
Go Back

End Segment

See the Program Edit Parameter tables for an explanation

13. For a Profile segment, press [C] to scroll to and edit '**Temp Type'**

14. Press [▲] or [▼] to change temperature type



The choices are:-

Step

Ramp

Dwell

See the Program Edit Parameter tables for an explanation

For Segment Type = Ramp the next two parameters are Temperature Target and Temperature Rate in ^{o}C/sec/min or hr as set in PROGRAM EDIT (Program) page

For Segment Type = Dwell the next two parameters are Temp Target which would normally take the previous value and Temp Dwell Time in h:m:s

For Segment Type = Step only Temperature Target is available

For Guaranteed soak Set Up Wait Events

17. Press [C] to scroll to and edit the **'Wait Event'**

18. Press [▲] or [▼] to choose Wait A, or Wait B

The program will not proceed to the next segment until the wait condition is satisfied.

See section 1.7.6. Note 3 for a further description of wait events.

Wait A =	Wait for load T/C A to catch up
Wait B =	Wait for load T/C B to catch up

For Optimum Control Performance in Set Up PID Sets in Each Segment

17. Press [↻] to scroll to and edit the **'PID Set'**

18. Press [▲] or [▼] to choose the required set from 1 to 6

Each segment can use a different set of PID values. This may be useful if the controller is required to operate over a large non-linear range of temperatures where different PID values are required for optimum control.
The PID values are set in **'Temperature SE (PID)'** page

Programmer Digital Outputs

19. Press [↻] to scroll to and edit the **'Prog DO Values'**

20. Press [▲] or [▼] to select □ or ▮

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

Segment Name

21. Press [↻] to scroll to and edit the **'Segment Name'**

Each segment can be allocated a name. 'Default Text' means that no name has been allocated.
Pressing [▲] or [▼] will scroll through a list of pre-prepared user text names.
User text names can be changed in configuration mode but it is not recommended since this text is used elsewhere in the controller.

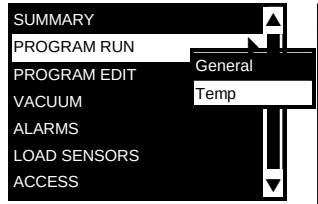
1.7.5 To Edit A Running Program

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

1.7.6 Example; To Change the Target Setpoint or Temp Rate

Place the program in **'Hold'**. Then:-

Do This	This Is The Display You Should See	Additional Notes
1. Select the '**PROGRAM RUN (temp)'** page		This is access level 1 view
2. Press [↻] to select the list of parameters for running the program. **3.** Press [↻] to scroll to **'Temp Target'** 4. Press [▲] or [▼] to change the value		*i* Temp Target can be set between high and low limits set in configuration level, see Engineering Handbook
5. Press [↻] to scroll to **'Temp Rate'** **6.** Press [▲] or [▼] to change the value		

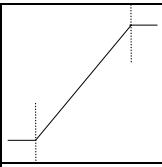
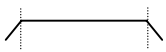
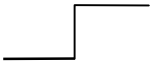
Now place the programmer in Run

1.7.7 PROGRAM EDIT (Segment) Parameters

Table Number: 1.7.7.	These parameters allow you to set up each segment in the program		PROGRAM EDIT (Segment)
Parameter Name	**Parameter Description**	**Value**	**Default**
Program Number	Selects the program number to be edited	1 to 50	
Segment Number	Selects the segment number to be edited	1 to 100	
Segment Type	Segment type	Profile End Segment Go Back	Profile
	Profile = a segment which can be set to Ramp, Dwell or Step End Segment = the last segment in the program (press ↵ to confirm) Go Back = repeat part of program. Not shown for segment 1.		
Temp Type	Profile setpoint 1 type Note 1	Step Dwell Ramp	
Not shown if Segment Type = End Segment			
Temp Target	Profile setpoint 1 target value The temperature which the program is heading for	PSP1 lo limit to PSP1 hi limit	0
Temp Dwell Tm	Profile setpoint 1 dwell time The time for which the temperature remains at its set value	d : h : m : s	
Only shown if Segment Type = Dwell			
Temp Rate	Profile setpoint 1 rate The rate at which the setpoint changes from its previous value to the target temperature		
Only shown if Segment Type = Ramp			
Temp Hbk Type	Profile setpoint 1 holdback type Note 2	Off Fine Lo Fine Hi Fine Band Course Lo Course Hi Course Band	Off
Only shown if holdback is configured per segment			

Wait Event	Wait if selected event is true Note 3	No wait Event A Event B Event C	No Wait
PID Set	A different set of PID values may be applied to each segment. Use ▲ or ▼ to select a set from	1 to 6	
Prog DO Values	Sets programmer event outputs on or off		4
Segment Name	Allows a user defined name to be chosen from a stored name in User Text - (Set in INSTRUMENT User Text – configuration mode only)	Default Text to 50:Usr 50	Default Text

Note 1 A profile segment may be set as:-

Ramp		**The setpoint ramps linearly**, from its current value to a new value, either at a set rate (called *ramp-rate programming*), or in a set time (called *time-to-target programming*). You must specify the ramp rate or the ramp time, and the target setpoint, when creating or modifying a program.
Dwell		**The setpoint remains constant** for a specified period at the specified target. When creating programs the target is inherited from the previous segment. When editing an existing program it is necessary to re-enter the target value. This allows the dwell target to be matched to a go-back segment.
Step		**The setpoint steps instantaneously** from its current value to a new value at the beginning of a segment.

Note 2 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.

In a **Ramp** 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.

In a **Dwell** it will freeze the dwell time if the difference between SP and PV exceeds pre-set limits.

In both cases it guarantees the correct soak 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.

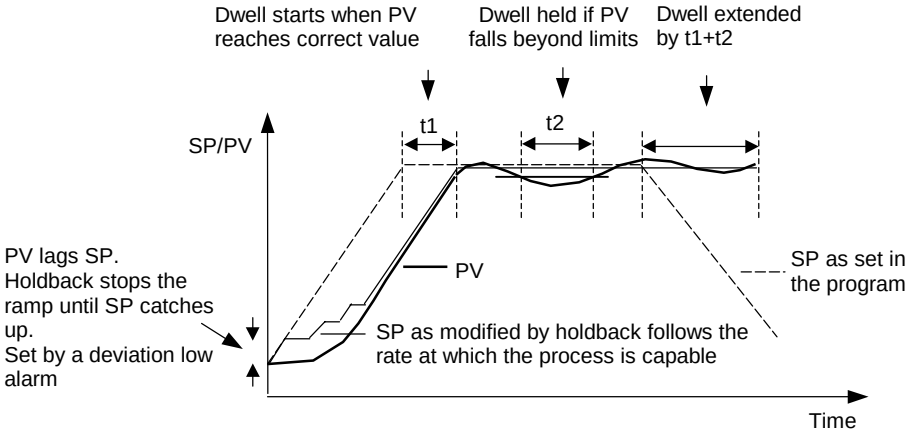
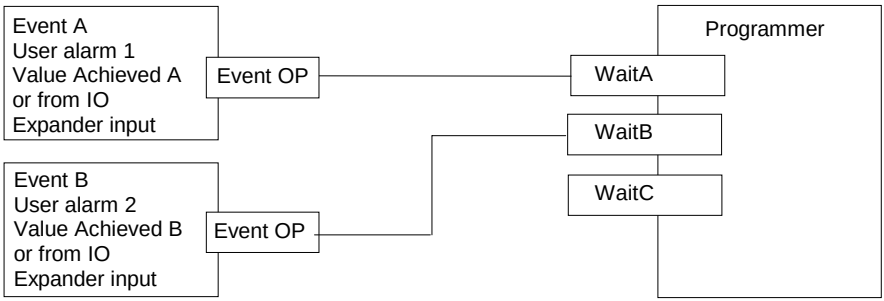


Figure 1-10: Effect of Holdback to Produce Guaranteed soak

Note 3 Wait

Events can be configured at the end of each segment, which, when active, will cause the program to wait before progressing to the next segment. Two wait conditions are provided which are triggered by any one of two user alarms named 'Value Achieved A' and Value Achieved B'. These alarms are configured as low deviation on Load inputs A & B from the current working setpoint. The Wait Events may also be triggered by digital inputs from the IO Expander. Each segment may then select No-Wait, Wait on Event A, or Wait on Event B. The program will not proceed until <u>all</u> profile segments are complete.



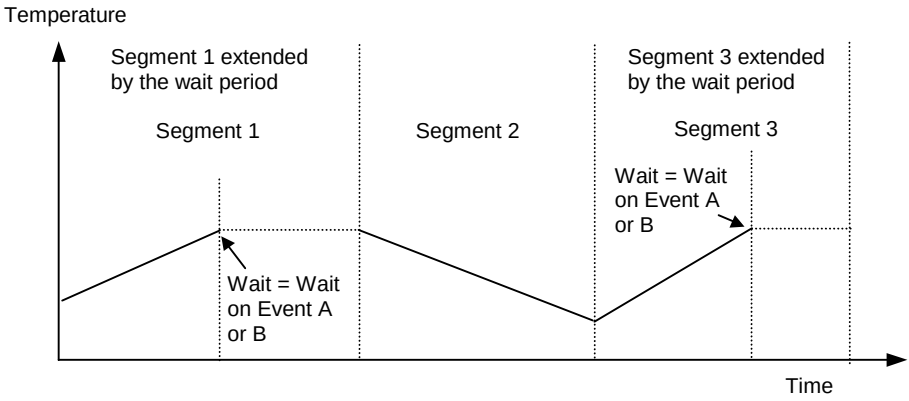


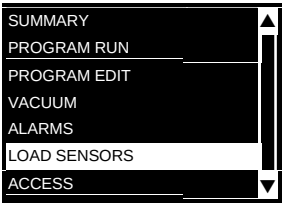
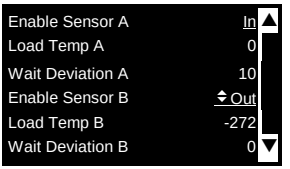
Figure 1-11: Wait Events

1.7.8 Load Sensors Page

This is a Parameter List style 'User Page' pre-configured for the following parameters:-

Parameter Name	Parameter Description	Value	Default
Enable Sensor A	Allows the Load A thermocouple connected to terminals 6C & 6D to operate	In – enabled Out - disabled	
Load Temp A	Load A temperature	Display range	
Wait Deviation A	To set the value of low deviation alarm which will trigger Wait Event A. This value can also be set in ALARMS (Value Achieved) See also Guaranteed Soak section 1.7.9.	Display range	10
Enable Sensor B	Allows the Load B thermocouple connected to terminals 6C & 6D to operate	In – enabled Out - disabled	
Load Temp B	Load B temperature deviation	Display range	
Wait Deviation B	To set the value of the full scale low alarm which will trigger Wait Event B. This value can also be set in ALARMS (Value Achieved) See also Guaranteed Soak section 1.7.9.	Display range	0

1.7.8.1 To Access Load Sensor Parameters

Do This	This Is The Display You Should See	Additional Notes
1. From any view press [ ] as many times as necessary to **'LOAD SENSORS'** page header		This is access level 1 view
2. Press [ ] to select the list of parameters for Load Sensors **3.** Press [ ] to again to scroll to the parameter required 4. Press [▲] or [▼] to change the value		

1.7.9 Guaranteed Soak

Guaranteed soak ensures that the furnace load will be processed for the correct time at the correct temperature. A combination of Holdback and Wait Events will help to ensure optimum conditions to achieve guaranteed soak.

1.8 SPECIFIC VACUUM CONTROLLER PAGE HEADERS

The list of page headers is generally as shown in Navigation Diagram in the Engineering Handbook. Some have specific names or parameter lists specific to vacuum control.

The following lists are specific to this clone file:-

1.8.1 Summary

This page is customised to show a summary of furnace temperature parameters.

Parameter Name	Parameter Description
Temperature WSP	The current working value of the temperature setpoint
Temp Target	The value which the temperature setpoint is aiming for when the programmer is running
Time Remaining	Time left to end of program
Temp Local SP	Temperature setpoint when the programmer is in reset

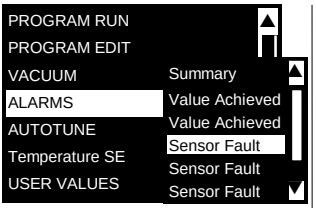
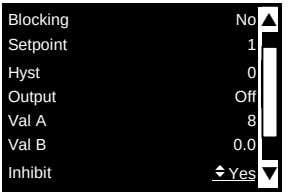
1.8.2 Alarms

The following alarms are configured but they may be switched on or off in Level 3.

Name	Alarm Source	Type
Value Achieved A	Load Temperature A	Deviation Low
Value Achieved B	Load Temperature B	Deviation Low
Sensor Fault?	Furnace TC	Full Scale High
Sensor Fault?	Load Temperature A	Full Scale High
Sensor Fault?	Load Temperature A	Full Scale High
Sensor Fault?	High Vacuum	Full Scale High
Sensor Fault?	Low Vacuum	Full Scale High
Sensor Fault?	Backing Vacuum	Full Scale High

1.8.3 To Activate/Deactivate Alarms

Any of the above alarms may be activated or deactivated in operating Level 3. The following example deactivates Load Temperature A alarm:-

Do This	This Is The Display You Should See	Additional Notes
3. Select the '**ALARMS' (sub-header)** page 4. Press ▲ or ▼ to scroll to the first Sensor Fault		This is an access level 3 view
5. Press ↺ to select the list of parameters for this alarm 6. Press ▲ or ▼ to scroll to **'Inhibit'** 7. Press ↺ to edit to **'Inhibit'** 8. Press ▲ or ▼ to select **'Yes'**		*i* This may be useful to prevent unused inputs which are not connected from indicating a sensor break alarm

1.8.4 Temperature SE

This is the Temperature Loop Set Up Page.

☞ The parameters are the same as described in the Engineering and the Installation & Operation handbooks under *LP1* SETUP.

1.9 ORDERING CODE

1	2	3	4	5	6	7	8	9	10	11	12	13

1. Controller Type	
2704VC	2704 Standard
2704VCF	2704 Profibus

2. Supply Voltage	
VH	85-264Vac
VL	20-29Vac/dc

3. Controller Function	
VXX	Vacuum only
VTX	Vacuum/ Temp

4. Furnace Control Sensor 5. Load Temp Sensors	
K	Type K
N	Type N
R	Type R
S	Type S
B	Type B
C	Type C
Z	RTD/Pt100
D	Type D
E	Type E
1	Ni/Ni 18%Mo
2	Pt20%Rh/Pt40 %Rh
3	W/W26%Re (Eng)
4	W/W26%Re (Hos)
5	W5%Re/W26 %Re (Eng)
6	W5%Re/W26 %Re (Hos)
7	Pt10%Rh/Pt40 %Re
Q	Custom curve

6. Temp Control Output	
4mA20	4-20mA
0mA20	0-20mA
0V10	0-10Vdc
0V5	0-5Vdc
1V5	1-5Vdc

7. High Vacuum Input 8. Low Vacuum Input 9. Backing/Foreline Vac IP	
V000	Edwards AIM-5
V020	Edwards APG-M
V030	Edwards APG-L
V060	Edwards PRM10
V110	Pfeiffer TPR265
V120	Pfeiffer IKR 251
V130	Pfeiffer PKR251
V200	Leybold ITR 100D
V210	Leybold TTR211/216
V220	Leybold PTR225/237
V230	Leybold TR090
V240	Leybold IR090
V300	Varian Mini BA-IMG
V310	Varian CovecTorr
Q000	Custom curve (8)

10. H Comms Slot	
XX	Not Fitted
A2	232 Modbus
Y2	2-wire 485 Modbus
F2	4-wire 485 Modbus
AE	232 Bisynch
YE	2-wire 485 Bisynch
FE	4-wire 485 Bisynch
PB	Profibus
DN	Devicenet

11. J Comms Slot	
XX	Not Fitted
A2	232 Modbus
Y2	2-wire 485 Modbus
F2	4-wire 485 Modbus
M1	232 Master
M2	2-wire 485 Master
M3	4-wire 485 Master

12. Toolkit Blocks	
XX	Standard
U1	Toolkit Level 1
U2	Toolkit Level 2

13. Manual	
ENG	English
FRA	French
GER	German

1.9.1 Ordering Code for the IO Expander