MODEL 2604 CONTROLLER

Engineering Handbook

Contents

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1. Chapter 1 INTRODUCTION

Thank you for selecting the 2604 High Performance Programmer/Controller. This chapter provides an overview of your controller including how to change modules and the principle of operation of the user interface.

1.1. ABOUT THIS MANUAL

This manual is intended for those who wish to configure the controller.
Installation and operation of the controller is described in the Installation and Operation Handbook, Part No. HA026491 supplied with the controller.

Access to the parameters in the controller is achieved through five levels of security. The 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. (Default Passcode = 2)
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. (Default Passcode = 3)
View Config	It is possible also to read the configuration of the controller at any level but the configuration cannot be changed. (Passcode = 2604)
Config	Configuration of the controller allows you to set up the fundamental characteristics of the controller so that it can be made to match the requirements of the process. (Default Passcode = 4)

1.1.1. The Structure Of This Manual

This chapter provides an overview of the controller including the principle of the key handling and parameter navigation diagram.

Chapter 2 describes the principle of function blocks.

Chapter 3 explains how to wire function blocks using software wiring.

The remaining chapters provide the parameter tables with explanations of their meanings. These chapters follow the order in which the features appear in the pull out navigation at the end of this chapter.

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.

Figure 1-1: Front Panel View of the 2604 Controller

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 this manual. 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. 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 1-1.

- 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.

1.3.1. Displays and Indicators

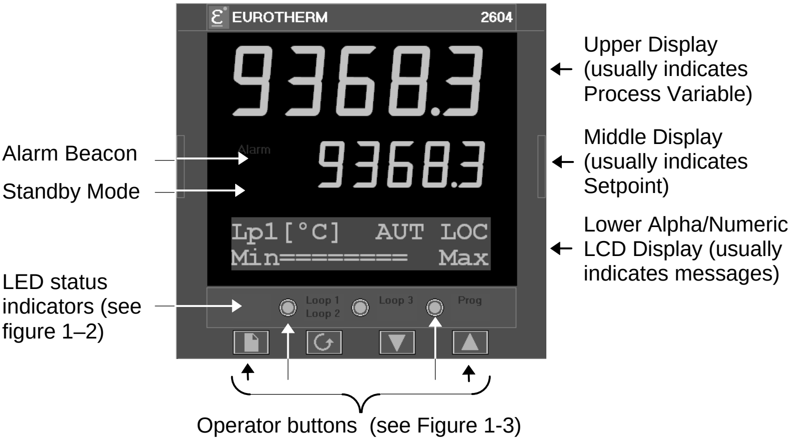
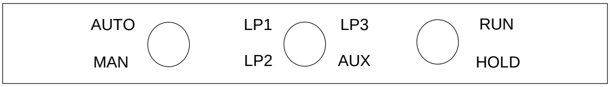


Figure 1-2: Operator Interface

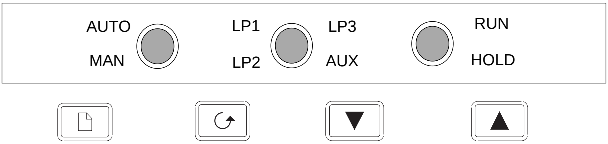
1.3.2. LED Status Indicators



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 or override then a second press of the loop button will cause the AUX indicator to illuminate together with the loop indicator. If the loop is configured as Ratio this display is also used to show the ratio parameters even though ratio only uses one control loop.
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.
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 1-3: Status Indicators

1.3.3. Operator Buttons



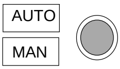
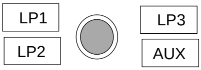
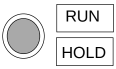
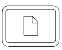
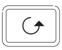
	Auto/Manual button	The Auto/Manual button only operates from the loop view. When pressed, this toggles between automatic and manual mode: • If the controller is in automatic mode the AUTO light will be lit. • If the controller is in manual mode, the MAN light will be lit.
	Loop select button	Repeat pressing 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 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.
The above three buttons (Function Keys 1 to 3) can be disabled, see Section 5.2.3.		
	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.

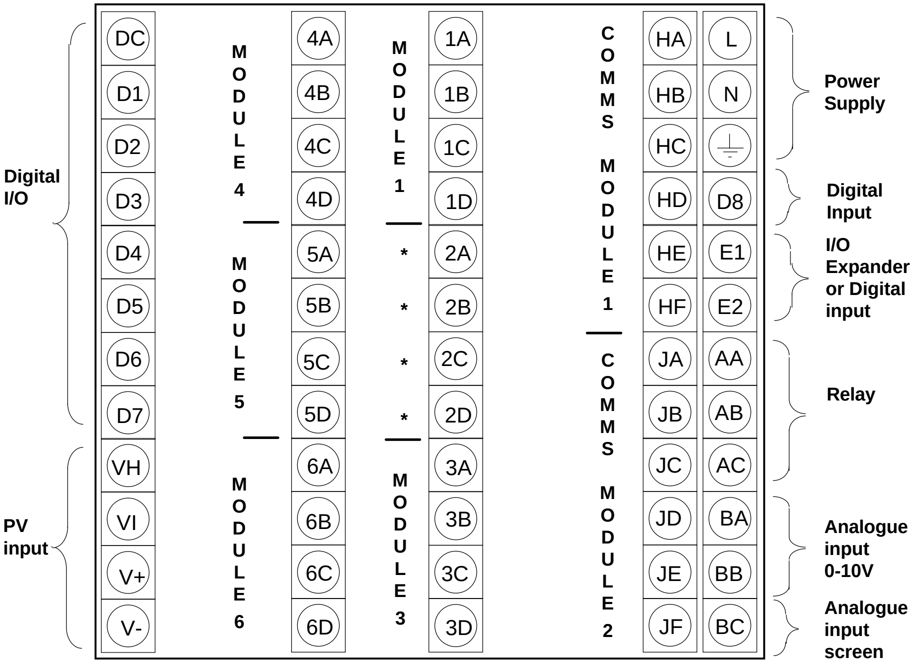
Figure 1-4: Operator Buttons

1.4. INSTALLATION - OVERVIEW

The 2604 controller must be mounted and wired in accordance with the instructions given in Chapter 2 of the Installation and Operation Handbook, Part No. HA026491

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 Com
Power supply	L, N, Earth

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

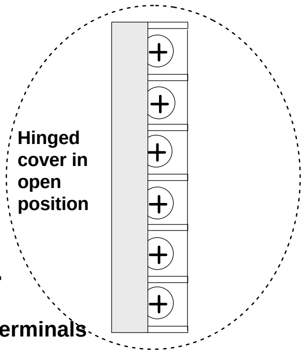


Figure 1-5: View of the Rear Terminals

1.5. 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 1-4

The modules are:

- Communications modules.
- I/O modules

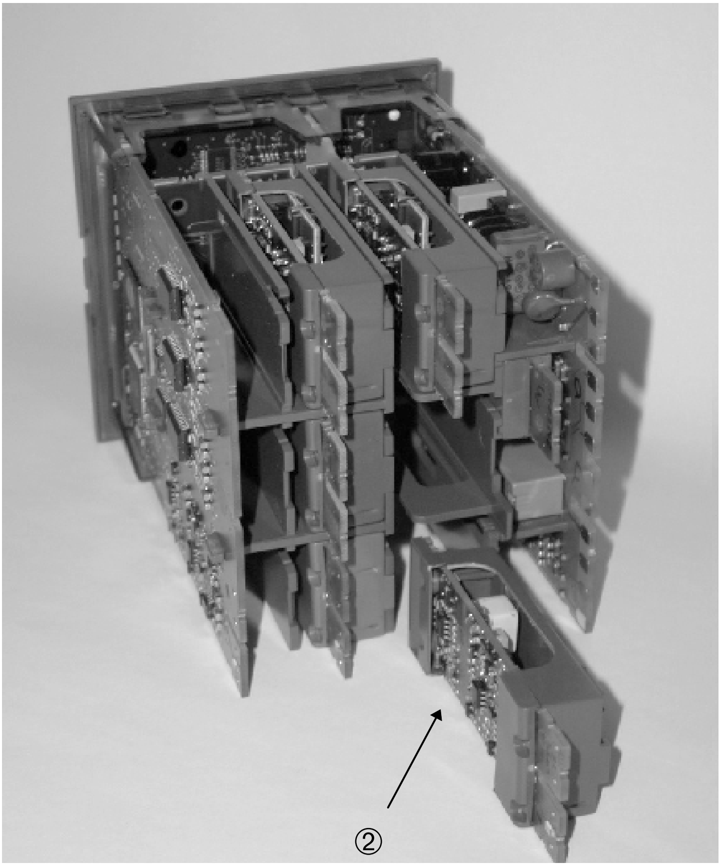


Figure 1-6: View of the Plug-in Modules

1.5.1. To Add or Change Modules

It is recommended that the controller is switched off before it is removed from its sleeve.

1. Remove the controller from its sleeve by pushing both latching ears ① (Figure 1-6) outwards and easing the controller forwards from its sleeve. It should not be necessary to use any tools for this.

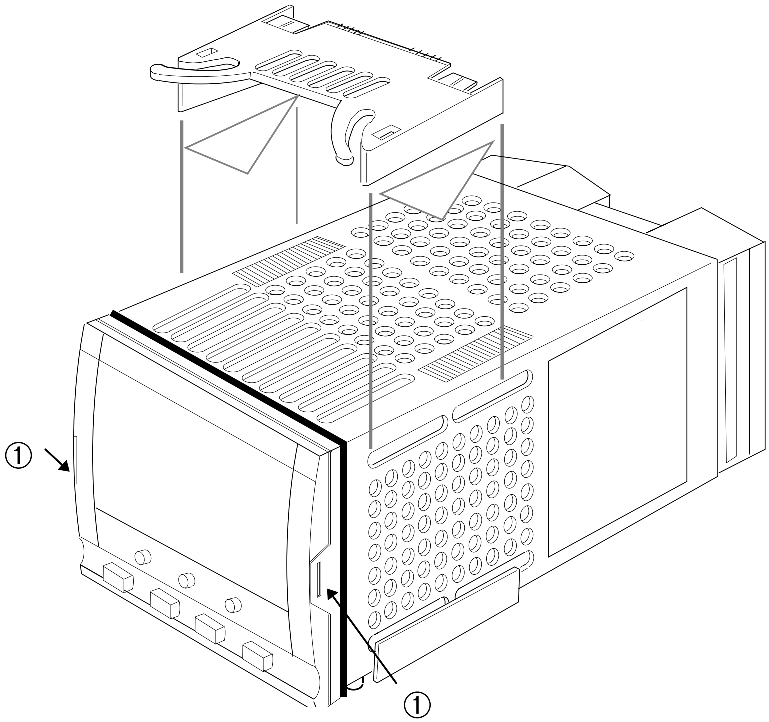


Figure 1-7: View of the Controller in its Sleeve

2. To remove a module it may be gripped by the rear terminals and pulled out from its location.
3. To fit a new module gently insert it into the required location ensuring that the raised section on the plastic cover ② (Figure 1-5) of the module slides into the slot in the retaining housing .
4. Slide the controller back into its sleeve and turn power back on.
5. After a brief initialisation period, the message **!:Module Changed** will appear in the lower LCD.
6. Press 🗋 and ⟳ together, as instructed on the lower display, to acknowledge.
7. If the message **Bad Ident** is displayed this indicates that the wrong type of module has been installed, for example an unisolated logic output module from 2400 series.

1.6. 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.

1.6.1. 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 1.xx.

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 and 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.

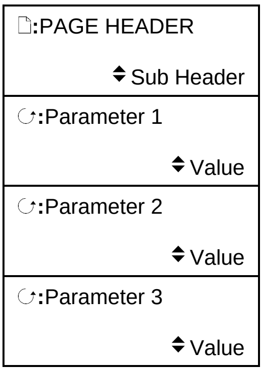
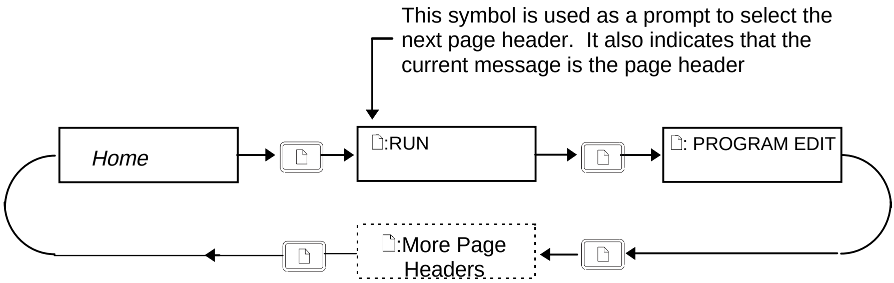


Figure 1-8: Page Concept

1.6.2. To Step Through Page Headers

Press 🗋 - (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 1-8 below. If the page button, 🗋, is held down continuously the pages auto advance.



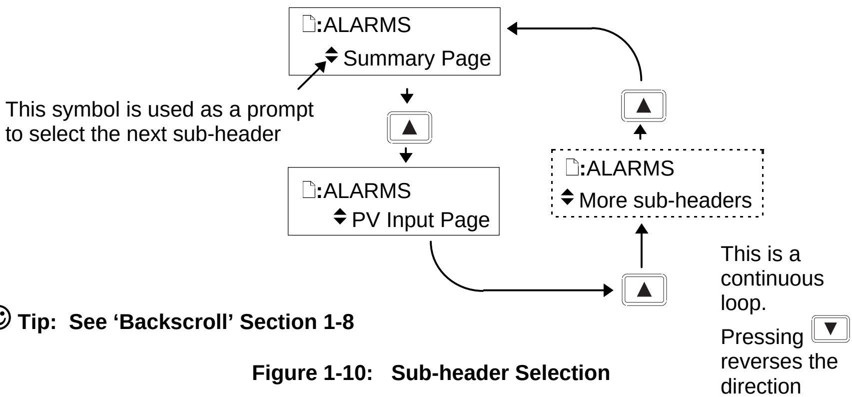
☺ **Tip: See 'Backpage' Section 1-7**

Figure 1-9: Stepping Through Page Headers

1.6.3. Sub-headers

The page header shown in Figure 1-9 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 1-8**

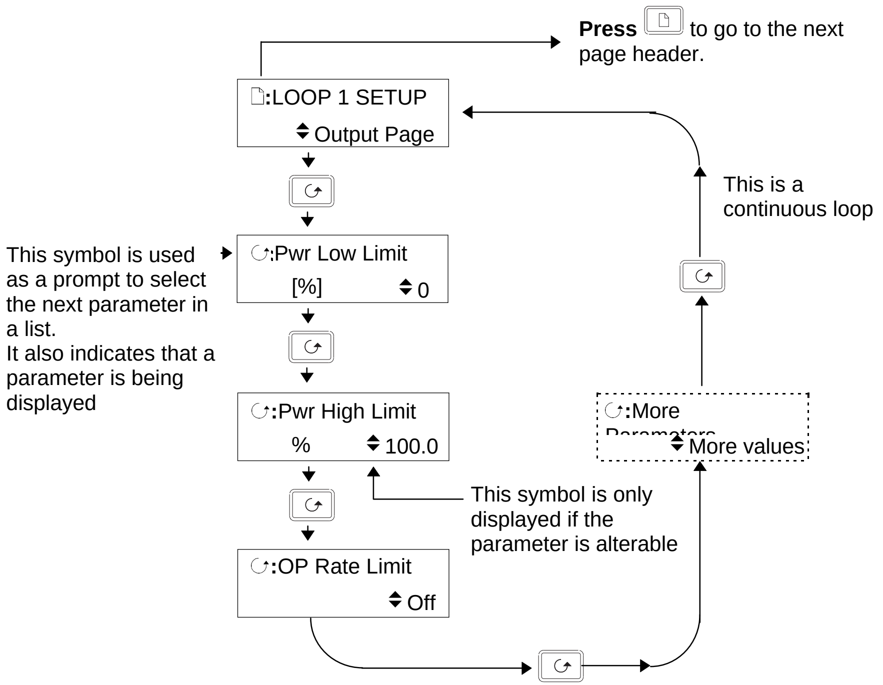
Figure 1-10: Sub-header Selection

1.6.4. To Step Through Parameters

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

Press [scroll button] - (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 button], is held down the parameters auto advance.



☺ **Tip: See 'Backscroll' Section 1-8**

Figure 1-11: Parameter Selection

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

1.6.5. 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 1-12 below shows the different types of parameter and how their values are changed.

1. Numerical Values

⟳:SP1 Low Limit
[°C] ⬍ 100.0

Press ▲ to increase the value
Press ▼ to decrease the value
(⬍ shown only if parameter alterable)

Note:
Units are displayed automatically if applicable

2. Enumerated Values

⟳:Program Status
⬍ Reset

Press ▲ to show next state
Press ▼ to show previous state

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

Prg: 1 Seg: 4
□□■□□□■□■□□□□□■□

Press ⟳ to step along the values. The selected value flashes.
Press ▼ or ▲ to turn the value on [■] or off [□]

☺ **Tip: See 'Backscroll' Section 1.8 to step back**

4. Parameter Addresses

⟳:Upper Param
⬍ 0000<u>1</u>: L1.PV

Press ▲ or ▼ to change the **Parameter address**. A cursor flashes under the parameter address indicating that it can be changed.
The parameter name for that address (if it exists) is shown in the lower right of the readout.

↓

Press ⟳ to change from parameter address to parameter name

↓

⟳:Upper Param
⬍ 00001: L1.P<u>V</u>

Press ▲ or ▼ to change the **parameter name**. A cursor flashes under the parameter name indicating that it can be changed.

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

Figure 1-12: Changing a Parameter Value

5. Text (User definable)

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

⟳:Program Name Program 1

← Press ▲ or ▼ to change the **character**.

↓

Press ⟳ to change to the next character

↓

⟳:Program Name Program 1

← Press ▲ or ▼ to change the **character**.
Up to 16 characters can be configured

☺ **Tip: See 'Backscroll' Section 1.8 to if you need to re-enter a previously entered character.**

6. Time

PSP1 Dwell Time ⬍ H:MM:SS

← Press ▲ or ▼ to increase or decrease the time setting.
This is an accelerating display.

Figure 1-13: Changing a Parameter Value (continued)

1.6.6. 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.

1.7. BACKPAGE

When stepping through list headers, a backpage short cut is provided by holding down and pressing ▲. 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.

1.8. BACKSCROLL

When stepping through parameters in a list, a backscroll short cut is provided by holding down 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.

1.9. JUMP TO HOME DISPLAY

Press and together to return the display to the configured HOME screen.

1.10. 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.

1.11. 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.

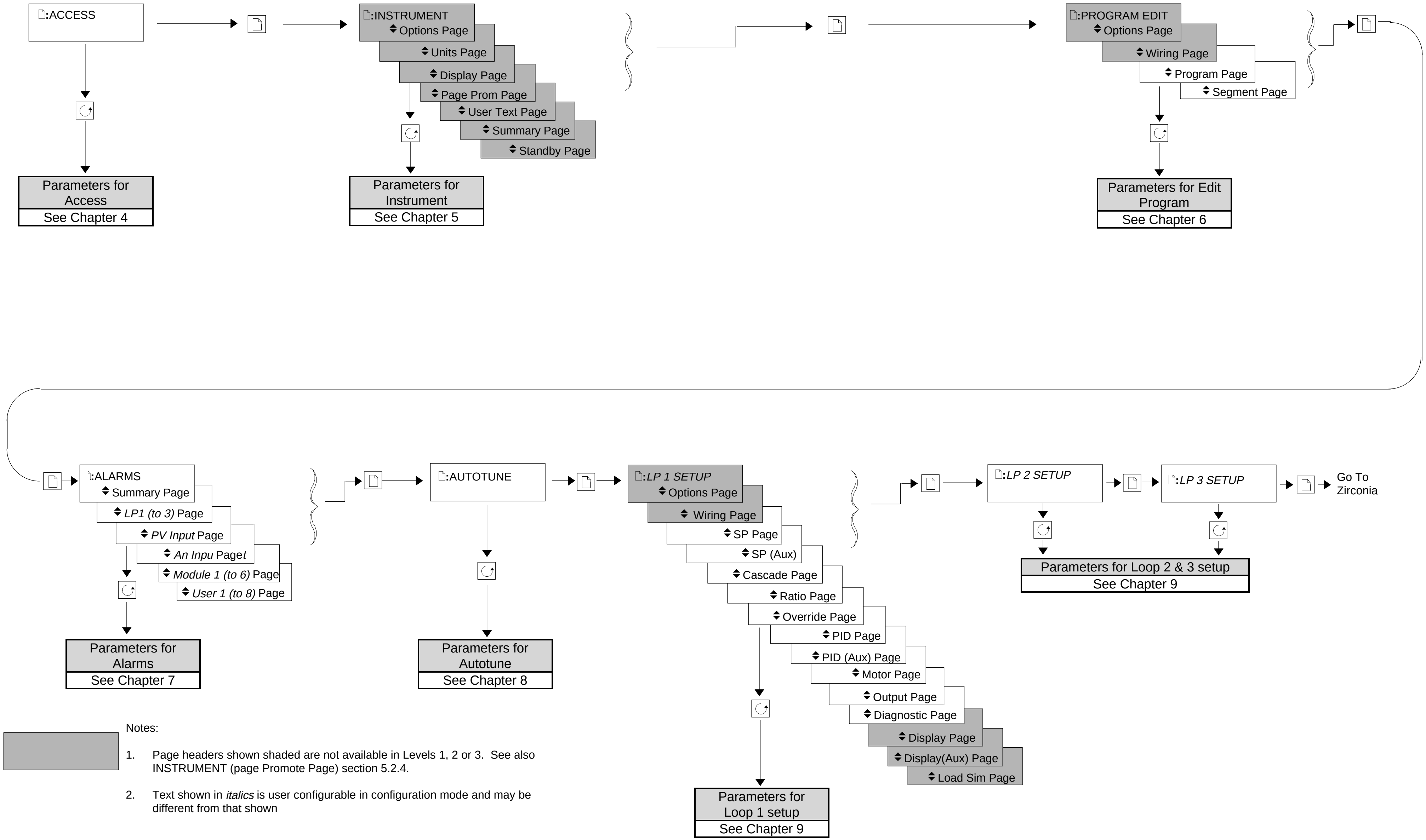
A parameter described as alterable is, generally, preceded by the ⬍ symbol which indicates that its value can be changed. A parameter which is not alterable may be viewed (subject to availability), but may be changed by an instrument algorithm.

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 Config Level.

1.12 NAVIGATION DIAGRAM



Notes:

1. Page headers shown shaded are not available in Levels 1, 2 or 3. See also INSTRUMENT (page Promote Page) section 5.2.4.

2. Text shown in *italics* is user configurable in configuration mode and may be different from that shown

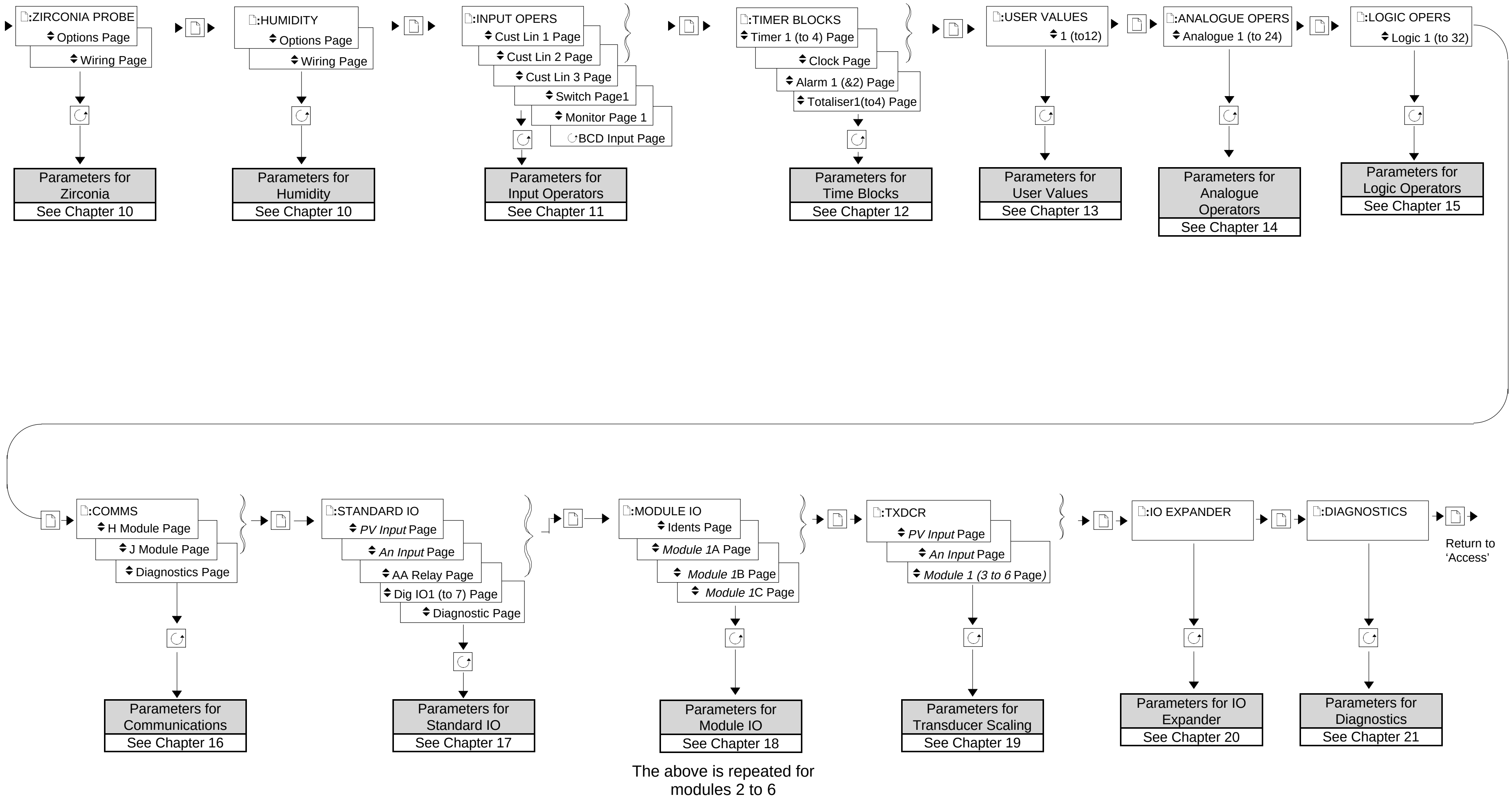


Figure 1-13: Navigation Diagram

2. Chapter 2 Function Blocks

2.1. WHAT IS A FUNCTION BLOCK?

A function block is a software device which performs a control strategy. Examples are PID Controller, Setpoint Programmer, Cascade Controller, Timer, etc. A function block may be represented as a 'box' which takes in data at one side (as 'Inputs'), manipulates the data internally (using parameter 'Settings') and 'outputs' data at the other side to interface with analogue or digital IO and other function blocks. Figure 2-1 shows a representation of a PID function block as used in the 2604 controller.

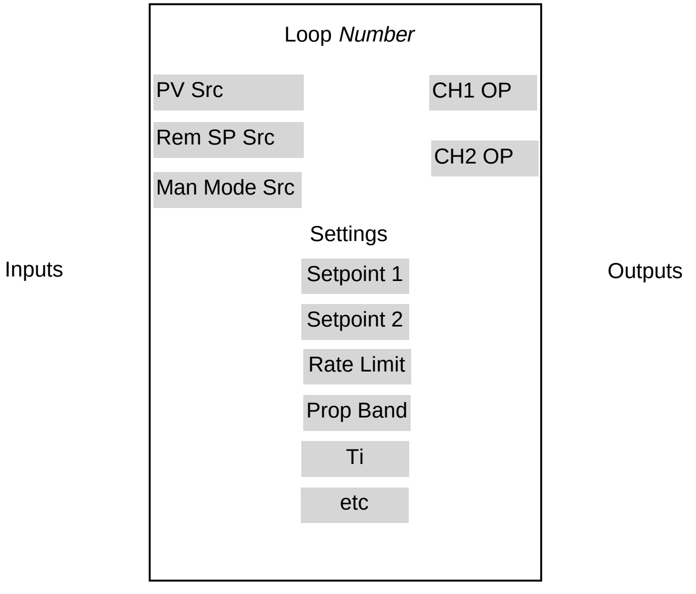


Figure 2-1: A Simple PID Function Block

2.1.1. Inputs

Inputs are provided to the function block from field sensors or from other function blocks within the controller. Each field input is served by an analogue or digital input block which processes the signal (depending upon the type of input) and makes it available to the function block in a useable form.

Each input 'wire' (see Chapter 3) is labelled as 'Src' since it defines the source of the signal.

2.1.2. Outputs

In a similar way the function block makes available signals to other blocks, plant actuators and other devices. Each output interfaces with analogue or digital output drivers which provide signals to the plant such as relay, 4-20mA, 0-10V outputs, etc

2.1.3. Settings

The purpose of a particular function block is defined by its internal parameters. Some of these parameters are available to the user so that they can be adjusted to suit the characteristics of the plant.
Examples of parameters available to the user are shown in Figure 2-1 as ‘Settings’. In this manual these parameters are shown in tables an example of which is shown in Section 2.1.4..

2.1.4. An Example of a Parameter Table

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				
This is a continuous loop which returns to the list header				

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.

Chapters 5 to 20 of this manual list the parameters available for particular functions and appear in the same order that they are found in the user interface in the controller.

3. Chapter 3 Soft Wiring

3.1. WHAT IS SOFT WIRING?

Soft Wiring (sometimes known as User Wiring) refers to the connections which are made in software between function blocks. This chapter describes the principles of soft wiring.

In general every function block has at least one input and one output. Input parameters are used to specify where a function block reads its incoming data (the ‘Input Source’). The input source is usually soft wired to the output from a preceeding function block. Output parameters are usually soft wired to the input source of subsequent function blocks.

It is possible to wire from any parameter using its Modbus address. In practice, however, it is unlikely that you will wish to wire from many of the available parameters. A list of commonly wireable parameters has, therefore, been produced and these are displayed in the controller with both their Modbus address and a mnemonic of the parameter name. An example is shown in the Section 3.1.2.1. i.e. 05108:PVIn.Val. The full list if these commonly wired parameters is given in Appendix D.

The function blocks used in this manual are drawn as follows:

1. Input parameters defined by ‘Src’ on the left of the function block diagram
2. Typically wired output parameters on the right hand side
3. Other parameters, which are not normally wired to, are shown as settings

A parameter which is not wired to can be adjusted through the front panel of the controller provided it is not Read Only (R/O) and the correct access level is selected.

All parameters shown in the function block diagrams are also shown in the parameter tables, in the relevant chapters, in the order in which they appear on the instrument display.

Figure 3-1 shows an example of how a PID function block (Loop 1) might be wired to other function blocks to produce a simple single loop controller. The ‘PV Src’ input is soft wired to the output value from the PV Input block on terminals V- to VH.
The channel 1 (heat) output from the PID block is soft wired to the input source (‘Wire Src’) of Module 1A, fitted as an output module.

Also in this example, a digital input to the ‘Man Mode Src’, allows the loop to be placed into manual depending upon the state of the digital input. The digital input is DIO1 connected to terminal D1 on the controller.

For further information on the configuration of the fixed IO and IO modules see Chapters 17 and 18 respectively.

Further examples of function block wiring are given in specific chapters throughout this manual.

3.1.1. An Example of Soft Wiring

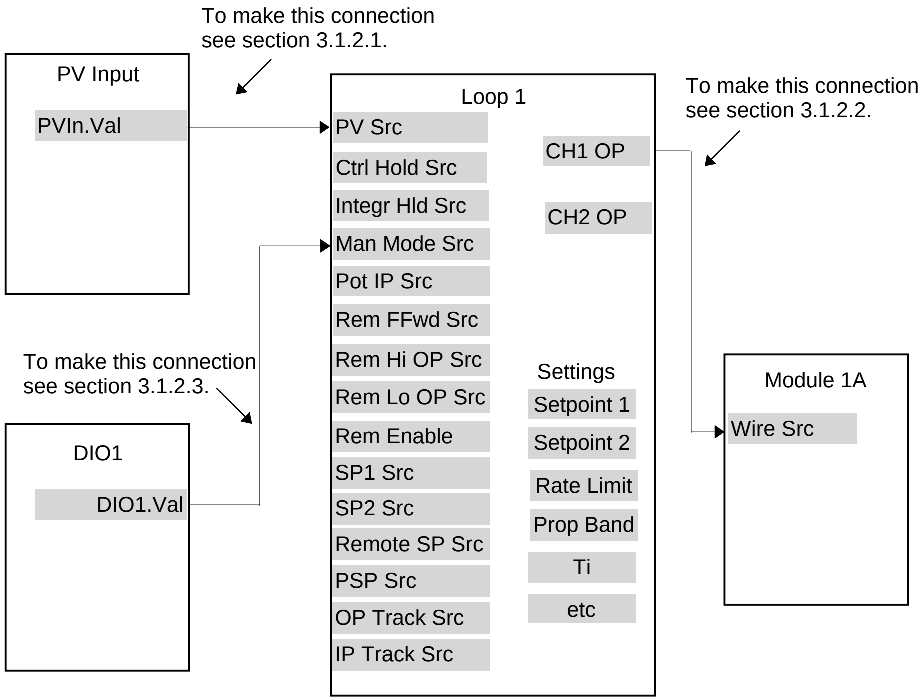


Figure 3-1: A Simple Wiring Example of a PID Function Block

3.1.2. Configuration of the Simple PID Loop

The following description explains how the wiring connections are made to produce the simple PID controller shown in Figure 3-1.

3.1.2.1. To connect the PV input to the Loop

The example is to connect the output from the 'PV Input' to the 'PV Source' of Loop 1. Firstly, enter Configuration mode. This is further explained in Chapter 4.
Then:-

Do This	This Is The Display You Should See	Additional Notes
From any display press [page button] as many times as necessary to select the module page header, i.e. **:STANDARD IO** Press [▲] or [▼] to select the required Module Page, i.e. **PV Input Page**	**Select the wire source** :STANDARD IO ⇕ PV Input Page	
Press [scroll button] as many times as necessary to select **PV Input. Val**	:PV Input. Val 1	This selects the parameter to be wired from. Val denotes the output value.
Press [AUTO/MAN] to copy this parameter. This button becomes a 'copy' button in this mode.	Address 05108 Copied	This display confirms that the parameter with Modbus address 05108 (ie PV Input.Val) has been copied. This display appears for as long as the A/M button is depressed
Press [page button] as many times as necessary to select the loop set up page header i.e. **:LP1 SETUP** Press [▲] or [▼] to select the **Wiring Page**	**Select the wire destination** :LP1 SETUP ⇕ Wiring Page	

Continued on next page

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Press to select **PV Src**	⟳:PV Src ⬍ -----: None	PV Src of LP1.is the parameter to be wired to. The flashing last character is the modbus address of the parameter to be wired from. If the address is known it can be entered directly here.

At this point you have three choices:

1. If the modbus address is known, enter it here by pressing the ▲ or ▼ button
2. If the modbus address is not known press . The display transfers to the name of the parameter. Press ▲ or ▼ to scroll through a list of parameter names. See Appendix D for the list of these parameters.
3. Paste the parameter (already copied) as follows

Paste the wire source

Press the Loop Select button, LP1 LP3 LP2 AUX, to paste the copied parameter ie 05108 to the PV Src of LPI. This button becomes a 'paste' button in this mode	Paste 05108? →Cancel ⟳→OK	The Loop Select button becomes a 'paste' button in this mode
Press to confirm Press to cancel as instructed	⟳:PV Src ⬍ 05108:PVIn.Val	The parameter with Modbus address 05108 is pasted to PV Src. The last character flashes to indicate that you can change the modbus address if required, using the ▲ or ▼ button
Press .	⟳:PV Src ⬍ 05108:PVIn.Val The connection is now made	The display transfers to the name of the parameter. The last character flashes to indicate that you can change the parameter by name if required, using the ▲ or ▼ button

3.1.2.2. To connect the Loop to the Output Module

The example is Loop 1 Channel 1 output to Module 1A input.

Do This	This Is The Display You Should See	Additional Notes
From any display press [page button] as many times as necessary to select the Loop 1 Set Up page header, i.e. **:LP1 SETUP** Press [▲] or [▼] to select the **Output Page**	**Select the wire source** :LP1 SETUP ⬍ Output Page	
Press [scroll button] as many times as necessary to select **CH1 OP**	:Ch1 OP 0	This selects the parameter to be wired from.
Press AUTO/MAN [button] to copy this parameter. This button becomes a 'copy' button in this mode.	**Copy the wire source** Address 00013 Copied	This display confirms that the parameter with Modbus address 00013 (ie CH1 OP) has been copied. This display appears for as long as the A/M button is depressed
Press [page button] as many times as necessary to select the Module IO page header i.e. **:Module IO** Press [▲] or [▼] to select the **Module 1 A Page**	**Select the wire destination** :MODULE IO ⬍ Module 1 A Page	

Continued on next page

Continued from previous page

Press ⟳ to select **Wire Src**

```
⟳:Wire Src
⬍ -----:        None
```

This is the parameter to be wired to.

The flashing last character is the modbus address of the parameter to be wired from.

At this point you have three choices:

1. If the modbus address is known, enter it here by pressing the ▲ or ▼ button
2. If the modbus address is not known press ⟳. The display transfers to the name of the parameter. Press ▲ or ▼ to scroll through a list of parameter names
3. Paste the parameter (already copied) as follows

Press the Loop Select button, LP1 LP2 ◉ LP3 AUX, to paste the copied parameter ie 00013 to the Wire Src of Module 1A.

This button becomes a 'paste' button in this mode

Paste the wire source

```
Paste 00013?
🗋→Cancel  ⟳→OK
```

The Loop Select button becomes a 'paste' button in this mode

Press ⟳ to confirm

Press 🗋 to cancel as instructed

```
⟳:PV Src
⬍ 00013:L1.Ch1 OP
```

The parameter with Modbus address 00013 is pasted to Wire Src of module 1A.

The last character flashes to indicate that you can change the modbus address if required, using the ▲ or ▼ button

Press ⟳.

```
⟳:PV Src
⬍ 00013:L1.Ch1 OP
```

The connection is now made

The display transfers to the name of the parameter.

The last character flashes to indicate that you can change the parameter by name if required, using the ▲ or ▼ button

☺ **Tip:**

You can page back by holding down the 🗋 button and pressing ▲ button.

You can scroll back by holding down the ⟳ button and pressing ▲ button.

3.1.2.3. To connect Digital Input DIO1 to Loop 1 Manual Input

The following description is given as a quick summary of the previous two examples.

1. Select the Wire Source 05402:DIO1.Val

2. Copy

3. Select the Wire Destination LP1 Man Mode Src

4. Paste

The source and destination of parameters is given in the **Parameter Tables** listed in following chapters.

4. Chapter 4 To Enter & Exit Configuration Level

4.1. THE DIFFERENT ACCESS LEVELS

There are five 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 chapter 5.2.4.	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 level allows access to configure the fundamental characteristics of the controller and it is this level which is described in this manual	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.

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’
Config	Passcode ‘4’
View Config	Passcode 2604 (Fixed)

These passcodes with the exception of View Config can be changed in configuration level, see Section 4.4.

If a passcode of ‘None’ has been entered for any level (apart from View Config, which is fixed) it will not be necessary to enter a passcode to enter that level.

Note:-
In configuration mode the controller enters a standby state in which all outputs are switched off. If the controller is connected to a process it will not control the process when in this mode.

4.3. TO ENTER CONFIGURATION LEVEL

Do This	This Is The Display You Should See	Additional Notes
From any display press 🗋 as many times as necessary until the **ACCESS** page header is displayed	🗋**:**ACCESS	
Press ⟳ to select ⟳**:Access Level**	⟳**:**Access Level ⇕ Level 1	
Press ▲ or ▼ to select the required access level. E.g. **Config** 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 ⇕ Config 2sec Enter Passcode Config ⇕ 0 Enter Passcode Config ⇕ 4 2sec 2sec ⟳**:**Access Level Config ⇕ PASS	The default passcode of a new controller is 4 to enter config level. If a new passcode has been previously entered it will be in the form 0 to 9999. If an incorrect passcode is entered, the display returns to ⇕ 0. Note: In the special case that the passcode has been configured as 'None', the display will blink momentarily when Config Level is selected and Config Level will be entered immediately

4.4. TO ENTER NEW PASSCODES

Do This	This Is The Display You Should See	Additional Notes
From the previous display	⟳:Access Level ⬍ Config	When the controller is in configuration level the upper display will show ConF The middle display will change depending on the parameter selected
Press ⟳ to select **⟳:Lev 2 Passcode** Press ▲ or ▼ to select a new passcode for level 2	⟳:Lev 2 Passcode ⬍ 2	The display will blink to accept the new passcode
Press ⟳ to select **⟳:Lev 3 Passcode** Press ▲ or ▼ to select a new passcode for level 3	⟳:Lev 3 Passcode ⬍ 3	The display will blink to accept the new passcode
Press ⟳ to select **⟳:Conf Passcode** Press ▲ or ▼ to select a new passcode for configuration level	⟳:Conf Passcode ⬍ 4	The display will blink to accept the new passcode

4.5. TO EXIT CONFIGURATION LEVEL

To exit configuration level it is only necessary to select the level which you wish to go to. When entering a new level from a higher level it is not necessary to enter the passcode for this level. It is only necessary to enter the passcode when going from a lower level of access to a higher level.

5. CHAPTER 5 INSTRUMENT CONFIGURATION................2

5. Chapter 5 Instrument Configuration

5.1. WHAT IS INSTRUMENT CONFIGURATION?

Instrument configuration allows you to set up features:-

2. The number of loops
3. To enable. PID Loops, Programmer, Zirconia, Humidity,Input Operators, Timer Blocks, Analogue and Logic Operators, Transducer Scaling
4. Displayed Units
5. The format of the upper, middle and lower readouts
6. The functions of the keys (buttons)
7. Promotion of selected parameters to different levels
8. User text
9. Format of the Summary Page
10. Standby Behaviour

5.1.1. To Select the Instrument Configuration Pages

Do This	This Is The Display You Should See	Additional Notes
From any display press [page key] as many times as necessary until the **INSTRUMENT** page header is displayed Press [up key] or [down key] to select the page header required. E.g. **Options Page**	:INSTRUMENT Options Page	The choice of page headers is:- Options Page Units Page Display Page Page Prom Page User Text Page Summary Page Standby Page

Note:-
It is only possible to configure chargeable options which have been ordered. An example of a chargeable option is the number of loops. For other chargeable options see Order Code, Appendix A.

5.2. TO CONFIGURE CONTROLLER OPTIONS

Do This	This Is The Display You Should See	Additional Notes
Select **INSTRUMENT (Options Page)**	:INSTRUMENT Options Page	
Press [scroll] to select **Num of Loops** Press [▲] or [▼] to select the required number of loops	:Num of Loops 1	1, 2 or 3 loops can be selected if the option has been supplied

The procedure for configuring the remaining parameters in this list is the same as described above. The following tables list all parameters in the INSTRUMENT Page:-

5.2.1. INSTRUMENT Options Page

Table Number: 5.2.1.	These parameters allow you to enable or disable instrument options which have been ordered		INSTRUMENT (Options Page)	
Parameter Name Press to select	**Parameter Description**	**OPC Name**	**Value** Default	**Modbus Address**
Num of Loops	To configure the number of loops		1, 2 or 3	
Programmer	To enable or disable the programmer		Disabled Enabled	
Zirconia	To enable or disable a zirconia block		Disabled Enabled	
Humidity	To enable or disable the humidity block		Disabled Enabled	
Input Opers	To enable or disable the Input Operators		Disabled Enabled	
Timer Blocks	To enable or disable the Timer Blocks		Disabled Enabled	
An/Logic Opers	To enable or disable the Analogue and Logic Operators		Disabled Enabled	

Txdcr Scaling	To enable or disable transducer scaling		Disabled Enabled	
IO Expander	To enable or disable the IO Expander		Disabled Enabled	
Serial Number	The controller serial number			
Inst Type	The type of controller		2604	
Inst Version	The firmware issue number[1]			
Feature Code 1	See below[1]			
Feature Code 2	See below[1]			
Clear Memory?	Clears all changes. Do not use unless the instrument is first cloned using iTools		No Yes	
Load Sim A Technical Note, Ref TIN123 is available for further information.	To enable or disable load simulation. This allows a simulation of a control loop to be enabled for test and demonstration purposes		Disabled Enabled	

Note 1. Feature codes 1 & 2.
These codes will be used in the future to enable feature upgrades when using the iTools configuration package

5.2.2. INSTRUMENT Units Page

Table Number: 5.2.2.	**These parameters allow you to configure instrument units**		**INSTRUMENT (Units Page)**	
Parameter Name Press ↻ to select	**Parameter Description**	**OPC Name**	**Value** <u>Default</u>	**Modbus Address**
Temp Units	Temperature Units		None °C, °F, °K	
Custom Units 1	An index of customised display units available in the controller.		01 to 50	
Custom Units 2				
Custom Units 3				
Custom Units 4				
Custom Units 5				
Custom Units 6				

5.2.3. INSTRUMENT Display Page

Table Number: 5.2.3.	These parameters allow you to configure the upper, middle and lower readouts		INSTRUMENT (Display Page)	
Parameter Name Press ↻ to select	**Parameter Description**	**OPC Name**	**Value** Default	**Modbus Address**
Language	Display language		English See note 1	
Startup Text 1	Index of user strings which may be used to override the default message			
Startup Text 2	Up to 50 text strings are available			
Upper Param	To define which parameter will be displayed in the upper readout in operation level[1].		See note 2	
Middle Param	To define which parameter will be displayed in the middle readout in operation level[1].		See note 2	
Home Page	Defines which page is displayed in the lower readout after initialisation[2].		See Note 3	
Home Timeout	To set a timeout for the display to return to the Home page.		None 9:99:99.9	
Disable Keys	Yes will disable all front panel buttons		No Yes	
Function Key 1	Function key 1 is Auto/Manual or disabled		Auto/Manual Disabled	
Function Key 2	Function key 2 is Loop Select key or disabled		View Loop Disabled	
Function Key 3	Function key 1 is Program Run/Hold or disabled		Run/Hold Disabled	
Page Key Src	Usually wired to a digital input for remote panel operation.		See note 1	
Scroll Key Src				
Lower Key Src				
Raise Key Src			Modbus address	
Func Key 1 Src				
Func Key 2 Src				
Func Key 3 Src				

Note 1:-
The 2604 stores the user interface in 2 languages. English is always available plus French, German or Spanish.

Note 2:-
Any parameter can be displayed in the upper and lower readout and wired to front panel buttons. For convenience the most often used parameters have been provided in the controller together with their Modbus addresses. A list of these parameters together with their Modbus addresses is given in Appendix D.

Note 3:-

The first page to be displayed when the instrument is switched on can be chosen from:-

Summary Page, Run Page
Loop 1, Loop 1 Aux., Loop 2, Loop 2 Aux., Loop 3, or Loop 3 Aux.
Access Page
Cycle Each Loop

5.2.4. INSTRUMENT Page Promote Page

Any page shown un-shaded in the Navigation Diagram, Figure 1-13 can be promoted to Level 1, Level 2 or Level 3 as follows:-

Do This	This Is The Display You Should See	Additional Notes
From any display press as many times as necessary until the **INSTRUMENT** page header is displayed Press ▲ or ▼ to select **Page Prom Page**	:INSTRUMENT Page Prom Page	
Press to select the pages which you wish to promote to Levels 1, 2 or 3. Press ▲ or ▼ to select **Lev1, Lev2,** or **Lev3.**	:SUMMARY Lev2	The Summary page will only be displayed at Level 2 (and Level 3). It will not be shown at Level 1

Repeat the above for every page which you wish to promote to a different level. By default all pages will be at Level 3 except those listed below:-

Parameter Name	Level
SUMMARY	Lev1
PROGRAM RUN (General)	Lev1
PROGRAM RUN (PSP1)	Lev1
PROGRAM RUN (PSP2)	Lev1
PROGRAM RUN (PSP3)	Lev1
ALARMS (Summary)	Lev1

5.2.5. INSTRUMENT User Text Page

This page allows you to configure up to 50 User Text strings of up to 16 characters. Any string can be used to provide a name for particular parameters. For example Loops can be given names which are more meaningful to the user, such as ‘Zone 1’, ‘Level Controller’, etc. To enter User Text:-

Do This	This Is The Display You Should See	Additional Notes
From any display press [page] as many times as necessary until the **INSTRUMENT** page header is displayed Press [▲] or [▼] to select **User Text Page**	:INSTRUMENT ⇕ User Text Page	
Press [scroll] to select **User Text** Press [▲] or [▼] to enable User Text	:User Text ⇕ Enabled	If Disabled no further pages are available
Press [scroll] to select **Text Number** Press [▲] or [▼] to select the Text Number	:Text Number ⇕ 1	Up to 50 Text Numbers are available
Press [scroll] to select **Text** Press [▲] or [▼] to change the first (flashing) character to the first character of your text.	:Text ⇕ Usr1	
Press [scroll] to select the next character up to 16 characters Press [▲] or [▼] to change the (flashing) character.	:Text ⇕ Usr1	Repeat this step for all characters

5.2.6. INSTRUMENT Summary Page

This page allows you to configure a list of 10 Parameters. If 'Show Summary' is enabled, as described below,
To configure Summary pages:-

Do This	This Is The Display You Should See	Additional Notes
1. From any display press [page] as many times as necessary until the **INSTRUMENT** page header is displayed Press [▲] or [▼] to select **Summary Page**	:INSTRUMENT Summary Page	
2. Press [scroll] to select **Show Summary?** Press [▲] or [▼] to select Yes or No	:Show Summary? Yes	If Yes is selected, up to 10 parameters will be shown in the Operation level 1, 2 or 3 as configured in section 5.2.4.
3. Press [scroll] to select **Promote Param** Press [▲] or [▼] to select the parameter to be promoted to Summary Page	:Promote Param 1	Up to 10 parameters are available
4. Press [scroll] to select **Promote Addr** Press [▲] or [▼] to change the Modbus Address of the parameter to be promoted. See also Appendix D.	:Promote Addr 00001: L1.PV	The flashing _ indicates the value to be changed
5. Press [scroll] to select the **Name** of the character to be promoted Press [▲] or [▼] to change the parameter to be promoted	:Promote Addr 00001: L1.PV	If the Modbus Address is not known it is possible to select the required parameter from a list of parameter names

6. Press ⟳ to select **Promote Name** Press ▲ or ▼ to choose between default text or the user text configured in section 5.2.5.	⟳**:**Promote Name ⬍01: Oven Temp	The text 'Oven Temp' is used as an example of user text.
7. Press ⟳ to select the **Promote Access** level Press ▲ or ▼ to select the Access Level	⟳**:**Promote Access ⬍Lev 1 Read Only	This sets the level to which the parameter is promoted. The choices are:- Lev 1 Read Only Lev 1 Alterable Lev 2 Read Only Lev 2 Alterable
8. Press ⟳**.** This shows the first parameter which will appear in the operation level selected in 7 above.	⟳**:**Usr1 [Units] ⬍L1.PV	The actual value of the parameter is shown in this display together with its allocated units

Repeat the above steps for 10 parameters which are to be promoted to the Summary page header.

5.2.7. INSTRUMENT Standby Page

The standby state of the controller occurs when it is in configuration mode or during the first few seconds after switch on, see also Section 1.3.2.
The INSTRUMENT Standby Page allows you to wire to a parameter such as a digital input which when true will switch the controller to Standby Mode.

5.2.7.1. Example:- To wire Standby to Fixed Digital Input 1.

Do This	This Is The Display You Should See	Additional Notes
1. From any display press [page] as many times as necessary until the **INSTRUMENT** page header is displayed Press [▲] or [▼] to select **Standby Page**	[page]:INSTRUMENT ⬍ Standby Page	
2. Press [scroll] to select **Standby** Press [▲] or [▼] to select On or Off	[scroll]:Standby ⬍ On	If On is selected the controller will be switched to Standby Mode when the event (DI01) becomes true. If Off is selected the event is ignored.
3. Press [scroll] to select **Standby Src** Press [▲] or [▼] to select the Modbus Address of the parameter to be wired to	[scroll]:Standby Src ⬍ 05402: DI01.Val	The Modbus Address of Fixed Digital Input number 01 is 05402
4. Press [scroll] to select the name of the parameter to be wired to. Press [▲] or [▼] to select the Modbus Address of the parameter to be wired to	[scroll]:Standby Src ⬍ 05402: DI01.Val	If the Modbus Address is not known the parameter can be selected by name

☺ **Tip: See 'Copy and Paste' Section 3.1.1.**

5.3. USER TEXT EXAMPLES

5.3.1. To Re-Name Loop 1 to Zone 1

First enable User Text since its factory default is disabled. A library of User Text can then be created from which the new loop name can be selected.

5.3.1.1. Implementation

1. In INSTRUMENT/User Text Page (Table 5.2.5),	set User Text = Enabled set 'Text Number' = 1 (or any unused text no.) set 'Text' = Zone 1 This defines Text Number 1 to be Zone 1.
2. In LOOP 1 SETUP /Display Page	set 'Loop Name' = 01:Zone 1 This replaces the default name (LP1) with Zone 1

5.3.2. To Re-Name User Alarm 1 and Provide a Message

User alarms can be re-named and also provide a diagnostic message to the user.

5.3.2.1. Implementation

1. In INSTRUMENT/User Text Page (Table 5.2.5),	set User Text = Enabled set 'Text Number' = 2 (or any unused text no.) set 'Usr2' = High Temp This defines Text Number 2 to be High Temp. set 'Text Number' = 3 (or any unused text no.) set 'Usr3' = Check Chiller
2. In ALARMS/User 1 Page	set 'Name' = 02:High Temp This replaces the default name with High Temp Set 'Message' =03:Check Chiller

5.3.3. To Re-Name Module 1 to be called Heat Output

Individual modules can be re-named to simplify plant diagnostics.

5.3.3.1. Implementation

1. In INSTRUMENT/User Text Page (Table 5.2.5),	set User Text = Enabled set 'Text Number' = 4 (or any unused text no.) set 'Usr4' = Heat Output This defines Text Number 4 to be Heat Output.
2. In MODULE IO/Module 1A Page	set 'Module Name' = 04:Heat Output This replaces the default name with Heat Output

5.3.4. To Show User Text in the Summary Page on an Event

This example will display the text ‘Test 1’ in the Summary Page when the Digital Input 1 becomes true.

5.3.4.1. Implementation

1. In INSTRUMENT/User Text Page (Table 5.2.5),	set User Text = Enabled set ‘Text Number’ = 5 (or any unused text no.) set ‘Usr5’ = Test 1
2. In STANDARD IO /Dig IO1 Page	set Channel Type = Digital Input This page also allows you to set the input for inverted operation
3. In INSTRUMENT/Summary Page (Table 5.2.6)	set ‘Show Summary? = Yes set ‘Promote Param’ = 1 (or the text no. above) set ‘Promote Addr’ = 05402:DIO1.Val This connects digital input 1 to the first parameter of the Summary display

In Operation Level, the text in the Summary page will show:-

↻:Test 1
⬍ 0 or 1

In place of 0 or 1, you may wish to display On or Off. This can be achieved by using a Logic or Analogue Operator. The implementation using Logic Operator 1 is as follows:

1. In INSTRUMENT/User Text Page (Table 5.2.5),	set User Text = Enabled set ‘Text Number’ = 5 (or any unused text no.) set ‘Usr5’ = Test 1
2. In STANDARD IO /Dig IO1 Page	set Channel Type = Digital Input This page also allows you to set the input for inverted operation
3. In LOGIC OPERS/Logic 1 Page	set ‘Operation = OR set ‘Input 1 Src = 05402:DIO1.Val set ‘Input 2 Src = 05402:DIO1.Val This connects digital input 1 to logic operator 1. Note: it is necessary to wire to both inputs of a logic (or analogue operator)
4. In INSTRUMENT/Summary Page (Table 5.2.6)	set ‘Show Summary? = Yes set ‘Promote Param’ = 1 (or the text no. above) set ‘Promote Addr’ = 07176:LgOp1.OP The logic operator is defined simply to provide On/Off annunciation in the display Summary page.

See Appendix D for list of Modbus addresses.

5.3.5. To Assign Custom Units to the Power Up Display

Most commonly used units can be selected for display on the user interface. In addition to the standard selection up to six custom units can be created. In this example the units of the PV Input will be Gal/m

5.3.5.1. Implementation

1. In INSTRUMENT/User Text Page (Table 5.2.5),	set User Text = Enabled set 'Text Number' = 6 (or any unused text no.) set 'Usr6' = Gal/m This defines Text Number 6 to be Gal/m.
2. In INSTRUMENT/Units Page (Table 5.2.2),	set 'Custom 1 Units' = 08:Gal/m This sets Custom Units 1 to Gal/m
3. In STANDARD IO/PV Input Page (Table 17.2.1.)	set 'Units' = Custom 1

5.3.6. To Customise the Power Up Display

In this example the users company name will be used provide the start up message when the controller is switched on. The company name will be CML Controls and is based in Scotland.

5.3.6.1. Implementation

1. In INSTRUMENT/User Text Page (Table 5.2.5),	set User Text = Enabled set 'Text Number' = 7 (or any unused text no.) set 'Usr7' = CML Controls This defines Text Number 7 to be CML Controls set 'Text Number' = 8 (or any unused text no.) set 'Usr8' = Scotland
2. In INSTRUMENT/Display Page (Table 5.2.3),	set 'Startup Text 1' = 07: CML Controls set 'Startup Text 2' = 08: Scotland

6. Chapter 6 Programmer Edit

This chapter describes Setpoint Programming and how to configure and edit the programmer function block. Editing and Running programs is described in more detail in the Installation and Operation Handbook, Part No, HA026491.

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.

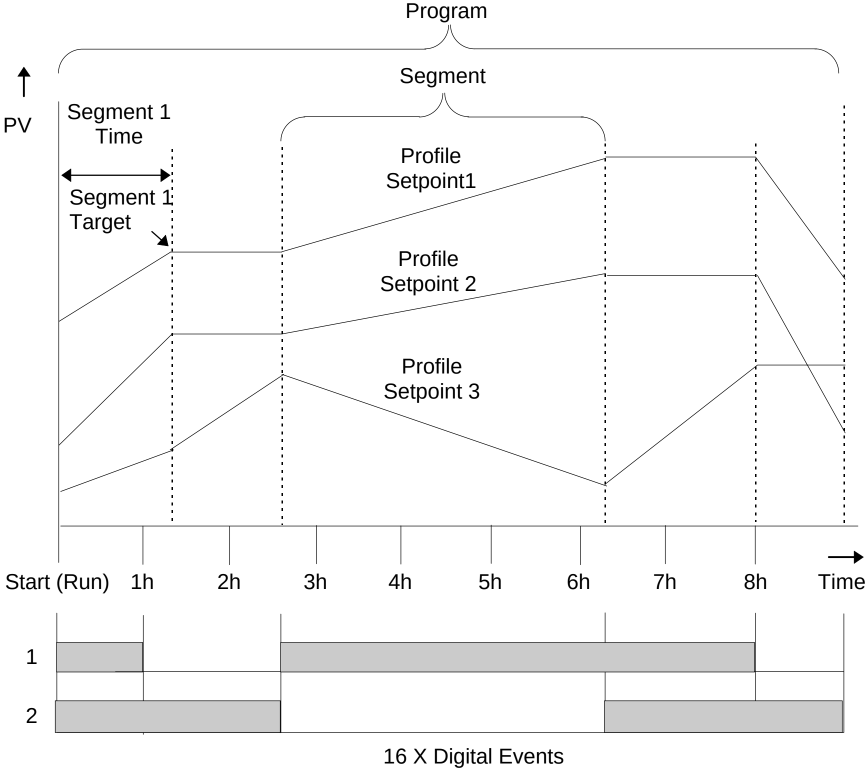


Figure 6-1: A Setpoint Program

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.

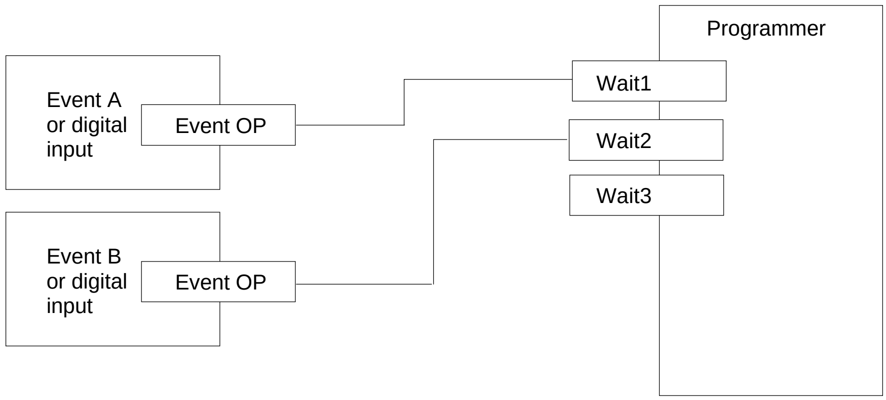
6.2.6. Power Fail Recovery

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.



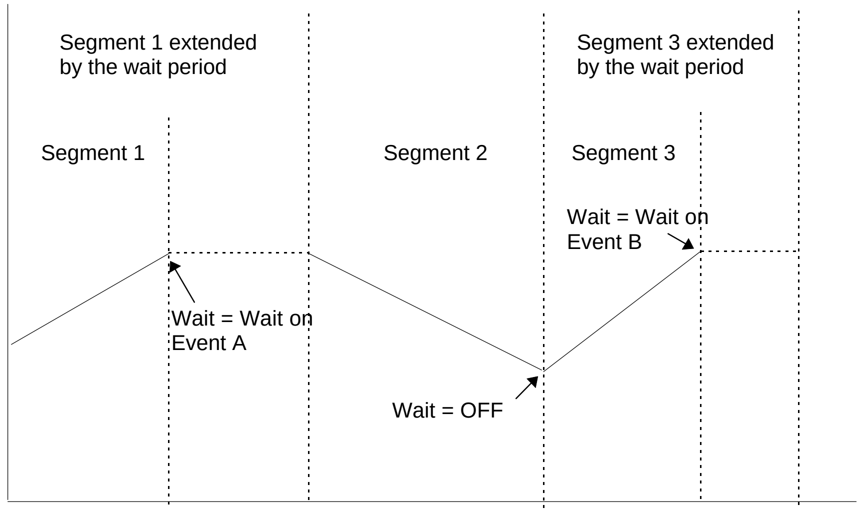


Figure 6-2: Wait Events

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.

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**.

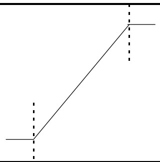
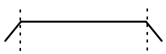
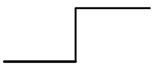
1. Each profiled setpoint must complete its segment before the programmer will move to the next segment. If one ramp reaches its target setpoint ahead of the other variables, it will dwell at that value until the other variables have completed. The program will then move to the next segment.
2. The duration 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

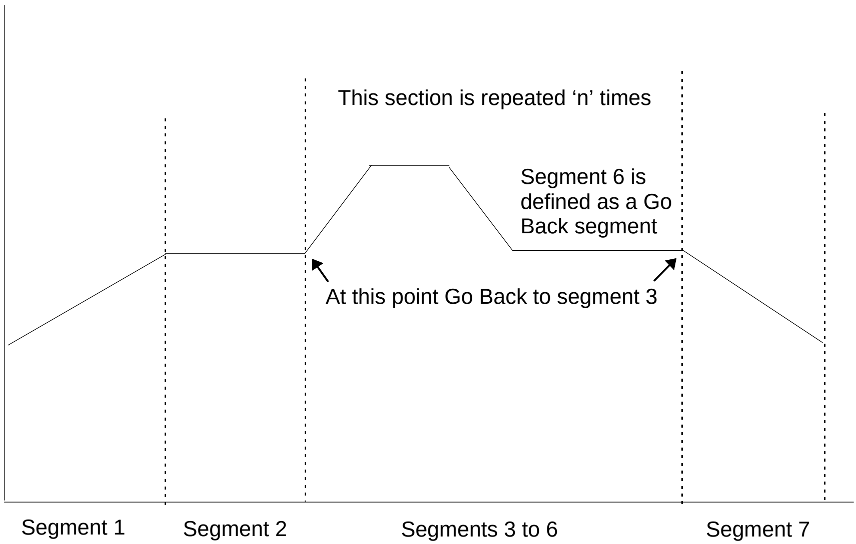


Figure 6-3: An Example of a Program with Repeating Section

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. TO ENABLE THE PROGRAMMER FUNCTION BLOCK

Do This	This Is The Display You Should See	Additional Notes
Select **INSTRUMENT (Options Page)**	:INSTRUMENT ⬍ Options Page	
Press ⟳ to select **Num of Loops** Press ▲ or ▼ to select the required number of loops	⟳-Num of Loops ⬍ 1	1, 2 or 3 loops can be selected if the option has been supplied
Press ⟳ to select **Programmer** Press ▲ or ▼ to select **Enabled**	⟳-Programmer ⬍ Enabled	If the Programmer is set to **Disabled** the Programmer pages do not appear. The **Program (Run)** pages do not appear in Configuration Level.

6.5. TO CONFIGURE PROGRAM TYPE

Do This	This Is The Display You Should See	Additional Notes
Select **PROGRAM EDIT (Options Page)**	[page]:PROGRAM EDIT ⇕ Options Page	
Press [scroll] to select **Program Type**	[scroll]:Program Type ⇕ Time to Target	The Program Type may be:- Time to Target - Each segment is a single duration. Or Ramp Rate - Segments are Ramp, Dwell or Step. Time to Target is the default
Press [▲] or [▼] to select **Time to Target** or **Ramp Rate**	[scroll]:Program Type ⇕ Ramp Rate Delete All Segments? [page]→ Cancel [scroll]→ OK If no button is pressed for 10 seconds the display reverts to previous.	**If programs have already been set up using the previous Program Type all segment data will be deleted and will need to be re-entered in Operation level.**
Press [scroll] to select confirm	[scroll]:Program Type INITIALISING [scroll]:Program Type ⇕ Ramp Rate	The Program Type requires a few seconds to re-configure during which time ‘INITIALISING’ is displayed. The Program Type is then confirmed
		The following table lists further parameters in this page ⇓

6.5.1. PROGRAM EDIT Options Page

Table Number: 6.5.1.	These parameters allow you to configure Program Type and Options		PROGRAM EDIT (Options Page)
Parameter Name Press ↻ to select	**Parameter Description**	**Value**	**Default**
Program Type	See 6.5 above		
Num of PSPs	Number of programmer setpoints	1, 2 or 3	
PID Schedule?	Activates the display of PID set	No Yes	
Wait Events?	Activates the Wait events option	No Yes	
BCD Prg Num?	Activates the use of BCD input to determine the program number	No Yes	
Hot Start	Activates the hot start option	No Yes	
Recovery Type	Defines the power recovery strategy	Ramp Back Reset Continue	Continue
Num of Prg DOs	Defines the number of digital event outputs used	None to 16	
PSP1 Units	Units to be displayed for PSP1	See Appendix D.2.	
PSP1 Resol	PSP1 decimal point resolution	XXXXX XXXX.X XXX.XX XX.XXX	
PSP1 Low Lim	PSP1 low limit	Display range	
PSP1 High Lim	PSP1 high limit	Display range	
PSP1 Reset Val	Safe state target setpoint	Prog SP lo lim to Prog SP hi lim	
The above parameters are repeated for PSP2 and PSP3 if these have been configured using Num of PSPs			

6.6. PROGRAMMER WIRING

6.6.1. Programmer Function Block

The programmer function block, shown in Figure 6-4, shows an example of soft wiring to other functions.. The connections can be made using the copy and paste method described in Section 3.1.1. with the exception of the Prg.DO1 to Prg.DO16 event outputs. These can be found by searching through the list of parameters or by entering the Modbus address directly. The Modbus addresses for these parameters are 05869 to 05883 inclusive.

The parameters which can be wired are listed in Table 6.6.2.- the default being shown underlined. These parameters can be wired to any other parameter by Modbus address or using the shorter list of parameter names

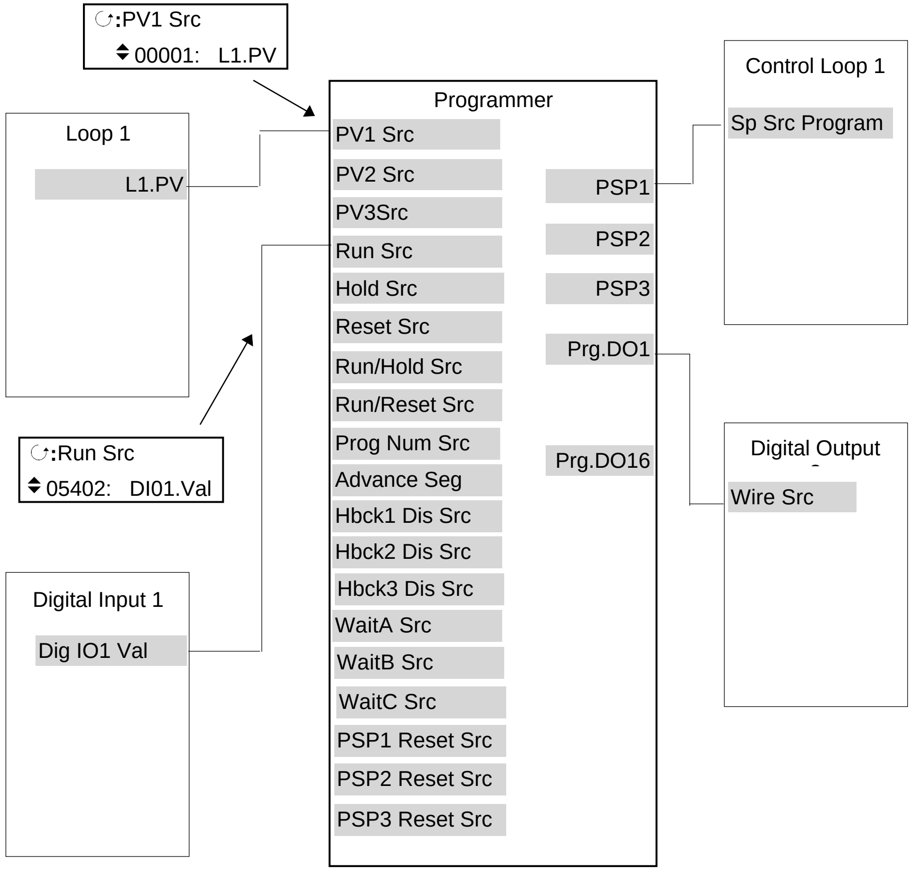


Figure 6-4: Programmer Function Block and Wiring Example

6.6.2. PROGRAM EDIT Wiring Page

Table Number: 6.6.2.	These parameters allow you to soft wire programmer functions	PROGRAM EDIT (Wiring Page)
Parameter Name Press ↻ to select	**Parameter Description**	**Default Wiring Value** Modbus Address:Parameter Mnemonic
PV1 Src	PV 1 source	00001:LP1 PV
PV2 Src	PV 2 source	01025:LP2 PV
PV3 Src	PV 3 source	02049:LP3 PV
Run Src	Run source	05494:DIO5
Hold Src	Hold Source	05642:DIO6
Reset Src	Reset Source	05690:DIO7
Run/Hold Src	Run/Hold Source	Note 2
Run/Reset Src	Run/Reset Source	Note 2
Prog Num Src	Program number source	Note 2
Advanc Seg Src	Advance segment source	12609:DI8
Hbck1 Dis Src	Holdback 1 disable source	Note 2
Hbck2 Dis Src	Holdback 2 disable source	Note 2
Hbck3 Dis Src	Holdback 3 disable source	Note 2
WaitA Src	Wait A source	Note 2
WaitB Src	Wait B source	Note 2
WaitC Src	Wait C source	Note 2
PSP1 Reset Src	PSP1 reset source (1)	00001:LP1 PV
PSP2 Reset Src	PSP2 reset source (1)	01025:LP2 PV
PSP3 Reset Src	PSP3 reset source (1)	02049:LP3 PV

Note 1:-
The PSP Reset Source defines the programmer starting conditions. To servo to setpoint, wire the relevant reset source into the SP. To servo to PV, wire the relevant reset source into the PV.
The value which is wired into the Reset Source is the value which appears at the programmer output.
Note2:-
By default these parameters are not soft wired.

6.6.3. PROGRAM EDIT Program Page

Table Number: 6.6.3	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. ‘Hot Start’	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. 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

6.6.4. PROGRAM EDIT Segment Page

Table Number: 6.6.4.	**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

6.6.5. Run Parameters

The Run list only appears when a program is running and is, therefore, available in operator levels. The tables are re-produced here for information and provide status information on a running program, as follows:-

Table Number: 6.6.5a.	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 (X10)	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		R/O

		Event B Event C		
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 ↻:Prg Reset DO □□■□□□■□■□□□□□■□			R/O Only shown if configured.

Table Number: 6.6.5b.	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

6.7. PROGRAMMER WIRING EXAMPLES

6.7.1. One Profile, Three Loops

This example explains how to configure a programmer to allow one profile to generate a setpoint for three control loops.

The 2604 program block can generate up to three profiled variables, which can then be internally wired to any parameter source. In most cases the PSPs are used to allow control loop setpoints to follow a pre-determined ramp/dwell sequence, but they can also be used, for example, to retransmit a setpoint to a slave device.

In this example PSP1 is soft wired to the program setpoints of each control loop. Also, the PV of loop1 is wired to the PV1 source, to provide holdback, and the PSP1 reset source, to provide servo start. This configuration is supplied from the factory by defining the hardware code field, in the 2604 order code, for loops/programs to be ‘321’ or ‘351’.

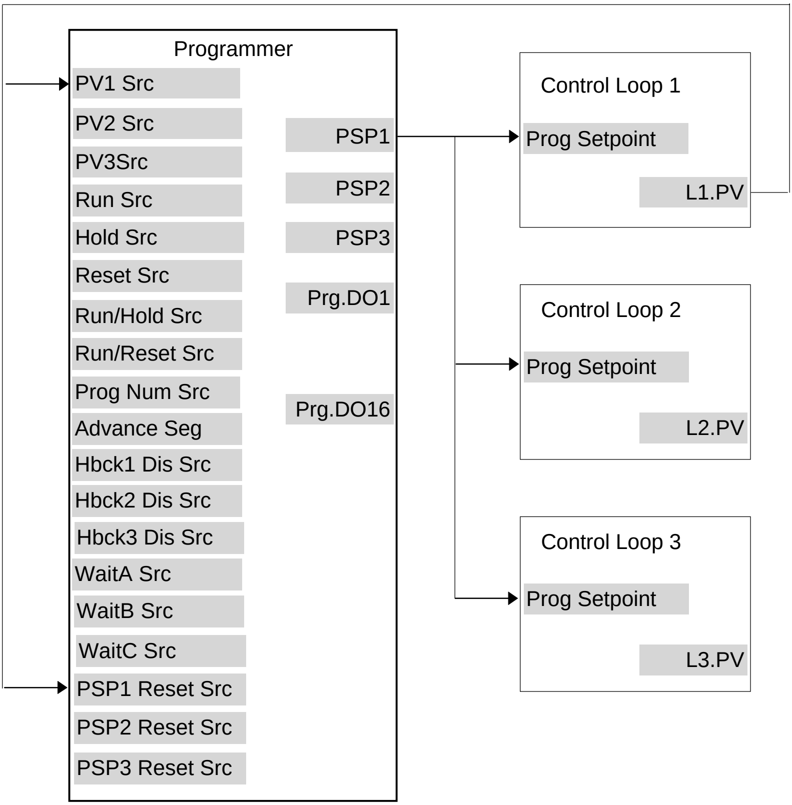


Figure 6-5: Example Programmer Wiring One Profile Three Loops

6.7.1.1. Implementation

1.	In INSTRUMENT/Options Page (Table 5.2.1),	set 'Num of Loops' = 3 set 'Programmer = Enabled
2.	In PROGRAM EDIT/Options Page (Table 6.5.1)	set 'Num of PSPs' = 1 (Note: other parameters such as number of digital event outputs, SP range and power failure recovery are also set in this page)
3.	In PROGRAM EDIT/Wiring Page (Table 6.5.1)	Set 'PV1 Src' = 00001:L1.PV This connection is required so that the programmer can use Loop 1 PV to calculate holdback.
4.	In PROGRAM EDIT/Wiring Page (Table 6.5.1)	Set 'PSP1 Reset Src' = 00001:L1.PV This connection is required so that the programmer can use Loop 1 PV to servo start.
5.	In LP1 SETUP/Options Page (Table 9.1.1)	Set 'Prog Setpoint' = PSP1 Connects PSP1 to become the program SP for Loop 1
6.	In LP2 SETUP/Options Page (Table 9.1.1)	Set 'Prog Setpoint' = PSP1 Connects PSP1 to become the program SP for Loop 2
7.	In LP3 SETUP/Options Page (Table 9.1.1)	Set 'Prog Setpoint' = PSP1 Connects PSP1 to become the program SP for Loop 3

See Appendix D for list of Modbus addresses.

☺ Tip:- See 'Copy and Paste' description in Chapter 3.

6.7.2. Two Profiles, Two Loops

This example explains how to configure a 2604 programmer to generate two setpoints which are then used to profile the setpoint for two independent control loops.

In this example PSP1 and PSP2 are soft wired to the program setpoints of loop 1 and loop 2 respectively. Also, the PV of loop1 is wired to the PV1 source, to provide holdback, and the PSP1 reset source, to provide servo start. The latter is repeated for Loop 2. This configuration is supplied from the factory by defining the hardware code field, in the 2604 order code, for loops/programs to be '222' or '252'.

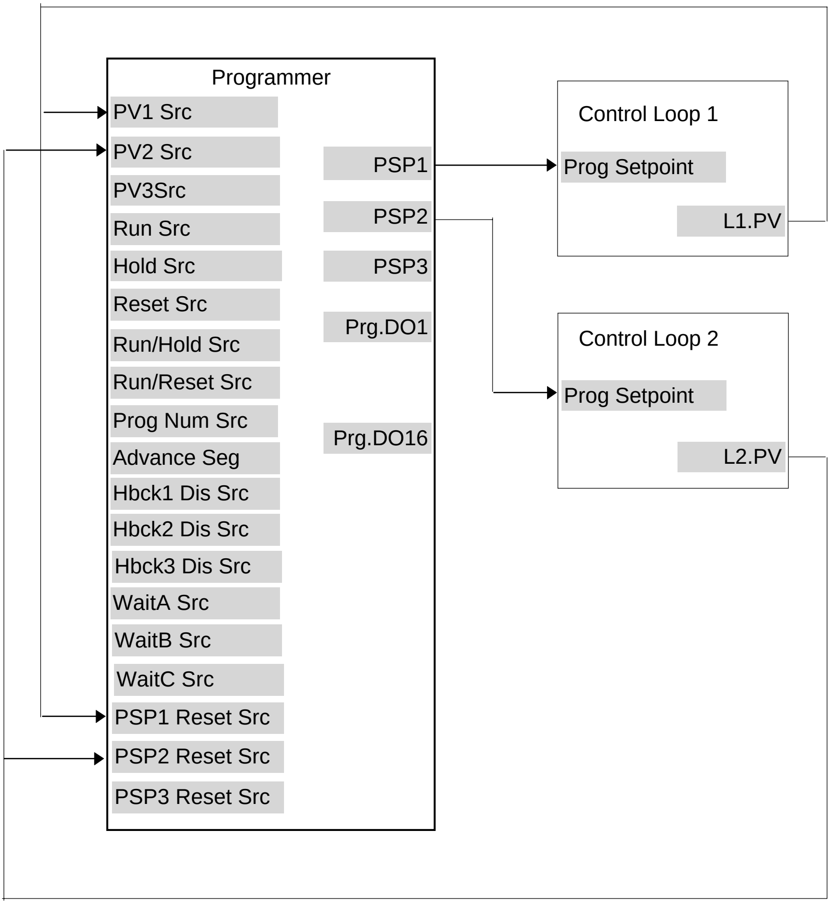


Figure 6-6: Example Programmer Wiring Two Profiles Two Loops

6.7.2.1. Implementation

1.	In INSTRUMENT/Options Page (Table 5.2.1),	set 'Num of Loops' = 2 set 'Programmer = Enabled
2.	In PROGRAM EDIT/Options Page (Table 6.5.1)	set 'Num of PSPs' = 2 (Note: other parameters such as number of digital event outputs, SP range and power failure recovery are also set in this page)
3.	In PROGRAM EDIT/Wiring Page (Table 6.5.1)	Set 'PV1 Src' = 00001:L1.PV This connection is required so that the programmer can use Loop 1 PV to calculate holdback for PSP1.
4.	In PROGRAM EDIT/Wiring Page (Table 6.5.1)	Set 'PV2 Src' = 01025:L2.PV This connection is required so that the programmer can use Loop 2 PV to calculate holdback for PSP2.
5.	In PROGRAM EDIT/Wiring Page (Table 6.5.1)	Set 'PSP1 Reset Src' = 00001:L1.PV This connection is required so that PSP1 can use Loop 1 PV to servo start.
6.	In PROGRAM EDIT/Wiring Page (Table 6.5.1)	Set 'PSP2 Reset Src' = 01025:L2.PV This connection is required so that PSP2 can use Loop 2 PV to servo start.
7.	In LP1 SETUP/Options Page (Table 9.1.1)	Set 'Prog Setpoint' = PSP1 Connects PSP1 to become the program SP for Loop 1
8.	In LP2 SETUP/Options Page (Table 9.1.1)	Set 'Prog Setpoint' = PSP2 Connects PSP2 to become the program SP for Loop 2

See Appendix D for list of Modbus addresses.

☺ Tip:- See 'Copy and Paste' description in Chapter 3.

7. Chapter 7 Alarm Configuration

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.

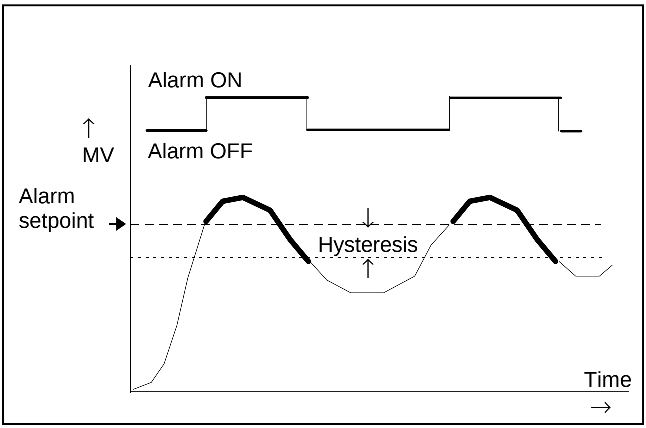
For the purposes of the operation of this controller, alarms and events can be considered the same.

7.2. 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

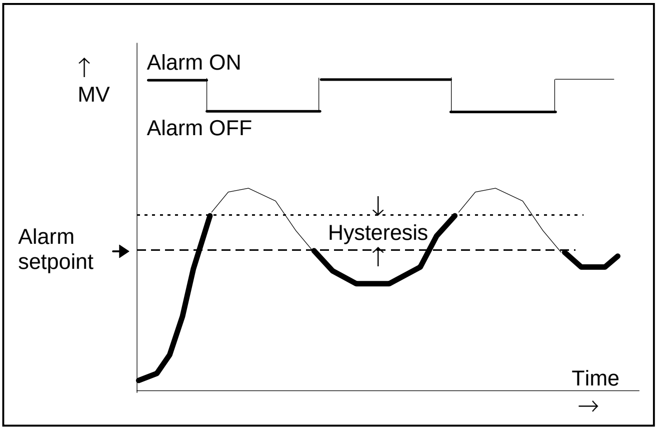
The Process Variable (PV) exceeds a set high level



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

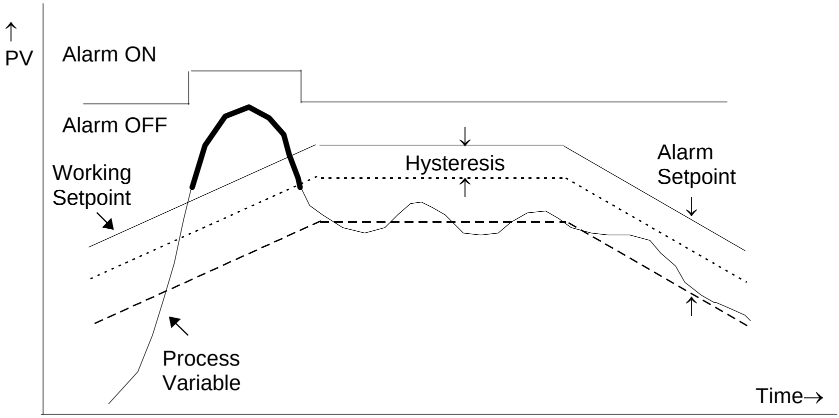
The Process Variable (PV) exceeds a set low level



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.

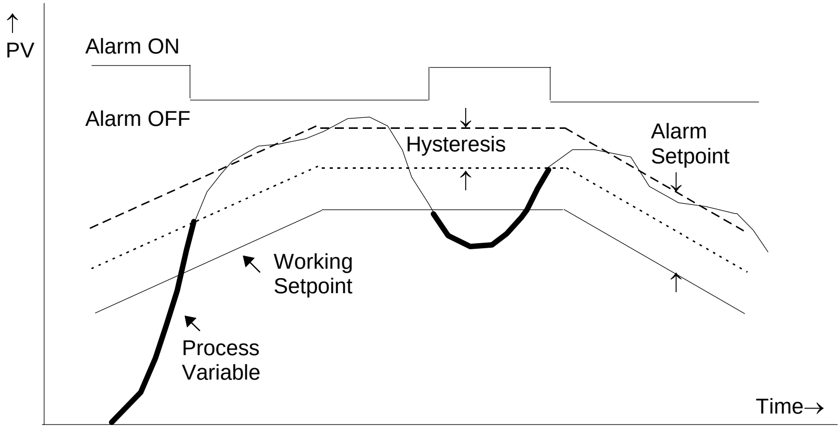
Note: For User Analogue Value the deviation is the difference between the two user wired analogue inputs.



7.2.4. Deviation Low Alarm

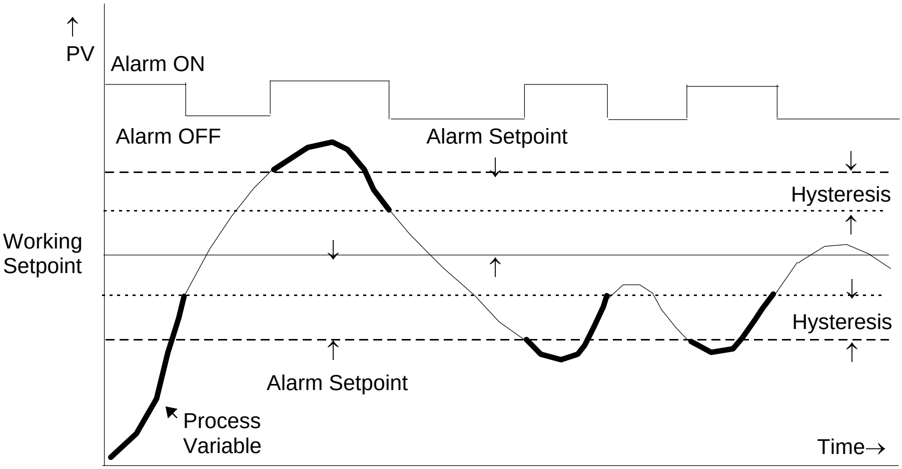
The alarm occurs when the difference between the process variable and the setpoint is negative by greater than the alarm setpoint.

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



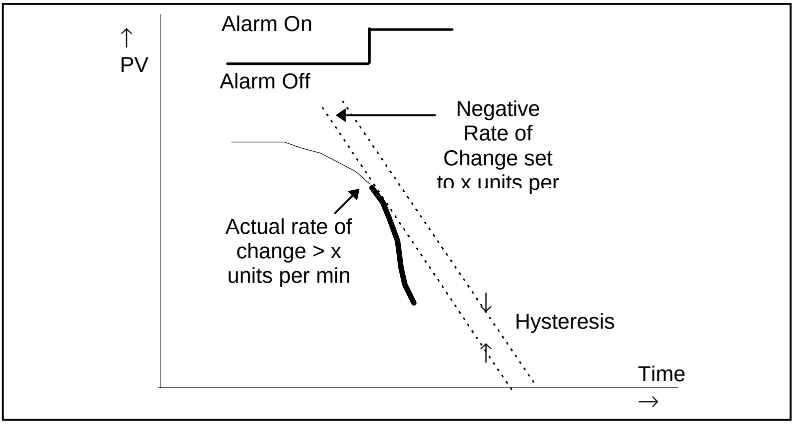
7.2.5. Deviation Band

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.



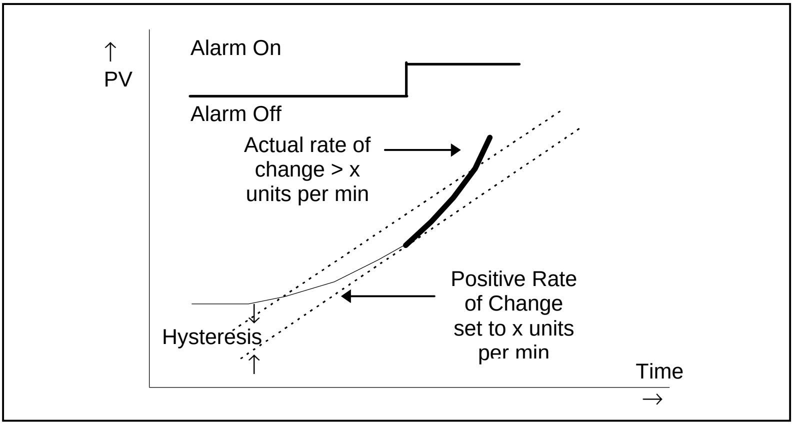
7.2.6. Rate Of Change Alarm (Negative Direction)

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:

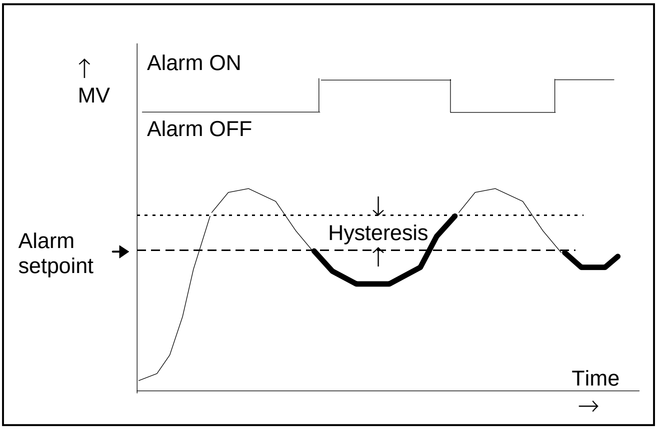
1. Separate alarms are required for positive and negative rates of change
2. An alarm is indicated during the period that the actual rate of change is greater than the set rate of change.
3. There may be a small delay before the instrument displays an alarm condition since the instrument requires several 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.

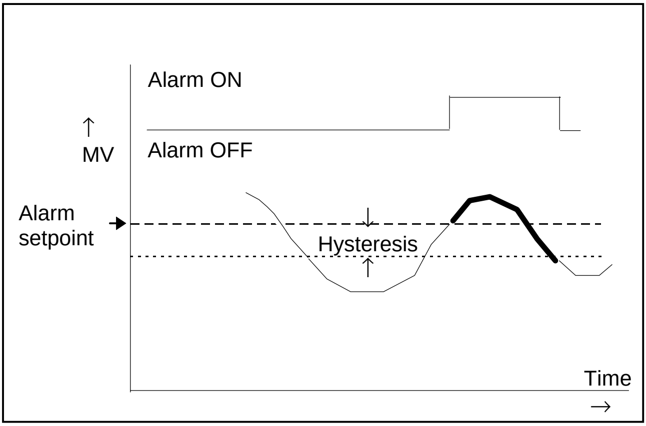
7.3.1. Full Scale Low With Blocking

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.



7.3.2. 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.

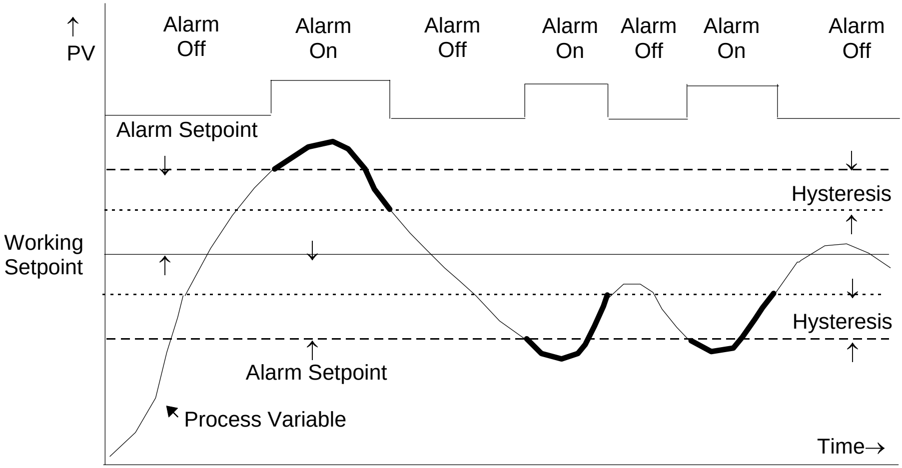


i.e. If the controller is powered up with PV > 'Hi Alarm SP' no alarm is indicated. The PV must reduce below the 'High Alarm SP' and increase again to > 'Hi Alarm SP'. The alarm condition will then be indicated.

If the controller is powered up with PV < 'Hi Alarm SP' an alarm is indicated as soon as PV > 'Hi Alarm SP'

7.3.3. 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:

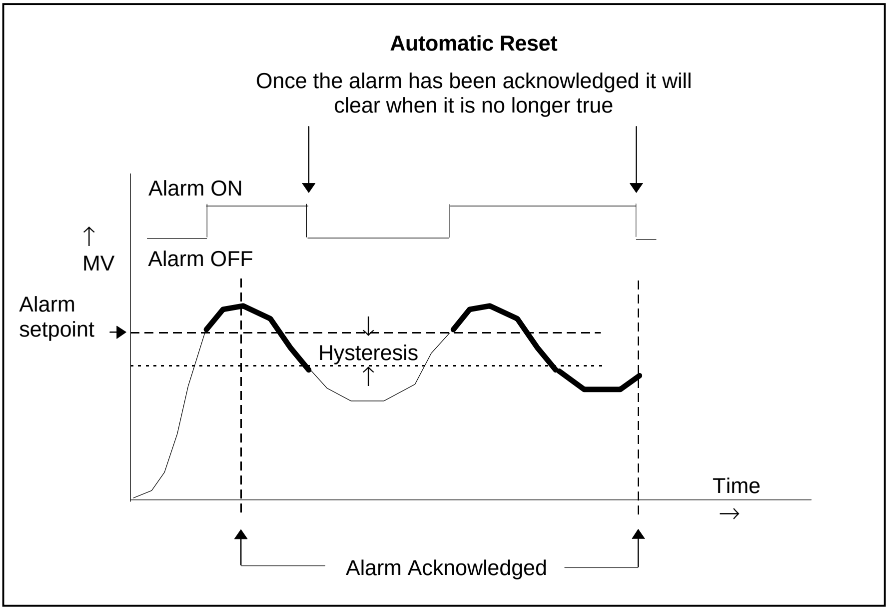
1. **Automatic Reset.** The alarm continues to be active until both the alarm condition is removed AND the alarm is acknowledged. The acknowledgement can occur **BEFORE** the alarm condition is removed.

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.

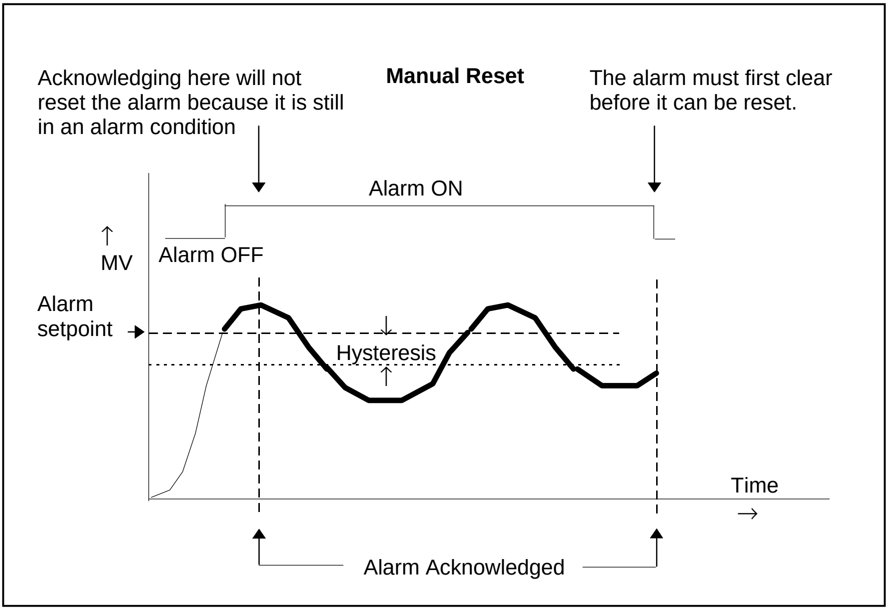
These are shown below for a Full Scale High Alarm

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 if they are required.
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. TO CONFIGURE LOOP 1 ALARM TYPE

There are two alarms associated with each loop. They are shown on the display as Alm1 and Alm2.

Do This	This Is The Display You Should See	Additional Notes
1. From any display press 🗋 as many times as necessary until the **ALARMS** page header is displayed Press ▲ or ▼ to select **LP1 Page**	🗋**:**ALARMS ⬍ *LP1* Page	Text shown in *italics* is user definable and will appear if:- 1. User text is enabled in INSTRUMENT page, see section 5.2.5. 2. The text has been assigned to this parameter
2. Press ⟳ to select **Alm1 Type** Press ▲ or ▼ to select the alarm type	⟳**:**Alm1 Type ⬍ Full Scale Low	For choices of Alarm Type see Note 1.
3. Press ⟳ to select **LP1 Ack** Press ▲ or ▼ to select Acknowledge or No	⟳**:***LP1* Ack ⬍ No	The choices are:- No — No acknowledge Acknowledge — Alarm will need to be acknowledged in operation level. This parameter is also available in Level 1
4. Press ⟳ to select **Alm1 Message** Press ▲ or ▼ to select a message which will appear on the display when the alarm occurs	⟳**:**Alm1 Message ⬍ Default Text	Default text - 'Full Scale Low', as set in 2 above, will be displayed in operation level when this alarm occurs. A choice of up to 50 messages may be substituted for the default message from the User Text 'library'' configured in INSTRUMENT page, see section 5.2.5.

5. Press ⟳ to select **Alm1 Latching** Press ▲ or ▼ to select the latching type	⟳:Alm1 Latching ⬍ None	The choices are:- None Auto Manual Event The operation of latching alarms is described in the Installation and Operation manual, Part No. HA026491.
6. Press ⟳ to select **Alm1 Blocking** Press ▲ or ▼ to select the latching type	⟳:Alm1 Blocking ⬍ No	The choices are:- No Yes The operation of blocking alarms is described in the Installation and Operation manual, Part No. HA026491.
7. Press ⟳ to select **Alm1 Setpoint** Press ▲ or ▼ to set the alarm trip value	⟳:Alm1 Setpoint ⬍ 0.0	This parameter can also be changed in Level 1
8. Press ⟳ to select **Alm1 Hyst** Press ▲ or ▼ to set the alarm hysteresis.	⟳:Alm1 Hyst ⬍ 0.0	This parameter can also be changed in Level 3
9. Press ⟳ to select **Alm1 Delay** Press ▲ or ▼ to set the alarm delay time.	⟳:Alm1 Delay ⬍ 0:00:00.0	The alarm will not be displayed until the time set here has been exceeded.
10. Press ⟳ to select **Alm1 Output**	⟳:Alm1 Output Off	This indicates the state of the alarm. It is also shown in Level 1.
11. Press ⟳ to select **Alm1 Inhibit Src** Press ▲ or ▼ to select the source	⟳:Alm1 Inhibit Src ⬍ 05450:DI02.Val	The alarm can be inhibited while an event is true. Here it is shown soft wired to Digital Input 02
12. Press ⟳ to select **Alm1 Inhibit** Press ▲ or ▼ to select No or Yes	⟳:Alm1 Inhibit ⬍ No	No → the event in 11 is ignored Yes → the alarm waits for the event in 11 to become true.

Note 1 Alarm Types
Off
Full Scale Low
Full Scale High
Deviation Band
Deviation High
Deviation Low
Rate of Change

7.6. ALARM TABLES

The following alarm pages are available:-

Summary	A summary of all alarms. This table is also available in Level 3 but can be promoted to Level 1, see section 5.2.4.	
Alarms Loop 1	See section 7.6 above	
Alarms Loop 2	These are the same as loop 1	Alarms for These pages are configured As in section 7.6
Alarms Loop 3	These are the same as loop 1	
PV Input	High and Low Alarms are available for the fixed PV Input.	
Analogue Input	High and Low Alarms are available for the fixed Analogue Input.	
Module 1, 3, 4, 5 & 6	High and Low Alarms are available each module.	
User 1 to 8	These are alarms which are user defined	

7.6.1. ALARMS (Summary Page)

Table Number: 7-6-1	These parameters indicate alarm status			ALARMS (Summary Page)
Parameter Name	**Parameter Description**	**Value**	**Default**	**Access Level**
New Alarm	Set to true on a new alarm Read only	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 for 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 for 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 for modules 1to 6. Note: module 2 position will always read □	□□□□□□ to ■■■■■■		R/O
Mod Alm Hi 1 - 6	Status of the high alarms for module 1 to 6. Note: module 2 position will always read □	□□□□□□ to ■■■■■■		R/O
Module 1 Ack	Group alarm acknowledge - Acknowledges both high and low alarms for module 1	No Acknowledge		L1
Module 3 Ack	Group alarm acknowledge - Acknowledges both high and	No		L1

	low alarms for module 3	Acknowledge		
Module 4 Ack	Group alarm acknowledge - Acknowledges both high and low alarms for module 4	No Acknowledge		L1
Module 5 Ack	Group alarm acknowledge - Acknowledges both high and low alarms for module 5	No Acknowledge		L1
Module 6 Ack	Group alarm acknowledge - Acknowledges both high and low alarms for 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
User 7 Ack	User alarm 7 acknowledge	No Acknowledge		L1
User 8 Ack	User alarm 8 acknowledge	No Acknowledge		L1
Ack All	Acknowledges all alarms (Global acknowledge)	No Acknowledge		L3
Ack All Src	Global Acknowledge Source	Modbus Address		Conf

Notes:-

1. Alarm parameters in the above table only appear if the function is enabled. The first parameter and the last two parameters always appear.
2. □ = No Alarm
   ■ = Acknowledged Alarm
   ■/□ = Un-acknowledged Alarm

7.6.2. ALARMS (LP1 Page) Parameters

Table Number: 7.6.2.	These parameters configure the Loop 1 alarms. Alarm 1 parameters only appear if the Alarm 1 Type has been set to anything other than None Alarm 2 parameters only appear if the Alarm 2 Type has been set to anything other than None		ALARMS (*LP1*) Page	
Parameter Name	**Parameter Description**	**Value**	**Default**	**Access Level**
Alm1 Type	Alarm 1 Type	Off Full Scale Low Full Scale High Deviation Band Deviation High Deviation Low Rate of Change	As order code	Conf
LP1 Ack	Group alarm acknowledge for loop 1. Acknowledges both loop alarms.	No Acknowledge	No	L1
Alm1 Message	Alarm 1 message. Use △ or ▽ to choose from User Text library set up in section 5.2.5.	Default Text or User defined Text 01 to 50	Default Text	Conf
Alm1 Latching	Alarm 1 latching. Use △ or ▽ to choose latching type	None Auto Manual Event	None	Conf
Alm1 Blocking	Alarm 1 blocking. Use △ or ▽ to enable/disable	No Yes	No	Conf
Alm1 Setpoint	Alarm 1 Setpoint	Controller range	0.0	L1
Alm1 Hyst	Alarm 1 hysteresis	Controller range		L3
Alm1 Delay	Alarm 1 delay	0:00:00.0	0.0	Conf
Alm1 Output	Alarm 1 output	Off On	Off	R/O
Alm1 Inhibit Src	Alarm 1 inhibit source	Modbus address	None	Conf
Alm1 Inhibit	Alarm 1 inhibit	No Yes	No	L3

Alm2 Type	Alarm 2 Type	As alarm 1 type	As order code	Conf
Alm2 Message	Alarm 2 message. Use △ or ▽ to choose from User Text library set up in section 5.2.5.	Default Text or User defined Text 01 to 50	Default Text	Conf
Alm2 Latching	Alarm 2 latching. Use △ or ▽ to choose latching type	None Auto Manual Event	None	Conf
Alm2 Blocking	Alarm 2 blocking. Use △ or ▽ to enable/disable	No Yes	No	Conf
Alm2 Setpoint	Alarm 2 Setpoint	Controller range	0.0	L1
Alm2 Hyst	Alarm 2 hysteresis	Controller range		L3
Alm2 Delay	Alarm 2 delay	0:00:00.0	0.0	Conf
Alm2 Output	Alarm 2 output	Off On	Off	R/O
Alm2 Inhibit Src	Alarm 2 inhibit source	Modbus address		Conf
Alm2 Inhibit	Alarm 2 inhibit	No Yes	No	L3

The above table is repeated for LP2 and LP3 if three control loops have been enabled, see Section 5.2.

7.6.3. ALARMS (PV Input Page) Parameters

Table Number: 7.6.3.	These parameters set up the alarms associated with the PV input signal. They are only displayed if enabled using the parameter FS Hi Alarm or FS Lo Alarm		ALARMS (PV Input Page)	
Parameter Name	**Parameter Description**	**Value**	**Default**	**Access Level**
FS Hi Alarm	Full scale high alarm enable/disable	Disabled Enabled		Conf
PV Alm Ack	Group acknowledge. Acknowledges both Hi and Lo alarms	No Acknowledge		L1
FS Hi Message	Full scale high message. Use △ or ▽ to choose from User Text library set up in section 5.2.5.	Default Text or User defined Text 01 to 50	Default Text	Conf
FS Hi Blocking	Full scale high blocking. Use △ or ▽ to enable/disable	No Yes		Conf
FS Hi Latching	Full scale high latching. Use △ or ▽ to choose latching type	None Auto Manual Event		Conf
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		Conf
FS Hi Output	Full Scale High alarm (1) output	Off On	Off	R/O
FS Lo Alarm	Full scale Low alarm enable/disable	Disabled Enabled		Conf
FS Lo Message	Full scale low alarm message. Use △ or ▽ to choose from User Text library set up in section 5.2.5.	Default Text or User defined Text 01 to 50	Default Text	Conf
FS Lo Latching	Full scale low latching. Use △ or ▽ to choose latching type	None Auto Manual		Conf

		Event		
FS Lo Blocking	Full scale low blocking. Use △ or ▽ to enable/disable	No Yes		Conf
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		Conf
FS Lo Output	Full Scale Low alarm (2) output	Off On	Off	R/O
Inhibit Src	PV input alarm inhibit source	Modbus address		Conf
Inhibit	Alarm 1 and 2 inhibit	No Yes	No	L3

7.6.4. ALARMS (An Input Page) Parameters

The parameters for the Analogue Input Alarms are identical to the PV Input Alarms

7.6.5. ALARMS (Module 1,3, 4, 5 & 6 Page) Parameters

The parameters for the Module Alarms are identical to the PV Input Alarms

7.6.6. ALARMS (User 1 to 8 Page) Parameters

Table Number: 7.6.6.	These parameters set up user defined alarms.			ALARMS (User 1 (to 8) Page)
Parameter Name	**Parameter Description**	**Value**	**Default**	**Access Level**
Type	Alarm Type	Off Full Scale Low Full Scale High Deviation Band Deviation High Deviation Low Rate of Change	As order code	Conf
User 1 Ack	Group alarm acknowledge for user alarm 1	No Acknowledge	No	L1
Src A	Alarm source A	Modbus address	None	Conf
Src B	Alarm source B	Modbus address	None	Conf
Name	User defined alarm name. Use △ or ▽ to choose from User Text library set up in section 5.2.5.	Default Text or User defined Text 01 to 50	Default Text	Conf
Message	User defined message. Use △ or ▽ to choose from User Text library set up in section 5.2.5.	Default Text or User defined Text 01 to 50	Default Text	Conf
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 Setpoint	Controller range		L1
Hyst	Alarm hysteresis	Controller range		L3
Delay	Alarm delay	0:00:00.0		Conf

Output	Alarm 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 Src	Alarm inhibit source	Modbus address		Conf
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

7.7. ALARM WIRING EXAMPLES

7.7.1. Control Loop With High and Low Alarms

In this example two alarms are added to the loop wiring example shown in Section 3.1. Alarm 1 is configured as a high alarm and operates the fixed relay 'AA'. This relay is inhibited until a digital input, 'DIO1' becomes true. Alarm 2 is configured as a low alarm and operates a relay module in slot 2.

- - - - - - - = Connections made in example shown in Section 3.1

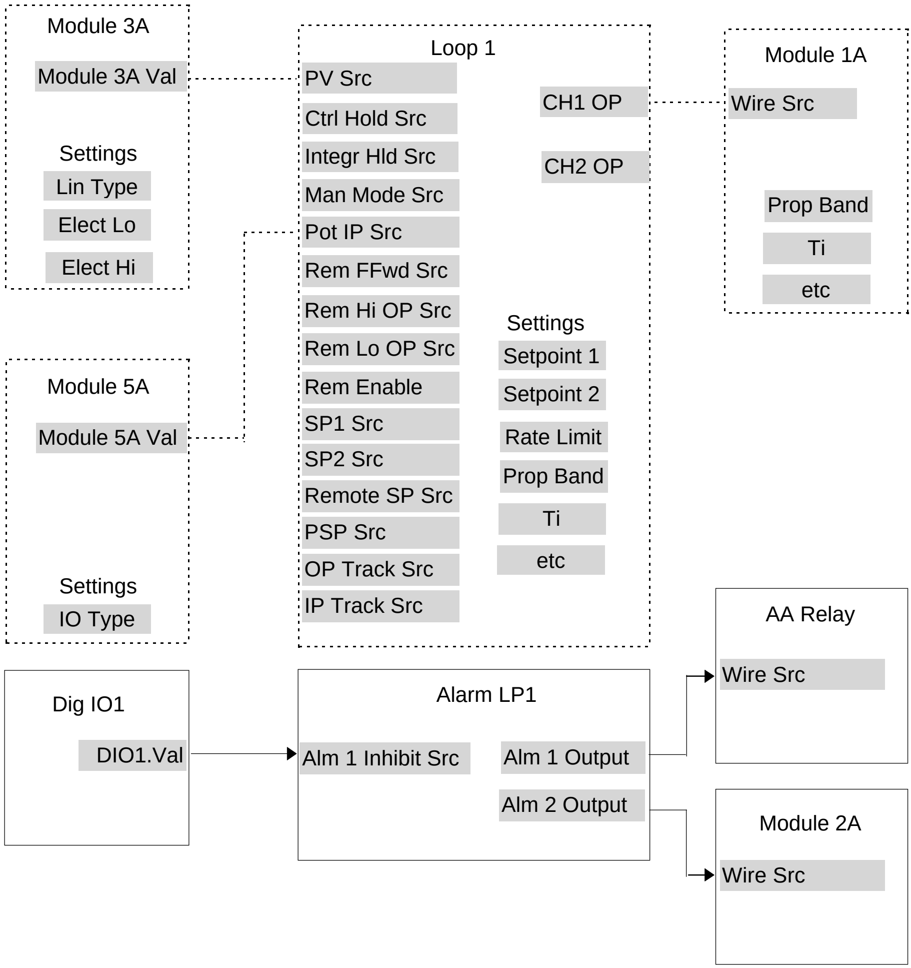


Figure 7-1: Loop Alarm Wiring

7.7.1.1. Implementation

1.	In ALARMS/LP1 Page (Table 7.6.2)	set 'Alm1 Type' = Full Scale High
2.	In ALARMS/LP1 Page (Table 7.6.2)	set 'Alm2 Type' = Full Scale Low (Note: other parameters such as alarm message, alarm latching, alarm blocking are also set in this page)
3.	In ALARMS/LP1 Page (Table 7.6.2)	Set 'Alm1 Inhibit Src' = 05402:DO1.Val This connects the alarm 1 inhibit to fixed digital input 1
4.	In STANDARD IO/AA Relay Page (Table 17.3.1)	Set 'Wire Src' = 11592:L1Alm1.OP This connects Alarm 1 output to operate the AA relay
5.	In MODULE IO/Module 2A Page (Table 18.3.1)	Set 'Wire Src' = 11602:L1Alm2.OP This connects Alarm 2 output to operate the relay fitted in module position 2.

See Appendix D for list of Modbus addresses.

☺ **Tip:- See 'Copy and Paste' description in Chapter 3.**

7.7.2. Loop Alarm Inhibited if Programmer not in Run

In this example the alarm is gated as in the previous example. To determine if the programmer is in Run mode an Analogue Operator (An Oper 1) is used.

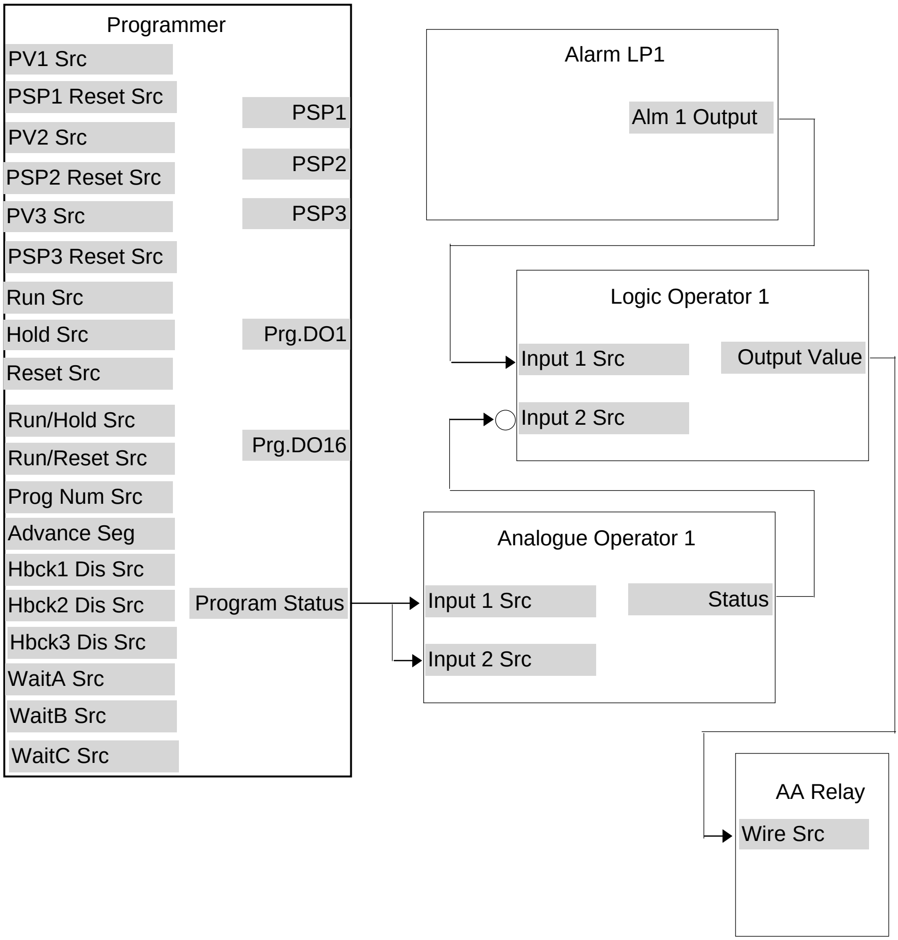


Figure 7-2: Loop Alarm Inhibited if Programmer not in Run

7.7.2.1. Implementation

1. In LOGIC OPERS/Logic 1 Page (Table 15.1.2)	set 'Operation' = AND set 'Invert' = Invert Input 1 Invert input 1 is necessary because the previous operation results in 0 for a true state Set 'Input 1 Src' = 06239:--------- This is the Status of the Logic Operator Set 'Input 2 Src' = 11592: L1Alm1.OP This sets the logic operator such that both inputs must be true before the output status is true
2. In ANALOGUE OPERS/Analogue 1 Page (Table 14.1.2)	set 'Operation' = Select Max set 'Input 1 Src = 05844:--------- This is the Programmer Status set 'Input 2 Src' = 05844 It is necessary to connect both inputs of an analogue operator set 'Input 1 Scalar' = 1 set 'Input 1 Scalar' = 2 set 'Low Limit' = +1 set 'High Limit' = +1 (Note: when Programmer Status = Run the result of the calculation is 0)
3. In STANDARD IO/AA Relay Page (Table 17.3.1)	Set 'Wire Src' = 07176:LgOp1.OP This connects Logic Operator 1 output to operate the AA relay

8. Chapter 8 Autotune

Tuning is explained in the Installation and Operation Handbook, Part No. HA026491. The table of parameters, all of which are available in operation level, is reproduced here for reference.

8.1. AUTOTUNE PARAMETERS

Table Number: 8.1..	These parameters allow you to autotune the controller		AUTOTUNE	
Parameter Name	**Parameter Description**	**Value**	**Default**	**Access Level**
Autotune Loop	Selects the loop to auto tune	Off *LP1* *LP1A* *LP1* (CSD) *LP2* *LP2A* *LP2* (CSD) *LP3* *LP3A* *LP3* (CSD)	Off	L1 R/O
Autotune State	Tuning state This can be interrogated here, but it is also displayed on the lower LCD display when the controller is tuning, see also 8.1.1.	Not Tuning Measuring Noise Tuning at SP Tuning to SP Finding Minimum Finding Maximum Storing Time End Calculating PID ABORTED	Not Tuning	
Tune OP	Output power during tuning	-100 to 100%		R/O
Tune OH	Auto tune high power limit. Allows a limit to be set on the power output during tuning	-100 to 100%		L1
Tune OL	Auto tune low power limit. Allows a limit to be set on the power output during tuning	-100 to 100%		L1
CSD Tune State	Cascade tuning state	Off Initialising Tuning Slave Waiting Waiting Again Initialising Tuning Master	Off	L1 R/O

8.1.1. How Tuning State is Displayed

When a loop is tuning the middle readout flashes between the parameter it is set up to display normally (usually SP), tune and the loop name, as follows:-

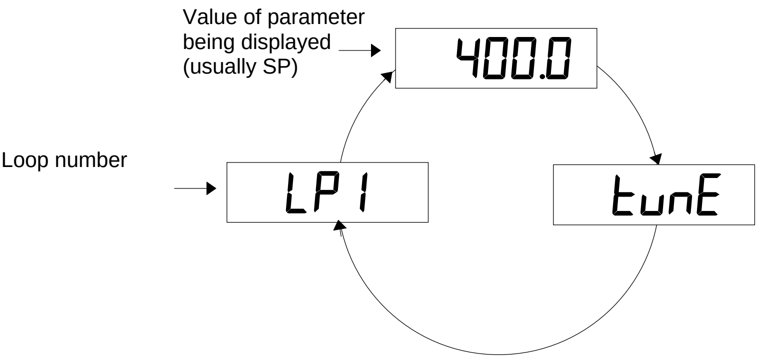


Figure 8-1: Display of Tuning State (Middle Display)

When the Loop View is selected the lower readout flashes between the current Tuning State message and the power output bar graph, as shown below.
Note: This message is only shown when the Loop View is selected

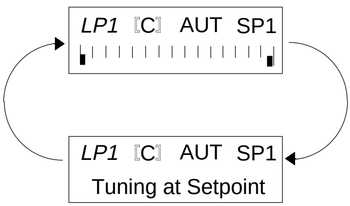


Figure 8-2: Display of Tuning State (Lower Display)

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

LP1 SETUP (Options Page)	These parameters configure loop options. (Shown - Always)
LP1 SETUP (Wiring Page)	These parameters allow you to soft wire between function blocks (Shown - Always)
LP1 SETUP (SP Page)	These parameters are associated with the setpoint of a particular loop (Shown - Always)
LP1 SETUP (SP(Aux)Page)	These parameters are associated with the setpoint of the auxiliary loop. (Shown - Cascade or Override)
LP1 SETUP (Cascade Page)	These parameters configure cascade control. (Shown - Cascade only)
LP1 SETUP (Ratio Page)	These parameters configure ratio control. (Shown - Ratio only)
LP1 SETUP (Override Page)	These parameters configure override control. (Shown - Override only)
LP1 SETUP (PID Page)	These parameters allow you to set up the three term or PID values for the selected loop. (Shown - Always)
LP1 SETUP (PID Aux) Page)	These parameters allow you to set up the three term or PID values for the selected auxiliary loop. (Shown - Cascade or Override)
LP1 SETUP (Motor Page)	To set up valve positioning output parameters when the selected loop is configured for motorised valve control.
LP1 SETUP (Output Page)	To set up output parameters when the selected loop is configured for analogue or digital control outputs. (Shown - Always)
LP1 SETUP (Diagnostic Page)	These parameters are for diagnostic purposes on the selected loop. (Shown - Always)
LP1 SETUP (Display Page)	These parameters configure the loop display summary. (Shown - Always)
LP1 SETUP (Disp Aux Page)	These parameters configure the auxiliary loop display in the lower readout. (Shown - Cascade or Override & Ratio)
LP1 SETUP (Load Sim Page)	These parameters allow you to simulate various closed loop controllers.(Shown - only if Load Simulation is enabled)

1. Each header listed above is repeated for each control loop configured.
2. Text shown in *italics* can be chosen from User Text library, see section 5.2.5.

9.1.1 LOOP SET UP (Options page)

Table Number: 9.1.1.	These parameters configure loop options (x) See notes for parameter further descriptions		*LP1* SETUP Options Page	
Parameter Name	**Parameter Description**	**Value**	**Default**	**Access Level**
Loop Type	To configure loop type	Single Cascade Override Ratio	As order code	Conf
Control Type (1)	Control type	See note 1	As order code	Conf
Control Action (2)	Control action	Reverse Direct	Reverse	Conf
Cool Type (3)	Cooling action	Linear Oil Water Fan		Conf
Prog Setpoint (4)	Loop 1 PSP select	PSP1 PSP2 PSP3 None		Conf
Deriv Type (5)	Derivative type	PV Error	PV	Conf
FF Type (6)	Feedforward type	None Wired Feedforward SP Feedforward PV Feedforward		Conf
Force Man Mode (7)	Forced manual output mode.	Off Track Step		Conf
Rate Lim Units (8)	Rate limit units	Per Second Per Minute Per Hour	Per minute	Conf
Bumpless PD	Initialises the manual reset on Auto/Manual transfer	Yes No	Yes	Conf

Ti/Td Units	Integral and Derivative time units	sec min	sec	Conf
OnOff SBk Type	Sensor break action. Only appears if On Off control is configured	-100 0 100		Conf
Prop Band Units	Proportional band units	Eng Units		R/O
Enable Pwr Fbk	Power feedback enable	Off On		Conf
Rem SP Config	Remote setpoint configuration	SP Only LSP Trim RSP Trim	SP Only	Conf
SBrk Type	Sensor break type	Output Hold		Conf
Manual Track [9]	Manual track	Off Track		Conf
Remote Track [10]	Remote tracking	Off Track		Conf
Program Track [11]	Programmer track	Off Track		Conf

Notes

1. Control Types

PID-Ch1 PID-Ch2	Both output channels PID. Use for heat/cool type applications
PID-Ch1 OnOff-Ch2	Channel 1 PID control, channel 2 On/Off. Use for single channel PID control plus On/Off Control
OnOff-Ch1&2	Both output channels On/Off. Use for On/Off control
PID-Ch1 Only	Channel 1 PID only. Use for single channel control only
OnOff-Ch1 Only	Channel 1 On/Off. Use for On/Off control.
VP-Ch1 Only	Channel 1 Motorised valve position output - boundless mode.

2. Control Action

Direct The output will increase positively if the PV > SP.

Reverse The output will increase positively if PV < SP.

3. Cool Type

Linear The control output follows linearly the PID output signal, i.e. 0% PID demand = 0 power output, 100% PID demand = 100% power output.

Oil, Water, Fan The control output is characterised to compensate for the non-linear effect of the cooling medium - oil, water and blown air. Typically used in extrusion processes.

4. Prog Setpoint

When the programmer is running, this parameter determines from which setpoint profile the loop obtains its setpoint. If None is selected this parameter can be soft wired.

5. Deriv Type

Derivative on PV defines that derivative action responds to changes to PV only
Derivative on Error defines that derivative action responds to changes to differences between SP and PV.

6. FF Type

Feedforward control is used typically to overcome time delays or to compensate for the effect of external influences such as control signals from other loops in the process. This is added directly to the output of the PID algorithm, before output limiting and dual output conversions are performed. Trim Limit applied to the PID calculated output is possible when Feedforward is enabled.

7. Force Manual Mode

Force Manual Mode allows you to select how the loop behaves on auto/ manual transfer.

Off	Transfer between auto/manual/auto takes place bumplessly
Track	Transfer from auto to manual, the output reverts to the <u>previous</u> manual value. Transfer from manual to auto takes place bumplessly
Step	Transfer from auto to manual, the output goes to a pre-set value. Transfer from manual to auto takes place bumplessly

8. Rate Limit Units

Rate limit can be applied to the SP, such that the change in PV takes place at a controlled rate. It is used where a full programmer is not justified and is typically used to protect the process from sudden changes in the PV.

9. Manual Track

When the controller is switched into Manual mode the working setpoint tracks the value of the PV so that on return to Auto mode is bumpless.

10. Remote Track

When the controller is switched into Remote SP mode the local setpoint tracks the value of the remote SP so that the return to Local SP is bumpless.

11. Program Track

When the controller is running a program the local setpoint tracks the value of the program setpoint. If the controller is switched to Local SP the transfer takes place bumplessly.

9.1.2 LOOP SET UP (Wiring page)

9.1.2.1 Controller Configured For Single Loop

Table Number: 9.1.2.1.	These parameters allow you to soft wire between function blocks.		*LP1* SETUP Wiring Page	
Parameter Name	**Parameter Description**	**Value**	**Default**	**Access Level**
Pv Src	Process variable source	Modbus address	05108: PVIn.Val	Conf
Ctrl Hold Src	Freeze control flag source	Modbus address		Conf
Integr Hld Src	Integral hold flag source	Modbus address		Conf
Man Mode Src	Auto/manual select source	Modbus address		Conf
Pot IP Src	Pot position source	Modbus address		Conf
Rem FFwd Src	Remote feedforward source	Modbus address		Conf
Rem Hi OP Src	Remote high power limit source	Modbus address		Conf
Rem Lo OP Src	Remote low power limit source	Modbus address		Conf
The above two parameters do not appear if Control Type (Table 9.1.1.) = On/Off				
Rem SP Ena Src	Remote setpoint enable source	Modbus address		Conf
Remote SP Src	Remote setpoint source	Modbus address		Conf
SP Select Src	Internal setpoint select source	Modbus address		Conf
SP1 Src	Setpoint 1 source	Modbus address		Conf
SP2 Src	Setpoint 2 source	Modbus address		Conf
Prog SP Src	LP1 PSP wire source	Modbus address		Conf
PID Set Src	PID Set Source	Modbus address		Conf
Power FF Src	Power feedforward source	Modbus address		Conf
Ena OP Trk Src (1)	OP track enable source	Modbus address		Conf
OP Track Src	Track output source	Modbus address		Conf

Notes:-

1. Track

The Track function is shown in the PID block diagram Figure 9-10. The purpose of Track is to allow an external source of output to stop integral wind up in some applications, such as cascade control. The integral will calculate a PID output to match the external value when manual to auto or bumpless transfer is activated.

9.1.2.2 Controller Configured For Cascade

Table Number: 9.1.2.2.	These parameters allow you to soft wire between function blocks.			*LP1* SETUP Wiring Page
Parameter Name	**Parameter Description**	**Value**	**Default**	**Access Level**
PV Src	Process variable source	Modbus address	05108: PVIn.Val	Conf
Aux PV Src	Auxiliary PV source	Modbus address		Conf
Aux LSP Src	Auxiliary local SP source	Modbus address		Conf
Casc Disable Src	Cascade disable source	Modbus address		Conf
Casc FFwd Src	Casc. feedforward source	Modbus address		Conf
The above parameter does not appear if FF Type (Table 9.1.1.) = None				
Casc TrmLim Src	Casc. FF trim limit source	Modbus address		Conf
Ctrl Hold Src	Freeze control flag source	Modbus address		Conf
AuxCtrlHold Src	Aux. freeze control flag src	Modbus address		Conf
Integr Hld Src	Integral hold flag source	Modbus address		Conf
Aux I Hold Src	Aux. Integral hold flag src	Modbus address		Conf
Man Mode Src	Auto/manual select source	Modbus address		Conf
Pot IP Src	Pot position source	Modbus address		Conf
Rem FFwd Src	Remote feedforward src	Modbus address		Conf
Rem Hi OP Src	Remote hi power limit src	Modbus address		Conf
Rem Lo OP Src	Remote lo power limit src	Modbus address		Conf
The above two parameters do not appear if Control Type (Table 9.1.1.) = On/Off				
Rem SP Ena Src	Remote SP enable source	Modbus address		Conf
Remote SP Src	Remote setpoint source	Modbus address		Conf
SP Select Src	Internal SP select source	Modbus address		Conf
SP1 Src	Setpoint 1 source	Modbus address		Conf
SP2 Src	Setpoint 2 source	Modbus address		Conf
Prog SP Src	LP1 PSP wire source	Modbus address		Conf
PID Set Src	PID Set Source	Modbus address		Conf
Aux PID Set Src	Auxiliary PID Set Source	Modbus address		Conf
Power FF Src	Power feedforward source	Modbus address		Conf
Ena OP Trk Src	OP track enable source	Modbus address		Conf
OP Track Src	Track output source	Modbus address		Conf
EnaAuxOPTrkSrc	Aux. OP track enable src	Modbus address		Conf
Aux OP Trk Src	Aux. track output source	Modbus address		Conf

9.1.2.3 Controller Configured For Ratio

Table Number: 9.1.2.3.	These parameters allow you to soft wire between function blocks.			*LP1* SETUP Wiring Page
Parameter Name	**Parameter Description**	**Value**	**Default**	**Access Level**
PV Src	Process variable source	Modbus address	05108: PVIn.Val	Conf
Lead PV Src	Lead PV source	Modbus address		Conf
Ratio SP Src	Ratio setpoint source	Modbus address		Conf
Ratio Trim Src	Ratio trim source	Modbus address		Conf
Ctrl Hold Src	Freeze control flag source	Modbus address		Conf
Integr Hld Src	Integral hold flag source	Modbus address		Conf
Man Mode Src	Auto/manual select source	Modbus address		Conf
Pot IP Src	Pot position source	Modbus address		Conf
Rem FFwd Src	Remote feedforward source	Modbus address		Conf
Rem Hi OP Src	Remote high power limit source	Modbus address		Conf
Rem Lo OP Src	Remote low power limit source	Modbus address		Conf
The above two parameters do not appear if Control Type (Table 9.1.1.) = On/Off				
Rem SP Enab Src	Remote setpoint enable source	Modbus address		Conf
Remote SP Src	Remote setpoint source	Modbus address		Conf
SP Select Src	Internal setpoint select source	Modbus address		Conf
SP1 Src	Setpoint 1 source	Modbus address		Conf
SP2 Src	Setpoint 2 source	Modbus address		Conf
Prog SP Src	LP1 PSP wire source	Modbus address		Conf
PID Set Src	PID Set Source	Modbus address		Conf
Aux PID Set Src	Auxiliary PID Set Source	Modbus address		Conf
Power FF Src	Power feedforward source	Modbus address		Conf
Ena OP Trk Src	OP track enable source	Modbus address		Conf
OP Track Src	Track output source	Modbus address		Conf

9.1.2.4 Controller Configured For Override

Table Number: 9.1.2.4.	**These parameters allow you to soft wire between function blocks.**		***LP1* SETUP Wiring Page**	
Parameter Name	**Parameter Description**	**Value**	**Default**	**Access Level**
PV Src	Process variable source	Modbus address	05108: PVIn.Val	Conf
Aux PV Src	Auxiliary PV source	Modbus address		Conf
Aux LSP Src	Auxiliary local SP source	Modbus address		Conf
Ctrl Hold Src	Freeze control flag source	Modbus address		Conf
AuxCtrlHold Src	Aux freeze control flag src	Modbus address		Conf
Integr Hld Src	Integral hold flag source	Modbus address		Conf
Aux I Hold Src	Aux. Integral hold flag src	Modbus address		Conf
Man Mode Src	Manual mode source	Modbus address		Conf
Active Lp Src	Active loop source	Modbus address		Conf
OVR Disab Src	Override disable source	Modbus address		Conf
OVR Trim Src	Override trim source	Modbus address		Conf
Pot IP Src	Pot position source	Modbus address		Conf
Rem FFwd Src	Remote feedforward src	Modbus address		Conf
Rem Hi OP Src	Remote hi power limit src	Modbus address		Conf
Rem Lo OP Src	Remote lo power limit src	Modbus address		Conf
The above two parameters do not appear if Control Type (Table 9.1.1.) = On/Off				
Rem SP Ena Src	Remote SP enable source	Modbus address		Conf
Remote SP Src	Remote setpoint source	Modbus address		Conf
SP Select Src	Internal SP select source	Modbus address		Conf
SP1 Src	Setpoint 1 source	Modbus address		Conf
SP2 Src	Setpoint 2 source	Modbus address		Conf
Prog SP Src	LP1 PSP wire source	Modbus address		Conf
PID Set Src	PID Set Source	Modbus address		Conf
Aux PID Set Src	Auxiliary PID Set Source	Modbus address		Conf
Power FF Src	Power feedforward source	Modbus address		Conf
Ena OP Trk Src	OP track enable source	Modbus address		Conf
OP Track Src	Track output source	Modbus address		Conf
EnaAuxOPTrkSrc	Aux. OP track enable src	Modbus address		Conf
Aux OP Trk Src	Aux. track output source	Modbus address		Conf

9.2 SETPOINT DEFINITION

The controller setpoint is the **Working Setpoint** which may be sourced from a number of alternatives. This is the value ultimately used to control the process variable in a loop.
LSP derives from a parameter called the local setpoint which is the value which the operator can alter. This local SP may be derived one of two setpoints, **Setpoint 1** or **Setpoint 2**.
Either of these setpoints may be selected by a parameter in the controller or soft wired to a digital input.
In remote mode, the working setpoint is modified by the **Remote SP + Local Trim**, when 'Enable Rem SP' is set to 'Yes'. When 'Remote Track' (*LP1* SETUP (Options Page)) is set to 'Track' the transition to the 'Active Local SP' (SP1 or SP2) takes place bumplessly and the Active Local SP tracks the value of the Remote SP.
In a controller/programmer the Working SP is derived from the output of the programmer function block. In this case the setpoint varies in accordance with fixed rates of change stored within a program.

9.2.1 Setpoint Function Block

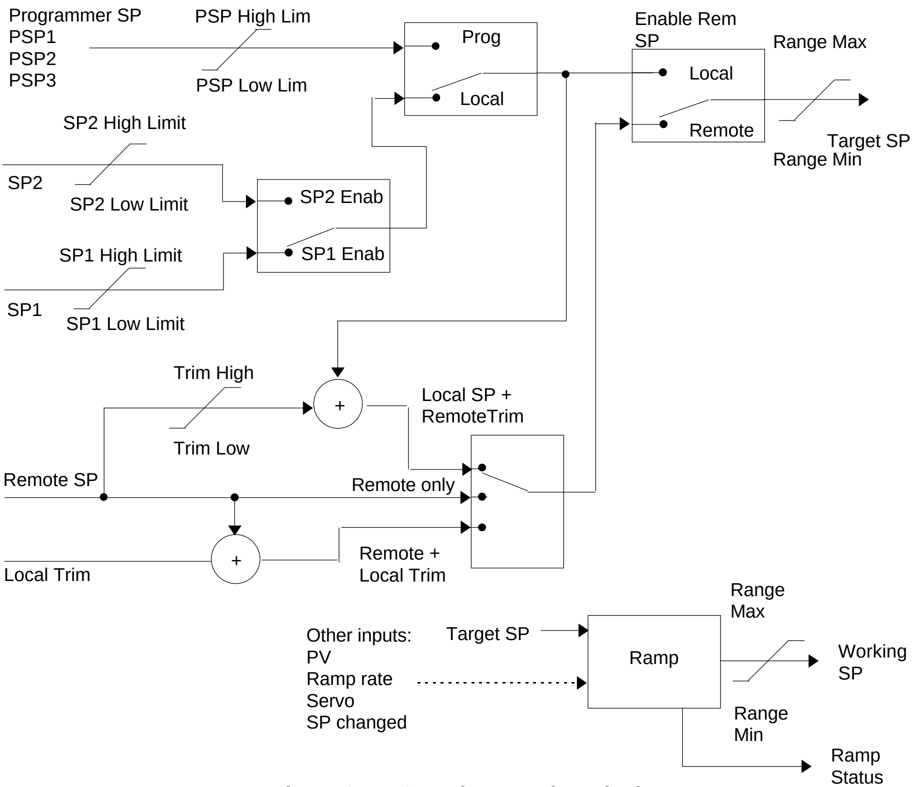


Figure 9-1: Setpoint Function Block

9.2.2 Setpoint Parameters

Table Number: 9.2.2.	**This list allows you to configure SP parameters** Other parameters are available in operation levels			***LP1* SETUP (SP Page)**
Parameter Name	**Parameter Description**	**Value**	**Default**	**Access Level**
Range Min	PV low limit	Min to max	-200 *	Conf
Range Max	PV high limit	disp. limit	1372 *	Conf
SP Select	Internal setpoint select	Setpoint 1 Setpoint 2		L1
SP1 Low Limit	Setpoint 1 low limit	Range units	-200 *	L3
SP1 High Limit	Setpoint 1 high limit		1372 *	L3
Setpoint 1	Setpoint 1 value			L1
SP2 Low Limit	Setpoint 2 low limit		-200 *	L3
SP2 High Limit	Setpoint 2 high limit		1372 *	L3
Setpoint 2	Setpoint 2 value			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	Applies a trim value to the remote setpoint			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 Band		L3
HBk Value	SP rate limit holdback value	Display range		R/O
HBk Status	SP rate limit holdback status	Off Holdback		L3
* If temp units = ^{o}C				

9.2.3 *LP1* SETUP (SP Aux) Page

Table Number: 9.2.3	**This list allows you to configure auxiliary loop setpoint limits.** It only appears if cascade or override control is configured, see section 9.1.1. Other parameters are available in operation levels**.**	***LP1* SETUP (SP Aux) Page**

Parameter Name	Parameter Description	Value	Default	Access Level
Range Min	Auxiliary PV low limit	Min to max display limit	-200 *	Conf
Range Max	Auxiliary PV high limit		1372 *	Conf
SP Low Limit	Auxiliary setpoint 1 low limit	Range units	-200 *	L3
SP High Limit	Auxiliary setpoint 1 high limit		1372 *	L3
Ovr SP Trim	Override loop setpoint trim			L3. Only appears when Override control is configured
Local SP	The setpoint which the controller reverts to when not in cascade, ratio or override			L1
Working SP	The current value of the setpoint in use			L1
* If temp units = ^oC				

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

9.3 CASCADE CONTROL

9.3.1 Overview

Cascade control is classified as an advanced control technique used, for example, 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.

9.3.2 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.

9.3.3 Cascade with Feedforward

An available option with cascade control is feedforward. It allows either the master PV, master SP or user defined variable (Remote Feedforward) 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 Cascade Trim Limit, set in engineering units, when Feedforward is selected. The Cascade Trim Limit is applied to the PID output of the master loop for PV and SP Feedforward. For Remote Feedforward, the Cascade Trim Limit is applied to the Remote Input source. These alternatives are shown in Figures 9-2 and 9-3 respectively.

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).
Remote feedforward is a user defined, wireable parameter (Rem FFwd Src). It may be 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

9.3.4 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.

9.3.5 Cascade Controller Block Diagram

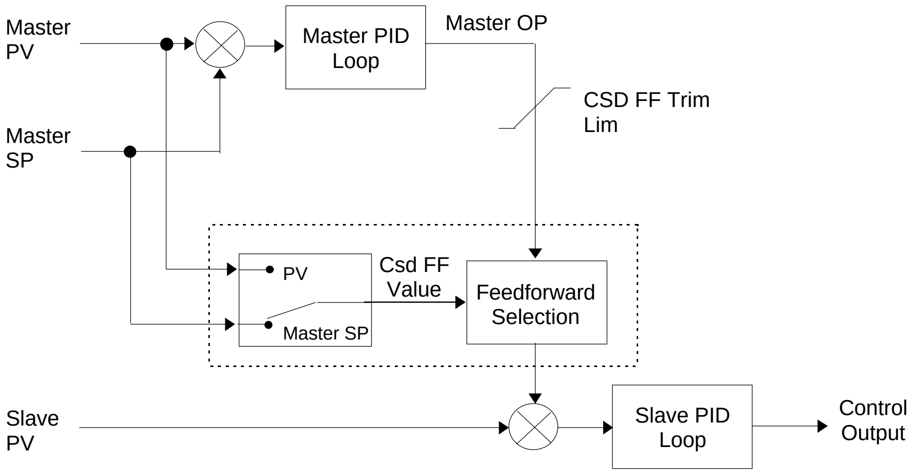


Figure 9-2: Cascade Controller with PV or SP Feedforward Block Diagram

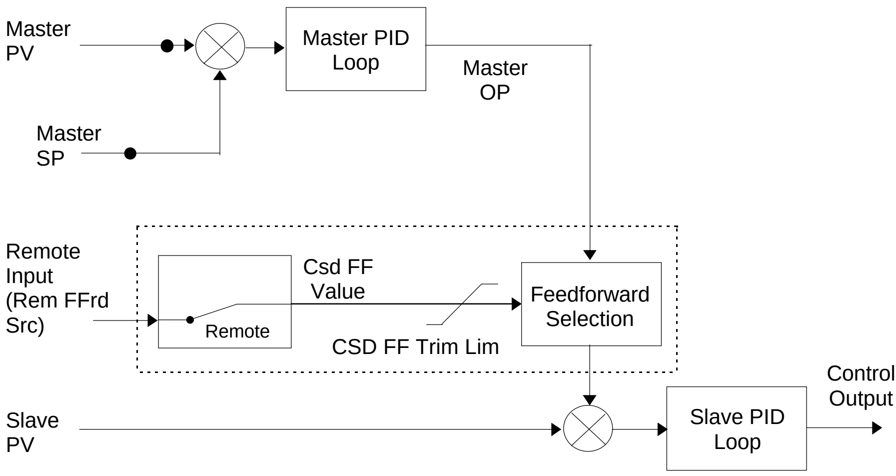


Figure 9-3: Cascade Controller with Remote Input Feedforward Block Diagram

9.3.6 Cascade Parameters

Table Number: **9.3.6.**	**This list allows you to set up parameters specific to cascade controllers.** It only appears if cascade is configured, see section 9.1.1.			***LP1* SETUP** **(Cascade Page)**
Parameter Name	**Parameter Description**	**Value**	**Default**	**Access Level**
Disable CSD	Cascade disable status. (It is sometimes useful to disable cascade when starting a process. This also returns the controller to single loop control using the local SP.)	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

9.3.7 Cascade Function Block

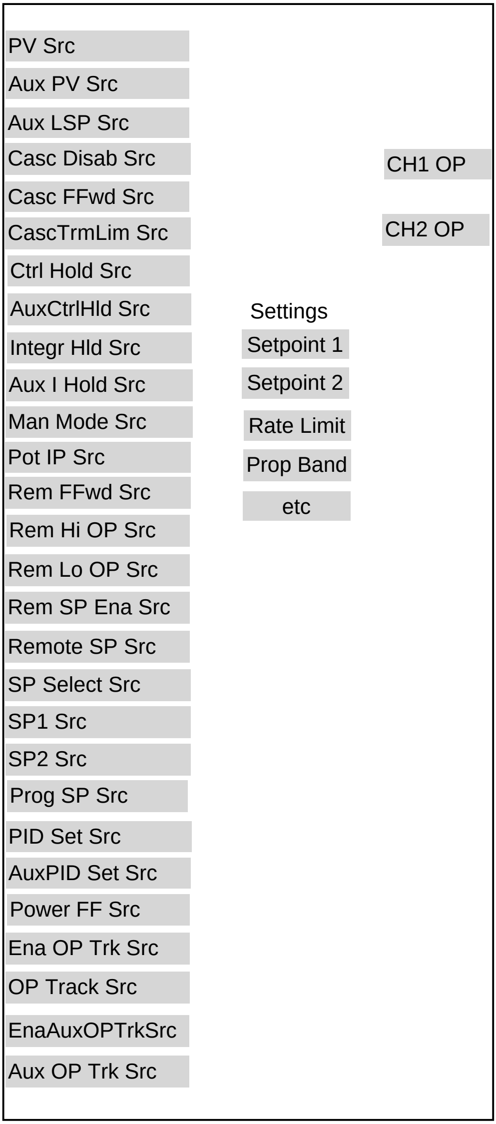


Figure 9-4: Cascade Function Block

Examples of wiring the cascade function block are given in Section 9.13.

9.4 RATIO CONTROL

9.4.1 Overview

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.

9.4.2 Basic Ratio Control

The 2604 contains a ratio control function block which can be used in any control loop. Figure 9.4 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.

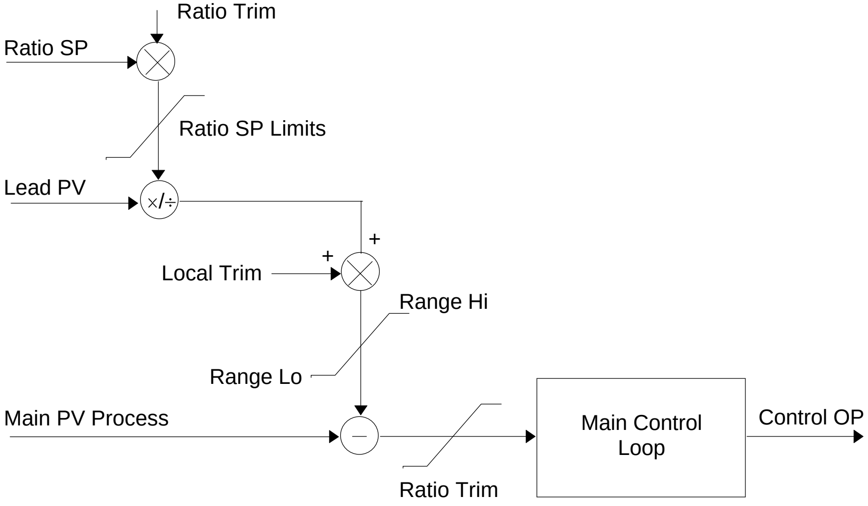


Figure 9-5: Simple Ratio Control Block Diagram

The measured ratio is calculated from the Lead PV and the Process PV. It is also possible to enable 'Ratio Track'. If 'Enable Ratio' is set to 'Off' and Ratio Track is set to 'On', then the Ratio SP will track the measured ratio. This feature allows the user to set the Ratio SP according to the condition of the process.

9.4.3 Ratio Parameters

Table Number: 9.4.3.	**This list allows you to set up parameters specific to ratio controllers.** It only appears if ratio is configured, see section 9.1.1.	***LP1* SETUP** (Ratio Page)

Parameter Name	Parameter Description	Value	Default	Access Level
Ratio Resol	Ratio display resolution	XXXXX XXXX.X XXX.XX XX.XXX		Conf
Ratio Type	Ratio type	Divide Multiply		Conf
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 Track	Ratio track mode	Off On		Conf
Ratio Trim	Ratio trim value			L1

9.4.4 Ratio Function Block

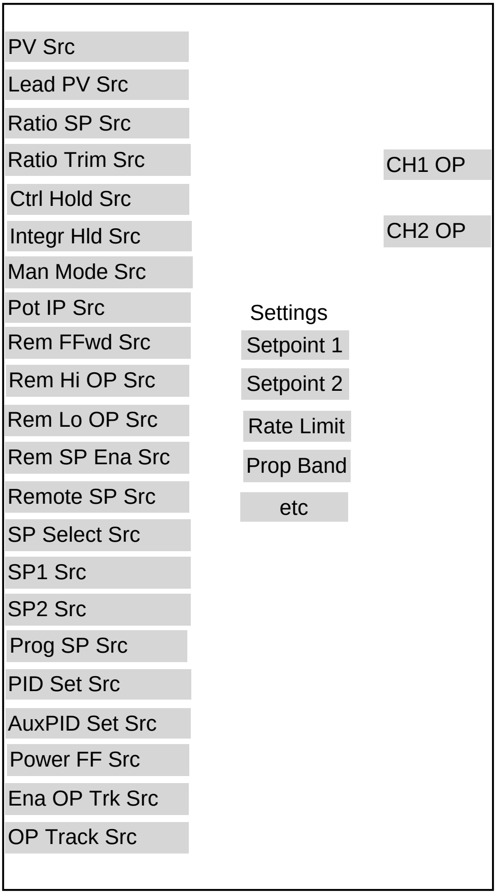


Figure 9-6: Ratio Function Block

9.5 OVERIDE CONTROL

9.5.1 Overview

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.

9.5.2 Simple Override

Override control is available with analogue, time proportioning and ON/OFF control outputs. It is not available with valve position outputs. Figure 9.7 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 only one Auto Manual switch for both loops. In manual mode the control outputs of both loops track the actual output, ensuring bumpless transfer when auto is selected. The transfer between main and override PID control is also bumpless.

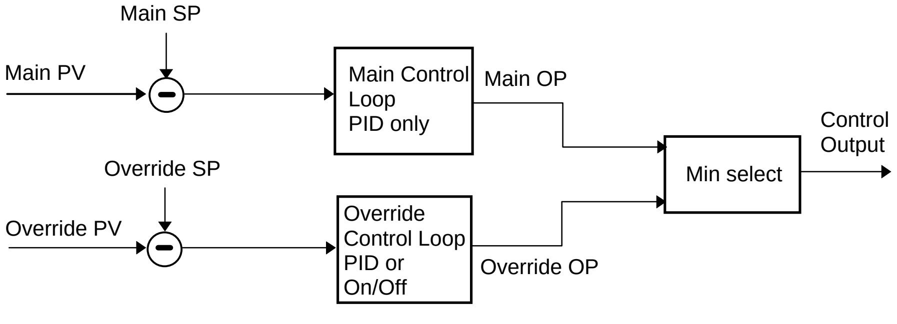


Figure 9-7: Simple Override Control (Select Minimum)

9.5.3 Override Parameters

Table Number: **9.5.3.**	**This list allows you to set up parameters specific to override controllers** It only appears if override is configured, see section 9.1.1.	***LP1* SETUP** **(Override Page)**

Parameter Name	Parameter Description	Value	Default	Access Level
Override Type	Override type See Note 1	Minimum Maximum Select		Conf
OVR Target SP	Override target setpoint	Display range		
Disable OVR	Disable override control. See Note 2.	No Yes		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**

Note 1:-
Minimum selects the lowest output power from the two loops to be the control output.
Maximum selects the highest output power from the two loops to be the control output.
Select allows either the main output or the override output to be used as the control output depending on the state of a digital input or via digital communications.

Note 2:-
The main control loop is active when Override control is disabled.

9.5.4 Override Function Block

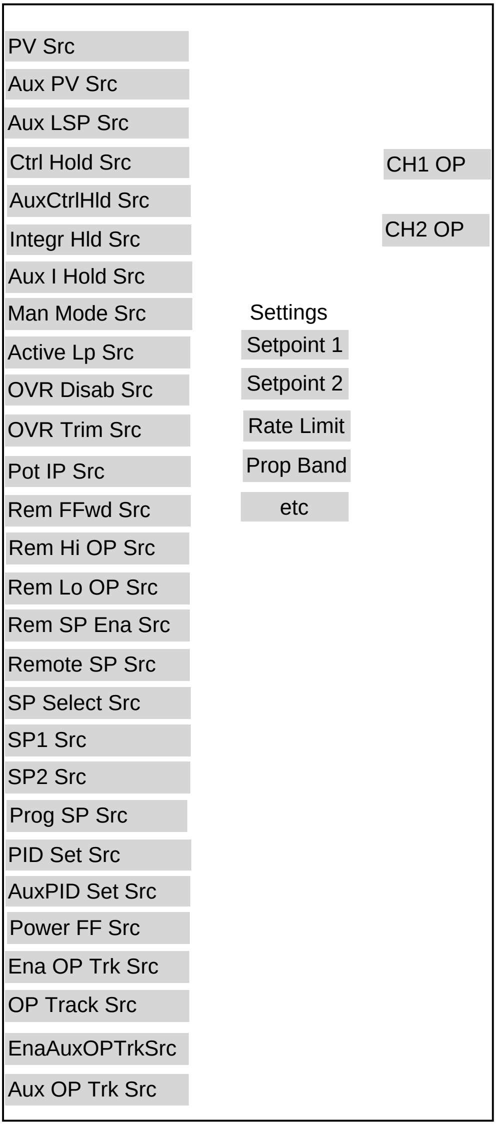


Figure 9-8: Override Function Block

9.6 PID CONTROL

PID control, also referred to as 'Three Term Control', is a technique used to achieve stable straight line control at the required setpoint. The three terms are:

P Proportional band
I Integral time
D Derivative time

The output from the controller is the sum of the contributions from these three terms. The combined output is a function of the magnitude and duration of the error signal, and the rate of change of the process value. It is possible to set P, PI, PD or PID control.

9.6.1 Proportional Term

The proportional term delivers an output which is proportional to the size of the error signal. An example of this is shown in Figure 9.8, for a temperature control loop, where the proportional band is $10^{O}C$ and an error of $3^{O}C$ will produce an output of 30%.

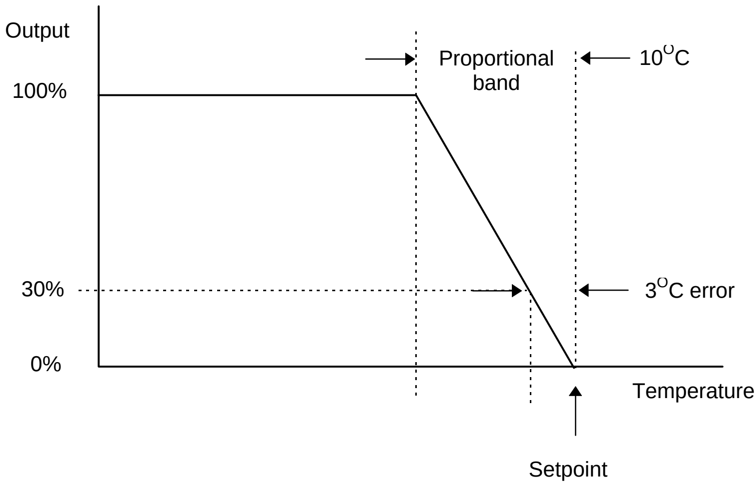


Figure 9-9: Proportional Action

Proportional only controllers will, in general, provide stable straight line control, but with an offset corresponding to the point at which the output power equals the heat loss from the system.

9.6.2 Integral Term

The integral term removes steady state control offset by ramping the output up or down in proportion to the amplitude and duration of the error signal. The ramp rate (reset rate) is the integral time constant, and must be longer than the time constant of the process to avoid oscillations.

9.6.3 Derivative Term

The derivative term is proportional to the rate of change of the temperature or process value. It is used to prevent overshoot and undershoot of the setpoint by introducing an anticipatory action. The derivative term has another beneficial effect. If the process value falls rapidly, due, for example, an oven door being opened during operation, and a wide proportional band is set the response of a PI controller can be quite slow. The derivative term modifies the proportional band according to this rate of change having the effect of narrowing the proportional band. Derivative action, therefore, improves the recovery time of a process automatically when the process value changes rapidly.

Derivative can be calculated on change of PV or change of Error. For applications such as furnace control, it is common practice to select Derivative on PV to prevent thermal shock caused by a sudden change of output following a change in setpoint.

9.6.4 High and Low Cutback

While the PID parameters are optimised for steady state control at or near the setpoint, high and low cutback parameters are used to reduce overshoot and undershoot for large step changes in the process. They respectively set the number of degrees above and below setpoint at which the controller will start to increase or cutback the output power.

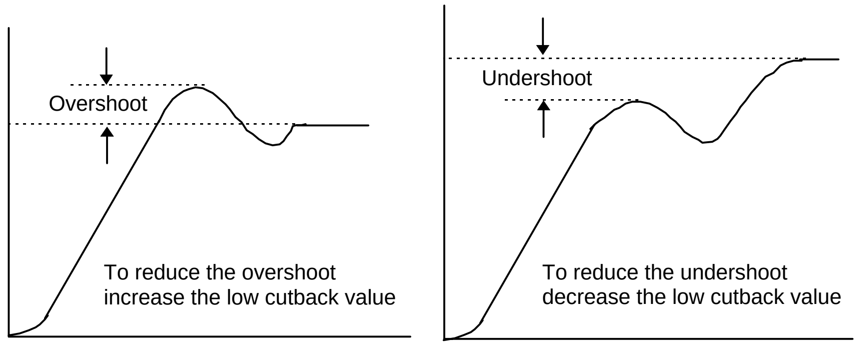


Figure 9-10: High and Low Cutback

9.6.5 PID Block Diagram

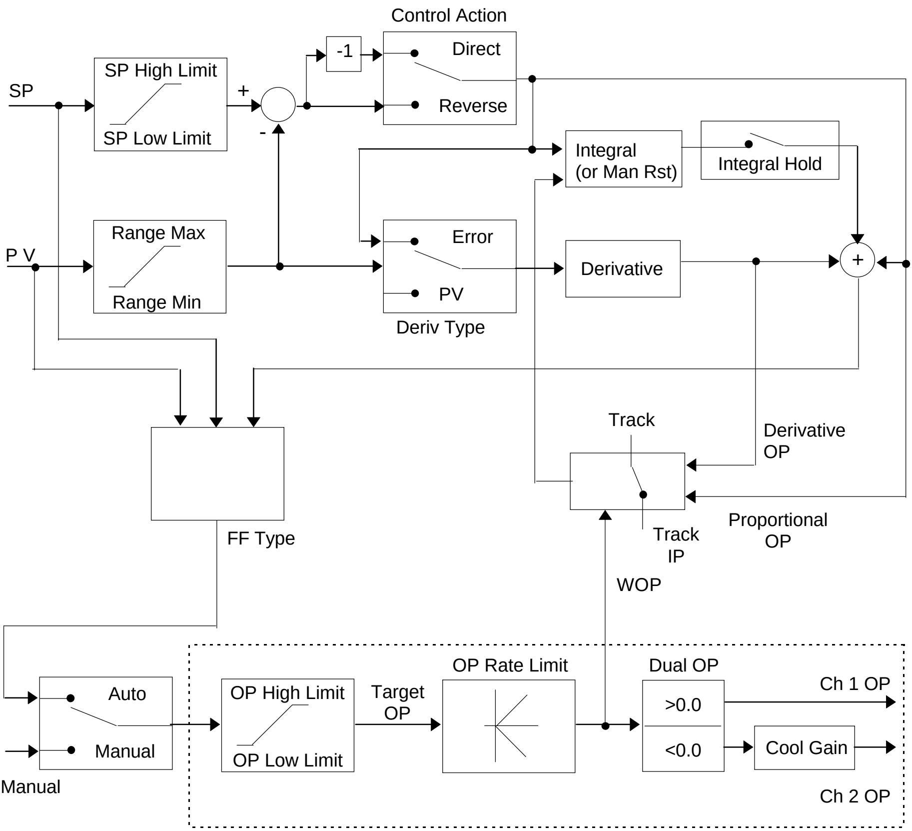


Figure 9-11: PID Block Diagram

9.6.6 Gain scheduling

Gain scheduling is commonly used to minimise the effect of non-linearity in a process, by automatically transferring control between one set of PID values and another. In the case of the 2604 controller, this is done on a presettable strategy defined by 'Schedule Type'. The choices are:-

PV The transfer between one set and the next depends on the value of the PV
SP The transfer between one set and the next depends on the value of the SP
Error The transfer between one set and the next depends on the value of the error
OP The transfer between one set and the next depends on the value of the OP demand
Set The transfer between one set and the next is selected by a digital input or via digital communications.

The 2604 controller has three sets of PID values. The maximum number of sets must be configured using the 'Num of Sets' parameter. You can select the active set from:

1. A digital input
2. A parameter in the *Loop* Setup(PID) page
3. Or you can transfer automatically in gain scheduling mode.

Gain scheduling is uni-directional acting on the magnitude of the scheduling variables. The transfer is bumpless and will not disturb the process being controlled.

9.6.7 PID Parameters

Table Number: 9.6.7.	These parameters allow you to configure PID sets			*LP1* SETUP (PID Page)
Parameter Name	**Parameter Description**	**Value**	**Default**	**Access Level**
Schedule Type	Scheduling type	Off Set SP PV Error OP	Off	Conf
Num of Sets	Number of PID sets to use	1 to 3	1	Conf
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	20	L1
Integral 1	Integral Time Set 1	Off to 999.9	360	L1
Derivative 1	Derivative Time Set 1	secs or mins	60	L1
Cutback Low 1	Cutback Low Set 1	Auto to		L1
Cutback High 1	Cutback High Set 1	display 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 cool gain set 1	0.1 to 10	1	L1
	Only present if ch 1 and ch 2 are configured in the same loop			
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 Prop. Band.			L3
	This parameter controls the amount that the PID can affect the output			
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

9.6.8 PID (Aux) Parameters

Table Number: 9.6.8.	These parameters allow you to set up the PID sets.(Override & Cascade only)		*LP1* SETUP PID(Aux) Page	
Parameter Name	**Parameter Description**	**Value**	**Default**	**Access Level**
Schedule Type	Scheduling type	Off Set SP PV Error OP	Off	Conf
Num of Sets	Number of PID sets to use	1 to 3	1	Conf
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	20	L1
Integral 1	Integral Time Set 1	Off to	360	L1
Derivative 1	Derivative Time Set 1	999.9 secs or mins	60	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 cool gain set 1	0.1 to 10	1	L1
	Only present if ch 1 and ch 2 are configured in the same loop			
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 9.1.8. and 9.1.9. are repeated for *Loop 2* and *Loop 3* if these have been configured

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

9.7 MOTORISED VALVE CONTROL

The 2604 controller can be used 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. The control is performed by delivering a 'raise' pulse, a 'lower' pulse or no pulse at all in response to the control demand signal via raise and lower relay or triac outputs.

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 output is configured. See Section 9.1.1. (Control Type)			***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	0:01:00:0	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

9.8 OUTPUT PARAMETERS

Typically the output(s) of the PID function block are wired to:

- The standard relay or logic outputs, configured for on/off or time proportioning pulses
- Relay, triac or logic output module, configured for on/off or time proportioning pulses
- Analogue output module, configured for Volts or mA

9.8.1 Table of Output Parameters

Table Number: 9.8.1	This list allows you to set up the parameters which control the output to the plant			***LP1* SETUP (Output Page)**
Parameter Name	**Parameter Description**	**Value**	**Default**	**Access Level**
Loop Mode	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%	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 in manual - alternative to bumpless transfer	-100% to 100%		L3
SBrk OP	Sets the level of the output in sensor break	-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)			L3
The above three parameters are repeated for channel 2				
Deadband	Deadband between ch1 and ch2 - On/Off control only 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		L1

		100%		
Rem Lo OP Lim	Remote low power limit	-100% to 100%		L3
Rem Hi OP Lim	Remote high power limit	-100% to 100%		L3
Ena OP Track	Output track enable	No Yes		L3
OP Track	Track input			L3
Ena Aux OP Trk	Auxiliary Output track enable	No Yes		L3
Aux OP Track	Auxiliary Track input			L3

9.9 DIAGNOSTICS

Diagnostic parameters are read only and provide information on the current operating conditions of the control loop. They are used for diagnostic purposes and are available at all levels.

9.9.1 Diagnostic Page

Table Number: 9.9.1.	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

9.10 DISPLAY

The Loop Page, shown in Operation level, (see Chapter 5, Installation and Operation Handbook Part No HA026491) consists of up to 10 pages, and may be customised using the parameters in the Display Page.

9.10.1 Display Page

Table Number: 9.10.1.	This list configures the Loop Summary display.		***LP 1* SETUP** (Display Page)	
Parameter Name	**Parameter Description**	**Value**	**Default**	**Access Level**
Loop Name	Loop name chosen from the User Text library, see Section 5.2.5.	Default Text or 01 to 50 User Text	Default Text	Conf
TSP/TOP Access	Sets the read/write access to Target Setpoint and Working Output shown in the Loop Summary Page.	Alterable Read Only	Alterable	Conf
Param Promote	Selects the parameter which is to be promoted to the Summary Page.	1 to 10		Conf
Param Address	The modbus address of the parameter selected by 'Param Promote'. See Appendix D.1.	Modbus address		Conf
Param Name	A name can be selected from User Text library (see 5.2.5.) and replaces the number of the 'Param Promote' parameter.	Default Text or 01 to 50 User Text		Conf
Param Access	Sets the read/write access level of the 'Param Promote' parameter.	Lev 1 Read Only Lev 1 Alterable Lev 2 Read Only Lev 2 Alterable		Conf

9.10.1.1 Example: To Rename Loop 1 to be Zone 1

Do This	This Is The Display You Should See	Additional Notes
From any display press [page key] as many times as necessary until the **INSTRUMENT** page header is displayed Press ▲ or ▼ to select **User Text Page**	:INSTRUMENT ⬍ User Text Page	
Press [scroll key] to select **User Text** Press ▲ or ▼ to enable User Text	:User Text ⬍ Enabled	If Disabled no further pages are available
Press [scroll key] to select **Text Number** Press ▲ or ▼ to select the Text Number	:Text Number ⬍ 1	Up to 50 Text Numbers are available
Press [scroll key] to select **Text** Press ▲ or ▼ to change the first (flashing) character to the first character of your text i.e. 'Z'.	:Text ⬍ Usr1	
Press [scroll key] to select the next of up to 16 characters Press ▲ or ▼ to change the (flashing) character, i.e. 'o'.	:Text ⬍ Usr1	Repeat this step for all characters until Zone 1 is displayed. Note, the blank between 'Zone' and '1' is entered as a blank character.
Press [page key] as many times as necessary until the **LP1 SETUP** page header is displayed Press ▲ or ▼ to select Display Page	:*LP1* SETUP ⬍ Display Page	*LP1* will be displayed if default text is chosen. It will be replaced by Zone 1 when the following operation is entered.
Press [scroll key] to select **Loop Name** Press ▲ or ▼ to select the chosen text.	:Loop Name ⬍ 01:Zone 1	

9.10.1.2 Example: To Promote Parameters to the Loop Summary Page

Do This	This Is The Display You Should See	Additional Notes
From any display press [🗋] as many times as necessary until the ***LP1* SETUP** header is displayed Press [▲] or [▼] to select **Display Page**	🗋**:***LP1* SETUP ⬍ Display Page	
Press [⟳] until **Param Promote** is displayed Press [▲] or [▼] to select a number which represents the parameter to promote	⟳**:**Param Promote ⬍ 1	Up to 10 parameter numbers can be selected. Parameter number 1 will be the first to appear in the Summary page and so on.
Press [⟳] to select **Param Address** Press [▲] or [▼] to select the parameter which is to be promoted.	⟳**:**Param Address ⬍ 0000<u>4</u>:L1.Wkg OP	Summary page number 1 will show the working output value in operation level The parameter can be selected by modbus address. If this is not known press [⟳] then use [▲] or [▼] to scroll through a list of parameter names
Press [⟳] to select **Param Name** Press [▲] or [▼] to select up to 50 customised names for the parameter from the User Text library set up in Section 5.3.5	⟳**:**Param Name ⬍ Default Text	
Press [⟳] to select **Param Access** Press [▲] or [▼] to select read/write access in the level 1 or 2.	⟳**:**Param Access ⬍ Lev 1 Read Only	

9.10.2 Display Auxiliary Page

Table Number: 9.10.2.	This list configures the Loop Summary display for the auxiliary loop. Also shown when loop configured for Ratio			***LP 1*** **SETUP** (Disp (Aux) Page)
Parameter Name	**Parameter Description**	**Value**	**Default**	**Access Level**
Loop Name	Loop name chosen from the User Text library, see Section 5.2.5.	Default Text or 01 to 50 User Text	Default Text	Conf
TSP/TOP Access	Sets the read/write access to Target Setpoint and Working Output shown in the Loop Summary Page.	Alterable Read Only	Alterable	Conf
Param Promote	Selects the parameter which is to be promoted to the Summary Page.	1 to 10		Conf
Param Address	The modbus address of the parameter selected by ‘Param Promote’. See Appendix D.1.	Modbus address		Conf
Param Name	A name can be selected from User Text library (see 5.2.5.) and replaces the number of the ‘Param Promote’ parameter.	Default Text or 01 to 50 User Text		Conf
Param Access	Sets the read/write access level of the ‘Param Promote’ parameter.	Lev 1 Read Only Lev 1 Alterable Lev 2 Read Only Lev 2 Alterable		Conf

9.11 LOOP 2 SET UP

All pages listed in sections 9.1.1 to 9.10.2 are repeated for Loop 2.

9.12 LOOP 3 SET UP

All pages listed in sections 9.1.1 to 9.10.2 are repeated for Loop 3.

9.13 CONTROL LOOP WIRING EXAMPLES

9.13.1 Cascade Wiring

This example shows how to configure Loop 1 to be a simple cascade controller. The master PV is connected to the Main PV input and the slave PV is connected to a PV Input module fitted in Slot 3. The control output is a 4-20mA signal which uses a DC control module fitted in Slot 1.

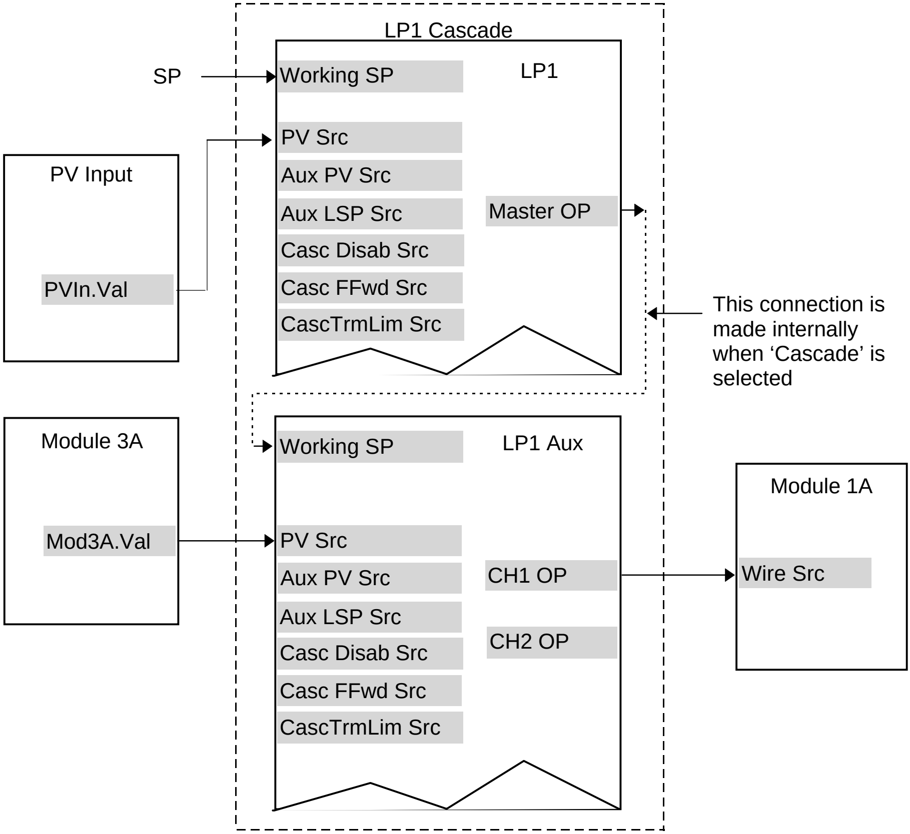


Figure 9-12: Wiring for Simple Cascade Control Loop

9.13.1.1 Implementation

1. In LP1 SETUP / Options Page (Table 9.1.1),	set ‘Loop Type’ = Cascade
2. In LP1 SETUP / Wiring Page (Table 9.1.2.2)	set ‘PV Src’ = 05108: PVIn.Val (Appendix D) *This connects the PV input to the master PV of the cascade loop*
3. In LP1 SETUP / Wiring Page (Table 9.1.2.2)	set ‘Aux PV Src’ = 04468: Mod3A.Val (Appendix D) *This connects the PV input from Module 3 to the slave PV of the cascade loop*
4. In MODULE IO / Module 1 A Page (Table 18.3.1)	set ‘Wire Src = 00013: L1.Ch1.OP (Appendix D) *This connects channel 1(heat) control to the DC output module*

See Appendix D for list of Modbus addresses.

☺ Tip:- See ‘Copy and Paste’ description in Chapter 3.

9.13.2 Cascade Control with SP Feedforward

SP Feedforward allows the master SP to be fed forward so that it directly influences the slave SP. By setting the feedforward trim parameter, it can be used to limit the amount by which the slave SP may differ from the master SP. The trim value is set in the slave in engineering units.

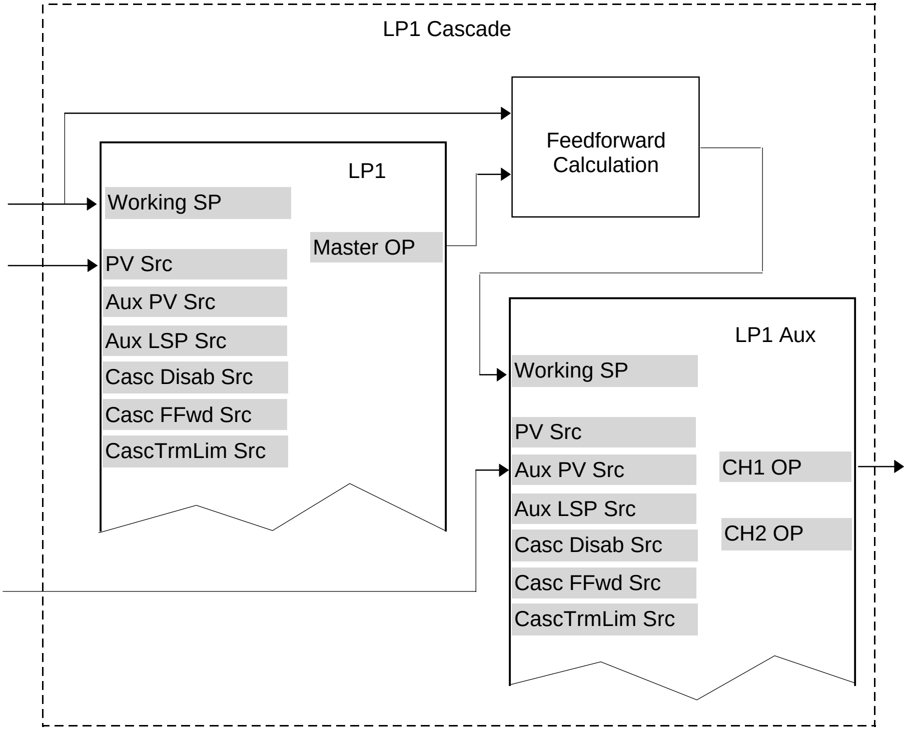


Figure 9-13: Cascade Control with SP Feedforward

9.13.2.1 Implementation

1. In LP1 SETUP / Options Page (Table 9.1.1),	set 'Loop Type' = Cascade
2. In LP1 SETUP / Options Page (Table 9.1.1)	set 'FF Type' = SP Feedforward *Cascade trim limits are found in LP1 SETUP/Cascade Page. To limit slave setpoint to ± 50 from master SP, set CSD FF TrimLim to 50.*
3. In LP1 SETUP / Wiring Page (Table 9.1.2.2)	set ' PV Src' = 05108: PVIn.Val (Appendix D) *This connects the main PV input to the master PV of the cascade loop*
4. In LP1 SETUP / Wiring Page (Table 18.1.2.2)	set 'Aux PV Src = 04468: Mod3A.Val (Appendix D) *This connects the PV input from Module 3 to the slave PV of the cascade loop.*
5. In MODULE IO / Module 1 A Page (Table 18.3.1)	set 'Wire Src = 00013: L1.Ch1.OP (Appendix D) *This connects channel 1(heat) control to the DC output module.*

See Appendix D for list of Modbus addresses.

☺ **Tip:- See 'Copy and Paste' description in Chapter 3.**

9.13.3 Ratio Wiring

This example shows how to configure Loop 1 to be a simple ratio controller. The main PV is connected to the PV Input (rear terminals V+ & V-) and the lead PV is connected to the Analogue Input (rear terminals BA & BB). The control output is a valve position signal which uses a dual triac control module fitted in Slot 1.

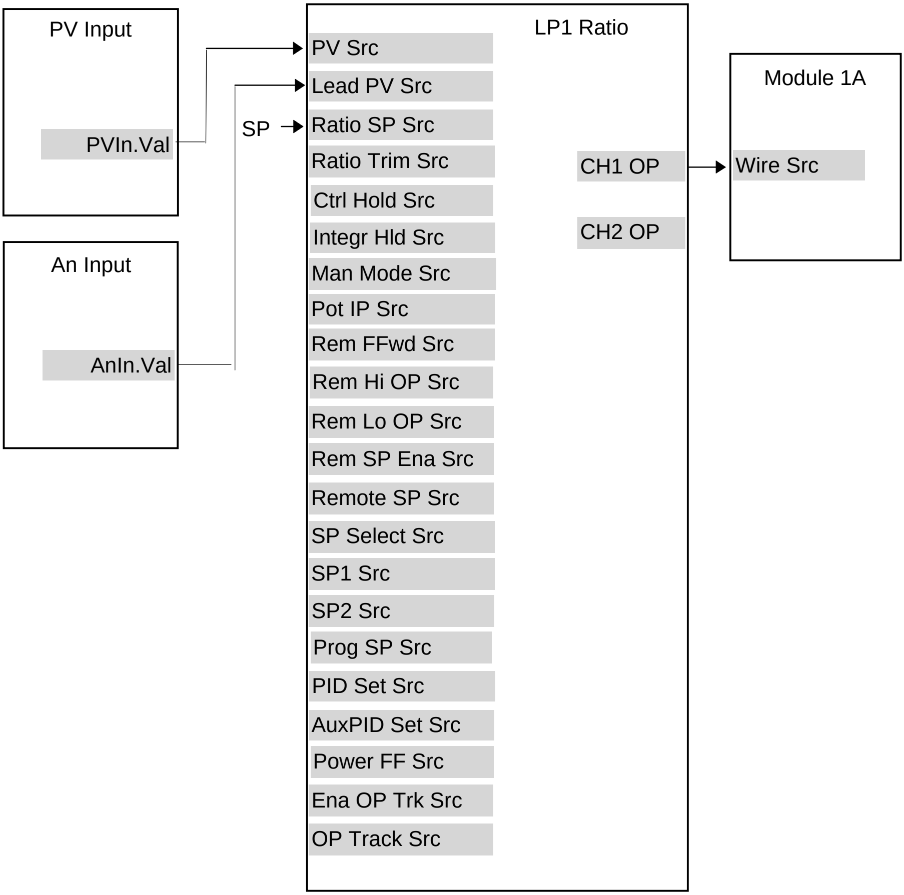


Figure 9-14: Wiring for Simple Ratio Control Loop

9.13.3.1 Implementation

1. In LP1 SETUP / Options Page (Table 9.1.1),	set 'Loop Type' = Ratio
2. In LP1 SETUP / Ratio Page (Table 9.4.3),	set 'Enable Ratio' = On Set other parameters as required
3. In LP1 SETUP / Wiring Page (Table 9.1.2.2)	set 'PV Src' = 05108: PVIn.Val (Appendix D) *This connects the PV input to the main PV of the ratio loop*
4. In LP1 SETUP / Wiring Page (Table 9.1.2.2)	set 'Lead PV Src' = 05268: AnIn.Val (Appendix D) *This connects the lead PV input of the ratio loop from Analogue Input*
5. In MODULE IO / Module 1 A Page (Table 18.3.1)	set 'Wire Src = 00013: L1.Ch1.OP (Appendix D) *This connects channel 1(heat) control to the Dual Triac output module*

See Appendix D for list of Modbus addresses.

☺ Tip:- See 'Copy and Paste' description in Chapter 3.

9.13.4 Override Wiring

This example shows how to configure Loop 1 to be a simple override furnace temperature controller. The main PV is connected to the PV Input (rear terminals V+ & V-) and the override PV is connected to a PV Input module fitted in slot 3 (rear terminals 3C & 3D). The control output is an analogue control module fitted in Slot 1.

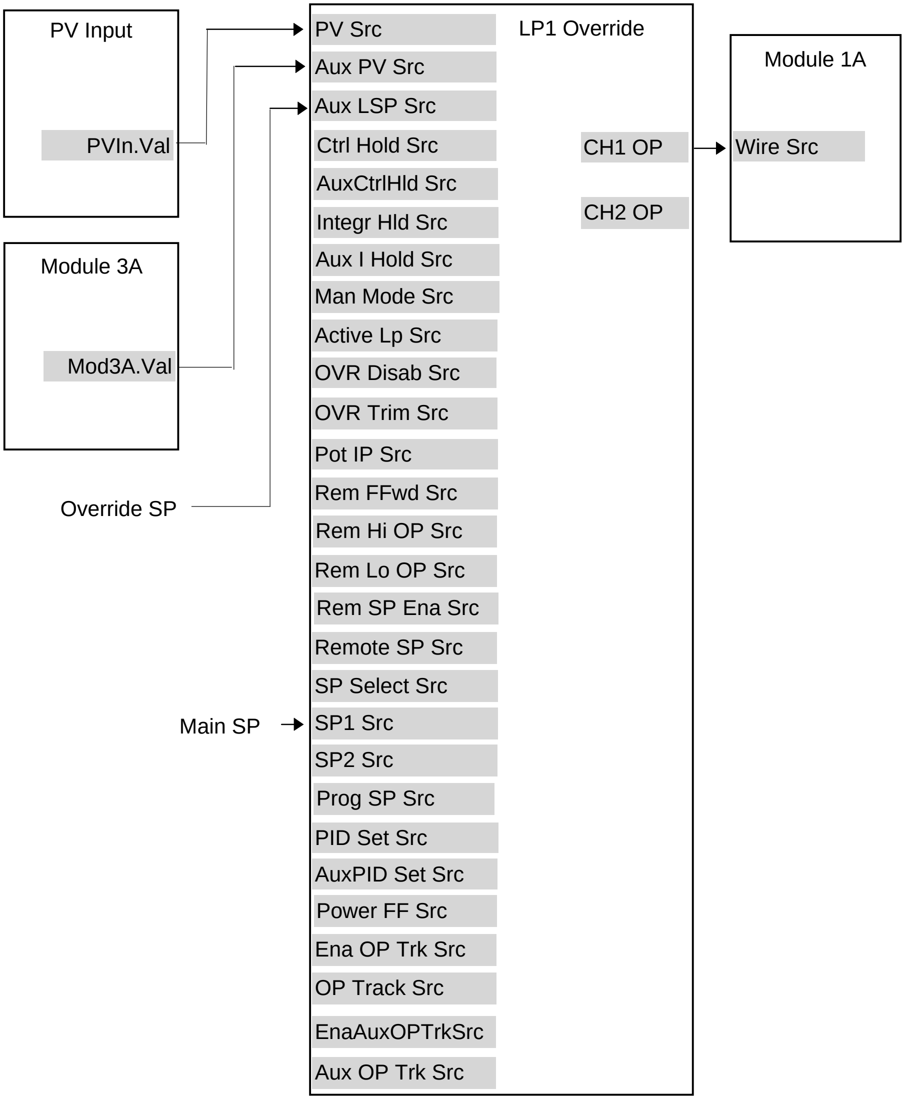


Figure 9-15: Wiring for Simple Override Control Loop

9.13.4.1 Implementation

1. In LP1 SETUP / Options Page (Table 9.1.1),	set 'Loop Type' = Override *This action also connects the main SP and override SP to SP1 and SP2 respectively.*
2. In LP1 SETUP / Override Page (Table 9.5.3),	set 'Override Type' = Minimum Set other parameters as required
3. In LP1 SETUP / Wiring Page (Table 9.1.2.2)	set 'PV Src' = 05108: PVIn.Val (Appendix D) *This connects the PV input to the main PV of the override loop*
4. In LP1 SETUP / Wiring Page (Table 9.1.2.2)	set 'Aux PV Src' = 04468: Mod3A.Val (Appendix D) *This connects the override PV input of the override loop from Analogue Input*
5. In MODULE IO / Module 1 A Page (Table 18.3.1)	set 'Wire Src = 00013: L1.Ch1.OP (Appendix D) *This connects channel 1(heat) control to the Analogue output module*

See Appendix D for list of Modbus addresses.

☺ Tip:- See 'Copy and Paste' description in Chapter 3.

10. Chapter 10 Controller Applications

10.1. ZIRCONIA - CARBON POTENTIAL CONTROL

An available option within the 2604 is the Zirconia function block. This feature is used to measure carbon potential, furnace dew point or oxygen concentration. The label containing the order code on the side of the controller should contain the code ‘ZC’.

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. Endothermic Gas Correction

A gas analyser may be used to determine the %CO concentration. If an analogue 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.

10.2. ZIRCONIA PROBE PARAMETERS

10.2.1. Options Page

Table Number: 10.2.1.	These parameters configure zirconia probe options. This list only appears if Zirconia is enabled, see Section 5.2.1.			ZIRCONIA PROBE (Options Page)
Parameter Name	**Parameter Description**	**Value**	**Default**	**Access Level**
Probe Type	Zirconia probe equation [1]	Select from a number of types		Conf
Units	Zirconia display units	See Appendix D.2.		Conf
Resolution	Zirconia display resolution	XXXXX XXXX.X XXX.XX XX.XXX		Conf
Oxygen Exp	Exponent of the oxygen units. May be set to correspond to the units used, eg set to 6 for PPM; 2 for %, etc.	1 to 19		Conf
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	OFF to		L3

	interval	0:00:00.1 to 99:54:00.0		
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

Note 1 The following probe types are supported:
Probe mV, Bosch Carbon, AACC, Drayton, Accucarb, SSI, MacDhui, Oxygen, Log Oxygen, Bosch, Dewpoint.

10.2.2. Wiring Page

Table Number: 10.2.2.	**These parameters configure zirconia probe block wiring.** This list only appears if Zirconia is enabled, see Section 5.2.1.		**ZIRCONIA PROBE (Wiring Page)**	
Parameter Name	**Parameter Description**	**Value**	**Default**	**Access Level**
Clean Src	Zirconia clean probe input source	Modbus address		Conf
mV Src	Zirconia probe mV input source	Modbus address		Conf
Temp Src	Zirconia probe temperature input source	Modbus address		Conf
Rem Gas Src	Remote gas reference/Process factor source	Modbus address		Conf. Only appears for O_2 & carbon

10.3. ZIRCONIA WIRING EXAMPLE

10.3.1. The Zirconia Function Block

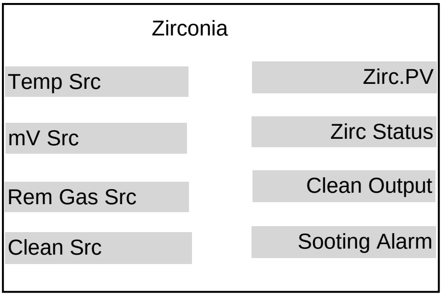


Figure 10-1: Zirconia Function Block

10.3.1.1. Main Features

Calculation of PV: The Process Variable can be carbon potential, Dewpoint or Oxygen concentration. The PV is derived from the probe temperature input, the probe mV input and remote gas reference input values. Various probe makes are supported.

Endothermic Gas Correction: This enables the user to set the percentage of carbon monoxide (%CO) present in the Endothermic Gas. This value can be measured via a gas analyser and fed into the controller as an analogue value.

Probe Clean: As these sensors are used in furnace environments they require regular cleaning. Cleaning (Burn Off) is performed by forcing compressed air through the probe. Cleaning can be initiated either manually or automatically using a timed period. During cleaning the PV output is frozen.

Health Alarm (Zirconia Probe Status): After cleaning an alarm output is generated if the PV does not return to 95% of its value within a specified time. This indicates that the probe is deteriorating and should be replaced.

Sooting Alarm: An output is generated which indicates that the furnace is about to soot.

10.3.2. Configuration of a Carbon Potential Control Loop

This example assumes that the probe temperature (Type K) input is connected to module 3 and the milli-volt input to module 6. Loop 1 normally controls temperature, so the carbon loop will be Loop 2. Carbon control and alarm outputs are relays and configured as On/Off.

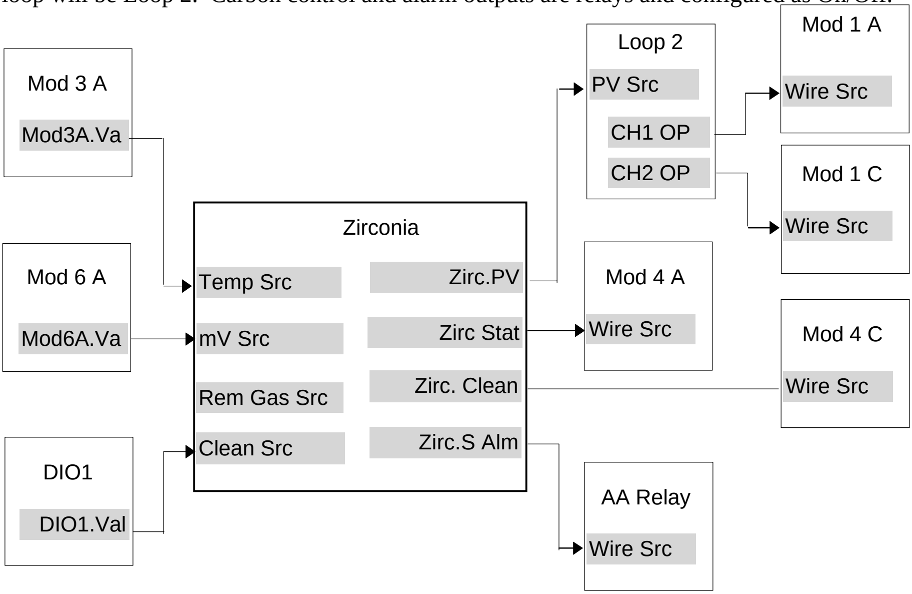


Figure 10-2: Zirconia Wiring for Carbon Potential

10.3.2.1. Implementation

1. In INSTRUMENT/Options Page (Table 5.2.1),	set 'Num of Loops' = 2 set 'Zirconia' = Enabled
2. In MODULE IO/Module 3A Page (Table 18.3.6)	set 'Channel Type' = Thermocouple set 'Linearisation' = K-Type set 'Units' = ^{o}C/^{o}F/^{o}K set 'Resolution' = XXXXX set 'SBrk Impedance' = Low set 'SBrk Fallback' = Up Scale set 'CJC Type' = Internal This configures Module 3 to measure temperature.
3. In MODULE IO/Module 6A Page (Table 18.3.6)	set 'Channel Type' = HZVolts set 'Linearisation' = Linear set 'Units' = mV set 'Resolution' = XXXXX set 'SBrk Impedance' = Off

	set ‘SBrk Fallback’ = Up Scale set ‘Electrical Lo’ = 0.00 set ‘Electrical Hi’ = 2.00 set ‘Eng Val Lo’ = 0.00 set ‘Eng Val Hi’ = 2000 This configures Module 6 to measure probe mV.
4. In STANDARD IO/Dig IO1 Page (Table 17.4.1)	set ‘Channel Type’ = Digital Input This configures DIO1 to be a digital input.
5. In ZIRCONIA PROBE/Options Page (Table 07.2.1)	set ’Probe Type’ = *Type of probe in use* set ‘Units’ = %CP set ‘Resolution’ = XXX.XX set ‘H-CO Reference’ = *Required Value* *This value defines the % carbon monoxide (%CO) in the gas used for carburising* This configures the zirconia probe
6. In ZIRCONIA PROBE/Wiring Page (Table 10.2.2)	set ’Clean Src’ = 05402:DI01.Val set ‘mV Src’ = 04948:Mod6A set ‘Temp Src’ = 04468:Mod3A This connects inputs to the Zirconia block
7. In LP2 SETUP/Options Page (Table 9.1.1)	set ’Loop Type’ = Single set ‘Control Type’ = OnOff→Ch1&2
8. In LP2 SETUP/Wiring Page (Table 9.1.2)	set ’PV Src’ = 11059:Zirc.PV This connects the PV to Loop 2 PV
9. In MODULE IO/Module 1A Page (Table 18.3.)	set ’Channel Type’ = On/Off set ‘Wire Src’ = 01037:L2.Ch1OP This connects LP2 Ch1 output to module 1
10. In MODULE IO/Module 1C Page (Table 18.3.)	set ’Channel Type’ = On/Off set ‘Wire Src’ = 01038:L2.Ch2OP This connects LP2 Ch2 output to module 1
11. In MODULE IO/Module 4A Page (Table 18.3.)	set ’Channel Type’ = On/Off set ‘Wire Src’ =11066:Zirc.Stat This connects the health (probe status) to module 4A
12. In MODULE IO/Module 4C Page (Table 18.3.)	set ’Channel Type’ = On/Off set ‘Wire Src’ = 11072: Zirc.Clean This connects the clean outputs to module 4C
13. In STANDARD IO/AA Relay Page (Table 17.3.1)	set ’Channel Type’ = On/Off set ‘Wire Src’ = 11068: Zirc.SAlm This connects the sooting alarm to the fixed relay output

See Appendix D for list of Modbus addresses.

☺ Tip:- See ‘Copy and Paste’ description in Chapter 3.

10.4. HUMIDITY PARAMETERS

10.4.1. 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 from a programmer block.
Also the controller may be configured to measure humidity using either the traditional Wet/Dry bulb method 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

10.4.2. Options Page

Table Number: 10.4.2.	**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	1013.0	L3
PMetric Const	Psychometric Constant	0.00 to 10.00	6.66	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

10.4.3. Wiring Page

Table Number: 10.4.3.	These parameters configure humidity block wiring. This list only appears if Humidity is enabled, see Section 5.2.1.	HUMIDITY (Wiring Page)

Parameter Name	Parameter Description	Value	Default	Access Level
Dry Bulb Src	Dry bulb temperature source	Modbus address.		Conf
Wet Bulb Src	Wet bulb temperature source	Modbus address.		Conf
Atm Press Src	Atmospheric pressure source	Modbus address.		Conf
PMtric Cst Src	Psychometric Constant source	Modbus address.	6.66	Conf

10.5. HUMIDITY WIRING EXAMPLE

10.5.1. The Humidity Function Block

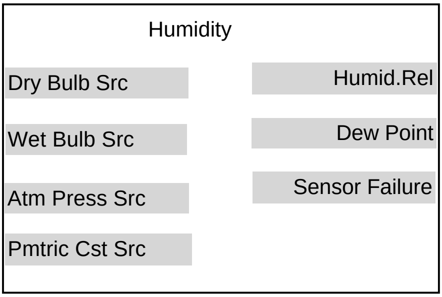


Figure 10-3: Humidity Function Block

10.5.1.1. Main Features

Calculation of PV: The Process Variable can be Relative Humidity or Dewpoint. The PV is derived from the wet and dry bulb inputs and atmospheric pressure.

Pressure Compensation: This value can be measured via a transmitter and fed into the controller as an analogue value. Alternatively, it can be set as a fixed parameter.

10.5.2. Configuration of a Humidity Control Loop

This example assumes that the dry temperature (Pt100) input is connected to the main PV and the wet input (Pt100) to module 3. Loop 1 normally controls temperature, so the humidity loop will be Loop 2. Humidity control outputs are relays and configured as time proportioning.

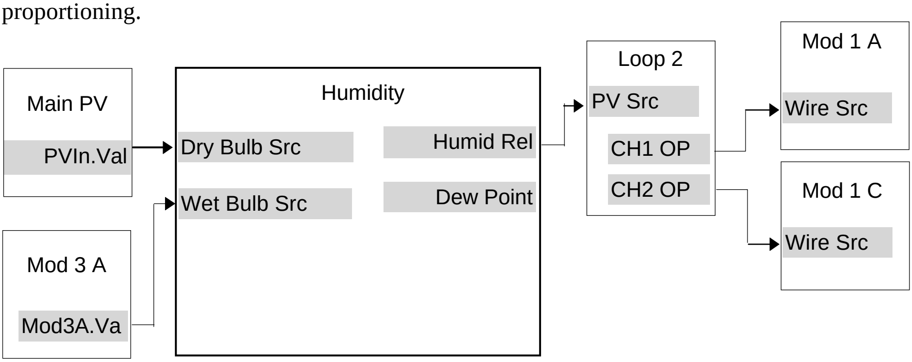


Figure 10-4: Humidity Control Loop

10.5.2.1.Implementation

1. In INSTRUMENT/Options Page (Table 5.2.1),	set 'Num of Loops' = 2 set 'Humidity' = Enabled
2. In STANDARD IO/PV Input Page (Table 17.2.2)	set 'Channel Type' = RTD set 'Linearisation' = PT100 set 'Units' = ^{o}C/^{o}F/^{o}K set 'Resolution' = XXXX.X set 'SBrk Impedance' = Low set 'SBrk Fallback' = Up Scale This configures the PV Input to measure dry temperature
3. In MODULE IO/Module 3A Page (Table 18.3.7)	set 'Channel Type' = RTD set 'Linearisation' = PT100 set 'Units' = ^{o}C/^{o}F/^{o}K set 'Resolution' = XXXX.X set 'SBrk Impedance' = Off set 'SBrk Fallback' = Up Scale This configures Module 3 to measure wet temperature
4. In HUMIDITY/Options Page (Table 10.4.2)	set 'Atm Pressure' = 1013.0 (for sea level)
5. In HUMIDITY/Wiring Page (Table 10.4.3)	set 'Dry Bulb Src = 05108:PVIn.Val set 'Wet Bulb Src = 04468:Mod3A.Val This connects the sensors to the humidity block
6. In LP2 SETUP/Options Page (Table 9.1.1)	set 'Control Type' = PID→Ch1 PID→Ch2
7. In LP2 SETUP/Wiring Page (Table 9.1.2)	set 'PV Src' = 11105:Humid.Rel Note: For Dewpoint select 11106 This connects the %RH output to Loop 2 PV
8. In LP2 SETUP/Output Page (Table 9.1.11)	set 'OP Low Limit' = -100.0 set 'OP High Limit' = 100.0
9. In MODULE IO/Module 1A Page (Table 18.3)	set 'Channel Type' = Time Proportion set 'Wire Src' = 01037:L2.Ch1OP This connects LP2Ch1 output to Module 1A
10. In MODULE IO/Module 1C Page (Table 18.3)	set 'Channel Type' = Time Proportion set 'Wire Src' = 01038:L2.Ch2OP This connects L21Ch2 output to Module 1C

See Appendix D for list of Modbus addresses.

☺ **Tip:- See 'Copy and Paste' description in Chapter 3.**

11. Chapter 11 Input Operators

11.1. WHAT ARE INPUT OPERATORS

It is 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, as described in Section 5.2

Note:
In addition to linearising the controller input 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. The first parameter in each table is shown as **'Input Src'**, and defines which input is to be linearised. These could be PV input, Analogue input or to any module which has been configured as analogue input or output.

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)**.

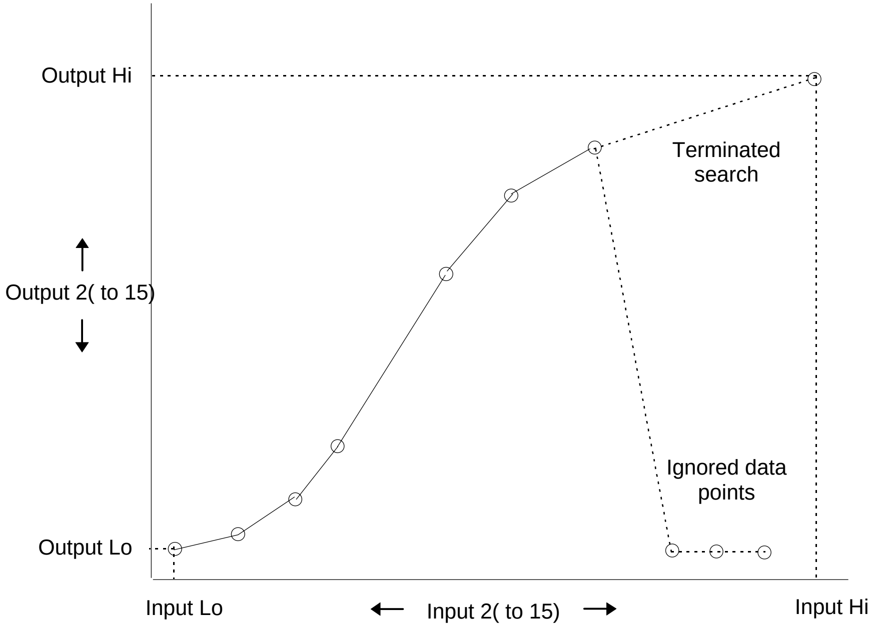


Figure 11-1: Linearisation Example

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.

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**
Enable	To enable custom linearisation	Off On	Off	Conf
Input Src	Custom linearisation input source	Modbus address		Conf
Output Units	Custom linearisation output units	See Appendix D.2.		Conf
Output Resol	Custom linearisation output resolution	XXXXX XXXX.X XXX.XX XX.XXX		
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)**

11.3. 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 11-2 shows a process heating over time with boundaries which define the switching points between the two devices. The higher boundary (Switch Hi) is normally set towards the top end of the thermocouple range and the lower boundary (Switch Lo) set towards the lower end of the pyrometer (or second thermocouple) range. The controller calculates a smooth transition between the two devices.

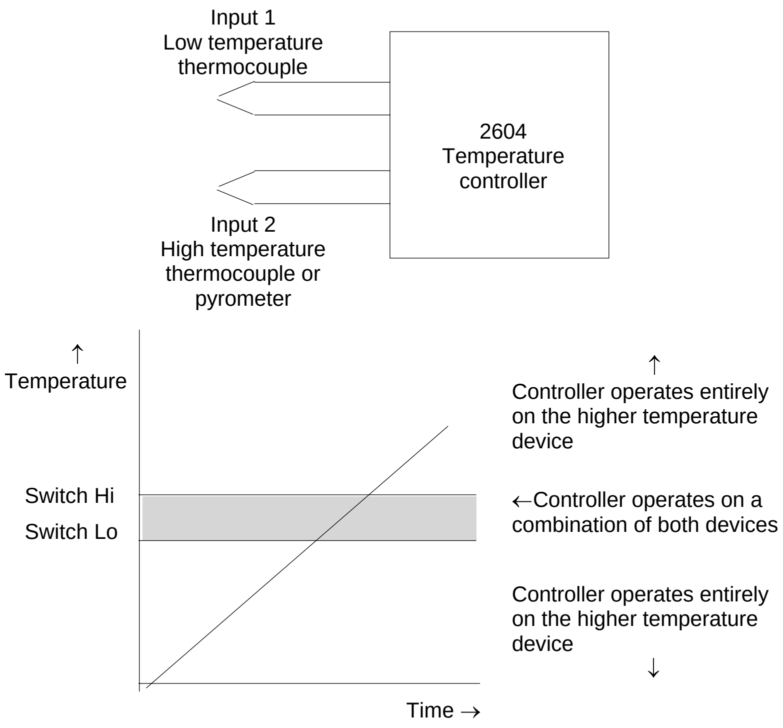


Figure 11-2: Thermocouple to Pyrometer Switching

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**
Enable	To enable switch over	Off On	Off	Conf
Input 1 Src	Input 1 source	Modbus address		Conf
Input 2 Src	Input 2 source	Modbus address		Conf
Input Lo	Display low limit	Display range		Conf
Input Hi	Display High limit	Display range		Conf
Switch Lo	PV = Input 1 below this value	Display Range		L3
Switch Hi	PV = Input 2 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**
Enable	Monitor enable	Disabled Enabled	Off	Conf
Input Src	Input source	Modbus addr		Conf
Reset Src	Reset source	Modbus addr		Conf
Input	Input value	Range		L1
Reset	Reset	No Yes		L3
Maximum	The maximum value recorded by the controller between resets.	Range		R/O
Minimum	The minimum value recorded by the controller between resets.	Range		R/O
Trigger	PV threshold for the timer log	Range		L3
Day	Days spent above threshold	0 to 32767		R/O
Time	Time spent 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

An available option with the 2604 is the Binary Coded Decimal (BCD) function block. This feature is normally used to select a program number by using panel mounted BCD decade switches. A configuration example for this block is given in Section 11.6.2.

11.5.1. Main Features

Calculation of BCD Value: The function calculates a BCD value dependant upon the state of the inputs. Unconnected inputs are detected as off. This value is available as a wireable parameter.

Calculation of BCD Value: The function calculates a decimal value dependant upon the state of the inputs. Unconnected inputs are detected as off. This value is available as a wireable parameter.

Digit 1 Output: The function calculates the first decade BCD value dependant on the state of inputs 1 to 4. Unconnected inputs are detected as off. This value is available as a wireable parameter.

Digit 2 Output: The function calculates the second decade BCD value dependant on the state of inputs 5 to 8. Unconnected inputs are detected as off. This value is available as a wireable parameter.

2nd Decade	1st Decade	BCD	Decimal	2nd Digit	1st Digit
0011	1001	39	57	3	9
0010	0110	26	38	2	6

11.5.2. BCD Parameters

Table Number: 11.5.1.	This page allows you to view the BCD input values		INPUT OPERS (BCD Input Page)	
Parameter Name	**Parameter Description**	**Value**	**Default**	**Access Level**
Enable	BCD enable	Off On	Off	Conf
Input1 Src	Input 1 source	Modbus address		Conf
Input2 Src	Input 2 source	Modbus address		Conf
Input3 Src	Input 3 source	Modbus address		Conf
Input4 Src	Input 4 source	Modbus address		Conf
Input5 Src	Input 5 source	Modbus address		Conf
Input6 Src	Input 6 source	Modbus address		Conf
Input7 Src	Input 7 source	Modbus address		Conf
Input8 Src	Input 8 source	Modbus address		Conf
BCD Value	Reads the value (in BCD) of the switch as it appears on the digital inputs	0-99		R/O
Decimal Value	Reads the value(in decimal) 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

11.6. INPUT OPERATORS WIRING EXAMPLES

11.6.1. Switch Over Loop With Custom Linearised Input

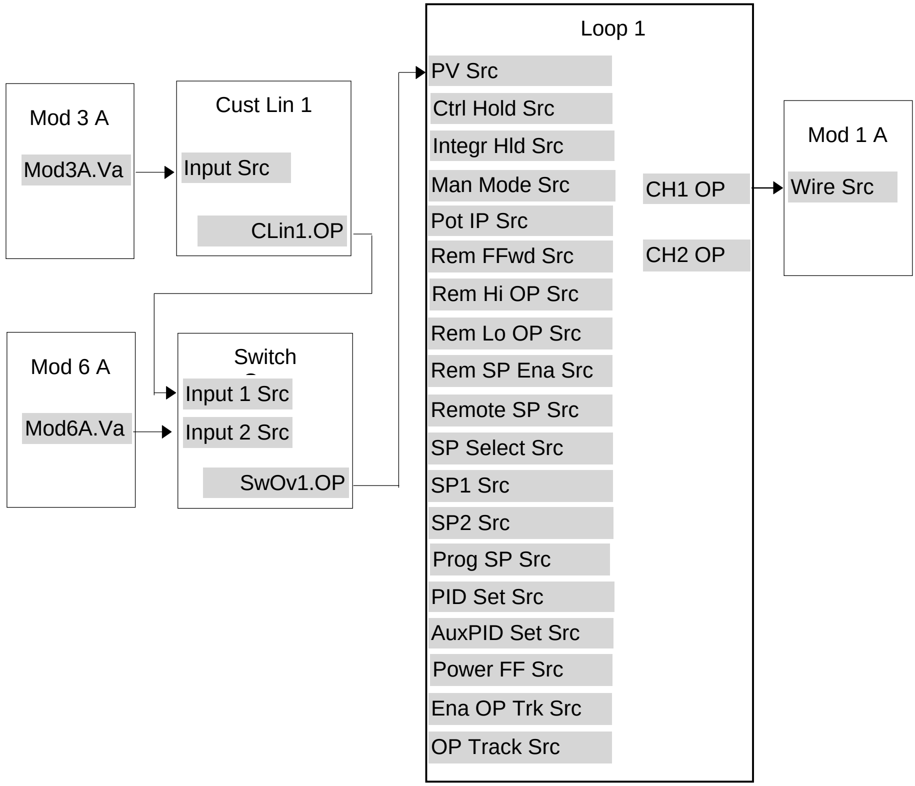


Figure 11-3: Example Wiring, Switch Over Loop with Custom Linearised Input

11.6.1.1.Implementation

1. In INPUT OPERS/Custom Lin 1 (Table 11.2.1),	set 'Input Src' = 04468:Mod3A.Val (Appendix D) This connects the input of the custom linearisation block to the output of Module 3A fitted as a PV input module.
2. In INPUT OPERS/Switch 1 Page (Table 11.3.1)	set 'Input 1 Src' = 03365:CLin1.OP (Appendix D) This connects input 1 of the switch over block to the output of custom linearisation block 1.
3. In INPUT OPERS/Switch 1 Page (Table 11.3.1)	set 'Input 2 Src' = 04948:Mod6A.Val (Appendix D) This connects input 2 of the switch over block to the output of module 6A fitted as an analogue input module.
4. In LOOP SETUP/Wiring Page (Table 9.1.2.1)	Set 'PV Src' = 03477:SwOv1.OP (Appendix D) This connects the PV input of Loop 1 to the output of the switch over block.
5. In MODULE IO/Module 1A Page (Table 18.3.1 if analogue output)	Set 'Wire Src' = 00004:L1.Wkg OP (Appendix D) This connects the input of module 1A to channel 1 output of loop 1. This module may be fitted as an analogue, relay, triac or logic output.

See Appendix D for list of Modbus addresses.

☺ Tip:- See 'Copy and Paste' description in Chapter 3.

11.6.2. Configuring the BCD Input

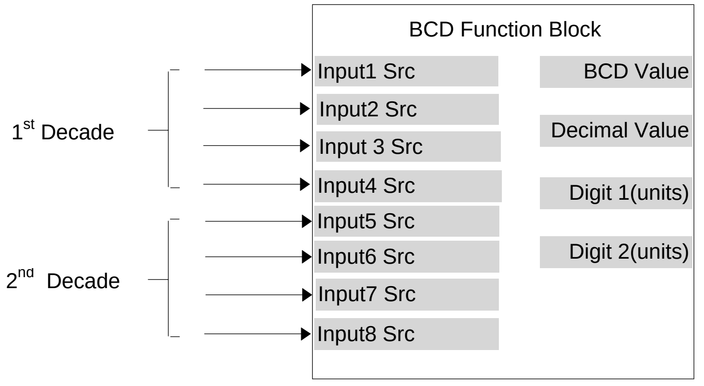


Figure 11-4: BCD Function Block

This example assumes that the digital inputs are connected to the standard IO.

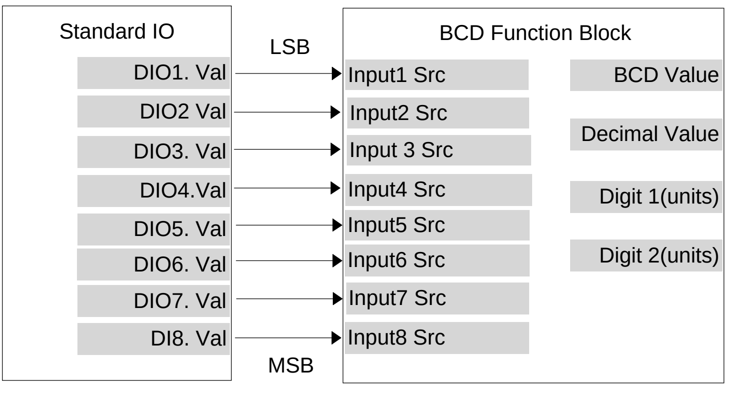


Figure 11-5: Wiring of Digital Inputs to the BCD Function Block

11.6.2.1.Implementation

1.	In PROGRAM EDIT/Options Page (Table 6.3.2.),	set ’BCD Prg Num’ = Yes
2.	In STANDARD IO/DI01 Page (Table 17.4.1.)	set ’Channel Type’ = Digital Input
3.	In STANDARD IO/DI02 Page	set ’Channel Type’ = Digital Input
4.	In STANDARD IO/DI03 Page	set ’Channel Type’ = Digital Input
5.	In STANDARD IO/DI04 Page	set ’Channel Type’ = Digital Input
6.	In STANDARD IO/DI05 Page	set ’Channel Type’ = Digital Input
7.	In STANDARD IO/DI06 Page	set ’Channel Type’ = Digital Input
8.	In STANDARD IO/DI07 Page	set ’Channel Type’ = Digital Input
9.	In INPUT OPERS/BCD Input Page (Table 11.5.)	set ’Enable’ = On
10.	In INPUT OPERS/BCD Input Page	Set ‘Input1 Src’ = 05402:DIO1.Val
11.	In INPUT OPERS/BCD Input Page	Set ‘Input2 Src’ = 05450:DIO2.Val
12.	In INPUT OPERS/BCD Input Page	Set ‘Input3 Src’ = 05498:DIO3.Val
13.	In INPUT OPERS/BCD Input Page	Set ‘Input4 Src’ = 05546:DIO4.Val
14.	In INPUT OPERS/BCD Input Page	Set ‘Input5 Src’ = 05594:DIO5.Val
15.	In INPUT OPERS/BCD Input Page	Set ‘Input6 Src’ = 05642:DIO6.Val
16.	In INPUT OPERS/BCD Input Page	Set ‘Input7 Src’ = 05690:DIO7.Val
17.	In INPUT OPERS/BCD Input Page	Set ‘Input8 Src’ = 11313:DIO8.Val

11.6.3. Holdback Duration Timer

This procedure describes how to configure a 2604 controller, using the Monitor Block, to accumulate the total time that a program has been in holdback within a segment. A holdback timer can be used to inform the user his application is taking longer to heat up than normal, possibly indicating a problem with the heat source or unusually high losses.

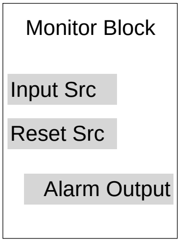


Figure 11-6: Monitor Function Block

The Monitor Block functions are as follows:

1. Logs the maximum and minimum excursions of its input value. These values are reset when:
    a) the controller power is cycled
    b) the block is reset
2. Counts the time above a threshold
3. Provides a time alarm

This example assumes that the controller has already been set up as a single loop programmer, and that program digital output 1 is used to enable the timer during certain segments. This used to reset the monitor at the end of the segment. The maximum expected holdback time is set to 30 minutes. When this time is exceeded the AA relay is switched on.

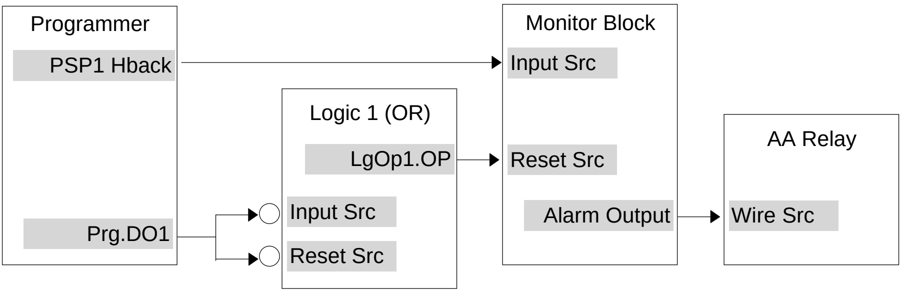


Figure 11-7: Example Wiring, Holdback Duration Timer

11.6.3.1. Implementation

1. In LOGIC OPERATORS/Logic 1 Page (Table 15.1.2.)	set ’Operation’ = OR set ’Input 1 Src’ = 05869:Prg.DO1 set ’Input 2 Src’ = 05869:Prg.DO1 set ’Invert’ = Invert Both This inverts the sense of Program DO1
2. In INPUT OPERS/Monitor 1 Page (Table 11.4.1.)	Set ‘Enable’ = Enabled Set ‘Input Src’ = 05804: This connects PSP1 Holdback Status Set ‘Reset Src’ = 07176:LgOp1.OP This connects Logic 1 Output to the Monitor Reset Set ‘Trigger’ = 1.0 Set ‘Day Alarm’ = 0 Set ‘Time Alarm’ = 0:30:00:0
3. In STANDARD IO/AA Relay Page (Table 17.3.1.)	Set ‘Channel Type’ = On/Off Set ‘Wire Src’ = 03500: This assigns AA Relay to Monitor OP

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

12.1. WHAT ARE TIMER BLOCKS?

Timer Blocks allow the controller to use time 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, see Section 5.2.1.

The Timer Blocks available in the 2604 controller are:

Four timer blocks	The timer block will normally be activated by an event, wired into the Input Source parameter. Alternatively, it may be activated by a parameter in the list. Timing continues for a set time period. An output is available which can be ‘wired’ to operate an event. Timer block modes of operation are described in Section 12.2.
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 to operate an event.
Four totaliser blocks	Totaliser blocks can also be ‘wired’ 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’ to operate an event such as a relay.

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. TIMERS

Each timer block can be configured to operate in four different modes. These modes are explained below

12.2.1. On Pulse Timer Mode

This timer is used to generate a fixed length pulse from an edge trigger.

- The output is set to On when the input changes from Off to On.
- The output remains On until the time has elapsed
- If the 'Trigger' input parameter recurs while the Output is On, the Elapsed Time will reset to zero and the Output will remain On
- The triggered variable will follow the state of the output

Figure 12.1 illustrates the behaviour of the timer under different input conditions.

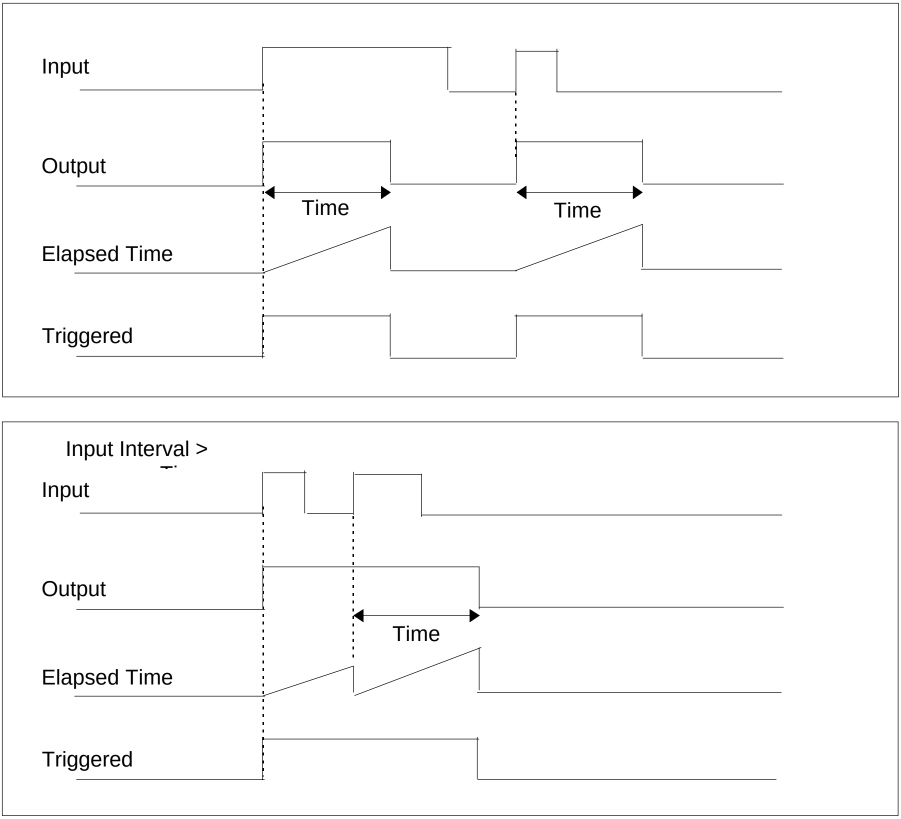


Figure 12-1: On Pulse Timer Under Different Input Conditions

12.2.2. Off Delay Timer Mode

This timer provides a delay between the trigger event and the Timer output. If a short pulse triggers the Timer, then a pulse of one sample time (110mS) will be generated after the delay time.

- The Output is set to Off when the Input changes from Off to On.
- The Output remains Off until the Time has elapsed.
- If the Input returns to Off before the time has elapsed, the Timer will continue until the Elapsed Time equals the Time. It will then generate a pulse of one Sample Time duration.
- Once the Time has elapsed, the Output will be set to On.
- The Output will remain On until the Input is cleared to Off.
- The Triggered variable will be set to On by the Input changing from Off to On. It will remain On until both the Time has elapsed and the Output has reset to Off.

Figure 12.2 illustrates the behaviour of the timer under different input conditions.

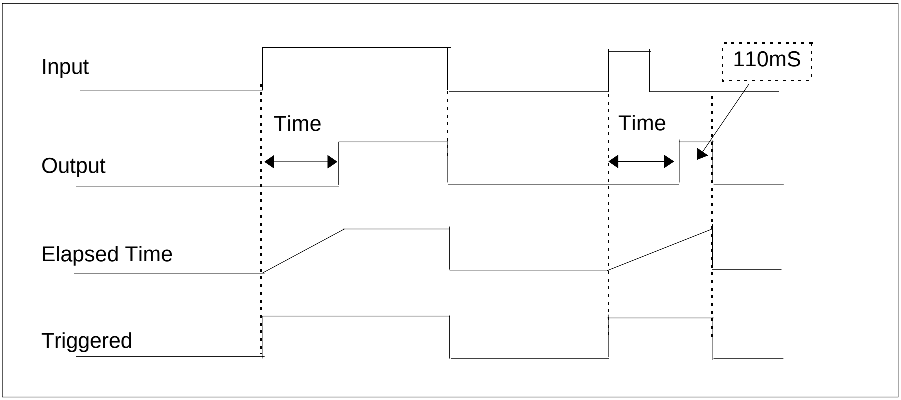


Figure 12-2: Off Delay Timer Under Different Input Conditions

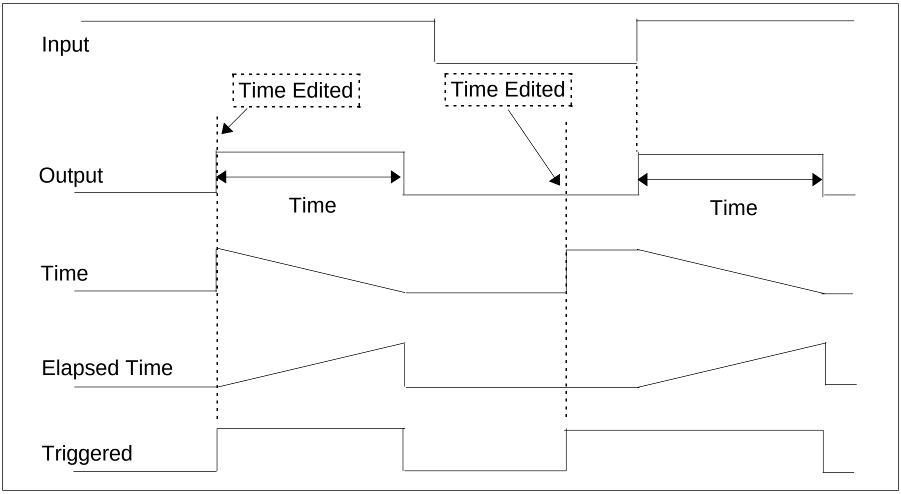
12.2.3. One Shot Timer Mode

This timer behaves like a simple oven timer.

- When the Time is edited to a non-zero value the Output is set to On
- The Time value is decremented until it reaches zero. The Output is then cleared to Off
- The Time value can be edited at any point to increase or decrease the duration of the On time
- Once set to zero, the Time is not reset to a previous value, it must be edited by the operator to start the next On-Time
- The Input is used to gate the Output. If the Input is set, the time will count down to zero. If the Input is cleared to Off, then the Time will hold and the Output will switch Off until the Input is next set.

  Note: since the Input is a digital wire, it is possible for the operator to NOT wire it, and set the Input value to On which permanently enables the timer.
- The Triggered variable will be set to On as soon as the Time is edited. It will reset when the Output is cleared to Off.

Figure 12.3 illustrates the behaviour of the timer under different input conditions.



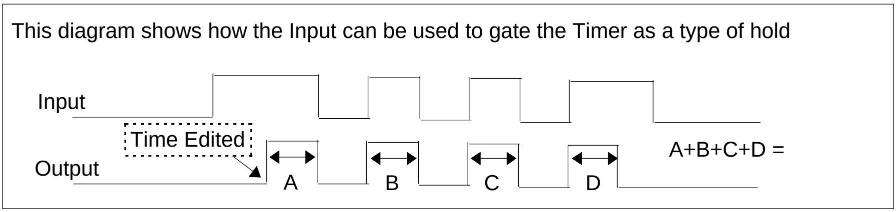


Figure 12-3: One Shot Timer

12.2.4. Minimum On Timer Mode

This timer has been targeted at guaranteeing that the output remains On for a duration after the input signal has been removed. It may be used, for example, to ensure that a compressor is not cycled excessively.

- The output will be set to On when the Input changes from Off to On.
- When the Input changes from On to Off, the elapsed time will start incrementing towards the set Time.
- The Output will remain On until the elapsed time has reached the set Time. The Output will then switch Off.
- If the Input signal returns to On while the Output is On, the elapsed time will reset to 0, ready to begin incrementing when the Input switches Off.
- The Triggered variable will be set while the elapsed time is >0. It will indicate that the timer is counting.

Figure 12.4 illustrates the behaviour of the timer under different input conditions.

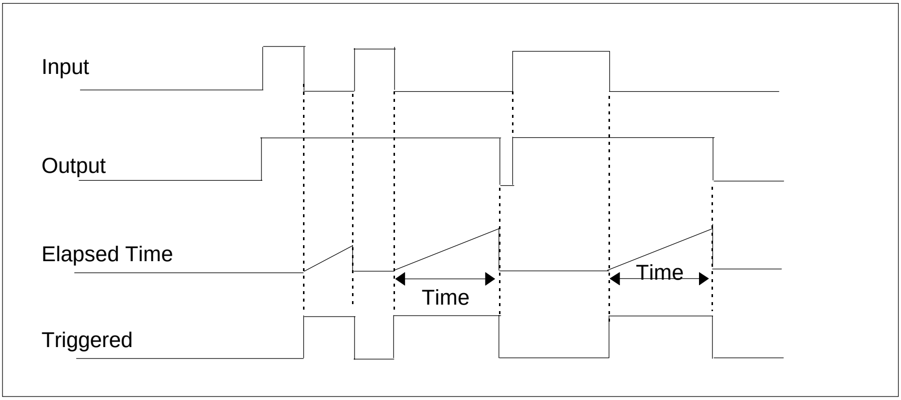


Figure 12-4: Minimum On Timer Under Different Input Conditions

12.2.5. Timer Parameters

Table Number: 12.2.5.	This page allows you to configure Timer Parameters			TIMER BLOCKS (Timer 1 to 4 Page)
Parameter Name	**Parameter Description**	**Value**	**Default**	**Access Level**
Type	Timer type	Off On Pulse Timer Off Delay Timer One Shot Timer Min-On Timer	Off	Conf
Input Src	Timer input wire source	Modbus address		Conf
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

The above table is repeated for Timers 2 to 4.

12.3. THE CLOCK

A real time clock is provided for use with various timer functions in the controller.

12.3.1. Clock Parameters

Table Number: 12.3.1.	This page allows you to configure set the clock			TIMER BLOCKS (Clock Page)
Parameter Name	**Parameter Description**	**Value**	**Default**	**Access Level**
Mode	Real time clock mode	Run Stop Set		Conf
Time	Real time clock time	HH:MM:SS		L1 R/O when Mode =Set
Day	Real time clock day	Never Monday Tuesday Wednesday Thursday Friday Saturday Sunday Mon-Fri Mon-Sat Sat-Sun Every Day		L1 R/O when Mode =Set

12.4. TIMER ALARMS

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

12.4.1. Alarm 1 (or 2) Page

All parameters in this page are available in L3 as well as Configuration level.

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 Page	
Press [Scroll] 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 [Scroll] 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 [Scroll] 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 [Scroll] 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 [Scroll] 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 totaliser function blocks which are used to measure the total quantity of a measurement integrated over time. A totaliser can, by soft wiring, be connected to any measured value. The outputs from the totaliser are its integrated value, and an alarm state. The user may set a setpoint which causes the alarm to activate once the integration exceeds the setpoint.

The totaliser has the following attributes:-

1. Run/Hold/Reset
   In Run the totaliser will integrate its input and continuously test against an alarm setpoint.
   In Hold the totaliser will stop integrating its input but will continue to test for alarm conditions.
   In Reset the totaliser will be zeroed, and alarms will be reset.
2. Alarm Setpoint
   If the setpoint is a positive number, the alarm will activate when the total is greater than the setpoint.
   If the setpoint is a negative number, the alarm will activate when the total is lower (more negative) than the setpoint.
   If the totaliser alarm setpoint is set to 0.0, the alarm will be off. It will not detect values above or below.
   The alarm output is a single state output. It may be cleared by resetting the totaliser, or by changing the alarm setpoint.
3. The total is limited to a maximum of 99999 and a minimum of -19999.

12.5.1. Totaliser Parameters

Table Number: 12.5.1.	This page allows you to configure Totaliser Parameters		TIMER BLOCKS (Totaliser 1 Page)	
Parameter Name	**Parameter Description**	**Value**	**Default**	**Access Level**
Input Src	Totaliser monitored parameter source	Modbus address		Conf
Run Src	Totaliser run source	Modbus address		Conf
Hold Src	Totaliser hold source	Modbus address		Conf
Run	Totaliser run	Reset Run		L1
Hold	Totaliser hold	Continue Hold		L1
Total	Totaliser accumulator	Display min to display max		L1
Alarm Setpoint	Totaliser alarm setpoint			L3
Alarm Output	Totaliser alarm output	Off On		L1

This page is repeated for Totalisers 2 to 4.

Note: When a totaliser is not running (eg when wired from a Run Src) it is automatically reset.

12.6. TIMER WIRING EXAMPLES

12.6.1. Compressor Timer

This example uses a Minimum On Timer to start a compressor. The compressor must be kept running for a period after the controller stops calling for cooling. If the controller requests cooling again the ‘compressor timeout’ timer deactivates until the cooling turns off again. The same action is required for de-humidification.

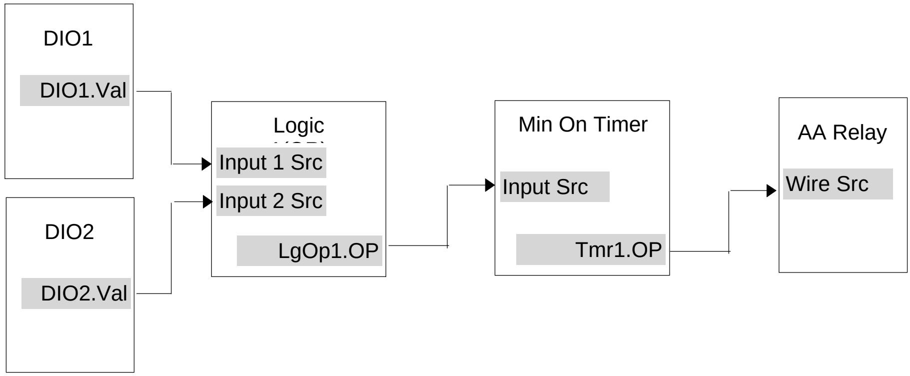


Figure 12-5: Compressor Timer

This example assumes that the controller has been set up as a two loop temperature and humidity controller. The controller will call for the compressor to be switched on when either the cool or de-humidify outputs are switched on. The cool output is DIO1 and the de-humidify output is DIO2. The compressor is switched by relay AA.

12.6.1.1. Implementation

1. In LOGIC OPERS/Logic 1 (Table 15.1.2),	set ’Operation’ = OR set ’Input 1 Src’ = 05409:------- set ’Input 2 Src’ = 05457:------- This connects the cool and dehumidify outputs to the logic 1 operator.
2. In TIMER BLOCKS/Timer 1 Page (Table 12.2.5)	set ’Type’ = Min-On Timer set ’Input Src’ = 07176:LgOp1.OP (Appendix D) set ’Time’ = 0:10:00:0 This uses Logic 1 to trigger the timer. The timer is set to 10 mins.
3. In STANDARD IO/AA Relay Page (Table 17.3.1)	set ’Channel Type’ = On/Off (Appendix D) set ’Wire Src’ = 08693:Tmr1.OP This assigns AA Relay to Timer 1 output

13. Chapter 13 User Values

13.1. WHAT ARE USER VALUES?

User Values are normally used as constants in analogue or digital operations.
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 as described in Section 5.2.1.

13.1.1. User Values Parameter Table

Table Number: 13.1.1.	**This page allows you to configure User Values**		**USER VALUES (User Val 1 Page)**	
Parameter Name	**Parameter Description**	**Value**	**Default**	**Access Level**
Units	User value units	See Appendix D.2.		Conf
Resolution	User values resolution	XXXXX XXXX.X XXX.XX XX.XXX		Conf
Low Limit	User values low limit	Display min to display max		Conf
High Limit	User values high limit	Display min to display max		Conf
User 1 Value	User 1 value	User val lo lim to user val hi lim		L1

The above table is repeated for User Values 2 to 12.

Note: It is often required to generate a User Value = 1, and to wire this from a source. A User Value can be used for this but this takes up one or more of the User Values available. An alternative is to use the parameter 'Const.1' which is a User Value = 1. This parameter is listed in Appendix D.

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. In access levels 1 to 3 the operator 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, as described in Section 5.2.1.

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

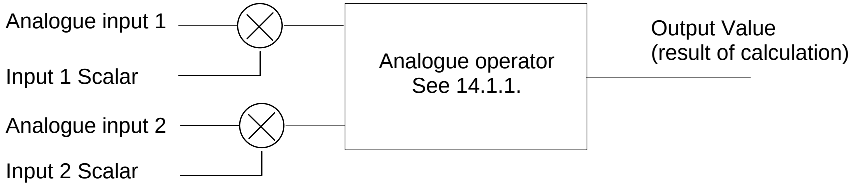


Figure 14-1: Analogue Operators

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
up to	the logic input. If logic input is true input 1 is switched through to the output.
Select Logic 32	If logic input is false input 2 is switched through to the output.

14.1.2. Analogue Operator Parameters

Table Number: 14.1.2.	This page allows you to configure Analogue Operators 1 to 24			ANALOGUE OPERS (Analogue 1 Page)
Parameter Name	**Parameter Description**	**Value**	**Default**	**Access Level**
Operation	The operation to be performed	See 14.1.1	Off	L1
Input 1 Src	Input 1 source	Modbus address		Conf
Input 1 Scalar	Input 1 scalar	-99.99 to 999.99		L3
Input 2 Src	Input 2 source	Modbus address		Conf
Input 2 Scalar	Input 2 scalar	-99.99 to 999.99		L3
OP Units	Output units	See Appendix D.2.		Conf
OP Resolution	Output resolution	XXXXX XXXX.X XXX.XX XX.XXX		Conf
Low Limit	Output low limit	Display min to display max		Conf
High Limit	Output high limit	Display min to display max		Conf
Default Enable	Enable fall back	No Yes		Conf
Default OP	Fall back value	Display min to display max		Conf
Input 1 Value	Input 1 Value	Display min to display max		L1
Input 2 Value	Input 2 Value	Display min to display max		L1
Output Value	output Value	Display min to display max		L1
Status	Status	Good Bad		L1

The above table is repeated for Analogue Operators 2 to 24.

15. Chapter 15 Logic Operators

Logic Operators allow the controller to perform logical operations 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. 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, as described in Section 5.1.1.

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 ≥ Input 2
Less or Equal	The output result is ON when Input 1 ≤ Input 2

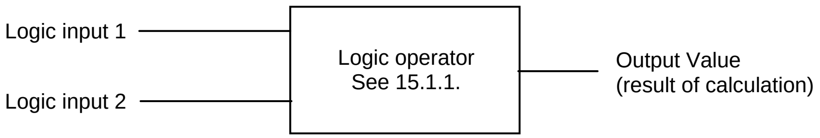


Figure 15-1: Logic Operators

Note

0 = OFF (or false)
Non 0 = ON (or true)

15.1.2. Logic Operator Parameters

Table Number: 15.1.2.	This page allows you to configure Logic Operators 1 to 31		LOGIC OPERS (Logic 1 Page)	
Parameter Name	**Parameter Description**	**Value**	**Default**	**Access Level**
Operation	The operation to be performed	See Section 15.1.1.	Off	L1
Input 1 Src	Input 1 source	Modbus address		Conf
Input 2 Src	Input 2 source	Modbus address		Conf
Invert	Invert inputs	None Invert Input 1 Invert Input 2 Invert Both		Conf
Default OP	Fall back value (Does not appear if 'Operation' = Off)	0 or 1		Conf
OP Resolution	Output resolution	XXXXX XXXX.X XXX.XX XX.XXX		Conf
Input 1 Value	Input 1 Value	Off On		L3
Input 2 Value	Input 2 Value	Off On		L3
Output Value	Output Value	Off On		L3
Status	Status	Good Bad		L3

The above table is repeated for Logic Operators 2 to 31.

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. 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.

16.1.1. H Module parameters

Table Number: 16.1.1.	**This page allows you to configure Digital Communications fitted in slot H.**			**COMMS (H Module Page)**
Parameter Name	**Parameter Description**	**Value**	**Default**	**Access Level**
Ident	Comms module identification	Comms		L1
Baud Rate	Baud rate	9600, 19200, 4800, 2400, 1200	9600	Conf
Parity	Parity	None Even Odd	None	Conf
Address	Mainboard controller address	1 to 255	1	L1
Resolution	Comms resolution	Full Integer	Full	L3

The above table is repeated for a Digital Communications module fitted into the J slot position.

16.1.2. Digital Communications Diagnostics

Table Number: 16.1.2.	This page allows you to monitor the number of times that a particular comms module has received a message			COMMS (Diagnostic Page)
Parameter Name	**Parameter Description**	**Value**	**Default**	**Access Level**
H Rx Messages	Valid H comms messages received			L3 R/O
J Rx Messages	Valid J comms messages received			L3 R/O

17. Chapter 17 Standard IO

17.1. WHAT IS STANDARD IO?

Standard IO allows you to configure the fixed Input/Output connections as listed in the table below. Parameters such as Input Types, Linearisation Curves, Resolution, Digital I/O Types, etc., can be adjusted in the Standard IO pages.

STANDARD IO (*PV Input* Page)	Allows access to parameters which configure 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 configure 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 configure 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 configure the fixed digital IO connected to terminals D1 to D7 and DC.
STANDARD IO (Diagnostic Page)	Allows access to parameters which configure the fixed digital Input connected to terminal D8 and DC.

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

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. Standard IO PV Input Parameters

Table Number: 17.2.1.	**This page allows you to configure the PV Input Parameters**			**STANDARD IO (PV Input Page)**
Parameter Name	**Parameter Description**	**Value**	**Default**	**Access Level**
Channel Type	Input/Output type	RTD, Thermocouple, Pyrometer 40mV, 80mV, mA, Volts, HZVolts, Ohms		Conf
Linearisation	Input linearisation	See note 1		Conf
Units	Engineering units	See Appendix D.2.		Conf
Resolution	Display resolution	XXXXX XXXX.X XXX.XX XX.XXX		Conf
CJC Type	CJC type Only shown if Channel \Type = thermocouple	Internal 0^oC 45^oC 50^oC None	Internal	Conf
SBrk Impedance	Sensor break enable for certain high output impedance sensors	Off Low High	Off	Conf
SBrk fallback	Sensor break fallback	Off Down scale Up Scale		Conf
Invert	Invert	Normal Inverted	Normal	Conf
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
CJC Temp	CJC temperature in mV read at the rear terminals	0 to 100mV		R/O
Cal State	Calibration state	See Chapter 22		Conf
Rear Term Temp	Temperature at the rear terminals	Auto See note 2		Conf
OP Cal Trim	Analogue output calibration low trim			Conf
PV In Status	Status of the PV input	OK Diagnostic messages are displayed to show the state of the Input if not OK.		R/O
SBrk Trip Imp	Sensor break value			R/O
PV Input Name	User defined name for PV input. Select from User Text Page Section 5.2.5.		Default Text	Conf

Notes

1. **Input Linearisation**
   J Type, K Type, L Type, R Type, B Type, N Type, T Type, S Type, Platinel II, C Type, PT 100, Linear, Square Root, Custom 1, Custom 2, Custom 3.

2. **Rear Terminal Temperature**
   Auto means that the controller automatically measures the temperature at the rear terminals for use with cold junction compensation. The temperature of the rear terminals can be measured externally, if required, and this measured value can then be entered manually when calibrating CJC.

17.2.2. Standard IO An Input Parameters

Table Number: 17.2.2.	This page allows you to configure the Analogue Input Parameters			STANDARD IO (An Input Page)
Parameter Name	**Parameter Description**	**Value**	**Default**	**Access Level**
Channel Type	Input/Output type	Volts mA		Conf
Linearisation	Input linearisation	See note 1		Conf
SBrk fallback	Sensor break fallback	Off Down scale Up Scale		Conf
SBrk Impedance	Sensor break enable for certain high output impedance sensors	Off Low High	Off	Conf
Units	Engineering units	See Appendix D.2.		Conf
Resolution	Display resolution	XXXXX XXXX.X XXX.XX XX.XXX		Conf
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
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
Cal State	Calibration state	See Chapter 22		Conf
An In Status	Status of the analogue	OK		R/O

	input	Diagnostic messages are displayed to show the state of the Input if not OK.		
SBrk Trip Imp	Sensor break value			R/O
An Input Name	User defined name for the analogue input. Select from User Text Page Section 5.2.5.		Default Text	Conf

Notes

1. **Input Linearisation**
   J Type, K Type, L Type, R Type, B Type, N Type, T Type, S Type, Platinel II, C Type, PT 100, Linear, Square Root, Custom 1, Custom 2, Custom 3.

17.3. THE FIXED RELAY OUTPUT PARAMETERS

Allows access to parameters which configure 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.

17.3.1. Standard IO AA Relay Parameters

Table Number: 17.3.1	**This page allows you to configure the Fixed Relay Parameters**			**STANDARD IO (AA Relay)**
Parameter Name	**Parameter Description**	**Value**	**Default**	**Access Level**
Channel Type	Function of the relay	On/Off Time Proportion Valve Lower Valve Raise		Conf
Wire Src	AA relay source	Modbus address		Conf
Invert	Relay energised Relay de-energised	Normal Inverted		Conf
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 (1)	Status of the relay output	-100 to 100 Negative values are not used		(editable if not wired)
	If configured as On/Off 0 = Relay Off; Any other value (+ or -) = Relay On			R/O L3
	If configured for control 0 = Relay off; 100 = on; 1 to 99 = time proportioning			R/O L3

Note 1: If the relay is wired to a source such as a loop output (Ch1 or Ch2) the 'value' will read in a positive direction only, i.e. it does not signify heating or cooling but just the position of the relay.

17.4. STANDARD DIGITAL IO PARAMETERS

This page allows access to parameters which set up the fixed digital IO connected to terminals D1 to D7 and DC.
The standard digital IO1 to 7 can either be configured as input or output.
. 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 17.4.1.

When the logic outputs are configured as time proportioning outputs, they can be scaled using the procedure described in the Installation and Operation Handbook, Part No. HA026491.

17.4.1. Standard IO Digital Input/Output Parameters

Table Number: 17.4.1.	This page allows you to configure the Digital I/O Parameters		STANDARD IO (Dig IO1 to 7 Page)	
Parameter Name	**Parameter Description**	**Value**	**Default**	**Access Level**
Channel Type	Input/Output type	Digital Input On/Off Time Proportion Valve Lower Valve Raise		Conf
Wire Src	Source of the signal to operate a digital output. This parameter does not appear for digital input	Modbus address		Conf
Invert	Normal/inverted I/O	Normal Inverted		Conf
The following five parameters only appear if the digital IO channel = Time Proportioning.				
Min Pulse Time	Minimum logic on or off time.	Auto = 0.05s or 0.1 to 999.9s	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			L3
Dig IO*1* Val (1)	If Channel Type = Digital Input this reads the state of the input	0 = Off 1 = On		R/O L3
	If configured as an output this reads the desired output value	or -100 to 100		
Electrical Value (1)	If Channel Type = Digital Input this value does not appear			R/O L3
	If configured as an output this reads the actual electrical value.	0 or 1		

Note 1: Only settings between 0 & 100 are valid for Dig IO-Val. The corresponding Electrical value is shown in the following table:-

Channel Type	Dig IO- Val	Electrical Value
On/Off	0 to 100	0.0 to 100.0
Time Proportion	0 to 100	0.0 (off) to 1.0 (on). Time proportions between 0.0/1.0 for other positive settings of Dig IO- Val
Valve Raise/Lower	0 to 100	0.0

17.5. 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

17.6. DIGITAL INPUT WIRING EXAMPLES

17.6.1. To Configure DIO1 to put Loop 1 into Manual

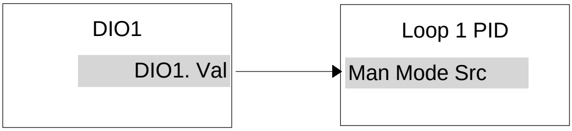


Figure 17-1: External Auto/Manual Switch

The DIO1 function block must be configured to be a digital input. The output of the block is wired to the Manual Mode Source in Loop 1 PID block.

17.6.1.1. Implementation

1. In STANDARD IO/Dig IO1 Page (Table 17.4.1.)	set 'Channel Type' = Digital Input
2. In LP1 SETUP/Wiring Page (Table 9.1.2.),	set 'Man Mode Src' = 05402:DIO1.Val This connects the output of the digital block to the manual mode wire in the LP1 PID block.

17.6.2. To Configure DIO2 to enable Remote SP in Loop 1

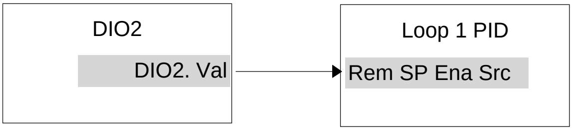


Figure 17-2: External Local/Remote Switch

The DIO2 function block must be configured to be a digital input. The output of the block is wired to the Remote Setpoint Source in Loop 1 PID block.

17.6.2.1. Implementation

1. In STANDARD IO/Dig IO2 Page (Table 17.4.1.)	set 'Channel Type' = Digital Input
2. In LP1 SETUP/Wiring Page (Table 9.1.2.),	set 'Rem SP Ena Src' = 05450:DIO2.Val This connects the output of the digital block to the remote setpoint enable wire in the LP1 PID block.

17.6.3. To Configure DIO3 to put Loop 1 and Loop 2 into Manual

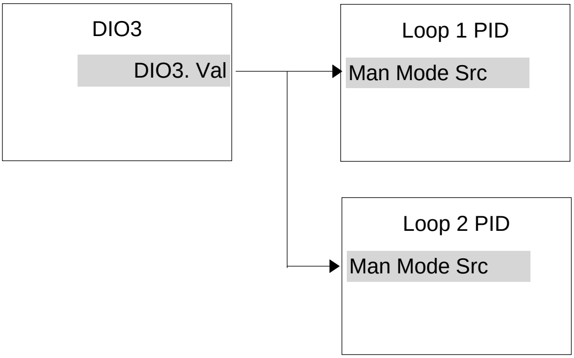


Figure 17-3: External Auto/Manual Switch - Loops 1 & 2

When wiring from a digital input function block it can have a multiple fan-out, i.e. one input can perform numerous functions.
The DIO3 function block must be configured to be a digital input. The output of the block is wired to the Manual Mode Source in both Loop 1 and Loop 2 PID block.

17.6.3.1. Implementation

1. In STANDARD IO/Dig IO1 Page (Table 17.4.1.)	set 'Channel Type' = Digital Input
2. In LP1 SETUP/Wiring Page (Table 9.1.2.),	set 'Man Mode Src' = 05498:DIO3.Val This connects the output of the digital block to the manual mode wire in the LP1 PID block.
3. In LP2 SETUP/Wiring Page (Table 9.1.2.),	set 'Man Mode Src' = 05498:DIO3.Val This connects the output of the digital block to the manual mode wire in the LP2 PID block.

18. Chapter 18 Module IO

18.1. WHAT IS MODULE IO?

Additional analogue and digital IO is provided by the plug in IO modules. With the exception of the PV Input these modules can be fitted in any of five slots (see Section 1.5). 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	Triac	1
Dual triac	TT	Dual 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

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

This page shows the type of module fitted in positions 1, 2, 3, 4, 5, and 6.

18.2.1. Idents Page

Table Number: 18.2.1.	This page allows you to read the type of module fitted.			MODULE IO (Idents Page)
Parameter Name	**Parameter Description**	**Value**	**Default**	**Access Level**
Module 1	Actual module fitted	See note 1		L1 R/O
Memory Module	Memory module position	No Module		L1 R/O
Module 2	Actual module fitted	See note 1		L1 R/O
Module 3	Actual module fitted	See note 1		L1 R/O
Module 4	Actual module fitted	See note 1		L1 R/O
Module 5	Actual module fitted	See note 1		L1 R/O
Module 6	Actual module fitted	See note 1		L1 R/O

Note 1:-
Module Types
No Module, Bad Ident, Form C Relay, Form A Relay, Triac, Dual Relay, Dual Triac, DC Control, DC Retrans, PV Input, Tri-Logic IP, Tri-Contact IP, Tri-Logic OP, Transmitter PSU

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 (A)**	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 and DC Retransmission

Table Number: 18.3.1.	This page allows you to configure a DC Output module.			MODULE IO (Module*1*(A))
Parameter Name	**Parameter Description**	**Value**	**Default**	**Access Level**
Ident	Module identification	DC Output		R/O
Channel Type	I/O type	Volts mA		Conf
Wire Src	Source to which the channel is wired	Modbus address		Conf
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 in operation mode	0 to 10.00		R/O L3
Module 1A Val (can be a user defined name).	The current output value in operation mode.	±100.0% -ve values are not used		R/O L3
Cal Status	Calibration status	See Chapter 22		R/O
Cal Trim	Analogue output calibration trim. Only available in calibration mode.			Conf
Module Name	User defined name for the module function. Select from User Text Page Section 5.2.5.		Default Text	Conf
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 configure 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	Module identification	Relay		R/O
Channel Type	Channel/Module Type	On/Off Time Proportion Valve Lower Valve Raise		Conf
Wire Src	Wire source	Modbus address		Conf
Invert	Relay energised Relay de-energised	Normal Inverted		Conf
The following six parameters only appear if Channel Type is set to Time Proportion.				
Min Pulse Time	Minimum relay on or off time	Auto = 0.05s Manual = 0.1 to 999.9	5 sec	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 in operation mode	0.00 or 1.00 (time prop)		R/O L3
Module 1A Val *Module 1A* can be user defined text.	The current output value in operation mode.	±100.0% -ve values are not used		R/O L3
Module Status	Module status	OK or message		R/O
Module Name	User defined name for the module function. Select from User Text Page Section 5.2.5.		Default Text	Conf

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 configure 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	Module identification	Triac		R/O
Channel Type	Channel/Module Type	On/Off Time Proportion Valve Lower Valve Raise		Conf
Wire Src	Wire source	Modbus address		Conf
Invert	Invert triac operation	Normal Inverted		Conf
The following six parameters only appear if Channel Type is set to Time Proportion.				
Min Pulse Time	Minimum triac on or off time	Auto = 0.05s or 0.1 to 999.9	5 sec	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 in operation mode	0.00 or 1.00 (time prop)		R/O L3
Module 1A Val *Module 1A* can be user defined text.	The current output value in operation mode.	+100.0% -ve values are not used		R/O L3
Module Status	Module status	OK or message		R/O
Module Name	User defined name for the module function. Select from User Text Page Section 5.2.5.		Default Text	Conf
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 configure a Logic Output module.			MODULE IO (Module *1*(A) Page)
Parameter Name	**Parameter Description**	**Value**	**Default**	**Access Level**
Ident	Module identification	Triple logic output		R/O
Channel Type	Channel/Module Type	On/Off Time Proportion Valve Lower Valve Raise		Conf
Wire Src	Wire source	Modbus address		Conf
Invert	Invert triac operation	Normal Inverted		Conf
The following six parameters only appear if Channel Type is set to Time Proportion.				
Min Pulse Time	Minimum on or off time	Auto = 0.05s or 0.1 to 999.9	Auto	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 in operation mode	0.00 or 1.00 (time prop)		R/O L3
Module 1A Val *Module 1A* can be user defined text.	The current output value in operation mode.	±100.0% -ve values are not used		R/O L3
Module Status	Module status	OK or message		R/O
Module Name	User defined name for the module function. Select from User Text Page Section 5.2.5.		Default Text	Conf
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	Module identification	Logic Input		R/O
Channel Type	Channel/Module Type	Digital Input	Digital Input	Conf
Invert	Invert input operation	Normal Invert		Conf
Module 1A Val *Module 1A* can be user defined text.	The current input value.	0 = Off 1 = On		R/O
Module Name	User defined name for the module function. Select from User Text Page Section 5.2.5.		Default Text	Conf
Module Status	Module status	OK or message		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: 18.3.6.	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	Module identification	PV Input		R/O
Channel Type	Input/Output type	RTD, Thermocouple, Pyrometer 40mV, 80mV, mA, Volts, HZVolts, Ohms		Conf
Linearisation	Input linearisation	See note 1		Conf
Units	Engineering units	See Appendix D.2.		Conf
Resolution	Display resolution	XXXXX XXXX.X XXX.XX XX.XXX		Conf
SBrk Impedance	Sensor break enable for certain high output impedance sensors	Off Low High	Off	Conf
SBrk fallback	Sensor break fallback	Off Down scale Up Scale		Conf
CJC Type	CJC type Only shown if Channel Type = thermocouple	Internal 0^oC 45^oC 50^oC None	Internal	Conf
Electrical Lo [units]	Electrical low input level	Input range		L3. Only shown for mV, V, mA
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
Emissivity	Emissivity Ch Type = pyrometer only	Off to1.00		

Electrical Val [units]	The current electrical value of the input	Input range		R/O L3
Module 3A Val *Module 3A* can be user defined text.	The current value in engineering units.			R/O
CJC Temp	Temperature read at the rear terminals ^{O}C Ch Type = thermocouple only			R/O
Cal State	Calibration state	See Chapter 22.		Conf
Rear Term Temp	Allows a user measured offset to be entered for CJC calibration Ch Type = thermocouple only	Auto to 50.00^{o}C		
Cal Trim	Analogue output calibration trim. Only available in calibration mode.			Conf
Module Status	Module status	OK or message		R/O
SBrk Trip Imp	Sensor break value			R/O
Module Name	User defined name for the module function. Select from User Text Page Section 5.2.5.		Default Text	Conf
This module has a single input. Its parameters are displayed under ‘channel’ (A). Channel (B) and channel (C) show ‘No IO Channel’.				

Notes

1. **Input Linearisation**
   J Type, K Type, L Type, R Type, B Type, N Type, T Type, S Type, Platinel II, C Type, PT 100, Linear, Square Root, Custom 1, Custom 2, Custom 3.

18.3.7. Transmitter Power Supply

Table Number: 18.3.7.	**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	Module identification	Transmitter PSU		R/O
Channel Type	Input/Output type	Transmitter PSU	Transmitter PSU	Conf
Module 1A Val *Module 1A* can be user defined text.	The current value in engineering units.			R/O
Module Status	Module status	OK or message		R/O
Module Name	User defined name for the module function. Select from User Text Page Section 5.2.5.		Default Text	Conf

This module has a single output providing 24Vdc at 20mA. Its parameters are displayed under ‘channel’ (A).

Channel (B) and channel (C) show ‘No IO Channel’.

18.4. MODULE IO WIRING EXAMPLES

18.4.1. To Configure Module 1 Channel A to Run a Program

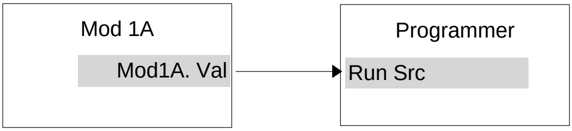


Figure 18-1: External Run/Hold Switch

This example assumes a Triple Logic module fitted in module slot 1. No configuration of the Module 1A function block is required but the output of the block must be wired to the Run Source in the Programmer block.

18.4.1.1. Implementation

1. In PROGRAM EDIT/Wiring Page (Table 6.6.2.)	set 'Run Src' = 04148:Mod1A.Val This connects the output of module 1A to the Run Source wire in the Programmer block.

18.4.2. To Operate a Relay from a Digital Input

This example assumes that a Relay Module is fitted in module slot 2, and it is required to operate when Digital Input 1 is true.

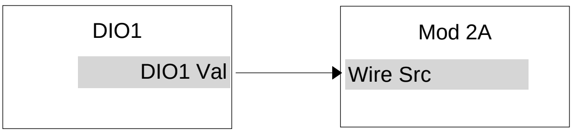


Figure 18-2: To Operate a Relay from a Digital Input

18.4.2.1. Implementation

1. In STANDARD IO/Dig IO1 Page (Table 17.4.1.)	set 'Channel Type' = Digital Input This configures DIO1 to be digital input
2. In MODULE IO/Module 2 A Page (Table 17.4.1.)	set 'Channel Type' = On/Off set 'Wire Src' = 05402:DIO1.Val This configures Module 2A to On/Off relay and connects DIO1 to operate this relay.

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.

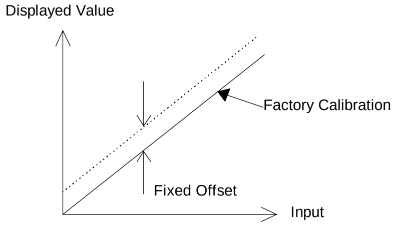


Figure 19-1: Transducer Scaling Fixed Offset

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.

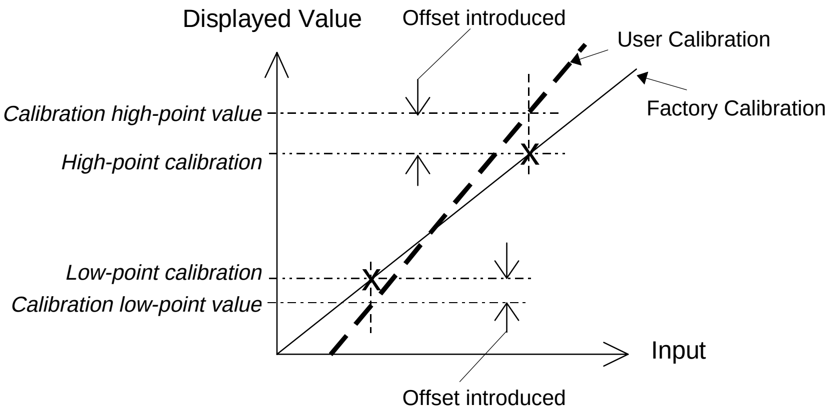


Figure 19-2: Transducer Scaling Two Point Calibration

19.4. TRANSDUCER SCALING PARAMETERS

Transducer scaling parameters are found in three sub-headers:-

PV Input Page
An Input Page
Module (1 to 6) Page
The parameters are the same in each list and all are also available in operation level.

19.4.1. Transducer Scaling Parameter Tables

Table Number: 18.3.1.	**This page allows you to configure a DC Output module.**			**MODULE IO (Module *1*(A))**
Parameter Name	**Parameter Description**	**Value**	**Default**	**Access Level**
Txdcr Scale	Transducer scaling enable	Factory Transducer		L3
Offset	Transducer scaling offset	Display range		L3
Display Lo	Transducer scaling offset low	Display range		L3
Display Hi	Transducer scaling offset high	Display range		L3
Input Lo	Transducer scaling point low	Display range		L3
Input Hi	Transducer scaling point high	Display range		L3

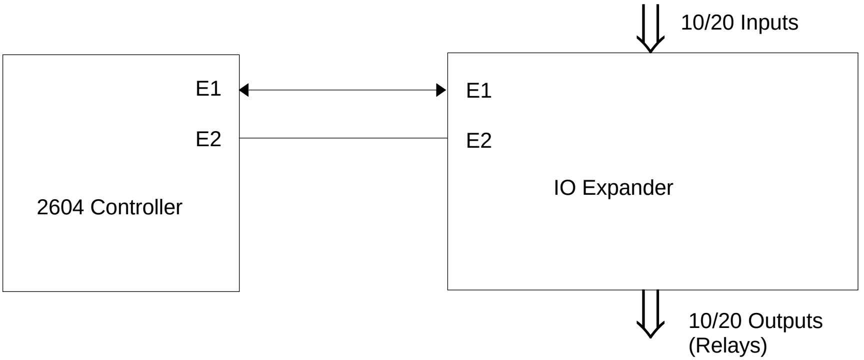
20. Chapter 20 IO Expander

20.1. WHAT IS IO EXPANDER?

The IO Expander is an external unit which can be used in conjunction with the 2604 controller to allow the number of digital IO points to be increased. There are two versions:-

1. 10 Inputs and 10 Outputs
2. 20 Inputs and 20 Outputs

Each input is fully isolated and voltage or current driven. Each output is also fully isolated consisting of four changeover contacts and six normally open contacts in the 10 IO version and four changeover and sixteen normally open contacts in the 20 IO version.
Data transfer is performed serially via a two wire interface as shown in Figure 20-1.



E1 and E2 are the terminal numbers on both Controller and IO Expander. It is recommended that a cable length of 10 metres is not exceeded, however, no shielding or twisted pair cable is required.

Figure 20-1: IO Expander Data Transfer

Wiring connections and further details of the IO Expander are given in the IO Expander Handbook, Part No. HA026893.

When this unit is connected to the controller it is necessary to set up parameters to determine its operation. These parameters can be set up in Operation Level 3 and are repeated here for information.

The IO Expander is enabled in INSTRUMENT/Options Page, see Chapter 5.

20.1.1. IO Expander parameters

Table Number: 20.1.1	This page allows you to inspect and adjust IO Expander parameters.			IO EXPANDER
Parameter Name	**Parameter Description**	**Value**	**Default**	**Access Level**
Expander Type	Expander type	None 10 in 10 out 20 in 20 out		Conf
OP 1 Src	Output 1 source Source of the signal to operate relay 1 in the IO Expander.	Modbus address		Conf
The above parameter is repeated for all 20 outputs available in the IO Expander				
In Status 1	Status of the first 10 digital inputs □□□□□□□□□□ to ■■■■■■■■■■	□ = Off ■ = On		L3 R/O
In Status 1	Status of the second 10 digital inputs □□□□□□□□□□ to ■■■■■■■■■■	□ = Off ■ = On		L3 R/O
OP Stat 1-10	Status of the first 10 digital outputs. The flashing output can be changed. Press ⟳ to select outputs in turn ⬍□□□□□□□□□□ to ⬍■■■■■■■■■■	□ = Off ■ = On		L3
OP Inv 1-10	Allows the sense of the first 10 outputs to be changed.	□ = direct ■ = Inverted		L3
Out Stat 11-20	Status of the second 10 digital outputs. The flashing output can be changed. Press ⟳ to select outputs in turn ⬍□□□□□□□□□□ to ⬍■■■■■■■■■■	□ = Off ■ = On		L3
OP Inv 11-20	Allows the sense of the second 10 outputs to be changed.	□ = direct ■ = Inverted		L3

21. Chapter 21 Diagnostics

21.1. 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:-

21.1.1. Diagnostics parameters

Table Number: 21.1.1	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

22. Chapter 22 Calibration

The 2604 controller is calibrated in three ways. These are:-

1. **Factory Calibration.** The controller is calibrated to very high accuracy during manufacture and the calibration values are permanently stored within the controller. Factory calibration is not available to the user, but it is always possible to revert to the factory values if required.
2. **Transducer Scaling.** This is described in Chapter 19. Transducer scaling allows offsets to be entered to compensate for errors or differences in the process measurement system.
3. **User Calibration.** This allows the instrument to be calibrated against a certified field calibration source. This chapter describes User Calibration.

22.1. USER CALIBRATION

The following inputs can be calibrated:

1. **PV Input.** This is the fixed PV input on terminals VH, V1, V+, V-. The PV Input can be configured for Thermocouple, Platinum Resistance Thermometer (RTD), Pyrometer, mV, Volt, High Impedance Input Volts or mA inputs. Each input type can be separately calibrated except mA and pyrometer which is included in the mV range.
2. **Analogue Input.** This is the fixed input on terminals BA, BB, BC, and is intended for volt or current sources.
3. **Analogue I/O Modules.** These are inputs which can be connected to terminals A, B, C, D of the module I/O. Any input type listed above can be connected to these modules.

See also the 'Installation' chapter in Installation and Operation handbook, Part No. HA026491 for details on terminal connections.

22.2. PRECAUTIONS

Before starting any calibration procedure the following precautions should be taken:-

1. When connecting a calibration source to any terminal, at least 1 hour should elapse before calibration.
2. If power is ever brought up with the V1 terminal unconnected (for as little as 1 sec) then calibration should not take place for at least 1 hour.

A pre-wired jig built using a spare instrument sleeve may help to speed up the calibration procedure especially if a number of instruments are to be calibrated. This can be built using a spare instrument sleeve available by quoting Part No. SUB26/SLE.
It is very important that power is turned on only after the controller has been inserted in the sleeve of the pre-wired circuit.
Allow at least 10 mins for the controller to warm up after switch on.

Failure to observe these precautions will result in the controller not being calibrated to its full capability.

22.3. PV INPUT

22.3.1. To Calibrate mV Range

Calibration of the PV Input is carried out using a milli-volt or volt source. Pyrometer and mA calibration is included in this procedure. To calibrate thermocouples it is first necessary to calibrate the mV range followed by CJC described in section 22.3.2.

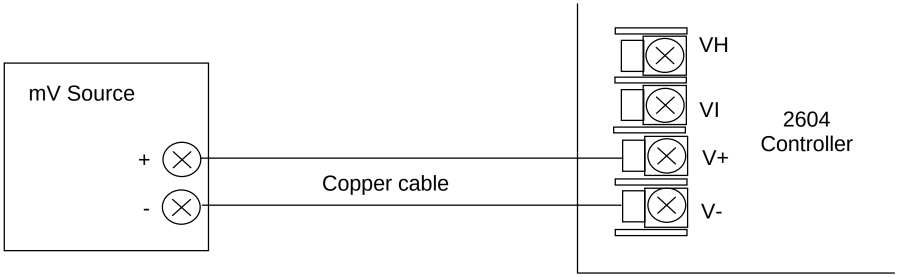


Figure 22-1: Connections for mV Range

Do This	This Is The Display You Should See	Additional Notes
1. From any display press [page key] as many times as necessary until the **STANDARD IO** page header is displayed	:STANDARD IO ⬍ PV Input Page	To choose PV Input
2. Press [scroll key] to select **Channel Type** Press [▲] or [▼] to choose the 40mV or 80mV range	:Channel Type ⬍ 40mV	To choose mV input range
3. Press [scroll key] until the parameter **Cal State** is displayed	:Cal State ⬍ Idle	

Calibrate at 0mV

4. Set mV source to 0mV		
5. Press ▲ to choose **Low - 0mV**	↻:Cal State ⬍ Low - 0mV ⬍ Confirm	Apply 0mV and press ▲ to confirm.
6. Press ▲ to **Go**	↻:Cal State ⬍ Go ⬍ Doing Fine Cal ⬍ Passed	Calibration at 0mV commences (**Go**) and progresses to 'passed' state. If the message ⬍ **Failed** appears this usually indicates that the input is not connected. At any point in this process press ▲ to select **Abort.**
7. Press ▲ to choose **Accept**	↻:Cal State ⬍ Accept ⬍ Idle	To accept the 0mV calibration values.

Calibrate at 50mV

8. Set mV source to 50mV		
9. Press ▲ to choose **High - 50mV**	↻:Cal State ⬍ High - 50mV ⬍ Confirm	Apply 50mV and press ▲ to confirm
10. Repeat step 7 to **Accept**		

At this point the calibration values are used by the controller. They will, however, be lost when the power to the controller is turned off. Complete the following step to store the values to the User Calibration area.

12. Press ▲ or ▼ to choose **Save to User**	↻:Cal State ⬍ Save to User ⬍ Idle	The 0mV and 50 mV calibration values are stored and used by the controller. To return to factory calibration press ▲ to **Restore Factory**

22.3.2. Thermocouple Calibration

Thermocouples are calibrated, firstly, by following the previous procedure using the 40mV or 80mV range, then calibrating CJC.

This can be carried out using an external CJC reference source such as an ice bath or using a mV source such as Eurotherm type 239. Replace the copper cable shown in Figure 22-1 with the appropriate thermocouple compensating cable. Set the mV source to internal compensation for the thermocouple in use and set the output for 0mV.

Then:-

Do This	This Is The Display You Should See	Additional Notes
1. From any display press [page key] as many times as necessary until the **STANDARD IO** page header is displayed	**:**STANDARD IO ⬍ PV Input Page	To choose PV Input
2. Press [scroll key] to select **Channel Type** Press [▲] or [▼] to choose **Thermoocouple**	**:**Channel Type ⬍ Thermocouple	To choose input type
3. Press [scroll key] to select **Linearisation** Press [▲] or [▼] to choose the type of thermocouple in use	**:**Linearisation ⬍ K-Type	To choose thermocouple type
4. Press [scroll key] until the parameter **Cal State** is displayed	**:**Cal State ⬍ Idle	
5. Press [▲] or [▼] to choose **CJC**	**:**Cal State ⬍ CJC ⬍ Confirm	

6. Press [▲] to confirm.
Then **Accept** and **Save to User** as described in previously in steps 7 and 12.

22.3.3. Voltage Calibration

The procedure is identical to mV calibration with the exception that the low calibration point is 0V and the high point is 8V.

22.3.4. High Z Voltage Calibration

The procedure is identical to mV calibration with the exception that the low calibration point is 0V and the high point is 1V.

22.3.5. RTD Calibration

Calibration of the PV Input for RTD requires a Decade Box between 100.00 and 400.00Ω.

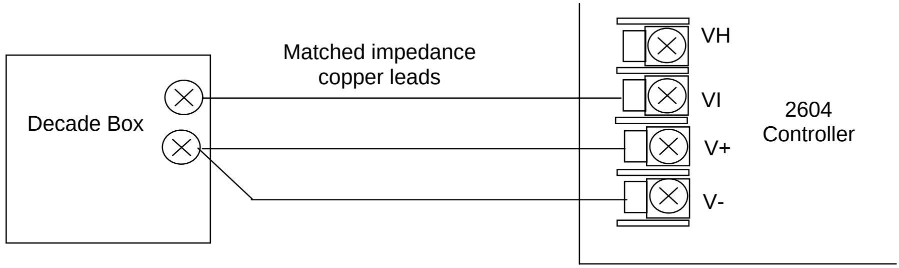


Figure 22-2: Connections for RTD

Do This	This Is The Display You Should See	Additional Notes
1. From any display press [page] as many times as necessary until the **STANDARD IO** page header is displayed	:STANDARD IO ⬍ PV Input Page	To choose PV Input
2. Press [scroll] to select **Channel Type** Press [▲] or [▼] to choose **RTD**	:Channel Type ⬍ RTD	These two steps may be omitted if the controller is already configured for RTD.
3. Press [scroll] to select **Linearisation** Press [▲] or [▼] to PT100	:Linearisation ⬍ PT100	
4. Press [scroll] until the parameter **Cal State** is displayed	:Cal State ⬍ Idle	

Calibrate at 150 ohms, then at 400 ohms

The procedure is now the same as for mV range using 150.00Ω source and 400.00Ω source in place of 0mv and 50mV respectively.

22.4. ANALOGUE INPUT

Calibration of the Analogue input is carried out using an 8 volt (±2mV) source.

There are three conditions to be calibrated - **Offset, Common Mode Rejection** and **Gain.**

The use of a pre-wired jig is recommended assuming that all three conditions are to be calibrated. The connections for this are shown in Figure 22-3.

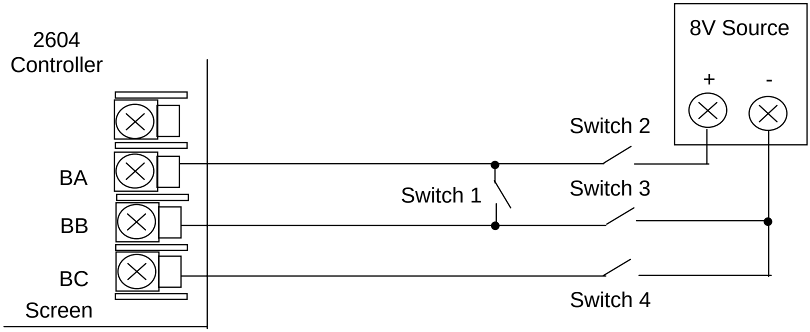


Figure 22-3: Analogue Input Calibration Connections

Do This	This Is The Display You Should See	Additional Notes
1. From any display press [page key] as many times as necessary until the **STANDARD IO** page header is displayed	:STANDARD IO An Input Page	Press [▲] to choose **An Input Page**
2. Press [scroll key] until the parameter **Cal State** is displayed	:Cal State Idle	

To calibrate Offset

Connect + and - terminals together by closing switch 1. Open switches 2, 3 and 4 to allow the short circuited inputs to float.

3. Press [▲] or [▼] to choose **Offset**	:Cal State Offset	The procedure is now the same as paragraphs 6, 7 and 12 for mV calibration.

To calibrate Common Mode Rejection Ratio

Close switches 2 and 4, while switch 1 remains closed and switch 3 remains open, so that 8V is applied to both + and - input terminals with respect to the Screen terminal.

4. Press ▲ or ▼ to choose **CMRR Enhance**	↻:Cal State ⬍ CMRR Enhance	The procedure is now the same as paragraphs 6,7 and 12 for mV calibration.

To calibrate Gain

Open switches 1 and 4 and close switches 2 and 3 so that 8V is connected to both + and - input terminals while floating.

5. Press ▲ or ▼ to choose **Gain**	↻:Cal State ⬍ Gain	The procedure is now the same as paragraphs 6,7 and 12 for mV calibration.

22.5. TO RESTORE FACTORY CALIBRATION VALUES

Do This	This Is The Display You Should See	Additional Notes
1. Press ↻ until the parameter **Cal State** is displayed	↻:Cal State ⬍ Idle	
2. Press ▲ or ▼ to choose **Restore Factory**	↻:Cal State ⬍ Restore Factory	The factory calibration values are restored for the input selected, i.e. if the Analogue Input is selected the PV Input and Module input values are not affected.

22.6. MODULE I/O

22.6.1. DC Output Module

The DC output module is calibrated in the factory at 10% and 90% of output level.
This is 1 and 9V for 0 to 10Vdc output and 2mA and 18mA for a 0 to 20mA output.
The factory calibration can be modified by the user by adjusting the **'Cal Trim'** parameter,
i.e. Actual Output = Factory Cal (Low & High) Value + User Cal (Low & High) Trim Value.
The user trim value can be accepted and saved as for input calibration data.

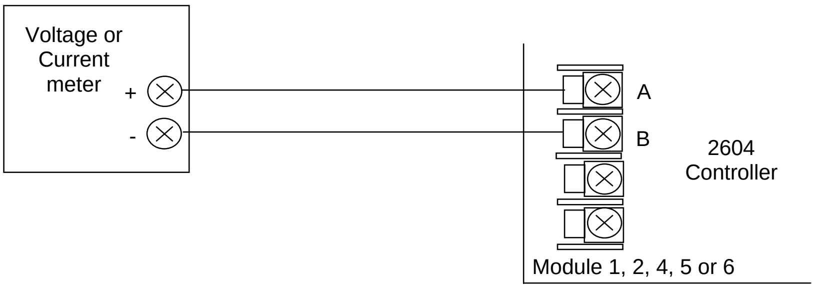


Figure 22-4: DC Module Connections Volts or Current Output

Do This	This Is The Display You Should See	Additional Notes
1. From any display press [page key] as many times as necessary until the **MODULE IO** page header is displayed	:MODULE IO *Module x A*	To choose the module in which the DC output module is fitted. The text in *italics* can be user defined.
2. Press [scroll key] to scroll to **Cal State**	:Cal State Idle	Other choices are: Cal Low Cal High Restore Factory Save (only appears after cal procedure complete.
3. Press [▲] to choose **Cal Low**	**Calibrate at 10% Output** :Cal State Cal Low Confirm	Other choices are: Go Abort

4. Press [▲] to choose **Go**	⟳**:**Cal State ⬍ Go ⬍ Now Trim O/P	
5. Press [⟳] to scroll to **Cal Trim** 6. Press [▲] or [▼] to achieve the required output value read by the multimeter. 1.00 Vdc or 2.00mA	⟳**:**Cal Trim ⬍ 0	The adjustment is between -9999 and +9999. These numbers do not have units and are used for indication only.
7. Press [⟳] and [▲] together to return to **Cal State** 8. Press [▲] to choose **Accept**	⟳**:**Cal State ⬍ Accept ⬍ Idle	You can also scroll forward using the [⟳] button only. This, however, means that you will need to scroll through all parameters in the list.
9. Press [▲] to choose **Cal High**	**Calibrate at 90% Output** ⟳**:**Cal State ⬍ Cal High ⬍ Confirm	Other choices are: Go Abort
10. Repeat steps 4 to 8 to calibrate at 90% output. 9.00Vdc or 18mA		

At this point the calibration values are used by the controller. They will, however, be lost when the power to the controller is turned off. From **Cal State/Idle:**

12. Press [▲] or [▼] to choose **Save**	⟳**:**Cal State ⬍ Save ⬍ Idle	The 10% and 90% calibration values are stored and used by the controller. To return to factory calibration press [▲] to **Restore Factory**

22.6.2. PV Input Module

PV Input modules can be fitted in positions 3 and 6. These modules can provide inputs for thermocouple, 3-wire RTD, mV, Volts or mA. The wiring connections for these inputs are shown below.

The calibration procedure is identical to that described in Section 21-3, but the **Cal State** parameter will be found under the page header **MODULE IO/Module 3 A Page** or **Module 6 A Page.**

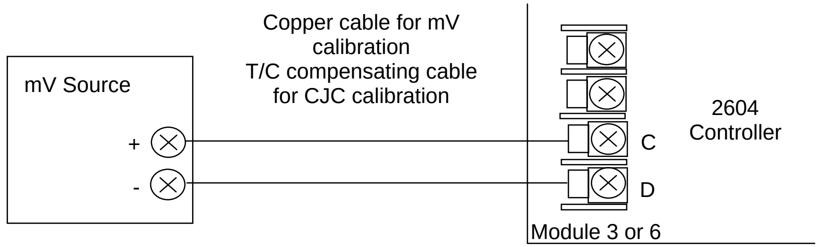


Figure 22-5: Volt, mV and Thermocouple Connections to Modules 3 & 6

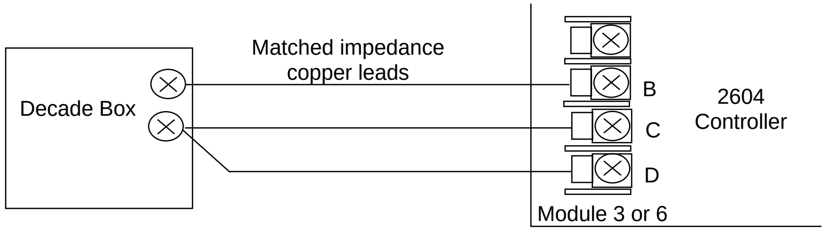


Figure 22-6: 3-Wire RTD Connections to Modules 3 & 6

A. Appendix A Order Code

A.1. 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.

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16

1	Controller Type
2604	Standard

2	Supply Voltage
VH	85-264Vac

3	Loops/Programs
First Digit	
1_ _	One Loop
2_ _	Two Loops
3_ _	Three Loops
Second Digit	
_XX	No Programs
_2_	20 Programs
_5_	50 Programs
Third Digit	
_ XX	No Programs
_ _1	1 Profile
_ _2	2 Profile
_ _3	3 Profile

4	Application
XX	Standard
ZC	Zirconia

5 - 9	I/O Slots 1 3 4 5 6
XX	None Fitted
R4	Change Over Relay
R2	2 Pin Relay
RR	Dual Relay
T2	Triac
TT	Dual Triac
D4	DC Control
D6	DC Retransmission
PV	PV Input(slots 3 & 6 only)
TL	Triple Logic Input
TK	Triple Contact Input
TP	Triple Logic Output
MS	24Vdc Transmitter PSU

10	Memory Module
XX	Not Fitted

11 - 12	Comms H J
Both Slots	
XX	None Fitted
A2	EIA-232
Y2	2 wire EIA-485
F2	4 wire EIA-485

13	Manual
ENG	English
FRA	French
GER	German
NED	Dutch
SPA	Spanish
SWE	Swedish
ITA	Italian

14	Toolkit Functions
XX	Standard
U1	16 An & 16 Dig
U2	24 An & 32 Dig

16	Config Tools
XX	None
IT	iTools

Hardware Code Example

2604/VH/323/XX/RR/PV/D4/TP/PV/XX/A2/XX/ENG/U1/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. iTools supplied with controller.

A.2. QUICK START CODE

The controller supplied in accordance with the hardware code on the previous page requires to be configured. For simple applications the controller may be supplied pre-configured using the following code:-

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

1 - 3 Loop function	
XXX	None
S___	Standard PID
C___	Cascade(7)
R___	Ratio
O___	Override(7)(8)
_PID	PID Control
_ONF	On/Off Control
_PIF	PID/OnOff Control
_VP1	VP without feedback

4 - 6 Process inputs (Input type)	
X	None
J	J Thermocouple
K	K Thermocouple
T	T Thermocouple
L	L Thermocouple
N	N Thermocouple
R	R Thermocouple
S	S Thermocouple
B	B Thermocouple
P	P Thermocouple
C	C Thermocouple
Z	RTD/PT100
A	4-20mA linear
Y	0-20mA linear
V	0-10Vdc linear
W	0-5Vdc linear
G	1-5Vdc linear
Custom Downloads(Replace C)	
D	D Thermocouple
E	E Thermocouple
1	Ni/Ni18%Mo
2	Pt20%Rh/Pt40%Rh
3	W/W26%Re(Eng)
4	W/W26%Re(Hos)
5	W5%Re/W26%Re(Eng)
6	W5%Re/W26%Re(Hos)
7	Pt10%Rh/Pt40%Rh
8	Exergen K80 IR Pyro

7	Analogue input
XXX	None
P2_	PV Loop 2
P3_	PV Loop 3
S1_	SP Loop 1
S2_	SP Loop 2
S3_	SP Loop 3
Input range	
Select third digit from table 1	

Table 1	
A	4-20mA linear
Y	0-20mA linear
V	0-10Vdc linear
W	0-5Vdc linear
G	1-5Vdc linear

8 - 12 Slot function	
Loop number	
XXX	Unconfigured
1__	Loop No 1
2__	Loop No 2
3__	Loop No 3
Single relay or triac	
_HX	PID Ch1
_CX	PID Ch2
Dual relay or triac	
_HC	PID Ch1 & Ch2
_VH	VP Heat
_AA	FSH & FSH
_AB	FSH & FSL
_AC	DH & DL
_AD	FSH & DH
_AE	FSL & DL
P12	Prog events 1 & 2
P34	Prog events 3 & 4
P56	Prog events 5 & 6
P78	Prog events 7 & 8
Triple logic output	
_HX	PID Ch1
_CX	PID Ch2
_HC	PID Ch 1+ Ch 2
HHH	Heat OP for loops 1, 2 & 3
DC outputs	
_H_	PID Ch1
_C_	PID Ch2
_T_	PV Retransmission
_S_	SP Retransmission
For output range select third digit from table 1	
DC inputs	
_R_	Setpoint
For input range select third digit from table 1	
Precision PV input	
_PV	PV input Module
-PA	Aux PV input(9)
-PL	Ratio lead input

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. In cascade and override configuration, both PV inputs will be set to the same sensor type.
8. VP1 or VP2 not available with override function.
9. For cascade and override inputs only.

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.

B. Appendix B Safety and EMC Information

This controller is manufactured in the UK by Eurotherm Controls Ltd.

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 for heavy/light industrial and residential/commercial environments as described by EN 50081-1 and EN 50082-1. 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.

B.3.4. Isolation

The fixed digital I/O and analogue input are not isolated. The PV Input and all plug in modules are fully isolated. This is shown in Figure B-1.

The Analogue Input is a self biased differential input suitable for either grounded or floating transducers of low output impedance generating signal in the range of +/-10V or +/-20mA (with a burden resistor of 100 Ohms across + and - terminals).
This input is neither isolated from the instrument ground (which can be earthed via fixed I/O ports) nor isolated from the instrument earth terminal, therefore, under no circumstances should mains potentials be applied to any of its inputs.
In order for the Input to operate safely the common voltage at the inputs measured with respect to instrument ground should not exceed +/-120Vdc or ac_{rms}. For actively enhanced common mode rejection (i.e. operation within the spec.) this voltage should be limited to +/-40Vdc.
Floating transducers will automatically be biased to +2.5V with respect to instrument ground upon connection.

> Note: All the other I/Os are fully isolated from the instrument ground and each other.

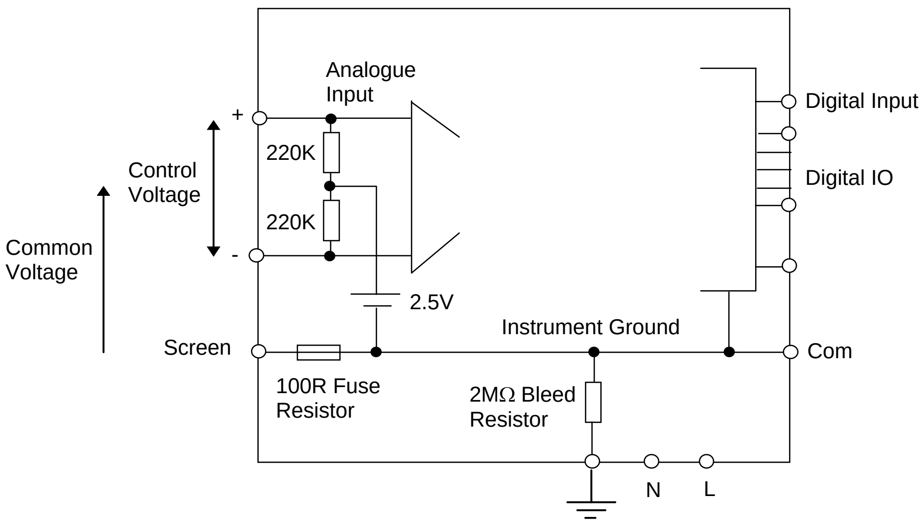


Figure B-1: Analogue Input and Fixed Digital I/O Equivalent Circuit

B.3.5. 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.3.6. 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.3.7. 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.3.8. 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.3.9. 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.3.10. 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.3.11. 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.3.12. 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

All figures quoted at 0 to 50°C unless otherwise stated.
Resolution is quoted as a typical figure with filter time constant (f.t.c) = 0.4sec. Resolution generally improves by a factor of 2 with every quadrupling of the f.t.c.

C.1. PRECISION PV INPUT

No of inputs	One standard and up to two additional PV input modules can be fitted in I/O slots 3 and 6 (isolated)
Sample rate	9Hz (110msec.)
Input filtering	OFF to 999.9 seconds of filter time constant (f.t.c.). Default setting is 0.4 seconds
mV input	Two ranges: ±40mV & ±80mV, used for thermocouple, linear mV source or 0 - 20mA with 2.5Ω Calibration accuracy @25°C: ±(1.5µV + 0.05% of absolute reading), Resolution (noise free): 0.5µV for 40mV range & 1µV for 80mV range Drift with ambient Temperature: <±(0.05µV + 0.003% of absolute reading) per °C Input impedance: >100MΩ, Leakage: < 1nA
0 - 2V input	-1.4V to +2V, used for zirconia Calibration accuracy @25°C: ±(0.5mV + 0.05% of absolute reading) , Resolution (noise free): 60µV Drift with ambient Temperature: < ±(0.05mV + 0.003% of absolute reading) per °C Input impedance: >100MΩ, Leakage: < 1nA
0 - 10V input	-3V to +10V, used for voltage input Calibration accuracy @25°C: ±(0.5mV + 0.1% of absolute reading), Resolution (noise free): 180µV Drift with ambient Temperature: <±(0.1mV + 0.01% of absolute reading) per °C Input impedance: 0.66MΩ
Pt100 input	3 wire, 0 to 400ohms (-200°C to +850°C) Calibration accuracy @25°C: ±(0.1°C + 0.04% of absolute reading in °C) Resolution (noise free): 0.02°C Drift with ambient temperature: < ±(0.006°C + 0.002% of absolute reading in °C) per °C Bulb current: 0.2mA. Up to 22Ω in each lead without errors.
Thermocouple types	Most linearisations including K,J,T,R,B,S,N,L,PII,C,D,E with error < ±0.2°C Internal compensation: CJC rejection ratio >40:1 typical., CJ Temperature calibration error: <± 0.5°C 0°C, 45°C and 50°C external compensation available. Refer to 'Ambient Temperature Rejection' document.

Zirconia probes	Most probes supported. Contact Eurotherm for details.
User calibration	Both the user calibration and a transducer scaling can be applied.
Sensor break	a.c. sensor break on each input (i.e. fast responding and no dc errors with high impedance sources).

C.2. ANALOGUE INPUT

No of inputs	One fixed (Not isolated) Can be used with either floating or ground referenced transducers of low impedance.
Input range	-3V to +10V linear or 0 -20 mA with burden resistor of 100Ω. The average voltage of the two inputs measured with respect to Remote Input Screen terminal, BC, can be up to ±42Vdc. Calibration accuracy @25°C: ±(1.5mV + 0.1% of [reading]), Resolution (noise free): 0.9mV Drift with ambient Temperature: < ±(0.1mV + 0.006% of [reading]) per °C Input Impedance: 0.46M½ (floating input), 0.23M½ (ground referenced input) CMRR : >110dB at 50/60Hz, >80dB at DC (i.e. input error <1mV per 10Vdc of the inputs average)
Sample rate	9Hz (110msec)
Input filtering	OFF to 999.9 seconds of filter time constant (f.t.c.). Default setting is 0.4 seconds.
User calibration	Both the user calibration and a transducer scaling can be applied
Sensor break	a.c. sensor break on each input
Functions	Process variable, remote setpoint, power limit, feedforward, etc.

C.3. STANDARD DIGITAL I/O

Allocation	1 digital input standard and 7 I/O which can be configured as inputs or outputs (Not isolated) ¨ plus 1 changeover relay
Digital inputs	Voltage level : input active < 2Vdc, inactive >4Vdc Contact closure : input active <100ohms, inactive >28kohms
Digital outputs	Open collector, 24Vdc@40mA drive capability, requires external supply
Changeover relay	Contact rating 2A@264Vac resistive
Functions	Refer to Chapter 17
Operations	1,000,000 operations with snubber fitted

C.4. DIGITAL INPUT MODULES

No of inputs	Three per module (isolated)
Allocation	Can be fitted into slots 1, 3, 4, 5 or 6
Contact closure	Active <100ohms, inactive >28kohms
Logic inputs	Current sinking : active 10.8Vdc to 30Vdc @ 2.5mA inactive -3 to 5Vdc @<-0.4mA
Functions	Refer to Chapter 18

C.5. DIGITAL OUTPUT MODULES

Module types	Single relay, dual relay, single triac, dual triac, triple logic module (isolated)
Allocation	Can be fitted into slot 1, 3, 4, 5 or 6 (max. 3 triac modules per instrument)
Relay rating	2A, 264Vac resistive
Logic drive	12Vdc @ 8mA
Triac rating	0.75A, 264Vac resistive
Functions	Refer to Chapter 18

C.6. ANALOGUE OUTPUT MODULES

Module types	1 channel DC control, 1 channel DC retransmission (5 max.) (Isolated)
Allocation	Can be fitted into slot 1, 3, 4, 5 or 6
Range	0-20mA, 0-10Vdc (isolated)
Resolution	1 part in 10,000 (2,000-noise free) 0.5% accurate for retransmission 1 part in 10,000 2.5% accurate for control
Functions	Refer to Chapter 18

C.7. TRANSMITTER PSU

Allocation	Can be fitted into slots 1, 3 ,4 ,5 or 6 (Isolated)
Transmitter	24Vdc@20mA

C.8. DIGITAL COMMUNICATIONS

Allocation	2 modules fitted in slots H & J
Modbus	RS232, 2 wire or 4 wire RS485, max baud 19.2kB in H module & 9.6kB in J module (Isolated)

C.9. ALARMS

No of Alarms	Input alarms (2), loop alarms (2) User alarms (8
Alarm types	Full scale, deviation, rate of change, sensor break plus application specific
Modes	Latching or non-latching, blocking, time delay
Parameters	Refer to Chapter 7

C.10. USER MESSAGES

No of messages	Maximum 50, triggered by operator or alarm or used for custom parameter names
Format	On LCD display, 2 lines x 16 characters

C.11. CONTROL FUNCTIONS

No of loops	One, two or three
Modes	On/off, PID, motorised valve without feedback
Options	Cascade, ratio, override or feed forward
Cooling algorithms	Linear, water, oil or fan
PID sets	3 per loop (Cascade loop includes master and slave parameters)
Manual mode	Bumpless transfer or forced manual output, manual tracking available
Setpoint rate limit	Display units per second, minute or hour

C.12. SETPOINT PROGRAMMER

No of programs	A maximum of 50 programs assignable over 500 segments for a time to target programmer and 400 segments for a ramp rate programmer. A program can consist of up to 3 variables. Programs can be given user defined 16 character names
Event outputs	Up to 16, can be assigned individually to segments or called as part of an event group

C.13. ADVANCED FUNCTIONS

Application blocks	32 digital operations 24 Analogue calculations
Timers	4, On Pulse, Off delay, one shot and min-On
Totalisers	4, trigger level & reset input
Real time clock	Day of week and time (Year 2000 compliant)

C.14. GENERAL SPECIFICATION

Display range	5 digits including up to 3 decimal places
Supply	85-264Vac, 20Watts (max)
Operating ambient	0 - 50°C and 5 to 95% RH non condensing
Storage temp	-10 to +70°C
Panel sealing	IP54
Dimensions	96H x 96W x 150D (mm)
EMC standards	EN50081-1 & EN50082-2 generic standards - suitable for domestic, commercial and light industrial as well as heavy industrial environments
Safety standards	Meets EN61010 installation category II, pollution degree 2
Atmospheres	Not suitable for use above 2000m or in explosive or corrosive atmospheres

C.15. GRAPHICAL REPRESENTATION OF ERRORS

This section shows graphically the effects of adding all contributions of different errors for each input type and range. The errors are a combination of:
Calibration accuracy, Drift with ambient temperature, Linearity error, Leakage

C.15.1. mV Input

Two ranges:

working range	+/-40mV		
full linear range	+/-60mV		
noise (resolution)	1uV - OFF,	0.5uV - 0.4sec,	0.25uV - 1.6sec
working range	+/-80mV		
full linear range	+/-105mV		
noise (resolution)	2uV - OFF,	1uV - 0.4sec,	0.5uV - 1.6sec

Calibration accuracy @ 25°C
< +/- (1.5uV + 0.05% of |reading|)

Drift with ambient temperature
< +/-(0.05uV + 0.003% of |reading|) per °C

Linearity error
< +/-0.002% of span (i.e. <1uV, <2uV)

Leakage
< +/-1nA (typically +/-200pA)

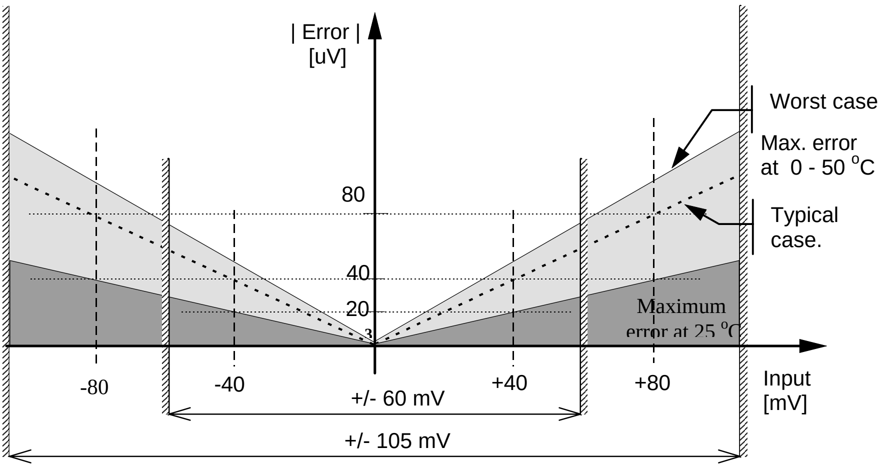


Figure C-1: Error Graph - mV Input

C.15.2. Mid range high impedance Input

0 - 2V Input type

Range:
working range -1.4V to +2V
full linear range -1.8V to +2.4V
noise (resolution) 100uV - OFF, 50uV - 0.4sec, 35uV - 1.6sec

Calibration accuracy @ 25°C
< +/- (0.5mV + 0.05% of |reading|)

Drift with ambient temperature
< +/-(0.05mV + 0.003% of |reading|) per °C

Linearity error
< +/- 0.01% of span (i.e. +/- 200uV)

Input Impedance & Leakage
>100MΩ < 1nA

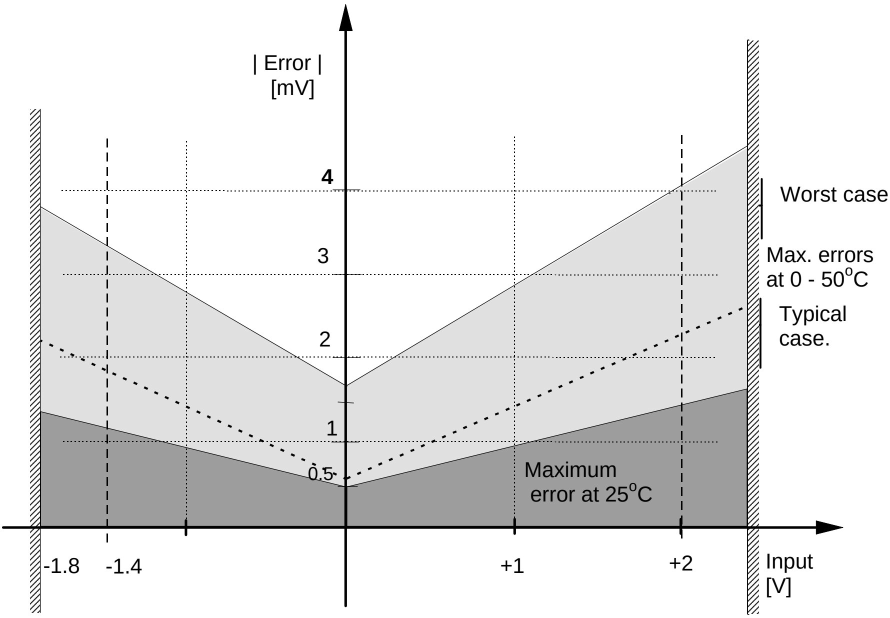


Figure C-2: Error Graph - 0 - 2V Input

C.15.3. High Level Input

0 - 10V Input type

Range:

working range -3V to +10V

full linear range - 5V to +14V

noise (resolution) 300uV - OFF, 150uV - 0.4sec, 100uV - 1.6sec

Calibration accuracy @ 25°C

< +/- (0.5mV + 0.1% of |reading|)

Drift with ambient temperature

< +/-(0.01mV + 0.006% of |reading|) per °C

Linearity error

< +/-0.02% of span (i.e. +/- 2mV)

Input Impedance

0.66 MΩ

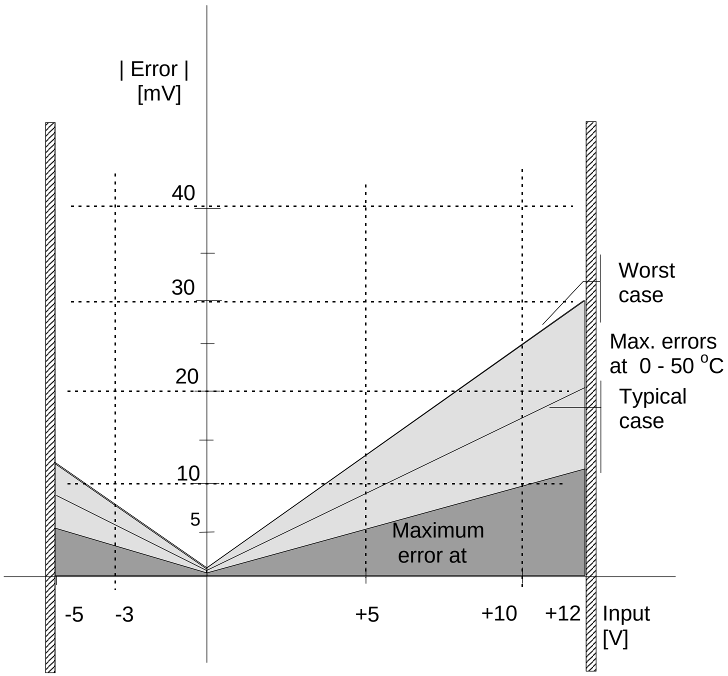


Figure C-3: Error Graph - 0 - 10V Input

C.15.4. RTD (Pt-100) Input type

Resistance measurement specification in Ohms:
Range

0 to 400 Ω with up to 22 Ω in each connecting lead

Noise (resolution)

80 mΩ - 0.4sec, 40mΩ - 1.6sec

Calibration accuracy limits @ 25°C

< +/- (35mΩ @110Ω + 0.03% of |reading - 110Ω|)

Drift with ambient temperature

+/- (0.002% of |reading|) per °C

Linearity error

< +/-15 mΩ

Pt-100 measurement specification in °C:

Range

-200 °C to +850 °C

Noise (resolution)

0.02 °C - 0.4sec, 0.01 °C - 1.6sec

Calibration accuracy limit @ 25°C

< +/- (0.1 °C + 0.03% of |reading in °C|)

Drift with ambient temperature

< +/-(0.0055 °C + 0.002% of |reading in °C|) per °C of ambient change

Linearity + Linearisation error

< +/- 55 °mC (i.e. 50 °mC + 5 °mC)

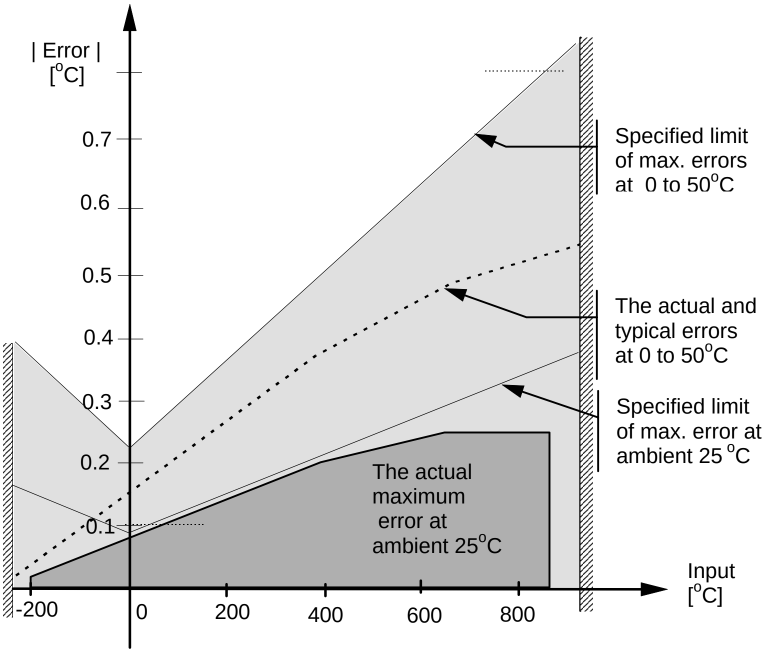


Figure C-4: Error Graph - RTD Input

C.15.5. Thermocouple Input type

Internal CJT sensing spec

Calibration error @ 25°C (including temp. difference between top and bottom screws)

< +/- 0.5°C

Total CJT error

< +/-(0.5°C + 0.012°C per 1°C of ambient change)

(i.e. CJC Rejection for measured temperatures above 0°C is > 80 : 1)

Noise (resolution)

0.01 °C

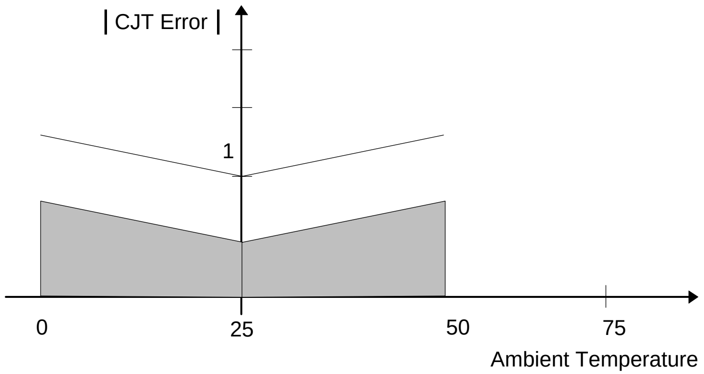


Figure C-5: Overall CJT Error at Different Ambient Temperatures

D. Appendix D Parameter Units and Addresses

D.1. COMMONLY USED PARAMETERS

Although any parameter can be chosen for Soft Wiring, Parameter Promotion or Customised Display purposes, the controller contains those which are most commonly used together with their Modbus Addresses. These parameters are shown below:

Parameter Name	Parameter Description	Refer To Section:-	Modbus Address
None	None		00000
L1.PV	Loop1 PV	Chapter 9	00001
L1.Wkg OP	Loop1 working output	LP1 SETUP	00004
L1.Wkg SP	Loop1 working setpoint	Diagnostic Page	00005
L1.Ch1 OP	Loop1 channel 1 output	Output Page	00013
L1.Ch2 OP	Loop1 channel 2 output	Output Page	00014
L2.PV	Loop2 PV	Chapter 9	01025
L2.Wkg OP	Loop2 working output	LP2 SETUP	01028
L2.Wkg SP	Loop2 working setpoint	Diagnostic Page	01029
L2.Ch1 OP	Loop2 channel 1 output	Output Page	01037
L2.Ch2 OP	Loop2 channel 2 output	Output Page	01038
L3.PV	Loop3 PV	Chapter 9	02049
L3Wkg OP	Loop3 working output	LP3 SETUP	02052
L3Wkg SP	Loop3 working setpoint	Diagnostic Page	02053
L3Ch1 OP	Loop3 channel 1 output	Output Page	02061
L3Ch2 OP	Loop3 channel 2 output	Output Page	02062
CLin1.OP	Custom linearisation 1	Chapter 11 INPUT OPERS Cust Lin 1	03365
CLin2.OP	Custom linearisation 2	Cust Lin 2	03413
CLin3.OP	Custom linearisation 3	Cust Lin 3	03461
SwOv1.OP	Switchover output value	Switch 1 Page	03477
Mod1A.Val	Module 1A output value	Chapter 18 MODULE IO Module 1A page	04148
Mod1B.Val	Module 1B output value	Module 1B page	04196
Mod1C.Val	Module 1C output value	Module 1C page	04244
Mod3A.Val	Module 3A output value	Module 3A page	04468
Mod3B.Val	Module 3B output value	Module 3B page	04516
Mod3C.Val	Module 3C output value	Module 3C page	04564
Mod4A.Val	Module 4A output value	Module 4A page	04628
Mod4B.Val	Module 4B output value	Module 4B page	04676
Mod4C.Val	Module 4C output value	Module 4C page	04724
Mod5A.Val	Module 5A output value	Module 5A page	04788
Mod5B.Val	Module 5B output value	Module 5B page	04836
Mod5C.Val	Module 5C output value	Module 5C page	04884
Mod6A.Val	Module 6A output value	Module 6A page	04948
Mod6B.Val,	Module 6B output value	Module 6B page	04996
Mod6C.Val	Module 6C output value	Module 6C page	05044
PVIn.Val	PV input value	Chapter 17	05108

		STANDARD IO PV Input page	
AnIn.Val	Analogue input value	An Input Page	05268
DIO1.Val	Digital input/output value 1	Dig IO1 Page	05402
DIO2.Val	Digital input/output value 2	Dig IO2 Page	05450
DIO3.Val	Digital input/output value 3	Dig IO3 Page	05498
DIO4.Val	Digital input/output value 4	Dig IO4 Page	05546
DIO5.Val	Digital input/output value 5	Dig IO5 Page	05594
DIO6.Val	Digital input/output value 6	Dig IO6 Page	05642
DIO7.Val	Digital input/output value 7	Dig IO7 Page	05690
Prg.WPSP1	Programmer working SP1	Chapter 6 RUN PSP1 Page	05800
Prg.WPSP2	Programmer working SP2	PSP2 Page	05801
Prg.WPSP3	Programmer working SP3	PSP3 Page	05802
Prg.DO1	Programmer digital OP1	Chapter 6 RUN General Page	05869
Prg.DO2	Programmer digital OP2		05870
Prg.DO3	Programmer digital OP3		05871
Prg.DO4	Programmer digital OP4		05872
Prg.DO5	Programmer digital OP5		05873
Prg.DO6	Programmer digital OP6		05874
Prg.DO7	Programmer digital OP7		05875
Prg.DO8	Programmer digital OP8		05876
AnOp1.OP	Analogue operator OP1	Chapter 14 ANALOGUE OPERS Analogue 1 Page	06158
AnOp2.OP	Analogue operator OP2	Analogue 2 Page	06178
AnOp3.OP	Analogue operator OP3	Analogue 3 Page	06198
AnOp4.OP	Analogue operator OP4	Analogue 4 Page	06218
AnOp5.OP	Analogue operator OP5	Analogue 5 Page	06238
AnOp6.OP	Analogue operator OP6	Analogue 6 Page	06258
AnOp7.OP	Analogue operator OP7	Analogue 7 Page	06278
AnOp8.OP	Analogue operator OP8	Analogue 8 Page	06298
AnOp9.OP	Analogue operator OP9	Analogue 9 Page	06318
AnOp10.OP	Analogue operator OP10	Analogue 10 Page	06338
AnOp11.OP	Analogue operator OP11	Analogue 11 Page	06358
AnOp12.OP	Analogue operator OP12	Analogue 12 Page	06378
AnOp13.OP	Analogue operator OP13	Analogue 13 Page	06398
AnOp14.OP	Analogue operator OP14	Analogue 14 Page	06418
AnOp15.OP	Analogue operator OP15	Analogue 15 Page	06438
AnOp16.OP	Analogue operator OP16	Analogue 16 Page	06458
LgOp1.OP	Logic operator output 1	Chapter 15 LOGIC OPERS Logic 1 Page	07176
LgOp2.OP	Logic operator output 2	Logic 2 Page	07192
LgOp3.OP	Logic operator output 3	Logic 3 Page	07208
LgOp4.OP	Logic operator output 4	Logic 4 Page	07224
LgOp5.OP	Logic operator output 5	Logic 5 Page	07240
LgOp6.OP	Logic operator output 6	Logic 6 Page	07256
LgOp7.OP	Logic operator output 7	Logic 7 Page	07272

LgOp8.OP	Logic operator output 8	Logic 8 Page	07288
LgOp9.OP	Logic operator output 9	Logic 9 Page	07304
LgOp10.OP	Logic operator output 10	Logic 10 Page	07320
LgOp11.OP	Logic operator output 11	Logic 11 Page	07336
LgOp12.OP	Logic operator output 12	Logic 12 Page	07352
LgOp13 OP	Logic operator output 13	Logic 13 Page	07368
LgOp14.OP	Logic operator output 14	Logic 14 Page	07384
LgOp15.OP	Logic operator output 15	Logic 15 Page	07400
LgOp16.OP	Logic operator output 16	Logic 16 Page	07416
Clk.Alm1	Timer alarm 1	Chapter 12 TIMER BLOCKS Alarm 1 Page	08711
Clk.Alm2	Timer alarm 2	Alarm 2 Page	08716
Tot1.Alm	Totaliser 1 alarm output	Chapter 12 TIMER BLOCKS Totaliser 1 Page	08743
Tot2.Alm	Totaliser 2 alarm output	Totaliser 2 Page	08757
Tot3.Alm	Totaliser 3 alarm output	Totaliser 3 Page	08775
Tot4.Alm	Totaliser 4 alarm output	Totaliser 4 Page	08791
Tmr1.OP	Timer 1 output	Chapter 12 TIMER BLOCKS Timer 1 Page	08963
Tmr2.OP	Timer 2 output	Timer 2 Page	08975
Tmr3.OP	Timer 3 output	Timer 3 Page	08987
Tmr4.OP	Timer 4 output	Timer 4 Page	08999
UVal1.Val	User 1 value	Chapter 13 USER VALUES User Val 1 Page	09220
UVal2.Val	User 2 value	User Val 2 Page	09225
UVal3.Val	User 3 value	User Val 3 Page	09230
UVal4.Val	User 4 value	User Val 4 Page	09235
Sum.LP2&3	0.0 | 0.0 ← PV 0.0 | 0.0 ← SP LP2 LP3		10246
Sum.PrName	Prg: 1 Seg: 4 ← 'Reset' if prog in reset *Program Name*	Chapter 6 PROGRAM RUN General Page	10247
Sum.D1-16	Prg: 1 Seg: 4 □□■□□□■□■□□□□□■□	Chapter 6 PROGRAM RUN General Page	10248
Sum.TiRem	Prg: 1 Seg: 4 d h: m: s ← 'Not Running' if prog in reset or complete	Chapter 6 PROGRAM RUN General Page	10249
Const.1	Constant value = 1 May be used in place of a User Value		10464

Zirc.PV	Zirconia Value	Chapter 10	11059
Zirc.Stat,	Probe Status	ZIRCONIA	11066
Zirc.SAlm	Sooting Alarm	PROBE	11068
Zirc.Clea	Clean State	Options Page	11072
Humid.Rel	Relative Humidity	Chapter 10 HUMIDITY Options Page	11105
DI8.Val	Status of digital input 8	Chapter 17 STANDARD IO Diagnostic Page	11313
DI-E1.Val	Status of IO expander inputs		11314
L1Alm1.OP	Loop1 alarm 1 output	Chapter 7 ALARMS LP1 Page	11592
L1Alm2.OP	Loop1 alarm 2 output	LP1 Page	11602
L2Alm1.OP	Loop2 alarm 1 output	LP2 Page	11640
L2Alm2.OP	Loop2 alarm 2 output	LP2 Page	11650
L3Alm1.OP	Loop3 alarm 1 output	LP3 Page	11688
L3Alm2.OP	Loop3 alarm 2 output	LP3 Page	11698
U1Alm.OP	User 1 alarm output	User 1 Page	11737
U2Alm.OP	User 2 alarm output	User 2 Page	11753
U3Alm.OP	User 3 alarm output	User 3 Page	11769
U4Alm.OP	User 4 alarm output	User 4 Page	11785
U5Alm.OP	User 5 alarm output	User 5 Page	11801
U6Alm.OP	User 6 alarm output	User 6 Page	11817
U7Alm.OP	User 7 alarm output	User 7 Page	11833
U8Alm.OP	User 8 alarm output	User 8 Page	11849
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D.2. PARAMETER UNITS

PSP Units are:-
None
^{o}C/^{o}F/^{o}K,
V, mV, A, mA,
PH, mmHg, psi, bar, mbar, %RH, %, mmWG, inWG, inWW, Ohms, PSIG, %O2, PPM, %CO2, %CP, %/sec,
^{O}C\\$^{o}$F\\$^{o}$K(rel),
Custom 1, Custom 2, Custom 3, Custom 4, Custom 5, Custom 6,
sec, min, hrs,

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