Chapter 1 OPERATION

FRONT PANEL LAYOUT

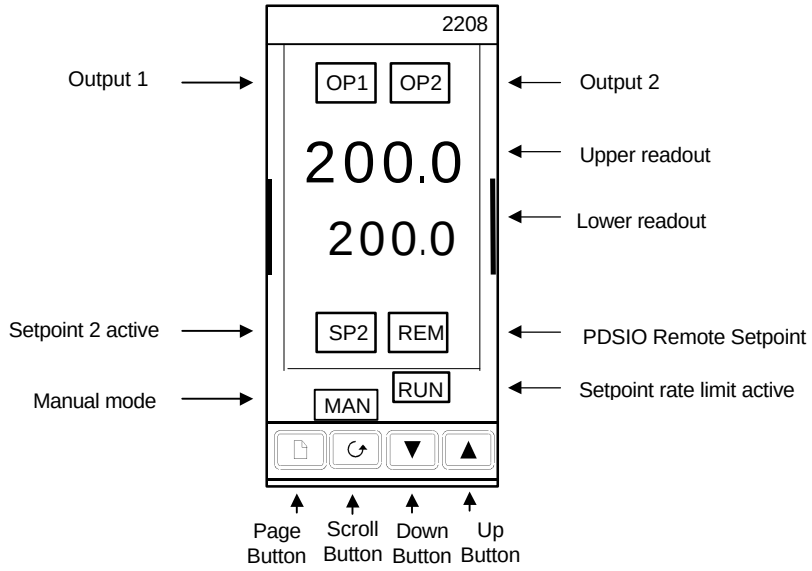


Fig 1-1 Model 2208 front panel layout

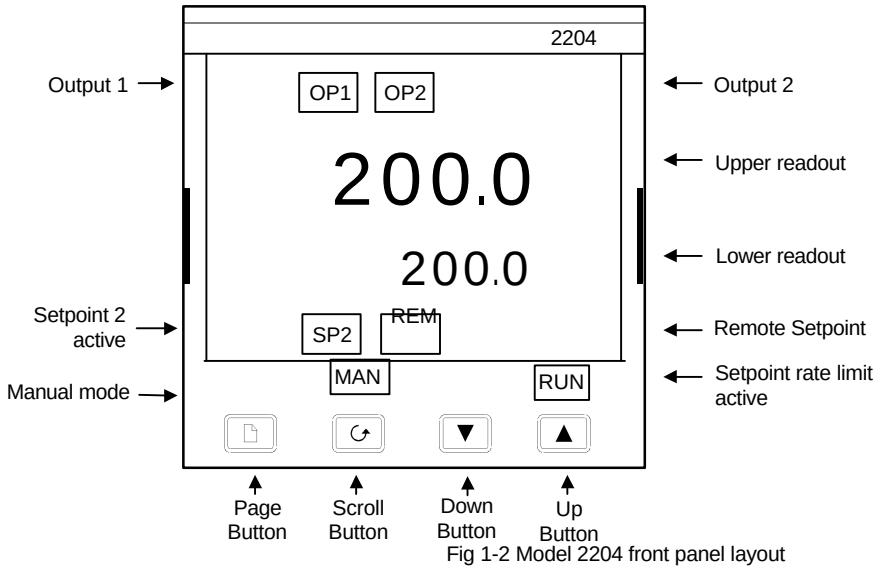


Fig 1-2 Model 2204 front panel layout

Button or indicator	Name	Explanation
OP1	Output 1	When lit, it indicates that output 1 is on. This is normally the heating output.
OP2	Output 2	When lit, it indicates that output 2 is on. This is normally the cooling output.
SP2	Setpoint 2	When lit, this indicates that Setpoint 2 has been selected.
REM	Remote Setpoint	When lit, this indicates that the PDSIO remote Setpoint input has been selected. 'REM' is also used to indicate that user comms is active.
MAN	Manual light	When lit, it indicates that manual mode has been selected
RUN	Run light	When lit, it indicates that Setpoint rate limit is active.
	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 value in the lower readout.
	Up button	Press to increase a value in lower readout.

Figure 1.3 Controller buttons and indicators

GETTING STARTED

Thank you for selecting the EUROTHERM 2208/2204 controller.
This section shows the **principle** of operation.

VIEWING THE PROCESS VALUE and SETPOINT

Install and wire up the controller in accordance with Chapter 2 and switch on. Following a 3-second self-test sequence, this is the display you will see:

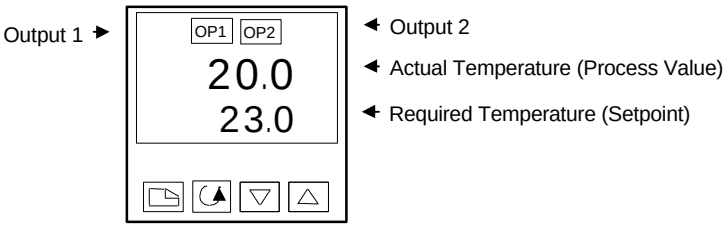


Fig. 1.4 The "Home Display"

NOTE

The display may flash an alarm message. Refer to the Parameter Tables later in this chapter for a complete list and meaning of the messages.

TO ADJUST THE SETPOINT

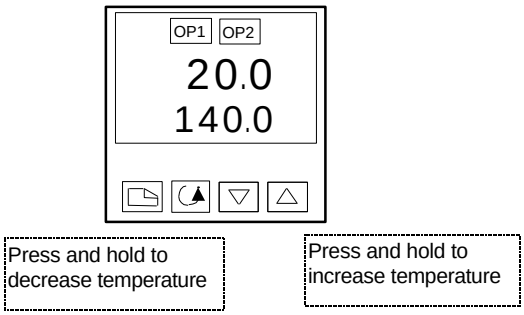


Fig 1.5 The lower readout shows the setpoint

After 2 secs the lower readout will 'blink' indicating that the new value has been accepted.
For everyday use you may not need to do anymore than this.

VIEWING THE DISPLAY UNITS

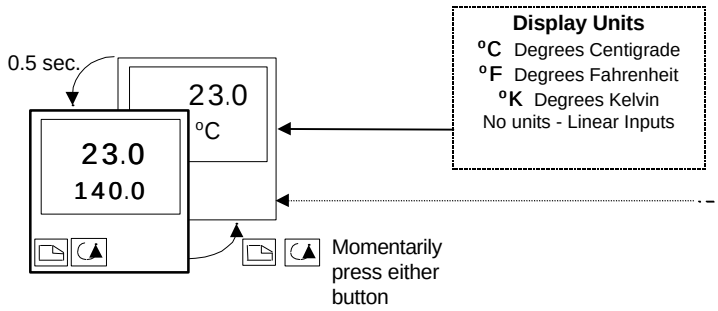


Fig. 1.6 Pressing or will flash the display units for 0.5 sec

NOTE

If you get lost, pressing and together will return you to the Home display

USE OF THE "SCROLL" BUTTON

Pressing the scroll button will display the output power level. Continued pressing will display further parameters in what is referred to as the operator scroll list.

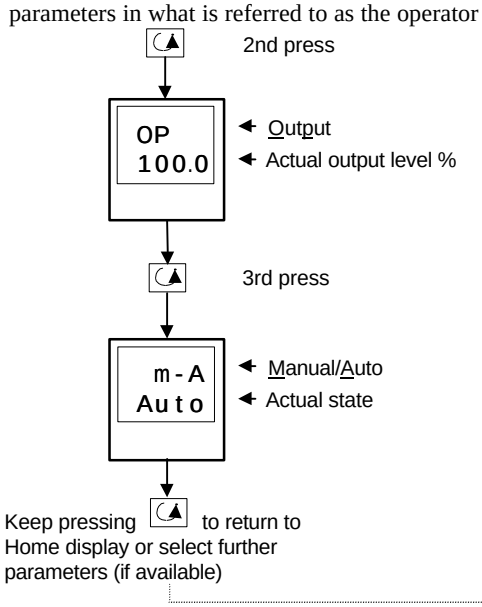


Fig. 1.7 Upper readout is parameter name. Lower is value

USE OF THE PAGE BUTTON

The “PAGE” button accesses parameter LISTS
Parameters are settings in the instrument which, generally, can be changed by the user to suit the process. Examples are: Alarms, Self-Tune, etc. They are found under headings called **LISTS** and a full set is given later in this chapter.

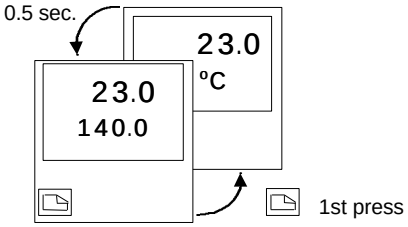
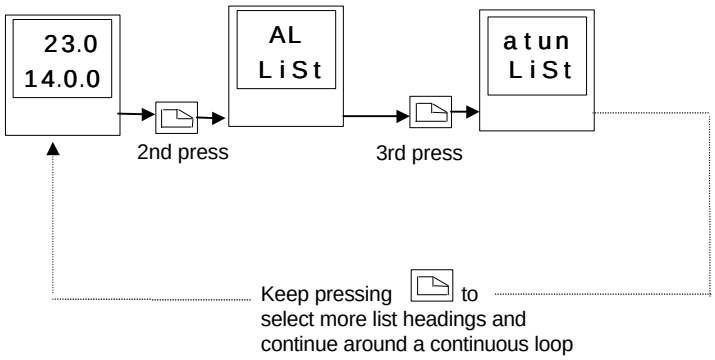


Fig 1.8 Press to choose a parameter list



NOTE

The actual list headings may be longer or shorter than indicated above and you can customise this for the operator’s convenience in EDIT level,
Chapter 3.

PARAMETER LISTS

Press [ ] to choose a LIST - "ALARMS" is a good one. This list allows you to set the alarm trip levels. The parameters, which appear in the list, will vary according to the configuration of your controller.

Fig. 1.9a Choose a list

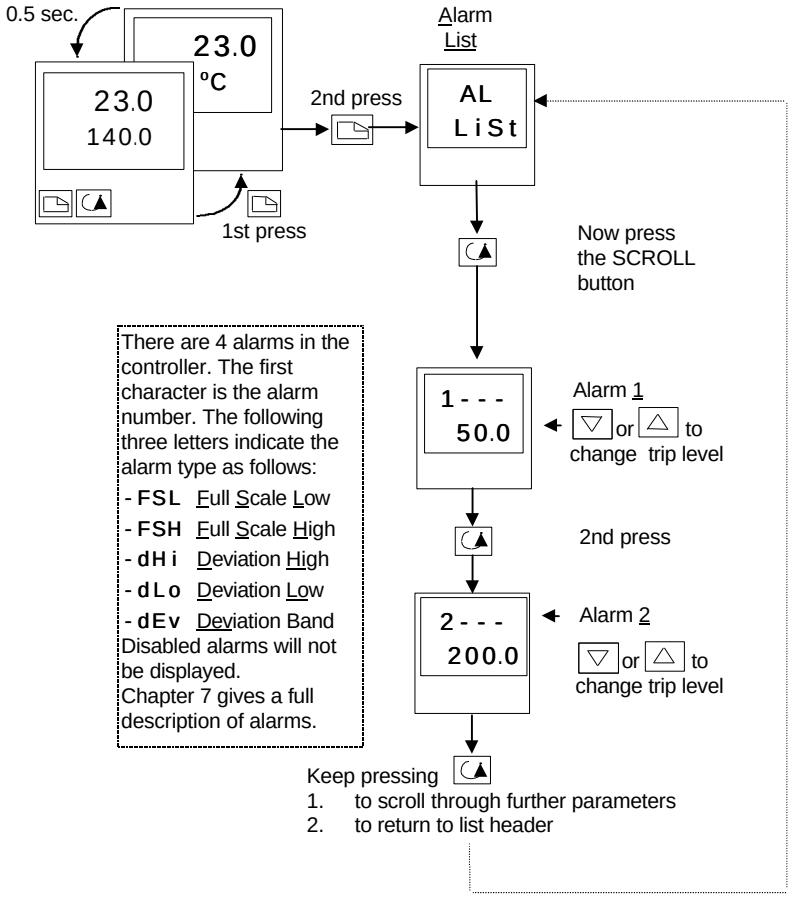


Fig. 1.9b Press [ ] to select a parameter

There are 4 alarms in the controller. The first character is the alarm number. The following three letters indicate the alarm type as follows:

- **FSL** Full Scale Low
- **FSH** Full Scale High
- **dHi** Deviation High
- **dLo** Deviation Low
- **dEv** Deviation Band

Disabled alarms will not be displayed.
Chapter 7 gives a full description of alarms.

NOTE

If, at any time, no key is pressed within 45 seconds, the display will always return to the "HOME" display.

OPERATING MODES

The controller can be used in two modes:
Automatic mode - in which the output power is automatically adjusted to hold the temperature at the required value. The controller normally operates in this mode.
Manual mode - in which the output is manually adjusted by the Operator. In this mode the 'MAN' light will be on.

One other mode is available:
Remote setpoint - The setpoint is generated as an input signal from a master 2000 series controller. In this mode the REM light is on.

AUTO or MANUAL SELECT

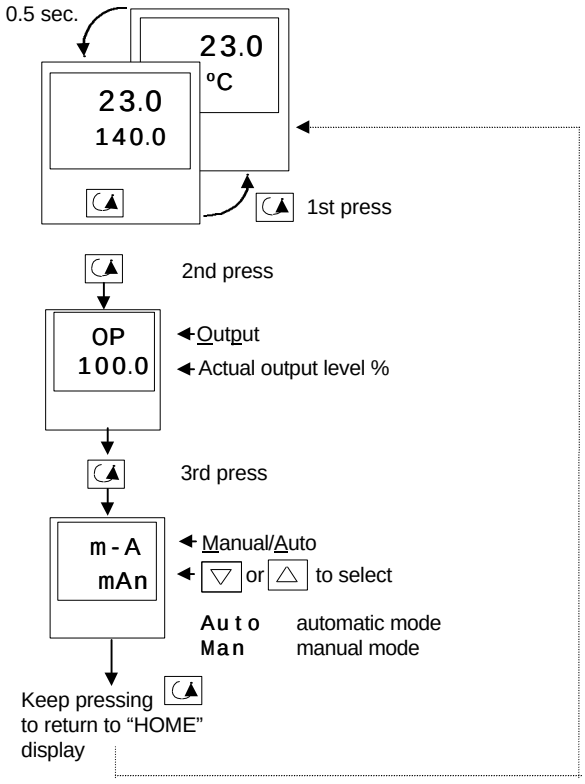


Fig. 1.10
Auto/manual
select

MANUAL ADJUSTMENT OF OUTPUT POWER

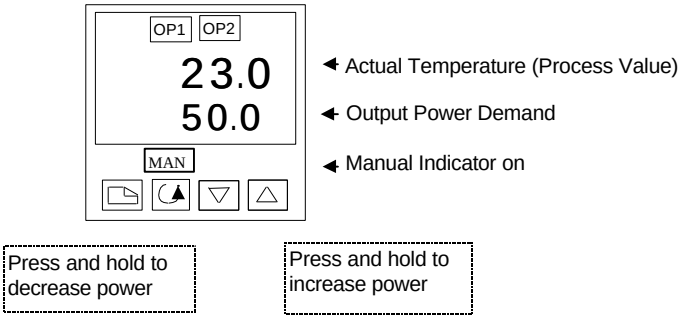


Fig. 1.11 The "Home Display" in manual mode

NOTE

Manual mode is generally used for test and commissioning purposes, take care not to leave the controller in this mode since damage or personal injury could occur.

SUMMARY

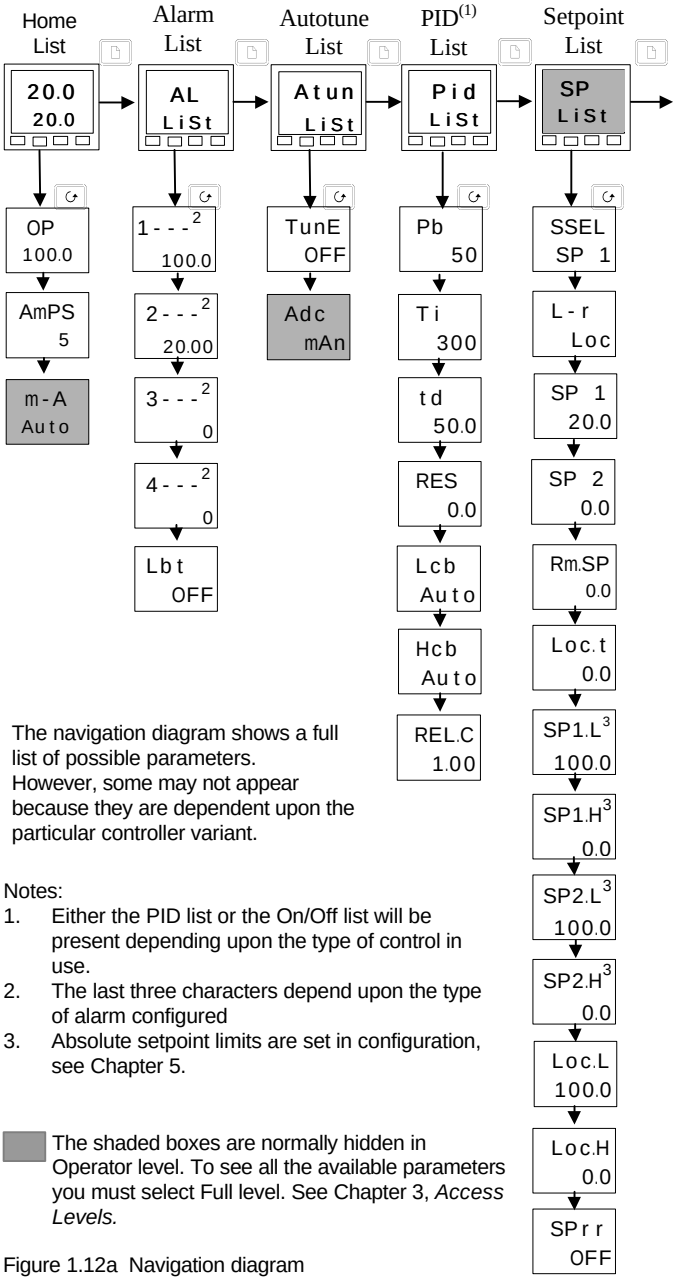
To step through list headers, press the Page button until the required header is obtained

To step through parameters within a particular list, press the Scroll button until the required parameter is obtained

To change the value (or state) of a parameter, press the Raise button or the Lower button

The remainder of this chapter provides a complete list of all parameters available.

NAVIGATION DIAGRAM *(Part A)*



The navigation diagram shows a full list of possible parameters. However, some may not appear because they are dependent upon the particular controller variant.

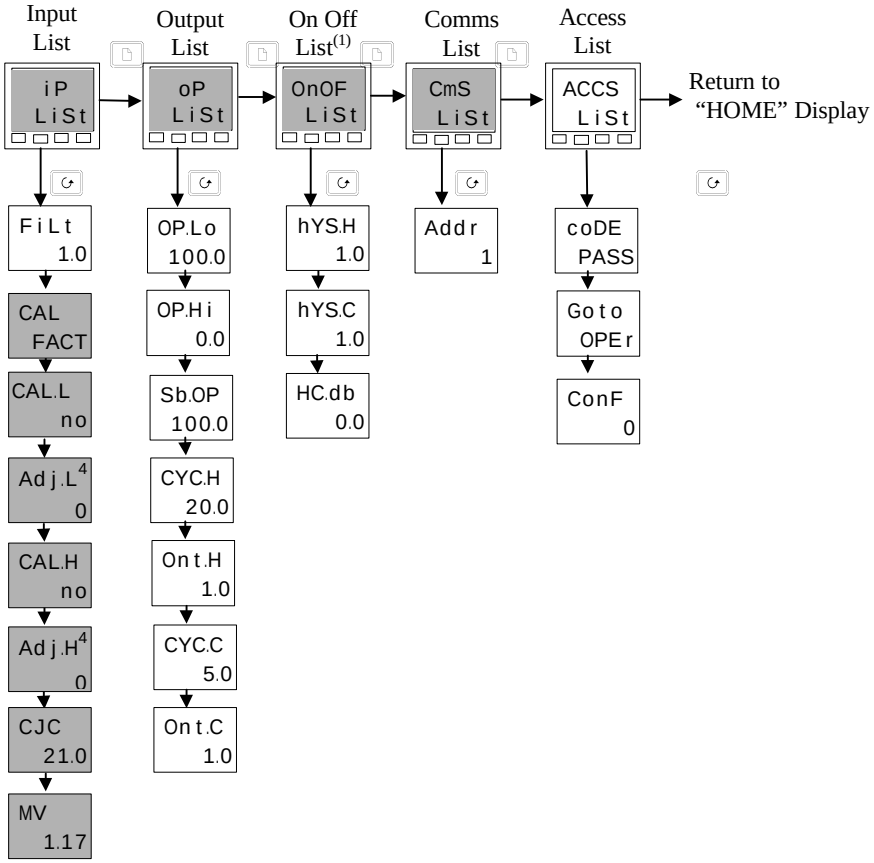
Notes:

1. Either the PID list or the On/Off list will be present depending upon the type of control in use.
2. The last three characters depend upon the type of alarm configured
3. Absolute setpoint limits are set in configuration, see Chapter 5.

The shaded boxes are normally hidden in Operator level. To see all the available parameters you must select Full level. See Chapter 3, *Access Levels.*

Figure 1.12a Navigation diagram

NAVIGATION DIAGRAM *(PART B)*



Note:

4. **Beware!** Used for calibration. See Chapter 6.

The shaded boxes are normally hidden in Operator level. To see all the available parameters you must select Full level. See Chapter 3, *Access Levels.*

Figure 1.12b Navigation diagram

PARAMETER TABLES

Name	Parameter Description	Default Value		Minimum	Maximum	Units	Customer Setting
		UK	USA	Value	Value		
	Home List						
Home	Measured Value and Setpoint (SP)	SP=25	SP=25			as display	
OP	% Output Level			0.00	100.00	%	
AmPS	Heater current (PDSIO mode 2)					Amps	
m-A	Auto/manual select	Auto	Auto				
Additional parameters may appear in the Home display if the 'promote' feature has been used (see *Edit Level*, Chapter 3).							
AL	**Alarm List**						
1---	Alarm 1 setpoint value	0	0	0	9999	as display	
2---	Alarm 2 setpoint value	0	0	0	9999	as display	
3---	Alarm 3 setpoint value	0	0	0	9999	as display	
4---	Alarm 4 setpoint value	0	0	0	9999	as display	
In place of dashes, the last three characters indicate the alarm type, as follows:							
-FSH	Full Scale High alarm						
-FSL	Full Scale Low alarm						
-DEv	Deviation band alarm						
-dHi	Deviation High alarm						
-dLo	Deviation Low alarm						
Lbt	Loop break time	OFF	OFF	0	9999	secs	
Atun	**Autotune List**						
tunE	Self tune enable	OFF	OFF	OFF	ON		
Adc	Automatic droop compensation (Manual Reset) enable (only present if ti set to OFF	MAN	MAN	MAN	CALC		
Pid	**PID List**						
Pb	Proportional band	20.0		0.0	9999	as display	
ti	Integral time	360		OFF	9999	seconds	
td	Derivative time	60		OFF	9999	seconds	
rES	Manual reset (appears when ti set to OFF)	0.0		0.00	100.0	%	
Lcb	Cutback low	Auto		0	9999	as display	
Hcb	Cutback high	Auto		0	9999	as display	
rEL.C	Relative cool gain (set 1)	1.00		0.01	9.99		
SP	**Set Point List**						
SSEL	Select SP1 or SP2	SP1		SP1	SP2		
L-r	Local or remote setpoint select *	Loc		Loc	rmt		
SP1	Setpoint 1 value	25		As display range			
SP2	Setpoint 2 value	25		As display range			
rm.SP	Remote setpoint	0		As display range			
Loc.t	Local trim	0		As display range			
SP1.L	Setpoint 1 low limit	0		As display range			
SP1.H	Setpoint 1 high limit	1000		As display range			
SP2.L	Setpoint 2 low limit	0		As display range			
SP2.H	Setpoint 2 high limit	1000		As display range			
Loc.L	Local setpoint trim low limit	-210		As display range			
Loc.H	Local setpoint trim high limit	1200		As display range			
SPrr	Setpoint rate limit	OFF		As display range			

***** Only appears if PDSIO fitted and configured in the HA comms slot.

Name	Parameter Description	Default Value		Minimum	Maximum	Units	Customer Settings
		UK	USA	Value	Value		
iP	**Input list**						
FiLt	Input filter time constant	1.6	1.6	1.0	999.9	secs	
The next 5 parameters will appear if User calibration has been enabled in configuration level. To perform a user calibration, refer to Ch 6.							
CAL	FACt will re-instate factory settings and disable User Calibration. Default setting FACt USEr will re-instate any previously set User Calibration offsets and make available User Calibration parameters as follows:						
CAL.L	User low point calibration if YES allows access to next parameter. if no the next parameter is hidden						
AdJ.L*	Adjust low point to calibrated ref. source						
CAL.H	User high point calibration if YES allows access to the next parameter if no the next parameter is hidden						
AdJ.H*	Adjust high point to calibrated ref. source						
The following two parameters are always present in Full Access level but not in Operator level							
CJC°	Cold Junction compensation temperature						
mV	Millivolt input						
* Do not make adjustments to the AdJ.L or AdJ.H parameters unless you wish to offset the controller calibration							

oP	**Output list** Note; If On/Off control is configured only Sb.OP, ont.H and ont.C will appear in the following list						
OP.Lo	Low (power) output limit	0.0 or -100.0 (cool)		-100.0	100.0	%	
OP.Hi	High (power) output limit	100.0	100.0	-100.0	100.0	%	
Sb.OP	Output setting when in sensor break	0.0 or -100.0 (cool)		-100.0	100.0	%	
CYC.H	Heat cycle time	1.0 (logic) 20 (relay)		0.2	999.9	secs	
CYC.C	Cool cycle time	1.0 (logic) 20 (relay)		0.2	999.9	secs	
ont.H	Heat output min. on time	0.1	0.1	Auto (50mS)	1.0	mins	
ont.C	Cool output min. on time	0.1	0.1	Auto (50mS)	1.0	mins	

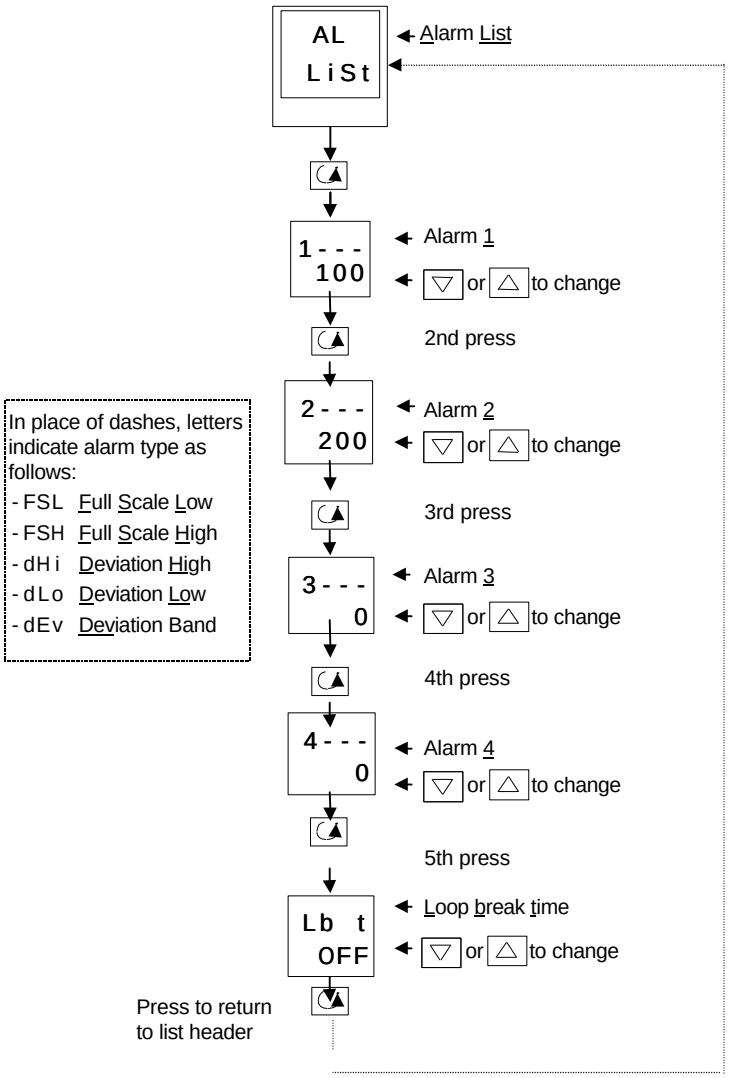
OnOf	**On/off list**						
This set of parameters only appear if On/Off control has been configured							
hYS.H	Heat hysteresis	0	0	0	9999	as display	
hYS.C	Cool hysteresis	0	0	0	9999	as display	
HC.db	Heat/Cool dead band	1	1	0	9999	as display	

cmS	**Comms list**						
Addr	Communications address	1	1	1	254		

ACCS	**Access list**						
codE	Full and Edit level password	1	1	0	9999		
Goto	Goto level - OPEr, FuLL, Edit, or conF	OPEr	OPEr	OPEr	conF		
ConF	Configuration level password	2	2	0	9999		

SETTING ALARM LEVELS

Up to 4 Alarms may be configured. Each alarm is given a name to describe its function - see table below:
If an alarm is not used it does not appear in the list below.



Diagnostic alarms

These indicate that a fault exists in either the controller or the connected devices.

Display shows	What it means	What to do about it
EE.Er	*Electrically Erasable Memory Error:* The value of an operator or configuration parameter has been corrupted.	This fault will automatically take you into configuration level. Check all of the configuration parameters before returning to operator level. Once in operator level, check all of the operator parameters before resuming normal operation. If the fault persists or occurs frequently, contact Eurotherm Controls.
S.br	*Sensor Break:* Input sensor is unreliable or the input signal is out of range.	Check that the sensor is correctly connected.
L.br	*Loop Break:* The feedback loop is open circuit.	Check that the heating and cooling circuits are working properly.
Ld.F	*Load failure* Indication that there is a fault in the heating circuit or the solid state relay.	This is an alarm generated by feedback from a Eurotherm TE10S solid state relay (SSR) operating in PDSIO mode 1-see *Electrical installation* Chapter 2. It indicates either an open or short circuit SSR, blown fuse, missing supply or open circuit heater.
SSr.F	*Solid state relay failure* Indication that there is a fault in the solid state relay	This is an alarm generated by feedback from a Eurotherm TE10S solid state relay (SSR) operating in PDSIO modes 2 or 3-see *Electrical installation* Chapter 2. It indicates either an open or short circuit condition in the SSR.
Htr.F	*Heater failure* Indication that there is a fault in heating circuit	This is an alarm generated by feedback from a Eurotherm TE10S solid state relay (SSR) operating in PDSIO modes 2 or 3-see *Electrical installation* Chapter 2. It indicates either a blown fuse, missing supply or open circuit heater.
HW.Er	*Hardware error* Indication that a module is of the wrong type, missing or faulty	Check that the correct modules are fitted.
rmt.F	*Remote input failure.* The PDSIO input is open circuit	Check for open or short circuit wiring on the PDSIO input
LLLL	*Out of Display range, low reading*	Check the value of the display range
HHHH	*Out of Display range, high reading*	Check the value of the display range
Err1	*Error 1:* ROM self-test fail	Return the controller for repair
Err2	*Error 2:* RAM self-test fail	Return the controller for repair
Err3	*Error 3:* Watchdog fail	Return the controller for repair
Err4	*Error 4: Keyboard failure* Stuck buttons, or a button was pressed during power up.	Switch the power off and then on without touching any of the controller buttons.
Err5	*Error 5: Input circuit failure*	Return the controller for repair
Pwr.F	*Power failure.* The line voltage is too low	Check that the supply to the controller is within the rated limits

Table 1.1 Diagnostic alarms

Chapter 2 INSTALLATION

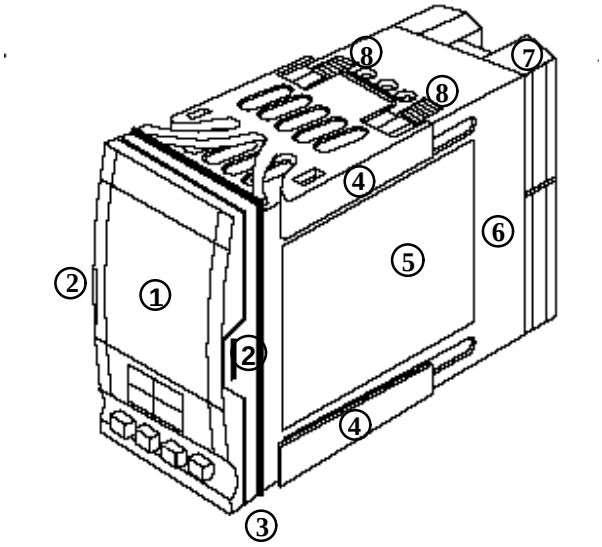


Figure 2-1 2208 1/8 DIN controller

KEY

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

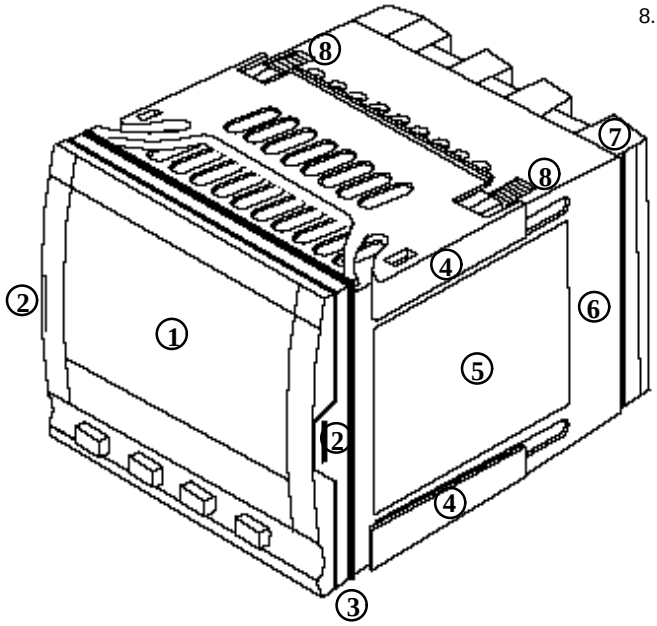


Figure 2-2 2404 1/4 DIN controller

Outline dimensions Model 2208

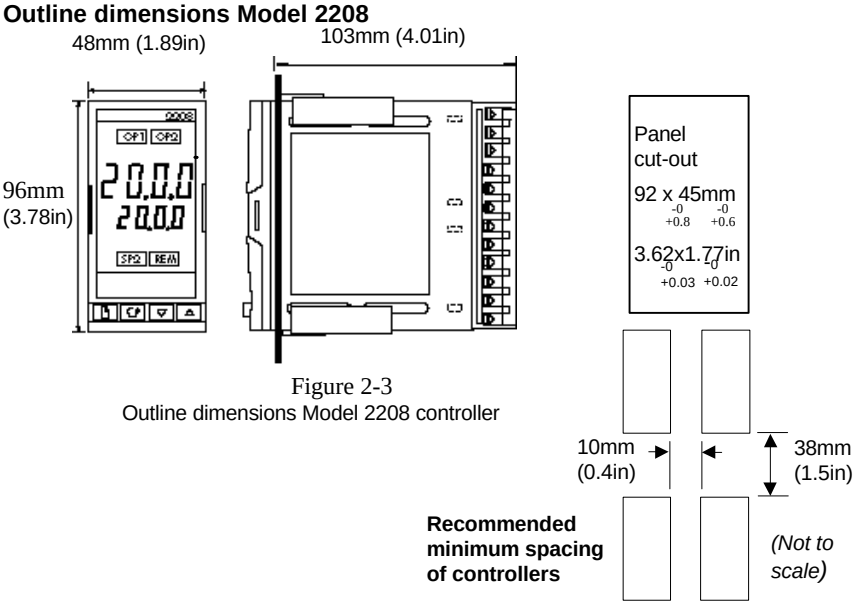


Figure 2-3
Outline dimensions Model 2208 controller

Outline dimensions Model 2204

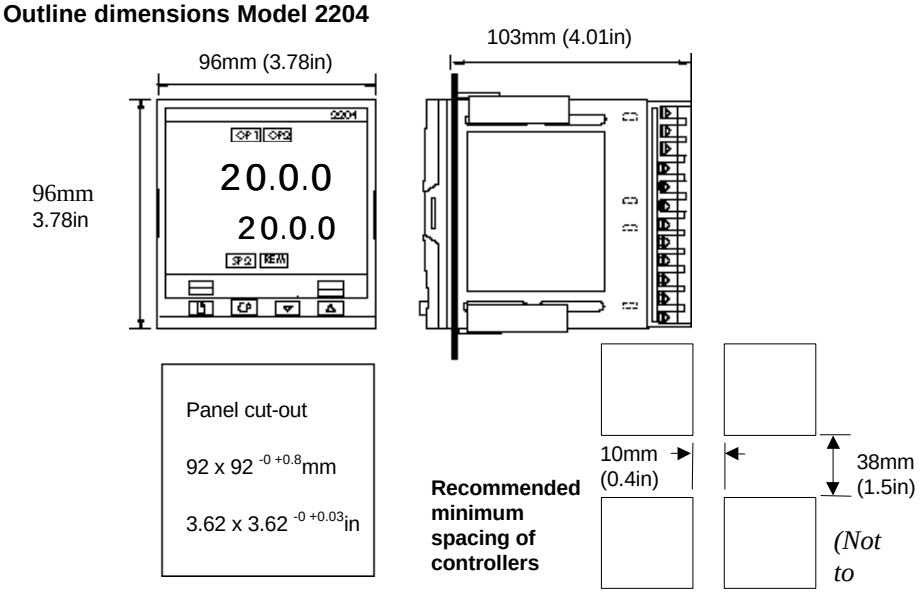


Figure 2-4 Outline dimensions Model 2204 controller

The controller plugs into a plastic sleeve, which in turn fits into the panel cut-out shown in Figures 2-3 and 2-4.

INTRODUCTION

The Models 2208 and 2204 are precision temperature controllers with self-tuning. They have a modular hardware construction, which provides two control outputs, two alarm relays and one communications port. Two logic inputs are provided as standard. In addition the Model 2204 has an optional plug-in 10A relay heating output.

Controller labels

The labels on the sides of the controller identify the ordering code, the serial number, and the wiring connections.

Appendix A, *Understanding the Ordering Code* explains the hardware and software configuration of your particular controller.

MECHANICAL INSTALLATION

To install the controller

1. Cut the panel to the relevant hole size shown in Figure 2-3 and 2.4.
2. Insert the controller through the front of this cut-out.
3. Spring the upper and lower panel retaining clips into place. Secure the controller in position by holding it level and pushing both retaining clips forward.

Note: If the panel retaining clips subsequently need removing, they can be unhooked from the side with either your fingers or a screwdriver.

Unplugging and plugging-in the controller

The controller can be unplugged from its sleeve by easing the latching ears outwards and pulling it forward out of the sleeve. When plugging the controller back into its sleeve, ensure that the latching ears click into place to maintain the IP65 sealing.

WIRING

Please read Appendix B, safety and EMC information before proceeding.

WARNING

Please ensure that the controller is correctly configured for your application. Incorrect configuration could result in damage to the process being controlled, and/or personal injury. The controller may either have been configured when ordered, or may need configuring now. See Chapter 5, *Configuration.*

Model 2208 connections

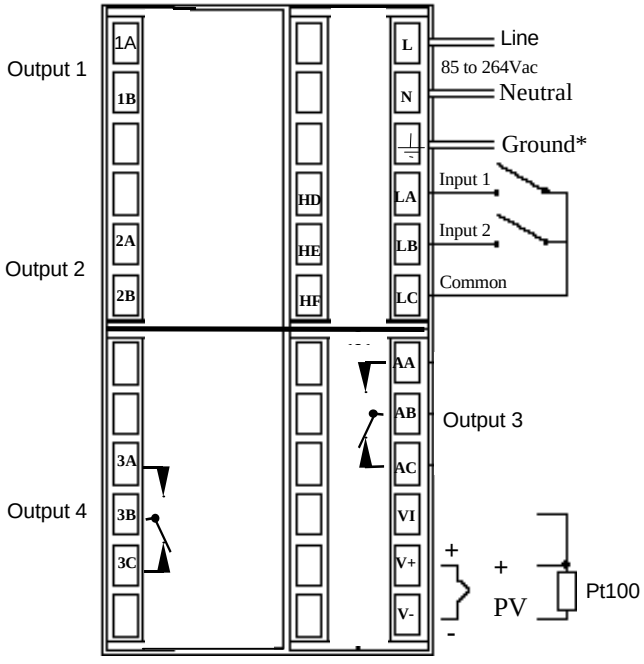


Figure 2-5 Model 2208 wiring connections

* The ground connection is not required for electrical safety but must be connected to satisfy EMC requirements.

Wire Sizes

All electrical connections are made to the screw terminals at the rear of the controller. These accept wire sizes from 0.5 to 1.5 mm^2 (16 to 22 AWG), and are protected by a hinged cover to prevent hands or metal making accidental contact with live wires. Rear terminal screws should be tightened to a torque of 0.4 Nm (3.5 lb. in).

Wiring connections

The wiring connections are shown in figures 2-5 and 2-6.
Outputs 1 and 2 are factory fitted modules which can be any one of the types shown in figure 2-8. Check the ordering code on the controller side label to determine which have been fitted.

Model 2204 connections

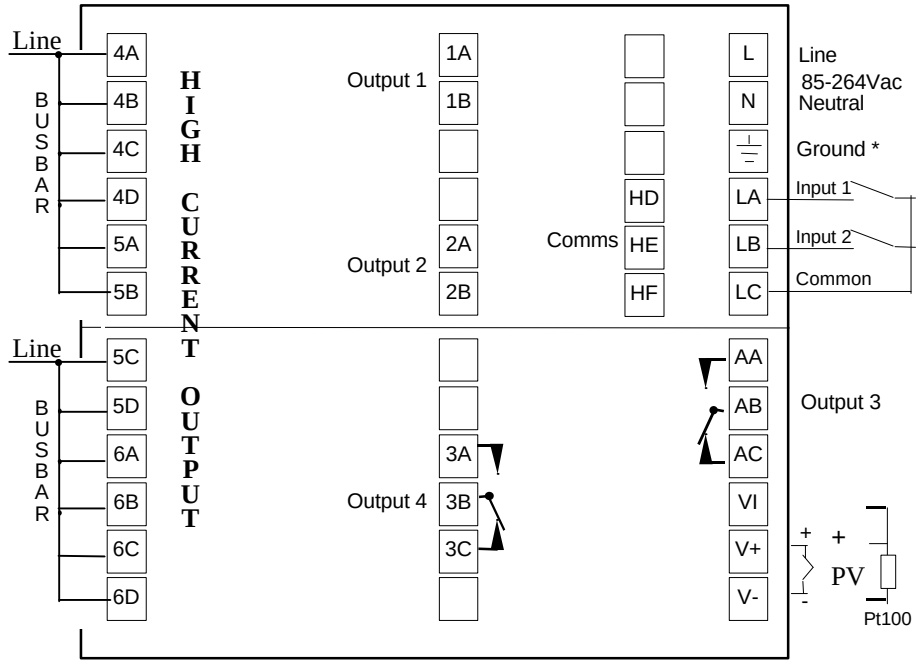


Figure 2-6 Model 2204 Wiring connections

* The ground connection is not required for safety purposes but must be connected to satisfy EMC requirements.

Sensor input connections
The connections for the various types of input are as follows:

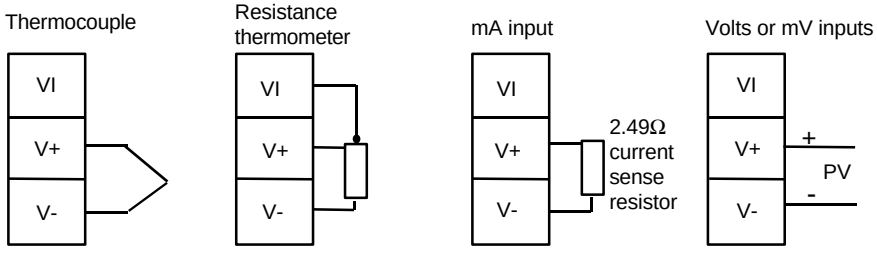


Fig 2-7 Sensor input connections

OUTPUTS 1 AND 2 CONNECTIONS

Outputs 1 and 2 can be any one of the types shown in the table below. Configured to perform any one of the functions shown.

To check which outputs are installed, and their configuration, refer to the ordering code and the wiring information on the controller side labels.

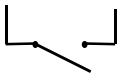
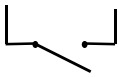
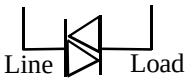
	Connections				
	Output 1		Output 2		Possible functions
Module type	1A	1B	2A	2B	
Relay: 2-pin *(2A, 264 Vac max.)*					Heating Cooling Alarms
Logic: non-isolated *(18Vdc at 24mA)*					PDSIO modes 1or 2 Heating Cooling Alarms
Triac *(1A, 30 to 264Vac)*					Heating or cooling
DC control: isolated *(18Vdc, 20mA max)*			DC not available in output 2		PID Heating or cooling

Figure 2-8 Outputs 1 and 2 connections

PDSIO modes

PDSIO is a proprietary technique developed by Eurotherm for bi-directional communications over a single pair of wires. There are several operating modes.

In **mode 1** a logic output delivers a power demand signal to a TE10 solid state relay (SSR) and the SSR responds with a single load circuit failure message.

In **mode 2** a logic output delivers a power demand signal to an SSR and the SSR responds with the ON state rms load current, and two fault messages - SSR failure or heater circuit failure.

Snubbers

The controller is supplied with 'snubbers' (15nF +100Ω) which should be wired across the relay or triac outputs when switching inductive loads such as mechanical contactors and solenoid valves. The snubbers are used to prolong contact life and to suppress interference when switching such loads.

Snubbers pass 0.6mA at 110Vac and 1.2mA at 240Vac, which may be sufficient to hold in high impedance relay coils. They should not, therefore, be used in such installations.

WARNING

When a relay contact is used in an alarm circuit, ensure that the current passing through the snubber when the relay contact is open does not hold in low power electrical loads and thereby interfere with the failsafe operation of the alarm circuit.

COMMUNICATIONS CONNECTIONS

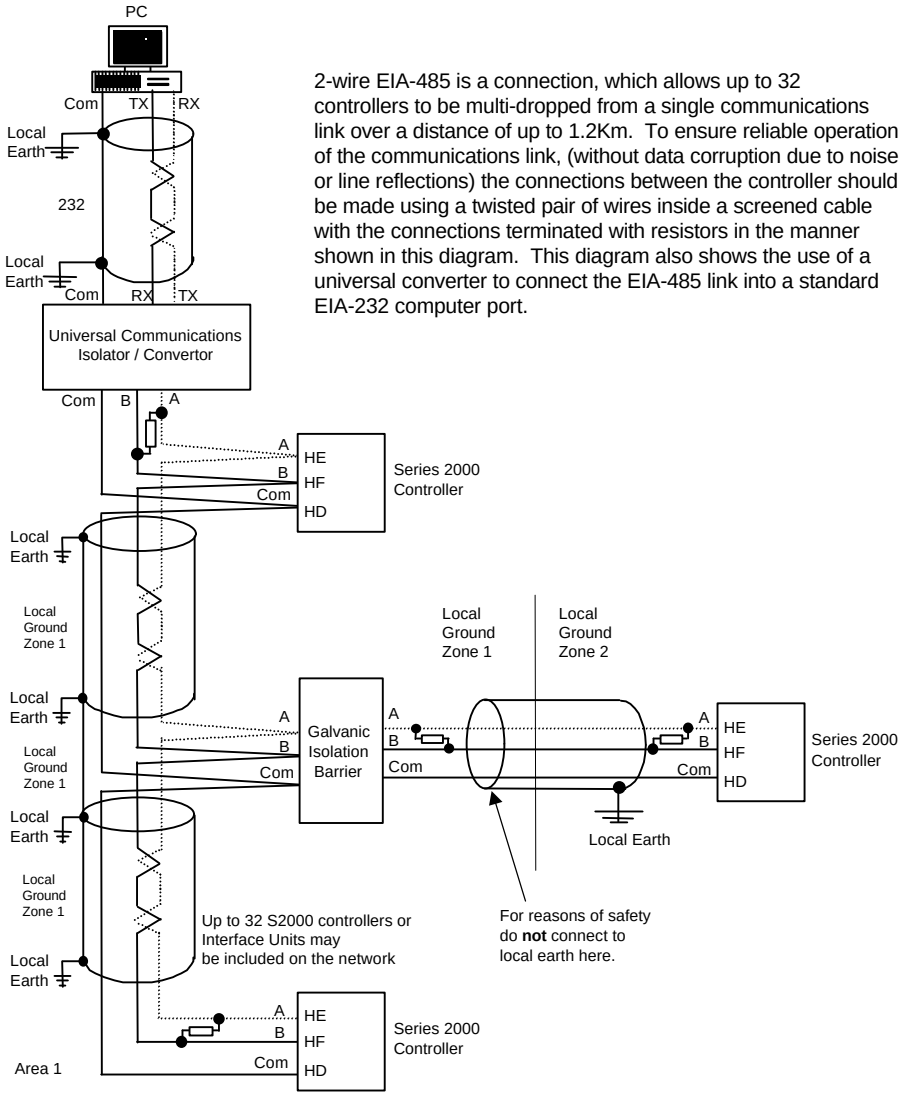
The communications option can be either of the two types shown in the table below:

Communications type	Connection		
	HD	HE	HF
2 wire EIA- 485 serial communications	Common	A	B
PDSIO Setpoint input	Not used	Signal	Common

Figure 2-9 Communication connections

The EIA 485 module can be configured for Modbus protocol.

Wiring of EIA 485 serial communication links



2-wire EIA-485 is a connection, which allows up to 32 controllers to be multi-dropped from a single communications link over a distance of up to 1.2Km. To ensure reliable operation of the communications link, (without data corruption due to noise or line reflections) the connections between the controller should be made using a twisted pair of wires inside a screened cable with the connections terminated with resistors in the manner shown in this diagram. This diagram also shows the use of a universal converter to connect the EIA-485 link into a standard EIA-232 computer port.

Note:
All resistors are 220 ohm 1/4W carbon composition.
Local grounds are at equipotential. Where equipotential is not available wire into separate zones using a galvanic isolator.
Use a repeater for more than 32 units.

Figure 2-10 EIA 485 wiring

TYPICAL WIRING DIAGRAM

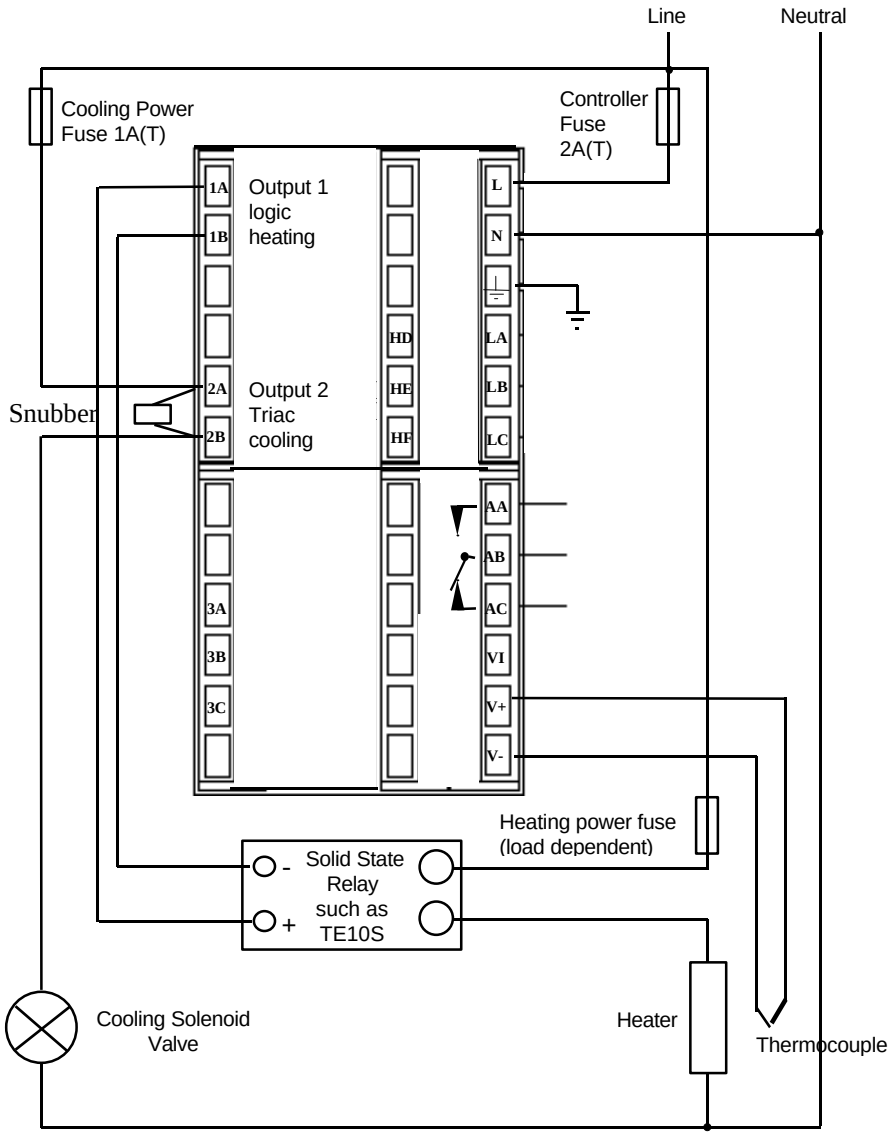


Fig 2-11 Typical wiring diagram, Model 2208 Controller

Chapter 3 ACCESS LEVELS

This chapter describes the different levels of access to the operating parameters within the controller.

There are three topics:

- THE DIFFERENT ACCESS LEVELS
- SELECTING AN ACCESS LEVEL
- EDIT LEVEL

THE DIFFERENT ACCESS LEVELS

There are four access levels:

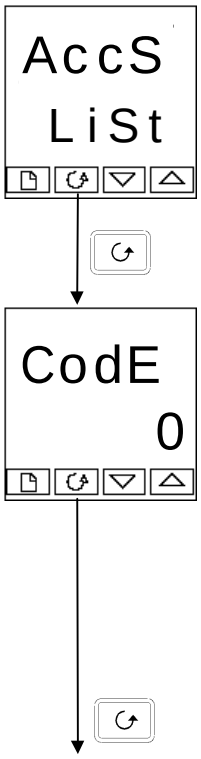
- **Operator level**, which you will normally use to operate the controller
- **Configuration level**, which is used to set up the fundamental characteristics of the controller
- **Full level**, which is used to commission the controller and the process being controlled
- **Edit level**, which is used to set up the parameters that you want an operator to be able to see and adjust when in Operator level.

Access level	Display shows	What you can do	Password Protection
Operator	OPEr	In this level operators can view and adjust the value of parameters defined in Edit level (see below).	No
Full	FuLL	In this level all the parameters relevant to a particular configuration are visible. All alterable parameters may be adjusted.	Yes
Edit	Edit	In this level you can set which parameters an operator in Operator level is able to view and adjust. You can hide or reveal complete lists and individual parameters within each list, and you can make parameters read-only or alterable. (See *Edit level* at the end of the chapter).	Yes
Configuration	ConF	This special level allows access to set up the fundamental characteristics of the controller.	Yes

Figure 3-1 Access levels

SELECTING AN ACCESS LEVEL

Access to Full, Edit or Configuration levels is protected by a password to prevent unauthorised access.
If you need to change the password, see Chapter 5, *Configuration*.



Access list header

Press [ ] until you reach the access list header 'ACCS'.

Press the Scroll button

Password entry

The password is entered from the 'CodE ' display.

Enter the password using the [▲] or [▼] buttons. Once the correct password has been entered, there is a two second delay after which the lower readout will change to show 'PASS ' indicating that access is now unlocked.
The pass number is set to '1' when the controller is shipped from the factory.

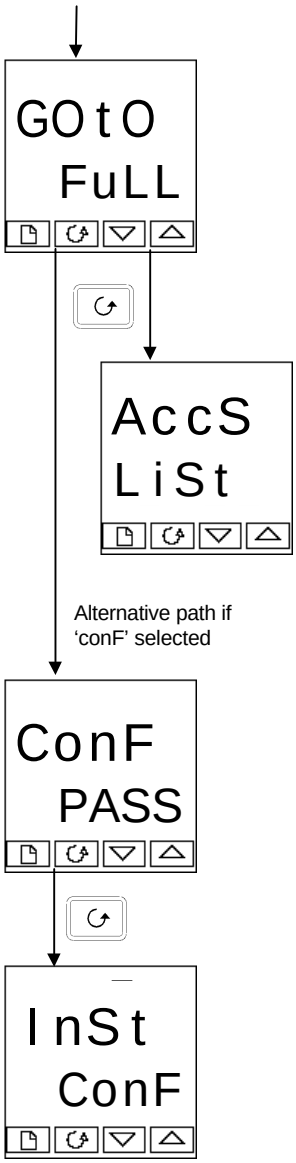
Note: A special case exists if the password has been set to '0'. In this case access will be permanently unlocked and the lower readout will always show 'PASS'

Press the Scroll button to proceed to the 'Goto' display.

(If an *incorrect* password has been entered and the controller is still 'locked' then pressing *Scroll* at this point will simply return you to the aCCs list header.)

Note: From this 'CODE' display you can access 'read only' configuration level by pressing [▲] and [▼] together.

To escape read only configuration press [ ] and [ ] together.



Level selection

The 'Goto' display allows you to select the required access level.

Use ▲ and ▼ to select from the following display codes:

OPEr: Operator level
FuLL: Full level
Edit: Edit level
conF: Configuration level

Press the Scroll button

If you selected either 'OPEr, FuLL or Edit level you will be returned to the 'ACCS list header in the level that you chose. If you selected 'conF', you will get an alternative display showing 'ConF' in the upper readout (see below).

Configuration password

When the 'ConF' display appears, you must enter the Configuration password in order to gain access to Configuration level. Do this by repeating the password entry procedure described in the previous section

The configuration password is set to '2' when the controller is shipped from the factory. If you need to change the configuration password, see Chapter 5, *Configuration*

Press the Scroll button

Configuration level

The first display of configuration is shown. See chapter 5, *Configuration* for details of the configuration parameters.

For instructions on leaving configuration level see Chapter 5, *Configuration.*

Returning to Operator Level

To return to operator level from either 'FuLL' or 'Edit' level, repeat entry of the password and select 'OPEr' on the 'Goto' display.

In 'Edit' level the controller will automatically return to operator level if no button is pressed for 45 seconds.

EDIT LEVEL

Edit level is used to set which parameters you can see and adjust in Operator level. It also gives access to the 'Promote' feature which allows you to select and add('Promote') up to twelve parameters into the Home display list, thereby giving simple access to commonly used parameters.

Setting operator access to a parameter

First you must select Edit level, as shown on the previous page.

Once in Edit level, you select a list or a parameter within a list in the same way as you would in Operator or Full level. That is to say, you move from list header to list header by pressing the Page button, and from parameter to parameter within each list using the Scroll button. ***However, in Edit level what is displayed is not the value of a selected parameter but a code representing the parameter's availability in Operator level.***

When you have selected the required parameter, use the ▲ and ▼ buttons to set its availability in operator level.

There are four codes:

ALtr	Makes a parameter alterable in Operator level
Pro	Promotes a parameter into the Home display list
READ	Makes a parameter or list header read-only *(it can be viewed but not altered)*
HidE	Hides a parameter or list header.

For example:

The parameter selected is the set point for Alarm 2 - Full Scale Low

Hiding or revealing a complete list

To hide a complete list of parameters, all you have to do is hide the list header. If a list header is selected only two selections are available: READ and HidE.
(It is not possible to hide the 'ACCS' list, which will always display the code: 'LiSt'.)

Promoting a parameter

Scroll through the lists to the required parameter and choose the 'Pro' code. The parameter is then automatically added(promoted) into the Home display list (the parameter will also be accessible as normal from the standard lists. a maximum of twelve parameters can be promoted. Promoted parameters are automatically 'alterable'.

Chapter 4 TUNING

Before tuning please read Chapter 1, *Operation*, to learn how to select and change a parameter.

This chapter has three main topics:

- WHAT IS TUNING?
- AUTOMATIC TUNING
- MANUAL TUNING

WHAT IS TUNING?

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

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

Tuning involves calculating and setting the value of the parameters listed in Table 4-1. These parameters appear in the PiD list.

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

Table 4-1 Tuning parameters

AUTOMATIC TUNING

This method automatically determines the value of the parameters listed in table 4-1 on the previous page.
The 2208 and 2204 use a 'one-shot' tuner which works by switching the output on and off to induce an oscillation in the measured value. From the amplitude and period of the oscillation, it calculates the tuning parameter values.
If the process cannot tolerate full heating or cooling being applied during tuning, then the level of heating or cooling can be restricted by setting the heating and cooling power limits in the Output list. However, the measured value *must* oscillate to some degree for the tuner to be able to calculate values
A One-shot Tune can be performed at any time but normally it is performed only once during the initial commissioning of the process. However, if the process under control subsequently becomes unstable (because its characteristics have changed), you can re-tune again for the new conditions.
It is best to start tuning with the process at ambient temperature. This allows the tuner to calculate more accurately the low cutback and high cutback values that restrict the amount of overshoot or undershoot.

Heating and Cooling Output Cycle Times

Before commencing a tuning cycle, set the values of CYC.H (heat cycle time) and CYC.C (cool cycle time) in the oP (output list). These values apply if you are using a logic, relay or triac output. They have no effect on a DC output.

A logic output switching a solid state relay should be set to 1 sec.

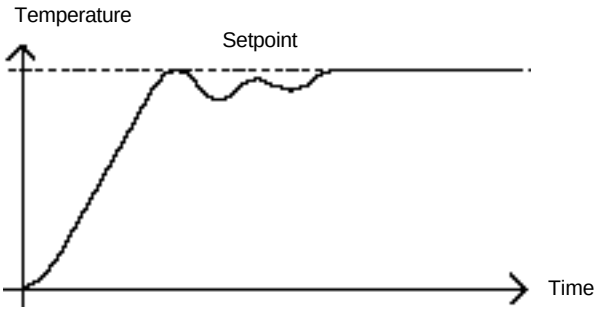
A relay or triac output should be set to 20 sec.

How to tune

1. Set the setpoint to the value at which you will normally operate the process.
2. In the 'Atun' list, select 'tunE' and set it to 'on'
3. Press the Page and Scroll buttons together to return to the Home display. The display will flash 'tunE' to indicate that tuning is in progress.
4. The controller will induce an oscillation in the temperature by turning the heating on and then off. The first cycle will not complete until the measured value has reached the required setpoint.
5. After two cycles of oscillation the tuning will be completed and the tuner will switch itself off.
6. The controller will then calculate the tuning parameters listed in Table 4-1 and will resume normal control action.

If you want 'Proportional only' or 'PD' or 'PI' control, you should set the 'ti' or 'td' parameters to OFF before commencing the tuning cycle. The tuner will leave them off and will not calculate a value for them.

Typical automatic tuning cycle



Calculation of the cutback values

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

MANUAL TUNING

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

With the process at its normal running temperature:

1. Set the Integral Time 'ti' and the Derivative Time 'td' to OFF.

2. Set High Cutback and Low Cutback, 'Hcb' and 'Lcb', to 'Auto'

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

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

5. Set the Pb, ti, td parameter values according to the calculations given in Table 4-2.

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

Table 4-2 Tuning values

Setting the cutback values

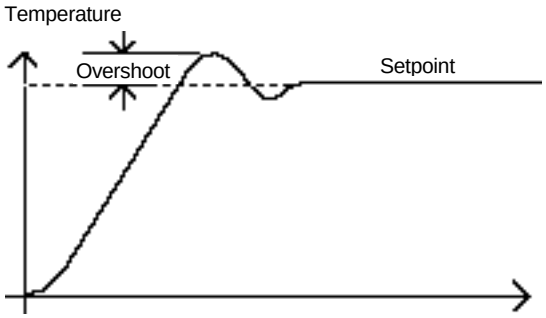
The above procedure sets up the parameters for optimum steady state control. If unacceptable levels of overshoot or undershoot occur during start-up or for large step changes in temperature, then manually set the cutback parameters Lcb and Hcb.

Proceed as follows:

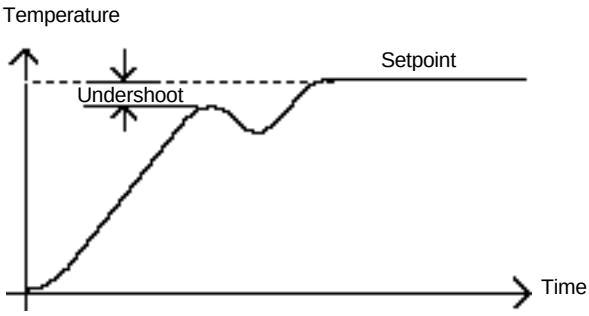
1. Set the low and high cutback values to three proportional bandwidths (that is to say, Lcb = Hcb = 3 x Pb).
2. Note the level of overshoot or undershoot that occurs for large temperature changes (see the diagrams below).

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

Example (a)



Example (b)



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

Integrating action and manual reset

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

Automatic droop compensation (Adc)

The steady state error from the setpoint, which occurs when the integral term is set to 'OFF', is sometimes referred to as 'droop'. Adc automatically calculates the manual reset value in order to remove this droop. To use this facility, you must first allow the temperature to stabilise. Then, in the autotune parameter list, you must set Adc to 'CALC'. The controller will then calculate a new value for manual reset, and switch Adc to 'mAn'.

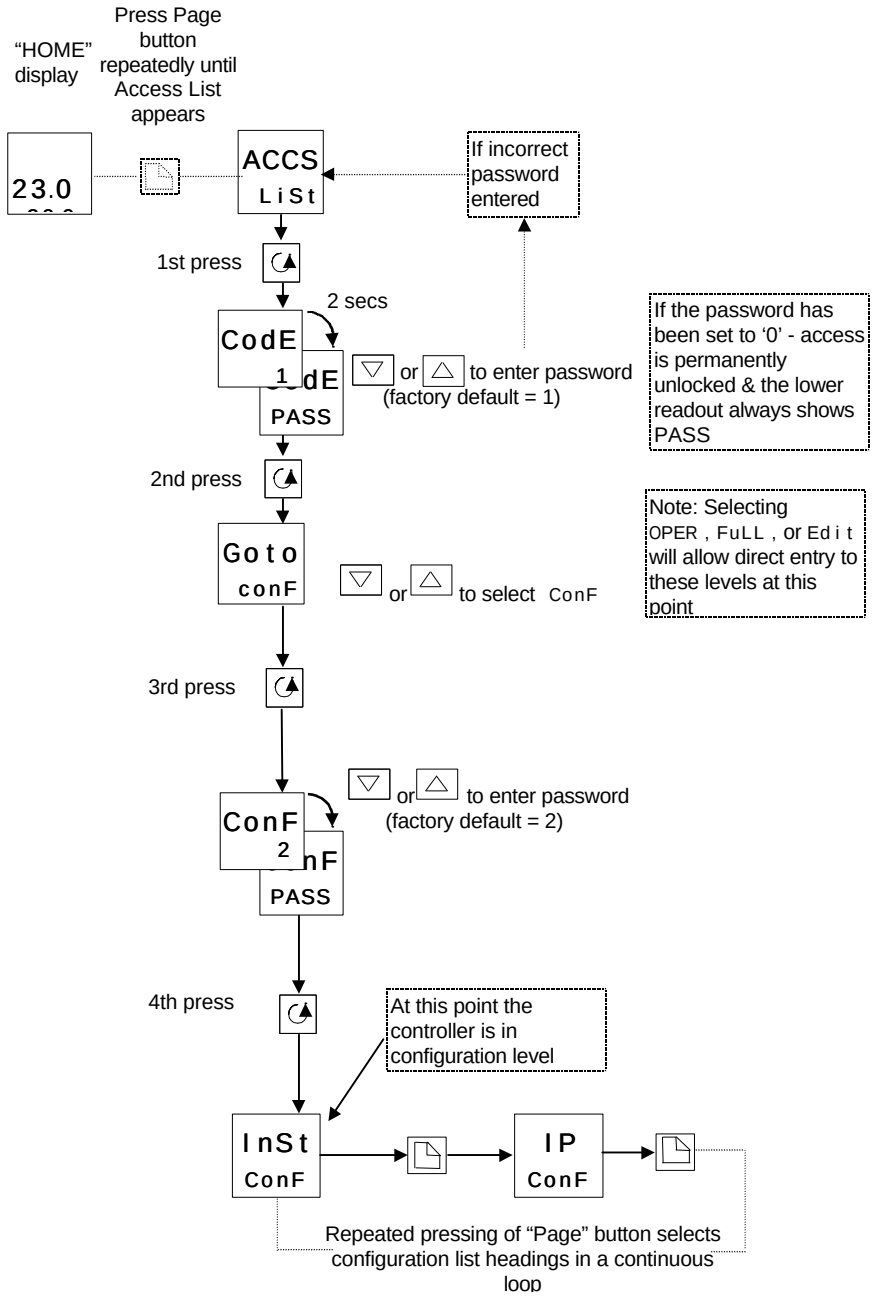
Adc can be repeated as often as you require, but between each adjustment you must allow time for the temperature to stabilise.

Chapter 5 CONFIGURATION

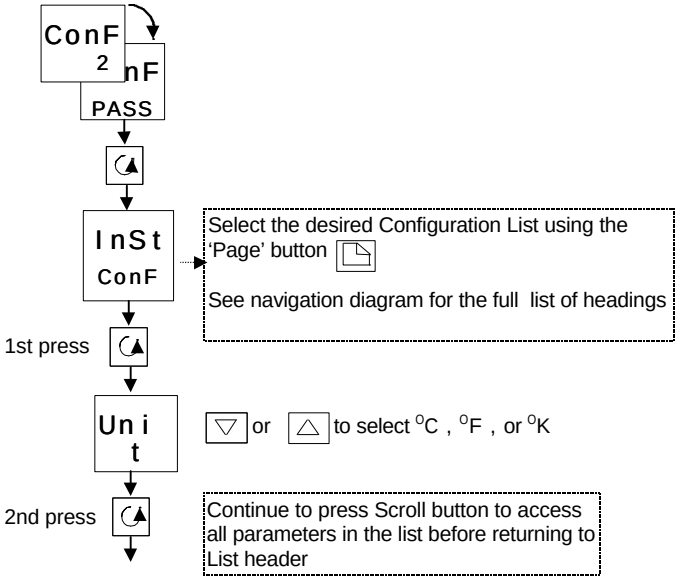
WARNING

Configuration is protected by a password and should be carried out by an authorised person. Incorrect configuration could result in damage to the process being controlled and/or personal injury. It is the responsibility of the person commissioning the process to ensure that the configuration is correct.

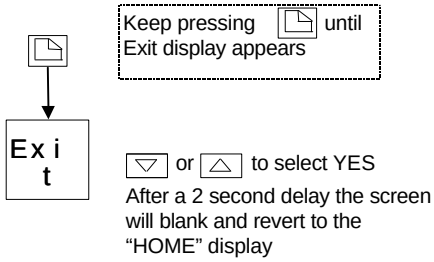
SELECTING CONFIGURATION LEVEL



SELECTING A CONFIGURATION PARAMETER (continued from previous page)



LEAVING CONFIGURATION LEVEL



STEPS INVOLVED IN CONFIGURING A CONTROLLER

The navigation diagram which follows shows the general location of parameters which define the way in which the controller works. They are grouped under headings.
The actual parameters shown in your controller may differ slightly since some appear only as a result of selecting others. A full list of possibilities is included in the PARAMETER TABLES which follow the navigation diagram.

NAVIGATION DIAGRAM *(PART A)*

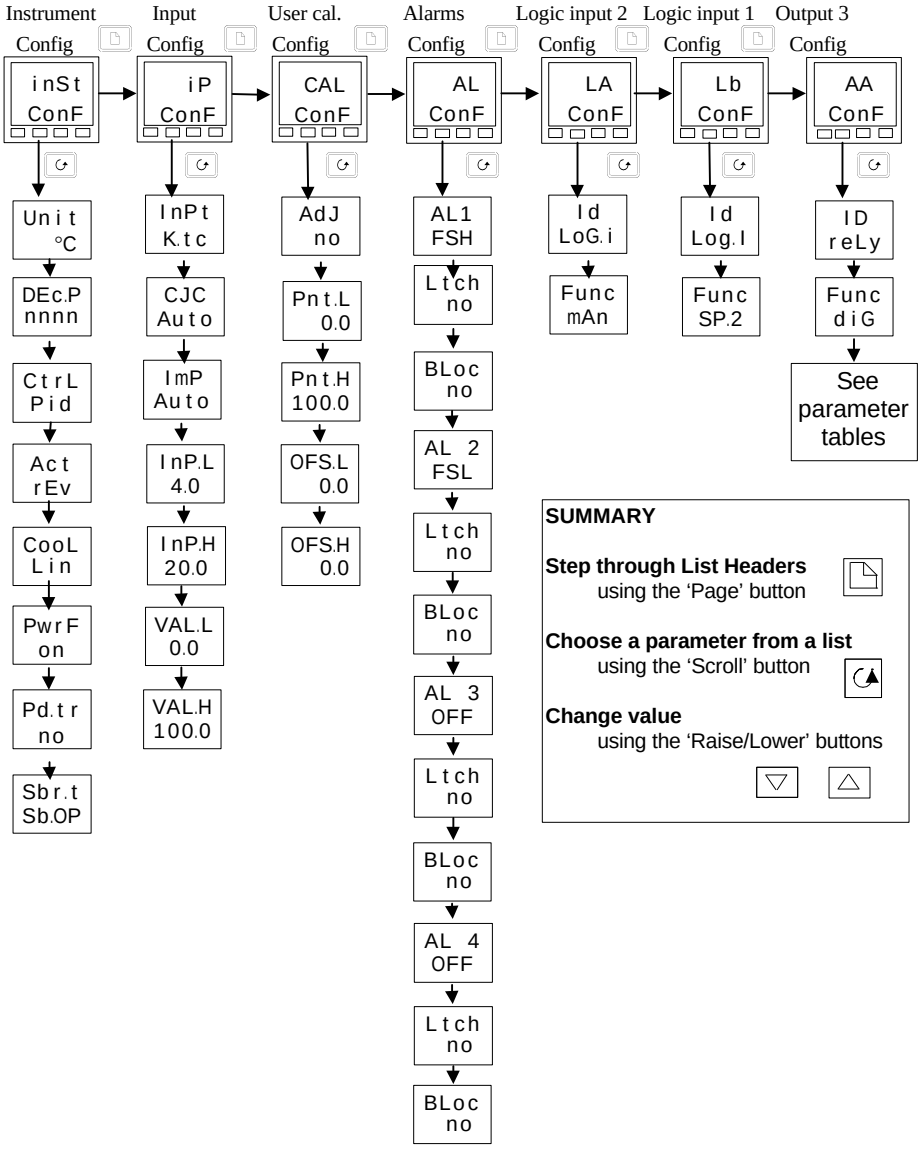


Fig 5.1a Navigation Diagram (Part A)

NAVIGATION DIAGRAM *(PART B)*

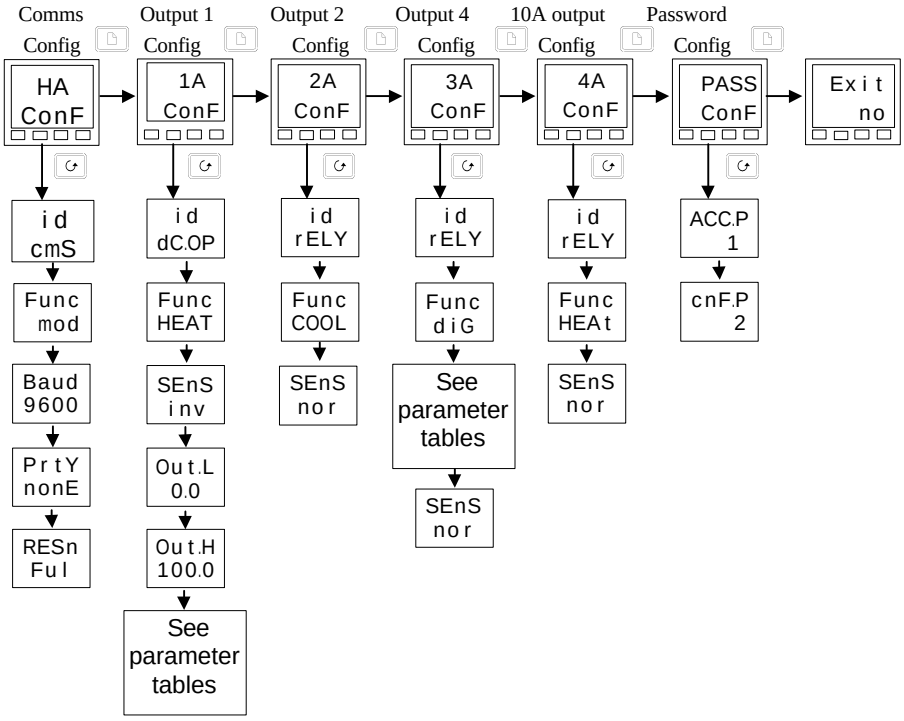


Fig 5.1b Navigation Diagram (Part B)

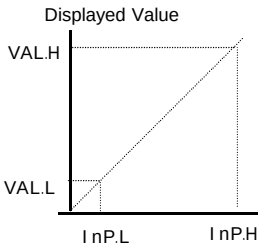
Heading	Input/Output Functions	Wiring Terminals
The first four headings set up the controller functions as follows:		
inSt ConF	Sets up display and control parameters	Not applicable
iP ConF	Selects the input sensor type	Not applicable
CAL ConF	To calibrate to external reference sources	Not applicable
AL ConF	Sets up the alarm types	Not applicable
The remaining headings configure the controller input/output functions. The upper readout corresponds to rear terminal numbers associated with a particular i/o		
La ConF	Sets up the action of logic input 1	LA
LB Conf	Sets up the action of logic input 2	LB
AA Conf	Sets up the action of the relay on output 3	AA to AC
HA Conf	Sets up digital comms. type	HA to HF
1A ConF	Sets up the output 1 module	1A & 1B
2A Conf	Sets up the output 2 module	2A & 2B
3A Conf	Sets up the action of the relay on output 4	3A to 3C
4A Conf	Sets the action of the 10A output relay in 2204	4A to 6D
Pass Conf	To choose new passwords	
Exit Conf	To leave configuration level and return to operator level	

CONFIGURATION PARAMETER TABLES

Name	Parameter description	Values	Meaning
inSt	**Instrument configuration**		
unit	Instrument units	°C	Centigrade (default UK)
		°F	Fahrenheit (default USA)
		°k	Kelvin
		nonE	Display units will be blanked
dEc.P	Decimal places in the displayed value	nnnn	None
		nnn.n	One
		nn.nn	Two
CtrL	Control type	On.OF	On/off control
		Pid	PID control
Act	Control action	rEv	Reverse acting (required for temperature control) - output decreases on approach to setpoint.
		dir	Direct acting
cooL	Type of cooling	Lin	Linear
		oiL	Oil (50mS min on time)
		H2O	Water(non-linear)
		FAn	Fan (0.5S min on time)
PwrF	Power feedback	on	Power feedback is on (compensates for changes in supply voltage)
		OFF	Power feedback is off
Pd.tr	Bumpless Manual/Auto transfer when using PD control	no	Non-bumpless transfer
		YES	Bumpless transfer (auto to manual and manual to auto)
Sbr.t	Sensor break output	Sb.OP	Go to pre-set value (maintains output at a known, safe level)
		HoLd	Freeze output (maintains output at value immediately before break)

NOTE

Factory default parameter values and states are included where applicable and are indicated by the shaded areas in the following tables.

Name	Parameter description	Value	Meaning
iP	**Input configuration**		
inPt	Input type	J.tc	J thermocouple (default USA)
		K.tc	K thermocouple (default UK)
		L.tc	L thermocouple
		r.tc	R thermocouple (Pt/Pt13%Rh)
		b.tc	B thermocouple (Pt30%Rh/Pt6%Rh)
		n.tc	N thermocouple
		t.tc	T thermocouple
		S.tc	S thermocouple (Pt/Pt10%Rh)
		PL.2	PL 2 thermocouple
	NOTE:	rtd	100Ω platinum resistance thermometer.
	After selecting an input type, do not forget to adjust the setpoint limits in Full Access level	C.tc	Custom downloaded input type. The default is C thermocouple, or the name of the downloaded custom input will be displayed.
		mV	Linear millivolt (Also mA input via an external 2.49Ω current sense resistor)
		voLt	Linear voltage
CJC	CJC ref. temperature *(CJC does not appear for linear inputs)*	Auto	Automatic cold junction compensation
		0°C	0°C external reference
		45°C	45°C external reference
		50°C	50°C external reference
Linear Input Scaling - *The next 4 parameters only appear if a linear input is chosen*			
inPL			Input value low
inPH			Input value high
VALL			Displayed reading low
VALH			Displayed reading high
ImP	Sensor break input impedance trip level	OFF	Sensor break detection is disabled *Appears for mV or V inputs only*
		Auto	Trip level set by the sensor input table
		Hi	Trip level set at 7.5KΩ
		HiHi	Trip level set at 15KΩ (reqd. for i/p code 8)

CAL	User calbration config.		See Chapter 6 - User calibration
AdJ	User cal enable	no	User calibration is disabled
		YES	User calibration is enabled
Pnt.L	User calibration point low	0	This is the value (in display units) at which a User last performed a low point calibration
Pnt.H	User calibration point high	100	This is the value (in display units) at which a User last performed a high point calibration
OFS.L	Low point calibration offset	0	Offset, in display units, at the user low calibration point 'Pnt.L'. This value is automatically calculated when performing low point calibration.
OFS.H	High point calibration offset	0	Offset, in display units, at the user high calibration point 'Pnt.H'. This value is automatically calculated when performing a high point calibration.

*If User calibration is enabled, then the User calibration parameters will appear in the Input list of Operator Full access level. See Chapter 6, *User calibration.*

Name	Parameter description	Values

AL	Alarm configuration	Values	Defaults if not specified
AL1	Alarm 1 Type	As table A	OFF
Ltch	Alarm 1 Latching	no / YES	no
bLoc	Alarm 1 Blocking(1)	no / YES	no
AL2	Alarm 2 Type	As table A	OFF
Ltch	Alarm 2 Latching	no / YES	no
bLoc	Alarm 2 Blocking(1)	no / YES	no
AL3	Alarm 3 Type	As table A	OFF
Ltch	Alarm 3 Latching	no / YES	no
bLoc	Alarm 3 Blocking(1)	no / YES	no
AL4	Alarm 4 Type	As table A	OFF
Ltch	Alarm 4 Latching	no / YES	no
bLoc	Alarm 4 Blocking(1)	no / YES	no
Table A: Alarm types			
OFF	No alarm		
FSL	Full scale low		
FSH	Full scale high		
dEv	Deviation band		
dHi	Deviation high		
dLo	Deviation low		

(1) Blocking allows the alarm to become active only after it has first entered a safe state.

NOTE

These are 'soft' alarms ie. Indication only. They would normally be attached to an output. See Chapter 7 for a step by step guide.

LA	Logic input 1 configuration	Functions	Action on contact closure
id	Identity of input	LoG.i	Logic input
Func	Function	nonE	None
		mAn	Manual mode select
		rmt	Remote setpoint select
		SP.2	Setpoint 2 select
		ti H	Integral hold
		Ac.AL	Acknowledge alarms
		StbY	Standby - ALL outputs = OFF
		AmPS	PDSIO load current input

Lb	Logic input 2 configuration	Functions	Action on contact closure
As per Logic input 1 except 'AmPS' not available			

Name	Parameter description	Functions	Meaning

AA	Output 3 configuration	Functions	Meaning
id	Identity of output	rELY	Relay
Func	Function	nonE diG HEAt COOL	None Function set by diG.F Heating output Cooling output
For function = diG go to table B on the next page			
SEnS	Sense of output (always appears)	nor inv	Normal *(heating & cooling outputs*) Inverted *(alarms de-energised in the alarm state*)

HA	Comms module config	Functions	Meaning
id	Identity of the option installed	PDS.i cmS	PDSIO setpoint input EIA 485 comms module
Func	Function		
The following parameters will appear if the EIA-485 option is installed			
		mod nonE	Modbus protocol None
The following parameters will appear if the PDSIO setpoint input option is installed.			
		NonE SP.iP	No PDSIO function PDSIO setpoint input
VAL.L	PDSIO displayed value low	Range = -999 to 9999	
VAL.H	PDSIO displayed value high	Range = -999 to 9999	
The following parameters will appear if the function chosen is Modbus protocol.			
BAud	Baud Rate	1200, 2400, 4800, 9600, 19.20 1920 (19200)	
Prty	Comms Parity	nonE EvEn Odd	No parity Even parity Odd parity
rESn	Comms Resolution	FuLL Int	Full resolution Integer resolution

Name	Parameter description	Function	Meaning
1A	Output 1 configuration	Function	Meaning
id	Identity of module installed	nonE	No module fitted
		rELY	Relay output
		dC.OP	DC output (isolated)
		LoG	Logic or PDSIO output
		SSr	Triac output
Func	Function	nonE	
		dIG	Function set by diG.F
		HEAt	Heating output
		COOL	Cooling output
	Only appear for id = LoG	SSr.1	PDSIO mode 1 heating
		SSr.2	PDSIO mode 2 heating
For function = diG go to table B below			
SEnS	Sense of output	nor	Normal *(e.g.heating and cooling*)
		inv	Inverted *(alarms - de-energise in alarm)*
DC output scaling For id = dC.OP the following parameters appear			
Out.L	DC output minimum		0mA to 'Out.H'
Out.H	DC output maximum		'Out.L' to 20mA

Table B The following parameters appear if 'dIG' is chosen as the function.

diG.F	Digital output functions Any number of the functions listed can be combined on to the output. Use the ▲ and ▼ buttons to select a desired digital function. After two seconds the display will blink and return to the 'no.CH' display. Use the arrows again to scroll through the function list. The previously selected function display will show two decimal points indicating that it has been added to the output.	no.CH	No change
		CLr	Clear all existing functions
		1 - - -	Alarm 1*
		2 - - -	Alarm 2*
		3 - - -	Alarm 3*
		4 - - -	Alarm 4*
		Sbr	Sensor break
		Lbr	Loop break
		LdF	PDSIO Load failure
		mAn	Manual mode
		SPAn	PV out of range
		rmtF	Remote setpoint failure
		HtrF	PDSIO Heater failure
		SSrF	PDSIO Solid state relay failure
		LdoP	PDSIO Load open (Amps<1)

*In place of the dashes, the last three characters indicate the alarm type as per table A in the AL list: eg 1FSL = Full Scale Low

If an alarm is not configured the displayed name will differ: e.g. 'AL 1' will be shown, for the first alarm

Name	Parameter description	Function	Meaning

2A	Output 2 configuration	Function	Meaning
id	Identity of module installed	nonE	No module fitted
		rELY	Relay output
		LoG	Logic output
		SSr	Triac output
Func	Function	nonE	none
		diG	Function set by diG.F
		HEAt	Heating output
		COOL	Cooling output
For Func = diG go to table B below			
SEnS	Sense of output	nor	Normal *(heat and cool outputs*)
		inv	Inverted *(alarms - de-energise in alarm)*

Table B	The following parameters appear if 'diG' is chosen as the function		
diG.F	Digital output functions Any number of the functions listed can be combined onto the output. Use the ▲ and ▼ buttons to select a desired digital function. After two seconds the display will blink and return to the 'no.CH' display. Use the arrows again to scroll through the function list. The previously selected function display will show two decimal points indicating that it has been added to the o/p	no.CH	No change
		CLr	Clear all existing functions
		1 - - -	Alarm 1*
		2 - - -	Alarm 2*
		3 - - -	Alarm 3*
		4 - - -	Alarm 4*
		Sbr	Sensor break
		Lbr	Loop break
		LdF	PDSIO Load failure
		mAN	Manual mode
		SPAn	PV out of range
		rmtF	Remote setpoint failure
		HtrF	PDSIO Heater failure
		SSrF	PDSIO Solid state relay failure
		LdoP	PDSIO Load open (Amps<1)

*In place of the dashes, the last three characters indicate the alarm type: eg 1FSL
If alarm not configured displayed name will differ: e.g. 'AL1 will be shown, for 1st alarm

3A	Output 4 configuration	As per output 3 configuration

4A	10Amp heating output	Available on 2204 only.
As per Output 3 'AA' relay configuration		

PASS	Password list
ACC.P	FuLL or Edit level password (default = 1)
cnF.P	Configuration level Password (default = 2)

Exit	Exit Configuration	no YES

Chapter 6 USER CALIBRATION

This chapter has five topics:

- WHAT IS THE PURPOSE OF USER CALIBRATION?
- USER CALIBRATION ENABLE
- SINGLE POINT CALIBRATION
- TWO POINT CALIBRATION
- CALIBRATION POINTS AND CALIBRATION OFFSETS

To understand how to select and change parameters in this chapter you will need to have read Chapter 1 - *Operation*, Chapter 3- *Access Levels* and Chapter 5 - *Configuration.*

WHAT IS THE PURPOSE OF USER CALIBRATION?

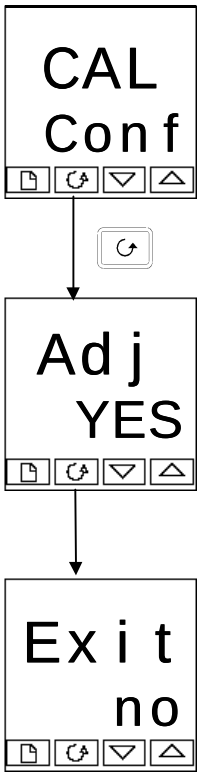
The basic calibration of the controller is highly stable and set for life. User calibration allows you to offset the 'permanent' factory calibration to either:

1. Calibrate the controller to 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 zero and span offsets onto the factory set calibration. The factory set calibration can always be retrieved.

USER CALIBRATION ENABLE

The User calibration facility must first be enabled in configuration level by setting the parameter 'AdJ' in the CAL conf list to 'YES' This will make the User calibration parameters appear in Operator 'FuLL' level.
Select configuration level as shown in Chapter 5, Configuration



The User calibration configuration List

Press [page] until you reach the 'CAL conf list

Press the Scroll button until you reach

User calibration enable

Use [▲] or [▼] to select:

- YES: Calibration enable
- no: Calibration disabled

Press [scroll] and [page] together to go to the Exit display

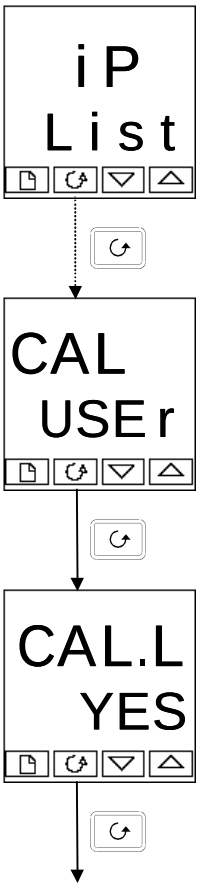
Exit configuration

Use [▲] or [▼] to select 'YES' and return to Operator level.

SINGLE POINT CALIBRATION

Your controller is calibrated for life against known reference sources during manufacture. A calibration offset is often used to allow the controller to compensate for sensor and other system errors. The normal procedure is to set up the system under test against a known independent reference, as follows:
Set up the process to be calibrated such that the known reference displays the required value (temperature).
Observe the reading on the controller. If it is different, proceed as follows:

Select 'FuLL' Access level as described in Chapter 3



Input list header

Press [D] until you reach the input list header.

Press Scroll until you reach the 'CAL' display

Calibration type

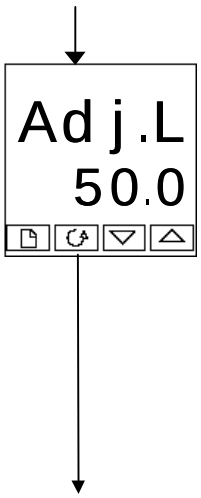
Use [▲] or [▼] to select either 'FACt' or 'USEr'.
Selecting 'FACt' will reinstate the factory calibration and hide the following User calibration parameters.
Selecting 'USEr' will reinstate any previously set User calibration and make available the User parameters, as follows:

Press the Scroll button

Calibrate low point?

Use [▲] or [▼] to select 'YES'
Selecting 'no' will hide the next parameter

Press the Scroll button
continued on the next page



Adjust the low point calibration

The controller will display the current measured input value in the lower readout.

Use ▲ or ▼ to adjust the reading to the reference source value, if different.
After a two-second delay the display will blink and the reading will change to the new, calibrated value.
You can calibrate at any point over the entire display range
This is a single point calibration, which applies a fixed offset over the full display range of the controller.
The calibration is now complete. You can return to the factory calibration at any time by selecting 'FACt' in the CAL display shown earlier.

Press ↺ and ☐ together to return to the Home display

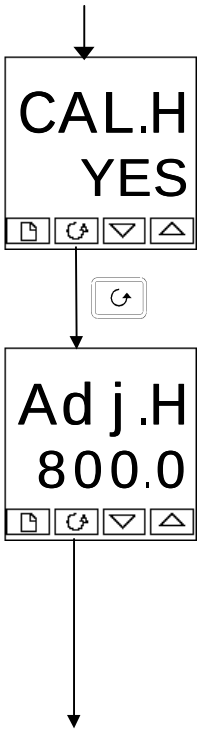
To protect the calibration against unauthorised adjustment return to Operator level and make sure that the calibration parameters are hidden. Parameters are hidden using the 'Edit' facility described in Chapter 3.

TWO POINT CALIBRATION

The previous section described how to perform a single point calibration, which applies a fixed offset over the full display range of the controller. A two-point calibration is used to calibrate the controller at two points and apply 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.

Proceed as follows:

1. Decide upon the low and high points at which you wish to calibrate.
2. Perform a single point calibration at the low calibration point in the manner described above
3. Set the process under calibration such that the known reference displays the required higher Process Value (temperature) and allow to stabilize.
4. Press the Scroll button to obtain the high calibration point as shown in the following diagrams.



Calibrate high point?

Use ▲ or ▼ to select 'YES'
(Selecting 'no' will hide the next parameter)

Press the Scroll button

Adjust the high point calibration

The controller will display the current measured input value in the lower readout.

Use ▲ or ▼ to adjust the reading to the reference source value, if different.
After a two-second delay the display will blink and the reading will change to the new, calibrated value.
The calibration is now complete. You can return to the factory calibration at any time by selecting 'FACt' in the CAL display shown earlier.

Press ↺ and 🗋 together to return to the Home display

To protect the calibration against unauthorised adjustment, return to Operator level and make sure that the calibration parameters are hidden. Parameters are hidden using the 'Edit' facility described in Chapter 3.

CALIBRATION POINTS AND CALIBRATION OFFSETS

If you wish to see the points at which the User calibration was performed and the value of the offsets introduced these are shown in Configuration, under CAL ConF. The parameters are:

Name	Parameter description	Meaning
Pnt.L	User low calibration point	This is the value (in display units) at which a User last performed an 'AdJ.L' (adjust low calibration).
Pnt.H	User high calibration point	This is the value (in display units) at which a User last performed an 'AdJ.H' (adjust high calibration).
OFS.L	Low point calibration offset	Offset, in display units, at the user low calibration point 'Pnt.L'
OFS.H	High point calibration offset	Offset, in display units, at the user high calibration point 'Pnt.H'.

Chapter 7 ALARM CONFIGURATION

The 2200 series controllers are capable of very sophisticated alarm strategies and, although setting up of alarms has already been covered in previous chapters, this section has been included to enable operators and commissioning engineers to design their own strategies for optimum plant operation.

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. Events are referred to as **Digital Output Functions** in the manual see pages 5-11 and 5-12.

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

TYPES OF ALARMS

The use of alarms in your controller is extremely versatile.
Up to 4 alarms can be configured and they are found under the Alarm List in Full Access Mode. Any combination of these 4 alarms can be attached to any one or more outputs. NOTE: in a three-term controller at least one of these outputs is used to maintain the required temperature of the process.
OR any number of the available “soft” alarms can be combined to operate a single output

Outputs 1 and 2	Are plug in modules. Conventionally used for control outputs, e.g. Heat and Cool, but can be used for alarms.
Output 3	Is a fixed relay. Conventionally used for alarms or events, but can be used as a control output.

There are five process alarm types listed below. Alarm Types are found in configuration mode under the Alarm Config. List.

ALARMS

Full Scale High	The PV exceeds a set high level
Full Scale Low	The PV exceeds a set low level
Deviation Band	The difference between PV & SP is outside a set band
Deviation High	The difference between PV & SP is higher than a set level
Deviation Low	The difference between PV & SP is lower than a set level

Each **alarm** can be set to:

Latching	Alarm is indicated until acknowledged
Blocking	Alarm occurs **after** it has been through a start up phase
Sense Of Output	Relay energised or de-energised in alarm condition

In addition there are nine “digital output functions” used as events or alarms depending upon the requirements of the process under control:

DIGITAL OUTPUT FUNCTIONS

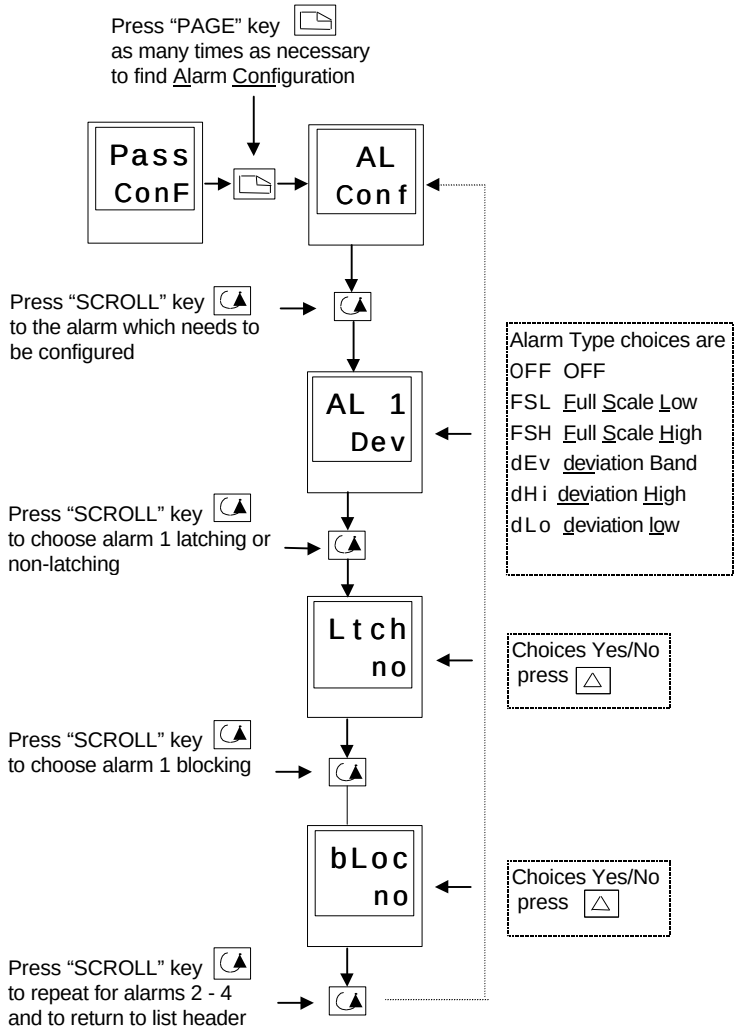
Sensor Break	The input is open circuit
Loop Break	The controller does not measure a response to an output change
Load Failure	Used with PDSIO partial load failure
Manual	Controller in manual mode
PV Out Of Range	Process Variable too high or too low
Remote SP Fail	No signal measured at the remote set point input terminals

Heater Fail	Used with PDSIO heater open circuit
Solid State Relay Fail	Used with PDSIO solid state relay open or short circuit
Load Open	Used with PDSIO no connection at the control output

The **Sense of the Output** can be set to relay energised or de-energised in the alarm condition for any of the above functions.

STEP1 - CONFIGURING THE FOUR 'SOFT' ALARMS

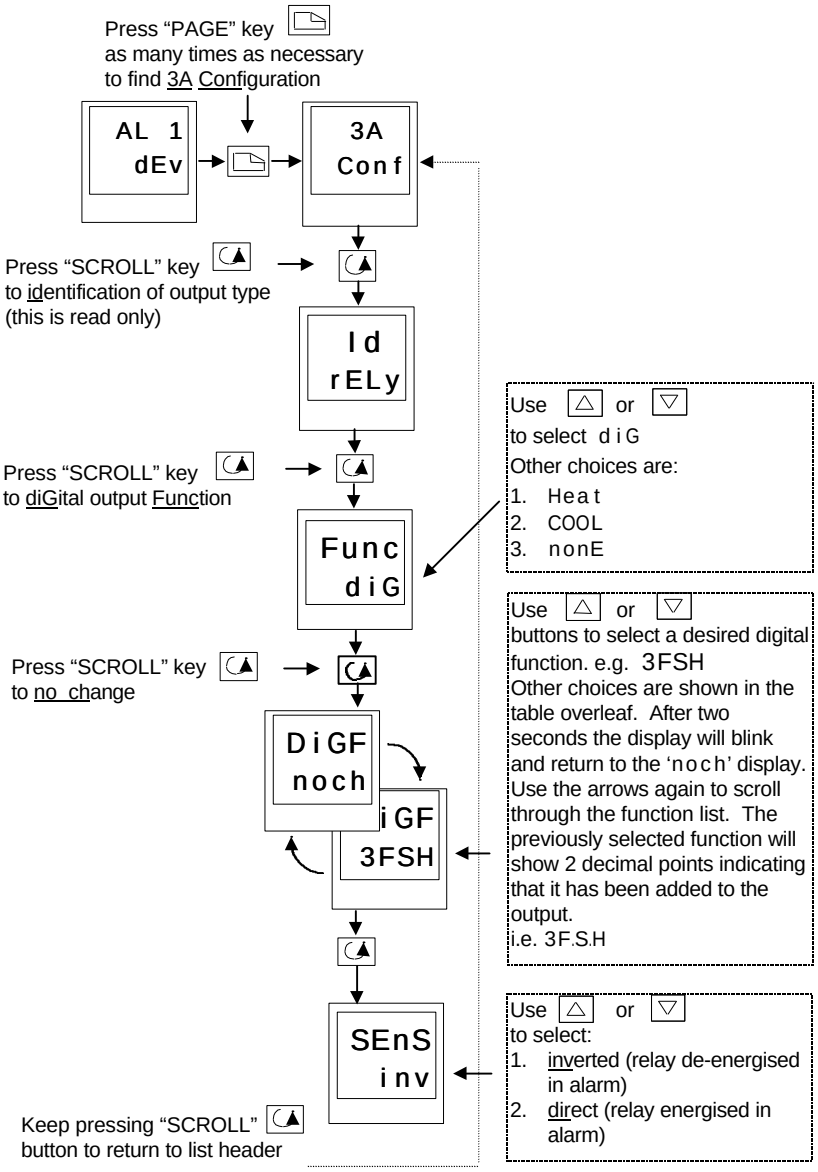
Go To Configuration Level
Refer to Chapter 5



STEP 2 - ATTACHING AN ALARM TO A PHYSICAL OUTPUT

This may be necessary if:

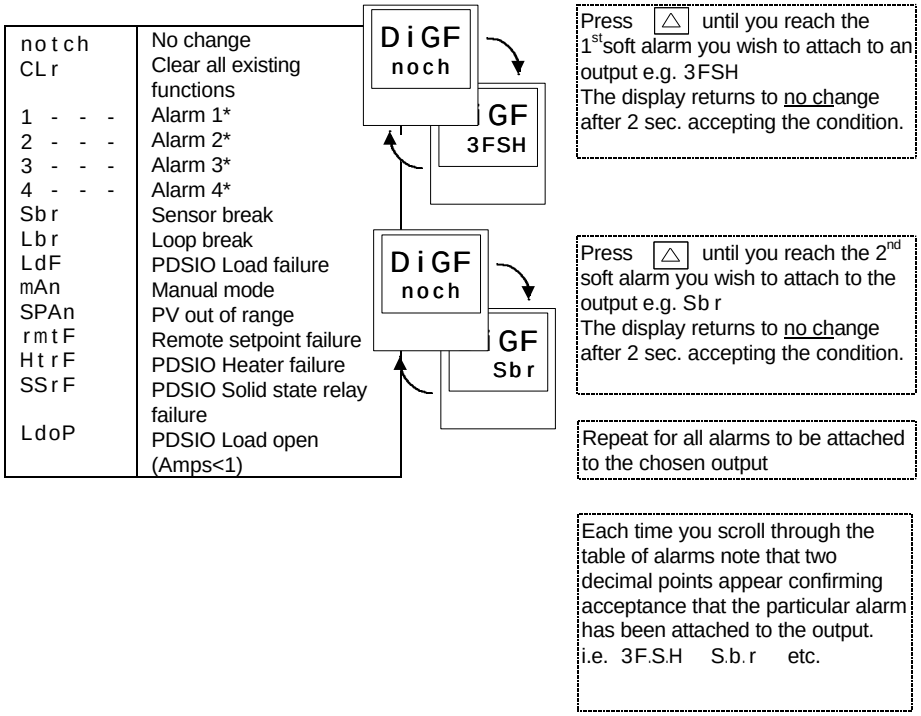
1. The instrument has been supplied un-configured or it is required to re-configure
2. Alarm relays are added



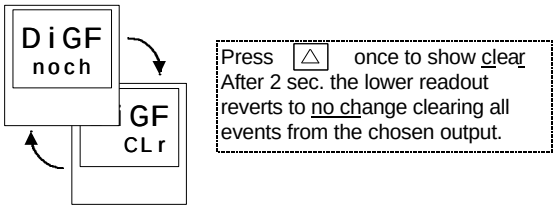
STEP 3 - GROUPING ALARMS ON A SINGLE OUTPUT

In the previous example one alarm condition is allocated to one output relay.

The 2200 controller allows alarms and events to be grouped on to a single output. These events are shown in the table below.



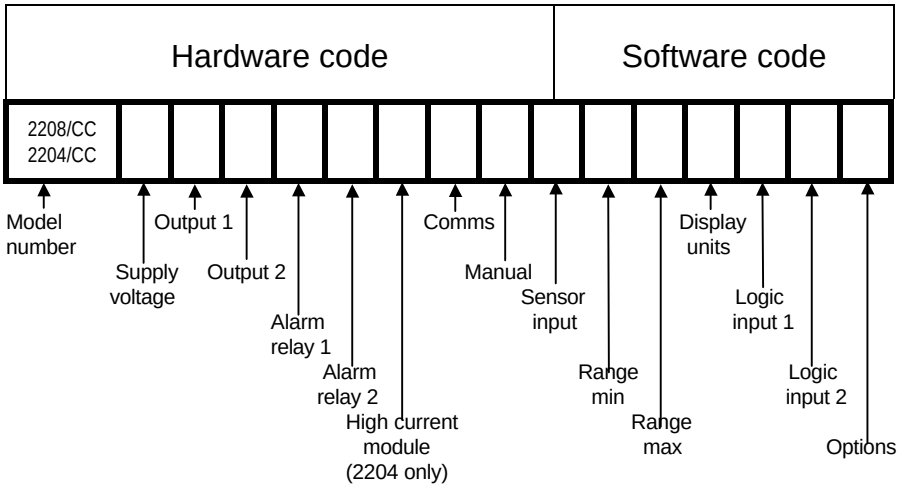
STEP 4 - REMOVING ALARMS FROM AN OUTPUT

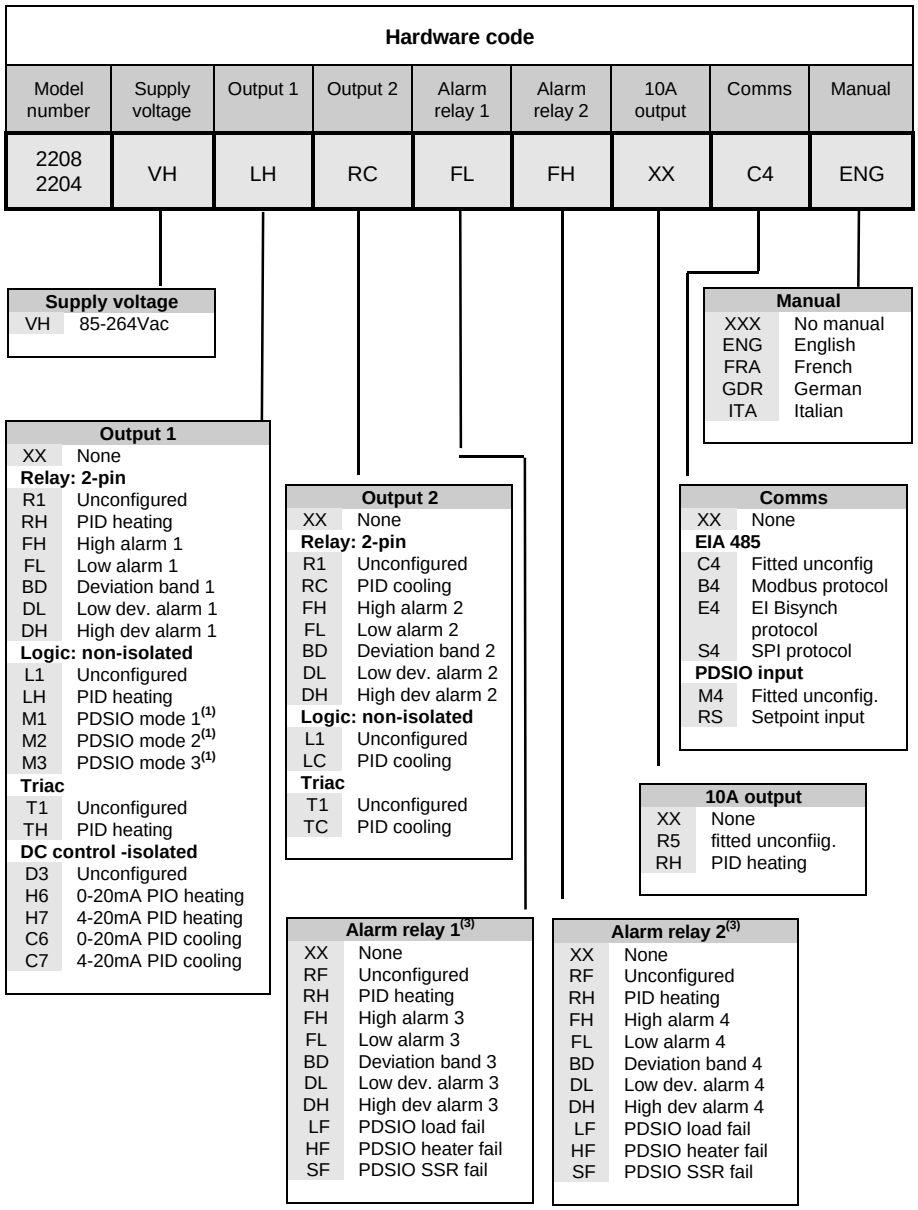


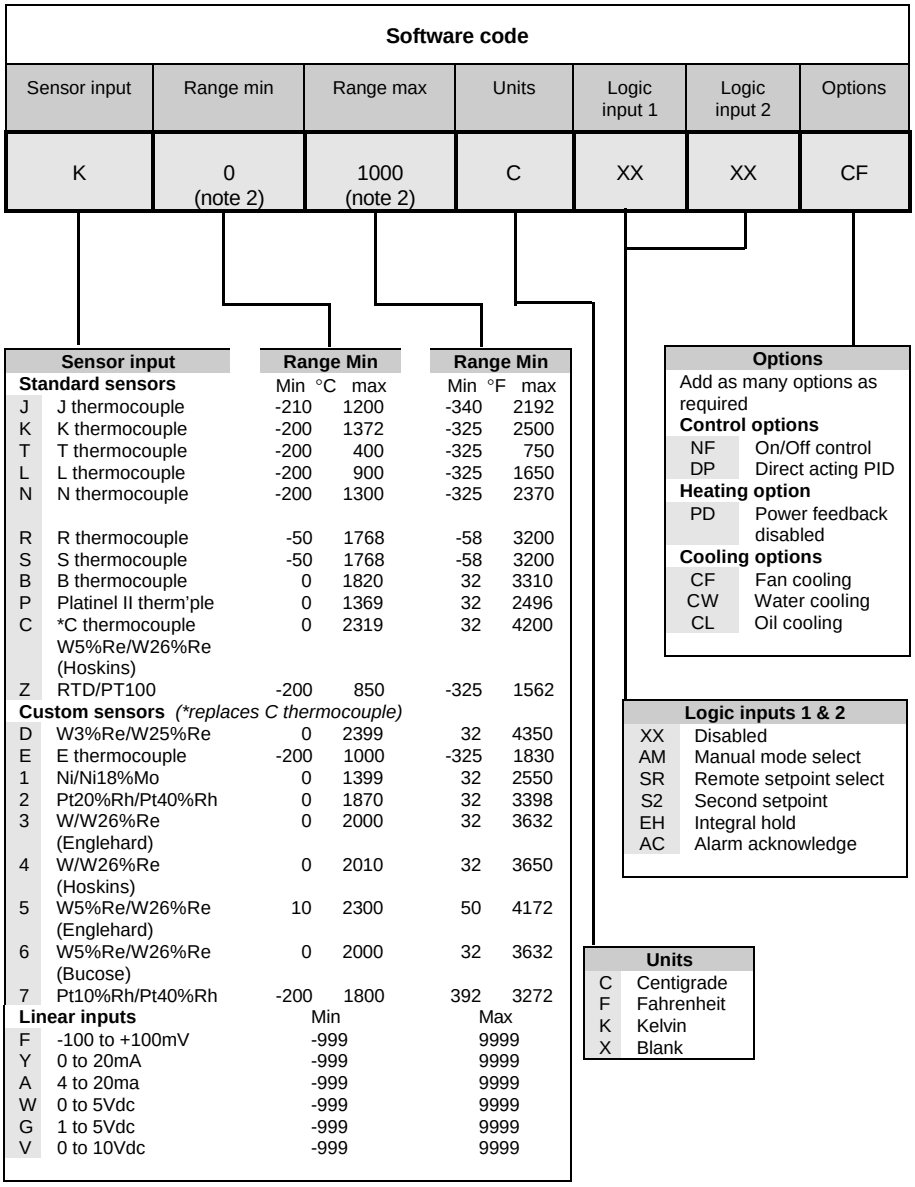
Appendix A
UNDERSTANDING THE ORDERING CODE

The 2208 and 2204 controllers have a modular hardware construction with the option of two control outputs, two alarm relays and one communications port. Two logic inputs are provided as standard. In addition the Model 2204 has an optional plug-in 10A heating output.

The ordering code is in two parts: the hardware code followed by the software code. The hardware code specifies the hardware build of the controller, and the software code specifies the software configuration. The software code is optional. If omitted, the controller will be configured as type K thermocouple input, with a range of 0 to 1000°C. The controller is fully configurable on site.




Hardware code
Model number
Supply voltage
Output 1
Output 2
Alarm relay 1
Alarm relay 2
10A output
Comms
Manual
2208 2204
VH
LH
RC
FL
FH
XX
C4
ENG
Supply voltage
VH 85-264Vac
Output 1
XX None
Relay: 2-pin
R1 Unconfigured
RH PID heating
FH High alarm 1
FL Low alarm 1
BD Deviation band 1
DL Low dev. alarm 1
DH High dev alarm 1
Logic: non-isolated
L1 Unconfigured
LH PID heating
M1 PDSIO mode 1(1)
M2 PDSIO mode 2(1)
M3 PDSIO mode 3(1)
Triac
T1 Unconfigured
TH PID heating
DC control -isolated
D3 Unconfigured
H6 0-20mA PIO heating
H7 4-20mA PID heating
C6 0-20mA PID cooling
C7 4-20mA PID cooling
Output 2
XX None
Relay: 2-pin
R1 Unconfigured
RC PID cooling
FH High alarm 2
FL Low alarm 2
BD Deviation band 2
DL Low dev. alarm 2
DH High dev alarm 2
Logic: non-isolated
L1 Unconfigured
LC PID cooling
Triac
T1 Unconfigured
TC PID cooling
Alarm relay 1(3)
XX None
RF Unconfigured
RH PID heating
FH High alarm 3
FL Low alarm 3
BD Deviation band 3
DL Low dev. alarm 3
DH High dev alarm 3
LF PDSIO load fail
HF PDSIO heater fail
SF PDSIO SSR fail
Alarm relay 2(3)
XX None
RF Unconfigured
RH PID heating
FH High alarm 4
FL Low alarm 4
BD Deviation band 4
DL Low dev. alarm 4
DH High dev alarm 4
LF PDSIO load fail
HF PDSIO heater fail
SF PDSIO SSR fail
10A output
XX None
R5 fitted unconfiig.
RH PID heating
Comms
XX None
EIA 485
C4 Fitted unconfig
B4 Modbus protocol
E4 EI Bisynch protocol
S4 SPI protocol
PDSIO input
M4 Fitted unconfig.
RS Setpoint input
Manual
XXX No manual
ENG English
FRA French
GDR German
ITA Italian



Software code						
Sensor input	Range min	Range max	Units	Logic input 1	Logic input 2	Options
K	0 (note 2)	1000 (note 2)	C	XX	XX	CF

Sensor input		Range Min °C min	max	Range Min °F min	max
Standard sensors					
J	J thermocouple	-210	1200	-340	2192
K	K thermocouple	-200	1372	-325	2500
T	T thermocouple	-200	400	-325	750
L	L thermocouple	-200	900	-325	1650
N	N thermocouple	-200	1300	-325	2370
R	R thermocouple	-50	1768	-58	3200
S	S thermocouple	-50	1768	-58	3200
B	B thermocouple	0	1820	32	3310
P	Platinel II therm'ple	0	1369	32	2496
C	*C thermocouple W5%Re/W26%Re (Hoskins)	0	2319	32	4200
Z	RTD/PT100	-200	850	-325	1562
Custom sensors *(*replaces C thermocouple)*					
D	W3%Re/W25%Re	0	2399	32	4350
E	E thermocouple	-200	1000	-325	1830
1	Ni/Ni18%Mo	0	1399	32	2550
2	Pt20%Rh/Pt40%Rh	0	1870	32	3398
3	W/W26%Re (Englehard)	0	2000	32	3632
4	W/W26%Re (Hoskins)	0	2010	32	3650
5	W5%Re/W26%Re (Englehard)	10	2300	50	4172
6	W5%Re/W26%Re (Bucose)	0	2000	32	3632
7	Pt10%Rh/Pt40%Rh	-200	1800	392	3272
Linear inputs		Min		Max	
F	-100 to +100mV	-999		9999	
Y	0 to 20mA	-999		9999	
A	4 to 20ma	-999		9999	
W	0 to 5Vdc	-999		9999	
G	1 to 5Vdc	-999		9999	
V	0 to 10Vdc	-999		9999	

Options	
Add as many options as required	
Control options	
NF	On/Off control
DP	Direct acting PID
Heating option	
PD	Power feedback disabled
Cooling options	
CF	Fan cooling
CW	Water cooling
CL	Oil cooling

Logic inputs 1 & 2	
XX	Disabled
AM	Manual mode select
SR	Remote setpoint select
S2	Second setpoint
EH	Integral hold
AC	Alarm acknowledge

Units	
C	Centigrade
F	Fahrenheit
K	Kelvin
X	Blank

Notes:

1. **PDSIO** is a proprietary technique developed by Eurotherm for bi-directional communication over a single pair of wires. There are several operating modes.

In **mode 1** a logic output delivers a power demand signal to a TE10 solid state (SSR) relay and the SSR responds with a single load circuit failure message.

In **mode 2** a logic output delivers a power demand signal to an SSR and the SSR responds with the ON state rms load current, and two fault messages - SSR failure or heater circuit failure.

2. ***Range min* and *Range max*:** Enter a numeric value, with a decimal point if required. Thermocouple and RTD sensor inputs will always display over the full operating range shown in the sensor-input table. The values entered here will act as low and high setpoint limits. For linear inputs, the values entered are used to scale the input signal.

Appendix B

SAFETY and EMC INFORMATION

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 safety or EMC. The installer must ensure the safety and EMC of any particular installation.

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.

Electromagnetic compatibility

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

GENERAL

The information contained in this manual is subject to change without notice. While every effort has been made to ensure the accuracy of the information, Eurotherm Controls shall not be held liable for errors contained herein.

Unpacking and storage

The packaging should contain an instrument mounted in its sleeve, two mounting brackets for panel installation and this operating book. Certain ranges are supplied with an input adapter.
If on receipt, the packaging or the instrument is damaged, do not install the product but contact your nearest Eurotherm Controls agent.
If the instrument is to be stored before use, protect from humidity and dust in an ambient temperature range of -30°C to +75°C.

SERVICE AND REPAIR

This controller has no user serviceable parts. Contact your nearest Eurotherm Controls agent 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. It may be convenient to partially withdraw the instrument from the sleeve, then pause before completing the removal. In any case, avoid touching the exposed electronics of an instrument when withdrawing it from the sleeve. Failure to observe these precautions may cause damage to components of the instrument or some discomfort to the user.

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.

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.

INSTALLATION SAFETY REQUIREMENTS

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.

Personnel

Installation must only be carried out by qualified personnel.

Enclosure of live parts

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

Caution: Live sensors

The logic and PDSIO outputs are electrically connected to the main PV input, (thermocouple etc.). If the temperature sensor is connected directly to an electrical heating element then these non-isolated inputs and outputs will also be live. The controller is designed to operate under these conditions. However you must ensure that this will not damage other equipment connected to these inputs and outputs and that service personnel do not touch connections to these i/o while they are live. With a live sensor, all cables connectors and switches for connecting the sensor and non-isolated inputs and outputs must be mains rated. The dc output has a 42V functional insulation to PV.

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). 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.

Power Isolation

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

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.

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.

Voltage rating

The maximum continuous voltage applied between any connection to ground must not exceed 264Vac.

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.

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, install 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.

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 be grounded. Do not rely on grounding through the framework of the machine.

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.

INSTALLATION REQUIREMENTS FOR EMC

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

- For general guidance refer to Eurotherm Controls EMC Installation Guide, HA025464.
- When using relay or triac outputs it may be necessary to fit a filter suitable for suppressing the conducted 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 tabletop equipment, 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.

Routing of wires

To minimise the pick-up of electrical noise, the low voltage DC connections and the sensor input wiring 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. In general keep cable lengths to a minimum.

TECHNICAL SPECIFICATION

Environmental ratings

Panel sealing:	Instruments are intended to be panel mounted. The rating of panel sealing is IP65, (EN 60529), or 4X, (NEMA 250).
Operating temperature:	0 to 55°C. Ensure the enclosure provides adequate ventilation.
Relative humidity:	5 to 95%, non-condensing.
Atmosphere:	Not suitable for use above 2000m or in explosive or corrosive atmospheres.

Equipment ratings

Supply voltage / frequency:	100 to 240Vac -15%, +10% / 48 to 62Hz.
Power consumption:	10Watts maximum.
Relay (isolated):	Maximum: 264Vac, 2A resistive. Minimum: 12Vdc, 100mA.
Triac output (isolated):	30 to 264Vac. Maximum current: 1A resistive.
High current switch (2204):	30 to 264Vac. Maximum current: 10A resistive. (isolated)
Leakage current:	External 'snubber' components are supplied to suppress voltage spikes on triac and relay contact outputs. The leakage current through these components is less than 2mA at 264Vac, 50Hz.
Over current protection:	Use a minimum of $0.5mm^2$ or 16awg wire for plant connections. External over current protection devices is required. Use independent fuses for the instrument supply and each relay or triac output. Suitable fuses are time-lag, (EN60127, type T) with ratings as follows; Instrument supply and relay outputs: 2A; Triac outputs: 1A, High current switch: 10A.
Low level i/o:	Input and output connections other than triac and relay are intended for low level signals less than 42V.
Logic output (non-isolated):	18V at 24mA.
DC output (isolated *):	0 to 20mA (600Ω max), 0 to 10V (500Ω min). (* see isolation)
PDSIO input (isolated):	Setpoint input from and holdback to a master PDSIO controller.
Digital communications:	EIA-232 or, 2-wire EIA-485, (both isolated).

Electrical safety

Safety Standard:	Meets EN 61010, Installation category II, pollution degree 2. Voltage transients on any mains power connected to the instrument must not exceed 2.5kV. Electrically conductive pollution must be excluded from the cabinet in which the instrument is mounted.
Isolation:	All inputs and outputs have reinforced insulation to provide protection against electric shock. The logic and PDSIO outputs are electrically connected to the main PV input, (thermocouple etc.). The dc output has a 42V functional insulation to PV.