3116
3200

TEMPERATURE CONTROLLERS

invensys
EUROTHERM

ENG **Engineering handbook**

3116 and 3200 Series PID Temperature Controllers

Engineering Handbook Part Number HA08651 Issue 2.0 Dec-04

Includes 3116, 3216, 3208 and 3204 Controllers.

Issue 2 of this handbook applies to software version 2 and includes Valve Position Control output.

Contents

1. Installation and Basic Operation

1.1 What Instrument Do I Have?

Thank you for choosing this 3200 series Temperature Controller/Programmer.

The 3200 series provide precise temperature control of industrial processes and is available in three standard DIN sizes:-

- 1/16 DIN Model Number 3216
- 1/8 DIN Model Number 3208
- 1/4 DIN Model Number 3204

A universal input accepts various thermocouples, RTDs or process inputs. Up to three (3216) or four (3208 and 3204) outputs can be configured for control, alarm or re-transmission purposes. Digital communications and a current transformer input are available as options.

The controller may have been ordered to a hardware code only or pre-configured using an optional 'Quick Start' code. The label fitted to the side of the sleeve shows the ordering code that the controller was supplied to. The last two sets of five digits show the Quick Code. If the Quick Code shows *****/***** the controller will need to be configured when it is first switched on.

This Manual takes you through all aspects of installation, wiring, configuration and use of the controller.

1.2 Unpacking Your Controller

The controller is supplied with:-

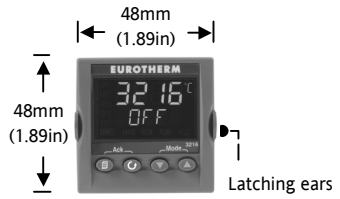
- Sleeve (with the controller fitted in the sleeve)
- Two panel retaining clips and IP65 sealing gasket mounted on the sleeve
- Component packet containing a snubber for each relay output (see section 2.9) and a 2.49Ω resistor for current inputs (see section 2.5)
- User Guide

1.3 Dimensions

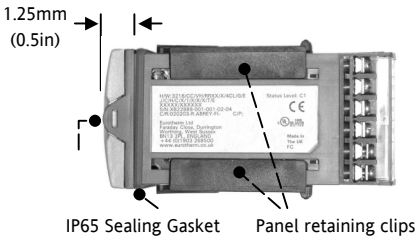
General views of the controllers are shown below together with overall dimensions.

3216 and 3116

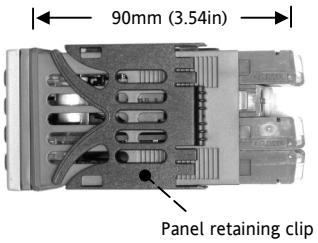
Front View



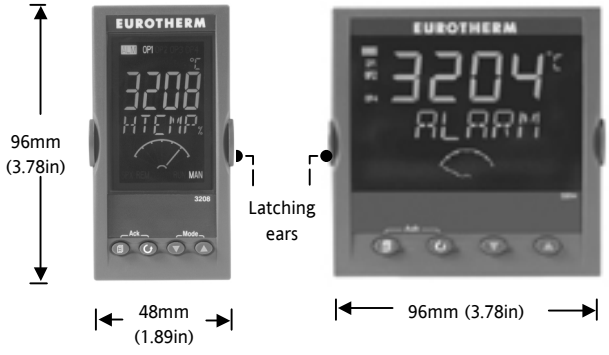
Side View



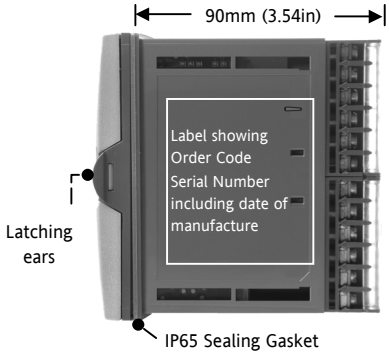
Top View



3208 and 3204 Front Views



Side View



1.4 Step 1: Installation

This instrument is intended for permanent installation, for indoor use only, and enclosed in an electrical panel

Select a location which is subject to minimum vibrations the ambient temperature is within 0 and 55°C (32 - 131°F) and humidity 5 to 95% RH non condensing.

The instrument can be mounted on a panel up to 15mm thick.

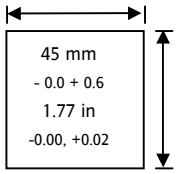
To ensure IP65 and NEMA 4 front protection, mount on a non-textured surface.

Please read the safety information in section 2.16 before proceeding. The EMC Booklet part number HA025464 gives further installation information.

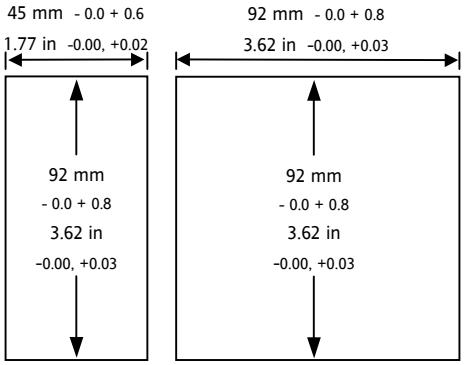
1.4.1 Panel Mounting the Controller

1. Prepare a cut-out in the mounting panel to the size shown. If a number of controllers are to be mounted in the same panel observe the minimum spacing shown.
2. Fit the IP65 sealing gasket behind the front bezel of the controller
3. Insert the controller through the cut-out
4. Spring the panel retaining clips into place. Secure the controller in position by holding it level and pushing both retaining clips forward.
5. Peel off the protective cover from the display.

1.4.2 Panel Cut Out Sizes



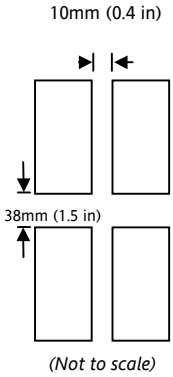
Model 3216



Model 3208 **Model 3204**

1.4.3 Recommended minimum spacing of controllers

Applies to all models.



(Not to scale)

1.4.4 To Remove the Controller from its Sleeve

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

1.5 Order Code

1	2	3	4	5	6	7	8	9	10	11	12	13	14
3116 3216 3208 3204													

1. Model	
1/16 DIN Size	3116
1/16 DIN Size	3216
1/8 DIN Size	3208
1/4 DIN Size	3204

2. Function	
Controller	CC
Programmer (1)	CP
Motorised Valve Controller (1)	VC
Motorised Valve Programmer (1)	VP

3. Power Supply	
20 – 29V	VL (2)
100 –240V	VH

4. Outputs 1, 2 and 3				
3116/3216		3208 and 3204		
OP1	OP2	OP1	OP2	OP3
L	R	L	R	R
R	R	R	R	R
L (3)	L (3)	L (3)	L (3)	R (3)
L (3)	D (3)	L	R	D
D	R	R	R	D
D (3)	D (3)	D (3)	D (3)	D (3)
		D (3)	R (3)	D (3)
L (3)	X (3)	Where: L=Logic (SSR drive), R = Relay, D = DC (1)		
X	X			

5. AA Relay (OP4)	
Disabled	X
Relay (Form C)	R

6. Options	
Not fitted	XXX
RS485 & Digital input A (1)	4XL
RS232 & Digital input A (1)	2XL
RS485, CT & Dig in A (1)	4CL
RS232, CT & Dig in A (1)	2CL
Digital input A (1)	XXL
CT & Digital input A (1)	XCL

7. Fascia colour	
Green	G
Silver	S
Wash down fascia (2)	W

8/9 Product/Manual Language	
English	ENG
French	FRA
German	GER
Italian	ITA
Spanish	SPA

10. Extended Warranty	
Standard	XXXXX
3 year	WL003
5 year	WL005

11. Certificates	
None	XXXXX

12. Custom Label	
FXXXX	

13. Specials Number	
XXXXXX	None
RES250	250Ω resistor for 5V input
RES500	500Ω resistor for 10V input

Quick Start Code
See Section 4

(1) Not available in 3116

(2) Available early 2005

(3) Not available with VL – low voltage supply

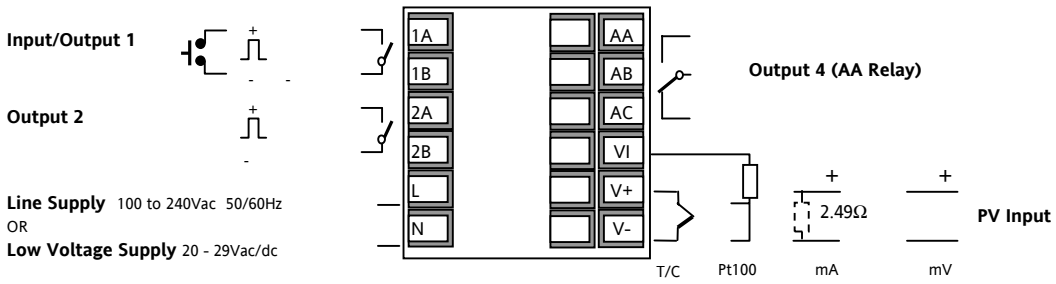
2. Step 2: Wiring

Warning

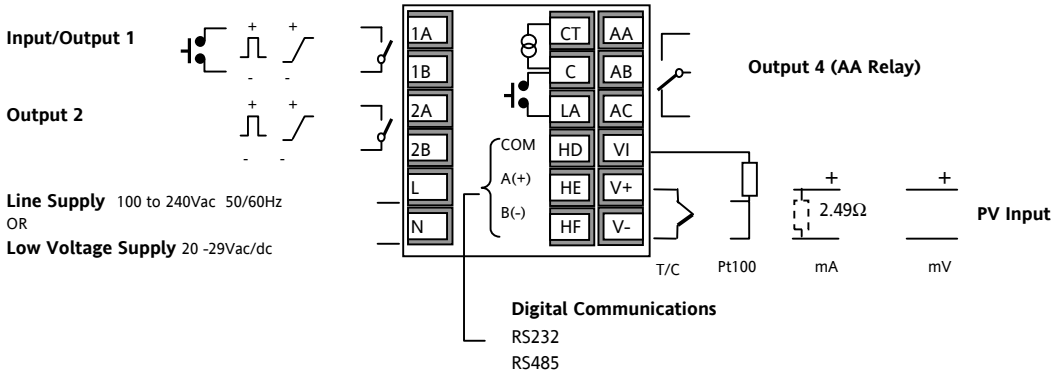
Ensure that you have the correct supply for your controller

Check order code of the controller supplied

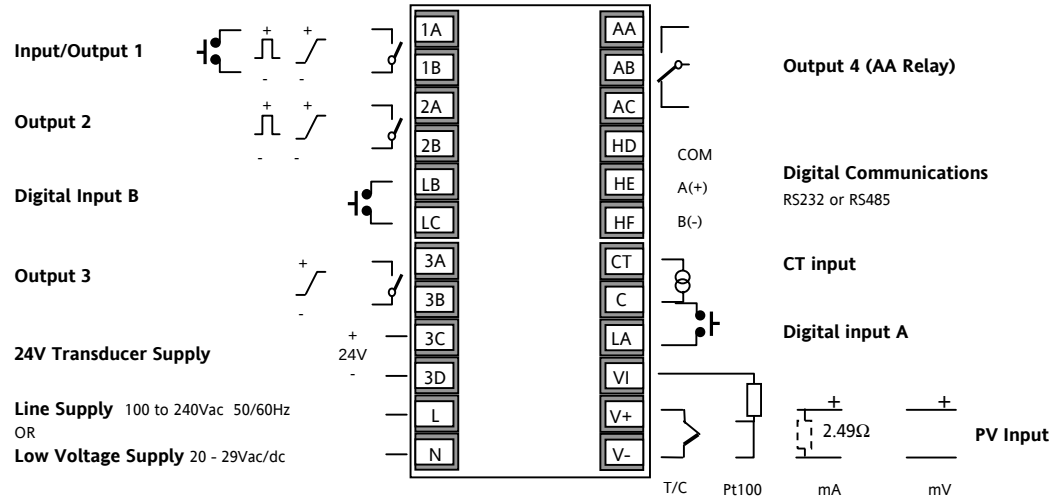
2.1 Terminal Layout 3116 Controller



2.2 Terminal Layout 3216 Controller



2.3 Terminal Layout 3208 and 3204 Controllers



Key to symbols

- Logic (SSR drive) output
- mA analogue output
- Relay

2.4 Wire Sizes

The screw terminals accept wire sizes from 0.5 to 1.5 mm (16 to 22AWG). Hinged covers prevent hands or metal making accidental contact with live wires. The rear terminal screws should be tightened to 0.4Nm (3.5lb in).

2.5 Sensor Input (Measuring Input)

- Do not run input wires together with power cables
- When shielded cable is used, it should be grounded at one point only
- Any external components (such as zener barriers, etc) connected between sensor and input terminals may cause errors in measurement due to excessive and/or un-balanced line resistance or possible leakage currents
- Not isolated from the logic outputs & digital inputs

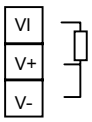
Thermocouple Input

Positive

Negative

- Use the correct compensating cable preferably shielded

RTD Input



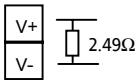
PRT

PRT

Lead compensation

- The resistance of the three wires must be the same. The line resistance may cause errors if it is greater than 22Ω

Linear Input (mA or V)



Positive

Negative

- For a mA input connect the 2.49Ω burden resistor supplied between the V+ and V- terminals as shown
- For a 0-10Vdc input an external input adapter is required (not supplied). Part number: SUB21/IV10

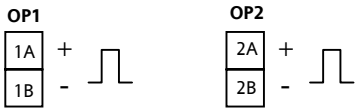
2.6 Input/Output 1 & Output 2

These outputs can be logic (SSR drive), or relay, or mA dc. In addition the logic output 1 can be used as a contact closure input.

Relay Output (Form A, normally open)

- Isolated output 240Vac CAT II
- Contact rating: 2A 264Vac resistive
- Output functions: Heating, or cooling, or alarm or motorised valve open or closed

Logic (SSR drive) Output



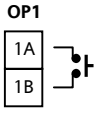
- Not isolated from the sensor input
- Output ON state: 12Vdc at 40mA max
- Output OFF state: <100mV, <100µA
- Output functions: Heating, or cooling, or alarm or motorised valve open or closed
- **The output switching rate must be set to prevent damage to the output device in use. See parameter 1.PLS or 2.PLS in section 4.2.**

DC Output

The DC output is not available in 3116.

- Not isolated from the sensor input
- Software configurable: 0-20mA or 4-20mA.
- Max load resistance: 500Ω
- Calibration accuracy: 1%, ±100µA
- Output functions: Heating, or cooling, or retransmission.

Logic Contact Closure Input (I/O 1 only)



- Not isolated from the sensor input
- Switching: 12Vdc at 40mA max
- Contact open > 500Ω. Contact closed < 200Ω
- Input functions: Please refer to the list in the Quick Start codes.

2.7 Output 3

Output 3 is available only in the models 3208 and 3204. It will be either a relay or a mA output.

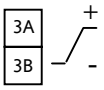
Relay Output (Form A, normally open)

OP3

- Isolated output 240Vac CAT II
- Contact rating: 2A 264Vac resistive
- Output functions: Heating, or cooling, or alarm or motorised valve open or closed

DC Output

OP3



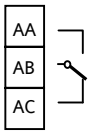
- Isolated output 240Vac CAT II
- Software configurable: 0-20mA or 4-20mA
- Max load resistance: 500Ω
- Calibration accuracy: 0.5%, ±100µA
- Output functions: Heating, or cooling, or retransmission.

2.8 Output 4 (AA Relay)

Output 4 is a relay and optionally available in all models.

Relay Output (Form C)

OP4



- Isolated output 240Vac CAT II
- Contact rating: 2A 264Vac resistive
- Output functions: Heating, or cooling, or alarm or motorised valve open or closed

*** General Note About Relays and Inductive Loads**

High voltage transients may occur when switching inductive loads such as some contactors or solenoid valves. Through the internal contacts, these transients may introduce disturbances which could affect the performance of the instrument.

For this type of load it is recommended that a 'snubber' is connected across the normally open contact of the relay switching the load. The snubber recommended consists of a series connected resistor/capacitor (typically 15nF/100Ω). A snubber will also prolong the life of the relay contacts.

WARNING

When the relay contact is open or it is connected to a high impedance load, the snubber passes a current (typically 0.6mA at 110Vac and 1.2mA at 240Vac). You must ensure that this current will not hold on low power electrical loads. If the load is of this type the snubber should not be connected.

2.9 Digital Inputs A & B

Digital input A is an optional input in all 3200 series controllers. It is not available in 3116. Digital input B is always fitted in models 3208 and 3204, but is not available in 3116 or 3216.

Dig in A

Dig in B

- Not isolated from the sensor input
- Switching: 12Vdc at 40mA max
- Contact open > 500Ω. Contact closed < 200Ω
- Input functions: Please refer to the list in the quick codes.

2.10 Current Transformer

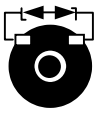
The current transformer input is an optional input in all 3200 series controllers. It is not available in 3116.

It can be connected to monitor the rms current in an electrical load and to provide load diagnostics. The following fault conditions can be detected: SSR (solid state relay) short circuit, heater open circuit and partial load failure. These faults are displayed as alarm messages on the controller front panel.

CT Input

Note: C is common to both the CT input and Digital input A. They are, therefore, not isolated from each other or the PV input.

- CT input current: 0-50mA rms (sine wave, calibrated) 50/60Hz
- A burden resistor, value 10Ω, is fitted inside the controller.
- It is recommended that the current transformer is fitted with a voltage limiting device to prevent high voltage transients if the controller is unplugged. For example, two back to back zener diodes. The zener voltage should be between 3 and 10V, rated at 50mA.

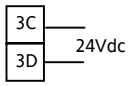


- CT input resolution: 0.1A for scale up to 10A, 1A for scale 11 to 100A
- CT input accuracy: ±4% of reading.

2.11 Transmitter Power Supply

The Transmitter Supply is not available in the Model 3216. It is fitted as standard in the Models 3208 and 3204.

Transmitter Supply



- Isolated output 240Vac CAT II
- Output: 24Vdc, +/- 10%. 28mA max.
- inside the controller

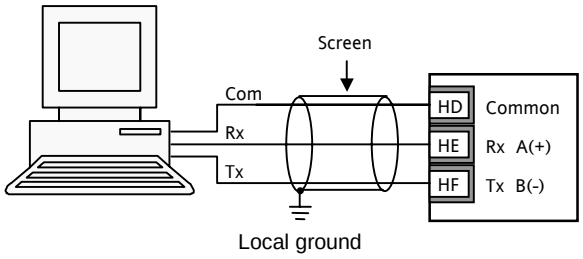
2.12 Digital Communications

Optional. (Not available in 3116)

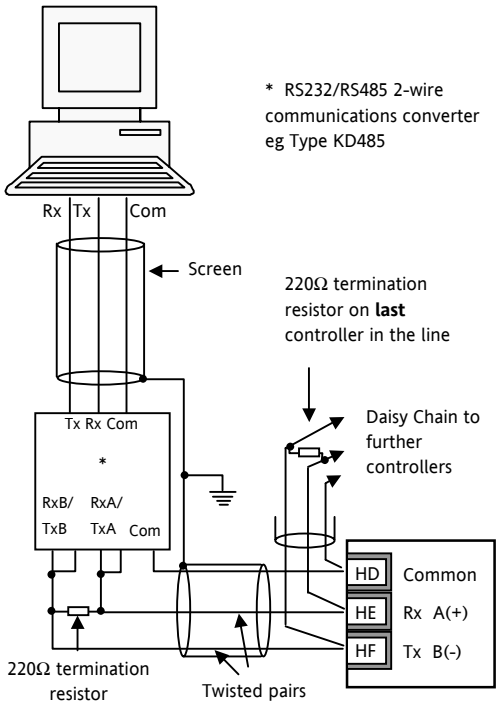
Digital communications uses the Modbus protocol. The interface may be ordered as RS232 or RS485 (2-wire).

- Isolated 240Vac CAT II.

RS232 Connections



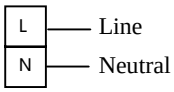
RS485 Connections



2.13 Controller Power Supply

1. Before connecting the instrument to the power line, make sure that the line voltage corresponds to the description on the identification label.
2. Use copper conductors only.
3. For 24V the polarity is not important
4. The power supply input is not fuse protected. This should be provided externally

Power Supply



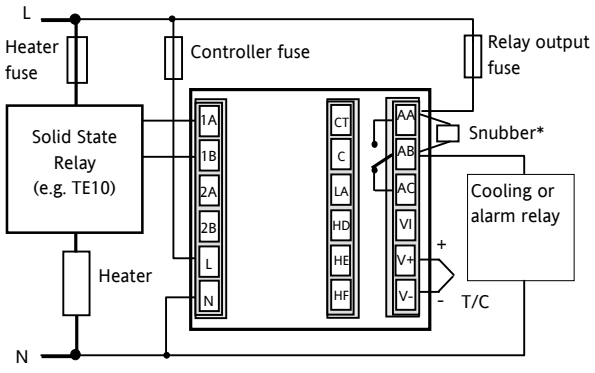
- High voltage supply: 100 to 240Vac, -15%, +10%, 50/60 Hz
- Low voltage supply: 24Vac/dc, -15%, +10%
- Recommended external fuse ratings are as follows:-

  For 24 V ac/dc, fuse type: T rated 2A 250V

  For 100-240Vac, fuse type: T rated 2A 250V.

2.14 Example Wiring Diagram

This example shows a heat/cool temperature controller where the heater control uses a SSR and the cooling control uses a relay.



Safety requirements for permanently connected equipment state:

- A switch or circuit breaker shall be included in the building installation
- It shall be in close proximity to the equipment and within easy reach of the operator
- It shall be marked as the disconnecting device for the equipment

Note: a single switch or circuit breaker can drive more than one instrument

2.15 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, by the application of the safety standard EN 61010.

Electromagnetic compatibility

This controller conforms with the essential protection requirements of the EMC Directive 89/336/EEC, by the application of a Technical Construction File. This instrument satisfies the general requirements of the industrial environment defined in EN 61326. 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, your supplier 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 an Installation & Operating guide. Certain ranges are supplied with an input adapter.

If on receipt, the packaging or the instrument are damaged, do not install the product but contact your supplier. 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 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. 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.

2.16 Installation Safety Requirements

Safety Symbols

Various symbols may be used on the controller. They have the following meaning:

⚠ Caution, (refer to accompanying documents)

⧈ Equipment protected throughout by DOUBLE INSULATION

☺ Helpful hints

Personnel

Installation must only be carried out by suitably qualified personnel.

Enclosure of Live Parts

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

Caution: Live sensors

The controller is designed to operate if the temperature sensor is connected directly to an electrical heating element. However you must ensure that service personnel do not touch connections to these inputs while they are live. With a live sensor, all cables, connectors and switches for connecting the sensor must be mains rated.

Wiring

It is important to connect the controller in accordance with the wiring data given in this guide. 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 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. 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.

Overcurrent protection

The power supply to the system should be fused appropriately to protect the cabling to the units.

Voltage rating

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

- relay output to logic, dc or sensor connections;
- any connection to ground.

The controller must 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.

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.

This product has been designed to conform to BSEN61010 installation category II, pollution degree 2. These are defined as follows:-

Installation Category II (CAT II)

The rated impulse voltage for equipment on nominal 230V supply is 2500V.

Pollution Degree 2

Normally only non conductive pollution occurs. Occasionally, however, a temporary conductivity caused by condensation shall be expected.

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.

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 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 table top 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.

3. Switch On

A brief start up sequence consists of a self test in which all elements of the display are illuminated and the software version is shown. What happens next depends on one of two conditions;-

1. The instrument is new and has been supplied un-configured (go to section 3.1)
2. The instrument has been supplied configured in accordance with the Quick Start code (go to section 3.3)

3.1 Initial Configuration

If the controller has not previously been configured it will start up showing the 'Quick Configuration' codes. This is a built in tool which enables you to configure the input type and range, the output functions and the display format.

The quick code consists of two 'SETS' of five characters. The upper section of the display shows the set selected, the lower section shows the five digits which make up the set.

Adjust these as follows:-.

1. Press any button. The first character will change to a flashing '-'.
2. Press ▲ or ▼ to change the flashing character to the required code shown in the quick code tables –see next page. Note: An * indicates that the option is not fitted.
3. Press ⟳ to scroll to the next character. If you need to return to the first character press ⧉. When all five characters have been configured the display will go to Set 2.

When the last digit has been entered press ⟳ again, the display will show 

Press ▲ or ▼ to 
.

The controller will then automatically go to the operator level.

SET 1

Input type		Range	
Thermocouple		**Full range**	
B	Type B	C	°C
J	Type J	F	°F
K	Type K	**Centigrade**	
L	Type L	0	0-100
N	Type N	1	0-200
R	Type R	2	0-400
S	Type S	3	0-500
T	Type T	4	0-800
C	Custom	5	0-1000
RTD		6	0-1200
p	Pt100	7	0-1400
Linear		8	0-1600
M	0-80mV	9	0-1800
2	0-20mA	**Fahrenheit**	
4	4-20mA	G	32-212
		H	32-392
		J	32-752
		K	32-1112
		L	32-1472
		M	32-1832
R	32-2912	N	32-2192
T	32-3272	P	32-2552

Input/Output 1		Output 2	Output 4
X	Unconfigured		
H	PID Heating (logic, relay or 4-20mA) or motor valve open (VC and VP only)		
C	PID Cooling (logic, relay or 4-20mA) or motor valve close (VC and VP only)		
J	ON/OFF Heating (logic or relay), or PID 0-20mA heating		
K	ON/OFF Cooling (logic or relay), or PID 0-20mA cooling		
Alarm: energised in alarm		**Alarm: de-energised in alarm**	
0	High alarm	5	High alarm
1	Low alarm	6	Low alarm
2	Deviation high	7	Deviation high
3	Deviation low	8	Deviation low
4	Deviation band	9	Deviation band
DC Retransmission			
D	4-20mA Setpoint	N	0-20mA Setpoint
E	4-20mA Temperature	Y	0-20mA Temperature
F	4-20mA output	Z	0-20mA output
Logic input functions (Input/Output 1 only)			
W	Alarm acknowledge	V	Recipe 2/1 select
M	Manual select	A	Remote UP button
R	Timer/program run	B	Remote DOWN button
L	Keylock	G	Timer/Prog Run/Reset
P	Setpoint 2 select	I	Timer/Program Hold
T	Timer/program Reset	Q	Standby select
U	Remote SP enable		

SET 2

Not applicable to 3116

Input CT Scaling	
X	Unconfigured
1	10 Amps
2	25 Amps
5	50 Amps
6	100 Amps

Digital Input A / Digital Input B	
X	Unconfigured
W	Alarm acknowledge
M	Manual select
R	Timer/Program Run
L	Keylock
P	Setpoint 2 select
T	Timer/Program reset
U	Remote SP enable
V	Recipe 2/1 select
A	Remote UP button
B	Remote DOWN button
G	Timer/Prog Run/Reset
I	Timer/Program Hold
Q	Standby select

Output 3 *			
X	Unconfigured		
H	PID heating or motor valve open (VC and VP only)		
C	PID cooling or motor valve close (VC and VP only)		
K	ON/OFF heating (not shown if VC or VP)		
J	ON/OFF cooling (not shown if VC or VP)		
Alarm Outputs			
Energised in alarm		De-energised in alarm	
0	High alarm	5	High alarm
1	Low alarm	6	Low alarm
2	Dev High	7	Dev High
3	Dev Low	8	Dev Low
4	Dev Band	9	Dev Band
DC outputs			
H	4-20mA heating		
C	4-20mA cooling		
K	0-20mA heating		
J	0-20mA cooling		
Retransmission output			
D	4-20 Setpoint		
E	4-20 Measured Temperature		
F	4-20mA output		
N	0-20 Setpoint		
Y	0-20 Measured Temperature		
Z	0-20mA output		

Lower Display	
T	Setpoint (std)
P	Output
R	Time remaining
E	Elapsed time
1	Alarm setpoint
A	Load Amps
D	Dwell/Ramp Time/Target
N	None
C	Setpoint with Output meter *
M	Setpoint with Ammeter *

* 3208 & 3204 only

* 3208 and 3204 only

3.2 To Re-Enter Quick Code mode

If you need to re-enter the 'Quick Configuration' mode this can always be done by powering down the controller, holding down the ⓘ button, and powering up the controller again. You must then enter a passcode using the ▲ or ▼ buttons. In a new controller the passcode defaults to 4. If an incorrect passcode is entered you must repeat the whole procedure.

Note- Parameters may also be configured using a deeper level of access. This is described in subsequent chapters of this handbook.

If parameters have been configured in this level then the quick codes may not be valid and not shown.

3.3 Pre-Configured Controller or Subsequent Starts

The controller will briefly display the quick codes during start up and then proceed to operator level 1.

Note:- If the Quick Codes do not appear during start up this means that the controller has been re-configured in a deeper level of access, as stated above, and the Quick Codes may no longer be valid.

The controller will power up in the mode it was in prior to shutdown and you will see the display shown below. It is called the HOME display.

The ALM beacon will show red if an alarm is present.

The OP4 beacon will be on if output 4 is active

Measured Temperature (or Process Value 'PV')

Target Temperature (Setpoint 'SP')

3.4 Front Panel Layout

ALM Alarm active (Red)

OP1 lit when output 1 is ON (normally heating)

OP2 lit when output 2 is ON (normally cooling)

OP3 lit when output 3 is ON

OP4 lit when output 4 relay is ON (normally alarm)

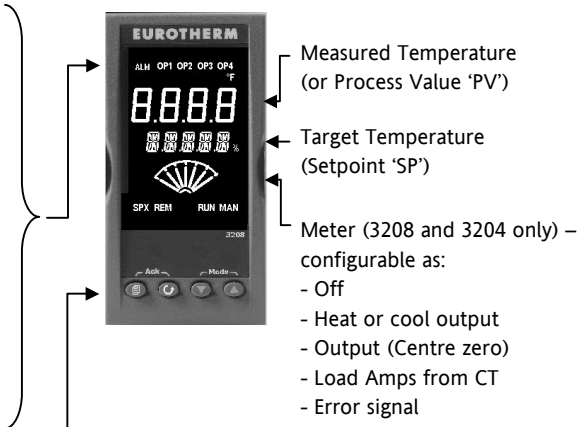
SPX Alternative setpoint in use (e.g. setpoint 2)

REM Remote digital setpoint. Also flashes when digital communications active

RUN Timer/programmer running

RUN (flashing) Timer/programmer in hold

MAN Manual mode selected



Operator Buttons:-

From any display - press to return to the HOME display

Press to select a new parameter. If held down it will continuously scroll through parameters**.**

Press to decrease a value

Press to increase a value

3.4.1 To Set The Target Temperature.

From the HOME display:-

Press to raise the setpoint

Press to lower the setpoint

The new setpoint is entered when the button is released and is indicated by a brief flash of the display.

3.4.2 Alarm Indication

If an alarm occurs, the red ALM beacon will flash. A scrolling text message will describe the source of the alarm. Any output attached to the alarm will operate.

Press and (ACK) together to acknowledge

If the alarm is still present the ALM beacon will light continuously.

The action which takes place depends on the type of alarm configured:-

Non latching	A non latching alarm will reset itself when the alarm condition is removed. By default alarms are configured as non-latching, de-energised in alarm.
Auto Latching	An auto latching alarm requires acknowledgement before it is reset. The acknowledgement can occur BEFORE the condition causing the alarm is removed.
Manual Latching	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 condition causing the alarm is removed.

3.4.3 Auto, Manual and Off Mode

The controller can be put into Auto, Manual or Off mode – see next section.

Auto mode is the normal operation where the output is adjusted automatically by the controller in response to changes in the measured temperature.

Manual mode means that the controller output power is manually set by the operator. The input sensor is still connected and reading the temperature but the control loop is 'open'. In manual mode the MAN beacon will be lit. The power output can be increased or decreased using the ⊙ or ⊙ buttons.

⚠ Manual mode must be used with care. The power level must not be set and left at a value that can damage the process or cause over-heating. The use of a separate 'over-temperature' controller is recommended.

Off mode means that the heating and cooling outputs are turned off. The alarm outputs will, however, still be active.

3.4.4 To Select Auto, Manual or Off Mode

Press and hold ⊙ and ⊙ (Mode) together for more than 1 second.

This can only be accessed from the HOME display.

1. 'Auto' is shown in the upper display. After 5 seconds the lower display will scroll the longer description of this parameter. ie 'LOOP MODE – AUTO MANUAL OFF'

2. Press ⊙ to select 'mAn'. Press again to select 'OFF'. This is shown in the upper display.

3. After 2 seconds the controller will return to the HOME display.

4. If **OFF** has been selected, OFF will be shown in the lower display and the heating and cooling outputs will be off

5. If manual mode has been selected, the **MAN** beacon will light. The upper display shows the measured temperature and the lower display the demanded output power.

6. The transfer from Auto to manual mode is 'bumpless'. This means the output will transfer to the same value it was at in Auto mode. Similarly when transferring from Manual to auto mode the initial output value will be the same.

7. In manual mode the Man beacon will be lit and the output power shown in the lower display. Press ⊙ or ⊙ to lower or raise the output. The output power is continuously updated when these buttons are pressed

8. To return to Auto mode, press ⊙ and ⊙ together. Then press ⊙ to select 'Auto'.

3.4.5 Operator Parameters Available in Level 1

Operator level 1 is designed for day to day operation of the controller and parameters are not protected by a pass code.

Press ⟳ to step through the list of parameters. The mnemonic of the parameter is shown in the lower display and its value in the upper. After five seconds a scrolling text description of the parameter appears.

The value of the parameter is shown in the upper display. Press ▲ or ▼ to adjust this value. If no key is pressed for 30 seconds the controller returns to the HOME display

The parameters that appear depend upon the functions configured. They are:-

Parameter Mnemonic	Scrolling Display and Description	Alterability
WRK.OP	WORKING OUTPUT The active output value	Read only. Appears when the controller is in AUTO or OFF mode. In a motorised valve controller (option VC or VP) this is the 'inferred' position of the valve
WKG.SP	WORKING SETPOINT The active setpoint value.	Read only. Only shown when the controller is in MAN or OFF mode.
SP1	SETPOINT 1	Alterable
SP2	SETPOINT 2	Alterable
T.REMN	TIME REMAINING Time to end of set period	Read only 0:00 to 99.59 hh:mm or mm:ss
DWELL	SET TIME DURATION Timer set time	Alterable. Only shown if timer (not programmer) configured.
A1.xxx	ALARM 1 SETPOINT	Read only. Only shown if the alarm is configured. Where: xxx = alarm type. HI = High alarm; LO = Low alarm d.HI = Deviation high; d.LO = Deviation low; d.HI = Deviation high
A2.xxx	ALARM 2 SETPOINT	
A3.xxx	ALARM 3 SETPOINT	
A4.xxx	ALARM 3 SETPOINT	
LD.AMP	LOAD CURRENT Load Amps	Read only. Only shown if CT is configured

4. Operator Level 2

Level 2 provides access to additional parameters. Access to these is protected by a pass code.

4.1 To Enter Level 2

1. From any display press and hold ☰.
2. After a few seconds the display will show:-

3. Release ☰.

(If no button is pressed for about 45 seconds the display returns to the HOME display)

4. Press ▲ or ▼ to choose LEu 2 (Level 2)

5. After 2 seconds the display will show:-

6. Press ▲ or ▼ to enter the pass code. Default = '2'

- If an incorrect code is entered the controller reverts to Level 1.

4.1.1 To Return to Level 1

1. Press and hold ☰
2. Press ▼ to select LEu 1

The controller will return to the level 1 HOME display. Note: A pass code is not required when going from a higher level to a lower level.

4.2 Level 2 Parameters

Press ⟳ to step through the list of parameters. The mnemonic of the parameter is shown in the lower display. After five seconds a scrolling text description of the parameter appears.

The value of the parameter is shown in the upper display. Press ▲ or ▼ to adjust this value. If no key is pressed for 30 seconds the controller returns to the HOME display

Backscroll is achieved when you are in this list by pressing ▲ while holding down ⟳.

The following table shows a list of parameters available in Level 2.

Mnemonic	Scrolling Display and description	Range	
WKG.SP	**WORKING SETPOINT** is the current target setpoint and appears when the controller is in Manual. It may be derived from SP1 or SP2, or, if the controller is ramping (see SP.RAT), it is the current ramp value.	SP.HI to SP.LO	
WRK.OP	**WORKING OUTPUT** is the output from the controller expressed as a percentage of full output. It appears when the controller is in Auto. In a motorised valve controller (option VC or VP) this is the 'inferred' position of the valve For a time proportioning output, 50% = relay or logic output on or off for equal lengths of time. For an On/Off output 0 to <1% = output off, >1 to 100% = output on	0 to 100% heat only -100 (max cooling) to 100% (max heating	
T.STAT	**TIMER STATUS** is only shown if a timer is configured. Allows the timer to be put into Run, Hold or Reset mode.	rES run hoLd End	Reset Running Hold Timed out
UNITS	**DISPLAY UNITS**	°C °F °K nonE PErc	Degrees C Degrees F Degrees K None Percentage
SP.HI	**SETPOINT HIGH** allows a high limit to be applied to SP1 and SP2	As quickcode SET1	
SP.LO	**SETPOINT LOW** allows a low limit to be applied to SP1 and SP2		
SP1	**SETPOINT 1** allows control setpoint 1 value to be adjusted	SP.HI to SP.LO	
SP2	**SETPOINT 2** allows control setpoint 2 value to be adjusted	SP.HI to SP.LO	
SP.RAT	**SETPOINT RATE LIMIT** sets the rate of change of setpoint. Limits the rate of heating or cooling.	OFF to 3000 display units per minute	
	The next section applies to the Timer only – see also section 13		
TM.CFG	**TIMER CONFIGURATION** configures the timer type - Dwell, Delay, Soft Start or none (only when in Reset) Note Programmer option is only shown if the programmer option has been ordered.	nonE dwEll dELY SFSt ProG	None Dwell Delayed switch on Soft start Programmer
TM.RES	**TIMER RESOLUTION** selects hours or minutes (only when in Reset)	Hour min	Hours Minutes
THRES	**TIMER START THRESHOLD** The timer will not run until the PV becomes in range of the value set by this parameter. This value can be changed when the timer is running.	OFF or 1 to 3000	
END.T	**TIMER END TYPE** The action of the timer when it has timed out can be selected from Dwell (control continues at the setpoint), Off (control outputs turn off), SP2 (control at setpoint 2). Can be changed while the timer is running.	OFF dwEll SP2	Control OP goes to zero Control continues at SP1 Go to SP2
SS.PWR	**SOFT START POWER LIMIT** Sets the power limit during start up	-100 to 100%	
SS.SP	**SOFT START SETPOINT** sets the threshold below which the power is limited	Between SP.HI and SP.LO	
DWELL	**SET TIME DURATION** - can be adjusted while the timer is running. This parameter only appears for a Dwell type timer.	0:00 to 99.59 hh:mm: or mm:ss	
T.REMN	**TIME REMAINING** Time remaining to reach the set time	0:00 to 99.59 hh:mm: or mm:ss	
	The following parameters are available when the timer is configured as a programmer – see also section 13.5		
SERVO	**SERVO MODE**. Defines how the program starts when 'Run' is selected or after a power cycle. See also section 5.4.1.	SP PV SP.rb PV.rb	Setpoint Process variable Ramp back to SP Ramp back to PV
TSP.1	**TARGET SETPOINT 1**. To set the target value for the first setpoint		
RMP.1	**RAMP RATE 1.** To set the first ramp rate		
DWEL.1	**DWELL 1**. To set the period of the first dwell		
The above three parameters are repeated for the next three program segments, i.e. TSP.2 (3 & 4), RMP.2 (3 & 4), DWEL.2 (3 & 4)			

Mnemonic	Scrolling Display and description	Range
	This section applies to Alarms only If an alarm is not configured the parameters do not appear	
A1.--- - to A4.---	**ALARM 1 (2, 3 or 4) SETPOINT** sets the threshold value at which an alarm is detected. Up to four alarms are available and are only shown if configured. --- = the mnemonic for the alarm type which may be:- LO Full Scale Low dnd Deviation Band dHI Deviation High HI Full Scale High dLO Deviation Low	SP.HI to SP.LO
	The following section applies to control parameters	
MTR.T	**MOTOR TRAVEL TIME.** Set this value to the time that it takes for the motor to travel from its fully closed to its fully open position. Note: In motorised valve control only the PB and TI parameters are active – see below. The TD parameter has no effect on the control.	0.0 to 999.9 seconds
A.TUNE	**AUTOTUNE** automatically sets the control parameters to match the process characteristics.	OFF Disable On Enable
PB	**PROPORTIONAL BAND** sets an output which is proportional to the size of the error signal. Units may be % or display units.	1 to 9999 display units Default 20
TI	**INTEGRAL TIME** removes steady state control offsets by ramping the output up or down in proportion to the amplitude and duration of the error signal.	OFF to 9999 seconds Default 360
TD	**DERIVATIVE TIME** determines how strongly the controller will react to the rate of change in the process value. It is used to prevent overshoot and undershoot and to restore the PV rapidly if there is a sudden change in demand.	OFF to 9999 seconds Default 60 for PID control Default 0 for valve position control
MR	**MANUAL RESET** applies to a PD only controller i.e. the integral term is turned off. Set this to a value of power output (from +100% heat, to -100% cool which removes any steady state error between SP and PV.	-100 to 100% Default 0
R2G	**RELATIVE COOL GAIN** adjusts the cooling proportional band relative to the heating proportional band. Particularly necessary if the rate of heating and rate of cooling are very different. **(Heat/Cool only**)	0.1 to 10.0 Default 1.0
HYST.H	**HEATING HYSTERESIS** sets the difference in PV units between output 1 turning off and turning on. **Only shown if channel 1 control action is On/Off**.	0.1 to 200.0 display units 0.2 Default 1.0
HYST.C	**COOLING HYSTERESIS** sets the difference in PV units between output 2 turning off and turning on. **Only shown if channel 2 control action is On/Off**.	0.1 to 200.0 display units Default 1.0
D.BAND	**CHANNEL 2 DEADBAND** adjusts a zone between heating and cooling outputs when neither output is on. Off = no deadband. 100 = heating and cooling off.	OFF or 0.1 to 100.0% of the cooling proportional band
OP.HI	**OUTPUT HIGH** limits the maximum heating power applied to the process or a minimum cooling output.	+100% to OP.LO
1. (2, 3 or 4) PLS.	**OUTPUT 1 (2, 3 or 4) MINIMUM PULSE TIME** Sets the minimum on and off time for the control output. ⚠ **Ensure this parameter is set to a value that is suitable for the output switching device in use. For example, if a logic output is used to switch a small relay, set the value to 5.0 seconds or greater to prevent damage to the device due to rapid switching.**	Relay outputs 0.1 to 150.0 seconds – default 5.0. Logic outputs Auto to 150.0 -Default Auto = 55ms
	This section applies to current transformer input only. If the CT option is not configured the parameters do not appear	
LD.AMP	**LOAD CURRENT** is the measured load current when the power demand is on	CT Range
LK.AMP	**LEAK CURRENT** is the measured leakage current when the power demand is off.	CT Range
LD.ALM	**LOAD CURRENT THRESHOLD** sets a low alarm trip point for the load current as measured by the CT. This detects partial load failure.	CT Range
LK.ALM	**LEAK CURRENT THRESHOLD** sets a high alarm trip point for the leakage current measured by the CT.	CT Range
HC.ALM	**OVERCURRENT THRESHOLD** sets a high alarm trip point to show over current as measured by the CT	CT Range
ADDR	**ADDRESS** - communications address of the controller. 1 to 254	1 to 254
HOME	**HOME DISPLAY** Defines the parameter which appears in the lower section of the HOME display	Std Standard OP Output power tr Time remaining ELAP Time elapsed AL First alarm setpoint Ct Load current CLr Clear (blank) tmr Combined setpoint and time
ID	**CUSTOMER ID** is a number from 0 to 9999 entered as a customised identification number for the controller	0 to 9999

Mnemonic	Scrolling Display and description	Range
REC.NO	**CURRENT RECIPE NUMBER** the most frequently used parameters can be stored in up to 5 recipes. This parameter selects the recipe to use.	nonE or 1 to 5 or FAiL if no recipe set stored
STORE	**RECIPE TO SAVE** the most frequently used parameter s can be stored in up to 5 recipes. This parameter allows you to store the current values in recipe numbers 1, 2, 3, 4, or 5. nonE does not store values.	nonE or 1 to 5 donE when stored

☺ Press ⓜ at any time to return immediately to the HOME screen at the top of the list.

☺ Hold ⟳ down to continuously scroll through the above list

5. Timer Operation

An internal timer can be configured to operate in one of four different modes. The mode is configured in Level 2 by the **'TM.CFG'** (timer configuration) parameter. Each Timing Mode is described in the pages that follow.

Operation	Action	Indication
To **Run** the timer	Press and quickly release ⊙ + ⊙	Beacon -- RUN = On Scrolling text display:- TIMER RUNNING
To **Hold** the timer	Press and quickly release ⊙ + ⊙	Beacon -- RUN = Flashing Scrolling text display:- TIMER HOLD
To **Reset** the timer	Press and hold ⊙ + ⊙ for more than 1 second	Beacon -- RUN = Off If the timer is a Dwell Type and configured to turn power off at the end of the timing period OFF will be displayed
	Timer has timed out (END state)	Beacon -- RUN = Off SPX = On if End Type = SP2 Scrolling display:- TIMER END. Note:- The timer can be re-run from the end state without the need to reset it.

The timer can also be RUN, HELD or RESET by the parameter 'T.STAT' (Timer status). It can also be controlled via digital inputs (if configured).

5.1 Dwell Timer

A dwell timer (‘**TM.CFG’ = ‘DwEll’**) is used to control a process at a fixed temperature for a defined period.

In reset the controller behaviour depends on the configuration of the END state parameter. See opposite.

In run the heating or cooling will come on. Timing starts when the temperature is within the threshold ‘**THRES’** of the setpoint. If the threshold is set to OFF the timing starts immediately.

If setpoint ramping is enabled, then the ramp completes before the timer starts.

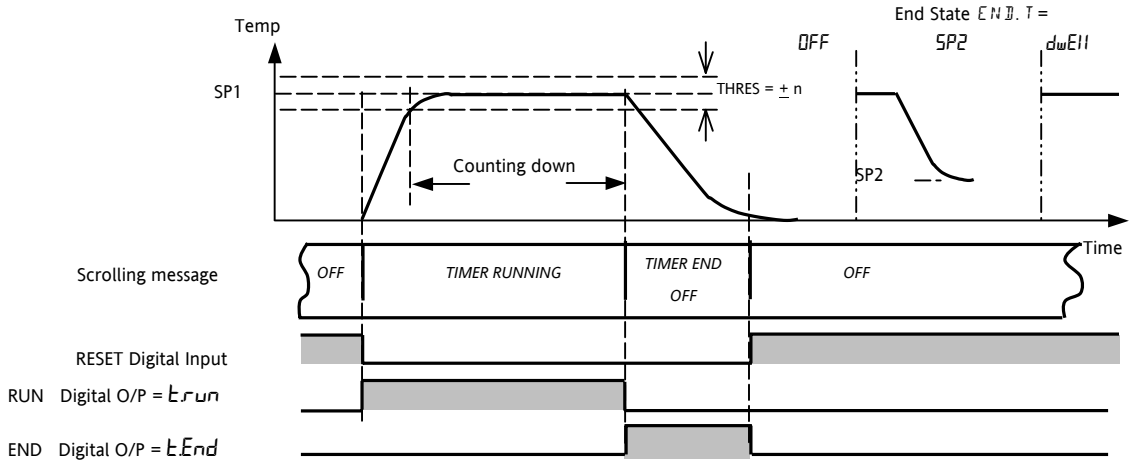
In the END state the behaviour is determined by the parameter ‘**END.T’** (End type):

OFF: The heating and cooling is turned OFF (resets to Off)

Dwell: Controls at setpoint1 (resets to Setpoint 1)

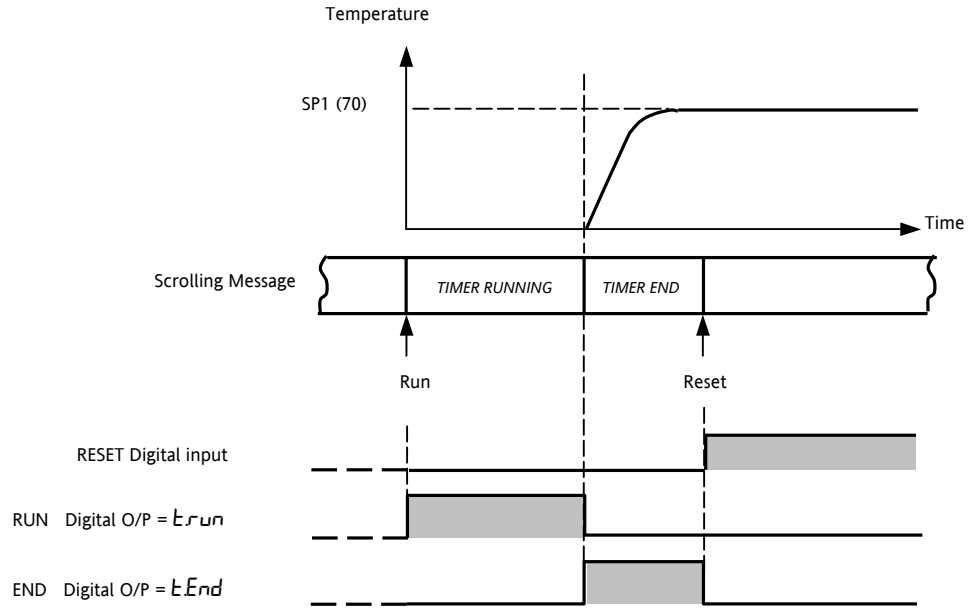
SP2 Controls at setpoint 2 (resets to Setpoint 1)

Note: The dwell period can be reduced or increased while the timer is running.



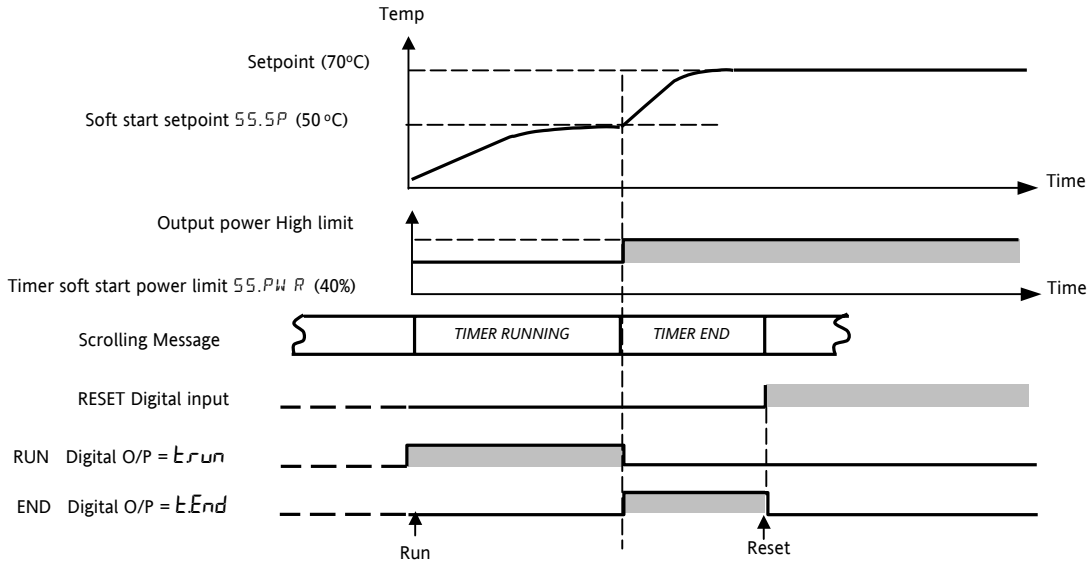
5.2 Delayed Timer

‘TM.CFG’ = ‘DELY’. The timer is used to switch on the output power after a set time. The timer starts immediately on power-up, or when run. The controller remains in standby with heating and cooling off until the time has elapsed. After the time has elapsed, the instrument controls at the target setpoint.



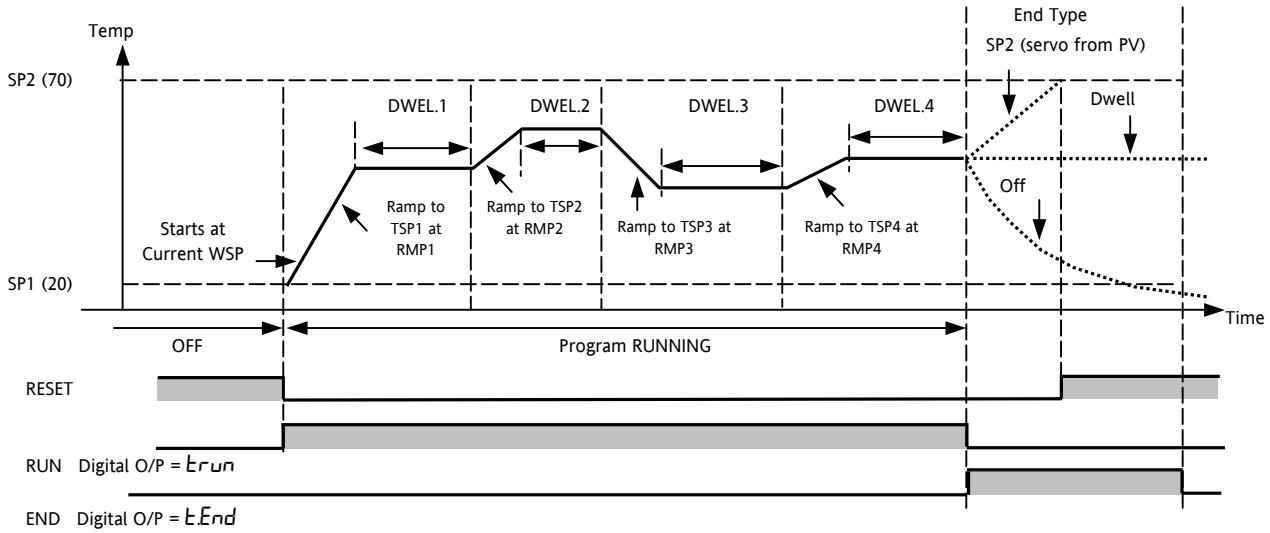
5.3 Soft Start Timer

‘**TM.CFG’ = ‘SS.St’.** A Soft Start timer starts automatically on power up. It applies a power limit (‘**SS.PWR’)** until the temperature reaches a threshold value (‘**SS.SP’)** or the timer times-out after the dwell period (‘**DwEll’)**. It is typically use to dry-out heaters in Hot Runner control systems



5.4 Programmer

‘**TM.CFG’ = ‘ProG**’. Function code CP contains a four segment programmer where each segment consists of a controlled ramp rate to a target setpoint followed by a dwell at that setpoint. These values are set by the user. The program profile is shown in the diagram below..



Notes:-

1. When a step change is required, the ramp rate should be set to ‘OFF’.
2. Where ramp/dwell pairs are not required, the ramp rate should be set to ‘OFF’ and the TSP the same as the preceding segment
3. TIMER END - when the end type is SP2, Timer END does not occur until the ramp is complete or SP2 is achieved. It is more usual to use a DWELL end type (the default setting)

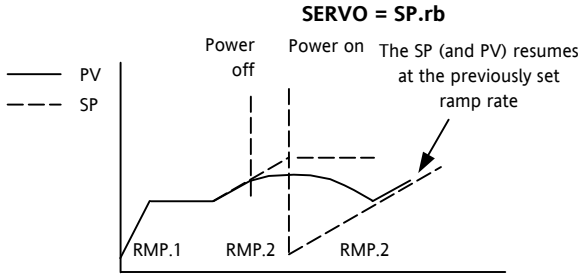
A single program event output is also available. To use this refer to the engineering manual.

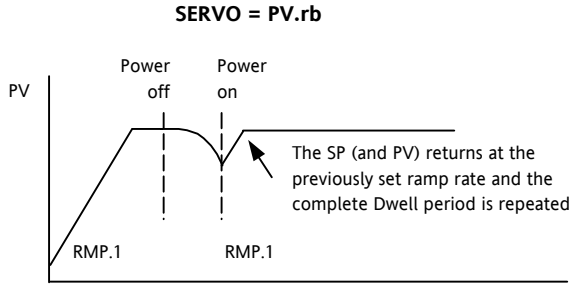
5.4.1 Programmer Servo Mode and Power Cycling

The way in which the program starts when 'Run' is selected or after the power is turned off and on again, is determined by the SERVO MODE parameter, as follows:-

SERVO MODE	
SP	The program will start from the current **setpoint** value. On recovery from power failure, the program will reset. It will require to be run again manually. The working setpoint will revert to SP1 or SP2 (depending on which was selected) and the whole program is repeated.
PV	The program will start from the **measured temperature**. On recovery from power failure, the program will reset. It will require to be run again manually, but it will start at the value of the PV at the point when the programmer is run again.
SP.rb	The program will start from the current **setpoint** value. On recovery from power failure, the program will automatically run at the **last** ramp rate from the **original setpoint value (SP1 or SP2)**, see the sketches below.
PV.rb	The program will start from the **measured temperature**. On recovery from power failure, the program will automatically run at the **last** ramp rate from the **current measured temperature**, see the sketches below.

The behaviour of the programmer following a power failure is shown graphically below for SERVO = SP.rb and PV.rb:-





5.4.2 To Operate the Programmer

Operation of the programmer is the same as the timer.

Operation	Action	Indication
To Run a program	Press and quickly release ▼ + ▲	Beacon -- RUN = On Scrolling display - TIMER RUNNING
To Hold a program	Press and quickly release ▼ + ▲	Beacon -- RUN = Flashing Scrolling display - TIMER HOLD
To Reset a program	Press and hold ▼ + ▲ for more than 1 second Or press ▣ + ↻	Beacon -- RUN = Off If End Type = Off then OFF will be displayed at the end of the program
	Program ended	Beacon -- RUN = Off SPX = On if End Type = SP2 Scrolling display - TIMER END
Repeat the above to Run the programmer again (Note: it is not essential to reset it after the End state is reached)		

Programs can also be operated from the **'T.STAT'** parameter found in the level 2 parameter list.

5.4.3 To Configure the Programmer

Select Access Level 2 – see section 4.

Operation	Action	Indication	Notes
Configure the Timer as a **Programmer**	1. Press ⟳ to select 'TM.CFG' 2. Press ▼ or ▲ to 'ProG'		
Set the **Resolution**	3. Press ⟳ to select 'TM.RES' 4. Press ▼ or ▲ to 'Hour' or 'mi n''		In this example the ramp rate and dwell period are set in hours
Set the **Threshold**	5. Press ⟳ to select 'THRES' 6. Press ▼ or ▲ to adjust		In this example the dwell periods will not start until the PV is within 5 units of the setpoint
Set the action when the programmer times out	7. Press ⟳ to select 'END.T' 8. Press ▼ or ▲ to 'OFF' or 'SP2' or 'dwEll'		In this example the controller will continue to control indefinitely at the last setpoint. OFF will turn the output power off and SP2 will control at setpoint 2
Set the **Servo Mode**	9. Press ⟳ to select 'SERVO' 10. Press ▼ or ▲ to 'PU', 'SP', 'SP.rb', or 'PU.rb'		In this example the program will start from the current value of the process temperature. See also section 5.4.1.
Set the first **Target Setpoint**	11. Press ⟳ to select 'TSP.1' 12. Press ▼ or ▲ to adjust		In this example the setpoint will ramp from the current value of the PV to the first target - 100
Set the first **Ramp Rate**	13. Press ⟳ to select 'RMP.1' 14. Press ▼ or ▲ to adjust		In this example the setpoint will ramp to 100 at 8.0 units per hour
Set the first **Dwell**	15. Press ⟳ to select 'DWEL.1' 16. Press ▼ or ▲ to adjust		In this example the setpoint will remain at the start value for 2 hours 11 minutes
Repeat the above three steps for all segments			

6. Access to Further Parameters

Parameters are available under different levels of security and are defined as Level 1 (LEV 1), Level 2 (LEV 2), Level 3 (LEV 3) and Configuration (CONF). Level 1 has no passcode since it contains a minimal set of parameters generally sufficient to run the process on a daily basis. Level 2 allows access to parameters which may used in commissioning a controller or settings between different products or batches. This has been described in the previous section.

Level 3 and Configuration level parameters are also available as follows:-

6.1.1 Level 3

Level 3 makes all operating parameters available and alterable (if not read only). It is typically used when commissioning a controller.

Examples are:-

Range limits, setting alarm levels, communications address.

The instrument will continue to control when in Levels 1, 2 or 3.

6.1.2 Configuration Level

This level makes available all parameters including the operation parameters so that there is no need to switch between configuration and operation levels during commissioning. It is designed for those who may wish to change the fundamental characteristics of the instrument to match the process.

Examples are:-

Input (thermocouple type); Alarm type; Communications type.

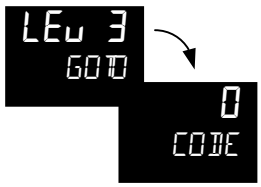
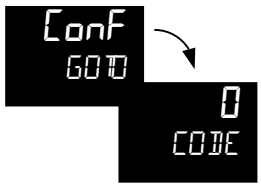
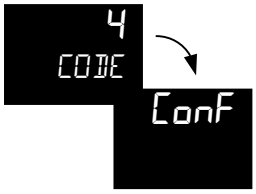
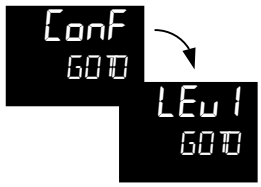
WARNING

Configuration level gives access to a wide range of parameters which match the controller to the process. 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.

In configuration level the controller is not controlling the process or providing alarm indication. Do not select configuration level on a live process.

Operating Level	Home List	Full Operator	Configuration	Control
Level 1	✓			Yes
Level 2	✓			Yes
Level 3	✓	✓		Yes
Configuration	✓	✓	✓	No

6.1.3 To Select Access Level 3 or Configuration Level

Do This	The Display You Should See	Additional Notes
1. From any display press and hold ⊜ for more than 5 seconds	**To Select Level 3** 	The display will pass from the current operating level, for example, LEu 1 to LEu 3 as the button is held down. (If no button is then pressed for about 50 seconds the display returns to the HOME display)
2. Press ▲ or ▼ to enter the passcode for Level 3		The default code is 3: If an incorrect code is entered the display reverts to 'GOTO'. The controller is now in the level 3 will then revert to the HOME display
3. When the LEU3 GOTO view is shown, as in paragraph 1 above, press ▲ to select 'ConF'	**To Select Configuration level** 	Note: ▲ must be pressed quickly before the controller requests the code for level 3
4. Press ▲ or ▼ to enter the passcode for Configuration level		The default code is 4: If an incorrect code is entered the display reverts to 'GOTO'. The controller is now in Configuration level will now show ConF
5. Press and hold ⊜ for more than 3 seconds 6. Press ▲ to select the required level eg LEV 1	**To Return to a Lower Level** 	The choices are: LEU 1 Level 1 LEU 2 Level 2 LEU 3 Level 3 ConF Configuration It is not necessary to enter a code when going from a higher level to a lower level. Alternatively, press ⊜ and scroll to the ACCES list header, then press ↻ to select the required level. The display will then flash 'ConF' for a few seconds and the controller will then go through its start up sequence, starting in the level selected. Do not power down while ConF is flashing. If a power down does occur an error message will appear – see section **12.4** 'Diagnostic Alarms'

☺ A special case exists if a security code has been configured as '0' If this has been done it is not necessary to enter a code and the controller will enter the chosen level immediately.

☺ When the controller is in configuration level the ACCESS list header can be selected from any view by holding down the ⊜ button for more than 3 seconds. Then press ⊜ again to select 'ACCES'

6.2 Parameter lists

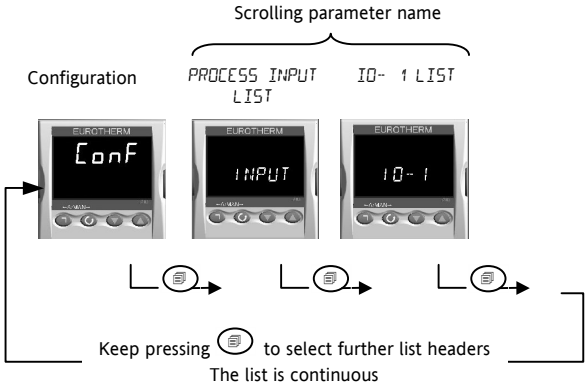
Parameters are organised in lists. The top of the list shows the list header only. The name of the list header describes the generic function of the parameters within the list. For example, the list header 'ALARM' contains parameters which enable you to set up alarm conditions.

6.2.1 To Choose Parameter List Headers

Press . Each list header is selected in turn every time this key is pressed.

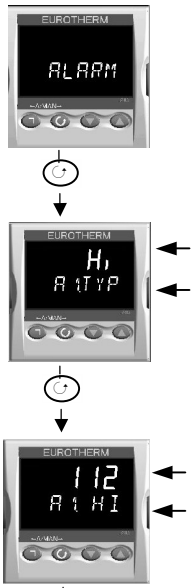
The name of the list header appears in the lower display, followed, after a few seconds, by a scrolling longer description of the name.

The following example shows how to select the first two list headers. (Views are shown for 3216 controllers).



6.2.2 To Locate a Parameter

Choose the appropriate list, then press . Each parameter in the list is selected in turn each time this button is pressed. The following example shows how to select the first two parameters in the ALARM List. All parameters in all lists follow the same procedure. (Views are shown for 3216 controllers).



Alarm List Header

Parameter 'Value'. In this case set to Full Scale High Alarm

Parameter mnemonic 'A1.TYP' followed by a scrolling message 'ALARM 1 TYPE'

Parameter 'Value'. In this case an 'numerical' value, set to '112'

Parameter mnemonic 'A1.HI' followed by a scrolling message 'ALARM 1 SETPOINT'

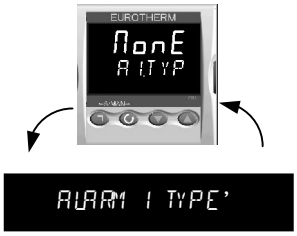
☺ Press to jump back to the list header.

6.2.3 How Parameters are Displayed

As shown above. whenever a parameter is selected it is displayed as a mnemonic, of four or five characters, for example 'A1.TYP'.

After a few seconds this display is replaced by a scrolling banner which gives a more detailed description of the parameter. In this example 'A1.TYP' = 'ALARM 1 TYPE'. The scrolling banner is only shown once after the parameter is first accessed. (Views are shown for 3216 controllers).

The name of the list header is also displayed in this way.



The upper part of the display shows the value of the parameter.

The lower part shows its mnemonic followed by the scrolling name of the parameter

6.2.4 To Change a Parameter Value

With the parameter selected, press to increase the value, press to decrease the value. If either key is held down the analogue value changes at an increasing rate.

The new value is entered after the key is released and is indicated by the display blinking. The exception to this is output 'Power' when in manual. In this case the value is entered continuously.

The upper display shows the parameter value the lower display shows the parameter name.

6.2.5 To Return to the HOME Display

Press + .

On release of the keys the display returns to the HOME list. The current operating level remains unchanged.

6.2.6 Time Out

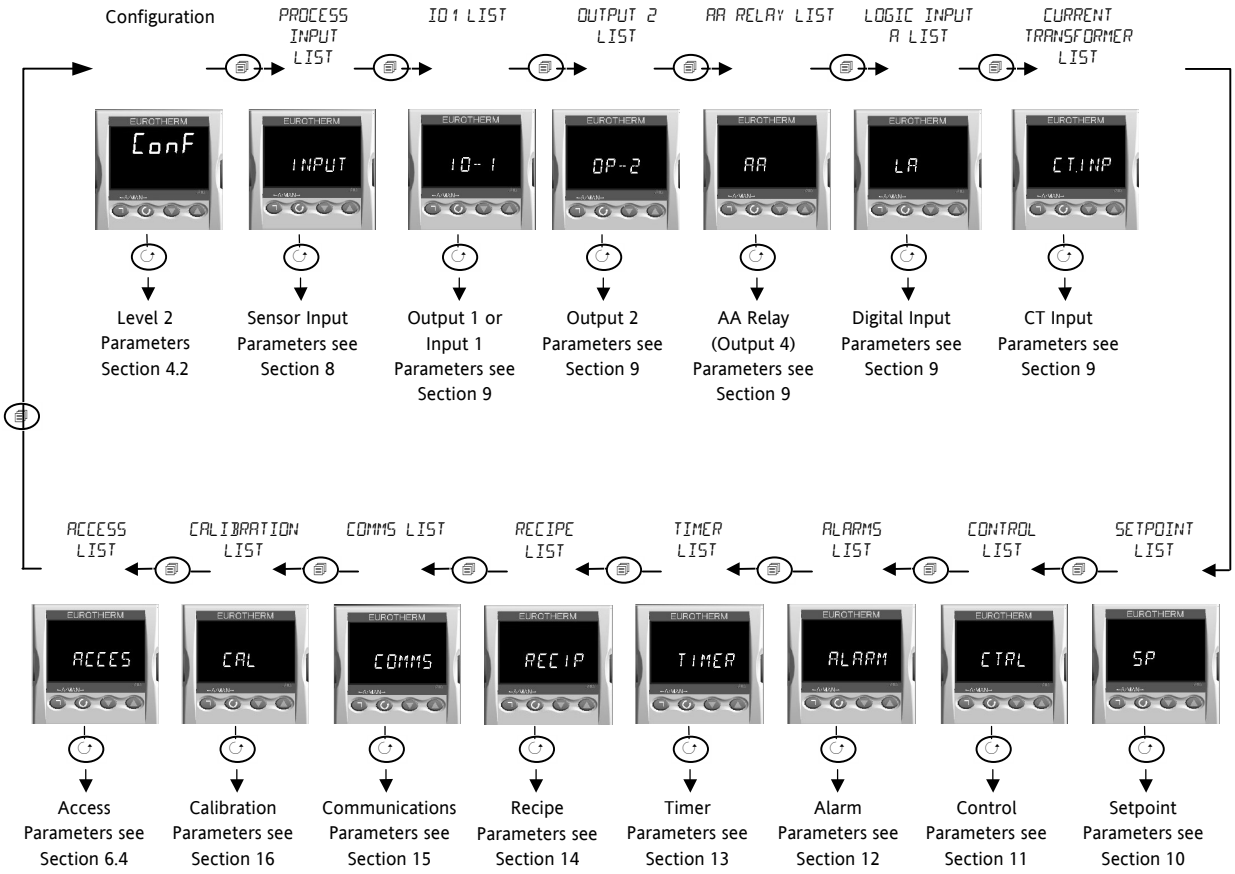
A time out applies to the 'Go To' and 'Control Mode' parameters. If no key presses are detected within a period of 5 seconds the display will revert back to the HOME list.

☺ Press and hold to scroll parameters forward through the list. With depressed, press to scroll parameters backward.

6.3 Navigation Diagram

The diagram below shows the all list headings available in configuration level for 3216 controllers.

The parameters in a list are shown in tables in the following sections of this manual together with explanations of their meanings and possible use.



For 3116 controllers not all headings are available. For example, Logic Input List, CT Input List, Timer List, Digital Communications List, AA Relay List and Output 3 List are not present.

For 3208 and 3204 controllers additional lists are available, for example Output 3 and Digital Input B

6.4 Access Parameters

The following table summarises the parameters available under the ACCESS list header

⚠ The Access List can be selected at any time when in configuration level by holding ▣ key down for 3 seconds, then press ▲ or ▼ with ▣ still held down.

ACCESS LIST		'ACCS'				
Name	Scrolling Display	Parameter Description	Values Allowed		Default	Access Level
GOTO	GOTO	Allows you to change the access level of the controller. Passwords prevent unauthorised change	LEv.1	Operator level 1	LEv.1	Conf
			LEv.2	Operator level 2		
			LEv.3	Operator level 3		
			ConF	Configuration level		
LEV2.P	LEVEL 2 PASSCODE	The Level 2 passcode	0-9999 0 = no passcode will be requested		2	Conf
LEV3.P	LEVEL 3 PASSCODE	The Level 3 passcode			3	Conf
CONF.P	CONFIG PASSCODE	To set a Configuration level passcode			4	Conf
ID	CUSTOMER ID	To set the identification of the controller	0-9999			Conf
HOME	HOME DISPLAY See Note 1	To configure the parameter to be displayed in the lower line of the HOME display	Std	Setpoint	Std	Conf
			OP	Output demand		
			tr	Time remaining		
			ELAP	Time elapsed		
			AL 1	Alarm 1 setpoint		
			Ct	Current transformer		
			CLr	No parameter		
			tmr	Time remaining		
K.LOC	KEYBOARD LOCK	To limit operation of the front panel buttons when in operator levels. ☺ If ALL has been selected, then to restore access to the keyboard, power up the controller with the ▣ button held down and enter the configuration level passcode as described in section 3.2. This will take you to the Quick Code mode. Press ↺ to EXIT and select YES. The front panel buttons can then be operated as normal.	nonE	Unlocked	nonE	Conf
			ALL	All buttons locked		
			Edit	Edit keys locked See Note 2		
			mod	Mode keys locked See Note 3		
			mAn	Manual mode locked		
			StbY	Press ▲ and ▼ to toggle between normal operation and standby mode		
			tmr	Prevents Auto/Manual/Off but allow timer operation using ▲ and ▼		
COLD	COLD START ENABLE/ DISABLE	**Use this parameter with care.** When set to yes the controller will return to factory settings on the next power up	no	Disable		Conf
			YES	Enable		
STBY.T	STANDBY TYPE	Turn ALL outputs off when the controller is in standby mode. Typical use when event alarms are used to interlock a process.	AbSA	Absolute alarms to remain active	AbSA	Conf
			OFF	All alarms off in standby		
METER	METER CONFIGURATION See Note 4	To configure the analogue meter to indicate any one of the parameters listed. This is only applicable to 3208 and 3204 controllers.	OFF	Meter display disabled		
			HEAt	Heat Output demand		
			COOL	Cool output demand		
			w.SP	Working setpoint		
			PV	Process value		
			OP	Heat output demand		
			C.OP	Cool output demand		
			Err	Error (SP – PV)		
			AmPS	Output current		
			Lcur	Load current from CT		

Note 1 Home Display Configuration

StD In automatic control the display shows setpoint. In manual mode the display shows output power.

OP Output power is shown in both automatic and manual modes.

tr Timer time remaining

ELAP Timer elapsed time.

AL 1 First configured alarm setpoint

Ct CT current

CLr Blank display

tmr The display shows setpoint while the timer is not running and time remaining when the timer is active.

Note 2 Edit keys locked. Parameters cannot be changed but viewed only. However, it is possible to run, hold and reset timer and acknowledge alarms.

Note 3 Mode key locked. Timer run, hold, reset and Auto/Manual cannot be operated from the Mode key.

The following sections in this handbook describe the parameters associated with each subject. The general format of these sections is a description of the subject, followed by the table of all parameters to be found in the list, followed by an example of how to configure or set up parameters.

Note 4 Meter Configuration

HEAt The meter shows a representation of the heat output being applied by the control loop to the load. It is scaled between 0 and 100% full scale deflection.

OP The meter displays the current Control Output setting scaled between the low and high output power limits. In a motorised valve controller (option VC or VP) this is the 'inferred' position of the valve

COOL The meter shows a representation of the cool output being applied by the control loop to the load. It is scaled between 0 and 100% full scale deflection.

C.OP The meter displays the current output power setting scaled between -100 and 100%, so that a value of zero is centred in the display. This indicates whether the controller is currently applying heating or cooling.

w.SP The meter shows a representation of the current working setpoint, scaled between the setpoint high and low limits. It may be used to indicate at what point in the setpoint range the instrument is currently operating.

PU The meter displays the current Process Variable scaled between the range high and low values. Provides an indication of the current temperature relative to the range of a process.

Err The meter displays the process error (i.e. the difference between the current temperature and the setpoint), scaled between +10 degrees and -10 degrees. This provides a visual indication of whether the process is close to setpoint.

AmPS The meter shows a representation of the instantaneous current through a load monitored using a current transformer, scaled between 0 Amps and the configured range of the Current Transformer. It may be used to visually indicate the health of the heating elements, since in normal use it will tend to flick from a low reading when the heating is off, to a higher reading when the heating is on. If the needle does not return to a low value, the SSR may be conducting regardless of the logic signal driving it. If the needle does not reach the expected level it is likely that one or more of the heater elements has burned out.

Lcur The meter displays a representation of the On State Current in a load monitored by the current transformer option. In normal operation it will tend to remain static and provides an alternative means of monitoring the health of a heating element to the 'Amps' option.

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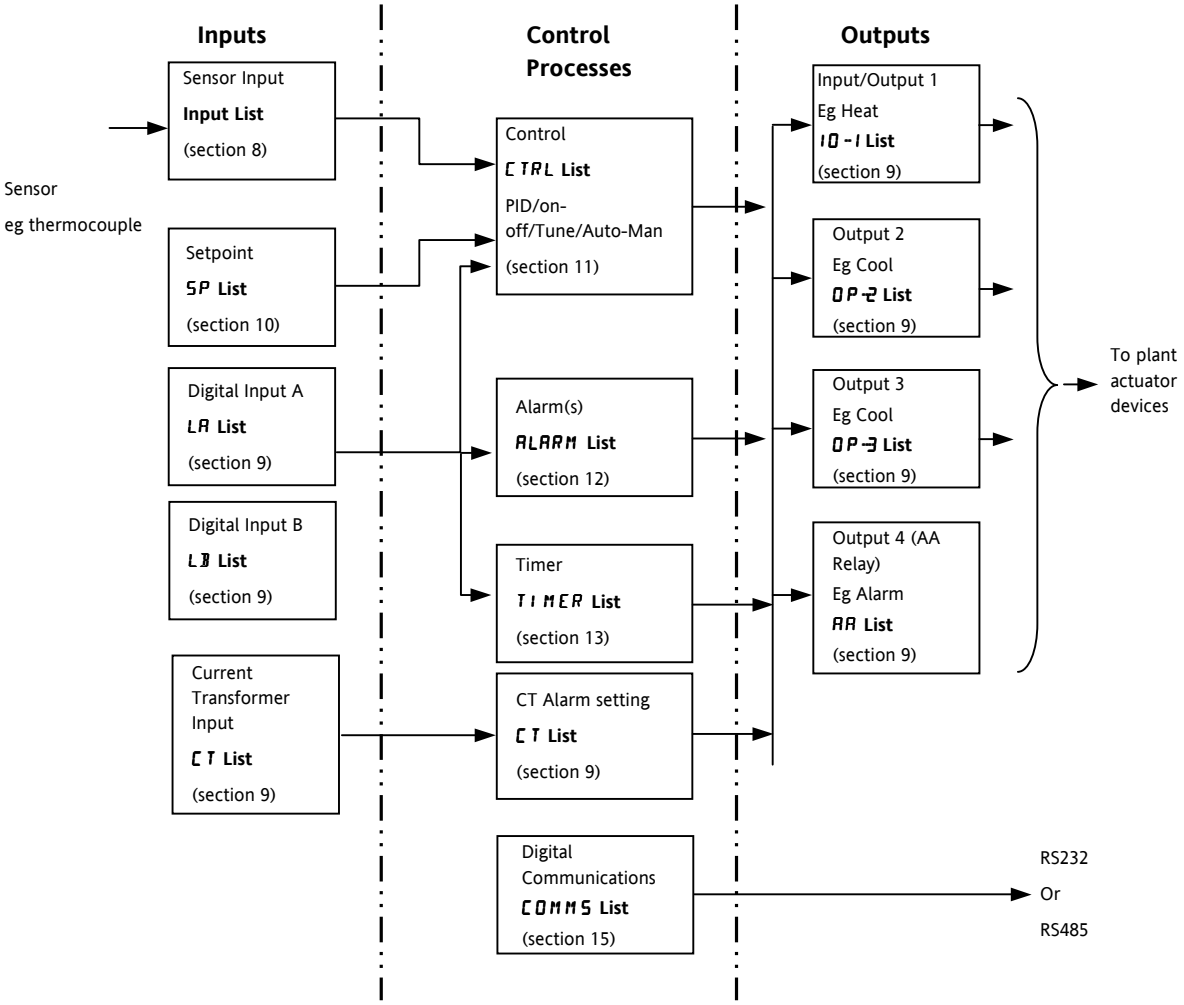
7. Controller Block Diagram

The block diagram shows the simple building blocks which make up the controller. Each block has a list of parameters headed by a list name. For example the 'Input List' contains parameters which define the input type.

The quick start code automatically sets the parameters to match the hardware.



The Temperature (or Process Value, PV) is measured by the sensor and compared with a Setpoint (SP) set by the user.

The purpose of the control block is to reduce the difference between SP and PV (the error signal) to zero by providing a compensating output to the plant via the output driver blocks.

The timer and alarms blocks may be made to operate on a number of parameters within the controller, and digital communications provides an interface to data collection and control.

The way in which each block performs 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 process which is to be controlled.

These parameters are found in lists and the name of each list corresponds with the name of the function block shown in the above diagram.

The above block diagram applies to 3208 and 3204 controllers.

For 3216 Output 3 and Logic Input B are not present.

For 3116 Logic Input List, CT Input List, Timer List, Digital Communications List, AA Relay List and Output 3 List are not present.

8. Temperature (or Process) Input

Parameters in the input list configure the input to match your sensor. These parameters provide the following features:-

Input Type and linearisation	Thermocouple (TC) and 3-wire resistance thermometer (RTD) temperature detectors Linear input (-10 to +80mV) through external shunt or voltage divider, mA assumes a 2.49Ω external shunt. See the table in section 8.1.1. for the list of input types available
Display units and resolution	The change of display units and resolution will all the parameters related to the process variable
Input filter	First order filter to provide damping of the input signal. This may be necessary to prevent the effects of excessive process noise on the PV input from causing poor control and indication. More typically used with linear process inputs.
Fault detection	Sensor break is indicated by an alarm message 'Sbr'. For thermocouple it detects when the impedance is greater than pre-defined levels; for RTD when the resistance is less than 12Ω.
User calibration	Either by simple offset or by slope and gain. See section 8.2. for further details.
Over/Under range	When the input signal exceeds the input span by more than 5% the PV will flash indicating under or over range. If the value is too high to fit the the number of characters on the display 'HHHH' or 'LLLL' will flash. The same indications apply when the display is not able to show the PV, for example, when the input is greater than 999.9°C with one decimal point.

8.1 Process Input Parameters

INPUT LIST	INPUT					
Name	Scrolling Display	Parameter Description	Value		Default	Access Level
IN.TYP	INPUT TYPE	Selects input linearisation and range	See section 8.1.1. for input types available			Conf L3 R/O
UNITS	DISPLAY UNITS	Display units shown on the instrument	none	No units - only for custom linearisation	°C	L3
			°C	Celsius		
			°F	Fahrenheit		
			°K	Kelvin		
			PErc	%		
DEC.P	DISPLAY POINTS	Decimal point position	nnnn	No DP	nnnn	Conf L3 R/O
			nnn.n	One DP		
			nn.nn	Two DP		
MV.HI	LINEAR INPUT HIGH	High limit for mV (mA) inputs	-10.00 to +80.00mV		80.00	Conf
MV.LO	LINEAR INPUT LOW	Low limit for mV (mA) inputs	-10.00 to +80.00mV		-10.00	Conf
RNG.HI	RANGE HIGH LIMIT	Range high limit for thermocouple RTD and mV inputs	From the high limit of the selected input type to the 'Low Range Limit' parameter minus one display unit.			Conf L3 R/O
RNG.LO	RANGE LOW LIMIT	Range low limit for thermocouple RTD and mV inputs	From the low limit of the selected input type to the 'High Range Limit' parameter minus one display unit.			Conf L3 R/O
PV.OFS	PV OFFSET	A simple offset applied to all input values. See section 8.2.	Generally one decimal point more than PV			L3
FILT.T	FILTER TIME	Input filter time	OFF to 100.0 seconds		1.6	L3
CJ.TYP	CJC TYPE	Configuration of the CJC type	Auto	Automatic	Auto	Conf and if T/C L3 R/O
			0°C	Fixed at 0°C		
			50°C	Fixed at 50°C		
SB.TYP	SENSOR BREAK TYPE	Defines the action which is applied to the output if the sensor breaks (open circuit)	oFF	No sensor break will be detected	on	Conf L3 R/O
			on	Open circuit sensor will be detected		
			LAt	Latching		
CJC.IN	CJC TEMPERATURE	Temperature measured at the rear terminal block. Used in the CJC calculation	Read only			Conf L3 R/O and if T/C
PV.IN	PV INPUT VALUE	Current measured temperature	Minimum display to maximum display range			Conf L3 R/O
MV.IN	MILLIVOLT INPUT VALUE	Millivolts measured at the rear PV Input terminals	xx.xx mV - read only			Conf L3 R/O

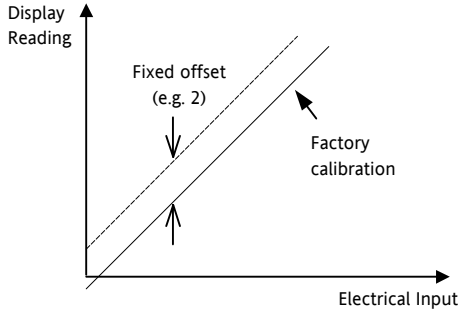
8.1.1 Input Types and Ranges

Input Type		Min Range	Max Range	Units	Min Range	Max Range	Units
J.tc	Thermocouple type J	-210	1200	°C	-238	2192	°F
K.tc	Thermocouple type K	-200	1372	°C	-238	2498	°F
L.tc	Thermocouple type L	-200	900	°C	-238	1652	°F
r.tc	Thermocouple type R	-50	1700	°C	-58	3124	°F
b.tc	Thermocouple type B	0	1820	°C	-32	3308	°F
n.tc	Thermocouple type N	-200	1300	°C	-238	2372	°F
t.tc	Thermocouple type T	-200	400	°C	-238	752	°F
S.tc	Thermocouple type S	-50	1768	°C	-58	3214	°F
Pt.d	Pt100 resistance thermometer	-200	850	°C	-238	1562	°F
mu	mV or mA linear input	-10.00	80.00				
Cms	Value received over digital communications (modbus address 203). This value must be updated every 5 seconds or the controller will show sensor break						

8.2 PV Offset

All ranges of the controller have been calibrated against traceable reference standards. This means that if the input type is changed it is not necessary to calibrate the controller. There may be occasions, however, when you wish to apply an offset to the standard calibration to take account of known errors within the process, for example, a known sensor error or a known error due to the positioning of the sensor. In these instances it is not advisable to change the reference (factory) calibration, but to apply a user defined offset.

PV Offset applies a single offset to the temperature or process value over the full display range of the controller and can be adjusted in Level 3. It has the effect of moving the curve up a down about a central point as shown in the example below:-



8.2.1 Example: To Apply an Offset:-

Connect the input of the controller to the source device which you wish to calibrate to

Set the source to the desired calibration value

The controller will display the current measurement of the value

If the display is correct, the controller is correctly calibrated and no further action is necessary. If you wish to offset the reading:-

Do This	Display	Additional Notes
1. Select Level 3 or Conf as described in Chapter 2. Then press ⊜ to select **'INPUT'**	INPUT	Scrolling display **'PROCESS INPUT LIST'**
2. Press ⟳ to scroll to **'PV.OFS'** 3. Press ▲ or ▼ to adjust the offset to the reading you require	2.0 PV.OFS	Scrolling display **'PV OFFSET'** In this case an offset of 2.0 units is applied

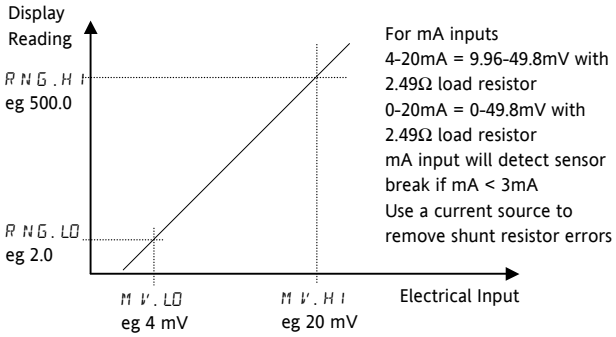
It is also possible to apply a two point offset which adjusts both low and high points. This is done in Level 3 using the CAL List, and the procedure is described in the Calibration section 16.

8.3 PV Input Scaling

Input scaling applies to the linear mV input range only. This is set by configuring the INPUT TYPE parameter to mV and has an input range of –10 to 80mV. Using an external burden resistor of 2.49Ω, the controller can be made to accept 4-20mA from a current source. Scaling of the input will match the displayed reading to the electrical input levels from the transducer. PV input scaling can only be adjusted in Configuration level and is not provided for direct thermocouple or RTD inputs.

The graph below shows an example of input scaling, where it is required to display 2.0 when the input is 4mV and 500.0 when the input is 20mV .

If the input exceeds ±5% of the mV.Lo or mV.Hi settings, sensor break will be displayed.



8.3.1 Example: To Scale a Linear Input

Select Configuration level as described in Chapter 2. Then:-

Do This	Display	Additional Notes
1. Then press ⊜ to select 'INPUT'	INPUT	Scrolling display 'PROCESS INPUT LIST'
2. Press ⟳ to scroll to 'IN.TYP' 3. Press ▲ or ▼ to 'mV'	mV IN.TYP	Scrolling display 'INPUT TYPE'
4. Press ⟳ to scroll to 'MV.HI' 5. Press ▲ or ▼ to '20.00'	20.00 MV.HI	Scrolling display 'LINEAR INPUT HIGH'
6. Press ⟳ to scroll to 'MV.LO' 7. Press ▲ or ▼ to '4.00'	4.00 MV.LO	Scrolling display 'LINEAR INPUT LOW'
8. Press ⟳ to scroll to 'RNG.HI' 9. Press ▲ or ▼ to '500.0'	500.0 RNG.HI	In operator level the controller will read 500.0 for a mV input of 20.00
10. Press ⟳ to scroll to 'RNG.LO' 11. Press ▲ or ▼ to '2.0'	2.0 RNG.LO	In operator level the controller will read 2.0 for a mV input of 4.00

9. Input/Output

This section refers to:-

- Digital Inputs
- Current Transformer Input
- Relay/Logic Outputs.

The availability of these is shown in the following table:-

Name	Availability				Output	Input	Output Function	I/O Sense	Beacon (lit when active)	Terminal
	3116	3216	3208	3204						
I/O-1	✓	✓	✓	✓	✓	✓	Heat Cool Alarm Retransmission (setpoint, temperature, output)	Normal Inverted	OP1	1A, 1B
OP-2	✓	✓	✓	✓	✓		Heat Cool Alarm Retransmission (setpoint, temperature, output)	Normal Inverted	OP2	2A, 2B
OP-3			✓	✓	✓		Heat Cool Alarm Retransmission (setpoint, temperature, output)	Normal Inverted	OP3	3A, 3B
OP4 (AA Relay)		✓	✓	✓	✓		Heat Cool Alarm	Normal Inverted	OP4	AA, AB, AC
LA		✓	✓	✓		✓		Normal Inverted		C, LA
LB			✓	✓		✓		Normal Inverted		LB, LC
CT		✓	✓	✓		✓				C, CT
Digital Comms		✓	✓	✓						HD, HE, HF

9.1 Input/Output Parameters

9.1.1 Input/Output 1 List (IO-1)

May be configured as relay, logic or DC output or to accept a digital input from external switch contacts. Connections are made to terminals 1A and 1B. OP1 beacon is operated from the IO-1 channel when it is configured as an output.

INPUT/OUTPUT LIST 1 'IO -1'						
Name	**Scrolling Display**	**Parameter Description**	**Value**		**Default**	**Access Level**
I..IO	I/O 1 TYPE	I/O channel 1 hardware type defined by the hardware fitted	none	No input or output fitted	As ordered	Read only
			dCOP	DC output (see note 1)		
			rELY	Relay output		
			LIO	Logic Input/Output		
I.FUNC	I/O 1 FUNCTION	I/O channel function. If the instrument is ordered as valve positioner (codes VC or VP), only options available are , none, d.out, UP, or dwn **Note: If output 1 is set to UP ensure the other valve position output is set to dwn and vice versa**	none	Disabled. If disabled no further parameters are shown	HEAt	Conf
			d.out	Digital output		
			UP	Valve open codes VC and VP only		
			dwn	Valve close codes VC and VP only		
			HEAt	Heat output		
			CooL	Cool output		
			di n	Digital input if 'I.IO' = 'LIO'		
			w.SP	Working setpoint		Shown if I/O 1 TYPE = dcOP Retransmission
			PV	Process variable (temperature)		
			OP	Output power demand		
I.SRC.A	I/O 1 SOURCE A	These parameters only appear when the channel function is a Digital output, i.e. 1.FUNC = d.out Selects an event status to be connected to the output channel. The output status is the result of an OR of Src A, Src B, Src C, and Src D Up to four events can, therefore, operate the output See section 9.1.4	none	No event connected to the output	none	Conf
I.SRC.B	I/O 1 SOURCE B		AL 1	Alarm 1		
I.SRC.C	I/O 1 SOURCE C		AL2	Alarm 2		
			AL3	Alarm 3		
I.SRC.D	I/O 1 SOURCE D		AL4	Alarm4		
			ALLA	All alarms		
			nwAL	Any new alarm		
			CtAL	CT alarm, load, leak & overcurrent		
			Lbr	Loop break alarm		
			Sbr	Sensor break alarm		
			t.End	Timer end status		
			trun	Timer run status		
			mAn	Manual status		
			rmt.F	Remote fail - see section 9.1.2.		
			PwrF	Power fail		
			PrG.E	Programmer event. See also section 13.5.4.		
I.DI.IN	DIGITAL INPUT FUNCTION	This parameter is only applicable to I/O 1 and only appears if the channel function is a Digital IP i.e. 1.FUNC = di n Only one function may be activated by a physical input	none	Input not used	AcAL	Conf
			AcAL	Alarm acknowledge		
			SP2	Setpoint 2 select		
			Loc.b	Front keypad disable (keylock)		
			trES	Timer/programmer reset		
			trun	Timer/programmer run		
			trrS	Timer/programmer run/reset. Make to run, break to reset		
			tHLd	Timer/programmer hold		
			mAn	Manual status		
			Sby	Standby mode. In this mode control outputs go to zero demand		
			rmt	Remote digital setpoint select		
			rEc	Recipe select through IO1 digital input		
			UP	Remote key 'Up'		
			dwn	Remote key 'Down'		

1.PLS	OUTPUT 1 MINIMUM PULSE TIME	Minimum output on/off time. Only applies to time proportioning outputs and prevents relays from switching too rapidly	0.0 to 150.0	Auto or 1.0 to 150.0 seconds Auto = 110mS	5.0 sec for relay. Auto for logic	Conf
1SENS	I/O 1 SENSE	To configure the sense of the input or output channel	nor InU	Normal See also section 9.1.3. Inverted See also section 9.1.3.	nor	Conf
1.RNG	DC OUTPUT RANGE	To configure 0-20mA or 4-20mA output Only appears if the output module is DC output	0.20 4.20	0-20mA output 4-20mA output		L3

Note 1:-

A DC output may require calibration. This is described in section 16.3.5.

9.1.2 Remote Digital Setpoint Select and Remote Fail

These parameters were added in software version 1.11 and are associated with the retransmission of remote setpoint through master comms (see section 15.2.1). 'rmt' allows the remote setpoint to be selected via a digital input and 'rmt.F' is a flag which is set if no comms activity is detected for 5 seconds or more when writing to the remote setpoint. The flag is reset when writing to the remote setpoint resumes.

9.1.3 Sense

If the module is an output, 'normal' means a relay output is energised for 100% PID demand. For a heating or cooling output, set this parameter to '*nor*'.

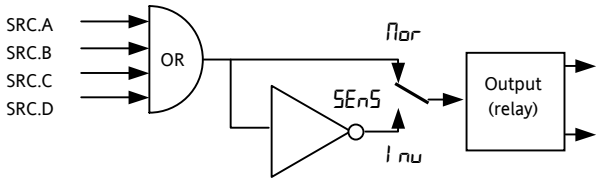
'Inverted' means a relay output is energised for 0% PID demand

For an alarm output set this parameter to '*Inu*' so that it de-energises to the alarm state.

If the module is an input, 'normal' means the function is activated when the input contact is closed, and 'inverted' means the function is activated when the input contact is open.

9.1.4 Source

The four parameters SOURCE A, SOURCE B, SOURCE C, and SOURCE D appear when the output is configured as a digital output i.e. '*-.FUNC*' = '*d.Out*' and provide the facility to connect up to four alarms or events to operate a single output (normally configured as a relay). If any one of the events becomes true then the output relay will operate.



9.1.5 Power Fail

An output, configured as a digital output, can be made to operate following a power fail. It can be acknowledged in the same manner as an alarm but no alarm message is given.

9.1.6 Example: To Configure IO-1 Relay to Operate on Alarms 1 and 2:-

Do This	Display	Additional Notes
1. From any display, press ▤ as many times as necessary to select '*IO -1*'	IO-1	Scrolling display '*IO - 1 LIST*'
2. Press ↻ to scroll to '*1.1D*'	rELY 1.1D	This is the identification of the hardware fitted and cannot be adjusted.
3. Press ↻ to scroll to '*1.FUNC*' 4. Press ▲ or ▼ to select '*d.out*'	d.out 1.FUNC	The output is configured as a digital output function. Scrolling display '*IO 1 FUNCTION*'
5. Press ↻ to scroll to '*1.SRC.A*' 6. Press ▲ or ▼ to select the event which you want to operate the output, eg '*AL.1*'	AL 1 1.SRCA	The output will activate if either alarm 1 or alarm 2 occur . Scrolling display '*IO 1 SOURCE A*'
7. If a second event is required to operate the same output, press ↻ to select '*1.SRC.B*' 8. Press ▲ or ▼ to select the second event which you want to operate the output, eg '*AL2*'	AL 2 1.SRCB	Scrolling display '*IO 1 SOURCE B*' Continue to select up to four events if required using *1.SRC.C* and *1.SRC.D*
9. Press ↻ to scroll to '*1.SENS*' 10. Press ▲ or ▼ to select '*Inu*'	Inu 1.SENS	'Inverted' means a relay output is energised for 0% PID demand 'Normal' means a relay output is energised for 100% PID demand Scrolling display '*IO 1 SENSE*'

9.1.7 Output List 2 (OP-2)

This is an optional normally open relay or logic output and is available on terminals 2A and 2B. The way in which this output operates is determined by parameters in the OP- 2 List. OP2 beacon is operated from this output channel.

OUTPUT LIST 2 'OP-2'						
Name	**Scrolling Display**	**Parameter Description**	**Value**		**Default**	**Access Level**
2.I D	OUTPUT 2 TYPE	Output channel 2 hardware type	none	Output not fitted	As ordered	Read only
			rELY	Relay output		
			L.OP	Logic output (3200 only)		
			dC.OP	0-20mA output. See note 1		
2.FUNC	FUNCTION	Output channel 2 function If the instrument is ordered as valve positioner (codes VC or VP), only options available are , none, d.out, UP, or dwn **Note: If output 2 is set to UP ensure the other valve position output is set to dwn and vice versa**	none	Disabled. If disabled no further parameters are shown	d.out	Conf
			d.out	Digital output		
			UP	Valve open codes VC and VP only		
			dwn	Valve close codes VC and VP only		
			HEAt	Heat output		
			CooL	Cool output		
			w.SP	Working setpoint		Shown if I/O 2 TYPE = dc.OP Retransmission
			PV	Process variable (temperature)		
			OP	Output power demand		
2.SRC.A	I/O 2 SOURCE A	These parameters only appear when the channel function is a Digital OP, i.e. 2.FUNC = d.Out Selects an event status to be connected to the output channel. The output status is the result of an OR of Src A, Src B, Src C, and Src D Up to four events can, therefore, operate the output See section 9.1.4.	none	No event connected to the output	none	Conf
2.SRC.B	I/O 2 SOURCE B		AL 1	Alarm 1 *		
			AL2	Alarm 2 *		
2.SRC.C	I/O 2 SOURCE C		AL3	Alarm 3 *		
			AL4	Alarm4 *		
2.SRC.D	I/O 2 SOURCE D		ALL.A	All alarms		
			nw.AL	Any new alarm		
			Ct.AL	CT alarm, load, leak & overcurrent		
			Lbr	Loop break alarm		
			Sbr	Sensor break alarm		
			t.End	Timer end status		
			t.run	Timer run status		
			mAn	Manual status		
			rmt.F	Remote fail - see section 9.1.2.		
			Pwr.F	Power fail		
			PrG.E	Programmer event. See also section 13.5.4.		
2.PLS	OUTPUT MINIMUM PULSE TIME	Minimum output on/off time. Only applies to time proportioning outputs and prevents relays from switching too rapidly	0.0 to 150.0	Auto or 1.0 to 150.0 seconds Auto = 110mS	5.0 sec for relay Auto for logic	Conf
2.SENS	SENSE	To configure the polarity of output channel 2	nor	Normal See also section 9.1.3.	nor	Conf
			Inv	Inverted See also section 9.1.3.		
2.RNG	DC OUTPUT RANGE	To configure 0-20mA or 4-20mA output Only appears if the output module is DC output	0.20	0-20mA output		L3
			4.20	4-20mA output		

* The mnemonic for the alarm will change depending upon the alarm configuration.

Note 1:-

A DC output may require calibration. This is described in section 16.3.5.

9.1.8 Output List 3 (OP-3)

This is an optional normally open relay or 0-20mA dc output and is available on terminals 3A and 3B on 3208 and 3204 only. The way in which this output operates is determined by parameters in the OP- 3 List. OP3 beacon is operated from the this output channel.

OUTPUT LIST 3 'OP-3'						
Name	**Scrolling Display**	**Parameter Description**	**Value**		**Default**	**Access Level**
3.I D	OUTPUT 3 TYPE	Output channel 3 hardware type	nonE	Output not fitted	As ordered	Read only
			rELY	Relay output		
			dC.OP	0-20mA output. See note 1		
3.FUNC	FUNCTION	Output channel 3 function If the instrument is ordered as valve positioner (codes VC or VP), only options available are , nonE, d.outt, UP, or dwn **Note: If output 3 is set to UP ensure the other valve position output is set to dwn and vice versa**	nonE	Disabled. If disabled no further parameters are shown	d.outt	Conf
			UP	Valve open codes VC and VP only		
			dwn	Valve close codes VC and VP only		
			HEAt	Heat output		
			CoolL	Cool output		
			w.SP	Working setpoint re-transmission		Shown if I/O 3 TYPE = dc.OP Retransmission
			PU	Process variable re-transmission		
			OP	Output re-transmission		
3.SRC.A	I/O 3 SOURCE A	These parameters only appear when the channel function is a Digital OP, i.e. 3.FUNC = d.Out Selects an event status to be connected to the output channel. The output status is the result of an OR of Src A, Src B, Src C, and Src D Up to four events can, therefore, operate the output See section 9.1.4.	nonE	No event connected to the output	nonE	Conf
3.SRC.B	I/O 3 SOURCE B		AL 1	Alarm 1 *		
3.SRC.C	I/O 3 SOURCE C		AL2	Alarm 2 *		
3.SRC.D	I/O 3 SOURCE D		AL3	Alarm 3 *		
			AL4	Alarm4 *		
			ALLA	All alarms		
			nw.AL	Any new alarm		
			CtAL	CT alarm, load, leak & overcurrent		
			Lbr	Loop break alarm		
			Sbr	Sensor break alarm		
			tEnd	Timer end status		
			trun	Timer run status		
			mAn	Manual status		
			rmtF	Remote fail - see section 9.1.2.		
			PwrF	Power fail		
			PrGE	Programmer event. See also section 13.5.4.		
3.PLS	OUTPUT MINIMUM PULSE TIME	Minimum output on/off time. Only applies to time proportioning outputs and prevents relays from switching too rapidly	0.0 to 150.0	Auto or 1.0 to 150.0 seconds Auto = 110mS	5.0 sec for relay Auto for logic	Conf
3.SENS	SENSE	To configure the polarity of output channel 3	nor	Normal See also section 9.1.3.	nor	Conf
			Inv	Inverted See also section 9.1.3.		
3.RNG	DC OUTPUT RANGE	DC output calibration. Only shown if 3.I D = dC.OP	4.20	4-20mA	4.20	Conf
			0.20	0-20mA		

Note 1:-

A DC output may require calibration. This is described in section 16.3.5.

9.1.9 AA Relay (AA) (Output 4)

This is a changeover relay and is optionally available in 3200 controllers. It is available as standard in 3116 controllers. Connections are made to terminals AA, AB, and AC. The way in which this relay operates is determined by parameters in the AA List. OP4 beacon is operated from the AA relay output channel.

AA RELAY 'AA'						
Name	**Scrolling Display**	**Parameter Description**	**Value**		**Default**	**Access Level**
4.TYPE	OUTPUT 4 TYPE	Output channel 4 hardware type	rELY	Relay output	rELY	Read only
4.FUNC	FUNCTION	Output channel 4 function If the instrument is ordered as valve positioner (codes VC or VP), only options available are , nonE, d.out, UP, or dwn **Note: If output 4 is set to uP ensure the other valve position output is set to dwn and vice versa**	nonE	Disabled	d.OUt	Conf
			d.OUt	Digital output		
			UP	Valve open codes VC and VP only		
			dwn	Valve close codes VC and VP only		
			HEAt	Heat output		
			CooL	Cool output		
4.SRC.A	I/O 4 SOURCE A	These parameters only appear when the channel function is a Digital OP, i.e. 4.FUNC = d.Out Selects an event status to be connected to the output channel. The output status is the result of an OR of Src A, Src B, Src C, and Src D Up to four events can, therefore, operate the output See section 9.1.4.	nonE	No event connected to the output	nonE	Conf
4.SRC.B	I/O 4 SOURCE B		AL 1	Alarm 1 *		
			AL2	Alarm 2 *		
4.SRC.C	I/O 4 SOURCE C		AL3	Alarm 3 *		
			AL4	Alarm4 *		
4.SRC.D	I/O 4 SOURCE D		ALL.A	All alarms		
			nw.AL	Any new alarm		
			Ct.AL	CT alarm, load, leak & overcurrent		
			Lbr	Loop break alarm		
			Sbr	Sensor break alarm		
			t.End	Timer end status		
			t.run	Timer run status		
			mAn	Manual status		
			rmt.F	Remote fail - see section 9.1.2.		
			Pwr.F	Power fail		
			PrG.E	Programmer event. See also section 13.5.4.		
4.PLS	OUTPUT MINIMUM PULSE TIME	Minimum output on/off time. Only applies to time proportioning outputs and prevents relays from switching too rapidly	0.0 to 150.0	0 to 150 seconds	5.0 sec	Conf
4.SENS	SENSE	To configure the polarity of output channel 4	nor	Normal See also section 9.1.3..	nor	Conf
			Inv	Inverted See also section 9.1.3.		

* The mnemonic for the alarm will change depending upon the alarm configuration.

9.1.10 Digital Input Parameters

Digital Input A. This is an optional input wired to terminals C and LA (not available in 3116), The input is typically from a voltage free contact, which can be configured to operate a number of functions as determined by parameters in the LA List.

Note: Terminal C is common to the CT input and is, therefore, not isolated from the CT.

Digital Input B. This is wired to terminals LB and LC and is available in 3208 and 3204 controllers only.

The parameter lists are identical as shown below:-

LOGIC INPUT LIST 'LA' / 'LB'						
Name	**Scrolling Display**	**Parameter Description**	**Value**		**Default**	**Access Level**
L.TYPE	LOGIC INPUT TYPE	Input channel type	LJP	Logic input	As order code	Conf Read only
L.D.IN	LOGIC INPUT FUNCTION	To configure the function of the digital input	nonE	Input not used	AcAL	Conf
			AcAL	Alarm acknowledge		
			SP2	Setpoint 2 select		
			Loc.b	Front keypad disable		
			t.rES	Timer/programmer reset		
			t.run	Timer/programmer run		
			t.rrS	Timer/programmer run/reset. Make to run, break to reset		
			t.HLd	Timer/programmer hold		
			mAn	Manual status		
			Sby	Standby mode. In this mode control outputs go to zero demand		
			rmt	To allow a remote setpoint to be selected through the LA digital input		
			rEc	Recipe select through IO1 digital input		
			UP	Remote key 'Up'		
			dwn	Remote key 'Down'		
L.SENS	LOGIC INPUT SENSE	To configure the polarity of the input channel	nor	Normal	nor	Conf
			Inu	Inverted		
3.RNG	DC OUTPUT RANGE	To configure 0-20mA or 4-20mA output Only appears if the output module is DC output	0.20	0-20mA output		L3
			4.20	4-20mA output		

9.2 Current Transformer Input Parameters

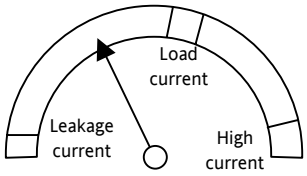
This is optional on 3200 controllers and can measure, via an external current transformer, the current flowing through the electrical load when the heat output is 'on' (load current) and also when it is 'off' (leakage current). This input is not available on 3116 controllers.

Alarm — If the load current is lower than a threshold limit or the leakage current is higher than a threshold limit, then an alarm triggers. The hysteresis to exit from either of these alarm conditions is fixed at 2% of the current transformer span.

Full scale value — Selectable from 10 to 1000A

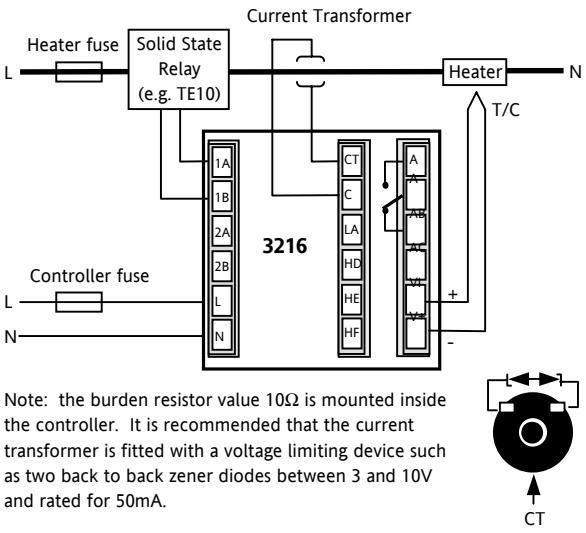
CURRENT TRANSFORMER LIST 'CT-INP'						
Name	**Scrolling Display**	**Parameter Description**	**Value**		**Default**	**Access Level**
CT.ID	MODULE TYPE	CT module identity	CtIn	CT input circuit fitted	As order code	Conf read only
CT.SRC	CT SOURCE	Selects the output controlling the current measured by the CT input. The source can only be selected if the output has been configured for Heat or Cool	none IO-1 OP-2 AA	None Input/output 1 Output 2 AA Relay		
CT.RNG	CT RANGE	Sets the CT inputs range	0 to CT full scale value (1000)		As order code	Conf
CT.LAT	CT ALARM LATCH TYPE	To configure the latch mode of the CT input alarm. A description of alarm latching is given in the alarm section	none Auto mAn	No latching Latched with automatic reset Latched with manual reset	no	Conf if CT alarm enabled
LO.AM	LOAD CURRENT THRESHOLD	Load open circuit alarm threshold – low alarm	OFF to CT full scale value (settable to 3000)			Read only
LK.ALM	LEAK CURRENT THRESHOLD	Leakage current in the off state alarm threshold – high alarm	OFF to CT full scale value (settable to 3000)			Read only
HC.AM	OVER CURRENT THRESHOLD	Overcurrent threshold – high alarm	OFF to CT full scale value (settable to 3000)			
LO.AMP	LOAD CURRENT	Measured load current				L3 if CT input enabled
LK.AMP	LEAK CURRENT	CT input leakage current				L3 if CT input enabled

9.2.1 Analogue Representation of Current Alarms



9.2.2 Current Transformer Wiring Diagram

This diagram shows an example of wiring for a CT input.



Note: the burden resistor value 10Ω is mounted inside the controller. It is recommended that the current transformer is fitted with a voltage limiting device such as two back to back zener diodes between 3 and 10V and rated for 50mA.

10. Setpoint Generator

The setpoint generator provides the target value at which it is required to control the process. It is shown in the controller block diagram, Section 7. The following functions are available:-

Number of setpoints	Two. setpoint 1 (SP1) and setpoint 2 (SP2). Each may be selected by a dedicated parameter or externally switched via a digital input suitably configured as described in section 9.1.10. An application example might be to use SP1 for normal operation and SP2 to maintain a low overnight temperature.
Setpoint limits	High and low limits can be pre-set to prevent inadvertent adjustment of the setpoint beyond that allowable for the process
Set point rate limit	Allows the setpoint to change from its current level to a new level at a fixed rate.
Direct setpoint access	The selected setpoint is accessible directly from the HOME display by pressing the raise or lower buttons

10.1 Setpoint Parameters

SETPOINT LIST 'SP'						
Name	**Scrolling Display**	**Parameter Description**	**Value**		**Default**	**Access Level**
SP.SEL	SETPOINT SELECT	This enables the main or secondary setpoint to be selected form the front panel buttons	SP 1	Setpoint 1 selected	SP 1	L3
			SP2	Setpoint 2 selected		
SP 1	SETPOINT 1	Main or normally selected setpoint	Low to high setpoint limits		0	L3
SP2	SETPOINT 2	Secondary or standby setpoint	Low to high setpoint limits		0	L3
SP.HI	SETPOINT HIGH LIMIT	Maximum allowable setpoint setting	Setpoint low limit (SP.LO) to high range limit. Also limited by the RNG.HI and RNG.LO parameters		Range High Limit	L3
SP.LO	SETPOINT LOW LIMIT	Minimum allowable setpoint setting	Low range limit to Setpoint high limit (SP.HI). Also limited by the RNG.HI and RNG.LO parameters		Range Low Limit	L3
RM . SP	REMOTE SETPOINT	Value of the remote setpoint over digital communications. If no value received within 5 seconds fallback is to local setpoint				Read only
LR	REMOTE SETPOINT SELECT	To select the remote digital communications setpoint	no	Not selected	no	Conf
			YES	Selected		
SP.RAT	SETPOINT RATE LIMIT	Limits the rate of change of the setpoint. Operates on both SP1 and SP2	Step change (OFF) or 0.1 to 3000 display units per minute. Resolution one decimal place more than PV		OFF	L3
RAMPU	SETPOINT RAMP UNITS	To set the units for the setpoint rate limit	min	Minutes	min	L3
			Hour	Hours		
			SEC	Seconds		
LOC.T	LOCAL SETPOINT TRIM	To apply a fixed offset to the setpoint in use	-199.9 to 300.0		0.0	L3

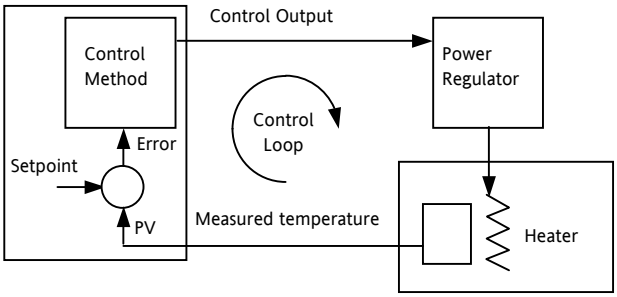
10.2 Example: To Set Ramp Rate

This is available in Level 3.

Do This	The Display You Should See	Additional Notes
1. Press ⓘ as many times as necessary to select **'SETPOINT LIST'**		
2. Press ↻ as many times as necessary to scroll to **'SP 1'** 3. Press ▲ or ▼ to adjust setpoint 1		This step can be repeated for the lower setpoint limit 'SP.LO'
4. Press ↻ to scroll to **'SP2'** 5. Press ▲ or ▼ to adjust setpoint 2		
6. Press ↻ as many times as necessary to scroll to **'SP.RAT'** 7. Press ▲ or ▼ to set the rate at which you require the setpoint to change		Whenever the setpoint is changed, the controller will ramp from its current setpoint to the new value at the rate set in units per second, minute or hours as set by the 'RAMPU' parameter. It will also change at the same rate when switching between SP2 and SP1 (but not between SP1 and SP2) The setpoint rate resolution is generally one decimal point more than setpoint/PV resolution

11. Control

Parameters in this section allow the control loop to be set up for optimum control conditions. An example of a temperature control loop is shown below:-



The actual temperature measured at the process (PV) is connected to the input of the controller. This is compared with a setpoint (or required) temperature (SP). If there is an error between the set and measured temperature the controller calculates an output value to call for heating or cooling. The calculation depends on the process being controlled but normally uses a PID algorithm. The output(s) from the controller are connected to devices on the plant which cause the heating (or cooling) demand to be adjusted which in turn is detected by the temperature sensor. This is referred to as the control loop or closed loop control.

11.1 PID Control

The PID controller consists of the following parameters:-

Parameter	Meaning or Function
Proportional Band	The proportional term, in display units or %, delivers an output which is proportional to the size of the error signal.
Integral Time	Removes steady state control offsets by ramping the output up or down in proportion to the amplitude and duration of the error signal.
Derivative Time	Determines how strongly the controller will react to the rate of change in the measured value. It is used to prevent overshoot and undershoot and to restore the PV rapidly if there is a sudden change in demand.
High Cutback	The number of display units, above setpoint, at which the controller will increase the output power, in order to prevent undershoot on cool down.
Low Cutback	The number of display units, below setpoint, at which the controller will cutback the output power, in order to prevent overshoot on heat up.
Relative Cool Gain	Only present if cooling has been configured. Sets the cooling proportional band, which equals the heat proportional band value divided by the cool gain value.

11.2 Tuning

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

Stable, 'straight-line' control of the PV at setpoint without fluctuation

No overshoot, or undershoot, of the PV setpoint

Quick response to deviations from the setpoint caused by external disturbances, thereby rapidly restoring the PV to the setpoint value.

Tuning involves calculating and setting the value of the parameters listed in the above table.

11.2.1 Automatic Tuning

This controller uses a one-shot tuner which automatically sets up the initial values of the parameters listed in the table on the previous page.

11.2.2 One-shot Tuning

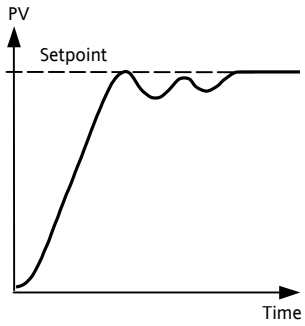
The 'one-shot' tuner works by switching the output on and off to induce an oscillation in the measured value. From the amplitude and period of the oscillation, it calculates the tuning parameter values.

If the process cannot tolerate full heating or cooling being applied, then the levels can be restricted by setting the high power limit ('OP.HI') and low power limit ('OP.LO'). 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 conditions and with the SP close to the normal operating level. This allows the tuner to calculate more accurately the low cutback and high cutback values which restrict the amount of overshoot, or undershoot.

Typical automatic tuning cycle



Autotune starts 1 minute after being turned on to determine steady state conditions.

Tuning normally takes place at a PV which has a value of setpoint x 0.7.

The power is automatically turned on and off to cause oscillations.

From the results the values shown in the table are calculated

11.2.3 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 PV (for example, under start-up conditions).

If either low cutback, or high cutback, is set to 'Auto' the values are fixed at three times the proportional band, and are not changed during automatic tuning.

To tune the cutback values, first set them to values other than Auto, then perform a tune as usual.

11.2.4 Manual Tuning

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

With the process at its normal running conditions:

Set the Integral Time and the Derivative Time to OFF.

Set High Cutback and Low Cutback to 'Auto'.

Ignore the fact that the PV may not settle precisely at the setpoint.

If the PV is stable, reduce the proportional band so that the PV just starts to oscillate. If PV 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 'P' and the period of oscillation 'T'.

Set the proportional band, integral time and derivative time parameter values according to the calculations given in the table below:-

Type of control	Proportional band (P)	Integral time (I) seconds	Derivative time (D) seconds
Proportional only	2xB	OFF	OFF
P + I	2.2xB	0.8xT	OFF
P + I + D	1.7xB	0.5xT	0.12xT

11.2.5 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 PV, then manually set the cutback parameters.

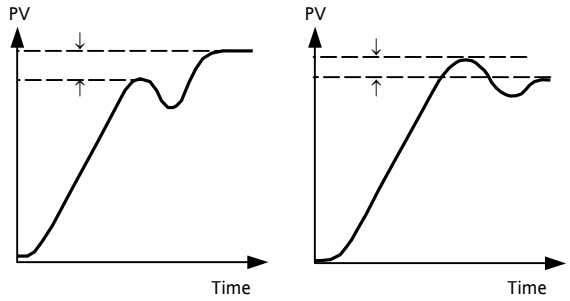
Proceed as follows:

Set the low and high cutback values to three proportional bandwidths (that is to say, CB.HI = CB.LO = 3 x PB).

Note the level of overshoot, or undershoot, that occurs for large PV changes (see the diagrams below).

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

Example (a) Example (b)



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

11.3 Integral Action and Manual Reset

In a full three-term controller (that is, a PID controller), the integral term automatically removes steady state errors from the setpoint. If the controller is set as a P or PD controller, the integral term will be set to 'OFF'. Under these conditions the measured value may not settle precisely at setpoint. The Manual Reset parameter (MR) 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.

11.4 Relative Cool Gain

The proportional band parameter 'PB' adjusts the proportional band for the heating output. Relative cool gain adjusts the cooling proportional band relative to the heating proportional band. If the rate of heating and rate of cooling are widely different it may be necessary to manually adjust Relative Cool Gain to achieve the optimum settings for the cooling proportional band.

(This parameter is set automatically when Autotune is used). A nominal setting of around 4 is often used.

11.5 Control Action

When set to reverse (rEv) the output increases when the PV is below setpoint. This is the best setting for heating control.

For cooling control only set to direct (dIR).

11.6 On/Off Control

On/Off control simply turns heating power on when the temperature is below setpoint and off when it is above setpoint. If cooling is used, cooling power is turned on when the temperature is above setpoint and off when it is below. The outputs of such a controller will normally be connected to relays – hysteresis may be set in the same way as described in the Alarms section to prevent relay chatter or to provide a delay in the control output action.

11.7 Valve Position Control

In the 3200 series programmer/controllers two relay or logic outputs may be configured to drive a valve in the open direction (UP) or the close direction (dwn) via a reversing motor drive. It operates in bounded mode and does not require a feedback from a potentiometer to define the valve

position. The control is performed by delivering an Up pulse, a Down pulse or no pulse at all in response to the control demand signal via the relay or logic outputs.

11.8 Loop Break Time

The loop is considered to be broken if the PV does not respond to a change in the output. Since the time of response will vary from process to process the Loop Break Time parameter allows a time to be set before a loop break alarm is initiated. In these circumstances the output power will drive to high or low limit. For a PID controller, if the PV has not moved by 0.5 x Pb in the loop break time the loop is considered to be in break. The loop break time is set by the Autoune, a typical value is 12 x Td. For an On/Off controller LBT is not shown and loop break alarm is inhibited.

11.9 Cooling Algorithm

The method of cooling may vary from application to application.

For example, an extruder barrel may be cooled by forced air (from a fan), or by circulating water or oil around a jacket. The cooling effect will be different depending on the method. The cooling algorithm may be set to linear where the controller output changes linearly with the PID demand signal, or it may be set to water, oil or fan where the output changes non-linearly against the PID demand. The algorithm provides optimum performance for these methods of cooling.

11.10 Control Parameters

The following table shows the parameters available.

CONTROL LIST 'CTRL'					
Parameter Name	Parameter Description (Scrolling Display)	Value		Default	Access Level
CTRL.H	HEATING TYPE	PID	PID	As order code	Conf
		oFF	Heating off		
		on.oF	On/Off		
		mtr	Valve position control		
CTRL.C	COOLING TYPE This is not available if the instrument is a valve position controller	oFF	Cooling disable	oFF	Conf
		PID	PID		
		on.oF	On/Off		
CTRL.A	CONTROL ACTION	rEu	Reverse acting. Output decreases as PV increases	rEu	Conf
		dir	Direct acting. Output increases as PV decreases		
PB.UNT	PROPORTIONAL BAND UNITS	EnG	In engineering units		
		PErc	In percent		
ATUNE	AUTO-TUNE ENABLE	OFF	Autotune off	OFF	L3
		On	Set to 'on' to start auto-tuning		
PB	PROPORTIONAL BAND	0.1 t 9999 display units or 1 to 999.9% if proportional band expressed as %		20	L3
TI	INTEGRAL TIME	OFF to 9999 seconds		360 sec	L3
TD	DERIVATIVE TIME	OFF to 9999 seconds TD defaults to OFF for valve position control		60 sec	L3
R2G	RELATIVE COOL GAIN See also section 11.4	0.1 to 10.0		1.0	L3
CBHI	CUTBACK HIGH See also section 11.2.5.	Auto or 1to 3000 display units		Auto = 3xPb	L3
CBLO	CUTBACK LOW See also section 11.2.5.	Auto or 1 to 3000 display units		Auto = 3XPb	L3
MR	MANUAL RESET	0 to 100% (heat only) -100.0 to 100.0% (heat/cool)		0.0%	L3
LBT	LOOP BREAK TIME	OFF or 1 to 9999 minutes			
OP.HI	OUTPUT HIGH	±100.0% Adjust to limit the maximum heating power applied to the process		100.0%	L3
OP.LO	OUTPUT LOW	±100.0% Adjust to limit the maximum cooling power applied to the process or to apply a minimum heating power		0.0%	L3
MTR.T	MOTOR TRAVEL TIME	Set this value to the time that it takes for the motor to travel from its fully closed to its fully open position. Note: In motorised valve control only the PB and TI parameters are active. The TD parameter has no effect on the control.		0.0 to 999.9 seconds	

d.bAnd	CHANNEL 2 DEAD BAND Period when no output is demanded from either channel 1 or channel 2 Adjust, for example, to increase the period when no heating or cooling power is applied	OFF or 0.1 to 100.0% of the cooling proportional band		OFF	L3
HYST.H	HEATING HYSTERESIS	-199.9 to 200.0 display units		1	L3 On/off only
HYST.C	COOLING HYSTERESIS	-199.9 to 200.0 display units		1	
SAFE	SAFE OUTPUT POWER	To set the output level in a sensor break (open circuit) condition		0 to 100%	0%
COOLT	NON-LINEAR COOLING TYPE This selects an algorithm most suited to the type of cooling. Typically used in extruders.	Lin	Linear	As order code	
		OIL	Oil cooling		
		H2O	Water cooling		
		FAn	Forced air cooling		
A-M	LOOP MODE – AUTO MANUAL OFF see also section 3.4.3.	Auto	To select automatic operation		
		mAn	To select manual operation		
		OFF	Control outputs inhibited		
LBR	LOOP BREAK STATUS	no	Shows the current status of loop break.		Read only
		YES			

11.11 Example: To Configure Heating and Cooling

Enter configuration level as described. Then:-

Do This	The Display You Should See	Additional Notes
1. Press ⊜ as many times as necessary to select **'CTRL'**		
2. Press ⊙ to scroll to **'CTRLH'** 3. Press ▲ or ▼ to select the **Heating Type**		Heating Type choices are:- PId PID (3 term) control onoF On/Off control oFF No heating output configured
4. Press ⊙ to select **'CTRL.C'** 5. Press ▲ or ▼ to select the **Cooling Type**		Cooling Type choices are:- oFF No cooling output configured PId PID (3 term) control onoF On/Off control
6. Press ⊙ to select **'CTRL.A'** 7. Press ▲ or ▼ to 'rEv'		Control Action choices are:- rEv Reverse - heating control dir Direct - cooling only control
8. Press ⊙ to scroll to **'PB.UNT'** 9. Press ▲ or ▼ to choose units		Proportional Band Units choices are:- EnG Engineering units PErc Percentage
10. Continue to select parameters using ⊙ for example **'OP.HI'** 11. Press ▲ or ▼ to change their values		When **PID control** is selected, this places a limit on the output demand from the PID which can be applied to the heating circuit. 'OP.LO' can be set up in the same way if required. If **on/off control** is selected these parameters do not apply. They are replaced by 'HYST.H' and 'HYST.L' to set the difference between the output switching off to switching on.

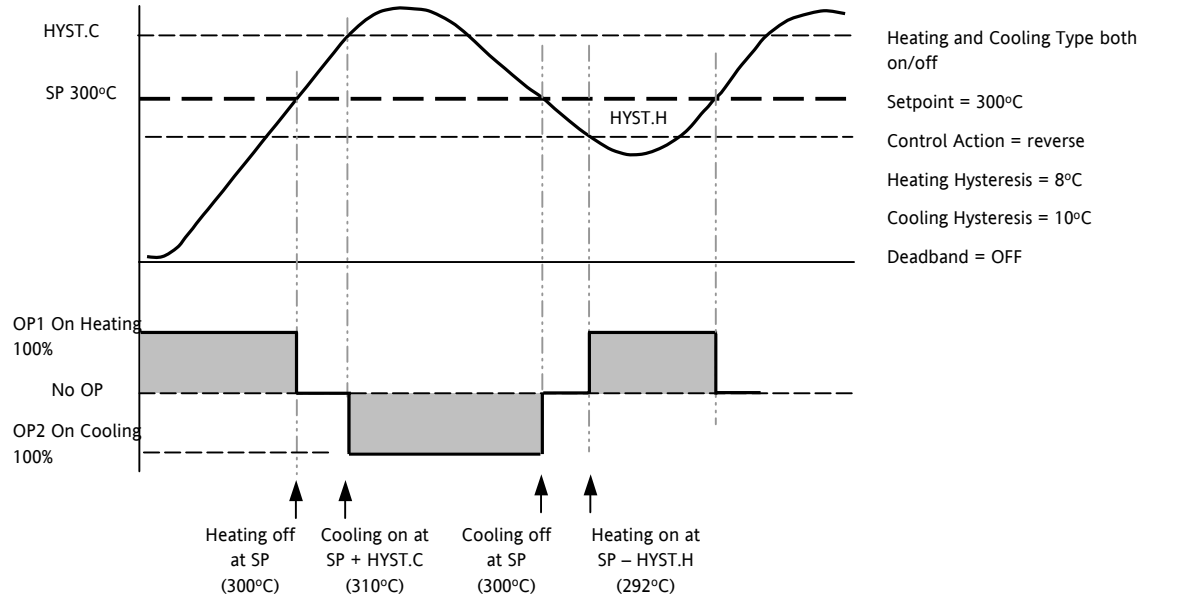
11.11.1 Effect of Control Action, Hysteresis and Deadband

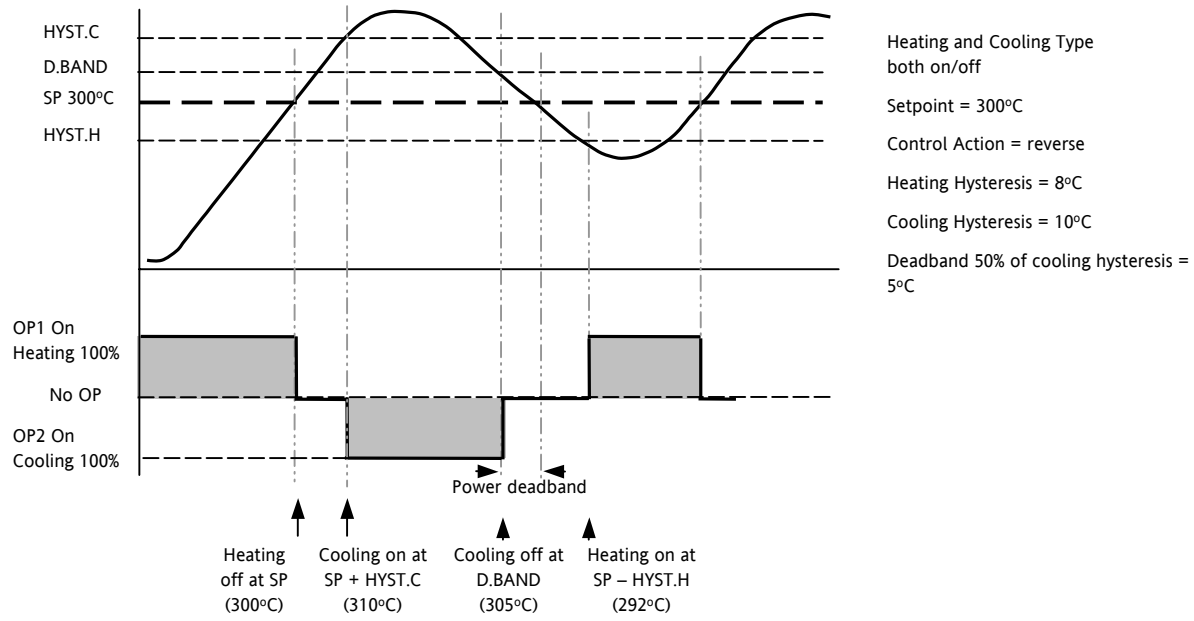
For temperature control 'CONTROL ACTION' will be set to 'rEu'. For a PID controller this means that the heater power decreases as the PV increases. For an on/off controller output 1 (usually heat) will be on (100%) when PV is below the setpoint and output 2 (usually cool) will be on when PV is above the setpoint

Hysteresis applies to on/off control only. It defines the difference in temperature between the output switching off and switching back on again. The examples below shows the effect in a heat/cool controller.

Deadband can operate on both on/off control or PID control where it has the effect of widening the period when no heating or cooling is applied. However, in PID control its effect is modified by both the integral and derivative terms. Deadband might be used in PID control, for example, where actuators take time to complete their cycle thus ensuring that heating and cooling are not being applied at the same time. Deadband is likely to be used, therefore, in on/off control only. The second example below adds a deadband of 20 to the above example.

In an on/off controller, if CONTROL ACTION = rev then OP2 will be on when PV is below SP. OP1 will be on when the PV is above SP. The outputs are, therefore, reversed in the above example.





12. Alarms

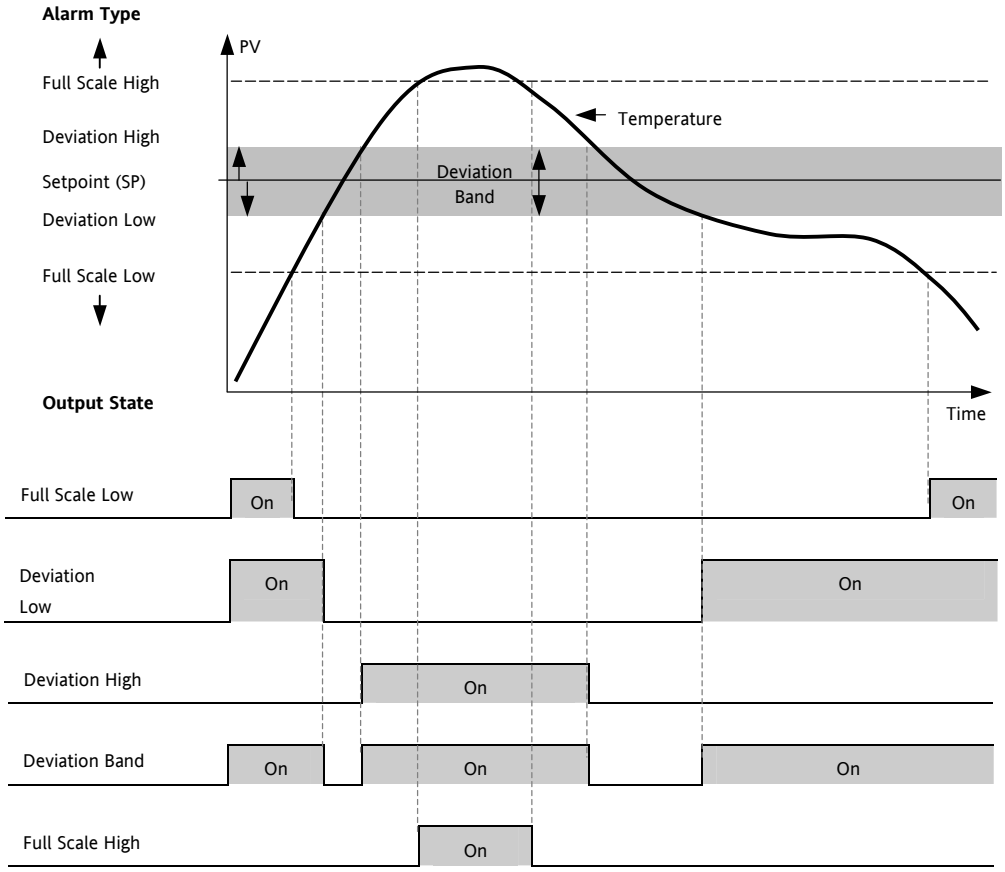
Alarms are used to alert an operator when a pre-set level has been exceeded. They are indicated by a scrolling message on the display and the red ALM beacon. They may also switch an output– usually a relay (see section 12.1.1) – to allow external devices to be operated when an alarm occurs. Alarms only operate if they have been ordered and configured.

Up to eight different alarms are available:-

- Alarm 1: configurable as full scale high or low, band or deviation high or low
- Alarm 2: configurable as full scale high or low, band or deviation high or low
- Alarm 3: configurable as full scale high or low, band or deviation high or low
- Alarm 4: configurable as full scale high or low, band or deviation high or low
- Sensor Fault alarm
- Loop Break alarm
- Current Transformer alarms – Leak, Load Fail, Overcurrent (see I/O section 9.2.)
- Remote Fail Alarm

12.1 Types of Alarm

This section shows graphically the operation of different types of alarm used in the controller. The graphs show changes in temperature plotted against time. (Hysteresis set to zero)



Hysteresis — is the difference between the point at which the alarm switches 'ON' and the point at which it switches 'OFF'. It is used to provide a definite indication of the alarm condition and to prevent alarm relay chatter.

Latching Alarm — is used to hold the alarm condition once an alarm has been detected. It may be configured as:-

nonE	Non latching	A non latching alarm will reset itself when the alarm condition is removed
Auto	Automatic	An auto latching alarm requires acknowledgement before it is reset. The acknowledgement can occur **BEFORE** the condition causing the alarm is removed.
mAn	Manual	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 condition causing the alarm is removed.
Evt	Event	ALM beacon does not light but an output associated with this parameter will activate. A scrolling message may be configured using iTools, as described in section 17.4. If a message has been configured it will scroll across the display while the event is true.

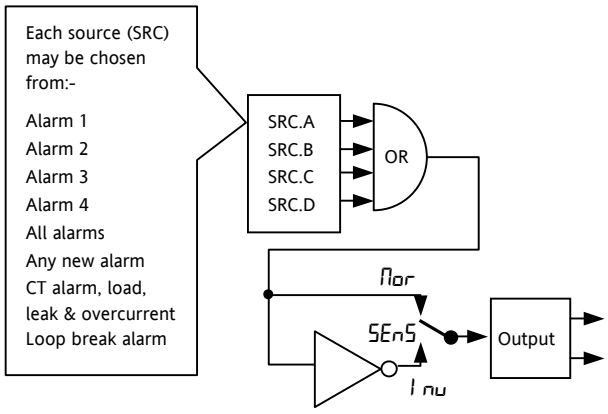
Blocking Alarms — The alarm may be masked during start up. Blocking prevents the alarm from being activated until the process has first achieved a safe state. It is used to ignore start up conditions which are not representative of running conditions.

A blocking alarm is re-initiated after a setpoint change.

See section 12.2 for an explanation of the behaviour of blocking alarms under different conditions.

12.1.1 Alarm Relay Output

Alarms can operate a specific output (usually a relay). Any individual alarm can operate an individual output or any combination of alarms, up to four, can operate an individual output. They are either supplied pre-configured in accordance with the ordering code or set up in configuration level.



12.1.2 Alarm Indication

- ALM beacon flashing red = a new alarm (unacknowledged)
- This is accompanied by a scrolling alarm message. A typical default message will show the source of the alarm followed by the type of alarm. For example, 'ALARM 1 FULL SCALE HIGH'
- Using Eurotherm iTools configuration package, it is also possible to download customised alarm messages. An example might be, 'PROCESS TOO HOT'.
- If more than one alarm is present further messages are flashed in turn in the main display. The alarm indication will continue while the alarm condition is present and is not acknowledged.
- ALM beacon on continuously = alarm has been acknowledged

12.1.3 To Acknowledge An Alarm

Press ⟲ and ▼ together.

The action, which now takes place, will depend on the type of latching, which has been configured

Non-Latched Alarms

Alarm condition present when the alarm is acknowledged.

- ALM beacon on continuously.
- The alarm message(s) will continue to scroll

This state will continue for as long as the alarm condition remains. When the alarm condition disappears all indication also disappears.

If a relay has been attached to the alarm output, it will de-energise when the alarm condition occurs and remain in this condition until acknowledged or the alarm is no longer present.

If the alarm condition disappears before it is acknowledged the alarm resets immediately.

Latched Alarms

See description in section 12.1.

12.2 Behaviour of Alarms After a Power Cycle

The response of an alarm after a power cycle depends upon the latching type, whether it has been configured to be a blocking alarm, it's state and the acknowledge status of the alarm.

The response of active alarms after a power cycle is as follows:

For a non-latching alarm or an event alarm blocking will be re-instated, if configured. If blocking is not configured the active alarm will remain active. If the alarm condition has gone safe during the down time the alarm will return inactive.

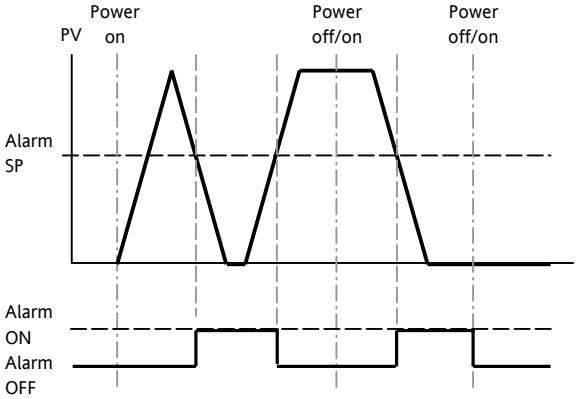
For an auto-latching alarm blocking will be re-instated, if configured, only if the alarm had been acknowledged prior to the power cycle. If blocking is not configured or the alarm had not been acknowledged the active alarm will remain active. If the alarm condition has gone safe during the downtime the alarm will return inactive if it had been acknowledged prior to the power cycle else it will return safe but not acknowledged. If the alarm was safe but not acknowledged prior to the power cycle the alarm will return safe but not acknowledged.

For a manual-latching alarm blocking will not be re-instated and the active alarm will remain active. If the alarm condition has gone safe during the downtime the alarm will return safe but not acknowledged. If the alarm was safe but not acknowledged prior to the power cycle the alarm will return safe but not acknowledged.

The following examples show graphically the behaviour under different conditions:-

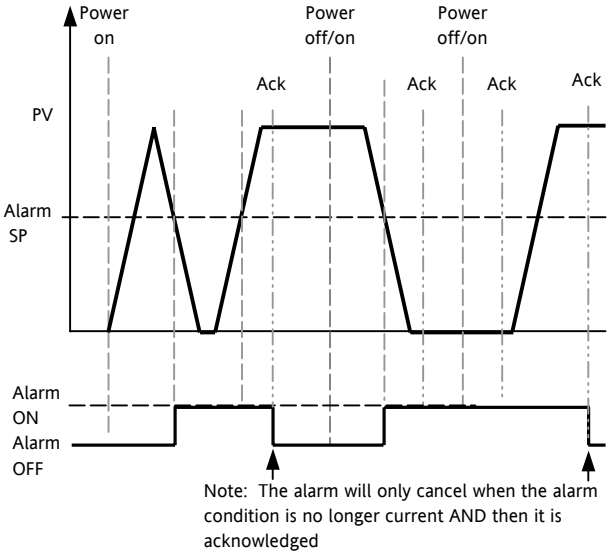
12.2.1 Example 1

Alarm configured as Absolute Low; Blocking: No Latching



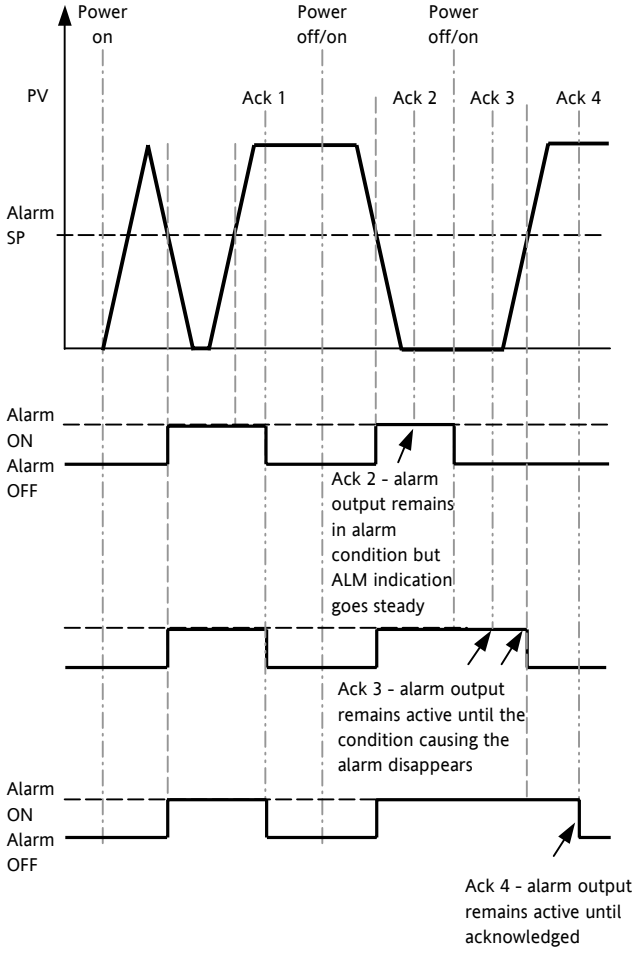
12.2.2 Example 2

Alarm configured as Absolute Low; Blocking: Manual Latching



12.2.3 Example 3

Alarm configured as Absolute Low; Blocking: Auto Latching



12.3 Alarm Parameters

Four alarms are available. Parameters do not appear if the Alarm Type = None. The following table shows the parameters to set up and configure alarms.

ALARM LIST 'ALARM'						
Name	**Scrolling Display**	**Parameter Description**	**Value**		**Default**	**Access Level**
A1.TYP	ALARM 1 TYPE	Selects the type of alarm	nonE	Alarm not configured	As order code	Conf
			Hi	Full Scale High		
			Lo	Full Scale Low		
			dHi	Deviation High		
			dLo	Deviation Low		
			bnd	Deviation band		
A1.----	ALARM 1 SETPOINT	Alarm 1 threshold value. The last three characters show the type of alarm configured from the above list	Instrument range		0	L3
A1.STS	ALARM 1 OUTPUT	Indicates the status of the alarm	OFF	Alarm off		Read only
			On	Alarm on		
A1.HYS	ALARM 1 HYSTERESIS	See description at the beginning of this section	0 to 9999			Conf
A1.LAT	ALARM 1 LATCHING TYPE	See description at the beginning of this section	nonE	Non-latching	As order code	Conf
			Auto	Latching with automatic resetting		
			mAn	Latching with manual resetting		
			Evt	Event (no alarm flashing beacon but messages can be displayed)		
A1.BLK	ALARM 1 BLOCKING	See description at the beginning of this section	no	No blocking	no	Conf
			YES	Blocking		
The above parameters are repeated for Alarm 2, A2; Alarm 3, A3; Alarm 4, A4						

12.3.1 Example: To Configure Alarm 1

Enter configuration level as described. Then:-

Do This	The Display You Should See	Additional Notes
1. Press ⊜ as many times as necessary to select 'ALARM'		
2. Press ⊙ to select 'A1.TYP' 3. Press ⊙ or ⊙ to select the required alarm type		Alarm Type choices are:- nonE Alarm not configured Hi Full Scale High Lo Full Scale Low dHi Deviation High dLo Deviation Low bnd Deviation Band
4. Press ⊙ to select 'A1.—' 5. Press ⊙ or ⊙ to set the alarm trip level		This is the alarm threshold setting for. The last three characters (---) will show the type of alarm configured from the above list. The alarm threshold is shown in the upper display. In this example the high alarm will be detected when the measured value exceeds 215
6. Press ⊙ to select 'A1STS'		This is a read only parameter which shows the status of the alarm output
7. Press ⊙ to select 'A1HYS' 8. Press ⊙ or ⊙ to set the hysteresis		In this example the alarm will cancel when the measured value decreases 2 units below the trip level (at 213 units)
9. Press ⊙ to select 'A1LAT' 10. Press ⊙ or ⊙ to select the latching type		Latching Type choices are:- nonE No latching Auto Automatic mAn Manual Evt Event See the introduction to the alarm section for an explanation
11. Press ⊙ to select 'A1BLK' 12. Press ⊙ or ⊙ to 'YES' or 'No' 13. Repeat the above to configure alarms 2, 3 and 4 if required		

12.4 Diagnostic Alarms

Diagnostic alarms indicate a possible fault within the controller or connected devices.

Display shows	What it means	What to do about it
E.ConF	A change made to a parameter takes a finite time to be entered. If the power to the controller is turned off before the change has been entered then this alarm will occur. Do not turn the power off to the controller while ConF is flashing	Enter configuration mode then return to the required operating mode. It may be necessary to re-enter the parameter change since it will not have been entered in the previous configuration.
E.CAL	Calibration error	Re-instate Factory calibration
E2.Er	EEPROM error	Return to factory for repair
EE.Er	Non-vol memory error	Note the error and contact your supplier
EL.in	Invalid input type. This refers to custom linearisation which may not have been applied correctly or may have been corrupted.	Go to the INPUT list in configuration level and set a valid thermocouple or input type

13. Timer/Programmer

A timer can be configured to operate in one of four different modes. These can be selected in Level 3 or configuration level as:-

1. Dwell timer
2. Delay timer
3. Soft start timer
4. Programmer – this is an orderable option

Operation of the timer has been described in section 5.

13.1 Timer Parameters

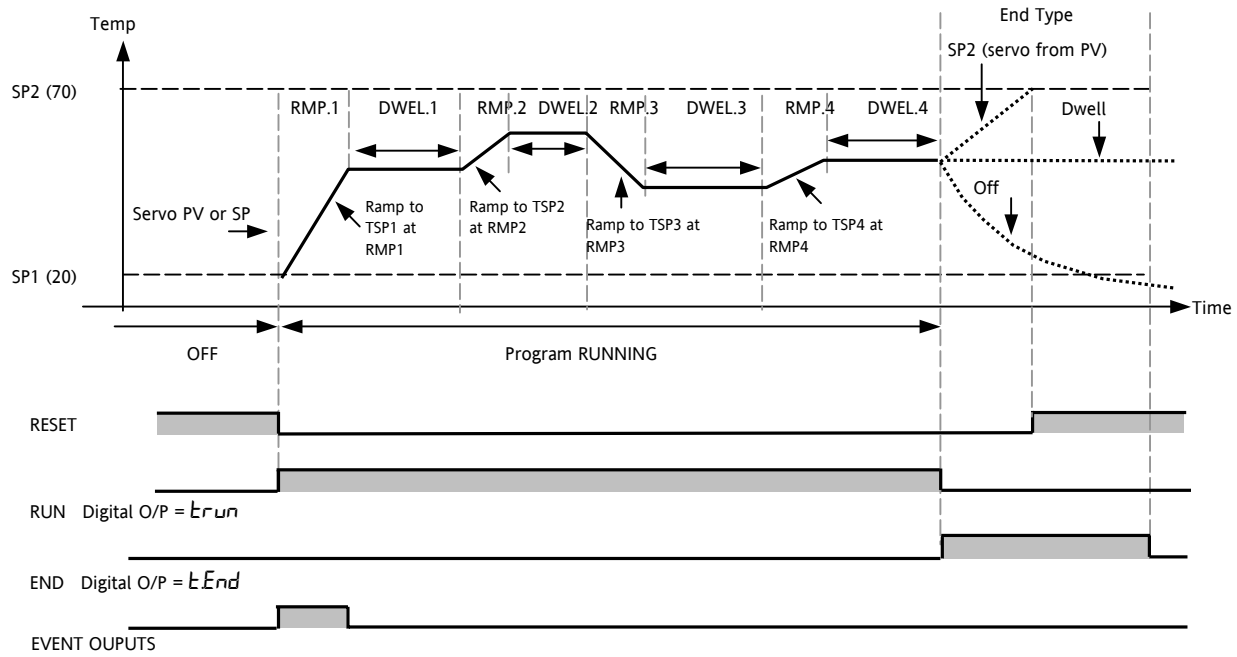
The full list of all available parameters in configuration level is given in the following table.

TIMER LIST	'TIMER'					
Name	**Scrolling Display**	**Parameter Description**	**Value**		**Default**	**Access Level**
TM.CFG	TIMER CONFIGURATION	Timer type configuration	nonE	Timer disabled	As order code	L3
			dwEll	Dwell		
			dELY	Delayed switch on		
			SFSt	Soft start		
			Prog	Programmer		
TM.RES	TIMER RESOLUTION	To set the time units	Hour	Hours HH:MM		Conf R/O L3
			min	Minutes MM:SS		
THRES	TIMER START THRESHOLD	To set the maximum deviation between SP and PV before the timer starts. **Dwell timer and Programmer only**	OFF or 1 to 3000 Units above and below setpoint		OFF	L3
ENT.T	TIMER END TYPE	To determine the action which takes place when the timer has timed out. **Dwell timer and Programmer only**	OFF	Control outputs go to zero %		Conf
			dwEll	Control continues at SP1		
			SP2	Go to setpoint 2		
SS.SP	SOFT START SETOINT	Sets the threshold below which the power is limited **SFSt timer only**	Controller input range		0	Conf
SS.PWR	SOFT START POWER LIMIT	Sets the limit to the power output during start up **SFSt timer only**	0 to 100%		0	Conf
T.STAT	TIMER STATUS	Timer status	rES	Reset		L3
			run	Running (counting)		
			hoLd	Running (hold)		
			End	Timed out		

SERVO	SERVO MODE	Defines the way in which the programmer starts and how it recovers from a power failure See also section 5.4.1. **Programmer only**	SP	Starts at SP1 (or SP2). The program must be re-started after a power failure.	SP	
			PV	Starts at the current Process value. The program must be re-started after a power failure.		
			SPrb	Starts at SP1 (or SP2). The program will continue to run from the original setpoint value at the last ramp rate.		
			Pvrb	Starts at the current Process value. The program will continue to run from the current process value and ramp back at the last ramp rate		
TSP.1	TARGET SETPOINT 1	To set the target value for the first setpoint	Controller input range		0	L2
RMP.1	RAMP RATE 1	To set the rate at which the setpoint changes to reach TSP.1	OFF, 0:1 to 3000 units per min or hour		OFF	L2
DWEL.1	DWELL 1	To set the time at which the setpoint remains at TSP.1	OFF, 0:01 to 99:59 hh:mm or mm.ss		OFF	L2
The above three parameters are repeated for the next 3 program segments, i.e. TSP.2, (3 & 4), RMP.2 (3 & 4), DWEL.2 (3 & 4)						
DWELL	SET TIMER DURATION	To set the time duration **(not programmer)**	0:00 to 99:59 hh:mm or mm.ss		0	L3
T.ELAP	ELAPSED TIME	Time elapsed from when the timer starts to run	0:00 to 99.59 hh:mm or mm.ss			L3 read only
T.REMN	TIME REMAINING	Time remaining to reach the set time.	0:00 to 99.59 hh:mm or mm.ss			L3
EVENT	EVENT OUTPUTS	Event output operates during the selected segment **Programmer only**	0 = No events operate in any segment 255 -= Events operate in all segments		0	L3
The timer can be restarted from the Reset condition by changing the time remaining parameter.						

13.2 Programmer

Model function CP is a controller which also contains a four segment setpoint programmer where each segment consists of a controlled rate ramp to a target setpoint followed by a dwell at that setpoint. These values can be set by the user. The program profile is shown in the diagram below.



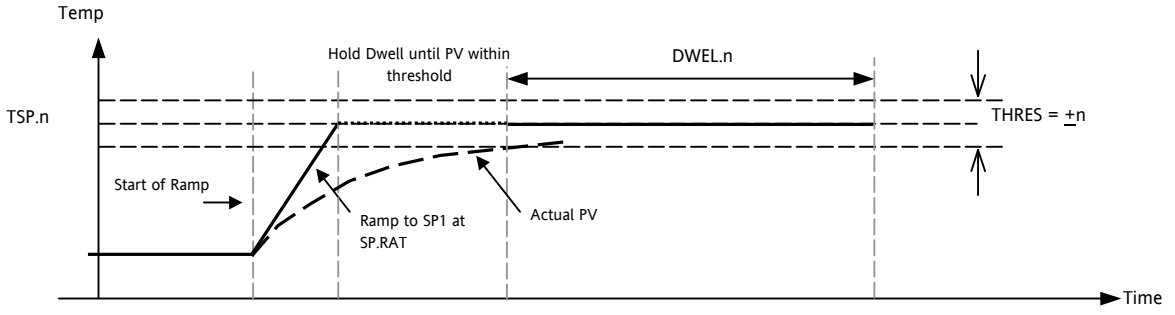
Notes:-

Where steps are required, the ramp rate in the ramp/dwell pair should be set to 'OFF'.

1. Where ramp/dwell pairs are not required, the ramp rate should be set to 'OFF' and the TSP the same as the preceding segment
2. TIMER END – when end type is SP2, Timer END does not occur until the ramp is complete or SP2 is achieved. It is more usual to use a DWELL End Type (the default setting)

13.2.1 Threshold

A single threshold value is available to provide a holdback on the entry to the dwell part of the ramp/dwell pair. It holds back the dwell until the PV has reached the band defined by +/- threshold around the PV as shown below:-



13.2.2 Run/End Digital Outputs

Digital outputs (normally relay) may be made to operate while the program is in Run mode or End mode, as shown in the diagram in section 13.2. These outputs are set up in configuration level by selecting the appropriate output parameter list - IO-1, OP-2, OP-3, or AA and assigning the parameter 'PrG.E' to the 'SRC.A' (B, C, or D) parameter. This is described in Chapter 9.

13.2.3 Event Outputs

A digital event may be configured to operate in any segment of the program. This is shown in the diagram and the example 'To Configure the Programmer' section 13.2.4.

In the TIMER List the parameter 'EVENT' selects in which segment of the program the output operates. This is set up to a decimal number calculated as follows:-

Decimal number	Dwell 4	Ramp 4	Dwell 3	Ramp 3	Dwell 2	Ramp 2	Dwell 1	Ramp 1
0	0	0	0	0	0	0	0	0
1	0	0	0	0	0	0	0	1
2	0	0	0	0	0	0	1	0
3	0	0	0	0	0	0	1	1
4	0	0	0	0	0	1	0	0
5	0	0	0	0	0	1	0	1
6	0	0	0	0	0	1	1	0
↓								
255	1	1	1	1	1	1	1	1
Decimal weighting	120	64	32	16	8	4	2	1

1 indicates the segment in which the event output is ON

0 indicates the segment in which the event output is OFF

Event outputs were added after software version 2.

13.2.4 To Configure the Programmer

The programmer can be configured in Level 2 as explained in section 4. The Event outputs, however, can only be configured in Level 3 or Configuration level as follows:-

Select Access Level 3 or Configuration level as described in section 6.1.3.

Operation	Action	Indication	Notes
Select the **TIMER** page	Press ⓟ as many times as necessary to 'TIMER'		
Configure the Timer as a **Programmer**	Press ⓒ to select 'TM.CFG' Press ▼ or ▲ to 'ProG'		
Set the **Resolution**	Press ⓒ to select 'TM.RES' Press ▼ or ▲ to 'Hour or 'mi n"		In this example the ramp rate and dwell period are set in hours
Set the **Threshold**	Press ⓒ to select 'THRES' Press ▼ or ▲ to adjust		In this example the dwell periods will not start until the PV is within 5 units of the setpoint
Set the action when the programmer times out	Press ⓒ to select 'END.T' Press ▼ or ▲ to 'OFF' or 'SP2' or 'dwEll'		In this example the controller will continue to control indefinitely at the last setpoint. OFF will turn the output power off and SP2 will control at setpoint 2
Set the **Servo Mode**	Press ⓒ (twice) to select 'SERVO' Press ▼ or ▲ to 'PU' or 'SP'		In this example the program will start from the current value of the process variable
Set the first **Target Setpoint**	Press ⓒ to select 'TSP.1' Press ▼ or ▲ to adjust		In this example the setpoint will ramp from the current value of the PV to the first target - 100
Set the first **Ramp Rate**	Press ⓒ to select 'RMP.1' Press ▼ or ▲ to adjust		In this example the setpoint will ramp to 100 at 8.0 units per hour
Set the first **Dwell**	Press ⓒ to select 'DWEL.1' Press ▼ or ▲ to adjust		In this example the setpoint will dwell at 100 for 2 hours 11 minutes
Repeat the above three steps for all segments			
Set the segment in which the relay operates	Press ⓒ to select 'EVENT' Press ▼ or ▲ to adjust		Set as described in section 13.2.3. In this example the event output will be active during Ramp 2.
Configure Output 4 (AA Relay) as the Event ouput	Press ⓟ to select 'AA' List Press ⓒ to select '4.SRC.A' Press ▼ or ▲ to select 'PrG.E'		This can only be done in Configuration level. You can also select 4.SRC.B, 4.SRC.C, or 4.SRC.D or assign these to other functions, for example 't.End' or 't.run' so that the relay also operates when the timer is running or when it completes.

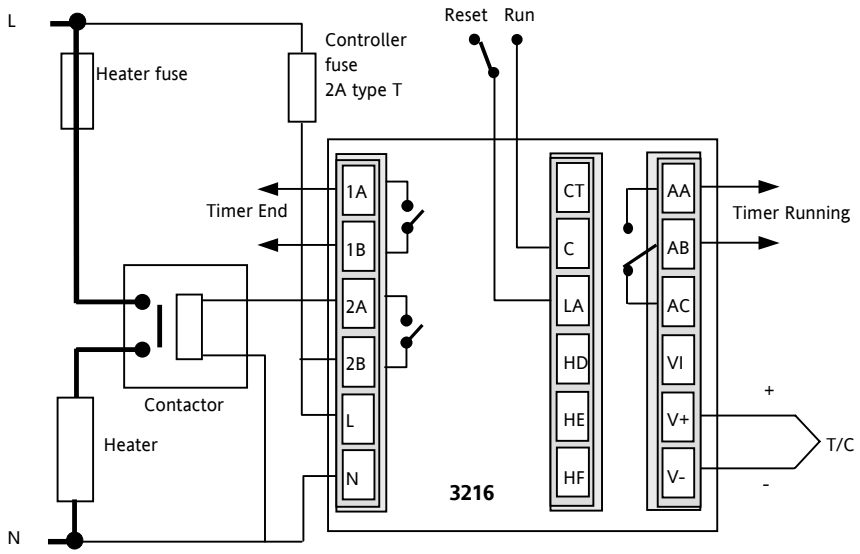
13.3 Example: To Configure a Dwell Timer as a Simple Two Step Programmer

If the instrument has been ordered as controller only, it is still possible to configure a simple ramp/dwell; ramp/dwell programmer.

This example assumes a hardware configuration as follows:-

Output 2	Heat output relay
I/O 1	Timer End digital output
AA Relay	Timer running digital output
Dig Input	Run/Reset input

A typical wiring diagram for this example is shown below:-



Configure the I/O as follows:-

Enter configuration level described in section 6.1.3. Then:-

Do This	The Display You Should See	Additional Notes
1. Press ⊜ as many times as necessary to select '**IO-1**'		**To configure the timer end digital output signal** Scrolling display '*IO-1 LIST*'
2. Press ⊙ (twice) to select '**1.FUNC**' 3. Press ▲ or ▼ to choose **d.out**		Scrolling display '*IO-1 FUNCTION*'
4. Press ⊙ to scroll to '**1.SRC.A**' 5. Press ▲ or ▼ to choose **t.End**		Also *1.SRC.B 1.SRC.C 1.SRC.D* **=nonE** and *1.SENS* **=nor** to energise the relay when the timer is in the end state Scrolling display '*IO-1 SOURCE*'
6. Press ⊜ as many times as necessary to select '**OP-2**'		**To configure the control output** Scrolling display '*OUTPUT 2 LIST*'
7. Press ⊙ to select '**2.FUNC**' 8. Press ▲ or ▼ to choose **HEAt**		Also *2.PLS* = **5.0** and *2.SENS* = **nor** Scrolling display '*OUTPUT 2 FUNCTION*'

9. Press ⊜ as many times as necessary to select **'AA'**		**To configure the AA relay timer run digital output signal** Scrolling display 'AA RELAY'
10. Press ⊙ to select **'4.FUNC'** 11. Press ▲ or ▼ to choose **d.out**		Scrolling display 'OUTPUT 4 FUNCTION'
12. Press ⊙ to select **'4.SRC.A'** 13. Press ▲ or ▼ to choose **t.run**		Also 4 SRC.B 4.SRC.C 4.SRC.D =**nonE** and 4 SENS =**nor** to energise the relay when the timer is in the running state Scrolling display 'OUTPUT 4 SOURCE'
14. Press ⊜ as many times as necessary to select **'LA'**		**To configure the LA digital input to Run/Reset the timer from an external contact**
15. Press ⊙ to select **'L.D.IN'** 16. Press ▲ or ▼ to choose **t.rrS**		Make to Run, break to Reset

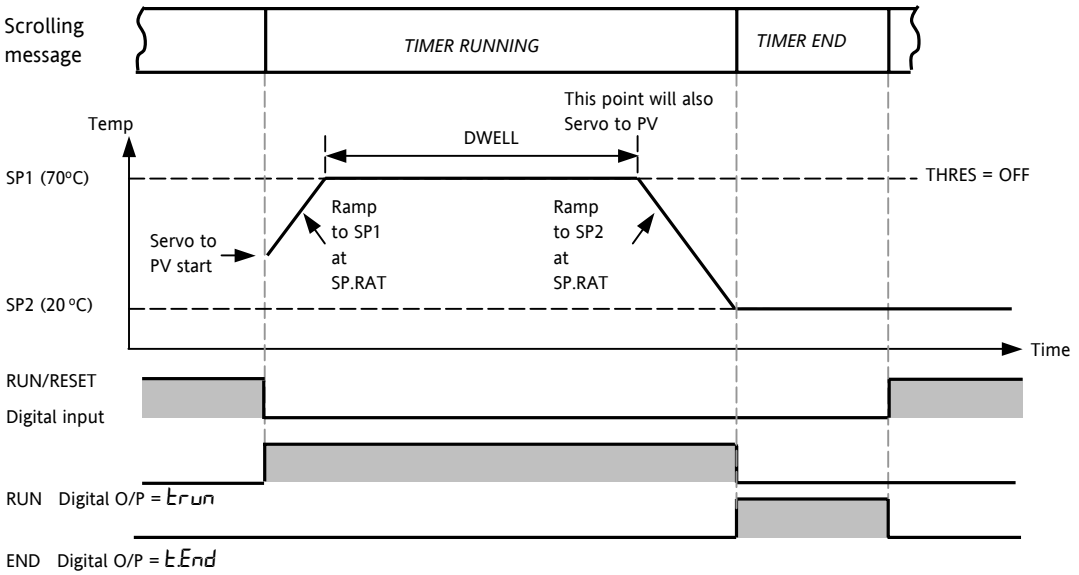
Configure the Timer

Do This	The Display You Should See	Additional Notes
17. Press ⊜ as many times as necessary to select **'TIMER'**		**To configure the timer.** This can also be done in Level 3. Scrolling display 'TIMER LIST'
18. Press ⊙ to select **'TM.CFG'** 19. Press ▲ or ▼ to choose **dwEll**		Also TM.RES = **min** or **Hour** as required Scrolling display 'TIMER CONFIGURATION'
20. Press ⊙ to select **'THRES'** 21. Press ▲ or ▼ to choose **2**		**To ensure the dwell starts when PV reaches 2° of setpoint** Scrolling display 'TIMER START THRESHOLD'
22. Press ⊙ to select **'END.T'** 23. Press ▲ or ▼ to choose **SP2**		Also set DWELL to the time period required Scrolling display 'TIMER END TYPE'
Return to Level 3 and operate the timer as previously described below		

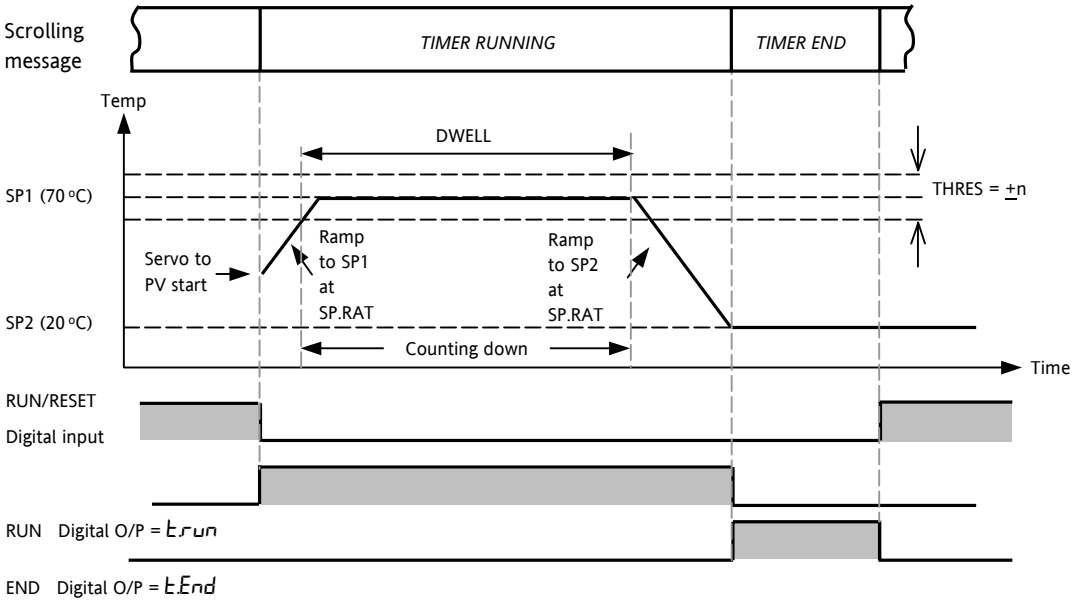
Assume the following settings

SP1 = 70°C End.T = SP2 = 20°C Ramp Rate (SP.RAT) = 20°C/min

The threshold value behaves like a holdback value and can be turned off. A digital output can be configured to operate an external buzzer, or other form of indication, to alert the operator to the end of the process. It is cancelled by pressing 'Ack ' and .



Threshold value turned off



Threshold value turned on

This now behaves as a simple four segment programmer of two ramps two dwells

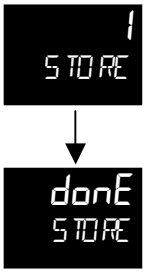
14. Recipe

A recipe can take a snapshot of the current values and store these into a recipe number.

There are five recipes available, which can store a range of parameter values for different processes. The list of parameters is shown in section 14.3.1.

Each recipe can be given a name using iTools configuration software. It is also possible to reconfigure which parameters are included in the recipe list using iTools, see section 17.

14.1 To Save Values in a Recipe

Do This	The Display You Should See	Additional Notes
1. Press ⊙ as many times as necessary to select **'RECIP'**		Scrolling display RECIPE LIST
2. Press ⊙ to scroll to **'STORE'** 3. Press ▲ or ▼ to choose the recipe number to store eg 1		Scrolling display RECIPE TO SAVE The current parameter values are stored in Recipe 1

14.2 To Save Values in a Second Recipe

In this example the proportional band will be changed and stored in recipe 2. All other values will remain the same as recipe 1:-

Do This	The Display You Should See	Scrolling display **Additional Notes**
1. Press ⊙ to scroll to **'CTRL'**		Scrolling display CONTROL LIST
2. Press ⊙ to scroll to **PB** 3. Press ▲ or ▼ to change the value eg **22**		Scrolling display PROPORTIONAL BAND
4. Press ⊙ to scroll to **'RECIP**		Scrolling display RECIPE LIST
5. Press ⊙ to **'STORE** 6. Press ▲ or ▼ to 2		Scrolling display RECIPE TO SAVE

14.3 To Select a Recipe to Run

Do This	The Display You Should See	Additional Notes
1. Press ⓜ as many times as necessary to select **'RECIP'**		Scrolling display RECIPE LIST
2. Press ⓒ to select **'REC.NO'** 3. Press ▲ or ▼ to choose recipe number 1		Scrolling display CURRENT RECIPE NUMBER The values stored in Recipe 1 will now be loaded. If a recipe number is chosen which has not been saved then FAIL will be displayed

14.3.1 List of Default Recipe Parameters:

Instrument resolution is always saved and restored, as are instrument units, proportional band units and dwell resolution. The following parameters are the other default recipe parameters.

PB	Proportional Band	A1.xx	Alarm 1 threshold1
TI	Integral time	A2.xx	Alarm 2 threshold2
TD	Derivative time	A3.xx	Alarm 3 threshold3
D.BAND	Channel 2 deadband	A4.xx	Alarm 4 hreshold4
CB.LO	Cutback low	LBT	Loop break time
CB.HI	Cutback high	HYST.H	Channel 1 hysteresis
R2G	Relative cool gain	HYST.C	Channel 2 hysteresis
SP1	Setpoint 1	HOME	Home Display
SP2	Setpoint 2	SP.HI	Setpoint High limit
MR	Manual reset On/off only	SP.LO	Setpoint Low limit
OP.HI	Output high limit	TM.CFG	Timer configuration
OP.LO	Output low limit	TM.RES	Timer reset
SAFE	Safe Output	SS.SP	Soft start setpoint
SP.RAT	Setpoint rate limit	SS.PWR	Soft start power limit
A1.HYS	Alarm 1 hysteresis	DWEL	Set time duration
A2.HYS	Alarm 2 hysteresis	THRES	Timer Threshold
A3.HYS	Alarm 3 hysteresis	END.T	Timer End Type
A4.HYS	Alarm 4 hysteresis		Ramp Units

15. Digital Communications

Digital Communications (or 'comms' for short) allows the controller to communicate with a PC or a networked computer system. Digital communications is not available in 3116 controllers.

This product conforms to MODBUS RTU ® protocol a full description of which can be found on www.modbus.org.

Two ports are available both using MODBUS RTU communication facilities:

1. a configuration port - intended to communicate with a system to download the instrument parameters and to perform manufacturing tests and calibration
2. an optional RS232 or RS485 port on terminals HD, HE and HF - intended for field communications using, for example, a PC running a SCADA package.

The two interfaces cannot operate at the same time.

For a full description of digital communications protocols (ModBus RTU) refer to the 2000 series Communications Handbook, part number HA026230, available on www.eurotherm.co.uk.

Each parameter has its own unique ModBus address. A list of these is given at the end of this section.

15.1 Digital Communications Wiring

15.1.1 RS232

To use RS232 the PC will be equipped with an RS232 port, usually referred to as COM 1.

To construct a cable for RS232 operation use a three core screened cable.

The terminals used for RS232 digital communications are listed in the table below. Some PC's use a 25 way connector although the 9 way is more common.

Standard Cable	PC socket pin no.		PC Function *	Instrument Terminal	Instrument
Colour	9 way	25 way			Function
White	2	3	Receive, RX	HF	Transmit, TX
Black	3	2	Transmit, TX	HE	Receive, RX
Red	5	7	Common	HD	Common
Link together	1 4 6	6 8 11	Rec'd line sig. detect Data terminal ready Data set ready		
Link together	7 8	4 5	Request to send Clear to send		
Screen		1	Ground		

* These are the functions normally assigned to socket pins. Please check your PC manual to confirm.

15.1.2 RS485

To use RS485, buffer the RS232 port of the PC with a suitable RS232/RS485 converter. The Eurotherm Controls KD485 Communications Adapter unit is recommended for this purpose. The use of a RS485 board built into the computer is not recommended since this board may not be isolated, which may cause noise problems, and the RX terminals may not be biased correctly for this application.

To construct a cable for RS485 operation use a screened cable with one (RS485) twisted pair plus a separate core for common. Although common or screen connections are not necessary, their use will significantly improve noise immunity.

The terminals used for RS485 digital communications are listed in the table below.

Standard Cable Colour	PC Function *	Instrument Terminal	Instrument Function
White	Receive, RX+	HF (B) or (B+)	Transmit, TX
Red	Transmit, TX+	HE (A) or (A+)	Receive, RX
Green	Common	HD	Common
Screen	Ground		

- These are the functions normally assigned to socket pins. Please check your PC manual to confirm .

See section 2.12 for wiring diagrams.

15.2 Digital Communications Parameters

The following table shows the parameters available.

DIGITAL COMMUNICATIONS LIST 'COMMS'						
Name	**Scrolling Display**	**Parameter Description**	**Value**		**Default**	**Access Level**
ID	MODULE IDENTITY	Comms identity	none	No module fitted	As order code	Conf L3 R/O
			r232	RS 232 Modbus interface		
			r485	RS485 Modbus interface		
ADDR	COMMUNICATIONS ADDRESS	Communications address of the instrument	1 to 254		1	L3
BAUD	COMMUNICATIONS BAUD RATE	Communications baud rate	1200	1200	9600	Conf L3 R/O
			2400	2400		
			4800	4800		
			9600	9600		
			19.20	19,200		
PRTY	COMMUNICATIONS PARITY	Communications parity	none	No parity	none	Conf L3 R/O
			EuEn	Even parity		
			Odd	Odd parity		
DELAY	RX/TX DELAY TIME	To insert a delay between Rx and Tx to ensure that drivers have sufficient time to switch over.	OFF	No delay		Conf L3 R/O
			on	Fixed delay applied		
RETRAN	COMMS RETRANSMISSION	Master comms broadcast parameter. See section 15.2.1.	none	None	none	
			w.SP	Working setpoint		
			PV	Process Variable		
			OP	Output demand		
			Err	Error		
REG.AD	COMMS RETRANSMISSION ADDRESS	Parameter added in the Slave address to which the master communications value will be written See section 15.2.1.	0 to 9999		0	

15.2.1 Broadcast Communications

Broadcast communications as a simple master is available on 3200 controllers from software versions 1.10 or greater. Broadcast master communications allows the 3200 controller to send a single value to any number of slave instruments. Modbus broadcast using function code 6 (Write single value) must be used. This allows the 3200 to link with other products, without the need for a supervisory PC, to create a small system solution. Example applications include multi-zone setpoint programming applications or cascade control using a second controller. The facility provides a simple and precise alternative to analogue retransmission.

The retransmitted parameter can be selected from Setpoint, Process Variable, Output Demand or Error. The controller will cease broadcast when it receives a valid request from a Modbus master - this allows iTools to be connected for commissioning purposes.

Warning

When using broadcast master communications, bear in mind that updated values are sent many times a second. Before using this facility, check that the instrument to which you wish to send values can accept continuous writes. ***Note that in common with many third party lower cost units, the Eurotherm 2200 series and the 3200 series prior to version V1.10 do not accept continuous writes to the temperature setpoint. Damage to the internal non-volatile memory could result from the use of this function. If in any doubt, contact the manufacturer of the device in question for advice.***

When using the 3200 series fitted with software version 1.10 and greater, use the Remote Setpoint variable at Modbus address 26 if you need to write to a temperature setpoint. This has no write restrictions and may also have a local trim value applied. There is no restriction on writing to the 2400 or 3500 series.

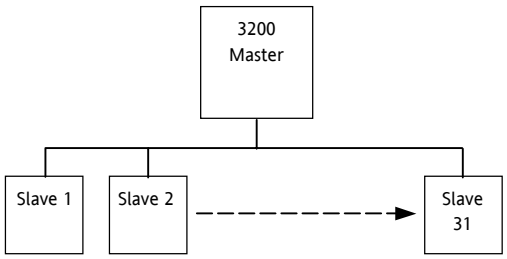
15.2.2 Broadcast Master Communications

The 3200 broadcast master can be connected to up to 31 slaves if no segment repeaters are used. If repeaters are used to provide additional segments, 32 slaves are permitted in each new segment. The master is configured by setting the 'RETRAN' parameter to wSP, PV, OP or Err.

Once the function has been enabled, the instrument will send this value out over the communications link every control cycle (250ms).

Notes:-

1. The parameter being broadcast must be set to the same decimal point resolution in both master and slave instruments.
2. If iTools, or any other Modbus master, is connected to the port on which the broadcast master is enabled, then the broadcast is temporarily inhibited. It will restart approximately 30 seconds after iTools is removed. This is to allow reconfiguration of the instrument using iTools even when broadcast master communications is operating.



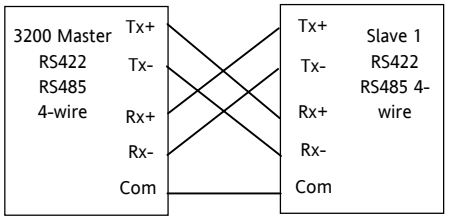
15.2.3 Wiring Connections

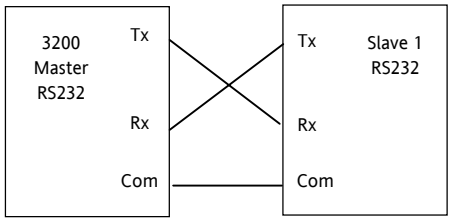
The Digital Communications module for use as a master or slave is fitted in Comms Module slot H and uses terminals HA to HF.

☺ RS422, RS485 4-wire or RS232

Rx connections in the master are wired to Tx connections of the slave

Tx connections in the master are wired to Rx connections of the slave



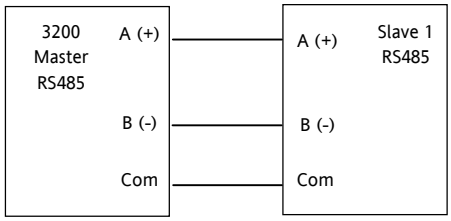


☺ RS485 2-wire

Connect A (+) in the master to A (+) of the slave

Connect B (-) in the master to B (-) of the slave

This is shown diagrammatically below



15.3 Example To Set Up Instrument Address

This can be done in operator level 3:-

Do This	Display View	Additional Notes
1. Press ⊜ as many times as necessary to select **'COMMS LIST'**		Scrolling display 'COMMS LIST'
2. Press ⊙ to scroll to **'ID'** 3. Press ▲ or ▼ to select RS232 or RS485 comms		Scrolling display 'ID'
4. Press ⊙ to scroll to **'ADDR'** 5. Press ▲ or ▼ to select the address for the particular controller		Up to 254 can be chosen but note that no more than 33 instruments should be connected to a single RS485 link. Scrolling display 'ADDRESS'

For further information see 2000 Series Communications Handbook Part No. HA026230.

15.4 DATA ENCODING

i Note that the Eurotherm Itools OPC server provides a straightforward means of accessing any variable in the 3200 controller in the correct data format without the need to consider data representation. However if you wish to write your own communications interface software, you will need to take the format used by the 3200 comms software into account.

Modbus data is normally encoded into a 16 bit signed integer representation.

Integer format data, including any value without a decimal point or represented by a textual value (for example 'off', or 'on'), is sent as a simple integer value.

For floating point data, the value is represented as a 'scaled integer', in which the value is sent as an integer which gives the result of the value multiplied by 10 to the power of the decimal resolution for that value. This is easiest to understand by reference to examples:

FP Value	Integer Represenation
FP Value	Integer Representation
9.	9
-1.0	10
123.5	1235
9.99	999

It may be necessary for the Modbus master to insert or remove a decimal point when using these values.

It is possible to read floating point data in a native 32 bit IEEE format. This is described in the Eurotherm Series 2000 Communications Handbook (HA026230), Chapter 7.

For **time** data, for example the length of a dwell, the integer representation depends on the resolution. For 'hours' resolution, the value returned is the number of minutes the value represents, so for example a value of 2:03 (2 hours and three minutes) would be returned as an integer value of 123. For 'minutes' resolution, the value used is the number of seconds the value represents, so that 12:09 (12 minutes and 9 seconds) would be returned as 729.

It is possible to read time data in a native 32 bit integer format, in which case it returns the number of milliseconds the variable represents regardless of the resolution. This is described in the Eurotherm Series 2000 Communications Handbook (HA026230), Chapter 7.

15.5 Parameter Modbus Addresses

Parameter Mnemonic	Parameter Name	Modbus Address
PV.IN	PV (Temperature) Input Value (see also Modbus address 203 which allows writes over Modbus to this variable).	1
TG.SP	Target Setpoint. ***NB – do not write continuously changing values to this variable. The memory technology used in this product has a limited (100,000) number of write cycles. If ramped setpoints are required, consider using the internal ramp rate function or the remote comms setpoint (Modbus address 26)in preference.***	2
MAN.OP	Manual Output Value	3
WRK.OP	Working Output	4
WKG.SP	Working Setpoint (Read Only)	5
PB	Proportional Band	6
CTRL.A	Control Action 0 = Reverse Acting 1 = Direct Acting	7
Ti	Integral Time (0 = No Integral Action)	8
Td	Derivative Time (0 = No Derivative Action)	9
RNG.LO	Input Range Low Limit	11
RNG.HI	Input Range High Limit	12
A1.---	Alarm 1 Threshold	13
A2.---	Alarm 2 Threshold	14
SP.SEL	Active Setpoint Select 0 = Setpoint 1 1 = Setpoint 2	15
D.BAND	Channel 2 Deadband	16
cB.Lo	Cutback Low	17
cB.HI	Cutback High	18
R2G	Relative Cool/Ch2 Gain	19
T.STAT	Timer Status 0 = Reset 1 = Run 2 = Hold 3 = End	23
SP1	Setpoint 1 ***NB – do not write continuously changing values to this variable. The memory technology used in this product has a limited (100,000) number of write cycles. If ramped setpoints are required, consider using the internal ramp rate function or the remote comms setpoint (Modbus address 26)in preference.***	24
SP2	Setpoint 2 ***NB – do not write continuously changing values to this variable. The memory technology used in this product has a limited (100,000) number of write cycles. If ramped setpoints are required, consider using the internal ramp rate function or the remote comms setpoint (Modbus address 26)in preference.***	25
Rm.SP	Remote (comms) setpoint. If selected using the remote setpoint selection (address 276 below, may also be controlled using the instrument HMI or a digital input) then this is used as a setpoint providing a value has been received within a window of about 5 seconds. If no value is received then the controller falls back to the currently selected setpoint (SP 1 or SP 2) with an error indication. The Remote Setpoint may have a local trim (SP Trim, address 27) added to it to compensate for variations in temperature in a particular zone. This parameter is not saved when the instrument is switched off. It may be written to continuously over communications without risk of damage to the instrument non-volatile memory.	26
LOC.t	Local Trim – added to the remote setpoint to compensate for local temperature variations in a control zone.	27
MR	Manual Reset	28
OP.HI	Output High Limit	30
OP.LO	Output Low Limit	31
SAFE	Safe Output Value for Sensor Break or other fault conditions.	34
SP.RAT	Setpoint Rate Limit Value (0 = no rate limit)	35

Parameter Mnemonic	Parameter Name	Modbus Address
P.Err	Calculated Error (PV-SP)	39
A1.HYS	Alarm 1 Hysteresis	47
A2.HYS	Alarm 2 Hysteresis	68
A3.HYS	Alarm 3 Hysteresis	69
A4.HYS	Alarm 4 Hysteresis	71
StAt	Instrument Status. This is a bitmap: B0 – Alarm 1 Status B1 – Alarm 2 Status B2 – Alarm 3 Status B3 – Alarm 4 Status B4 – Auto/Manual Status B5 – Sensor Break Status B6 – Loop Break Status B7 – CT Low load current alarm status B8 – CT High leakage current alarm status B9 – Program End B10 – PV Overrange (by > 5% of span) B11 – CT Overcurrent alarm status B12 – New Alarm Status B13 – Timer/Ramp Running B14 – Remote (comms) SP Fail B15 – Autotune Status In each case, a setting of 1 signifies 'Active', 0 signifies 'Inactive'.	75
LL.AMP	Load Leakage Current	79
LD.AMP	Load ON Current	80
A3.---	Alarm 3 Threshold	81
A4.---	Alarm 4 Threshold	82
LBT	Loop Break Time	83
HYST.H	Ch1 On/Off Hysteresis in Eng Units	86
Di.IP	Digital Inputs Status. This is a bitmap: B0 – Logic input 1A B1 – Logic input LA B2 – Logic input LB B7 – Power has failed since last alarm acknowledge A value of 1 signifies the input is closed, otherwise it is zero. Values are undefined if options are not fitted or not configured as inputs.	87
HYST.C	Ch2 On/Off Hysteresis in Eng Units	88
FILT.T	Input Filter Time	101
Home	Home Display. 0 – Standard PV and SP display 1 – PV and Output Power display 2 – PV and Time remaining display 3 – PV and Timer elapsed time display 4 – PV and Alarm 1 setpoint 5 – PV and Load Current 6 – PV only 7 – PV and Composite SP/Time remaining	106
-	Instrument version number. Should be read as a hexadecimal number, for example a value of 0111 hex is instrument V1.11	107
SP.HI	Setpoint High Limit	111
SP.LO	Setpoint Low Limit	112
-	Instrument type code.	122
ADDR	Instrument Comms Address	131
PV.OFS	PV Offset	141
C.Adj	Calibration Adjust	146

Parameter Mnemonic	Parameter Name	Modbus Address
IM	Instrument Mode 0 – Auto Mode (normal control) 1 – Manual Mode 2 – Standby Mode	199
MV.IN	Input value in millivolts	202
PV.CM	Comms PV Value. This may be used to write to the Process Variable (temperature) parameter over Modbus when a linearisation type of 'Comms' is selected, allowing the instrument to control to externally derived values. If sensor break is turned on, it is necessary to write to this variable once every 5 seconds. Otherwise a sensor break alarm will be triggered as a failsafe. If this is not required, turn sensor break off.	203
CJC.IN	CJC Temperature	215
SBR	Sensor Break Status (0 = Off, 1 = Active)	258
NEW.AL	New Alarm Status (0 = Off, 1 = Active)	260
LBR	Loop Break (0 = Off, 1 = Active)	263
A.TUNE	Autotune Enable (0 = Off, 1 = Enabled)	270
A-M	Mode of the Loop (0 = Auto, 1 = Manual)	273
Ac.All	Acknowledge all alarms (1 = Acknowledge	274
L-R	Local Remote (Comms) Setpoint Select	276
A1.STS	Alarm 1 Status (0 = Off, 1 = Active)	294
A2.STS	Alarm 2 Status (0 = Off, 1 = Active)	295
A3.STS	Alarm 3 Status (0 = Off, 1 = Active)	296
A4.STS	Alarm 4 Status (0 = Off, 1 = Active)	297
LD.ALM	Low Load Current Threshold	304
LK.ALM	High Leakage Current Alarm (0 = Off, 1 = Active)	305
HC.ALM	Over Current Alarm Threshold	306
LOAD.A	Load Alarm Status (0 = Off, 1 = Active)	307
LEAK.A	Leak alarm Status.	308
HILC.A	Over Current alarm Status (0 = Off, 1 = Active)	309
REC.NO	Recipe to Recall	313
StOrE	Recipe to Save	314
TM.CFG	Timer type configuration 0 – No Timer 1 – Dwell Timer 2 – Delay Timer 3 – Soft Start Timer 10 – Programmer (Programmer Option only)	320
TM.RES	Timer Resolution 0 – Hours:Mins 1 – Mins:Secs	321
SS.SP	Soft Start Setpoint	322
SS.PWR	Soft Start Power Limit	323
DWELL	Requested Timer Duration	324
T.ELAP	Elapsed Time	325
T.REMN	Time Remaining	326
THRES	Timer Start threshold	327
End.T	Timer End Type 0 – Off 1 – Dwell at current setpoint 2- Transfer to Setpoint 2 and dwell	328
SERVO	'Servo' Mode (programmer option only) 0 – Start first ramp from current Working Setpoint 1 - Start first ramp from current PV (temperature)	329
CTRL.H	Heat/Ch1 Control Type	512

Parameter Mnemonic	Parameter Name	Modbus Address
	0 – Off 1 – On/Off Control 2 – PID Control 3 – mtr Valve Position Control	
CTRL.C	Cool/Ch2 Control Type 0 – Off 1 – On/Off Control 2 – PID Control	513
PB.UNT	Proportional Band Units 0 – Engineering Units 1 – Percent of Span	514
MTR.T	Motor Travel Time	21
Lev2.P	Level 2 Code	515
UNITS	Display Units 0 – Degrees C 1 – Degrees F 2 – Kelvin 3 – None 4 – Percent	516
Lev3.P	Level 3 Code	517
Conf.P	Config Code	518
Cold	If set to 1 instrument will reset to factory defaults on next reset or power cycle.	519
COOL.t	Cooling Algorithm Type: 0 – Linear 1 – Oil 2 – Water 3 – Fan	524
DEC.P	Decimal Point Position 0 – XXXX. 1 – XXX.X 2 – XX.XX	525
STBY.T	Standby Type 0 – Absolute Alarm Outputs Active – others off 1 – All outputs inactive	530
RAMP UNITS	0 – Ramp per Minute 1 – Ramp per Hour 2 – Ramp per Second	531
Meter	(3208/3204 Only). Ammeter configuration 0 – No ammeter 1 – Heat Output (0-100%) 2 – Cool Output (0-100% cooling) 3 – Working Setpoint (scaled within SP limits) 4 – PV (scaled within range) 5 – Output Power (scaled within Op Low and OP High limits) 6 – Output centered between –100% and 100% 7 – Error (PV-SP) (scaled between +/- 10 degrees) 8 – Instantaneous Amps (scaled 0 to CT Span) 9 – Load Current (scaled 0 to CT Span)	532
uCAL	User Calibration Enable	533
A1.TYP	Alarm 1 Type 0 – Off 1 –Absolute High 2 – Absolute Low 3 – Deviation High	536

Parameter Mnemonic	Parameter Name	Modbus Address
	4 – Deviation Low 5 – Deviation Band	
A2.TYP	Alarm 2 Type (as Alarm 1 Type)	537
A3.TYP	Alarm 3 Type (as Alarm 1 Type)	538
A4.TYP	Alarm 4 Type (as Alarm 1 Type)	539
A1.LAT	Alarm 1 Latching Mode 0 – No latching 1 – Latch - Automatic Reset 2 – Latch – Manual Reset	540
A2.LAT	Alarm 2 Latching Mode (as Alarm 1 Latching Mode)	541
A3.LAT	Alarm 3 Latching Mode (as Alarm 1 Latching Mode)	542
A4.LAT	Alarm 4 Latching Mode (as Alarm 1 Latching Mode)	543
A1.BLK	Alarm Blocking Mode Enable (0 = OFF, 1 = BLOCK)	544
A2.BLK	Alarm Blocking Mode Enable (0 = OFF, 1 = BLOCK)	545
A3.BLK	Alarm Blocking Mode Enable (0 = OFF, 1 = BLOCK)	546
A4.BLK	Alarm Blocking Mode Enable (0 = OFF, 1 = BLOCK)	547
Di.OP	Digital Outputs Status. This is a bitmap: B0 – Output 1A B1 – Output 2A B2 – (not used) B3 – Output 4/AA It is possible to write to this status word to use the digital outputs in a telemetry output mode. Only outputs whose function is set to 'none' are affected, and the setting of any bits in the Digital Output Status word will not affect outputs used for heat (for example) or other functions. Thus it is not necessary to mask in the settings of these bits when writing to this variable.	551
OFS.HI	Adjust High Offset	560
OFS.LO	Adjust Low Offset	561
PNT.HI	Adjust High Point	562
PNT.LO	Adjust Low Point	563
CT.RNG	CT Range	572
Sb.tyP	Sensor Break Type 0 – No Sensor Break 1 – Non-Latching Sensor Break 2 – Latching Sensor Break	578
Id	Customer ID – May be set to any value between 0-9999 for identification of instruments in applications. Not used by the instrument itself.	629
PHASE	Calibration Phase 0 – None 1 – 0 mv 2 – 50 mv 3 – 150 Ohm 4 – 400 Ohm 5 – CJC 6 – CT 0 mA 7 – CT 70 mA 8 – Factory Defaults 9 – Output 1 mA low cal 10 – Output 1 mA high cal 11 – Output 2 mA low cal 12 – Output 2 mA high cal	768

Parameter Mnemonic	Parameter Name	Modbus Address
	13 – Output 3 ma low cal (3208/3204 only) 14 – Output 3 ma high cal (3208/3204 only)	
GO	Calibration Start 0 – No 1 – Yes (start cal) 2 – Cal Busy 3 – Cal Pass 4 – Cal Fail Note values 2-4 cannot be written but are status returns only	769
-	Analogue Output Calibration Value	775
K.LOC	Allows instrument to be locked via a key/digital input 0 - unlocked, 1 – all keys locked 2 – Edit keys (raise and lower) disabled 3 – Mode key disabled 4 – Manual mode disabled 5 – Enter standby mode when Mode combination pressed 6 – Timer keys disabled	1104
Dwel.1	Programmer Dwell 1 Duration	1280
TSP.1	Programmer Target Setpoint 1	1281
RMP.1	Programmer Ramp Rate 1	1282
Dwel.2	Programmer Dwell 2 Duration	1283
TSP.2	Programmer Target Setpoint 2	1284
RMP.2	Programmer Ramp Rate 2	1285
Dwel.3	Programmer Dwell 3 Duration	1286
TSP.3	Programmer Target Setpoint 3	1287
RMP.3	Programmer Ramp Rate 3	1288
Dwel.4	Programmer Dwell 4 Duration	1289
TSP.4	Programmer Target Setpoint 4	1290
RMP.4	Programmer Ramp Rate 4	1291
IN.TYP	Input Sensor Type 0 – J Type Thermocouple 1 – K Type Thermocouple 2 – L Type Thermocouple 3 – R Type Thermocouple 4 – B Type Thermocouple 5 – N Type Thermocouple 6 – T Type Thermocouple 7 – S Type Thermocouple 8 – RTD 9 – millivolt 10 – Comms Input (see Modbus address 203) 11 – Custom Input (Downloadable)	12290
CJ.tyP	CJC Type 0 – Auto 1 – 0 Degrees C 2- 50 Degrees C	12291
mV.HI	Linear Input High	12306
mV.LO	Linear Input Low	12307
L.TYPE	Logic Input A channel hardware type 0 – None 1 – Logic Inputs	12352
L.D.IN	Logic input A function 40 – None 41 – Acknowledge all alarms	12353

Parameter Mnemonic	Parameter Name	Modbus Address
	42 – Select SP1/2 43 – Lock All Keys 44 – Timer Reset 45 – Timer Run 46 – Timer Run/Reset 47 – Timer Hold 48 – Auto/Manual Select 49 – Standby Select	
L.SENS	Configures the polarity of the logic input channel A (0 = Normal, 1 = Inverted)	12361
L.TYPE (LB)	Logic Input B channel hardware type (3208/3204 only) 0 – None 1 – Logic Inputs	12368
L.D.IN (LB)	Logic input B function (3208/3204 only) 40 – None 41 – Acknowledge all alarms 42 – Select SP1/2 43 – Lock All Keys 44 – Timer Reset 45 – Timer Run 46 – Timer Run/Reset 47 – Timer Hold 48 – Auto/Manual Select 49 – Standby Select	12369
L.SENS (LB)	Configures the polarity of the logic input channel B (0 = Normal, 1 = Inverted) (3208/4 only)	12377
ID	Comms Module Type 0 – None 1 – RS485 2 – RS232	12544
BAUD	Baud Rate 0 – 9600 1 – 19200 2 – 4800 3 – 2400 4 – 1200	12548
PRTY	Parity setting 0 – None 1 – Even 2 – Odd	12549
DELAY	RX/TX Delay – (0 = no delay, 1 = delay) Select if a delay is required between received and transmitted comms messages. Sometimes required when intelligent RS485 adaptors are used.	12550
RETRN	Comms Retransmission Variable selection: 0 – Off 1 – Working Setpoint 2 – PV 3 – Output Power 4 – Error	12551
REG.AD	Modbus register address to broadcast retransmission to. For example if you wish to retransmit the working setpoint from one 3200 to a group of slaves, and receive the master working setpoint into the slaves' remote setpoint, set this variable to 26 (the address of the remote setpoint in the slave units).	12552
Ct.Id	Current Transformer	12608
CT.SRC	CT Source 0 – None 1 – IO1 2 – OP2	12609

Parameter Mnemonic	Parameter Name	Modbus Address
	8 – AA (OP4)	
CT.LAT	CT Alarm Latch Type 0 – No latching 1 – Latch – Automatic Reset 2 – Latch – Manual Reset	12610
1.ID	IO channel 1 hardware type 0 – None 1 – Relay 2 – Logic I/O	12672
1.D.IN	IO1 Digital input function Logic input function 40 – None 41 – Acknowledge all alarms 42 – Select SP1/2 43 – Lock All Keys 44 – Timer Reset 45 – Timer Run 46 – Timer Run/Reset 47 – Timer Hold 48 – Auto/Manual Select 49 – Standby Select	12673
1.Func	I/O Channel Function 0 – None (or Telemetry Output) 1 – Digital Output 2 – Heat or UP if valve position 3 – Cool or DOWN if valve position 4 – Digital Input 10 – DC Output no function 11 – DC Output Heat 12 – DC Output Cool 13 – DC Output WSP retransmission 14 – DC Output PV retransmission 15 – DC Output OP retransmission	12675
1.RNG	IO Channel 1 DC Output Range 0 – 0-20mA 1 – 4-20mA	12676
1.SRC.A	IO Channel 1 Source A 0 – None 1 – Alarm 1 2 – Alarm 2 3 – Alarm 3 4 – Alarm 4 5 – All Alarms (1-4) 6 – New Alarm 7 – CT Alarm (Load, Leak or Overcurrent) 8 – Loop Break Alarm 9 – Sensor Break Alarm 10 – Timer End (or Not Ramping) 11 – Timer Run (or Ramping) 12 – Auto/Manual	12678
1.SRC.B	IO Channel 1 Source B As IO Channel 1 Source A (Modbus address 12678)	12679
1.SRC.C	IO Channel 1 Source C As IO Channel 1 Source A (Modbus address 12678)	12680
1.SRC.D	IO Channel 1 Source D As IO Channel 1 Source A (Modbus address 12678)	12681
1.SENS	Configures the polarity of the input or output channel (0 = Normal, 1 = Inverted)	12682
1.PLS	IO1 Time proportioning Output minimum pulse time	12706

Parameter Mnemonic	Parameter Name	Modbus Address
2.ID	Output 2 Type 0 – None 1 – Relay 2 – Logic Output	12736
2.FUNC	Output 2 Channel function 0 – None (or Telemetry Output) 1 – Digital Output 2 – Heat or UP if valve position 3 – Cool or DOWN if valve position 10 – DC Output no function 11 – DC Output Heat 12 – DC Output Cool 13 – DC Output WSP retransmission 14 – DC Output PV retransmission 15 – DC Output OP retransmission	12739
2.RNG	IO Channel 2 DC Output Range 0 – 0-20mA 1 – 4-20mA	12740
2.SRC.A	Output 2 source A As IO Channel 1 Source A (Modbus address 12678)	12742
2.SRC.B	Output 2 source B As IO Channel 1 Source A (Modbus address 12678)	12743
2.SRC.C	Output 2 source C As IO Channel 1 Source A (Modbus address 12678)	12744
2.SRC.D	Output 2 source D As IO Channel 1 Source A (Modbus address 12678)	12745
2.SENS	Output 2 Polarity (0 = Normal, 1 = Inverted)	12746
2.PLS	Output 2 Time proportioning Output minimum pulse time	12770
3.ID	Output 3 Type 0 – None 1 – Relay	12800
3.FUNC	Output 3 Channel function 0 – None (or Telemetry Output) 1 – Digital Output 2 – Heat or UP if valve position 3 – Cool or DOWN if valve position 10 – DC Output no function 11 – DC Output Heat 12 – DC Output Cool 13 – DC Output WSP retransmission 14 – DC Output PV retransmission 15 – DC Output OP retransmission	12803
3.RNG	IO Channel 3 DC Output Range 0 – 0-20mA 1 – 4-20mA	12804
3.SRC.A	Output 3 source A As IO Channel 1 Source A (Modbus address 12678)	12806
3.SRC.B	Output 3 source B As IO Channel 1 Source A (Modbus address 12678)	12807
3.SRC.C	Output 3 source C As IO Channel 1 Source A (Modbus address 12678)	12808
3.SRC.D	Output 3 source D As IO Channel 1 Source A (Modbus address 12678)	12809
3.SENS	Output 3 Polarity (0 = Normal, 1 = Inverted)	12810
3.PLS	Output 3 Time proportioning Output minimum pulse time	12834
4.TYPE	Output AA Type	13056

Parameter Mnemonic	Parameter Name	Modbus Address
	0 – None 1 – Relay	
4.FUNC	Output 4 Channel function 0 – None (or Telemetry Output) 1 – Digital Output 2 – Heat or UP if valve position 3 – Cool or DOWN if valve position	13059
4.SRC.A	Output AA source A As IO Channel 1 Source A (Modbus address 12678)	13062
4.SRC.B	Output AA source B As IO Channel 1 Source A (Modbus address 12678)	13063
4.SRC.C	Output AA source C As IO Channel 1 Source A (Modbus address 12678)	13064
4.SRC.D	Output AA source D As IO Channel 1 Source A (Modbus address 12678)	13065
4.SENS	Output Polarity (0 = Normal, 1 = Inverted)	13066
4.PLS	Output AA Time proportioning Output minimum pulse time	13090

16. Calibration

The process value can be offset to take into account known errors within the process. The procedure is carried out in the INPUT list as described in sections 8.2 and 8.3.

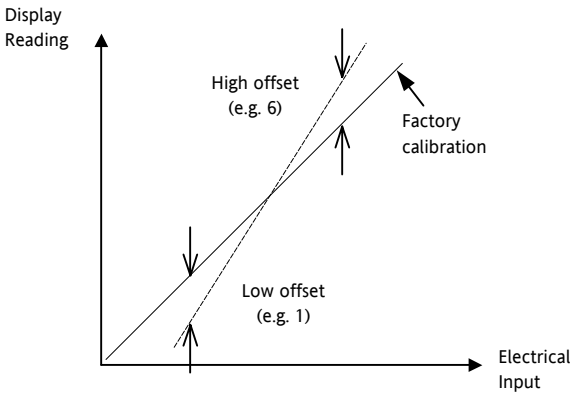
It is also possible to adjust the low and high points as a two point offset. This is done in **Level 3** in the 'CAL' list and is described in this section.

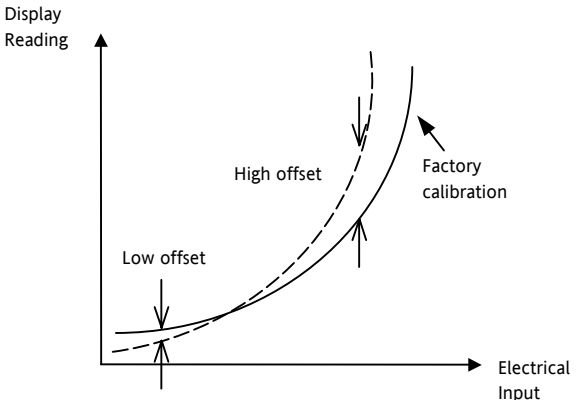
All ranges are calibrated during manufacture to traceable standards for every input type. When changing ranges it is not necessary to calibrate the controller.

The controller can, however, be field calibrated if required. This is done in the 'CAL' list, and the procedures are described in this section. It is always possible to revert to the factory calibration if necessary.

16.1 Two Point Offset

A two point offset adjusts both a low point and a high point and applies a straight line between them. Any readings above and below the 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 as shown in the example below:-





Decide on the high and low points at which you wish to apply the offsets, then:-

Do This	Display View	Additional Notes
1. Select **Level 3** as described in Chapter 2. Then press ⊜ to select **'CAL'**	CAL	Two pint offset can only be carried out in Level 3
2. Press ⟳ to scroll to **'U.CAL'**	IdLE UCAL	Scrolling message USER CALIBRATION
3. Press ▲ or ▼ to **'Lo'**	Lo UCAL	To revert to the original values, select rSEt
4. Press ⟳ to scroll to **'C.ADJ'** 5. Press ▲ or ▼ to set the low offset value	6 C.ADJ	
6. Repeat the above for the high offset		

16.2 Input Calibration

Inputs are calibrated in Configuration level. Inputs which can be calibrated are:-

- **mV Input.** This is a linear 80mV range calibrated at two fixed points. This should always be done before calibrating either thermocouple or resistance thermometer inputs. mA ranges are included in the mV range.
- **Thermocouple** calibration involves calibrating the temperature offset of the CJC sensor only. Other aspects of thermocouple calibration are also included in mV calibration.
- **Resistance Thermometer**. This is also carried out at two fixed points - 150Ω and 400Ω.
- **Current Transformer**. This calibrates against the CT in use

16.2.1 Precautions

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

- RTD and CJC calibration must not be carried out without prior mV calibration.
- 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.
- Power should be turned on only after the controller has been inserted in the sleeve of the pre-wired circuit. Power should also be turned off before removing the controller from its sleeve.
- Allow at least 10 minutes for the controller to warm up after switch on.

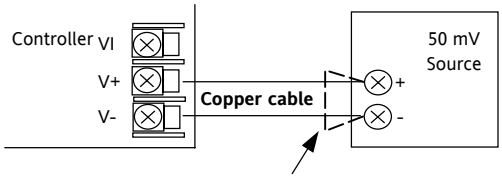
16.3 Output Calibration

Outputs are calibrated in Configuration level. Outputs which can be calibrated are:-

- I/O 1 mA
- Output 2 mA
- Output 3 mA

16.3.1 To Calibrate mV Range

Calibration of the mV range is carried out using a 50 milli-volt source, connected as shown in the diagram below. mA calibration is included in this procedure.



For best results 0mV should be calibrated by disconnecting the copper wires from the mV source and short circuiting the input to the controller

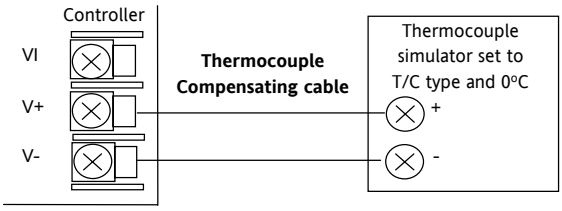
Select **Conf Level** as described in Chapter 2, set the controller input to mV range, then:-

Do This	Display View	Additional Notes
1. From any display press ▤ as many times as necessary until the '**CAL**' page header is displayed.	CAL	Scrolling display 'CALIBRATION LIST'
2. Press ⟳ to select '**PHASE**'	nonE PHASE	Scrolling display 'CALIBRATION PHASE'
3. Set mV source for 0mV		
4. Press ▲ or ▼ to choose '**0**'	0 PHASE	
5. Press ⟳ to select '**GO**' 6. Press ▲ or ▼ to choose '**YES**'	YES GO bUSY GO PASS GO	Scrolling display 'CALIBRATION START' The controller automatically calibrates to the injected input mV. As it does this the display will show bUSY then PASS, assuming a successful calibration. If it is not successful then 'FAIL' will be displayed. This may be due to an incorrect input mV
7. **Set mV source for 50mV**		
8. Press ⟳ to select '**PHASE**' **9.** Press ▲ or ▼ to choose '**50**' **10.** Repeat 5 and 6 above to calibrate the high point	50 PHASE	The controller will again automatically calibrate to the injected input mV. If it is not successful then 'FAIL' will be displayed

16.3.2 Thermocouple Calibration

Thermocouples are calibrated, firstly, by following the previous procedure for the mV ranges, then calibrating the CJC.

This can be carried out using an external CJC reference source such as an ice bath or using a thermocouple mV source. Replace the copper cable shown in the diagram below with the appropriate compensating cable for the thermocouple in use.

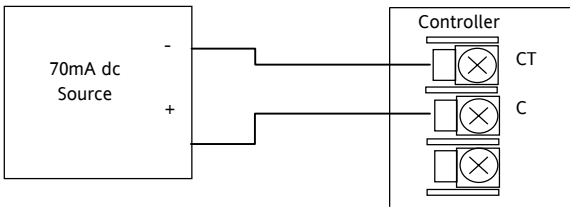


Set the mV source to **internal compensation** for the thermocouple in use and set the output for **0mV**. Then:-

Do This	Display View	Additional Notes
1. From the mV calibration, press ▲ or ▼ to select '**CJC**'	CJC PHASE	
2. Press ↺ to select '**GO**' 3. Press ▲ or ▼ to choose '**YES**'	YES GO bUSY GO PASS GO	The controller automatically calibrates to the CJC input at 0mV. As it does this the display will show *bUSY* then *PASS*, assuming a successful calibration. If it is not successful then *'FAIL'* will be displayed. This may be due to an incorrect input mV

16.3.3 CT Calibration

To calibrate the current transformer input, connect the current transformer to terminals CT and C.



Do This	Display View	Additional Notes
1. From the '**CAL**' list header press ↺ to select '**PHASE**' **2.** Press ▲ or ▼ to choose '**Ct 0**'	Ct 0 PHASE	Scrolling display *'CALIBRATION PHASE'*
3. Adjust the CT for no current applied to the input		
4. Press ↺ to select '**GO**' 5. Press ▲ or ▼ to '**YES**'	YES GO bUSY GO PASS GO	Scrolling display *'CALIBRATION START'*
The controller automatically calibrates to the zero current input. As it does this the display will show *bUSY* then *PASS*, assuming a successful calibration. If it is not successful then *'FAIL'* will be displayed. This may be due to an incorrect input current		
6. Press ▲ or ▼ to choose '**Ct 70**'	Ct 70 PHASE	
7. Adjust the CT for a current of 70mA dc		
8. Press ↺ to select '**GO**' 9. Press ▲ or ▼ to '**YES**'		The controller again automatically calibrates to 70mA If it is not successful then *'FAIL'* will be displayed

16.3.4 RTD Calibration

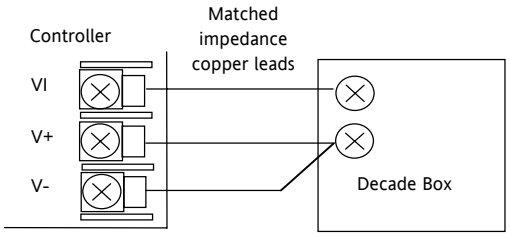
The two points at which the RTD range is calibrated are 150.00Ω and 400.00Ω.

Before starting RTD calibration:

- A decade box with total resistance lower than 1K must be connected in place of the RTD as indicated on the connection diagram below **before the instrument is powered up**. If at any instant the instrument was powered up without this connection then at least 10 minutes must elapse from the time of restoring this connection before RTD calibration can take place.
- The instrument should be powered up for at least 10 minutes.

Before using or verifying RTD calibration:

- The mV range must be calibrated first.

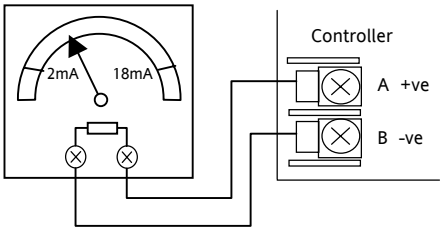


Do This	Display View	Additional Notes
1. From any display press ⓜ as many times as necessary until the '**CAL**' page header is displayed.	CAL	Scrolling display 'CALIBRATION LIST'
2. Press ⓒ to select '**PHASE**'	nOnE PHASE	Scrolling display 'CALIBRATION PHASE'
3. Set the decade box for 150.00Ω		
4. Press ▲ or ▼ to choose '**150R**'	150r PHASE	
5. Press ⓒ to select '**GO**' 6. Press ▲ or ▼ to choose '**YES**'	YES GO bUSY GO PASS GO	Scrolling display 'CALIBRATION START'
The controller automatically calibrates to the injected 150.00Ω input. As it does this the display will show bUSY then PASS, assuming a successful calibration. If it is not successful then 'FAIL' will be displayed. This may be due to an incorrect input resistance		
7. **Set the decade box for 400.00Ω**		
8. Press ▲ or ▼ to choose '**400R**'	400r PHASE	
9. Repeat 5 and 6 above to calibrate the high point		
The controller will again automatically calibrates to the injected 400.00Ω input. If it is not successful then 'FAIL' will be displayed		

16.3.5 To Calbrate mA Outputs

I/O1, Output 2 and/or Output 3 may be supplied as mA outputs. The outputs may be adjusted as follows:-

Connect an ammeter to the output – terminals 1A/1B, 2A/2B or 3A/3B as appropriate.



Then, in configuration level:-

Do This	Display View	Additional Notes
1. From the **'CAL'** list header press ⟳ to select **'PHASE'** **2.** Press ▲ or ▼ to choose **'ImAL'**		Scolling message 'CALIBRATION PHASE'
3. Press ⟳ to select **'VALUE'** 4. Press ▲ or ▼ to adjust the value read on the meter to 2mA		Scolling message 'DC OUTPUT READING' The value represents 2.00mA
5. Press ⟳ to go back to **'PHASE'** 6. Press ▲ or ▼ to choose **'ImAH'**		Scolling message 'CALIBRATION PHASE'
7. Press ⟳ to select **'VALUE'** 8. Press ▲ or ▼ to adjust the value read on the meter to 18mA		Scolling message 'DC OUTPUT READING' The value represents 18.00mA

16.3.6 To Return to Factory Calibration

Do This	Display View	Additional Notes
1. From the **'CAL'** list header press ⟳ to select **'PHASE'**		
2. Press ▲ or ▼ to choose **'FACt'**		
3. Press ⟳ to select **'GO'** 4. Press ▲ or ▼ to choose **'YES'**	 	The controller automatically returns to the factory values stored during manufacture

16.4 Calibration Parameters

The following table lists the parameters available in the Calibration List.

CALIBRATION PARAMETER LIST			'CAL'			
Name	**Scrolling Display**	**Parameter Description**	**Value**		**Default**	**Access Level**
UCAL	USER CALIBRATION		IdLE		IdLE	L3
			Lo			
			Hi			
			rESt			
The following parameters appear when calibrating the controller ie UCAL = Lo or Hi						
C.ADJ	CALIBRATION ADJUST	To set an offset value. See section 16.1.	-1999 to 9999			L3
PHASE	CAL PHASE	To calibrate low and high offset	nonE	Not selected	nonE	Conf
			0	Select mV low calibration point		
			50	Select mV high calibration point		
			150r	Select PRT low cal point		
			400r	Select PRT high cal point		
			CJC	Select CJC calibration		
			Ct 0	Select CT low cal point		
			Ct 70	Select CT high cal point		
			FAct	Return to factory settings		
			1mAL	Low mA output from I/O 1		
			1mAH	High mA output from I/O 1		
			2mAL	Low mA output from output 2		
			2mAH	High mA output from output 2		
			3mAL	Low mA output from output 3		
			3mAH	High mA output from output 3		
GO		To start the calibration sequence	nO		nO	Conf
			YES	Start		
			buSY	Calibrating		
			PASS	Calibration successful		
			FAIL	Calibration unsuccessful		

17. Configuration Using iTools

iTools is a configuration and monitoring package which will edit, store and 'clone' complete controller configurations.

iTools can be used to configure all the functions of the 3216 controller described in this manual. It is also possible using iTools to configure additional functions such as customised messages and parameter promotion. These features are described in this chapter.

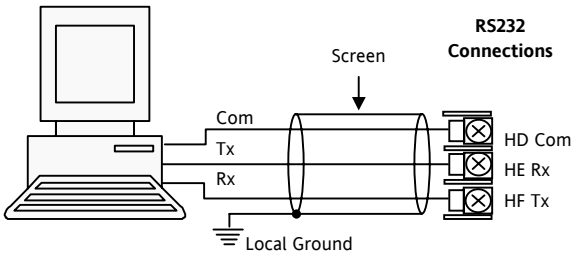
You may also wish to refer to the iTools User Handbook Part No. HA026179 which can be downloaded from www.eurotherm.co.uk. for further information on how to install, connect and generally operate iTools.

17.1 Connecting a PC to the Controller

In the 3216 controller this may be done using digital communications port H or by a configuration clip.

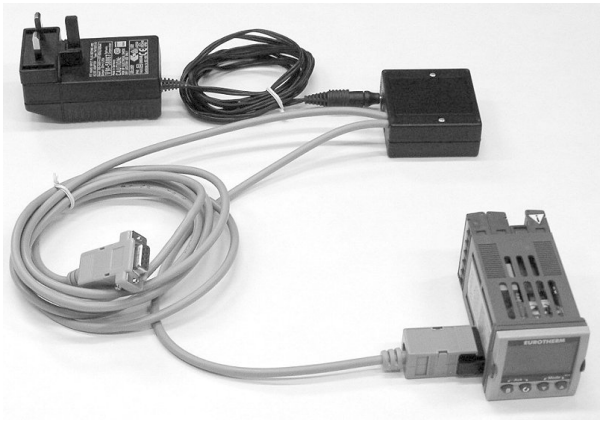
17.1.1 Using the H Communications Port

Connect the controller to the RS232 serial comms port of the PC shown in the diagram below.



17.1.2 Configuration Clip

A Configuration Clip is available with iTools by quoting part number 3000CK in the iTools ordering code. The clip can be fitted into the side of a controller as shown below.



The benefit of using this arrangement is that it is not necessary to power the controller, since the clip provides the power to the internal memory of the controller.

17.2 Starting iTools

Open iTools and, with the controller connected, press 

on the iTools menu bar. iTools will search the communications ports and TCPIP connections for recognisable instruments. Controllers connected with the configuration clip (CPI), will be found at address 255 regardless of the address configured in the controller.

In the following pages it is assumed that the user is familiar with these instructions and has a general understanding of Windows.

17.3 Configuring a Function

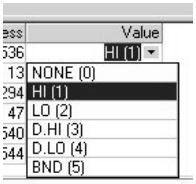
When the instrument is detected a screen view similar to the one shown below will be displayed. The browser on the left shows the List Headers. Open the parameter lists either by double clicking the Header or pressing 'Parameter Explorer' when the list header is selected.

The instrument view may be turned on or off using the 'View' menu and selecting 'Panel Views'.

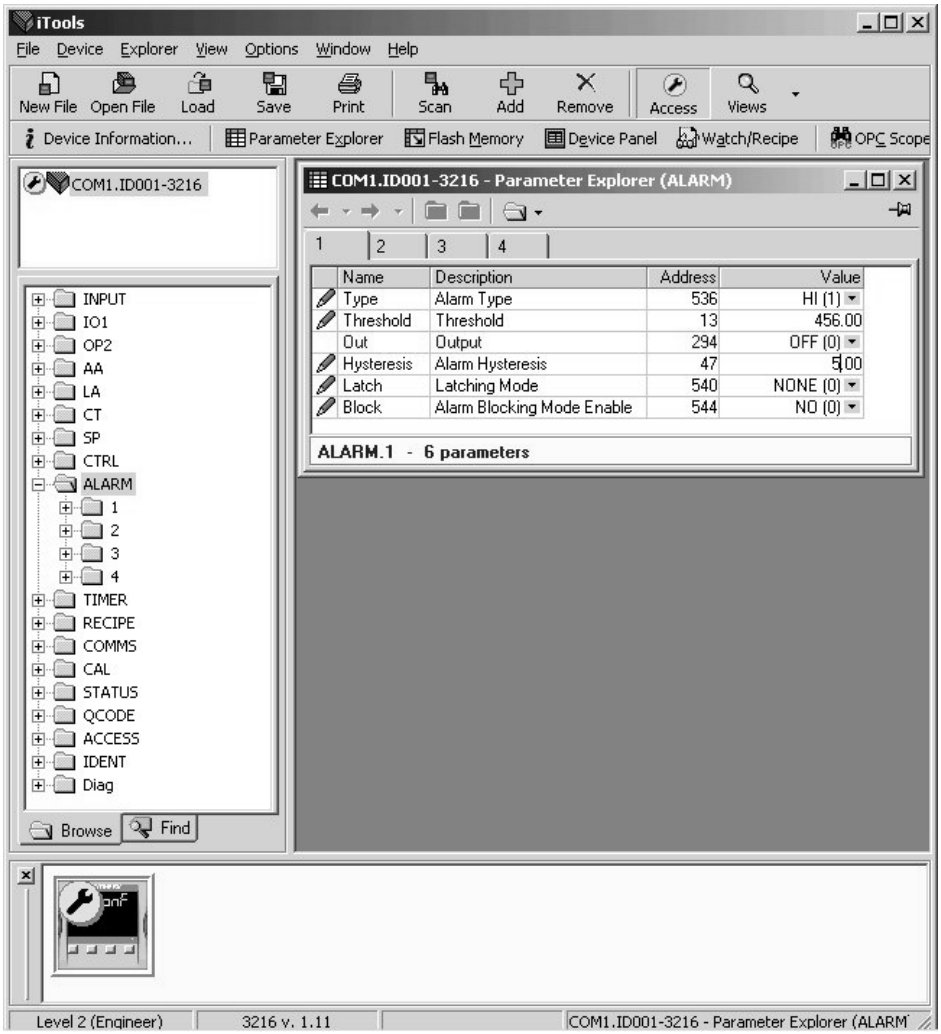
17.3.1 Example: To Configure an Alarm

The procedure is the same for all functions.

1. Press Access to put the controller into Configuration level
2. Select the list header from the browser – in this case 'ALARM' '1'
3. To configure 'Alarm Type' open the drop down under 'Value'



3. Select the alarm type – in this example HI. (1) is the enumeration of the value.
4. Select and set all other parameters using the same procedure



17.4 To Customise Messages

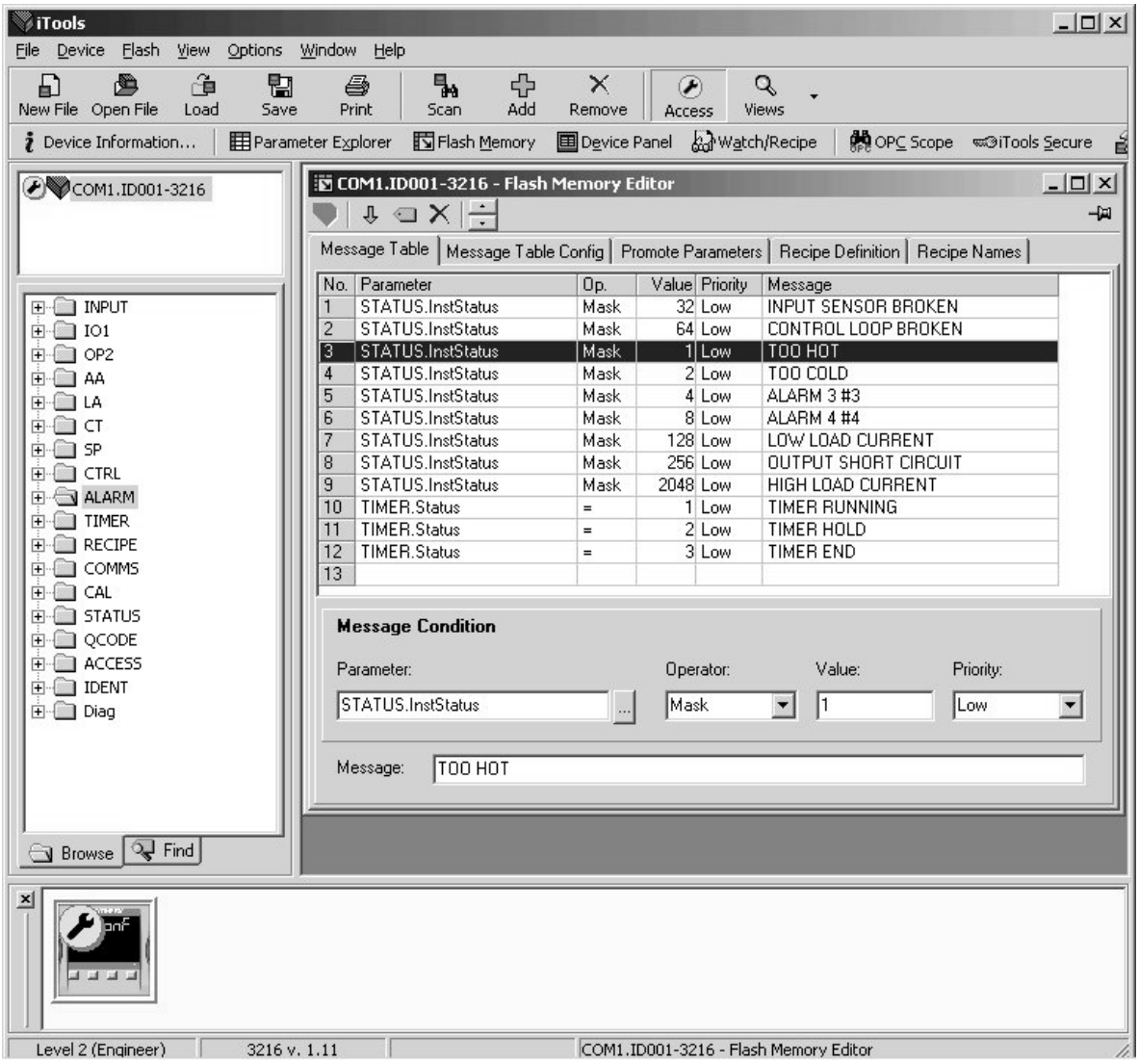
The message which scrolls across the controller display during normal operation may be customised using iTools to show a message which is more meaningful to the user.

17.4.1 Example: To Customise Alarm 1 Message

In this example the alarm 1 message will read ‘TOO HOT’.

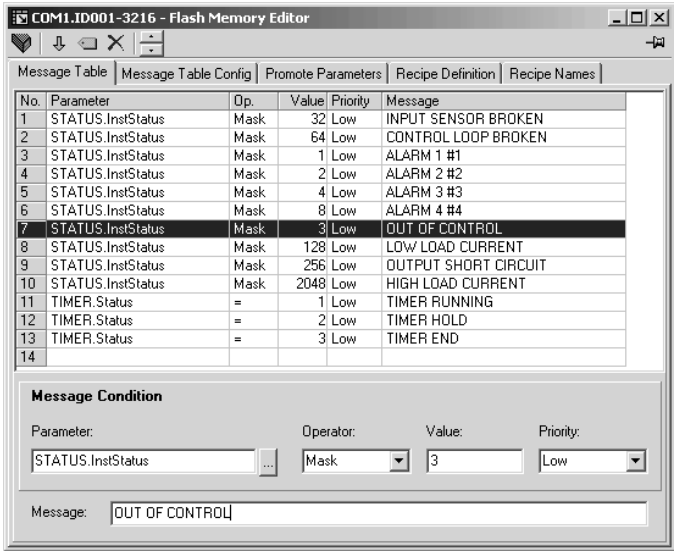
1. Press Flash Memory and select the ‘Memory Table’ tab
2. Select Parameter ‘ALARM1 #1’
3. In the ‘Message Condition’ area change ‘Message’ to TOO HOT
4. Press ‘Update Device Flash Memory’ button

In the example shown below Alarm 2 message has also been configured to ‘TOO COLD’



17.4.2 Example 2

Display the message 'OUT OF CONTROL' if both Alarm 1 and Alarm 2 are active.

Operation	Action	Indication
Add a parameter	1. Right click where the parameter is required 2. Select 'Insert Item' 3. Choose the parameter from the pop up box eg **'STATUS InstStatus'**	
Set the Operator	4. From the Operator drop down box select **'Mask'** See also note 1 below Alternatively a message may be configured to appear if the enumeration of the parameter:- = equals the 'Value' != is not equal to the 'Value' > is greater than the 'Value' < is less than the 'Value'	
Set the value The bitmap list is given here and in the Digital Comms chapter	5. Click in the 'Value' box and press enter 6. From the pop up box either tick the bit field values or type in the decimal equivalent in 'New Value'. In this example 3.	**Instrument Status - Bitmap** B0 – Alarm 1 Status B1 – Alarm 2 Status B2 – Alarm 3 Status B3 – Alarm 4 Status B4 – Auto/Manual Status B5 – Sensor Break Status B6 – Loop Break Status B7 – CT Low load current alarm status B8 – CT High leakage current alarm status B9 – Program End B10 – PV Overrange (by > 5% of span) B11 – CT Overcurrent alarm status B12 – New Alarm Status B13 – Timer/Ramp Running B14 – Remote Fail, New Alarm B15 – Autotune Status In each case, a setting of 1 signifies 'Active', 0 signifies 'Inactive'.
Set the priority	7. From the drop down select Low Medium or High	
Enter the message	8. In the message section enter OUT OF CONTROL	
Download to the controller	9. Press  'Update Device Flash Memory' button	

Note 1

Mask allows any combination of parameters in the above bitmap field to activate the custom message. The table below shows how this operates for the four alarm fields.

Value	Bitmap	Parameter (Alarm) active
1	0001	Alarm 1
2	0010	Alarm 2
3	0011	Alarm 1 + Alarm 2
4	0100	Alarm 3
5	0101	Alarm 3 + Alarm 1
6	0110	Alarm 2 + Alarm 3
7	0111	Alarm 1 + Alarm 2 + Alarm 3
8	1000	Alarm 4

Other parameters can be added by extending this table.

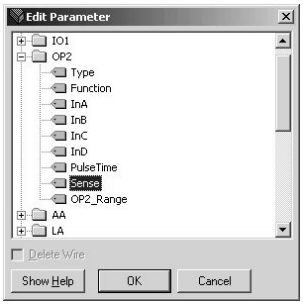
17.5 To Promote Parameters

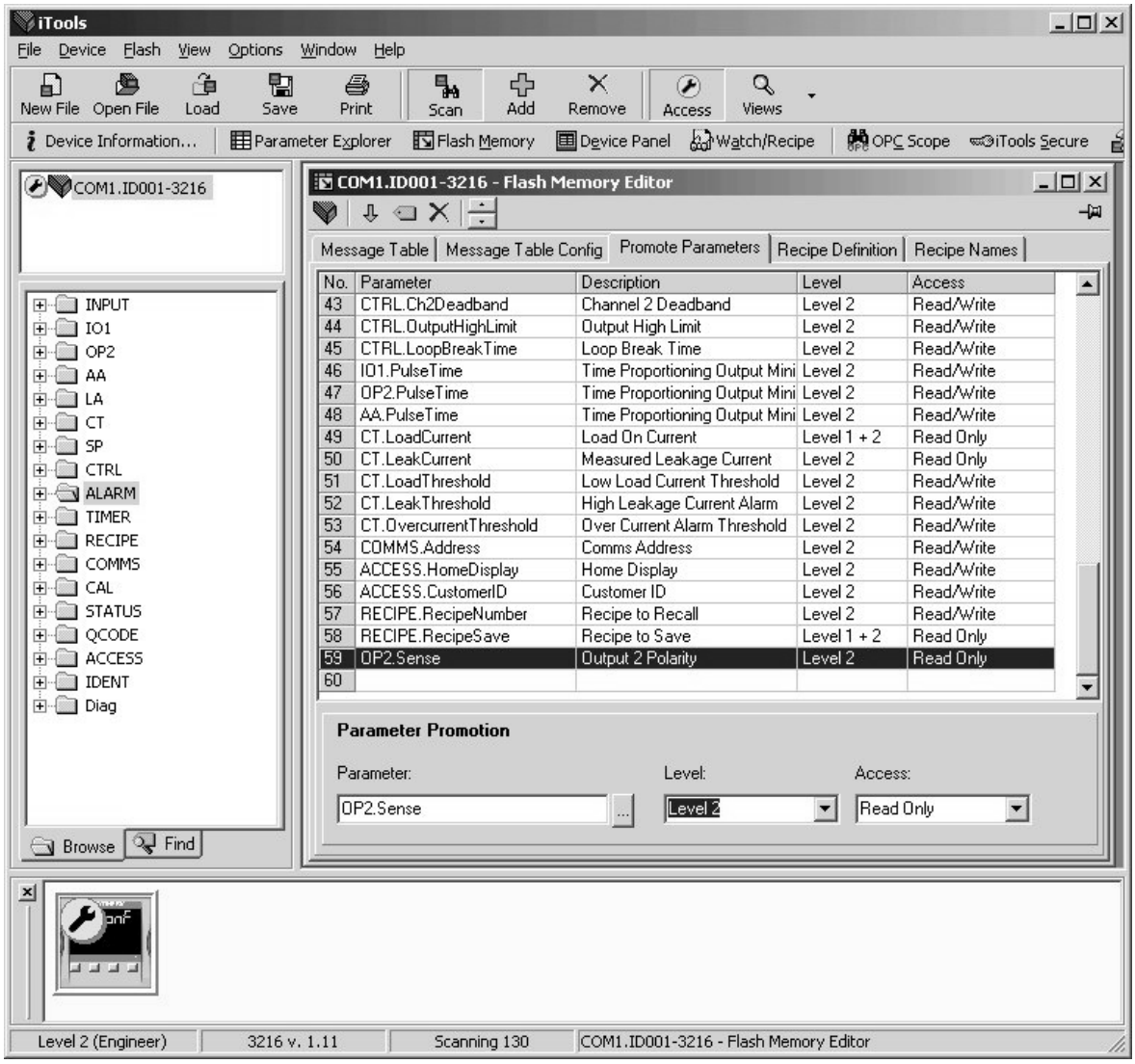
The list of parameters which are available in operator levels 1 or 2 can be changed using iTools.

17.5.1 Example: To Change Parameters in the Operator Lists

In this example the parameter 'OP2.Sense' is added to the to the Level 2 list.

1. Press Flash Memory and select the Memory Table tab
2. Select the 'Promote Parameters' tab
3. Highlight the position where you want the new parameter to be placed
4. Press ... button and from the pop up window select the required parameter. Alternatively use the ⇩ button.
5. In the Level box select Level 2 (or Level 1 + 2 if it is required to display this parameter in Level 1 as well)
6. In the Access box select 'Read Only' or 'Read/Write' as required
7. Press ✕ to remove a selected parameter
8. Press 'Update Device Flash Memory' button



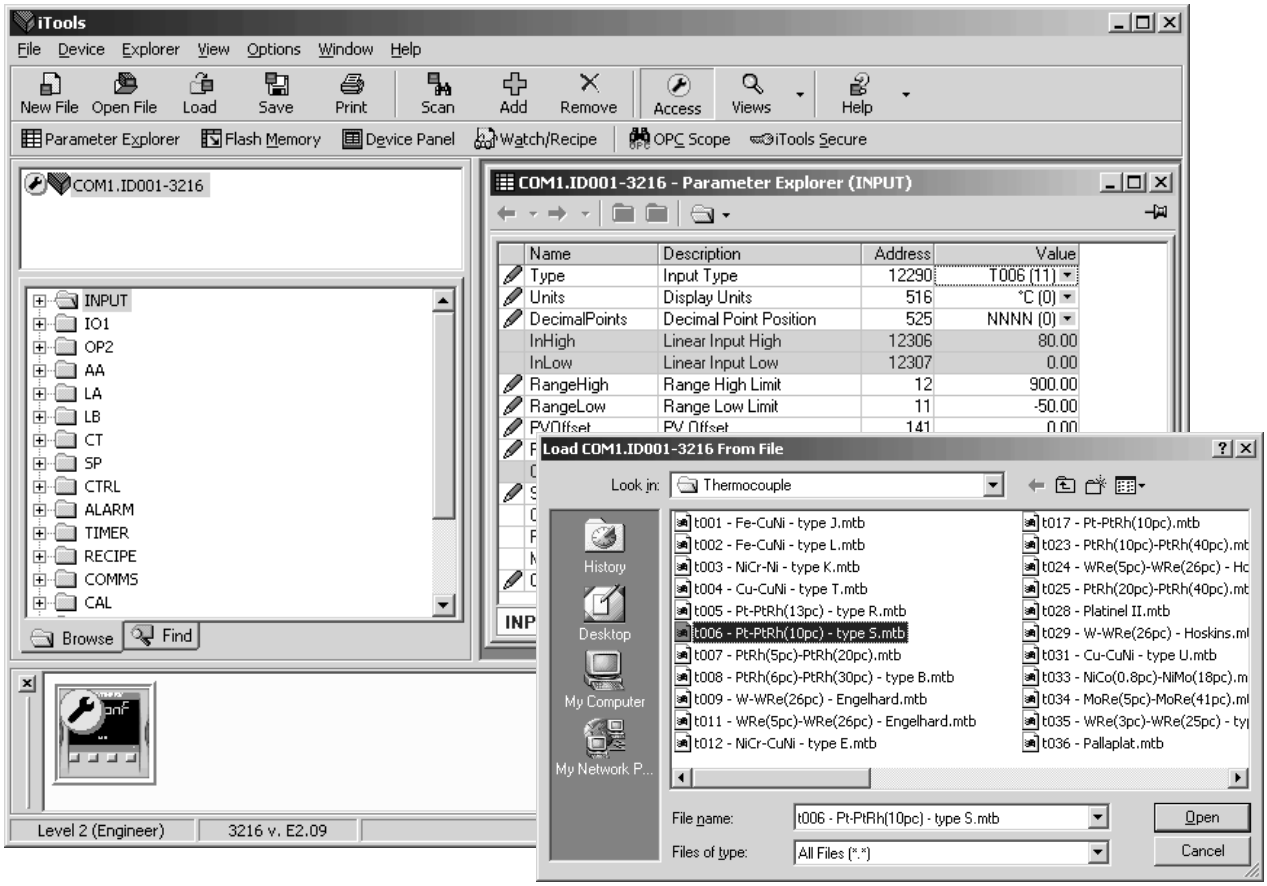


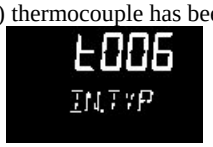
17.6 To Load A Special Linearisation Table

In addition to the built in standard linearisation tables, custom tables can be downloaded from files.

1. Press 

2. Select the linearistion table to be loaded from files with the extension .mtb. Linearisation files for different sensor types are supplied with iTools and may be found in Program Files → Eurotherm → iTools → Linearisations → Thermocouple etc.



3. In this example a Pt-PTRh(10%) thermocouple has been loaded into the controller. The controller will display the linearisation table downloaded:- 

17.7 Cloning

The cloning feature allows the configuration and parameter settings of one instrument to be copied into another. Alternatively a configuration may be saved to file and this used to download to connected instruments. The feature allows new instruments to be rapidly set up using a known reference source or standard instrument. Every parameter and parameter value is downloaded to the new instrument which means that if the new instrument is used as a replacement it will contain exactly the same information as the original. Cloning is generally only possible if the following applies:

- The target instrument has the same hardware configuration as the source instrument
- The target instrument firmware (ie. Software built into the instrument) is the same as or a later version than that of the source instrument. The instrument firmware version is displayed on the instrument when power is applied.
- Generally, cloning will copy all operational, engineering and configuration parameters that are writable. **The communications address is not copied.**

Every effort has been made to ensure that the information contained within the clone files is a replica of that configured in the instrument. It is the users responsibility to ensure that the information cloned from one instrument to another is correct for the process to be controlled, and that all parameters are correctly replicated into the target instrument.

Below is a brief description of how to use this feature. Further details are available in the iTools Handbook

17.7.1 Save to File

The configuration of the controller made in the previous sections may be saved as a clone file. This file can then be used to download the configuration to further instruments.

From the File menu use ‘Save to File’ or use the ‘Save’ button on the Toolbar.

17.7.2 To Clone a New Controller

Connect the new controller to iTools and Scan to find this instrument as described at the beginning of this chapter.

From the File menu select ‘Load Values From File’ or select ‘Load’ from the toolbar. Choose the required file and follow the instruction. The new instrument will be configured to this file.

17.7.3 To Clone Directly from One Controller to Another

Connect the second controller to iTools and scan for the new instrument

From the File menu select ‘Send to Device’. Select the controller to be cloned and follow the instructions. The old instrument will be configured the same as the new one.

18. Appendix A TECHNICAL SPECIFICATION

Analogue Input

	Sample rate	4Hz (250mS)
	Calibration accuracy	±0.25% of reading ±1LSD
	Resolution	<5, 0.5µV when using a 5 second filter
	Linearisation accuracy	<0.1% of reading
	Input filter	Off to 59.9 secs
	Zero offset	User adjustable over the full display range
	Thermocouple Types	Refer to Sensor inputs and display ranges table
	Cold junction compensation	Automatic compensation typically >30 to 1 rejection of ambient temperature change or external reference 0°C (32°F)
	CJC Calibration accuracy	<±1.0°C at 25°C ambient
	RTD/PT100 Type	3-wire, Pt100 DIN43760
	Bulb current	0.2mA
	Lead compensation	No error for 22 ohms in all 3 leads
	Process Linear	-10 to 80mV, 0 to 10V with external potential divider module 100KΩ/800
	Current transformer	50mAac into 10 ohm. This burden resistor is fitted inside the controller
	Fusing	Fit a 2A type T fuse in line with this controller

Digital input

	Contact closure or logic 12V @ 5-40mA	
	Contact open >500Ω	
	Contact closed <200Ω	

Outputs

Relay	Rating: 2-pin relay	Min: 12V, 100mA dc Max: 2A, 264Vac resistive
	Rating: change-over, alarm relay	Min: 12V, 100mA dc Max: 2A, 264Vac resistive
	Application	Heating, cooling, alarms or valve position
Logic	Rating	On/High 12Vdc at 5 to 44mA
	Application	Off/Low <100mV <100µA
		Heating, cooling, alarms or valve position

Communications (Not 3116)

Digital	Transmission standard	EIA-485 2wire or EIA-232 at 1200, 2400, 4800, 9600, 19,200 baud
	Protocols	Modbus®

Control functions

Control	Modes	PID or PI with overshoot inhibition, PD, PI, P only or On/Off or valve position
	Application	Heating and cooling
	Auto/manual	Bumpless transfer
	Setpoint rate limit	Off to 9999 degrees or display units per minute
Tuning	One-shot tune	Automatic calculation of PID and overshoot inhibition parameters
Alarms	Types	Full scale high or low. Deviation high, low, or band
	Modes	Latching or non-latching. Normal or blocking action
		Up to four process alarms can be combined onto a single output

Current Transformer Input

	Input current	0 to 50mA rms calibrated, 50/60Hz
	Scale	0 to 10, 25, 50 or 100Amps
	Input impedance	<20Ω
	Accuracy	±4% of reading
	Alarms	Leakage current, overcurrent
	Indication	Custom scrolling message and beacon
	Types	High, low, deviation band, sensor fault, load leakage current, over current, internal events

Recipes

Number	5
Parameters stored	38
Selection	Key press or via remote communications

General

Text Messages	10 x 30 character messages
Dimensions and weight	48W x 48H x 90Dmm (1.89W x 1.89H x 3.54D in) 8.82oz (250g)
Power Supply	100 to 240Vac -15%, +10%. 48 to 62Hz. 5 watts max
Temperature and RH	Operating: 32 to 131°F (0 to 55°C), RH: 5 to 90% non-condensing.
Storage temperature	-10 to 70°C (14 to 158°F)
Panel sealing	IP 65, plug-in from front panel
Safety standards	EN61010, installation category II (voltage transients must not exceed 2.5kV), pollution degree 2.
Electromagnetic compatibility	EN61326-1 Suitable for domestic, commercial and light industrial as well as heavy industrial environments. (Class B emissions, Industrial Environment immunity). Low supply voltage versions are suitable for industrial environments only.
Atmospheres	Not suitable for use above 2000m or in explosive or corrosive atmospheres.

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