MODEL 2604 CONTROLLER

Installation and Operation Handbook

Contents

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1. Chapter 1 INTRODUCTION

Thank you for selecting the 2604 High Performance Programmer/Controller. This chapter provides a general overview of your controller to help you to become more familiar with its use, and to ensure that it is the correct type for your process.

1.1. ABOUT THIS MANUAL

This manual is intended for those who wish to install, operate or commission the controller. Operation of the controller is provided by three levels of security access. This manual, therefore, is confined to these levels.

The three levels of access are:-

Level 1	Operation only. This level allows, for example, parameters to be changed within safe limits or programmers to be run, held or reset.
Level 2	Supervisory level. This level allows, for example, parameter limits to be pre-set or programs to be edited or created.
Level 3	Commissioning level. This level is intended for use when commissioning the instrument. It allows, for example, calibration offsets to be adjusted to match transducer and transmitter characteristics.
View Config	It is possible also to read the configuration of the controller at any level but the configuration cannot be changed.

Configuration of the controller is available in a fourth level of access. This is explained in a separate engineering manual, available on request by quoting Part Number HA026761.

1.1.1. The Structure Of This Manual

This chapter provides a general overview of the controller

Chapter 2 describes how to mount and wire the controller.

Chapter 3 explains the principle of operation

The remaining chapters explain the operation of individual features of the controller. These chapters follow the order in which the features appear in the pull out navigation diagram in chapter 2.
In each chapter the purpose of the feature is described, followed by its operation, and, where applicable, includes worked examples of how to set up specific aspects of a feature.

1.2. WHAT IS 2604

The 2604 is a high accuracy, high stability temperature and process controller which is available in a single, dual or three loop format. It has a dual 7-segment display of process value and setpoint with a LCD panel for display of information and user defined messages.

When the 2604 is configured as a programmer it provides advanced programming facilities such as:

- storage of up to 50 programs.
- up to three variables can be profiled in each program, or one profile can be assigned to run in more than one loop.
- up to sixteen event outputs can be assigned to each program.

Special machine controllers can be created by connecting analogue and digital parameters to the control loops, either directly or by using a selection of mathematical and logical functions.

Other features include:

- A wide variety of inputs which can be configured, including thermocouples, Pt100 resistance thermometers and high level process inputs.
- Direct connection of zirconia oxygen probes is also supported for use in heat treatment furnaces and ceramic kiln applications.
- Each loop can be defined to be PID, On/Off or valve position and can control using a variety of strategies including single, cascade and ratio control.
- PID control outputs can be relay, logic, triac or dc with valve position outputs being relay triac or logic.
- Auto tuning and PID gain scheduling are available to simplify commissioning and optimise the process

Configuration of the controller is explained in a separate Engineering Manual, Part No. HA026761. Configuration is achieved either via the front panel operator interface or by using ‘iTools’ - a configuration package which runs under the Windows 95, or NT operating systems.

1.3. BEFORE YOU BEGIN

1.3.1. Unpacking

All parts comprising the 2604 are boxed individually. The packaging is designed to withstand reasonable transit shocks. It is suggested that each item is unpacked carefully and the contents inspected for damage.

If there is evidence of shipping damage, please notify your supplier within 72 hours. The packaging should be retained for inspection.

All packaging contains anti-static materials to prevent the build up of static which can damage electronic assemblies.

1.3.2. Contents of Packaging

Each box contains the following parts:-

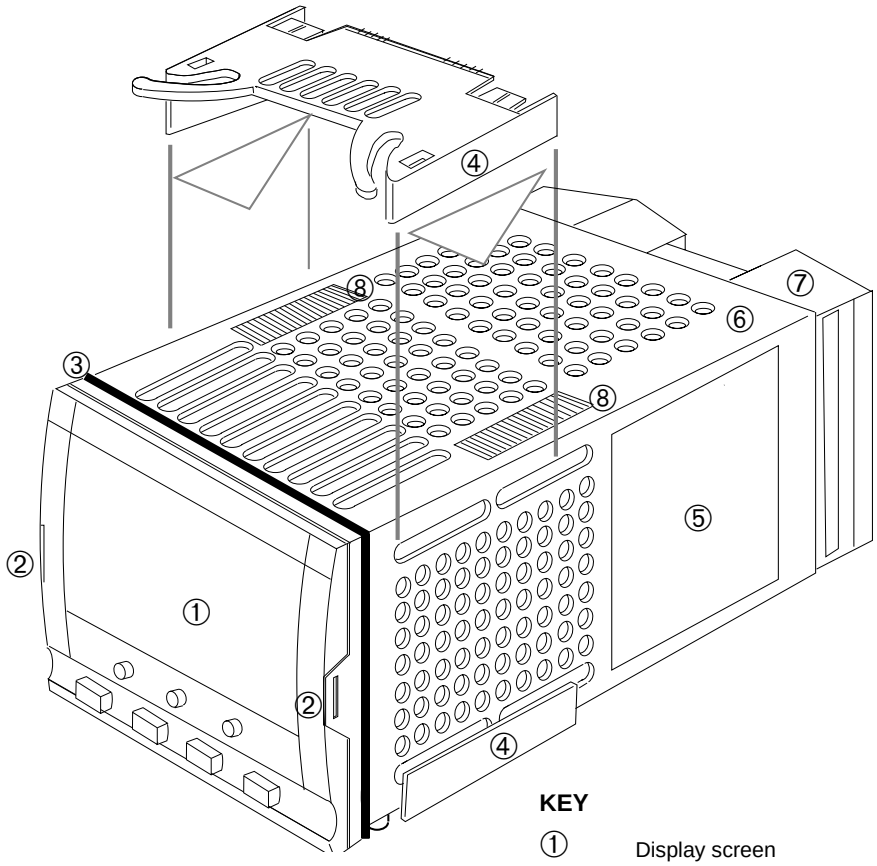
1. The 2604 controller fitted into its corresponding sleeve. Labels on the sleeve identify the controller code, its serial number, and the customer reference number. These details should be checked against your requirements before installing the unit into the panel. A description of the instrument code is given in Appendix A.
2. A bag containing two panel retaining clips
3. A bag containing input resistors for use with mA inputs
4. This Installation and Operation Handbook

Please refer to Figure 1-2 showing a general view of the controller.

1.3.3. Does the Controller Match the Process?

Every controller is supplied with a specific hardware configuration to match the process which it is designed to control. For example, there are five ‘slots’ which can contain different plug in modules. These are defined by a hardware code as shown in Appendix A. Before installing the 2604 controller check the label on the side of the instrument against the instrument coding given in Appendix A for correct type.

Where possible the controller is supplied with its software configured to match the process. This is defined by a quick start order code given in Appendix A. This should also be checked on the instrument label to ensure that the controller is suitable for the process to be controlled.
The 2604 controller contains a large number of variants to fulfil the demands of specific processes In general the software configuration can be changed through the front panel of the controller. The procedures are described both in this manual and the Engineering Manual, Part No. HA026761. Alternatively, ‘iTools’ configuration software may be supplied. The order code for this is also shown in Appendix A.



KEY

①	Display screen
②	Latching ears
③	Panel sealing gasket
④	Panel retaining clips
⑤	Label
⑥	Sleeve
⑦	Terminal covers
⑧	Ratchets

Figure 1-2: General View of 2604 Controller

1.4. OPERATOR INTERFACE - OVERVIEW

The front panel of the 2604 consists of two 5 digit numeric displays, one alpha numeric display, eight LED status indicators and seven operator push-buttons. See Figure 1-3.

- The upper numeric display normally indicates the current process value from the plant.
- The centre display is slightly smaller than the upper display and normally shows the setpoint.
- The lower display is an alpha numeric LCD display which provides access to instrument operating and configuration parameters.
- The eight LED status indicators are illuminated to show controller operating mode such as a loop view, auto/manual or programmer run/hold.
- The seven operator buttons allow adjustments to be made to the controller.

1.4.1. Displays and Indicators

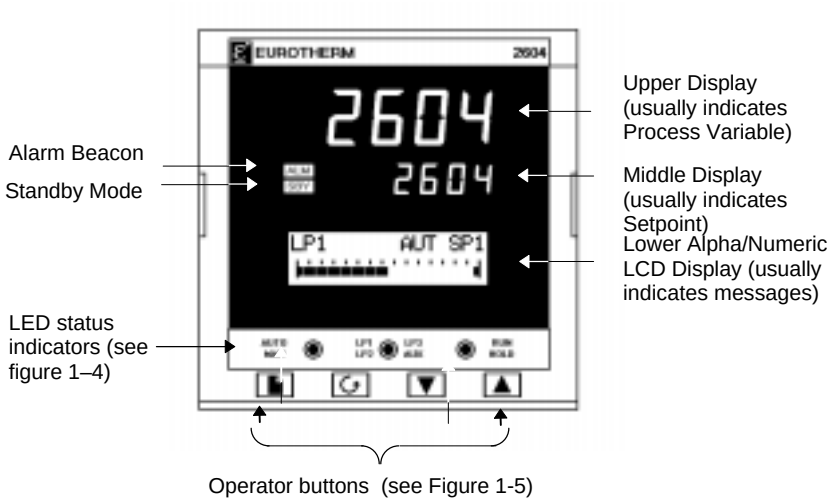


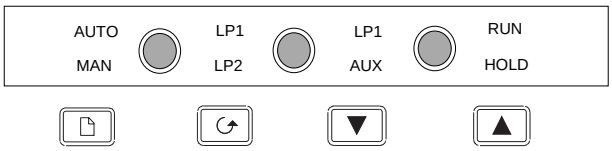
Figure 1-3: Operator Interface

1.4.2. LED Status Indicators

Indicator	Function
AUTO	The selected loop is in automatic (closed loop) control
MAN	The selected loop is in manual (open loop) control
LP1	Indicates which control loop is selected
LP2	
LP3	
AUX	Indicates that the selected loop has a second control function. For example, if a loop is configured as cascade, ratio or override then a second press of the loop button will cause the AUX indicator to illuminate together with the loop indicator.
RUN	Indicates a program is activated
HOLD	Indicates a program is held at its current levels
ALARM BEACON	This is a red LED which will flash when any new alarm occurs. It will be accompanied by a message displayed on the lower readout. The beacon will be permanently lit when an alarm is acknowledged but is still present. See Chapter 7 ‘Alarm Operation’ for further details.
STANDBY BEACON	This is a green LED which will be lit when the controller is in Standby mode. When the controller is in standby mode all interfaces to the plant are switched to a rest condition. For example, all control outputs = 0. **When this beacon is lit the controller is no longer controlling the process.** This beacon will be lit when:- • The controller is in configuration mode • Standby mode has been selected through the user interface or via an external digital input • During the first few seconds after start up

Figure 1-4: Status Indicators

1.4.3. Operator Buttons



AUTO / MAN	Auto/Manual button	The Auto/Manual button only operates from the loop view. When pressed, this toggles between automatic and manual mode: • If the controller is in automatic mode the AUTO light will be lit. • If the controller is in manual mode, the MAN light will be lit. The Auto/Manual button can be disabled in configuration level.
LP1 / LP2 — LP1 / AUX	Loop select button	Repeat pressing to select:- Loop1 ▸ Loop2 ▸ Loop 3 ▸ Back to Loop1 If any one loop is cascade, ratio or override the AUX indicator will illuminate as well as the loop indicator
RUN / HOLD	Run/Hold button	• Press once to start a program (RUN light on.) • Press again to hold a program (HOLD light on) • Press again to cancel hold and continue running (HOLD light off and RUN light ON) • Press and hold in for two seconds to reset a program (RUN and HOLD lights off) The RUN light will flash at the end of a program. The HOLD light will flash during holdback.
	Page button	Press to select a new list of parameters.
	Scroll button	Press to select a new parameter in a list.
	Down button	Press to decrease a parameter value.
	Up button	Press to increase a parameter value.

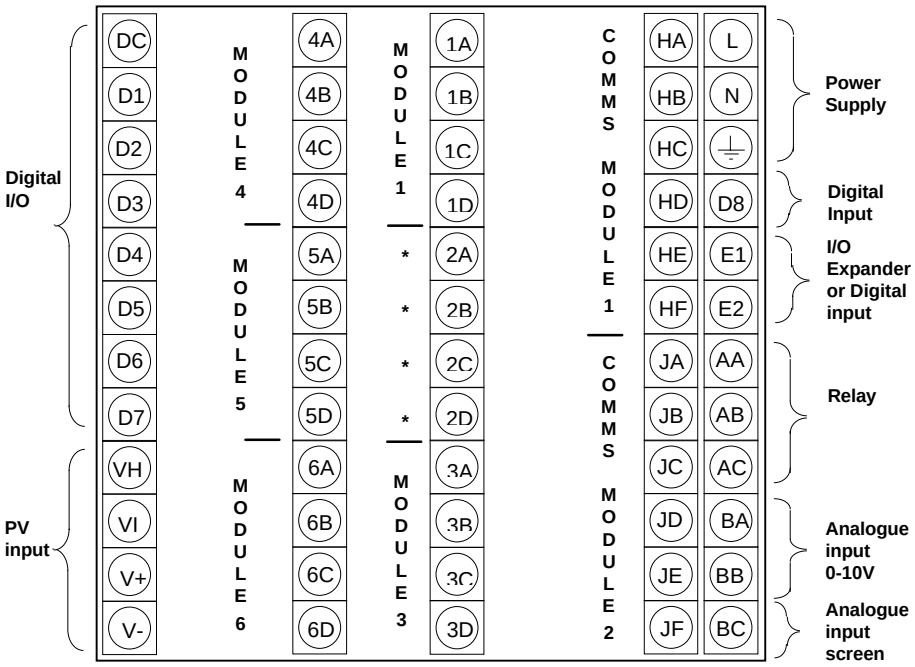
Figure 1-5: Operator Buttons

1.5. INSTALLATION - OVERVIEW

The 2604 controller must be mounted and wired in accordance with the instructions given in Chapter 2.

The controller is intended to be mounted through a cut out in the front panel of an electrical control cabinet. It is retained in position using the panel mounting clips supplied.

All wires are connected to terminals at the rear of the instrument. Each block of six terminals is protected by a hinged cover which clicks into closed position.



The functionality of the two outer rows of terminals is common to all instrument variants, as follows:-

PV input	VH, VI, V+, V-
Analogue input	BA, BB
I/O expander	E1, E2
Fixed changeover relay	AA, AB, AC
Digital I/O channels	D1 to D8 and DC
Power supply	L, N, Earth

*** Terminals 2A, 2B, 2C, 2D must not be wired to.**

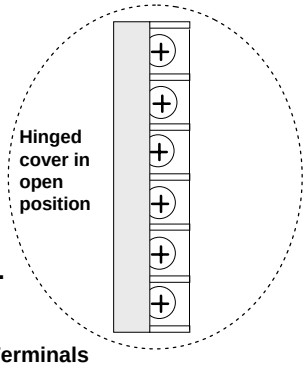


Figure 1-6: View of the Rear Terminals

1.6. I/O MODULES

The 2604 controller has the facility to fit optional plug in modules. The connections for these modules are made to the inner three connector blocks as shown in Figure 1-6
The modules are:

- Communications modules. See also section 2.4
- I/O modules See also section 2.5

These modules are fitted simply by sliding them into the relevant position as shown in Figure 1-7.

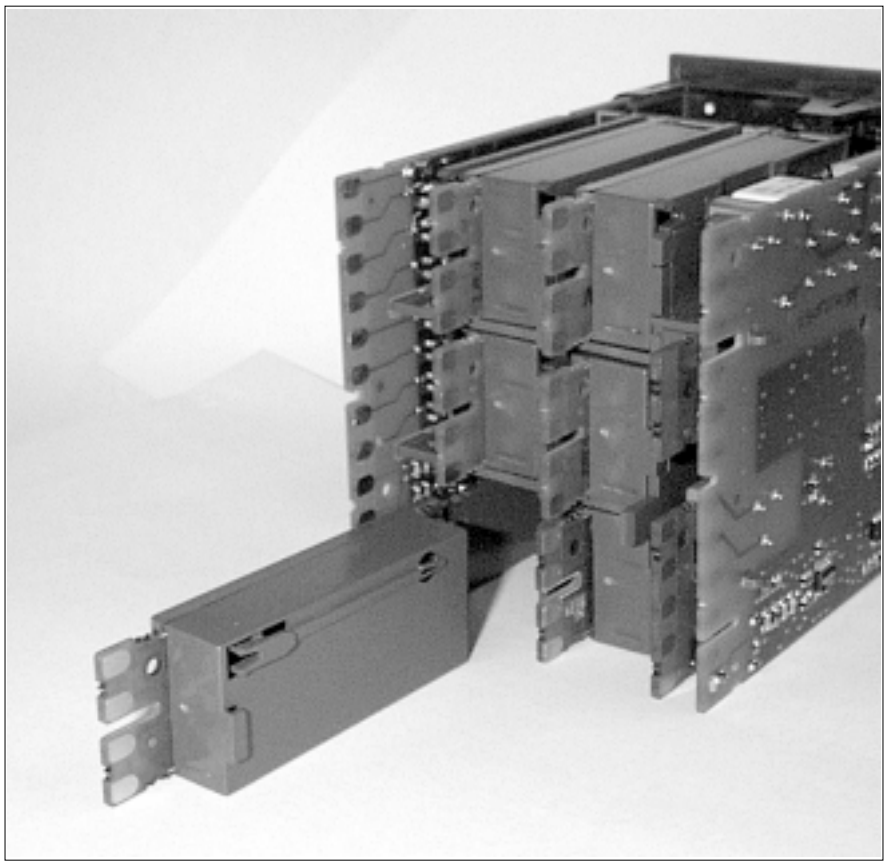


Figure 1-7: View of The Plug-in Modules

2. Chapter 2 INSTALLATION

2.1. MECHANICAL INSTALLATION

2.1.1. Positioning

The controller can be mounted vertically or on a sloping panel of maximum thickness 15mm (0.6in). Adequate access space must be available at the rear of the instrument panel for wiring and servicing purposes. The outline dimensions are shown in figure 2-1.
Take care not to cover ventilation holes in the top, bottom and sides of the instrument.

Before proceeding please read Appendix B ‘Safety and EMC Information’.

2.1.2. Outline dimensions Model 2604

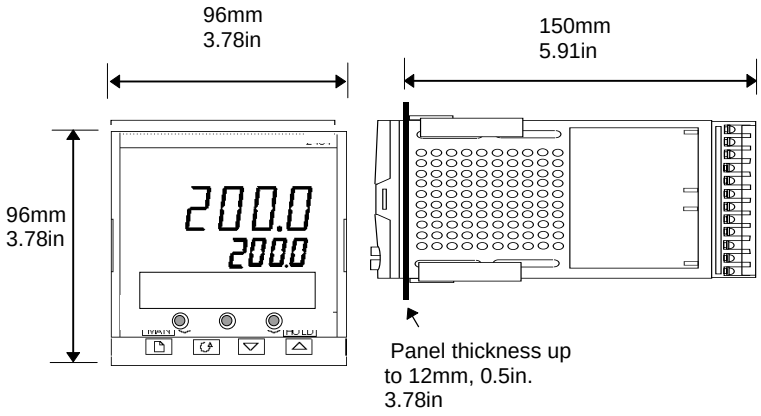


Figure 2-1: Outline Dimensions

2.1.3. Mounting the Controller

1. Prepare the panel cut-out to the size shown in Figure 2-2. Ensure that there is sufficient spacing between instruments as shown by the minimum dimensions given in Figure 2-2. Ensure also that the controller is not mounted close to any device which is likely to produce a significant amount of heat which may affect the performance of the controller.
2. Insert the controller through the panel cut-out.
3. Spring the upper and lower panel retaining clips into place. Secure the controller in position by holding it level and pushing both retaining clips forward.

Note:- If the retaining clips subsequently need removing, in order to extract the controller from the control panel, they can be unhooked from the side with either your fingers or a screwdriver.

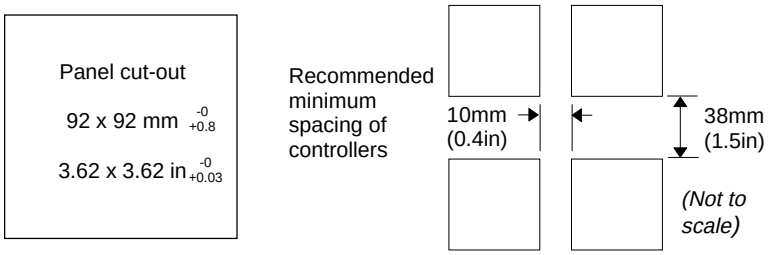


Figure 2-2:- Panel Cut-out and Minimum Spacing Requirements

2.1.4. Unplugging and Plugging in the Controller

If required, the controller can be unplugged from its sleeve by easing the latching ears outwards and pulling the controller forward out of the sleeve. When plugging the controller back into its sleeve, ensure that the latching ears click into place.

It is recommended that the power to the controller is switched off when un-plugging or plugging the controller into its sleeve. This is to prevent premature wear on the controller connectors when current is flowing through them.

2.2. WIRING

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. The controller may either have been configured when ordered, or may need configuring now. See 2604 Engineering Manual Eurotherm Part Number HA026761 for details.

Before proceeding further, please read Appendix B, Safety and EMC information.

2.2.1. Electrical Connections

All electrical connections are made to the screw terminals at the rear of the controller. They accept wire sizes from 0.5 to 1.5 mm^2 (16 to 22 AWG) and should be tightened to a torque of 0.4Nm (3.5lbin). If you wish to use crimp connectors, the correct size is AMP part number 349262-1. The terminals are protected by a clear plastic hinged cover to prevent hands, or metal, making accidental contact with live wires.

2.2.2. Rear Terminal Layout

The rear terminal layout is shown in Figure 2-3, which identifies terminal designations and their functions. Refer to the individual diagrams to wire the controller to your requirements.

The two outer terminal strips have fixed functionality for all versions of the instrument, as follows:-

- A Process Variable input which can be configured for:-
    - Thermocouple, RTD, Pyrometer, Voltage (e.g. 0-10Vdc) or Milliamp (e.g. 4-20mA) signals
- Seven Digital I/O, configurable as input or output.
    - Inputs are logic (-1 to 35Vdc) or contact closure, and can be configured for:- Manual, Remote, Run, Hold, Reset, etc,.
    - Outputs are open collector requiring an external power supply, and can be configured as event, status time proportioning or valve position outputs.
- One digital input
- An I/O expander which allows additional I/O via an external unit.
- A changeover relay which can be configured as an alarm or event output. It cannot be configured as a time proportioning output.
- An analogue input for volts (e.g. 0-10Vdc) or Milliamp (e.g. 4-20mA) signals to a second PID loop, setpoint, etc,. (This input can be characterised to match a particular curve from a transmitter. It cannot accept thermocouple inputs directly).
- Power supply to the unit. The supply may be 85 - 264Vac 50 or 60 Hz,

The three central terminal strips are for optional plug in modules, as follows:-

- Terminals marked 2A to 2D are reserved for a Memory Module only. No connections should be made to these terminals.
- Terminals marked HA to HF are connections for optional RS232, RS485, or RS422 communications modules.
- Terminals marked JA to JF are connections for an optional slave communications module or second communications port used to communicate with other Eurotherm instruments.

The modules fitted into the above two communications slots can be inter-changed.

For a full list of available modules refer to the Ordering code - Appendix A and the Technical Specification - Appendix C. The functionality of these modules is given in subsequent chapters.

⚠ **Warning:- Take care that mains supplies are connected only to the power supply terminals (85 to 254Vac only), the fixed relay terminals or to relay or triac modules. Under no circumstances should mains supplies be connected to any other terminals.**

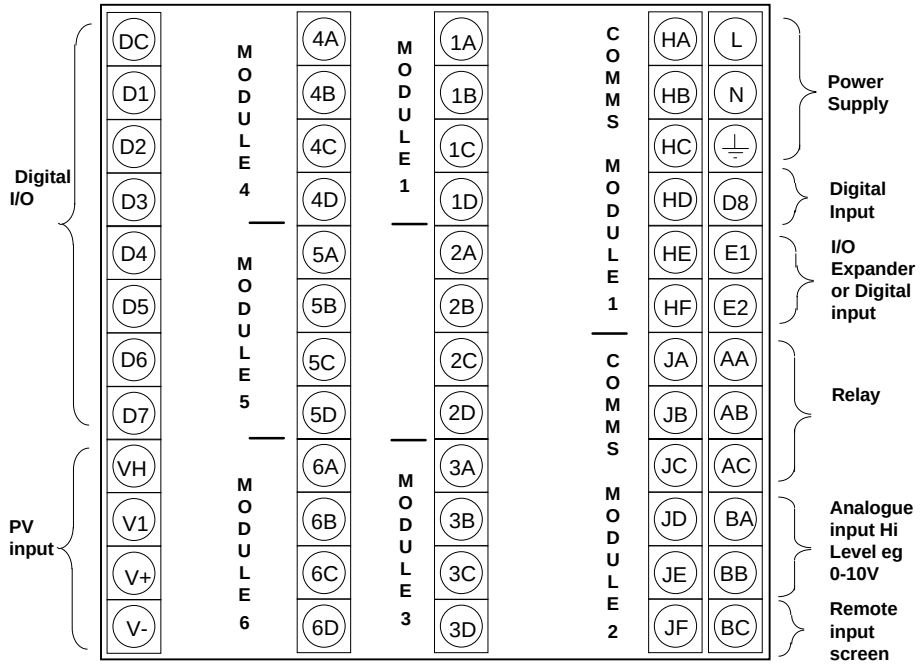


Figure 2-3:- Rear Terminal Layout

2.3. STANDARD CONNECTIONS

2.3.1. Power Supply Wiring (Line voltage)

The 2604 controller is suitable for connection to a power supply of between 85 and 264Vac 50 or 60 Hz. It is the users responsibility to provide an external fuse or circuit breaker. Suitable fuses are T type (EN60127 time-lag type) rated at 1A

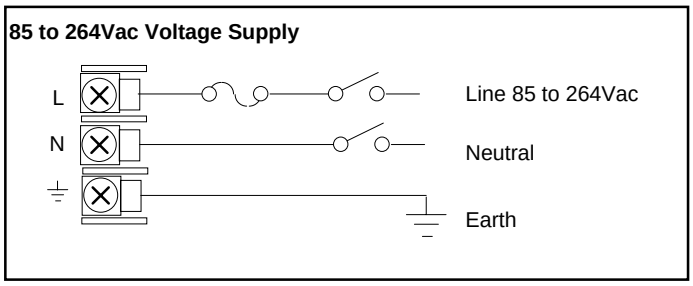


Figure 2-4:- Wiring Connections For Line Voltage

2.3.2. Relay Output

A single changeover relay is provided as standard. It can be configured as a control output or an alarm or event output.

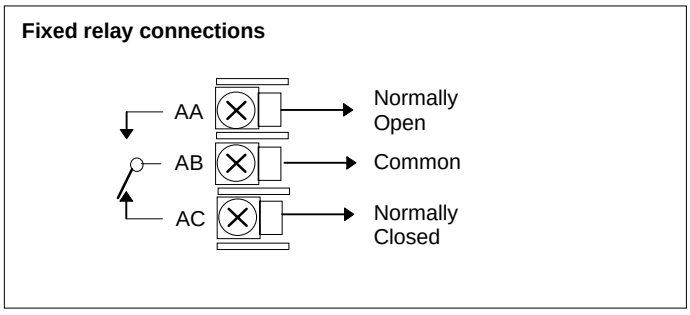


Figure 2-5: Wiring Connections for Fixed Relay Output

2.3.3. Sensor Input Connections

The fixed PV input can accept a range of sensors including Thermocouple, RTD, Pyrometer, Voltage (e.g. 0-10Vdc) or Milliamp (e.g. 4-20mA) signals. These sensors are used to provide inputs to Control Loop 1.

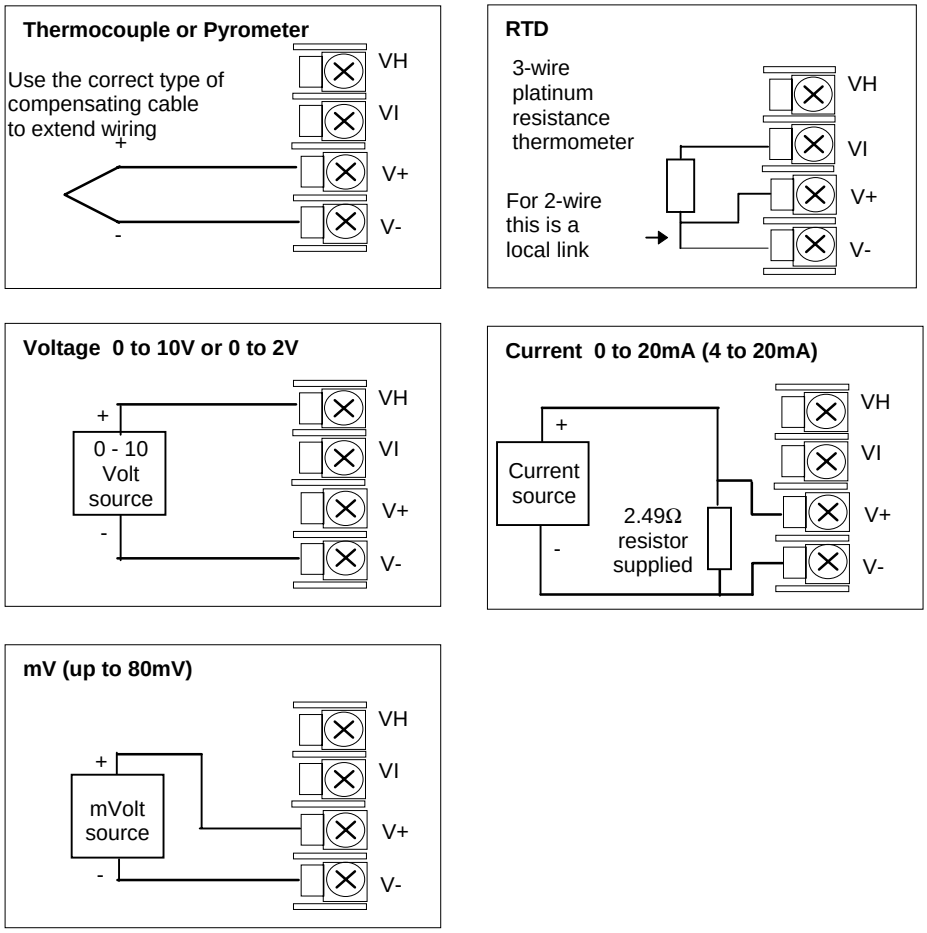


Figure 2-6:- Wiring Connections for PV Input

2.3.4. Analogue Input Connections

The analogue input is supplied as standard and is intended to accept 0 to 10 Vdc from a voltage source. A milli-amp current source can be used by connecting a 100Ω resistor across terminals BA and BB. This input can be used as a remote setpoint input, remote setpoint trim or as a high level PV input to a control loop. This input is non-isolated.

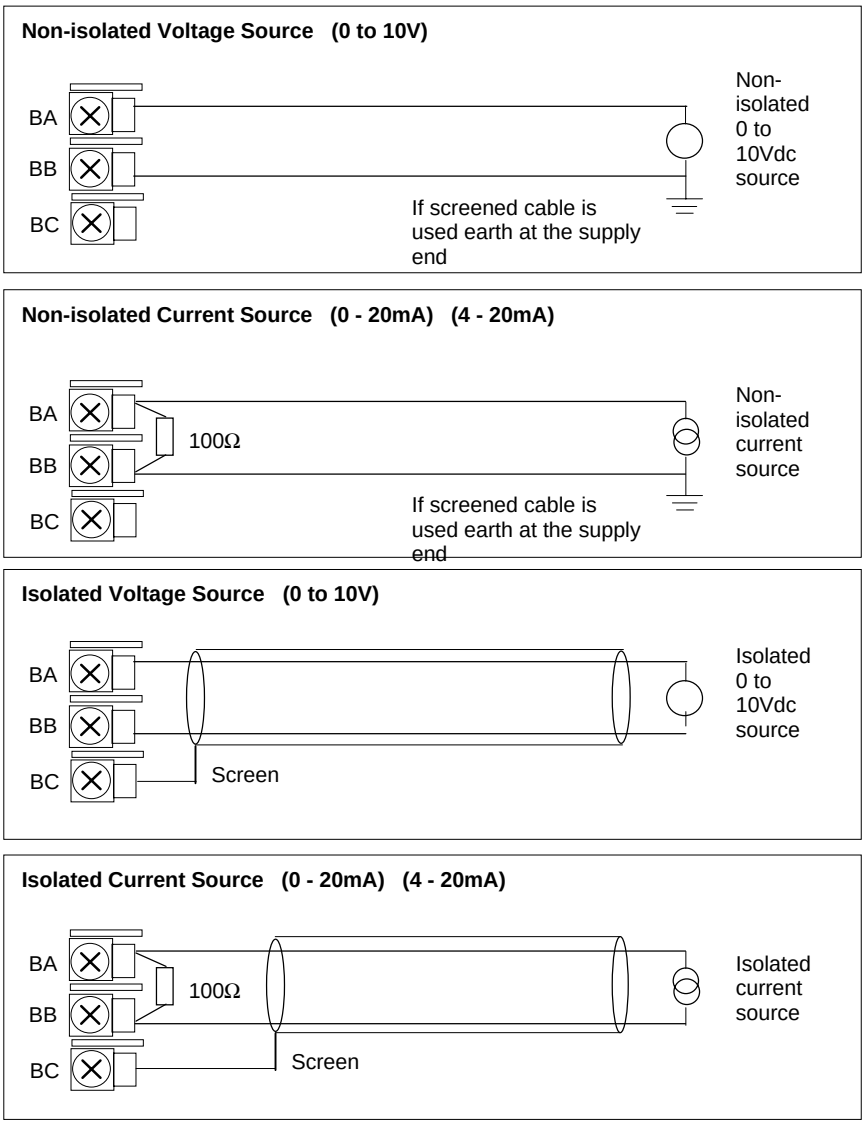


Figure 2-7:- Wiring Connections for Analogue Input

2.3.5. I/O Expander (or Additional Digital Input)

The I/O expander is used with the 2604 to allow the number of I/O points to be increased by a further 20 digital inputs and 20 digital outputs. Data transfer is performed serially via a two wire interface from instrument to expander.
If the expander unit is not required it is possible to use terminals E1 & E2 as a secondary digital input. These terminals are not part of the digital I/O on terminals D1 to D8 and if used in this way connect a 2K2, ¼ W limiting resistor in series with the input, as shown in Figure 2-9.

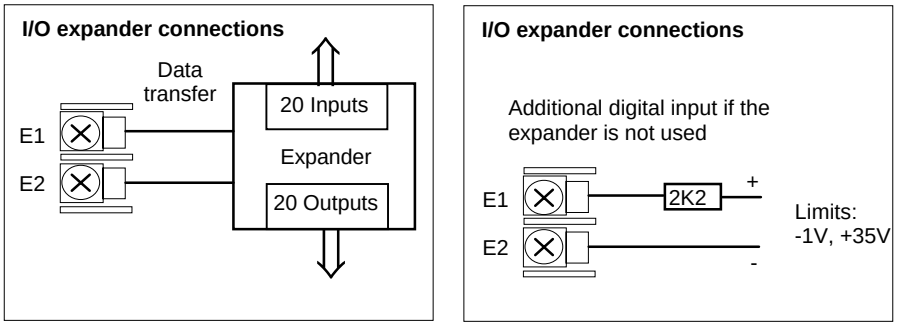


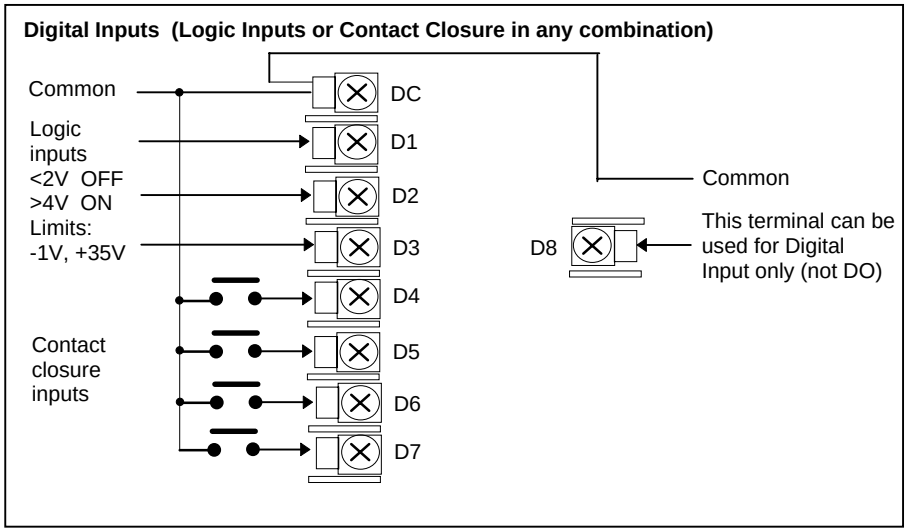
Figure 2-8: Wiring Connections for the I/O Expander

2.3.6. Digital I/O

Eight digital I/O connections are provided as standard. They can be configured as:

1. Inputs Run, Hold, Reset, Auto/Manual, etc, - logic or contact closure.
2. Outputs Configurable as Control outputs, Programmer Events, Alarms, etc.

Digital IO is not isolated from instrument ground.



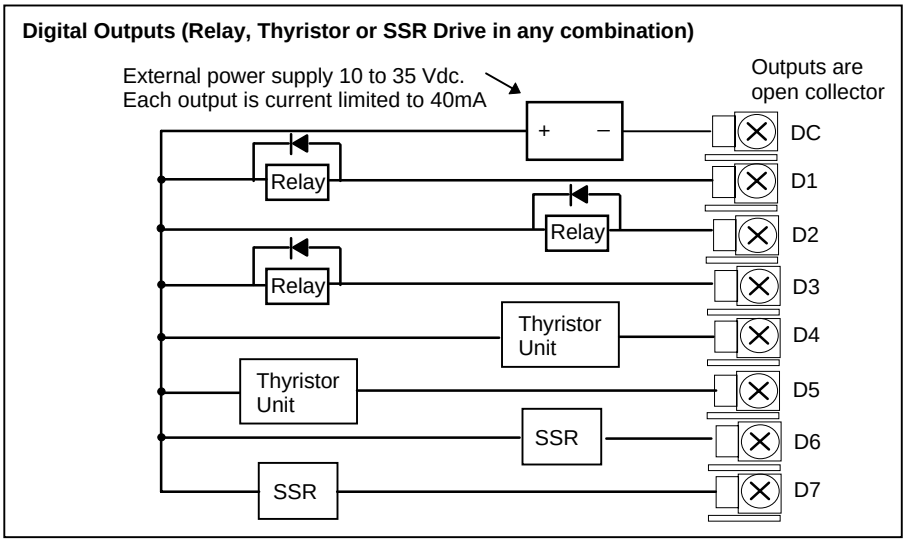


Figure 2-9:- Wiring Connections for Digital I/O

2.4. OPTIONAL PLUG IN MODULE CONNECTIONS

2.4.1. Digital Communications Connections

Digital Communications modules can be fitted in two positions in the 2604 controller, (see also section 1.5). The connections being available on HA to HF and JA to JF depending on the position in which the module is fitted. The two positions could be used, for example, to communicate with 'iTools' configuration package on one position, and to a PC running a supervisory package on the second position.

The connections shown in the following diagrams show RS232, 2-wire RS485, 4-wire RS422 and master/slave comms to a second controller.

The diagrams show connections for 'bench top test' wiring. For a full description of the installation of a communications link, including line matching resistors, see Eurotherm 2000 series communications handbook, part no. HA026230, and EMC Installation Guide, part no. HA025464.

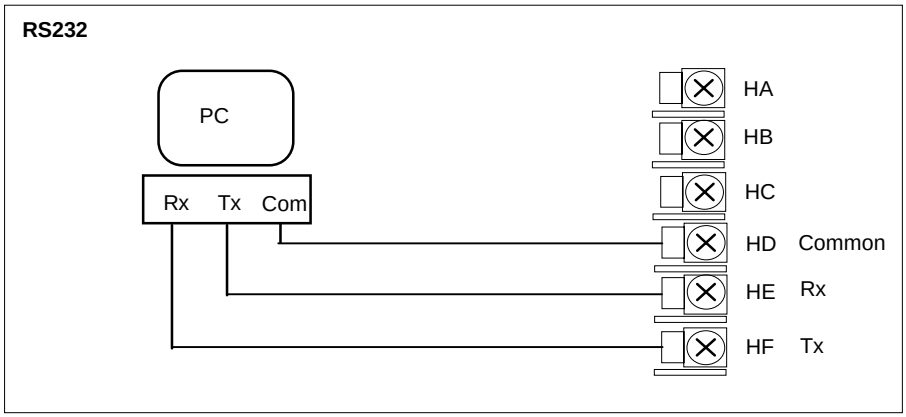


Figure 2-10: RS232 Communications Connections

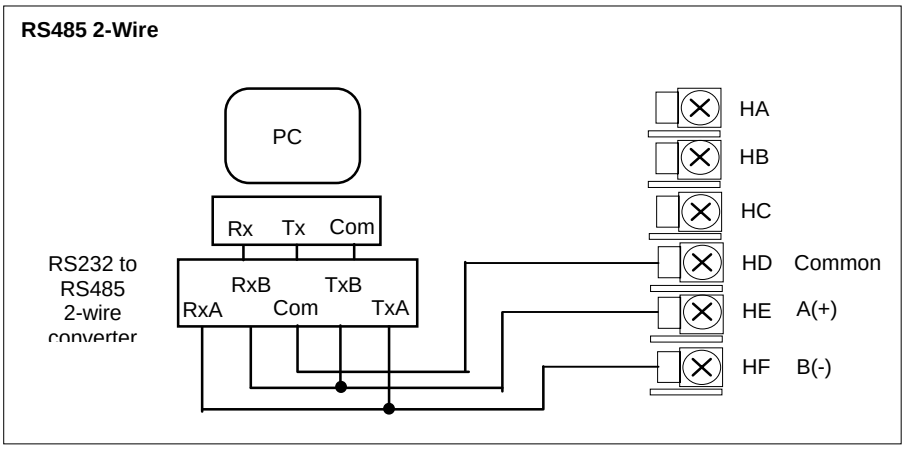


Figure 2-11: RS485 2-wire Communications Connections

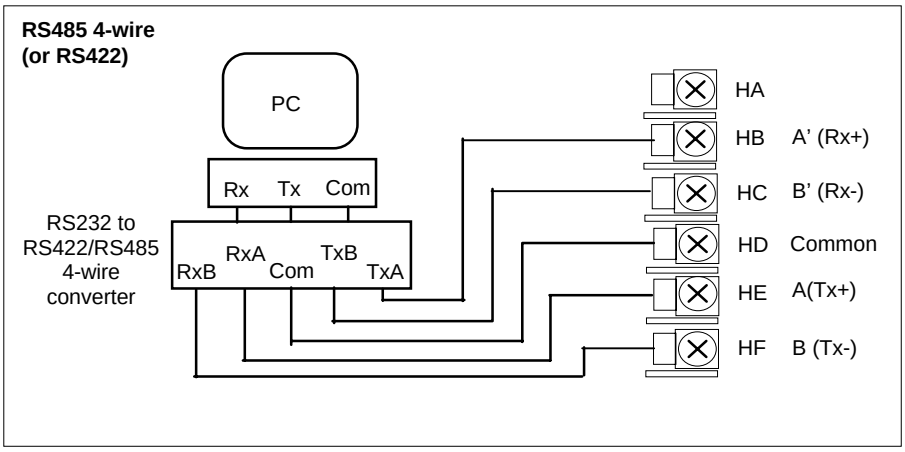
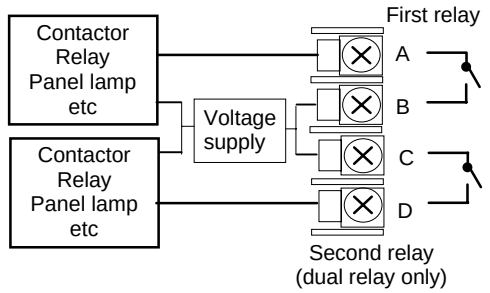
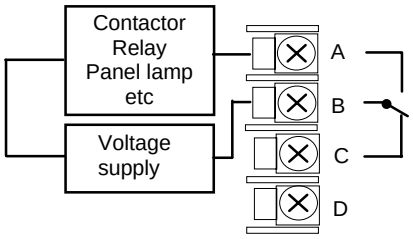
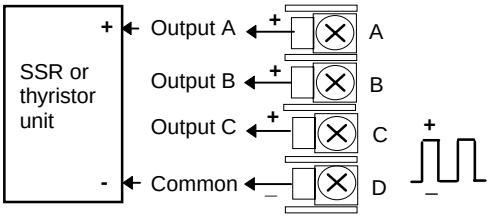


Figure 2-12: RS485 4-wire Communications Connections

2.4.2. I/O Modules

The 2604 controller contains five positions in which 4-terminal I/O modules can be fitted. These positions are marked Module 1, Module 3, Module 4, Module 5, Module 6, in Figure 2-3. Module 2 is reserved for the Memory Module which can only be fitted in this position. To find out which modules are fitted check the ordering code which is found on a label on the side of the instrument.

Any module, listed in this section, can be fitted in any position, except the PV input which is limited to positions 3 and 6 only. Care should be taken, therefore, to ensure that modules are fitted as expected from the order code. The instrument can be interrogated in 'View Config' level to locate the positions in which the modules are fitted. See Chapter 4, Access Levels. If modules have been added, removed or changed it is recommended that this is recorded on the instrument code label.

I/O Module	Typical usage	H/W Code	Connections and examples of use
Note: The order code and terminal number is pre-fixed by the module number. Module 1 is connected to terminals 1A, 1B, 1C, 1D; module 3 to 3A, 3B, 3C, 3D, etc.			
Relay (2 pin) and Dual Relay 2A, 264Vac max 1mA 1V min	Heating, cooling, alarm, program event, valve raise, valve lower	R2 and RR	
Change Over Relay (2A, 264Vac max)	Heating, cooling, alarm, program event, valve raise, valve lower	R4	
Triple Logic Output (18Vdc at 8mA max.)	Heating, cooling, program events	TP	

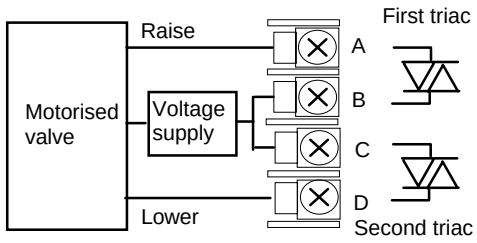
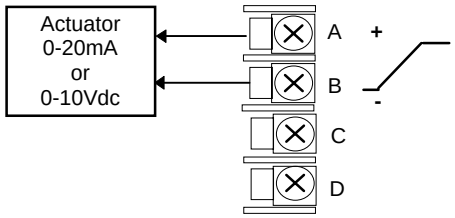
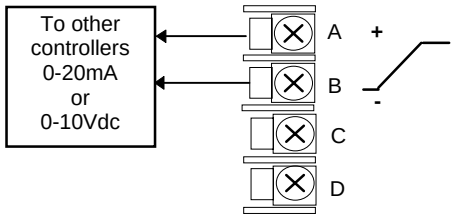
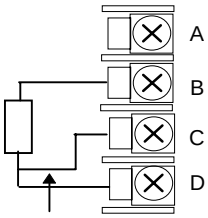
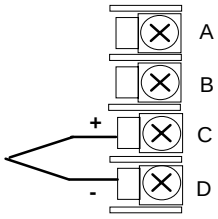
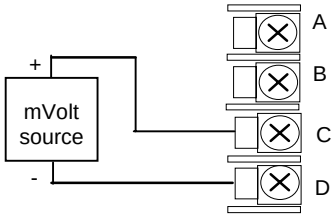
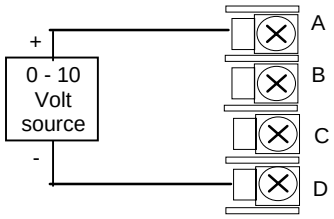
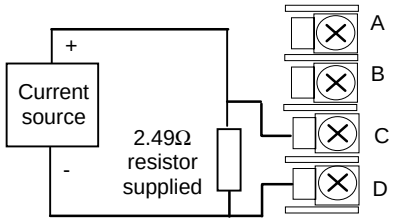
I/O Module	Typical usage	H/W Code	Connections and examples of use
Triac and Dual Triac (0.7A, 30 to 264Vac combined rating)	Heating, cooling, valve raise, valve lower	T2 and TT	 Note: Dual relay modules may be used in place of dual triac. **Note:-** **The combined current rating for the two triacs must not exceed 0.7A.**
DC Control (10Vdc, 20mA max)	Heating, cooling e.g. to a 4-20mA process actuator	D4	
DC Re-transmission (10Vdc, 20mA max)	Logging of PV, SP, output power, etc., (0 to 10Vdc, or 0 to 20mA)	D6	

Figure 2-13: Wiring Connections for IO Modules

I/O Module	Typical usage	Order Code	Connections and examples of use
PV Input (T/C & RTD) Modules 3 & 6 only	Second or third PV input TC or RTD	PV	**3-wire RTD**  For 2-wire this is a local link **Thermocouple** 
PV Input (High level)	V or mA		**mV (up to 80mV)**  **Voltage 0 to 10V or 0 to 2V**  **Current 0 to 20mA (4 to 20mA)** 

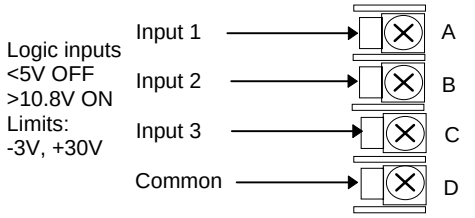
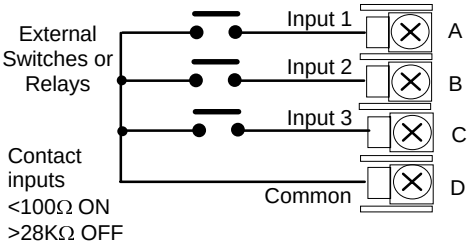
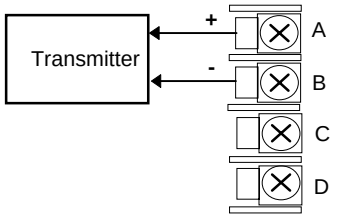
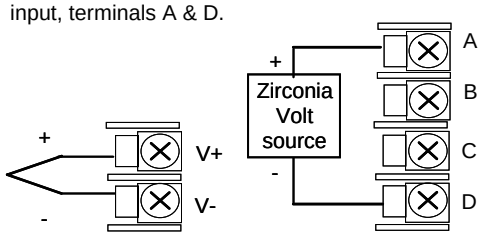
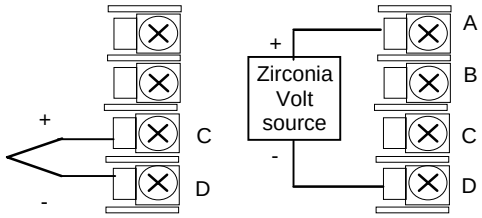
I/O Module	Typical usage	Order Code	Connections and examples of use
Triple Logic Input	Events e.g. Program Run, Reset, Hold	TL	
Triple Contact Input	Events e.g. Program Run, Reset, Hold	TK	
24V Transmitter Supply (20mA)	To power an external transmitter	MS	

Figure 2-13: Wiring Connections for IO Modules (continued)

2.5. TO CONNECT ZIRCONIA PROBE

I/O Module	Typical usage	Order Code	Connections and examples of use
Carbon Potential Controller (high impedance source)	Connection for the voltage source of a Zirconia probe		**Example 1:- Using Fixed PV Input and a Module** The temperature sensor of a zirconia probe can be connected to the PV input connections V+ & V-, with the Volt Source connected to a module input, terminals A & D.  **Example 2:- Using Two Modules** The temperature sensor of a zirconia probe can be connected to the precision PV input of one I/O module, connections C & D, with the Volt Source connected to the second module, terminals A & D. 

For further information see Chapter 10.

Figure 2-14: Wiring Connections for Zirconia Probe

3. Chapter 3 PRINCIPLE OF OPERATION

This chapter explains how to locate and change the value of parameters using the front panel buttons. Operation of these buttons changes the display view by bringing up different pages. The pages and the location of parameters within these pages follows a set order. This chapter describes how to navigate between the pages.

Note: The 2604 controller is an application specific controller and can be configured to the preferences of a particular process, site or even user. This means that the displays shown in this and following chapters may not be identical to those shown in your instrument. Where the text on a display is user configurable it is shown in italics, eg *Loop1*

About this chapter

This chapter describes:

◊ How to change setpoint

◊ The operator buttons

◊ Parameters and how to access them

◊ Pages

◊ How to step through pages

◊ How to step through parameters

◊ How to change parameter values

◊ The navigation diagram

◊ Parameter tables

3.1. POWER UP

Install and wire up the controller in accordance with Chapter 2 and switch on. A short self test sequence takes place during which the controller identification is displayed together with the version number of software fitted.

3.1.1. The HOME Page

The controller then shows a default display, referred to as the HOME page. It is possible to customise all three readouts of this display but the format is shown in Figure 3-2. It is also the default display on a new controller.

The HOME page will be displayed under the following conditions:-
1. When the controller is switched on
2. When the access mode is changed from configuration level to a different level
3. When  and  are pressed together (see 3.10)
4. When a timeout (if configured) occurs

The upper and middle readouts can be configured to display any available parameter but the default is Process Variable and Setpoint respectively.
The lower readout can be configured to show:-
1. Loop Views - LP1 to LP3 as shown
2. The Access page (see Chapter 4)
3. The Summary page (see Chapter 5)
4. The Run page (see Chapter 6)
5. Cycle each loop. LP1 to LP3 pages are cycled in turn

The configuration of these displays is described in the Engineering manual, Part No. HA026761.

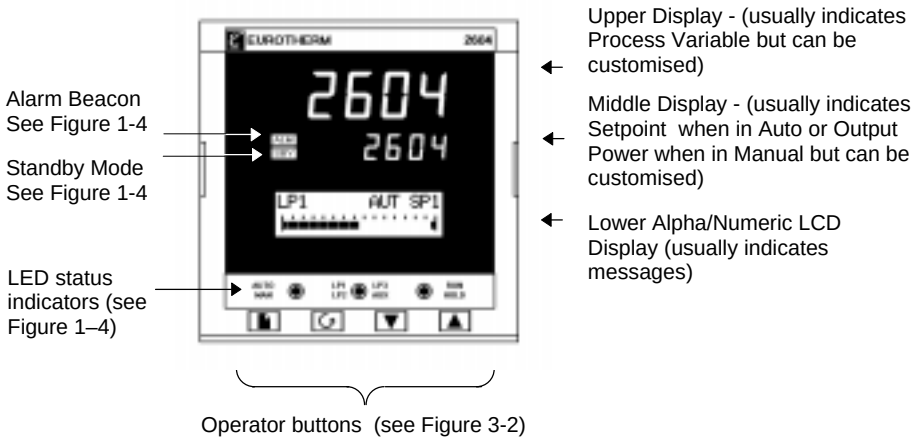
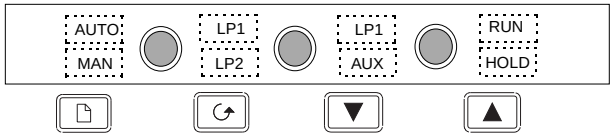


Figure 3-1: The 'HOME' Page

3.2. THE OPERATOR BUTTONS



AUTO / MAN	Auto/Manual button (See 3.4)	When pressed, this toggles between automatic and manual mode: • If the controller is in automatic mode the AUTO light will be lit. • If the controller is in manual mode, the MAN light will be lit. The Auto/Manual button can be disabled in configuration level.
LP1 / LP2 — LP1 / AUX	Loop select button The auxiliary loop (A) is used for ratio, cascade or override control only (See 3.3)	Each press selects: If configured: Loop1 LP1 illuminates Loop1A LP1 + AUX illuminates Loop2 LP2 illuminates Loop2A LP2 + AUX illuminates Loop3 LP3 illuminates Loop3A LP3 + AUX illuminates Back to Loop1
RUN / HOLD	Run/Hold button This button operates the programmer on all loops (See 3.5)	• Press once to start a program (RUN light on.) • Press again to hold a program (HOLD light on) • Press again to cancel hold and continue running (HOLD light off and RUN light ON) • Press and hold in for two seconds to reset a program (RUN and HOLD lights off) The RUN light will flash at the end of a program. The HOLD light will flash during holdback.
	Page button (See 3.6.2)	Press to select new page headings.
	Scroll button (See 3.6.4)	Press to select a new parameter under the page heading.
	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

Note:- Any button in any combination may have been disabled in configuration level.

Figure 3-2: Functions of the Operator Buttons

3.3. THE AUTO MANUAL BUTTON

The controller has two basic modes of operation:

- **Automatic Mode** in which the 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 loop view. Press the Loop Select button to select the loop view, then press **AUTO/MAN** to toggle between auto and manual. When the controller is in **AUTO**, 'AUT' will be displayed on the loop summary page as shown in Figure 3-3 (LP1). The middle readout will default to the **Working Setpoint** in a standard controller.
When the controller is in **MANUAL**, 'MAN' will be displayed on the loop summary page as shown in Figure 3-3 (LP2). The middle readout will default to **Output Power** in a standard controller.

If the loop summary page is not being displayed, pressing the AUTO/MAN button will select the first available loop summary. Subsequent presses will change between Auto and Manual for the selected loop as above.

Note: See also Chapter 5 for customised display formats.

3.4. THE RUN/HOLD BUTTON

If the controller is configured as a programmer this button has three functions:

- To put the programmer into **RUN** mode. This causes the working setpoint to follow the profile set in the program being used.
- To put the programmer into **HOLD** mode. This stops the program from running and maintains the setpoint at the current level..
- To put the programmer into **RESET** mode. This resets the programmer to the controller setpoint, the working setpoint can be changed manually using the Raise/Lower buttons.

If the controller is in reset or hold mode, press the RUN/HOLD button. The program begins to run, and the RUN LED illuminates.
If the controller is in run mode, press the RUN/HOLD button. The program will hold at its current conditions, and the HOLD LED illuminates.
If the controller is in run or hold mode, press the RUN/HOLD button and hold it pressed for two seconds. The program will reset, and the RUN and HOLD LEDs will extinguish.

This button operates all programmer loops simultaneously.

See also Chapter 6, 'Programmer Operation'.

3.5. THE LOOP SELECT BUTTON

The 2604 controller can be supplied with up to three control loops. The Loop Select button allows you to select a summary of each loop from whatever page is being displayed at the time. Each press of the Loop Select button will change the display to the next loop summary. (If only one loop is configured further presses of the loop button have no effect).

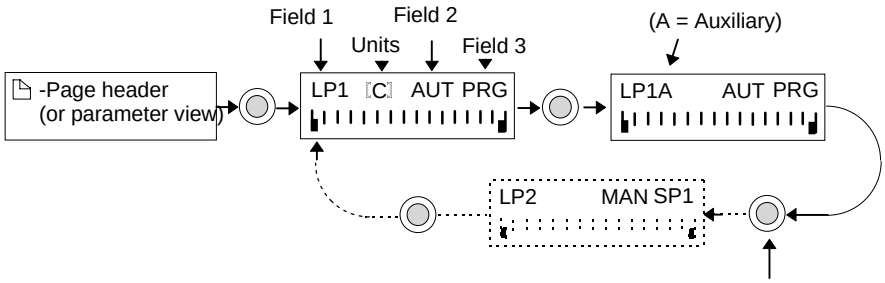
A loop is designated by the mnemonic 'LP' followed by the loop number. If the loop is ratio, cascade or override the loop number may be followed by the character 'A'. This shows a summary of the 'inner' or 'auxiliary' loop. This text could, however, have been replaced by user defined text.

In addition, each press of the loop select button causes the relevant beacon, LP1 to LP3, to illuminate to indicate which main loop is selected. If the auxiliary loop is configured the AUX beacon will also illuminate.

The upper and middle displays will show the PV and SP of the loop selected, (see also section 3.7).

To return to the original page view at any time, press the page button,  . Alternatively, a timeout may have been set which will return the display to the HOME page view after a set period. The timeout and period is set in configuration level, see Engineering Manual part no HA026761.

Typical example of the loop summary display - the bar graph shows output power



Notes:

Field 1	Loop number or user defined loop name. Can be up to 16 characters in length. If loop name > 6 characters (approx) - units are not shown If loop name > 8 characters (approx) - Field 2 is not shown If loop name > 12 characters (approx) - Field 3 is not shown
Units	Optional
Field 2	AUT(o)/MAN(ual) or CSD(cascade)/RAT(io)/OVR(override).
Field 3	Setpoint source - SP1/SP2/REM(ote)/PRG(program)

Figure 3-3: Operation of the Loop Button

3.5.1. To Change Setpoint (when the loop is in Auto)

Do This	This Is The Display You Should See	Additional Notes
From any display press the Loop Select button, LP1 LP2 LP3 AUX, as many times as necessary to select the required loop number.	LP1 [C] AUT SP1	This is the loop overview
Press ▲ or ▼ to select the **Target SP**	Target SP ◆ 0.0	If no key is pressed for 5secs the display returns to the loop overview
Press ▲ or ▼ again to raise or lower the setpoint.	Target SP ◆ 200.0	The lower readout will blink to accept the new value. At the same time the middle readout will also update.

3.5.2. To Change Output Power (when the loop is in Manual)

Do This	This Is The Display You Should See	Additional Notes
From any display press the Loop Select button, LP1 LP2 LP3 AUX, as many times as necessary to select the required loop number.	LP1 [C] MAN SP1	This is the loop overview
Press ▲ or ▼ to select the **Target OP**	Target OP ◆ 0.0	If no key is pressed for 5secs the display returns to the loop overview
Press ▲ or ▼ again to raise or lower the output power.	Target OP ◆ 30.0	The output power increases or decreases continuously whilst the raise/lower keys are held down. At the same time the middle readout will also update.

If a loop is configured as Cascade, Ratio, Override or motor valve position the names of parameters shown above will differ slightly. These are explained in section 3.7.

3.6. PARAMETERS AND HOW TO ACCESS THEM

Parameters are settings, within the controller, which determine how the controller will operate. They are accessed using the lower alpha-numeric display and can be changed by the user to suit the process. Selected parameters may be protected under different security access levels.

Examples of parameters are:-
Values - such as setpoints, alarm trip levels, high and low limits, etc.,
or
States - such as auto/manual, on/off, etc. These are often referred to as enumerated values.

3.6.1. Pages

The parameters are organised into different pages. A page shows information such as page headers, parameter names and parameter values.

Parameters are grouped in accordance with the function they perform. Each group is given a '**Page Header'** which is a generic description of the parameter group. Examples are 'The Alarm Page', 'The Programmer Page', etc,. A complete list of pages are shown in the navigation diagram, Section 3.12.

The 2604 contains a set of default pages for most applications. It is possible to configure different start up pages as the Home page, but the principle of navigation is the same as the default pages.

Note:-
A page only appears on the controller if the function has been ordered <u>and</u> has been enabled in Configuration mode. For example, if a programmer is not configured the RUN page and the EDIT PROGRAM pages will not be displayed.

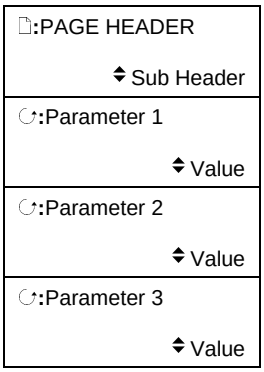
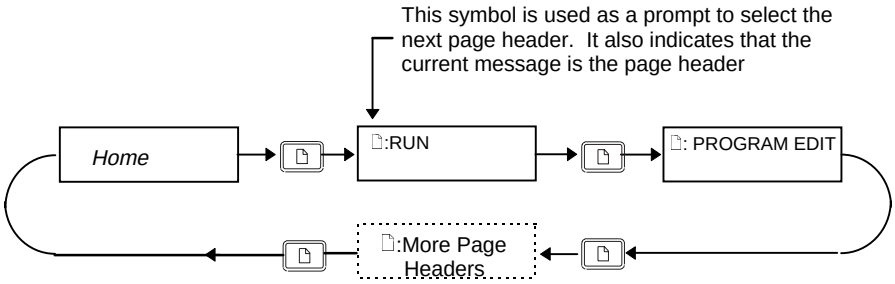


Figure 3-4: Page Concept

3.6.2. To Step Through Page Headers

Press [page] - (The Page Button).

At each press the first line of the alpha-numeric display will change to the name of the **page header**. This is a continuous list which will eventually return to the starting point, as shown in Figure 3-5 below. If the page button, [page], is held down continuously the pages auto advance.



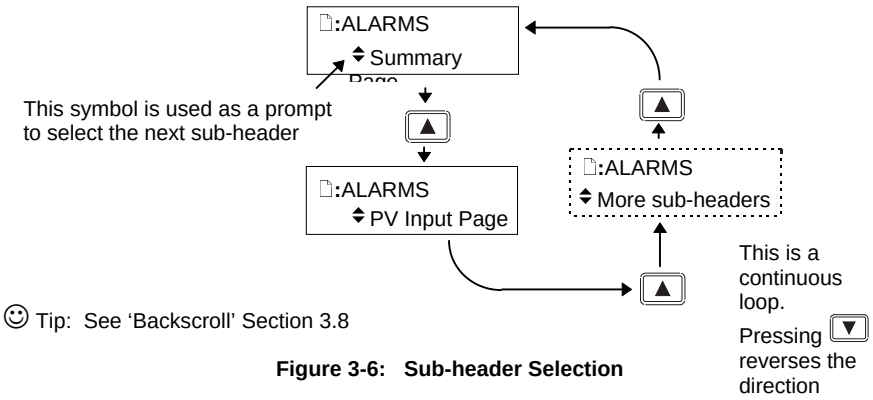
☺ Tip: See 'Backpage' Section

Figure 3-5: Stepping Through Page Headers

3.6.3. Sub-headers

The page header shown in Figure 3-6 contains sub-headers.. The sub-header appears in the lower right hand corner of the alpha-numeric display.

The sub-header can be changed using the [▲] or [▼] buttons, as prompted by the ⇕ symbol. This is a continuous list which will return to the first sub-header.



☺ Tip: See 'Backscroll' Section 3.8

Figure 3-6: Sub-header Selection

3.6.4. To Step Through Parameters

When the page header (and sub-header) which contains the required parameter has been selected :-

Press [scroll] - (The Scroll Button)

This will access the first parameter on the page. At each subsequent press the next parameter in the list is displayed. This is a continuous list which will eventually return to the list header. If the scroll button, [scroll], is held down the parameters auto advance.

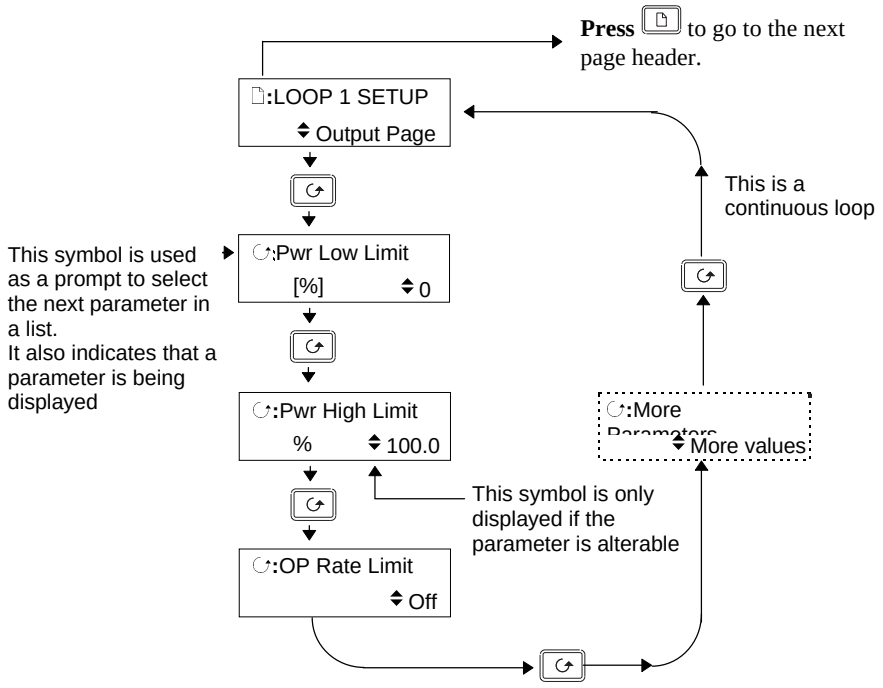


Figure 3-7: Parameter Selection

Tip:- To return to the Page Header at any time press [page].

3.6.5. To Change Parameter Values

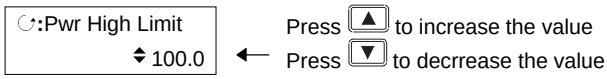
When the required parameter has been selected its value is shown in the lower part of the alpha-numeric readout.

To change a parameter value press ▲ or ▼ - (The Raise or Lower Buttons)

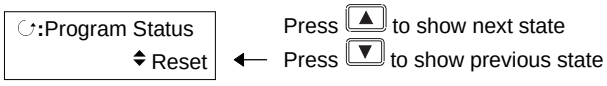
If an attempt is made to change a read only parameter, the parameter value will be replaced by ------ as long as the ▲ or ▼ buttons are held. For many parameters an upper and lower limit can be set. When changing a parameter value its new value must be within these limits.

Parameter values can be displayed in different ways depending upon the parameter type. Figure 3-8 below shows the different types of parameter and how their values are changed.

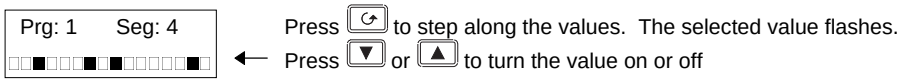
1. Numerical Values



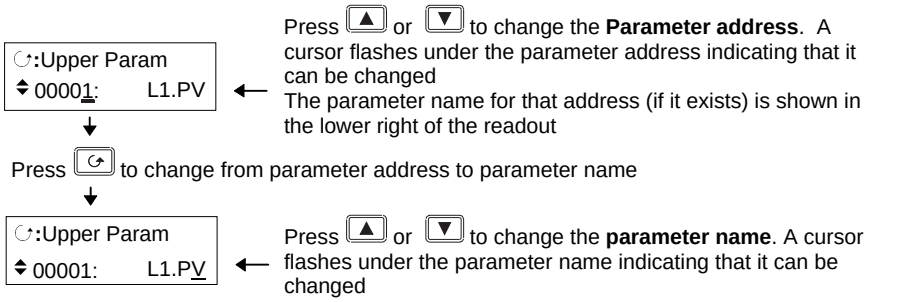
2. Enumerated Values



3. Digital Values (e.g. programmer event outputs)



4. Parameter Addresses

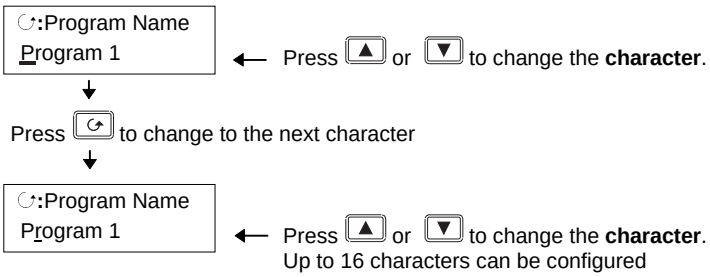


Note:- The above examples are generally only available in configuration level, but are included here to illustrate the principle of operation.

Figure 3-8: Changing A Parameter Value

5. Text (User definable)

The first character alternates between the character and _ indicating that it can be changed



☺ Tip: See 'Backscroll' Section 3.8 to if you need to re-enter a previously entered character.

6. Time

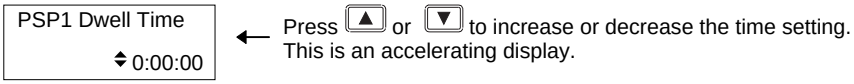


Figure 3-8: Changing A Parameter Value (continued)

3.6.5.1. CONFIRMATION MECHANISM

When the ▲ or ▼ key is released, the display will blink after a period of 1.5 seconds, indicating that the new parameter value has been accepted. If any other key is pressed during the 1.5 second period the parameter value is accepted immediately.

There are exceptions for specific parameters. Examples of these are:-

Output Power adjustment when in Manual mode. The value is written continuously as the value is changed.

Alarm Acknowledge. If the Alarm Acknowledge is changed from 'No' to 'Acknowledge' a confirmation message appears. Press ↵ key to confirm the change. If no key is pressed for 10 seconds the value is restored to its previous value.

3.6.6. Parameter Tables

The Navigation Diagram, Section 3.12, refers to parameter tables. The table below is an example of a parameter table.

Column 1 gives the name of the parameter as it appears on the lower readout of the alpha-numeric display.
Column 2 is a description and possible usage of the parameter
Column 3 is the range of values which can be set. . This may be a numerical value, eg -n to +n, or the condition (enumeration) of a parameter, eg the parameter 'Program Status' has enumerations 'Run', 'Hold', 'Reset'.
Column 4 is the default value of the parameter set during manufacture
Column 5 is the access level required to change the value of the parameter. R/O is Read Only.

Table Number:	**Description of the page**			**Page Header**
1 **Parameter Name**	**2** **Parameter Description**	**3** **Value**	**4** **Default**	**5** **Access Level**
Program Number	The number of the selected program			L3
Segment Number	The currently running segment number			L3
PSP1 Type	Program Setpoint 1 type			L3
PSP1 Working SP	Program Setpoint 1 working setpoint			L3
PSP1 Target	Program Setpoint 1 target setpoint			L3
PSP1 Dwell Time	Program Setpoint 1 dwell time			L3
This is a continuous loop which returns to the list header				

Each subsequent chapter of this manual explains features available in the 2604 controller. The tables produced in these chapters list those parameters which are available in the controller in access Levels 1, 2 and 3. Access Levels are described in Chapter 4.
For Configuration Level access see 2604 Engineering Manual, Eurotherm part number HA 026761
Any parameter available in a lower access level is also available in a higher level.

Note:-
A parameter only appears if it is relevant to the configuration of the controller. For example, a programmer configured as Time to Target will not display the Rate parameter.

3.7. SPECIFIC DISPLAYS FOR CASCADE, RATIO, OVERRIDE AND VALVE POSITION

When the loop select button is pressed the upper and middle readouts generally show PV and SP, see section 3.5. If the loops are configured as Cascade, Ratio, Override or Motor Valve Control the parameters displayed, specific to these configurations, are shown in the table below:-

Loop	**Main**				**Aux**			
Type	**Auto**		**Manual**		**Auto**		**Manual**	
	Upper	Middle	Upper	Middle	Upper	Middle	Upper	Middle
Single	PV	WSP	PV	WOP	-	-	-	-
Cascade	PV	WSP	PV	WOP	Aux PV	Aux WSP	Aux PV	WOP
Override	PV	WSP	PV	WOP	Aux PV	Aux WSP	Aux PV	WOP
Ratio	PV	WSP	PV	WOP	Ratio PV	Ratio SP	Ratio PV	WOP
If any loop is configured as Valve Position, WOP is replaced by Valve Position								

In sections 3.5.1 and 3.5.2 it was shown how to access and change Setpoint when in Auto and Output Power when in Manual. If the loops are configured as Cascade, Ratio, Override or Motor Valve Control the specific parameters displayed are shown in the table below:-

From the bar-graph display press ▲ or ▼

Loop	**Main**		**Aux**	
Type	Auto Main Loop	Manual Main Loop	Auto Aux Loop	Manual Aux Loop
Single	Target SP	Target OP	-	-
Cascade	Target SP	Target OP	Target SP	Target OP
Override	Target SP	Target OP	Override SP	Target OP
Ratio	Target SP	Target OP	Ratio SP	Target OP
If any loop is configured as Valve Position, Target OP is replaced by Valve Position				
If cascade is disabled Target SP reverts to Local SP.				

3.7.1. Loop Summary Parameters

When the Loop Select Button is pressed a summary of the loop is displayed as shown in Figure 3-3.

Press  button to access up to 10 additional parameters which may have been promoted, in configuration level, to the loop summary page. If the loop types are configured as cascade, ratio or override some of these 10 parameters are pre-defined as shown in the following table.

Loop Type	Main	Aux
Single	Working OP Target SP Plus up to 8 promoted parameters	-
Cascade	Working OP Target SP Disable Csd Plus up to 7 promoted parameters	Working OP Target SP Disable Csd Plus up to 7 promoted parameters
Override	Working OP Target SP Disable OVR Active Loop Main OP Override OP Plus up to 4 promoted parameters	Working OP OVR Target SP Disable OVR Active Loop Main OP Override OP Plus up to 4 promoted parameters
Ratio	Working OP Target SP Enable Ratio Ratio Trim Lead PV Plus up to 5 promoted parameters	Working OP Ratio SP Enable Ratio Ratio Trim Lead PV Plus up to 5 promoted parameters

Note. If any of the loops have been configured as a programmer, the Working OP parameter is preceded by the Program Loop Summary display shown below>

Prg: 1 Seg: 4
Program Name

3.8. BACKPAGE

When stepping through list headers, a backpage short cut is provided by holding down [page] and press [▲]. Each press of [▲] will step back one position of the list header in a continuous loop.

This function is provided as a short cut and is not necessary to navigate through the pages.

3.9. BACKSCROLL

When stepping through parameters in a list, a backscroll short cut is provided by holding down [scroll] and pressing [▲]. Each press of [▲] will step back to the previous parameter, until the page header is reached.

This function is provided as a short cut and is not necessary to navigate through the parameters.

3.10. JUMP TO HOME DISPLAY

Press [page] and [scroll] together to return the display to the configured HOME screen.

3.11. INVALID KEY ACTIONS

At any time some state transitions may be invalid, due, for example, to contention with digital inputs or to the current operating state of the instrument.
Examples are:-

1. Digital inputs have priority over the operator buttons.
2. If a parameter value cannot be changed the ⇕ prompt is not shown
3. If the [▲] or [▼] button is pressed for a read only parameter a number of dashes, ----, is displayed.

3.12. PARAMETER AVAILABILITY AND ALTERABILITY

A parameter which appears on a page is described as available. Parameters are not available if they are not appropriate for a particular configuration or instrument status. For example, relative cool gain does not appear in a heat only controller, and integral time does not appear in an On/Off controller.

A parameter described as alterable is, generally, preceded by the ⬍ symbol which indicates that its value can be changed. A parameter which is not alterable may be viewed (subject to availability), but may be changed by an instrument algorithm.

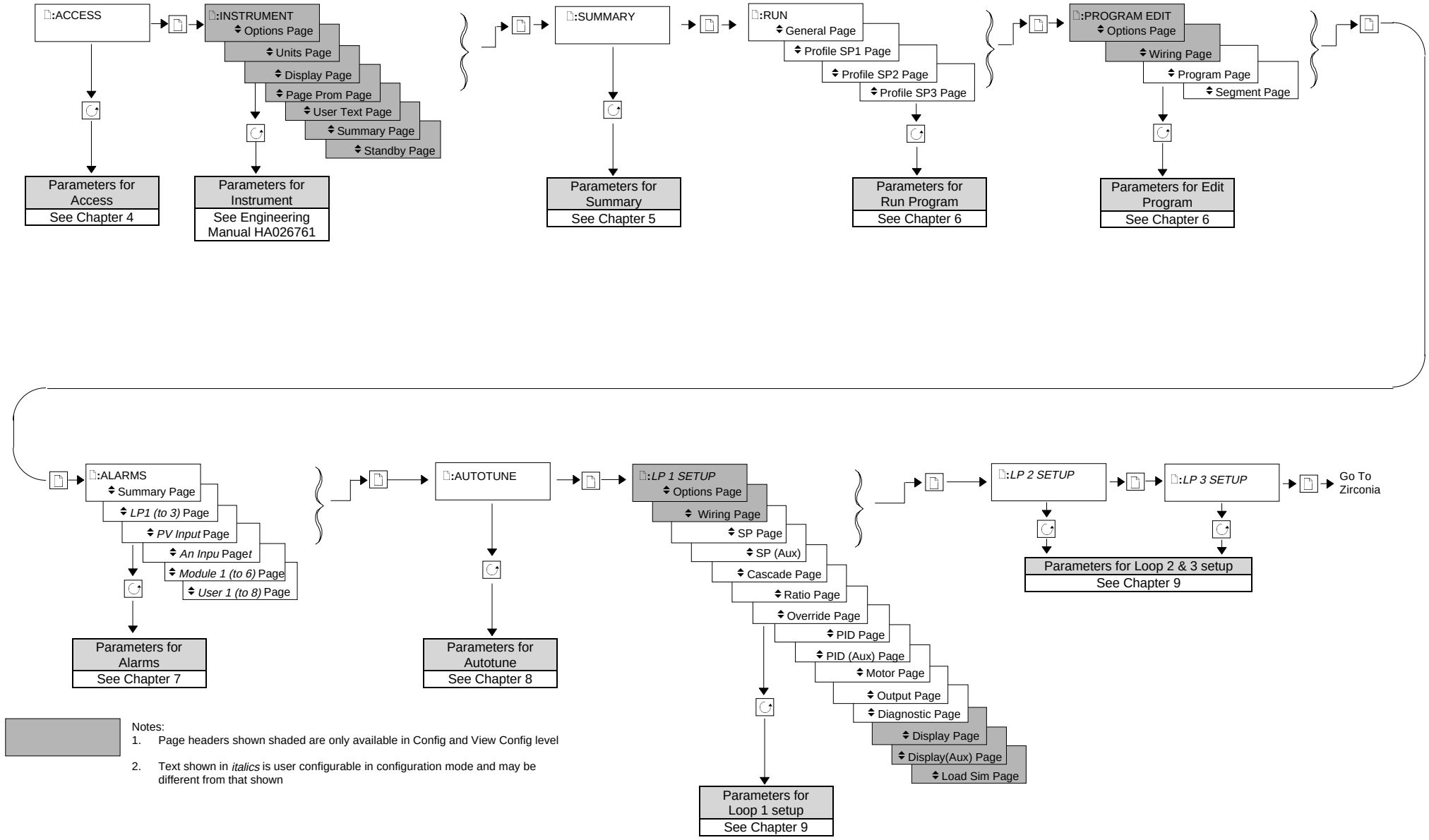
A parameter is alterable only if the following conditions are satisfied:-

- The parameter is READ/WRITE
- The parameter does not conflict with the status of the instrument. For example, the proportional band will not be alterable if autotune is active
- The instrument keys must be enabled. Keys can be disabled by a logic input, turned off in configuration level or via digital communications. A logic input can be configured to disable front panel keys; this will not remove remote control of the user interface via digital communications.

The Navigation Diagram which follows shows all pages which are available at Level 3. For a particular configuration not all pages are displayed on the controller. For example:-
the programmer pages do not appear if a programmer is not configured; the Loop 2 and 3 set up pages do not appear for a single loop controller.

Any one or all of the pages shown in the navigation diagram can also be displayed at Level 1 & 2. This, however, will have been pre-set in Configuration Level (see 2604 Engineering Manual Part No HA026761).

3.13 NAVIGATION DIAGRAM



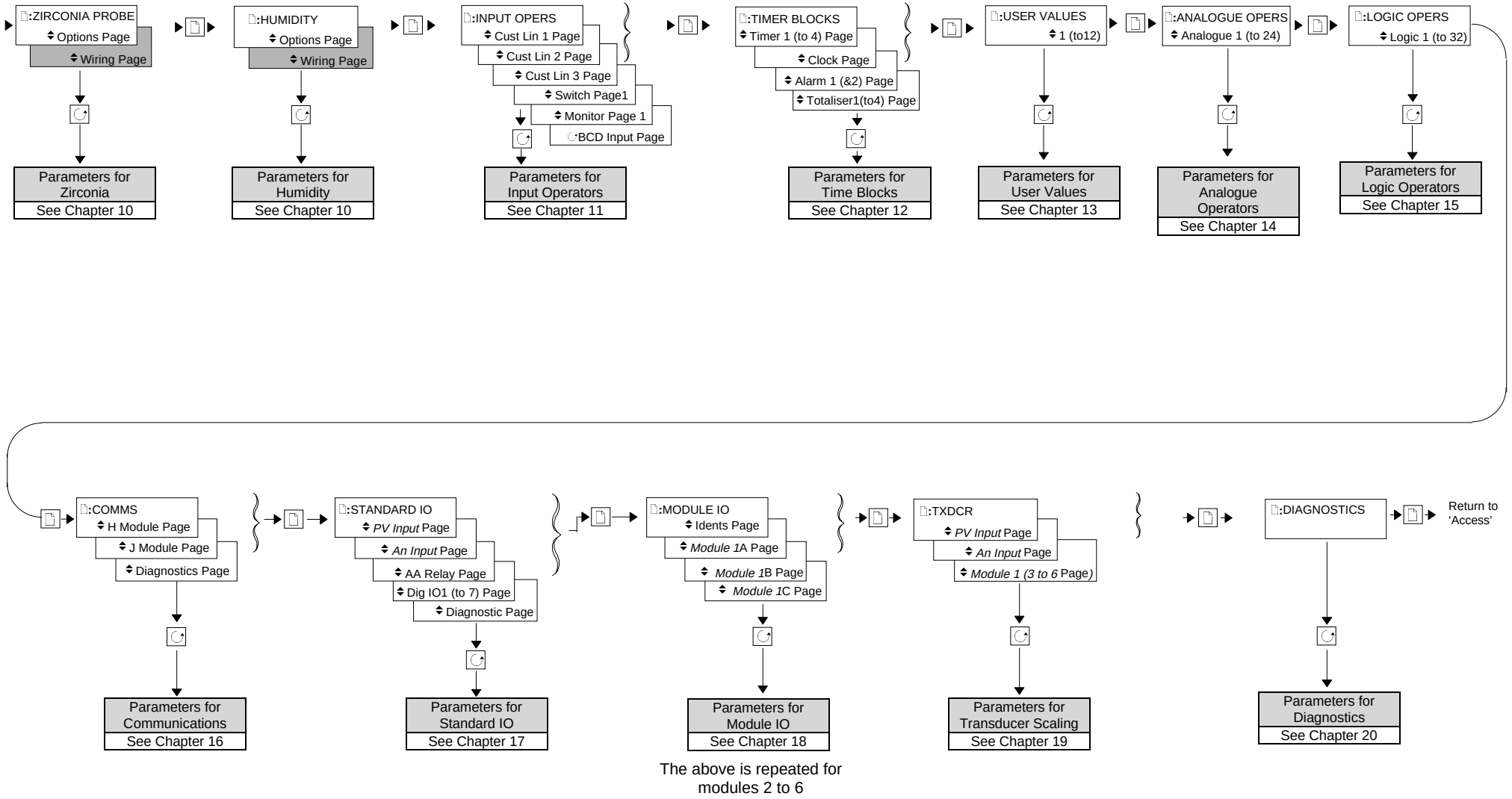


Figure 3-9: Navigation Diagram

4. Chapter 4 ACCESS LEVELS

Parameters are protected under different levels of access for which security codes may be necessary. This chapter describes the different levels of access to the operating parameters available in the controller.

4.1. THE DIFFERENT ACCESS LEVELS

There are four access levels:

Access Level	What you can do	Password Protection
Level 1	This is sometimes referred to as Operator Level since it allows operators to view and adjust parameters within limits set in higher levels. Any page available in levels 2 or 3 may appear in level 1. This is done from the configuration level using the page promote feature, see Engineering Manual HA 026761	No
Level 2	This is sometimes referred to as Supervisor level since all the parameters relevant to a particular configuration are visible. All alterable parameters can be adjusted.	Yes
Level 3	These are parameters which are generally required when commissioning the controller.	Yes
Config	This special level allows access to configure the fundamental characteristics of the controller and is not included in this operating handbook. For configuration details see Engineering Manual available on request from Eurotherm Controls, part no HA 026761	Yes
View Config	This is a read only level which allows you to view the configuration of the controller. It is not possible to change parameter values in this level. It is not possible to read passcodes in this level.	Yes

4.2. PASSCODES

On switch on the controller defaults to Level 1 which is not protected by a passcode. A limited set of parameters can be changed in this level. The parameter tables in each chapter list those parameters which can be changed.

Level 2, level 3 and Configuration level are protected by passcodes. The default passcodes set in a new controller are:

Level 2 Passcode ‘2’
Level 3 Passcode ‘3’
View Config Passcode 2604

These passcodes can only be changed in configuration level.
See Engineering Manual HA 026761.

If a passcode of 'None' has been entered for any level it will not be necessary to enter a passcode to enter that level.

The levels of access covered by this manual are Levels 1, 2, 3 and View Config. In any of these levels the controller continues to monitor and control the process to which it is connected. This allows parameter values to be altered to suit the operating conditions of the process.
Configuration of the controller allows the fundamental characteristics of the controller to be changed and for this reason it enters a standby state in which all IO is frozen. In this condition the instrument no longer controls the process to which it is connected.

4.3. TO SELECT AN ACCESS LEVEL

Do This	This Is The Display You Should See	Additional Notes
From any display press [Page] as many times as necessary until the **ACCESS** page header is displayed	:ACCESS	To select the page header which contains the access levels
Press [Scroll] to select **Access Level (Level1)**	-Access Level Level 1	
Press [▲] or [▼] to select the required access level. E.g. **Level 2** Press [▲] or [▼] to enter the passcode. 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 2 2sec Enter Passcode Level 2 0 Enter Passcode Level 2 1 2sec 2sec -Access Level Level 2 PASS	The default passcode of a new controller is 1 to enter level 2. If a new passcode has been entered in Config level this 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 2 is selected and level 2 will be entered immediately

Repeat the above steps for level 3.

5. Chapter 5 THE SUMMARY PAGE

5.1. WHAT IS THE SUMMARY PAGE

The Summary Page header contains up to 10 individual pages each of which may customised in configuration level. Each page is selected in turn using the button. The summary page may be promoted (in configuration level) to be the HOME page. If the summary page is the HOME page it is shown under the following conditions:-

1. When the controller is switched on
2. When the access mode is changed from configuration level to a different level
3. When and are pressed together (see 3.9)
4. When a timeout (if configured) occurs

5.1.1. To Select Summary Pages

Do This	This Is The Display You Should See	Reason
From any display press as many times as necessary until the **SUMMARY** page header is displayed	:SUMMARY	This is the lower readout. The upper and middle readouts will display parameters configured, normally PV - upper and SP - lower.
Press to view the first customised display	*User defined text 1* *User defined param 1*	This shows the normal structure of a Summary page, i.e. the first line is user defined text, and the second line is a selected parameter.
Keep pressing to view up to 10 customised displays	*User defined text 2* *User defined param 2*	Note: If the Summary page has been enabled in configuration level, but no pages have been defined 'No Parameters ' is shown.
	Prg:01 Seg:040	Some Summary pages are application specific as shown in this example.

6. Chapter 6 PROGRAMMER OPERATION

This chapter explains Setpoint Programming and how to Create, Edit and Run programs. Parameters which are associated with setpoint program operation are also listed in tables as a general reference.

Note: The 2604 controller is an application specific controller and can be configured to the preferences of a particular process, site or even user. This means that the displays shown in this and following chapters may not be identical to those shown in your instrument. Displays shown in *italics* are user definable and may, therefore, vary between instruments.

About this Chapter

This chapter describes:

- ◊ The meaning of setpoint programs
- ◊ Setpoint programming terminology
- ◊ Programmer types
- ◊ How to run, hold or reset a program
- ◊ How to create or edit a program
- ◊ Examples of how to set up specific features of a program

6.1. WHAT IS SETPOINT PROGRAMMING ?

Many applications need to vary the process value over time. Such applications need a controller which varies a setpoint as a function of time. The 2604 controller will program up to three separate profiles. These may be temperature, pressure, light level, humidity, etc., depending on the application, and are referred to as **Profiled Setpoints (PSPs).** A setpoint program containing three profile setpoints is shown in Figure 6-1.

The **Program** is divided into a flexible number of **Segments** - each being a single time duration, - and containing details for each profiled setpoint. The total number of segments available is **100 per program** with a **maximum of 500.**
A controller containing functionality to control profile setpoints against time is referred to as a **Programmer**. The 2604 programmer works on a single timebase for all programs.

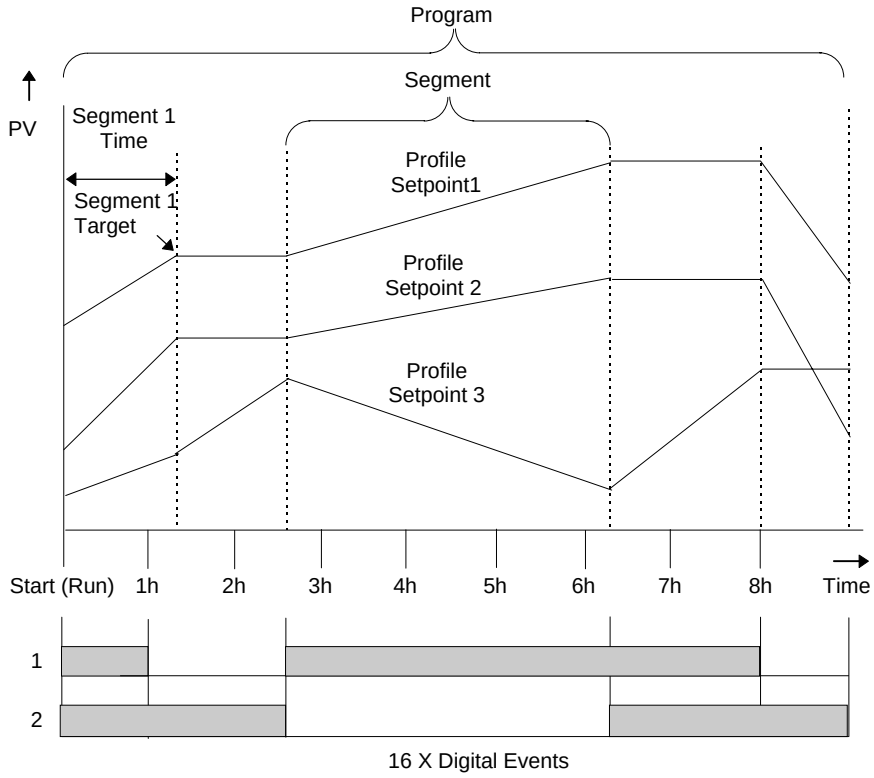


Figure 6-1: A Setpoint Program

The profiled setpoints may be used as either **control loop setpoints** or independent parameters for **retransmission** or use in **derived calculations**.
The 2604 may store up to **20 programs** as standard, with up to 50 if purchased.

6.2. THE 2604 SETPOINT PROGRAMMER DEFINITIONS

6.2.1. Run

In run the programmer varies the setpoint in accordance with the profile set in the active program.

6.2.2. Hold

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 (if programmer configured for ramp rate) or segment duration (if programmer configured as Time to Target). Such changes will only remain effective until the end of the currently running segment, when they will be overwritten by the stored program values.

6.2.3. Reset

In reset the programmer is inactive and the controller behaves as a standard controller, with the setpoint determined by the raise/lower buttons.

6.2.4. Servo

When a program is run the setpoint can start from the initial controller setpoint or from the current process value. Whichever it is the starting point is called the servo point. This can be set in the program.
The usual method is to servo to the process value because this will produce a smooth and bumpless start to the process.
If, however, it is essential to guarantee the time period of the first segment it may be better to set the controller to servo to setpoint.

6.2.5. Hot Start

Hot start can occur in any segment type, for any PSP but is most useful to ramp segments. When run is initiated it allows the program to automatically advance to the correct point in the profile which corresponds to the operating temperature of the process. Hot start is enabled in configuration level and specifies which programmed variable to use when deciding the correct segment.

6.2.6. Power Fail Recovery

In the event of power fail to the controller, a strategy may be set in configuration level, which defines how the controller behaves on restoration of the power. These strategies include:

Continue	The program runs from the last setpoint. This may cause full power to be applied to the process for a short period to heat the process back to its value prior to the power failure
Ramp back	This will ramp the process value back to its original value at a controlled rate. This will be the last encountered rate.
Reset	The process is aborted by resetting the program

6.2.7. Wait

Three wait conditions are provided at the end of each segment which may be wired, in configuration level, using a 'Toolkit Block' expression or by a digital input. Each segment may then select No-Wait, Wait on Event A, Wait on Event B or Wait on Event C. When all profile segments are complete, and the configured wait event is active, the program waits until the wait event becomes in-active before progressing to the next segment.

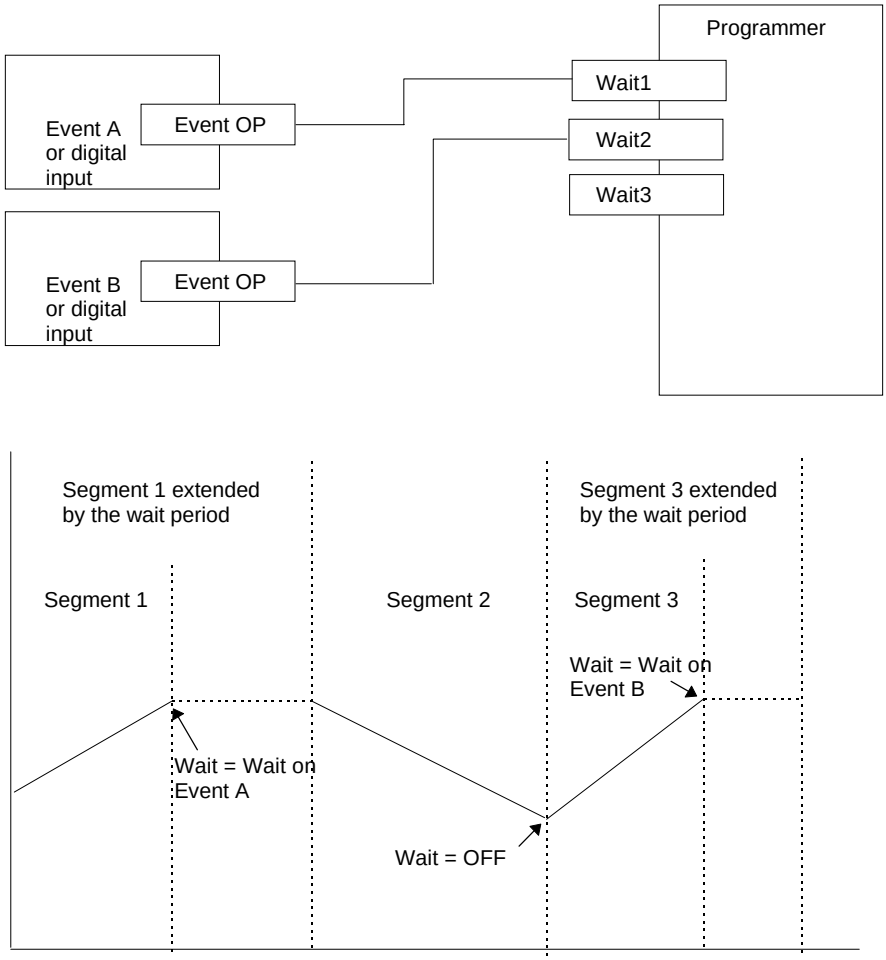


Figure 6-2: Wait Events

See Section 6.6.2. for a description of operation.

6.2.8. Holdback (Guaranteed Soak)

Holdback freezes the program if the process value does not track the setpoint by an amount which can be set by the user. It may operate in any type of segment
In a **Ramp** segment 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** segment 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. See also section 6.6.2.
Holdback 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

Holdback Type defines how holdback operates, either in the whole program, or in each segment as configured above. The holdback type may be configured in four modes;

- OFF - holdback does not operate
- Deviation High. PV is above the SP by a pre-set value
- Deviation Low. PV is below the SP by a pre-set value
- Deviation Band. PV is above or below the SP by a pre-set value

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.

During a dwell period the holdback type may be set to deviation band. This guarantees that the dwell or soak period operates only when the process value is within both high and low deviation limits.

During a ramp down period the holdback type may be set to deviation high. If the process cannot cool at the rate set by the ramp down rate the program will be held until the process catches up.

When a profile is placed into holdback the other profiles are (normally) not held. They continue and rendezvous at the end of the segment.

6.2.9. Digital Inputs

Digital inputs are available on the controller which can be configured for the following programmer functions:

Run	Allows the program to be run from an external source such as a pushbutton or other event
Hold	Allows the program to be held from an external source such as a pushbutton or other event
Reset	Allows the program to be reset from an external source such as a pushbutton or other event
Run/Hold	Allows the program to be run or held from a single external input source
Run/Reset	Allows the program to be run or reset from a single external input source
Advance Segment	Selects the next segment from an external input source
Program Number	Selects the next program from an external input source. When this event occurs, the controller display will change to programmer view. Subsequent changes of this input source will cause the program number to increment.
Holdback disabled	Disables holdback from an external input source
BCD Program switch	Allows different programs to be selected using an external BCD switch

For more information on digital inputs refer to Chapters 17 and 18. For configuration of these inputs see Engineering Manual Part No. HA026761.

6.3. PROGRAMMER TYPES

The programmer can be configured as **Time to Target** or **Ramp Rate.** A time to target programmer requires fewer settings and is simple to use since all segments are the same. A time to target programmer can, in general contain more segments than a ramp rate.

6.3.1. Time To Target Programmer

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.

6.3.2. Ramp Rate Programmer

Each segment can be specified by the operator as **Ramp Rate, Dwell or Step**.

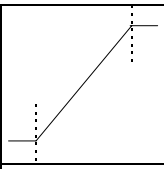
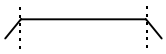
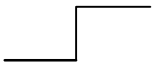
1. Each profiled setpoint must complete its segment before the programmer will move to the next segment. If one ramp reaches its target setpoint ahead of the other variables, it will dwell at that value until the other variables have completed. The program will then move to the next segment.
2. The duration parameter for a segment is read only unless the segment contains only dwells. In this case the dwell period can be changed when the program is in Hold..
3. The duration is determined by the longest profile setting.

6.3.3. Segment Types

A segment type can be defined as **Profile, Go Back** or **End.**

6.3.3.1. Profile

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.

6.3.3.2. Go Back Segment

Go Back allows segments in a program to be repeated by a set number of times. It is the equivalent of inserting ‘sub-programs’ on some controllers. Figure 6-2 shows an example of a program which is required to repeat the same section a number of times and then continue the program.
A Go Back segment is used to save the total number of segments required in a program and to simplify setting up. When planning a program it is advisable to ensure that the end and start setpoints of the program are the same otherwise it will step to the different levels. A Go Back segment. is defined when editing a program, see section 6..5.4. It

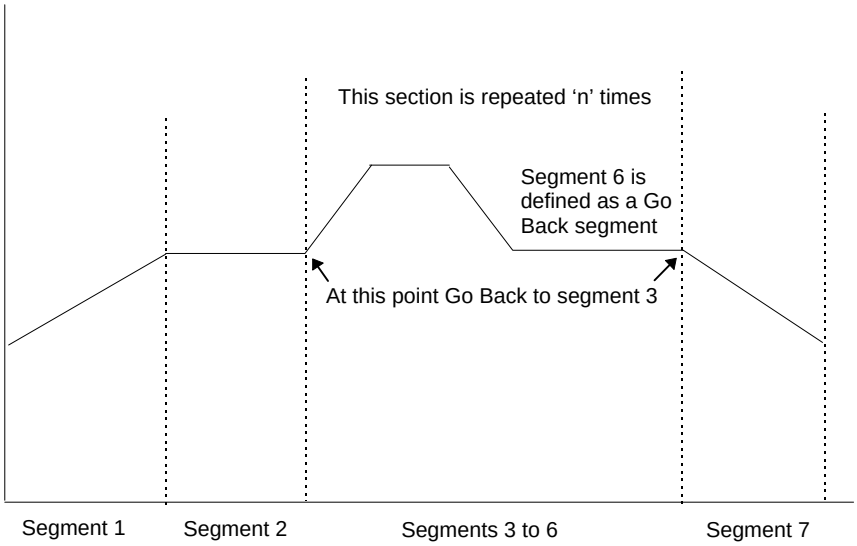


Figure 6-3: An Example of a Program with Repeating Section

6.3.3.3. End Segment

The last segment in a program is normally defined as an End segment
The program either ends, repeats or resets in this segment. You specify which is the case when you create, or modify, the program. When the program ends, the programmer is put into either, a continuous dwell state with all outputs staying unchanged, or the reset state.

6.4. PROGRAM RUN PARAMETERS

6.4.1. To Run, Hold or Reset a Program

A selected program may be run, reset or held as follows:

1. Press the RUN/HOLD button once, the RUN beacon will illuminate. Press the RUN/HOLD button again, the HOLD beacon will illuminate. Press and hold the RUN/HOLD button for 3 seconds, the program will reset and both beacons will extinguish.
2. If digital inputs have been configured and wired for an external RUN, HOLD or RESET, activate the relevant digital input.
3. By selecting the Program Status parameter (in the Run List). This method may be preferred if the number of the program to be run must also be selected.

6.4.1.1. To Run, Hold or Reset a Program from the Run List

Do This	This Is The Display You Should See	Additional Notes
From any display press [Page] as many times as necessary until the '**PROGRAM RUN' (General Page)** header is displayed	:PROGRAM RUN General Page	This page provides access to parameters of a running program.
Press [Scroll] Press [▲] or [▼] to select the program to run	Prg: 1 Seg 1 *Program 1*	Shows selected program number, current segment number and name of the program. This is shown in *italics* since it is user definable
Press [Scroll]	Prg: 1 Seg 1 Not Running	Shows the current status of the program
Press [Scroll] until **'Fast Run'** is displayed Press [▲] or [▼] if fast run is required	:Fast Run No **Warning!** Fast run allows the program to be tested by quickly running through the program segments. If the controller is connected to the process, ensure that it is not affected if fast run is selected. The default value, **No,** means that the program will run at the set rate	
Press [Scroll] until **'Program Status'** is displayed Press [▲] or [▼] to select **Run**	:Program Status Reset	The choices are:- **Run** see 6.2.1 **Hold** see 6.2.2 **Reset** see 6.2.3

6.4.2. Run Parameters

The Run list provides status information on a running program, as follows:-

Table Number: 6.4.2a.	These parameters show the status of the overall program		PROGRAM RUN (General Page)	
Parameter Name	**Parameter Description**	**Value**	**Default**	**Access Level**
These displays may be promoted by the user as an over-view of the program status	Prg: 1 Seg: 4 *Program Name*	Program Number Segment Number Program Name		R/O
	Prg: 1 Seg: 4 □□■□□□■□■□□□□□■□□	Digital outputs states. Only appears if digital outputs configured		L1. Can be changed in Hold
	Prg: 1 Seg: 4 d h: m: s	Program Time Remaining		R/O
Fast Run	Allows the program to fast run	No Yes		L3. Alterable in reset or complete
Program Status	Displays the status of the program	Reset Run Hold Complete		L1.
Prog Time Elap	Program time elapsed	d: h: m: s		R/O
Prog Cycle Rem	Remaining number of cycles	1 to 999		R/O
Total Segments	Number of segments in the running program	0 to 100		R/O
Segment Number	The currently running segment number	1 to 100		R/O
Segment Type	Running program segment type Profile = normal segment Go Back =repeat part of prog	Profile End Segment Go Back		R/O
Seg Time Rem	Time remaining in the current segment	d: h: m: s		L1. Read or alterable if Time To Target prog and in Hold
Wait Status	Wait Status	No Wait Event A Event B Event C		R/O

Wait Condition	Wait condition for the running segment	No Wait Event A Event B Event C		L1. Alterable in Hold
PID Set	PID values used in running program	PID Set 1 to PID Set 3		R/O - Only shown if configured
Goback Rem	Number of repeat cycles remaining	1 to 999		R/O
End Action	The state required in the end segment	Dwell Reset		R/O
Prog Reset DO	These are the digital events in Reset 			R/O Only shown if configured.

Table Number: 6.4.2b.	**These parameters are associated with Profiled Setpoint number 1**		**PROGRAM RUN (PSP1 Page)**	
Parameter Name	**Parameter Description**	**Value**	**Default**	**Access Level**
Seg Time Rem	Segment time remaining	h: m: s		
PSP1 Type	Running segment type for profiled setpoint 1	Step Dwell Ramp		R/O - shown in Ramp Rate prog.
PSP1 WSP	Working setpoint for profiled setpoint 1	Display range [1]		L1. Alterable in Hold
PSP1 Target	Running segment target for profiled setpoint 1	Display range [1]		L1. Alterable in Hold
PSP1 Dwell Tm	Time remaining in running segment for profiled SP 1	Display range		L1. Alterable in Hold
PSP1 Rate	Running segment rate for profiled setpoint 1	Display range [1]		L1. Not in Time To Target prog
PSP1 HBk Appl	Holdback applied for profiled setpoint 1	No Yes		R/O - shown if configured

1. Range limited by user defined upper and lower limits

Table Number: 6.4.2c	These parameters are associated with PSP2 and only appear if PSP2 is configured		PROGRAM RUN (PSP2 Page)	
Parameter Name	**Parameter Description**	**Value**	**Default**	**Access Level**
Seg Time Rem	Segment time remaining	h: m: s		
PSP2 Type	Running segment type for profiled setpoint 2	Step Dwell Ramp		L1. Read Only shown in Ramp Rate prog.
PSP2 WSP	Working setpoint for profiled setpoint 2	Display range [1]		L1. Alterable in Hold
PSP2 Target	Running segment target for profiled setpoint 2	Display range [1]		L1. Alterable in Hold
PSP2 Dwell Tm	Time remaining in running segment for profiled SP 2	Display range		L1. Alterable in Hold
PSP2 Rate	Running segment rate for profiled setpoint 2	Display range [1]		L1. Not in Time To Target prog
PSP2 HBk Appl	Holdback applied for profiled setpoint 2	No Yes		L1. Read only shown if configured

1. Range limited by user defined upper and lower limits

Table Number: 6.4.2d	These parameters are associated with PSP3 and only appear if PSP3 is configured		PROGRAM RUN (PSP3 Page)	
Parameter Name	**Parameter Description**	**Value**	**Default**	**Access Level**
Seg Time Rem	Segment time remaining	h: m: s		
PSP3 Type	Running segment type for profiled setpoint 3	Step Dwell Ramp		L1. Read Only shown in Ramp Rate prog.
PSP3 WSP	Working setpoint for profiled setpoint 3 [1]	Display range		L1. Alterable in Hold
PSP3 Target	Running segment target for profiled setpoint 3 [1]	Display range		L1. Alterable in Hold
PSP3 Dwell Tm	Time remaining in running segment for profiled SP 3	Display range		L1. Alterable in Hold
PSP3 Rate	Running segment rate for profiled setpoint 3 [1]	Display range		L1. Not in Time To Target prog
PSP3 HBk Appl	Holdback applied for profiled setpoint 3	No Yes		L1. Read only shown if configured

[1] Range limited by user defined upper and lower limits

6.5. TO CREATE OR EDIT A PROGRAM

- A running program cannot be edited, it must be put into **Reset** mode.
- Changes can be made to remaining segments of a running program but these are 'temporary' changes which apply only to the current run. These changes will not apply to subsequent runs.
- Other programs can be created or edited when another program is running.

To create or edit a program it is first necessary to define the effect that various parameters will have on the overall program. These parameters will be found under the page header **PROGRAM EDIT (Program Page),** see section 6.5.1. and 6.5.2.

When these parameters have been defined then set up the parameters which define each individual segment. These parameters will be found under the page header **PROGRAM EDIT (Segments Page),** see section 6.5.3. and 6.5.4.

6.5.1. To Define Parameters Common To A Program

Do This	This Is The Display You Should See	Additional Notes
From any display press [PAGE] as many times as necessary until the **PROGRAM EDIT** page header is displayed Press [▲] if necessary to select **Program Page**	:PROGRAM EDIT Program Page	The PROGRAM EDIT page is not available in Access levels 1 & 2. It is available as read only in View Config level
Press [SCROLL]. to select. **Edit Prog: 1**. This is the first parameter in the list Press [▲] or [▼] to choose the program number to be edited The second line of the lower readout will change to the program name. This is shown in *italics* to indicate that the program name is user definable.	P 01 S 006 Edit Prg: 1 *Program 1*	The upper display shows the selected program number. The middle display shows the total number of segments Up to 20 programs as standard. 50 programs as an option.
Press [SCROLL]. to select. the next parameter in the list. This is **:HBk Mode**.	-HBk Mode None	This enables Holdback. The choices are:- None Per Program Per Segment
Continue pressing [SCROLL] to access the further parameters in this page Continue pressing [▲] or [▼] to change the parameter values or states	:PSP1 HBk Type Low	Further parameters may be set up in the same way. These are listed together with an explanation of their function in the following table ⇓

6.5.2. PROGRAM EDIT (Program Page) Parameters

Table Number: 6-5.2	These parameters affect the overall program. Only shown at Level 3.		PROGRAM EDIT (Program Page)	
Parameter Name	**Parameter Description**	**Value**	**Default**	**Access Level**
Edit Prg: 1	Selects the program number to be edited	1 to 20 or 1 to 50	1	L3
Hbk Mode	Holdback mode None = no holdback applied Per prog = common to prog Per seg = active in every segment	None Per Program Per Segment	None	L3
PSP1 HBk Type	Holdback type for PSP1 These are deviation values between setpoint and process value	Off Low High Band	Off	L3 Only displayed if Per Program configured
PSP1 Hbk Value	Holdback value for PSP1	SP1 hi limit to SP1 lo limit	0	L3. Only displayed if HBk Type ≠ Off
The next four parameters are only displayed if PSP2 and PSP3 are configured				
PSP2 Hbk Type	Holdback type for PSP2 These are deviation values between setpoint and process value	Off Low High Band	Off	L3
PSP2 Hbk Value	Holdback value for PSP2	SP1 hi limit to SP1 lo limit	0	L3
PSP3 Hbk Type	Holdback type for PSP3 These are deviation values between setpoint and process value	Off Low High Band	Off	L3
PSP3 Hbk Value	Holdback value for PSP3	SP1 hi limit to SP1 lo limit	0	L3

Hot Start PSP	Allows hot start to be applied to each PSP. See also 6.2.5.	None PSP1 PSP2 PSP3	None	L3. Only appears if Hot Start option has been enabled in config level.
Rate Units	Rate units for a Ramp Rate Programmer	Per Second Per Minute Per Hour		L3. Only displayed if the programmer is Ramp Rate
Prog Cycles	Sets the number of times the complete program is executed.	Continuous to 999	Continuous	L3
End Action	Defines the action in the end segment. Dwell - the program will dwell indefinitely at the conditions set in the end segment, see 6.5.3. Reset - the program will reset to the start conditions.	Dwell Reset		L3
Program Name	Allows a user defined name to be given to the program number	User string		L3

6.5.3. To Set Up Each Segment Of A Program

Do This	This Is The Display You Should See	Additional Notes
From any display press [page] as many times as necessary until the **PROGRAM EDIT** page header is displayed Press [▲] if necessary to select **Segment Page**	[page]: PROGRAM EDIT ◆ Segment Page	This page allows each segment to be edited.
Press [scroll]. To select. **Edit Prg: 1**. This is the first parameter in the list Press [▲] or [▼] to choose the program number to be edited	P 01 S. 001 ◆ Edit Prg: 1 *Program 1* If the program exists, go to next parameter. If the program is new, confirm as instructed on the display Edit Prg: 2 [page]→Cancel [scroll]→OK	The upper display shows the selected program number The middle display shows the current segment number After x secs or when [page] is pressed the display returns to that shown above
Press [scroll]. To select. **Segment Number**. Press [▲] or [▼] to choose the segment to be edited	[scroll]:Segment Number ◆ 1	Up to 100 segments are available per program
Continue pressing [scroll] to access the further parameters in this page Continue pressing [▲] or [▼] to change the parameter value or state .		Further parameters may be set up in the same way. These are listed together with an explanation of their function in the following table ⇓

6.5.4. PROGRAM EDIT(Segment Page) Parameters

Table Number: 6.5.4.	These parameters allow you to set up each segment in the program			PROGRAM EDIT (Segment Page)
Parameter Name	**Parameter Description**	**Value**	**Default**	**Access Level**
Edit Prg: 1 (to 20 or 50)	Selects the program number and name	1 to 20 (or 50)		
Segment Number	Selects the segment number to be edited	1 to 100		L2
Segment Type	Segment type Profile = a normal segment End Segment = the last segment in the program (press ↵ to confirm) Go Back = repeat part of prog. Not shown for segment 1.	Profile End Segment Go Back	Profile	L2
PSP1 Type	Profile setpoint 1 type	Step Dwell Ramp		L2. Only shown for Ramp Rate programmer and not End
PSP1 Target	Profile setpoint 1 target value	SP1 lo limit to SP1 hi limit	0	L2
PSP1 Dwell Tm	Profile setpoint 1 dwell time	d : h : m : s		L2. Only shown for Ramp Rate programmer, a Dwell segment and not End
PSP1 Rate	Profile setpoint 1 rate			L2. Only shown for Ramp Rate programmer, a ramp segment and not End
PSP1 Hbk Type	Profile setpoint 1 holdback type	Off Low High Band	Off	L2. Only shown if holdback is configured per segment

The next ten parameters are only displayed if PSP2 and PSP3 are configured				
PSP2 Type	Profile setpoint 2 type	Step Dwell Ramp		L2. Only shown for Ramp Rate programmer and not End
PSP2 Target	Profile setpoint 2 target value	SP2 lo limit to SP2 hi limit	0	L2
PSP2 Dwell Tm	Profile setpoint 2 dwell time	d : h : m : s		L2. Only shown for Ramp Rate programmer , a Dwell segment and not End
PSP2 Rate	Profile setpoint 2 rate			L2. Only shown for Ramp Rate programmer , a ramp segment and not End
PSP2 Hbk Type	Profile setpoint 2 holdback type	Off Low High Band	Off	L2. Only shown if holdback is configured per segment
PSP3 Type	Profile setpoint 3 type	Step Dwell Ramp		L2. Only shown for Ramp Rate programmer and not End
PSP3 Target	Profile setpoint 3 target value	SP3 lo limit to SP3 hi limit	0	L2
PSP3 Dwell Tm	Profile setpoint 3 dwell time	d : h : m : s		L2. Only shown for Ramp Rate programmer , a Dwell segment and not End
PSP3 Rate	Profile setpoint 3 rate			L2. Only shown for

				Ramp Rate programmer, a ramp segment and not End
PSP3 Hbk Type	Profile setpoint 3 holdback type	Off Low High Band	Off	L2. Only shown if holdback is configured per segment
Seg Duration	Duration for Time to Target programmer	d : h : m : s		L2. Does not appear for Ramp Rate Programmer or End segment
Wait Event	Wait if selected event is true	No wait Event A Event B Event C	No Wait	L2. Only shown if wait events configured
PID Set	Selects a set of PID values	PID Set 1 to PID Set 3		L2. Only shown if PID sets configured
Prog DO Values	Sets programmer event outputs on or off			L2. Only shown if Dout configured
Go Back Seg	Allows repeat segments to be set up within a profile. Go back defines the point in the program where the repeat segments are entered.	1 to no. of segments		L2. Only shown if segment. type is Go Back
Go Back Cycles	Sets up the number of times the segments are repeated	1 to 999	1	L2. Only shown if segment. type is Go Back

6.6. EXAMPLES

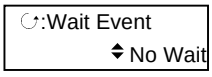
6.6.1. Program Data Entry Example in a Ramp Rate Programmer

Do This	This Is The Display You Should See	Additional Notes
1. Select the **PROGRAM EDIT (Segment Page)** page header	:PROGRAM EDIT Segment Page	
2. Press ↺ to select **Edit Prg: 1** Press ▲ or ▼ to select the program number to be edited	Edit Prg: 1 *Program 1*	The name of the program may have been customised If this is a new program, the message **'Create Prog 1?'** will be displayed. Press ↺ **to confirm**
3. Press ↺ to select **Segment Number** Press ▲ or ▼ to select segment **(1)**	:Segment Number 1	
4. Press ↺ to select **Segment Type** Press ▲ or ▼ to select **Profile**	:Segment Type Profile	Select:- **Profile** for a normal segment **End** for an end segment **GoBack** to repeat segments in the program see 6.3.3.2.
5. Press ↺ to select **PSP1 Type 1** Press ▲ or ▼ to select **Ramp**	:PSP1 Type Ramp	Select:- **Ramp** to ramp the setpoint up or down **Dwell** to dwell **Step** to jump from the current setpoint to a new target
6. Press ↺ to select **PSP1 Target** Press ▲ or ▼ to set the setpoint which you wish to ramp to	:PSP1 Target 40	The setpoint will ramp to 40
7. Press ↺ to select **PSP1 Target** Press ▲ or ▼ to set the setpoint which you wish to ramp to	:PSP1 Rate 1	The setpoint will ramp to 40 at the rate of 1 unit per sec, min or hour. If PSP1 Type = Dwell This parameter is Dwell Tm If PSP1 Type = Step This parameter is omitted

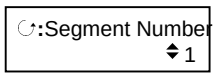
If PSP 2 is configured, steps 4 to 7 are repeated for PSP2.

If PSP 3 is configured, steps 4 to 7 are again repeated for PSP3.

If Wait Events are configured:-

8. Press [↻] to select **Wait Event** Press [▲] or [▼] to select the **wait event**		The choice are:- No Wait Event A Event B EventC See also 6.6.4

If Digital Event Outputs have been Configured:-

9. Press [↻] to select **Prg DO Values** Press [▲] or [▼] to select the digital output event to be On or Off		The first digital output will alternate between □ and _ indicating that it can be changed. □ = Off ■ = On
10. Press [↻] to scroll through each event output in turn		
11. Press [↻] to return to **Segment Number** Press [▲] or [▼] to select the next required segment and repeat the above.		

☺ **Tip:- To avoid scrolling through parameters you do not need to change, press [□] to return to the page header, then [↻] to select Segment Number.**

6.6.2. Prog Data Entry Example - Time to Target Programmer

This is the same as the previous procedure except that there are no Dwell, Rate or Step segments. They are all Time segments.
From the PROGRAM EDIT (segment Page) header:-

Do This	This Is The Display You Should See	Additional Notes
Press [↻] to select **Segment Number** Press [▲] or [▼] to select the segment	↻:Segment Number 1	
Press [↻] to select **Segment Type** Press [▲] or [▼] to select **Profile**	↻:Segment Type Profile	The choices are :- Profile End Segment Go Back for segments after the first
Press [↻] to select **PSP1 Target** Press [▲] or [▼] to set the start level of the segment (if necessary)	↻:PSP1 Target 40	For any segment ≠ 1, this value will normally be inherited from the Target level of the previous segment.
Press [↻] to select **Seg Duration** Press [▲] or [▼] to set the segment time	↻:Seg Duration 0:01:00	The setpoint will ramp to 40 at the rate of 1 unit per sec, min or hour As in the previous example, if PSP2, PSP3, Wait Events and Event Outputs have been configured they will appear here.
Press [↻] as many times as necessary to select **Segment Number** again Press [▲] or [▼] to select the next segment **(2)** and repeat the above.	↻:Segment Number 2	For a ramp PSP1 - Seg No. 1& PSP1 - Seg No. 2 will be different values. For a dwell PSP1 Seg No. 1& PSP1 - Seg No. 2 will be the same value.

☺ **Tip:- To avoid scrolling through parameters you do not need to change, press [🗋] to return to the page header, then [↻] to select Segment Number.**

6.6.3. Holdback Example

To apply holdback (see also 6.2.8) to each segment of the program or to the overall program, follow this procedure:-

Do This	This Is The Display You Should See	Additional Notes
Select the **PROGRAM EDIT (Program Page)** page header, (see 6.5.1.)	:PROGRAM EDIT Program Page	To select the page header which contains the holdback parameters
Press [▶] until **Edit Prg:** is displayed Press [▲] or [▼] to choose the required program	Edit Prg: 2 *Program 2*	
Press [▶] to display **HBk Mode** Press [▲] or [▼] to choose Per Program (or Per Segment)	:Hbk Mode Per Program	Only appears if Holdback has been configured. If per program is chosen press [▲] or [▼] to choose the holdback type to be applied to the whole program. If per segment is chosen the parameter Holdback Type does not appear.
Press [▶] to select **PSP1 HBk Type** Press [▲] or [▼] to choose Low, (or High or Band)	:PSP1 HBk Type Low	
Press [▶] to select **PSP1 HBk Val** Press [▲] or [▼] to choose the value which will hold the program	:PSP1 HBk Val 5	In this example holdback will occur in any segment of the program if the PV falls by more than 5 units below the SP.
Repeat the above two steps for PSP2 or PSP3 if configured.		If holdback per segment is chosen the holdback type can be chosen for each segment but the holdback value is the same for each segment.

6.6.4. Wait Example

The wait feature prevents the programmer from proceeding to the next segment if an event is true (see also section 6.2.7.). It only applies to controllers which have been 'wired' for wait events in configuration level. If the controller has been configured for 'Wait', the operator can set up the conditions as follows:-

Do This	This Is The Display You Should See	Additional Notes
Select the **PROGRAM EDIT** page header, and select **Segment Page** (see 6.5.3)	:PROGRAM EDIT Segment Page	
Press [⟳] until the parameter **Wait Event** is displayed Press [▲] or [▼] to choose the event on which the programmer should wait eg **Event A**	:Wait Event Event A	This selects the **Wait Event** which will prevent the program from proceeding to the next segment. The choices are:-

No Wait	The wait condition does not apply to the selected segment
Event A (B or C)	The selected segment will wait for event A (B or C) to become false before the program continues

6.6.4.1. Wait Example - How Wait is Displayed in Run Mode

The status of the Wait condition is displayed in a running program as follows:-

Do This	This Is The Display You Should See	Additional Notes
Select the **PROGRAM RUN (General Page)** page header	:PROGRAM RUN General Page	
Press [G] until the parameter **Wait Status** is displayed	:Wait Status No Wait	The status is off if not waiting and true if waiting. The choices are:- No Wait — The program is not waiting Event A (B or C) — The program is waiting on event A (B or C)
Press [G] once - the parameter **Wait Condition** is displayed	:Wait Condition Event A	The condition for the running segment is displayed. The choices are:- No Wait — The program is not waiting Event A (B or C) — The program is waiting on event A (B or C)
Press [▲] or [▼] to override the condition (No Wait), or to select a different event (Event A (B or C).	:Wait Condition No Wait	The condition can be changed if the program is in **Hold**

6.6.5. Program Names example

To produce a user defined program name:-

Do This	This Is The Display You Should See	Additional Notes
Select the **PROGRAM EDIT (Program Page)** page header	:PROGRAM EDIT Program Page	
Press [↻] until **Program Name** is displayed The first character alternates between _ and P. Press [▲] or [▼] to change the character to one of your choice	:Program Name Program 1	Program 1 is the default name of a program. A full range of characters is available including capitals, numbers and common symbols
Press [↻] to select the next character Press [▲] or [▼] to change the next character to one of your choice	:Program Name Program 1	

Repeat the above steps until the program name of your choice is displayed. A name of up to 16 characters can be entered.
This name will be displayed on every view which contains Program Name.

7. Chapter 7 ALARM OPERATION

7.1. DEFINITION OF ALARMS AND EVENTS

Alarms are used to alert an operator when a pre-set level or condition has been exceeded. They are normally used to switch an output - usually a relay - to provide interlocking of the machine or plant or external audio or visual indication of the condition.

Soft Alarms are indication only within the controller and are not attached to an output (relay).

Events - can also be alarms - but are generally defined as conditions which occur as part of the normal operation of the plant. They do not generally require operator intervention. An example might be to open/close a vent during a programmer cycle.
The controller does not display the alarm status on the front panel.

For the purposes of the operation of this controller, alarms and events can be considered the same.

7.1.1. Customisable Parameter Names

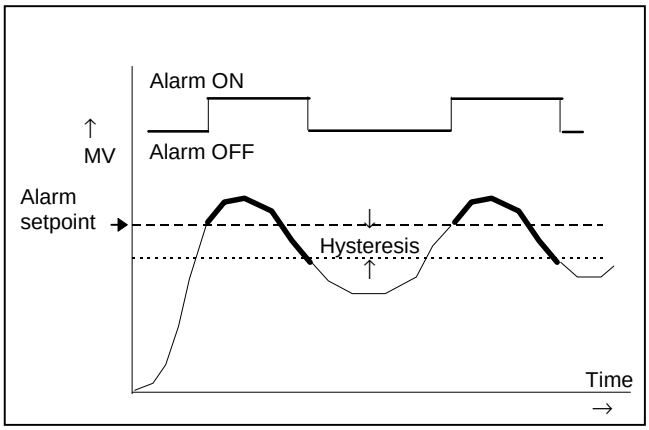
Throughout this chapter parameter names shown in *italics* are customisable by the user when in configuration access level. The name of the parameter may vary, therefore, from instrument to instrument.
Typical customisable parameter names are:
Alarm names
Loop names
Module and input names
Custom units
Promoted parameters
Program names
Start up message
Segment names (2704 controller only)

7.2. TYPES OF ALARM USED IN 2604 CONTROLLER

This section describes graphically the operation of different types of alarm used in the 2604 controller. The graphs show measured value plotted against time. The measured value may be any analogue value available in the controller.

7.2.1. Full Scale High

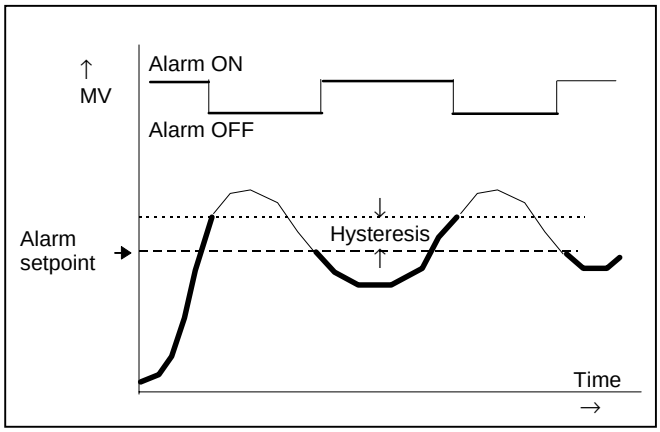
The Process Variable (PV) exceeds a set high level



Hysteresis is the difference between the alarm ON value and the alarm OFF value. It is used to prevent relay chatter.

7.2.2. Full Scale Low

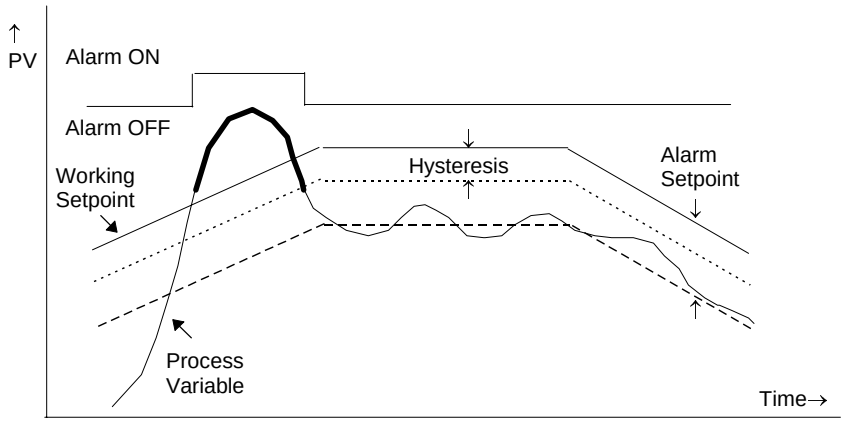
The Process Variable (PV) exceeds a set low level



7.2.3. Deviation High Alarm

The alarm occurs when the difference between the process variable and the setpoint is positive by greater than the alarm setpoint.

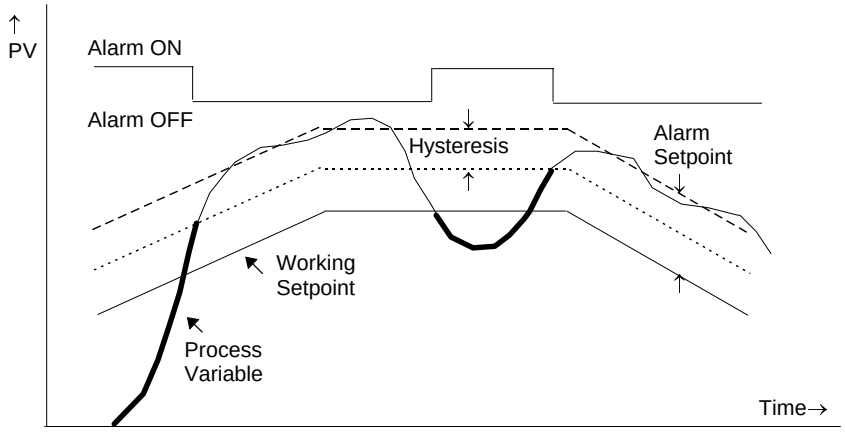
Note: For User Analogue Value the deviation is the difference between the two user wired analogue inputs.



7.2.4. Deviation Low Alarm

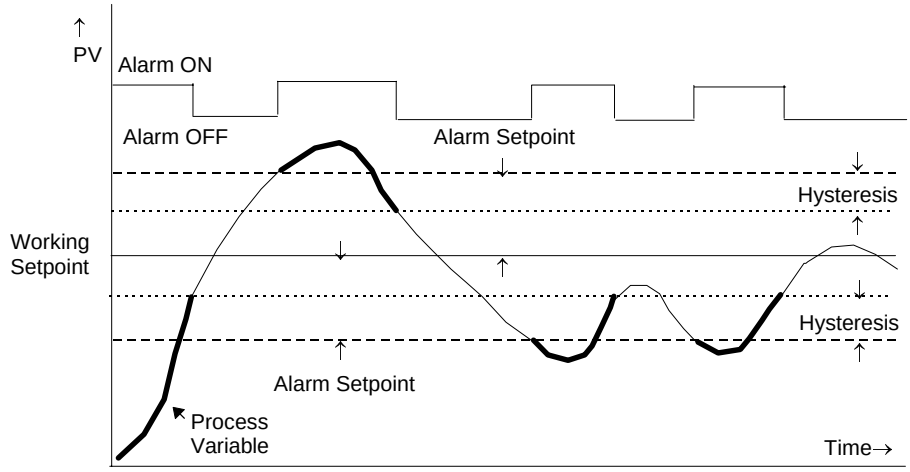
The alarm occurs when the difference between the process variable and the setpoint is negative by greater than the alarm setpoint.

Note: For User Analogue Value the deviation is the difference between the two user wired analogue inputs.



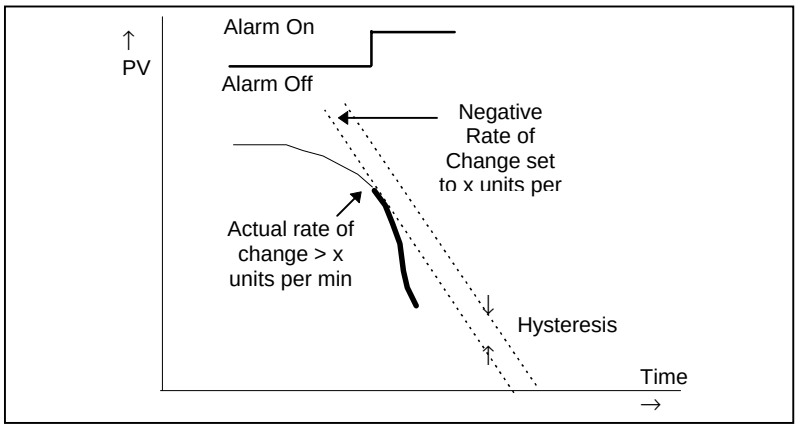
7.2.5. Deviation Band

A deviation band alarm monitors the process variable and the working setpoint and continuously compares the difference against the alarm setpoint. If the difference is either negative by less than, or positive by greater than the alarm setpoint, the alarm state will be active.



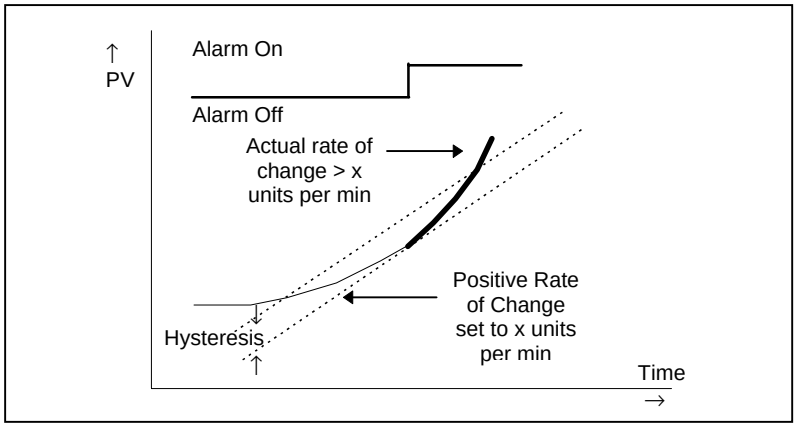
7.2.6. Rate Of Change Alarm (Negative Direction)

The Process Value falls faster than the alarm setting.



7.2.7. Rate Of Change Alarm (Positive Direction)

The Process Value rises faster than the alarm setting.



Notes:

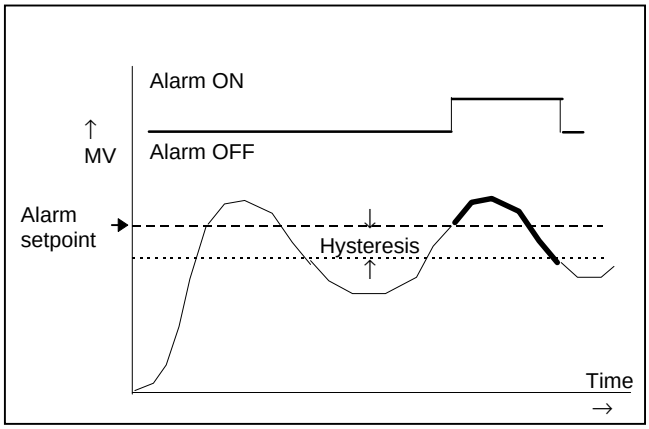
1. Separate alarms are required for positive and negative rates of change
2. An alarm is indicated during the period that the actual rate of change is greater than the set rate of change.
3. There may be a small delay before the instrument displays an alarm condition since the instrument requires several samples. This delay increases if the set value and actual value are close together
4. A hysteresis value of, say, 1 unit per second will prevent the alarm from ‘chattering’ if the rate of change varies by this amount

7.3. BLOCKING ALARMS

A Blocking Alarm only occurs **after** it has been through a start up phase. It is typically used to prevent alarms from being indicated until the process has settled to its normal working conditions.

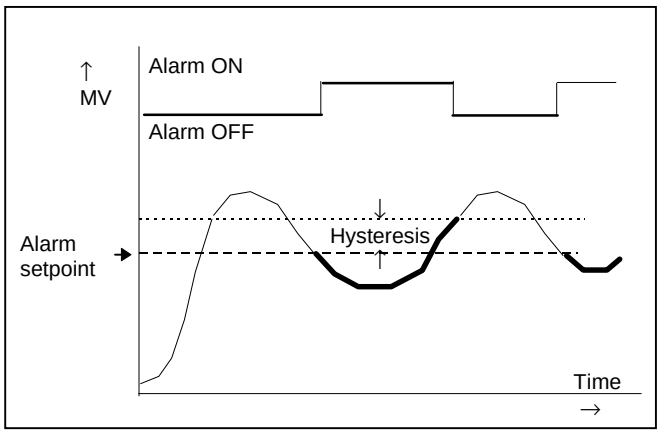
7.3.1. Full Scale High Alarm With Blocking

The alarm only occurs **after** the start up phase when high alarm has first entered a safe state. The next time a high alarm occurs will cause the alarm to become active.



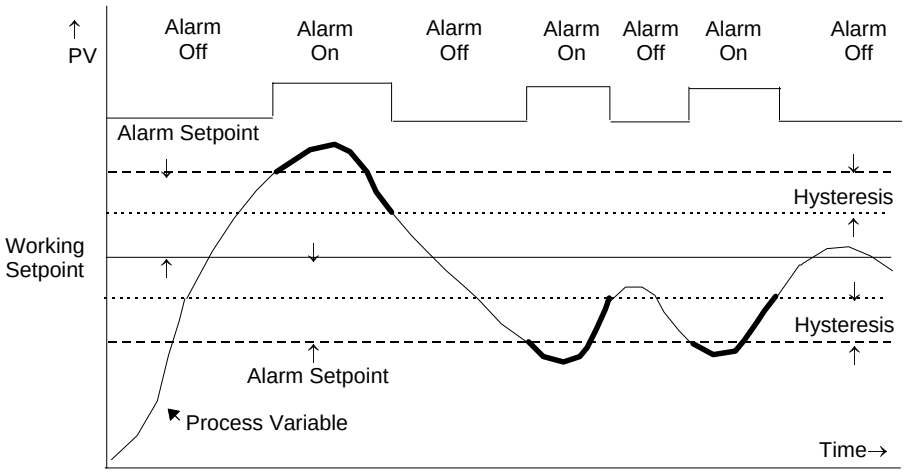
7.3.1.1. Full Scale Low With Blocking

The alarm only occurs **after** the start up phase when low alarm has first entered a safe state. The next time a low alarm occurs will cause the alarm to become active.



7.3.1.2. Deviation Band With Blocking

The alarm only occurs **after** the start up phase when low deviation alarm has first entered a safe state. The next time an alarm occurs, whether high band or low band will cause the alarm to become active.



7.4. LATCHING ALARMS

The alarm is indicated until it is acknowledged by the user. Acknowledgement of an alarm can be through the controller front buttons, from an external source using a digital input to the controller or through digital communications.

There are two ways that the alarm can be acknowledged:

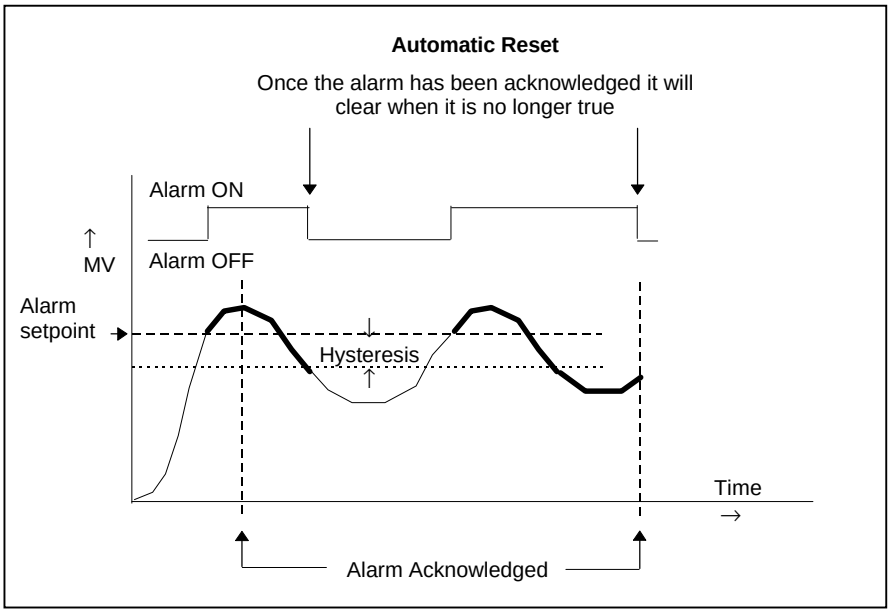
1. **Automatic Reset.** The alarm continues to be active until both the alarm condition is removed AND the alarm is acknowledged. The acknowledgement can occur **BEFORE** the alarm condition is removed.

2. **Manual Reset.** The alarm continues to be active until both the alarm condition is removed AND the alarm is acknowledged. The acknowledgement can only occur **AFTER** the alarm condition is removed.

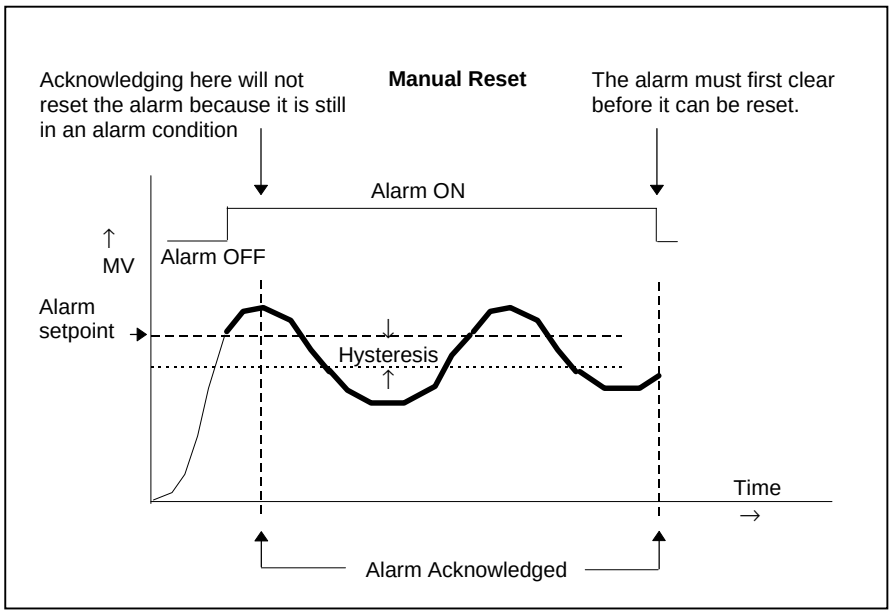
These are shown below for a Full Scale High Alarm

7.4.1. Latched Alarm (Full Scale High) With Automatic Reset

The alarm is displayed until it is acknowledged



7.4.2. Latched Alarm (Full Scale High) With Manual Reset



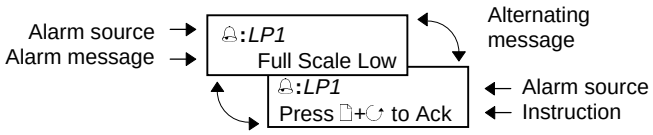
7.4.3. Grouped Alarms

Alarms can be associated with different aspects of the process. They are grouped in accordance with the functions they perform as follows:

Loop Alarms	Alarms associated with each control loop. Examples are: High, Low, Deviation and Rate of Change. Two alarms are available for each loop. On a new controller these are the only alarms which are configured - those listed below must be enabled in configuration level, see Engineering Handbook HA026761.
PV Input Alarms	Alarms which operate on the PV input. Examples are: High and Low. Two alarms are available with this input.
Analogue Input Alarms	Alarms which operate on the analogue input. Examples are: High and Low. Two alarms are available with this input.
Module Alarms	Alarms which operate on each plug in module. These can be input or output alarms depending upon the function of the module fitted. These alarms are associated with modules 1, 3, 4, 5, & 6, since module 2 is reserved as a an extra memory module
User Alarms	Eight undedicated alarms which can be wired to any variable.

7.5. HOW ALARMS ARE INDICATED

When an alarm occurs the red ALM beacon in the middle display will flash. This will be accompanied by a message on the lower display which will indicate the source and the type of alarm. The format of this alarm message is:



If a relay has been connected to the output of the alarm the relay it will operate to allow an external beacon or audible device to be activated.

Events will not cause either a message or the beacon to be illuminated.

7.5.1. The Alarm Summary Page

The status of alarms is displayed in the Alarm Summary page. To inspect the status:

Do This	This Is The Display You Should See	Additional Notes
From any display press [▯] as many times as necessary until the '**Alarms'** page **(Summary)** header is displayed	:ALARMS Summary Page	To access the Alarm Summary page header.
Press [↻] The first parameter displayed is **'New Alarm'**	↻:New Alarm No	No There are no new alarms Yes One or more new alarms have occurred since the last acknowledgement
Press [↻] Further pages only appear if the alarms have been configured. The first of these pages is ***'LP1 Alm 1-2'*** Note: Customised Parameter name (see 7.1.1)	↻:*LP1 Alm 1 & 2* Loop1 Alarm 1 status Loop1 Alarm 2 status	Alarm active. No alarm Flashes if acknowledged but the alarm is still present.

7.5.2. Alarms (Summary) Parameters

Table Number: 7-5-2	These parameters indicate alarm status		ALARMS (Summary Page)	
Parameter Name	**Parameter Description**	**Value**	**Default**	**Access Level**
New Alarm		No Yes		R/O
LP1 Alm 1 & 2	Status of the two alarms associated with loop 1	□□ to ■■		R/O
LP1 Ack	Group alarm acknowledge - Acknowledges both alarms	No Acknowledge		L1
LP2 Alm 1 & 2	Status of the two alarms associated with loop 2	□□ to ■■		R/O
LP2 Ack	Group alarm acknowledge - Acknowledges both alarms	No Acknowledge		L1
LP3 Alm 1 & 2	Status of the two alarms associated with loop 3	□□ to ■■		R/O
LP3 Ack	Group alarm acknowledge - Acknowledges both alarms	No Acknowledge		L1
PV Input Lo-Hi	Status of the low and high alarms associated with the PV input	□□ to ■■		R/O
PV Input Ack	Group alarm acknowledge - Acknowledges both alarms	No Acknowledge		L1
An Input Lo-Hi	Status of the low and high alarms associated with the analogue input	□□ to ■■		R/O
An Input Ack	Group alarm acknowledge - Acknowledges both alarms	No Acknowledge		L1
Mod Alm Lo 1 - 6	Status of the low alarms associated with modules 1to 6. Note: module 2 position will always read □	□□□□□□ to ■■■■■■		R/O
Mod Alm Hi 1 - 6	Status of the high alarms associated with module 1 to 6. Note: module 2 position will always read □	□□□□□□ to ■■■■■■		R/O
Module 1 Ack	Group alarm acknowledge - Acknowledges both high and	No Acknowledge		L1

	low alarms associated with module 1			
Module 3 Ack	Group alarm acknowledge - Acknowledges both high and low alarms associated with module 3	No Acknowledge		L1
Module 4 Ack	Group alarm acknowledge - Acknowledges both high and low alarms associated with module 4	No Acknowledge		L1
Module 5 Ack	Group alarm acknowledge - Acknowledges both high and low alarms associated with module 5	No Acknowledge		L1
Module 6 Ack	Group alarm acknowledge - Acknowledges both high and low alarms associated with module 6	No Acknowledge		L1
User Alm 1 - 8	Status of the user alarms 1 to 8	□□□□□□□□ to ■■■■■■■■		R/O
User 1 Ack	User alarm 1 acknowledge	No Acknowledge		L1
User 2 Ack	User alarm 2 acknowledge	No Acknowledge		L1
User 3 Ack	User alarm 3 acknowledge	No Acknowledge		L1
User 4 Ack	User alarm 4 acknowledge	No Acknowledge		L1
User 5 Ack	User alarm 5 acknowledge	No Acknowledge		L1
User 6 Ack	User alarm 6 acknowledge	No Acknowledge		L1
Ack All	Acknowledges all alarms	No Acknowledge		L3

7.6. ALARM ACKNOWLEDGEMENT

A new alarm can be acknowledged in four ways:

1. By pressing and simultaneously
2. From an external source, such as a pushbutton, connected to a suitably configured digital input
3. Through digital communications

The message will remain on the screen and the front panel beacon will continue to flash until the alarm is acknowledged - you are prompted to do this by pressing and simultaneously. The beacon will stop flashing and remain illuminated until all alarm conditions are removed. If a further alarm occurs the beacon will start flashing again and a new alarm message will be shown in the lower display.

The message displayed indicates the source of the alarm and may be customised to the users terminology. The source will inherit the name of the channel or the loop or the user alarm name.

The operation of the alarm acknowledgement depends whether the alarm is non-latching or latching, auto or manual reset. This is shown in the following tables:-

Non Latched Alarms

Alarm Condition	Acknowledge	Beacon	Message	Ext relay (if fitted)	Alarm summary
ON	No	Flashing	Alarm message	On	
Off	No	Off	Former display	Off	

Alarm Condition	Acknowledge	Beacon	Alarm message	Ext relay	Alarm summary
ON	No	Flashing	Alarm message	On	
On	Yes	Steady	Former display	Off	
Off		Off	Former message	Off	

Latched Alarm - Auto

Alarm Condition	Acknowledge	Beacon	Message	Ext relay (if fitted)	Alarm summary
ON	No	Flashing	Alarm message	On	
Off	No	Flashing	Alarm message	On	
Off	Yes				

Alarm Condition	Acknowledge	Beacon	Message	Ext relay (if fitted)	Alarm summary
ON	No	Flashing	Alarm message	On	
ON	Yes	Steady	:Access Level	Off	■□
Off	-	Off	Normal display	Off	□□

Latched Alarm - Manual

Alarm Condition	Acknowledge	Beacon	Message	Ext relay (if fitted)	Alarm summary
ON	No	Flashing	Alarm message	On	
Off	No	Flashing	Alarm message	On	
Off	Yes	Off	Access Level	Off	□□

Alarm Condition	Acknowledge	Beacon	Message	Ext relay (if fitted)	Alarm summary
ON	No	Flashing	Alarm message	On	
ON	Yes	Steady	Former display	Off	■□ Flashing
Off	-	Steady	Former display	Off	■□ Flashing
Off	To acknowledge see below	Off	Former display	Off	□□

Table 7.6

7.6.1. To Acknowledge a Latched - Manual Alarm

Do This	This Is The Display You Should See	Additional Notes
In addition to the procedure in Table 7.6, choose the page to which the alarm is attached	:ALARMS *LP1* Page	The display is shown for Loop 1 alarms, but is the same principle for other configured alarms.
Press [↻] The next parameter displayed is '***LP1 Ack***'	:*LP1 Ack* No	
Press [▲] or [▼] to select Acknowledge	:*LP1 Ack* Acknowledge Acknowledge? → Cancel ↻→ OK	Press [🗋] to cancel Press [↻] to acknowledge **both** alarms on Loop 1

Note:
The group alarm acknowledge is repeated at the beginning of each alarm page as described in the following sections

Further parameters in this page heading are listed in Table 7.5.2.

7.7. TO SET ALARM TRIP LEVELS

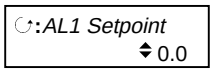
The alarm trip level (setpoint) is adjusted by accessing the page header for the chosen alarm. The following example adjusts the alarm trip level for Alarm 1/Loop 1:

Do This	This Is The Display You Should See	Additional Notes
From any display press [page] as many times as necessary until the '**Alarms'** page **(LP1)** header is displayed	[page]:ALARMS ▲▼ LP1 Page	The alarm type must have been selected in config level. Otherwise the alarm parameters will not be available
Press [scroll] The first parameter displayed is **'*LP1 Ack*'** This is the same group alarm parameter which appears in the Alarm (Summary) page	[scroll]:*LP1 Ack* ▲▼ No ▲▼ No ▲▼ Acknowledge Do not acknowledge The following action occurs: Acknowledge? [page]→ Cancel [scroll]→ OK	Press [page] to cancel Press [scroll] to acknowledge **both** alarms on Loop 1
Press [scroll] to display '*Alm1 Setpoint*' Press [▲] or [▼] to change the setpoint	[scroll]:*AL1 Setpoint* ▲▼ 0.0	This is adjustable between the input ranges of the controller or the ranges of its modules.

7.8. TO SET HYSTERESIS

To set hysteresis the controller must be placed in access level 3, see Chapter 4.

From the previous display:-

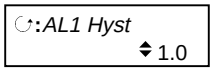


Do This	This Is The Display You Should See	Additional Notes
Press ⟳ to display '***Alm1 Hyst***' Press ▲ or ▼ to change the hysteresis	:AL1 Hyst 1.0	This is adjustable between the input ranges of the controller or the ranges of its modules.

7.9. ALARM DELAY TIME

A delay can be set for each alarm between the occurrence of the alarm and the indication of the alarm in the controller. This is useful to prevent spurious alarms from being indicated in some noisy or rapidly changing processes.
To set delay time the controller must be placed in access level 3, see Chapter 4.

From the previous display:-



Do This	This Is The Display You Should See	Additional Notes
Press ⟳ to display '***Alm1 Delay***' Press ▲ or ▼ to change the hysteresis	:AL1 Delay 0:00:00.0	This is adjustable from 0.1 sec upwards

Further parameters are:-

Alm1 Output	Alarm 1 output	Off On	Off	L1
Alm1 Inhibit	Alarm 1 Inhibit	No Yes	No	L2

The above sections are repeated for Loop 1 Alarm 2

7.9.1. ALARMS (LP1 Page) Parameters

Table Number: 7.9.1.	These parameters set up the Loop 1 alarms The alarm type must have been selected in config level.			ALARMS (*LP1*) Page
Parameter Name	**Parameter Description**	**Value**	**Default**	**Access Level**
LP1 Ack	Group alarm acknowledge for loop 1	No Acknowledge	No	L1
Alm1 Setpoint	Alarm 1 Setpoint	Controller range		L1
Alm1 Hyst	Alarm 1 hysteresis	Controller range		L3
Alm1 Delay	Alarm 1 delay	0:00:00.0		R/O
Alm1 Output	Alarm 1 output	Off On	Off	R/O
Alm1 Inhibit	Alarm 1 inhibit	No Yes	No	L3
Alm2 Setpoint	Alarm 2 Setpoint	Controller range		L1
Alm2 Hyst	Alarm 2 hysteresis	Controller range		L3
Alm2 Delay	Alarm 2 delay	0:00:00.0		R/O
Alm2 Output	Alarm 2 output	Off On	Off	R/O
Alm2 Inhibit	Alarm 2 inhibit	No Yes	No	L3

The above table is repeated for LP2 and LP3 if three control loops have been configured.

7.9.2. ALARMS (PV Input Page) Parameters

Table Number: 7.9.2.	These parameters set up the alarms associated with the PV input signal. They are only displayed if enabled in configuration level, using the parameter FS Hi Alarm or FS Lo Alarm		ALARMS (PV Input Page)	
Parameter Name	**Parameter Description**	**Value**	**Default**	**Access Level**
PV Input Ack	Group alarm acknowledge for PV input	No Acknowledge	No	L1
FS Hi Setpoint	Full Scale High Alarm (1) Setpoint	Controller range		L1
FS Hi Hyst	Full Scale High alarm (1) hysteresis	Controller range		L3
FS Hi Delay	Full Scale High alarm (1) delay	0:00:00.0		R/O
FS Hi Output	Full Scale High alarm (1) output	Off On	Off	R/O
FS Lo Setpoint	Full Scale Low Alarm (2) Setpoint	Controller range		L1
FS Lo Hyst	Full Scale Low alarm (2) hysteresis	Controller range		L3
FS Lo Delay	Full Scale Low alarm (2) delay	0:00:00.0		R/O
FS Lo Output	Full Scale Low alarm (2) output	Off On	Off	R/O
Inhibit	Alarm 1 inhibit (one per alarm)	No Yes	No	L3

7.9.3. ALARMS (An Input Page) Parameters

Table Number: 7.9.3.	These parameters set up the alarms associated with the analogue input signal. They are only displayed if enabled in configuration level, using the parameter FS Hi Alarm or FS Lo Alarm			ALARMS (An Input Page)
Parameter Name	**Parameter Description**	**Value**	**Default**	**Access Level**
An Input Ack	Group alarm acknowledge for analogue input	No Acknowledge	No	L1
FS Hi Setpoint	Full Scale High alarm (1) Setpoint	Controller range		L1
FS Hi Hyst	Full Scale High alarm (1) hysteresis	Controller range		L2
FS Hi Delay	Full Scale High alarm (1) delay	0:00:00.0		R/O
FS Hi Output	Full Scale High alarm (1) output	Off On	Off	R/O
FS Lo Setpoint	Full Scale Low Alarm (2) Setpoint	Controller range		L1
FS Lo Hyst	Full Scale Low alarm (2) hysteresis	Controller range		L3
FS Lo Delay	Full Scale Low alarm (2) delay	0:00:00.0		R/O
FS Lo Output	Full Scale Low alarm (2) output	Off On	Off	R/O
Inhibit	Alarm 1 inhibit (one per alarm)	No Yes	No	L3

7.9.4. ALARMS (Module 1 Page) Parameters

Table Number: 7.9.4.	These parameters set up the alarms associated with module 1. They are only displayed if enabled in configuration level, using the parameter FS Hi Alarm or FS Lo Alarm		ALARMS (Module 1 Page)	
Parameter Name	**Parameter Description**	**Value**	**Default**	**Access Level**
Module 1 Ack	Group alarm acknowledge for module 1	No Acknowledge	No	L1
FS Hi Setpoint	Full Scale High alarm (1) Setpoint	Controller range		L1
FS Hi Hyst	Full Scale High alarm (1) hysteresis	Controller range		L2
FS Hi Delay	Full Scale High alarm (1) delay	0:00:00.0		R/O
FS Hi Output	Full Scale High alarm (1) output	Off On	Off	R/O
FS Lo Setpoint	Full Scale Low Alarm (3) Setpoint	Controller range		L1
FS Lo Hyst	Full Scale Low alarm (3) hysteresis	Controller range		L3
FS Lo Delay	Full Scale Low alarm (3) delay	0:00:00.0		R/O
FS Lo Output	Full Scale Low alarm (3) output	Off On	Off	R/O
Inhibit	Alarm 1 inhibit (one per alarm)	No Yes	No	L3

The above table is repeated for:
Module 3
Module 4
Module 5
Module 6

7.9.5. ALARMS (User 1 Page) Parameters

Table Number: 7.9.5.	These parameters set up user defined alarms. The alarm type must have been selected in config level.			ALARMS (User 1 Page)
Parameter Name	**Parameter Description**	**Value**	**Default**	**Access Level**
User 1 Ack	Group alarm acknowledge for user alarm 1	No Acknowledge	No	L1
Latching	Indicates if the alarm has been configured as latching	None Auto Manual Event		R/O at L3
Blocking	Indicates if the alarm has been configured as blocking	No Yes		R/O at L3
Setpoint	Alarm 1 Setpoint	Controller range		L1
Hyst	Alarm 1 hysteresis	Controller range		L3
Delay	Alarm 1 delay	0:00:00.0		R/O at L3
Output	Alarm 1 output	Off On	Off	R/O at L1
Val A	Used if the user alarm is deviation. Normally internally wired to the PV	Disp min to disp max		R/O at L3 if wired to PV source
Val B	Used if the user alarm is deviation. Normally internally wired to the SP	Disp min to disp max		R/O at L3 if wired to PV source
Inhibit	Alarm inhibit	No Yes	No	L3

The above table is repeated for:

User alarm 2
User alarm 3
User alarm 4
User alarm 5
User alarm 6
User alarm 7
User alarm 8

8. Chapter 8 Tuning

This chapter describes how to tune your controller to match the characteristics of the process under control.
There are four topics:

- WHAT IS TUNING?
- AUTOMATIC TUNING
- MANUAL TUNING
- GAIN SCHEDULING

This chapter should be read in conjunction with Chapter 9, Loop Set Up.

8.1. WHAT IS TUNING

In tuning, you match the characteristics of the controller to those of the process being controlled in order to obtain good control. Good control means:

- Stable, 'straight-line' control of the temperature at setpoint without fluctuation
- No overshoot, or undershoot, of the temperature setpoint
- Quick response to deviations from the setpoint caused by external disturbances, thereby rapidly restoring the temperature to the setpoint value.

Tuning involves calculating and setting the value of the parameters listed in Table 8-1. These parameters appear in the *Loop* Setup (PID) list, see Chapter 9.

Parameter	Meaning or Function
Proportional band	The bandwidth, in display units or %, over which the output power is proportioned between minimum and maximum.
Integral time	Determines the time taken by the controller to remove steady-state error signals.
Derivative time	Determines how strongly the controller will react to the rate-of-change of the measured value.
High Cutback	The number of display units, above setpoint, at which the controller will increase the output power, in order to prevent undershoot on cool down.
Low cutback	The number of display units, below setpoint, at which the controller will cutback the output power, in order to prevent overshoot on heat up.
Cool gain	Only present if cooling has been configured and a module is fitted. Sets the cooling proportional band, which equals the proportional band value divided by the cool gain value.

Table 8-1 Tuning parameters

8.2. AUTOMATIC TUNING

The 2604 controller uses a one-shot tuner which automatically sets up the initial values of the parameters listed in Table 8-1 on the previous page.

8.2.1. One-shot Tuning

The 'one-shot' tuner works by switching the output on and off to induce an oscillation in the measured value. From the amplitude and period of the oscillation, it calculates the tuning parameter values.

If the process cannot tolerate full heating or cooling being applied during tuning, then the level of heating or cooling can be restricted by setting the heating and cooling power limits in the *Loop* Setup(Output) page. However, the measured value *must* oscillate to some degree for the tuner to be able to calculate values.

A One-shot Tune can be performed at any time, but normally it is performed only once during the initial commissioning of the process. However, if the process under control subsequently becomes unstable (because its characteristics have changed), you can re-tune again for the new conditions.

It is best to start tuning with the process at ambient temperature. This allows the tuner to calculate more accurately the low cutback and high cutback values which restrict the amount of overshoot, or undershoot.

8.3. TO AUTOTUNE CONTOL LOOP *LP1*

In most cases it will only be necessary to carry out the Autotune procedure when commissioning your controller. In some processes, however, it may be necessary to tune the controller manually. This is described below. It should be noted, however, that the parameters will be found under the heading Loop Setup. This heading is also described in the following chapter.

Do This	This Is The Display You Should See	Additional Notes
Set the setpoint to the value at which you will normally operate the process.		
From any display press [page] as many times as necessary until the '**AUTOTUNE'** page header is displayed	:AUTOTUNE	Autotune page is at Level 3 by default but may have been promoted to L1 or L2.
Press [scroll] to display **'Autotune Loop**	:Autotune Loop Off	Note: Text shown in *italics* is user definable in configuration mode and may be different from that shown
Press [▲] or [▼] to select the loop number to tune	:Autotune Loop *LP1*	

1. The controller induces an oscillation in the temperature by first turning the heating on, and then off. The first cycle is not complete until the measured value has reached the required setpoint.

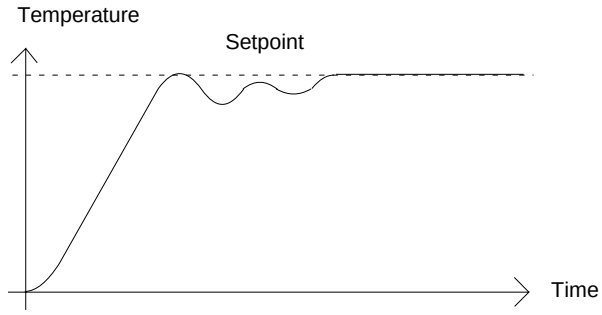
2. After two cycles of oscillation the tuning is completed and the tuner switches itself off.

3. When the controller is autotuning the status of autotune is shown periodically on the relevant loop summary

4. The controller then calculates the tuning parameters listed in Table 8-1 and resumes normal control action.

If you want 'Proportional only', 'PD', or 'PI' control, you should set the Integral time parameter or derivative time parameter to OFF before commencing the tuning cycle. These parameters are found in the *Loop* Setup (PID) pages, see Chapter 9xx. The tuner will leave them off and will not calculate a value for them.

Typical automatic tuning cycle



Calculation of the cutback values

Low cutback and *High cutback* are values that restrict the amount of overshoot, or undershoot, that occurs during large step changes in temperature (for example, under start-up conditions).
If either low cutback, or high cutback, is set to 'Auto' the values are fixed at three times the proportional band, and are not changed during automatic tuning.

8.3.1. To View the Status of Autotune

The states described above are shown in the next parameter in the Autotune page as autotune progresses.

Do This	This Is The Display You Should See	Additional Notes
From the previous display Press [⟳] to display **'Autotune State**	⟳**:**Autotune State Not tuning	This parameter displays the state of Autotuning. The choices are: Not tuning Monitor noise Tuning at SP Tuning to SP Finding maximum Finding minimum End Aborted In the relevant loop summary, the bargraph is periodically replaced by this text and 'tune' is flashed in the middle LED display.

8.4. MANUAL TUNING

If for any reason automatic tuning gives unsatisfactory results, you can tune the controller manually. There are a number of standard methods for manual tuning. The one described here is the Ziegler-Nichols method.

With the process at its normal running temperature:

1. Set the Integral Time and the Derivative Time to OFF.

2. Set High Cutback and Low Cutback to 'Auto'.

3. Ignore the fact that the temperature may not settle precisely at the setpoint.

4. If the temperature is stable, reduce the proportional band so that the temperature just starts to oscillate. If the temperature is already oscillating, increase the proportional band until it just stops oscillating. Allow enough time between each adjustment for the loop to stabilise. Make a note of the proportional band value 'B' and the period of oscillation 'T'.

5. Set the proportional band, integral time and derivative time parameter values according to the calculations given in Table 8-2.

Type of control	Proportional band 'Pb'	Integral time 'ti'	Derivative time 'td'
Proportional only	2xB	OFF	OFF
P + I control	2.2xB	0.8xT	OFF
P + I + D control	1.7xB	0.5xT	0.12xT

Table 8-2 Tuning values

8.4.1. Setting the cutback values

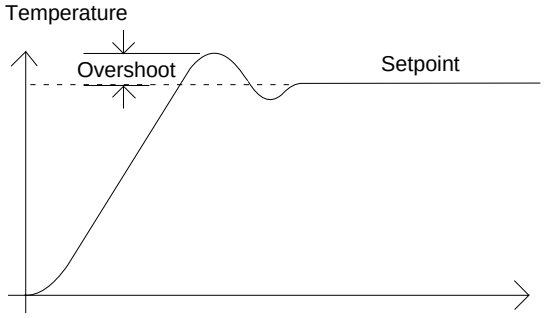
The above procedure sets up the parameters for optimum steady state control. If unacceptable levels of overshoot or undershoot occur during start-up, or for large step changes in temperature, then manually set the cutback parameters.

Proceed as follows:

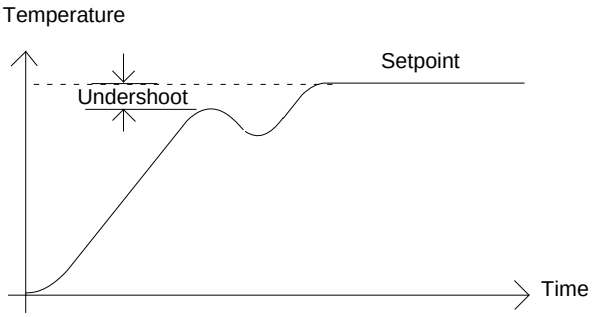
1. Set the low and high cutback values to three proportional bandwidths (that is to say, Lcb = Hcb = 3 x Pb).
2. Note the level of overshoot, or undershoot, that occurs for large temperature changes (see the diagrams below).

In example (a) increase Low Cutback by the overshoot value. In example (b) reduce Low Cutback by the undershoot value.

Example (a)



Example (b)



Where the temperature approaches setpoint from above, you can set High Cutback in a similar manner.

8.4.2. Integral action and manual reset

In a full three-term controller (that is, a PID controller), the integral term automatically removes steady state errors from the setpoint. If the controller is set up to work in two-term mode (that is, PD mode), the integral term will be set to 'OFF'. Under these conditions the measured value may not settle precisely at setpoint. When the integral term is set to 'OFF' the parameter *manual reset* appears in the *Loop* Setup (PID) page. This parameter represents the value of the power output that will be delivered when the error is zero. You must set this value manually in order to remove the steady state error.

8.4.3. To Manually Set PID Values

See Section 9.2 'To Set Up PID Parameters '.

8.4.4. Valve Position Control

See section 9.7 'Control of Valve Positioning Motors', for an explanation of the additional parameters required for motorised valves and how to set the values of these parameters.

8.5. GAIN SCHEDULING

Gain scheduling is the automatic transfer of control between one set of PID values and another. In the case of the 2604 controller, this is done at a presettable process value. It is used for the more difficult to control processes which exhibit large changes in their response time or sensitivity at, for example, high and low temperatures, or when heating or cooling.

The 2604 controller has three sets of PID values. You can select the active set from either a digital input, or from a parameter in the *Loop* Setup(PID) page, see Chapter 9, or you can transfer automatically in gain scheduling mode. The transfer is bumpless and will not disturb the process being controlled.

8.5.1. To Use Gain Scheduling

Do This	This Is The Display You Should See	Additional Notes
From any display press [page] as many times as necessary until the '***LP* SETUP' (PID)** page header is displayed	:*LP1* SETUP PID Page	Alternatives are *LP 2* and *LP 3*. These only appear in the list if the loops are configured *LP* SETUP page is at Level 3 by default but may have been promoted to L1 or L2.
Press [scroll] to display **'Active PID Set'** is displayed Press [▲] or [▼] to select the required number of PID sets	:Active PID Set PID Set 1	The choices are PID Sets 1 to 3

You must now set up the three sets of PID values. The values can be manually set, or automatically tuned as described earlier in this chapter. When tuning automatically you must tune three times, once below the switching point '1/2 Boundary' once between 1/2 Boundary' and '2/3 Boundary' ' and finally above '2/3 Boundary'.

9. Chapter 9 Loop Set Up

9.1. WHAT IS LOOP SET UP

The 2604 controller can have up to three control loops, and each control loop will have an auxiliary loop if cascade, ratio and override control has been configured. The Loop Setup pages allow you to set up the parameters associated with the operation of each of these loops. The Loop Setup pages are divided into a number of sub-headers - briefly described below:-

LP1 Setup (SP Page)	These parameters are associated with the setpoint of a particular loop
LP1 Setup (SP(Aux)Page)	These parameters are associated with the setpoint of the auxiliary loop.
LP1 Setup (Cascade Page)	These parameters only appear if the control loop is configured for cascade control.
LP1 Setup (Ratio Page)	These parameters only appear if the control loop is configured for ratio control.
LP1 Setup (Override Page)	These parameters only appear if the control loop is configured for override control.
LP1 Setup (PID Page)	These parameters allow you to set up the three term or PID values for the selected loop. See also Chapter 8
LP1 Setup (PID Aux) Page	These parameters allow you to set up the three term or PID values for the selected auxiliary loop. See also Chapter 8
LP1 Setup (Motor Page)	These parameters allow you to set up the values for a valve positioning output when the selected loop is configured for motorised valve control. See also Chapter 8
LP1 Setup (Output Page)	These parameters allow you to set up the values for the output when the selected loop is configured for analogue or digital control outputs.
LP1 Setup (Diagnostic Page)	These parameters are for diagnostic purposes on the selected loop.
LP1 Setup (Diag Aux) Page	These parameters are for diagnostic purposes on the selected auxiliary loop.

Each header listed above is repeated for each control loop configured.

Notes:
1. Text shown in *italics* is user definable in configuration mode and may be different from that shown
2. Since this chapter may be read in conjunction with the previous chapter - ‘Tuning’ - the manual setting of PID parameters is described first.

9.2. TO SET UP PID PARAMETERS

The PID parameters are **Proportional Band, Integral Time** and **Derivative Time**. The value of these parameters are dependant upon the characteristics of the application under control. Control stability is also achieved by setting other parameters such as **Cutback, Manual Reset, Relative Cool Gain, Feedforward**, etc,. Further information is available in Chapter 8xx, Tuning.
For processes where the rate of change varies significantly over the operating range, i.e. non-linear processes, a single set of tuning parameters may not be adequate. The 2604 controller allows three sets of tuning parameters to be held in memory. Each set can be active at different points in the range to provide best control at different process values. These transition points are set using the parameters 1/2 Boundary and 2/3 Boundary. This is also referred to as **Gain Scheduling**.

9.2.1. To Manually Set The PID And Other Tuning Parameters

Do This	This Is The Display You Should See	Additional Notes
From any display press [Page] as many times as necessary until the '***LP1* SETUP (PID Page)'** header is displayed	***LP1* SETUP** PID Page	Alternatives are Loop 2 and Loop 3. These only appear in the list if the loops are configured. Available at L3 but may have been promoted to L1 or L2.
Press [Scroll] until **'Active PID Set'** is displayed	**'Active PID Set** PID Set 1	R/O. Shows the working PID set based upon PV and 1/2 & 2/3 boundaries. The choices are: PID Set 1 PID Set 2 PID Set 3
Press [Scroll] until **'Prop Band 1'** is displayed Press [▲] or [▼] to set the value of the proportional band to be stored in Set 1.	This number determines the gain set being edited **'Prop Band 1** 10.0	The proportional band can be displayed in % or in engineering units, and is adjustable between 1 and 9999.9.
	Note: Text shown in *italics* is user definable in configuration mode and may be different from that shown	Further parameters may be set up in the same way. These are listed together with an explanation of their function in the following table

9.2.2. PID Page

Table Number: 9.2.2.	These parameters allow you to set up the PID sets			*LP1* SETUP (PID Page)
Parameter Name	**Parameter Description**	**Value**	**Default**	**Access Level**
Active PID Set	The PID set in current use	Set 1 to 3		R/O
Prop Band 1	Proportional Band Set 1	1 to 9999.9 eng units		L1
Integral 1	Integral Time Set 1	Off to 999.9		L1
Derivative 1	Derivative Time Set 1	secs or mins		L1
Cutback Low 1	Cutback Low Set 1	Auto to disp.		L1
Cutback High 1	Cutback High Set 1	range		L1
Manual Reset 1	Manual Reset Set 1 (only applies to a PD controller)	Off, -99.9 to +100		L1
Cool Gain 1	Relative channel 1/channel 2 Gain Set 1 (e.g. cooling. Only present if ch 1 and ch 2 are configured in the same loop)	0.1 to 10		L1
The above seven parameters are repeated for set 2 and again for set 3 if the number of PID sets has been configured to 2 or 3 respectively.				
FF Offset	Feedforward Offset Value			L3
FF Prop Band	Feedforward Proportional Band. This parameter controls the amount that the PID can affect the output			L3
FF Trim Limit	Feedforward Trim Limit			L3
Remote FFwd	Remote feedforward			L3
1/2 Boundary	Sets the level at which PID set 1 changes to PID set 2	Range units		L3
2/3 Boundary	Sets the level at which PID set 1 changes to PID set 2	Range units		L3
Loop Brk Time	Loop break time	Off On		L3
AutoDroop Comp	Manual reset when Integral turned off	Manual Calc		L3
Control Hold	Control hold flag. Freezes the control output	No Yes		L3
Integral Hold	Integral hold flag	No Yes		L3

9.2.3. PID (Aux) Page

Table Number: 9.2.3.	These parameters allow you to set up the PID sets		*LP1* SETUP PID(Aux) Page	
Parameter Name	**Parameter Description**	**Value**	**Default**	**Access Level**
Active PID Set	The PID set currently being used	PID Set 1 to 3		L1
Prop Band 1	Proportional Band Set 1	1 to 9999.9 eng units		L1
Integral 1	Integral Time Set 1	Off to 999.9 secs or mins		L1
Derivative 1	Derivative Time Set 1	Off to 999.9 secs or mins		L1
Cutback Low 1	Cutback Low Set 1	Auto to display limit		L1
Cutback High 1	Cutback High Set 1	Auto to display limit		L1
Manual Reset 1	Manual Reset Set 1 (only applies to a PD controller)	Off, -99.9 to +100		L1
Cool Gain 1	Relative channel 1/channel 2 Gain Set 1 (e.g. cooling. Only present if ch 1 and ch 2 are configured in the same loop)	0.1 to 10		L1
The above seven parameters are repeated for set 2 and again for set 3 if the number of PID sets has been configured to 2 or 3 respectively.				
1/2 Boundary	Sets the level at which PID set 1 changes to PID set 2	Range units		L3
2/3 Boundary	Sets the level at which PID set 1 changes to PID set 2	Range units		L3
Control Hold	Aux. Control hold flag. Freezes the control output	No Yes		L3
Integral Hold	Aux. Integral hold flag	No Yes		L3

The tables in sections 9.2.2 and 9.2.3 are repeated for *Loop 2* and *Loop 3* if these have been configured

This table does not appear if the Loop Type is Ratio.

9.3. TO ADJUST SETPOINT PARAMETERS

The method of access to parameters associated with setpoints is identical to that already described. The list of these parameters is given in the table below:-

Table Number: 9.3.	**This list allows you to select the setpoint to use, its value, setpoint limits and trims for the main loop.**			***LP1* SETUP (SP Page)**
Parameter Name	**Parameter Description**	**Value**	**Default**	**Access Level**
SP Select	Internal setpoint select	Setpoint 1 Setpoint 2		L1
SP1 Low Limit	Setpoint 1 low limit	Range units		L3
SP1 High Limit	Setpoint 1 high limit	Range units		L3
Setpoint 1	Setpoint 1 value	Range units		L1
SP2 Low Limit	Setpoint 2 low limit	Range units		L3
SP2 High Limit	Setpoint 2 high limit	Range units		L3
Setpoint 2	Setpoint 2 value	Range units		L1
Disable Rate L	Setpoint Rate limit disable	No Yes		L3
Rate Limit Val	Rate of change of setpoint	Off to range		L3
Trim Lo Lim	Local setpoint trim low limit	Range units		L3
Trim Hi Lim	Local setpoint trim high limit	Range units		L3
Local SP Trim	Allows a trim value to be applied to the remote setpoint	Range units		L1
Enable Rem SP	Remote setpoint enable	No Yes		L1
Remote SP	Remote setpoint value	Range units		L1
HBk Type	SP rate limit holdback type	Off Low High		L3

		Band		
HBk Value	SP rate limit holdback value	Display range		R/O
HBk Status	SP rate limit holdback status	Off Holdback		L3

9.3.1. *LP1* SETUP (SP Aux) Page

Table Number: 9.3.1	**This list allows you to select the setpoint value and setpoint limits specific to the auxiliary loop.**			***LP1* SETUP (SP Aux) Page**
Parameter Name	**Parameter Description**	**Value**	**Default**	**Access Level**
SP Low Limit	Auxiliary setpoint 1 low limit	Range units		L3
SP High Limit	Auxiliary setpoint 1 high limit	Range units		L3
Ovr SP Trim	Override loop setpoint trim	Range units		L3. Only appears when Override control is configured
Local SP	The setpoint which the controller reverts to when not in cascade, ratio or override	Range units		L1
Working SP	The current value of the setpoint in use	Range units		L1

This table does not appear if the Loop Type is Ratio.

9.4. CASCADE CONTROL

9.4.1. Overview

Cascade control is a technique used to enable processes with long time constants to be controlled with the fastest possible response to process disturbances, including setpoint changes, whilst still minimising the potential for overshoot. It is a combination of two PID controllers, where the output signal from one (the master) forms the setpoint for the other (the slave). For cascade control to be effective the slave loop should be more responsive than the master.

9.4.2. Simple Cascade

The main process is controlled using the master PID loop, the output of which is used to determine the setpoint of the slave. The implementation of cascade control in the 2604 is available as a standard option. ie ; it is not necessary to order a dual loop controller to perform cascade control.

9.4.3. Cascade with Feedforward

An available option with cascade control is feedforward. It allows either the master PV, master SP or user defined variable to be fed forward so that it directly influences the slave setpoint. The master PID output contribution of the slave setpoint is limited by the trim limit set in engineering units. This parameter also adjusts the gain of the feedforward path.
A typical application for SP feedforward could be in a heat treatment furnace, where it can be used to extend the life of heating elements by limiting their maximum operating temperature.
An application using PV feedforward could be in autoclaves or reactor vessels where it is sometimes required to protect the product from excessive temperature gradients (also referred to as Delta T Control).

9.4.3.1. Standard Feedforward

Standard feedforward is used if there is a requirement for some additional parameter, for example an analogue input, to trim the master PID output value before the slave setpoint is applied. An application may be a liquid temperature control system using cascade control of heater temperature where variations in control rate can be directly fed forward into the slave loop, modifying heater temperature and giving rapid compensation

9.4.4. Auto/Manual Operation

Auto/Manual operates on both master and slave loops.
When the controller is placed in manual the slave working setpoint will track the value of the slave process value continually, therefore ensuring bumpless transfer.
When cascade is deactivated the master loop will monitor the setpoint of the slave loop and provide a smooth transition of output power when the loop moves back to cascade mode.

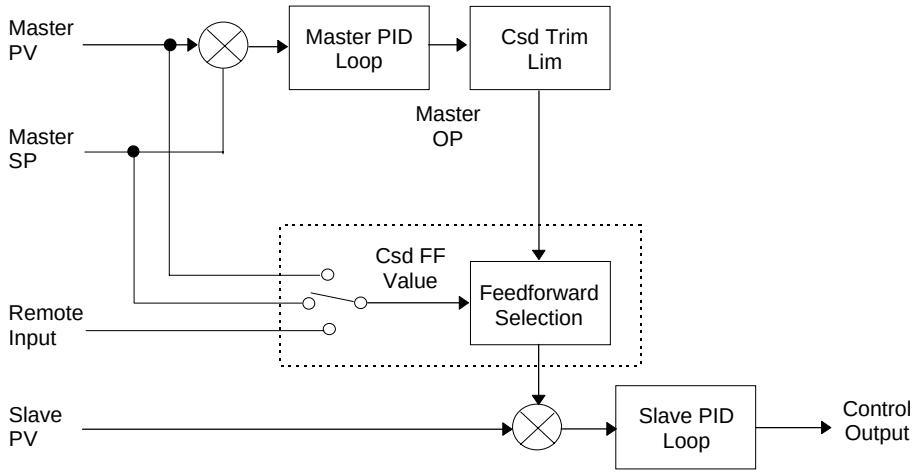


Figure 9.1: Cascade with Feedforward

9.4.5. Cascade Parameters *LP1* SETUP (Cascade Page)

Table Number: 9.4.5.	**This list allows you to set up parameters specific to cascade controllers**		***LP1* SETUP (Cascade Page)**	
Parameter Name	**Parameter Description**	**Value**	**Default**	**Access Level**
Disable CSD	Cascade disable status	Off On		L1
CSD FF Value	Cascade feedforward value i.e. The value being fed forward	Range of signal being fed forward		L3
CSD FF Trim Lim	Cascade feedforward trim limit i.e. The amount the master output can be trimmed up and down.	Range of slave loop		L3
Master OP	Cascade master PID output power	Range of slave loop		R/O

9.5. RATIO CONTROL

9.5.1. Introduction

Ratio Control is a technique used to control a process variable at a setpoint which is calculated as a proportion of a second (lead) input. The ratio setpoint determines the proportion of the lead value that is to be used as the actual control setpoint. The ratio setpoint can be applied as either a multiplier or as a divisor to the second input.
A typical application is in gas fired furnaces where in order to achieve efficient combustion, the gas and air flow supplied to the burners needs to be maintained at a constant ratio.

9.5.2. Basic Ratio Control

The 2604 contains a ratio control function block (function blocks are explained in the Engineering Manual Part No. HA026761) which can be used in any control loop. Figure 9.2 shows a block diagram of a simple ratio controller. The lead PV is multiplied or divided by the ratio setpoint to calculate the desired control setpoint. Prior to the setpoint calculation, the ratio setpoint can be offset by the ratio trim value and must obey the overall ratio setpoint operating limits. Another useful feature of the is the automatic calculation of the actual measured ratio which is then available to be displayed on the controller front panel.

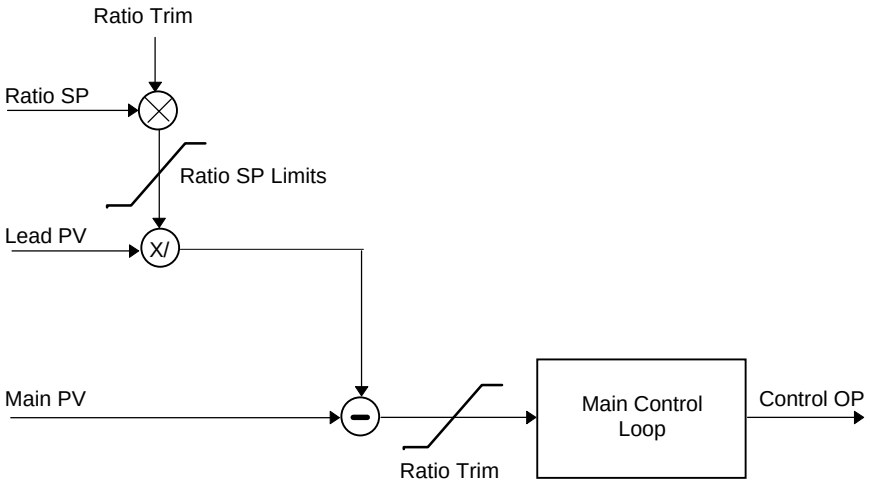


Figure 9.2: - Simple Ratio Control Block Diagram

Control

9.5.3. Setpoint Tracking

When the control loop is placed in manual or ratio has been deselected, setpoint tracking can be used to recalculate the actual achieved ratio, thereby ensuring bumpless transfer between modes. If the input from the lead process value at any time becomes invalid, then the working setpoint of the loop will remain at its current value

9.5.4. Ratio Control Parameters *LP1* SETUP (Ratio Page)

Table Number: 9.5.5.	**This list allows you to set up parameters specific to ratio controllers**			***LP1* SETUP (Ratio Page)**
Parameter Name	**Parameter Description**	**Value**	**Default**	**Access Level**
Lead PV	The value of the lead process variable			L1
Measured Ratio	Measured Ratio			R/O
Ratio WSP	Ratio working setpoint			R/O
Ratio Lo Lim	Ratio setpoint low limit			L3
Ratio Hi Lim	Ratio setpoint high limit			L3
Ratio SP	Ratio setpoint			L1
Enable Ratio	Ratio enable	Off On		L1
Ratio Trim	Ratio trim value			L1

9.6. OVERRIDE CONTROL

9.6.1. Introduction:

Override Control allows a secondary control loop to override the main control output in order to prevent an undesirable operating condition. The override function can be configured to operate in either minimum, maximum or select mode.
A typical example can be implemented in a heat treatment furnace with one thermocouple attached to the workpiece, and another situated close to the heating elements. Control of the furnace during the heating up period is regulated by the override (heating element) temperature controller which provides a safeguard against overheating. Control of the furnace will switch over to the workpiece temperature controller at some point when the temperature is near to its target setpoint. The exact point of switchover is determined automatically by the controller, and will be dependent on the selected PID terms.

9.6.2. Simple Override

Override control is available with analogue, time proportioning and ON/OFF control outputs. It is not available with valve position outputs. Figure 9.3 shows a simple override control loop. The main and override controller outputs are fed to a low signal selector. The override controller setpoint is set to a value somewhere above the normal operating setpoint, but below any safety interlocks.
There is one Auto Manual switch for both loops. In manual mode the control outputs of both loops track the actual output therefore ensuring bumpless transfer when auto is selected.

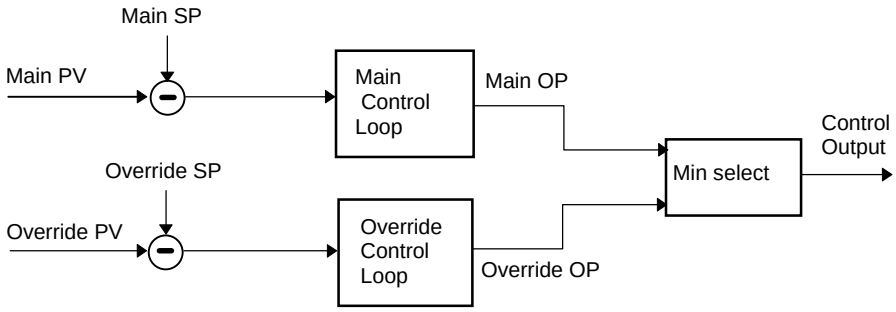


Figure 9.3:- Simple Override Control

9.6.3. Override Control Parameters *LP1* SETUP (Override Page)

Table Number: 9.6.3.	This list allows you to set up parameters specific to override controllers			*LP1* SETUP (Override Page)
Parameter Name	**Parameter Description**	**Value**	**Default**	**Access Level**
Override Type	Override type	Minimum Maximum Select		L3
OVR Target SP	Override target setpoint	Display range		
Disable OVR	Disable override control	Off On		L1
Active Loop	Displays the loop which is controlling at any time			L1
OVR SP Trim	Override loop setpoint trim	Range limit		L1
Main OP	Override main output	-100 to 100		R/O
Override OP	Override output	-100 to 100		R/O

9.7. CONTROL OF VALVE POSITIONING MOTORS

The 2604 controller can be configured for motorised valve control as an alternative to the standard PID control algorithm. This algorithm is designed specifically for positioning motorised valves and operates in *boundless* mode, which does not require a position feedback potentiometer for control purposes

An example on how to connect a motorised valve controller is given in Chapter 2 section 2.4.2xx. The control is performed by delivering open, or close, pulses in response to the control demand signal via raise and lower relay or triac outputs.

The following page will appear if your controller is configured for motorised valve control.

9.7.1. Motor Parameters

Table Number: 9.7.1.	**This list allows you to set up the motor interface parameters for a valve positioning output. This page only appears if a motor valve positioning controller is configured**			***LP1* SETUP (Motor Page)**
Parameter Name	**Parameter Description**	**Value**	**Default**	**Access Level**
Travel Time	This parameter is set to match the time taken for the motor to travel from fully closed to fully open	0:00:00.1	0:00:60:0	L3
Inertia	This parameter is set to match the inertia (if any) of the motor	Off to 0:00:00.1	0:00:20:0	L3
Backlash	This parameter compensates for any backlash which may exist in the linkages	Off to 0:00:00.1	0:00:20:0	L3
Min Pulse Time	Sets the minimum on time of the signal which drives the motor	Auto to 0:00:00.1	Auto = 0:00:00:2	L3
VP SBrk Action	Sets the sensor break action for a valve position controller when no feedback potentiometer is used.	Reset Up Down		L3
Valve Position	Indicates the position of the valve	0 to 100%		R/O

9.7.2. Commissioning the Motorised Valve Controller

1. Measure the time taken for the valve to be raised from its fully closed to its fully open position and enter this as the value in seconds into the 'Travel Time' parameter.
2. Set all the other parameters to the default values shown in 9.7.1.

The controller can then be tuned using any of the automatic, or manual, tuning procedures described in Chapter 8. As before, the tuning process, either automatic or manual, involves setting the values of the parameters in Table 9.7.1. The only difference with boundless control is that the derivative term, although present, will have no effect.

9.7.2.1. Adjusting the minimum pulse-time

The default value of 0.2 seconds is satisfactory for most processes. If, however, after tuning the process, the valve activity is excessively high, with constant oscillation between raise and lower pulses, the minimum on-time can be increased.
The minimum on-time determines how accurately the valve can be positioned and therefore the control accuracy. The shorter the time, the more precise the control. However, if the time is set too short, process noise will cause an excessively busy valve.

9.7.2.2. Inertia and backlash settings

The default values are satisfactory for most processes, i.e. 'Off'.
Inertia is the time taken for the valve to stop after the output pulse is turned off. If this causes a control problem, the inertia time needs to be determined and then entered into the 'Inertia' parameter. The inertia time is subtracted from the raise and lower output pulse times, so that the valve moves the correct distance for each pulse.
Backlash is the output pulse time required to reverse the direction of the valve, i.e. the time taken to overcome the mechanical backlash of the linkages. If the backlash is sufficient to cause a control problem, then the backlash time needs to be determined and then entered into the 'Backlash' parameter.
The above two values are not part of the automatic tuning procedure and must be entered manually.

9.8. OUTPUT PARAMETERS

Table Number: 9.8.	This list allows you to set up the parameters which control the control output to the plant			*LP1* SETUP (Output Page)
Parameter Name	**Parameter Description**	**Value**	**Default**	**Access Level**
Manual Mode	On/Off control output only. Allows the controller to be switched into manual	Auto Manual		
OP Low Limit	Sets a low limit on an analogue output signal	-100% to 100%		L3
OP High Limit	Sets a high limit on an analogue output signal	-100% to 100%		L3
OP Rate Limit	Sets the rate at which the output value changes	Off to 99.99 %/sec		L3
Forced OP	Sets the output value when the controller is switched to manual - alternative to bumpless transfer	-100% to 100%		L3
SBrk OP	Sets the level of the output under sensor break conditions	-100% to 100%		L3
CH1 OP	Reads the current value of channel 1 output	-100% to 100%		R/O
Ch1 Hysteresis	Only shown if the output relay 1 is configured as on/off. It sets the difference between relay on and relay off.	Off to 9999.9		L3
Ch1 Min Pulse	Output minimum on time (on/off control)			
The above three parameters are repeated for channel 2				
Deadband	Deadband between ch1 and ch2 - only applies if both ch1 and ch2 are configured	Off to 100.0		L3
Target OP	Target output power	-100 to 100%		L1
On/Off OP	On Off control output	-100% 0 100%		L1
Rem Lo OP Lim	Remote low power limit	-100% to 100%		L3
Rem Hi OP Lim	Remote high power limit	-100% to		L3

		100%		
Ena OP Track	Output track enable	No Yes		
OP Track	Track input			
Ena Aux OP Trk	Auxiliary Output track enable	No Yes		
Aux OP Track	Auxiliary Track input			

9.9. *LP 1* SETUP (DIAGNOSTIC PAGE)

This page is read only and provides information on the current operating conditions of the control loop. It is used for diagnostic purposes.

Table Number: 9.9.	**This list allows you to interrogate operating conditions of the loop**		***LP 1* SETUP (Diagnostic ,Page)**	
Parameter Name	**Parameter Description**	**Value**	**Default**	**Access Level**
PV	Process Variable	Display range		L3
Aux PV	Auxiliary Process Variable	Display range		L3
Working SP	The value of the working setpoint	Display range		L3
Working OP	The value of the working output	-100 to 100		L3
Error	Value of main loop error (PV - SP)	Display range		L1
Aux Error	Value of the auxiliary loop error (PV - SP)	-9999 to 9999		R/O
P OP	Proportional component of the output	-999 to 9999		R/O
Aux P OP	Proportional component of the auxiliary loop output	-999 to 9999		R/O
I OP	Integral component of the output	-999 to 9999		R/O
Aux I OP	Integral component of the auxiliary loop output	-999 to 9999		R/O
D OP	Derivative component of the output	-999 to 9999		R/O
Aux D OP	Derivative component of the auxiliary loop output	-999 to 9999		R/O
FF OP	Feedforward component of output	-9999 to 9999		R/O
SRL Complete	Setpoint rate limit complete			R/O
VP Velocity	VP output velocity	-100 to 100		R/O

10. Chapter 10 Controller Applications

The 2604 controller contains control blocks specifically designed to suit a number of different applications.
Examples are:-
Carbon Potential, Oxygen or Dew Point control using Zirconia probes
Humidity control using wet and dry platinum resistance thermometers

About this chapter

This chapter gives general descriptions (which are not intended to be of a particular installation) of the use of the 2604 controller in the above applications.

- ◊ Brief description and terminology applications using zirconia probes
- ◊ An example wiring diagram for carbon potential control
- ◊ Viewing and adjusting the parameters for a carbon potential controller
- ◊ Brief description of humidity control
- ◊ An example wiring diagram for humidity control
- ◊ Viewing and adjusting the parameters for a humidity controller

10.1. ZIRCONIA - CARBON POTENTIAL CONTROL

A dual loop 2604 controller is required to control temperature of the process on one loop and carbon potential on the other. The controller is often a programmer which generates temperature and carbon potential profiles synchronised to a common timebase. In this section it is assumed that a programmer is used.

10.1.1. Temperature Control

The sensor input of the temperature loop may come from the zirconia probe but it is common for a separate thermocouple to be used. The controller provides a heating output which may be connected to gas burners or thyristors to control electrical heating elements. In some applications a cooling output may also be connected to a circulation fan or exhaust damper.

10.1.2. Carbon Potential Control

The zirconia probe generates a millivolt signal based on the ratio of oxygen concentrations on the reference side of the probe (outside the furnace) to the amount of oxygen in the furnace. The controller uses the temperature and carbon potential signals to calculate the actual percentage of carbon in the furnace. This second loop generally has two outputs. One output is connected to a valve which controls the amount of an enrichment gas is supplied to the furnace. The second output controls the level of dilution air.

10.1.3. Sooting Alarm

In addition to other alarms which may be detected by the controller (see also Chapter 7 ‘Alarm Operation’), the 2604 can trigger an alarm when the atmospheric conditions are such that carbon will be deposited as soot on all surfaces inside the furnace.

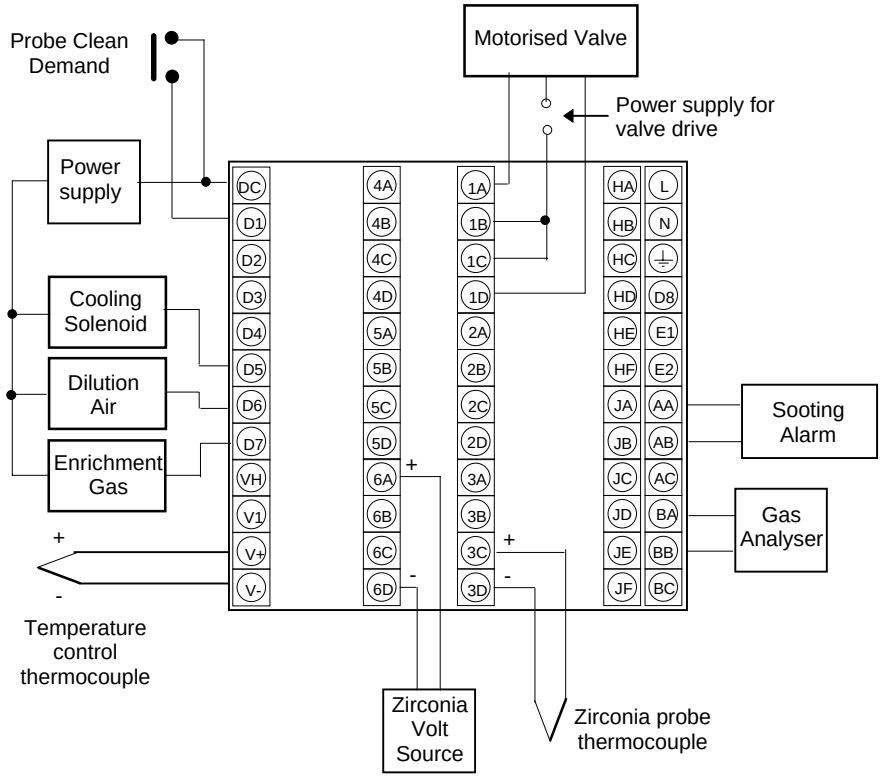
10.1.4. Automatic Probe Cleaning

The 2604 has a probe clean and recovery strategy that can be programmed to occur between batches or manually requested. A short blast of compressed air is used to remove any soot and other particles that may have accumulated on the probe. Once the cleaning has been completed the time taken for the probe to recover is measured. If the recovery time is too long this indicates that the probe is ageing and replacement or refurbishment is due. During the cleaning and recovery cycle, the %C reading is frozen thereby ensuring continuous furnace operation.

10.1.5. Enriching Gas Correction

A gas analyser may be used to determine the CO concentration of the enriching gas. If a 4-20mA output is available from the analyser, it can be fed into the 2604 to automatically adjust the calculated % carbon reading. Alternatively, this value can be entered manually.

10.1.6. Example Of Carbon Potential Controller Wiring



In the above example the following modules are fitted. This will change from installation to installation:

Module 1	Dual triac or relay to drive motorised valve
Module 3	PV input module for zirconia probe thermocouple
Module 6	Analogue input module for the zirconia probe input
Standard Digital I/O	Used as logic input for manual probe clean and outputs for solenoid valve drives
Standard PV Input	For the temperature control thermocouple input
Standard Analogue Input	For gas analyser
Standard Relay Output	For sooting alarm

Figure 10.1: An Example of 2604 Wiring for Carbon Potential Control

10.2. TO VIEW AND ADJUST ZIRCONIA PARAMETERS

Do This	This Is The Display You Should See	Additional Notes
From any display press [page] as many times as necessary until the **Zirconia Probe (Options)** page header is displayed	:ZIRCONIA Options Page	To select the page header which contains the zirconia parameters
Press [scroll] to select the first parameter in the list	:Zirconia Value No	Zirconia Control Process Value No Yes R/O
Press [scroll] to select the next parameter in the list	:Probe SBrk 0	Probe sensor break R/O
Press [scroll] to select the next parameter in the list	:Sooting Alarm Good	Displays the sooting status of the zirconia probe Good Bad
Press [scroll] to select the next parameter in the list Press [up] or [down] to Enable or disable the Remote Gas	:Enable Rm H-Co Disabled	See Table 10.2.1. for the full list of parameters available under this list header ⇓

10.2.1. Zirconia Parameters

Table Number: 10.2.1.	These parameters allow you to view or adjust the parameters associated with zirconia probes		ZIRCONIA PROBE (Options Page)	
Parameter Name	**Parameter Description**	**Value**	**Default**	**Access Level**
Zirconia Value	Zirconia control process value - the O2 or dew point value derived from temperature and remote gas reference inputs	Range units		R/O
Probe SBrk	Probe sensor break			R/O
Sooting Alarm	Probe sooting alarm output	Off On		R/O
Enable Rem H-CO	Remote gas enable	Disabled Enabled		L3
H-CO Reference	Gas reference or process factor	0.0 to 999.0		L3
Clean State	The burn off state of the zirconia probe	Inactive Cleaning Recovering		R/O
Probe Status	Probe clean Probe requires cleaning	Good Bad		L1
Next Clean	Time to next cleaning. (counts down to 0:00:00.0)	0:00:00.1		R/O
Clean Freq	Zirconia probe cleaning interval	0:00:00.1 to 99:54:00.0		L3
Clean Duration	Sets the cleaning time	0:00:00.1 to 1:39:54.0		L3
Recovery Time	Maximum recovery time after purging	0:00:00.1 to 1:39:54.0		L3
Probe Offset	Zirconia mV offset	-999.0 to 2000.0		L3
Temp Offset	Sets the temperature offset for the probe	-999.0 to 2000.0		L3
Probe IP	Zirconia probe mV input	-0.100 to 2.000		R/O
Temp IP	Zirconia probe temperature input value	Temp range units		R/O
Working H-CO	Working gas reference or process factor	0.0 to 999.0		R/O

10.3. HUMIDITY CONTROL

10.3.1. Overview

Humidity (and altitude) control is a standard feature of the 2604 controller. In these applications the controller may be configured to generate a setpoint profile (see Chapter 6 'Programmer Operation').
Also the controller may be configured to measure humidity using either the traditional Wet/Dry bulb method (figure 10.2) or it may be interfaced to a solid state sensor.
The controller output may be configured to turn a refrigeration compressor on and off, operate a bypass valve, and possibly operate two stages of heating and/or cooling

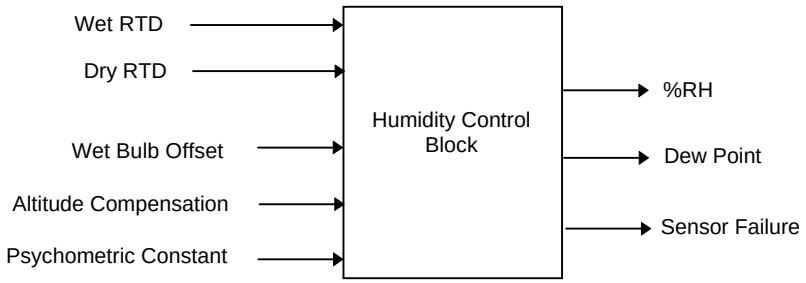
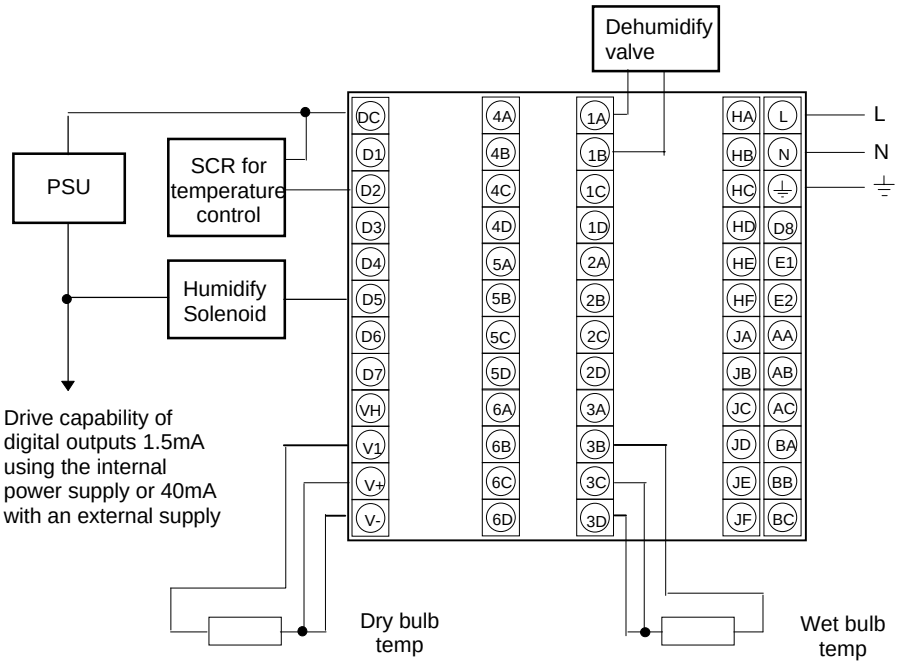


Figure 10.2:- Humidity Control Block

10.3.2. Example Of Humidity Controller Wiring



In the above example the following modules are fitted. This will change from installation to installation:

Module 1	Analogue or relay to drive dehumidify valve
Module 3	PV input module for wet bulb temperature RTD
Standard Digital I/O	Used as logic outputs for humidify solenoid valve and temperature control SCR
Standard PV Input	For the dry bulb RTD used for the temperature control and humidity calculation

Figure 10.3:- Example of Humidity Controller Connections

10.3.3. Temperature Control Of An Environmental Chamber

The temperature of an environmental chamber is controlled as a single loop with two control outputs. The heating output time proportions electric heaters, usually via a solid state relay. The cooling output operates a refrigerant valve which introduces cooling into the chamber. The controller automatically calculates when heating or cooling is required.

10.3.4. Humidity Control Of An Environmental Chamber

Humidity in a chamber is controlled by adding or removing water vapour. Like the temperature control loop two control outputs are required, i.e. Humidify and Dehumidify.
To humidify the chamber water vapour may be added by a boiler, an evaporating pan or by direct injection of atomised water.
If a boiler is being used adding steam increases the humidity level. The humidify output from the controller regulates the amount of steam from the boiler that is allowed into the chamber.
An evaporating pan is a pan of water warmed by a heater. The humidify output from the controller humidity regulates the temperature of the water.
An atomisation system uses compressed air to spray water vapour directly into the chamber. The humidify output of the controller turns on or off a solenoid valve.
Dehumidification may be accomplished by using the same compressor used for cooling the chamber. The dehumidify output from the controller may control a separate control valve connected to a set of heat exchanger coils.

10.4. TO VIEW AND ADJUST HUMIDITY PARAMETERS

Do This	This Is The Display You Should See	Additional Notes
From any display press [page] as many times as necessary until the **Humidity (Options)** page header is displayed	:HUMIDITY OptionsPage	To select the page header which contains the humidity parameters
Press [scroll] to select the first parameter in the list	:Dew Point 0.0	Read only display of Dew Point
Press [scroll] to select the next parameter in the list	:Rel Humidity 0.0	Read only display of Relative Humidity
Press [scroll] to select the next parameter in the list Press [▲] or [▼] to change the value	:Atm Pressure 0.0	See Table 10.4.1. for the full list of parameters available under this list header

10.4.1. Humidity Parameters

Table Number: 10.4.1.	These parameters allow you to view or adjust the parameters associated with humidity control			HUMIDITY (Options Page)
Parameter Name	**Parameter Description**	**Value**	**Default**	**Access Level**
Dew Point	Wet/Dry temperature measurement of dew point	-999.9 to 999.9		L1 R/O
Rel Humidity	Relative Humidity	0.0 to 100.0		L1 R/O
Atm Pressure	Atmospheric Pressure	0.0 to 2000.0		L3
PMetric Const	Psychometric Constant	0.0 to 10.0		L3
Wet Bulb Offs	Wet bulb temperature correction	-100.0 to 100.0		L3
Humidity SBrk	Sensor break action for humidity control	No Yes		L1
Dry Bulb Temp	Dry Bulb Temperature	Range units		L1 R/O
Wet Bulb Temp	Wet Bulb Temperature	Range units		L1 R/O

11. Chapter 11 Input Operators

11.1. WHAT ARE INPUT OPERATORS

The 2604 controller can have three control loops. Each loop can be independently configured to the process to be controlled. This has been described in Chapters 9 and 10 for PID, Cascade, Ratio, Override, Humidity Control, etc. It is also possible to apply custom linearisation to the inputs of each loop. This is a 16 point straight line linearisation and the parameters can be made available at Levels 1, 2 and 3 so that scaling can be carried out during commissioning.
Custom linearisation is achieved under three page headers in the controller, one header for each loop. The parameters listed under each header are the same for each loop.

Also included in this section are parameters which allow you to switch inputs between different thermocouple types or between a thermocouple and pyrometer when the process is a high temperature furnace.

The page headers are:

INPUT OPERS (Cust Lin 1 Page)	These parameters set up the custom linearisation for input 1
INPUT OPERS (Cust Lin 2 Page)	These parameters set up the custom linearisation for input 2
INPUT OPERS (Cust Lin 3 Page)	These parameters set up the custom linearisation for input 3
INPUT OPERS (Switch 1 Page)	These parameters provide switch over between thermocouple types or pyrometer
INPUT OPERS (Monitor 1 Page)	Logs maximum and minimum, counts time above threshold
BCD INPUT	Monitors the Digital Inputs when configured for BCD switch

The Input Operators page is only available if Input Operators has been enabled in configuration level. This is described in the Engineering Handbook, Eurotherm part no. HA026761.

Note:
In addition to linearising the controller inputs channels, it is equally valid to customise other sources such as Output Channels. This allows you, for example, to compensate for non linear control valve characteristics.

11.2. CUSTOM LINEARISATION

The linearisation uses a 16 point straight line fit.
Figure 11.1 shows an example of a curve to be linearised and is used to illustrate the terminology used for the parameters found in the **INPUT OPERS (Cust Lin*1* Page)**.

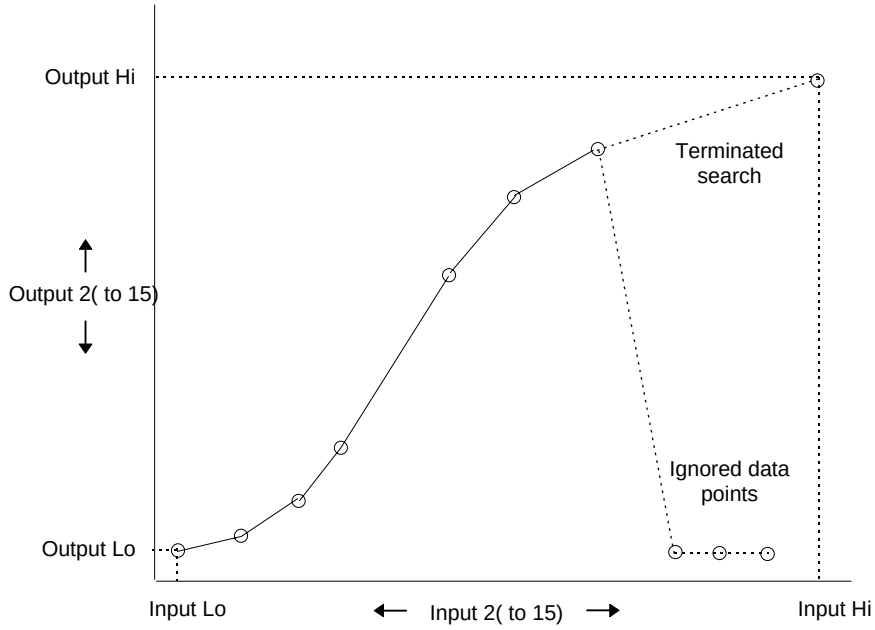


Figure 11.1: Linearisation Example

Notes:
1. The linearisation block works on rising inputs/rising outputs or rising inputs/falling outputs. It is not suitable for outputs which rise and fall on the same curve.
2. Input Lo/Output Lo and Input Hi/Output Hi are entered first to define the low and high points of the curve. It is not necessary to define all 15 intermediate points if the accuracy is not required. Points not defined will be ignored and a straight line fit will apply between the last point defined and the Input Hi/Output Hi point.

Do This	This Is The Display You Should See	Additional Notes
From any display press [page] as many times as necessary until the **INPUT OPERS (Cusl Lin 1 Page)** header is displayed	:INPUT OPERS Cust Lin 1 Page	To select the Input (or Output) to linearise
Press [scroll] to select **Enabled** Press [▲] or [▼] to **On**	:Enabled Off	This enables custom linearisation
Press [scroll] to select **Input Value**	:Input Value 5.0	Displays the Current input value. Access level 1
Press [scroll] to select **Output Value**	:Output Value 15.0	Displays the Current Output value. Access level 1
Press [scroll] to select **Output Status**	:Output Status Good	Good The input is good and in range Bad If the input is bad or out of range the output value is bad
Press [scroll] to select **Input Lo** Press [▲] or [▼] to set the minimum input value	:Input Lo 1.0	This is the value read by the sensor. Access level 3
Press [scroll] to select **Output Lo** Press [▲] or [▼] to set the output value which corresponds to the Input Lo value	:Output Lo 2.0	This is the displayed value Repeat the above two steps to set the high points then continue for as many intermediate points as required

The following table gives the full list of parameters available under this list header ⇓

11.2.1. Input Operator Custom Linearisation Parameters

Table Number: 11.2.1.	This page allows you to set up a customised linearisation curve			INPUT OPERS (Cust Lin *1*)
Parameter Name	**Parameter Description**	**Value**	**Default**	**Access Level**
Enabled	To enable custom linearisation	Off On	Off	L3
Input Value	The current value of the input	Range		R/O
Output Value	The current value of the output	Range		R/O
Output Status	The conditions are OK The conditions are bad or out of range	Good Bad		R/O
Input Lo	Adjust to the low input value	Range		L3
Output Lo	Adjust to correspond to the low input value	Range		L3
Input Hi	Adjust to the high input value	Range		L3
Output Hi	Adjust to correspond to the high input value	Range		L3
Input 2	Adjust to the first break point	Range		L1
Output 2	Adjust to correspond to input 2	Range		L1
The above two parameters are repeated for all intermediate break points, ie 2 to 14				
Input 15	Adjust to the last break point	Range		L1
Output 15	Adjust to correspond to input 15	Range		L1

The above table is repeated for three linearisation curves under the page headers:

- **INPUT OPERS (Cust Lin 2 Page)**
- **INPUT OPERS (Cust Lin 3 Page)**

11.2.2. Compensation for Sensor Discontinuities

The custom linearisation feature can also be used to compensate for errors in the sensor or measurement system. The intermediate points are, therefore, available in Level 1 so that known discontinuities can be calibrated out. Figure 11.2 shows an example of the type of discontinuity which can occur in the linearisation of a temperature sensor.

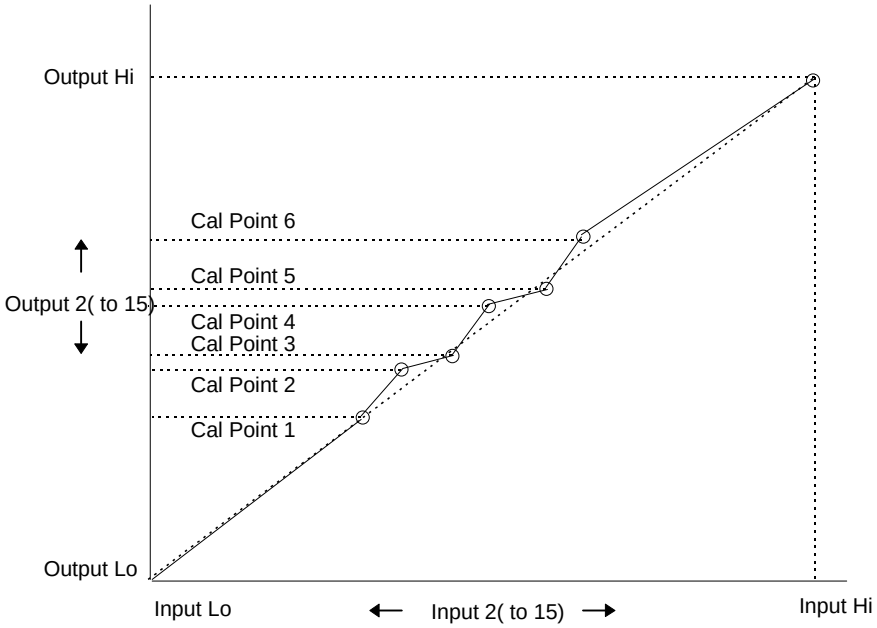


Figure 11.2: Compensation for Sensor Discontinuities

The calibration of the sensor uses the same procedure as described above. Adjust the output (displayed) value against the corresponding input value to compensate for any errors in the standard linearisation of the sensor.

11.3. TO SET UP THERMOCOUPLE/PYROMETER SWITCHING

This facility is commonly used in wide range temperature applications where it is necessary to control accurately over the range. A thermocouple may be used to control at lower temperatures and a pyrometer then controls at very high temperatures. Alternatively two thermocouples of different types may be used.
Figure 11-3 shows a process heating over time with boundaries which define the switching points between the two devices. The higher boundary (2 to 3) is normally set towards the top end of the thermocouple range and the lower boundary (1 to 2) set towards the lower end of the pyrometer (or second thermocouple) range. The controller calculates a smooth transition between the two devices.

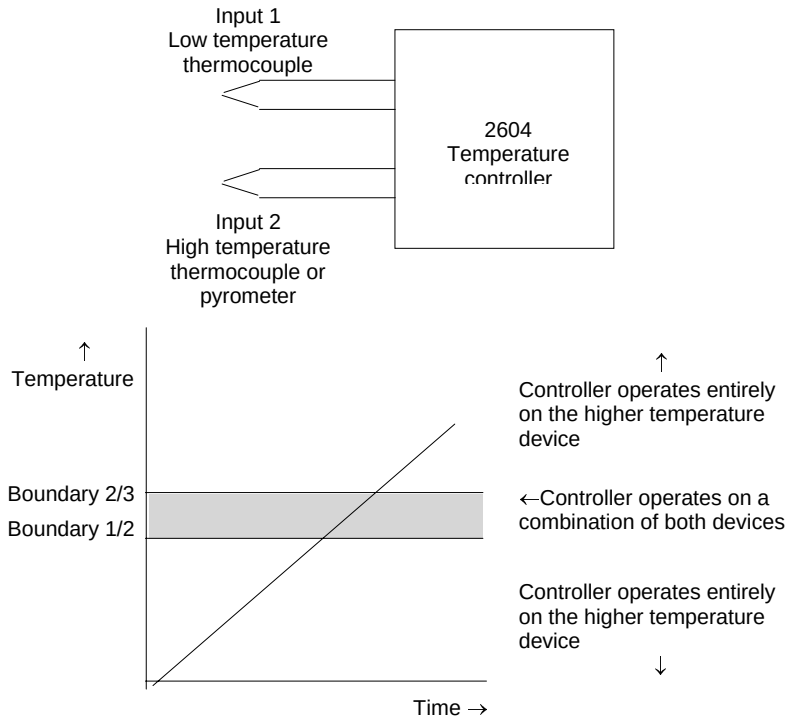


Figure 11-3: Thermocouple to Pyrometer Switching

Do This	This Is The Display You Should See	Additional Notes
From any display press [ ] as many times as necessary until the **INPUT OPERS (Switch 1 Page)** header is displayed Press [▲] or [▼] to select the sub-header	:INPUT OPERS Switch 1 Page	To select Switch over
Press [ ] to select the first parameter in the list Press [▲] or [▼] to change the value	:Switch Lo 500	The Process Value used by the controller is derived from Input 1when it is below the value set on the display
Press [ ] to select the first parameter in the list Press [▲] or [▼] to change the value	:Switch Hi 700	The Process Value used by the controller is derived from Input 2 when it is above the value set on the display. The transition between Input 1 and Input 2 is determined by the Switch Over algorithm
		The following table gives the full list of parameters available under this list header ⇓

11.3.1. Input Operators Switch Over Parameters

Table Number: 11.3.1.	This page allows you to set up Switch Over parameters			INPUT OPERS (Switch 1 Page)
Parameter Name	**Parameter Description**	**Value**	**Default**	**Access Level**
Switch Lo	PV = Input 1 below this value	Display Range		L3
Switch Hi	PV = Input 1 above this value	Display Range		L3
Output Value	The current working value	Display Range		R/O
Output Status	The conditions are OK The conditions are bad or out of range	Good Bad		R/O
Input 1 Value	The current working value	Display Range		L1
Input 1 Status	The conditions are correct The conditions are bad or out of range	Good Bad		R/O
Input 2 Value	The current working value	Display Range		R/O
Input 2 Status	The conditions are correct The conditions are bad or out of range	Good Bad		L1

11.4. TO SET UP INPUT OPERATORS (MONITOR)

The Monitor block:

1. Logs the Maximum and Minimum excursions of the PV. These values are reset when:-
   a) The controller power is switched off and on again
   b) An external logic input, configured as reset, is enabled
   c) The reset parameter, see Table 11.4.1, is changed to Yes
2. Counts the time above a threshold
3. Provides a time alarm

11.4.1. Input Operator Monitor Parameters

Table Number: 11.4.1.	This page allows you to set up Monitor parameters			INPUT OPERS (Monitor 1 Page)
Parameter Name	**Parameter Description**	**Value**	**Default**	**Access Level**
Input	Input value	Range		L1
Reset	Reset	No Yes		L3
Maximum	The maximum value recorded by the controller between resets, see 1. above	Range		R/O
Minimum	The minimum value recorded by the controller between resets, see 1. above	Range		R/O
Trigger	PV threshold for the timer log	Range		L3
Day	Days above threshold	0 to 32767		R/O
Time	Time above threshold	0:00:00.0		R/O
Day Alarm	This sets the alarm threshold for the number of days that the alarm is active	0 to 32767		L3
Time Alarm	This sets the alarm threshold for the time that the alarm is active	0:00:00.0		L3
Alarm Output	Displays an alarm when the number of days and time has been exceeded	Off On		R/O

11.5. BCD INPUT

If the fixed digital inputs have been configured for a BCD input the following parameters show the values appearing at the digital inputs and is useful for diagnostic purposes

Table Number: 11.5.	This page allows you to view the BCD input values			INPUT OPERS (BCD Input Page)
Parameter Name	**Parameter Description**	**Value**	**Default**	**Access Level**
BCD Value	Reads the value (in decimal) of the switch as it appears on the digital inputs	0-99		R/O
Decimal Value	Reads the value of the switch as it appears on the digital inputs	0-255		R/O
Digit 1(units)	Units value of the first switch	0-9		R/O
Digit 2(Tens)	Tens value of the second switch	0-9		R/O

12. Chapter 12 Totaliser, Timer, Clock, Counter Operation

12.1. WHAT ARE TIMER BLOCKS?

Timer Blocks allow the controller to use time/date information as part of the control process. They can be triggered by an event and used to initiate an action. For example, a programmer can be set to RUN at a particular day and time or an action delayed as a result of a digital input signal. The Timer Blocks page is only available if Timer Blocks has been enabled in configuration level. This is described in the Engineering Handbook, Eurotherm part no. HA026761.

The Timer Blocks fitted in the 2604 controller are:

Four timer blocks	The timer type will have been set in Configuration level. The timer will be activated by an event. The event will also have been defined in Configuration mode or it may be triggered by a parameter in the list. Timing continues for a set time period. This output can be 'wired' in configuration mode to operate an event. Configuration of Timer function blocks is described in Engineering Handbook HA026761
Clock	This is a real time clock which can be used to operate other time based functions.
Two alarm (clock) blocks	Alarms can be switched on or off at a particular day or time and provide a digital output. This output can be wired in configuration mode to operate an event. Configuration of Timer Alarm function blocks is described in Engineering Handbook HA026761
Four totaliser blocks	Totaliser blocks can also be 'wired', in Configuration level, to any parameter. They are used to provide a running total of a parameter and give an output when a pre-set total is reached. An example might be to totalise the flow through a pipe. The output can also be 'wired' in Configuration level to operate an event such as a relay. Configuration of Totaliser function blocks is described in Engineering Handbook HA026761

Timer Blocks are grouped under page headers as follows:

TIMER BLOCKS (Timer 1 Page)	Parameters to set the time period and read elapsed time for timer 1
TIMER BLOCKS (Timer 2 Page)	Parameters to set the time period and read elapsed time for timer 2
TIMER BLOCKS (Timer 3 Page)	Parameters to set the time period and read elapsed time for timer 3
TIMER BLOCKS (Timer 4 Page)	Parameters to set the time period and read elapsed time for timer 4
TIMER BLOCKS (Clock Page)	To read time
TIMER BLOCKS (Alarm 1 Page)	Parameters to set a time and day alarm and read the alarm output condition for alarm 1
TIMER BLOCKS (Alarm 2 Page)	Parameters to set a time and day alarm and read the alarm output condition for alarm 2
TIMER BLOCKS (Totaliser1 Page)	Parameters to read the totalised value, set and monitor an alarm on totalised value.
TIMER BLOCKS (Totaliser2 Page)	Parameters to read the totalised value, set and monitor an alarm on totalised value.
TIMER BLOCKS (Totaliser3 Page)	Parameters to read the totalised value, set and monitor an alarm on totalised value.
TIMER BLOCKS (Totaliser4 Page)	Parameters to read the totalised value, set and monitor an alarm on totalised value.

12.2. TIMER BLOCKS

There are four timer blocks. The following example shows how to set the time on Timer block 1. This is identical for Timer blocks 2 to 4. The example is followed by the table of parameters available for Timer blocks.

Do This	This Is The Display You Should See	Additional Notes
From any display press [page] as many times as necessary until the **TIMER BLOCKS (Timer 1 Page)** header is displayed	:TIMER BLOCKS Timer 1 Page	To select Timer 1 function block
Press [enter] to select the first parameter in the list Press [up] or [down] to set the time period	:Time 0:00:00.0	Displays and allows the time period to be set in Timer block 1 The following table gives the full list of parameters available under this list header ⇓

12.2.1. Timer Parameters

Table Number: 12.2.1.	This page allows you to set up Timer Parameters			TIMER BLOCKS (Timer 1 to 4 Page)
Parameter Name	**Parameter Description**	**Value**	**Default**	**Access Level**
Time	Timer Time	0:00:00.0		L1
Input	Trigger/Gate input. Turn On to start timing	Off On	Off	L1
Triggered	Timer triggered (timing)	Off On		R/O
Output	Timer output. Occurs when the timer has timed out	Off On	Off	L1
Elapsed Time	Timer elapsed time	0:00:00.0		R/O

12.3. THE CLOCK

The clock time and day is set in configuration mode as described in the Engineering manual, Eurotherm part Number HA026761. In access levels 1 to 3 the time can be read as folows:-

Do This	This Is The Display You Should See	Additional Notes
From any display press [page] as many times as necessary until the **TIMER BLOCKS (Clock Page)** header is displayed Press [▲] or [▼] to select ⬍ Clock	:TIMER BLOCKS ⬍ Clock Page	
Press [↷] to select the first parameter in the list	:Time 0:00:00.0	Displays the set time
Press [↷] to select the next parameter in the list	:Day Monday	Displays the set day

12.4. TIME BASED ALARMS

There are two alarms available which allow an output to be turned **on** or **off** at a set time and day.

Do This	This Is The Display You Should See	Additional Notes
From any display press [page] as many times as necessary until the **TIMER BLOCKS (Alarm 1 Page)** header is displayed Press [▲] or [▼] to select **Alarm 1** or **Alarm 2**	:TIMER BLOCKS Alarm 1	
Press [↺] to select the first parameter in the list Press [▲] or [▼] to set the day	:On-Day Never	Selects the day to turn the alarm on. The choices are: Never, Monday, Tuesday, Wednesday, Thursday, Friday, Saturday, Sunday, Mon-Fri, Mon-Sat, Sat-Sun, Every Day
Press [↺] to select the next parameter in the list Press [▲] or [▼] to set the time	:On-Time 0:00:00	Selects the time of day to turn the alarm on.
Press [↺] to select the next parameter in the list Press [▲] or [▼] to set the day	:Off-Day Never	Selects the day to turn the alarm off. The choices are: Never, Monday, Tuesday, Wednesday, Thursday, Friday, Saturday, Sunday, Mon-Fri, Mon-Sat, Sat-Sun, Every Day
Press [↺] to select the next parameter in the list Press [▲] or [▼] to set the time	:Off-Time 0:00:00	Selects the time of day to turn the alarm off.
Press [↺] to select the next parameter in the list	:Output Off	The status of the alarm output. This can be forced on or off using the [▲] or [▼] buttons

12.5. TOTALISERS

There are four totalisers. The following example shows how to access the parameters available for a totaliser block.

Do This	This Is The Display You Should See	Additional Notes
From any display press [D] as many times as necessary until the **TIMER BLOCKS (Totaliser1 Page)** header is displayed Press [▲] or [▼] to select **Totaliser 1 (or2, 3 or4) Page**	:TIMER BLOCKS Totaliser1 Page	
Press [↵] to select **Run** Press [▲] or [▼] to turn the totaliser **On** or **Off**	:Run Run	Run starts the totaliser Reset resets the totaliser
Press [↵] to select **Hold** Press [▲] or [▼] to turn the totaliser **On** or **Off**	:Hold Not Holding	Hold stops the totaliser Not Holding allows the totaliser to run Note: The Run & Hold parameters are designed to be wired to (for example) digital inputs. Run must be 'on' and Hold must be 'off' for the totaliser to operate.
Press [↵] to select **Total**	:Total 0	This shows the totalised value
Press [↵] to select **Alarm Setpoint** Press [▲] or [▼] to set the totaliser alarm setpoint	:Alarm Setpoint 0	This allows an alarm to be set to operate when a totalised value is reached
Press [↵] to select **Alarm Output**	:Alarm Output Off	This is a read only value which indicates the alarm output On or Off

13. Chapter 13 User Values

13.1. WHAT ARE USER VALUES?

User Values are normally used as constants in an analogue or digital operation.
The 2604 controller contains up to 12 user values which are in a single list under the page header User Values. The User Values page is only available if Analogue and Logic Operators have been enabled in configuration level. This is described in the Engineering Handbook Eurotherm part no. HA026761.

13.2. TO SET UP USER VALUES

Do This	This Is The Display You Should See	Additional Notes
From any display press [ ] as many times as necessary until the **USER VALUES** page header is displayed	:USER VALUES User Val1 Page	
Press [ ] to select **User 1 Value**	:User 1 Value [Units] 0	The value can be adjusted between high and low limits as set in configuration level
Press [▲] or [▼] to set the value		

[Units] If units have been selected in configuration level they will be displayed here.
The choices are:-
$^{o}C/^{o}F/^{o}K$
V, mV, A, mA
PH
mmHg, psi, bar, mbar, mmWg, inWg, inWW, PSIG
Ohms
%, %RH, %O2, %CO2, %CP,
PPM
Custom units are also possible

14. Chapter 14 Analogue Operators

14.1. WHAT ARE ANALOGUE OPERATORS?

Analogue Operators allow the controller to perform mathematical operations on two input values. These values can be sourced from any available parameter including Analogue Values, User Values and Digital Values. Each input value can be scaled using a multiplying factor or scalar as shown in Figure 14.1.
The parameters to use, the type of calculation to be performed and the acceptable limits of the calculation are determined in Configuration level (see Engineering Handbook HA026761).
In access levels 1 to 3 you can change values of each input, the scalars applied to each input and read the result of the calculation.
The Analogue Operators page is only available if Analogue and Logic Operators have been enabled in configuration level. This is described in the Engineering Handbook Eurotherm part no. HA026761.

Up to 24 separate operations can be performed and a separate page header is provided for each one.

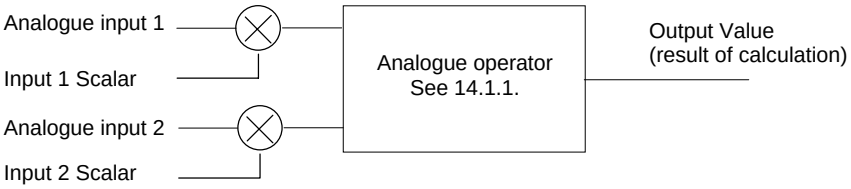


Figure 14.1: Analogue Operators

14.1.1. Analogue Operations

The following operations can be performed:

Off	The selected analogue operator is turned off
Add	The output result is the addition of Input 1 and Input 2
Subtract	The output result is the difference Input 1 and Input 2 where Input 1 > Input 2
Multiply	The output result is the multiplication of Input 1 and Input 2
Divide	The output result is Input 1 divided by Input 2
Absolute Difference	The output result is the absolute difference between Input 1 and Input 2
Select Max	The output result is the maximum of Input 1 and Input 2
Select Min	The output result is the minimum of Input 1 and Input 2
Hot Swap	Input 1 appears at the output provided input 1 is 'good'. If input 1 is 'bad' then input 2 value will appear at the output. An example of a bad input occurs during a sensor break condition.
Sample and Hold	Normally input 1 will be an analogue value and input B will be digital. The output = input 1 when input 2 changes from 0 to 1. The output will remain at this value until input 2 again changes from 0 to 1. Input 2 can be an analogue value and must change from 0 to 100% to provide a sample and hold at the output.
Power	The output is the value at input 1 raised to the power of the value at input 2. I.e. input $1^{input\ 2}$
Square Root	The output result is the square root of Input 1. Input 2 has no effect.
Log	The output result is the logarithm (base 10) of Input 1. Input 2 has no effect
Ln	The output result is the logarithm (base n) of Input 1. Input 2 has no effect
Exp	The output result is the exponential of Input 1. Input 2 has no effect
10x	The output result is 10 raised to the power of Input 1 value. I.e. $10^{input\ 1}$. Input 2 has no effect
Select Logic 1	Input 1 or input 2 is switched to the output depending upon the state of the logic input. If logic input is true input 1 is switched through to the output. If logic input is false input 2 is switched through to the output.
up to	
Select Logic 32	

14.2. TO VIEW AND ADJUST ANALOGUE OPERATOR PARAMETERS

Do This	This Is The Display You Should See	Additional Notes
From any display press [page] as many times as necessary until the **ANALOGUE OPERS** page header is displayed Press [up] or [down] to choose the **Analogue Operator** from **1** to **24**	:ANALOGUE OPERS Analogue 1 Page	
Press [scroll] to select **Input 1 Scalar** Press [up] or [down] to change the value	:Input 1 Scalar 1.00	This scalar is used as a multiplying factor on input 1
Press [scroll] to select **Input 2 Scalar** Press [up] or [down] to change the value	:Input 2 Scalar 1.00	This scalar is used as a multiplying factor on input 2
Press [scroll] to select **Input 1 Value**	:Input 1 Value 0.0	This is a read only value of input 1
Press [scroll] to select **Input 2 Value**	:Input 2 Value 0.0	This is a read only value of input 2
Press [scroll] to select **Output Value**	:Output Value [Units] 0.0 [Units] If units have been selected in configuration level they will be displayed here.	This is a read only value of the result of the calculation.
Press [scroll] to select **Status**	:Status Good	The result of the calculation is Good or Bad. Eg. It is within high and low limits set in configuration level.

15. Chapter 15 Logic Operators

Logic Operators allow the controller to perform logical calculations on two input values. These values can be sourced from any available parameter including Analogue Values, User Values and Digital Values.
The parameters to use, the type of calculation to be performed, input value inversion and 'fallback' value are determined in Configuration level (see Engineering Handbook HA026761). In levels 1 to 3 you can view the values of each input and read the result of the calculation.
The Logic Operators page is only available if Analogue and Logic Operators have been enabled in configuration level. This is described in the Engineering Handbook Eurotherm part no. HA026761.

Up to 32 separate calculations can be performed and a separate page header is provided for each one.

15.1.1. Logic Operations

The following calculations can be performed:

Off	The selected logic operator is turned off
AND	The output result is ON when both Input 1 and Input 2 are ON
OR	The output result is ON when either Input 1 or Input 2 is ON
XOR	Exclusive OR. The output result is true when one and only one input is ON. If both inputs are ON the output is OFF.
Latch	The output is ON when input 1 turns ON. The output remains ON when input 1 turns OFF. The output is reset to OFF by turning input 2 ON.
Equal	The output result is ON when Input 1 = Input 2
Greater	The output result is ON when Input 1 > Input 2
Less than	The output result is ON when Input 1 < Input 2
Greater or Equal	The output result is ON when Input 1 $\geq$ Input 2
Less or Equal	The output result is ON when Input 1 $\leq$ Input 2

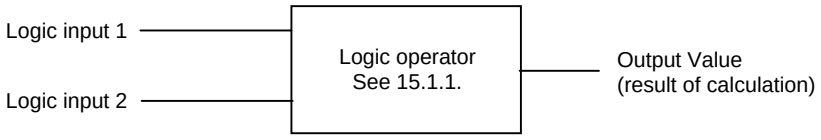


Figure 15.1: Logic Operators

15.2. TO VIEW LOGIC OPERATOR PARAMETERS

Do This	This Is The Display You Should See	Additional Notes
From any display press [page] as many times as necessary until the **LOGIC OPERS** page header is displayed Press [up] or [down] to choose the **Logic Operator** from **1** to **24**	:LOGIC OPERS Logic 1	
Press [scroll] to select **Input 1 Value**	:Input 1 Value Off	This is a read only value, Off or On.
Press [scroll] to select **Input 2 Value**	:Input 2 Value Off	This is a read only value, Off or On.
Press [scroll] to select **Output Value**	:Output Value Off	This is a read only value of the result of the calculation, Off or On.
Press [scroll] to select **Status**	:Status Good	The result of the calculation is Good or Bad. An example of a bad status may occur if a sensor break condition is detected. The output will default to a 'fallback' value previously set in configuration level. This is described in the Engineering Handbook, Eurotherm part no.

16. Chapter 16 Digital Communications

16.1. WHAT IS DIGITAL COMMUNICATIONS?

Digital Communications (or ‘comms’ for short) allows the controller to communicate with a PC or a networked computer system. The comms protocol used is MODBUS or JBUS and comms modules can be fitted which use RS232, RS485 or RS422 Transmission Standards. A full description of these standards is given in the 2000 series Communications Handbook, part number HA026230.

Comms modules can be fitted into either or both of two positions referred to as the H slot and the J slot which correspond to the rear terminal connections, see also section 2.4. Both slot positions may be used at the same time. An example is, to allow a multi-drop connection between a number of controllers and a computer running, say, a SCADA package on one comms position and a separate PC used for configuration purposes on the second comms position. In this example an RS485 module may be fitted for the multi-drop/SCADA requirement and RS232 in the second position for the single PC/configuration requirement.

Note: When the controller is placed into Configuration Level it is taken ‘off line’ and placed into a standby state. In this state it no longer monitors or controls the plant.

16.2. TO SET COMMUNICATIONS ADDRESS AND RESOLUTION

Parameters in the Comms page allow you to set up the Address and Resolution of the controller.
The operation of the H and J Modules is the same.

Do This	This Is The Display You Should See	Additional Notes
From any display press [page] as many times as necessary until the **COMMS** page header is displayed Press [▲] or [▼] to choose the **H Module** or **J Module**	:COMMS H Module Page	Digital communications modules may be fitted in either one or both positions.
Press [↵] to select **Ident**	:Ident Comms	This identifies the slot position as comms.
Press [↵] to select **Address** Press [▲] or [▼] to set the **Instrument Address**	:Address 1	Up to 254 addresses can be set
Press [↵] to select **Resolution** Press [▲] or [▼] to set **Full** or **Integer**	:Resolution Full	

16.3. COMMUNICATIONS DIAGNOSTICS

Digital communications diagnostics is available under the Comms page header. Two parameters are displayed. These show the number of times that the particular comms module has received a message. They are displayed as follows:

Do This	This Is The Display You Should See	Additional Notes
From any display press [page] as many times as necessary until the **COMMS** page header is displayed Press [▲] or [▼] to choose **Diagnostics**	:COMMS Diagnostics Page	
Press [scroll] to select **H Rx Messages**	:H Rx Messages 0	This is a read only parameter which increments each time a valid message is received via the H Comms Module
Press [scroll] to select **J Rx Messages**	:J Rx Messages 0	This is a read only parameter which increments each time a valid message is received via the J Comms Module

17. Chapter 17 Standard IO

17.1. WHAT IS STANDARD IO?

Standard IO refers to the fixed Input/Output connections as listed in Table 17-1 below. Parameters such as input/output limits, filter times and scaling of the IO can be adjusted in the Standard IO pages.

This chapter also describes **User Scaling** of the standard IO.
The controller is calibrated for life against known reference standards during manufacture. User scaling allows you to offset the 'permanent' factory calibration to either:

1. Scale the controller to your reference standards
2. Match the calibration of the controller to an individual transducer or sensor
3. To compensate for known offsets in process measurements

These offsets can be made to parameters in the Standard IO pages.

STANDARD IO (*PV Input* Page)	Allows access to parameters which set up the fixed Process Variable Input connected to terminals VH, VI, V+ and V-. This is, generally, the PV input for a single loop controller.
STANDARD IO (*An Input* Page)	Allows access to parameters which set up the fixed Analogue Input connected to terminals BA, BB and BC. This is the high level input from a remote source.
STANDARD IO (AA Relay Page)	Allows access to parameters which set up the fixed Relay output connected to terminals AA, AB and AC. This relay may be used as an alarm relay. a time proportioning control output or valve raise/lower..
STANDARD IO (Dig IO1 Page) to STANDARD IO (Dig IO7 Page)	Allows access to parameters which set up the fixed digital IO connected to terminals D1 to D7 and DC.
STANDARD IO (Diagnostic Page)	Allows access to parameters which set up the fixed digital Input connected to terminal D8 and DC.

Note:-
Names shown in *italics* can be customised.

Table 17-1: Standard I/O

17.2. PV INPUT

Allows access to parameters which set up the fixed Process Variable Input connected to terminals VH, VI, V+ and V-. This is the PV input for a single loop controller.

17.2.1. To Scale the PV Input

Scaling of the PV input applies to linear process inputs, eg linearised transducers, where it is necessary to match the displayed reading to the electrical input levels from the transducer. PV input scaling is not provided for direct thermocouple or RTD inputs.
Figure 17-1 shows an example of input scaling. where an electrical input of 4-20mA requires the display to read 2.5 to 200.0 units.

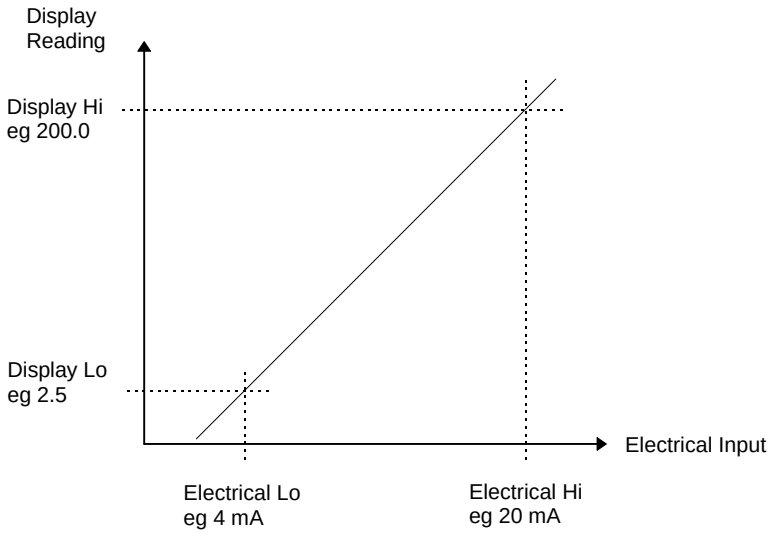


Figure 17 -1: Input Scaling (Standard IO)

To scale the PV Input proceed as follows

Do This	This Is The Display You Should See	Additional Notes
From any display press [page] as many times as necessary until the **STANDARD IO** page header is displayed Press [▲] or [▼] to choose the ***PV Input*** **Page** (if necessary)	:STANDARD IO *PV Input*	The PV Input is connected to terminals VH, V+, V-.
Press [scroll] to select **Electrical Lo** Press [▲] or [▼] to set the adjust the value.	:Electrical Lo [mA] 0.00	Set this value to the lowest level of the input, eg 4mA. The units displayed here may be mV, mA or Ohms depending on what type
Press [scroll] to select **Electrical Hi** Press [▲] or [▼] to set the adjust the value	:Electrical Hi [mA] 0.00	Set this value to the highest level of the input , eg 20mA.
	[Units] If units have been selected in configuration level they will be displayed here. The choices are:- °C/°F/°K V, mV, A, mA PH mmHg, psi, bar, mbar, mmWg, inWg, inWW, PSIG Ohms %, %RH, %O2, %CO2, %CP, PPM Custom units are also possible	
Press [scroll] to select **Eng Value Lo** Press [▲] or [▼] to set the adjust the value	:Eng Value Lo [Units] 2.50	Set up the displayed value (instrument minimum span) which corresponds to the Electrical Lo input, eg 2.50
Press [scroll] to select **Eng Value Hi** Press [▲] or [▼] to set the adjust the value	:Eng Value Hi [Units] 200.00	Set up the displayed value (instrument maximum span) which corresponds to the Electrical Hi input, eg 200.00

17.2.2. To View and Change Input Filter Time

An input filter provides damping of the input signal. This may be necessary to prevent the effects of excessively noise on the PV input.
The filter may be turned off or set up to 10mins
If the input is configured to accept process levels, eg 4-20mA, as in the above example, the parameter which follows 'Eng Value Hi' is 'Filter Time'.

For thermocouple and RTD inputs the first parameter to be displayed is the Input Filter Time, since the input scaling parameters do not appear for specific linearised inputs.

Do This	This Is The Display You Should See	Additional Notes
From any display press [page] as many times as necessary until the **STANDARD IO** page header is displayed Press [▲] or [▼] to choose the **PV Input Page** (if necessary)	:STANDARD IO PV Input	The PV Input is connected to terminals VH, VI, V+, V-.
Press [↻] to select **Filter Time** Press [▲] or [▼] to set the adjust the **Filter Time** between Off and 10mins	:Filter Time 0:00:00.1	The following table gives the full list of parameters available under this list header ⇓

17.2.3. Standard IO PV Input Parameters

Table Number: 17.2.3.	This page allows you to set up PV Input Parameters			STANDARD IO (PV Input Page)
Parameter Name	**Parameter Description**	**Value**	**Default**	**Access Level**
Electrical Lo	Electrical low input level	Input range		L3. Do not appear for T/C or RTD inputs
Electrical Hi	Electrical high input level	Input range		
Eng Value Lo	Low display reading	Display range		
Eng Value Hi	High display reading	Display range		
Filter Time	PV input filter time.	⬍ Off to 0:10:00.0		L3
Emissivity	Emissivity. Only appears if the PV input is configured as a pyrometer	0.00 to 1.00		L3
Electrical Val	The current electrical value of the PV input	Input range		R/O
PV Input Val	The current value of the PV input in engineering units. *PV Input* can be a user defined name.	Display range		R/O
Module Status	Module status	Good □ Bad ■		R/O
SBrk Val	Sensor break value	Display range		R/O

17.3. ANALOGUE INPUT

Allows access to parameters which set up the fixed Analogue Input connected to terminals BA, BB and BC. This is the high level input from a remote source.

17.3.1. To Scale the Analogue Input

The procedure is the same as that described in section 17.2.1.

17.3.2. Standard IO Analogue Input Parameters

Table Number: 17.3.2.	This page allows you to set up Analogue Input Parameters			STANDARD IO (An Input Page)
Parameter Name	**Parameter Description**	**Value**	**Default**	**Access Level**
Electrical Lo	Electrical low input level	Input range		L3
Electrical Hi	Electrical high input level	Input range		L3
Eng Value Lo	Low display reading	Display range		L3
Eng Value Hi	High display reading	Display range		L3
Filter Time	Analogue input filter time	⬍ Off to 0:10:00.0		L3
Emissivity	Emissivity. Only appears if the analogue input is configured as a pyrometer	0.00 to 1.00		L3
Electrical Value	The current electrical value of the analogue input	Input range		R/O
An Input Val	The current value of the An Input in engineering units *An Input* can be a user defined name.	Display range		R/O
Module Status	Module status	Good □ Bad ■		R/O
SBrk Val	Sensor break value	Display range		R/O

17.4. THE FIXED RELAY OUTPUT PARAMETERS

Allows access to parameters which set up the fixed Relay output connected to terminals AA, AB and AC. This relay may be used as an alarm relay. or a time proportioning control output.

17.5. TO SCALE THE FIXED RELAY OUTPUT

If the relay is used as a time proportioning control output this means that the relay will, by default, be fully off for 0% power demand, fully on for 100% power demand and equal on/off times at 50% power demand.
As with input scaling you can change these limits to suit the process. It is important to note, however, that these limits are set to safe values for the process. For example, for a heating process it may be required to maintain a minimum level of temperature. This can be achieved by applying an offset at 0% power demand which will maintain the relay on for a period of time. Care must be taken to ensure that this minimum on period does not cause the process to overheat
These offsets can be made to parameters in the 'AA Relay' pages. The above example is shown in Fig 17-2

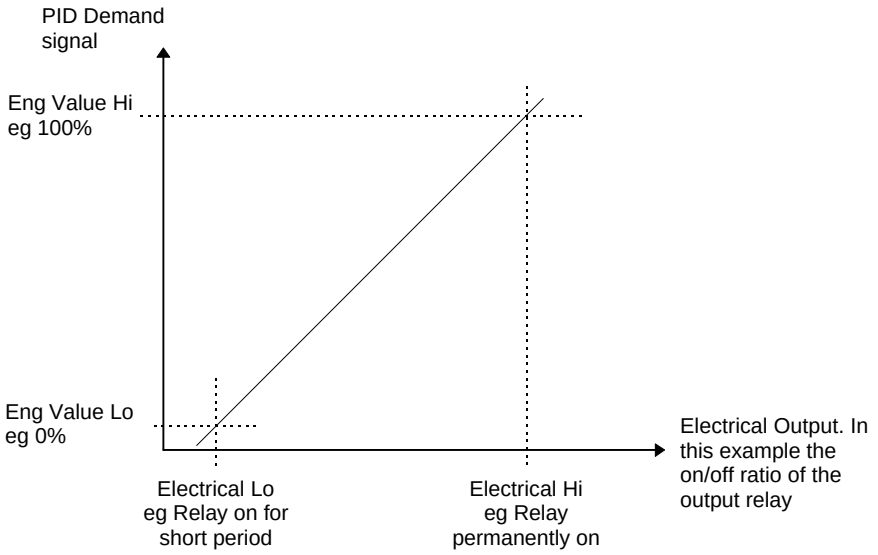


Figure 17-2: Fixed Relay Scaling

To set up and scale the Fixed Relay Output proceed as follows

Do This	This Is The Display You Should See	Additional Notes
From any display press [page] as many times as necessary until the **STANDARD IO** page header is displayed Press [▲] or [▼] to choose the **AA Relay Page**	:STANDARD IO AA Relay	The AA Relay is connected to terminals AA,AB and AC
Press [↻] until **Electrical Lo** appears Press [▲] or [▼] to set the adjust the value.	:Electrical Lo [%] 0.00	If the relay is wired to the PID output demand signal, as shown in Figure 17-2,.set this to a low value, normally 0.
Press [↻] to select **Electrical Hi** Press [▲] or [▼] to set the adjust the value	:Electrical Hi [%] 100.00	If the relay is wired to the PID output demand signal, as shown in Figure 17-2,.set this to a high value, normally 100.
Press [↻] to select **Eng Value Lo** Press [▲] or [▼] to set the adjust the value	:Eng Value Lo 0.00	Set up this value so that the relay switches fully off corresponding to the Electrical Low setting
Press [↻] to select **Eng Value Hi** Press [▲] or [▼] to set the adjust the value	:Eng Value Hi 100.00	Set up this value so that the relay switches fully on corresponding to the Electrical High setting The following table gives the full list of parameters available under this list header ⇓

17.5.1. Standard IO AA Relay Parameters

Table Number: 17.5.1	This page allows you to set up the Fixed Relay Parameters			STANDARD IO (AA Relay)
Parameter Name	**Parameter Description**	**Value**	**Default**	**Access Level**
Min Pulse Time	Minimum relay on or off time	Auto = 0.05s or 0.1 to 999.9	20sec	L3
Electrical Lo	Electrical low input level	Input range		L3
Electrical Hi	Electrical high input level	Input range		L3
Eng Value Lo	Low display reading	Display range		L3
Eng Value Hi	High display reading	Display range		L3
AA Relay Value	Status of the relay output	-100 to 100		R/O. (editable if not wired)

17.6. STANDARD DIGITAL IO PARAMETERS

This page allows access to parameters which set up the fixed digital IO connected to terminals D1 to D7 and Com.
The standard digital IO1 to 7 can either be input or output as set up in configuration level, see Engineering handbook HA026761
. The choices are:-

1. Digital Input IO configured as a digital input
2. On/Off IO configured as a digital output
3. Time Proportion IO configured as a control output
4. Valve Lower IO configured to raise the output of a motor valve controller
5. Valve Raise IO configured to lower the output of a motor valve controller

The parameters which appear in the Dig IO pages depend upon the function of the digital IO configured. These are shown in Table 17.6.1.

The parameters are accessed in the same way as the sections above. When the logic outputs are configured as time proportioning outputs, they can be scaled using the same procedure as the fixed relay output, described above

.
The logic IO parameters are listed in the following table:-

17.6.1. Standard IO Digital Input/Output Parameters

Table Number: 17.6.1.	This page allows you to set up the Digital I/O Parameters		STANDARD IO (Dig IO1 to 7 Page)	
Parameter Name	**Parameter Description**	**Value**	**Default**	**Access Level**
The following five parameters only appear if the digital IO channel is configured as a time proportioning output.				
Min Pulse Time	Minimum logic on or off time.	Auto = 0.05s or 0.1 to 999.9	20sec	L3
Electrical Lo	Electrical low input level	Input range		L3
Electrical Hi	Electrical high input level	Input range		L3
Eng Value Lo	Low display reading	Display range		L3
Eng Value Hi	High display reading	Display range		L3
Dig IO*1* Val	If configured as an output this reads the desired output value If configured as an input this reads the state of the digital input	-100 to 100 or 0 = On not 0 = Off		L3 or R/O
Electrical Value	The current electrical value of the output demand signal. If configured as a digital input this value does not appear	0 to 100 or 0 = On not 0 = Off		R/O

17.7. STANDARD IO DIAGNOSTIC PAGE PARAMETERS

This page allows you to inspect the status of Digital Input 8 or the IO Expander if fitted. It is a read only page for diagnostic purposes only. The parameters are shown in Table 17.7

Table Number: 17.7	This page allows you to inspect Digital Input 8 or IO Expander status			STANDARD IO (Diagnostic Page)
Parameter Name	**Parameter Description**	**Value**	**Default**	**Access Level**
Dig In8 Val	Status of digital input 8	Off On		R/O
Dig In E1 Val	Status of IO expander input	Off On		R/O
Bad Channels	A bad input or output will be displayed as ■ and will occur if the I/O is either a short or open circuit	□□□□□□□ to ■■■■■■■		R/O

18. Chapter 18 Module IO

18.1. WHAT IS MODULE IO?

Additional analogue and digital IO is provided by the plug in IO modules. These modules can be fitted in any of five slots (see Section 2.4.2). The type and position of any modules fitted in the controller is shown in the order code printed on the label on the side of the controller. This can be checked against the order code in Appendix A of this manual. Modules are available as single channel, two channel or three channel IO as listed below

Module	Order Code	Displayed As	Number of Channels
Change over relay	R4	Form C Relay	1
2 pin relay	R2	Form A Relay	1
Dual relay	RR	Dual Relay	2
Triac	T2	Dual triac	1
Dual triac	TT	Triac	2
DC control	D4	DC Control	1
DC retransmission	D6	DC Retrans	1
PV input	PV	Precision PV	1
Triple logic input	TL	Tri-Logic	3
Triple contact input	TK	Tri-Logic IP	3
Triple logic output	TP	Tri-Logic	3
24V transmitter supply	MS	PSU	1

Table 18-1: I/O Modules

Parameters for the above modules, such as input/output limits, filter times and scaling of the IO, can be adjusted in the Module IO pages. The procedures are very similar to those covered in Chapter 17 ‘STANDARD IO’.

18.2. MODULE IDENTIFICATION

The first page which appears under the heading Module IO shows the type of module fitted in each slot position.

Do This	This Is The Display You Should See	Additional Notes
From any display press [page] as many times as necessary until the **MODULE IO** page header is displayed Press [▲] or [▼] to choose **Idents Page** (if necessary)	:MODULE IO Idents Page	
Press [scroll] to select **Module 1**	:Module 1 DC Control	No Module is displayed if the slot is empty. If a module is fitted in Module position 1, it's type, as listed in Table 18-1, is displayed.
Press [scroll] to select **Memory Module**	:Memory Module No Module	No Module is displayed.
Press [scroll] to select **Module 3 (to 6)**	:Module 3 Dual Relay	Modules 3 to 6 are the same as Module 1

18.3. MODULE IO PARAMETERS

Do This	This Is The Display You Should See	Additional Notes
From any display press [▯] as many times as necessary until the **MODULE IO** page header is displayed	▯:MODULE IO ▲▼ Module 1(A)	If a module is not fitted in the selected position the sub header is not displayed
Press [▲] to choose **Module 1 (B)**	Each time [▲] is pressed the sub-header changes as follows:- Module 1(A) 1(B) 1(C) Module 3(A) 3(B) 3(C) Module 4(A) 4(B) 4(C) Module 5(A) 5(B) 5(C) Module 6(A) 6(B) 6(C) (A), (B), (C) refer to the output channel of a single, dual or triple module respectively If the channel is not used the message 'No IO Channel' is displayed	The following tables show the parameters available for different module types

18.3.1. DC Control

Table Number: 18.3.1.	This page allows you to set up the parameters for a DC Output Control module.			MODULE IO (Module*1*(A))
Parameter Name	**Parameter Description**	**Value**	**Default**	**Access Level**
Ident	DC Output			R/O
Electrical Lo	Electrical low input level	O/P range		L3. See output scaling
Electrical Hi	Electrical high input level	O/P range		
Eng Value Lo	Low display reading	Disp. range		
Eng Value Hi	High display reading	Disp. range		
Electrical Val	The current electrical value of the output	0 to 100%		R/O
Module 1A Val	The current value in engineering units. *Module 1A* can be a user defined name.			
Module Status	Module status	▯ Good ■ Bad		R/O
This module has a single output. Its parameters are displayed under 'channel' (A). Channel (B) and channel (C) show 'No IO Channel'.				

18.3.2. Relay Output

Table Number: 18.3.2.	This page allows you to set the parameters for a Relay Output module. **Changeover relay Ident Form C Relay** **2 Pin Relay Ident Form A Relay** **Dual Relay Ident Dual Relay**			MODULE IO (Module *1*(A) Page)
Parameter Name	**Parameter Description**	**Value**	**Default**	**Access Level**
Ident	Relay			R/O
Min Pulse Time	Minimum relay on or off time	Auto = 0.05s or 0.1 to 999.9	20sec	L3 Only
Electrical Lo	Electrical low input level	O/P range		shown
Electrical Hi	Electrical high input level	O/P range		for time
Eng Value Lo	Low display reading	Disp. range		prop.
Eng Value Hi	High display reading	Disp. range		O/Ps
Electrical Val	The current electrical value of the output	0 to 100%		R/O
Module 1A Val	The current output value. *Module 1A* can be a user defined name.	-100 to 100%		
Module Status	Module status	□ Good ■ Bad		R/O
The changeover relay and 2 pin relay are single output modules. The parameters above are displayed under 'channel' (A) only. (Channel (B) and channel (C) show 'No IO Channel'). Dual Relay has two outputs. The parameters above are displayed under Channel (A) and Channel (C). Channel (B) shows 'No IO Channel'. Module status is shown only once.				

18.3.3. Triac Output

Table Number: 18.3.3.	This page allows you to set the parameters for a Triac Output module. Triac Ident Triac Dual Triac Ident Dual Triac			MODULE IO (Module *1*(A) Page)
Parameter Name	**Parameter Description**	**Value**	**Default**	**Access Level**
Ident	Triac			R/O
Min Pulse Time	Minimum relay on or off time	Auto = 0.05s or 0.1 to 999.9	20sec	L3 Only
Electrical Lo	Electrical low input level	O/P range		shown
Electrical Hi	Electrical high input level	O/P range		for time
Eng Value Lo	Low display reading	Disp. range		prop.
Eng Value Hi	High display reading	Disp. range		O/Ps
Electrical Val	The current electrical value of the output	0 to 100%		R/O
Module 1A Val	The current output value. *Module 1A* can be a user defined name.	-100 to 100%		
Module Status	Module status	□ Good ■ Bad		R/O

The triac output is a single output module. The parameters above are displayed under 'channel' (A) only. Channel (B) and channel (C) show 'No IO Channel'.

The dual triac has two outputs. The parameters above are displayed under Channel (A) and Channel (C). Channel (B) shows 'No IO Channel'. Module status is shown only once.

18.3.4. Triple Logic Output

Table Number: 18.3.4.	This page allows you to set the parameters for a Logic Output module.			MODULE IO (Module *1*(A) Page)
Parameter Name	**Parameter Description**	**Value**	**Default**	**Access Level**
Ident	Logic Output			R/O
Min Pulse Time	Minimum relay on or off time	Auto = 0.05s or 0.1 to 999.9	20sec	L3 Only
Electrical Lo	Electrical low input level	O/P range		shown
Electrical Hi	Electrical high input level	O/P range		for time
Eng Value Lo	Low display reading	Disp. range		prop.
Eng Value Hi	High display reading	Disp. range		O/Ps
Electrical Val	The current electrical value of the output	0 to 100%		R/O
Module 1A Val	The current output value. *Module 1A* can be a user defined name.	-100 to 100%		
Module Status	Module status	□ Good ■ Bad		R/O
This module has three outputs. Each output is found under Module *1*(A), (B) and (C). The Module Status is only displayed once.				

18.3.5. Triple Logic and Triple Contact Input

Table Number: 18.3.5.	This page allows you to set the parameters for a Triple Logic Input module.			MODULE IO (Module *1*(A) Page)
Parameter Name	**Parameter Description**	**Value**	**Default**	**Access Level**
Ident	Logic Input			R/O
Module 1A Val	The current input value. *Module 1A* can be a user defined name.			R/O
Module Status	Module status	□ Good ■ Bad		R/O
This module has three inputs. Each input is found under Module *1*(A), (B) and (C). The Module Status is only displayed once.				

18.3.6. PV Input

Table Number: 18.3.7.	This page allows you to set the parameters for a PV Input module. This module can only be fitted in slots 3 or 6.			MODULE IO (Module *3*(A) Page)
Parameter Name	**Parameter Description**	**Value**	**Default**	**Access Level**
Ident	PV Input			R/O
Electrical Lo [units]	Electrical low input level	Input range		L3. See input scaling
Electrical Hi [units]	Electrical high input level	Input range		
Eng Value Lo	Low display reading	Display range		
Eng Value Hi	High display reading	Display range		
Filter Time	Input filter time	Off to 0:10:00.0		L1
Electrical Val [units]	The current electrical value of the input	Input range		R/O
Module 3A Val	The current value in engineering units. *Module 3A* can be a user defined name.			R/O
Module Status	Module status	□ Good ■ Bad		R/O
SBrk Val	Sensor break value			R/O
This module has a single input. Its parameters are displayed under 'channel' (A). Channel (B) and channel (C) show 'No IO Channel'.				

18.3.7. DC Retransmission

Table Number: 18.3.8.	This page allows you to set the parameters for a DC Retransmission module.		MODULE IO (Module *1*(A) Page)	
Parameter Name	**Parameter Description**	**Value**	**Default**	**Access Level**
Ident	DC Retrans			R/O
Electrical Lo	Electrical low input level	Range units		L3. See output cal.
Electrical Hi	Electrical high input level	Range units		
Eng Value Lo	Low display reading	Display range		
Eng Value Hi	High display reading	Display range		
Electrical Val	The current electrical value of the output	Input range		R/O
Module 1A Val	The current value in engineering units. *Module 1A* can be a user defined name.			
Module Status	Module status	□ Good ■ Bad		R/O
This module has a single output. Its parameters are displayed under 'channel' (A). Channel (B) and channel (C) show 'No IO Channel'.				

18.3.8. Transmitter Power Supply

Table Number: 18.3.9.	This page allows you to set the parameters for a Transmitter Power Supply module.		MODULE IO (Module *1*(A) Page)	
Parameter Name	**Parameter Description**	**Value**	**Default**	**Access Level**
Ident	Transmitter PSU			R/O
Module 1A Val	The current value in engineering units. *Module 1A* can be a user defined name.			
Module Status	Module status	□ Good ■ Bad		R/O
This module has a single output. Its parameters are displayed under 'channel' (A). Channel (B) and channel (C) show 'No IO Channel'.				

18.4. MODULE SCALING

The IO modules are scaled as already described in Chapter 17 for the fixed inputs and outputs. The procedures are repeated below:-

18.4.1. To Scale the PV Input

Scaling of the PV input applies to linear process inputs, eg linearised transducers, where it is necessary to match the displayed reading to the electrical input levels from the transducer. PV input scaling is not provided for direct thermocouple or RTD inputs.
Figure 18-1 shows an example of input scaling. where an electrical input of 4-20mA requires the display to read 2.5 to 200.0 units.

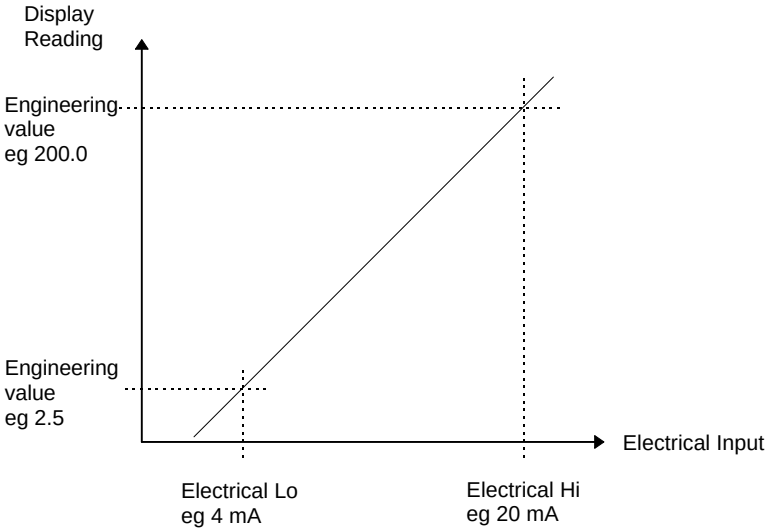


Figure 18-1: Input Scaling (Modules)

Do This	This Is The Display You Should See	Additional Notes
From any display press [page] as many times as necessary until the **MODULE IO** page header is displayed Press [▲] or [▼] to choose the module slot which contains the PV Input module	:MODULE IO Module *6*(A)	
Press [scroll] until **Electrical Lo** is displayed Press [▲] or [▼] to set the adjust the value.	:Electrical Lo [mA] 0.00	Set this value to the lowest level of the input, eg 4mA.
Press [scroll] to select **Electrical Hi** Press [▲] or [▼] to set the adjust the value	:Electrical Hi [mA] 0.00	Set this value to the highest level of the input , eg 20mA.
	[Units] If units have been selected in configuration level they will be displayed here. The choices are:- ^{o}C/^{o}F/^{o}K V, mV, A, mA PH mmHg, psi, bar, mbar, mmWg, inWg, inWW, PSIG Ohms %, %RH, %O2, %CO2, %CP, PPM Custom units are also possible	
Press [scroll] to select **Eng Value Lo** Press [▲] or [▼] to set the adjust the value	:Eng Value Lo [Units 2.50	Set up the displayed value (instrument minimum span) which corresponds to the Electrical Lo input, eg 2.50
Press [scroll] to select **Eng Value Hi** Press [▲] or [▼] to set the adjust the value	:Eng Value Hi [Units 200.00	Set up the displayed value (instrument maximum span) which corresponds to the Electrical Hi input, eg 200.00

18.4.2. To scale Output modules

If the output module is DC or if it is a relay, triac or logic used as time proportioning control, it can be scaled such that a lower and upper level of PID demand signal can limit the operation of the output value. This is shown in Figure 18-2 applied to a relay output or any time proportioning output..

By default, the relay will be fully off for 0% power demand, fully on for 100% power demand and equal on/off times at 50% power demand. You can change these limits to suit the process. It is important to note, however, that these limits are set to safe values for the process. For example, for a heating process it may be required to maintain a minimum level of temperature. This can be achieved by applying an offset at 0% power demand which will maintain the relay on for a period of time. Care must be taken to ensure that this minimum on period does not cause the process to overheat
These offsets can be made to parameters in the relevant Module IO pages.

If the output is DC the electrical low and electrical high parameters are analogue values and can be set as in the example given for DC Output Retransmission, section 18.4.3.

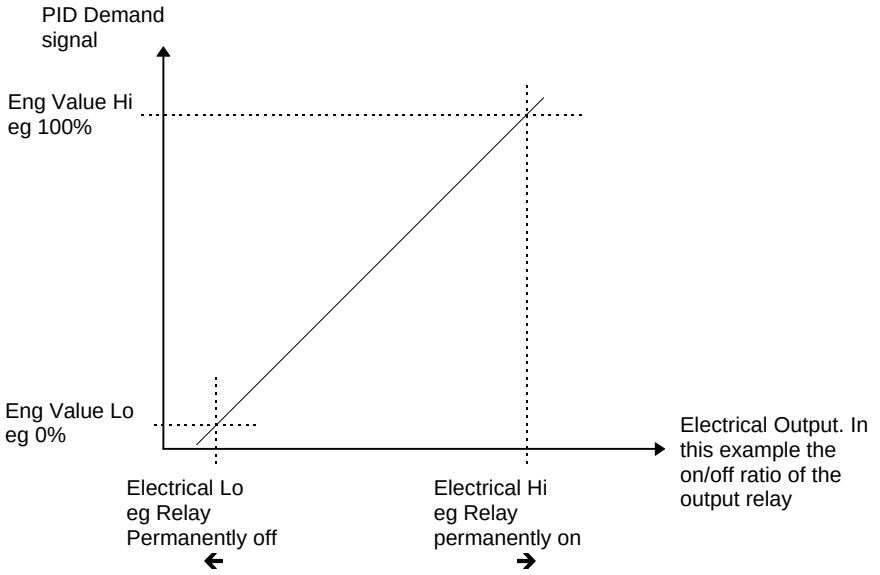


Figure 18-2: Time Proportioning Relay, Triac or Logic Output

Do This	This Is The Display You Should See	Additional Notes
From any display press [page] as many times as necessary until the **Module IO** page header is displayed Press [▲] or [▼] to choose the module slot which contains the output module to be scaled	:MODULE IO Module *1A*	
Press [scroll] until **Electrical Lo** appears Press [▲] or [▼] to set the adjust the value.	:Electrical Lo [%] 0.00	Set this to a low value, normally 0.
Press [scroll] to select **Electrical Hi** Press [▲] or [▼] to set the adjust the value	:Electrical Hi [%] 100.00	Set this to a high value, normally 100.
Press [scroll] to select **Eng Value Lo** Press [▲] or [▼] to set the adjust the value	:Eng Value Lo [Units 0.00	Set up this value so that the relay (triac or logic) switches fully off corresponding to the Electrical Low setting
Press [scroll] to select **Eng Value Hi** Press [▲] or [▼] to set the adjust the value	:Eng Value Hi [Units 100.00	Set up this value so that the relay (triac or logic) switches fully on corresponding to the Electrical High setting

18.4.3. To Scale a Retransmission Output

The retransmission output can be scaled so that the output value corresponds to range of the signal to be retransmitted.
Figure 18-3 shows an example where the retransmitted signal is PV or SP where an electrical output of 4-20mA represents 20.0 to 200.0 units.

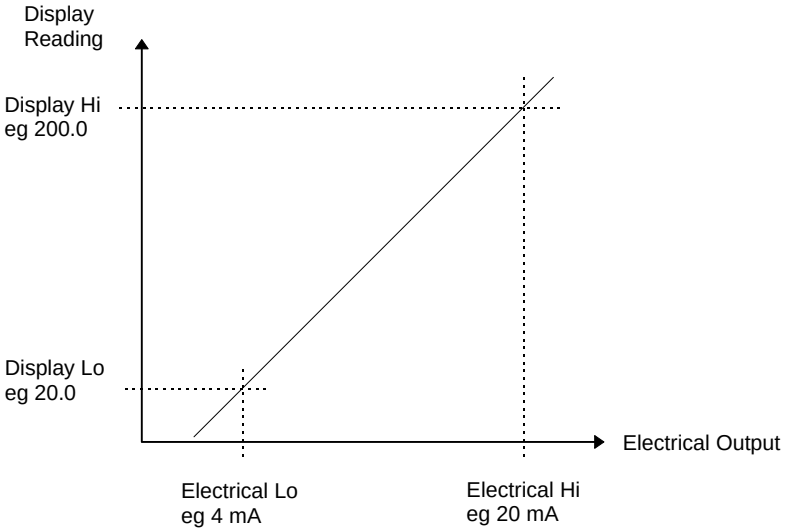


Figure 18-3: Scaling a Retransmitted Signal

Do This	This Is The Display You Should See	Additional Notes
From any display press [page] as many times as necessary until the **Module IO** page header is displayed Press [▲] or [▼] to choose the module slot which contains the Retransmission module	:MODULE IO Module *6*(A)	
Press [scroll] until **Electrical Lo** is displayed Press [▲] or [▼] to set the adjust the value.	:Electrical Lo [mA] 0.00	Set this value to the lowest level of the input, eg 4mA.
Press [scroll] to select **Electrical Hi** Press [▲] or [▼] to set the adjust the value	:Electrical Hi [mA] 0.00	Set this value to the highest level of the input , eg 20mA.
	[Units] If units have been selected in configuration level they will be displayed here. The choices are:- $^{o}C/^{o}F/^{o}K$ V, mV, A, mA PH mmHg, psi, bar, mbar, mmWg, inWg, inWW, PSIG Ohms %, %RH, %O2, %CO2, %CP, PPM Custom units are also possible	
Press [scroll] to select **Eng Value Lo** Press [▲] or [▼] to set the adjust the value	:Eng Value Lo [Units 20.0	Set up the displayed value which corresponds to the Electrical Lo input, eg 20.0
Press [scroll] to select **Eng Value Hi** Press [▲] or [▼] to set the adjust the value	:Eng Value Hi [Units 200.00	Set up the displayed value which corresponds to the Electrical Hi input, eg 200.00

19. Chapter 19 Transducer Scaling

19.1. WHAT IS TRANSDUCER SCALING?

The 2604 controller is highly stable and calibrated for life. Transducer scaling allows you to offset the 'permanent' factory calibration to either:

1. Calibrate the controller to the your reference standards.
2. Match the calibration of the controller to that of a particular transducer or sensor input.
3. Calibrate the controller to suit the characteristics of a particular installation.

User calibration works by introducing a single point or two-point offset onto the factory set calibration.

19.2. SINGLE OFFSET

Offset calibration is used to apply a single fixed offset over the full display range of the controller.

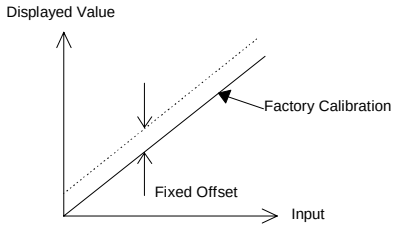


Figure 19-1: Transducer Scaling Fixed Offset

To calibrate, proceed as follows:

1. Connect the input of the controller to the source device to which you wish to calibrate.
2. Set the source to the desired calibration value.
3. The controller will display the current measurement of the value.
4. If the displayed value is correct, then the controller is correctly calibrated and no further action is necessary. If it is incorrect, then follow the steps shown below.

19.2.1. To Apply an Offset to the PV Input

Do This	This Is The Display You Should See	Additional Notes
From any display press [D] as many times as necessary until the **TXDCR SCALING** page header is displayed	:TXDCR SCALING PV Input Page	
Press [↻] to select **Txdcr Scale** Press [▲] or [▼] to select Factory or Transducer	:Txdcr Scale Factory	Factory — Reinstates the factory calibration Transducer — Enters offset and scaling values
Press [↻] to **Offset** Press [▲] or [▼] to set the value as shown in Figure 19-1	:Offset [Units] 0.0	

The same procedure is followed to apply an offset to:

1. The Analogue Input
2. Any module configured as an input

19.3. TWO-POINT CALIBRATION

The previous section described how to apply a fixed offset or trim, over the full input range of the controller, to the transducer calibration. This is used to calibrate the controller at two points and applies a straight line between them. Any readings above, or below, the two calibration points will be an extension of this straight line. For this reason it is best to calibrate with the two points as far apart as possible.

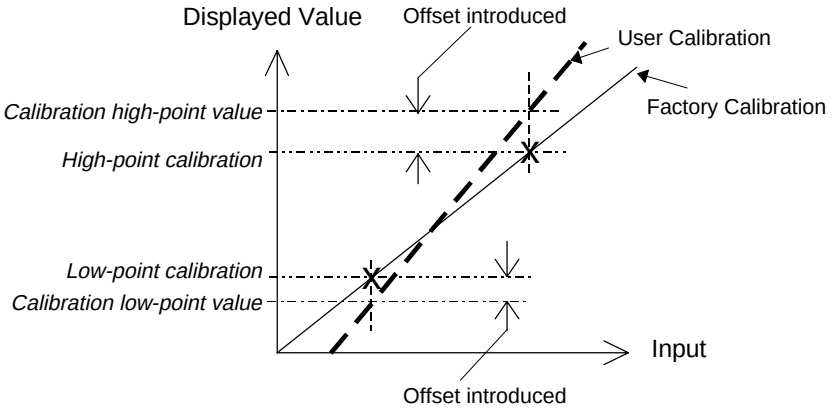


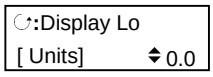
Figure 19-2: Transducer Scaling Two Point Calibration

Proceed as follows:

1. Decide upon the low and high points at which you wish to calibrate.
2. Perform a two point calibration on the PV Input in the manner described below.

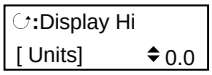
Do This	This Is The Display You Should See	Additional Notes
From any display press [D] as many times as necessary until the **TXDCR SCALING** page header is displayed	:TXDCR SCALING PV Input Page	
Press [↻] to select **Txdcr Scale** Press [▲] or [▼] to select Factory or Transducer	:Txdcr Scale Factory	Factory — Reinstates the factory calibration Transducer — Enters offset and scaling values
Press [↻] to **Offset**	:Offset [Units] 0.0	Leave the Offset at 0.0

Press [↻] to select **Display Lo**



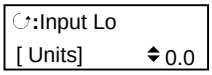
Press [▲] or [▼] to set the displayed value required for the lowest input level

Press [↻] to select **Display Hi**



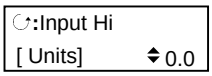
Press [▲] or [▼] to set the displayed value required for the highest input level

Press [↻] to select **Input Lo**



Press [▲] or [▼] to set the input value offset which corresponds to the lowest displayed value

Press [↻] to select **Input Hi**



Press [▲] or [▼] to set the input value offset which corresponds to the highest displayed value

The above procedure is the same as that already described in section 18.4.1.

The same procedure is followed to apply an offset to:

1. The Analogue Input
2. Any module configured as an input

20. Chapter 20 Diagnostics

20.1. WHAT IS DIAGNOSTICS?

Diagnostics provides information on the internal state of the controller. They are intended for use in an advanced fault finding situation. The diagnostic parameters are listed below:-

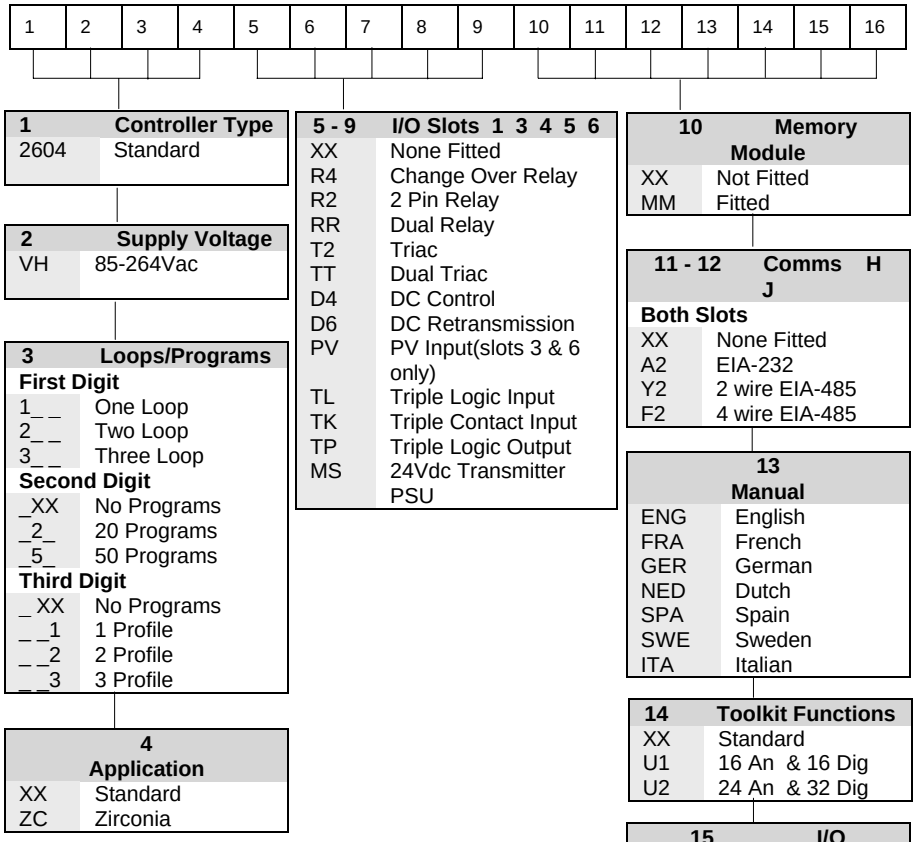
20.1.1. Diagnostics parameters

Table Number: 20.1.1	This page allows you to inspect diagnostic information		DIAGNOSTICS	
Parameter Name	**Parameter Description**	**Value**	**Default**	**Access Level**
Error Count	Number of errors recorded			R/O
Error 1	Historical errors where 1 is the most recent			R/O
Error 2				R/O
Error 3				R/O
Error 4				R/O
Error 5				R/O
Error 6				R/O
Error 7				R/O
Error 8				R/O
CPU % Free	A measure of the loading on the CPU			R/O
Con Task Ticks	A measure of the activity of the algorithm			R/O
UI Task 1 Ticks				R/O
UI Task 2 Ticks				R/O
Logic IO Stat	The status of the digital I/O connections. Measures short circuit conditions across the terminals			R/O
Power FF	Power feedback. Measures the supply voltage to the controller			R/O
Loop Brk Stat	Loop break status			R/O

A. Appendix A Order Code

A. HARDWARE CODE

The 2604 controller has a modular hardware construction, which accepts up to six plug-in modules and two communications modules. Eight digital IO and a relay form part of the fixed hardware build.



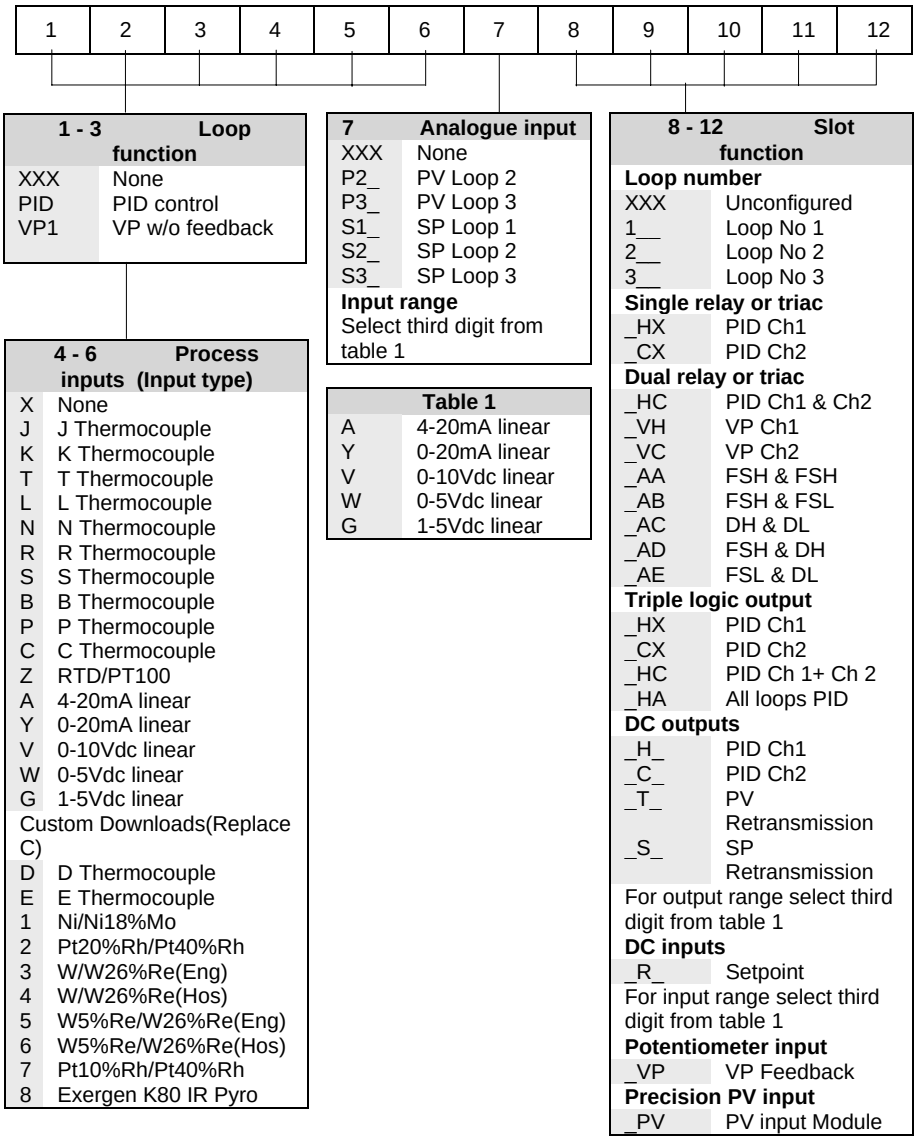
Hardware Code Example

2604/VH/323/XX/RR/PV/D4/TP/PV/XX/A2/XX/ENG/U1/E1/IT

Three loop controller with capability to store 20 three profile programs. Supply voltage 85 - 264 Vac.
Modules: 2 x PV input, 1 x Dual relay, 1 x DC control, 1 x Triple logic output, EIA-232 Comms.
16 analogue and 32 digital operations. 10 in/10 out expander and iTools supplied with controller.

B. QUICK START CODE

The controller supplied in accordance with the hardware code on the previous page requires to be configured. Configuration is carried out using iTools. Alternatively, for simple applications the controller may be supplied pre-configured using the following code:-



Notes

1. Loop 1 PV defaults to main input on microboard. Loop 2 and 3 PV inputs must be fitted in I/O slots 3 or 6 or be assigned to the analogue input.
2. This alarm configuration refers to loop alarms only. One selection per loop is allowed. Additional alarms are available for the user to configure
3. Thermocouple and RTD inputs assume sensor min and max values with no decimal point.
4. Linear inputs are ranged 0-100%, no decimal point
5. Temperature inputs will be C unless ordered by USA where F will be supplied.
6. Remote setpoints assume loop min & max ranges
7. Retransmission outputs assume loop min & max ranges

Quick start code example:

VP1/PID/PID/K/Z/A/S1A/1VH/2PV/2HV/3HC/3PV

This code configures the hardware specified on page A2 to be:

Loop1: Valve position control, Type K input, Ch1 VP output in slot 1, 4-20mA remote setpoint input.
Loop 2: PID control, RTD input in slot 3, 0-10Vdc Ch1 output in slot 4.
Loop 3: PID control, 4-20mA input in slot 6, Logic Ch1/Ch2 output in slot 5.

C. ORDER CODE FOR iTOOLS

iTools is a Windows® based software package designed to configure communicating 2604 controllers. It will operate on personal computers running Windows® 95 or NT (NT versions 4 or later). It uses Modbus RTU communications via a serial port. The ordering code is included since it may have been supplied for use with your controller.

Instrument Tools Coding

ITOOLS	Software tools for programming and commissioning S2000						
	WIN	Windows 95 and NT					
		3.5	3.5 in disks				
		CD	CD Rom				
			2200	*2200 templates only*			
			2400	2400 templates only			
			2500	2500 templates only			
			T630	*T630 templates only*			
			COMP	*All product templates*			
				MODBUS	Modbus OPC driver		
				PROFIBUS	*Profibus OPC driver*		
					STD	Stand alone package	
					STDNW	Networkable package	
					TOOLKIT	*OPC/Activex components.*	
							ENG Eng Manual
							FRA etc

Notes:

All items in *ITALICS* - please refer to the factory for availability.

B. Appendix B Safety and EMC Information

Please read this section carefully before installing the controller

This controller is intended for industrial temperature and process control applications when it will meet the requirements of the European Directives on Safety and EMC. Use in other applications, or failure to observe the installation instructions of this handbook may impair the safety or EMC protection provided by the controller. It is the responsibility of the installer to ensure the safety and EMC of any particular installation.

B.1. SAFETY

This controller complies with the European Low Voltage Directive 73/23/EEC, amended by 93/68/EEC, by the application of the safety standard EN 61010.

B.1.1. Electromagnetic compatibility

This controller conforms with the essential protection requirements of the EMC Directive 89/336/EEC, amended by 93/68/EEC, by the application of a Technical Construction File. This instrument satisfies the general requirements of an industrial environment as described by EN 50081-2 and EN 50082-2. For more information on product compliance refer to the Technical Construction File.

B.2. SERVICE AND REPAIR

This controller has no user serviceable parts. Contact your supplier for repair.

Caution: **Charged capacitors**

Before removing an instrument from its sleeve, disconnect the supply and wait at least two minutes to allow capacitors to discharge. Failure to observe this precaution will expose capacitors that may be charged with hazardous voltages. In any case, avoid touching the exposed electronics of an instrument when withdrawing it from the sleeve.

B.2.1. Electrostatic discharge precautions

When the controller is removed from its sleeve, some of the exposed electronic components are vulnerable to damage by electrostatic discharge from someone handling the controller. To avoid this, before handling the unplugged controller discharge yourself to ground.

B.2.2. Cleaning

Do not use water or water based products to clean labels or they will become illegible. Isopropyl alcohol may be used to clean labels. A mild soap solution may be used to clean other exterior surfaces of the product.

B.3. INSTALLATION SAFETY REQUIREMENTS

B.3.1. Safety Symbols

Various symbols are used on the instrument, they have the following meaning:


Caution, (refer to the accompanying documents)


Functional earth (ground) terminal

The functional earth connection is not required for safety purposes but to ground RFI filters.

B.3.2. Personnel

Installation must only be carried out by qualified personnel.

B.3.3. Enclosure of live parts

To prevent hands or metal tools touching parts that may be electrically live, the controller must be installed in an enclosure.

Caution: **Live sensors**

The fixed digital inputs, non-isolated dc, logic and PDSIO output modules, are all electrically connected to the main process variable input. If the temperature sensor is connected directly to an electrical heating element then these non-isolated inputs and outputs will also be live. The controller is designed to operate under these conditions. However you must ensure that this will not damage other equipment connected to these inputs and outputs and that service personnel do not touch connections to these i/o while they are live. With a live sensor, all cables, connectors and switches for connecting the sensor and non-isolated inputs and outputs must be mains rated.

B.3.4. Wiring

It is important to connect the controller in accordance with the wiring data given in this handbook. Take particular care not to connect AC supplies to the low voltage sensor input or other low level inputs and outputs. Only use copper conductors for connections (except thermocouple inputs) and ensure that the wiring of installations comply with all local wiring regulations. For example in the in the UK use the latest version of the IEE wiring regulations, (BS7671). In the USA use NEC Class 1 wiring methods.

B.3.5. Power Isolation

The installation must include a power isolating switch or circuit breaker. This device should be in close proximity to the controller, within easy reach of the operator and marked as the disconnecting device for the instrument.

B.3.6. Earth leakage current

Due to RFI Filtering there is an earth leakage current of less than 0.5mA. This may affect the design of an installation of multiple controllers protected by Residual Current Device, (RCD) or Ground Fault Detector, (GFD) type circuit breakers.

B.3.7. Overcurrent protection

To protect the internal PCB tracking within the controller against excess currents, the AC power supply to the controller and power outputs must be wired through the fuse or circuit breaker specified in the technical specification.

B.3.8. Voltage rating

The maximum continuous voltage applied between any of the following terminals must not exceed 264Vac:

- line or neutral to any other connection;
- relay or triac output to logic, dc or sensor connections;
- any connection to ground.

The controller should not be wired to a three phase supply with an unearthed star connection. Under fault conditions such a supply could rise above 264Vac with respect to ground and the product would not be safe.

Voltage transients across the power supply connections, and between the power supply and ground, must not exceed 2.5kV. Where occasional voltage transients over 2.5kV are expected or measured, the power installation to both the instrument supply and load circuits should include a transient limiting device.

These units will typically include gas discharge tubes and metal oxide varistors that limit and control voltage transients on the supply line due to lightning strikes or inductive load switching. Devices are available in a range of energy ratings and should be selected to suit conditions at the installation.

B.3.9. Conductive pollution

Electrically conductive pollution must be excluded from the cabinet in which the controller is mounted. For example, carbon dust is a form of electrically conductive pollution. To secure a suitable atmosphere in conditions of conductive pollution, fit an air filter to the air intake of the cabinet. Where condensation is likely, for example at low temperatures, include a thermostatically controlled heater in the cabinet.

B.3.10.Over-temperature protection

When designing any control system it is essential to consider what will happen if any part of the system should fail. In temperature control applications the primary danger is that the heating will remain constantly on. Apart from spoiling the product, this could damage any process machinery being controlled, or even cause a fire.

Reasons why the heating might remain constantly on include:

- the temperature sensor becoming detached from the process;
- thermocouple wiring becoming short circuit;
- the controller failing with its heating output constantly on;
- an external valve or contactor sticking in the heating condition;
- the controller setpoint set too high.

Where damage or injury is possible, we recommend fitting a separate over-temperature protection unit, with an independent temperature sensor, which will isolate the heating circuit.

Please note that the alarm relays within the controller will not give protection under all failure conditions.

B.3.11.Grounding of the temperature sensor shield

In some installations it is common practice to replace the temperature sensor while the controller is still powered up. Under these conditions, as additional protection against electric shock, we recommend that the shield of the temperature sensor is grounded. Do not rely on grounding through the framework of the machine.

B.4. INSTALLATION REQUIREMENTS FOR EMC

To ensure compliance with the European EMC directive certain installation precautions are necessary as follows:

- For general guidance refer to EMC Installation Guide, HA025464.
- When using relay or triac outputs it may be necessary to fit a filter suitable for suppressing the emissions. The filter requirements will depend on the type of load. For typical applications we recommend Schaffner FN321 or FN612.
- If the unit is used in a portable enclosure which is plugged into a standard power socket, then it is likely that compliance to the commercial and light industrial emissions standard is required. In this case to meet the conducted emissions requirement, a suitable mains filter should be installed. We recommend Schaffner types FN321 and FN612.

B.4.1. Routing of wires

To minimise the pick-up of electrical noise, the wiring for low voltage dc and particularly the sensor input should be routed away from high-current power cables. Where it is impractical to do this, use shielded cables with the shield grounded at both ends.

C. Appendix C Technical Specification

Main Process Value Input and Second DC Input

Low level range	±100mV
High level range	0 to 10Vdc or 0-20mA with external 2.49Ω current shunt. All configurable between limits
Sample Rate	9Hz (110mS)
Resolution	<2µV for low level range, <0.2mV for high level range
Linearity	Better than 0.2°C
Calibration accuracy	The greater of 0.25% of reading or ± 1°C or ±1LSD
User calibration	Low and high offsets can be applied
Input filter	Off to 999.9 secs
Thermocouple types	Refer to the ordering code sensor input table
Cold junction compensation	>30 to 1 rejection of ambient temperature changes in automatic mode. Uses INSTANT ACCURACY™ cold junction sensing technology to eliminate warm up drift and to respond quickly to ambient temperature changes. External references 0, 45, and 50°C
RTD/PT100 input	3-wire, Pt100 DIN43750. Bulb current 0.3mA. Up to 22Ω in each lead without error
Potentiometer input	330 to 15Kohm
Analogue input functions	Process value, remote setpoint, setpoint trim, external power limit, feedforward input,, valve position feedback
Second process value input functions	Select min, select max, derived value, transfer to 2nd PV

Digital inputs

Isolated except for fixed digital inputs 1 & 2

Contact closure inputs	Open circuit voltage: 24 to 30 Vdc Short circuit current: 24 to 29mA Off state: < 100 ohms input resistance On state: > 28Kohm input resistance
Logic inputs (current sinking)	Off state: -3 to 5Vdc @ <-0.4mA On stare: 10.8 to 30Vdc @ 2.5mA
Digital input functions	Refer to the ordering code

Digital Outputs

Relay rating	Min: 12V, 100mAdc. Max:2A, 264Vac resistive
Single logic output	18Vdc, 20mA. This output is not isolated from the main process value input
Triple logic output	12Vdc, 8mA per channel (isolated)
Digital o/p functions	As per the ordering code
High current output	10Amp, 264Vac resistive
Triac rating	1A, 30 to 264Vac resistive (isolated)

Analogue outputs

Range	Scaleable between 0-20mA and 0-10Vdc (isolated)
Resolution	1 part in 10,000 for analogue retransmission
Analogue output functions	Refer to ordering code

Transmitter supply

Rating	20mA, 24Vdc

Control functions

Control modes	On/Off, PID, or motorised valve control, with or without feedback potentiometer
Cooling algorithms	Linear, water (non-linear), fan (min on time), oil
Tuning	One shot (automatic tune of PID and overshoot inhibition parameters) and continuous adaptive tuning
Number of PID sets	Two
Auto/manual control	Bumpless transfer or forced manual output available
Setpoint rate limit	Display units per second, minutes or hour

Alarms

Number of alarms	Four
Alarm types	Absolute high or low. Deviation band, deviation high, deviation low. Rate of change
Alarm modes	Latching or non-latching. Blocking. Energised or de-energised in alarm

Setpoint programming

Number of programs	Up to sixteen
Segments per program	16
Event outputs	Up to eight

Communications (all modules are isolated)

Profibus	High speed, RS485. Up to 1.5Mb/s
Modbus ®	RS232,2-wire,RS 485 and 4 wire RS485 modules
Baud rate	1200, 2400, 4800, 9600 and 19,200 baud

PDSIO

Slave input (isolated)	Remote setpoint input with holdback to master
Master output	Isolated from main PV. Retransmission of setpoint, process value or output

General

Display	Dual, 4 digit x 7 segment LED. Up to two decimal places
Supply	85 to 264Vac, 48 to 62 Hz, 21 W max OR
Operating ambient	0 to 50°C and 5 to 90% RH non-condensing
Storage temperature	-10 to +70°C
Panel sealing	IP54
Dimensions	2404: 96mm wide x 96mm high x 150mm deep
Weight	250g
EMC standards	EN50081-2 & EN 50082-2 generic standards for industrial environments
Safety standards	Meets EN61010, installation category II (voltage transients must not exceed 2.5kV), pollution degree 2
Atmospheres	Not suitable for use above 2000m or in explosive or corrosive atmospheres. Electrically conductive pollution must be excluded from the cabinet in which this controller is mounted

EUROTHERM CONTROLS LIMITED

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